United States Patent

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[72] Inventors **Kenneth A. Browne**
Lakewood, Ohio;
James T. Brown, Johnstown, Pa.

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[73] Assignee **Bethlehem Steel Corporation**

[54] **ARTICULATED CONNECTION FOR RAILWAY HOPPER CAR**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** ..... **105/1 R,** 105/4 R, 105/247, 105/364, 214/42 B
[51] **Int. Cl.** **B61d 7/00,** B61f 3/12, B65g 67/22
[50] **Field of Search** ..... 105/1 R, 3, 4 R, 247, 248, 364; 214/42 B

[56] **References Cited**

UNITED STATES PATENTS

1,427,174	8/1922	Stucki	308/226
1,490,492	4/1924	Stucki	308/226
3,396,673	8/1968	Livelsberger et al.	308/137 X
2,839,010	6/1958	Harbulak	105/1 R

Primary Examiner—Arthur L. La Point
Assistant Examiner—Howard Beltran
Attorney—James T. Seavey

ABSTRACT: An intermediate structure for efficiently joining adjacent ends of a pair of coupled open-top hopper car bodies for carrying bulk materials such as coal, and thereby forming a single articulated hopper car of large capacity. The car is continuously loadable from end to end, is exceptionally stable in transit even when fully loaded and at normal speeds, and is substantially leakproof at joints even while negotiating sharp curves in track.

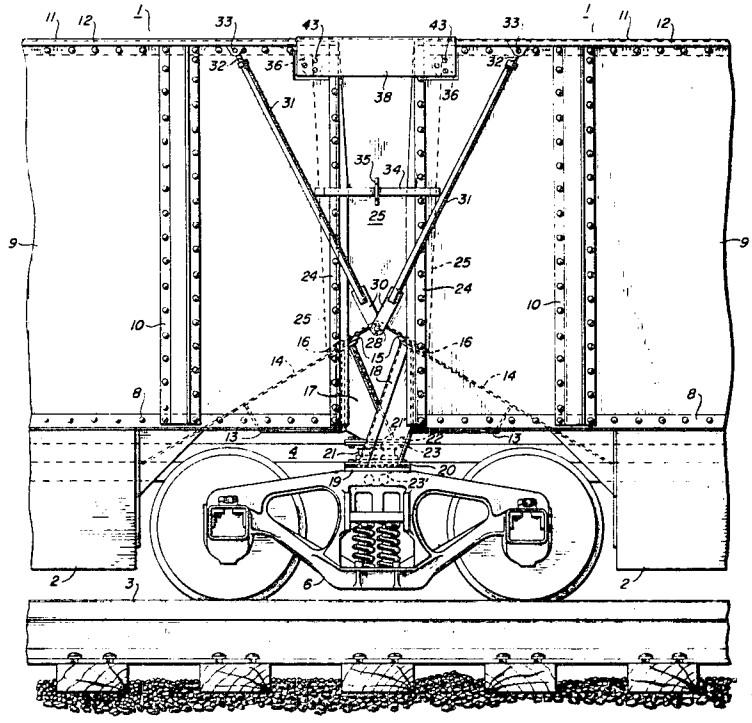


Fig. 1

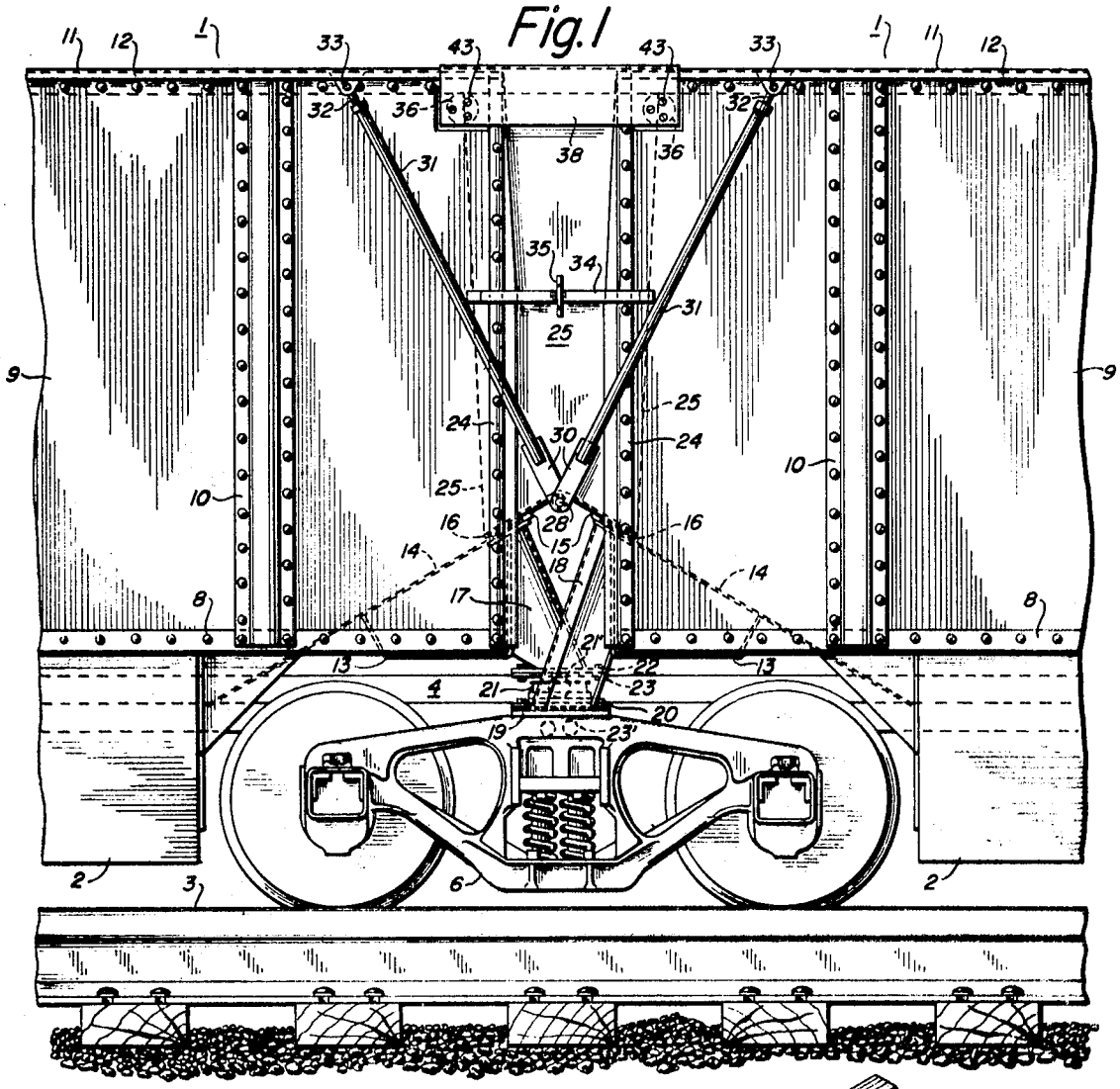
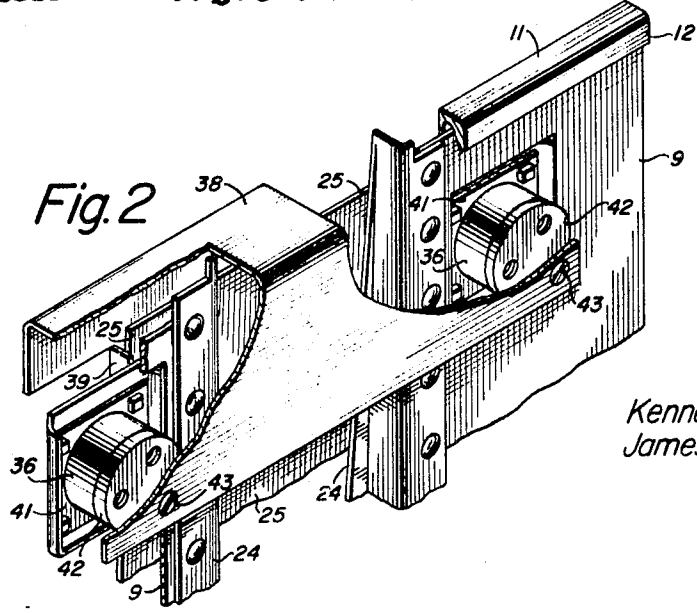
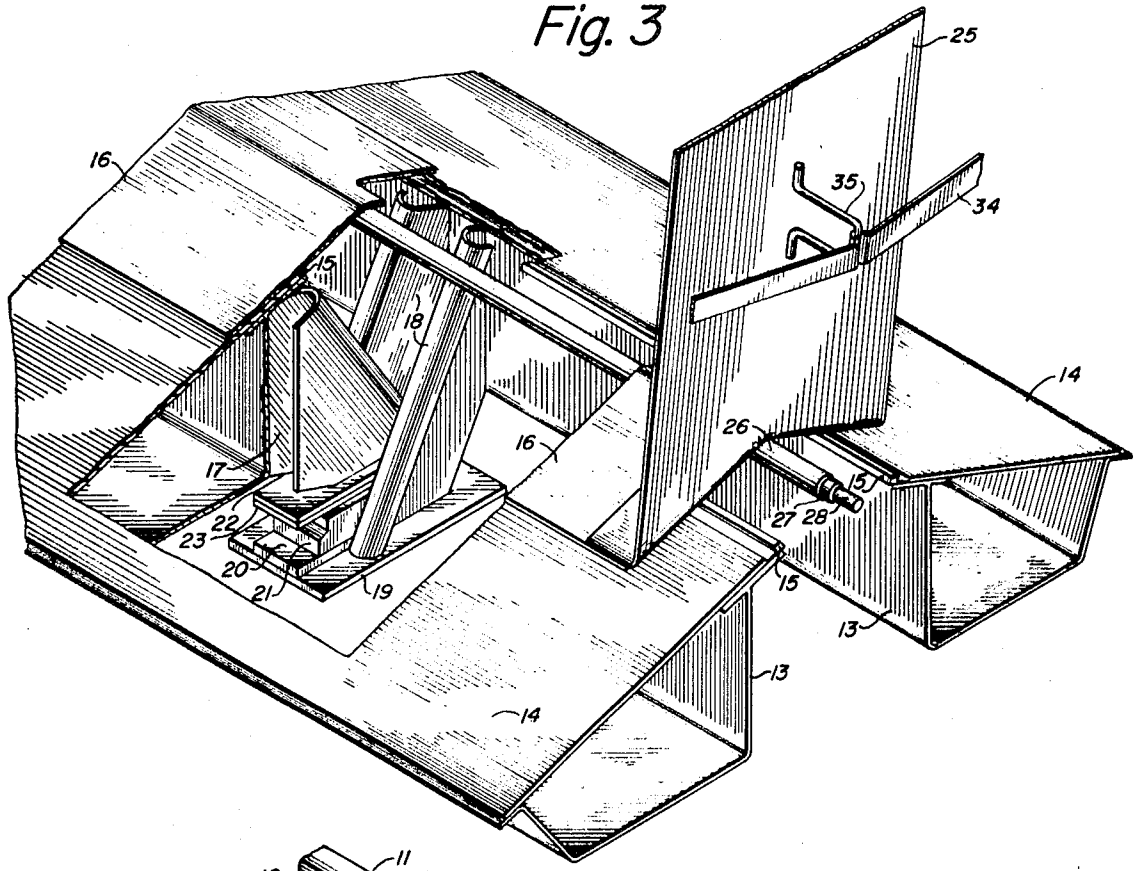


Fig. 2



INVENTORS
Kenneth A. Browne
James T. Brown

Fig. 3



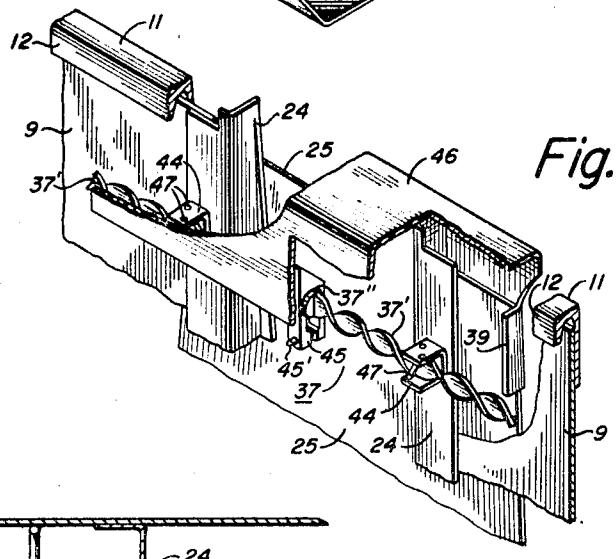


Fig. 4

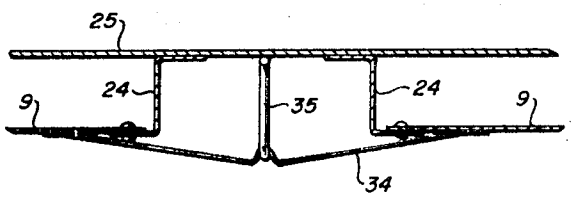


Fig. 5

INVENTORS
Kenneth A. Browne
James T. Brown

ARTICULATED CONNECTION FOR RAILWAY HOPPER CAR

BACKGROUND OF THE INVENTION

The field of art to which this invention relates is that of articulated railway cars, and more specifically to an articulated car of the open-top and bottom-dumping hopper type.

The constant demand of the railroads for larger hopper cars to haul coal and similar ladings has heretofore been attempted to be met by car builders primarily by enlarging the accepted dimensions of a standard longitudinally rigid car so as to increase its cubic capacity. In this manner the capacity of a hopper car has gradually been raised from 50 tons to 100 tons, and even in some instances to 125 tons. However, that form of evolution has now reached a point of diminishing returns, due largely to the limitations of the curvature and gages of existing track. These factors impose definite restrictions on the possible length and width of a standard car. As a matter of necessity, therefore, conventional hopper cars of large capacity (100 tons or more) now uniformly tend to have very high sides, raising their centers of gravity so much as to be quite topheavy when loaded. One result is that they exhibit a strong tendency to rock dangerously on their springs, and even to derail, at speeds as low as about 15 to 20 miles per hour on regular track. A long articulated car of the type described herein is believed to be a better answer to the problems of greater capacity and economy of manufacture, together with safety and speed of carriage.

An articulated hopper car, however, is subject to certain special problems not experienced with standard cars with respect to suspension, flexibility, strength and support at the area of central joinder.

For instance, the increased weight in the midsection of a long articulated car when loaded renders it necessary to provide an additional center truck to support the adjacent ends of the body units. Accordingly, body clearance above the center truck must be sufficient to permit said truck to swivel freely and without interference from adjacent parts of the car as the truck follows curves in track. However, the use of a center truck does desirably reduce the turning radius of the car, and by halving the distances between truck centers to end trucks markedly lessens the rocking of the car attributable to staggered rail joints and end-battered rails.

Moreover, the adjacent ends of the bottoms on each hopper body must be oppositely inclined sufficiently to provide adequate angles of slope for self-clearing of the load when dumping, and they must also support some part of the load in the articulated portion during transport.

The foregoing factors make it obvious that the sidewalls and angular floor connections in the articulated area of the car must be of ample strength, but yet not so rigidly arranged as to prevent proper coaction and flexion. The present car construction meets these special requirements.

SUMMARY OF THE INVENTION

It is an object of this invention to meet all the requirements above referred to.

Another object of the invention is to provide a strong and substantially leakproof connecting portion for joining a pair of hopper car bodies of substantially conventional type to form a single large capacity multiple hopper articulated car which is stable and well adapted for continuous loading.

Another object is to provide means for uniformly centering said connecting portion while the car is bending on curves.

Another object is to provide a compact and evenly balanced vertical arrangement for center truck side bearings.

Still other objects, purposes and advantages of the invention will be noted herein in the specification, and in the appended drawings and claims.

DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is an outer side elevation of adjacent ends of two coupled-together hopper car bodies provided with the articulated side structure embodying the preferred form of the invention;

FIG. 2 is a perspective detail view, partly broken away, of the preferred embodiment of the upper connecting elements of said articulated side structure, taken on the same side as in FIG. 1;

FIG. 3 is a perspective view of portions of the adjacent ends of two car bodies, with portions of the connecting structure therebetween broken away to better disclose the construction;

FIG. 4 is a perspective detail view, also partly broken away, of an alternative form of the upper connecting elements; and

FIG. 5 is a top plan detail view of the side attachment means for the articulated center connection of the invention.

Our invention comprises an articulated connection by which a pair of identical body units of well-known type are joined to make a single large car which bends at its longitudinal center line while traversing curved track.

As it is an operating necessity for an articulated hopper car to be able to couple with ordinary hopper cars in trains, it will be understood that the outer end-coupling devices and related end equipment of this car are of conventional design, height and arrangement. Also, for maximum economy of manufacture and maintenance, this car includes as much as possible of standard hopper car construction.

While it is necessary to show in the attached drawings only so much of old car structure as will suffice to show the connection of our invention therewith, it is believed that a brief written description of the entire car will aid in an understanding of the invention.

Each of the above-mentioned body units **1** is basically an ordinary open-top steel hopper car, comprising two or more self-clearing hopper sections with upright walls and sloping floors and bottom doors **2** hinged lengthwise of the unit and dumping between the rails **3**, as standardized by the Committee on Car Construction of the Mechanical Division of the Association of American Railroads. The outer end (not shown) of each body unit **1** is pivotally mounted as in usual practice on a standard truck, while the inner end of said body unit is open and is modified as shown in FIG. **1** to permit articulation.

The underframe of each body unit **1** includes a longitudinal center sill **4**, which member may be conventionally fabricated of a pair of standard ship channels welded toe to toe in rectangular box shape. The adjacent ends of the center sills **4** of each pair of body units are coupled together by any suitable universal coupling or connector assembly, such as is disclosed, for example, in U.S. Pat. No. 3,396,673 granted Aug. 13, 1968 to K. V. Livelsberger et al. Such connector assemblies (not shown) comprise elongated male and female steel coupler link castings joined by a vertical king pin (also not shown), which permits the center truck **6** to swivel thereon.

The horizontal side sills **8** of each body unit are conventionally fabricated of rolled steel angles. Borne upon said side sills **8** are riveted upright side sheets forming sidewalls **9** externally braced by riveted hat-shaped side stakes **10** and surmounted by riveted top chord bulb angles **11** with outwardly facing flanges **12**.

The lower inner ends of adjacent body units **1** are provided with transversely extending triangular car bolsters **13** including inclined end flanges supporting bottom sheets **14** having upwardly sloping surfaces and surmounted by lateral bearing strips or wear bars **15**. Upon said wear bars **15** are slidingly supported the opposite ends of an inverted V-shaped cross ridge sheet **16** which serves to bridge the middle opening between the upper ends of the sloping bottom sheets **14** of adjacent car bodies. Inwardly beneath the middle portion of the car, the car bolsters **13** of the respective body units are mounted upon rearwardly inclined U-shaped front struts **17** secured under the leading body unit and similar but oppositely inclined rear struts **18** attached beneath the following body unit. Said struts may be conveniently formed from substantially square plates bent diagonally as shown to form truncated triangular supports.

The lower ends of said rear struts **18** are mounted, as by welding, upon a first horizontal wear plate **19**, upon which wear plate **19** is also secured a flat baseplate **20** whereon is mounted a standard single roller side bearing **21** such as A. Stucki Company's Design 656–C. Such a single roller side bearing includes a roller **21'** (not shown) pivotally mounted in an open-top boxlike housing, as shown for example in Stucki U.S. Pat. No. 1,490,492, issued Apr. 15, 1924.

The lower ends of the front struts **17** are mounted on a horizontal plate **22** fastened to a second wear plate **23**, which in turn is borne upon the single roller **21'** of said side bearing **21**.

The first wear plate **19** is conventionally supported upon the rollers **23'** of a double-roller side bearing (not shown), as illustrated in Stucki U.S. Pat. No. 1,427,174 issued Aug. 29, 1922, the housing of which is preferably made integral as by welding or casting upon the upper face of the truck bolster (not shown) of the truck **6**.

By the above-described arrangement, the interposed roller **21'** of the single-roller side bearing **21** allows sufficient horizontal motion and play between the struts **17** and **18**, which interdigitatedly support the respective body units to permit a degree of flexion and relative movement between side plates at the central area of the car while on curves in track, while the rollers **23'** of the double-roller side bearing function to support in line and in proper balance the full weight of the car on that side in the usual manner, so as to eliminate frictional interference with free swiveling of the truck **6** about its pivot point.

In order to permit uninterrupted loading of the car, there are no individual end walls above the adjacent ends of the sloping bottom sheets **14** on the adjacent ends of either car body unit.

On each side of the car, adjacent the articulated central portion, the facing ends of the top chord bulb angle **11** and sidewalls **9** of the two car bodies are spaced apart. The inner marginal edges of said sidewalls **9** may be secured as by riveting to spaced vertical corner posts **24** consisting of inwardly extending parallel upright pressed zee-sections of downwardly increasing depth, although such corner posts **24** may be omitted if it is desired to have the closure means (hereinafter described) in direct sliding engagement with the flat ends of the sidewalls **9**.

Somewhat longer than and interiorly spanning the space between either said sidewalls or the two upright corner post sections **24** on each side of the car, with the inner surfaces of which sections it engages and forms a tight sliding seal, is an interposed downwardly sloping flat side closure sheet **25**. The bottom edge of said closure sheet **25** is extended and is bent inwardly to conform to the upper surfaces of the inverted V-shaped cross ridge sheet **16**, whereon it overlaps and is supported.

Extending transversely beneath the articulated center portion of the car and engaging and supporting said cross ridge sheet **16** and side closure sheet **25** is a large outer pipe **26**, which encloses a smaller inner pipe **27**. Inside the outer ends of said pipe **27** are welded round plugs or bars **28** upon which are pivotally secured socket means **30** for receiving the lower ends of upwardly diverging pairs of suspension arms or tension members **31** such as pipes or the like on the outer sides of the car. The upper ends of each pair of tension members **31** are provided with eyebolts **32** or the like which are pivotally secured as by pins **33** to the adjacent ends of top chord bulb angles **11** on that side of the car.

The cross ridge sheet **16** is thus in effect supported by the pipe **26**, which in turn is supported by the two diverging suspension members **31** running up to the top chords **11**. As the suspension members **31** are pin connected at both ends, the included angle between them will tend to vary as the car negotiates curves. The cross ridge sheet **16** is additionally supported by the wear bars **15**.

The included angle between each pair of suspension members **31** regulates the functioning of the articulated joint. As the car negotiates a curve the point of intersection of the two suspension members **31** and the transverse support pipe **26** will either rise or lower. Likewise, the wear bars **15** affixed to the sloping upper surfaces of bottom sheets **14** will either ride up or down the slope of the cross ridge sheet **16**. Accordingly, the angular change between the suspension members **31** is synchronized with the displacement of the body bolsters **13** to insure adequate support and proper positioning of the cross ridge sheet **16** as the car negotiates curves.

On each side of the car, being positioned externally of the car and spaced outwardly across the middle of the articulated joint, is an arcuate generally horizontal leaf spring **34** having its outer ends resiliently engaging the opposing edges of the car body sidewalls **9**. The center portion of said leaf spring **34** is indented so that it engages within an upright U-shaped bracket **35**. The legs of said upright bracket **35** are welded centrally on the side closure sheet **25** so as to inhibit the inward motion of said closure plate **25**, as shown in FIG. **5**.

In this manner the side closure sheet **25** is held tightly against the sidewalls **9** and the corner posts **24** at midheight of the joint by the leaf spring **34**. Said leaf spring **34** is held in position by the bracket **35** and by the normal forces acting between the ends of said spring and the car sides. These normal forces are developed by preload forces built into said leaf spring **34**. The ends of the spring are free to slide longitudinally on the car body sidewalls **9** as the car negotiates a curve.

Bridging longitudinally between the top chords **11** of adjacent ends of the two car bodies is an inverted U-shaped pressed steel upper side member **38** or **46** which with its appurtenances has the following functions:

a. Holds the subjacent side closure sheet **25** against the car sidewall and corner posts **24** to provide a seal.
b. Keeps said side closure sheet **35** centrally located between the two car bodies when the car negotiates a curve or is subjected to longitudinal impact loads.
c. Provides a bearing surface located midway between car couplers for a clamp on a rotary car dumper if one is employed.

The above-mentioned bridging members **38** or **46** are basically similar except in their mode of connection to the two car bodies. Member **38** shown in FIG. **2** utilizes a pair of rubber or rubberlike shear pads **36**, interposed between its outer leg and the car body side, while in FIG. **4** the connecting element is a twisted steel bar of helix **37**. The inner leg of either bridging member is coped and inwardly flanged at its lower corners as at **39** so as to engage the side edges of the closure sheet **25** and thus function as guide means limiting its range of sidewise sliding motion at the top of the car.

In the rubber mounted bridging arrangement shown in FIG. **2**, a metal plate **42** cemented on the outer surface of each shear pad **36** is attached as by screws **43** to the outer leg of the bridging member **38**, and the other surface of said pad **36** is fastened to the contiguous car body side by a recessed mounting plate **41**. When the car is negotiating a curve the rubber will stretch in any direction which may be required in order to allow controlled displacement of the bridging member **38** relative to the car bodies. The spring rate of the rubber is of sufficient magnitude in all directions so that it will always return the bridging member to its neutral position and hold the closure plate properly centered relative to the sidewalls **9** on that side. In addition to its positioning function the rubber will serve as a vibration damper when the car is subjected to a car shaker and also as an impact cushioning unit for the whole body joint when the empty car is impacted.

As alternatively shown in FIG. **4**, each helix **37** may be formed from two horizontal twisted steel bars **37'** of opposite hand joined together in alignment by a central steel spool **37''**. The spool has end flanges preventing longitudinal displacement within a bifurcated bracket or anchor block **45** on the bridging member wherein the spool is retained by a pin **45'**. Said pin **45'** is located to allow the spool to rotate and also to move vertically approximately one-half inch within the confines of said bracket **45**. This range of vertical motion is neces-

sary to accommodate the upward displacement of the bridging member when the car is negotiating a convex vertical curve. The spool bracket **45** is welded centrally inside the outer leg of the bridging member **46**. Each of the outer ends of the helix **37** extends longitudinally between two staggered pins **47** in a centering guide **44** secured to the sidewalls **9** or corner posts **24** of each car body. The staggered pins **47** within each guide **44** are set at an angle to accommodate the angle of twist of the helix **37** disposed between the pins.

With this arrangement, the helix **37** will assume an extended position as the guides **44** move apart when the car is negotiating a convex vertical curve or a horizontal curve and the helix is on the outer side of the curve. Conversely, the helix **37** assumes a contracted position as the guides **44** move toward each other while the car is negotiating a concave vertical curve or a horizontal curve and the helix is on the inside of the curve. Nevertheless, both distances from the centerline of the spool to the helix guides on the same side of the car will remain equal at all times and in turn the vertical closure sheet **25** will remain centrally disposed with respect to the two car bodies.

However, the rubber mounted bridging arrangement shown in FIG. **2** is regarded as preferable over the helix arrangement, because of lower initial cost, superior vibration dampening characteristics, and lower maintenance cost.

It will be noted that the suspension of the inverted V-shaped cross ridge sheet **16** by the pivoted tension members **31** from the top chord bulb angles **11** operates to stabilize said cross ridge sheet **16** in position against the tendency of said cross ridge sheet **16** to tend to rise on one side of the car and to fall on the other side of the car, in response to the relative approach or separation of the body bolsters **13** when the car is rounding a curve in track. As the lower end of each side closure sheet **25** is supported on the cross ridge sheet **16**, the movements of such closure sheet **25** are responsive to the movements of the cross ridge sheet **16** on that particular side, and are cushioned by the resilient means by which said closure sheet **25** is connected to the sidewalls. The effect of the above-described construction is to provide a flexibly floating articulated connection between the component hopper car bodies, which connection provides full continuity between the interiors of said car bodies and thereby creates greater capacity than prior heavy-duty cars.

A prototype car as described above has successfully hauled coal ladings exceeding 122 tons at normal operating speeds, and has negotiated curves of 150 feet radius without difficulty. The flexible center joint enables the entire car to be somewhat over 52 feet long, or about seven feet longer than most 100-ton cars. Width is 10 feet 8 inches. The length of the car is distributed over three trucks on truck centers of 22 feet 1 inch, as compared with the two trucks on 36-foot truck centers of conventional cars. Overall height is 11 feet 6 inches, or almost 1 foot lower than large hopper cars of conventional types. The short distance between truck centers and the low silhouette of the car increase its stability and help to counteract any tendency to rock in heavy-duty service. On a weight basis, as compared to a standard 100-ton triple hopper car weighing 59,000 pounds, this car is less than 10 percent heavier, yet will carry over 20 percent more payload, primarily because of its long uninterrupted inside length.

We claim:

1. The combination, in an articulated railway car comprising a pair of coupled-together open-top hopper car bodies, each of said car bodies including an upwardly sloping floor and sidewalls, the adjacent marginal edges of said sidewalls being spaced apart, wherein the improvement comprises:

a. an inverted V-shaped cross ridge member the ends of which rest upon and slidably connect the sloping floors,

b. an elongated rigid member extending laterally beneath and supporting the center of said cross ridge member,

c. pivotally mounted oppositely inclined outer suspension members having variable included angles controlled by track curvature and extending respectively from adjacent ends of said sidewalls to said rigid member,

d. side closure sheets slidably engaging adjacent sidewalls and closing the space between the car bodies,

e. the bottom portion of said side closure sheets being extended inwardly so as to rest slidably upon said V-shaped cross ridge member,

f. bridging members mounted to adjacent sidewalls of the car bodies through resilient mounting means, said bridging members having guide means to center the side closure sheets with respect to the sidewalls, and

g. resilient means for urging said side closure sheets against the sidewalls of the respective car bodies.

2. The combination as claimed in claim **1**, wherein the guide means of subparagraph (f) comprises end stop lugs on the bridging members for engaging adjacent edges of the sidewalls.

3. The combination as claimed in claim **1**, wherein the resilient means of subparagraph (g) comprise leaf spring means connected to said side closure sheet and slidable upon adjacent sidewalls.

4. The combination as claimed in claim **1**, wherein the resilient mounting means of subparagraph (f) comprises rubber shear pads.

5. The combination as claimed in claim **1**, wherein the resilient mounting means of subparagraph (f) comprises a metal helix having a middle spool portion rotatably secured to said bridging member and its ends in centering guides attached to adjacent sidewalls.