Title: RAILCAR HAVING IMPROVED SIDE SILL CONSTRUCTION

Abstract: An improved side sill (82) having one or more double-reentrant bends is provided for motor-vehicle carrying railway cars, well cars and other types of railcars (10). The side sill (82) has an S-shaped cross-sectional portion which provides vertical and horizontal clearance from items located along the track side. Additional clearance provided by the side sills (82) avoids inadvertent contact with track side equipment such as that encountered in hump yards, despite weakening of the railcar suspension due to age, for example. The side sills (82) are joined at their ends to cross-bearers (62, 64) which transmit draft and buff loads to center sill stub sill members at each end of the car.
RAILCAR HAVING IMPROVED SIDE SILL CONSTRUCTION

Background of the Invention

1. Field Of The Invention

The present invention pertains to low level railcars having side sills closely spaced to the tracks and to track side rail equipment, and more particularly to an improved railcar for carrying motor vehicles.

2. Background Of The Present Invention

One of the challenges in designing railcars for transportation of motor vehicles is to provide sufficient clearance in the railcar interior to permit the doors of the vehicles to be opened to a sufficient degree that drivers can easily enter and exit the vehicles in the course of loading and unloading operations. In the past, the large, heavy vertical posts that support the upper decks of typical auto rack railway cars have intruded significantly into the interior. The vertical posts, along with cross-braces, knee braces and gussets, restrict available interior clearance for opening of automobile doors, and also restrict movement of workers in the railcar interior. Contact with structural components of the railcar may damage the finish on the doors of new motor vehicles. Door edge protection comprising foam padding or the like is generally applied to the railcar interior to prevent such damage, but has the disadvantage of decreasing the available clearance for opening of the doors.

In recent years, clearance has been improved in certain railcar designs (see, for example, United States Patent No. 5,765,486). However, there remains room for improvement in this area.

The width and height of railcar bodies are limited by industry regulations, based on spacing between
adjacent tracks and clearance required to avoid trackside equipment, signals, tunnels, etc. Interior width is further limited by the need to include sufficient structure in the sidewalls to support one or more upper decks loaded with motor vehicles, and to accommodate the dynamic loads encountered in commercial rail service. In addition to vertical loads due to the weight of the upper decks and the motor vehicles supported thereon, such loads may also include substantial longitudinal impact loads, as well as lateral loads encountered due to rock and roll of the car bodies, and due to travel on nonlinear track configurations. Any effort to provide increased width must take these factors into account.

Another issue encountered in development of railcars for carrying motor vehicles is increasing the vertical dimension of the space available for motor vehicles on each deck. This is of particular interest with respect to tri-level railcars.

To increase vertical clearance on the bottom deck ("A" deck), the deck may have a lowered central portion, with ramps being provided to carry motor vehicles between the lowered central portion and the end portions. It is generally desirable to maximize the length of the lowered central portion of the A deck, and concomitantly to limit the lengths of the ramps. However, if the slope of the ramps is too great, the bottom clearance for the ends of certain motor vehicles may be insufficient. The invention generally addresses these and other issues relating to interior clearances in railcars for transportation of motor-vehicles.

Frequently, railcars are made to pass track side rail equipment which is positioned very close to the railcar. Examples are found in railway yards during the automated, unattended hitching of railway cars to one another, in an operation generally referred to as "humping". During humping, unattended railway cars are accelerated over an elevation, or "hump" so that the car gathers enough speed to be coupled to another car upon
impact. Railcar retarders, spaced close to the path of oncoming railcars, are employed to control the speed of railcars passing unattended through a hump yard. A prescribed space must be maintained between the outside, bottom corner of the railcar and the trackside equipment. As noted above, such space cannot be taken from the railcar interior, without regard for internal clearances and issues relating to the strength of the car body.

Summary Of The Invention

The invention provides a railcar with a side sill providing an increased clearance from track side railway equipment, such as retarders, without sacrificing the strength of the railcar, or unduly increasing the weight or the fabrication cost of the railcar.

It is an object of the invention to provide an improved side sill construction offering the advantages discussed immediately above.

Another object is to provide railcars such as well cars, double-stack well cars, railcars carrying automotive vehicles, and other railcars with an improved side sill construction.

These and other objects of the present invention are provided in a railcar which comprises a low-level railcar body with sides extending between opposed ends, and a wheel truck adjacent each end. The body comprises a pair of side walls and a floor and a pair of side sills joining said side walls to said floor. Each of the side sills have a concave exterior portion to provide increased clearance at the exterior bottom corners of the car body.
Brief Description Of The Drawings

FIG. 1 is a side-elevational view of a railcar in accordance with a preferred embodiment of the invention;

FIG. 2 is a cross-sectional view taken along the line 2-2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3-3 of FIG. 1;

FIG. 4 is an end view looking in the direction of arrows 4-4 of FIG. 1;

FIG. 5 is an enlarged fragmentary view showing the right-hand side of deck 15 of FIG. 2;

FIG. 6 is an enlarged fragmentary view of the upper right-hand corner of FIG. 2.

FIG. 7 is a perspective view of structural elements at one end of the railcar of FIG. 1;

FIG. 8 is a perspective view illustrating the end structure of FIG. 2;

FIG. 9 shows the bottom portion of Fig. 2 taken on an enlarged scale; and

FIG. 10 is a cross-sectional view taken along the line 10-10 of FIG. 7.

Detailed Description Of The Preferred Embodiment

The invention is preferably embodied in a railcar having side sills offering improved clearance. Such side sills find immediate application in "low level" railcars where mid-portions of the railcar bodies are placed as close to top-of-rail as possible to reduce the overall height of the railcar, and to lower the center of gravity. The improved side sill construction of the invention finds particular application with low level cars such as motor vehicle carrying railcars, well cars, and double-stack well cars where central portions of the car body are placed as close to top-of-rail as possible.

The invention is preferably embodied in a railway car 10 for transporting motor vehicles. In the
illustrated embodiment, the car comprises a single unit. However, it should be appreciated that the invention might alternatively be embodied in an articulated railway car comprising two or more units. In the illustrated embodiment, the car includes a floor or "A" deck 12, a second deck or "B" deck 14, and a third deck or "C" deck 16. A roof 18 extends over the top of the railcar. The interior of the car is substantially enclosed by sidewalls 20 and end doors 22. Further details concerning railcar 10 may be found in commonly assigned United States Patent Application Serial No. 09/324,430 filed June 1, 1999, the disclosure of which is incorporated as if fully set forth herein.

While the illustrated embodiment comprises a tri-level railcar, it should be appreciated that the improved side sill according to principles of the invention might alternatively be embodied in a bi-level railcar, in a well car, and in other types of railcars.

The upper decks 14 and 16 of the railcar 10 are supported between end structures 17 by upper and lower longitudinally extending beams 24 and 26, rather than by large, heavy vertical posts. As shown in Figs. 1 and 2, each sidewall of the railcar includes upper and lower longitudinal beams 24 and 26 disposed generally parallel to and spaced from one another, connected directly to the B and C decks 14, 16.

Each of the beams is configured to provide support to its associated deck without unnecessarily reducing interior clearances, and without unduly increasing the weight of the railcar. In addition, the beams are intended to be capable of economical manufacture so as to be suitable for use in commercial mass production of railcars. While different beams of various configurations might satisfy these criteria, the illustrated beam configuration is described in detail below for purposes of example. Each beam 24, 26 is preferably composite i.e., it comprises a plurality of longitudinally coextensive sections. Each beam further
comprises a hollow, generally rectangular outer portion 94 and an inwardly extending portion 96 that is joined to the deck to form an elongated hollow structure of generally trapezoidal shape.

Turning to a more detailed description of the illustrated embodiment, each of the illustrated beams comprises outer and inner sections 30 and 32. The outer section has a narrow profile, with its vertical dimension being substantially greater than its width. The inner section comprises a vertical outer web 34, a horizontal top wall 36, a vertical inner flange 38 depending from the top wall 36, and a horizontal bottom wall 40 extending inward from the bottom of the outer web. The inner section 32 comprises a vertical web 42, a horizontal bottom wall 44, extending inward therefrom, an angled support wall 46 extending inward and upward from the bottom wall 44 to engage the bottom of the deck, and a flange 48 extending inward along the bottom of the deck. Each of the inner and outer sections is preferably an integral, unitary, one-piece rolled steel member.

In the illustrated embodiment, the bottom wall 44 of the inner section overlies a portion of the bottom wall 40 of the outer section and is welded continuously thereto. An upper portion of the web 42 of the inner section overlaps the flange 38 of the outer section and is welded continuously thereto. As shown in Fig. 5, the inner section further includes a closure plate 51 extending inward from the inner web 42 to the bottom of the deck. The closure plate 51 preferably extends inward to the inner flange 48, cooperating with web 42 and walls 44 and 46 to form a closed tube. A flange 49 may extend from the inner web 42 to the top of the deck as an alternative to, or in addition to the closure plate 51. The closure plate and/or the flange may be welded to both the web 42 and the deck.

To facilitate welding of the inner section 32 to the outer section 30, the bottom wall 40 of the outer section preferably extends inward beyond the bottom wall
44 of the inner section, defining an inner lip or ledge 53 beneath a portion the angled wall 46. The beams 24 and 26 preferably have sufficient strength to support the weight of the loaded decks without relying upon large, heavy vertical support posts between the end structures 17. To provide the beams 24 and 26 with sufficient strength, they may be rolled from, e.g., 3/8 in. or 5/16 in steel.

The outer surface of the side wall is preferably devoid of footholds that would facilitate climbing of the side wall of the car. To this end, the outer surface of the outer portion 94 preferably is substantially coplanar with the outer surface of the surrounding sidewall structure. Each sidewall preferably has a plate girder construction that employs the horizontal beams as its principal supports. In the illustrated embodiment, the beams 24 and 26 are joined to sidewall panels or plates 50 and a plurality of light vertical stiffeners 52. The plates may have openings formed therein for light and ventilation. To eliminate the need for the many mechanical fasteners used in typical prior art auto racks, the preferred sidewalls are of welded construction, with all joints between the various components being welded.

In contrast to typical prior art auto rack railcars, the railcar 10 of the preferred embodiment includes top chords along the upper edges of the sidewalls. Top chords 91 and roof rails 92 extend along the upper ends of the sidewalls 20, and side sills 82 extend along the lower ends. As shown in Fig. 6, each top chord 91 preferably has a generally b-shaped cross section, comprising a lower tubular section 110 of rectangular, square cross-section with a flange 112 extending upward along one side.

The roof rail 92 has a generally L-shaped cross-section, comprising a horizontal flange 118 and a vertical web 120, and is seated on the top of the top chord, abutting the flange 112 and the top wall of the
tubular section 110. An upper edge portion 114 of the roof rail web is angled inward to join a sloped edge portion 116 of the roof. The top chord preferably functions as a structural member of the plate construction of the sidewall between the end structures 17. The top chord 91 preferably extends continuously along the top of the sidewall 20, and preferably comprises a single continuous member welded to vertical stiffeners 52 and sidewall panels 50.

In other embodiments, the sidewalls might have other configurations. For example, instead of the illustrated grid of stiffeners, stiffness might be provided by diagonal members, or by vertical members only. Alternatively, the sidewall panels 50 themselves might be made sufficiently strong to eliminate the need for additional stiffeners, e.g., by increasing their thickness, or by making the sidewall panels of nonplanar configuration, as by incorporating ribs or other integral structure to add rigidity.

Each of the end structures 17 preferably comprises an offset H frame 56 that includes a longitudinally extending draft sill 58 coupled to a body bolster 60, and inner and outer cross bearers 62 and 64 respectively coupled to the draft sill. In the offset H frame, the draft sill slopes downward and inward, with the inner cross bearer 62 being at a lower elevation than the outer one. Inner and outer vertical posts 66 and 68 extend upward at each end of each cross bearer to support the longitudinal beams. Between the end structures 17, the central portion 28 of the railcar preferably has an interior width of slightly over 9 feet, 7 inches, which is more than 6 inches greater than the corresponding width in conventional prior art auto rack designs.

Side sills 82 extend along the bottom side edges of the car body between the inner cross-bearers 62 (see Figs. 7 and 10). The side sills 82 differ from prior art side sills which may comprise, for example, heavy steel angles or elongated members. As can be seen
for example in Figs. 3 and 9a-9c, the side sills 82 are formed with a medial concave portion when received from outside the car. Referring to Fig. 3, each side sill 82 includes lower and upper generally upright portions 82a, 82b which are outwardly facing. As can be seen in the figures, side sill portions 82a, 82b are preferably angled from the vertical, so as to extend in an outward and upward direction.

Side sill 82 further comprises an intermediate or medial portion 82c which provides a step or lateral offset for portions 82a, 82b. Although not necessary, portions 82a, 82b are arranged generally parallel to one another. As mentioned above, side sills 82 have their ends joined to cross-bearers 62 as can be seen, for example, in Fig. 7. At the upper end of the side sill, portion 82b is secured in a conventional manner, (preferably by continuous welding along its length) to the lower end of outer wall plate 120 (see Fig. 3). At the lower end of side sill 82, an extension 82d is provided for joinder to a floor member 122. Thus, as can be seen in Figs. 3 and 9a, the preferred side sill 82 has four cross-sectional portions, two of which, 82a, 82b are substantially upright while the other two, 82c and 82d are substantially horizontal. The outer portions 82b, 82d are provided for securement to sidewall 120 and floor 122, respectively. The intermediate cross-sectional portions 82a, 82c form a concave depression when viewed from the outside of the railcar.

In Figures 9b and 9c alternative side sills are shown. In Figure 9b, side sill 82' has three cross-sectional portions, including end portions 82b, 82d for joinder to the sidewall and the floor, as mentioned above. In side sill 82' a concave depression is formed by a single curved cross-section 82e which replaces the intermediate cross-sectional portions 82a, 82c of side sill 82. In Figure 9c, side sill 82'', a concave depression is formed by intermediate portion 82f having a diagonal cross-sectional configuration.
In the preferred embodiment, the side sills 82 are formed by cold rolling a one-half inch thick plate of steel. One example of a suitable material is 935 GR 50 Type 1, Class 2 steel. Other types of material can be employed, as well, and the material can be shaped by conventional processes other than cold rolling. It is generally preferred that the side sills be formed as a single monolithic piece. However, if desired, the side sills could be made from a weldment of longitudinally extending components.

As noted above, the side sills according to the invention include a lower end portion 82d for joinder to a floor of the railcar with remaining portions of the side sill extending above the railcar floor and including an upper end portion for joinder to a railcar sidewall. This allows for a "clean" construction underneath the railcar floor allowing the draw gear and other underside equipment to be made compact, thereby imparting an improved low clearance for the railcar, above the track height.

In the preferred embodiment, side sill 82 offers a horizontal recess dimension C of approximately three and one-half inches, and a vertical recess dimension A of approximately six inches. The recesses are shown in Fig. 9, where reference numeral 130 refers to construction lines corresponding to a cross-section of heavy steel angle members of approximately one-half inch thickness employed to form side sills for railcar 10 prior to the invention. In Fig. 9, the lateral dimensions of railcar 10 are shown in addition to the aforementioned recessed clearances. In the preferred embodiment, the lateral dimension E is 8 feet, seven and seven-sixteenths inches while lateral dimension F is nine feet, two and seven-sixteenths inches. The dimensions B and D relating to the side sill are four inches and eight and three-eighths inches, respectively. This allows the floor 12 to be spaced approximately twelve and one-half inches above the top of rail, under normal operating
conditions, a distance well above the minimum set by the
Association of American Railroads Plate H Clearances.

Further advantages are provided by the
preferred side sill construction shown in Fig. 9a, as
well as other side sill constructions shown in Figs. 9b
and 9c. With reference to Fig. 9a, the near-vertical end
portion 82b has a length of approximately four inches, to
provide sufficient overlap for welded joinder with the
outside skin and structural members of the railcar. The
opposite end portion of the side sill construction,
identified by reference indicator 82d in Fig. 9a is
lengthened from a minimum dimension (between three and
four inches) to an extended dimension of ten inches, more
than sufficient to provide overlap with floor 12 for
welded joinder therewith. The additional length of side
cross-sectional portion 82d provides added weight or
ballast at the bottom of railcar 10, a feature
particularly advantageous when railcar 10 is provided
with three decks.

Other configurations of the recessed or offset
side sill are possible. It should be mentioned that the
added external clearance provided by side sills according
to the invention is provided at a portion of the railcar
located below the height of doors 22 (see Fig. 4) and
also below the tops of wheels 142 as well as axles 102
(see Fig. 1). With reference to Fig. 1, it has been
observed in practical rail yard environments that the
added clearance provided by the present invention is
required for approximately a central one-fourth portion
of the total railcar length. In particular, added
clearance offered by the side sills according to the
invention have been found to offer particular advantages
in providing clearance from rail side retarders in
conformance with Association of American Railroads plate
H equipment diagram, standard S-2040-93.

As indicated in Figs. 2 and 3, for example, it
is generally preferred, for weight savings purposes, that
the cross-sectional shapes of sills according to the
invention are exposed in the railcar interior. Side sills according to the invention help to guide workers footsteps as they exit the railcar, after delivering vehicles on board the lower level or A deck of the railcar. Side sills according to the invention also provide a protected space for utilities (such as brake rigging including brake system air lines) that run along the rail car A deck. Due to the preferred light weight construction of the railcar, such utilities are exposed within the interior of the A deck cavity. It is generally preferred that such utilities run along the corner of the side sill where outer portion 82b blends with its adjoining side sill portion. The portion 82c of the side sill (see Fig. 9a), in addition, provides a surface for storage wheel chocks temporarily removed from chock tracks in the railcar floor.

The side sills 82 transmit draft and buff loads along the central portion of the car. With reference to Fig. 7, draft and buff loads are transmitted to the side sills from the draft sill 58 through the inner cross bearer 62, the body bolster 60, one or more of the floor plates 84, 86 and 88, which may act as shear plates, and upper side sill extensions 90.

As shown in Fig. 7, the draft sill 58 has a substantially horizontal segment 98 at an appropriate elevation for support of draft gear compatible with that of other railcars, a downwardly sloping intermediate segment 100, and a generally horizontal inner segment 102. The bottom of the draft sill curves downward at its inner end to join the bottom wall 108 of the inner cross bearer, which functions as a shear plate to transmit draft and buff loads to the side sills 82. The illustrated body bolster 60 is integrated with the draft sill 58 to some extent in that a central portion of the body bolster 60 comprises a portion 104 of the inner segment 102 of the draft sill. The body bolster 60 shown in Fig. 7 has a pair of arms 106 to support side bearings, and in
the illustrated embodiment extends to the side sill extensions 90 and is welded thereto.

In other embodiments, the width of the body bolster may be reduced, e.g., it may extending only as far as necessary to support the side bearings, without extending the full width of the railcar. In the preferred embodiment, the floor plate 84 over the inner segment 102 of the draft sill functions as a shear plate, and is joined to the top of the body bolster. To enable the floor plate 84 to withstand the shear stresses and other loads encountered during use, the floor plate 84 is preferably a heavy steel plate. For example, a 3/8-inch plate may be employed.

As can now be seen, the side sill of the present invention provides increased vertical and horizontal clearance at mid-portions of the railcar. As will be appreciated by those skilled in the art, increased vertical clearance is especially important where track side rail equipment is located adjacent a hump or other rise in the track, especially for railcars of substantial length. Further, the horizontal clearance provided by the present invention further aids in avoiding track side obstacles. As mentioned, the side sill of the preferred embodiment is preferably formed with three bends. The side sill can be economically formed of inexpensive materials using conventional techniques, such as cold rolling. Depending upon the composition of the metal plate used for the side sill, the forming operation may result in a side sill which can be reduced in thickness, offering savings compared to conventional angle plate side sills in use today.

The drawings and the foregoing descriptions are not intended to represent the only forms of the invention in regard to the details of its construction and manner of operation. Changes in form and in the proportion of parts, as well as the substitution of equivalents, are contemplated as circumstances may suggest or render expedient; and although specific terms have been
employed, they are intended in a generic and descriptive sense only and not for the purposes of limitation, the scope of the invention being delineated by the following claims.
WHAT IS CLAIMED IS:

1. A railcar comprising a low-level railcar body with sides extending between opposed ends, and a wheel truck adjacent each end;
   said body comprising a pair of side walls and a floor;
   a pair of side sills joining said side walls to said floor; and
   each of the side sills having a concave exterior portion to provide increased clearance at the exterior bottom corners of said car body.

2. The railcar of claim 1 wherein the side sills have at least three cross-sectional portions, one of which extends generally in the direction of the sides and another of which extends generally in the direction of the floor.

3. The railcar of claim 1 wherein the side sills have a central, rounded cross-sectional portion.

4. The railcar of claim 1 wherein the side sills have a central, diagonal cross-sectional portion.

5. The railcar of claim 1 wherein the side sills have four cross-sectional portions with the two medial cross-sectional portions arranged to form a step.

6. The railcar of claim 1 wherein the railcar body includes a longitudinally medial portion located between end portions with the longitudinally medial portion comprising the low-level body portion.

7. The railcar of claim 6 wherein the side sills extend substantially the entire length of the longitudinally medial portion.
8. The railcar of claim 1 wherein the low-level body portion extends below the tops of the wheel trucks.

9. The railcar of claim 1 wherein the low-level body portion extends below the axles of the wheel trucks.

10. The railcar of claim 1 wherein the railcar comprises a motor vehicle carrying railcar.

11. The railcar of claim 1 wherein the railcar comprises a well car.

12. The railcar of claim 1 wherein the railcar comprises a triple deck well car.

13. A motor vehicle carrying well car railcar comprising a low-level railcar body with sides extending between opposed ends, and a wheel truck adjacent each end;

   said body comprising a pair of side walls and a floor;

   a pair of side sills joining said side walls to said floor; and

   each of the side sills having a concave exterior portion to provide increased clearance at the exterior bottom corners of said car body.

14. The railcar of claim 13 wherein the side sills have at least three cross-sectional portions, one of which extends generally in the direction of the sides and another of which extends generally in the direction of the floor.
A. **CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification (IPC) or to both national classification and IPC

B. **FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 105/396, 404, 406.2, 418

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. **DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>US 3,017,840 A (Fairweather) 23 January 1962 (23.01.1962) whole document.</td>
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<td>X</td>
<td>US 5,979,335 A (Saxton et al) 09 November 1999 (09.11.1999), whole document.</td>
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Further documents are listed in the continuation of Box C.

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- **"B"** earlier application or patent published on or after the international filing date
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