Jan. 26, 1965 J. E. GUTRIDGE ETAL 3,167,028

LONG TRAVEL CUSHIONING ARRANGEMENT FOR CRANE LIFT FREIGHT CONTAINERS

Original Filed Feb. 26, 1959 5 Sheets-Sheet 1

Fig-1

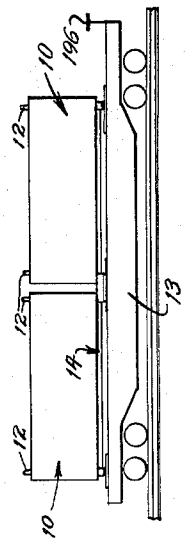


Fig-2

Fig-4

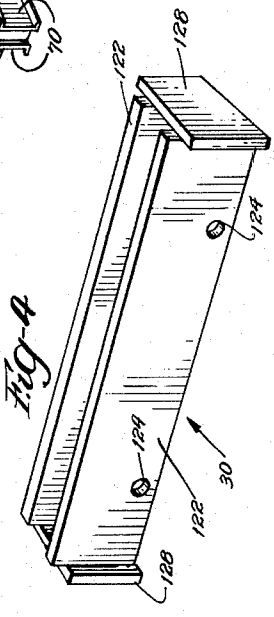
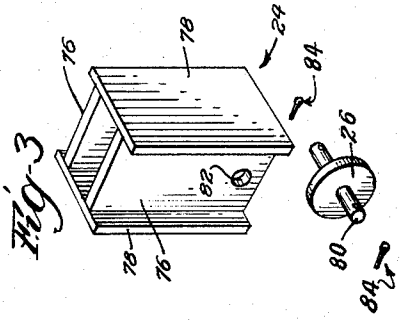


Fig-3



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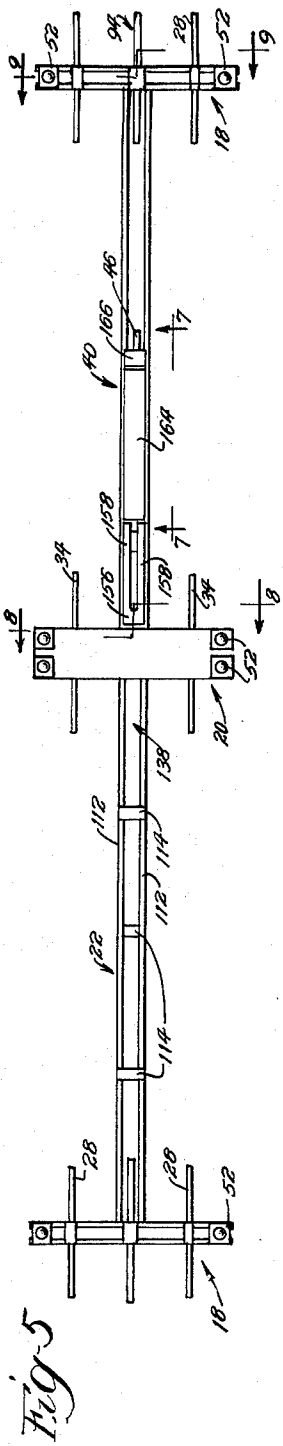


Fig-5

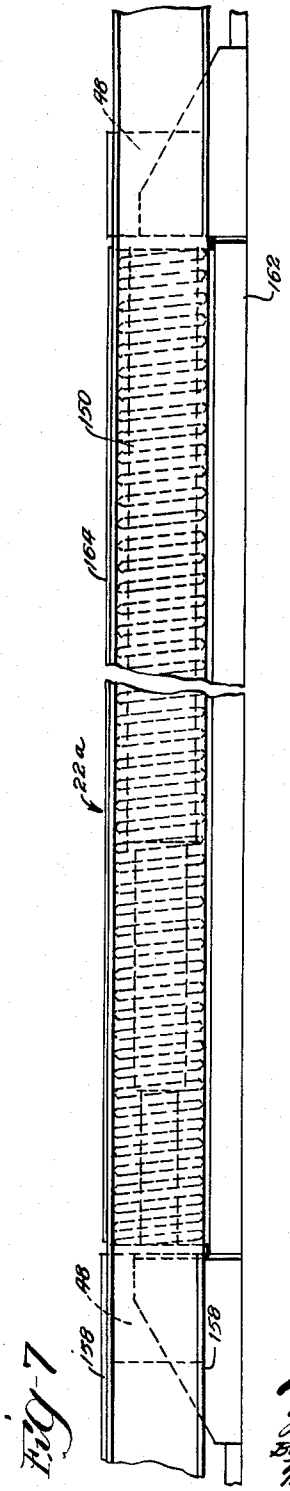


Fig-7

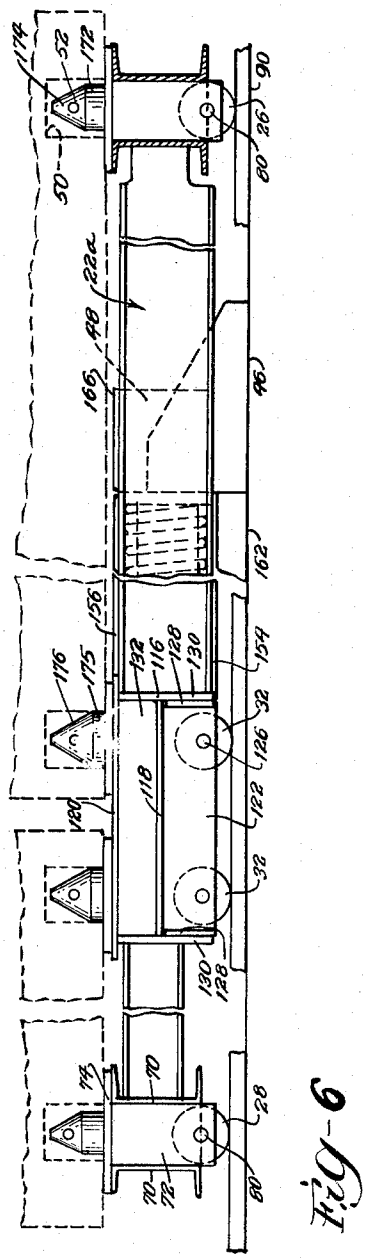


Fig-6

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LONG TRAVEL CUSHIONING ARRANGEMENT FOR CRANE LIFT FREIGHT CONTAINERS

Original Filed Feb. 26, 1959 5 Sheets-Sheet 3

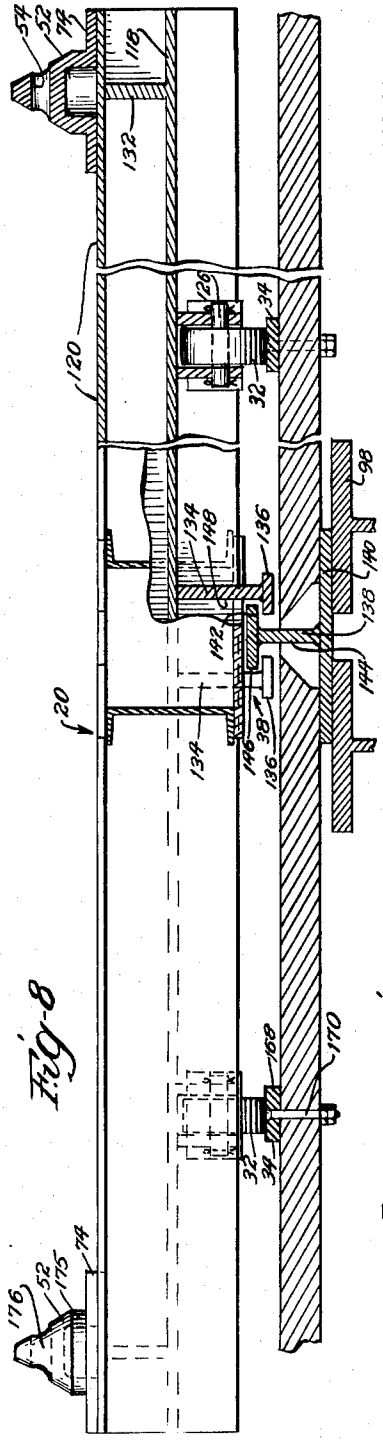


Fig-8

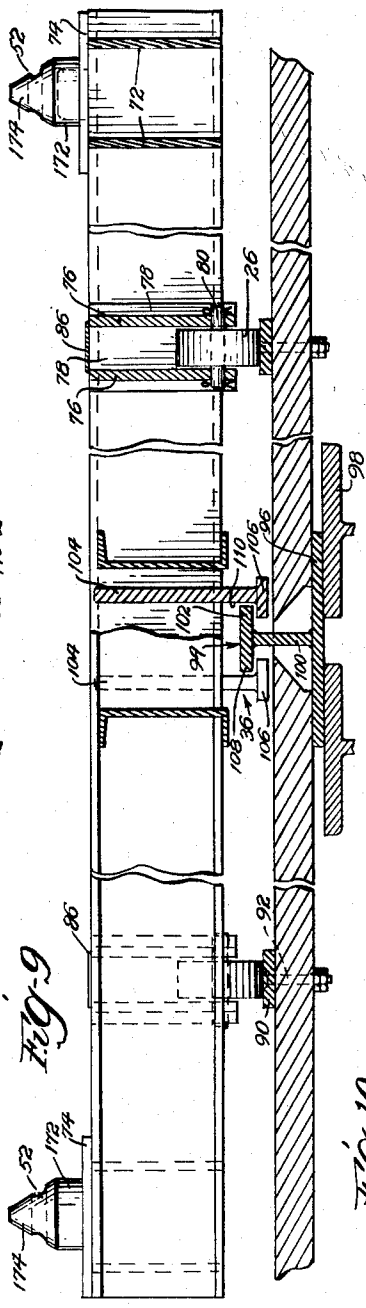


Fig-9

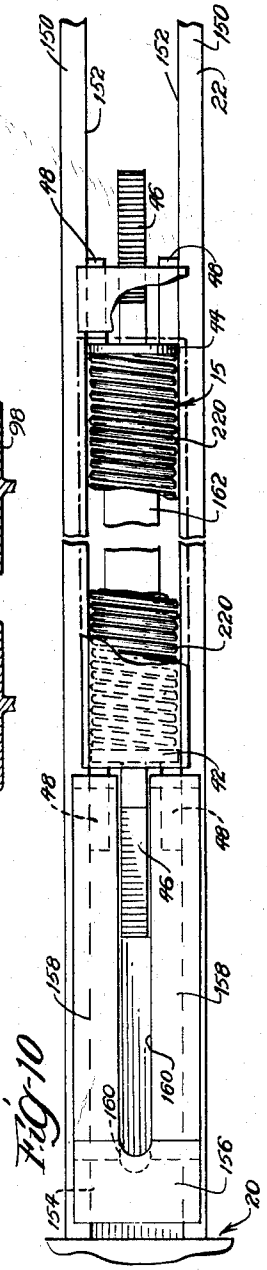


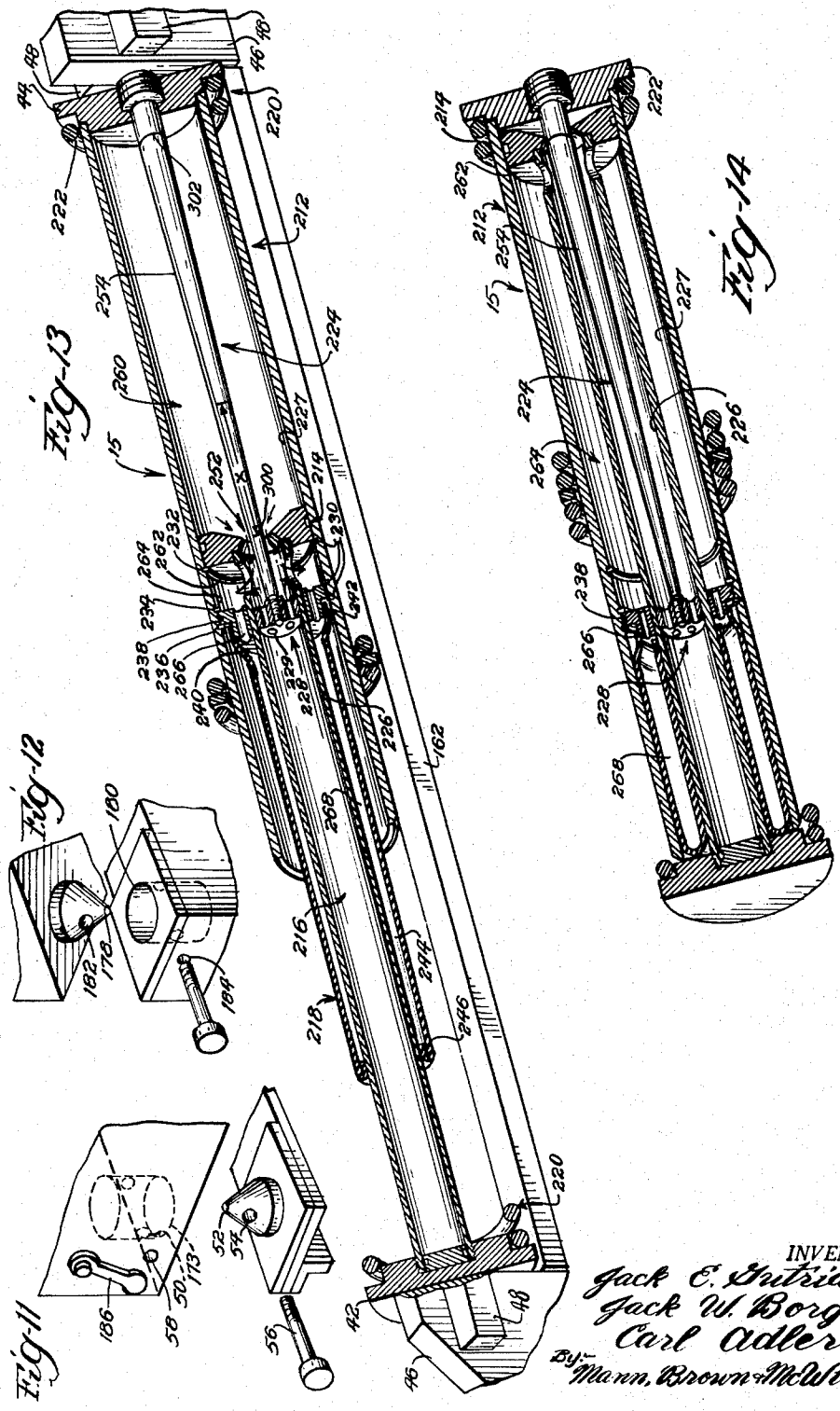
Fig-10

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LONG TRAVEL CUSHIONING ARRANGEMENT FOR CRANE LIFT FREIGHT CONTAINERS

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LONG TRAVEL CUSHIONING ARRANGEMENT FOR CRANE LIFT FREIGHT CONTAINERS

Original Filed Feb. 26, 1959 5 Sheets-Sheet 5

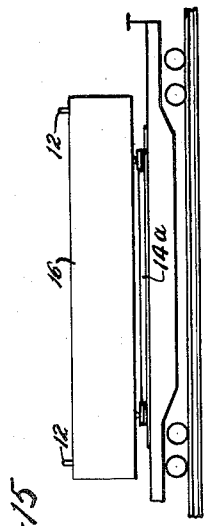


Fig-15

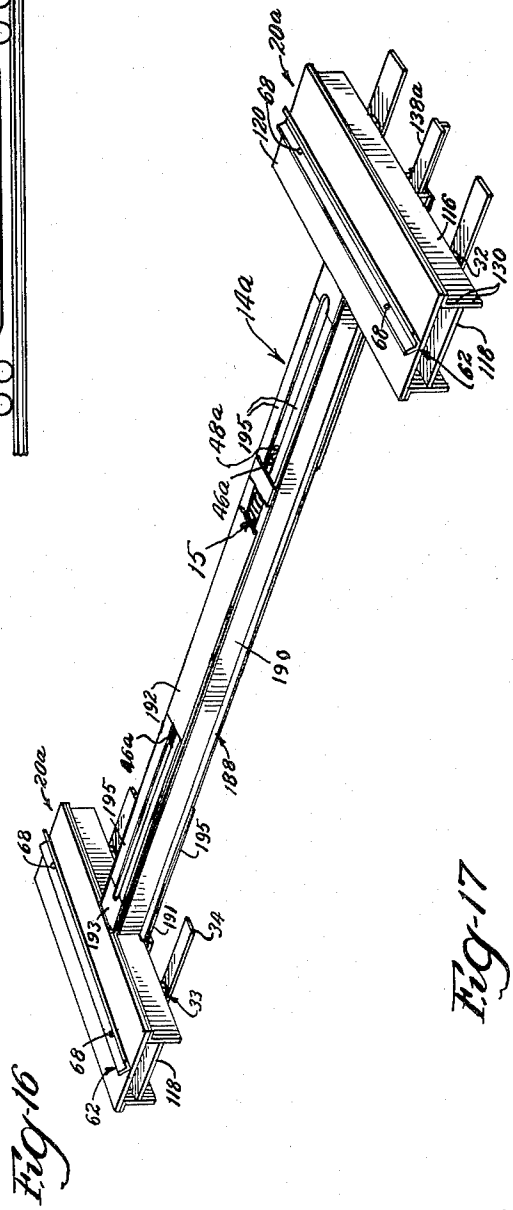


Fig-16

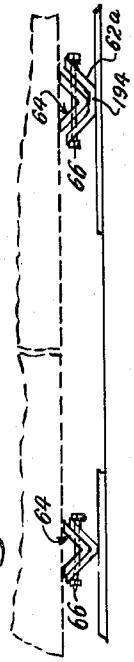


Fig-17

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United States Patent Office 3,167,028 Patented Jan. 26, 1965

3,167,028

LONG TRAVEL CUSHIONING ARRANGEMENT FOR CRANE LIFT FREIGHT CONTAINERS

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Continuation of application Ser. No. 21,056, Apr. 8, 1960, which is a continuation of application Ser. No. 795,706, Feb. 26, 1959. This application Sept. 6, 1963, Ser. No. 308,616

10 Claims. (Cl. 105—366)

This application is a continuation of our abandoned application Serial No. 21,056, filed April 8, 1960, which was a continuation of our abandoned application Serial No. 795,706, filed February 26, 1959.

Our invention relates to a long travel cushioning arrangement for transporting freight containers on railroad cars, and more particularly, to a cushioned container supporting platform or carriage arrangement for application to standard flatcars for protecting, during transit, lading in crane lift type containers in accordance with the principles described in the copending application of William H. Peterson, Serial No. 856,963, filed December 3, 1959 now Patent No. 3,003,436, granted October 10, 1961 (the entire disclosure of which is incorporated herein by this reference).

Lading damage resulting from coupler impacts and the claims resulting therefrom have always been a major problem for the railroad industry, but during recent years the problem has been greatly magnified by increased service speeds with the resulting increase in severity and frequency of coupler impacts between freight cars.

The invention of said Peterson application Serial No. 856,963 provides a new approach to the protection of lading in transit on railroad cars, which is applicable to both standard railroad cars, such as boxcars and flatcars, as well as to cars specially designed for piggyback and freight container systems of handling freight.

As disclosed in said Peterson application Serial No. 856,963, during impacts, changes in the absolute velocity of the lading, which are normally caused by stopping and starting of the car, and by impacts against the car couplers during transit, are affected by adding or subtracting kinetic energy to the lading through the frictional forces acting between the lading and the car as well as the pressure of the car end wall on the lading (the car end wall involved depending on whether the car coupler is initially subjected to the longitudinal shock and whether the shock is in buff or in draft). Said Peterson application discloses that damage free lading protection against longitudinal impacts (that is, impacts applied against the car couplers) can be obtained if there is interposed between the couplers and the car body containing the lading a cushioning device or arrangement having a cushion travel sufficient in capacity and length that the absolute velocity of the lading is changed to that required by the Law of Conservation of Momentum for Inelastic Bodies by employing to a substantial degree the frictional forces acting between the lading and the car, as distinguished from the compressive forces applied to the lading by the car end wall. This novel approach is particularly applicable to resilient lading (goods packed in fibre boxes) and involves, among other things, extending the time of closure of the cushioning device employed sufficiently so that the changes that must occur to the absolute velocity of the lading (by reason of the aforementioned Law of Conservation of Momentum) occur to the lading as a unit. The length of travel found essential for U.S. railroad practices is in the range of 20 to 40 inches, and preferably is on the order of 30 inches.

It has been found, as disclosed in said Peterson application, that a cushion travel in this range permits the inherent stability of the load and the friction between the lading and the car body to act as substantial factors in creating the lading acceleration (either positive or negative) necessary to achieve the absolute velocity dictated by the aforementioned Law of Conservation of Momentum, without developing within the lading the destructive compressive forces which cause lading damage.

Said Peterson application discloses that the benefits of his invention may be employed in practicing container systems of handling freight by mounting on a standard flatcar a platform or carriage on which the freight container is supported, and interposing between the platform or carriage and the bed of the flatcar a cushioning device of the character contemplated by the Peterson invention.

Our invention relates to a specific embodiment of such an arrangement.

In recent years, container systems of transporting freight, employing demountable containers, have received considerable attention because of increased economies in use of equipment and improved service to shippers. This is particularly true with regard to less-than-carload shipments. However, container systems heretofore proposed have in general failed to make adequate provision to protect container lading from the adverse effects of longitudinal shocks during railroad tansit.

Cushion underframes for cars adapted for use in container systems as well as for boxcars and the like have provided a partial answer to the problem of absorbing longitudinal shocks, but new cars of this type are an expensive investment which most railroads desire to avoid, so long as existing equipment can be maintained in operation.

A principal object of our invention is to provide a simplified cushioned support or rack arrangement for mounting freight containers on standard railroad cars such as flatcars.

A further principal object of the invention is to provide a carriage for mounting containers, particularly those of the crane lift type, on standard railroad flatcars, including a long travel cushioning arrangement that insures lading protection against longitudinal impacts.

Yet a further object of the invention is to provide a cushioning arrangement for mounting crane lift containers on railroad cars which is capable of, without lading damage, transferring and dissipating substantially all of the kinetic energy applied to the container by coupler impacts of collision magnitudes and thus leaving little or no energy to cause lading damage.

Other objects of the invention are to provide an improved indexing and locating arrangement for securing the container to the railroad car, to provide a simplified wheeled carriage structure for application to standard railroad cars on which freight containers may be mounted for transit, and to provide railroad freight handling apparatus that is inexpensive of manufacture, convenient in use and readily adapted for handling most types of existing freight containers.

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

In the drawings:

FIGURE 1 is a small scale side elevational view of a standard railroad flatcar having our invention applied thereto and showing two crane lift type containers mounted for transit on the railroad car;

FIGURE 2 is a perspective view of the container supporting carriage structure employed in the arrangement of FIGURE 1, the car bed being omitted for ease of illustration;

FIGURES 3 and 4 are perspective views of two differ-

ent types of roller housings employed in the carriage of FIGURE 2;

FIGURE 5 is a plan view of the carriage shown in FIGURE 2;

FIGURE 6 is a side elevational view of the carriage of FIGURE 2, on an enlarged scale and with parts being broken away (the containers being shown in outline form);

FIGURE 7 is an elevational view approximately along line 7—7 of FIGURE 5;

FIGURE 8 is a cross-sectional view approximately along line 8—8 of FIGURE 5;

FIGURE 9 is a cross-sectional view approximately along line 9—9 of FIGURE 5;

FIGURE 10 is a plan view of the structure shown in FIGURE 7, parts being broken away to facilitate illustration;

FIGURES 11 and 12 are fragmental perspective views illustrating two forms of container indexing and latching devices that may be employed in connection with this invention;

FIGURE 13 is a diagrammatic perspective view, in section, of the hydraulic cushion unit employed in connection with this invention, showing same in extended position and in association with adjacent stops and lugs employed n the railroad car employed in the arrangement of FIGURE 2;

FIGURE 14 is a perspective view of the same hydraulic cushion unit, but showing same in contracted relation;

FIGURE 15 is a small scale elevational view illustrating a modified form of container support carriage applied to a conventional flatcar and showing a somewhat different type of container applied thereto;

FIGURE 16 is a perspective view of the container supporting carriage of FIGURE 15; and

FIGURE 17 is a fragmental side elevational view illustrating a modified form of container indexing and latching device employed in the embodiment of FIGURES 15 and 16.

General description

For convenience, the invention has been illustrated in connection with the handling of seagoing or maritime containers of the type that are designed to form trailer bodies, but it will be obvious that the invention has broader aspects and can be applied to any form of container that is adapted to be applied to a railroad car or other load carrying vehicle.

The form of seagoing or maritime container for which the invention was specifically designed is a conventional twenty-four foot trailer forming body that is employed both for ocean and railroad transit as well as highway transit. Two such containers are generally indicated at **10** in FIGURE 1 and these containers are conventionally applied with suitable hooks **12** at their corners for attachment to a suitable crane that transfers the containers, for instance, between ship and shore.

Containers **10** serve the general purposes of avoiding unpacking and repacking lading when transferring them between railroad cars and ships, or between either these load carrying vehicles and highway vehicles. The railroad car structure shown in the drawings is designed to convey containers **10** by rail transit from distant inland points to ports, whereupon the container may be crane lifted to lake or oceangoing ships, the railroad car structures then being available to receive incoming containers **10** for rail transit to inland destinations.

In accordance with our invention, the individual containers **10** are secured to a standard railroad car **13** (see FIGURE 1), such as a flatcar, by a carriage or rack structure generally indicated at **14**, which is mounted for movement longitudinally of the car **13**. Interposed between the carriage **14** and the railroad car **13** is a long travel hydraulic cushion unit **15** (see FIGURES 10 and 13) which preferably is designed in accordance with the principles of said Peterson application Serial No. 856,963.

The embodiment of FIGURES 1–14 is designed to hold two containers **10**, while the embodiment of FIGURES 15–17 is designed to hold a single container **16** of somewhat greater size.

The embodiment of FIGURES 1–14 comprises a pair of spaced end bolster structures **18** and a center bolster structure **20** connected together by longitudinally extending beams **22** and **22***a*. The end bolster structures **18** are provided with roller assemblies **24** including rollers **26** that engage on tracks **28**. The central bolster structure **20** includes at each end thereof a roller assembly structure **30** including rollers **32** that engage tracks **34**. The movement of the carriage **14** longitudinally of the car (on longitudinal impacts) is guided by end bolster aligning structures **36** (see FIGURE 9) and center bolster aligning structures **38** (see FIGURE 8). Cushion device **15** normally holds the carriage **14** against movement longitudinally of the car.

As best seen in FIGURES 2, 5 and 10, the hydraulic cushion device **15** is applied between the carriage and the railroad car bed where generally indicated by arrow **40**. The ends **42** and **44** of the hydraulic cushion device engage spaced stops **46** fixed to the railroad car bed and spaced lugs **48** that are fixed to beams **22***a*.

Containers **10** are conventionally provided with cylindrical recesses **50** (see FIGURES 6 and 11) in their corners for engaging cone-like bracket structures **52** that, in accordance with our invention, are applied to the ends of bolsters **18** and **20** to serve as means for mounting the container on the rack. The cone-like bracket structures **52** serve to index the container with respect to the carriage and are formed with holes **54** that receive suitable pins **56** (see FIGURE 11) which also pass through suitable openings **58** in the containers to lock the containers against vertical movement.

The embodiment of FIGURES 15–17 is quite similar to that of FIGURES 1–14, the carriage **14***a* employing two bolster structures **20***a*, which are essentially the same as the bolster **20** of FIGURE 2, and which are connected by longitudinally extending beams **188**. The carriage **14***a* includes roller assemblies **30** and tracks **34** as well as aligning structures of the type shown at **38** in FIGURE 8. The cushion device **15** is applied to the carriage **14***a* where indicated generally by the arrow in FIGURE 16, the arrangement of FIGURES 15–17 also employing stops **46***a* and lugs **48***a* (corresponding stops **46** and **48**, respectively) against which engage the ends of the cushion device.

In the embodiment of FIGURES 15–17, a modified form of container indexing and latching device is employed which contemplates the use of angle members **62** and **62***a* on the bolster structures **20** and corresponding angle members **64** that are fixed to the container body **16**. The containers **16** are latched to the carriage **14***a* by suitable bolts **66** (see FIGURE 17) passing through perforations **68** formed in the respective angle members.

The hydraulic unit **15** is designed to provide a constant force travel cushioning characteristic over a closure distance on the order of thirty inches.

When the cars of FIGURES 1 and 15 receive longitudinal impacts, there is a relative movement between the carriage and the car body which is opposed by the cushion device **15**. Under the impulse of an impact, the cushion device moves from the extended position of FIGURE 13 to the contracted position of FIGURE 14, and in doing so, dissipates part of the kinetic energy of the impulse in the form of heat and gradually transfers the rest to the carriage and its load, except for that stored as potential energy for recentering purposes. In accordance with said Peterson application, the travel of the cushion unit **15**, under maximum impact conditions, between extended and contracted relations, and the relative movement between the carriage **14** or **14***a* and the railroad car should be

made in the range of from about twenty to about forty inches, since lading damage is substantially eliminated by the transfer and dissipation of shocks due to moderate coupler impact over travel in this range. Best results are achieved with a cushion travel on the order of thirty inches under maximum impact conditions.

The embodiments illustrated insure the protection of lading even at relatively high impacts. For instance, units 15 will easily handle 15 mile per hour impacts and thus provide maximum protection for the lading, though impacts of this magnitude will undoubtedly damage the railroad car.

Specific description

The end bolsters 18 of the embodiment of FIGURES 1–14 each generally comprise a pair of spaced channel members 70 secured together at their ends by shear plates 72 (see FIGURE 9), and cone bracket flanges 74. The roller assemblies 24 are interposed between the spaced channels 70 and include housing plates 76 that journal the respective rollers 26. Housing plates 76 are joined together by tie plates 78 which are in turn fixed to the respective channel members 70. This may all be done by welding.

The rollers 26 are rotatably mounted on suitable pins 80 that are received in appropriate holes 82 formed in the respective plates 76. Any suitable device, such as cotter pins 84 (see FIGURE 3), may be employed to prevent dislodgment of pins 80. The roller assemblies 24 are preferably closed by a top plate 86 welded between the channels 70 and the housing plates 76.

The tracks 28 comprise elongated metal strips or plates 90 fixed in place as by bolts 92 or in any other suitable manner (see FIGURE 9).

At and along the longitudinal center line of the railroad car and carriage, and adjacent each end of the carriage, a T-shaped guide member 94 (forming part of aligning structures 36) is fixed to the car in upright position in any suitable manner as by being welded to a suitable base plate 96 that is in turn welded to the car center sill 98. The guide members 94 each comprise a vertical element 100 and a horizontal element 102 which projects laterally of the center line of the car on both sides thereof. A pair of spaced mounting plates 104 are secured between the channels 70 of each end bolster 18 and carry at their lower ends laterally projecting guide elements 106 which are interposed under the laterally projecting sides of horizontal element 102 of guide member 94. The edges 108 of element 102 engage surfaces 110 of plates 104 to effect and maintain the desired degree of alignment of the carriage with the center line of the car. The projection of the elements 106 underneath element 102 prevents the carriage from being lifted from the railroad car in the event that container securing pins 56 are inadvertently not removed before an unloading operation takes place.

The connecting beams 22 may be in the form of channel members 112 fixed in any suitable manner between one of the end bolsters 18 and the center bolster 20. Beams 22 are preferably reinforced by one or more appropriate tie plates 114.

The center bolster 20 is illustrated in the form of an I-beam 116 positioned with its web 118 disposed horizontally and closed at its top by an appropriate cover plate 120. The center bolster roller housings 30 are positioned within the ends of I-beam 116 and below its web portion 118. Each roller housing 30 includes housing plates 122 formed with appropriate openings 124 in which roller shafts 126 of rollers 32 are journalled. The housing plates 122 are held in spaced relation by tie plates 128 which are in turn welded to the respective flanges 130 of I-beam 116. Plates 122 and 128 may be secured together by welding and roller shafts 126 may be held against dislodgment by any suitable means such as the cotter pins shown in FIGURE 3. As indicated in FIGURE 8, a brace plate 132 is preferably fixed in place between cover plate 120 and web 118 at each end of the center bolster.

Adjacent the center line of the car, a pair of spaced depending mounting plates 134 are welded between I-beam web 118 and its flanges 130; mounting plates 134 carry laterally projecting elements 136 that cooperate with the T-shaped guide member 138 which serves the same purpose as guide member 94 at the end bolsters. Guide member 138 comprises a T-shaped structure fixed to the car bed in any suitable manner as by being welded to plate 140 which is in turn fixed to the car center sill 98.

The T-shaped structure 138 includes horizontal member 142 mounted on vertical member 144. Edges 146 of the horizontal member 142 cooperate with surfaces 148 of the mounting plates 134 to provide the aligning action desired and the inwardly directed edges of the elements 136 project under edges 146 of member 142 to aid in preventing vertical movement of the carriage with respect to the railroad car.

Beams 22*a*, between which the cushion device 15 is mounted, are welded between one of the end bolsters 18 and the center bolster 20. Beams 22*a* may also take the form of conventional channel members 150, but preferably are somewhat stronger because of the longitudinal forces acting through them on cushioning of impacts.

In the illustrated embodiment, lugs 48 are four in number and are welded to the inner surfaces 152 of channel members 150. Appropriate tie plates 154 and 156 reinforce the channels adjacent the center bolster 20, upper and lower plates 158 also being secured, as by welding, between the upper and lower ends, respectively, of the two lugs 48 closest to center bolster 20, the respective channels 150, and the respective plates 154 and 156 to effect further reinforcement. Plates 158 are formed to define slots 160 to accommodate the relative movement of the adjacent cushion stop 46 that is fixed to the railroad car bed.

As indicated in FIGURES 6, 7 and 10, a cushion base plate 162 is positioned between the spaced stops 46 on which the cushion device 15 rests. The cushion device is proportioned to be received between the channel members 152 and is covered by an appropriate cover plate 164 (see FIGURE 2) after being mounted in place. An appropriate tie plate 166 may be welded in place between the two channel members 154 and the underlying lugs 48 for reinforcing purposes.

Tracks 34 on which center bolster rollers 32 ride may comprise suitable elongated strips or plates 168 fixed in place by appropriate bolts 170 or in any other suitable manner. It will be noted from FIGURE 6 that rollers 26 and 32 of the respective roller assemblies place the rack or carriage 14 in weight transmitting engagement with car 13 in substantial vertical alignment with vertical planes extending transversely of the rack or carriage 14 and passing througgh the respective bracket structures 52. This minimizes the application of bending stresses to the rack 14 due to the weight of its container load.

The beams 22 and 22*a* in accordance with our invention, may be relatively light members since they are provided primarily for purposes of joining together the spaced bolsters. This is achieved by the modification that we have made in the cone-shaped indexing and latching container mounting devices formed by bracket structures 52 that are mounted at the ends of the bolsters. As best seen in FIGURE 6, the cone-shaped bracket structures 52 that are mounted on the end bolsters are reduced in diameter at their cylindrical portions 172, though their tapered portions 174 retain the same angulation as the corresponding tapered portions 176 of the cone-shaped structures at the center bolster. The cylindrical portions 172 are preferably reduced sufficiently to provide a lost motion connection with about a one-quarter inch play or more between the container wall structure 173 defining recesses 50 and these end cone-shaped structures. Cylindrical portions 175 of the center bolster bracket struc-

tures are proportioned as is conventional to provide about a one-sixteenth inch clearance between these bracket structures and container walls 173.

Thus, when a container 10 is applied to the cone-shaped structures 52 at one end of the carriage 14, the cone-shaped structures 52 positioned on the center bolster apply camming action on the container that effects centering or locating of the container longitudinally of the carriage, the play or loose fit at the end bolsters permitting any longitudinal movement required because of misalignment of the recesses 50 and the cone structures 52.

This is done for several reasons. One is to avoid applying shear forces to the bolsters with consequent application of either tension or compressive forces to connecting beams 22 or 22*a* caused merely by the weight of the load alone. Conventional manufacturing tolerances make impossible exact positioning of any four cone structures 52 with respect to corresponding container recesses 50, and by making the cone structures at the end bolsters sufficiently small to permit the adjustment required, the cone structures at the center bolster effect the longitudinal indexing that is necessary without applying these extra stresses to the connecting beams.

Furthermore, the longitudinal forces acting between the carriage and the container during cushioning of impacts are resisted by the relatively strong center bolster structure.

Of course, the cone structures at the center bolster might be reduced in diameter rather than those at the end bolsters, but the embodiment of FIGURE 6 is preferred since only the center bolster need be designed for withstanding maximum loads.

An alternative form of indexing and locking device is shown in FIGURE 12 in which the cone-shaped bracket structures 178 are applied to the containers while tubular cylinders 180 are fixed to the end of the bolsters to receive the cone-shaped structures 178. These members may be formed with suitable holes 182 and 184 to receive a pin similar to pin 56.

In both of these embodiments, the pin 56 may be held in latching position by pivoted arm 186 held against swinging movement in any suitable manner.

In the embodiment of FIGURES 15–17, two bolster structures 20*a* are employed which are similar in structure to center bolster 20 previously described. Identical references indicate like parts. The bolsters 20*a* are connected by beams 188 in the form of channels 190. Channels 190 are braced by reinforcing plates 191, 193 and 195 corresponding to plates 154, 156 and 158. Cushion device 15 is mounted in the same manner as described above and cooperates with similar lugs 48*a* and stops 46*a*. Cover plate 192 corresponds to cover plate 164 of FIGURE 2 and other reinforcement may be employed as desired. The bolsters 20*a* include the alignment structures shown in FIGURE 8 for cooperation with T-shaped guide members 138*a* and tracks 34 are the same in both embodiments of the invention.

The angle members 62, 62*a* and 64 comprising the modified container indexing and latching bracket arrangement are formed and mounted to permit the longitudinal container movement required to avoid the application of shear forces to the bolsters due to the load of the container as well as to insure that only one of the bolsters resists longitudinal forces during cushioning, as in the embodiment of FIGURES 1–14. In this embodiment of the invention, the angle member marked 62*a* is broadened or flattened at its apex portion 194 to permit the relative movement between the angle members 64 and 62*a* that is necessitated by the exact indexing of the two angle members at the other bolster. Bolts 66 that secure angle members 62 and 64 against displacement may be of any conventional type.

If desired, the cone-shaped structures of the embodiment of FIGURES 1–14 may be employed on the bolster 20*a* instead of the angle members illustrated, and of course, these angle members may be employed in the embodiment of FIGURES 1–14 instead of the cone-shaped structures there illustrated.

The embodiment of FIGURE 15 is designed to carry a trailer type crane lift container 16 on the order of thirty-five to forty feet long, when applied to a standard railroad car such as a flatcar.

In both embodiments of the invention, the hooks 12 illustrated are intended to represent any conventional device permitting attachment of crane cables or lines. Suitable antifriction glide blocks may be substituted for the carriage rollers illustrated, and these devices and their equivalents are referred to in the appended claims by the term "glide means."

Hydraulic cushioning device

The hydraulic unit 15 is preferably either that described in the copending application of William H. Peterson, Serial No. 782,786, filed December 24, 1958, now Patent No. 3,035,827, granted May 22, 1962, or that described in application Serial No. 9,785, filed February 19, 1960 by the same inventor (now Patent No. 3,035,714, granted May 22, 1962), the entire disclosures of which are hereby incorporated herein by this reference. The device or unit 15 is a dissipative energy system type substantially constant force travel long travel cushioning mechanism arranged to transfer and dissipate substantially all kinetic energy imposed upon the carriages 14 or 14*a* by draft or buff forces applied to the car couplers (in excess of the minor amounts absorbed by the draft gear and return springs of device 15). This is to be distinguished from conservative energy system type cushioning devices that merely store the energy on impact and return it in the form of oscillations. As described in said Peterson application Serial No. 856,963, device 15 is a one hundred percent efficient cushion travel device meaning that it transfers and dissipates the required energy with minimum travel and no recoil.

In other words, and as specified in said Peterson application Serial No. 856,963, the cushioning device 15 should have a travel of from about 20 inches to about 40 inches, or its equivalent, and be characterized by its ability to dissipate a sufficient amount of the energy of impact (other than that portion of such energy needed to recenter the cushioning device), either on closing of the device, or on closing and return of the device (note that the restricted flow of hydraulic liquid in cushioning device 15 on its return to normal is energy dissipating and thus cushion 15 has controlled recoil), so that the major portion of the remaining energy of impact is transmitted as kinetic energy to the load. Thus, in essence this makes the cushioning device 15 a dissipative energy system cushion as opposed to a conservative energy system cushion that stores and returns substantially all kinetic energy applied to it, although such dissipative energy system cushion should have sufficient energy storing and return characteristics to return the cushion and the rack to neutral or recentered position.

By employing the long travel cushioning device 15, the time required for the transfer of, for instance, the momentum of a striking car to a struck car (carrying the lading in question) is prolonged sufficiently to achieve the aforedescribed benefits that are disclosed in said Peterson application Serial No. 856,963.

The device 15 illustrated (see FIGURES 13 and 14) is that described in said Peterson application Serial No. 782,786 and it generally comprises a tubular cylinder 212 in which a piston head 214 is reciprocably mounted, a tubular rod 216 fixed to the piston head 214, an invaginating tubular member or boot 218 connected between the tubular cylinder 212 and the tubular piston rod 216, and helical compression springs 220 extending between the closure members 222 and 223 of the tubular cylinder 212 and tubular piston rod 216, respectively.

The closure member 222 of tubular cylinder 212 (forming end 44 of unit 15) carries a metering pin 224 that is reciprocably received within the bore 226 of the tubular piston rod 216. The metering pin 224 preferably is provided with a guide member 228 at its projecting end when the cushion device of said Peterson application Serial No. 782,786 is employed.

The internal surface 227 of tubular cylinder 212 is formed in any suitable manner as at 230 to receive three snap rings 232, 234 and 236. The snap ring 232 serves as a stop for piston head 214 when the device is in its extended position of FIGURE 13, while the snap rings 234 and 236 hold in place a piston rod guide member 238 to which one end 240 of the invaginating boot or tubular member 218 is secured by a suitable clamp 242. The other end of boot 218 is turned outside in, and is secured to the external surface 244 of the piston rod 216 by a suitable clamp 246.

The device 15 is charged with hydraulic liquid as described in said copending application Serial No. 782,786 to completely fill the space defined by the tubular cylinder 212, the tubular piston rod 216 and the invaginating boot 218. When the device 15 is in use, the normal positioning of the device components is that shown in FIGURE 13, the device being mounted between stops 46 and lugs 48 as previously described. When the railroad car receives a shock in either buff or draft, either the tubular cylinder 212 will commence movement to the left of FIGURE 13 or the tubular piston rod 216 and piston head 214 will commence movement to the right of FIGURE 13, or possibly both movements may occur. In any event, as the device 15 retracts under the force being cushioned, the metering pin 224 displaces hydraulic liquid contained within the tubular piston rod 216 and the piston head 214 causes a hydraulic liquid flow through its orifice 252 through which the metering pin 224 extends. The metering pin is preferably provided with a tapered surface 254 that is designed to provide the aforementioned constant force travel characteristic as the hydraulic cushion contracts under the shock imposed upon it; that is, the arrangement is such that for every unit of travel, the cushioning device provides a substantially constant cushioning effect.

As indicated in FIGURE 13, the oil flow then initiated is from chamber 260 on the high pressure side of piston head 214 through orifice 252 and into the bore 226 of tubular piston rod 216, thence radially outwardly of the piston rod 216 through orifices or ports 262 of the tubular piston rod. As the hydraulic liquid within the tubular piston rod is displaced by the metering pin 224, it likewise moves through ports 262, as indicated by the arrows. Metering pin guide member 228 is formed with relatively large apertures 229 to permit a free flow of hydraulic liquid during movement of the metering pin.

The hydraulic liquid flow through ports 262 is under relatively high velocity and creates great turbulence in the chamber 264 that is formed by the space between tubular piston guide member 238 and piston head 214. This great turbulence is caused at least in part by the radially directed flow of hydraulic liquid impinging directly against the inner surface 227 of tubular cylinder 212, and is responsible for dissipation of much of the kinetic energy of the hydraulic liquid in the form of heat.

As the contraction of the cushion device 110 proceeds, the high presure chamber 260 is reduced in volume by the advancement of the piston head 214 toward the tubular cylinder closure member 222. The hydraulic liquid passing through orifice 252 fills the chamber 264 behind the piston head 214, while a volume of hydraulic liquid equivalent to that displaced by the total entry into the fluid chamber of the piston rod 216 passes through apertures 266 of guide member 238 into the space 268 enclosed by the invaginating boot or tubular member 218 which inflates or expands and rolls to the position suggested by FIGURE 14. The apertures 266, as seen in

FIGURES 13 and 14, are relatively large in cross-sectional area, which provides or permits a relatively large volume and consequently low pressure hydraulic liquid flow from chamber 264 to space 268. This avoids generation of any appreciable compressive force on the relatively slender metering pin and prevents any possibility of it buckling.

After the shock has been fully dissipated, compression springs 220, acting in tandum, return the hydraulic cushion components to the initial extended position of FIGURE 13. During this movement under the action of the compression springs, the oil flow illustrated in FIGURE 13 is reversed, and invaginating tubular member or boot 218 deflates and returns to the position of FIGURE 13, thereby insuring that the hydraulic liquid displaced by the piston rod 216 is restored to its normal operative locations.

In the illustrative embodiments, the inner surfaces of beams 22*a* (or beams 188), the cushion base plates 162 and cover plates 164 (or 192) serve to guide the contraction and expansion of device 15 and prevent it from jackknifing.

It will thus be seen that not only is the device 15 composed of few and simple components, and that all sliding or dynamic seals have been eliminated, but a reliable long travel cushioning action is provided. Furthermore, all kinetic energy applied to the cushion device, with the exception of the small potental energy stored in return springs 220, is either dissipated in the form of heat by the passing of the hydraulic liquid through orifice 252 and the turbulence in chamber 264, or is transferred as kinetic energy (positive or negative, depending on the condition of impact) to the carriage structure 14 (or 14*a*) and the container loads they carry.

Reference may be had to said copending application Serial No. 782,786 for a more specific description of the specific unit 15 illustrated. It may be added, however, that the tapering surface 254 of the metering pin 224 extends between points 300 and 302 (see FIGURE 13), and that the contour of tapered surface 254 in the illustrated embodiment is designed from the relationship

$$A_x = A_0\sqrt{1-\frac{x}{d}}$$

wherein A_x is the orifice area of any position x (see FIGURE 13) over the total nominal stroke d (the length of the tapered surface 254), and A_0 is the initial orifice area defined by orifice 252 at the beginning of a stroke, in the case where a completely rigid body is being cushioned from impact. While in most cases this assumption will result in a reasonably efficient design, small alterations can be readily made to this shape to give a closer approach to the optimum constant force travel characteristic for a given situation after a few experimental trials. However, the shape given by the above formula is the best starting point. Furthermore, it is usually possible to obtain a reasonably efficient design by approximating the curved shape given by the above expression as by calculating a series of spaced cross-sectional areas of the pin 224 and connecting the cross-sectional areas so determined by straight tapers, if this facilitates manufacture. Moreover, the pin could be contoured so as to provide for the desired stroke in the range of 20–40 inches while having a reserve stroke which would give a substantially higher force travel characteristic than that throughout the normal stroke, in order to protect against overloads or other unusually severe conditions.

The orifice areas referred to are the orifice areas of orifice 252 minus the cross-sectional area of the metering pin at any given position along the stroke of the metering pin.

The components of the unit 15 may be formed from any suitable materials, boot 218 of the illustrated embodiments being formed from suitable oil impervious, flexible, rubber-like material with special additives for low temperature flexibility, and clamps 242 and 246 being of

the type of clamp sold under the trademark "Punch-Lok," made and sold by the Punch-Lok Company of Chicago, Illinois. The unit 15 of the illustrated embodiments is preferably charged with the high viscosity index oil sold by Shell Oil Company under the trade designation Aeroshell No. 4, as this oil desirably has a relatively small variation in viscosity between the extremes of minus 60 degrees F. and 150 degrees F.

The hydraulic liquid when the device 110 is in fully extended position is under very little pressure, perhaps no more than 2 p.s.i., but even though the pressures in the high pressure chamber 260 may rise to as much as 8,000 p.s.i. as when the device is employed in railroad cars to cushion buff and draft forces, the maximum pressure within the invaginating boot 218 (when fully inflated) is believed to be about 10 p.s.i. Boot 218 stretches about 100 percent when fully inflated. Units 15 can be designed for operating pressures up to the limit of the yield strength of cylinder 212 and the device of FIGURES 13 and 14 is capable of absorbing kinetic energy on the order of a million foot pounds, depending, of course, on the specific design required for a specific purpose. Units 15 will thus easily handle 15 mile per hour impacts when applied to, for instance, the railroad car structures shown in FIGURES 1–12 and 15–17.

Distinguishing characteristics of invention

It will thus be seen that we have provided a simplified but rugged and highly advantageous cushioned carriage support for mounting containers on railroad cars. Not only is the carriage or rack itself of simplified construction, but it provides an inexpensive manner of cushioning containers against longitudinal impact, since standard railroad cars may readily be modified to carry these carriages.

Thus, it will be noted that the carriage or rack and its cushioning device are in substantially horizontal coplanar relation, and thus are readily applied to the tops or decks of standard flatcars as the rack components merely require attachment to the car and need not be housed therein. This latter feature also keeps the sanding height of container loads to a minimum, since the container is supported closely adjacent the car deck.

While the invention is especially useful in connection with the crane lift type containers illustrated, it may be adopted to carry freight or other containers of any description merely by providing suitable holding devices on the bolsters and spacing the bolsters as may be necessary to properly distribute the load on the railroad car. When the cushion device 15 is employed, the highly desirable long travel cushioning action with its constant force travel characteristic is provided, in accordance with said Peterson application Serial No. 856,963. However, any reliable cushioning device (which is also an energy dissipating device) having a travel on the order specified will ordinarily be satisfactory.

In the embodiment of FIGURES 1–14, the bolsters are eight feet long and the carriage is on the order of forty-eight to fifty feet in length. This embodiment of the invention is shown in FIGURE 1 applied to a sixty foot railroad flatcar of standard design, the carriage being positioned so that the long travel is accommodated without interferring with hand brake 196. In the embodiment of FIGURES 15–17, the bolsters are also on the order of eight feet long and are spaced approximately sixteen feet apart. FIGURE 15 shows this modified carriage applied to a standard railroad flatcar.

The foregoing description and the drawings are given merely to explain and illustrate our 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 our disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

We claim:

1. In a railroad vehicle including a wheeled railroad flatcar bed having couplers at opposite ends thereof, a freight container support rack positioned on and carried by said bed, means for mounting said rack on said bed for movement longitudinally of said bed, and dissipative energy system type cushioning means operatively interposed between said rack and said bed for cushioning impacts applied to the car through the couplers and having a cushion travel of about twenty or more inches,
the improvement wherein:
said rack comprises a pair of spaced sill members extending longitudinally of the car bed,
a pair of spaced cross members rigidly joined to the sill members at longitudinally spaced points,
glide means interposed between the rack and the bed for transferring the load carried by the rack to the flatcar bed,
and securing means for mounting a freight container on the rack to provide at one end of the container a rigid anchorage to the rack and at the other end of the container a lost motion connection therewith,
said securing means including at least two indexing devices secured to said rack and spaced apart longitudinally of said rack with each of said indexing devices being constructed and arranged to cooperate with a complemental indexing device on the under side of the freight container,
one of said rack indexing devices having a relatively tight fit with respect to its complemental indexing device on the container and the other rack indexing device having a relatively loose fit with respect to its complemental indexing device on the container,
said glide means including an antifriction device for each of said spaced indexing devices with each such antifriction device being located adjacent to its associated indexing device,
whereby said spaced sills, being relieved by said securing means of longitudinal stress due to the weight of the container when mounted on said rack, may be relatively light weight.

2. The improvement set forth in claim 1 wherein said spaced cross members constitute end bolster structures,
said end bolster structures each comprising:
a horizontally disposed beam having a generally I-shaped configuration in cross section and extending transversely of said rack,
said beams being positioned with their respective central webs disposed horizontally,
a roller assembly applied to the respective beams on either side of the longitudinal center of said rack and below said webs thereof, respectively,
said roller assemblies comprising said anti-friction devices and each comprising a housing structure fixed to the respective beams and rotatably mounted rollers that have peripheries that are proportioned to project below the respective beams for contact with the car bed,
with said indexing devices being secured to the respective bolster structures and being fixed to the respective beams thereof above and in vertical alignment with said central web thereof,
and including bracket plate means applied between said central web of the respective beams and the respective indexing devices for bracing the latter.

3. The improvement set forth in claim 1 wherein:
each of said indexing devices comprises a vertically disposed member on the rack that is provided with a tapering upper surface adapted to cooperate with a correspondingly located recess in the bottom wall of the container.

4. The improvement set forth in claim 1:
in which said indexing devices comprise spaced parallel V-shaped bars extending transversely of the rack and respectively adapted to nest together with com-

plementary V-shaped bars secured to the container bottom when the container is rested on the rack.

5. The improvement set forth in claim 1 including guide means interposed between said rack and said bed for guiding the movement of said rack longitudinally of said bed, said guide means comprising:

a vertically disposed member fixed to said bed adjacent and beneath each of said rack cross members with the respective vertically disposed members each comprising a plate member extending longitudinally of the car and having a cross flange affixed to the upper portion of said plate member along the length thereof and extending transversely of the rack, whereby said vertically disposed members define elongated T-shaped elements that extend lengthwise of the car,

said cross members each having secured thereto a pair of depending guide members disposed on either side of the respective T-shaped elements,

said depending guide members of each cross member being positioned for guiding engagement with the outwardly extending edges of said cross flanges, respectively, said depending guide members adjacent their lower ends including projections extending under the cross flanges of the respective T-shaped elements,

whereby the outwardly extending edges of said cross flanges of the respective T-shaped elements cooperate with said respective pairs of depending guide members to guide the rack on movement thereof longitudinally of the vehicle.

6. The improvement set forth in cl aim 1:

in which said spaced sill members are relatively close together and said spaced cross members extend laterally beyond said sill members to provide overhanging ends,

and in which said indexing devices on the rack are carried on said overhanging ends.

7. The improvement set forth in claim 6:

in which said antifriction devices comprising said glide means are mounted on said cross members.

8. In a railroad vehicle including a wheeled railroad flatcar bed having couplers at opposite ends thereof, a freight container support rack positioned on and carried by said bed, said rack being mounted on said bed for movement longitudinally of said bed, and dissipative energy system type cushioning means operatively interposed between said rack and said bed for cushioning impacts applied to the car through the couplers and having a cushion travel of about twenty or more inches,

the improvement wherein:

said rack comprises at least three parallel cross members connected together by spaced sill members, with the outer cross members constituting end bolster structures and the other cross member constituting a central bolster structure,

glide means interposed between the rack and the bed for transferring the load carried by the rack to the flatcar bed,

and securing means for mounting two aligned freight containers on said rack with said central bolster structure supporting the adjacent ends of the two containers, and with the rack providing for cooperation with one end of each container a rigid anchorage to the rack and at the other end a lost motion connection therewith,

said securing means for each container including at least two indexing devices secured to the rack and spaced apart longitudinally of the rack with each of said indexing devices being mounted on one of said bolster structures to comprise bolster structure container indexing means,

with each of said indexing devices for each container being constructed and arranged to cooperate with a complemental indexing device on the underside of the respective freight containers,

one of said indexing devices for each container having a relatively tight fit with respect to its complemental indexing device on such container and the other indexing device for each container having a relatively loose fit with respect to its complemental indexing device on such container,

said glide means including an antifriction device for each of said spaced indexing devices with each such antifriction device beng located adjacent to its associated indexing device,

whereby said spaced sill members, being relieved by said securing means of longitudinal stress due to the weight of the respective containers when mounted on said rack, may be of relatively light weight.

9. The improvement set forth in claim 8 wherein said end bolster structures each comprise:

a pair of channel members fixed together in spaced parallel relation,

said channel members of each end bolster structure being horizontally disposed and extending transversely of said rack with their webs vertically disposed,

with said indexing means of said end bolsters being fixed between the respective channel members thereof,

and bracket plate means applied between said respective channel members and the last mentioned indexing means, respectively, for bracing the latter,

and a roller assembly applied between said channel members of each end bolster structure on either side of the longitudinal center of said rack,

said roller assemblies comprising said antifriction devices and each comprising a housing structure fixed to the respective channel members of each end bolster structure and rotatably mounting a roller having a periphery that is proportioned to project below the respective end bolster structures for contact with the car bed.

10. The improvement set forth in claim 8 wherein said central bolster structure comprises:

a horizontally disposed beam having a generally I-shaped configuration in cross section and extending transversely of said rack,

said beam being positioned with its central web disposed horizontally,

a roller assembly applied to said beam on either side of the longitudinal center of said rack and below said web thereof,

said roller assemblies comprising said antifriction devices and each comprising a housing structure fixed to said beam and rotatably mounted rollers that have peripheries that are proportioned to project below the beam for contact with the car bed,

with said indexing means of said central bolster being fixed to said beam above and in vertical alignment with said central web thereof,

and including bracket plate means applied between said beam central web and the last mentioned indexing means for bracing the latter.

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