

March 15, 1960

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2,928,536

SHIPPING UNIT

Filed July 16, 1956

3 Sheets-Sheet 1

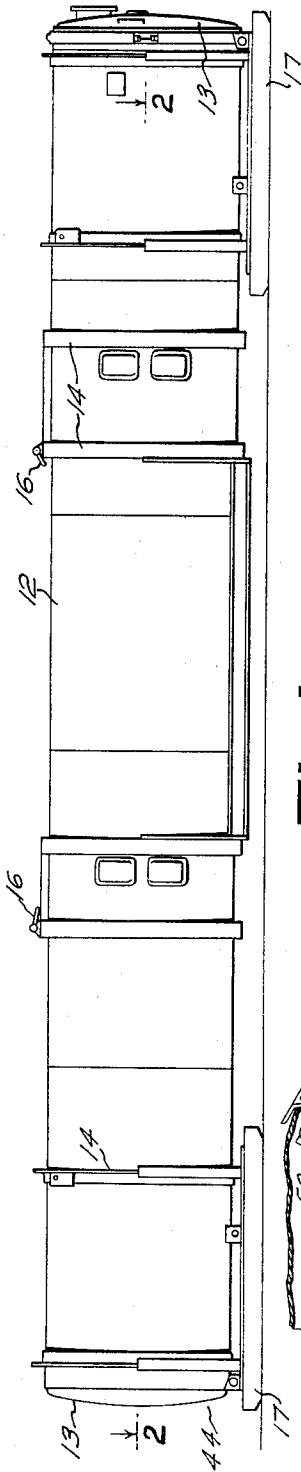


Fig. 1.

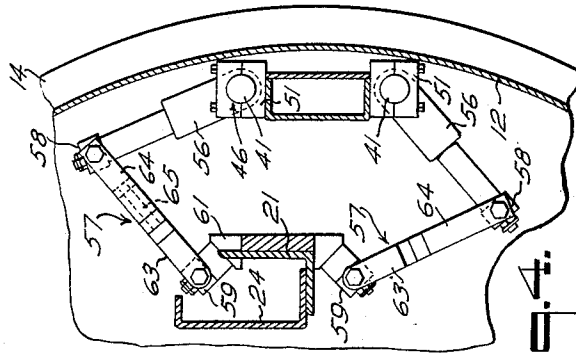


Fig. 4.

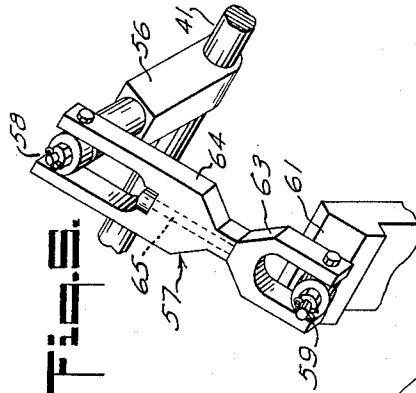


Fig. 5.

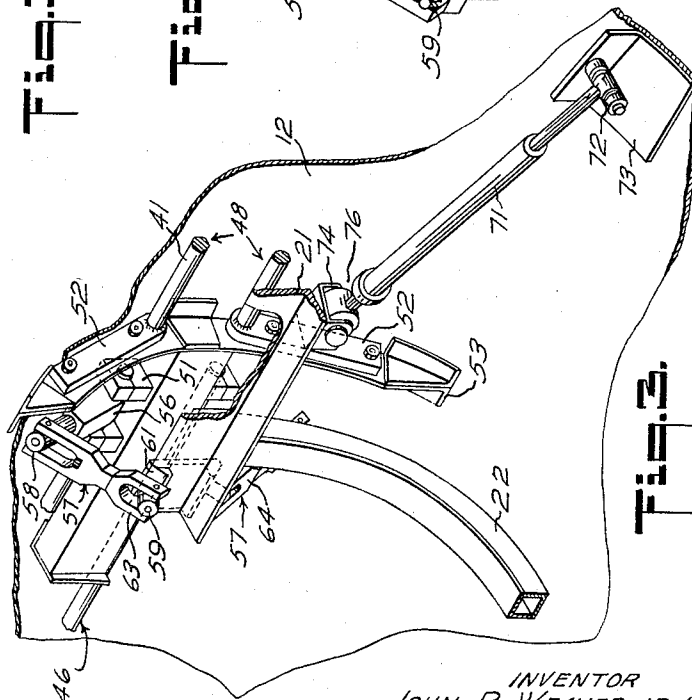


Fig. 3.

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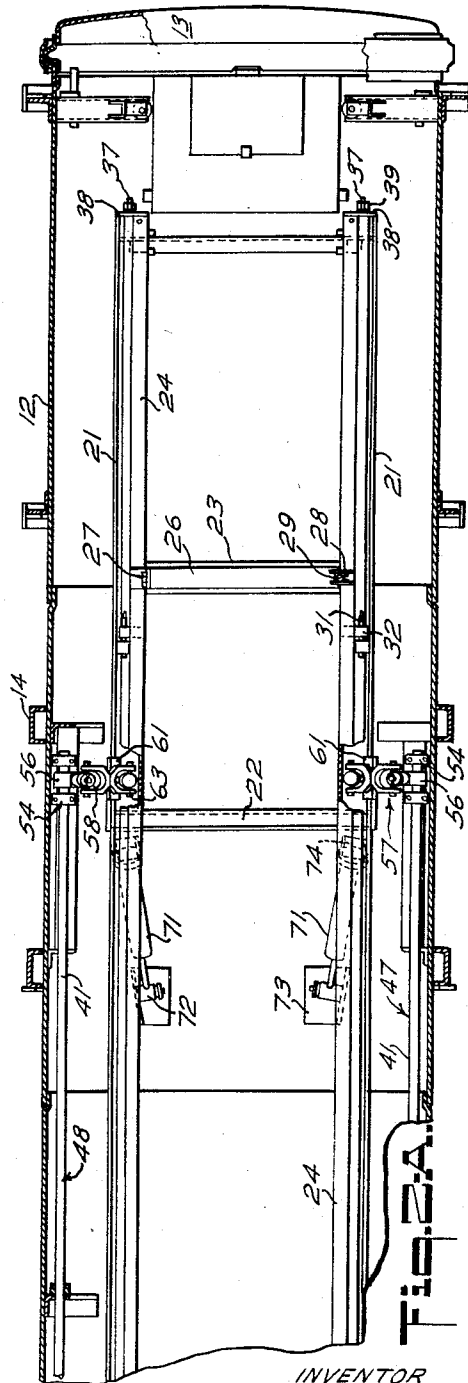
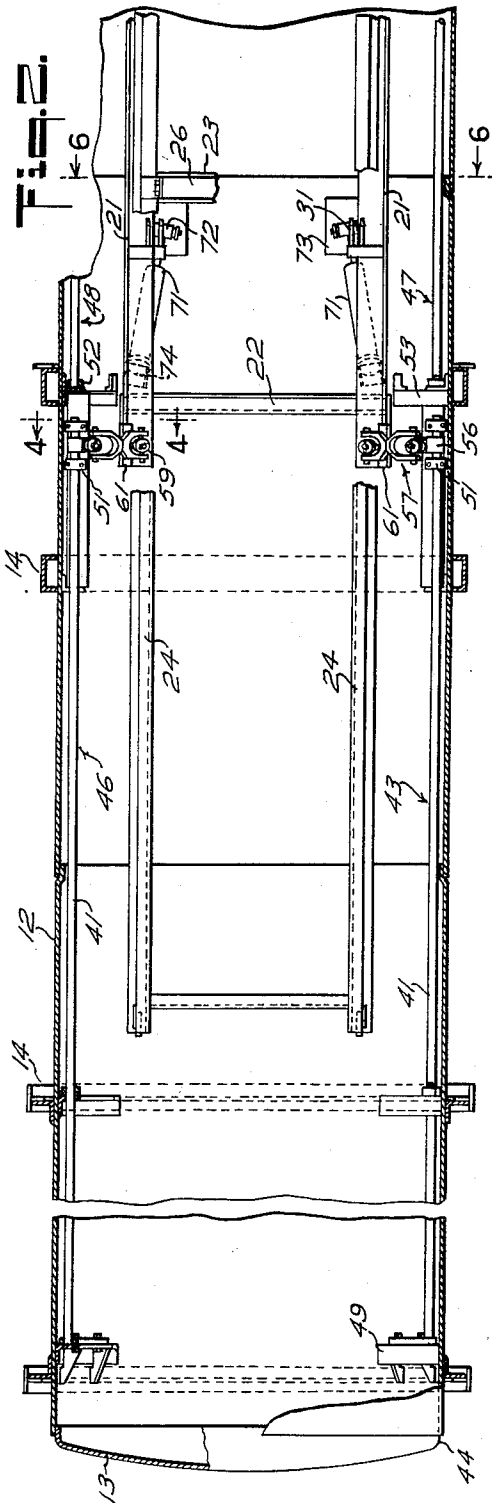
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Fig. 8.

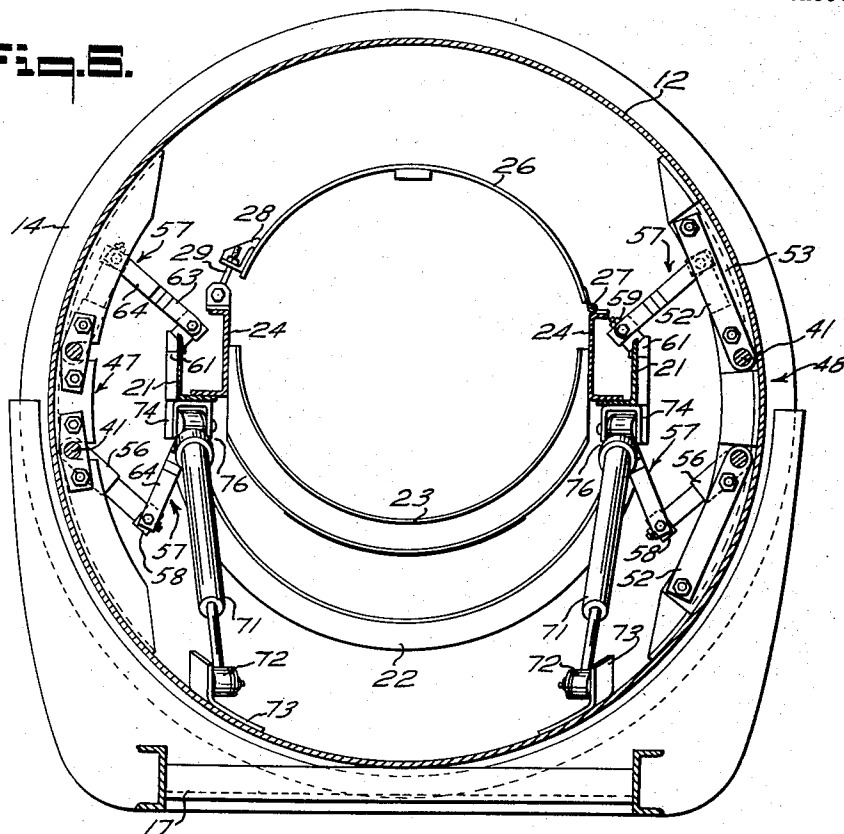
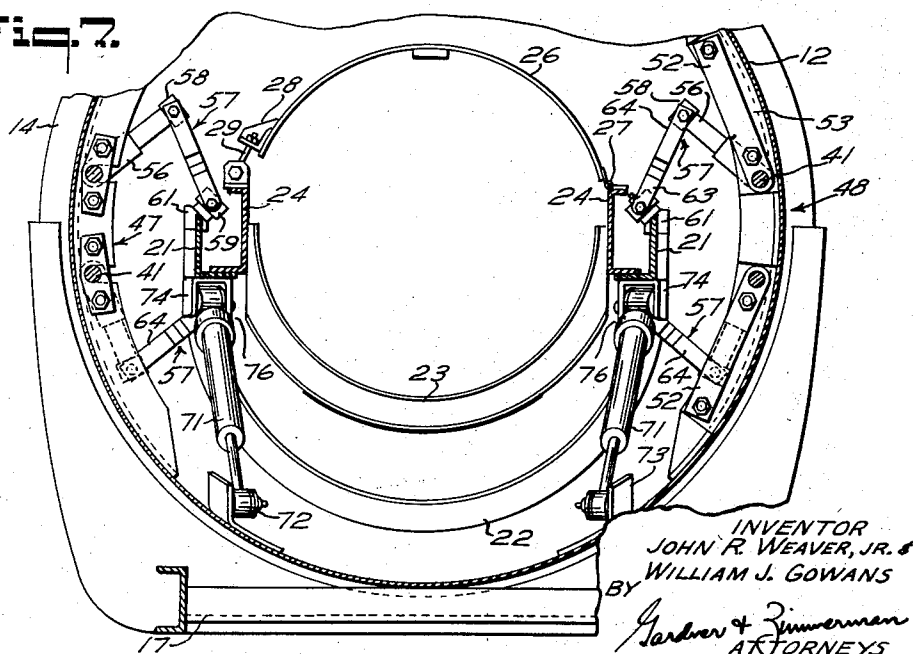


Fig. 7.



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3 Claims. (Cl. 206—46)

This invention relates in general to carrier units designed for supporting an article in suspended position for shipment and the like so as to protect the article from jolts, shocks, etc. particularly during transit. More specifically, the present invention is directed to a suspension system of the character described in which the shocks and vibrations to which the article is subjected are resisted and absorbed by a novel arrangement of torsion members.

In the shipping of articles such as engines, precision machinery, missiles and the like, it has become accepted practice to utilize a frame, enclosure, or container having an article suspension system incorporated therewith. The shortcomings of a rigid type of article suspension system are obvious, and even where resilient mountings have been employed for the purpose of absorbing shocks or vibrations, many difficulties have heretofore been encountered. For example, high amplitude vibrations are frequently developed, and/or free universal movement of the suspended article in all directional and rotational senses is not permitted. Furthermore, besides other problems attendant the manufacture or use of the shipping unit, there is no adequate provision for absorption of the kinetic energies created by such movement.

It is accordingly an object of the present invention to provide a shipping carrier adapted to support an article in such a manner as to permit six degrees of freedom of motion to the article; i.e., translational and rotational movement in three mutually perpendicular planes, while at the same time absorbing the kinetic energies created by any combination of such movements.

Another object of the invention is to provide a shipping unit affording the article to be shipped a yielding support and freedom of movement in all directions, and in which such support and the magnitude of such movement is controlled by members subject to torsion alone.

A further object of the invention is to provide a shipping unit of the character described in which the means utilized for cushioning the article in supported position and for snubbing the movement thereof due to jolts, shocks, etc. will be of a form and nature as to require minimum space for positioning and operation within the unit, will not interfere with the ready insertion or withdrawal of the article in or from the unit, and may be used practically indefinitely and for articles of varying sizes or forms without requiring extensive adjustment of the parts.

A further object of the invention is to provide a shock and vibration isolation system of the type referred to in which the shocks or vibrations are instantaneously, smoothly, and effectively distributed throughout the entire system, and which is equally effective irrespective of climatic or temperature changes.

Yet another object of the present invention is to provide an article carrier unit possessing the above characteristics in which the article is supported on a plurality of generally parallel bars, one end of each bar being rela-

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tively fixed and the other end thereof being operatively connected to the article in such a manner that any of the forces imparted to the article is translated into torsion loads on the bars.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

Figure 1 is a side elevational view of an article shipping unit in which the suspension system of the present invention has been incorporated.

Figures 2 and 2A are horizontal longitudinal sectional views on an enlarged scale taken substantially in the plane indicated by line 2—2 of Figure 1, and showing the forward and aft portions respectively of the unit.

Figure 3 is a perspective view of a portion of the suspension system.

Figure 4 is a vertical cross-sectional view on an enlarged scale, the plane of the figure being substantially indicated by line 4—4 of Figure 2.

Figure 5 is a perspective view of a portion of the suspension system.

Figure 6 is another enlarged vertical cross-sectional view taken substantially in the plane indicated by line 6—6 of Figure 2.

Figure 7 is a portional view similar to Figure 6, but illustrating the position of the parts in their loaded condition.

In broad terms, the illustrated embodiment of the invention includes an outer case, a cradle positioned within the case, a harness which may be attached to the article for connecting the same to the cradle, and a novel suspension system operatively connecting the cradle to the case. As will be hereinafter more clearly understood, for certain types of articles, the cradle and/or harness may be dispensed with, and the article attached directly to the suspension system. However, for purpose of explanation, these elements have been included in the unit, and the structure selected for illustration is one particularly adapted for supporting an article of generally cylindrical configuration, although it will be clear that the particular shape or nature of the article has no bearing on the general characteristics of the unit.

The outer case may merely consist of a suitable frame or, as illustrated, be in the form of a container 12 in which the article is supported and shipped. Where constructed as a container, it is preferable to have the same of cylindrical configuration for reasons of strength, and one or both of the ends thereof is provided with a suitable closure 13 by means of which access may be had to the interior of the container for loading and unloading purposes. The outer surface of the container may be provided with peripherally extending reinforcing elements 14, two of which have shackles 16 attached thereto for facilitating the lifting of the container in a horizontal position. Also, to lend stability to the container when in a stored position, skids 17 or similar supporting brackets are attached to the under surface of the container and normally position the latter in slightly spaced relation to a supporting surface. It is not believed necessary to go into further detail in describing the container 12 since as above mentioned, the use of a container in place of any other type of case or frame is optional and dependent upon the particular requirements of the article and/or manner of transport.

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The suspension system of the present invention in the particular form here illustrated, preferably includes a cradle carried by such system and on which the article is supported. As here shown, the cradle consists of a pair of horizontal rails 21 extending longitudinally and parallel within the container at substantially diametrically opposed portions thereof. The rails are positioned radially inwardly of the container walls and are rigidly secured together by means of downwardly bowed cross members or yokes 22. The manner in which such rails are resiliently mounted will be hereinafter discussed in detail. For the present, it will be seen that the rails are each formed from structural steel angles with the horizontal flanges thereof directed radially inwardly of the container.

Rails 21 are adapted to permit sliding or rolling entry and egress of the article, not shown, into the container, and to facilitate this operation, the previously mentioned harness may be advantageously employed. The harness as here shown is designed for use with a cylindrical article, and accordingly comprises a plurality of spaced transverse yokes 23 attached at their opposite ends to a pair of horizontal rails 24. The yokes 23 are of arcuate form to accommodate the article. As best seen in Figure 4 of the drawings, the rails 24 are formed of outwardly directed channel members, the lower flanges of which may slide along the upper surfaces of the horizontal flanges of rails 21, or, if desired, the latter may be provided with conventional rollers, not shown, to permit a rolling contact between the rails 21 and 24. The upper flanges of rails 24 are in part foreshortened to provide room for portions of the suspension system, and have associated therewith a plurality of arcuate straps 26 designed to straddle the article and retain same in the yokes 23. One end of the straps is pivoted, as indicated at 27, to one of the upper flanges, while the other end of the strap is provided with a slotted bracket 28 for receiving a swing bolt 29 pivotally attached to the other of the upper flanges. In this manner, the article is first placed in the yokes 23, the straps 26 tightened around the article, and the entire assembly may then be rolled or otherwise moved along the rails 21 and into the container. To provide for centering and to prevent substantially transverse displacement between the rails 21 and 24, the rails 21 may be provided with fixed longitudinally extending pins 31 adapted to enter apertured brackets 32 mounted on the rails 24. Locking of the article on rails 21 against longitudinal movement may be provided for in any suitable manner, such as by bolts 37 extending from the rear ends of rails 21 and engageable with brackets 38 of rails 24 and secured thereto such as by nuts 39 or the like.

It will be clear from the foregoing that when the article is secured in position, neither rotational, transverse, or longitudinal displacement thereof relative to the cradle rails 21 will be permitted, and therefore all shocks or vibrations imparted to the article will likewise be imparted to the cradle rails 21. It follows therefore that by suspending the rails in the container in such a manner as to absorb and/or isolate shocks, jolts, and the like, the article will be effectively protected during transit.

As previously explained, it is a relatively simple matter to merely provide a resilient suspension for the cradle rails. However, in order to permit six degrees of freedom of movement of the rails while preventing the development of high amplitude vibrations, and at the same time providing for effective distribution of the shocks, etc. to all parts of the suspension system, the novel arrangement set forth below has been developed. Broadly speaking, such system comprises a plurality of torsion members, here shown in the form of bars or rods 41 extending longitudinally within container 12 with one end of each bar anchored to the container to prevent relative movement therebetween, and the other end anchored to the cradle rails 21 or, as above suggested, to the article

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itself. The anchoring connections to the rails are effected through a novel crank and link arrangement and in such manner as to avoid any binding action, but to cause any movement of the article or rails within the container to result in a torque load being applied to the respective bars, thereby dampening and absorbing the kinetic energies and serving to quickly and smoothly return the article to its normal position within the container.

The torsion bars are arranged in sets, each preferably containing two torsion bars, and in the present embodiment a set of bars is positioned in the space between the cradle and the container walls in generally horizontal alignment. The two sets cooperate to support the cradle and the pair of such sets are for convenience here termed complementary sets. Complementary sets are provided at longitudinally spaced points of the unit. More specifically, as best seen in Figures 2, 4, 6 and 7, one set, generally indicated by the numeral 43 is positioned between the inner container wall and one of the rails 21, with the bars in vertically spaced relation above and below a horizontal diameter of the container respectively. This set extends from adjacent the forward end 44 of the container to a position medially of the length thereof, and by viewing the container from the aft end, such set may be referred to as the forward left set. The complementary set 46 is positioned diametrically opposite to set 43, extending for the same longitudinal distance, and may be called the forward right set. The sets 43 and 46, are supplemented with complementary sets 47 and 48 which are axially aligned with sets 43 and 46 respectively but have their forward ends adjacent the aft ends of the forward sets and their aft ends terminating adjacent the aft end portion of the container. Set 47 thus becomes the aft left set while set 48 is the aft right set.

The forward ends of bars 41 of the complementary forward sets 43 and 46 are welded or otherwise suitably anchored to brackets 49 carried by the container and extending radially inwardly from diametrically opposed wall portions thereof, and bearings 51 support the bars at spaced locations along the length thereof. The forward ends of the bars of the complementary rear sets 47 and 48 are likewise anchored to the container, and as will be clear from viewing Figure 3, these bars may be welded to brackets 52, bolted or otherwise affixed to a pair of angles 53 extending circumferentially along the inner wall of the container. Bearings 54 properly support intermediate and rear end portions of the rods.

Means are provided for securing the torsion bars to the rails 21 for supporting the latter within the container, and in such manner as to permit full freedom of movement of the rails relative to the bars and provide for a smooth transfer of such movement into only torsional loads on the bars. Broadly, such means includes a crank arm and link arrangement interconnecting the rear end of each bar with a portion of the cradle assembly, preferably the rail adjacent the particular bar. As here shown, each of the bars has affixed thereto, preferably at the rear end thereof, a crank arm 56. One end of the arm is rigidly connected to the bar, while the other end is connected to one end of a link member 57, which is in turn connected at its other end to the rail by means of a bracket 61. The link connections with the crank arm and the rail are made through commercial universal joints 58 and 59 respectively. This manner of connection, permits free movement of the rails with respect to the crank arms, thereby avoiding the transmissal of any bending stresses to the bars, but confining the bar to shear or torsional stresses. However, in order to obtain true universal movement, the link 57 is formed of two longitudinally aligned portions 63 and 64 secured together by a longitudinally extending pivot pin 65 on which the portions may relatively rotate about a longitudinal axis. As will be evident this condition prevails whether the article and its associated rail mechanism

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translates vertically, axially or laterally within the container or moves rotationally in pitch, roll or yaw.

The relative positioning of the crank arms 56 to their associated links 57 is also of importance to insure effective distribution of loads to all of the bars. For example, notwithstanding the universal link connections, movement of the article in a direction generally normal to the axis of the arms will impart a greater torsion load to the bar than where the movement is generally aligned with the arm axis. Thus, if an indiscriminate positioning of the arms and links was adopted, it is possible that movement of the article would be rigidly rather than resiliently resisted such as when the forces resulting from such movement act on dead centers of all of the crank arms.

In view of the foregoing, in the present embodiment of the invention, an arrangement of the connecting members is illustrated which provides for efficient application and translation of the forces. As will be seen from Figure 6, in which the parts are illustrated in the unloaded condition of the cradle, the upper crank arm 56 of each set is directed upwardly (relative to a horizontal diameter of the container) and inwardly towards a vertical diameter of the container. The lower crank arm of each set is accordingly directed downwardly and inwardly. Since the complementary sets are symmetrically disposed about the vertical diameter, this relationship will be maintained regardless of the movement and positioning of the cradle with respect to the container. Thus, in Figure 7 where under the load of the article, the cradle has been moved to a lower position within the container, the relationship of the arms remains, notwithstanding the complete change in position of the members. It will also be noted that when the crank and link members are in the loaded position of the cradle, both torsion bars of each set are in a torsion loaded condition with the links disposed substantially normal to their respective crank arms. In this manner, in the normal loaded position of the cradle, the torsion is distributed through all of the bars. It will be evident that the relationship of the members will be maintained regardless of the relative movement of the cradle with respect to the container, and thus the torsion load will practically invariably be distributed at least in part to both bars of each of the complementary sets thereof.

The torsion bar suspension system as above described, due to the universal type of mountings, is capable of absorbing loads created by longitudinal movement of the article, as well as movements in other directions. It has been found more effective to preload the torsion bars before the application of the article weight thereto.

Furthermore, while the torsion bar system will in general absorb the kinetic energies developed by any article movement, little dampening action is present. Therefore, it is desirable to augment such a system with additional shock absorbing means primarily arranged for the dampening of motions.

As here shown, the auxiliary dampening means preferably consists of four conventional double acting automotive type shock absorbers 71, one of such shock absorbers being associated with each set of torsion bars. Each of the members 71 extends generally longitudinally and vertically of the container and is subjacent to the rails 21. The lower end of each member is attached by a universal joint 72 to a bracket 73 mounted on the container, and the upper end of each member extends upwardly to connect to a bracket 74 through a universal joint 76, the bracket being secured to and depending from the horizontal flange of rail 21. It will be noted that the two forward shock absorbers extend from brackets 73 forwardly and upwardly to adjacent a transverse vertical plane defined by the forward end of bar sets 47 and 48,

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while the two rear absorbers extend rearwardly and upwardly from brackets 73 to adjacent a transverse plane defined by the rear end of these bar sets. Obviously, where no cradle or harness is used, the upper ends of the shock absorbers could be connected directly to the article.

From the foregoing description, the constructional and operational details of the apparatus of the present invention should be clear, and it will be appreciated how the kinetic energies imparted by an article having six degrees of freedom will be distributed and absorbed. It should likewise be recognized that the size requirements of a container provided with the present suspension system may be minimized since the energy absorbing elements, i.e., the rods 41, extend longitudinally of the container, rather than movement absorbing and load cushioning means having considerable transverse or radial dimensions.

What is claimed is:

1. A shipping unit comprising a longitudinally extending container, a plurality of torsion bars within said container and disposed adjacent opposed wall surfaces thereof, one end of each bar being anchored to said container for resisting axial and rotational displacement therebetween, each rod having a crank arm adjacent the other end thereof, a lading supporting member within said container, a link attached at one end by a universal joint to each of said crank arms and having its other end pivotally connected to said member, and a plurality of automotive type shock absorbers having one end thereof attached by a universal joint to said container and the other end extending longitudinally and upwardly and pivotally connected to said member.

2. Apparatus of the character described comprising a longitudinally extending container, a plurality of torsion bars within said container and extending longitudinally thereof adjacent opposed wall portions of the container, one end of each bar being rigidly anchored to said container, a pair of generally parallel laterally spaced and longitudinally extending rail members positioned within said container and adapted to slidably receive an article inserted through an end of said container, means on said members adapted to releasably secure an article thereto, the other end of each bar having a crank arm thereon, and a link for each crank arm, one end of each link being connected to a crank arm with a universal joint and the other end of each link being connected to one of said rail members with a universal joint, the crank arms and links adjacent the opposed wall portions of said container being symmetrical about a vertical axis of said container.

3. Apparatus as set forth in claim 2 in which four pairs of said torsion bars are provided, each of said pairs being positioned intermediate said rail members and said container, two of said pairs extending from adjacent an end of said container and terminating medially of the length thereof and the other two pairs being axially aligned with said first two pairs, each of said pairs having its respective bars lying in a generally horizontal plane respectively above and below the general horizontal plane defined by said rail members.

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