Aug. 8, 1967 W. H. PETERSON 3,334,757

LONG TRAVEL DUAL SILL CUSHIONING ARRANGEMENT FOR RAILROAD CARS

Original Filed March 15, 1965 4 Sheets-Sheet 1

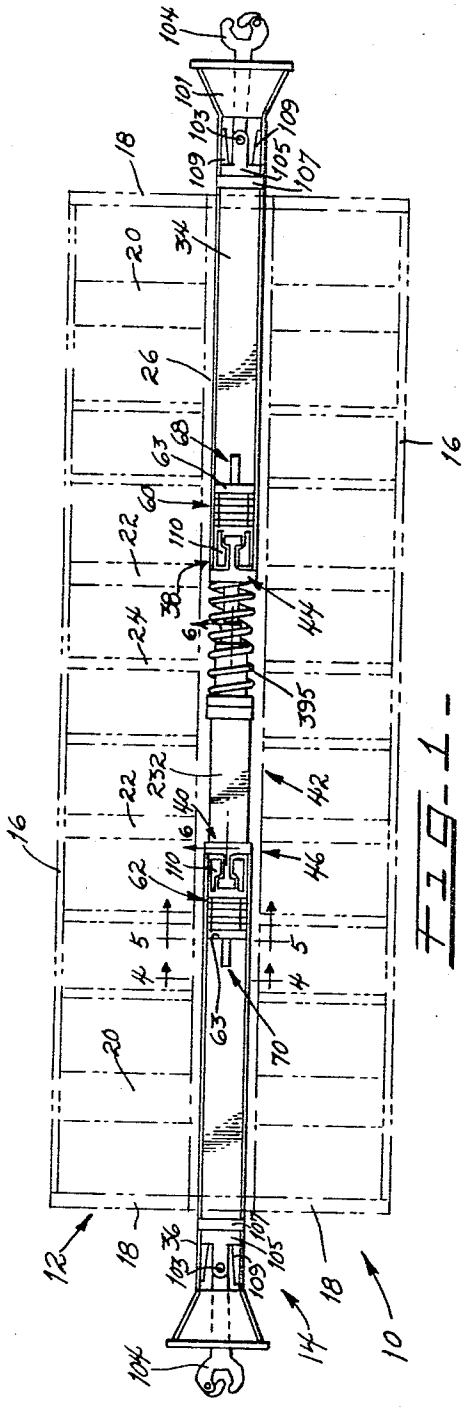


FIG. 1

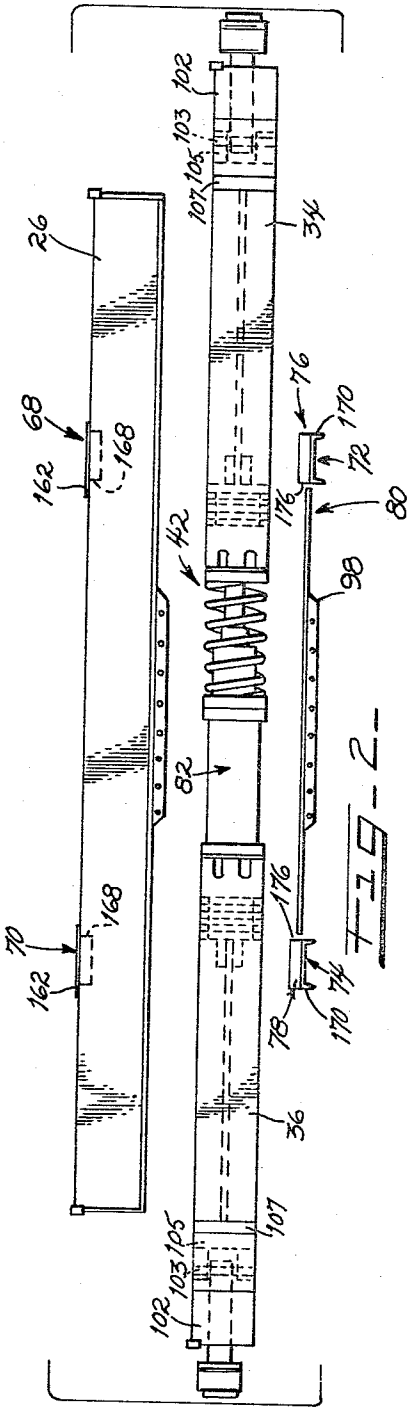


FIG. 2

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Original Filed March 15, 1965 4 Sheets-Sheet 2

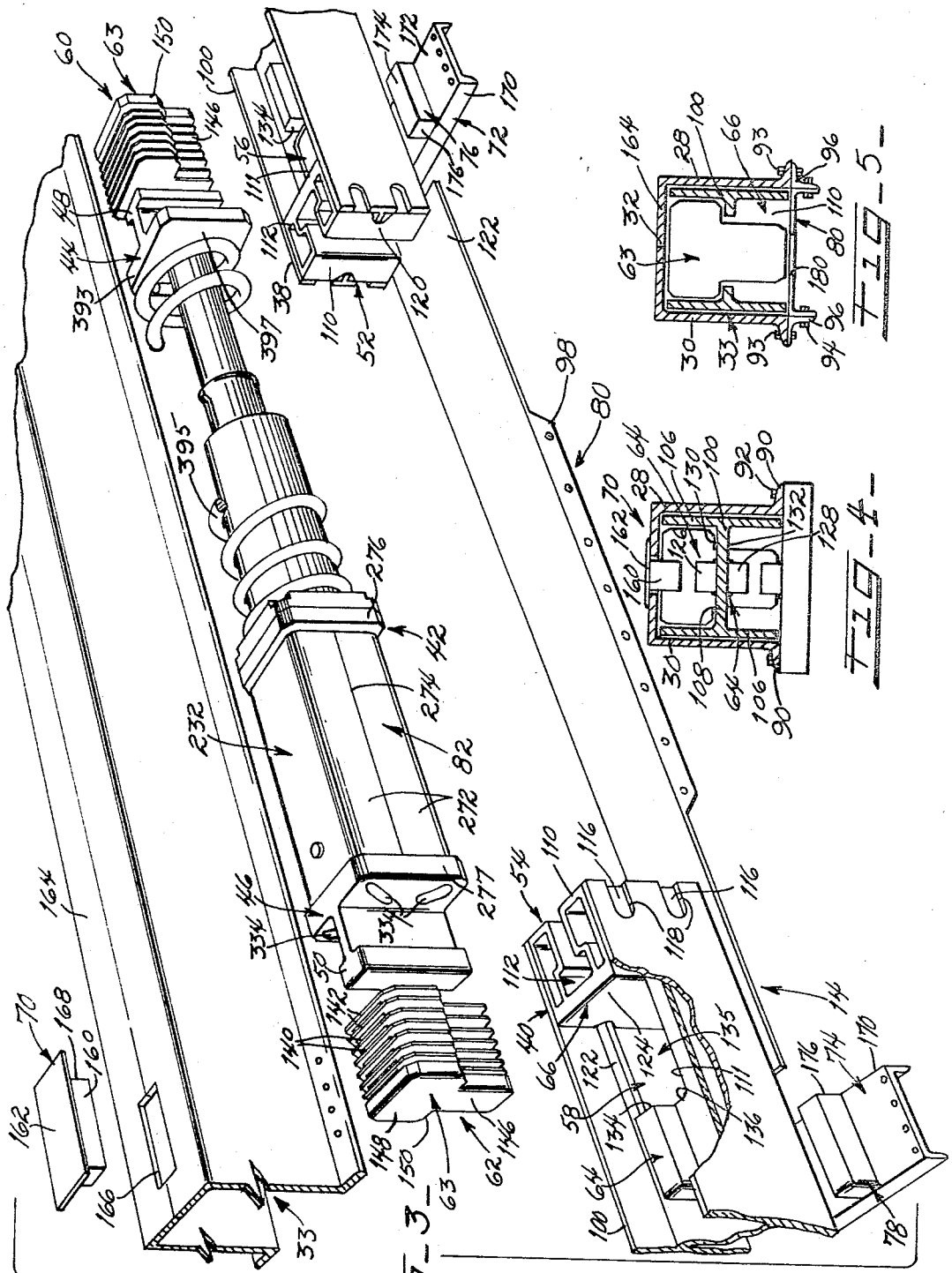


FIG-3

FIG-5

FIG-4

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LONG TRAVEL DUAL SILL CUSHIONING ARRANGEMENT FOR RAILROAD CARS

Original Filed March 15, 1965 4 Sheets-Sheet 3

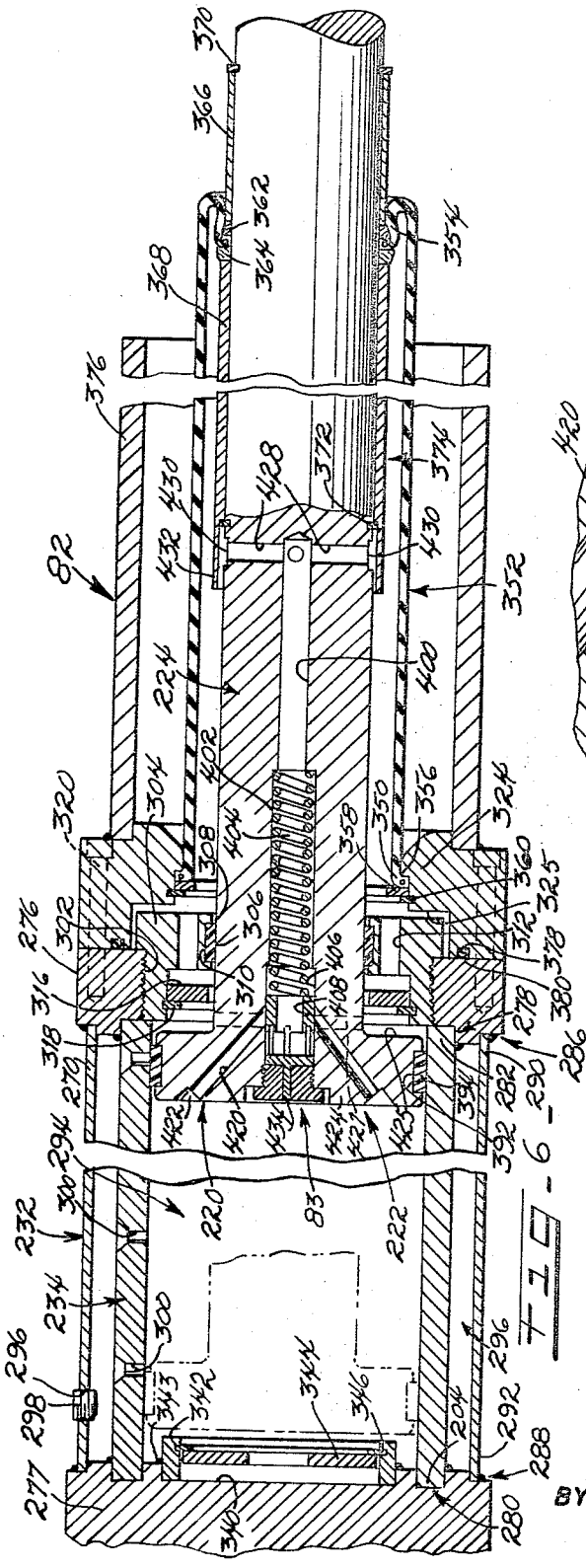


FIG. 6

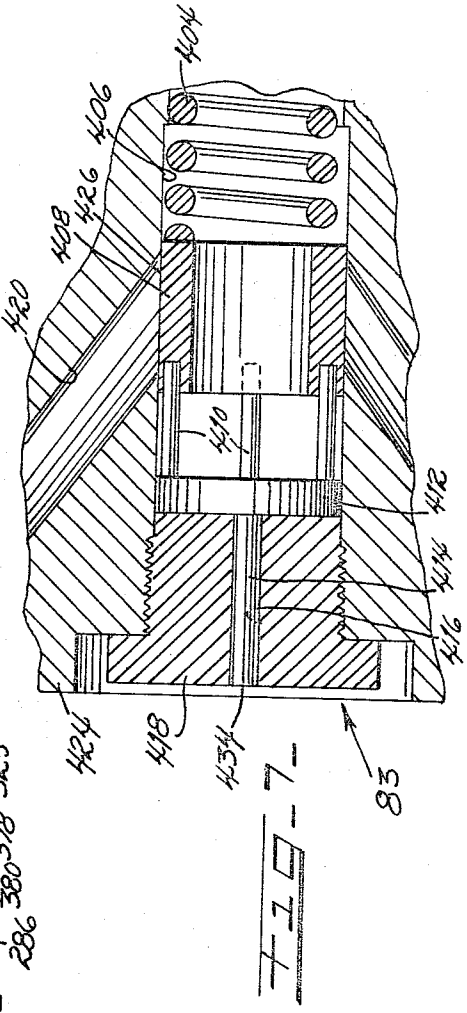


FIG. 7

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LONG TRAVEL DUAL SILL CUSHIONING ARRANGEMENT FOR RAILROAD CARS

Original Filed March 15, 1965 4 Sheets-Sheet 4

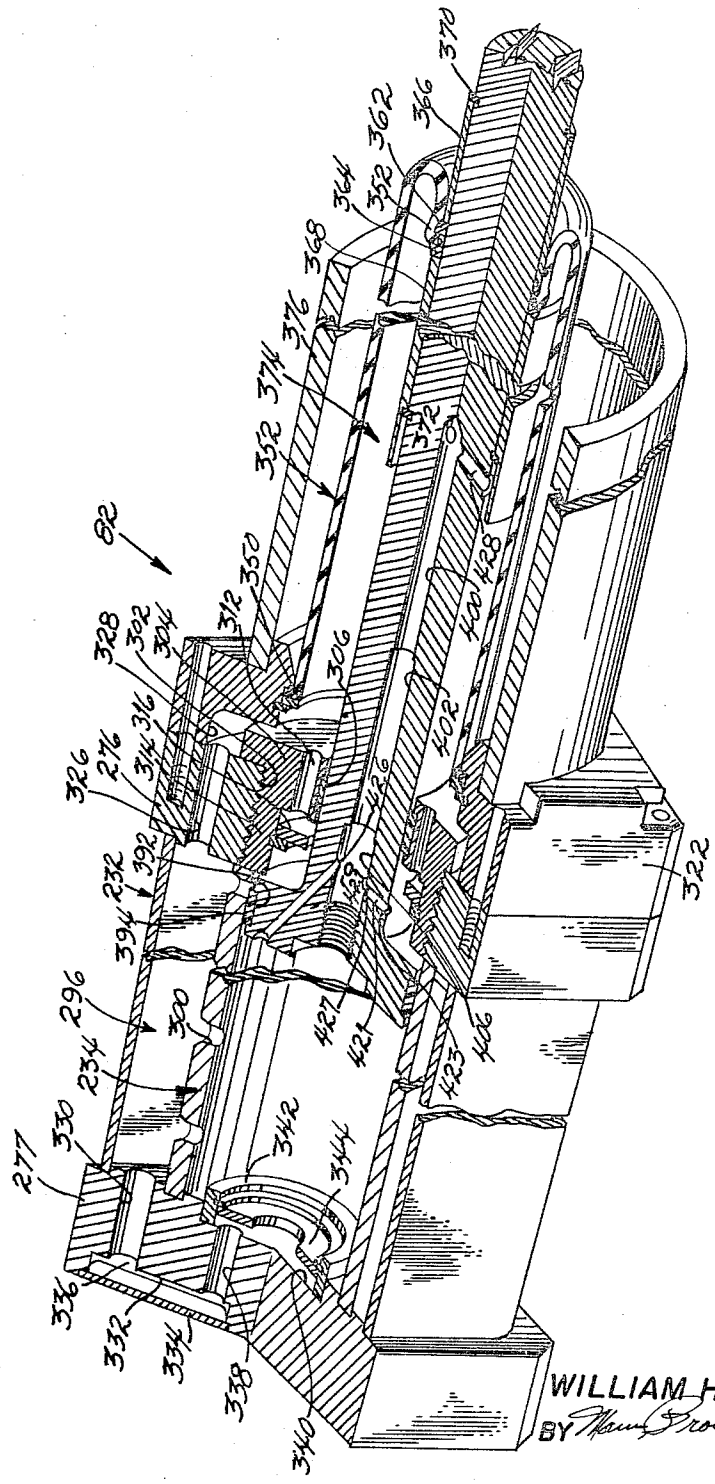


FIG. 8

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United States Patent Office 3,334,757
Patented Aug. 8, 1967

3,334,757

LONG TRAVEL DUAL SILL CUSHIONING ARRANGEMENT FOR RAILROAD CARS

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Continuation of application Ser. No. 439,631, Mar. 15, 1965. This application May 16, 1966, Ser. No. 562,990
5 Claims. (Cl. 213—8)

ABSTRACT OF THE DISCLOSURE

A railway vehicle including a wheeled frame structure having a draft and buffing column carried thereby with couplers attached to the respective ends of the draft and buffing column. A cushioning means is operatively interposed between stop means fixed on the frame and the column for cushioning longitudinal impacts applied to the couplers. The column comprises a pair of sections positioned in spaced apart relationship and in longitudinal alignment for movement longitudinally with respect to each other and to the frame structure. A keying means is formed in the adjacent ends of each of the columns and a cushion pocket is formed outboard of each of the keying means. A resilient cushioning device is mounted in each of the cushion pockets for engagement with the stop means so as to be operative to absorb draft impacts applied on the column when the column sections are in the spaced position. A hydraulic cushion is disposed between the sections and includes a hydraulic fluid filled cylinder and a piston assembly reciprocal therein. The cylinder and piston assembly have a length of travel substantially equal to the spaced distance between the column sections. The cylinder and the piston assembly have means on the respective ends for keying to the column sections. A return spring is disposed between the cylinder and the piston assembly.

This is a continuation of U.S. patent application Ser. No. 439,631 filed Mar. 15, 1965, now abandoned.

My invention relates to a long travel dual sill cushioning arrangement for railroad cars, and more particularly, to a railroad car cushioning arrangement of the sliding sill or draft and buffing column type that is especially adapted to provide long travel cushioning benefits for all impact situations with which the car will in practice be involved.

Railroad car cushioning arrangements most commonly employed at the present time for box cars and the like are the so-called sliding sill or draft and buffing column arrangement, and the so-called end of car cushioning arrangements. While the principles of long travel cushioning may be applied to both of these cushioning arrangement types, end of car cushioning having travels in cushion travel ranges much in excess of conventional draft gear travel has not been widely adopted because of the train slack problem, and sliding sill type arrangements have the limitation that when the cushion car is disposed in a string or line of cars and is impacted during train operation the sliding sill arrangements and cushion units used heretofore do not provide cushioning after the initial impact has been dissipated and the cushioning unit returns to its normal non-impacted position so that excessively rapid run-in and run-out of slack may occur.

A principal object of my invention is to provide a new and improved cushioning arrangement of the sliding sill or draft and buffing column type which provides for long travel cushioning protection which obviates the difficulties encountered heretofore during train action.

Another principal object of my invention is to provide a conversion cushioning assembly for readily converting standard box cars and the like (cars having conventional draft gear cushioning only) to cushion underframe cars.

Yet another principal object of my invention is to provide a novel center of car long travel cushioning device of the hydraulic type that is arranged to protect itself against overload conditions that can be created by excessive speed-high mass impacts.

Still another principal object of the invention is to provide a cushioning arrangement for sliding sills of the dual sill type in which each section of the sill is connected by a double acting hydraulic cushion having a substantially constant force travel characteristic upon buff impact and during the return stroke after a buff impact has been dissipated.

It is still a further object taken in conjunction with the immediately foregoing object to provide a resilient cushioning means which is operative to cushion draft impacts under conditions in which the sill sections and hydraulic cushion are in neutral positions.

Additional objects of my invention are to provide a simplified and more compact hydraulic cushioning arrangement, to provide a simplified assembly arrangement and method for converting standard box cars and the like to cushion cars, and to provide a cushioning arrangement for railroad cars that is inexpensive of manufacture, convenient to install in new or old cars, and efficient and long lived in operation.

Other objects, uses, and advantages will be obvious or become apparent from a consideration of the following detailed description and the application drawings.

In the drawings:

FIG. 1 is a plan view diagrammatically illustrating a railroad car underframe having the sliding sill or draft and buffing column cushioning arrangement of this invention applied thereto;

FIG. 2 is a diagrammatic side elevational view of the fixed center sill of the underframe shown in FIG. 1 and the sliding sill type cushioning arrangement that is associated therewith in accordance with this invention, with the cushioning arrangement displaced below the underframe fixed center sill to better illustrate the components involved;

FIG. 3 is a fragmental diagrammatic exploded perspective view illustrating the principal components of the cushioning arrangement embodiment illustrated in FIGS. 1 and 2, together with the adjacent portion of the underframe fixed center sill and the lugs and stops that couple the sliding sill arrangement with the fixed center sill to provide for transmission of impact forces therebetween;

FIG. 4 is a fragmental cross-sectional view substantially along line 4—4 of FIG. 1;

FIG. 5 is a fragmental cross-sectional view substantially along line 5—5 of FIG. 1;

FIG. 6 is a longitudinal cross-sectional view through the hydraulic cushioning unit that forms a part of the cushioning device of FIGS. 1–5 taken substantially along line 6—6 of FIG. 1;

FIG. 7 is a fragmental large scale sectional view illustrating a portion of the piston pressure relief valve that is shown in FIG. 6; and

FIG. 8 is a diagrammatic perspective view in section of the hydraulic cushioning unit shown in FIGS. 6 and 7, parts being omitted to better illustrate other parts.

However, it is to be understood that the specific drawing illustrations provided are supplied primarily to comply with the requirements of 35 U.S.C. 112, and that the invention may have other embodiments that will be obvious to those skilled in the art.

General description

Reference numeral **10** of FIG. 1 generally indicates a sliding sill or draft and buffing column cushion underframe arranged in accordance with this invention in which the car body underframe **12** has applied thereto a sliding sill or draft and buffing column cushioning arrangement **14** that is arranged to provide long travel cushioning characteristics of the type described in my Patent 3,003,436.

The underframe **12** is shown only diagrammatically as it may be any conventional type of underframe and thus may include side sills **16**, end sills **18**, bolsters **20**, cross bearers **22**, cross ties **24**, and fixed center sill **26**, all of which may be arranged and secured together in any conventional manner. In FIG. 1, these familiar underframe components are illustrated in broken lines only, although the fixed center sill **26** is more fully illustrated in FIGS. 2–5.

The fixed center sill **26** is shown as the usual and customary Z–26 type and thus comprises a pair of Z members **28** and **30** fixed together as by welding at **32** to define a downwardly opening channel shaped center sill structure forming the usual chamber **33** in which the sliding sill is to be mounted.

In accordance with this invention, the sliding sill or draft and buffing column cushioning arrangement **14** which is received in chamber **33** comprises a pair of column sections **34** and **36** positioned in spaced apart arrangement in longitudinal alignment and having like ends **38** and **40** thereof operatively secured to a center of car cushioning device **42**.

Further in accordance with this invention, the cushioning device **42** at the respective ends **44** and **46** thereof is provided with keys or lugs **48** and **50**, respectively, that are adapted to be received in the respective key slot structures **52** and **54** that form a part of the respective sill section ends **38** and **40**.

The sill sections **34** and **36** adjacent their respective ends **38** and **40** are formed to define the respective cushion pockets **56** and **58** in which are respectively mounted rubber pad type resilient cushioning assemblies **60** and **62**, each of which is T-shaped in transverse cross-sectional configuration and which include a follower **63**. Each column section is formed with a pair of opposed stop or abutment structures **64** and **66** on either side of the respective cushion pockets **56** and **58**, with the cushion devices **60** and **62**, respectively, abutting against the respective stop structures, as indicated in FIG. 1.

The center sill structure **26** is provided with a pair of stop structures **68** and **70** that are intended to engage against the respective follower plates **63** of the respective cushioning devices **60** and **62** when the cushioning arrangement **14** is operatively mounted within the underframe **14**. Spaced tie members or bars **72** and **74** are fixed to the center sill structure **26** vertically below the stop structures **68** and **70** and have secured thereto similar stop structures **76** and **78** that are to engage against the respective follower plates **63** of the cushioning devices **60** and **62** in a similar manner when the cushioning arrangement **14** is in its operative position. A cushion support platform or plate **80** is fixed to the center sill structure **26** beneath cushion device **42** to hold the cushion device **42** in its operative position between column sections **34** and **36**.

Cushioning device **42** includes the novel hydraulic cushioning unit indicated at **82** in FIGS. 6 and 8, the essential features of which are disclosed in my copending application Ser. No. 439,630, filed Mar. 15, 1965, now abandoned, the disclosure of which is hereby incorporated herein by this reference. Hydraulic cushioning unit **82** includes a novel piston pressure relief valve arrangement **83** for protecting the cushioning unit **82** against excessive speed-high mass impact situations.

In use, the fixed sill stop devices **68** and **70** are applied to the fixed sill **26** in any suitable manner and the column sections and cushioning device **42** are mounted within the center sill structure **26** in any appropriate manner. Cushion support platform or plate **80** is positioned below the cushioning device **42**, and the tie bars **72** and **74** are positioned underneath the column section ends **38** and **40**, all substantially in the manner indicated in FIGS. 2 and 3, and by being fixed to the lower portion of the center sill structure **26**. Additional supports for the column sections may be provided as may be necessary or desirable in the manner usual for sliding sills, as at the underframe bolsters, cross bearers, end sills, etc.

In operation, when buff impacts are occasioned, the hydraulic cushioning device **42** contracts for its length of travel, which preferably is in the range from about 20 to about 40 inches, thereby contracting the draft and buffing column at the center of the car, with the cushion force being applied to the car underframe through the appropriate stop devices or structure **68** or **70**, depending upon which end of the car is impacted. Draft impacts are cushioned by the respective resilient pad cushioning devices **60** or **62**, depending on which end of the car is draft impacted, when the hydraulic cushion device **82** is in the neutral position as to be more fully explained hereinafter.

The cushioning arrangement of this application is particularly useful in converting standard uncushioned boxcars and the like (cars with standard draft gear cushioning only) to cushion underframe cars, but also is highly suitable for use in new cars as well.

Specific description

Underframe **10** may be of any type known to the art, and is only diagrammatically illustrated in FIG. 1 (in which it is shown in broken line), to show a familiar structural environment that specific embodiments of this invention will ordinarily be associated with. The center sill structure **26** is conventional in nature, except as modified in accordance with this invention, and defines outwardly directed flanges **90** along its lower edges to which the tie members or bars **72** and **74** and the cushion support plate or platform **80** are affixed in any appropriate manner, as by the bolts **92** and **94** shown in FIGS. 4 and 5. In accordance with the specific arrangement illustrated, the flanges **90** on either side of the position that the cushion device **42** is to occupy have affixed thereto spaced angle members **96**, as by employing bolts **93**, to which plate or platform **80** is affixed by the aforedescribed bolts **94**; plate **80** includes spaced downwardly extending flanges **98** on either side thereof that are affixed to the angle members **96** by the aforesaid bolts **94**.

The column sections **34** and **36** are similar in nature and each is made up of a beam **100** that has an H-shaped configuration in transverse cross section (see FIG. 4), and as indicated in FIGS. 1 and 2, the beams **100** at the column section ends **102** have operatively connected thereto in any suitable manner conventional coupler **104**. The attachment of the coupler to the respective column sections may be done in any suitable manner, but preferably the coupler is pivotally secured directly to the column section, as indicated in the drawings, and the customary draft gear is eliminated, as the cushioning devices **60** and **62** serve the purpose of draft gear in accordance with this invention. In the coupler attachment arrangement shown in the drawings, coupler housings **101** are fixed to the outer ends of the column sections, and the coupler **104** is attached for swinging movement by pin **103** carried by coupler support **105** disposed between a tie plate **107** fastening the housing **101** to the column section, and stops **109** fixed in the housing **101**. Reference may be had to my copending application Ser. No. 196,320, filed May 21, 1962, for a more detailed description of the coupler housing and mounting structure.

The beams **100** thus define a beam structure having

vertically disposed flanges **106** connected together by a web **108**.

The column sections **34** and **36** at their ends **38** and **40** have their webs **108** removed as at **111** to define cushion pockets **56** and **58** and receive structural units **110** which define and comprise the respective slot structures **52** and **54**. Units **110**, which are preferably in the form of castings, are shaped to define the illustrated T-shaped slot **112** in each unit **110**. The slots **112** are proportioned to complement the shape of the respective T-shaped lugs or keys **48** and **50**, and as indicated, the respective slots **112** and lugs or keys **48** and **50** have a dove tail lug and slot type relation for interlocking the cushion device ends **44** and **46** with the ends **38** and **40** of the respective column section ends. As indicated in FIG. 3, the units **110** are preferably arranged so that the slots **112** are vertically disposed when the column sections are in their operative positions with respect to the car underframe, and thus the cushioning unit **42** may be applied to the underframe sections by vertically aligning the respective cushion device lugs or keys **48** and **50** with the respective slots **112** and then elevating the cushion unit into place to dispose the respective lugs within the respective slots.

Units **110** are preferably affixed to the respective column section ends **38** and **40** by welding or the like, and the column section ends may be cut away as at **116** to permit U-shaped welds to be applied as at **118**. The castings **110** are formed with grooves **120** to receive the remaining side portions **122** of the respective webs **108**, and it will thus be seen that units **110** can be readily slid onto the respective column section ends **38** and **40** for welding in the indicated positions.

The cushion pockets **56** and **58** are thus defined by the faces **124** of castings **110**, the stop structures **64** and the web side portions **122**. Faces **124** of castings **110** form the aforementioned stop structures **66**.

The stop structures **64** of the respective column sections each comprise a pair of blocks **126** and **128** affixed as by welding to the upper and lower surfaces **130** and **132** of the column section webs **108**, with the end faces **134** of the blocks **126** and **128** being in vertical alignment with the web interruption end **136**.

The cushioning devices **60** and **62** each comprise a plurality of resilient pads **140** (made from, for instance, rubber) adhered to the opposite sides of metallic separating plates or discs **142**, in accordance with known arrangements for resilient pad cushioning devices. Associated with the pads and plates **140** and **142** at one end of each cushioning device **60** and **62** is a follower plate **63**, and as indicated in FIG. 3, the pads **140**, the plates **142** and the follower plates **63** are given the T-shaped configuration indicated in the drawings, with these parts being proportioned to that their downwardly extending or depending portions **146** are received within the interruption **111** formed in webs **108** to form pocket **58**, with the upper portions **148** of these elements being enlarged to define shoulders **150** that rest on the respective web side portions **122** about the cushioning devices **60** and **62** within the column sections **34** and **36**.

As also indicated in the drawings, the resilient cushioning devices **60** and **62** are positioned so that follower plates **63** abut against stop structures **64** of each pocket and stop structures **68**, **76** and **70**, **78** that are adjacent the respective pockets. It is preferable to apply the cushioning devices **60** and **62** within cushion pockets **58** with a prestressing on the order of that conventionally used in such devices.

Stop structures **68** and **70** each comprise a block **160** affixed to a base plate **162**. The top portion **164** of center sill structure **26** is formed with a pair of openings **166** which receive the respective blocks **160** in a position to dispose their end surfaces **168** in engagement with the respective follower plates **148**. Base plates **162** and blocks **168** are welded to the center sill structure **26** in any appropriate manner to secure the rigid affixment of the respective devices **68** and **70** to the center sill structure. Preferably, the openings **166** are made to substantially complement the configuration of the respective blocks **160** so that the respective blocks **160** are firmly keyed to the center sill structure **26**.

The tie bars or members **72** and **74** and in the form illustrated comprise suitable channel shaped members **170** which each have affixed to their respective upper surfaces **172** a suitable block **174** that forms the respective stop structures **76** and **68**. Channel members **170** should be fixed between the flanges **90** of the center sill structure in a position appropriate so that faces **176** of blocks **174** will be in abutting engagement with follower plates **63** of the cushioning devices **60** and **62**, when the cushioning devices are in their assembled position.

Thus, the faces **134**, **168** and **176** of the stop devices **64**, **70** and **78** for column section **36** should be in substantial vertical alignment, while the faces **134** and **168** and **176** of the stop devices **64**, **68** and **76** of the column section **34** should be in substantial vertical alignment.

Hydraulic cushioning device

The hydraulic cushioning device **82** (see FIGS. 6–8) includes a piston member **220** defining a piston head **222** and a piston rod **224** which is affixed to the lug or key structure **48** that forms the cushion end **44**.

Hydraulic cushioning device **82** further comprises a housing **232** which has affixed thereto the lug or key structure **50** that forms the end **46** of cushion device **42**, and mounted in housing **232** is a cylinder **234** in which the piston head **222** operates. Pressure relief valve device **83** is operably associated with the piston member **220**.

The hydraulic cushioning device housing **232** comprises a shell or casing **270** of generally quadrilateral transverse cross-sectional configuration, which may be defined by a pair of channel shaped members **272** welded together as at **274**. Associated with the casing or shell **270** are end plates **276** and **277**, which also mount between them cylinder **234** in which piston member **220** operates. Integrally united with end plate **277** is the lug or key **50**.

As indicated in FIG. 6, the end plates **276** and **277** are each formed with recesses indicated at **278** and **280**, respectively, in which the ends **282** and **284** of the cylinder **234** are respectively received. The end plates **276** and **277** are also recessed as at **286** and **288**, respectively, to receive the respective ends **290** and **292** of the shell or casing. The end plates **276** and **277** are secured to the cylinder and shell or casing respectively by welding, as indicated in FIG. 6, although any other suitable means of securement that provides an effective hydraulic seal may be employed, as will be understood by those skilled in the art.

As clearly indicated by FIGS. 6 and 8, the cylinder **234** defines with the end plates **276** and **277** a working chamber **294** in which the piston member head **222** operates. The casing or shell **270** defines with cylinder **234** and end plates **276** and **277** an annular reservoir **296** for hydraulic liquid with which the cushioning device **82** is filled, as through a port **297** in shell or casing **270** (see FIG. 6) which may be sealed off by a suitable plug **298**.

The cylinder **234** is preferably formed with a plurality of orifices **300** that are arranged to provide a substantially constant force travel characteristic when the piston member **220** is moved, relative to cylinder **234**, or vice versa, under buff impacts from the full line position of FIG. 6 to the broken line position of that figure. This may be done in any conventional manner, as by making orifices **300** all of the same diameter and spacing them at the varying distances required, or by forming the orifices **300** of varying diameters and spacing them uniformly lengthwise of the cylinder, all as required in accordance with known procedures in this art to achieve substantially constant force travel closure characteristics. As many orifices **300** may be provided in the cylinder **234** as may be re-

quired for efficient operation of cushioning device **82**. A typical arrangement of the orifices to achieve the substantial constant travel characteristic is described in my U.S. Patent 3,216,592. It is to be noted that the orifices **300** are arranged so that the substantially constant force travel characteristic is also obtained during the return stroke of the piston head after the buff impact has been dissipated.

The housing **232**, cylinder **234**, piston member **220**, and the remaining components of cushioning device **82** are proportioned to provide a long travel cushioning stroke which may be in the range of from about 20 inches to about 40 inches, preferably 30 inches.

The end plate **276** of cushion device **82** is formed to define a threaded opening **302** which threadedly receives an annular collar **304** through which the piston rod **224** extends. Interposed between the piston rod and the collar is a non-metallic ring **306** that is preferably formed of a laminated resin, such as the type designated by the National Electrical Manufacturers Association as 9 coarse, grade C. Preferably the plastic ring **306** has an I.D. that substantially complements the O.D. of the piston rod, and which is sufficiently less than the I.D. of the collar **304** at its annular opening **308** to avoid metal to metal contact between ring **306** and the piston rod **24**. Ring **306** is seated in annular recess **310** of collar **104**.

The collar **304** is also formed with a plurality of ports or passages **312** and an annular flange portion **314** that receives an annular flap valve plate **316** which is secured against displacement from flange portion **314** by a suitable locking ring **318**.

As indicated in FIGS. 6 and 8, end plate **276** has secured thereto by appropriate bolts (indicated in dashed lines at **320** in FIG. 6) a base plate **322** that defines a radially inwardly extending annular ridge portion **324** through which piston rod **224** extends.

The base plate **322** on its end plate side defines a recess **325** that is quadrilateral in configuration and substantially complements the exterior transverse cross-sectional configuration of plate **322**; recess **325** receives the collar **304** when the base plate **322** is secured to the end plate **276**, as indicated in FIGS. 6 and 8. As the collar **304** is round or cylindrical in configuration, the base plate **322** recess **325** defines with the collar **304** at each of the four corners of the base plate **322** a passage **328** which in accordance with the present arrangement is aligned with a correspondingly placed passage **326** formed in the end plate **276** in the manner suggested in FIG. 8. This provides for hydraulic liquid communication between the reservoir **296** and external surface **329** of the piston rod **224** exteriorly of the collar **304** through the four corners of the abutting plates **276** and **322**. Hydraulic liquid communication is also provided between the same portion of the piston rod **224** and the chamber **294** through ports **312** of collar **304** and around flap plate **316**, when the flap plate **316** is not seated in check valve closing relation over the ends of the ports **312** (plate **316** is proportioned to do this, as indicated in FIG. 6).

End plate **277** at each of its four corners is provided with a passage **330** which provides hydraulic liquid communication between reservoir **296** and recesses **332** which are formed at each corner (see FIG. 8 and my said copending application Ser. No. 439,630). Each recess **332** is sealed shut by welding in place an appropriate cover element **334**, and each recess **332**, and with the cover plate **334** defines a passage **336**, communicates with chamber **294** through passages **338** formed in the end plate **277**.

As indicated in FIG. 8, the passages **338** terminate in an annular recess **340** formed in the inner face of end plate **377** in which an annular member of ring **342** is fixed, as by welding at **343**. Annular member or ring **342** has mounted therein an annular flap valve plate **344** which is secured against displacement within the ring **342** by a suitable locking ring **346**.

Thus, hydraulic liquid communication is provided between reservoir **296** and chamber **294** through passages **330**, **336**, **338**, when flap valve plate **340** is displaced from check valve closing relation with respect to passages **338**. Flap valve plate **342** is proportioned to overlie the passages **338**, as indicated in FIG. 6.

It will thus be seen that the end plates **276**, **277** and base plate **322** are quadrilateral in transverse cross-sectional configuration and are provided with hydraulic liquid conducting passageways at their four corners.

Secured to the annular ridge portion **324** of base plate **322** is one end **350** of an annular flexible static seal member or boot **352** that has its other end **354** turned outside in, with said end **354** being secured to the piston rod **224**.

In the case of the boot end **350**, this place is locked between a shoulder **356** and a ring **358** held in place by a suitable locking ring **360**, while in the case of the boot end **354**, it is held in place by being secured between a pair of annular members **362** and **364** against which abut the respective sleeves **366** and **368** that are held in place by suitable locking rings **370** and **372**, respectively. Parenthetically, all locking rings referred to herein, such as rings **370** and **372**, are seated in appropriate recesses, in accordance with standard practice in connection with such devices.

The annular static seal member or boot **352** thus defines with the piston rod **224** an annular hydraulic liquid receiving chamber **374**.

Base plate **322** has affixed thereto as by welding an annular extension ring or cylinder **376**, which is proportioned to overlie the boot **352** when the hydraulic cushion device **82** is in its contracted relation.

Base plate **322** is formed with an endless recess **378** about its recess **325** which receives a suitable O-ring seal **380** for insuring a hydraulic liquid seal between the base plate **322** and end plate **376** (see FIG. 6). This has been omitted from the showing of FIG. 8 to simplify the drawing of that figure.

The piston member **220** in accordance with this invention is a one piece element formed from a suitable forging steel or the like to permit the piston head **222** to be formed to a suitable piston head configuration by an appropriate forging operation. One suitable material for this purpose is C–1050 steel, normalized and of a suitable forging quality.

The rim **390** of the piston head is suitably machined to form annular recess **392** in which a laminated plastic ring **394** is mounted. Ring **394** is preferably made of the same substance as ring **306**, and preferably has an O.D. that exceeds that of piston head rim **390** sufficiently to prevent metal to metal contact between piston head **222** and cylinder **234**.

The piston rod **224** at its outwardly extending end **391** is fixed (as by welding or screw threading) to a plate structure **393** that has a transverse cross-sectional configuration similar to that of end plates **276** and **277** and base plate **322**. Recentering spring **395** is seated between base plate **322** and plate structure **393** and returns the hydraulic cushion **82** and sill arrangement **14** to their extended relations after a buff impact has been cushioned. Plate structure **393** comprises a spring plate **397** that is integrally connected to lug or key **48**.

Cushion device end plates **276** and **277**, base plate **322**, and spring plate **397** are proportioned to fit easily within but substantially complement the interior configuration of fixed sill **26**, with the result that the sill **26** guides the contracting and extension action of cushion device **82**.

The pressure relief valve **83** in accordance with this invention is mounted entirely within the piston member **220**. As indicated in FIGS. 6–8, the piston member **220** is formed with a longitudinally extending bore **400** that is counterbored as at **402** to receive compression spring **404** which extends into a cylindrical valve chamber **406** in which is slidably mounted an annular ring valve or valve stem member **408** that preferably has an O.D. that sub-

stantially complements the I.D. of the chamber **206**. Fixed to the tubular valve stem member **408** are a plurality of studs or pins **410** that extend longitudinally of the axis of bore **400** and chamber **406** and bear against a disc **412** that has secured thereto a pin **414** which also extends longitudinally of the axes of bore **400** and chamber **406**. The pin **414** is slidably mounted within a bore **416** formed in a retainer nut **418** that is threadedly mounted at the piston head end of chamber **406**.

The piston member **220** is formed with a plurality of diagonal passages **420** defining inlet ports **422** at the working face or high pressure side **424** of the piston head **222** and exhaust ports **426** opening into chamber **406**. Piston member also is preferably formed with radial passages **421** defining inlet ports **423** at the side **425** of piston rod **224** and exhaust ports **427** opening into chamber **406**, with passages **420** and **421** being in alternating relation about the axis of rod **224**.

The bore **400** communicates with a plurality of cross bores **428** that extend transversely of the piston rod **224** and terminate in exhaust ports **430** which are directed laterally of the piston rod. As indicated in FIG. 6, the sleeve **366**, in accordance with this invention, is preferably formed with an extension **432** which overlies the ports **430** and deflects hydraulic liquid discharge from ports **430** to the left as viewed in FIG. 6 rather than directly against the static seal member **352**.

Spring **404** is selected to have a strength such as to hold the tubular valve stem member **408** substantially in the position shown in FIG. 6 during normal operation of the gear on cushioning buff. However, the strength is selected such that when excessive buff impact conditions cause pressures to rise in chamber **294** to about 85 to 90 percent of the strength of cylinder **234**, the pressure acting on the end **434** of pin **214** will force stem **408**, through disc **412** and pins **410**, to the right of FIG. 6 to the extent that ports **426** and **423** will be opened to chamber **406** and thus to bore **400** through the hollow center of the helical spring **404**. This permits hydraulic liquid to discharge through the relief valve **83** and to chamber **374**, and also to discharge through passages **421** to the back side of the piston and thus relieve the excess pressures building up in cylinder **34**.

The arrangement of valve **83** as illustrated and described permits the use of a spring with a relatively light preload to adequately protect the hydraulic cushion unit. For instance, spring **404** can be arranged to have a preload as light as on the order of two hundred and eighty pounds, and yet hold the valve **83** closed up pressures on the order of twelve thousand p.s.i. in chamber **294**. A suitable spring for this purpose is formed from vanadium steel or its equivalent into four gauge wire size and provided with a spring rate of 131.6 pounds per inch with twenty-six active coils and an outside diameter of one and one-quarter inches.

In use, the hydraulic cushioning unit **82** is fully charged with hydraulic liquid in the spaces defined by the reservoir **296**, the chamber **294**, the chamber **374**, and all passages connecting same. This may be done in any suitable manner, but care should be taken to have all air bled out of the system while at the same time avoiding overcharging of the unit. The boot **352** should be disposed substantially as shown in the full lines of FIG. 6 when properly charged with hydraulic liquid.

In normal buff impact absorbing operation, the piston member **220** moves from the full line position to the broken line position of FIG. 6, and the valve **83** remains closed. As the piston head moves between these two positions, hydraulic liquid discharges from chamber **294** through the orifices **300** into reservoir **296** and returns to the chamber **294** on the other side of the piston head **222** through the orifices **300** that the piston head **222** has passed, as well as through passages **326**, **328**, **312** and valve plate **316**. Flap valve plate **344** under the pressure build up before piston side **424** shuts off the passages **338** in the end plate **377**. This hydraulic liquid flow through the orifices **300** creates a substantially constant force travel characteristic and continues until the piston head reaches its maximum extent of buff absorbing travel (approximately the broken line position of FIG. 6) after which the compression spring **395** acting on base plate **322** and spring plate **397**, and therefore on piston rod **224**, draws the piston member **220** to the right of FIG. 6 and reverses the hydraulic liquid flow into chamber **294**. The hydraulic liquid flow will then be from the side **425** of piston head **222** through the orifices **300** on the high pressure piston side **425** and to reservoir **296** and then back into chamber **294** through those of the orifices **300** that have been opened by the movement to the right of FIG. 6 of the piston member **220**. During the return flow through the orifices **300** the flow is again such as to impart a substantially constant flow characteristic to the cushion device **42**. Also, flap valve plate **316** will close off passages **312** and hydraulic liquid flow will occur between reservoir **296** and chamber **294** through passages **330**, **336** and **338** of end plate **377** and past flap valve plate **344**.

One function of the flexible static seal **352** is to form an accumulator chamber to take the hydraulic liquid displaced from chamber **294** by the entry of the piston rod **224** into same, and the seal member **352** expands somewhat under the pressure of the additional hydraulic liquid discharged into the chamber **374**. The member **352** is made sufficiently resilient so that as the piston member **220** returns to the full line position of FIG. 6, it tends to aid in discharging hydraulic liquid from chamber **374** back through the passages **328** and **326** and into reservoir **296**, etc. Chamber **374** also serves as a surge chamber to take care of excessive pressure surges in reservoir **296**; pressures in reservoir **296** are relieved through passages **326** and **328**.

It will therefore be seen that I have provided a long travel dual sill arrangement with a double acting hydraulic cushioning device incorporated therein that forms a unique sliding sill or draft and buffing column cushioning arrangement for protecting both the car and its lading against coupler impacts.

My new sliding sill or draft and buffing column arrangement is especially suited for ready converting of existing standard boxcars to cushion underframe cars. This arrangement is largely self-contained from a cushioning standpoint, and insofar as modification of existing underframes is concerned, the only important changes required are those involved in applying the fixed stops to the underframe stationary center sill structure, as well as the necessary supports for supporting and guiding the sliding sill itself.

When a longitudinal impact is encountered, as, for example, against the right hand end of the sliding sill arrangement **14** of FIG. 1, the sill section moves to the left of FIG. 1 with respect to underframe **12** with the result that the casting **110** of column section end **38** presses against end **44** of cushion device **42**. This action presses the end **46** of the cushion device **42** against the casting **110** of the end **40** of column section **36**, which in turn presses the rubber pad cushioning device **62** against the stop structures **70** and **78** that are affixed with respect to the center sill structure **26**. As the cushion device **62** acting on stop structures **70** and **78** prevents any substantial movement of the cushion device **42** to the left of FIG. 1 under the impetus of the buff impact, the cushion device **42** contracts under the action of column section **34** continuing to move to the left of FIG. 1 against the action of cushion device recentering spring **395**, with the result that the piston member **220** moves from the full line position of FIG. 6 to the broken line position of FIG. 6 to provide the long travel cushioning action having a substantially constant force travel characteristic.

After the cushion device has completed its closure stroke, the recentering spring **395** or a draft force applied at the right hand returns the hydraulic cushion device piston member **220** to its full line position of FIG. 6, and at the same time moves column section **34** to the right of FIG. 1 to return the column arrangement **14** to its extended full line position shown in FIG. 1, which is reached when cushion device **60** follower plate **63** seats against stops **68** and **76**. During the return movement the cushion device **42** as heretofore described is characterized by a substantially constant resisting force during its travel.

Coupler impacts in buff from the other direction are handled in a similar manner, though in the opposite directions, and in this case, the fixed stop structures **68** and **76** form the means for transmitting the impact energy to the underframe and the weight that it carries. Coupler impacts from the left of FIG. 1 cause the housing **232** of cushioning device **82** to move with respect to its piston member **222**, but the hydraulic liquid flows above described remain the same.

It will thus be seen, assuming a car in question includes underframe **12** and is subjected to a free standing impact, the impacted end of the draft and buffing column moves with respect to the underframe against the cushioning device, while the other end of the draft and buffing column remains substantially stationary relative to the underframe throughout the stroke of the cushioning device.

When the car including underframe **12** and cushioning arrangement **14** is at the end of a cut of cars and is impacted, the column section impacted moves inwardly of the car with respect to underframe **12**, and since the struck column section in the ordinary functioning of cushioning arrangement **14** travels the full stroke length of the cushioning device **42** with respect to the other column section, the impacted car will be protected as the hydraulic cushion device **82** performs its energy transmitting and dissipating functions with substantially constant force travel closure characteristics over the indicated travel length.

The cushioning device **42** does not come into play when draft impacts are applied on the car and the piston member **220** is in the full line position shown. For instance, assuming that the coupler **104** of column section **34** is subjected to a draft impact, the column section **34** tends to move to the right of FIG. 1 with respect to underframe **12** (carrying with it column section **36**), thereby compressing rubber pad cushioning device **60** between the face **66** of casting **110** of the column section end **38** and faces **176** and **186** of stop structures **68** and **76**, respectively. The cushioning device **60** is arranged to provide a travel on the order of that of conventional draft gear to handle the draft impact, for instance, in the range of two to five inches, after which the resilience of the cushioning device **60** returns the draft impacted column section **34** (as well as column section **36**) to the left of FIG. 1 with respect to underframe **12** to recentered position.

Draft impacts at the other end of the underframe are handled in like manner, but in reverse directions, the cushion device **62** having a travel similar to that of device **60**.

The cushioning device **82** includes a number of improvements in addition to the pressure relief valve **83**.

As already mentioned in connection with the hydraulic cushioning device, the piston member **220** is a one piece element, which eliminates the need to weld the piston head on a piston rod and the consequent distortion due to heat treating and welding.

Furthermore, it will be noted that the boot **352** not only serves to accumulate the hydraulic liquid displaced from the chamber **294** by the full entry of the piston rod into that chamber, but it also serves as a surge chamber to minimize forces within the reservoir **296** in the chamber **294** during displacement of the hydraulic liquid by the piston **220**.

The hydraulic cushion device piston arrangement also eliminates to a considerable extent the machining that has formerly been required in connection with components of this type.

Pressure relief valve **83** is simple and reliable, and does not require a sensitive adjustment to adapt it to its desired working condition. The valve **83** is entirely housed within the piston member **220**, and thus is not only compactly arranged, but fully protected during use.

Another important aspect of this invention is that the low car body forces provided by practicing the invention of my Patent 3,003,436 are also available to the sliding sill itself, which means that substantially lighter sliding sill constructions may be employed than was heretofore thought possible.

Still another important aspect of the invention is that since the end of the car sill that is impacted moves inwardly of the car without the sill at the other end of the car moving outwardly of the car, the uncoupling device at each end of the car can be greatly simplified.

Moreover, where a cushion car equipped with this invention is at the end of a cut of cars and is impacted, the car next to it received the benefit of long travel cushioning, whereas with a cushion underframe car with a continuous sliding sill, this was not possible.

The foregoing description and the drawings are given merely to explain and illustrate my invention and the invention is not to be limited thereto, except insofar as the appended claims are so limited, since those skilled in the art who have my disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

What is claimed is:

1. In a railway vehicle including a wheel frame structure, a draft and buffing column carried by said frame structure and including means for securing a coupler at each end thereof, cushioning means operatively interposed between stop means fixed on said frame structure and said column for cushioning longitudinal impacts applied to the couplers, the improvement wherein:

said column comprises a pair of sections positioned in spaced apart relation in longitudinal alignment and mounted for movement longitudinally thereof with respect to each other and to said frame structure,

said columns each include keying means at the adjacent ends thereof, and formed to define a cushion pocket outboard of said keying means,

a resilient cushioning device mounted in each of said cushion pockets in engagement with said stop means so as to be operative to absorb draft impacts applied on said column when said column sections are in said spaced position,

a hydraulic cushioning means comprising a self-contained hydraulic unit disposed between said sections, a hydraulic fluid filled cylinder, a piston assembly reciprocable therein, and means arranged to displace fluid in a manner to achieve a substantially constant force travel characteristic when said cylinder and said piston assembly are reciprocated relative to each other upon buff impact applied on said column, and having a length of travel substantially equal to said spaced distance between said sections,

means for detachably keying said cylinder for movement with one of said columns,

means for detachably keying said piston member for movement with the other of said columns,

and return spring means disposed between said cylinder and said piston assembly for returning said column sections to a spaced position after a buff impact has been dissipated.

2. The improvement set forth in claim **1** wherein:

said keying means on each of said columns comprises vertically disposed open socket means and said key-

ing means of said hydraulic cushion means comprises vertically disposed lug means interengaging said open socket means,

and support means removably secured to said frame structure and underlying said unit,

whereby, on removal of said support means, said unit may be lowered to separate said keying means and remove said unit from between said sections.

3. The improvement set forth in claim 2 wherein:

said resilient cushioning devices being resiliently compressible longitudinally of said column and each defining an end portion facing the coupler ends of said column,

and said stop means comprises lug means engaging the respective resilient cushioning device end portion and fixed to said frame structure.

4. The improvement set forth in claim 3 wherein:

said column sections each comprise elongate members having an H configuration in transverse section and defining a horizontally disposed web portion,

and wherein said web portions of said sections are

interrupted adjacent said socket structures to receive the respective resilient cushioning devices.

5. The improvement set forth in claim 4 wherein:

said resilient cushioning devices are T-shaped in transverse cross-sectional configuration with the upper portions thereof being proportioned to rest on the respective web portions.

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