

Exhibit 5

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Wong

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[45] **Date of Patent:** **Jul. 17, 1990**

[54] **STEEL END STRUCTURE FOR ALUMINUM RAILCAR**

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[73] **Assignee:** Procor Ltd., Canada

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105/418; 105/420

[58] **Field of Search** 105/407, 409, 410, 411,
105/416, 418, 420, 421

[56] **References Cited**

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Primary Examiner—Andres Kashnikow

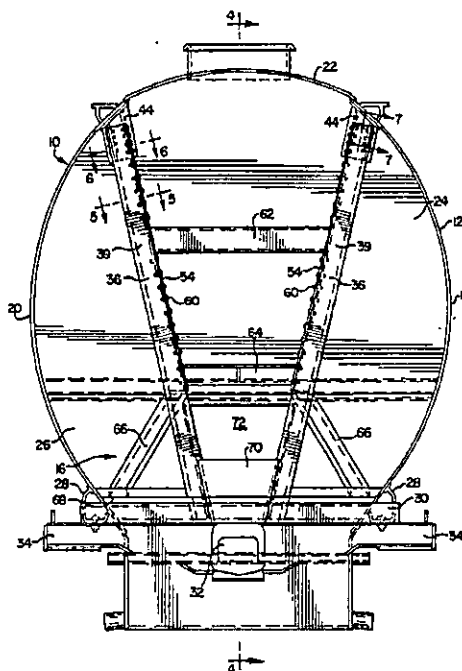
Assistant Examiner—Christopher G. Trainor

Attorney, Agent, or Firm—Dressler, Goldsmith, Shore, Sutker & Milnamow, Ltd.

[57] **ABSTRACT**

A covered hopper railcar having an aluminum body portion comprising aluminum side, top and end sheets. A side sill is secured to the lower marginal portion of each of the side sheets. The end structure assembly includes a steel center stub sill assembly, a steel shear plate, steel body bolsters, and a pair of spaced-apart steel end stiffener members. The end stiffener members extend between and are secured at their bottom ends to the upper surface of the shear plate, at their top portions to the end sheet and side sheet, and at intermediate portions to the end sheet. The top portion of the end stiffener members is secured to aluminum connector plates, which plates are secured to the end sheet and a side sheet by huckbolts passing therethrough. The intermediate portion of the end stiffener members is huckbolted to an aluminum bracket which in turn is secured to the end sheet.

17 Claims, 4 Drawing Sheets



EXHIBIT

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FIG. 2

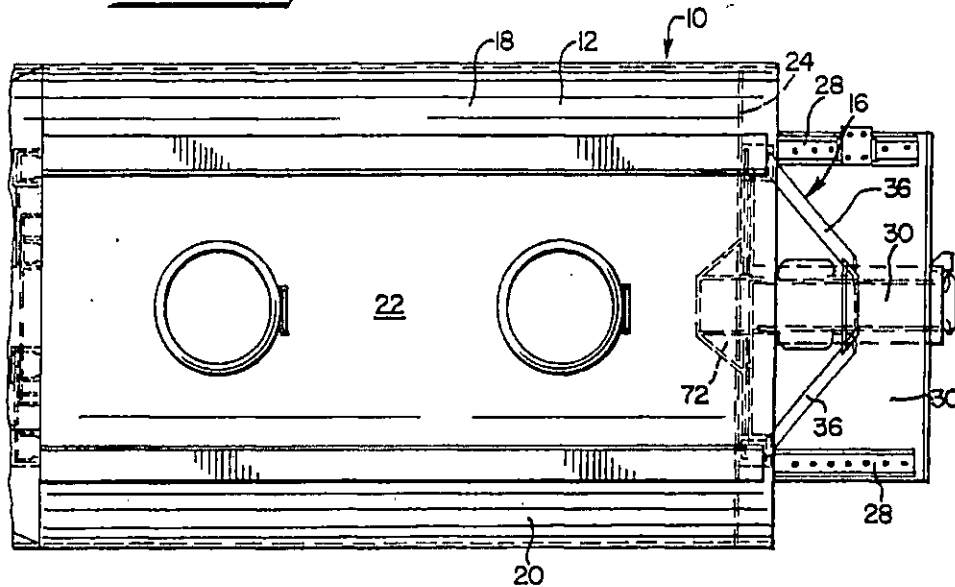


FIG. 1

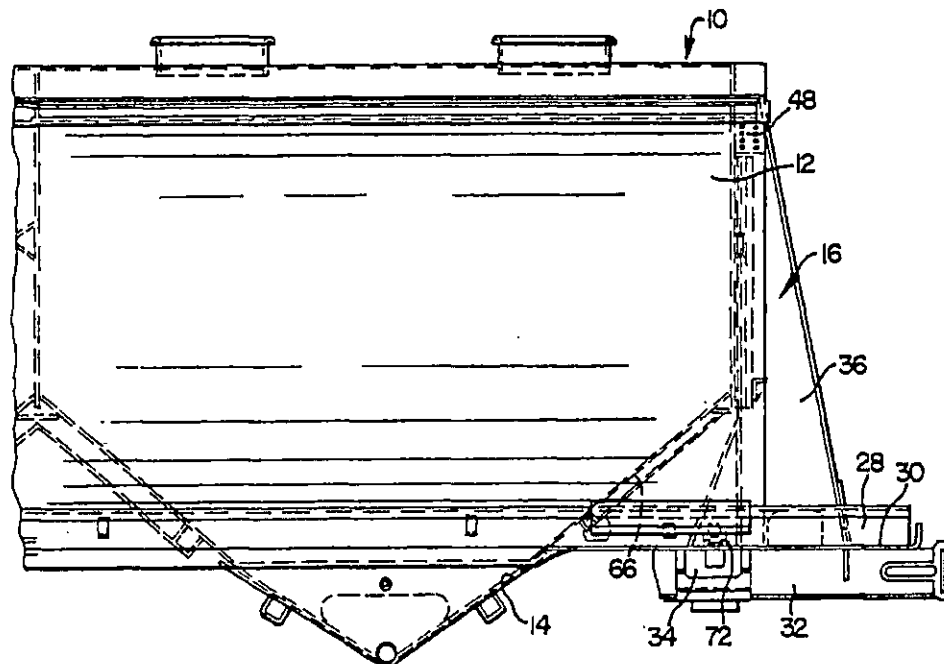
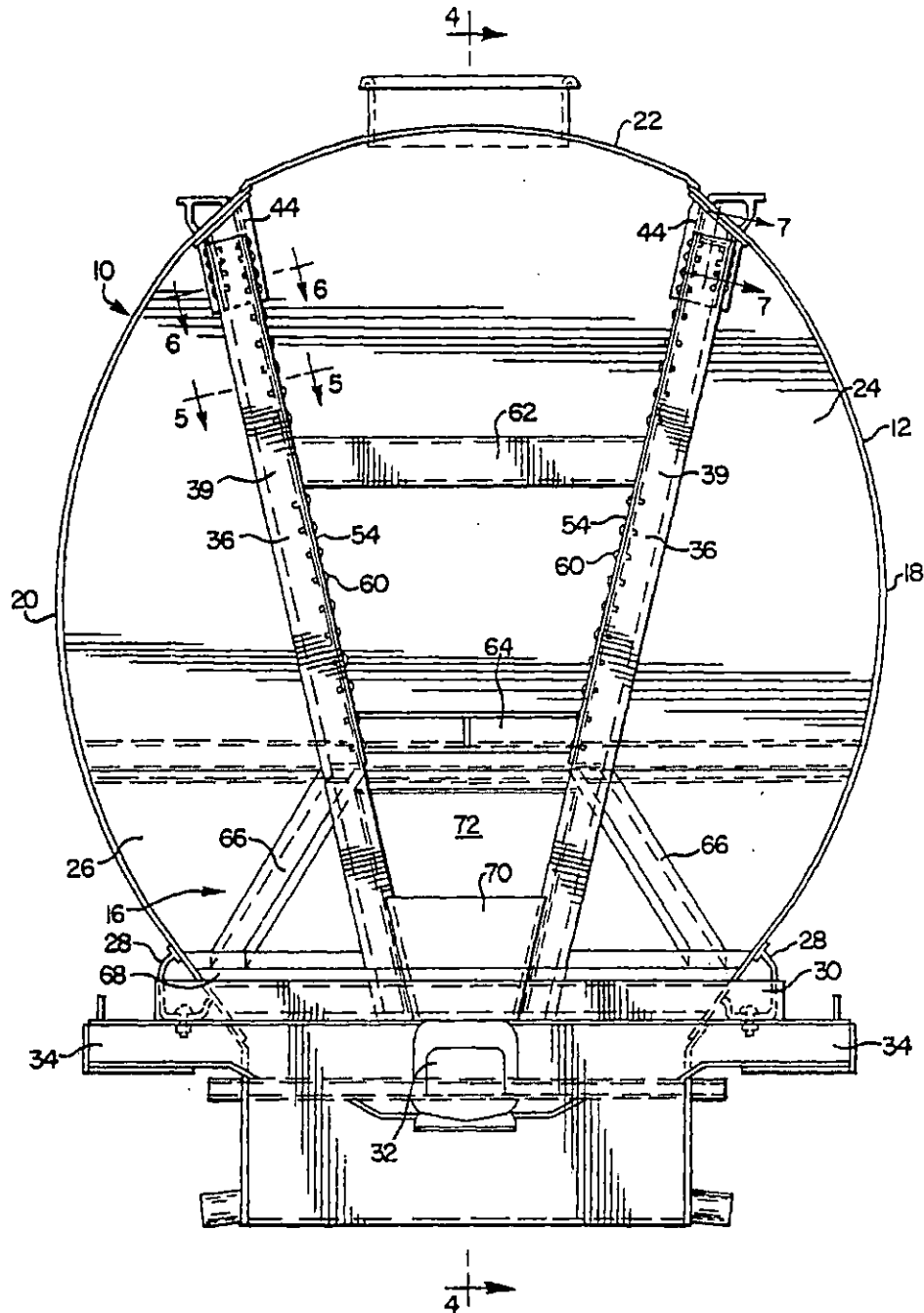
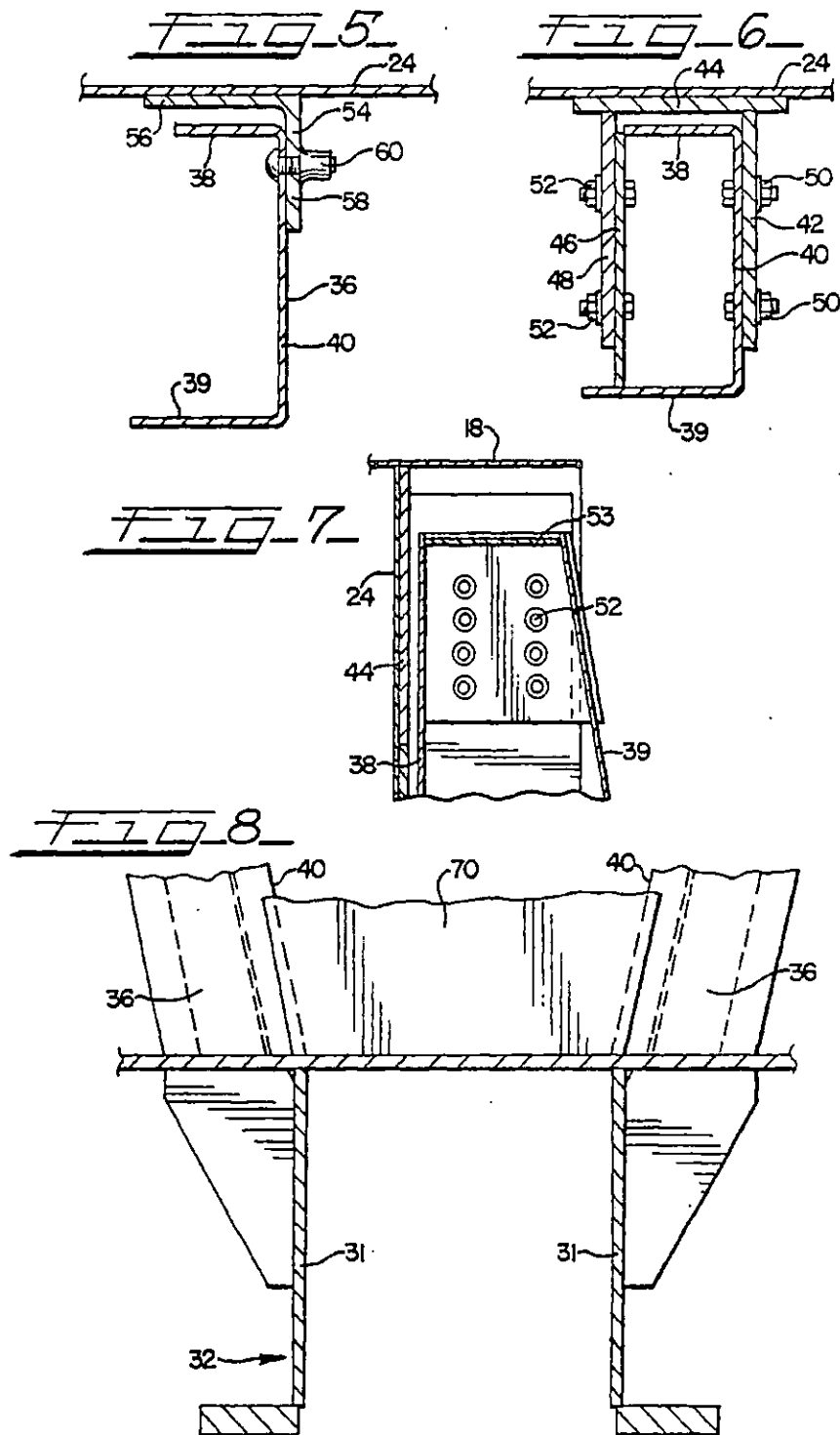


FIG. 3



STEEL END STRUCTURE FOR ALUMINUM RAILCAR

FIELD OF INVENTION

The invention relates to aluminum railcar construction and, more specifically, to an all-steel end structure for a railcar having an aluminum body portion.

BACKGROUND OF THE INVENTION AND TECHNICAL PROBLEMS POSED BY THE PRIOR ART

The design of aluminum railcars within the fatigue strength of welded aluminum has been a great challenge to railcar designers. It is highly desirable to use aluminum in areas for product containment, where corrosion protection is needed and to reduce the weight of the railcar, and to use higher strength steel in critical areas for sustaining coupler and vertical lading loads.

Railcars having aluminum body portions comprising side sheets, a top sheet and end sheets made from aluminum are well-known in the art. Some of such railcars utilize an expensive full-length steel center sill underframe arrangement, while others utilize steel/aluminum stub sill underframes. In the latter instance there are two primary approaches. One uses all-aluminum components, including the stub sill. The steel striker and rear draft lugs that accommodate the draft system are usually connected to the aluminum stub sill by means of two-piece fasteners. The other approach employs steel stub sills and bolsters that are fastened to aluminum shear plates and aluminum end stiffeners that are welded to the end sheets.

The prior art aluminum railcar designs are expensive to build and costly to maintain because of the high quality demanded and the use of complicated structural arrangements necessary to avoid high stresses at the welded aluminum areas. Accordingly, there is a need for a simple and more cost-effective aluminum railcar design. More specifically, there is a need for an improved connection arrangement for connecting an all-steel end structure to an aluminum railcar body.

SUMMARY OF THE INVENTION

An aluminum railcar is provided that utilizes high-strength steel in critical areas for sustaining coupler and vertical loads and aluminum for product containment where corrosion protection is needed. The invention utilizes a fabricated all-steel end structure comprising a shear plate, stub sill, body bolsters and end stiffener members. The end structure is connected to the aluminum car body primarily at two locations; namely, the side sills to the shear plates and the end stiffener members to the end and side sheets of the aluminum car body. The end stiffener members allow the stub sill and the aluminum car body to work in unison with the shear plate and bolsters in sustaining loads.

In accordance with a preferred embodiment of the invention, a covered hopper railcar is disclosed having an aluminum body portion comprising aluminum side, top and end sheets. A side sill is secured to the lower marginal portion of each of the side sheets extending lengthwise of the car and to the shear plate. The end structure assembly includes a steel center stub sill assembly, a steel shear plate, steel body bolsters, and a pair of spaced-apart steel end stiffener members. The center stub sill assembly is located generally on the longitudinal centerline of the car body and the body

bolsters extend transversely of the car body intermediate the outer end of the center stub sill assembly and the ends of the side sills.

The shear plate is supported on and attached to the body bolsters and the center stub sill. The side sills are secured to the upper surface of the shear plate by fasteners passing therethrough. A pair of spaced-apart end stiffener members extends between and is secured at their bottom ends to the upper surface of the shear plate and at their top ends to the end sheet and side sheets. The end stiffener members are preferably secured at their intermediate portions to the end sheet. The end stiffener members extend downwardly and inwardly from the upper portion of the side sheets towards a portion of the shear plate above the center stub sill assembly and have a depth that increases from the top toward the bottom thereof.

In accordance with a unique feature of the invention, the top portion of the end stiffener members is secured to aluminum connector plates, that are secured to the end sheet and a side sheet, by fasteners passing therethrough. The intermediate portion of the end stiffener members is preferably fastened to an aluminum bracket which in turn is secured to the end sheet. The aluminum side sills, end sheets and side sheets are reinforced with aluminum stiffeners, pads and gussets.

The foregoing end structure construction and connections provide the necessary strength and minimize the forces exerted on the welded aluminum components in the car body, while at the same time facilitating the fabrication of both the end structures and the aluminum car body.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming part of the specification, in which like numerals are employed to designate like parts throughout the same,

FIG. 1 is a side elevational view of an end portion of an aluminum railcar having an end structure in accordance with the invention, with certain parts removed for clarity;

FIG. 2 is a top plan view of the railcar shown in FIG. 1;

FIG. 3 is an enlarged end view of the railcar shown in FIG. 1;

FIG. 4 is a cross-sectional view taken generally along the plane 4—4 in FIG. 3;

FIG. 5 is an enlarged cross-sectional view taken generally along the plane 5—5 in FIG. 3;

FIG. 6 is an enlarged cross-sectional view taken generally along the plane 6—6 in FIG. 3;

FIG. 7 is an enlarged cross-sectional view taken along the plane 7—7 in FIG. 3; and

FIG. 8 is an enlarged cross-sectional view taken through the center stub sill assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

While this invention is susceptible of embodiment in many different forms, the description of this invention and the accompanying drawings disclose only one specific form as an example of the use of the invention. The invention is not intended to be limited to the embodiment so described, and the scope of the invention will be pointed out in the appended claims.

Some of the figures illustrating the preferred embodiment of the apparatus show structural details and me-

chanical elements that will be recognized by one skilled in the art. However, the detailed descriptions of some of these elements are not necessary to an understanding of the invention and, accordingly, are not herein presented.

Referring to FIGS. 1-4, an end portion of a center stub sill covered hopper railcar 10 is shown with various components thereof, such as wheel trucks, removed for clarity. Railcar 10 includes a conventional body portion 12, defining hoppers 14 therein, having an end structural assembly 16 of the present invention at either end of the car. Only one such end structure assembly 16 is shown since the end structure is identical at each end of the car.

Car body portion 12 includes side sheets 18 and 20, top sheet 22, end sheets 24 and end slope sheets 26. Side sheets 18 and 20 and top sheet 22 extend outwardly beyond the end sheets 24. Sheets 18, 20, 22 and 24 are of aluminum construction and are attached to one another in a well-known manner so as to define body portion 12. Aluminum side sills 28 are attached to the lower marginal portions of the respective side sheets 18 and 20, with the sills extending substantially the entire length of the side sheets and beyond the outer edges thereof.

In accordance with the present invention, end structure assembly 16 of the present invention is attached to the aluminum body portion 12 in a manner that sustains the coupler and vertical lading loads and provides effective stress transfer paths to the aluminum car body. End structure assembly 16 is essentially a fabricated all-steel construction comprising a shear plate 30, a center stub sill 32, body bolsters 34, and end stiffener members 36.

Body bolsters 34 are rigidly secured to the bottom of the side sills 28 and to center stub sill 32 so as to support one end of the car body 12 on trucks (not shown) in a well-known manner. A shear plate 30 extends between and is rigidly attached to the upper surfaces of the body bolsters 34 and the upper surface of the center stub sill 32. The lower surfaces of the side sills 28 are fastened to the upper surface of the shear plate 30 by two-piece fasteners extending therethrough. Shear plate 30 extends from a point outward of end slope sheet 26 to a short distance from the outer end of center stub sill 32, as best seen in FIG. 4. Shear plate 30, side sills 28, and center stub sill 32 extend outwardly beyond the end sheet 24. Body bolsters 34 are generally in transverse alignment with the end sheet 24.

A pair of spaced-apart end stiffener members 36 extends between and is secured to the upper surface of shear plate 30 and to the end sheet 24 and a respective side sheet 18 and 20. Referring to FIGS. 3-6, end stiffener member 36 is preferably a channel-shaped member defined by side portions 38 and 39 and a web portion 40. As best seen in FIG. 5, web portion 40 is located perpendicular to end sheet 24 and has a depth that increases from the top toward the bottom thereof, as best seen in FIG. 4. Side portion 38 extends substantially parallel to end sheet 24 and is spaced a short distance therefrom. End stiffener members 36 are positioned so as to extend downwardly and inwardly from the upper portion of the corresponding side sheet 18 or 20 towards a portion of the shear plate 30 above the center stub sill 32, such that the lower end of web portion 40 is generally in alignment with the side walls 31 of center stub sill 32, as best seen in FIG. 8.

In accordance with the present invention, the steel end stiffener members 36 are connected to the aluminum body 12 by means of two-piece fasteners. The top

portion of the end stiffener members 36 is secured to the end sheet and the adjacent side sheet and the intermediate portion of the end stiffener members 36 is preferably secured to the end sheet.

Referring to FIGS. 6 and 7, the upper portion of the web portion 40 of the end stiffener members 36 is attached to an aluminum connector plate 42, which plate in turn is welded to end plate 24 and an aluminum plate 44 welded to end sheet 24 and a respective side sheet 18 and 20. Web portion 40 is attached to connector plate 42 by a plurality of two-piece fasteners, such as nut and bolt assemblies 50 passing therethrough, as best seen in FIG. 6. A steel plate 46 is welded across the upper portions of side portions 38 and 39 of end stiffener members 36 at the outer edge of side portion 38 in facing relationship and spaced from web portion 40. Plate 46 is attached to an aluminum connector plate 48, which connector plate in turn is welded to end sheet 24 and plate 44. Plate 46 is attached to connector plate 48 by a plurality of two-piece fasteners, such as nut and bolt assemblies 52. Referring to FIG. 7, a steel plate 53 is welded between the uppermost portions of side portions 38 and 39 and web portion 40.

Referring to FIGS. 3, 4 and 5, the intermediate portion of the end stiffener members is preferably attached to end sheet 24 through an aluminum angle member 54. Angle member 54 extends from the lower edge of connector plate 42 to the lower edge of end sheet 24 and is oriented generally parallel to web portion 40. Angle member 54 is defined by a leg portion 56 in facing contact with end sheet 24 and welded thereto and a leg portion 58 extending generally perpendicular to end sheet 24 and parallel to web portion 40. The intermediate portion of web portion 40 is attached to leg portion 58 along the entire length thereof by a plurality of spaced-apart two-piece fasteners, such as huckbolts 60, passing therethrough, as best seen in FIG. 5.

The lower end of end stiffener member 36 is welded to the upper surface of shear plate 30 such that the web portion thereof is substantially in vertical alignment with the side walls 31 of stub sill 32, as best seen in FIG. 8.

An aluminum channel stiffener member 62 preferably extends between the intermediate portions of end stiffener members 36 and is welded to end plate 24 and the angle members 54. A substantially horizontal steel reinforcing angle member 64 preferably extends between and is welded to the web portions 40 of the end stiffener members adjacent the lower ends of angle members 54. The end slope sheets 26 are preferably reinforced by aluminum channel stiffener members 66 welded thereto and extending downwardly and outwardly from a point adjacent the intersection between the end stiffener members 36 and the upper edge of end slope sheet 26 towards the lower outer edge of sheet 26 at horizontal aluminum channel stiffener member 68.

A trapezoidal-shaped plate 70 extends between and is welded to the lower portions of the side portions 39 of stiffener members 36. A trapezoidal-shaped plate 72 extends between and is welded to the lower portions of the side portions 38 of stiffener members 36. An end stiffener support assembly 72 is preferably provided to provide further support at the intersection between the end stiffener member 36 and the shear plate 30, as best seen in FIGS. 2 and 4.

It will be appreciated by those skilled in the art that the all-steel end structure 16, and the connection thereof to an aluminum railcar body, in accordance with the

teachings of the invention, results in the utilization of high-strength steel in critical areas for sustaining coupler and vertical lading loads and aluminum for product containment where corrosion protection is needed. From the foregoing, it can be seen that there has been provided an aluminum railcar having an end structure that provides the necessary strength and minimizes the forces exerted on the welded aluminum components in the car body.

It will be readily observed from the foregoing detailed description of the invention and from the illustrated embodiment thereof that numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concepts or principles of the invention.

What is claimed is:

1. In a railcar having an aluminum body portion comprising aluminum side sheets and aluminum end sheets, and a side sill secured to a lower marginal portion of each of said side sheets and extending lengthwise of the car; an improved steel end structure assembly connected to said aluminum body portion, comprising: a steel center stub sill assembly located generally on the longitudinal centerline of the body portion, steel body bolsters extending transversely of said body portion intermediate an outer end of said center stub sill assembly and the ends of said side sills; a steel shear plate supported on and attached to said body bolsters and said center stub sill; a pair of spaced-apart steel end stiffener members extending between and secured to the upper surface of said shear plate and to said end sheet and said side sheets; said end stiffener members having a depth that increases from the top toward the bottom thereof; said end stiffener members extending downwardly and inwardly from an upper portion of said side sheets towards a portion of said shear plate above said center stub sill assembly; said end stiffener members being secured at a top portion thereof to a first aluminum connector plate that is secured to said end sheet and said side sheet; said end stiffener members being secured at an intermediate portion thereof to an aluminum bracket member secured to said end sheet; and said bracket member being an elongated angle bracket member having a first leg portion in contact with and secured to said end sheet and a second leg portion in contact with and secured to said intermediate portion of said stiffener member.

2. The invention as defined in claim 1 wherein said second leg portion is substantially perpendicular to said end sheet and is bolted to said stiffener member.

3. The invention as defined in claim 1 wherein said end stiffener member is a channel-shaped member having a web portion oriented generally perpendicular to said end sheet and said second leg portion is secured to said web portion by a plurality of two-piece fastener means extending therethrough.

4. The invention as defined in claim 1 wherein a lower portion of said end stiffener member is welded to said shear plate.

5. The invention as defined in claim 1 wherein said end stiffener member is a channel-shaped member having a web portion, said web portion having a bottom end generally in vertical alignment with said center stub sill assembly.

6. The invention as defined in claim 1 wherein a plate member extends between and is secured to lower end portions of said end stiffener members.

7. The invention as defined in claim 1 wherein a channel-shaped aluminum stiffener member is secured to said end sheet and extends between said intermediate portions of said end stiffener members.

8. The invention as defined in claim 1 wherein said end stiffener member is a channel member having a web portion and a pair of spaced-apart side portions and said first connector plate is secured to said web portion by two-piece fastener means passing therethrough.

9. The invention as defined in claim 8 wherein said side portions have a steel plate extending therebetween and secured to the upper portions thereof.

10. The invention as defined in claim 9 wherein said steel plate is secured to a second aluminum connector plate by two-piece fastener means extending therethrough, and said second connector plate being secured to said end sheet and said side sheet.

11. The invention as defined in claim 10 wherein the upper edges of said first connector plate and said second connector plate are welded to a plate that is welded to said end sheet and said side sheet.

12. In a covered railway hopper car having an aluminum body portion defined by side sheets, a top sheet, and end sheets, a plurality of hoppers spaced at intervals along the length of the car including an end hopper at each end having an end hopper slope sheet extending downwardly and inwardly from a lower portion of one of said end sheets, and side sills secured to a lower marginal portion of each of said side sheets and extending lengthwise of the car; an improved steel end structure connected to said aluminum body portion, comprising: a steel center stub sill assembly located generally on the longitudinal centerline of the body portion; steel body bolsters extending transversely of said body portion intermediate an outer end of said center stub sill assembly and the ends of said side sills; a steel shear plate extending between and attached to an upper portion of said body bolsters; a pair of spaced-apart steel end stiffener members extending between and secured to an upper surface of said shear plate and to said end sheet and said side sheets; said end stiffener members having a depth that increases from the top towards the bottom thereof; said end stiffener members extending downwardly and inwardly from an upper portion of said side sheets towards a portion of said shear plate above said center stub sill assembly; said end stiffener members being secured at a top portion thereof to a first aluminum connector plate that is secured to said end sheet and said side sheet; said end stiffener members being secured at an intermediate portion thereof to an aluminum bracket member secured to said end sheet; and said bracket member being an elongated angle bracket member having a first leg portion in contact with and secured to said end sheet and a second leg portion in contact with and secured to said intermediate portion of said stiffener member.

13. The invention as defined in claim 12 wherein said top portion of said end stiffener member is secured to said first aluminum connector plate by two-piece fastener means extending therethrough.

14. The invention as defined in claim 13 wherein said end stiffener member is a channel member having a web portion extending between a pair of spaced-apart side portions, said web portion extending perpendicular to said end sheet.

15. The invention as defined in claim 14 wherein said web portion is secured to said first connector plates by two-piece fastener means passing therethrough.

16. The invention as defined in claim 15 wherein said side portions have a steel plate extending therebetween and secured to the upper portions thereof, said steel plate being secured to a second aluminum connector plate by two-piece fastener means extending there-

through, and said second connector plate being secured to said end sheet and said side sheet.

17. The invention as defined in claim 10 wherein the upper edges of said first connector plate and said second connector plate are welded to plate that is welded to said end sheet and said side sheet.

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Exhibit 6

CAR BUILDERS' CYCLOPEDIA

1946

EXHIBIT

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1946 Car Builders' Cyclopedia Of American Practice

Definitions and Typical Illustrations of Railroad and Industrial
Cars, Their Parts and Equipment; Cars Built in America
for Export to Foreign Countries; Descriptions and
Illustrations of Shops and Equipment Employed
in Car Construction and Repair

Seventeenth Edition—1946

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First 1879	Tenth 1922
Second 1884	Eleventh 1925
Third 1895	Twelfth 1928
Fourth 1903	Thirteenth 1931
Fifth 1906	Fourteenth 1937
Sixth 1909	Fifteenth 1940
Seventh 1912	Sixteenth 1943
Eighth 1916	Seventeenth 1946
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Foreword

In the tenth edition, 1922, of this work it was transformed from what might be termed an illustrated Dictionary to a Cyclopedia and the data were compiled in a manner differing radically from that of previous editions; all information relating to a specific subject was combined within a single section instead of being placed in several separate groups. In former editions each of these groups—Association of American Railroads (formerly American Railway Association, Mechanical Division, and originally Master Car Builders' Association) specifications and drawings, general illustrations, and manufacturers' descriptive pages—were in different sections of the book, necessitating considerable cross reference and inconvenience in obtaining complete information on any subject. In the tenth edition, the material was so arranged and indexed that reference to the general index, or the table of contents gave the location of each class of cars or appliances.

Other indexes—General Index to Car Parts and Products—Trade Name Index and Index to Advertisers—were given in the last pages of the book. The Association of American Railroads "Rules of Interchange" and diagrams of the "Loading Rules" were omitted as these are now obtainable in convenient booklet forms.

In this volume, the Seventeenth Edition, the same general arrangement has been followed, with the division into sections clearly defined. In a few cases the arrangement has been changed somewhat in order to make the material more readily accessible. As a further aid, the Table of Contents by sections and subdivisions on page six and the General Index to Car Parts and Products at the end of the book have been amplified and improved and in addition a summary of the contents of each section is given on the first page of the several sections.

Many new designs of cars and appliances in the field of railway car construction have been made since the publication of the previous edition. These have been included as far as possible in order that this Edition might contain the latest practices in American Car Construction and Equipment.

The work of compiling data and rearranging the book has entailed a vast amount of research and revision, in connection with which valuable assistance has been given by an Advisory Committee appointed by the Mechanical Division of the Association of American Railroads, by many other railway mechanical officers, by the railway car builders and by the manufacturers of railway supplies.

Body Brace. An inclined member of the body side or end framing of the car.

Body Center Plate. The center plate attached to the under side of the body bolster. See CENTER PLATE.

Body Check or Safety Chain Eye. An eye bolt or clevis for fastening a truck check chain or safety chain to the car body.

Body Check or Safety Chain Hook. An iron hook on the check chain, which enters into the check chain eye.

Body Cross Tie. A metal bar extending across a hopper or other form of open-top freight car and fastened to the sides to prevent their bulging.

Body End Furring. Furring in the end of a car. See FURRING.

Body End Plate. A transverse member in the end of a car connecting the side plates. See END PLATE.

Body End Rail. See WAINSCOT RAIL.

Body Framing. The framework of that part of a car above the underframe, so called to distinguish it from the underframe. It is commonly subdivided into side, end and roof framing.

Body Post (Freight Car Bodies). An upright piece which is fastened to the sill and plate of a freight car. The body posts and corner posts form the vertical members of the side frame of a car body. See POST and SIDE POST.

Body Side Bearing. The upper one of the two side bearings, which is attached to the body bolster. See SIDE BEARINGS.

Body Transom. A name sometimes given to a Needle-beam or Crossbearer.

Body Unit. One complete part of an articulated car. See ARTICULATED CAR.

Bogie. A British term for a swiveling car truck. American eight-wheel cars are termed bogie carriages, or wagons, in Great Britain.

Bogus Plate (Refrigerator Cars). A horizontal timber attached to the posts on the inside of the car, a short distance below the plate. The bogus plates support horizontal cross members, called meat racks, or hanging bars, to which hooks are attached for hanging meat. See MEAT RACK.

Bolster. A cross member on the under side of a car body and in the center of a truck, through which the weight is transmitted. The bolsters carry the body and truck center plates, the body bolster resting on the truck bolster.

Truck bolsters are either swing bolsters, admitting of lateral motion to mitigate shocks, or rigid bolsters, which permit no lateral motion. See BODY BOLSTER, SWING BOLSTER and TRUCK BOLSTER.

Bolster Anchor. An arm pivoted to the truck frame and to the truck bolster to constrain the movement of the latter in a desired manner.

Bolster Bridge (Six-Wheel Truck). See SIDE BEARING ARCH.

Bolster Center Filler. A hollow box-shaped member placed between the center sills and body bolster plates; the king bolt passes through it.

Bolster Diaphragm. See BODY BOLSTER DIAPHRAGM.

Bolster Guide Bars (Diamond Arch Bar Trucks). See COLUMN.

In modern trucks with cast steel side frames the bolster guide bars are cast integral, as part of the frame.

Bolster Hanger. See SWING HANGER.

Bolster Hanger Carrier. A Swing Hanger Pin Bearing.

Bolster Jack Screw (Wreck Cranes). A jack screw attached to the spring plank for the purpose of taking the load off the springs and making the entire truck and car body one rigid structure when the derrick of the crane is in use.

Bolster Roll Stabilizer. Comprises a split spring plank, the two separate parts of which are connected to each other and to the bolster so as to prevent the bolster from moving out of plane with the track and overloading the springs.

Bolster Spring. The main spring of a car, supporting the truck bolster, on which the weight of the car body rests.

Bolster Thimble. A small filler sometimes used between the cover plates of a bolster when the main filler or web does not extend clear to the end of the bolster.

Boom (Steam Shovel). The heavy swinging arm which carries the boom engine and ratchet beam. It is stepped at the foot of the "A" frame and held in its inclined position by boom guys.

Bottom Arch Bar. See ARCH BAR.

Bottom Connecting Rod. The brake rod connecting the bottom ends of the live and dead truck brake levers.

Bottom Rod. See BRAKE ROD and BOTTOM CONNECTING ROD.

Bottom Rod Guard or Emergency Support. Name applies to devices designed to support the bottom rod and prevent it from dropping to the track in case of failure of any part which normally supports the bottom rod. Also called safety support.

Bottom Truck Connection. See BOTTOM CONNECTING ROD.

Bow. See PLATFORM HOOD BOW.

Box. See JOURNAL BOX.

Box Car. A car with sides enclosed and having a roof; doors are placed in the sides or sides and ends. Used for general service and especially for lading which must be protected from the weather.

Box Car Door. Used on both the sides and sometimes on the ends of automobile car.

Box Cars, Framing for. See general drawings of cars. Sections 2 and 3.

Box Car End, Design and Strength. Manual, C-7.

Box Cover. See JOURNAL BOX LID.

Box Guide. See PEDESTAL.

Box Lid. See JOURNAL BOX COVER or LID.

Box Packing. See JOURNAL PACKING.

Box Section Bolster. A bolster whose cross-section is of rectangular shape.

Box Steps. A term sometimes used to distinguish platform steps made with sides, from open steps.

Brace. An inclined piece which unites two or more of the points of a frame or truss, where other members of the structure are connected together, and which prevents them from turning about their joints.

Bracket Lamp. A lamp attached to a wall by a suspension in the form of a bracket.

Bracket Steps (Hopper Cars). Steps secured to the side of the car on the inside to serve as a substitute for a running board.

Brake or Brake Gear. The whole combination of parts by which the motion of a car or train is retarded or arrested. The foundation brake gear includes all the parts by which the pressure of the

- the bolt. A cotter is then inserted, thus securing the nut.
- Ceiling.** The inside or under surface of the roof or covering of a car. This term is sometimes used to mean Sheathing. The ceiling of a passenger car is generally termed Head Lining. Deafening Ceiling is boarding under the sills of a car. See HEAD LINING.
- Ceiling Furring.** Strips or pieces of wood fastened to the under side of the carlines, to which the paneling or veneering of the ceiling is applied.
- Ceiling Veneers.** Thin boards used for covering the ceilings of passenger cars. The term is also misapplied to the thin preparations of paper maché, etc., in imitation of natural wood veneers. See VENEER.
- Celestial Field.** A term used in interior illumination. The celestial field of a car interior would be the upper walls and ceilings.
- Cement Car.** See COVERED HOPPER CAR.
- Center Anchor.** An arrangement of plates, which are riveted to the tank and to the center sills at the center of a tank car. These plates anchor the tank to the frame and supplant head blocks and double anchors at the ends.
- Center Bearing.** The place in the center of a truck where the weight of the body rests, the truck bolster center plate. A body center plate attached to the car body here rests on a truck center plate attached to the truck. The general term center bearing is used to designate the whole arrangement and the functions which it performs, in distinction from Side Bearing. See also CENTER PLATE.
- Center Bearing Arch Bar.** See CENTER BEARING BRIDGE.
- Center Bearing Beam.** See CENTER BEARING BRIDGE.
- Center Bearing Bridge (Six-Wheel Trucks).** A structure formed by the top and bottom center bearing arch bars to support the center plate block or center bearing beam and transmit the weight of the car to the bolsters, on which its extremities rest.
- Center Bolster.** A center bearing bridge made in a single unit either built up, welded or cast steel.
- Center Buffer Spring.** A spiral spring situated above the draft springs in some forms of passenger draft gear and intended for buffing purposes only.
- Center Buffer Stem.** See BUFFER STEM.
- Center Door Rail.** See MIDDLE DOOR RAIL.
- Center Draft Drawbar.** A drawbar which is connected directly with the king bolt of a truck. It is especially designed for use on very sharp curves. Sometimes termed radial drawgear.
- Center Dump Car.** A car which will discharge its entire load between the rails.
- Center Girth.** See DOOR CENTER GIRTH.
- Center Pin or King Bolt.** A large bolt which passes through the center plates on the body bolster and truck bolster. The truck turns about the bolt, but the stress is taken by the center plates. It is, therefore, a mere pin and not a bolt in the usual sense. The name king bolt is derived from the name of the corresponding part of the front wheels of a wagon. Center pin, however, is the more common term.
- Center Pin Floor Plate.** A plate or casting set into the floor of a passenger equipment car to cover the head of the center pin.
- Center Plate.** One of a pair of plates which fit one into the other and which support the car body on the trucks, allowing them to turn freely under the car. The center pin or king bolt passes through both, but does not really serve as a pivot. The body center plate or male center plate is attached to the under side of the body bolster or in cast steel bolsters is made an integral part of the casting. The female or truck center plate is attached to the top side of, or cast integral with, the truck bolster. When the car is tilted, as on a curve, part of the weight is carried on the Side Bearings. See ANTI-FRICTION, BALL BEARING, and ROLLER CENTER PLATES.
- Center Plate Block.** The member supporting the center plate of a six-wheel truck.
- Center Rod (Postal Car).** A device which fits in a socket at the top of the pedestals, and to which the ends of the two rods, which support the distributing trays, etc., near the center of the car, are fastened.
- Center Sill.** The central longitudinal member of the underframe of a car, which forms, as it were, the backbone of the underframe and transmits most of the buffing shocks, from one end of the car to the other. In the A. A. R. standard box car the center sill is one of the units for which a required standard has been established. In freight cars with cushioned underframe a special type of floating center sill construction is followed. For passenger cars no set standard has been established and some unique designs are in use, as in the case of passenger cars built entirely of stainless steel. See CUSHIONED UNDERFRAME.
- Center Sill Bottom Angle.** The angle at the bottom of a center sill of the built-up type.
- Center Sill Bottom Cover Plate.** See CENTER SILL COVER PLATE.
- Center Sill Cover Plate.** A flat plate riveted or welded across steel center sills, either above or below, to give additional strength.
- Center Sill Separator.** A filler piece placed between the center sills at cross members.
- Center Sills, Splicing of.** See Manual, C-10.
- Center Sill Stiffener.** A filling piece riveted between the center sills to act as a brace for holding them rigid.
- Center Sill Top Angle.** The angle at the top of a center sill of the built-up type.
- Center Sill Top Cover Plate.** See CENTER SILL COVER PLATE.
- Center Sill Web Plate.** The plate which forms the web of a center sill of the built-up type.
- Center Stop (Tip Car).** A bracket or block attached to a draw member to restrain the body from moving longitudinally.
- Centering Device.** See COUPLER CENTERING DEVICE.
- Centering Gage.** A gage to fix the middle point of an axle.
- Centrifugal Dirt Collector.** A device connected in the branch pipe between the brake pipe and distributing valve, or triple valve, and so constructed that due to the combined action of centrifugal force and gravity, all dirt and foreign material is automatically eliminated from the air flowing through the collector chamber and by means of a plug may be removed without breaking any pipe connections whatever. When this device is used, the brake pipe air strainer is omitted.
- Chafing Plate.** A removable metal plate to resist wear, used on truck transoms, pedestal jaws, and other places where wear concentrates.
- Chair.** The usual designation for the seats of parlor cars. Ordinary chairs are used in dining cars. See RECLINING CHAIR, PARLOR CAR CHAIR.

As its name implies, the resilience of the rubber draft gear is provided by blocks or rubber set between steel plates.

For further draft gear details see Section 10.

Draft Gear Attachments. The parts which connect the Coupler and the Draft Gear.

Draft Gear Carrier. A plate which extends underneath the draft sills and supports the draft gear.

Draft Gear Cheek Casting. See DRAFT CASTING.

Draft Gear Followers. See FOLLOWERS.

Draft Gear Pocket. The space occupied by the draft gear and followers in the center or draft sills. Manual M-901.

Draft Gear Yoke. See YOKE.

Draft Key. A key used to connect the coupler shank to the yoke. It is extended to pass through key slots in the draft sills and front draft lugs. Section 10.

Draft Key Retainer. A pin inserted at one end of the draft key to prevent it from backing out through the slot in the center sills. The pin has an elongated head to provide a larger wearing surface against the sill.

Draft Lug Angle. An angle riveted to the bottom of the center sill at the draft gear, to which the lower part of the draft lug is fastened.

Draft Plate. See DRAFT LUG.

Draft Sill. Same as CENTER SILL.

Draft Sill Tie Plate. A plate riveted to the draft sills to aid in holding them rigid.

Draft Spring. A spring attached to a coupler or drawbar to give elasticity. They are so arranged by means of follower plates at each end as to resist either tension or compression.

Drain Cock. See RESERVOIR DRAIN COCK.

Drain Cup (Air Brake). A globular receptacle under a triple valve to collect the water of condensation.

(Refrigerators and Ice Cars.) A metal cup through which the drippings from the ice pass, but which is so arranged as to prevent the entrance of air to the car.

Drain Valve (Car Heating). A valve for draining off the water condensed in the steam pipes where an automatic trap is not used.

Drapes. Heavy cloth hung at windows instead of roller curtains. They are usually supported on rods to adjust the closure. Also used in door ways to smoking and reclining rooms.

Draw Head. The head of an A. A. R. automatic coupler, exclusive of the knuckle, knuckle pin and lock.

Drawbar. A term formerly used synonymously with Coupler. It has been used indiscriminately to designate both the old link and pin drawbar and the modern automatic car coupler. There has been in the past an effort to confine the name drawbar to the old link and pin type, but in the proceedings of the M. C. B. Association, now A. A. R., in speaking of the height of drawbars, the term is applied to the standard automatic coupler. See COUPLER.

Drawbar Safety Lug. See COUPLER HORN.

Drawbar Stop. See DRAFT CASTING.

Drawing Room. A small room or compartment in a sleeping or drawing-room car. Usually fitted with double berths, a sofa or lounge and private toilet facilities. See STATEROOM.

Drinking Cup Vendor. A device for holding and supplying drinking cups.

Drip Coupling or Basin Coupling (Wash Basin). The connection of the waste pipe or drip pipe with the basin.

Drip Pan (Refrigerator Car). A dish or pan at one corner or end of the car for receiving the water from the melting ice, usually permitting it to escape to the roadbed through a trap.

Drop Bottom. See DROP DOOR.

Drop Bottom Car. A gondola car with a level floor or bottom, equipped with a number of drop doors, for discharging the load. See also HOPPER BOTTOM GONDOLA CAR.

Drop Brake Shaft. A brake shaft for flat cars which is normally in a vertical position, but can be dropped to a horizontal position and still remain operative should conditions of lading require this to be done.

Drop Door. A door at the bottom of a drop bottom or hopper gondola car for unloading it quickly by allowing the load to fall through the opening. Drop doors are usually in pairs, and are supported by a chain wound upon a winding shaft; or by a lever arrangement. Frequently a drop door beam extends across the car above the winding shaft to assist in supporting it and to stiffen the car.

Drop Door Chain. A chain attached to a drop door, and usually connecting it with a winding shaft, for the purpose of controlling the door. Also sometimes termed Hopper Chain.

Drop Door Chain Ring. An iron ring to which are fastened the single chain passing around the door winding shaft and the two chains which are attached to eye bolts in each of the double drop doors.

Drop Door Eye Bolt. An iron bolt with an eye in the upper end which is fastened to a drop door near the edge away from the hinge and to which is secured the drop door chain.

Drop Door Gear. See DOOR OPERATING GEAR.

Drop End. Used on many gondola cars. The entire end is arranged to swing down at right angles to its normal position, for loading long materials.

Drop End Gondola Car. A gondola car with the ends in the form of doors, which can be dropped when the car is used for shipping long material which extends over more than one car.

Drop Forging. One made by the use of dies, under a drop hammer.

Drop Suspension (Electric Lighting). A drop or bent frame attached to the truck frame. The belt or chain is adjusted by sliding the generator along on the frame and this arrangement is called the sliding-type suspension. See SUSPENSION.

Drop Table. A table hinged to the wall so as to drop against it out of the way when desired.

Drovers' Car. A car similar to a caboose except that a drovers' car is equipped with bunks for the accommodation of stockmen and drovers who accompany a train carrying a shipment of livestock. The car is attached to a stock train.

Drum. (Hoisting Gear.) The main cylinder upon which the hoisting rope winds and unwinds. The spur wheel is carried on the same shaft.

Drum Shaft (of a Derrick or Crane). The shaft on which the winding drum is carried.

Dry Closet. A closet, so called in distinction from a water closet, which is not flushed with water.

Dummy End (Passenger Equipment). See BLIND-END CAR.

To overcome contact friction, rollers, and rockers are used in many different ways. If the portion containing the anti-friction member is fastened to the truck bolster, it is known as a truck side bearing; if fastened to the body bolster, it is considered a body side bearing.

Other types of side bearings employ springs and friction elements to maintain constant contact and control relative movement between car body and truck.

Side Bearing Arch or Bridge (Six-Wheel Truck). A truss attached to the bolsters to support the truck side bearing.

Side Bearing Brace. A filler block between the body bolster diaphragms that supports the side bearing.

Side Bearing Truck. A truck in which the weight of the car is transmitted at the side instead of the center. The term balanced side bearing truck is also used to indicate that the car body is so balanced on the truck that the weight is equally distributed to all the wheels at all times. Not commonly used.

Side Brace. Commonly designated as body brace or brace, except when the end braces are to be distinguished from them.

Side Casting. See DRAFT LUG.

Side Deck Lamp. A bracket lamp fastened above the windows and to the deck sill, or to the lower deck ceiling and the deck post.

Side Door. Designated thus to distinguish from end door on both freight and passenger equipment.

Side Door Bottom Guide. An iron bracket attached to the side of freight cars having sliding doors to guide the door while it is being opened and shut and also to prevent its swinging away from the car at the bottom.

Side Door Fixtures. See Section 3.

Side Door Hanger. See DOOR HANGER.

Side Door Protection Strip. See PROTECTION STRIP.

Side Door Top Track. See DOOR TRACK.

Side Dump Car. A car so constructed that its contents may be discharged to either side or both sides of the track through doors in the car sides, or drop doors in the floor; by means of an inclined floor and side doors; or by tipping the car body sidewise. See also DUMP CAR.

Side Eave. A term sometimes used to designate a steel plate running along the eaves or edge of the roof of a steel passenger equipment car.

Side Fascia. See FASCIA.

Side Frame. The frame which forms the side of a car body or a truck. It includes the posts, braces, plate, belt rail, etc., for the car body; and the side member of a truck frame. See TRUCK SIDE FRAME.

Side Furring. See FURRING.

Side Lamp. A lamp attached to the side of a passenger car in distinction from a center lamp, which is attached to the roof. They are usually made with brackets, by which they can be conveniently fastened.

Side Nailing Strip. A piece of wood bolted outside the side sills of steel underframe cars to which the ends of the floor planks and the bottom ends of the sheathing are nailed. See NAILING STRIP.

Side Plate. More properly, simply plate. The longitudinal member connecting the tops of the side posts of the car body. So called as distinguished from the end plate.

Side Plate Stiffening Angle (Steel Cars). An angle iron riveted to the side plate, and serving the same purpose as the stakes. Often called stake.

Side Plate Tie Rod. A rod extending across the top of the car and tying the side plates together.

Side Post. Vertical member used in the side framing of freight and passenger cars.

Side Rail. A longitudinal member extending along the top of the side frame of a coal or ore car. It rests upon posts and braces and connects with end rails, which go across the end of the car. It corresponds to the plate of a box car, but does not carry any carlines, as does a plate.

Side Seat. A longitudinal car seat, the back of which is against the side of a car.

Side Sheet. A plate used for closing in the sides of a steel car.

Side Sill. The outside longitudinal members of the underframe. In some designs of steel cars the side sills are dispensed with and the entire side of the car is designed as a deep plate girder to carry most of the load to the bolster.

Side Sill Step. See SILL STEP and Section 14.

Side Slope. That part of the floor which slopes from the side of a hopper to the hopper door. See HOPPER SLOPE SHEET.

Side Stake. See STAKE.

Side Stake Pocket. See STAKE POCKET.

Side Stem. A bar attached to the side of a three-stem coupler to transmit part of the force to springs separate from the regular draft springs. See THREE-STEM PLATFORM EQUIPMENT.

Side Straps (Wooden Gondola Car). The straps to which the end planks and sometimes also the side planks, are bolted. They are also called side plank tie straps.

Side Strut for Hopper Floor (Hopper Cars). An inclined strut or support for the hopper floor between the bolster and the end of the car, fastened to the corner of the end sill.

Siding. See SHEATHING.

Signal Branch Pipe. A pipe leading from the train air signal pipe to the car discharge valve.

Signal Cord. A rope or sash cord extending along a passenger car wall inside and attached to the air signal discharge valve; a pull on the cord releases the air in the signal pipe and blows the signal in the cab.

Signal Cord Bushing. A thimble lining a hole through a partition for a signal cord to pass through, in distinction from a signal cord guide, which is attached to the side or roof of the car or to the signal cord hanger.

Signal Cord Guide. A metal eye or ring attached to the roof or ceiling of a car, or to the end of a Signal Cord Hanger, and by which a signal cord is carried or conducted. See also SIGNAL CORD BUSHING.

Signal Cord Splice. A metal coupling with right and left hand screws for permanently splicing the ends of a broken cord. See also SIGNAL CORD COUPLING.

Signal Hose. An air hose similar to, but of smaller diameter than, an air brake hose, and used between cars to connect the train air signal lines.

Signal Lamp. See MARKER.

Signal Lamp Bracket. See MARKER BRACKET.

Signal Lamp Socket. See MARKER BRACKET.

- called the brake step, is also sometimes used. A bracket called a tank step is attached to the tanks of tank cars.
- Step Box.** A portable box-shaped step, for use between the bottom passenger car step and a low station platform.
- Step Hanger.** A vertical board or metal plate by which the steps are supported from the corner of a car and from the platform end sill.
- Step Nosing.** A metallic facing or molding for the tread of stair steps.
- Step Riser.** The vertical portion of a step in stairs.
- Step Treads.** See SAFETY TREAD and TREAD.
- Steps, Folding.** On many streamlined passenger cars the vestibule steps are hinged to fold up when closed, forming a smooth outline.
- Stile.** The upright pieces on the outer edge of a door or sash, as door stile, sash stile, window stile, etc.
- Stirrup.** A kind of ring or bent bar of iron resembling somewhat the stirrup of a saddle. A coupler carry iron is sometimes called a stirrup.
- Stock Car.** A car for the transportation of live stock, equipped with roof, slatted sides and side doors, single or double deck and frequently with feed and water troughs.
- Stop Bar (Sleeping Car).** A bar to connect the two seats on which the seat bottoms may rest when drawn down to make up a lower berth. It rests upon a stop bar plate.
- Stop Bar Guide.** An attachment to hold a stop bar in place laterally.
- Stop Cock.** A simple form of cock having a body and tapered plug which has an opening through it. When the plug is turned so that the holes in it correspond to the ports in the body the liquid flowing in the pipe can pass through the cock. When the plug is turned so that the openings do not correspond, the flow is stopped.
- Stop-Key Journal Bearing.** A key or wedge with a lug or projection which bears against the end of the axle to restrain lateral motion and thus dispense with a collar on the axle. Not in general use.
- Storage Battery.** A storage battery consists of a number of metallic plates, separated by suitable insulators, immersed in an electrolyte within a proper container. Its function is to convert electrical energy into chemical energy during the operation known as charging and the reverse when discharging. When charging, the terminals are properly connected to a source of electrical supply, usually a direct-current generator driven from the car axle or by an independent engine. Storage batteries are used to supply current for car lighting and air conditioning in passenger train cars and are carried in battery boxes suspended from the underframe.
- Storage Battery Car.** A motor car driven from storage batteries.
- Stove Pipe Jack.** A covering or bonnet for the aperture of a stove pipe on the outside of a car. Practically obsolete except on cabooses and work cars.
- Strap Bolt or Lug Bolt.** A round bolt with a flat bar of iron or steel welded to it, and usually with a hook on the end which serves the purpose of a head. The flat bar has holes in it, by which it can be fastened in place with rivets, bolts, or screws.
- Strap Washer.** An iron or steel strap which takes the heads of several bolts. Also called washer plate.
- Streamline.** The general term given to the type of construction which provides a smooth continuous outer surface on passenger cars. By rounding both ends of a train equipped with such cars, head-on air resistance and air drag are reduced.
- Street Ell.** An elbow pipe fitting with male thread on one end and female thread on other end.
- Striker.** See STRIKING PLATE.
- Striker Arm.** A seat arm. The terms striker arm, seat back arm and seat arm are commonly used.
- Striking Horn.** The stop shoulder, or horn of a coupler, arranged to touch the striking plate before the draft gear goes solid.
- Striking Plate.** A member placed on the ends of the center sills of freight cars against which the horn of the coupler strikes, preventing damage to the draft gear and center sills.
- String Board (Passenger Car Steps).** A vertical plate which supports the ends of the steps. A step hanger.
- Stringer.** A term sometimes applied to a floor nailing strip or a steel member which acts as a support for a nailing strip. A longitudinal floor stringer sometimes occupies a position similar to that of an intermediate sill but is not designed to perform its duties. See NAILING STRIP.
- Stringer Pocket.** A casting for supporting the end of a beam or stringer. In automobile and similar cars, for facilitating the use of a second or upper deck for increasing the loading capacity for small freight.
- Strut (Truss).** A member subjected to a strain of compression. A vertical strut is usually called a post. See also BRAKE BEAM STRUT.
- Stud.** A headless bolt, threaded on both ends. A standing bolt, pin, boss or protuberance designed to hold an attached object in place. Especially a headless bolt permanently screwed into a tapped hole in a casting or forging.
- Sub-Carline (Refrigerator Car).** A strip of wood under the main carline, supporting the sub-roof. See CARLINE.
- Sub-Floor (Refrigerator Car).** A layer of flooring boards under the main floor, and usually separated from it by an air space and hair felt or some other form of special insulation.
- Sub-Roof (Refrigerator Car).** The inside layer of boards of the roof proper, supported on sub-carlines.
- Sub-Sill.** A sill attached under another sill to reinforce it.
- Subway Car.** An electric motor car for use in subways in large cities.
- Sugar Cane Car.** See CANE CAR.
- Supply Pipe (Air Compressor).** A pipe sometimes connected to the air inlet of an air compressor by means of which the air supply is drawn from a point some distance away from the compressor. (Lavatory Fittings.) Pipes which carry hot or cold water to the basin faucets.
- Supply Valve (Steam Heating).** A valve for regulating the supply of steam in the radiator pipes of a car.
- Suspension (Motor Car).** The method of supporting a railway motor. Except in the case of gearless motors, the suspension is designed to put as little dead weight as possible on the axle. (Electric Lighting.) The iron work and fittings which are attached to the body or truck for supporting or suspending the axle generator and which include the belt tightening and aligning devices. The

Trap Door Latch (Vestibule). The latch for the vestibule trap door.

Trap Door Lock. See TRAP DOOR LATCH.

Traversing Jack. A jack that can be moved horizontally on a bed or track while under its load. See JACK.

Tread (of a Step). The part on which the foot is placed. See TREAD BOARD and SAFETY TREAD.

(Of a Car Wheel.) The exterior cylindrical surface of a car wheel next to the flange which comes in contact with the rail.

Tread Board (of a Step). The horizontal part on which the foot is placed. Usually covered with rubber or metal safety treads to prevent slipping. See TREAD and SAFETY TREAD.

Triple Valve (Air Brake). A device which automatically performs three functions in operating the air brakes on older freight cars. It charges the auxiliary reservoir, applies the brakes and releases the brakes according to the varying pressures in the train line. Now being superseded by AB equipment.

Triple Valve Branch Pipe (Air Brake). A short pipe by which the triple valve is connected with the brake pipe.

Triple Valve Gasket. A gasket placed in the joint between the triple valve and the passenger brake cylinder or freight car auxiliary reservoir.

Triple Valve Piston (Air Brake). See TRIPLE VALVE.

Trolley. See PANTAGRAPH TROLLEY.

Truck. The general term covering the assembly of parts comprising the structures which support a car body at each end (or, in the case of articulated cars, the joint support of two abutting car ends) and also provide for attachment of wheels and axles.

Truck Bolster. A cross member in the center of a truck, on which the car body rests. The truck bolster is connected to the body bolster by a center pin, which passes through both.

Truck Bolster Guide. A small projection at the ends of a truck bolster that engages the vertical member of the truck frame preventing spreading of the latter.

Truck Bolster Guide Bar. See BOLSTER GUIDE BAR.

Truck Car. A car used in a wreck train for carrying spare trucks. See WRECK TRAIN EQUIPMENT.

Truck Center Plate. See CENTER PLATE.

Truck Frame. A structure made of cast steel in one piece, to which the journal boxes or pedestals, springs and other parts are attached, and which forms the skeleton of a truck. See TRUCK SIDE FRAME.

Truck Lever. That part of the foundation brake rigging which applies the power of the brake cylinder at the brake beams. On freight car trucks there is a live lever and a dead lever collectively known as truck levers. On passenger cars truck levers assume various positions according to the type of brake rigging used.

Truck Lever Connection. A rod or bar connecting the brake levers on the truck brake gear.

Truck Side Bearing. A device attached to the top of the truck bolster and having an upper bearing surface which comes in contact with a similar bearing surface fastened to the underside of the body bolster. See SIDE BEARING.

Truck Side Frame. The longitudinal portion of a truck structure, on the outside of the wheels, which extends from one axle to the other, and to which the journal boxes and bolsters or transoms are attached or form a part.

Truck Springs. The springs that carry the weight of the car body and its load to the running gear or trucks. On freight cars the truck springs are generally of the helical type placed in groups between the bolster and bottom chord of the truck frame. Helical springs are used on passenger car trucks both as equalizer springs and sometimes at the bolster. On some cars helical springs are placed directly over the journal box, the truck frame resting upon them. Elliptical springs are made in groups for use on passenger car bolsters and occasionally semi-elliptic springs are employed in different types of trucks. See SPRING, ELLIPTIC, HELICAL AND VOLUTE.

Trunnion. A cylindrical projection on the side of any part that allows a turning or oscillating movement.

Truss. An engineering term applied to certain types of built-up load-carrying structures so designed that the individual members comprising together the complete unit are subject only to compression or tension loads.

Truss Rod. A rod or set of rods usually placed beneath the sills of wooden cars to carry the tension stress of a truss.

Tufting Button. A button used in upholstery to hold the cord which passes through the upper covering of the upholstered surface, dividing it into squares or diamonds.

Tumbler (Lock). A latch engaging with a notch in a lock bolt, or otherwise opposing its motion until it is lifted or arranged by the key so as to remove the obstacle.

Tup. See HAMMER.

Turbo-Generator. A steam turbine direct-connected to a generator for furnishing electric current. The turbo-generator receives steam from the locomotive.

Turnbuckle. An elongated sleeve with a right and left hand thread at either end for the purpose of tightening two rods together.

Turn Over Seat. See REVERSIBLE CAR SEAT.

Turtle Back Roof. See ARCHED ROOF.

Twin Car Seat. A seat stand with a division arm, two cushions and two seat backs with two striker arms each, so that they may be turned to bring the occupants face to face. See RECLINING CHAIR.

U

U-Bolt. A double bolt made of a bar of steel or iron bent to the shape of the letter U, with a screw thread on each end.

U-Bolt Casting. A casting so shaped that a U-bolt can fit around it to form a bearing or carrier for a pin or bolt.

U C Brake Equipment. A standard brake equipment for general passenger train service. The principal units include a Universal Valve used with three reservoirs, Auxiliary, Service, and Emergency, also one brake cylinder for both service and emergency applications, except in the cases of very heavy cars which require the use of two cylinders.

Uncoupling Lever or Uncoupling Rod. A rod with a bent handle forming a lever, usually attached to the end sill, by which the lock of the automatic coupler is opened and the cars uncoupled without going between them. The lever proper is the part attached to the rod and operating the unlocking mechanism, but in the case of freight cars the lever and rod are generally made in one piece. The short lever which is directly connected to a passenger

- Vestibule Lamp.** A lamp used for lighting a car vestibule.
- Volt.** The basic unit of electric potential, pressure, or electro-motive force. The International Volt is the potential difference required to maintain a steady current of one ampere in a circuit whose resistance is one ohm.
- Voltmeter.** An instrument for measuring the voltage of electric currents.
- Volute Spring.** A spring made of flat metal wound in a spiral scroll. Used for in certain types of friction bolster springs and for buffer springs on foreign cars.

W

- Wagon.** British for Freight Car.
- Wainscoting.** The lining for interior walls of a passenger car body. Term applies especially when paneling and relatively elaborate workmanship are employed.
- Wainscot Panel (Passenger Car Interior).** A panel under the windows between the two wainscot rails.
- Wainscot Rails (Passenger Car Interior).** Longitudinal strips extending from one end of the car to the other, used in connection with wainscoting. The wainscot end rails are the wainscot rails at the end of the car.
- Walkover Seat.** A term used to designate a type of car seats in which the back does not turn over when the seat is reversed. Also called GLIDEVER, PUSH-OVER and SLIDEVER.
- Wall Lamp.** A lamp to fit in a recess in the wall of a car or corridor.
- Wall Seat End.** The seat end next to the wall or side of a car, so called in distinction from the aisle seat end.
- Wardrobe (Postal Car).** See POSTAL CARS.
- Wards (Lock).** The interior circular ridges which fit into corresponding recesses in the bit of a key (the latter also termed wards), the surrounding solid parts of the bit being called the web.
- Washer.** A plate of metal or other material, usually annular, which is placed under a nut or bolt head to give it a better bearing. Washers in car work generally take their name from that of the bolt or rod to which they are attached.
- Washer Plate.** See STRAP WASHER.
- Washstand.** A basin or lavatory installed as a permanent fixture for cleaning purposes. Equipped with water supply and outlet. On some types of cars the washstands are made to fold up out of the way when not in use.
- Waste.** Threads of wool or cotton or mixtures of these into which is incorporated mechanically curled vegetable fiber, often cocoanut fiber, to impart to the product an elasticity not possessed by wool or cotton threads. The material is saturated with lubricating oil and placed in a journal box so that it comes in contact with the lower half of the journal. Sometimes called packing or dope. Various special compositions have been developed, sometimes with springs inserted in the mass to impart greater resiliency. Manual, A-905.
- Waste Cock.** A cock for drawing off water from a tank or basin. (Baker Heaters.) A cock attached to the expansion drum or circulating drum of the Baker heater for drawing off or changing the water in the heater pipes.
- Wastometer.** A device for flushing water closets.
- Water Alcove.** A recess in the side of a partition of a passenger car to receive the faucet of a water cooler or water pipe and a drinking cup.
- Water Circulation Heating System.** See HOT WATER CIRCULATION HEATING SYSTEM.
- Water Cooler.** A tank or vessel for carrying drinking water, which is cooled by electric refrigeration or with ice. The sides are generally made double, and the space between filled with some non-conducting substance. See WATER ALCOVE, WATER TANK.
- Water Drip.** A pan or receptacle to receive the waste water from a water cooler. A drip pipe, or waste pipe, is connected to it.
- A slight projection or raised seam in the roof of a passenger or baggage car over the side doors, or at the end of the car in the platform roof to divert the water so it will not fall upon persons entering the car or passing from one car to the next.
- Water Gage.** See GLASS WATER GAGE.
- Water Mixing Valve.** A device for mixing hot and cold water in a lavatory.
- Water Seal.** See TRAP.
- Water Supply.** The system of water supply used in coaches and Pullman cars is under air pressure. The system provides for forcing water into the wash bowls by air pressure taken from the air brake system. Hot water is usually heated by using live steam from the locomotive.
- Water Tank.** A vessel or reservoir for holding water. Those used on cars for drinking water are usually made of sheet iron, and often extend to the roof. They are then usually drawn from by a water alcove, the tank usually being in the corner and concealed from the interior of the car. Water used in dining car kitchens is usually carried in overhead tanks.
- For size and arrangement of water tank in postal cars, see POSTAL CARS.
- Watt.** The unit commonly used in measuring electric power. The International Watt represents the power expended by an electric current of one International Ampere flowing through a resistance of one International Ohm. In d. c. electrical calculations the product of voltage multiplied by amperage equals the number of watts. One watt equals $\frac{1}{746}$ th of one horsepower or conversely, one horsepower equals 746 watts. Also see AMPERE, OHM, OHM'S LAW, and VOLT.
- Wattmeter.** An instrument for measuring electric power directly in watts. See WATT.
- Waved Moldings.** Moldings which by a special machine are made of a corrugated section longitudinally.
- Way Car.** See CABOOSE.
- Wear Plate.** A plate placed between two moving surfaces to withstand frictional wear.
- Weather Strips.** A strip for application around the crevices of windows or doors, for excluding the dust and wind, and for preventing water from entering around the windows.
- Web.** A term applied to the center portion of a beam, as an I-beam, which ties the flanges together.
- Web Filler.** See BODY BOLSTER FILLER.
- Webbing.** A strong fabric, made of hemp or other material which is not likely to stretch, used in upholstering car seats.

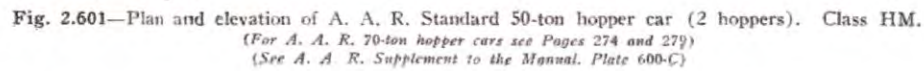


Fig. 2.601—Plan and elevation of A. A. R. Standard 50-ton hopper car (2 hoppers). Class HM.
(For A. A. R. 70-ton hopper cars see Pages 274 and 279)
(See A. A. R. Supplement to the Manual, Plate 600-C)

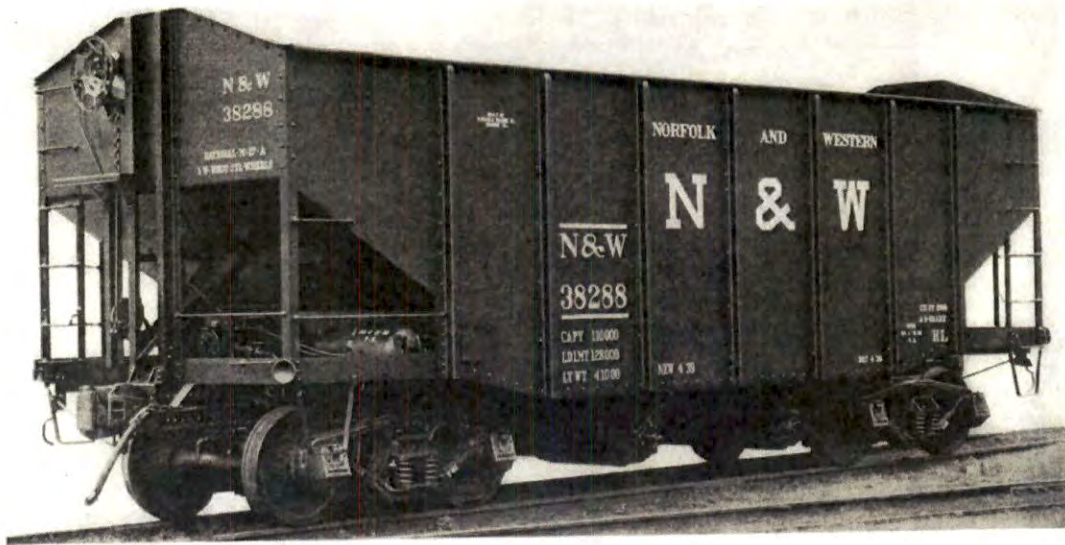


Fig. 2.605—Norfolk & Western 55-ton hopper car, Road Class HL, A. A. R. Class HM. Road Numbers 22,000-25,999; 38,000-39,999; 56,500-59,999; 67,000-69,999
(See also Figs. 2.604-2.607)

DIMENSIONS AND WEIGHTS—N. & W. CLASS HL HOPPER CAR

Length over striking plates.....	32 ft. 4 in.	Inside width	9 ft. 9 $\frac{3}{4}$ in.
Coupled length	34 ft. 10 in.	Cubical capacity, level full.....	1,998 cu. ft.
Truck centers	21 ft. 4 in.	Cubical cap., with 30 deg. heap.....	2,429 cu. ft.
Truck wheel base.....	5 ft. 6 in.	Weight of empty car (average).....	41,200 lb.
Axle journals	5 $\frac{1}{2}$ in. x 10 in.	Load limit (average).....	127,800 lb.
Inside length	31 ft. 0 in.	Weight of one truck.....	7,200 lb.
		Height from rail to top car side.....	11 ft. 0 in.

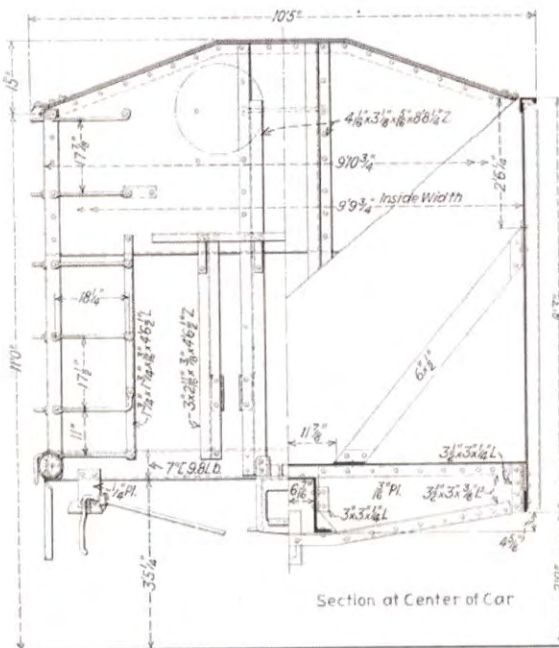
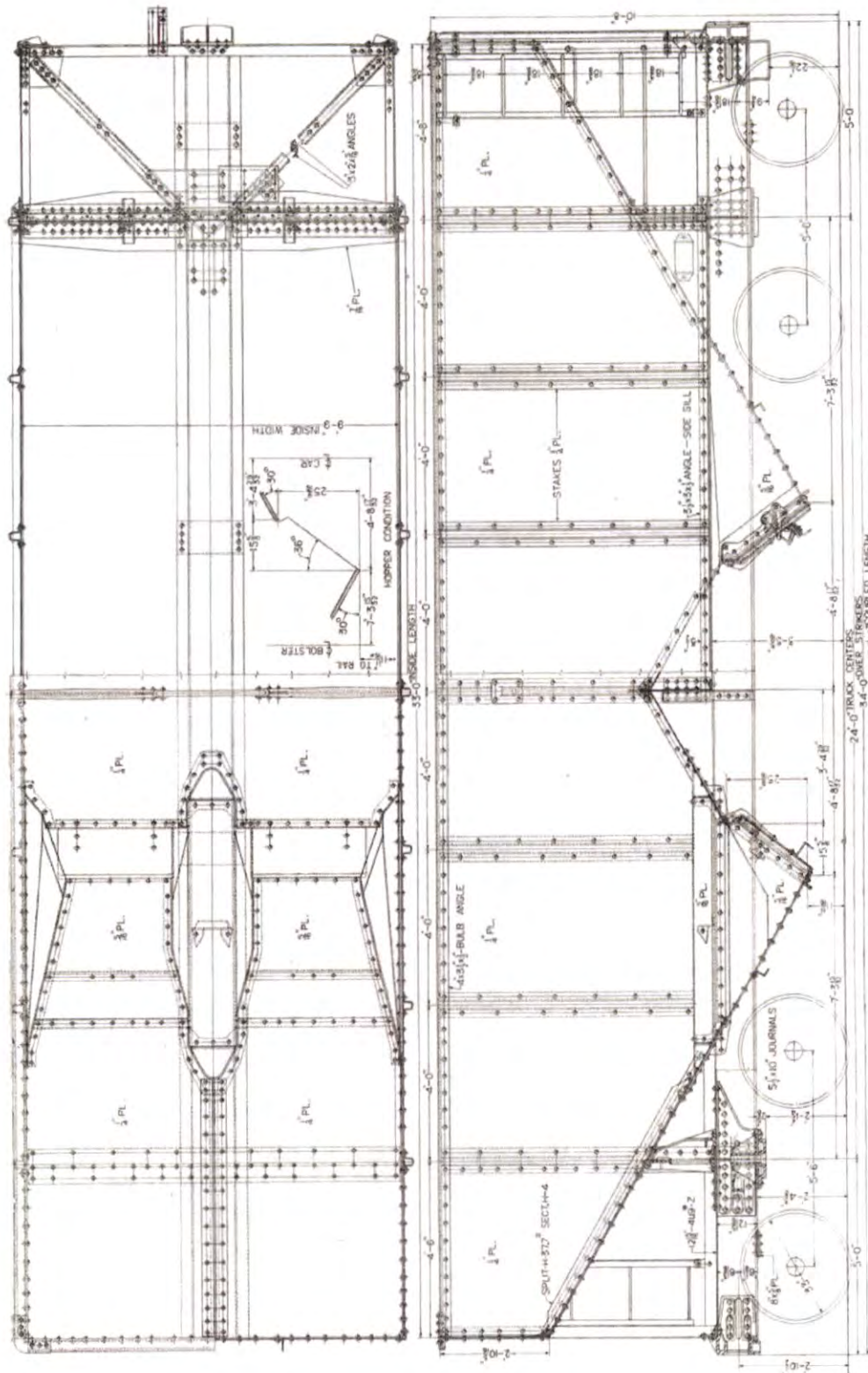


Fig. 2.606—End view and cross section of Norfolk & Western Class HL hopper car shown on Page 258.



Fig. 2.607—Norfolk & Western 55-ton hopper car, Road Class HL.



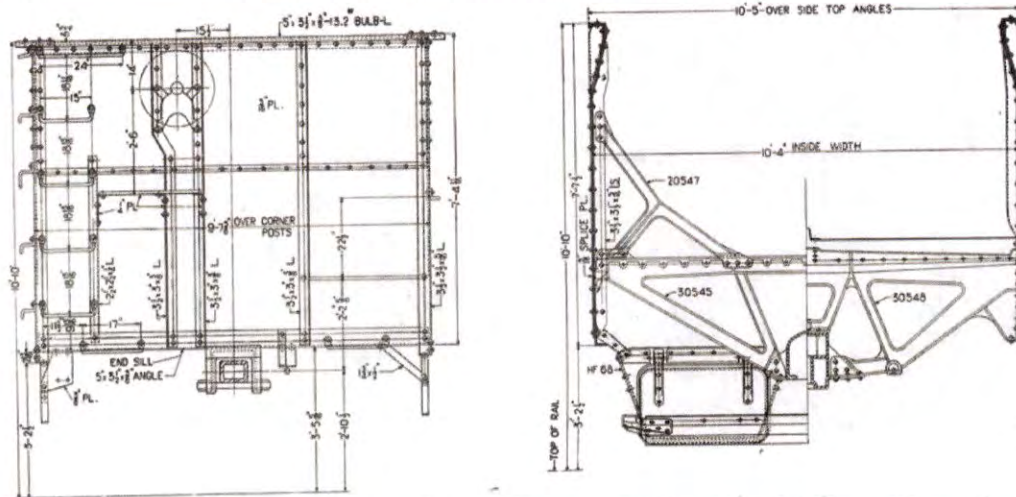


Fig. 2.610—End elevation and half cross-sections at bolster and crossbearer of Unitcast design 60-ton twin hopper car.
(See also Page 260)



Fig. 2.611—Side view of 70-ton hopper car using Unitcast design cast steel body bolsters, crossbearers and hopper frames.

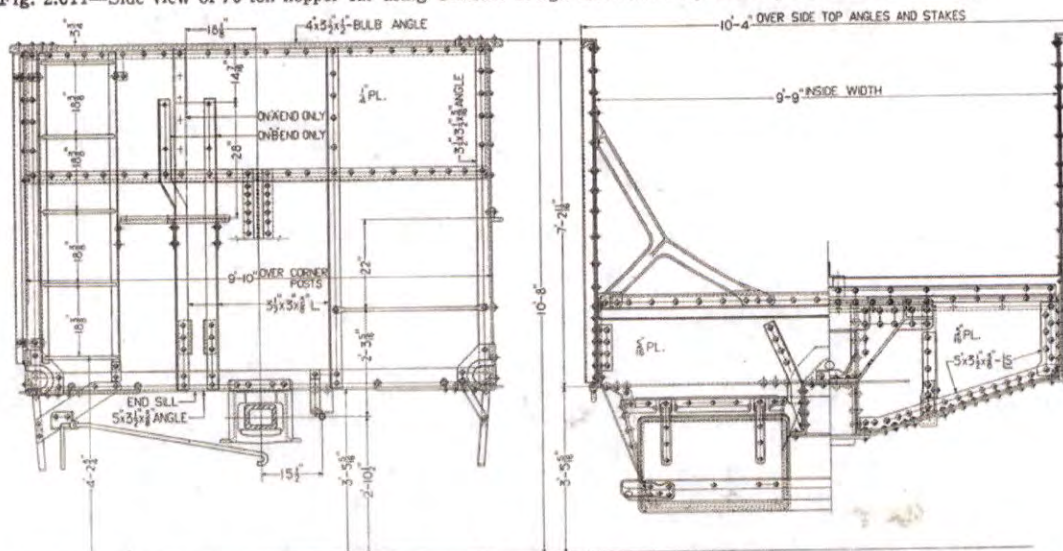


Fig. 2.612—End elevation and half cross-sections of Unitcast design 55-ton twin hopper car incorporating cast steel crossbearer arms, body bolster center, center sill hood ends and hopper frames.
(See also Page 262)

Unitcast Corporation
(See also Pages 260, 261, 262)

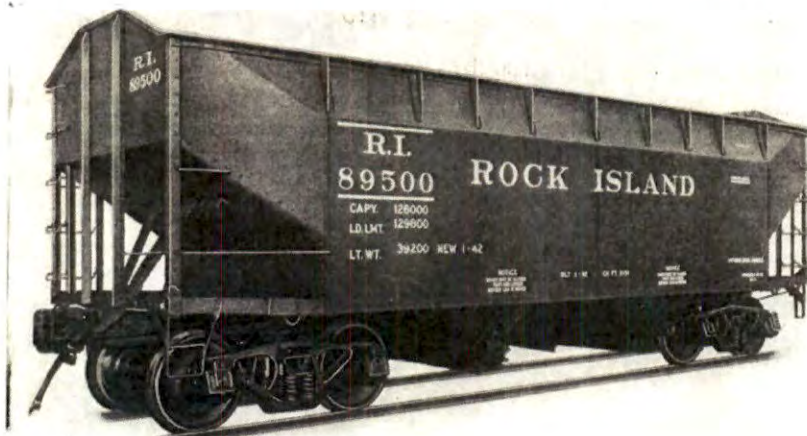


Fig. 2.613—Chicago, Rock Island & Pacific 128,000-lb. capacity twin hopper coal car. Builder, American Car and Foundry Co.

Light weight, 39,200 lb.; load limit, 129,800 lb.; capacity, 2,191 cu. ft.; inside, length 33 ft. 0 in.; width 10 ft. 4 in.; height of sides 10 ft. 8 in.

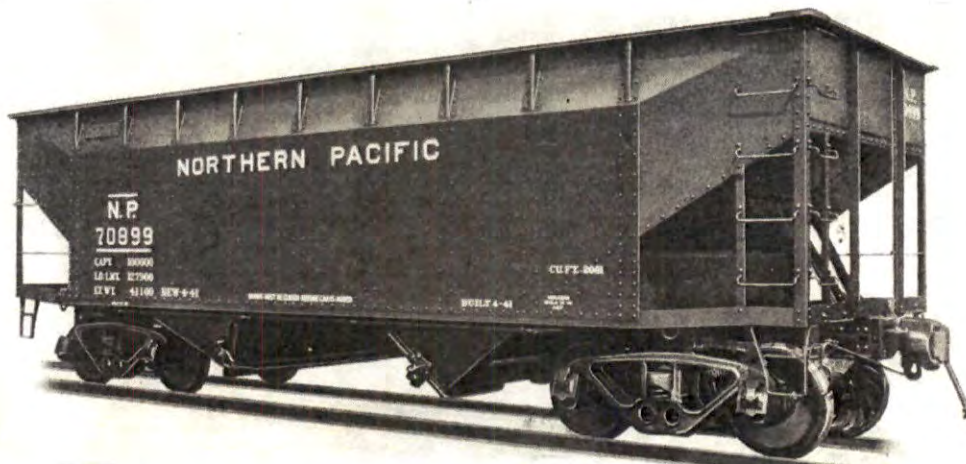


Fig. 2.614—Northern Pacific 50-ton twin hopper coal car. Builder, American Car and Foundry Co. Light weight, 41,100 lb.; load limit, 127,900 lb.; capacity, 2,081 cu. ft.; inside, length 33 ft. 0 in.; width 10 ft. 4 in.; height of sides 10 ft. 5 in.



Fig. 2.615—C. B. & Q. 55-ton aluminum twin hopper coal car. Rebuilt on old steel frame. Built at Havelock shops. Light weight, 36,800 lb.; load limit, 132,200 lb.; capacity, 2,075 cu. ft.; inside, length 34 ft. 3 in.; width 9 ft. 6 in.; height of sides 10 ft. 9 in. Descriptions: *Railway Mechanical Engineer*, Sept. 1944; *Railway Age*, Sept. 9, 1944. (See also Page 267).

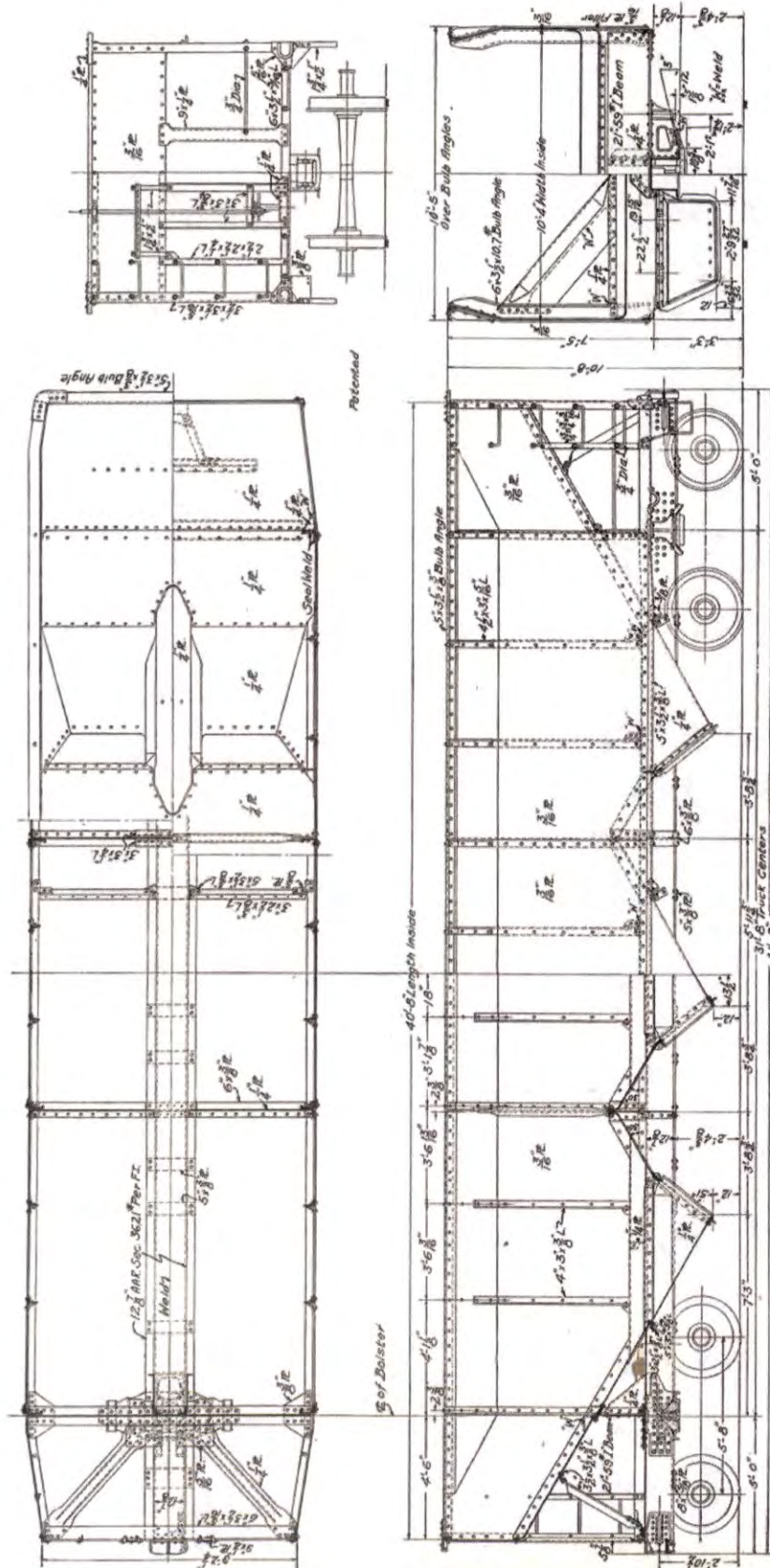


Fig. 2636—75-Ton all-steel 6 in. by 11 in. axle load Triple Hopper Car with Enterprise hoppers and bolster construction. A. A. R. Class HT. Cubic capacity, 2,758 cu. ft. level or 3,147 cu. ft. with 12 in. average heap.

Enterprise Railway Equipment Company
(See also page 257)

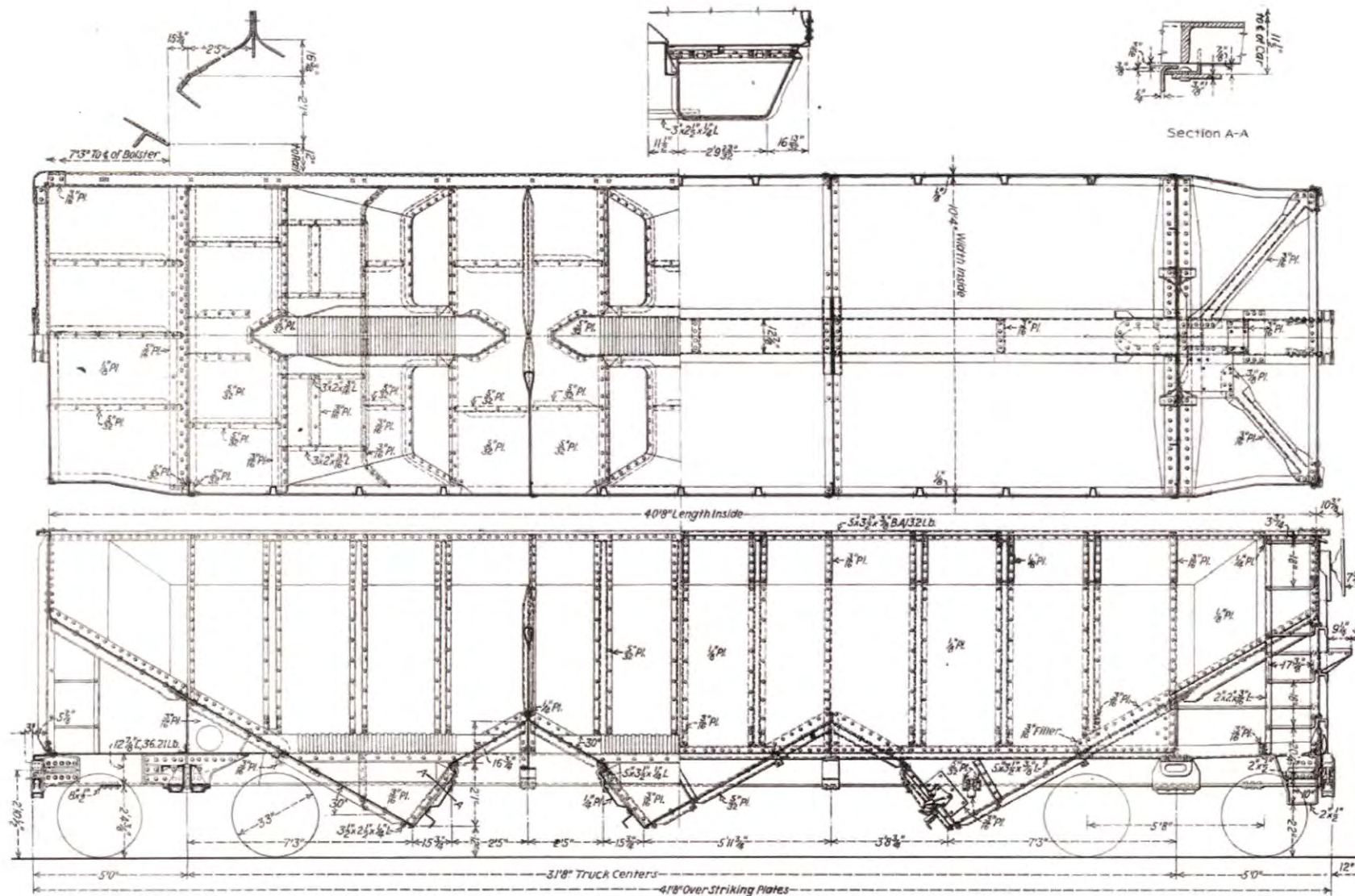


Fig. 2.637—Bessemer & Lake Erie 90-ton triple hopper car, light weight (USS Cor-Ten steel). 6½ in. x 12 in. Journal Axles. Road Class HT17.
(Note—Cars of 70 tons capacity were also built. These differed only in having trucks with 6 in. x 11 in. axles—See Fig. 2.640)
(See also Page 277)

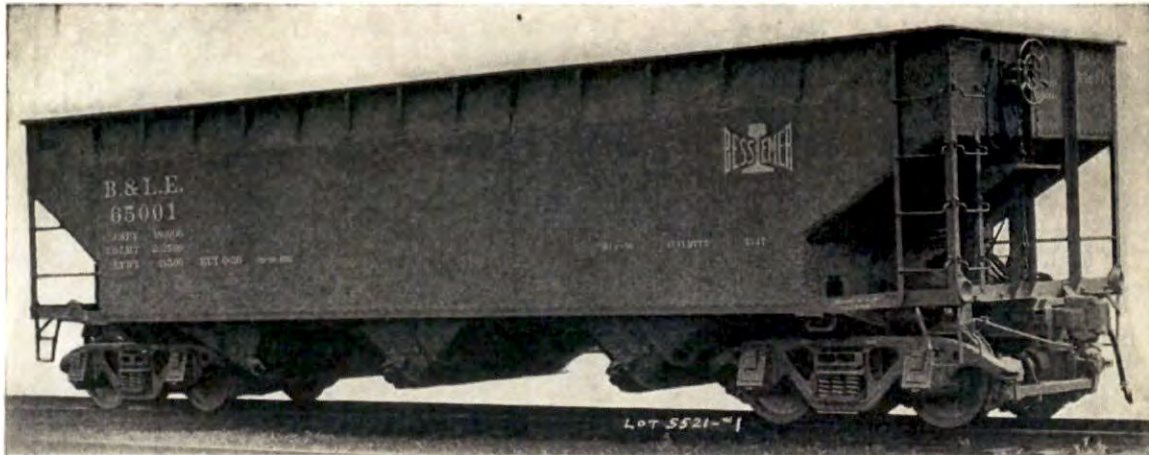


Fig. 2.638—Bessemer & Lake Erie 90-ton light weight hopper car. Built of USS Cor-Ten steel, Road Class HT17.

Light weight, 48,500 lb.; load limit, 202,500 lb.; capacity, 2,775 cu. ft.; axle journals, $6\frac{1}{2}$ in. x 12 in.

Also built in 70-ton capacity with 6 in. x 11 in. journals, Road Class H16. See Fig. 2.642.

NOTE: Earlier 90-ton cars of carbon steel weighed 58,800 lb. with load limit 192,200 lb.

(See also Page 276)

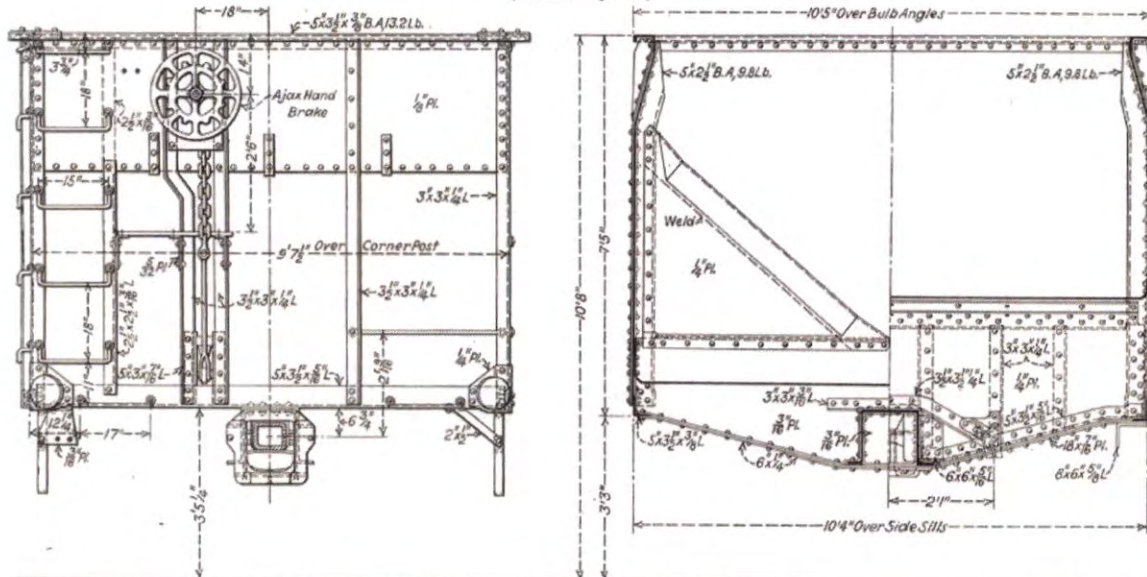
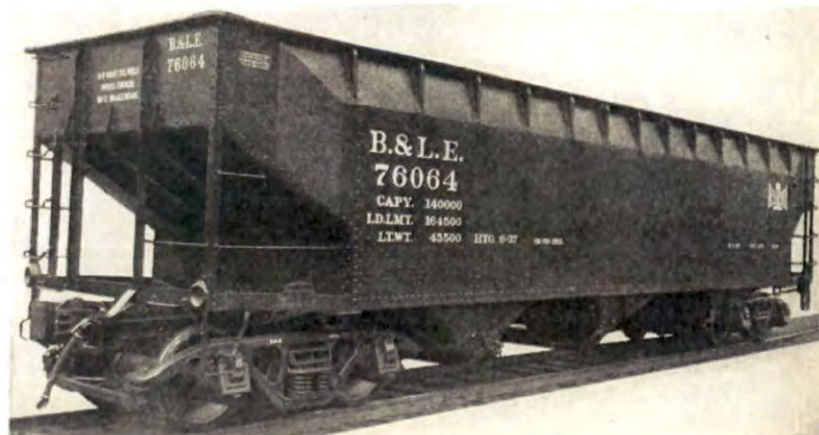


Fig. 2.639—End elevation and cross section of B. & L. E. 70-ton and 90-ton cars shown in Figs. 2.637, 2.638 and 2.640.

Fig. 2.640 — Bessemer & Lake Erie 70-ton light weight hopper cars of USS Cor-Ten steel. Road Class HT16.

Light weight..... 45,500 lb.
Load limit..... 164,500 lb.
Capacity 2,775 cu. ft.



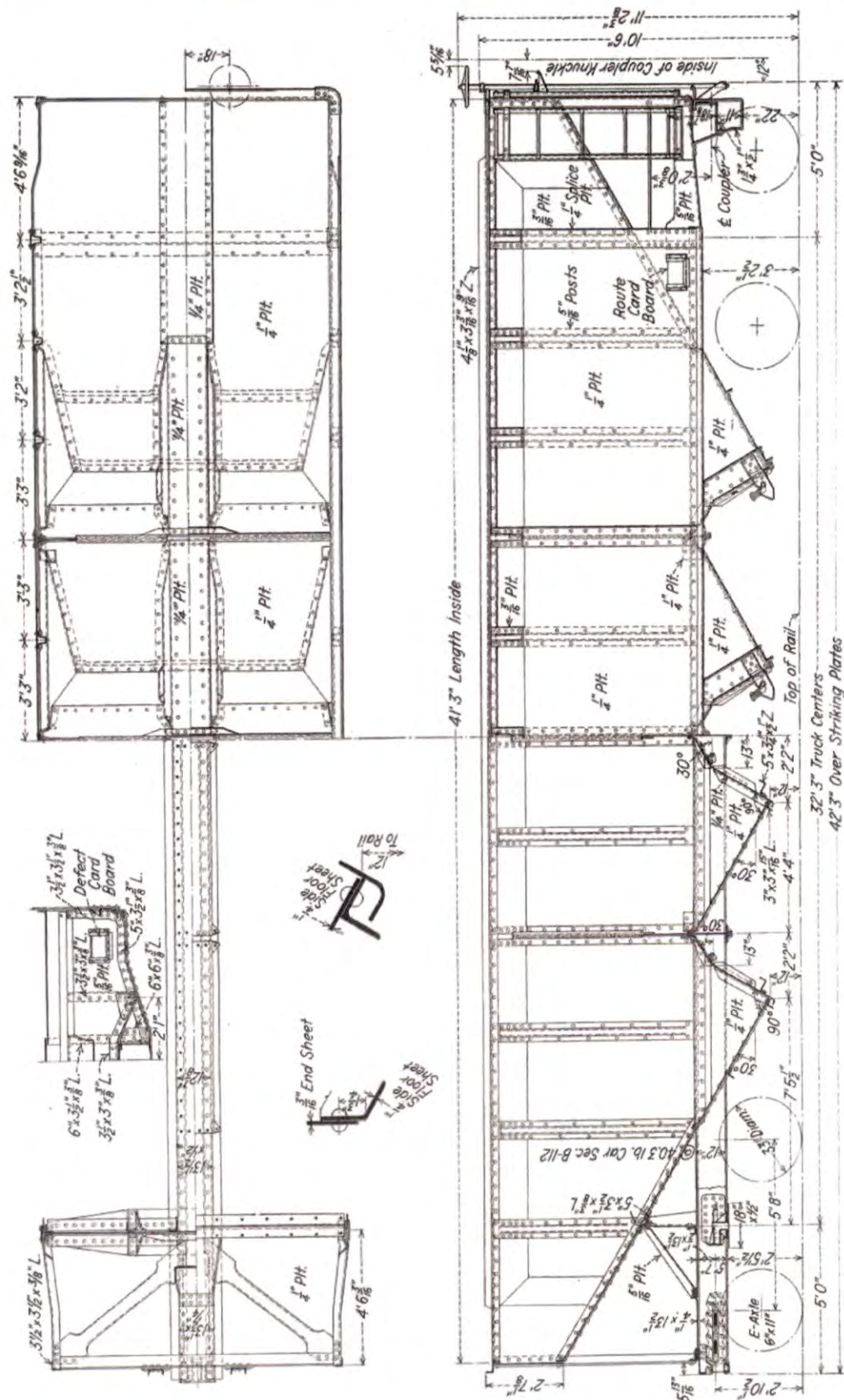


Fig. 2.646—Plan and elevation of Baltimore & Ohio 70-ton capacity quadruple hopper car. Design follows general lines of A. A. R. Recommended Practice Car, Class HT. (See also Page 281)

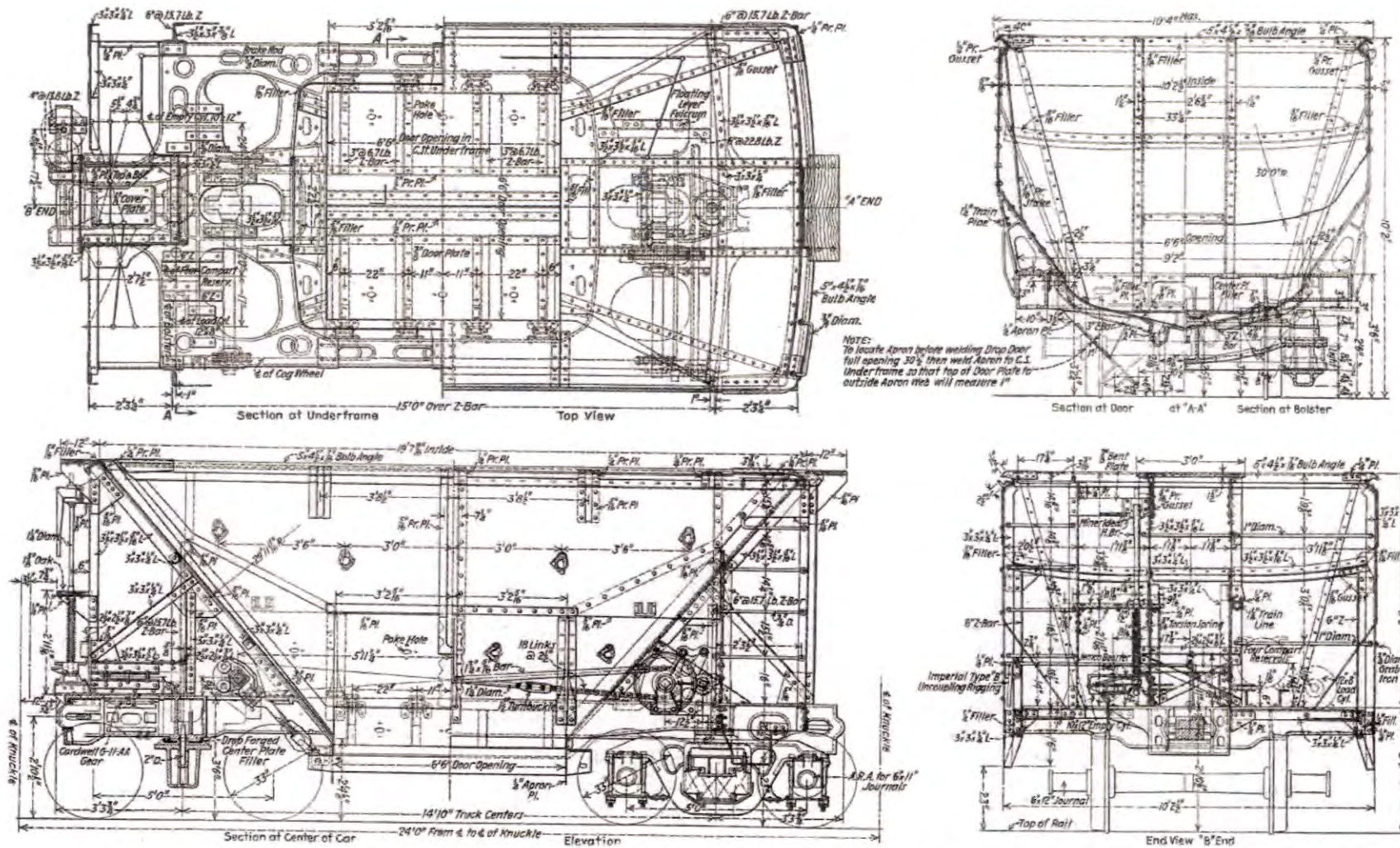


Fig. 2.665—Plan, elevation and sections of Duluth, Missable & Iron Range 80-ton capacity hopper ore car with Commonwealth cast steel underframe. Road Class U-14. Roads Nos. 22,001-22,125; capacity, 935 cu. ft.; light weight, 47,600 lb.; load limit, 162,400 lb. Descriptions: *Railway Age*, Feb. 8, 1928. *Railway Mechanical Engineer*, May 1928 (Later cars have been of fabricated type. See Fig. 2.667) (For ore car door operating mechanism see Sec. 3)



Fig. 2.666—Great Northern 75-ton capacity hopper iron ore car. Series 90,000-92,999. Builder, Bethlehem Steel Company.

A. A. R. Class.....	HMA	Length inside	19 ft. 10 $\frac{3}{4}$ in.
Nominal capacity	150,000 lb.	Width inside	10 ft. 5 $\frac{1}{2}$ in.
Load limit	167,500 lb.	Coupled length	24 ft. 0 in.
Cubic capacity, level	1,262 cu. ft.	Length over strikers	21 ft. 5 $\frac{3}{4}$ in.
Light weight	42,500 lb.	Width outside	10 ft. 6 in.
Axle journals	6 in. x 11 in.	Height of sides	10 ft. 2 in.

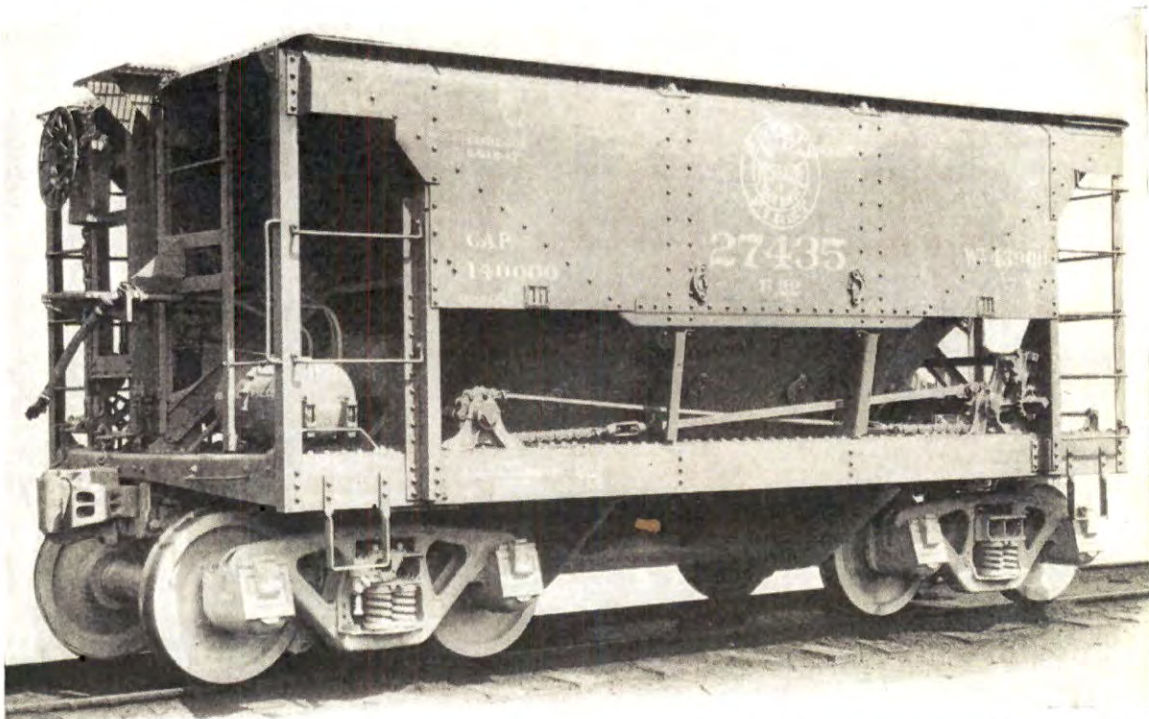


Fig. 2.667—Duluth, Missabe & Iron Range 70-ton capacity hopper iron ore car. Road Class U22. Builder, Pressed Steel Car Company, Inc.

A. A. R. Class.....	HMA	Axle journals	6 in. x 11 in.
Nominal capacity	140,000 lb.	Length over strikers	21 ft. 6 in.
Load limit	166,100 lb.	Length inside	19 ft. 11 in.
Cubic capacity, level	1,000 cu. ft.	Width inside	10 ft. 5 $\frac{1}{2}$ in.
Light weight	43,900 lb.	Height of sides	10 ft. 2 in.

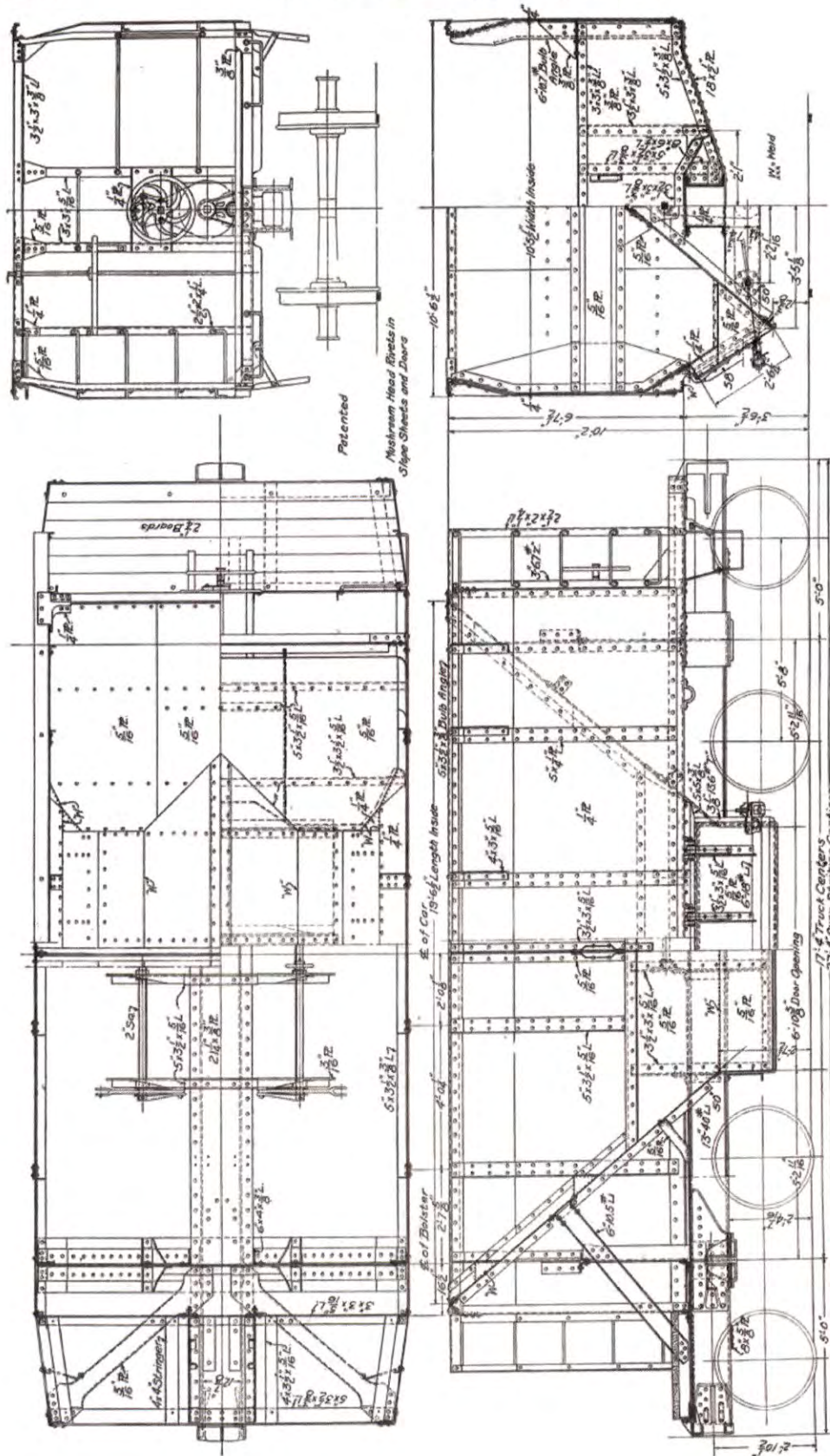


Fig. 2569—70-Ton all-steel Enterprise hopper ore car, side discharge. Cubic capacity, 981 cu. ft. level or 1,170 cu. ft. with 12 in. average heap.

Enterprise Railway Equipment Company
(See also Page 299)

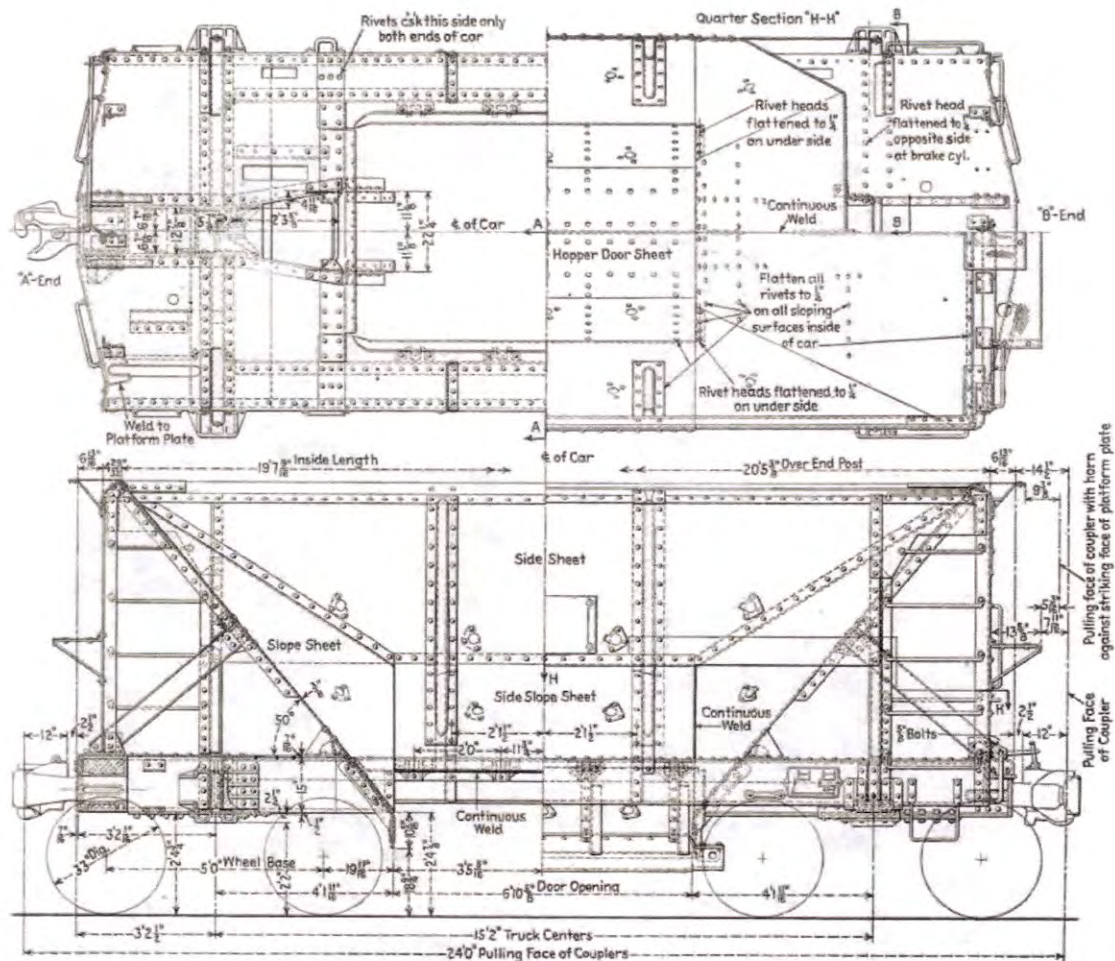
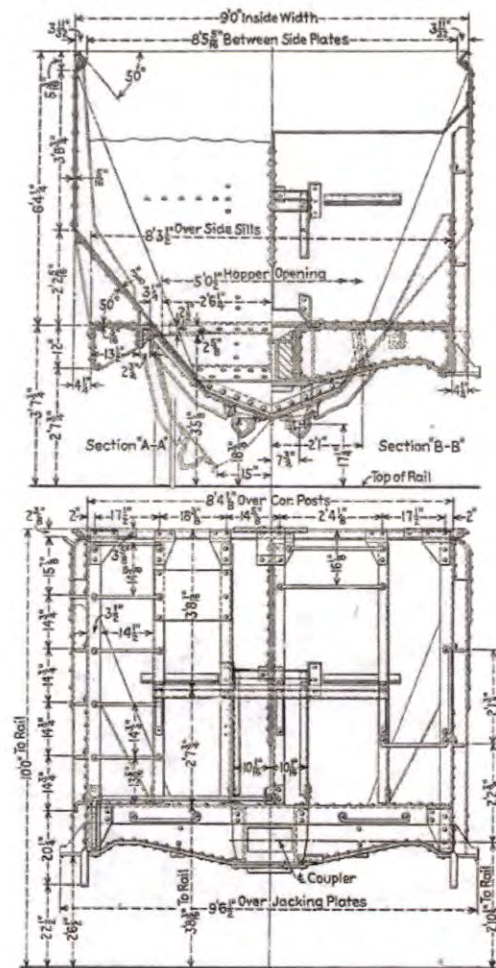


Fig. 2,670—Plan, elevation and sections of Canadian Pacific 50-Ton center discharge ore car.
Builder, National Steel Car Corporation, Ltd.
Series 114,100-114,349
(See also Fig. 2,673)



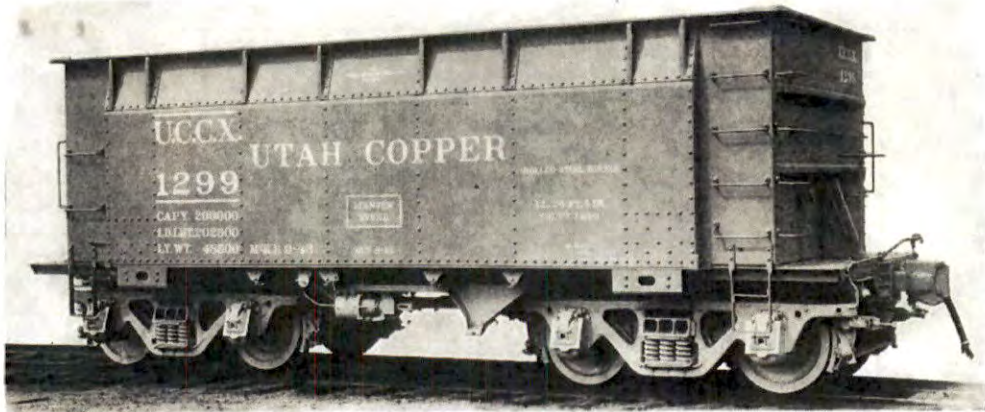


Fig. 2.671—Utah Copper Company 200,000-lb. capacity high-tensile steel, flat bottom, ore car. Unloaded by car dumper. Builder, Pressed Steel Car Company, Inc.
Light weight, 48,500 lb.; load limit, 202,500 lb.; capacity, 1,640 cu. ft.; inside, length 24 ft. 5 in.; width 10 ft. 6 in.; height 6 ft. 6½ in.
Description of earlier lot: *Railway Age*, October 30, 1937



Fig. 2.672—Union Pacific (O.-W. R. & N.) 70-ton ore car, AAR Class HMA. Builder, St. Louis Car Company.
Light weight, 62,300 lb.; load limit, 147,700 lb.; capacity, 1,360 cu. ft.; inside, length 28 ft. 0 in.; inside, width 9 ft. 6 in.



Fig. 2.673—Canadian National 50-ton center discharge ore car for use at Steep Rock mining operations. Built by National Steel Car Corporation, Ltd.
Light weight, 40,600 lb.; load limit, 128,400 lb.; capacity, 825 cu. ft.; length inside, 19 ft. 8 in.
* (See also page 294)

Enterprise Bulk Commodity, Ore and Ballast Cars



Fig. 2.678—70-ton Bulk Commodity Covered Hopper Car

THE Bulk Commodity Covered Hopper Car has become a standard service car for many commodities formerly hauled in sack, barrel or loosely in box cars.



Fig. 2.679—Enterprise Bulk Commodity Outlet

The Enterprise Outlet Unit illustrated in Fig. 2.679 is of cast steel, a finished machined product which provides a close, tight seal against leakage, a large opening and convenient means for operating. For general plan of Enterprise 70-ton car see Fig. 2.677, page 298 and application of outlet see Fig. 3.218, page 496.

The Enterprise has also developed a new seal tight Hatch with Door Lock for use in loading this type of car, which is illustrated and shown applied in Fig. 2.677, page 298, details, Figs. 3.221 and 3.222, page 497.



Fig. 2.682—75-ton Center Discharge Ore Car

ENTERPRISE RAILWAY EQUIPMENT COMPANY, 59 E. Van Buren St., CHICAGO 5, ILL.

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 2—299

Enterprise Multi-Service Ballast Cars

The Enterprise Multi-Service Ballast Car illustrated in Fig. 2.680 is of 55 tons capacity and of Standard A.A.R. dimensions, 34 ft. 0 in. overall length and 10 ft. 8 in. height.

The car is designed to release ballast from a moving train to the sides or center of the track, free of the rails and in quantities as desired by the operator.



Fig. 2.680—55-ton Multi-Service Car

The floors of the car are steep; corner pockets are eliminated and the passageways between the floors and outlet hoppers are wide, providing for a free unrestricted flow of the ballast which is essential to prompt and clean unloading of the car. For general design, see page 288.



Fig. 2.681—70-ton Multi-Service Car

Enterprise Ore Car—Door Mechanism

The 75-ton Hopper Ore Car shown in Fig. 2.682 illustrates the Center Discharge Car commonly used in the Iron Ore Service. Steep floors, rounded corners and a large door opening are essential to quick and free discharge of the load. The door opening is closed by a pair of longitudinally hinged doors which are controlled by the Enterprise Door Mechanism which is operative from either side of the car and securely locks the doors when in closed position. A general plan of Enterprise 75-ton ore car is illustrated in Fig. 2.668, page 292. A side discharge ore or concentrate car is illustrated in Fig. 2.669, page 293.

Freight Car Construction Details

THE CONSTRUCTION AND OPERATION of freight cars on American railroads has resulted in the adoption of certain fundamentals of design which general practice has shown to be most practicable. This subject has for many years been studied by the Committee on Car Construction of the Mechanical Division of the Association of American Railroads and as a result various "Standards" and "Recommended Practices" have been adopted for guidance in building such equipment.

Fundamentals of Car Design
A.A.R. Standard—ADOPTED,
 1920; REVISED, 1927, 1934
 and 1938
 (Manual—Page C-3)

1. Height from rail to center of brake shoe face... 13 in.
2. Height from rail to brake beam hanger fulcrum 24 $\frac{3}{4}$ in.
- 3a. Height from rail to center plate wearing surface (empty car), old standard 26 $\frac{3}{4}$ in.
- 3b. Height from rail to center plate wearing surface (empty car). New standard for "Z" section center sills 25 $\frac{3}{4}$ in.
4. Distance from truck center plate wearing surface to top of truck side bearing $\frac{7}{8}$ in.
5. Distance from center to center of side bearings 50 in.
- 6.* Average clearance per side bearing, per truck: Minimum $\frac{1}{8}$ in. Maximum $\frac{1}{4}$ in.
7. Distance between center sills 12 $\frac{7}{8}$ in.
- 8a. Area of center sills between rear followers (minimum). Old standard for cars not equipped with roofs 30 sq. in.
- Old standard for cars equipped with roofs 28 sq. in.
- 8b. Area of center sills between rear followers, all cars (minimum). New standard for "Z" section center sills 21.3 sq. in.
9. Distance from center of truck to end sill striking face for cars with 4-wheel trucks:
 Hopper cars with horizontal yoke attachment 5 ft. 0 $\frac{1}{2}$ in.
 Hopper cars with vertical yoke 5 ft. 0 in.
 Other cars with horizontal yoke attachment 5 ft. 6 $\frac{1}{2}$ in.
 Other cars with vertical yoke 5 ft. 6 in.
10. Coupler horn clearance (minimum) 3 in.
11. Coupler shank side clearance, total 3 $\frac{1}{2}$ in.
12. Draft gear follower thickness 2 $\frac{1}{4}$ in.
13. Ratio of unit stress to end load (maximum) for center sills 05
14. Ratio of unit stress to end load (maximum) for draft attachments 125
 For draft attachments the area of steel in square inches equivalent to the minimum required strength value is:
15. Tension or compression (square inches)
 grade "A" steel 12
 Grade "B" steel 10 $\frac{1}{2}$
16. For shear (square inches), grade "A" or "B" steel 15
17. For bearing (square inches), grade "A" steel 7 $\frac{1}{2}$
 Grade "B" steel 6 $\frac{9}{16}$
18. Length of standard draft gear pocket in the car sills (plus 0 in., minus $\frac{1}{8}$ in.) 24 $\frac{5}{8}$ in.

* See Manual C-3, for procedure in making adjustments.

1946 C. B. C.

Inside dimensions of A. A. R. box cars, 1932 design, were:
 Length 40 ft. 6 in.; width 8 ft. 9 in.; height 9 ft. 4 in.

For 1937 design, length 40 ft. 6 in.; width 9 ft. 2 in.; height 10 ft. 0 in. In 1941 an alternate height of 10 ft. 6 in. was adopted.

For large capacity box and auto-box cars, 1941 design, length 50 ft. 6 in.; width 9 ft. 2 in.; height 10 ft. 6 in.

NOTE.—Standards for some of these fundamentals had already been adopted by the former M. C. B. Association, namely:

Area of center sills, adopted in 1914 as Recommended Practice.

Side bearing clearance, adopted in 1914, as Recommended Practice, advanced to Standard in 1917.

Distance between center sills adopted in 1905 as Recommended Practice, advanced to Standard in 1907.

Coupler horn clearance, adopted in 1905 as Recommended Practice, advanced to Standard in 1907.

Coupler shank side clearance, adopted in 1899 as Standard, modified in 1896, 1899, 1905, 1907 and 1909.

Draft Gear Followers, adopted as Recommended Practice in 1905. Advanced to Standard in 1907.

Height of floors, refrigerator cars, adopted as Recommended Practice in 1911.

Inside dimensions of box cars, adopted as Recommended Practice in 1904.

Height and width of cars, adopted as Recommended Practice in 1904.

Side Bearings, spread of, adopted as Recommended Practice in 1915. Truck center height of 25 $\frac{3}{4}$ in. has been used generally since 1932.

Classifications—Axles, Trucks, Cars

(Manual—Page C-4)

In connection with the above fundamentals a standard method of designating cars, axles, journal boxes and contained parts was adopted as standard.

Axle having 3 $\frac{3}{4}$ x7 in. journal to be designated as A axle.

Axle having 4 $\frac{1}{4}$ x8 in. journal to be designated as B axle.

Axle having 5x9 in. journal to be designated as C axle.

Axle having 5 $\frac{1}{2}$ x10 in. journal to be designated as D axle.

Axle having 6x11 in. journal to be designated as E axle.

Axle having 6 $\frac{1}{2}$ x12 in. journal to be designated as F axle.

Classification 2A, 2B, 2C, etc., adopted for two axle trucks, the letter designating the axle used and the figure designating the number of axles in the truck. Classification 3A, 3B, 3C, etc., adopted for three axle trucks, to be used in the same manner.

Classification 4A, 4B, 4C, etc., and 6A, 6B, 6C, etc., adopted for cars, the letters designating the axles used, and the figures designating the numbers of axles under the car.

Load Limits

(Interchange Rule 86, Axles)

The following load limits or total weight on rail have been adopted for cars with four-wheel trucks:

A axle	3 $\frac{3}{4}$ in. x 7 in. journal.....	load limit	66,000 lb.
B axle	4 $\frac{1}{4}$ in. x 8 in. journal.....	load limit	103,000 lb.
C axle	5 in. x 9 in. journal.....	load limit	136,000 lb.
D axle	5 $\frac{1}{2}$ in. x 10 in. journal.....	load limit	169,000 lb.
E axle	6 in. x 11 in. journal.....	load limit	210,000 lb.
F axle	6 $\frac{1}{2}$ in. x 12 in. journal.....	load limit	251,000 lb.

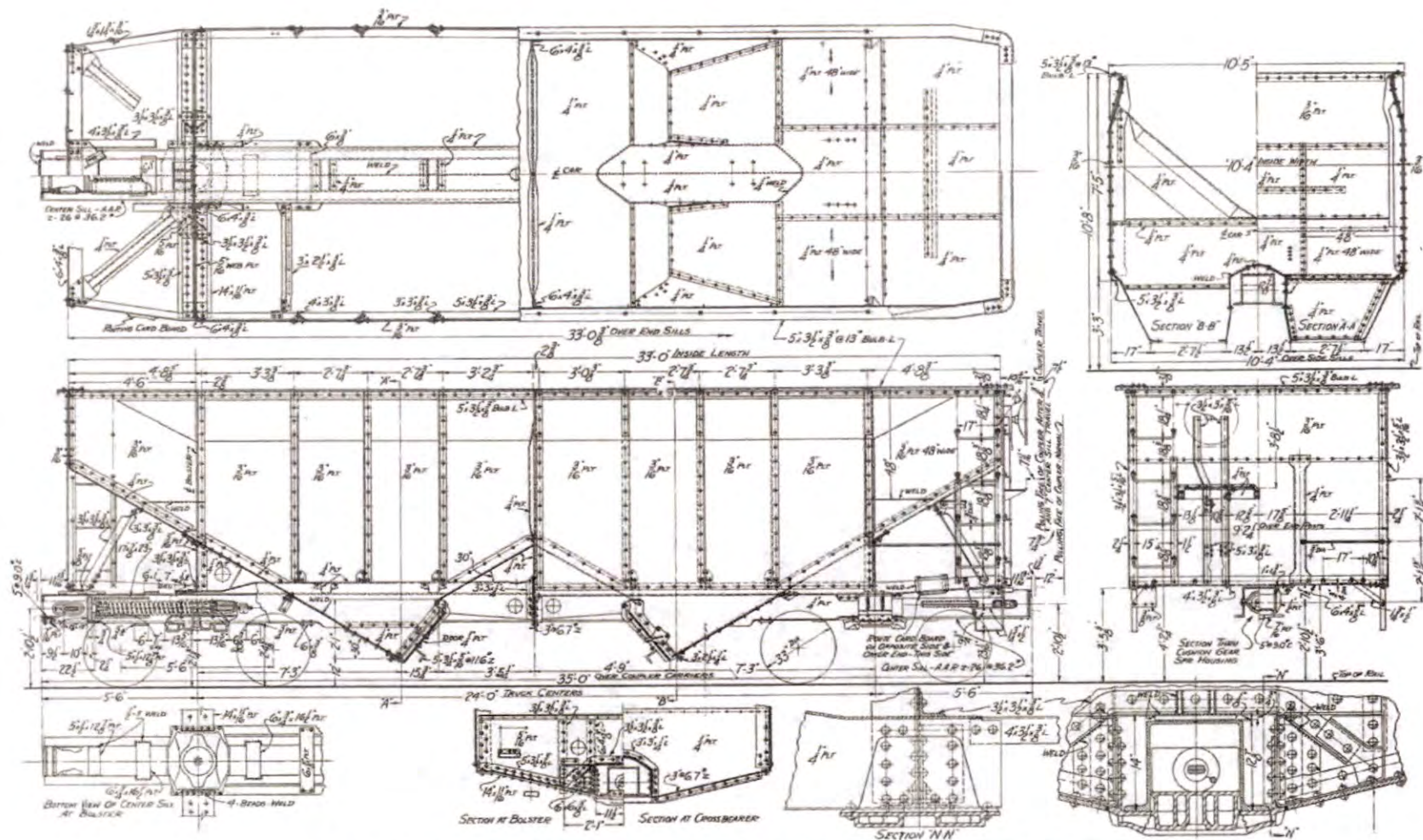


Fig. 3.29—Duryea Underframe with Long-Travel, Cushion Gear as applied to a 50-ton hopper car.

O. C. Duryea Corporation

(For description see Section 10)

Draft Gears

DRRAFT GEAR IS THE TERM used to designate the apparatus which connects the coupler or draw-bar with the sills; it receives and dissipates the shocks received by the coupler, thus tending to prevent damage to equipment. Various forms of spring and friction gears have been employed.

Some older types consisted simply of heavy springs arranged in pairs—either twin springs—side by side; or tandem springs—one behind the other—and placed between follower plate contained within a coupler yoke. A special design of friction draft spring which is of such design as to increase its capacity by friction between the coils has also been used.

The form of gear now in general use is known as the Friction Draft Gear—a gear which makes use of friction for absorbing and dissipating the energy of buffing and tension shocks transmitted through the couplers. It is made in many different designs utilizing a combination of steel plates, cast blocks and springs.

The development of draft gears for railway equipment has kept pace with the constant increase in size and weight of rolling stock and the great increase in length of trains. The draft capacity required for heavy modern traffic has necessitated larger and stronger gear, and these conditions have been met successfully.

Tests and Specifications

In 1918 an extensive test of draft gears was made under the supervision of the United States Railroad Administration, and much valuable data were obtained.

Draft gear tests of an extensive character were begun in 1927 by the Mechanical Division of the American Railway Association, and in this connection a new draft gear drop test machine with falling weights of 27,000 lb. and 9,000 lb. was installed at Purdue University. A description of the machine is given in the 1927 Proceedings. A very complete report of the results of these tests, together with tentative specifications for freight car draft gears, is contained in the 1929 Proceedings. Standards since adopted include—general specifications; certificate of approval; purchase specifications.

Specifications covering "Approved Draft Gears for Freight Service" are covered by Specification M-901 in Section A of the Manual. These specifications, which were adopted in 1931, were revised in 1933, 1934 and 1936. Appendix A of this specification contains instructions regarding "certificate of approval for draft gears." The maximum permitted dimensions outside are $9\frac{1}{32}$ in. by $12\frac{3}{4}$ in., with a length of $24\frac{5}{8}$ in. for gear and follower when released. Travel to be not less than $2\frac{1}{2}$ in. or more than $2\frac{3}{4}$ in. Solid height of gear and followers not less than $2\frac{1}{8}$ in.

The Purchase Specifications for Approved Draft Gears for Freight Service is covered by Specifications M-901 and M-902.

Draft Gears have been classified under three different groups or sections as shown in Interchange Rule 101, as follows:

Section I—A.A.R. Approved Friction Draft Gears

Section II—Non-Approved Friction Draft Gears

Section III—Obsolete Types of Friction Draft Gears

According to Interchange Rule 3, cars built after January 1, 1934, and draft gears, new, applied to any car after January 1, 1935, must be of a type for which a "certificate of approval" has been issued.

Rules covering "Inspection and Maintenance of Draft Gears by Car Owners" will be found in the Manual, page L14-1.

General Requirements

Under "Fundamentals of Car Design," Manual, page C-3, are the following requirements:

Distance between center sills, $127\frac{7}{8}$ in.

Area of center sills between rear followers—(minimum)

For cars not equipped with roofs, 30 sq. in.

For cars equipped with roofs, 28 sq. in.

Draft gear travel—on car, $2\frac{3}{4}$ in.

Coupler horn clearance, 3 in.

Minimum draft gear capacity, 150,000 lb.

Coupler shank side clearance, total, 3 in.

Draft gear followers—thickness, $2\frac{1}{4}$ in.

Ratio of unit stress to end load—maximum—for draft attachments, 125.

For draft attachments the area of steel in square inches equivalent to the minimum required value is:

Tension or compression—sq. in.—grade "A" steel, 12.

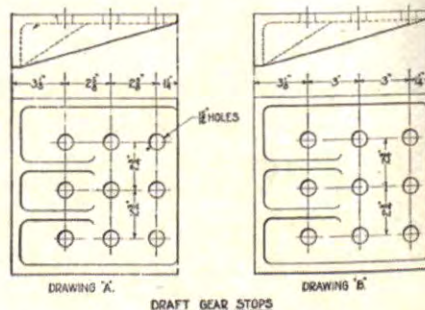
For shear—sq. in., 15.

For bearing—sq. in., $7\frac{1}{2}$.

Draft Gear Followers

A.A.R. Recommended Practice
(Manual, Page C-61)

Separate followers to be used with friction draft gears shall be made from open hearth steel of 0.40-



A.A.R. Standard Dimensions for Front and Back Draft Stops.

0.55 per cent carbon. The size of the followers shall be $12\frac{1}{2}$ in. — $\pm \frac{1}{8}$ in. by $8\frac{7}{8}$ in. — $\pm \frac{1}{8}$ in. by $2\frac{1}{4}$ in. — $\pm \frac{1}{32}$ in. Edges of followers shall be formed in such a manner that they will be free from cutting edges. Shearing will not be permitted.

Where the follower is a part of the friction surface of the draft gear, hardened followers should be used.

Edgewater Ring Spring Draft Gear

THE Edgewater B-32-KA draft gear uses a ring spring to cushion the impact blows of freight car service in order to prevent damage to lading and car structure.

Principle of the Ring Spring

The ring spring consists of a series of solid heat-treated alloy steel rings nested into each other as shown in Figure A. The inner surfaces of the outer rings are tapered and work against the conical surfaces on the outside of the inner ring. When an

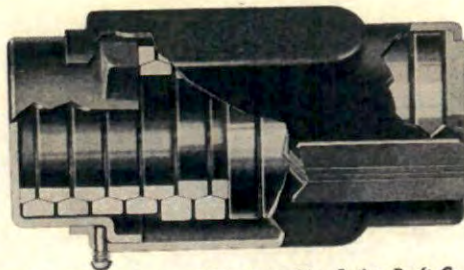


Fig. A—Sectional view of Edgewater Ring Spring Draft Gear

axial load is applied, the rings telescope into each other while the outer rings expand and the inner rings contract, giving a spring action. Friction between the conical surfaces increases the compression force and decreases the recoil force. The ring spring is so designed that it will telescope into a solid tube before the stresses become sufficiently high to cause permanent deformation of the rings. The stress in the outer rings is all tension and in the inners is all compression. This fact permits more efficient utilization of metal than is possible in any other type of spring.

Features of the Ring Spring Draft Gear

The action of the spring is positive and uniform because the contacting surfaces are lubricated for life with a heavy graphite grease. This eliminates sticking and assures the gear's expansion upon removal of the applied load, thus eliminating harmful free slack. By dissipating energy on compression and release, friction reduces impact energy from a destructive agent to the moderate force required to prevent the gear from creeping solid. The ring spring provides the friction to absorb shock and the force to return the gear promptly to full length ready for the next blow.

Figure A shows the spring installed in the rugged pressed steel housing, which protects it from dirt and retains the rings and lubricant in position. The

two pins which are inserted between the movable end cup and housing reduce the length of the gear so that it can be readily installed in the pocket in the car. The first service blow compresses the spring sufficiently to eject the pins allowing the gear to become tight in the pocket. This device is necessary to permit easy installation of the gear and still prevent free play which would cause harmful slack.

Inspection of B-32-KA Draft Gears

The heat-treated rolled alloy steel rings are individually inspected and tested for size and hardness in order to insure long service life. Each gear as it comes from the assembly line after the final manufacturing operation passes under a special hydraulic press so arranged that a Force Closure Diagram is taken automatically. A sample test card is shown in Figure B. Testing of each gear before shipment assures compliance not only with the requirements of A.A.R. Specifications, but also with the much more rigid standard of Edgewater inspectors.

B-32-KA Draft Gears are A. A. R. Approved

Edgewater ring spring draft gears have been tested extensively by the Association of American Railroads, Mechanical Division. In 1933 the draft gear was submitted to the specification tests and received the A.A.R. Certificate of Approval for freight car draft gears. The certificate tests prove that the Edgewater gear exceeds the specification requirements by a large margin. They also demonstrate that the gear reaction

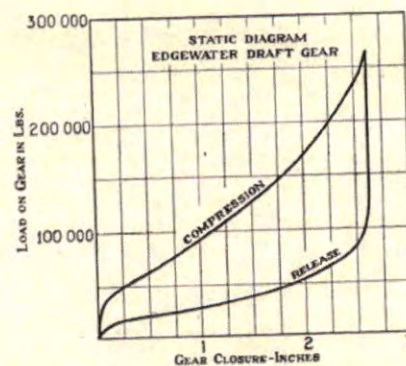


Fig. B—Typical force-closure diagram of Edgewater Ring Spring Draft Gear

(force transmitted to the car body) is exceptionally low for a given amount of energy absorbed. An analysis of the test results has been prepared and will be sent to interested persons on request.

EDGEWATER STEEL COMPANY, PITTSBURGH, PA.

Products and Branch Offices Are Listed in the Classified Indexes

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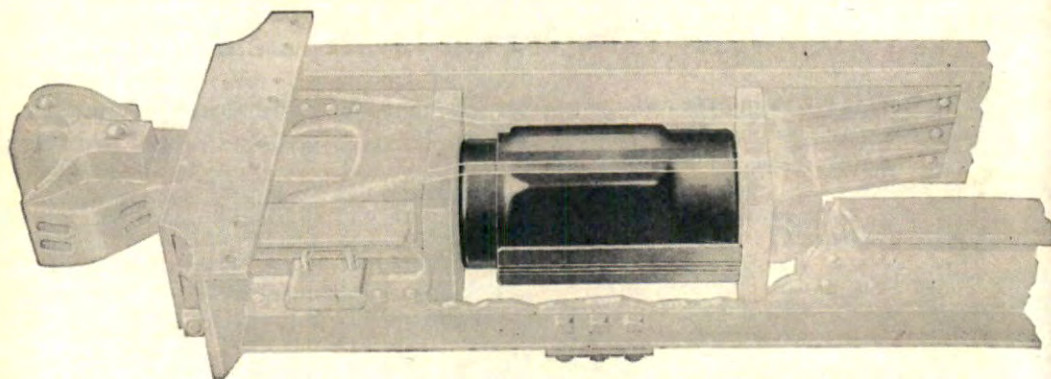


Fig. 10.43—Edgewater Ring Spring Draft Gear as applied with A.A.R. standard vertical yoke.

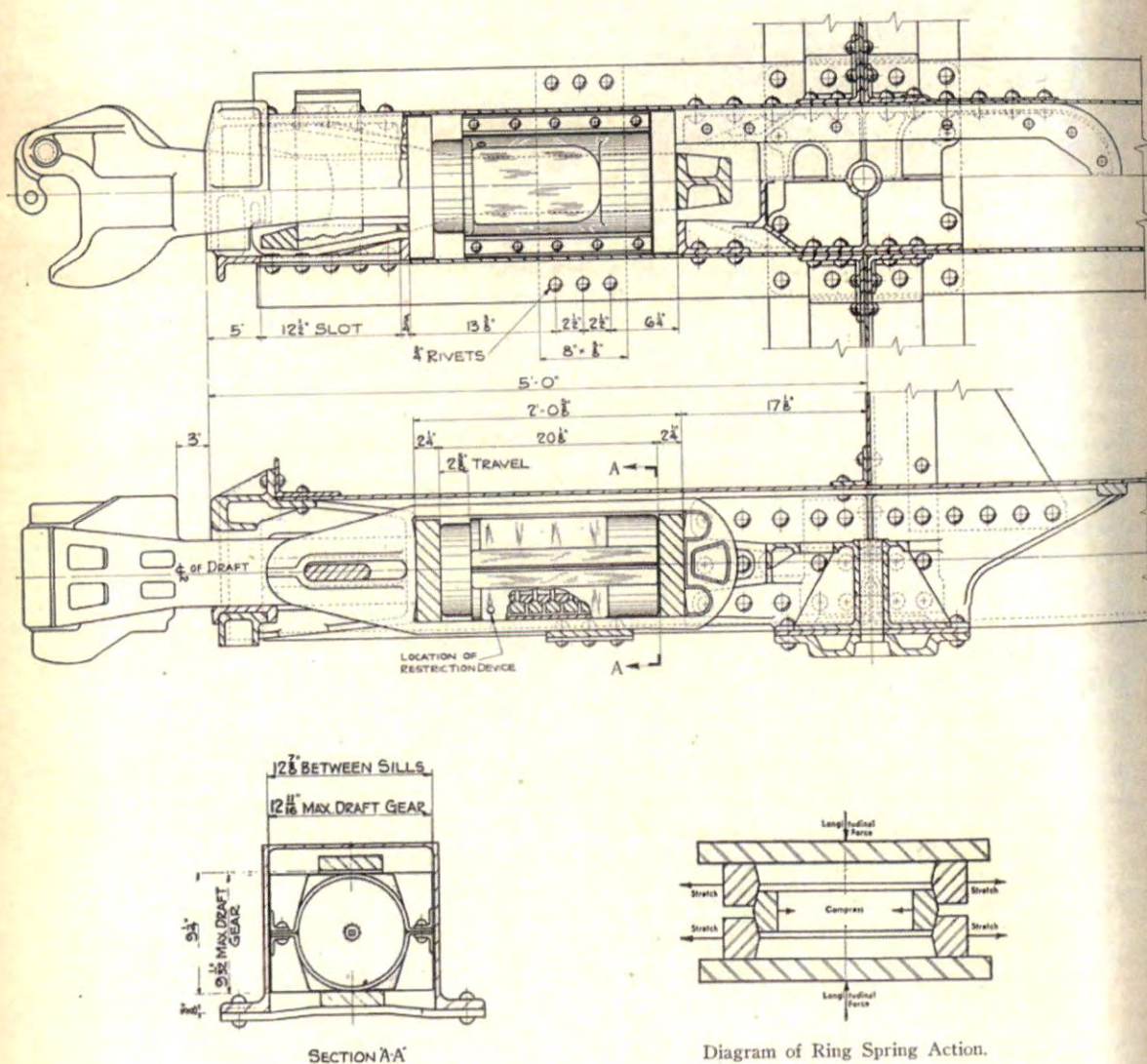


Fig. 10.44—Edgewater B-32-KA Draft gear as applied to A.A.R. cars with standard vertical yoke attachment.

Edgewater Steel Company

(See also Page 937)

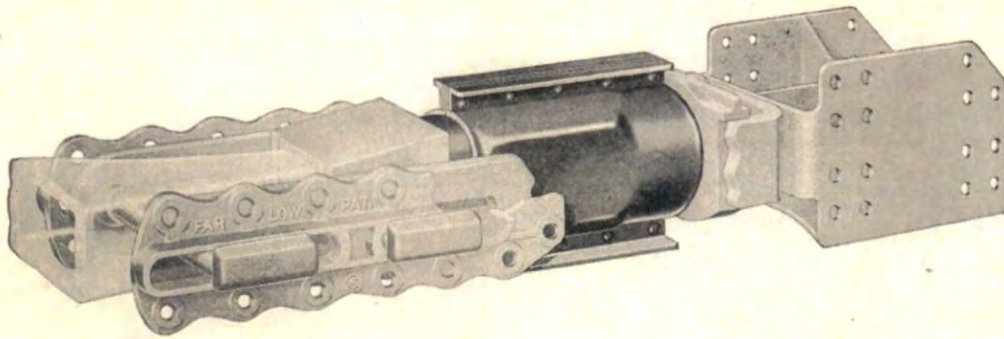


Fig. 10.45—Edgewater Ring Spring Draft Gear as applied with Farlow attachments.

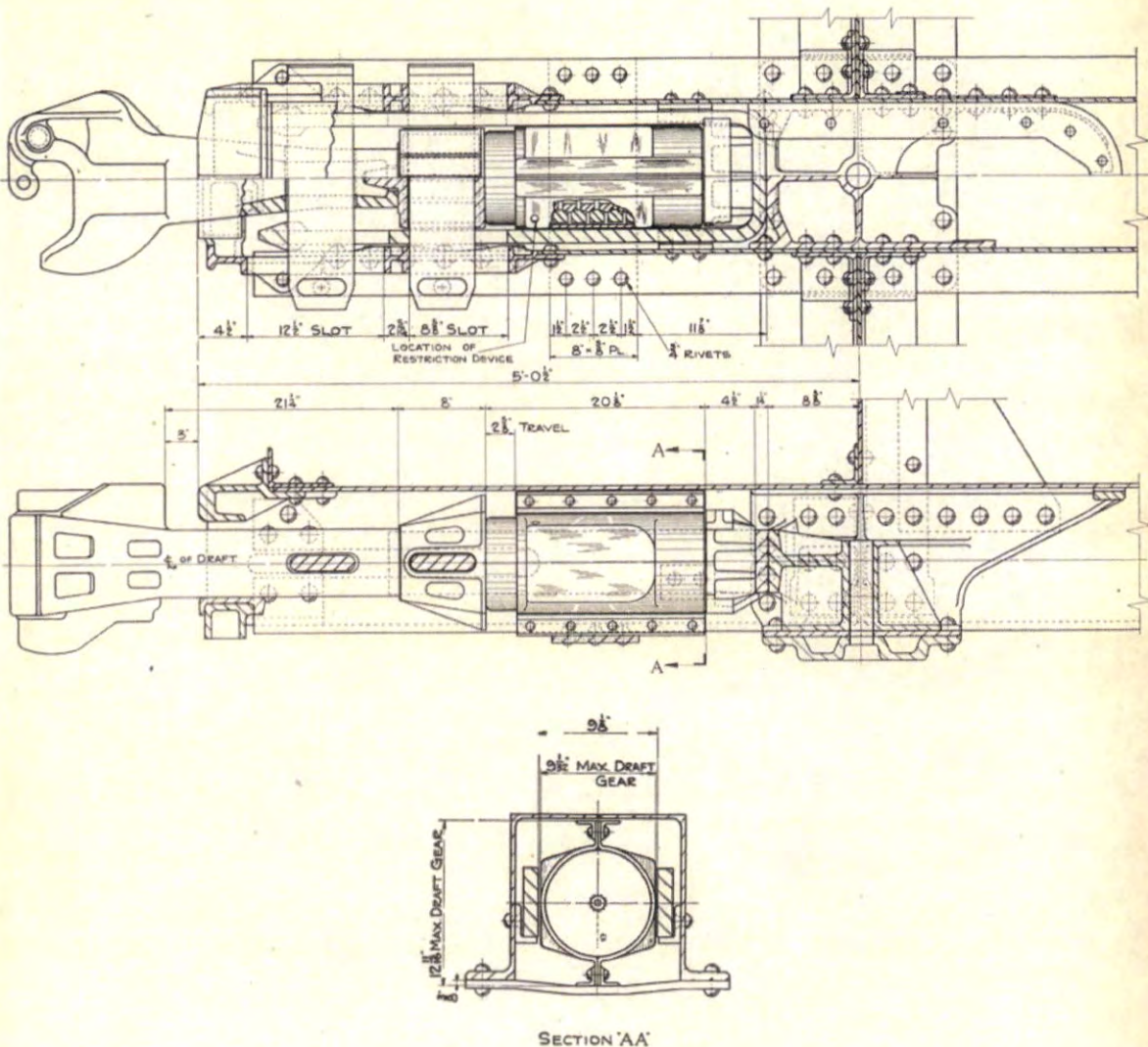
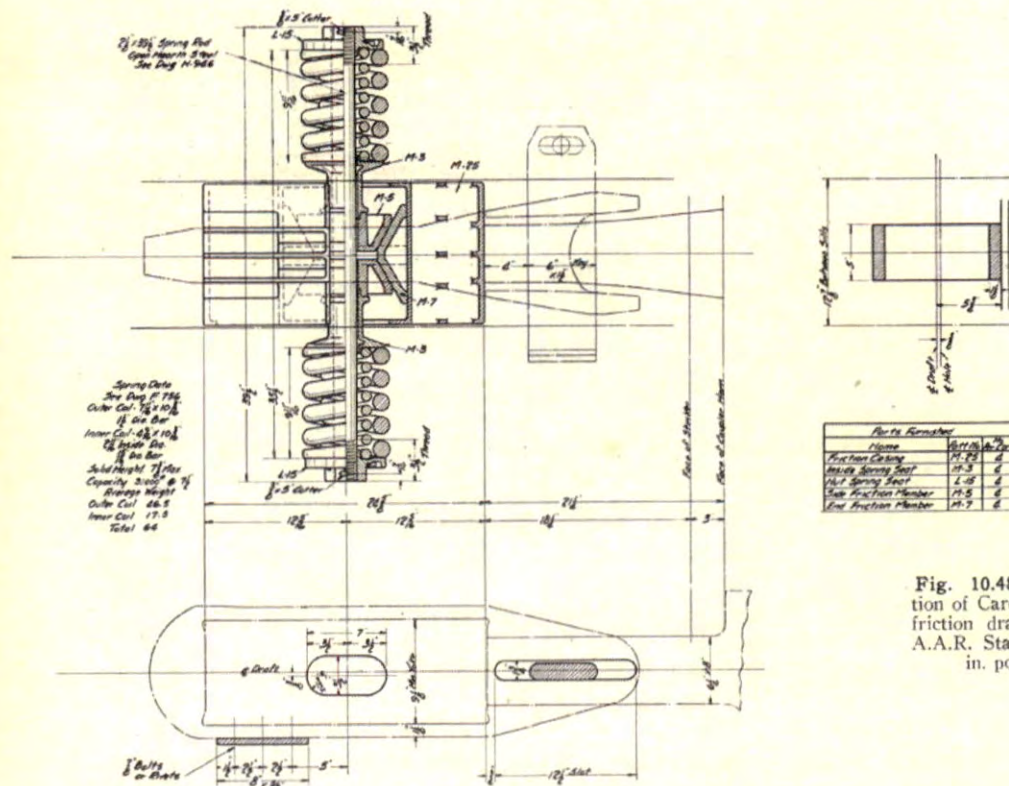
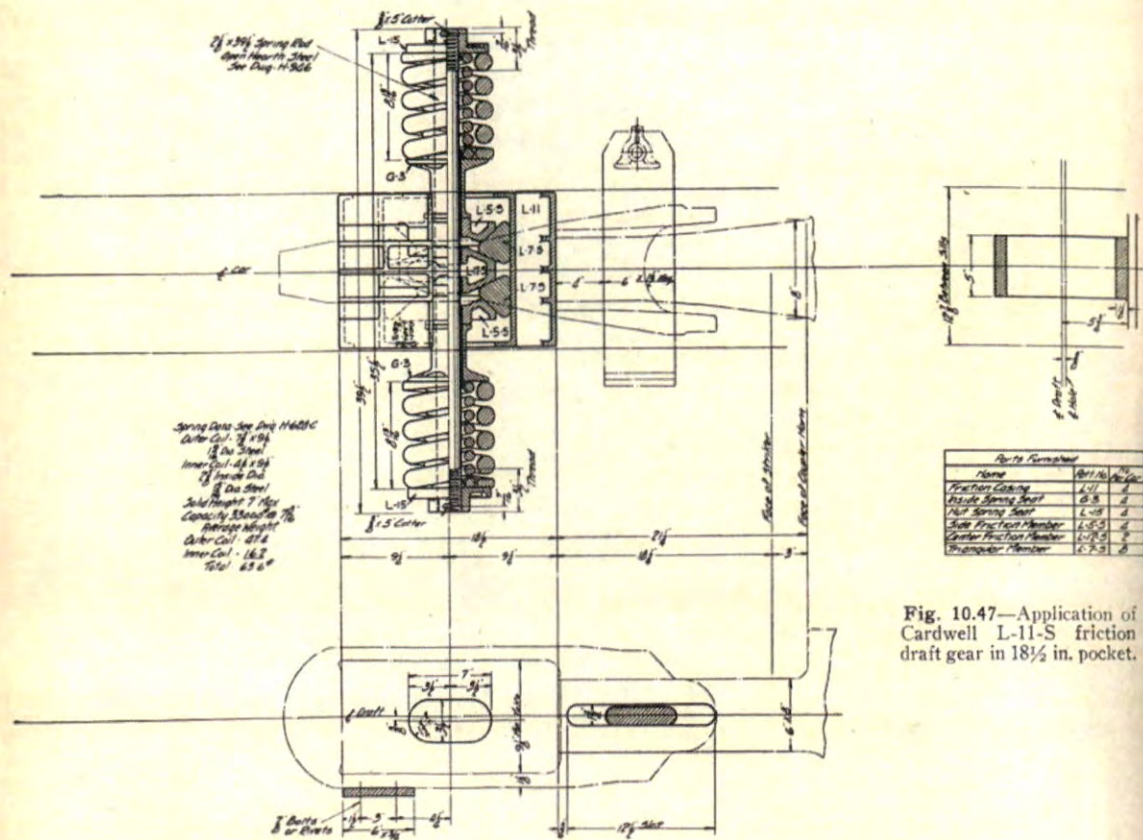


Fig. 10.46—Edgewater B-32-KA Draft Gear as applied to A.A.R. car with standard horizontal yoke attachment.

Edgewater Steel Company

(See also Page 937)

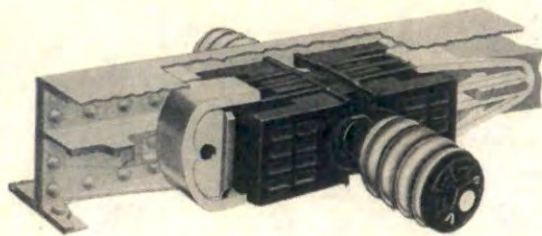


Cardwell Westinghouse Company
(See also Pages 941, 943)

The Cardwell Friction Draft Gear

Features include invariable high capacity, rugged construction, ease of inspection and repairs

INCREASES in weights of railway rolling stock, and in speed of operation, were long ago recognized by this company as normal progress which would continue into the future. Consequently, the capacity of Cardwell Friction Draft Gears has always been kept well in advance of current requirements. Cardwell Draft Gears provide a degree of protection to cars and lading which is not only ample for the present, but for a considerable future increase in the severity of service. To determine the condition of a Cardwell Friction Draft Gear, it



Cardwell M-25 draft gear, certified A.A.R.

is only necessary to inspect the spring and spring rod; and this is done with the gear on the car and without disassembling. Friction parts are easily replaced to restore the gear to its high initial efficiency.

The Cardwell Friction Draft Gear

The manufacturers of this gear were among the first to adopt the friction principle as a means of dissipating the energy of moving cars. This principle is now followed in practically all draft gears. The design of the Cardwell Friction Draft Gear itself, however, is radically different from others. It can be easily restored to high efficiency, after years of service, resulting in considerable economy.

Improvements Give Greater Protection

Incorporated in the Cardwell series of gears, are the results of investigations and tests which are being carried on continuously.

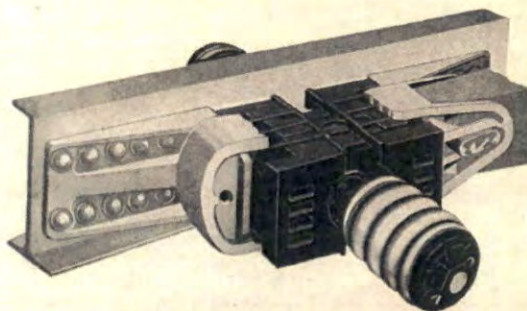
While the basic design remains unchanged, additional capacity and sturdiness make this gear, with standard attachments, capable of withstanding as great final forces as any other known combination.

Design Details

The friction members of this gear are encased in two housings. The spring rod supports coil springs which hold the friction members under compression. The coupler yoke encircles the two housings.

Cardwell Friction Draft Gear Is Distinctive in Design

The feature which distinguishes the Cardwell Friction Draft Gear is the arrangement of its springs which are crosswise of the sills. Its working mechanism is so disposed that its condition may be determined in an instant, by an inspection from the outside. This arrangement of springs allows the gear to be made longitudinally compact, which is a decided advantage in nearly all cases and particularly so in short cars.



The Cardwell type L-11-S draft gear

Summarizing, the distinguishing features of the Cardwell Draft Gears are high work capacity, simplicity, long efficient life, positive release and ability to restore its capacity. This gear can be repaired by regular car repair men.

The Cardwell M-25 Draft Gear is designed for the A. A. R. Standard 24 $\frac{5}{8}$ -in. pocket.

The Cardwell L-11-S Draft Gear has the same capacity as the M-25 but is designed for an 18 $\frac{1}{2}$ -in. pocket.

Important instructions for inspecting Cardwell Friction Draft Gears and keeping these gears working at their full capacity are contained in the Cardwell Draft Gear Chart which will be sent to interested railroad men upon request.

CARDWELL WESTINGHOUSE COMPANY, CHICAGO, ILL.
CANADIAN CARDWELL CO., LTD., MONTREAL

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 10-941

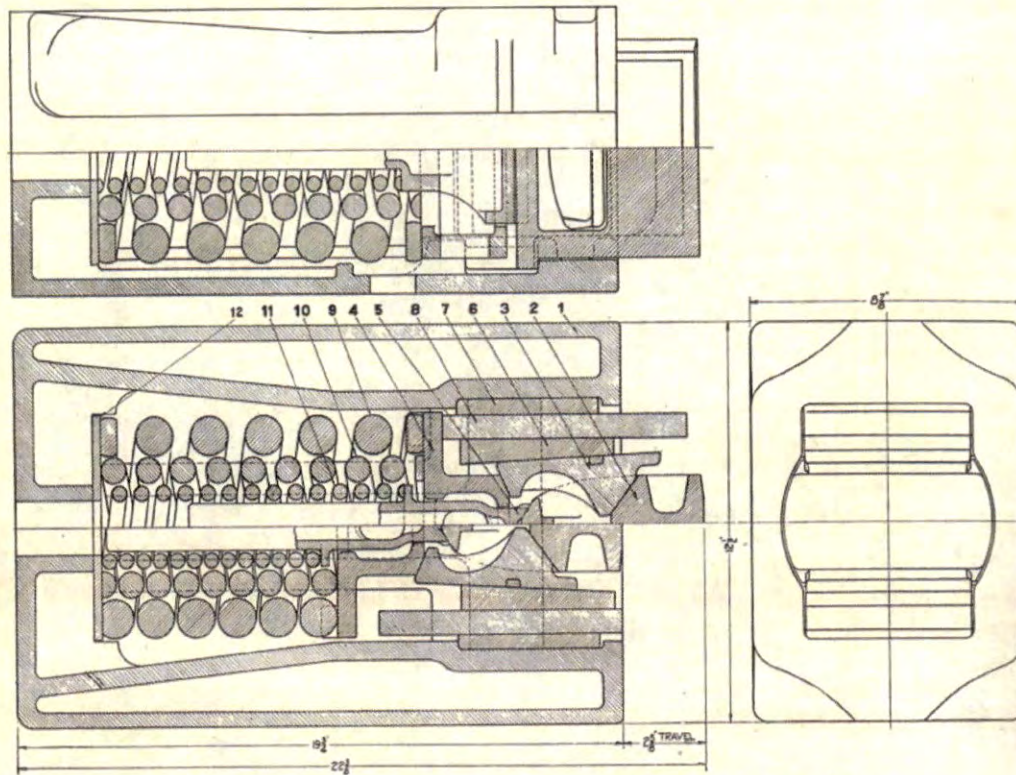


Fig. 10.49—Cross sections of Westinghouse Type NY-11-F friction draft gear.

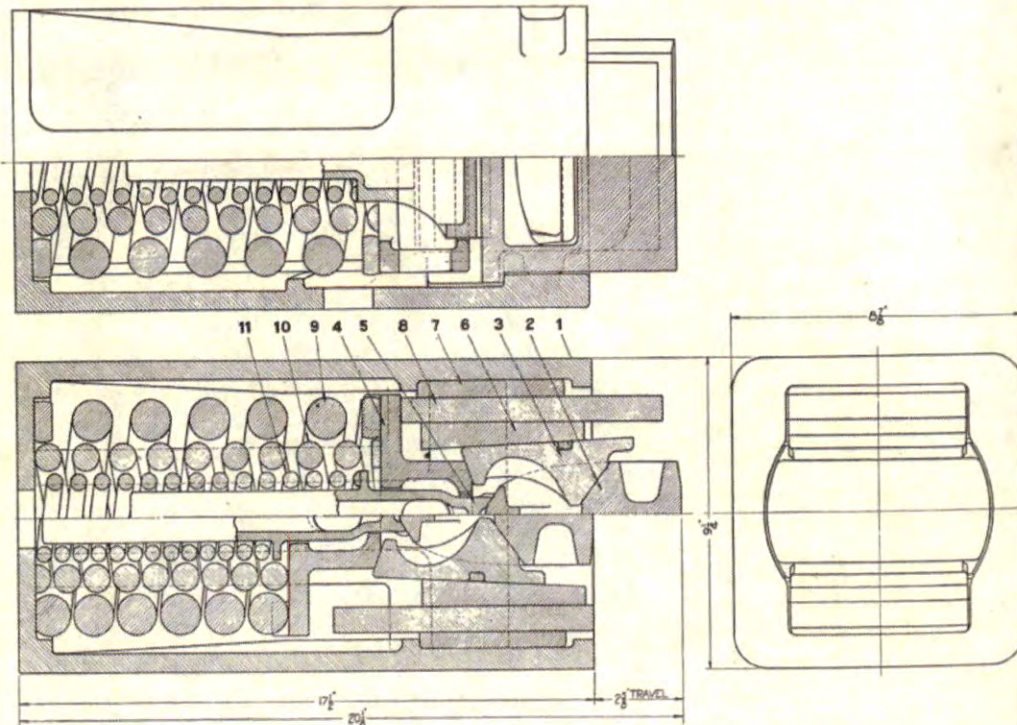


Fig. 10.50—Cross sections of Westinghouse Type NZ-11-F friction draft gear.

Cardwell Westinghouse Company

(See also Pages 941, 943)

Westinghouse Friction Draft Gears

Feature strength and shock-absorbing capacity

THE Westinghouse Type NY-11-F and Type NZ-11-F Draft Gears give the increased car protection necessitated by the heavy loads and high speeds of present-day traffic. The gears are designed to give ample capacity, strength and durability for the shocks encountered in hump-yard or other switching, or in the severe service to which they are subjected in high-speed trains, with a minimum maintenance. The friction members are made of a metal especially suited to the stresses and wear to which they are subjected.

Westinghouse Type NY-11-F and NZ-11-F Draft Gears

The Type "N" Westinghouse Draft Gears are unusually rugged, with special high-duty characteristics which lower maintenance costs and give an unusual



Westinghouse type NZ-11-F draft gear, certified A.A.R.

degree of protection to attachments, car structure and lading.

The gear consists essentially of a multiple arrangement of friction members, in combination with springs, which furnish the elastic resistance and the means for releasing the gear. Its movable parts are encased in a housing of rectangular cross-section, and held together under initial compression by a self-locking arrangement.

The construction throughout is substantial and of the best materials. The housing is a heat-treated steel casting of highest quality. The friction members are of hardened alloy steel, a combination which offers high resistance with minimum wear.

Low Initial Resistance

The operating advantages include a low initial resistance to provide the necessary movement for starting long trains.

Positive Release

These gears are so designed and constructed as to insure prompt and certain return to normal position in readiness for subsequent duty up to full capacity.

Minimum Recoil

One of the desirable features of this Gear—minimum recoil—is effected by the proper design, proportioning and arrangement of the frictional and spring elements.

Installation

These gears can be applied with proper follower plates to any standard 24 $\frac{5}{8}$ -in. pocket using either vertical or horizontal Yoke attachments.

Gear Travel

The soft starting action and ultimate high capacity are obtained with a travel of 2 $\frac{5}{8}$ in.

The Gear Is Self-Contained

The fact that the various members of the gear are held together under initial compression insures, first, that all parts are always in their proper relation; and second, that the gear can be handled as a single unit.

No Friction Wear on Housing

There is no wear on the housing—the most expensive single part to replace—which insures that no repairs will be required from this source. This is achieved by so designing the gear that the wear affects the removable elements only. Exceptionally large frictional surfaces are provided, which distribute the work over a large area, consequently the rate of wear is low. The housing is strong enough to withstand, safely, blows far in excess of the capacity of the coupler.

Two Types of Gears

Within these two classes of gears, details are similar, and operate to produce the same excellent performance.



Westinghouse type NY-11-F draft gear, certified A.A.R.

The NY-11-F has a capacity and ruggedness which make it adequate for the great majority of applications. The NZ-11-F has equal capacity and both are designed for cars and locomotives subjected to severe service.

Both gears meet all A.A.R. requirements. If further information is desired, the Cardwell Westinghouse Company will be pleased to have one of their experienced draft gear men call and discuss specific draft gear requirements to suit any individual case.

CARDWELL WESTINGHOUSE COMPANY, CHICAGO, ILL.
CANADIAN CARDWELL CO., LTD., MONTREAL

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 10—943

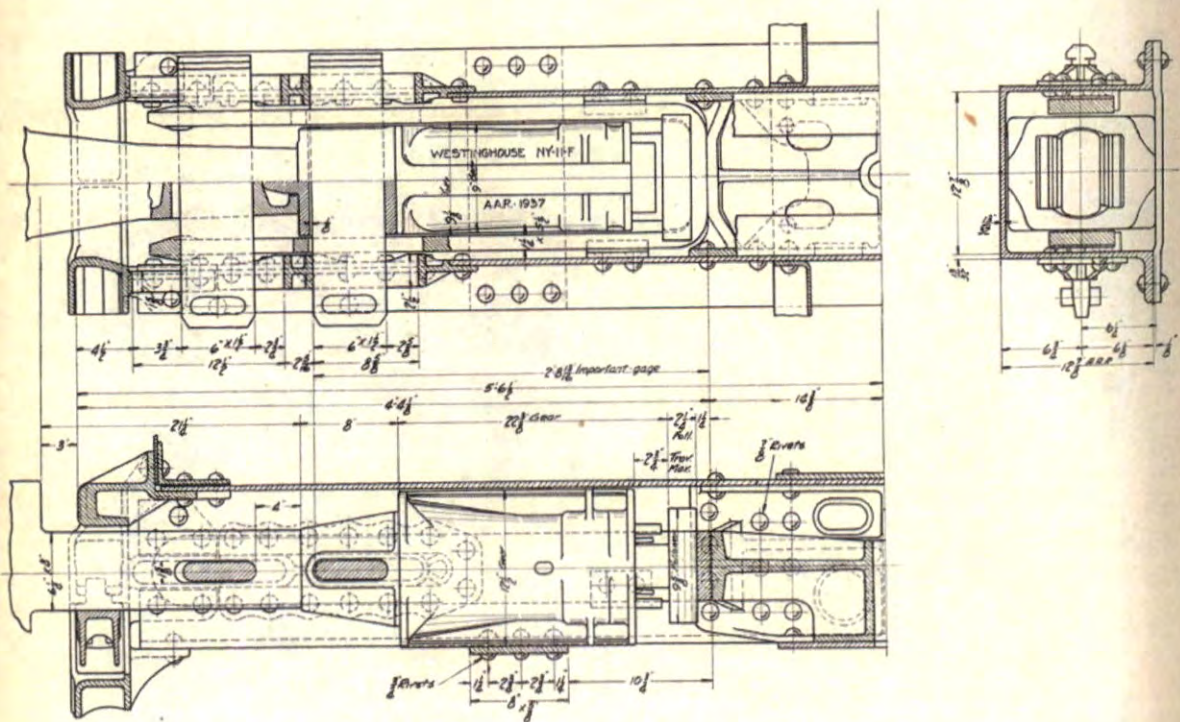
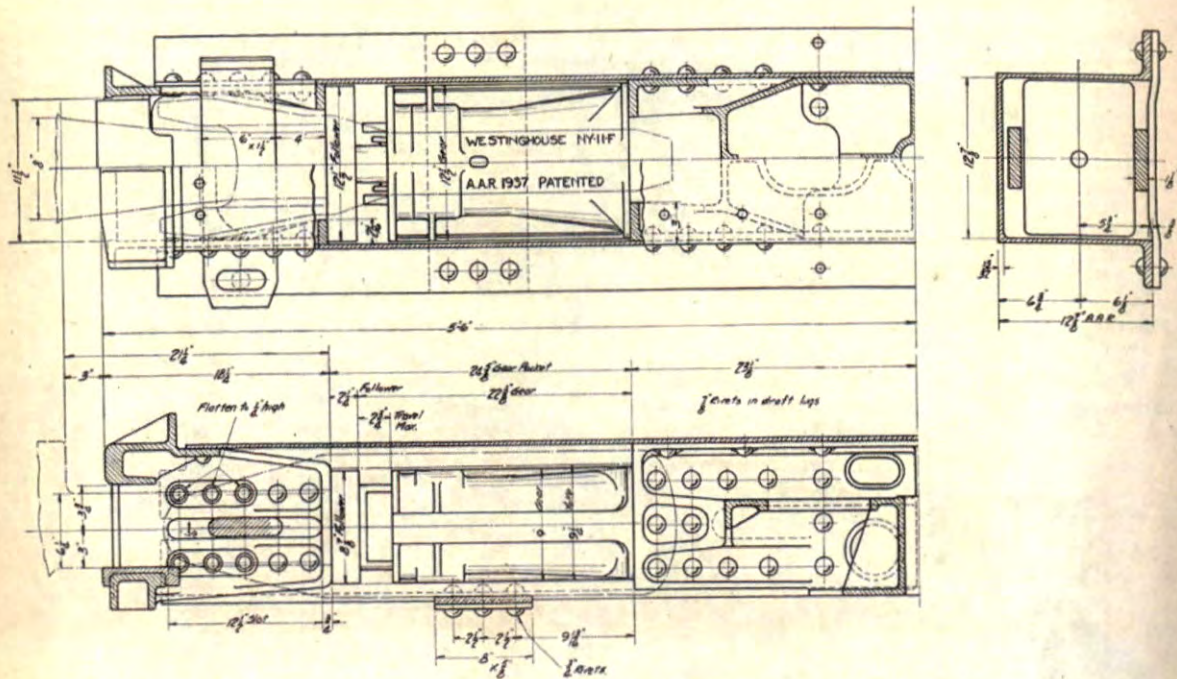


Fig. 10.52—Application of Westinghouse Type NY-11-F friction draft gear with horizontal yoke.

Cardwell Westinghouse Company

(See also Pages 941, 943)

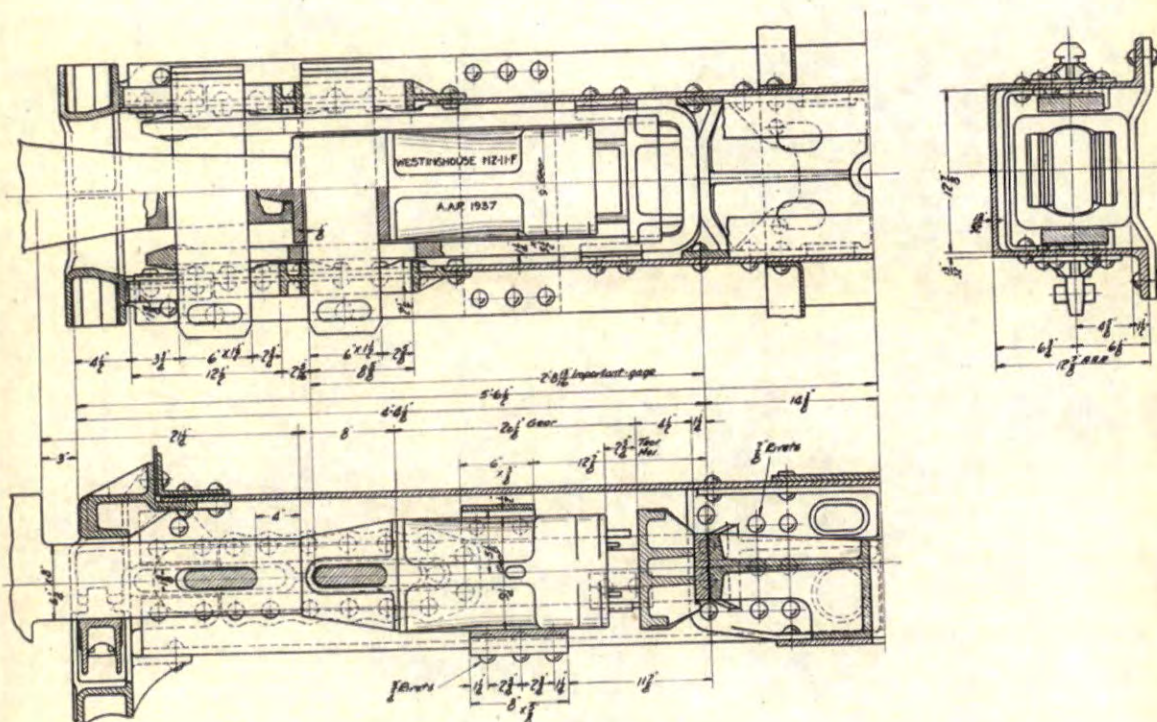
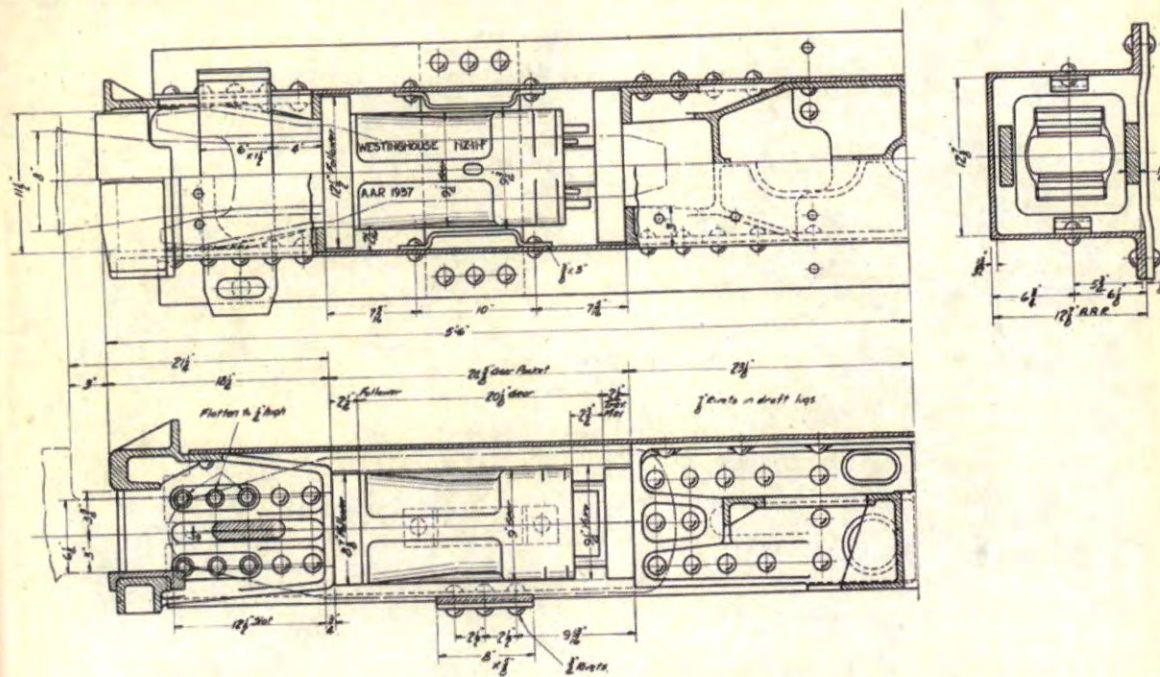


Fig. 10.54—Application of Westinghouse Type NZ-11-F friction draft gear with horizontal yoke.

Cardwell Westinghouse Company

(See also Pages 941, 943)

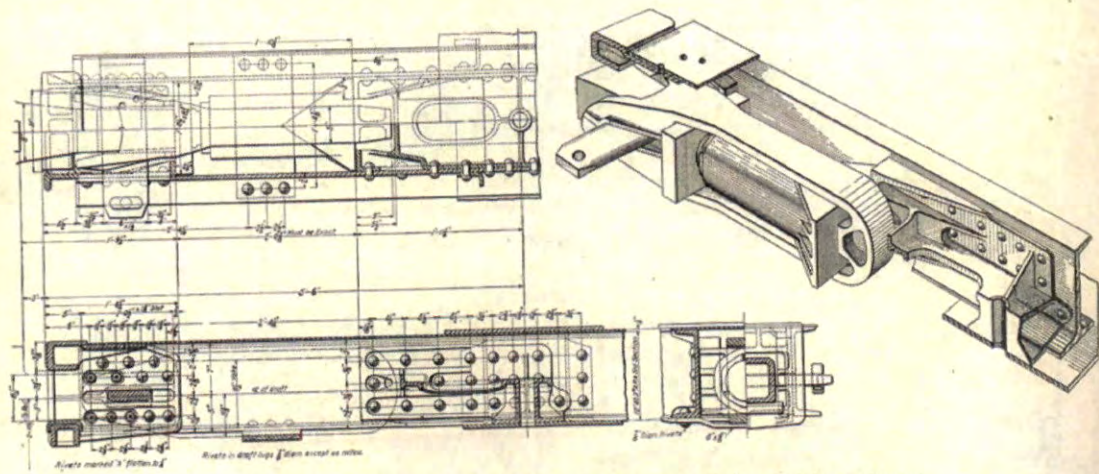


Fig. 10.55—Miner Class A-22-XB friction draft gear applied to freight equipment.

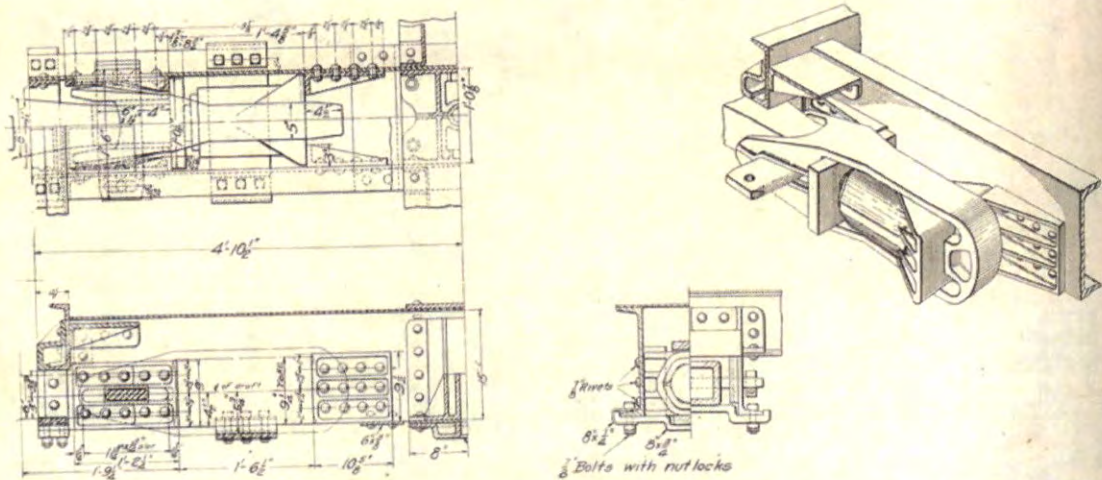


Fig. 10.56—Miner Class A-69-XB friction draft gear applied to freight equipment.

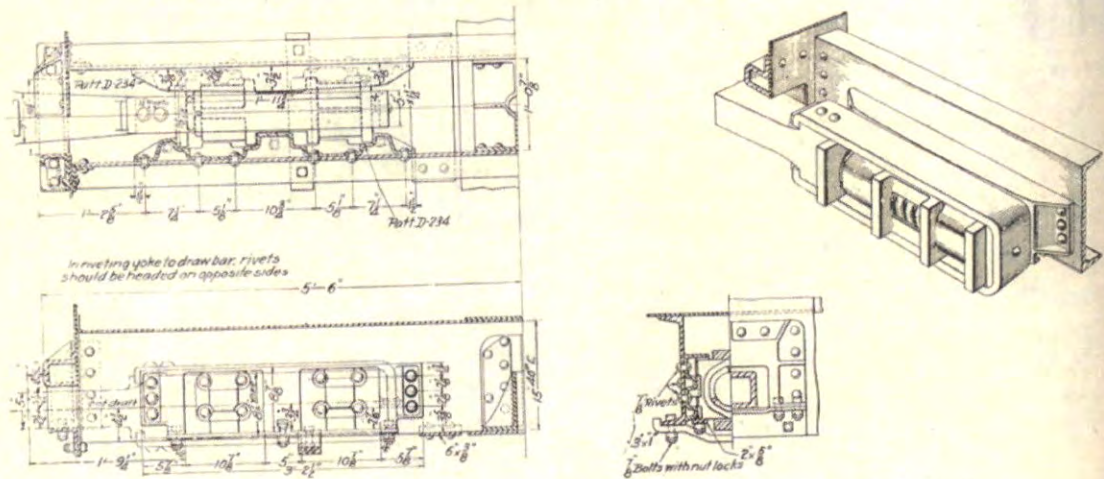


Fig. 10.57—Miner Class A-19-XB friction draft gear applied to freight equipment having Miner tandem draft attachments.

W. H. Miner, Inc.

(See also Page 947)

Miner Friction Draft Gears

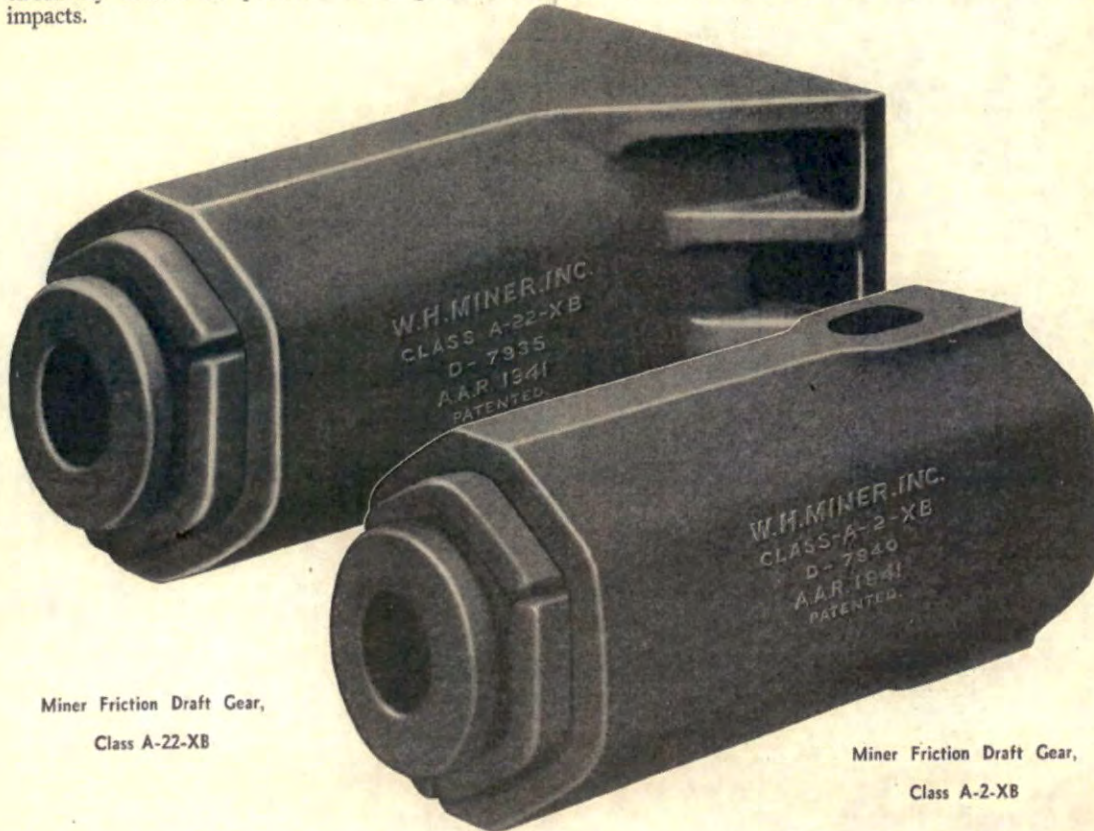
For Freight Equipment

MINER Friction Draft Gears perform a vital service in the economic operation of high-speed freight trains. These devices have thoroughly demonstrated their ability to protect car structure and lading under the most severe operating conditions. Miner gears are powerful shock absorbers which effectively reduce sill pressure resulting from car impacts.

capacity with low sill pressure is maintained for many years of service. For typical application, see Figure 10.55.

Miner A-2-XB Gear

The Miner Class A-2-XB Gear is also certified by the Association of American Railroads. This device



The Miner method of manufacturing the materials of which these devices are made and the subsequent steps in the fabrication and heat-treatment of the component parts positively ensure the high quality necessary to satisfy the exacting demands of shock-prevention service. The friction elements are made of drop-forged steel, thoroughly heat-treated and inspected. The springs are wound to exact specifications in accordance with the latest scientific practice. Each device is individually inspected and tested under a 27,000-pound drop hammer, thereby definitely ensuring correct action and capacity. Extensive service experience has positively demonstrated the ability of Miner gears to withstand shock and to protect car and lading from damage.

Miner A-22-XB Gear

The Miner Class A-22-XB Gear is certified by the Association of American Railroads and meets fully every requirement for heavy freight train protection. This device provides great column strength, and the extraordinary resistance to wear ensures that high

has a high degree of mechanical efficiency, resulting in the reduction of lading and equipment damage. The gear is applied to the standard pocket in combination with two follower plates. See Figure 10.58 for typical application.

Miner A-69-XB Gear

The Miner Class A-69-XB Gear is similar in construction and performance to the Class A-22-XB gear except that it is especially designed to fit the 18½-in. pocket. Application to car conditions is shown in Figure 10.56.

Miner Class A-28-XB Gear

This device was designed for caboose cars. It provides an initial resilient spring action of 1½ in., ensuring comfort for the trainmen, and an additional 1-in. travel of frictional resistance so vitally necessary to protect the car when it is used in pusher service. Figure 10.60 shows typical application.

W. H. MINER, INC., CHICAGO, ILL.

Sec. 10-947

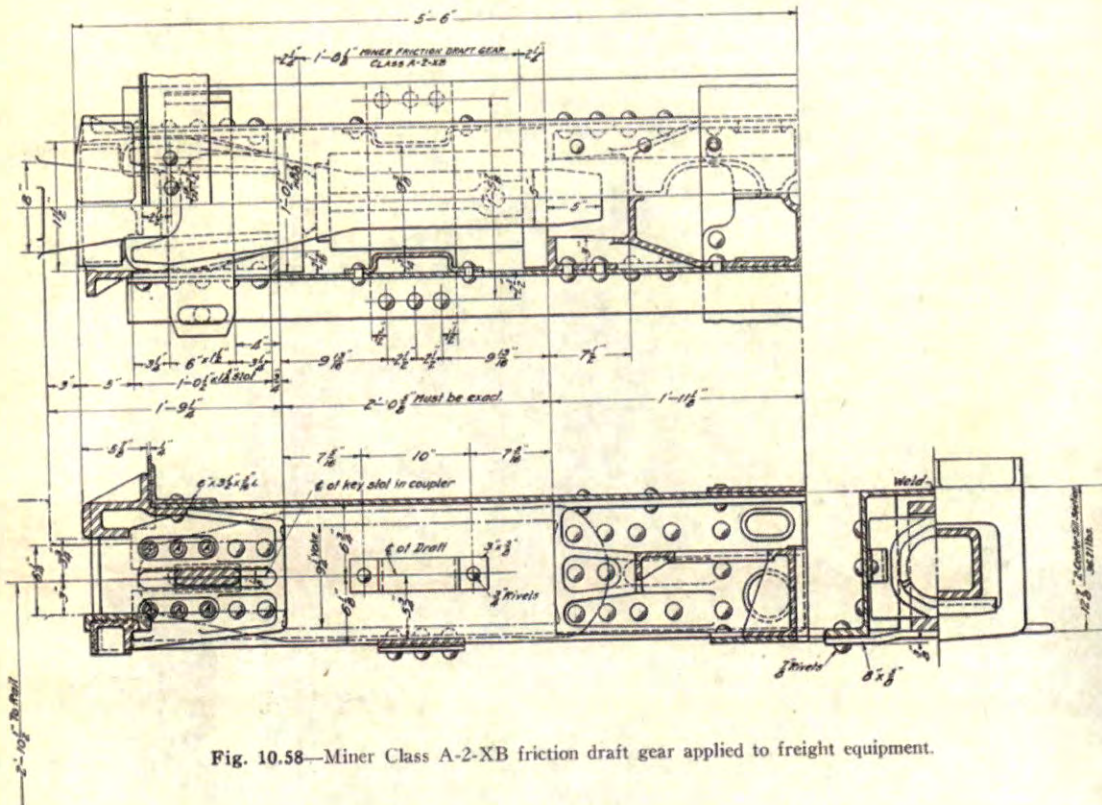


Fig. 10.58—Miner Class A-2-XB friction draft gear applied to freight equipment.

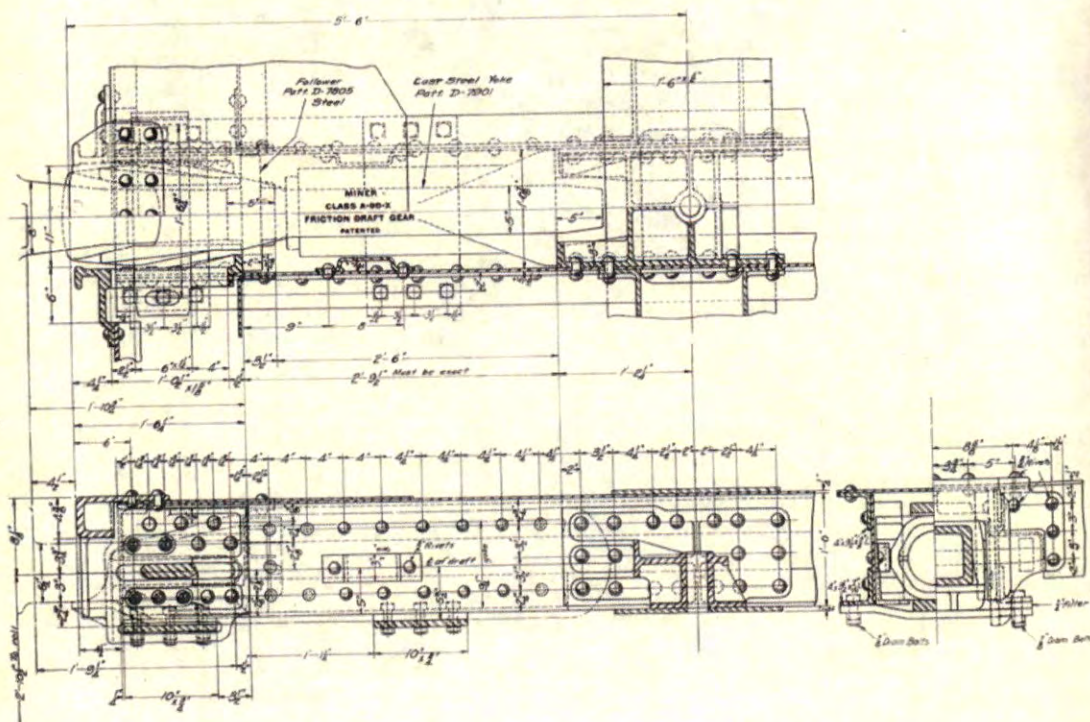
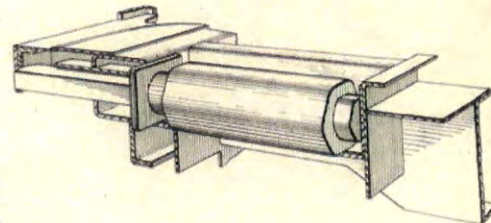
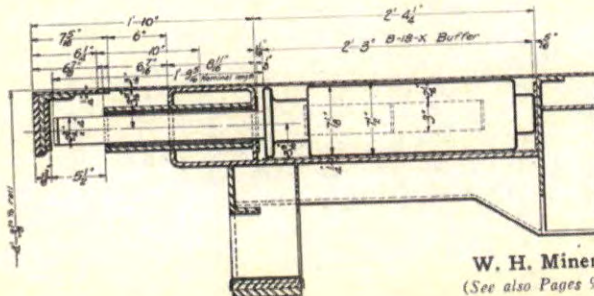
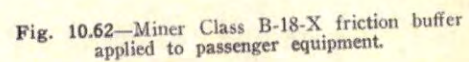
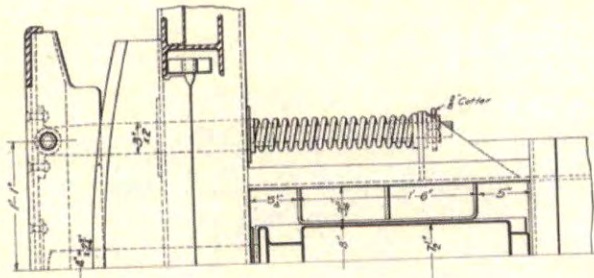
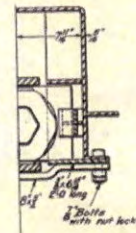
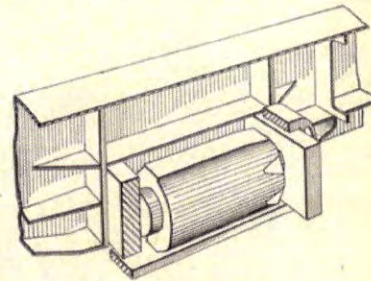
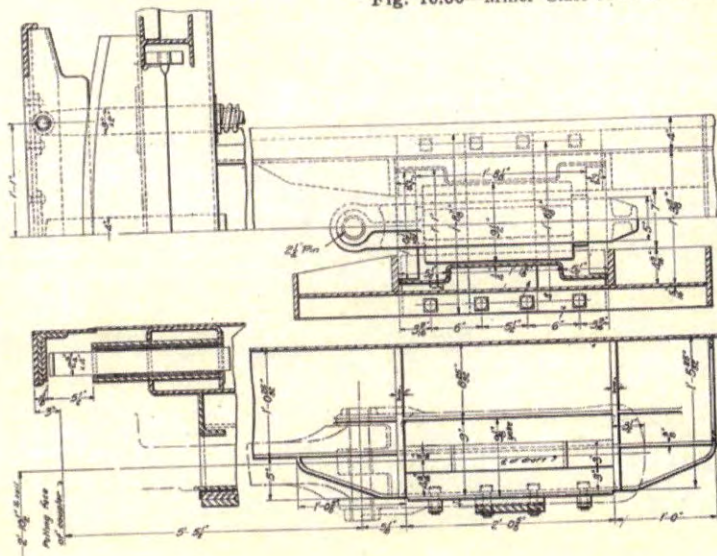
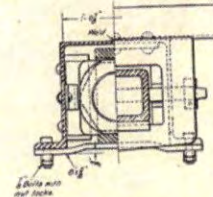
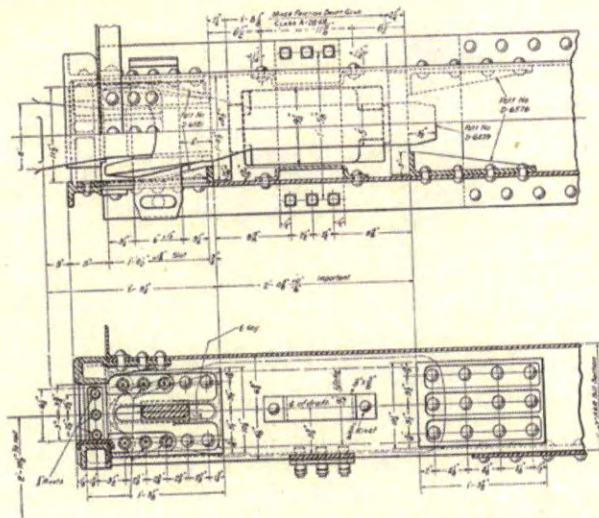


Fig. 10.59—Miner Class A-98-X friction draft gear applied to freight equipment.

W. H. Miner, Inc.

(See also Page 947)



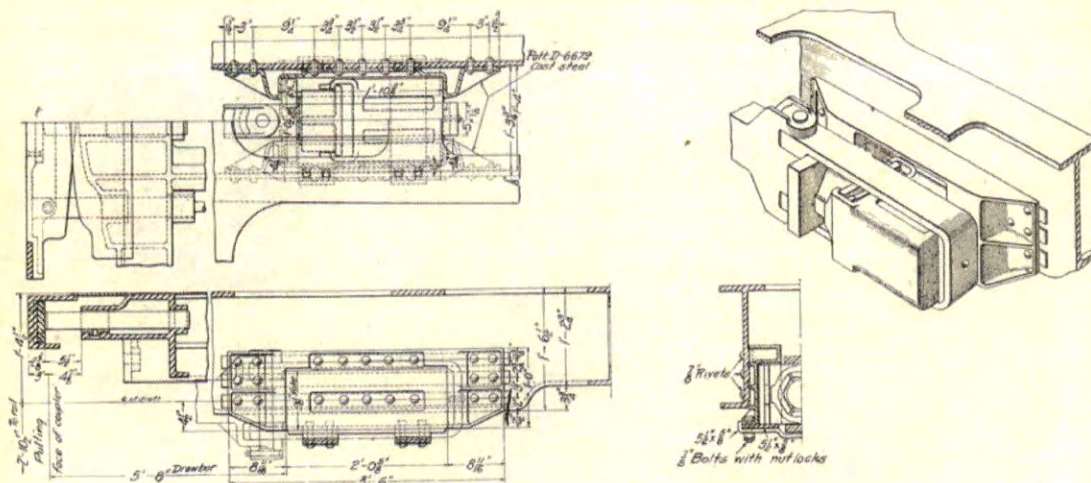


Fig. 10.63—Miner Class A-5-XB friction draft gear applied to passenger equipment.

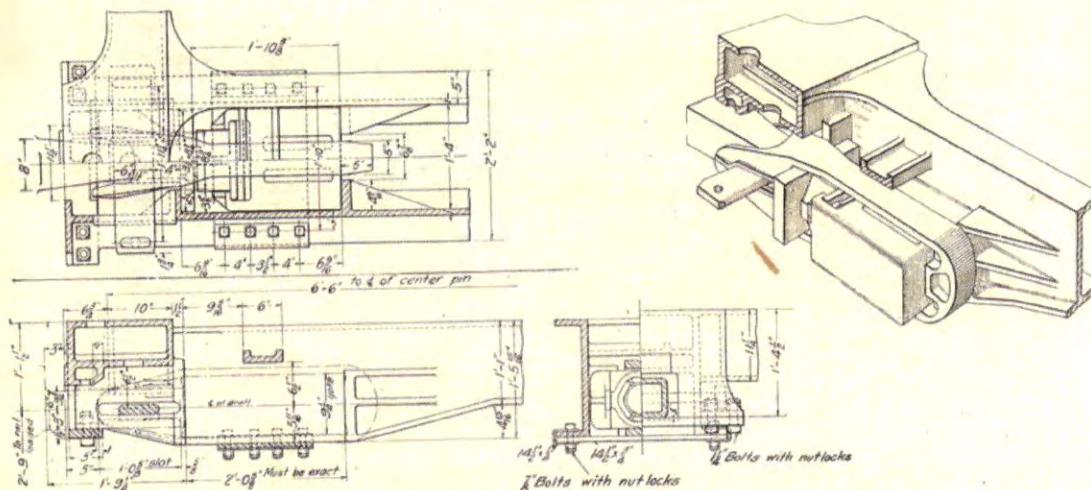


Fig. 10.64—Miner Class A-94-XB friction draft gear applied to passenger equipment.

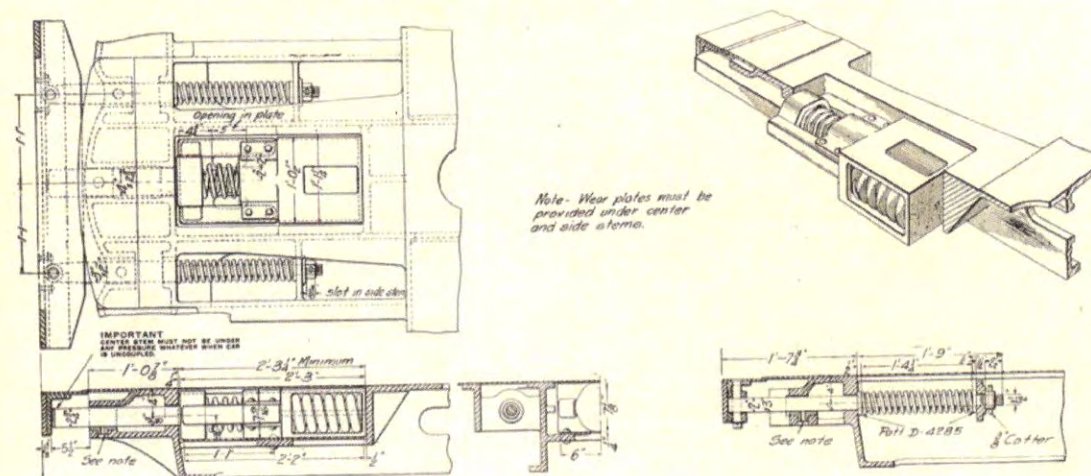


Fig. 10.65—Miner Class B-10-X friction buffer applied to passenger equipment.

W. H. Miner, Inc.

(See also Page 951)

Miner Friction Draft Gears and Buffers For Passenger Equipment

It is imperative that correctly designed cushioning devices be selected for passenger equipment in order to ensure a maximum of comfort for the traveling public. Miner Velvet-Action Draft Gears and Buffers successfully fulfill every requirement of modern passenger train operation, not only protecting equipment from rough handling but facilitating smooth starting and stopping of cars. They also provide proper blending of the differences in speed between the motive power and the individual cars while the train is in motion.

Miner A-4-XB Gear

The Miner Class A-4-XB Gear (Figures A and 10.61) is made of high-strength steel, ensuring extraordinary durability. This device, which fits the standard draft gear pocket, provides the necessary live spring action for the smooth and noiseless starting of trains. High frictional resistance is developed

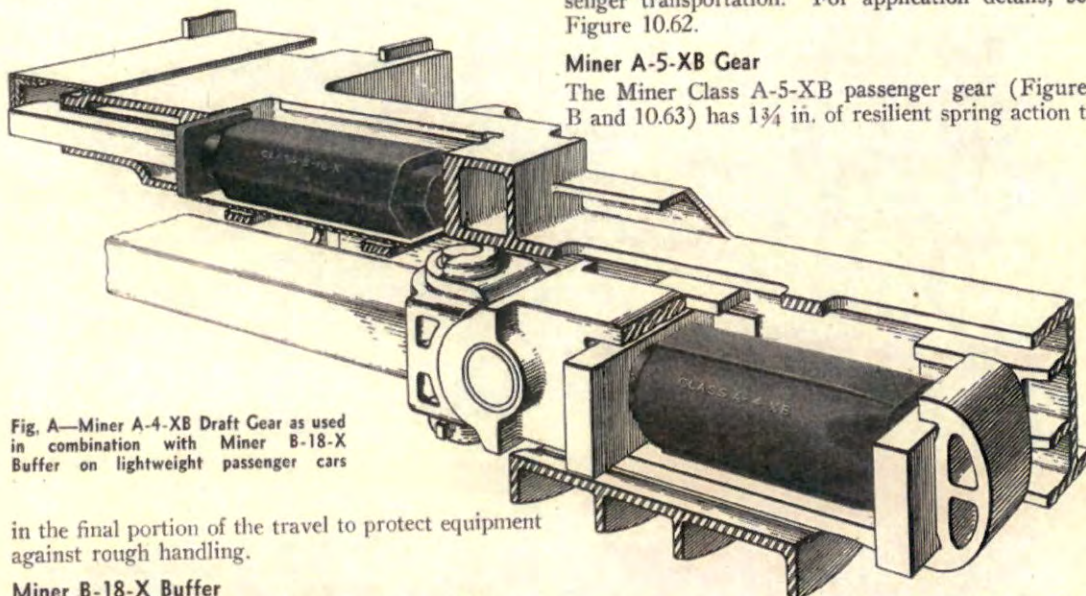


Fig. A—Miner A-4-XB Draft Gear as used in combination with Miner B-18-X Buffer on lightweight passenger cars

in the final portion of the travel to protect equipment against rough handling.

Miner B-18-X Buffer

The Miner Class B-18-X Buffer is designed for use in combination with the Class A-4-XB gear on mod-

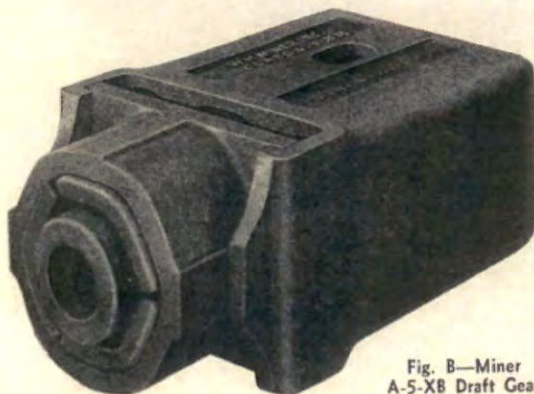


Fig. B—Miner A-5-XB Draft Gear

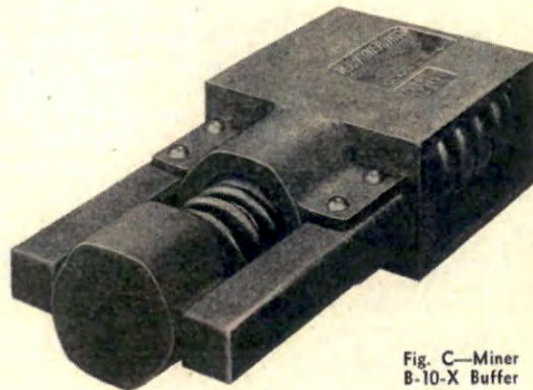


Fig. C—Miner B-10-X Buffer

ern passenger cars. Several years of service on leading high-speed trains testify to their success in meeting the exacting requirements of present-day passenger transportation. For application details, see Figure 10.62.

Miner A-5-XB Gear

The Miner Class A-5-XB passenger gear (Figures B and 10.63) has $1\frac{3}{4}$ in. of resilient spring action to

permit easy starting and stopping of trains. This spring resilience also responds to the pulsing development of the drawbar pull and, by synchronizing with this surging, transmits uniform traction to the train. This action blends into heavy frictional capacity at the end of the stroke to protect car structure against overload shocks.

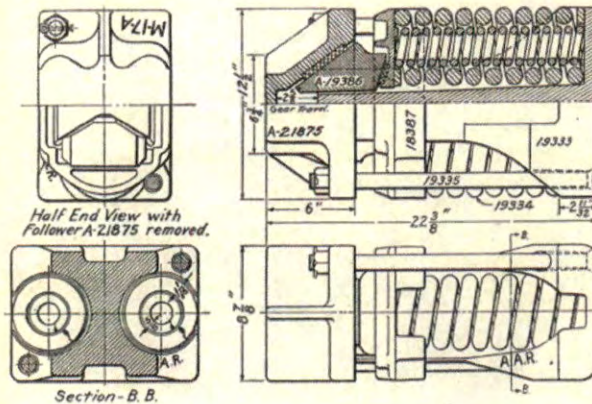
Miner B-10-X Buffer

The Miner Friction Buffer (Figures C and 10.65) provides live spring resistance for precoupling action, during which the buffer works in conjunction with the side stem springs to maintain positive contact between vestibule plates. The final travel augments the draft gear capacity.

Miner passenger appliances are correctly designed and made of the finest quality steel, thoroughly heat-treated. Each device is carefully and rigidly inspected and tested before shipment.

W. H. MINER, INC., CHICAGO, ILL.

Sec. 10—951



List of Parts of Fig. 10.66

NUMBER	NAME	NO. PER GEAR
18387	Friction Segment Seat	1
A-21875	Follower Wedge	1
19333	Friction Member	1
19334	Draft Spring	2
19335	Retaining Rod and Nut	2
A-19386	Friction Segment	2

Travel of Gear.....Min., $2\frac{1}{4}$ in.; Max., $2\frac{3}{4}$ in.

Weight of Gear.....Average 370 lb.

Fig. 10.66—National friction draft gear, Type M-17-A, A.A.R. approved—Certificate No. 2.

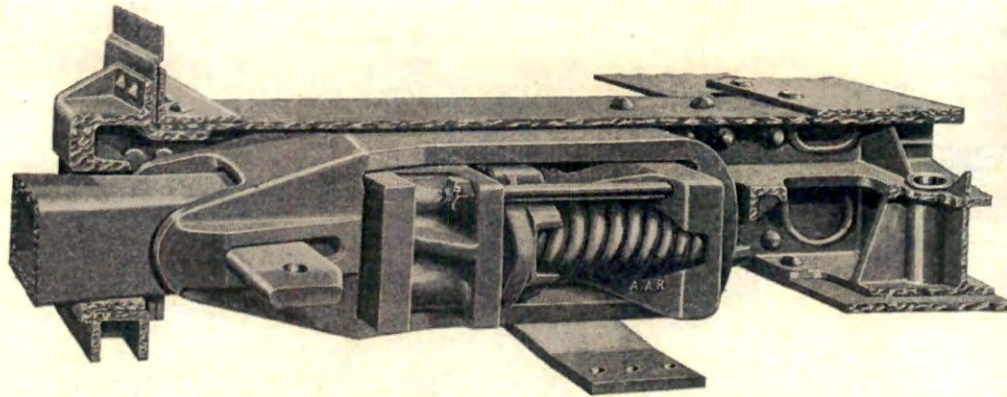


Fig. 10.67—National friction draft gear, Type M-17-A, A.A.R. approved. Applied to car in combination with A.A.R. Standard E Coupler and vertical cast steel yoke.

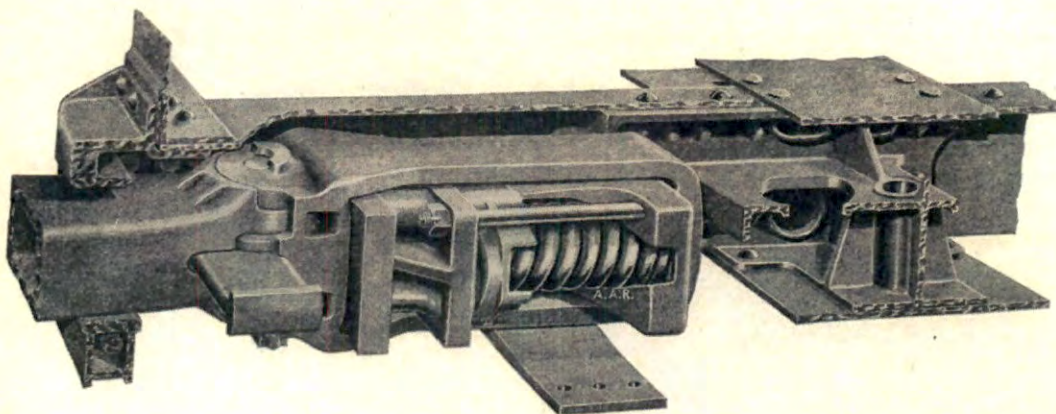


Fig. 10.68—National friction draft gear, Type M-17-A, A.A.R. approved. Applied to car in combination with A.A.R. Alternate Standard E Coupler and vertical cast steel swivel yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)

National Friction Draft Gears

THE present National Friction Draft Gears are the result of many years of service, investigation and development work to obtain a gear of simple design and with the fewest number of parts possible, consistent with a ruggedness and capacity that would insure a long life of the gear in service and afford the maximum protection to the cars against the extremely heavy shocks and blows of present day train operation. To attain this object the material used in the construction of National Friction Draft Gears is of special high quality. Each vital part of these gears is separately treated to obtain the exact physical properties necessary to best enable it to perform its individual function.

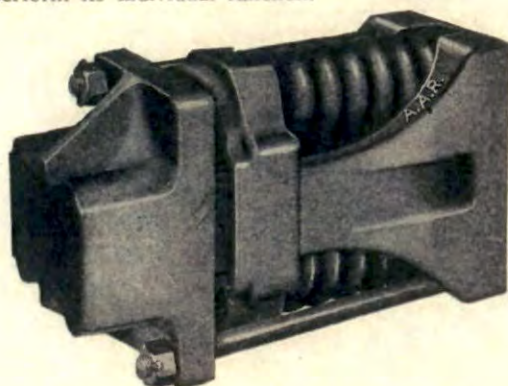


Fig. A—National Friction Draft Gear Type M-17-A
A. A. R. Approved, Cert. No. 2

Important and Distinctive Features

National Friction Draft Gears embody several important and distinctive features:

First: National gears are built upon the principle of inwardly acting wedge pressure and a centrally located friction member. The friction segments are wedged inwardly against the central member, with the result that this member is subjected only to compressive stresses. Any wear that may develop on this member, therefore, does not weaken it or lessen its ability to withstand these stresses.

Second: All castings entering into the construction of these gears are made of alloy steels, heat-treated to secure a hardness and strength best suited for the service each part must perform. The central friction member is specially hardened, providing a ductile, shock-resisting body with surfaces of extreme hardness. The friction segments are of a special alloy steel, heat-treated to secure a degree of hardness somewhat less than that of the surfaces of the central friction member but still very hard. The follower wedge and segment seat are made of Naco Steel on account of its proven strength and toughness.

Third: National Gears in types M-17-A and M-50-B are provided with central friction members of sufficient area and strength to carry the over-solid blows as well as the normal friction stresses and are of ample strength to meet the most rigid requirements.

The draft springs are never compressed solid, even

when the gear is fully closed, which protects the frictional parts as well as the springs themselves from excessive stresses.

Fourth: National gears are so designed that when they are assembled and locked to the correct length for application to the car, the draft spring is under considerable initial compression. On account of this initial compression the frictional elements are always held in close contact with one another, ready to respond instantly to any applied force. This initial spring compression automatically compensates for any frictional wear that may take place during the life of the gear. The gears are locked to the proper length by retaining rods with nuts and cotters. These rods are not removed in applying the gears to equipment. The gears do not have to be boxed or crated for shipment as they cannot get out of adjustment or come apart through rough handling. The vital parts are so protected that they are not liable to injury.

Fifth: All friction and wedging surfaces are accurately machined or ground, and when assembled, each gear is given a series of factory tests in a specially designed machine equipped with an automatic recording pressure gage. Each gear is thoroughly inspected and when tested must show a minimum required capacity before it is accepted for shipment.

Sixth: As there is no case or barrel surrounding the gear, all parts are exposed to view for inspection, yet they are so protected that injury to any part is impossible.

The M-17-A gears require one follower and

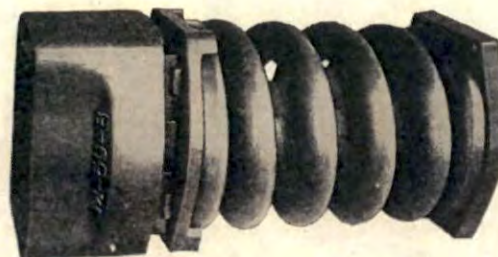


Fig. B—National Friction Draft Gear, Type M-50-B
A. A. R. Approved, Cert. No. 10

the M-50-B gears require two followers, when used in the standard draft lug spacing of $24\frac{5}{8}$ in.

Seventh: Prior to shipment, National gears are temporarily shortened about $\frac{1}{2}$ in. to facilitate their application to the cars. The small studs used for this purpose drop out during the first compression of the gears after application to a car and thus the gear is released to its normal length.

Eighth: The National M-17-A and M-50-B Draft Gears have been subjected to the tests required by the A.A.R. Standard Specifications for Approval of Draft Gears for Freight Car Service, and have passed all these requirements with an excellent margin. These gears therefore are approved as standard by the Association of American Railroads and are sold under their approval certificates.

NATIONAL MALLEABLE AND STEEL CASTINGS CO., CLEVELAND 6, O.

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 10—953

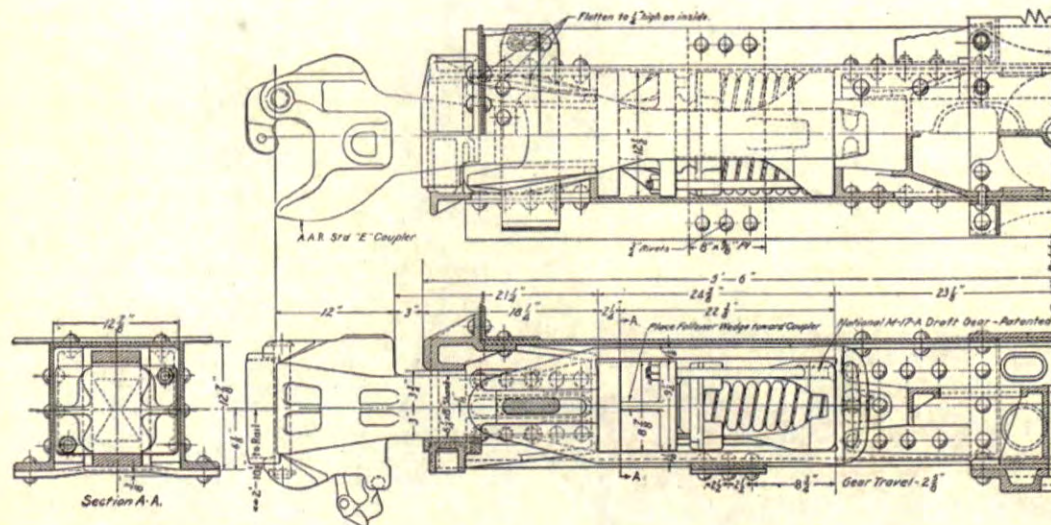


Fig. 10.69—National friction draft gear, Type M-17-A, applied to A.A.R. Type car in combination with A.A.R. Standard E Coupler and vertical cast steel yoke.

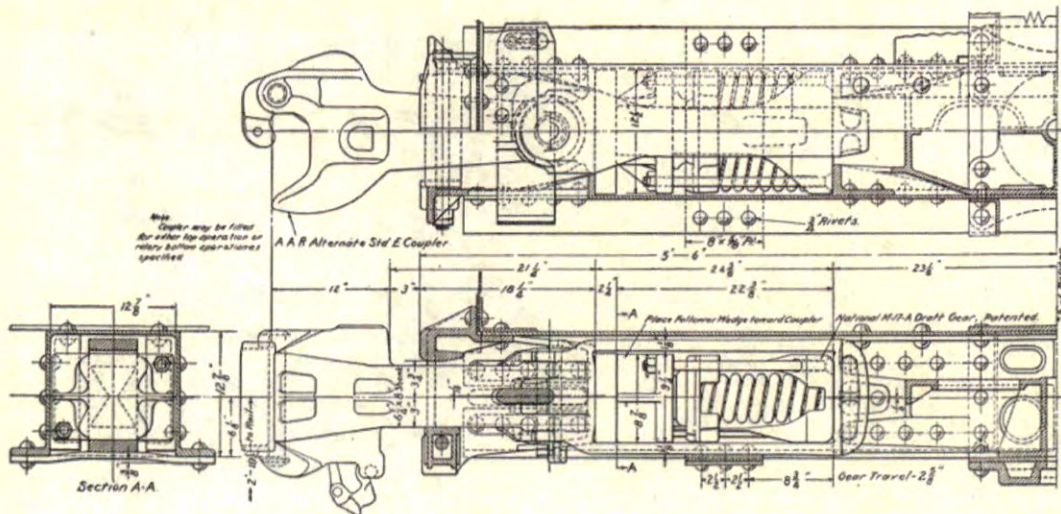


Fig. 10.70—National friction draft gear, Type M-17-A, applied to A.A.R. Type car in combination with Alternate Standard E Coupler and vertical cast steel swivel yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)

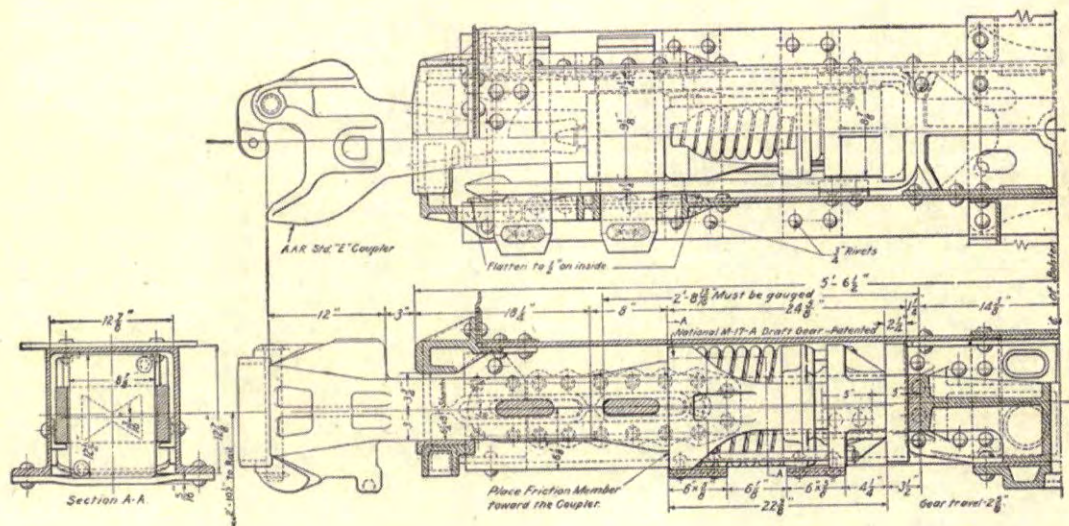


Fig. 10.71—National friction draft gear, Type M-17-A, applied to A.A.R. type car in combination with A.A.R. Standard E Coupler and horizontal cast steel yoke.

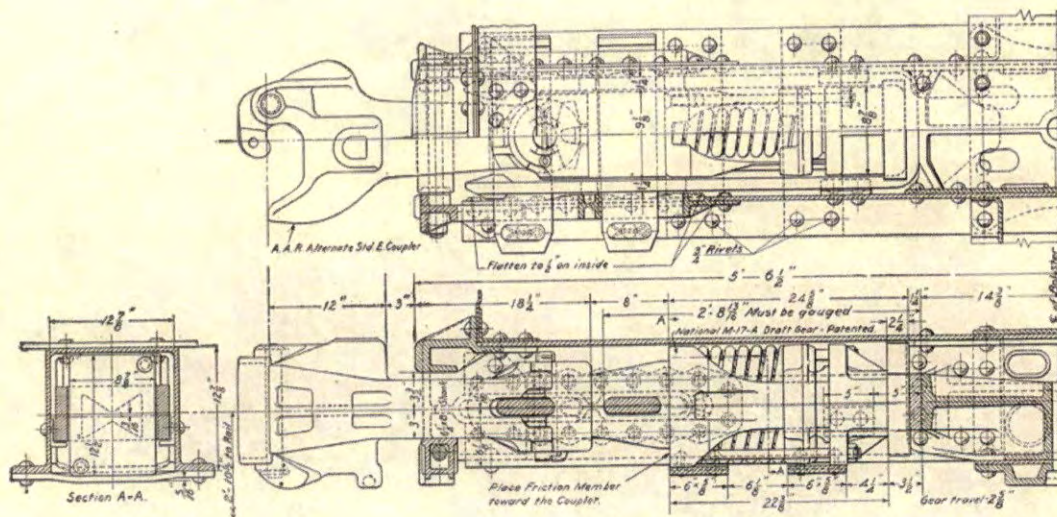
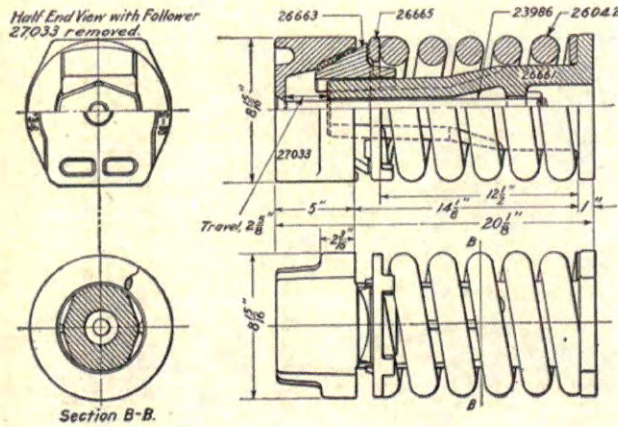


Fig. 10.72—National friction draft gear, Type M-17-A, applied to A.A.R. type car in combination with Alternate Standard E Coupler, swivel butt casting and horizontal cast steel yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)



List of Parts of Fig. 10.73

NUMBER	NAME	NO. PER GEAR
26665	Friction Segment Seat.....	1
27033	Follower Wedge	1
26661	Friction Member	1
26042	Draft Spring	1
23986	Retaining Rod and Nut.....	1
26663	Friction Segment	2

Travel of Gear.....Min., $2\frac{1}{2}$ in.; Max., $2\frac{3}{4}$ in.

Weight of Gear.....Average 245 lb.

Fig. 10.73—National friction draft gear, Type M-50-B. A.A.R. approved, certificate No. 10.

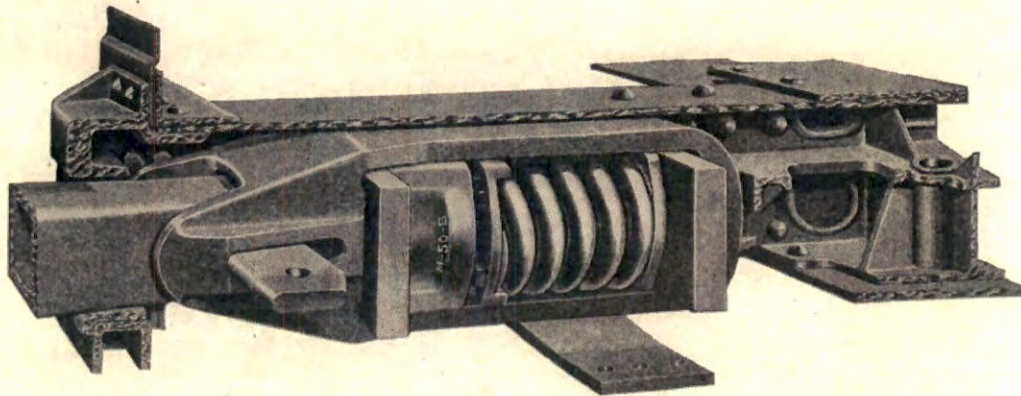


Fig. 10.74—National friction draft gear, Type M-50-B, A.A.R. approved, applied to car in combination with A.A.R. Standard E Coupler and vertical cast steel yoke.

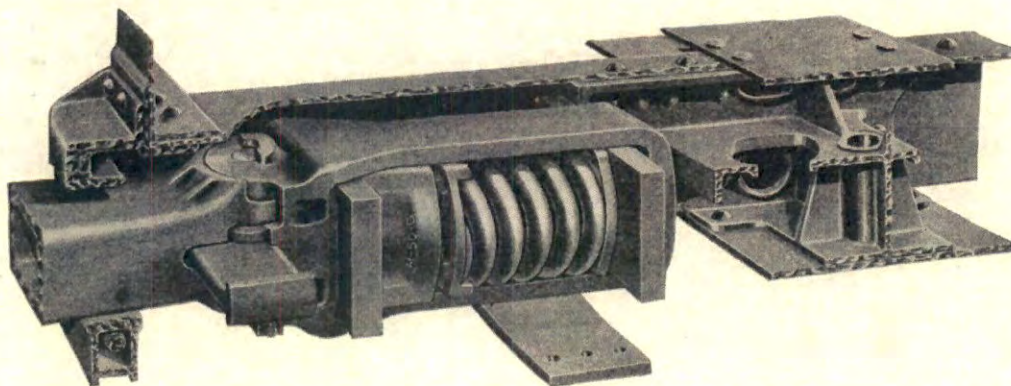


Fig. 10.75—National friction draft gear, Type M-50-B, A.A.R. approved, applied to car in combination with A.A.R. Alternate Standard E Coupler with vertical cast steel swivel yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)

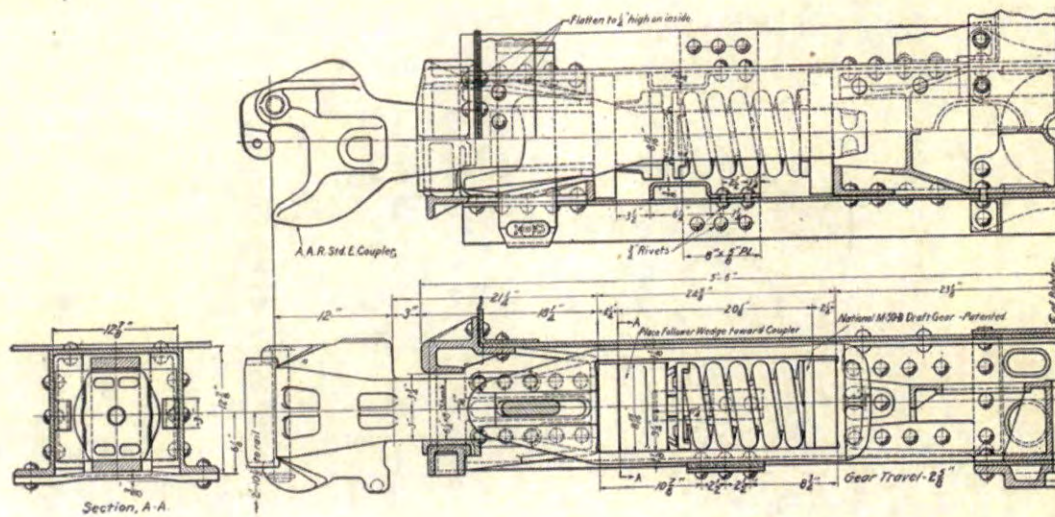


Fig. 10.76—National friction draft gear, Type M-50-B, applied to A.A.R. Type car in combination with A.A.R. Standard E Coupler and vertical cast steel yoke.

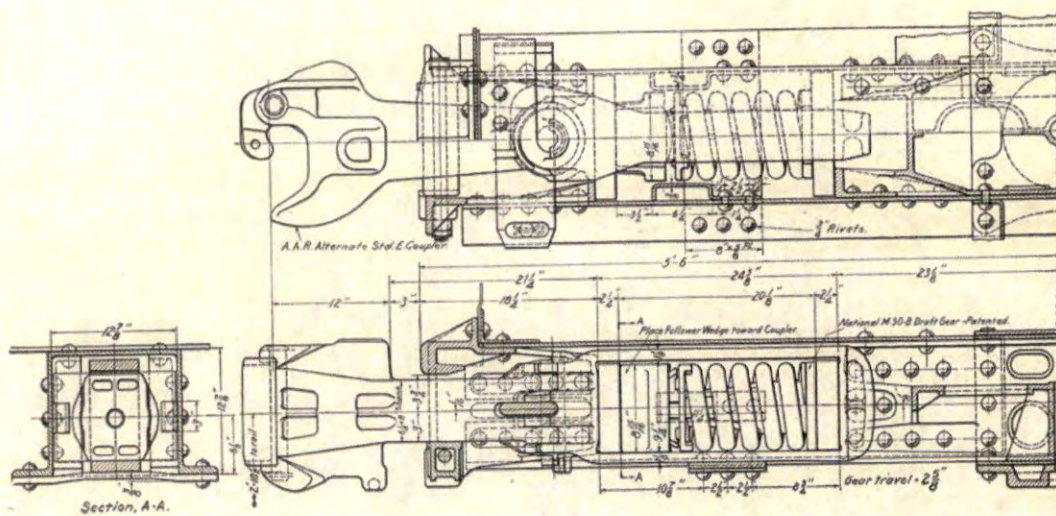


Fig. 10.77—National friction draft gear, Type M-50-B, applied to A.A.R. Type car in combination with A.A.R. Alternate Standard E Coupler and vertical cast steel swivel yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)

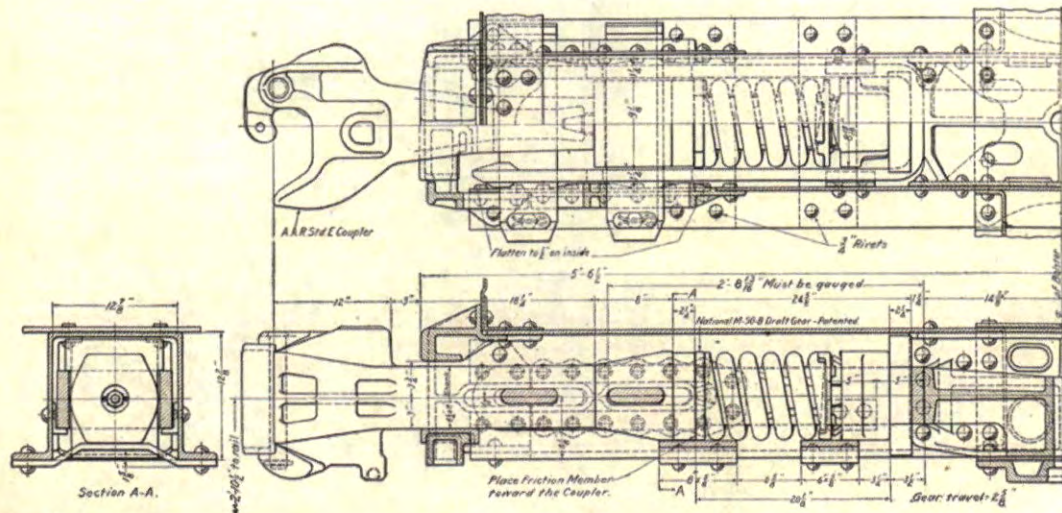


Fig. 10.78—National friction draft gear, Type M-50-B, applied to A.A.R. Type car in combination with A.A.R. Standard E Coupler and horizontal yoke.

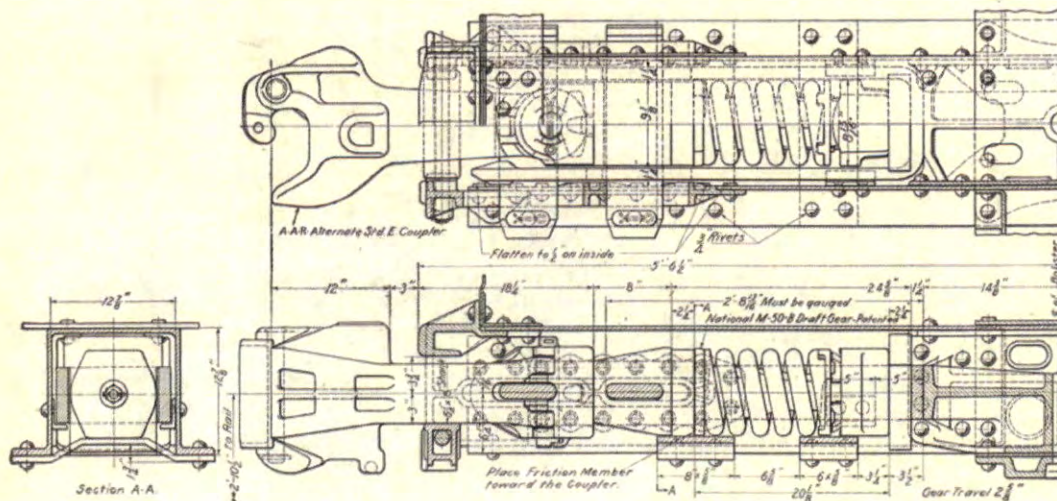


Fig. 10.79—National friction draft gear, Type M-50-B, applied to A.A.R. Type car in combination with A.A.R. Alternate Standard E coupler, swivel-butt castings and horizontal yoke.

National Malleable and Steel Castings Company

(See also Pages 953, 959)

National Draft Gear, Type K-4

Designed to meet the exacting requirements of passenger and caboose equipment service

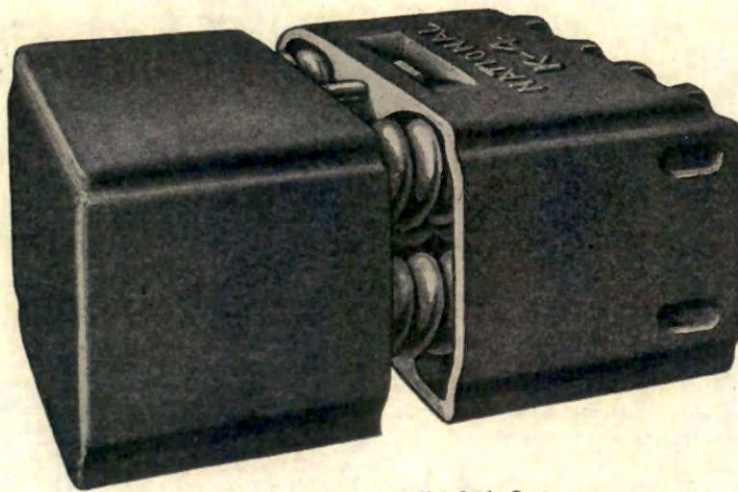


Fig. C—National Type K-4 Draft Gear

THE National Type K-4 Passenger and caboose Draft Gear embodies a combination of spring and friction resistance, the first one and one-half inches of travel in buff or draft being resisted by spring action, while for the remainder of the travel the spring action is augmented by frictional resistance to cushion the occasional heavier shocks incident to coupling, slack run-in, etc. This gear is of standard dimensions, $8\frac{7}{8}$ in. by $12\frac{1}{2}$ in. by $22\frac{3}{8}$ in., and requires one follower. The total nominal travel is $2\frac{1}{2}$ in.

Figure D shows a typical closure curve for this gear. The initial spring compression is approximately 3,000 pounds. This spring resistance increases as the gear closes, until at $1\frac{1}{2}$ inches compression it is 45,000 pounds. After this the resistance increases more rapidly as the friction system comes into action.

The internal construction of this gear is such that as the gear releases, the friction system releases first, followed by release of the spring system. This means that the frictional cushioning capacity of the gear is always available, even in the case of a rapid succession of blows. The spring resistance and

frictional resistance are so proportioned that pulsations in locomotive tractive effort are absorbed by the gear, thus insulating the cars from such disturbances.

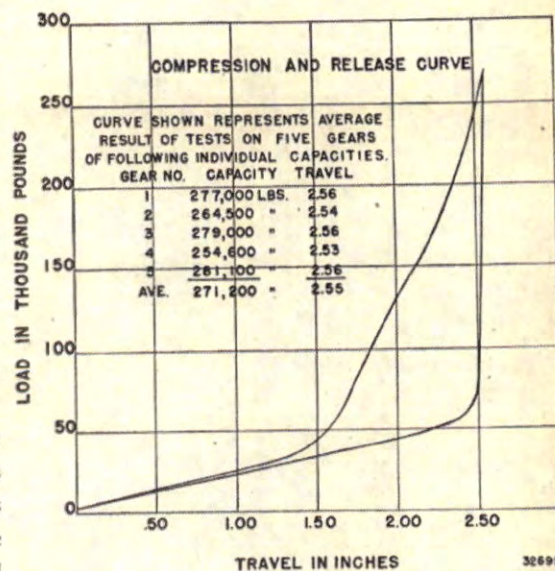


Fig. D—Closure Chart for Type K-4 Gears

NATIONAL MALLEABLE AND STEEL CASTINGS CO., CLEVELAND 6, O.

Products and Branch Offices Are Listed in the Classified Indexes

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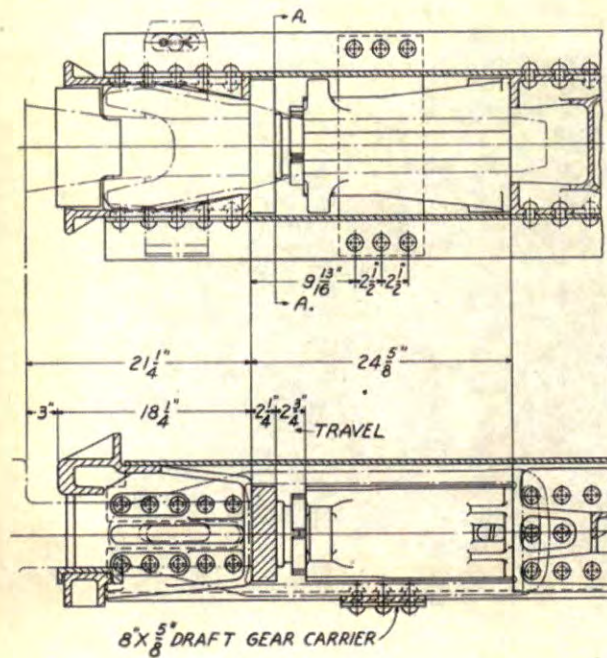


Fig. 10.81—Application of Peerless Type "H-1-B" friction draft gear with A.A.R. standard vertical yoke.

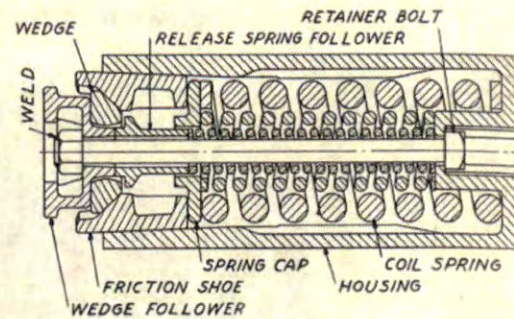
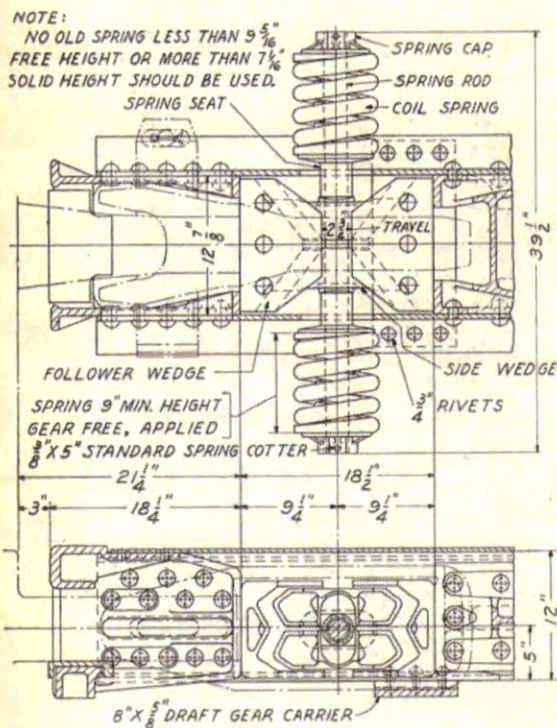
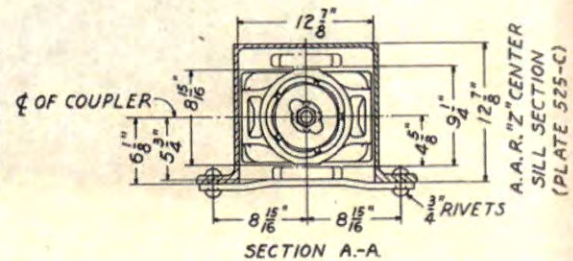
Fig. 10.80—Peerless Type "H-1-B" friction draft gear.
A.A.R. approved.

Fig. 10.82—Peerless Type "KC" friction draft gear.

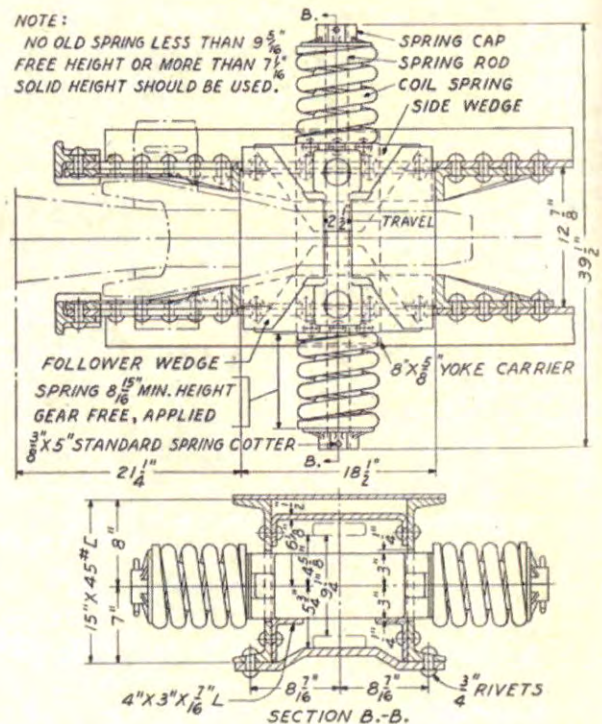


Fig. 10.83—Peerless Type "C" friction draft gear.

Peerless Equipment Company.

(See also Page 961)

Peerless Type H-1-B Friction Draft Gear

Clever design, careful selection of materials, and skilled workmanship
Provide light weight, maximum protection, heavier pay load and long service life

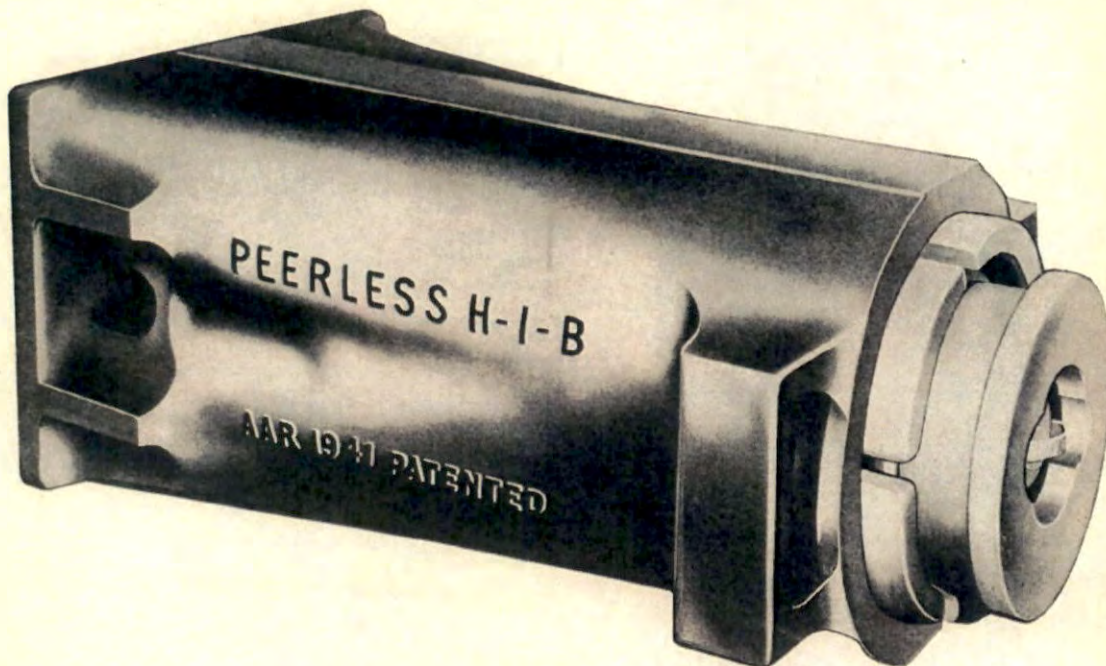
THE Peerless Type H-1-B A.A.R. Approved Friction Draft Gear was particularly designed to meet the requirements imposed upon draft appliances under the most severe conditions.

This gear is designed for uniformity, smoothness of action and high absorption qualities, with low recoil, resulting in a highly efficient mechanism adapted to effectively absorb the violent impacts incidental to present day traffic requirements.

shipped from the plant. This tup is a duplicate of the machine under which draft gears are tested for certification by the Association of American Railroads.

Other Interesting Features

The following features about the Peerless Type H-1-B Friction Draft Gear are worthy of note from the



Peerless Type H-1-B Hylastic Vanadium Steel Friction Draft Gear.
A. A. R. Certificate of Approval No. 8

Care in Manufacture

Great care is exercised in the selection of materials, and the best physical properties suited for each part of the gear are determined by exhaustive tests. Each unit as assembled is "worked-in" to insure uniformity. The final result is a completely heat-treated product, each part being required to pass rigid physical and chemical requirements.

Inspection

Peerless H-1-B Draft Gears are tested for capacity, travel and action under a 27,000-lb. tup before being

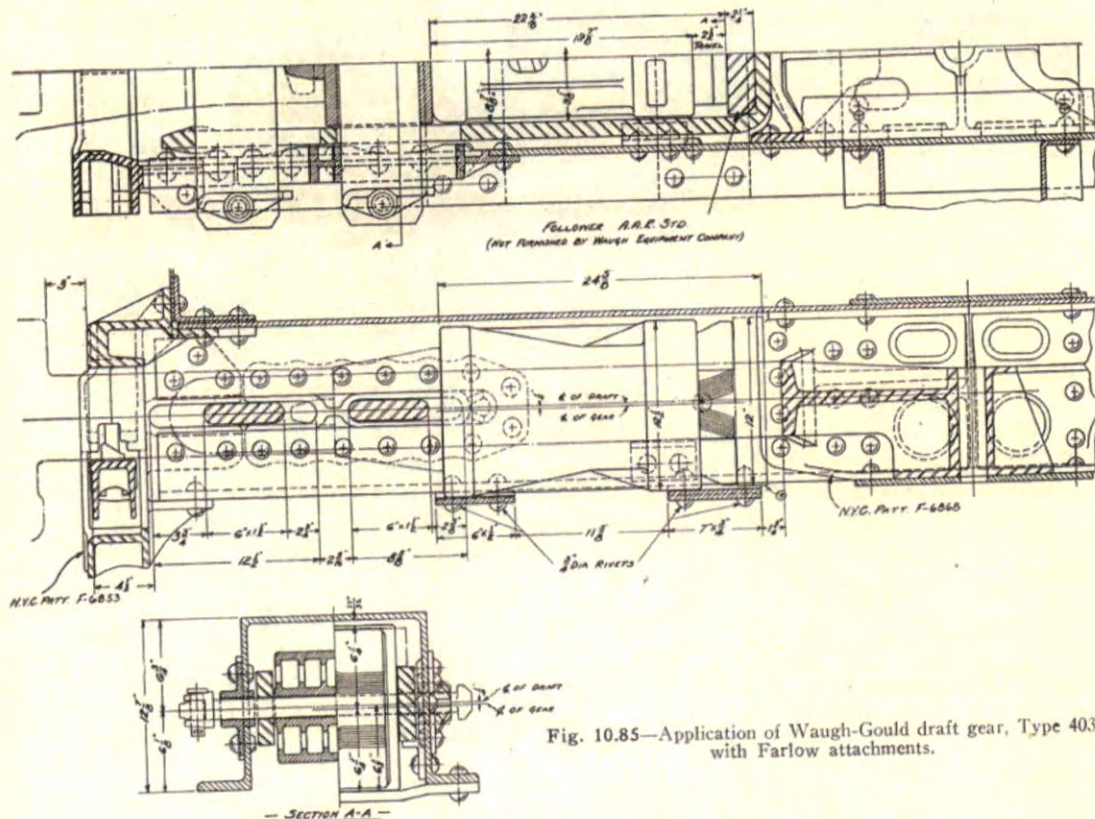
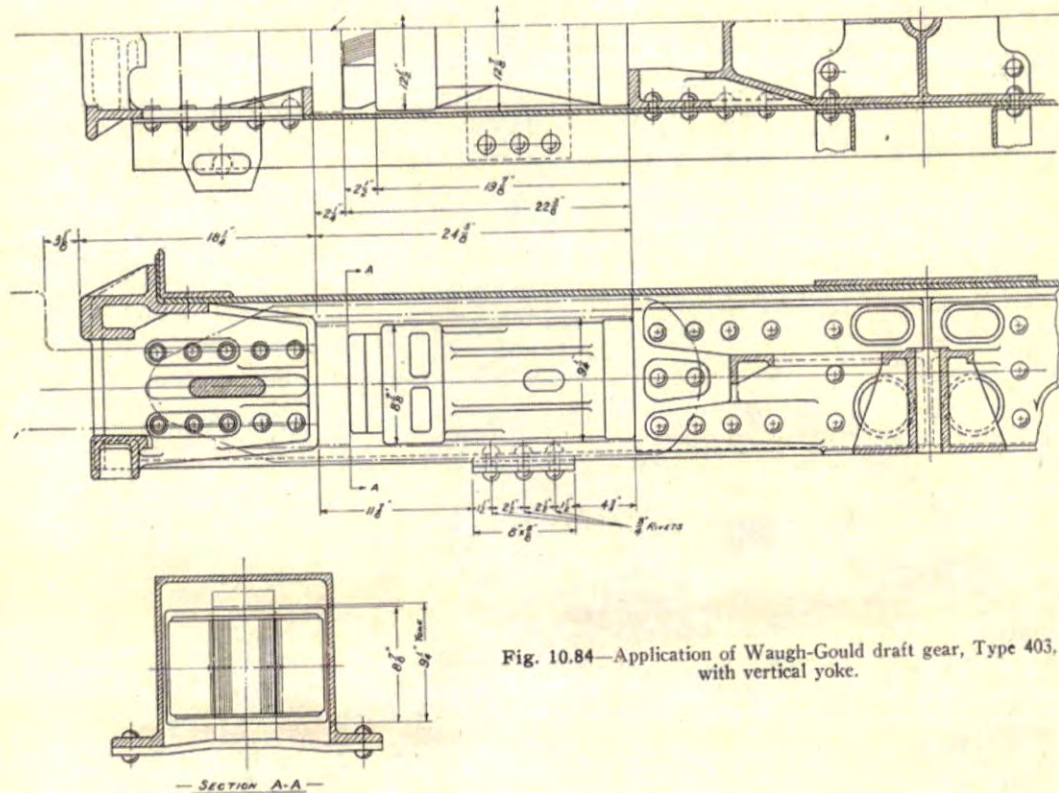
standpoint of operation and construction:—

1. In tests conducted at the A. A. R. Draft Gear Laboratory, Purdue University, and upon the results of which Certificate of Approval No. 8 was issued, this gear exceeded by a wide margin every requirement of the A. A. R. Specifications for Approved Friction Draft Gears.
2. Self-contained, easily assembled and easily applied.
3. Light in weight.
4. Positive release insured by an independent releasing mechanism. In the entire A. A. R. tests there was never a stuck blow.
5. Uniform and soft in action, high absorption, low recoil.

PEERLESS EQUIPMENT COMPANY, CHICAGO, ILL.

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 10—961



Waugh Equipment Company
(See also Page 963)

Waugh-Gould Type 403 Friction Draft Gear

THE Waugh-Gould Type 403 Friction Draft Gear was awarded the first draft gear certificate of approval issued by the Association of American Railroads. Sturdy construction insures ample strength to withstand the severest impacts received in service. The resilience of the housing structure reduces to a minimum the forces resulting from oversolid blows. This gear will protect equipment and lading over a long period of time and will resist the heaviest shocks impressed upon it without damage to any of its parts.

Space Requirements

The normal external dimensions are $8\frac{7}{8}$ in. by $12\frac{1}{2}$ in. by $22\frac{3}{8}$ in. requiring one follower for application to standard draft gear pockets. It is furnished with means for temporarily restricting the overall length to facilitate installation. The normal travel is $2\frac{1}{2}$ in.

Construction

The Waugh-Gould Type 403 Draft Gear is comprised of a cast steel heat-treated housing having integral friction surfaces against which casehardened wedges operate under the pressure of leaf springs. These leaf springs are held both in alignment and in position between the wedges by means of end-nibs. The gear is held assembled by means of a lug at the bottom of each wedge, which is locked into the housing.

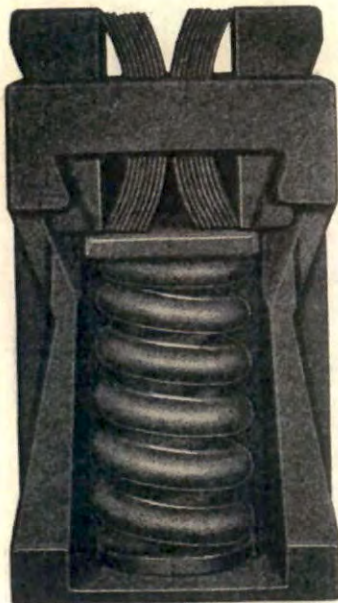
Operation

As the gear is compressed, the leaf spring pressure gradually increases on the wedges to a maximum at the point of full closure. This uniformly increasing

pressure of the leaf springs against the wedges as the gear is closed, brings about exceptional smoothness of operation. The use of leaf springs for developing working pressures of the friction system eliminates slippage and minimizes loss of gear capacity due to rust or other etching elements. Under no circumstances will the gear creep or become closed under continued surges in heavy draft. Soft metal inserts in the wedges stabilize the coefficient of friction and maintain smooth friction surfaces, practically eliminating wear both on the wedges and housing.



Waugh Gould
403 Draft Gear



Cross-section
of the
403
Gear
showing
spring
arrangement

All parts are interchangeable. No special tools or appliances are required to assemble or disassemble the gears. They can be readily taken apart for inspection and easily reassembled.

Adaptable for Light Cars Used in Foreign Service

The Waugh-Gould 403 Friction draft gear, designed primarily for American freight service, can be readily converted to provide a gear suitable for lighter weight cars by making one small change. Six leaf springs are removed and a spacer is substituted. This provides a gear of lower capacity but one retaining the characteristic smoothness of the Type 403 Draft Gear.

WAUGH EQUIPMENT COMPANY, NEW YORK 17, N. Y.

Products and Branch Offices Are Listed in the Classified Indexes

Sec. 10-963



Fig. 10.99—Buckeye A.A.R. vertical-plane draft yoke for 24 $\frac{5}{8}$ in. friction gears.



Fig. 10.100—Buckeye A.A.R. vertical-plane draft yoke of high-tensile steel.

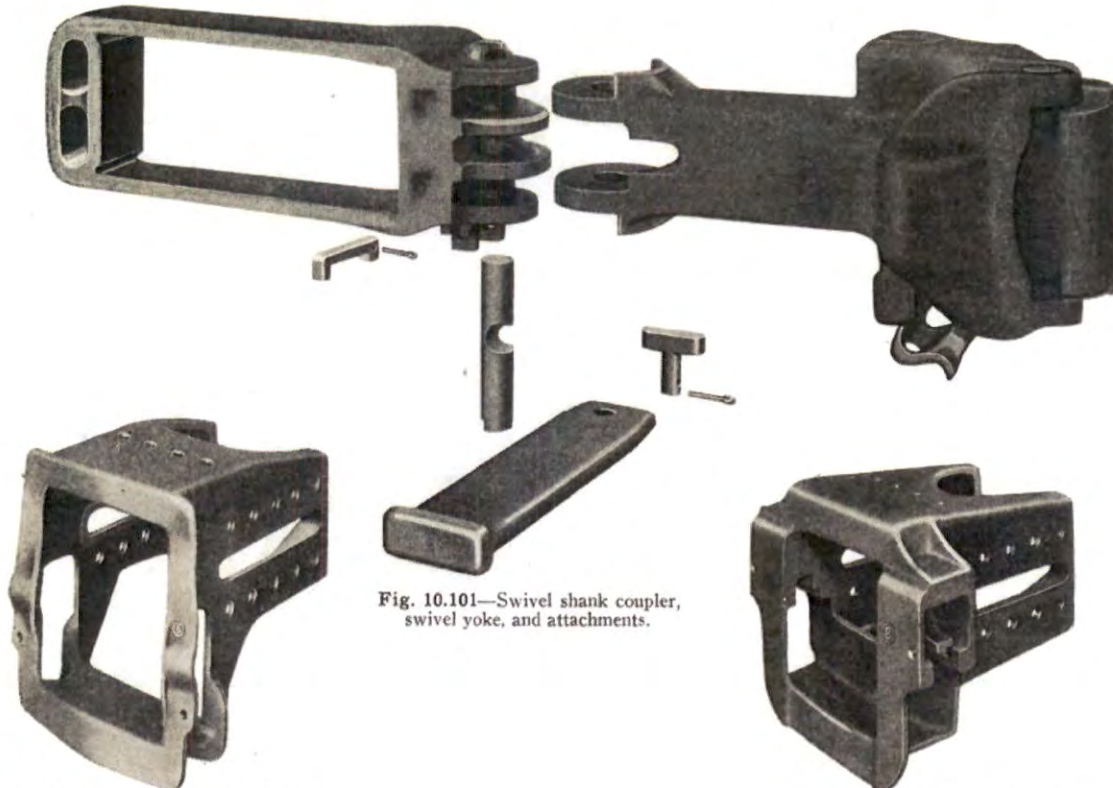


Fig. 10.101—Swivel shank coupler, swivel yoke, and attachments.

Fig. 10.102—Striker with Integral Front Lugs and Swing Coupler Carrier.

Fig. 10.103—Swing Motion Striker with Integral Front Lugs.



Fig. 10.104—Bolster Center Filler and Rear Draft Gear Lugs for box car.

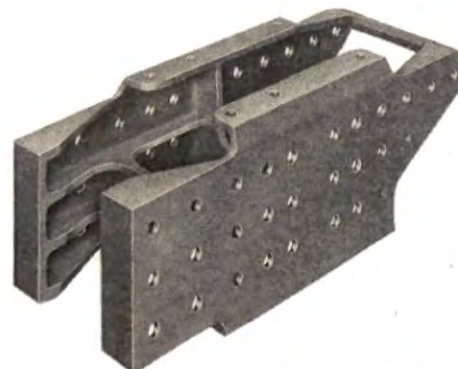
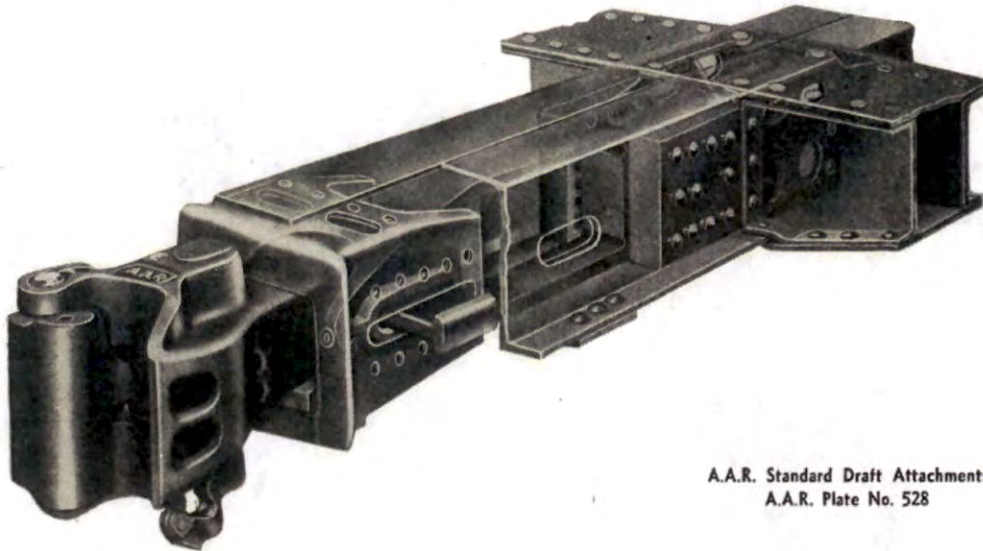


Fig. 10.105—Bolster Center Filler and Rear Draft Lugs for hopper car.

The Buckeye Steel Castings Company

(See also Page 973)

Buckeye Yokes and Draft Attachments



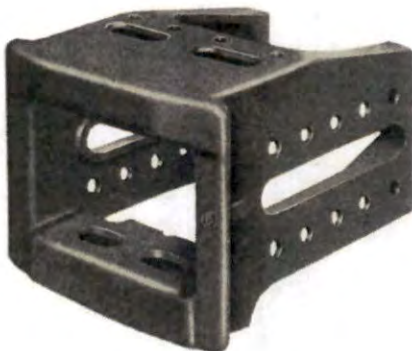
A.A.R. Standard Draft Attachments
A.A.R. Plate No. 528



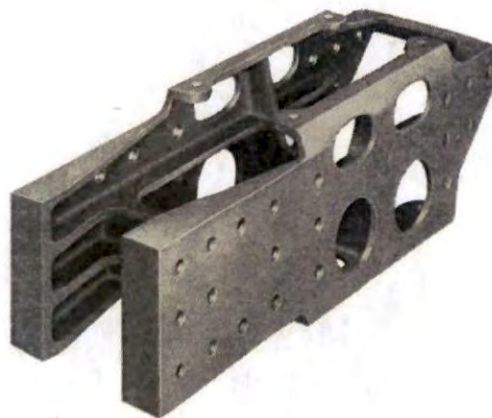
A.A.R. Standard
Vertical-Plane Draft Yoke



A.A.R. Alternate Standard
Vertical-Plane Draft Yoke



Striker with Integral Carrier
and Front Draft Lugs
A.A.R. Plate No. 532



Combined Bolster Center Filler
and Rear Draft Lugs
A.A.R. Plate No. 534

THE BUCKEYE STEEL CASTINGS COMPANY, COLUMBUS, OHIO

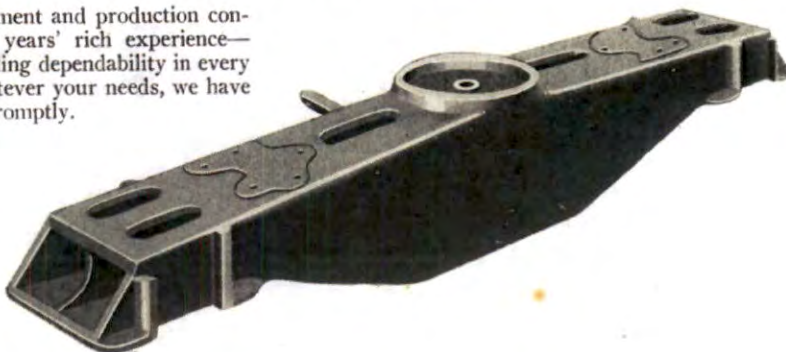
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Sec. 10—973

Specify Scullin for Stamina and Service In Freight and Locomotive Castings

THE most modern equipment and production controls—plus almost 50 years' rich experience—are your assurance of unfailing dependability in every Scullin steel casting. Whatever your needs, we have the facilities to fill them promptly.

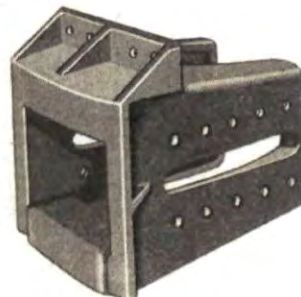
Truck
Bolster



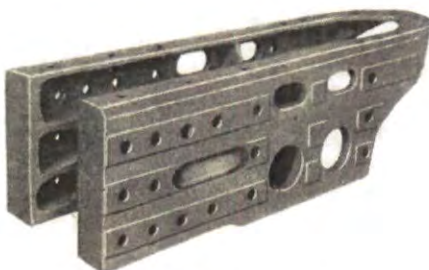
Integral-Journal-Box
Side Frame



A.A.R. Vertical Plane Cast Yoke
for Friction Gear



Striker with Integral Carrier
and Front Lugs



Bolster Center Filler and
Rear Draft Lugs



Swing Motion Striker with
Integral Front Lugs

SCULLIN STEEL CO., ST. LOUIS 10, MISSOURI

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Sec. 14—1136



Exhibit 7

C. A. LINDSTRÖM AND J. F. STREIB.

DUMP CAR CONSTRUCTION.

APPLICATION FILED JUNE 9, 1915.

Patented Nov. 18, 1919.

9 SHEETS—SHEET 1.

1,321,928.

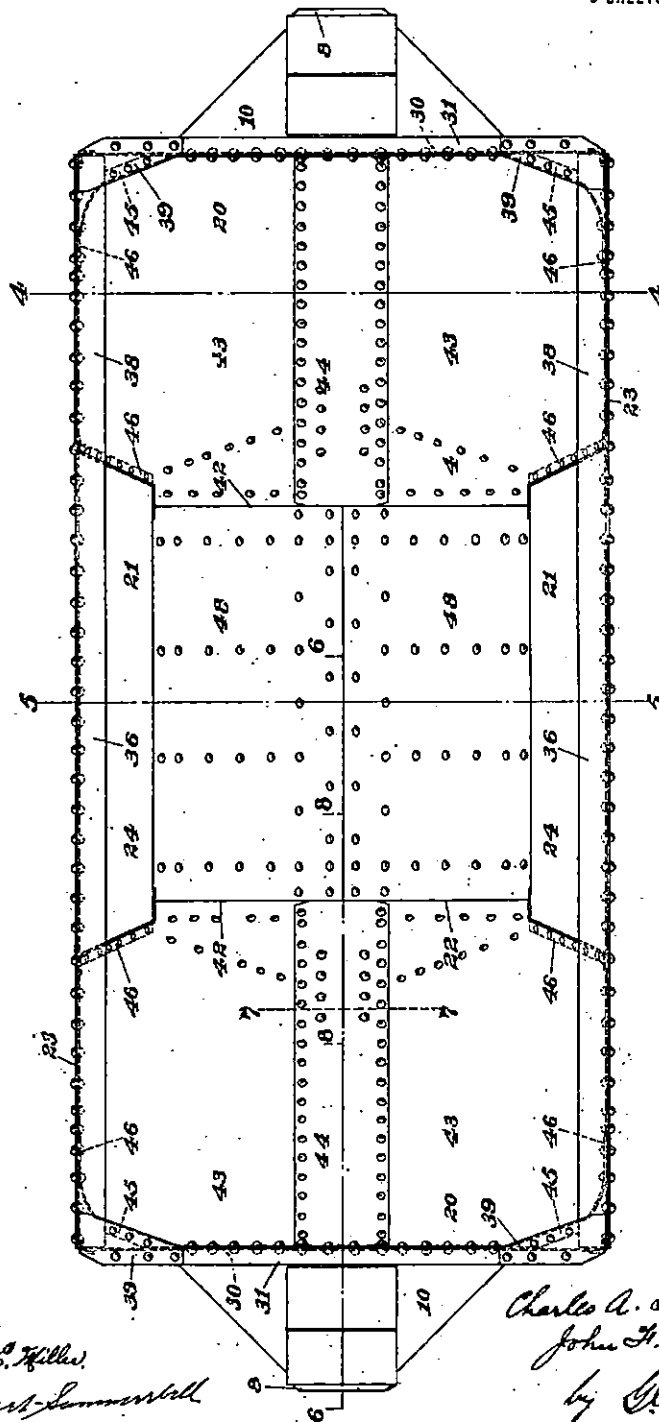


Fig. 1.

Witnesses

Frank C. Miller

Hagerst-Lummerell

Inventor

Charles A. Lindström,

John F. Streib

by C. A. Laube,

Attorney



DUMP CAR CONSTRUCTION.
APPLICATION FILED JUNE 9, 1915.

9 SHEETS—SHEET 2.

1,321,928.

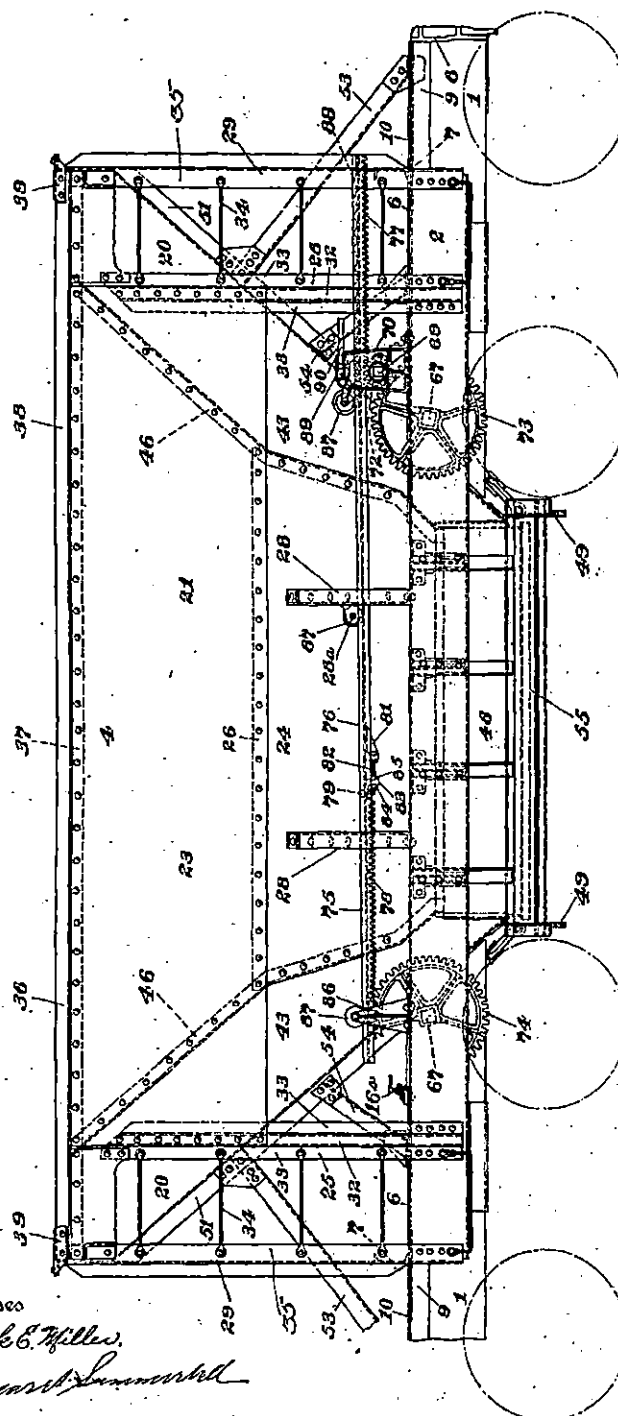


Fig. 2:

Witnesses

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Margaret Sumnerbell

Inventor
Charles A. Lindstrom
John F. Streib,
by C. Hawley.

Attorney

C. A. LINDSTROM AND J. F. STREIB.

DUMP CAR CONSTRUCTION.

APPLICATION FILED JUNE 9, 1915.

Patented Nov. 18, 1919.

9 SHEETS—SHEET 3.

1,321,928.

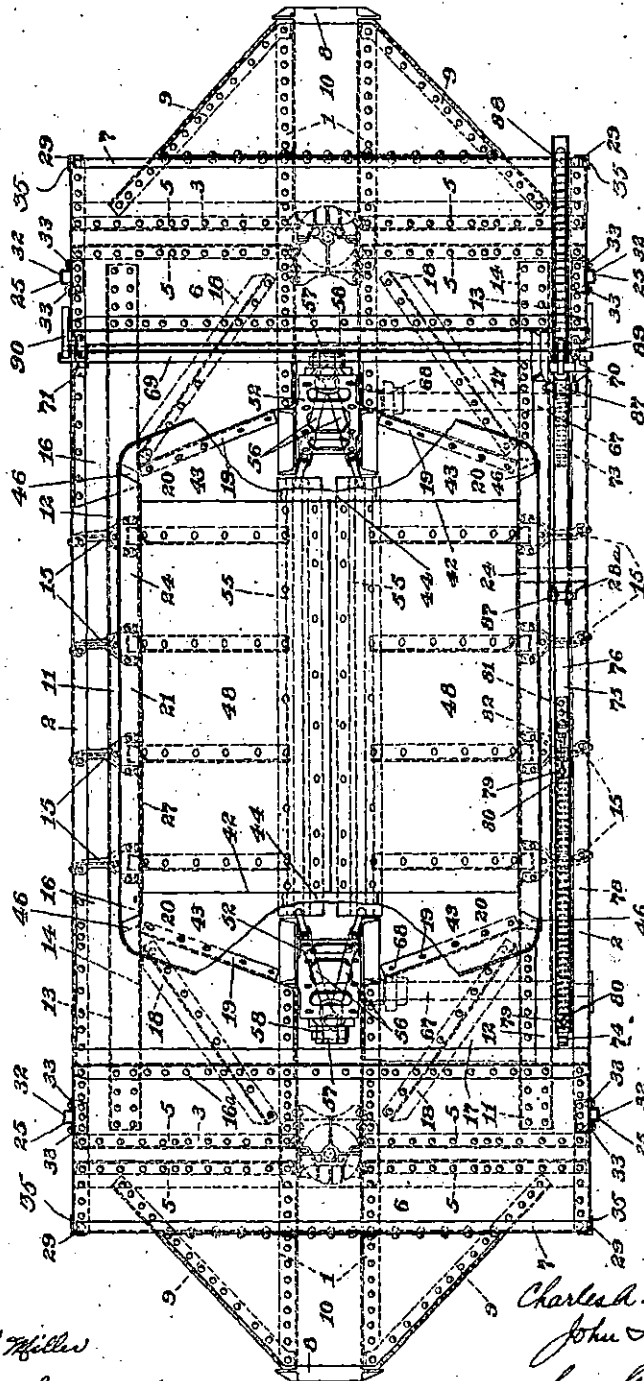


Fig. 3.

Witnesses

Frank C. Miller

Harold J. Summerville

Inventor.

Charles A. Lindstrom,

John F. Streib.

by *W. H. Lamb*,

Attorney

C. A. LINDSTRÖM AND J. F. STREIB.

DUMP CAR CONSTRUCTION.

APPLICATION FILED JUNE 9, 1915.

Patented Nov. 18, 1919.

9 SHEETS—SHEET 4.

1,321,928.

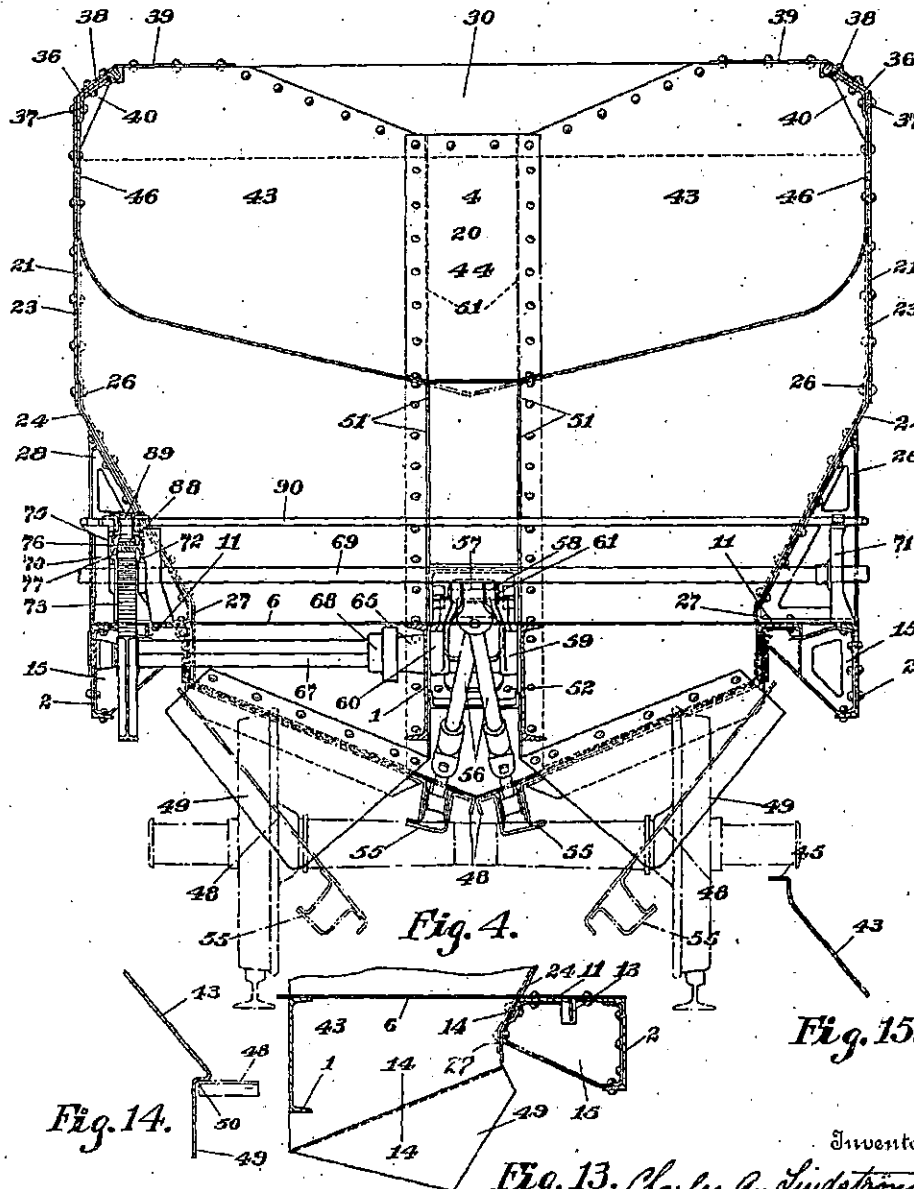


Fig. 14.

Fig. 4.

Fig. 15.

Witnesses

Frank C. Miller

Harper Summerhill

Fig. 13. Charles A. Lindström,

John F. Streib.

by C. C. Lamb.

Attorney

C. A. LINDSTRÖM AND J. F. STREIB,
DUMP CAR CONSTRUCTION.
APPLICATION FILED JUNE 9, 1915.

1,321,928.

Patented Nov. 18, 1919.

9 SHEETS—SHEET 5.

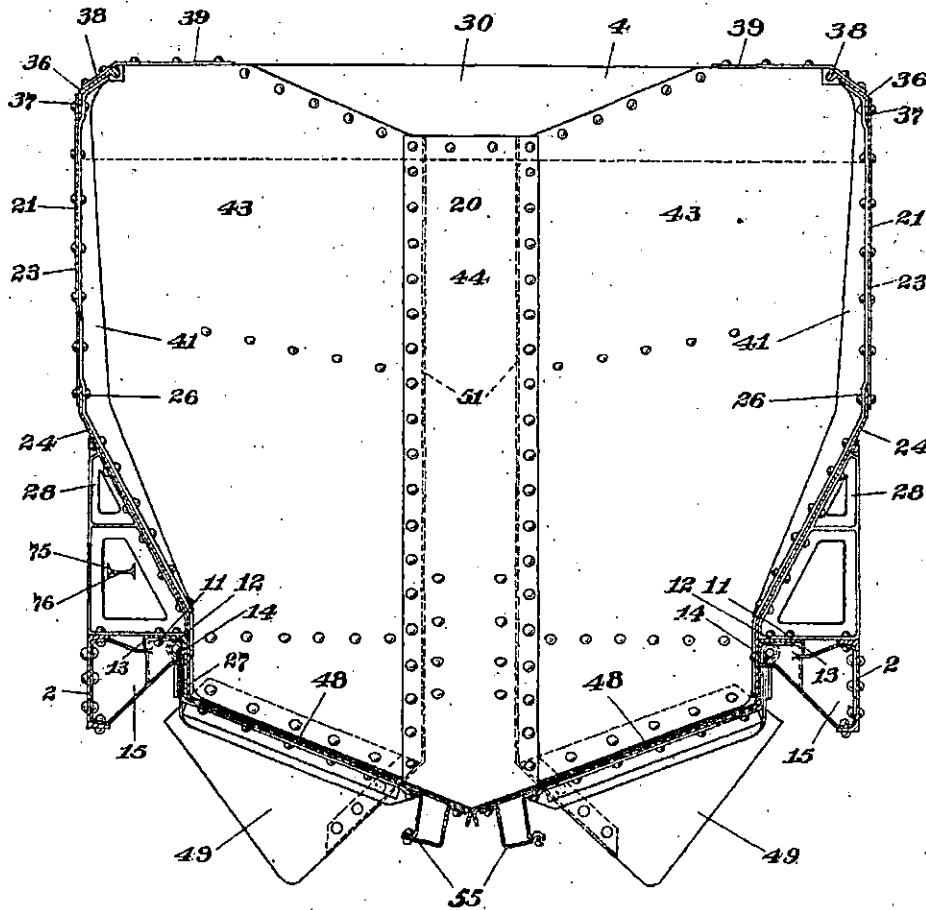


Fig. 5.

Witnesses

Frank C. Miller

Margaret Summerville

Inventor

Charles A. Lindström,

John F. Streib,

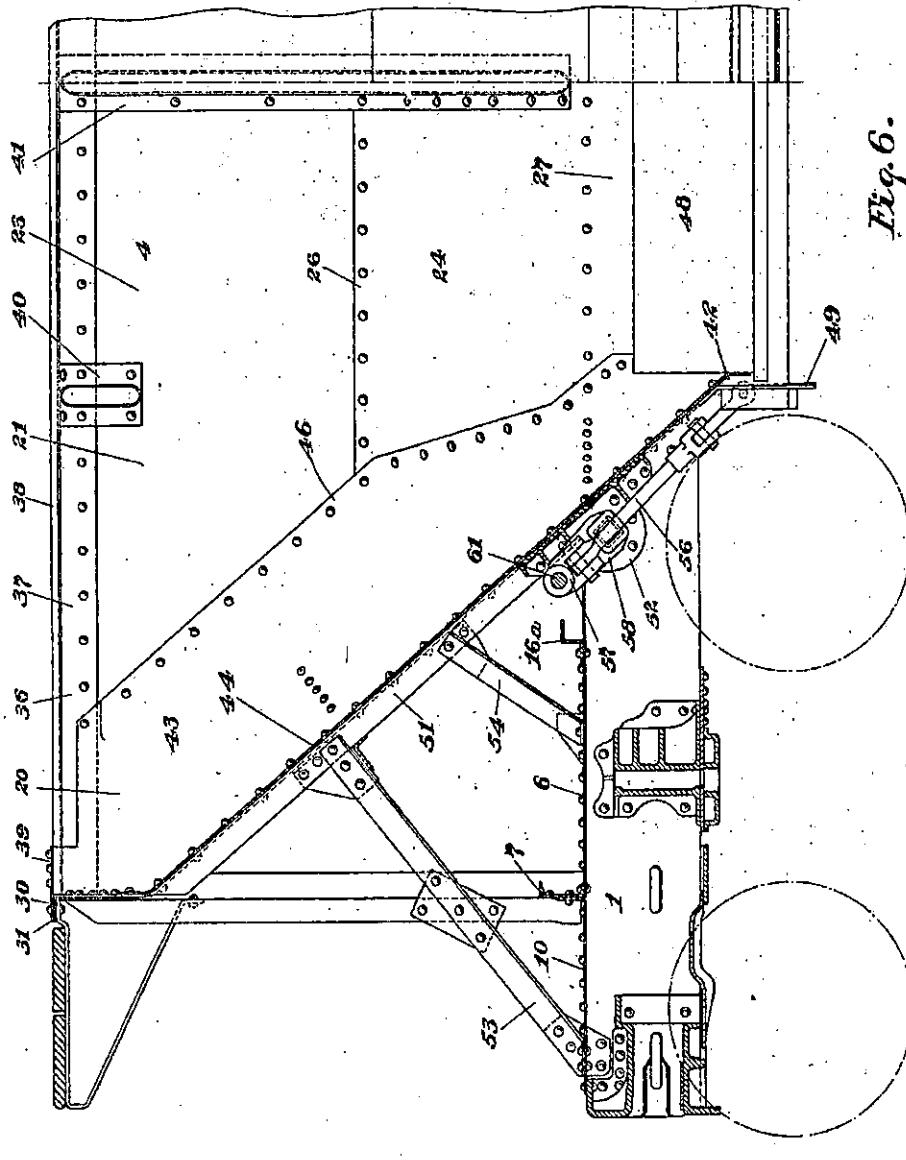
by A. H. Hume,

Attorney

C. A. LINDSTRÖM AND J. F. STREIB.
DUMP CAR CONSTRUCTION.
APPLICATION FILED JUNE 9, 1915.

1,321,928.

Patented Nov. 18, 1919.
9 SHEETS--SHEET 6.



Witnesses
Frank C. Keller
Margaret Summerbell

Inventor
Charles A. Lindström,
John F. Streib,
by *W. H. Lawrence*
Attorney

C. A. LINDSTRÖM AND J. F. STREIB.
DUMP CAR CONSTRUCTION.
APPLICATION FILED JUNE 9, 1915.

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9 SHEETS—SHEET 7.

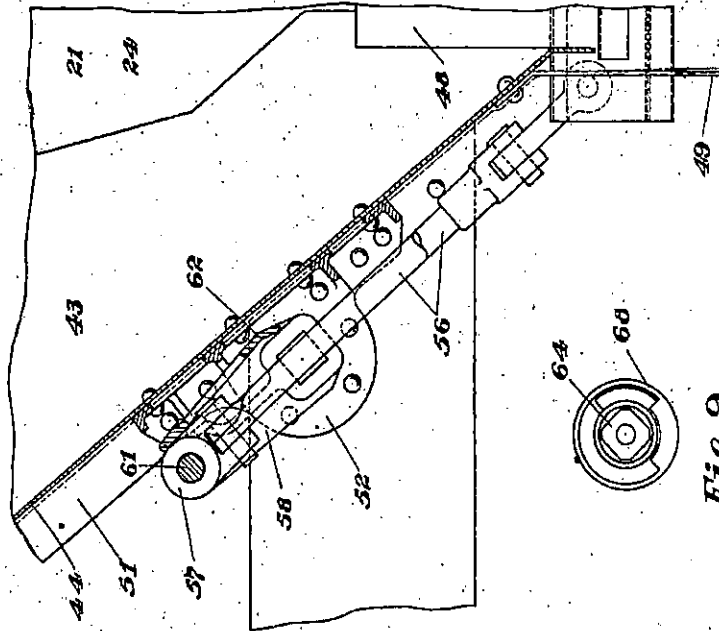


Fig. 8.

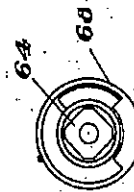


Fig. 9.

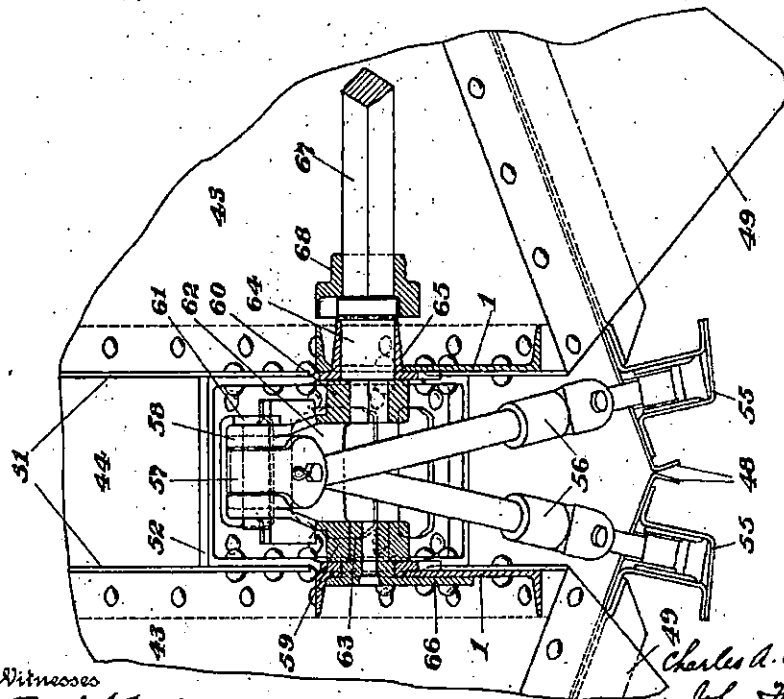


Fig. 7.

Witnesses

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DUMP CAR CONSTRUCTION.

APPLICATION FILED JUNE 9, 1915.

Patented Nov. 18, 1919.

9 SHEETS—SHEET 8.

1,321,928.

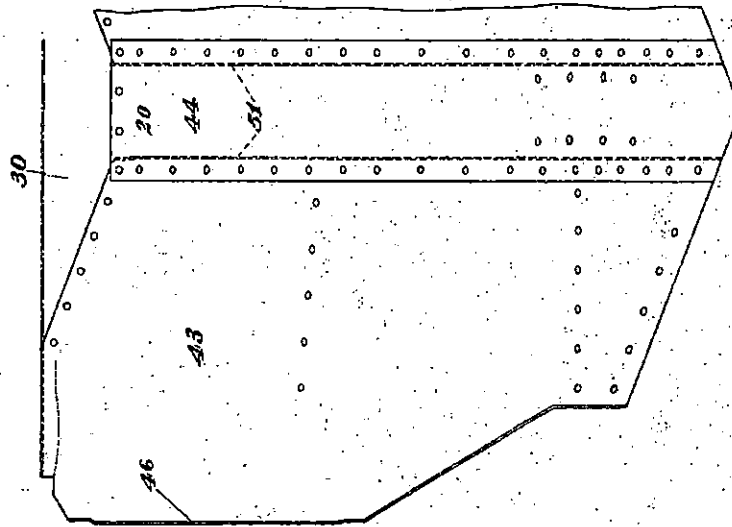


Fig. 11.

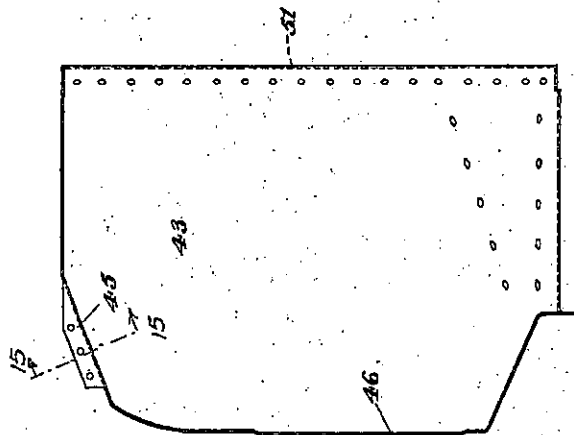


Fig. 10.

Witnesses

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9 SHEETS—SHEET 9.

1,321,928.

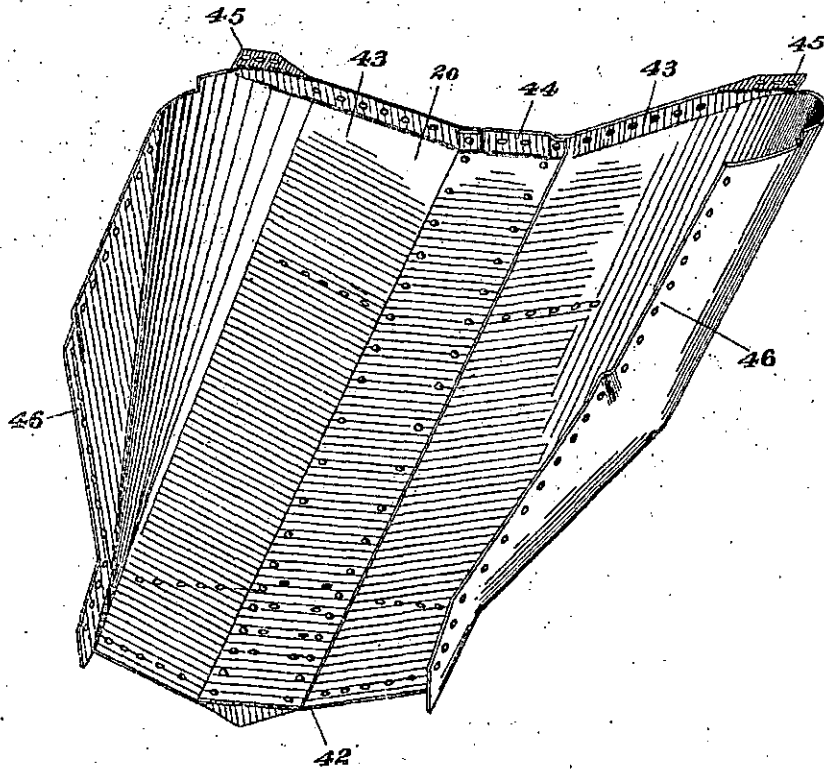


Fig. 12.

Witnesses

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UNITED STATES PATENT OFFICE.

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DUMP-CAR CONSTRUCTION.

1,321,928.

Specification of Letters Patent. Patented Nov. 18, 1919.

Application filed June 9, 1915. Serial No. 33,027.

To all whom it may concern:

Be it known that we, CHARLES A. LINDSTRÖM and JOHN F. STREIB, citizens of the United States, residing at #138 Stratford Ave., Pittsburgh, and #739 Taylor Ave., Avalon, respectively, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Dump-Car Construction, of which the following is a specification.

The present invention relates to improvements in dumping cars and door gears therefor.

One of the objects of our invention is to provide a dumping car having a large cubic capacity within certain limiting over-all dimensions of the car.

Another object of our invention is to provide a dumping car having the floor plates so shaped and arranged as to provide a large cubic capacity within certain limiting over-all dimensions and facilitate the complete and rapid discharge of the lading.

Another object of our invention is to provide a center dumping car having a single unobstructed discharge opening with means whereby the lading will be prevented from falling on the rails when being discharged.

Another object of our invention is to provide means for bracing the inwardly projecting legs of the side sheet top members against damage by falling material when the car is being loaded, or from other causes.

Another object of our invention is to provide a dumping car having novel framings at its sides and ends, which framings are rigidly connected together and which are well adapted to take care of the stresses and strains set up in the car.

Another object of our invention is to provide a dump car with an improved door-operating mechanism of the types shown in the Lindström United States Letters Patent Nos. 1,002,356, and 1,012,260.

With the above and other objects in view our invention resides in the construction, arrangements and combinations of parts hereinafter described and claimed.

Referring now to the drawings in which like reference characters refer to like parts and in which Figure 1 is a plan view of a car constructed in accordance with the inven-

tion, Fig. 2 is a side elevational view of the car; Fig. 3 is a plan view of the car with portions of the sloping end and side floors and the entire side sheets removed; Fig. 4 is an enlarged cross sectional view taken on the line 4-4 of Fig. 1; Fig. 5 is an enlarged cross sectional view taken on the line 5-5 of Fig. 1; Fig. 6 is an enlarged longitudinal sectional view of a portion of the length of the car taken on the line 6-6 of Fig. 1; Fig. 7 is an enlarged cross sectional view taken on the line 7-7 of Fig. 1, parts of the discharge door operating mechanism being removed in order to more clearly show the relation of the various component parts to each other; Fig. 8 is an enlarged detail view taken on the line 8-8 of Fig. 1; Fig. 9 is an enlarged detail view of one of the safety clutches; and Figs. 10, 11 and 12 are enlarged detail plan, part inside elevation and perspective views respectively of one of the sloping end floor sheets. Fig. 13 is a cross sectional view of a portion of a car illustrating modified forms of construction; Fig. 14 is a sectional view taken on the line 14-14 of Fig. 13, and Fig. 15 is a sectional view of one of the sloping end floor plates taken on the line 15-15 of Fig. 10.

Referring now in detail to the drawings 1, 1 indicate the draft sills, 2, 2 the side sills, 3, 3 the bolsters and 4 the car body. Each of the bolsters 3 comprises members 5, 5 which members at their inner ends are secured to the draft sills 1, 1 and at their outer ends are secured to the side sills 2, 2. The side sills 2, 2 are preferably of channel form and may extend from end to end of the car body 4. The side sills 2, 2, draft sills 1, 1 and bolster 3, at each end of the car, are connected together by a member 6 which is preferably in the form of a horizontally extending flat plate, thus forming a strong and rigid end framing. To further strengthen the end framing, a member 7 is provided which extends transversely of the car. This member 7 is preferably secured at its ends to the side sills 2, 2 and intermediate its ends to the draft sills 1, 1, and it may also be secured to the horizontal plate 6. The draft sills 1, 1 extend beyond the member 7 and at their ends are provided with the ordinary striking plate 8 and are braced by diagonal

members 9, 9 each of which has one of its ends secured to one of the draft sills, their other ends being secured to the member or plate 6. These sills 1, 1 are further strengthened and braced by a member 10 which is preferably in the form of a flat plate. This member 10 may be a continuation or part of the horizontal plate 6.

11, 11 indicate longitudinally extending members which are preferably of channel form, having their webs 12, 12 disposed in a horizontal direction and their flanges 13, 13 and 14, 14 disposed downwardly in a vertical direction. Each of these members extend preferably parallel with the side sills 2 and is secured to the framing at either end of the car by rivets or other suitable means. At intervals throughout their length each of these members 11 is connected with one of the side sills 2 by the transversely extending members 15 which are preferably of cast metal but if desired may be of pressed or built up construction. At the ends of the car and at one side of the longitudinal center line thereof, plates 16 are provided which are preferably secured to the draft sills 1, side sills 2 and the transverse member 16*, while on the opposite side of the longitudinal center line, plates 17 are provided which are secured to the draft sills 1, the longitudinally extending member 11 and the transverse member 16*. Each of these plates 16 and 17 are strengthened by diagonal brace members 18 which are preferably of Z form but which may be of any other suitable form. At their inner edges each of these plates 16 and 17 are provided with flanges 19 which are secured to the sloping end floors, herein after more fully described.

The longitudinal members 11 and the side sills 2, when connected in the manner just described, provide a composite or built up side framing construction which is adapted not only to receive and transmit the buffing and pulling strains to which the car is subjected when in use, but also serves to retain the rigidity of the car against the racking strains to which cars of this type are subjected.

The body 4 of the car is of substantially modified V-shape in longitudinal section and comprises sloping end floors 20, 20, and combined side walls and sloping floors 21, 21, some times herein referred to as sloping side floors, which are formed and connected together in such a manner as to permit of the free discharge of the lading through the single central unobstructed discharge opening 22 which is defined by the lower portions of such sloping end floors and combined side walls and sloping floors, and it will be observed that the longitudinal central portion of each end floor is V-shaped in cross-section. This longitudinal central portion is substantially open and unob-

structed for its full length, in other words the floor surface or load supporting surface of each end floor is a V-shaped portion which is clear and unobstructed for the full length and breadth of the floor. Because the end floor, and particularly the lower end thereof is an unobstructed V-shape, viz., because the central discharge opening 22 is clear and open for its full length and breadth and because it has no obstructing member extending along or across it, there is enabled to be realized a car which has a larger capacity and which also permits a freer discharge of the lading through the single unobstructed discharge opening 22 than would be realized if the floor construction were not made to embody the features above referred to.

Each of the combined side walls and sloping floors 21 may be made from a single sheet of metal, but for convenience in manufacture they preferably comprise an upper side plate 23 and a lower or sloping floor plate 24. The plate 23 is preferably flat throughout its length and at each of its end portions is connected with one of the posts 25 which may be secured to the side sills 2. The lower or sloping floor plate 24 is inclined downwardly and inwardly toward the longitudinal center line of the car and is provided with an upper flange 26 which is adapted to be secured to the lower portion of the upper plate 23, and is further provided with a lower flange 27 which may be secured to the flange 14 of the member 11, thus stiffening the lower portion of the combined side wall and sloping floor plate against bulging or buckling when the car is loaded with heavy material. We do not wish, however, to be limited to this exact construction for it will be seen from Fig. 13 of the drawings that if desired the sloping portion of the floor plate 24 may be secured to the flange 14 of the member 11 and the flange 27 of the floor plate may be secured to the members 15. To assist in supporting and stiffening the combined side walls and sloping floor plate 21, 21, members 28 are provided which are preferably of triangular form and secured to the longitudinally extending columns, viz., to the side sills 2, 2 and the members 11, 11 thereof, and to the sloping floor plates 24, 24.

At each end of the car body corner posts 29, 29 are provided which, at their lower end portions, are secured to the side sills 2, 2 and to the member 7. The upper end portions of these corner posts are connected together transversely of the car by a plate 30, which forms an end wall of the car body, and is provided with a stiffening flange 31.

Each of the posts 25 is preferably provided with a channel shaped corrugation

8z and with flanges 33, 33 which flanges may be secured to the side sill 2. When these posts 25 are secured to the side sill 2, the corrugations 32 extend outwardly beyond the vertical plane of the side sill and at their upper portion are connected with the side wall sheets 23 by rivets or other suitable means. At the sides of the car and at opposite ends thereof the ordinary ladder irons 34 are provided, each of which is secured to one of the flanges 33, of one of the posts 25 and the flange 35 of one of the posts 29. It will be seen from the foregoing description that the ladder irons 34 when secured to the posts 25 and 29 will be located wholly within the plane of the sheet 23 of the combined side wall and sloping floor plates where they will be, as nearly as possible, free from accidental damage.

36, 36 indicate top members of the car body which are preferably of angular form in cross-section, each having a vertically disposed flange 37 and a flange 38 which is preferably inclined. The flange 37 of each member is secured at its end portions to the corner posts 29 and intermediate its ends is secured to the upper portion of the side wall sheet 23. The flange 38 preferably extends in a direction toward the longitudinal center line of the car and at its end portions may be connected with the flange 31 of each end top plate 30 by a gusset member 39. To stiffen and strengthen the flange 38 of the members 36 against damage when the car is being loaded, brace members 40 are provided which may be secured to the under side of the flange 38 and to the side wall sheet 23. To further stiffen and strengthen the combined side walls and sloping floors 21, 21, stakes 41 are provided which are preferably of U-shape in cross section having lateral flanges, which are secured to the plates 23 and 24 by rivets or other suitable means. The upper end portions of these stakes are formed in such a manner as to also form stiffeners or braces for the flanges 37 of the top members 36.

Each of the end floors 20 is gradually depressed from its sides to its lowest portion at or near the longitudinal center line of the car and slopes downwardly and inwardly from the end of the body 4 toward the transverse center line of the car and as indicated at 42, the lower portion of the sloping end floor defines one end of the single central discharge opening 22, which discharge opening is rectangular in horizontal projection or plan. The form and slope of these end floors 20, 20 not only facilitate the free discharge of the lading but also provide for an increase in capacity without increasing the length or width of the car body. Each of these end floors is preferably of substan-

tially V-shape in cross section—take any transverse vertically extending cross-section—and the lower end of the V-shape portions define the ends of the discharge opening 22. Each end of the discharge opening 22 is in plan a straight line that extends transversely and at right angles to a line parallel with the longitudinal center line of the car. Each of the sloping end floors may be made of a single plate, but for convenience in manufacturing may comprise side end floor plates 43, 43 and a center end floor plate 44. The upper portions of the plates 43, 43 at each end of the body 4 are preferably secured to the plate 30 and may be provided with top flanges 45, 45 which may be secured to the gusset member 39. From the plate 30 and the gusset member 39 these end floor plates 43, 43 slope downwardly and inwardly to the discharge opening 22, and at their outer sides are bent in such a manner as to form flanges 46, 46 which are secured to the plates 23 and 24 of the combined side walls and sloping floors 21, 21. These plates 43, 43, besides sloping in a direction longitudinally of the car, also slope in a direction transversely of the car and converge from the combined side walls and sloping floors 21, 21 toward each other, and at their inner portions may be connected together by the center floor plate 44. If desired the plate 44 may be dispensed with and the plates 43, 43 may extend to the longitudinal center line of the car as shown in dot and dash lines Fig. 4 of the drawings and may be secured together in any suitable manner. As indicated at 47 in the drawings, the lower portions of these plates 43, 43 and 44 extend below the combined side walls and sloping floors and define the end edges of the single central unobstructed discharge opening 22. The doors 48, 48 are preferably hinged at the sides of the car to and between the jaws formed in the transverse members 15 and when in closed position said doors are adapted to contact with lower edges of the plates 43, 43. To the lower portions of the plates 43, 43 baffle plates or wings 49, 49 are secured which prevent the escape of the lading past the ends of the rectangular, substantially flat doors 48, 48 when such doors are in an open position. It will be seen that when the lading is being discharged the doors 48, 48 form in effect continuations of the combined side walls and sloping floors 21, 21, and such doors in conjunction with the baffle plates or wings 49, 49 will direct the discharge of the lading wholly within the space between the track rails. It will be noted that the wings 49 are depending triangular-shaped members that extend vertically and transversely of the car. It will also be observed that the triangular-shaped members or plates depend from the sides of

the V of the V-shape portions; or in other words, from the lower ends of the central V-shape portions of the sloping end floors. We do not wish to be limited to this exact construction of the lower portions of the sloping end floor plates 43, 43 and baffle plates or wings 49, 49, for it will be seen from Figs. 13 and 14 of the drawings that the baffle plates or wings may be made integral with the floor plates 43, 43. When these baffle plates are made integral with the plates 43, 43, flat surfaces 50, 50 may be provided against which the doors 48, 48 may contact when such doors are in closed position. The inner edge portions of the floor plates 43, 43, at each end of the car, may be provided with outwardly extending stiffening flanges 51, 51.

52, 52 indicate connection members each of which is secured to the draft sills 1, 1, flanges 51, 51 of the sloping end floor plates 43, 43 and to the sloping end floor plate 44, thus forming a connection between the body of the car and the underframe. Besides forming a connection between the body of the car and the underframe, this member also forms a support for portions of the door operating mechanism hereinafter more fully described. The lower portions of the sloping end floor plates are secured to the flanges 19 of the plates 16 and 17 thus providing additional connections between the body and the underframe.

To assist in supporting and bracing the body 4, members 53 and 54 are provided, each of which is preferably of angular form. One end of each of these members is preferably secured to one of the sills 1, and each member extends upwardly and the upper end thereof may be connected with the flange 51 of one of the floor plates 43 by rivets or other suitable means.

For the purpose of operating the doors 48, 48 we have provided a mechanism which is similar to the mechanism shown in U. S. Letters Patent No. 1,002,856 and 1,012,260, granted to Charles A. Lindstrom, with the following improvements: Instead of locating the crank operating mechanism on both sides of the car in such a manner that the mechanism on one side operates one end of each of the doors and the mechanism on the other side operates the other end of each of the doors, in which location they are difficult to inspect without going from side to side of the car, the mechanism has been mounted on one side of the car. This improvement also reduces the number of pinion wheels from two to one, and permits the whole mechanism to be constructed more accessible and compact, and also cheaper.

The present mechanism including parts previously used and the modifications are as follows: Each of the discharge doors 48 is provided with a beam 55, composed of Z or

other suitable section or sections extending along and under its free edge and projecting slightly on each end of the door. The ends of beams 55, 55 are connected through the medium of universally jointed links 56 to yokes 57, 57 pivotably mounted in crank frames 58, 58, which are preferably located between the sills 1, 1, and at each end of the doors. That is to say, there is a pair of links 56 at each end of the discharge doors, one end of each of said links being connected to the end of its respective beam 55, the other end of each pair of links being brought together and pivotally mounted in the yoke 57. Each of the crank frames which are oppositely disposed consists of a pair of crank arms 59, 60 connected together through the medium of a web 62. At the free ends of the crank arm there is carried the crank pins 61 upon which the yokes 57 are directly mounted. Each of the crank frames 58 is journaled, as later described, in the draft sills 1, 1 in such a position that when the discharge doors 48, 48 are closed, the links 56 and yoke 57 are on the dead center of the crank frame 58, or slightly beyond the same toward the sloping floor, so that the load on the doors tends to force the crank frame in the closing direction and thus the doors are automatically locked against opening from jars or shocks during transit. It will be noted from the drawings that the crank frames 58 are oppositely disposed so that through the medium of the yokes 57 and the links 56 they oppose each other, which arrangement is a further safe-guard against accidental opening of the doors during transit.

The arms 59 of the crank frames 58 are journaled on trunnions 63, while the arms 60 are provided with trunnions 64 having cylindrical outer bearing portions which are suitably journaled in bearing members 65 preferably integral with the members 52 secured between the sills 1, 1. Each of these trunnions is provided with a squared inner end which fits in a square perforation in the crank arm 60 and may form a member of the safety clutch hereinafter referred to. Trunnions 63 are each provided with a flange 66 which is preferably secured to the outer face of the sill 1.

For operating the crank frames 58, shafts 67 are provided which are secured in the outer portions of the clutches hereinafter described by any suitable means. The shafts 67 extend transversely from the clutches to the side of the car, and are supported at their outer ends by suitable bearings. Near the outer ends of the shafts 67, segments of gears are secured thereto, connected with rack operating mechanism hereinafter described.

Safety clutches are introduced for the purpose of permitting the dropping of the

doors quickly without danger to the operator. The clutch members 68 and the trunnions 64 are provided with projecting lugs, such lugs being in the same rotary plane so that the lug in the clutch member 68 when rotating will strike the lug on the trunnion 64 and transmit motion to such trunnion 64 and, conversely, either the clutch member or the trunnion is capable of limited non-transmitting movement relative to the other. These clutches are of the same general character as described in United States Letters Patent Nos. 865,714, 865,920 and 865,921 granted to Charles A. Lindstrom. It will be noted that the crank frames 58, in dropping the doors will make about one half revolution, and this being the case, because of the interposition of the clutches, such movement will not be transmitted to the shafts 67, and hence will be independent of shafts 67 and the balance of the mechanism.

It is necessary that the two crank frames 58 operate simultaneously to prevent undue strain on either side of a door due to one crank frame operating before the other, also that the two crank frames move away from the end sloping floors when the doors are being opened and toward the floors when the doors are being closed, which enables the placing of the crank frames closer to the floors and also allows the use of straight connections to the beams 55; further, as the load on the doors is naturally great, on account of the size of the doors as well as the nature of the lading, a power increasing mechanism is necessary. For this purpose the two shafts 67 are operatively connected to a common operating shaft 69, preferably extending transversely of the car and journaled in bearings 70 and 71. The shaft 69 is connected to one of the shafts 67 through the medium of a pinion 72 secured on the shaft 69, meshing with a segment gear 73 on the shaft 67, such segment gear projecting upwardly between the side sill 2 and the member 11, and shaft 69 being preferably located above the horizontal plane of the upper surfaces of the side and draft sills. The operating shaft 69 is connected with the other shaft 67 by means of a segment gear 74 on the shaft 67, the pinion 72 on the shaft 69 and toothed racks 75 meshing with and operatively connecting said segment gear 74 and pinion 72.

The rack 75 comprises a member 76 which is preferably of I form having toothed members 77 and 78 attached to its horizontally disposed web in such position as to mesh with the pinion 72 and the segment gear 74 respectively. The toothed member 78 is attached to the web of the member 76 through the medium of bolts 79 which pass through perforations in the member 78 and through slotted perforations 80 in the member 76, such bolts being held in position by

nuts or other suitable means. To the member 76, intermediate the members 77 and 78, a bracket 81 is secured. Held within this bracket and extending outwardly therefrom is a threaded member 82 which is adapted to pass through a perforation in the lug 83 of the member 78. This member 82 is provided with nuts 84 and 85 which are adapted to engage the opposite faces of the lug 83 and hold the member 78 in any desired position. When for any reason it is desired to lengthen or shorten the distance between the members 77 and 78 the nuts 84 and 85 are turned to effect such adjustment.

The rack 75 is supported in operative position by means of brackets 86 and 70, projections being provided on the inner sides of the vertical portion of the sides of the brackets, on which slide the side extensions or flanges of the rack. The rack is retained in such a position, that the teeth shall be in mesh with the teeth of the pinion 72 and segment gear 74, by means of rollers 87 which contact with the upper portions of the rack, and which are held in such position by means of pins which are passed through the upward extensions of the brackets 86 and 70. Intermediate the brackets 86 and 70 the rack is retained in position by a roller journaled between the lugs 28 which are preferably integral with one of the members 28.

For the purpose of holding the shaft 69 against movement when the mechanism is not being operated, a toothed member 88 is provided which is mounted on the rack 75 and which may be engaged by a pawl 89 pivotally mounted on the member 70 above the rack 75. This pawl 89 is adapted to be engaged by a cranked portion of a rod 90 which rod extends preferably from side to side of the car, and which may be operated from either side of the car by means of the cranked ends which are provided.

All of the parts of the mechanism having been described, the operation of the same may be briefly described as follows:—Assuming the doors to be closed and the car to be loaded with ore with the parts in the position as shown in Figs. 2, 3, 4, 6, 7, and 8 of the drawings, the operator grasps the rod 90 by one of its cranked ends and through its operation throws the pawl 89 out of engagement with the toothed member 88. A crank or wrench is then applied to the end of the shaft 69, which is then operated in the direction of the arrow, as shown in Fig. 2. This results in turning one of the shafts 67 in the same direction, and the other of the shafts 67, *i. e.*, the shaft geared directly to the shaft 69, in an opposite direction to the direction of rotation of the shaft 69. As the shafts 67 rotate, the lugs on their clutch members strike the lugs on the trunnions 64 which turn with the crank frame 58, whereupon the crank frames 58 are turned and the

links 56, yokes 57 and crank frames 58 run away from the shafts 67 for about one-half of a revolution as already described. To close the doors these movements are reversed.

We do not wish to be limited to the exact construction of the framing, body and end floors and discharge door operating mechanism as described in the specifications, for it will be apparent to those skilled in the art to which this invention appertains, that many changes may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. A dump car having sides, sloping end floors each for its full length being substantially V-shape in cross section, the longitudinal central V-shape portion of which is unobstructed throughout its full length, side floor plates connected to said sides, the lower portions of said side floor plates and the lower portions of the floor plates, that provide the sloping end floors, together defining a single unobstructed central discharge opening in the bottom of the car, and doors for closing said opening.

2. A dump car having connected sides and end floors, which end floors slope downwardly and inwardly, and with the sides define a simple unobstructed central discharge opening that is rectangular in plan, the lower end portion of each of the end floors which define the ends of the discharge opening each being substantially V shape, and having an unobstructed central portion.

3. A dump car having connected sides and end floors, the end floors each having, in each half that is outside of the longitudinal central portion of the car, a flat surface that slopes downwardly and inwardly toward the transverse central portion of the car and that slopes upwardly toward the corresponding side of the car, the lower edges of said end floors defining the ends of a single unobstructed discharge opening, the lower edge of each end floor in a transverse vertical view being substantially a V, and the load supporting surfaces at the lower end portion of each end floor being unobstructed.

4. A dump car having connected sides and end floors, the end floors each having a pair of flat surfaces, each of which surfaces slopes downwardly and inwardly toward the transverse central portion of the car and downwardly and inwardly toward the longitudinal central portion of the car, the floor surface at the lower end portion of each end floor being unobstructed and the lower edge of each end floor defining an end of a single central door opening provided in the car, each of which door opening ends are

in plan straight lines extending at right angles with a longitudinal center line of the car, that portion of each end floor which defines an edge of the door opening being substantially V-shaped in a transverse vertical view.

5. In a dump car, the combination with the sides and end framing thereof of a body mounted on said framing, said body having side plates with inwardly and downwardly extending side floor plates, and end floors each comprising a pair of end floor plates sloping downwardly and inwardly toward the longitudinal and transverse central portions of the car and a central floor plate connecting said sloping end floor plates, which central floor plate slopes downwardly and inwardly toward said transverse center line, the lower edge portions of said side floor plates and of said sloping end and central floor plates defining a single unobstructed discharge opening in the center of the bottom of the car, the load supporting surfaces along the lower central portion of the end floors being unobstructed whereby the lading is freely discharged when the discharge doors are open.

6. A dump car having a sloping end floor which throughout its length is of substantially V shape in cross section, the longitudinal central portion of said floor, and particularly the lower end thereof, being unobstructed, said floor comprising a plurality of metal plates connected longitudinally along the longitudinal central portion of the car, the lower edges of the sloping end floor forming the end of a single central discharge opening, and a pair of cooperating doors for closing said opening, which doors are substantially flat on the load carrying portion, meet at the longitudinal center of the car and are hinged along the car sides.

7. A dump car having at each end thereof a sloping end floor of substantially V shape in cross section, each of said end floors comprising a plurality of metal plates connected longitudinally along the longitudinal central portion of the car, the lower edges of the V portions of the sloping end floors defining the ends or opposite edges of a single central unobstructed discharge opening, the longitudinal central portion of each end floor being unobstructed whereby a free discharge of the lading is enabled to be realized.

8. A dump car having a single central discharge opening in its bottom, doors for closing said opening, sloping end floors of substantially V shape in cross section, and substantially triangular shaped means depending from the lower ends of the V portions of the sloping end floors, which triangular shaped means extend vertically and transversely of the car and are adapted to prevent

lading from falling on the track rails when said doors are in an open position.

9. A dump car having sloping sides, end floors of substantially V shape in cross section connected to said sides and with the sides defining a single central discharge opening in the bottom of the car, doors hinged at the sides of the car for closing said opening, and transversely extending extensions on said V-shape end floors adapted to prevent lading from falling on the track rails when the doors are in an open position.

10. A dump car having sloping sides, end floors having central portions of substantially V shape in cross section and curved side portions connected to said sides, which sloping sides and V shape central portions define a single central discharge opening in the bottom of the car, doors hinged at the sides of the car for closing said opening, and floor extensions depending from said V shape central portions adapted to prevent lading from falling on the track rails when the doors are in open position.

11. A dump car having sloping sides, end floors each of substantially V shape in cross section and unobstructed throughout its length and breadth which end floors are connected to said sloping sides and with said sloping sides defining a single central unobstructed discharge opening in the bottom of the car, and doors hinged at the sides of the car, meeting at the center of the car, and extending from end floor to end floor so as to close said opening.

12. A dump car body having sloping end floors having central portions of substantially V shape in cross section, a single discharge opening in its bottom, substantially triangular shaped plates depending from said V shape central portion adjacent to said opening which triangular plates extend vertically and transversely, and cooperating doors extending from the central portion of one end floor to the central portion of the other end floor for closing said opening, said triangular plates and doors being arranged so as to direct the dumping of the lading.

13. A dump car having sloping end floors with central portions of substantially V shape in cross section, a single discharge opening in its bottom, substantially triangular shaped plates depending from the lower ends of said V shape central portions and located adjacent to said opening, and doors meeting along a longitudinal center of the car for closing said opening, said doors being arranged between said depending plates, extending from end floor to end floor and hinged along the car sides and so that the free ends can swing downwardly and outwardly.

14. A dump car body having sloping end floors having central portions of substantially V shape in cross section and curved

side portions, a single discharge opening in its bottom, triangular wing plates depending from said V shape central portions adjacent the ends of said opening, and doors closing said opening, which doors are located between but are arranged to cooperate with said plates.

15. A dump car body having a sloping end floor at each end of the car, the longitudinal central portion of each end floor being substantially V shape in cross section, a discharge opening in the bottom of the car, substantially triangular shaped plates depending from said V shape central portion, which triangular shaped plates are located adjacent the ends of said opening, and doors hinged at the sides of the car body for closing said opening, said doors being adapted to swing between said plates.

16. A dump car body having sloping end floors of substantially V shape in cross section which define the ends of a central discharge opening, transversely extending triangular wing plates each depending from a side of the V of a V shape portion, and each located adjacent an end of said opening, and doors hinged at the sides of the body for closing said opening, said doors being adapted to swing between said plates.

17. A dump car body having sloping end floors with central portions of substantially V shape in cross section, a discharge opening in its bottom, said opening being of greater width than the distance between the track rails, doors hinged at the sides of the body for closing said opening, and substantially triangular shaped plates depending from said V shape central portions adjacent the ends of said doors and extending transversely of the car, said doors, when the latter are in an open position, cooperating with said plates to discharge the lading wholly within the space between the track rails.

18. A dump car having a single discharge opening in its bottom, said opening being of greater width than the distance between the track rails, but of shorter length than the distance between the inner truck wheels, sloping end floors having central portions of substantially V-shape in cross section, doors hinged at the sides of the body for closing said opening, and transversely extending plates depending from the lower V shape central portion of said sloping end floors and located adjacent the ends of said doors, said doors when in an open position cooperating with said plates to discharge the lading wholly within the space between the track rails.

19. A dump car having a substantially V-shape in cross section sloping end floor, said floor having at the lower portion thereof vertically depending portions forming transversely extending baffle plates.

20. A dump car having sloping side and

end floors which define a single discharge opening in the bottom of the car, the end floors having central portions of substantially V-shape in cross section and curved side portions, said central V shape portions having transversely extending depending portions, and doors for closing said opening arranged between said depending portions, the construction being such that the sloping sides are connected to the curved side portions of the end floors:

21. A dump car having sloping side and end floors which define a single discharge opening in the bottom of the car, the end floors having central portions of substantially V-shape in cross section and curved side portions, and doors for closing said opening, the construction being such that the sloping sides are connected to the curved side portions of the end floors.

22. A dump car having sloping side floors, sloping end floors with central portions of substantially V-shape in cross section and curved side portions connected to said side floors, which side and end floors define a single discharge opening in the bottom of the car, and doors for closing said opening.

23. A dump car having sloping end floors with central portions of substantially V-shape in cross section and curved side portions, a discharge opening in the bottom of the car, said opening being of greater width than the distance between the track rails, substantially triangular shaped wings depending from said central V shape portions at each end of said opening, and a pair of cooperating doors one hinged at one side of the car and the other hinged at the other side of the car, which doors are adapted to swing between said wings to close said opening.

24. A dump car having sloping side floors and end floors which longitudinally slope downwardly and toward the transverse center line of the car, which said side and end floors define a single unobstructed discharge opening in the bottom of the car, each of said end floors throughout its entire length being gradually depressed toward the longitudinal center line of the car, and also being unobstructed whereby the lower portion of each end floor is in cross-section substantially a V.

25. A dump car having an end floor which slopes longitudinally and which is gradually depressed toward a longitudinal center line of the car, said end floor having vertically and transversely extending depending portions at its lower end.

26. A dump car having sloping side floors and sloping end floors, said end floors comprising companion plates having upwardly extending outer side flanges for connection with said side floors and having depending flanges at their adjacent inner edges, which

depending flanges are connected with the framing of the car.

27. A dump car having sloping end floors of substantial V-shape in cross section, each of said floors comprising a pair of sloping floor plates, each floor plate having an upwardly extending flange along its outer edge and a downwardly extending flange along its inner edge.

28. A dump car having sides, end walls, gusset plates connecting said sides and end walls, and sloping end floors having upwardly extending flanges secured to said sides, and horizontal top flanges secured to said gusset plates.

29. In a dump car, the combination of an end wall, a side wall, a sloping end floor having horizontal top flanges, and a gusset plate adapted to connect said walls and flanges together.

30. In a dump car, the combination with the end framing, of side framing secured thereto, said side framing comprising a plurality of parallel channel shaped members having their webs disposed substantially at right angles to each other, transverse members adapted to connect said channel members, and a body extending between and carried by said framings.

31. In a dump car, the combination with the end framings, of side framings connecting said end framings, said side framings each comprising a plurality of parallel double flanged members having their webs disposed at substantially right angles to each other, flanged transverse members adapted to connect said flanged members, and a body carried by said end and side framings, the lower portions of said body extending between said flanged members.

32. A dump car having in combination a horizontally extending plate located at each end of the car, composite side framings each comprising a longitudinally extending member with vertically extending web, and a longitudinally extending member with horizontally extending portion, which longitudinally extending members are connected by transversely extending members so as to form the built-up or composite side framing construction, said longitudinally extending members being located below and secured to the horizontally extending plates, draft sills located below and secured to said horizontally extending plates, bolsters located between and secured to said composite side sills, and a body having sloping end floors secured to said draft sills, and sloping side floors secured to said side framing.

33. A dump car having in combination a horizontally extending plate located at each end of the car, a pair of composite side framings each framing comprising a longitudinally extending member with vertically extending web, and a longitudinally ex-

tending member with horizontally extending portion, which longitudinally extending members are connected by transversely extending members so as to form the built-up or composite framing construction which is located at the side of the car, draft sills located below and secured to said horizontally extending plates, bolsters located between and secured to said composite side framings, spaced transversely extending braces or stiffening members located at each end of the car above the horizontally extending plate at each end of the car and secured to the longitudinally extending side framing and draft sills, and a body having sloping end floors secured to said draft sills and sloping side floors secured to said side framing construction.

34. In a dump car, side framing comprising a plurality of channel shaped members having their webs disposed at substantially right angles to each other, means for connecting said members together, and a sloping side floor secured to one of said channel shaped members.

35. In a dump car, a side framing comprising a plurality of connected channel shaped members, the web of one of said members being disposed horizontally and the web of the other of said members being vertically disposed, and a sloping side floor

secured to one of said channel shaped members.

36. In a dump car, a side framing comprising a plurality of channel shaped members having their webs disposed at substantially right angles to each other, transverse members connecting said channel shaped members and a discharge door hinged to said transverse members.

37. In a dump car, a side framing comprising a plurality of members having webs disposed at substantially right angles to each other, and transverse members, secured to and connecting the webs of said members, and a discharge door hinged to said transverse members.

38. In a dump car, a side framing comprising a plurality of longitudinally extending channel shaped members having their webs disposed at substantially right angles to each other, transverse members secured to the webs of said channel shaped members and a discharge door hinged to said transverse members.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES A. LINDSTRÖM.

JOHN F. STREIB.

Witnesses:

FRANK E. MILLER,

MARGARET SUMMERBELL.

Exhibit 8



US008132515B2

(12) United States Patent
Forbes et al.**(10) Patent No.: US 8,132,515 B2**
(45) Date of Patent: Mar. 13, 2012**(54) RAILROAD GONDOLA CAR STRUCTURE AND MECHANISM THEREFOR****(75) Inventors:** James W. Forbes, Campbellville (CA); Marcus Thlesen, Hamilton (CA); Dave Keats, Brantford (CA)**(73) Assignee:** National Steel Car Limited (CA)**(*) Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.**(21) Appl. No.:** 12/816,660**(22) Filed:** Jun. 16, 2010**(65) Prior Publication Data**

US 2010/0251922 A1 Oct. 7, 2010

Related U.S. Application Data**(62) Division of application No. 12/559,065, filed on Sep. 14, 2009.****(30) Foreign Application Priority Data**

Sep. 14, 2009 (CA) 2678605

(51) Int. Cl.**B61D 17/00** (2006.01)**(52) U.S. Cl.** 105/406.1; 105/248; 105/240; 105/247; 105/250**(58) Field of Classification Search** 105/406.1, 105/406.2, 396, 404, 411, 413, 416, 417, 105/418, 419, 250

See application file for complete search history.

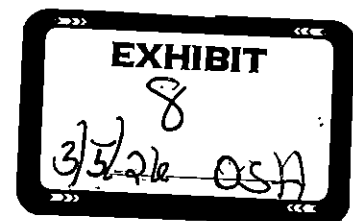
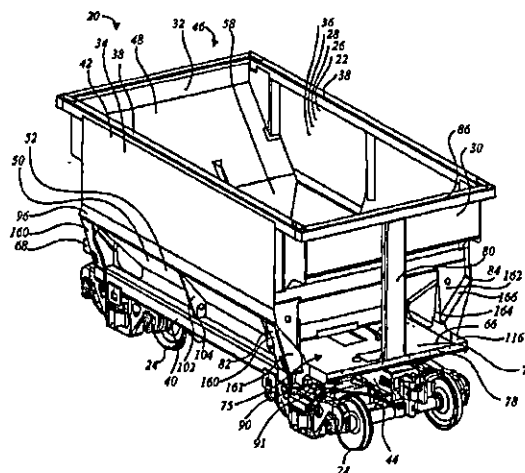
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5 Photographs of Quebec Iron and Titanium (QIT) ore hopper car No. 556, dated Aug. 15, 2007.

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Primary Examiner — Joe Morano, IV*Assistant Examiner* — Jason C Smith**(74) Attorney, Agent, or Firm** — Hahn Loeser & Parks LLP; Michael H. Minns**(57) ABSTRACT**

A railroad gondola car has a hopper carried between two trucks. The hopper has convergent end and side slope sheets that feed a bottom discharge. The bottom discharge has a pair of longitudinal doors. The door closing mechanism is a mechanical transmission that includes a set of linkages running from the door to a reciprocating pneumatic cylinder. The linkages run generally parallel to the slope sheet. The car has a very short draft installation that includes a removable coupler carrier bar, and the main shear plate has a removable draft gear installation panel. There is a machinery space above the end section shear plate. It is overhung by the slope sheet that is substantially unobstructed by any other primary structure. The pneumatic cylinder is mounted on an angle in this unobstructed machinery space, oriented longitudinally over the draft sill beneath the main drag link of the mechanical transmission, and above the main pivot of the driving input lever of the transmission. The main lever is bifurcated, and straddles the pneumatic cylinder. The mechanism includes a primary lock in the form of an over center lever arrangement, and a compact secondary lock that acts sideways rather than lengthwise. The sidewalls of the car include vertical stiffeners and side sheets. The lower portion of the side sheets lies laterally inboard of the stiffener web, while the upper portion lies laterally outboard of the stiffener web. The side slope sheet of the hopper meets the sidewall at the transition of the sidewall sheet from the inside-the-post to the outside-the-post condition.

44 Claims, 18 Drawing Sheets

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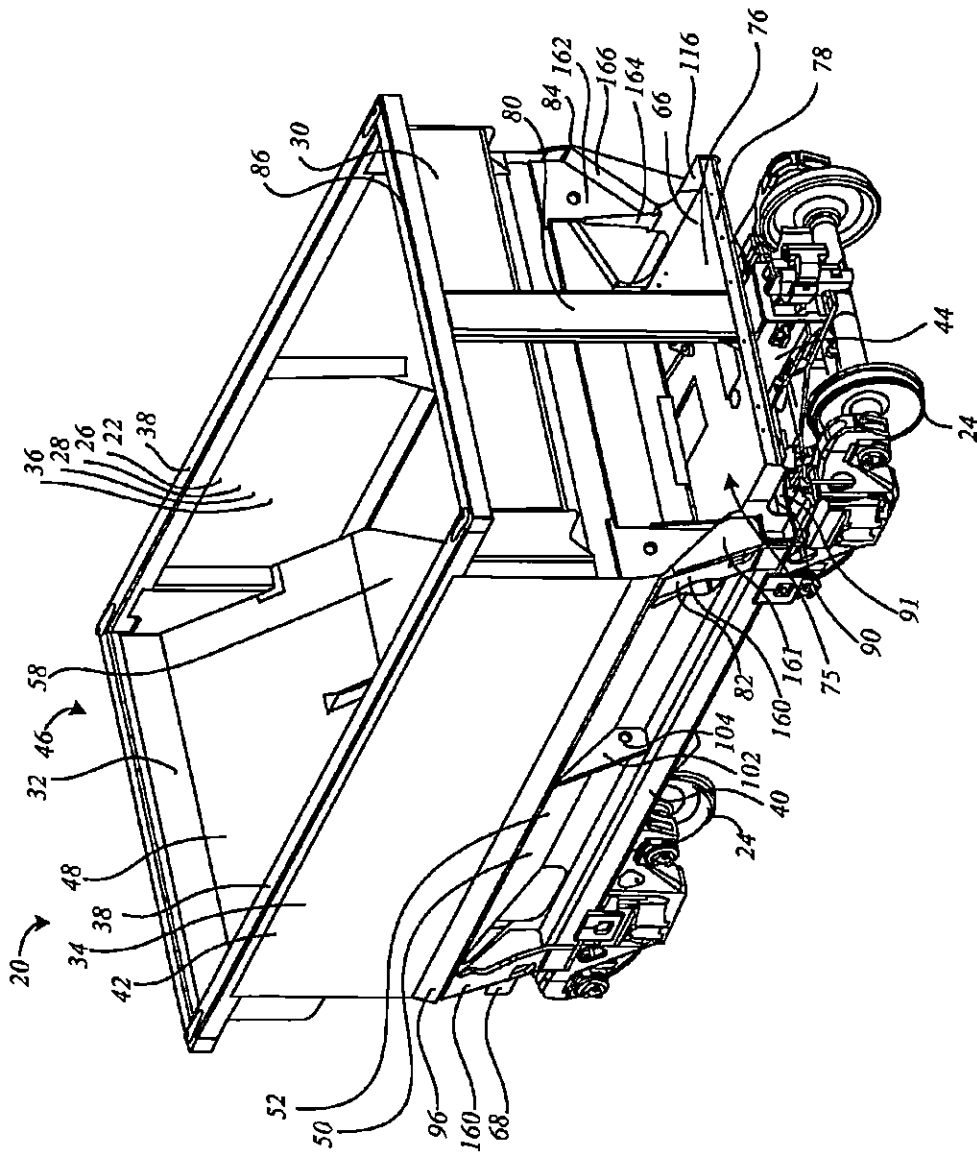


Figure 1

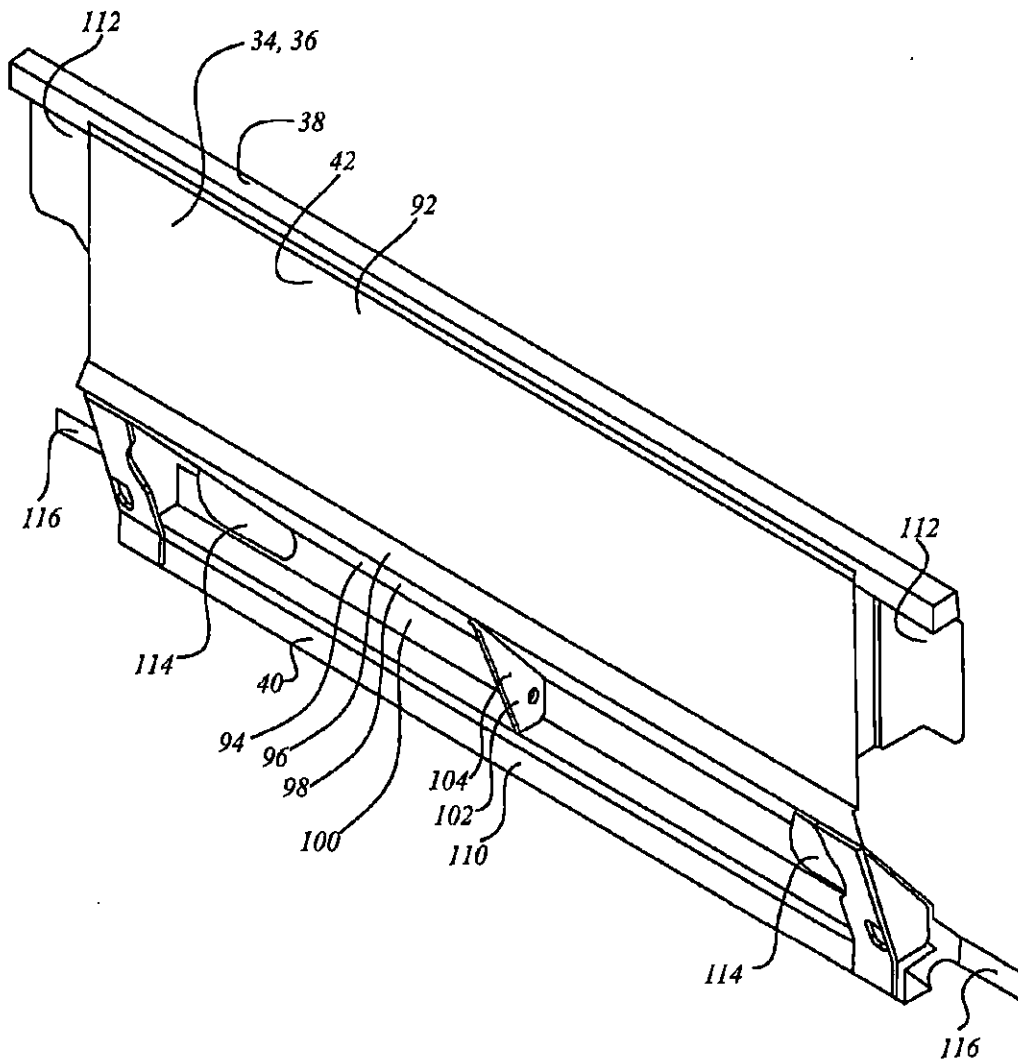
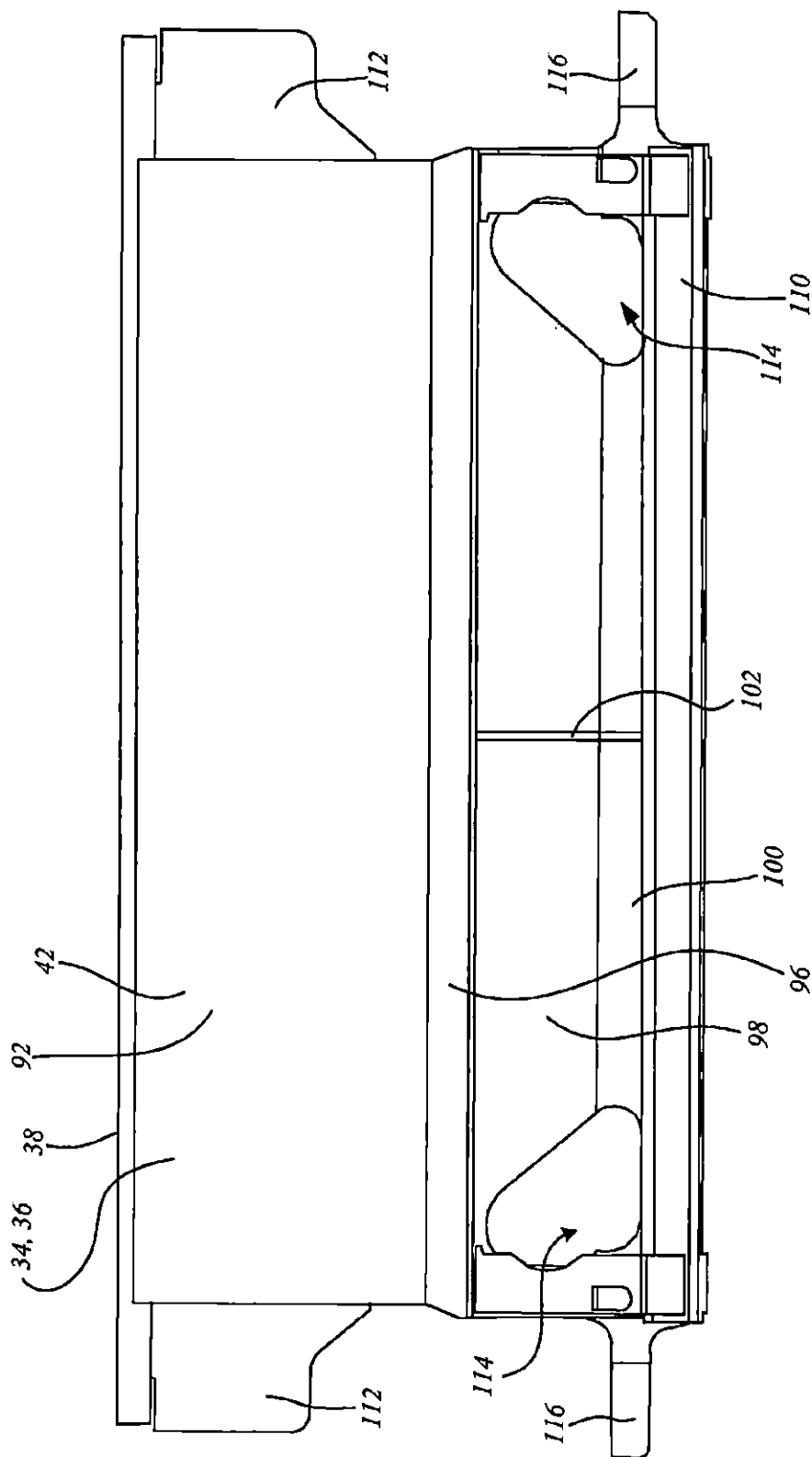


Figure 2a

*Figure 2b*

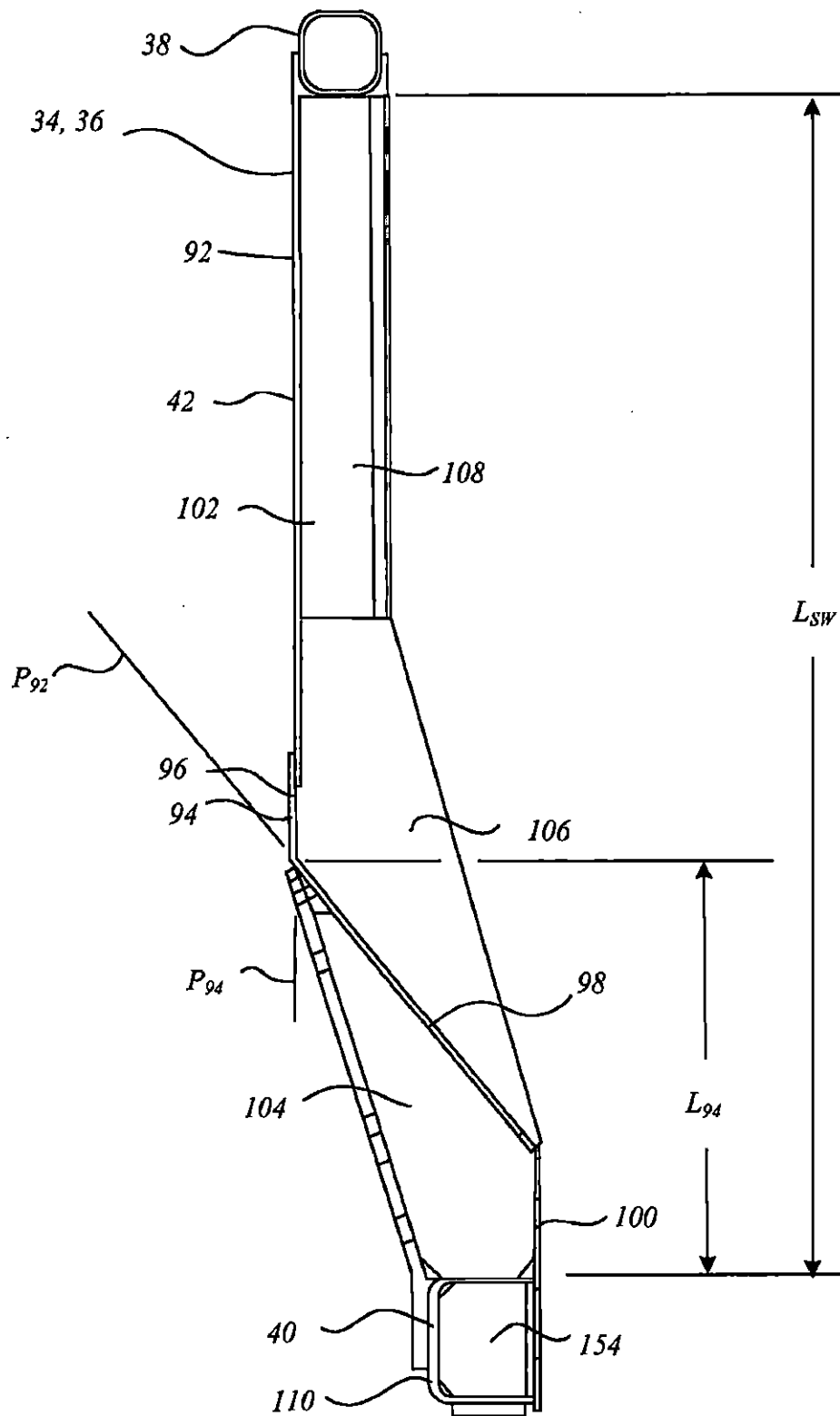
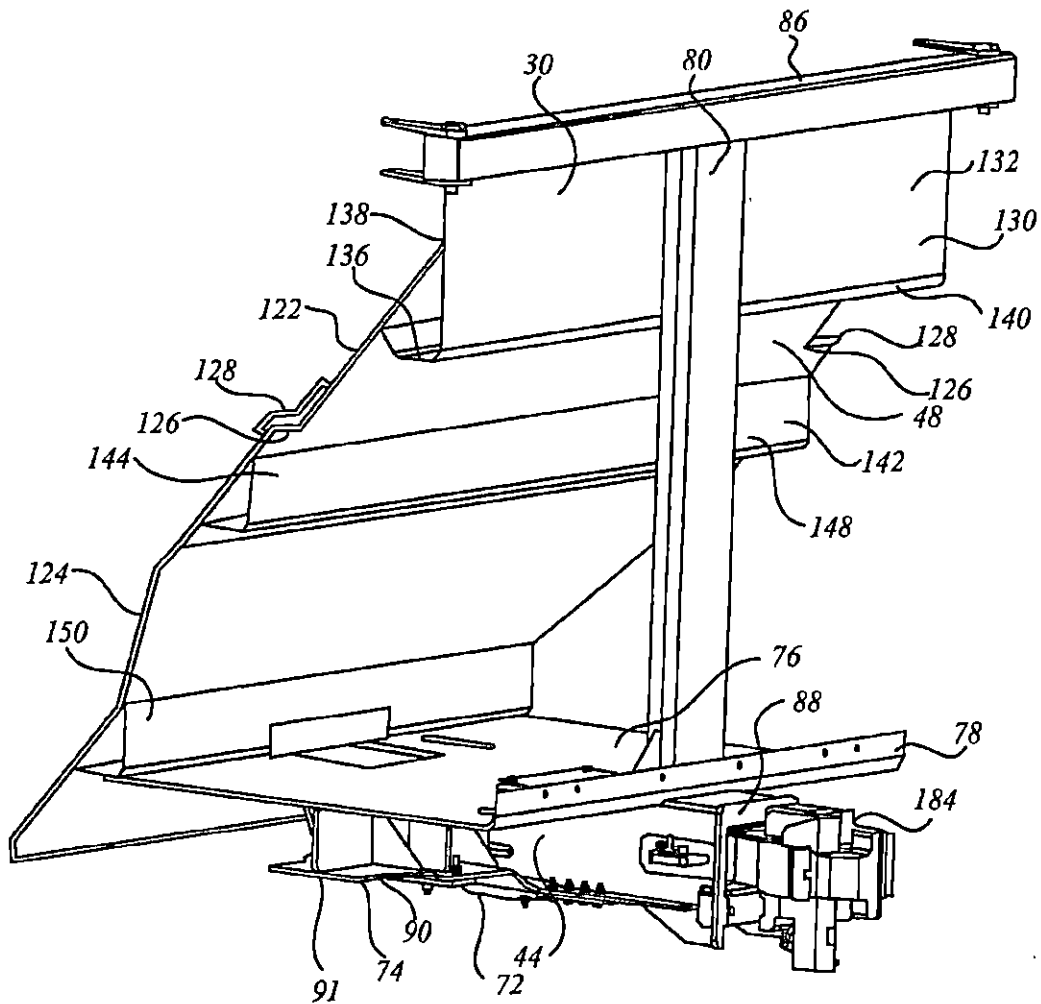


Figure 2c

*Figure 3a*

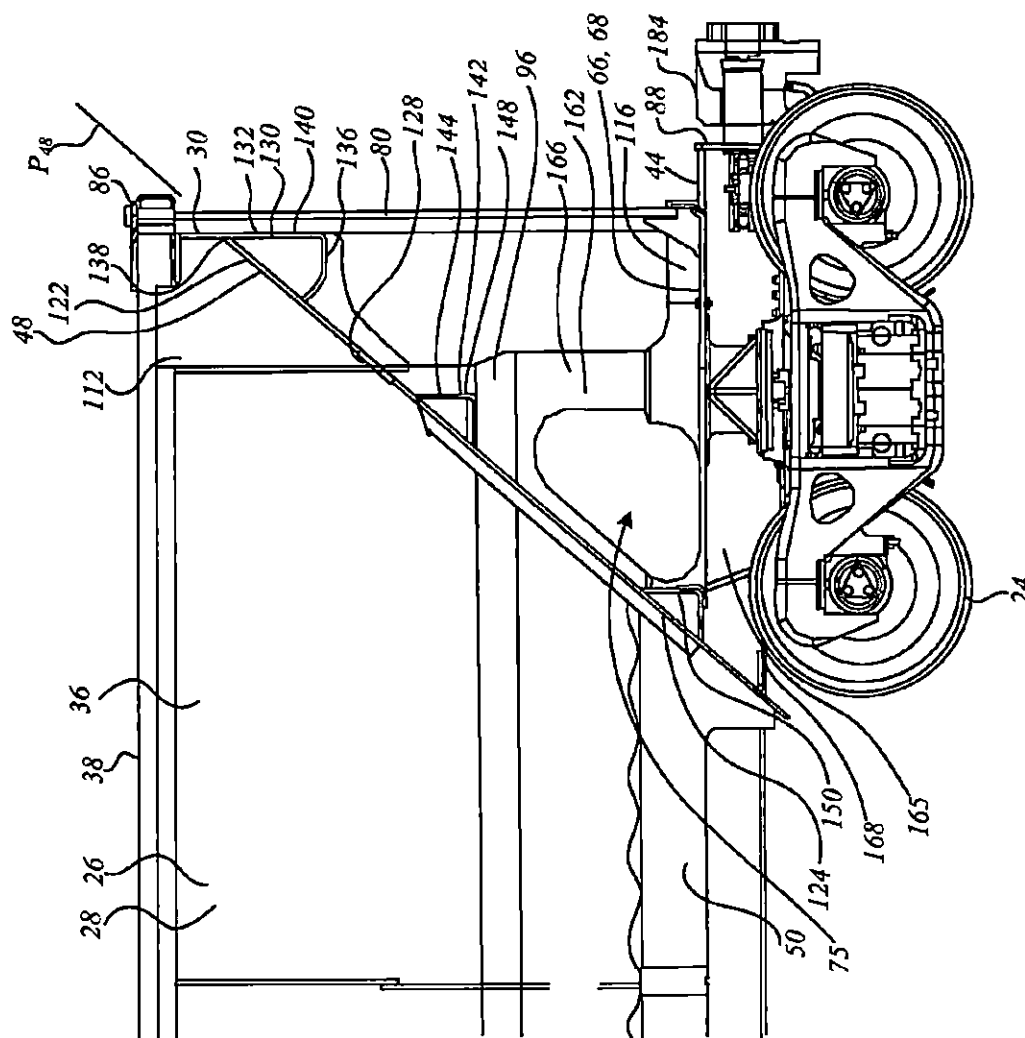


Figure 3b

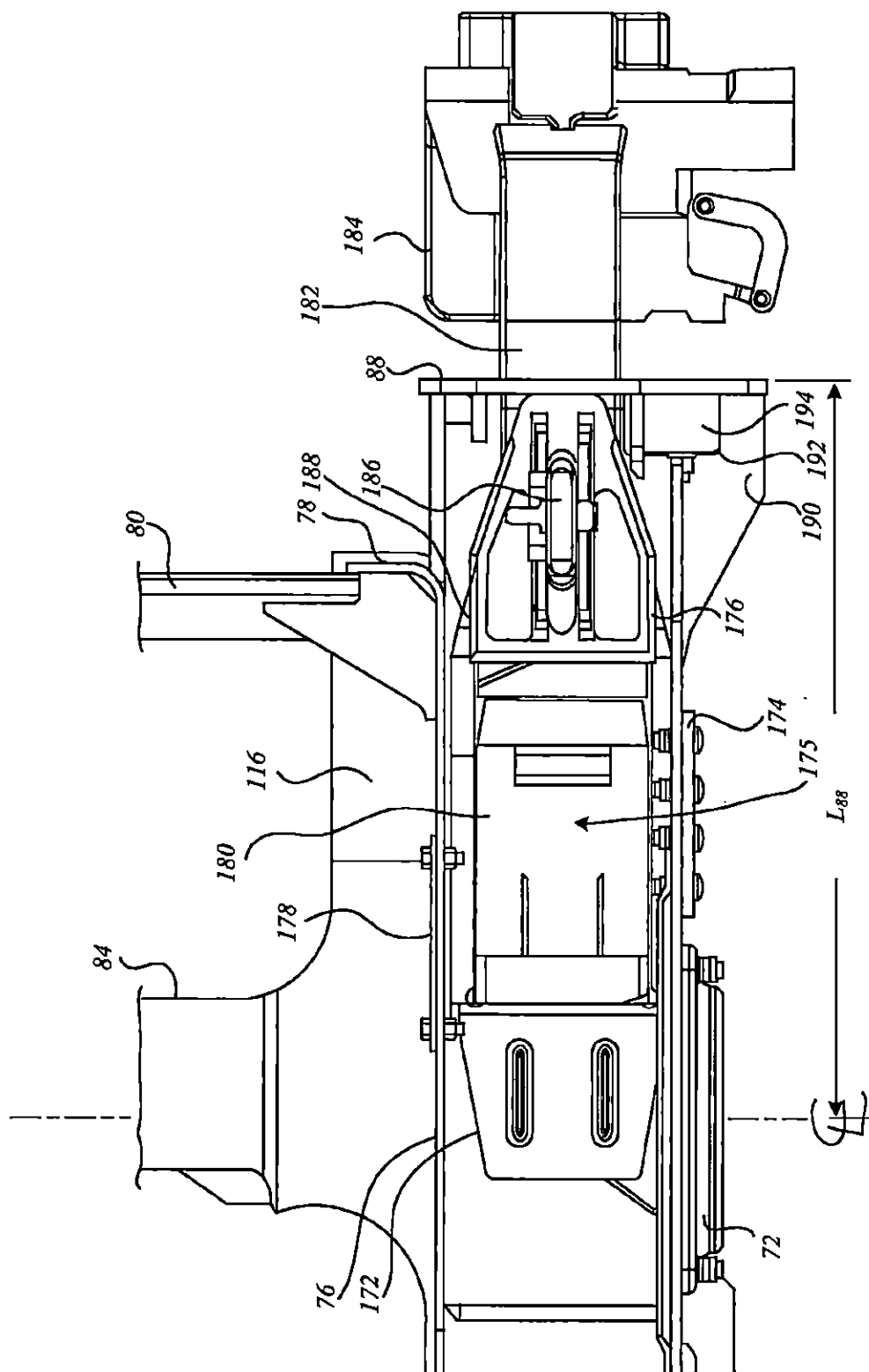


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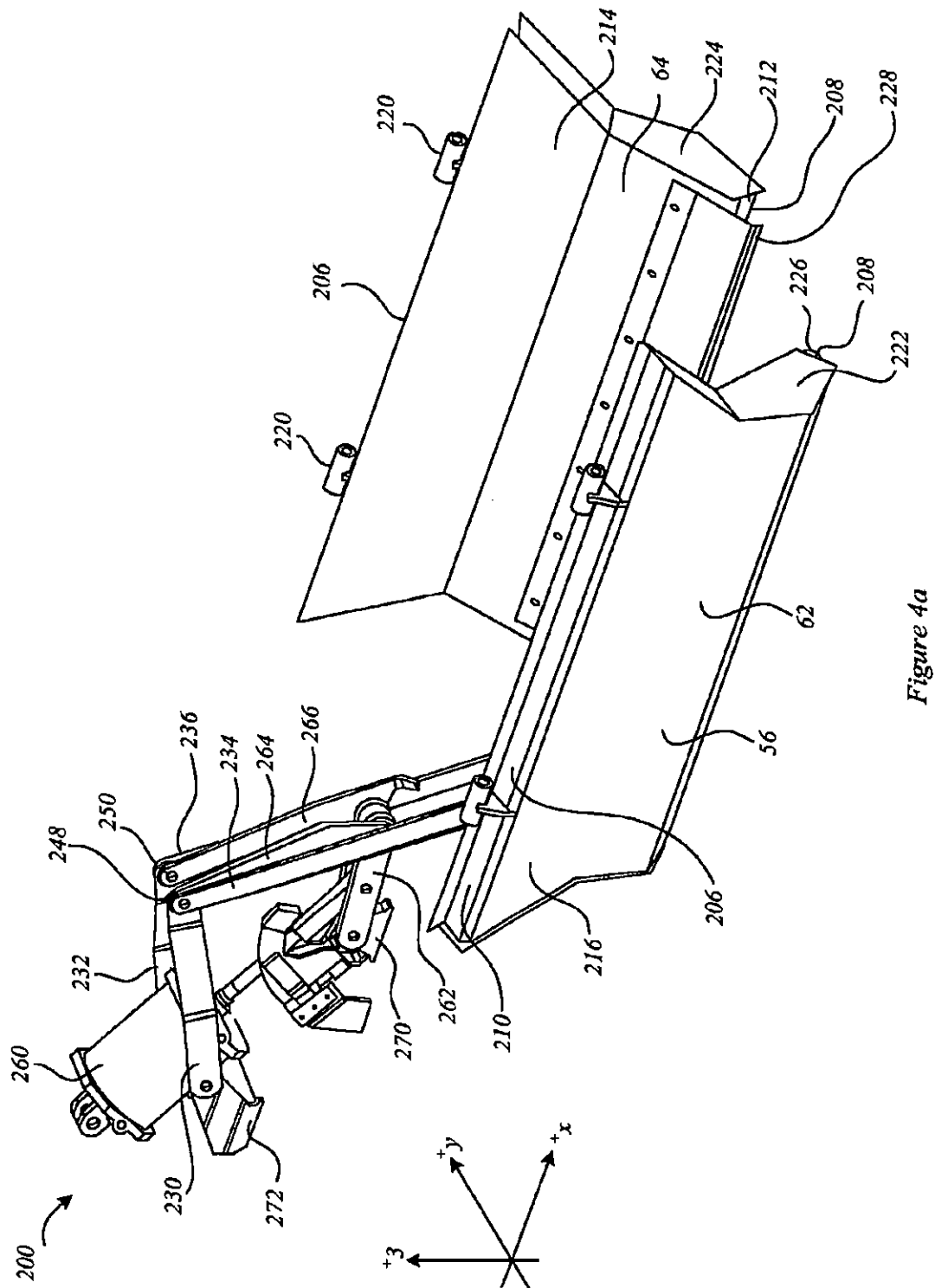
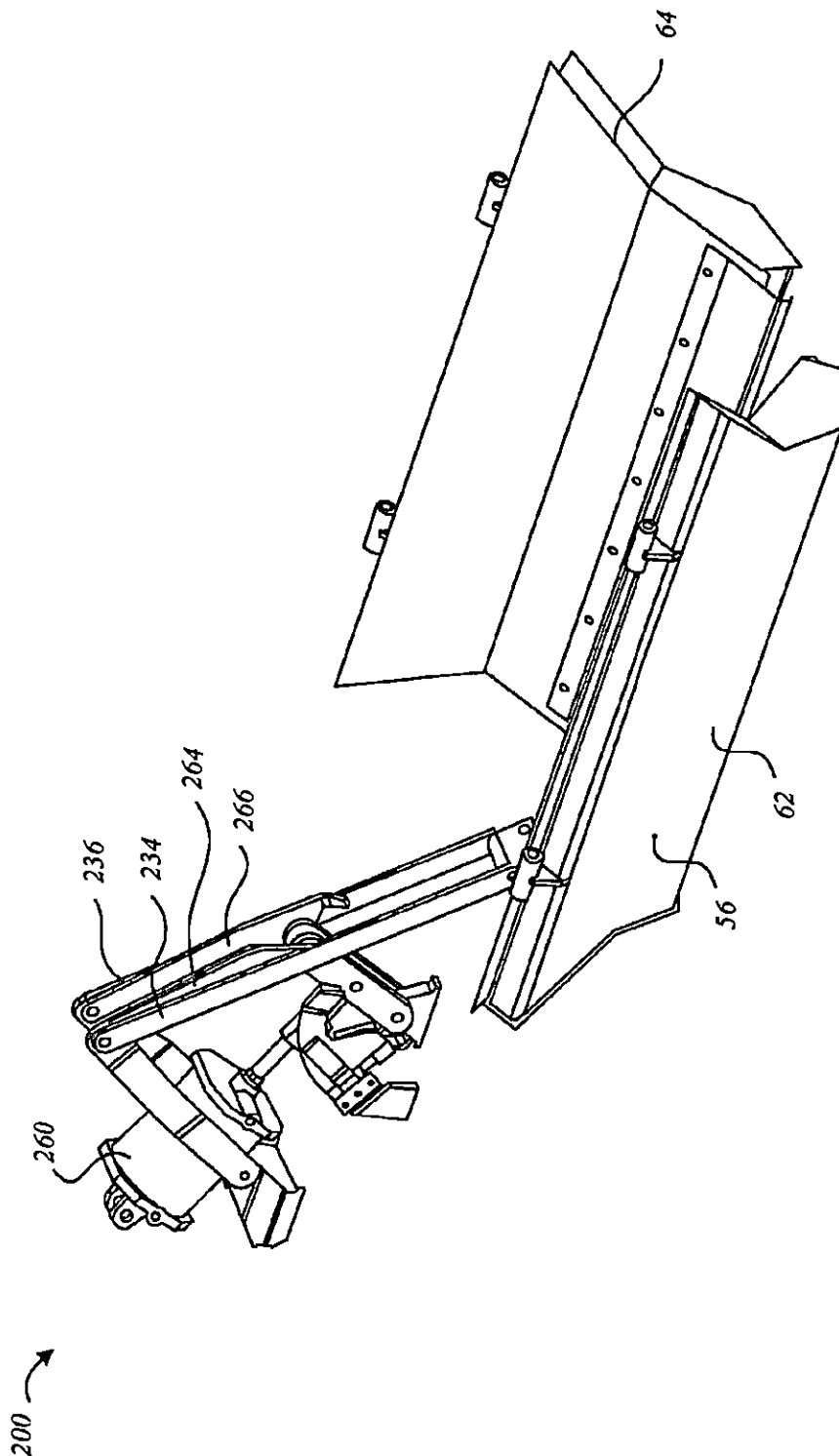


Figure 4a

*Figure 4b*

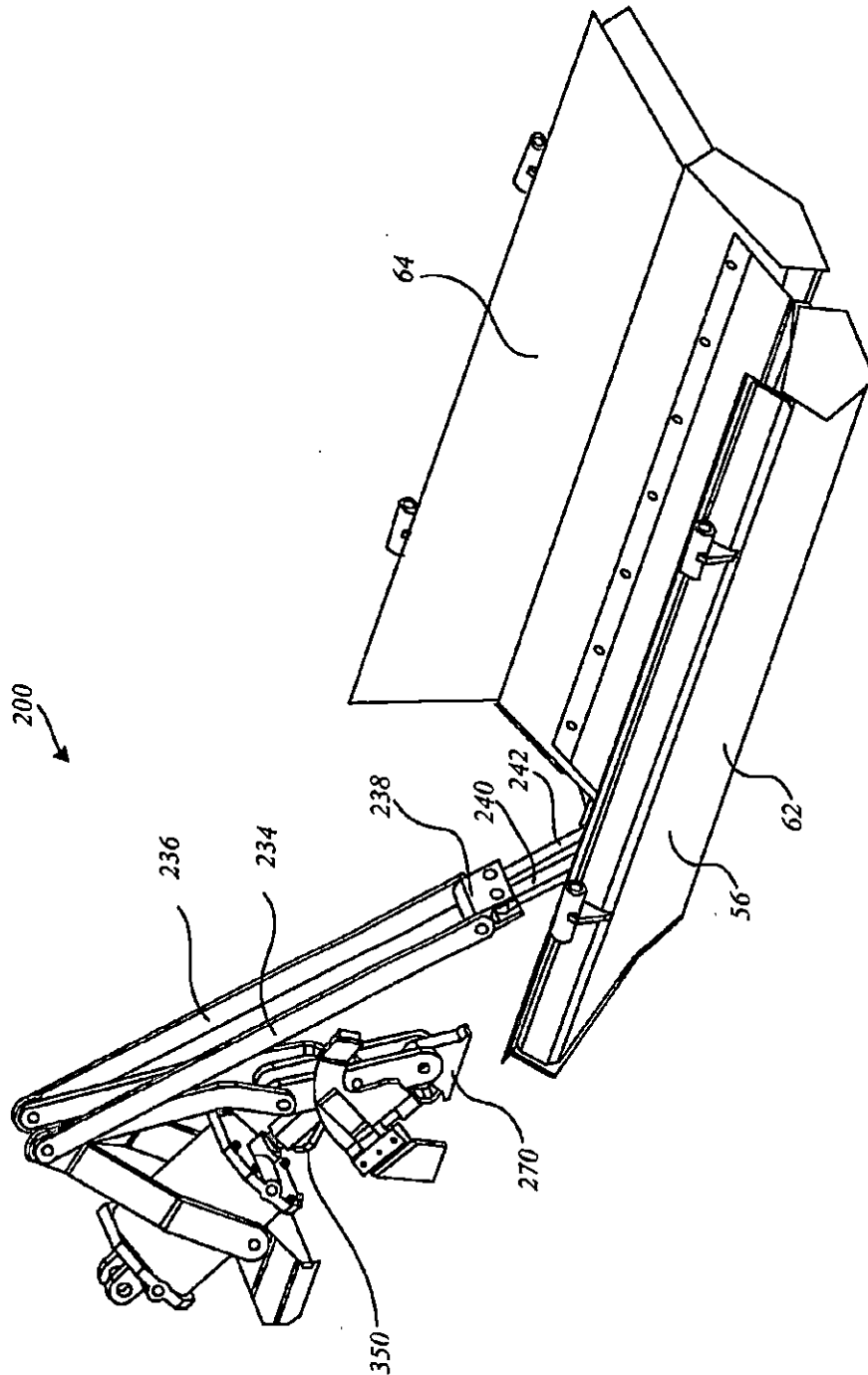


Figure 4c

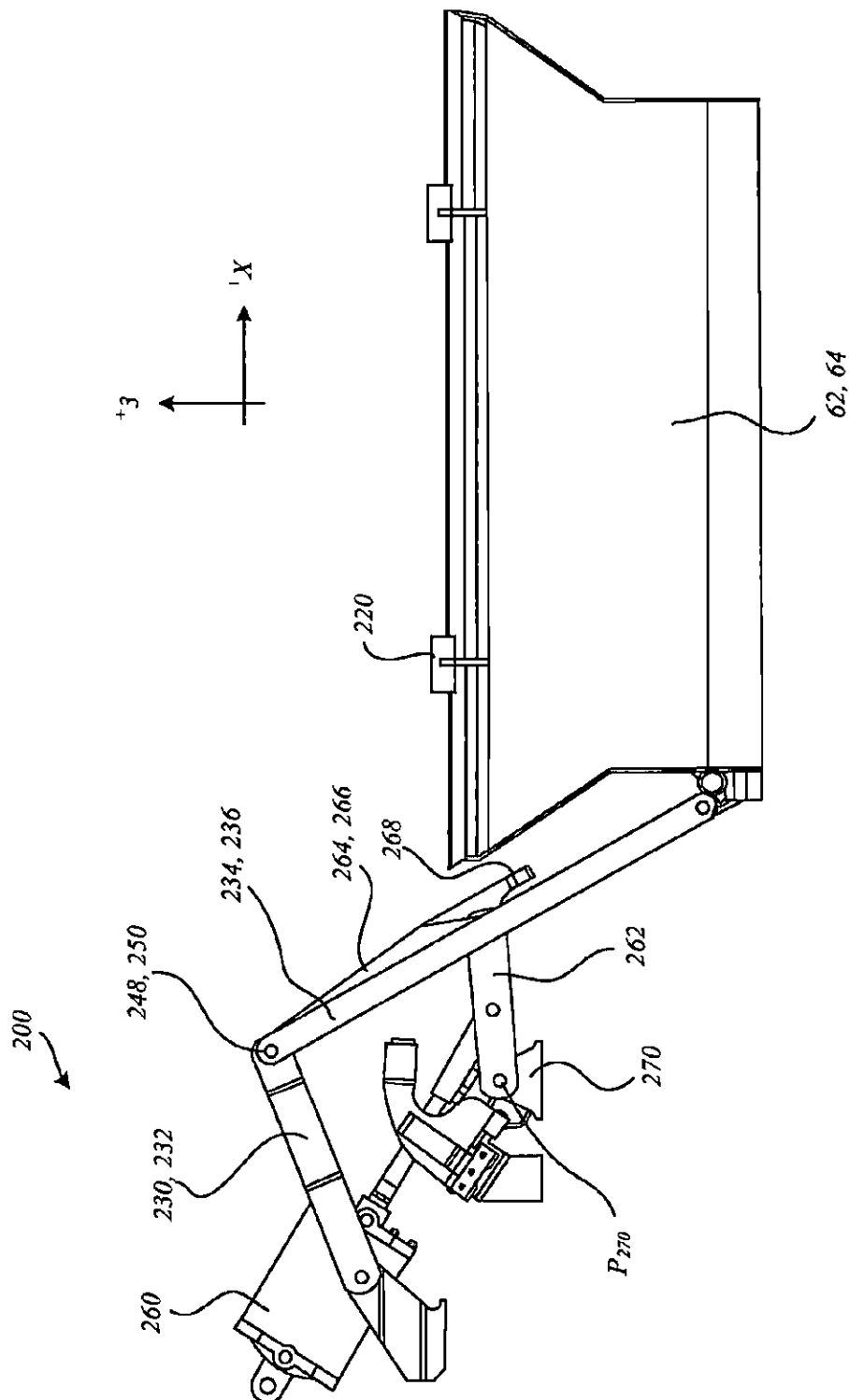


Figure 5a

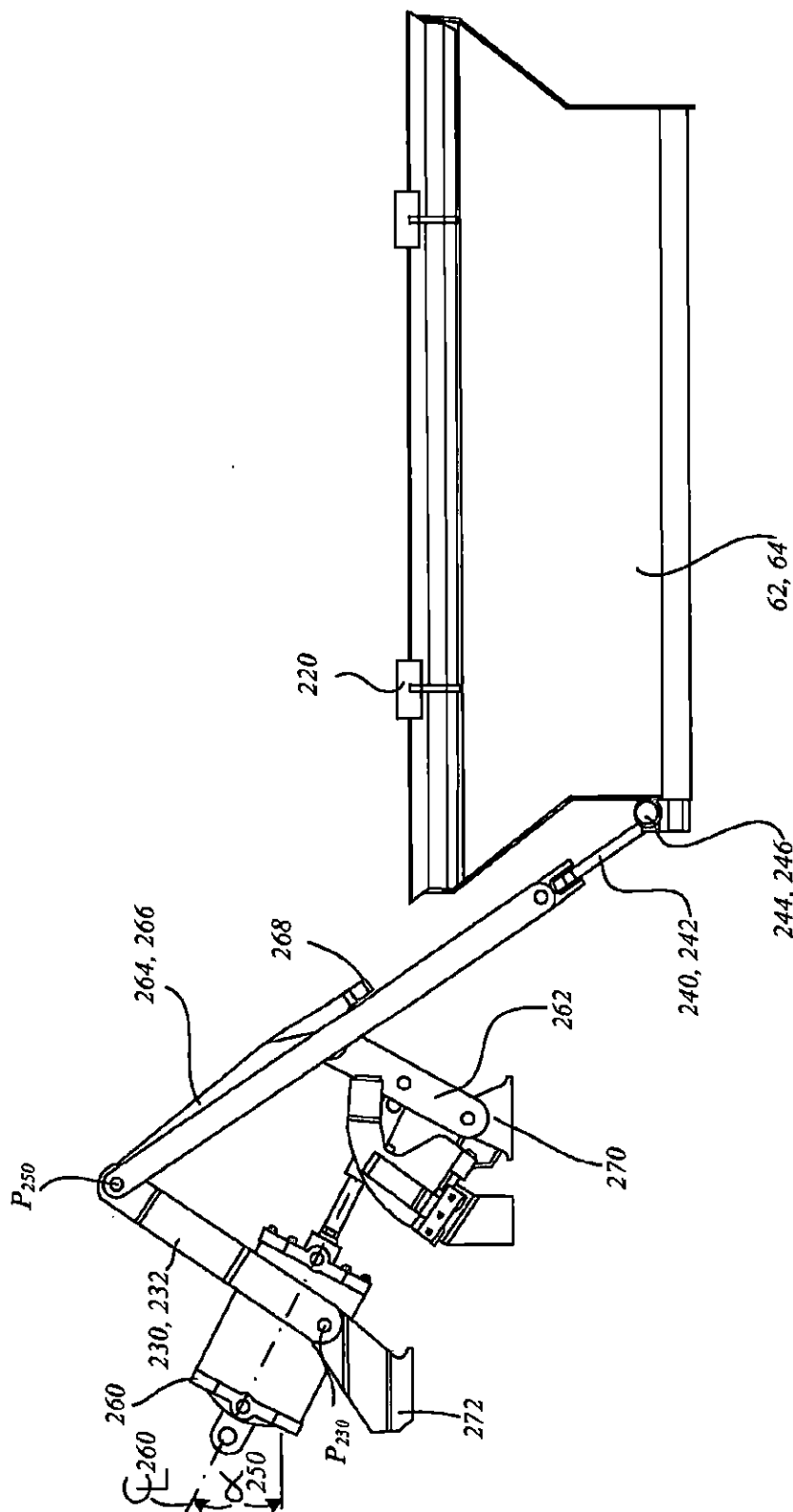


Figure 5b

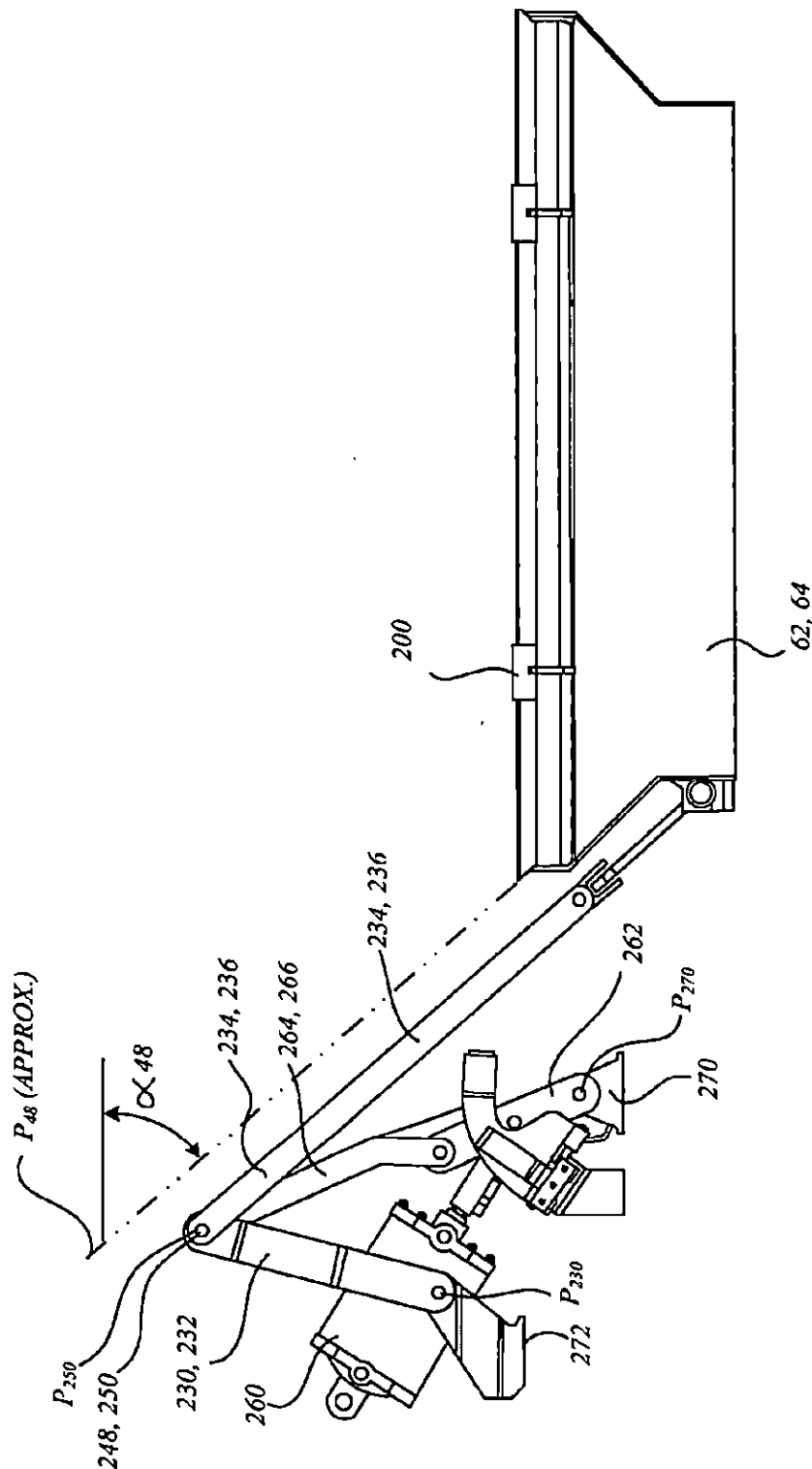


Figure 5c

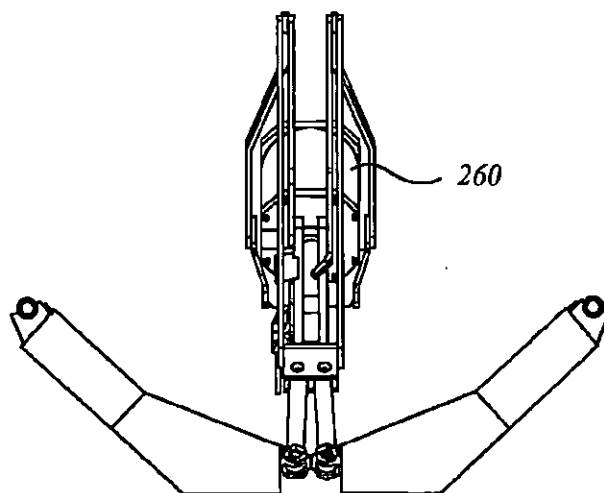


Figure 6c

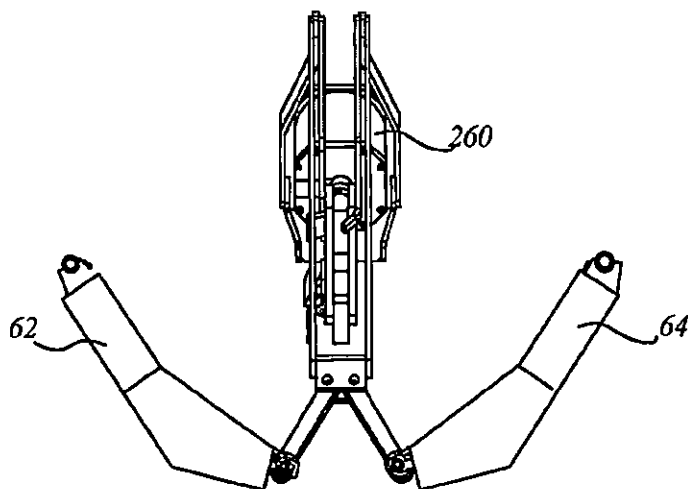


Figure 6b

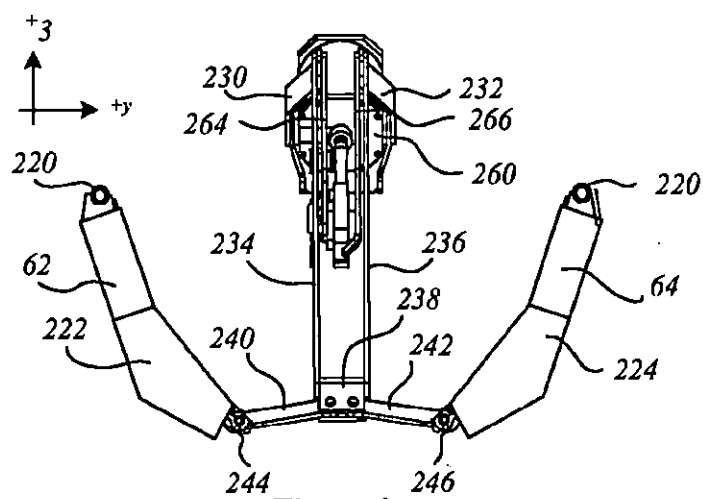
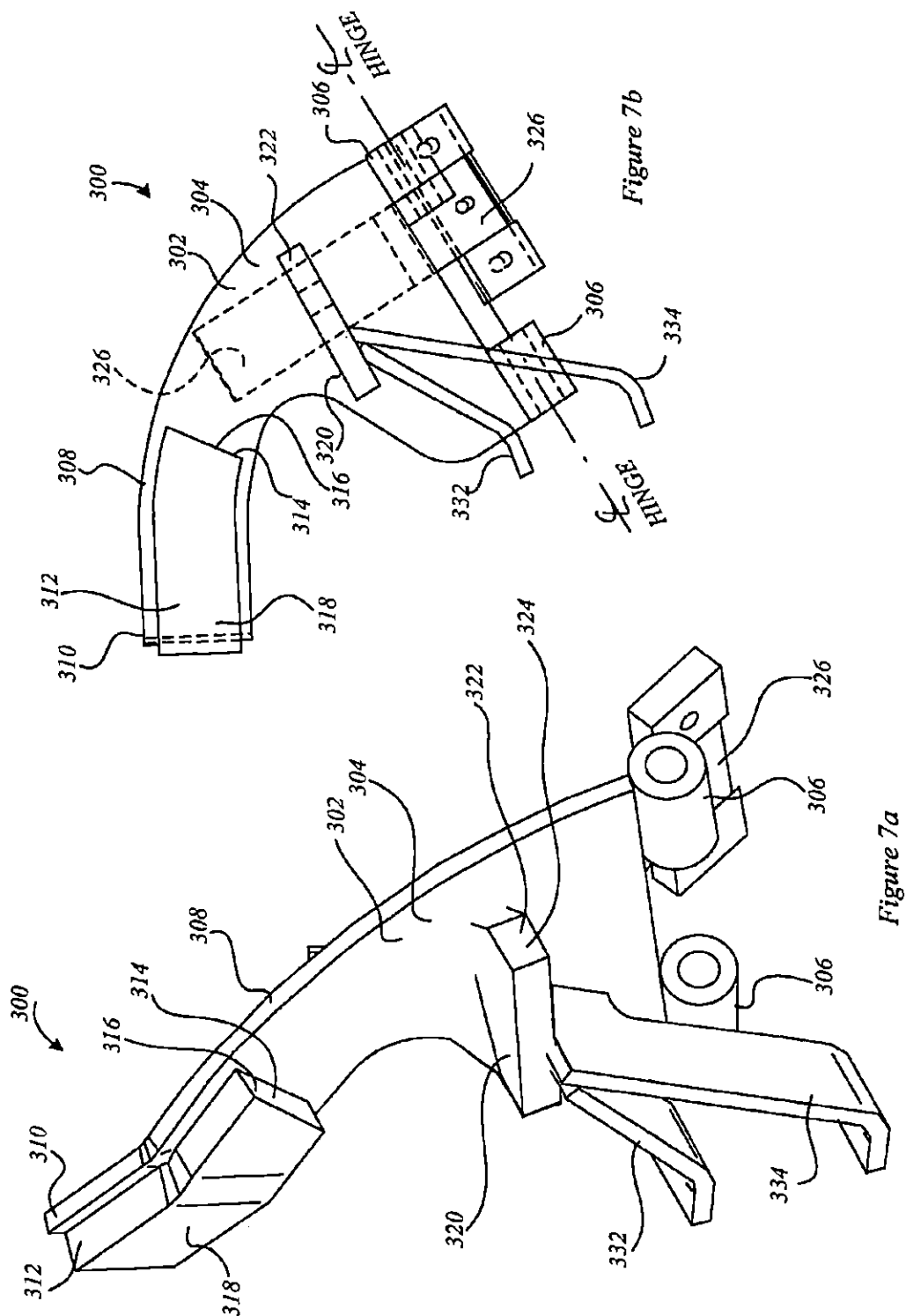


Figure 6a



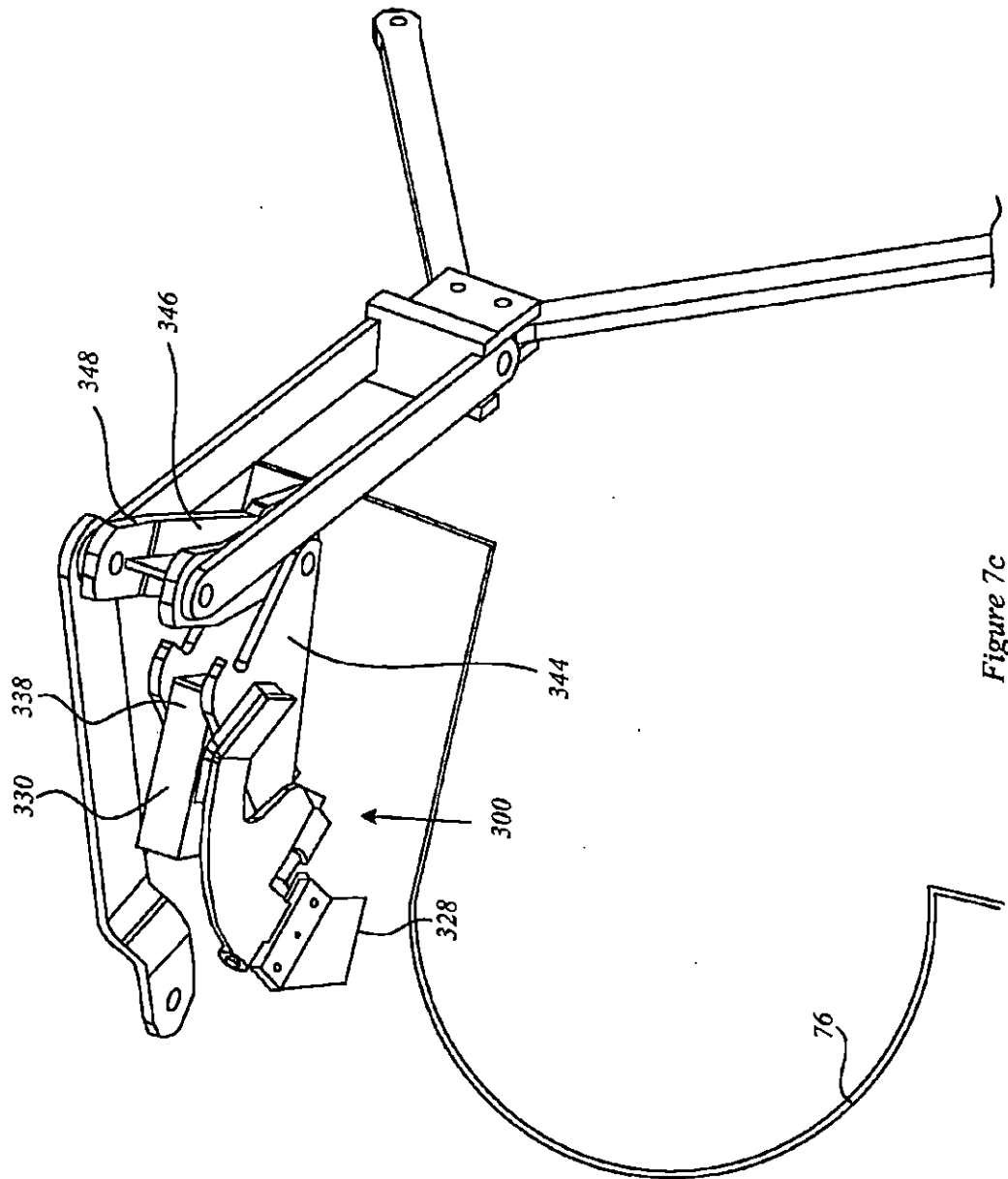


Figure 7c

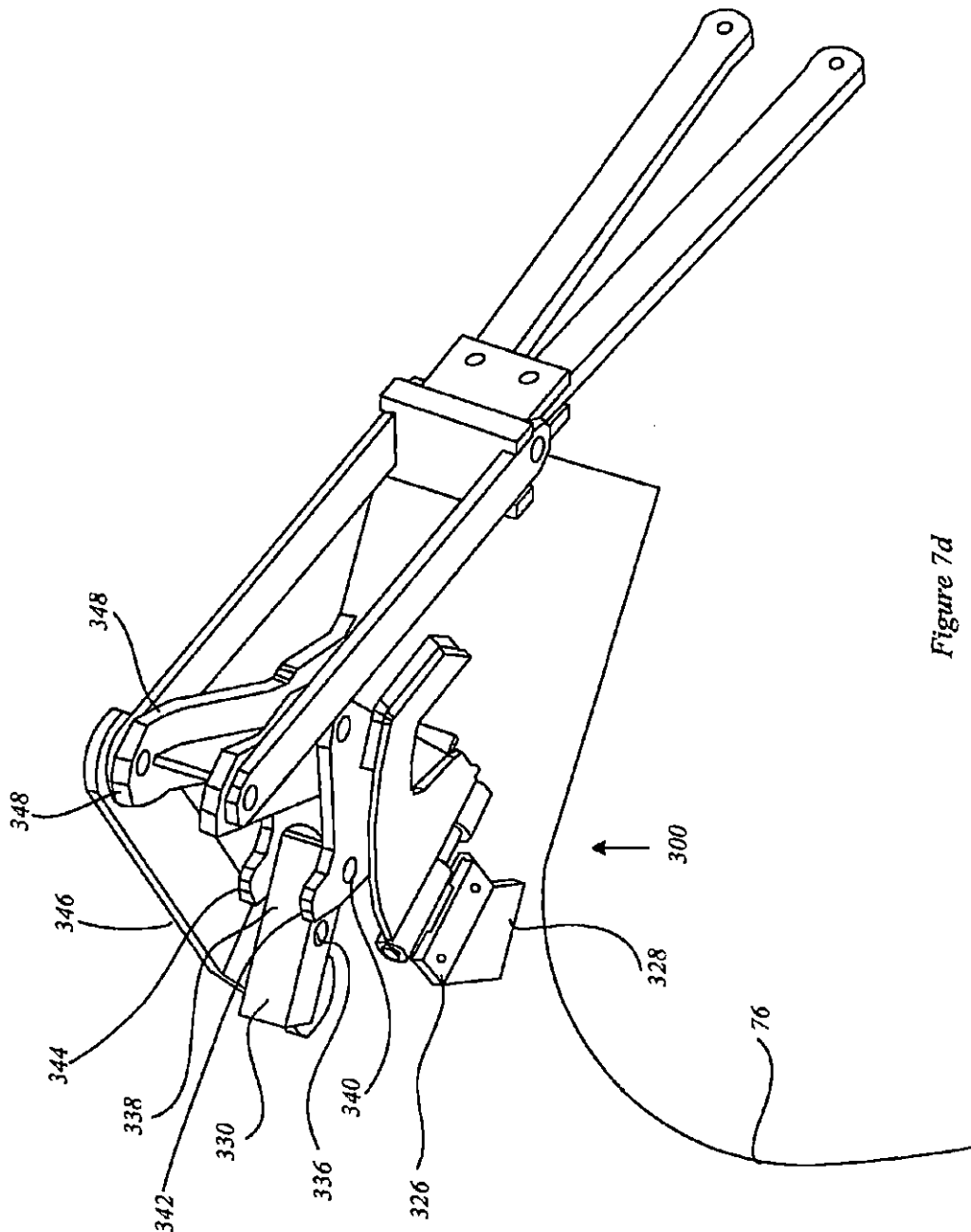


Figure 7d

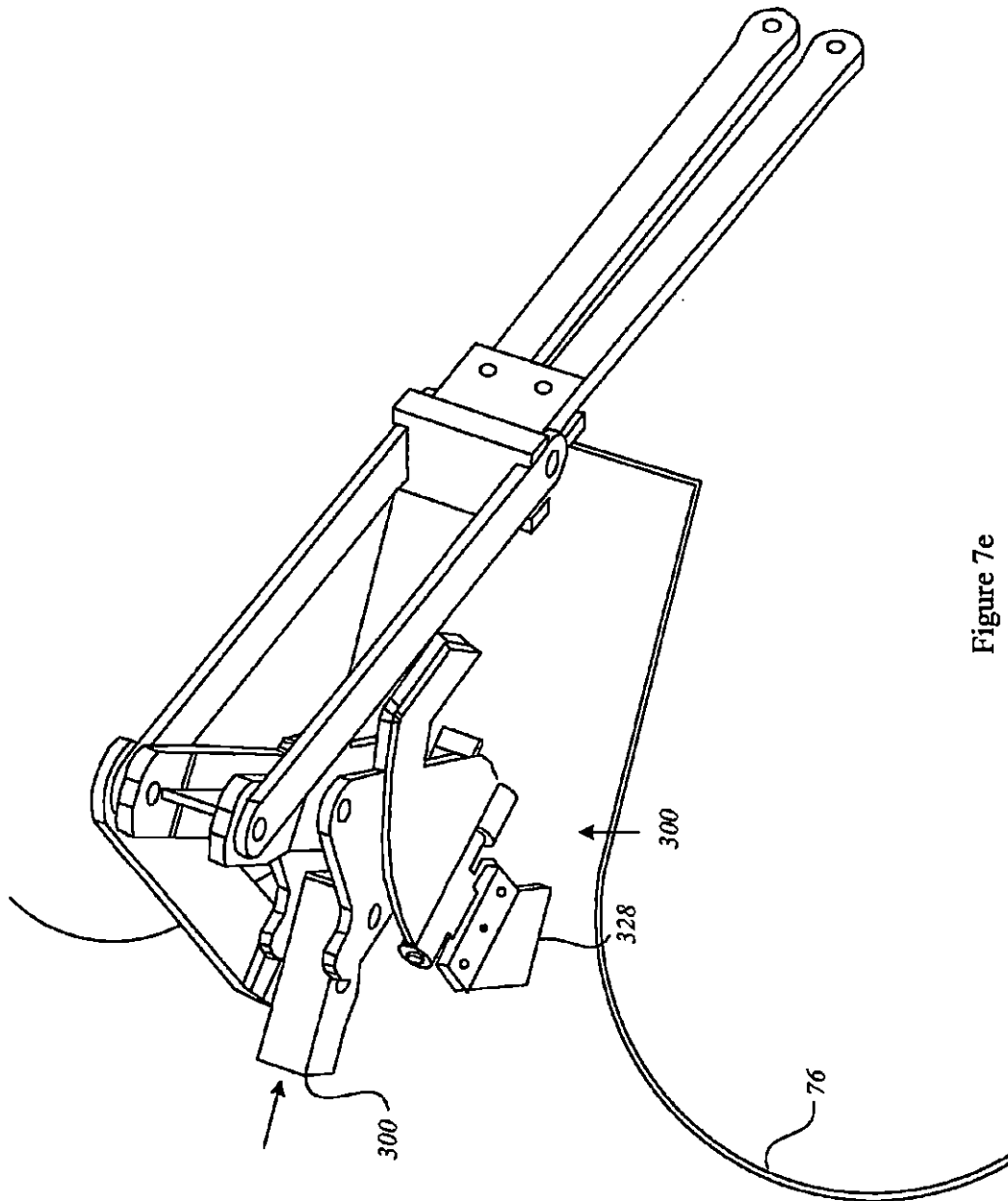


Figure 7e

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RAILROAD GONDOLA CAR STRUCTURE AND MECHANISM THEREFOR

This application is a divisional application of U.S. patent application Ser. No. 12/559,065 entitled "Railroad Gondola Car Structure and Mechanism Therefor," filed Sep. 14, 2009, which claims priority under 35 USC 119 to Canadian Patent Application Serial Number 2,678,447, entitled "Railroad Gondola Car Structure and Mechanism Therefor" filed Sep. 11, 2009, and Canadian Patent Application Serial Number 2,678,605, entitled "Railroad Gondola Car Structure and Mechanism Therefor" filed Sep. 14, 2009. U.S. patent application Ser. No. 12/559,065 is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to the field of railroad freight cars, and, in particular to rail road gondola cars such as may employ bottom unloading gates or doors.

BACKGROUND

There are many kinds of rail road cars for carrying particulate material, be it sand or gravel aggregate, plastic pellets, grains, ores, potash, coal or other granular materials. Many of those cars have an upper opening, or accessway of some kind, by which the particulate is loaded, and a lower opening, or accessway, or gate, or door by which the particulate material exits the car under the influence of gravity. While the inlet opening need not necessarily have a movable gate, the outlet opening requires a governor of some kind that is movable between a closed position for retaining the lading while the lading is being transported, and an open position for releasing the lading at the destination. The terminology "flow through" or "flow through rail road car" or "center flow" car, or the like, may sometimes be used for cars of this nature where lading, typically particulate lading, is introduced at the top, and flows out at the bottom.

Discharge doors for gondola cars or other bottom dumping cars may tend to have certain desirable properties. First, to the extent possible it is usually desirable for the door opening to be large so that unloading may tend to be relatively fast, and for the sides of any unloading chute to be relatively steep so that the particulate will tend not to hang up on the slope. Further, to the extent that the door can be large and the slope sheets steep, the interior of the car may tend to have a greater lading volume for a given car length. Further still, any increase in lading achieved will tend to be at a relatively low height relative to Top of Rail (TOR) and so may tend to aid in maintaining a low center of gravity. A low center of gravity tends to yield a better riding car that is less prone to derailment, and perhaps less prone to cause as much wear or damage to tracks.

For a given length of car, hopper volume, and hence overall car volume, can be maximized by reducing the proportion of the length of the car occupied by the trucks, and occupied by the door opening drive mechanism. Furthermore, where the lading to be carried by the car is of greater than usual density, it may often be helpful for the truck center length to be relatively short such that the length of the span between the trucks is smaller, and the weight of the structure may be correspondingly decreased relative to the maximum permissible gross weight on rail for the car. In some instances, as with iron ore or other high density lading, that truck center distance may be very short.

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It may also be that in some circumstances ore cars are used in quasi-permanent sets that form a unit train. The unit train may tend to follow a single route for substantially its entire operational service life. In the case of an ore car, that operational route may be from a mine or concentrator facility, at which the cars receive the lading; to a discharge facility, whether a mill or a break of bulk terminal at a port. In these circumstances the line may be owned by the mine or mill, and the cars may not necessarily be used for interchange service. To the extent that they are not used for interchange service they may not necessarily comply with all AAR standards. The cars may have short, possibly non-standard draft sills, draft gear, and couplers, or a combination thereof.

The cars may have tightly limited space envelopes over the end shear plates, and yet these spaces may nonetheless be intended to accommodate, for example, the brake reservoir and pneumatic gear for operating the gondola discharge doors.

SUMMARY OF THE INVENTION

In an aspect of the invention there is a railroad hopper car. It has at least one hopper having a bottom discharge, the bottom discharge including a door movable between a closed position for retaining lading and an open position for permitting egress of lading. The hopper is carried on spaced apart railroad cars trucks for rolling motion along railroad tracks in a lengthwise direction of the car. The hopper has at least a first end slope sheet inclined downwardly in the lengthwise direction toward the door. There is a linkage connected to the door. The linkage is oriented lengthwise with respect to the car. A drive is connected to the linkage. The drive is operable to move the linkage and thereby to urge the door to a closed position. The linkage is movable from a first position corresponding to the open position of the door to a second position corresponding to the closed position of the door. The linkage includes at least a drag link. When the linkage moves from the first to the second position one of (a) the overall motion from the first to the second position includes displacement of the drag link in a direction having a predominant component of motion parallel to the first end slope sheet; and (b) the motion of the drag link is at least instantaneously parallel to the first end slope sheet.

In another feature of that aspect of the invention the linkage includes a first pivot arm pivotally connected to a datum structure at a first pivot connection. The drive is also mounted to the datum structure. The linkage includes a second pivot arm pivotally connected to the datum structure at a second pivot connection. The second pivot arm has the door mounted thereto. The first pivot arm has a second connection distant from the first pivot connection. The second pivot arm has a second connection distant from the second pivot connection. A mechanical transmission is mounted between the second connection of the second pivot arm and the second connection of the first pivot arm. The mechanical transmission includes the drag link. The drive is connected to move the first pivot arm, and, in moving from the first position to the second position, each position of the first pivot arm being associated with a unique position of the drag link. In a further feature, the linkage includes left and right hand first pivot arms pivotally connected to a datum structure at respective first pivot connections, the respective first pivot connections being co-axial. The linkage includes left and right hand second pivot arms pivotally connected to the datum structure at respective second pivot connections. The door is a left hand door of a pair of co-operable right and left hand doors, the left hand door being mounted to the left hand second pivot arm and the right hand

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door being mounted to the right hand second pivot arm. Each first pivot arm has a respective second connection distant from its respective first pivot connection, the respective second connections being pivot connections and being mutually co-axial. Each second pivot arm has a respective second connection distant from the respective second pivot connection. A mechanical transmission is mounted between the respective second connections of the second pivot arms and the respective second connections of the first pivot arms. The drag link is a left hand drag link, and the mechanical transmission includes a mated parallel right hand drag link. The left and right hand drag links each have a first end mounted to one of the respective second connections of the first pivot arms. The left and right hand drag links have second ends yoked together distantly from the first ends. The transmission member includes left and right hand slave links extending between and connecting the second ends of the drag links to the second connections of the second pivot arms respectively.

In still another feature, the linkage includes left and right hand first pivot arms pivotally connected to a datum structure at respective first pivot connections, the respective first pivot connections being co-axial. The linkage includes left and right hand second pivot arms pivotally connected to the datum structure at respective second pivot connections. The door is a left hand door of a pair of co-operable right and left hand doors, the left hand door being mounted to the left hand second pivot arm and the right hand door being mounted to the right hand second pivot arm. Each first pivot arm has a respective second connection distant from its respective first pivot connection, the respective second connections being pivot connections and being mutually co-axial. The left and right hand pivot arms co-operate to define a bifurcated lever straddling the drive. In yet another feature, the drive includes an actuating cylinder having an axially reciprocating member, the axially reciprocating member being inclined relative to horizontal. In still another feature the drag link lies between the actuating cylinder and the first end slope sheet of the hopper. In another feature the railroad hopper car includes a first end section, the first end section includes a draft sill and a substantially horizontal shear plate mounted over the draft sill, the drive includes an actuating cylinder having an axis of reciprocation lying in a central vertical-lengthwise plane of the car, the actuating cylinder is mounted above the shear plate, the first end slope sheet at least partially overhangs the actuating cylinder; and the drag link is located between the actuating cylinder and the first slope sheet.

In another aspect of the invention there is a railroad hopper car. It has at least one hopper having a bottom discharge, the bottom discharge including a gate movable between a closed position for retaining lading and an open position for permitting egress of lading. The car includes structure by which the hopper is carried on spaced apart railroad cars trucks for rolling motion along railroad tracks in a lengthwise direction of the car. A door operating linkage is connected to the gate, the door operating linkage being oriented lengthwise with respect to the car. An actuating cylinder connected to drive the door operating linkage, the actuating cylinder also being oriented to act lengthwise with respect to the car, the actuating cylinder having an axis of reciprocation. The axis of reciprocation being tilted such that displacement of the actuating cylinder includes a vertical component of motion.

In another feature of that aspect of the invention, the hopper car includes an end section mounted over one of the trucks, the end section includes a substantially horizontal shear plate, and the actuating cylinder is mounted on a pedestal mounted to the shear plate, the pedestal including an inclined mounting for the cylinder. In a further feature, the railroad hopper car

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has a longitudinal-vertical central plane, and the axis or reciprocation lies in the longitudinal-vertical plane. In a still further feature, the hopper includes at least a first end slope sheet extending longitudinally and being inclined longitudinally inboard and downwardly toward the gate, and at least part of the actuating cylinder is overhung by at least part of the first end slope sheet. In a yet further feature, the hopper car includes an end section having a substantially horizontal shear plate mounted over a draft sill. The hopper includes a first end slope sheet, the first end slope sheet at least partially overhanging the horizontal shear plate. The actuating cylinder is mounted above the shear plate, centrally aligned over the draft sill. The actuating cylinder is at least partially overhung by the first end slope sheet. In still yet another further feature the first slope sheet is substantially planar and has a first angle of inclination relative to horizontal. The actuating cylinder is inclined longitudinally inboard downwardly, and is inclined at a second angle. The second angle lies between horizontal and the first angle. In yet another feature the car has an underframe and the door operating linkage includes a first linkage component, a second linkage component, a third linkage component, and a fourth linkage component. The first linkage component is a reference datum component and includes structure immovable relative to the underframe. The second linkage component is a first pivot linkage mounted to the first linkage component at a main pivot connection, the first pivot linkage being a first pivot arm constrained to pivot on an axis of rotation oriented horizontally cross-wise relative to the underframe. The fourth linkage component is a second pivot linkage pivotally mounted to the first linkage component and includes at least the gate. The third linkage component includes a drag link element connected to the first pivot arm, the drag link element having at least a first pivotal attachment to at least a portion of the fourth linkage component, whereby input motion of the second linkage component uniquely determines position and motion of the third and fourth linkage components relative to the first linkage component. Motion of the second linkage component is driven by the actuator. In still another feature the main pivot connection of the first pivot arm to the first linkage component is located lower than the actuating cylinder. In yet still another feature, the drag link element is connected to the first pivot arm at a distal pivot connection relative to the main pivot connection, and, when the gate is in the closed position and the car is viewed in side view, the actuating cylinder is located between the main pivot connection and the distal pivot connection.

In another aspect there is a railroad hopper car. It has at least one hopper having a bottom discharge, the bottom discharge including a gate movable between a closed position for retaining lading and an open position for permitting egress of lading. It has first and second end sections to which the hopper is mounted, the first and second end sections being mounted to respective first and second railroad car trucks for rolling motion along railroad tracks in a lengthwise direction of the car. There is a door operating linkage connected to the gate, the door operating linkage being oriented lengthwise with respect to the car and connected. An actuating cylinder is connected to drive the door operating linkage. The actuating cylinder is also oriented to act in a lengthwise extending plane with respect to the car. The actuating cylinder has an axis of reciprocation. The door operating linkage includes a first pivot arm pivotally mounted to the first end section at a first pivot connection. There is a mechanical transmission connected between the first pivot arm and the gate. The mechanical transmission includes at least a drag link movably connected to the first pivot arm at a location distant from the first

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pivot connection. The first pivot connection is lower than the actuating cylinder as seen when viewing the first end section in side view.

In another feature of that aspect of the invention, when the gate is in the closed position and the car is viewed in side view, the actuating cylinder is located between the main pivot connection and the distal pivot connection. In still another feature, the actuating cylinder drives an intermediate lever that is connected to drive the first pivot arm.

In another aspect of the invention there is a rail road hopper car. It has a hopper carried between a pair of trucks, the hopper having first and second upstanding sidewalls running lengthwise therealong. The hopper has a lower discharge and convergent slope sheets giving onto the discharge. The rail road car has a side sill and a top chord. The first upstanding sidewall extends from the side sill to the top chord. The first upstanding sidewall has a predominantly upwardly running sidewall stiffener mounted thereto. The sidewall stiffener is located at a longitudinal station intermediate the trucks. The first upstanding sidewall has a first region, the first region being a lower region thereof. The first upstanding sidewall has a second region. The second region is an upper region thereof. The sidewall stiffener has a first portion, the first portion being a lower portion thereof. The first portion is mounted to the first region of the first upstanding sidewall. The sidewall stiffener has a second portion, the second portion being an upper portion thereof. The second portion is mounted to the second region of the upstanding sidewall. The first portion of the first upstanding sidewall stiffener is laterally outboard of the first region of the first upstanding sidewall. The second portion of the sidewall stiffener is laterally inboard of the second region of the first upstanding sidewall. The sidewall has a continuous section between the first and second regions thereof. The sidewall stiffener has web continuity between the first and second portions thereof.

In a feature of that aspect of the invention, the first and second portions of the sidewall stiffener are substantially co-planar, and are substantially vertically aligned when seen in a sectional view looking along the car. In another feature, the first upstanding sidewall has a third region intermediate the first and second regions. The third region includes a side sheet transition portion passing across the sidewall stiffener from an inboard margin thereof to an outboard margin thereof, and the stiffener has vertical web continuity through the transition portion. In another feature, the first upstanding sidewall has a third region intermediate the first and second regions. The third region includes a side sheet transition portion passing across the sidewall stiffener from an inboard margin thereof to an outboard margin thereof. The hopper includes first and second sloped side sheets. The first sloped side sheet meets the first sidewall at the transition portion. In another feature, the first sidewall has an overall height from the side sill to the top chord, L, and the transition is located a distance above the side sill that is in the range of $\frac{1}{4}$ to $\frac{3}{4}$ L. In a still further feature the first sidewall has an overall height from the side sill to the top chord, L, and the first slope sheet meets the transition at an height that is in the range of $\frac{1}{4}$ to $\frac{3}{4}$ L above the side sill.

In a further aspect of the invention there is a railroad hopper car. It has at least one hopper having a bottom discharge, the bottom discharge having a bottom discharge governor movable between a closed position for retaining lading and an open position for permitting egress of lading. The car has structure by which the hopper is carried on spaced apart railroad cars trucks for rolling motion along railroad tracks in a lengthwise direction of the car. The hopper has a door operating linkage oriented lengthwise with respect to the car.

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There is an actuating cylinder also oriented to act in a lengthwise extending plane with respect to the car, the actuating cylinder being connected to drive the door operating linkage. The door operating linkage includes a pair of first and second linkage members co-operably mounted to either transverse side of the actuating cylinder, whereby the actuating cylinder is bracketed by the linkage members.

In another feature of that aspect of the invention, the car has an underframe and the linkage is a closed loop bar linkage in which there is a first linkage component, a second linkage component, a third linkage component, and a fourth linkage component. The first linkage component is a reference datum component and includes structure immovable relative to the underframe. The second linkage component is a first pivot linkage mounted to the first linkage component at a main pivot connection, and which includes the first and second linkage members, the first and second linkage members being a matched pair of left and right hand pivot arms constrained to pivot on a common axis of rotation relative to the underframe. The fourth linkage component is a second pivot linkage pivotally mounted to the first linkage component and which includes at least one pivotally mounted door assembly defining the bottom discharge governor. The third linkage component includes a drag link element having at least a first pivotal attachment to at least a portion of the fourth linkage component, whereby input motion of the second linkage component uniquely determines position and motion of the third and fourth linkage components relative to the first linkage component. Motion of the second linkage component is driven by the actuator.

In another feature the hopper includes a hopper end slope sheet. The end slope sheet extends substantially in a plane inclined downwardly and lengthwise inwardly toward the bottom discharge. Displacement of the third linkage component associated with motion of the door assembly between the open position is predominantly in a direction generally parallel to the end slope sheet. In another feature the hopper includes a hopper end slope sheet. The end slope sheet extends substantially in a plane inclined downwardly and lengthwise inwardly toward the bottom discharge. During at least an instantaneous portion of motion of the third linkage component while the door assembly is in a position between the open position and the closed position the third linkage component moves parallel to the end slope sheet. In still another feature the third linkage component includes at least a first element and a second element mounted thereto. The first element is pivotally mounted to the first linkage component, and is constrained to move in a lengthwise-vertical plane relative to the first linkage component. The second element has a first connection to the first component the first connection being a pivot connection. The second element has a second connection to the fourth linkage component, the second connection having at least one degree of freedom of motion. The second element is constrained always to be coplanar with the first connection, the second connection, and the main pivot connection. In yet still another feature, the bottom discharge governor includes a door. The actuating cylinder is connected to drive the door operating linkage through a lever assembly. The lever assembly has an over-center lock that is operable to prevent release of the bottom gate to the open position when the actuating cylinder is inactive. In yet a further feature, motion of the first pivot linkage occurs in a longitudinal-vertical plane. The second pivot linkage moves in a plane generally cross-wise to the longitudinal-vertical plane. In still a further feature the main pivot connection is beneath the actuating cylinder when the hopper car is seen in side view. In again another feature one of (a) the main

pivot is beneath the drag link element; and (b) the actuating cylinder is between the main pivot and the drag link element. In a yet still further feature, the hopper includes at least a first end slope sheet, and the bottom discharge governor includes a door. The first end slope sheet is inclined longitudinally downwardly and inboard toward the door. The drag link element is inclined on a slope predominantly parallel to, and adjacent to, the first end slope sheet. The actuating cylinder is oriented along the lengthwise direction, and is also tilted longitudinally downwardly and inwardly toward the door.

In another aspect of the invention there is a railroad hopper car. It has at least one hopper carried by railroad car trucks for motion in a lengthwise direction of the car along railroad tracks. The hopper has a bottom discharge. The bottom discharge has a door movable between a closed position for retaining lading and an open position for permitting egress of lading. A mechanical transmission is connected to the door. The mechanical transmission is oriented lengthwise with respect to the car. A door actuator is connected to the mechanical transmission and is operable to urge the door from the open position toward the closed position, the door actuator being oriented to reciprocate in a first direction. The hopper car has a first lock operable to prevent movement of the door from the closed position to the open position when the door actuator is inactive. The hopper car has a second lock operable to prevent movement of the door from the closed position to the open position when the door actuator is inactive if the first lock should fail. The second lock is movable between an engaged position in which it prevents movement of the door to the open position thereof. In moving between the engaged and disengaged positions, the second lock has a displacement that is predominantly cross-wise to the first direction of the reciprocation of the door actuator.

In another feature of that aspect of the invention, the car has a central lengthwise-vertical plane, the door actuator is positioned to reciprocate in the central lengthwise-vertical plane, and the second lock is movable between the engaged and disengaged positions in motion predominantly transverse to the central lengthwise-vertical plane. In another feature, the second lock is mounted on an hinge and pivots in a circumferential direction between the engaged and disengaged positions. In still another feature the second lock is mounted on an hinge, the hinge has an axis lying parallel to the lengthwise vertical plane, and the second lock pivots circumferentially between the engaged and disengaged positions. In another feature, the second lock is biased toward the engaged position. In still another feature, the second lock is biased toward the engaged position. In yet another feature the apparatus is one in which one of: (a) the second lock has a cam and the actuator has a mating cam follower; and (b) the second lock has a cam follower and the actuator has a mating cam. The cam and cam follower are co-operable, and are oriented to deflect the second lock away from the engaged position as the door moves from the open position to the closed position thereof.

In another aspect of the invention, there is a lock mechanism for a door actuating transmission of a railroad gondola car, the door actuating transmission including a reciprocating actuating cylinder mounted to a datum structure, the cylinder being movable forward and backward in an axial direction. The lock mechanism has a body having a first fitting, a second fitting and a third fitting. The first fitting is a mounting by which to connect the lock mechanism to the datum structure. The second fitting is one of (a) a cam for co-operation with a member of the door actuating transmission, that member being a cam follower; and (b) a cam follower for co-operation with a member of the door actuating transmission, that mem-

ber being a cam. The third fitting includes an abutment for co-operation with a mating fitting of the door actuating transmission. The third fitting is movable between a first position and a second position, in the first position the abutment being presented to obstruct motion of the mating fitting of the door actuating transmission and thereby to prevent the door from moving to an open position thereof. The second fitting is movable between a first position and a second position, in the first position thereof the second fitting being positioned to intercept the member of the door actuating transmission and to be deflected away from the first position toward the second position thereby. The first fitting has a first degree of freedom of motion permitting the first and second fittings to move between their respective first and second positions. The degree of freedom constrains the third fitting to motion predominantly cross-wise to the axial direction.

In another feature, the lock mechanism there is a bias member oriented to urge the third fitting toward the first position thereof. The bias member is a spring having a first end and a second end, the first end being mounted to bear against the body of the lock mechanism, the second end having a foot for reaction against the datum structure. In another feature, the first degree of freedom of motion is an angular degree of freedom, and the predominantly cross-wise motion is predominantly circumferential motion about an axis of rotation. In a feature the first fitting is an hinge, the axis of rotation is an axis of rotation of the hinge, and the axis of rotation of the hinge is substantially parallel to the axial direction of the door actuating transmission. In still another further feature, the first fitting of the lock mechanism includes an hinge and a footing of the hinge for mounting to the datum structure. The axis of rotation is an axis of rotation of the hinge, and the footing has a substantially planar footprint. The axis of rotation of the hinge is angularly inclined relative to the substantially planar footprint. In yet another feature, the lock mechanism has all or any combination of the foregoing additional features.

In still another aspect of the invention there is a railroad hopper car for carrying particulate material. The hopper car there has a hopper and first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction. The hopper is suspended between the first and second end sections. The hopper has a discharge section through which to release lading, and first and second end slope sheets oriented toward the first and second end sections, the slope sheets being inclined in the longitudinal direction to feed the discharge section. The first end section includes a draft sill extending in the longitudinal direction, a main bolster extending cross-wise to either side of the draft sill, and a shear plate mounted to the draft sill and to the main bolster. The shear plate extends lengthwise along the draft sill and cross-wise from side to side of the hopper car. The first end slope sheet of the hopper overhangs the shear plate of the first end section. The hopper car is free of primary structure directly above the shear plate of the first end section under the overhang of the first slope sheet of the hopper.

In another feature of that aspect of the invention, there is one of: (a) the first slope sheet has an upper margin and the hopper car includes an end post extending upwardly from the draft sill to the upper margin of the slope sheet; and (b) the first slope sheet has an upper margin terminating at an end wall, and the hopper car includes an end post extending upwardly from draft stub sill to the end wall. In another feature, the shear plate has a longitudinally outboard margin and the draft sill has a striker located outboard of the longitudinally outboard margin of the shear plate, and the end post

is one of: (a) rooted to the draft sill adjacent to the striker; (b) rooted to the shear plate adjacent to the longitudinally outboard margin of the shear plate. In a further feature, the bolster has first and second laterally outboard distal ends, and the hopper car has corner posts extending upwardly from the distal ends of the hopper to the first slope sheet.

In still another feature, the bolster has first and second laterally outboard distal ends, and the hopper car has corner posts extending upwardly from the distal ends of the hopper to the first slope sheet. In another feature, one of: (a) the first slope sheet has an upper margin and the hopper car includes an end post extending upwardly from the draft sill to the upper margin of the slope sheet; and (b) the first slope sheet has an upper margin terminating at an end wall, and the hopper car includes an end post extending upwardly from draft stub sill to the end wall; the shear plate has a longitudinally outboard margin and the draft sill has a striker located outboard of the longitudinally outboard margin of the shear plate, and the end post is one of: (a) rooted to the draft sill adjacent to the striker; (b) rooted to the shear plate adjacent to the longitudinally outboard margin of the shear plate. The bolster has first and second laterally outboard distal ends, and the hopper car has corner posts extending upwardly from the distal ends of the hopper to the first slope sheet. The hopper car has a machinery space bounded by (a) the first slope sheet; (b) the shear plate of the first end section; (c) the end post; and (d) the corner posts, and the machinery space is free of any other primary structure.

In yet another feature the hopper car has at least one longitudinally hinged discharge door, the discharge door being movable cross-wise between open and closed positions. A longitudinally acting pneumatic actuator is at least partially lodged in the machinery space directly above the draft sill. In still yet another feature a brake reservoir is also at least partially lodged in the machinery space. In a yet further feature the shear plate is mounted above and to the main bolster and defines an upper flange thereof. The main bolster has a lower flange downwardly spaced from the upper flange, the lower flange terminating at respective distal end portions at either side of the car. The car includes a side sill running along the car between the first and second end sections. The side sill has an upper flange, the upper flange of the side sill being substantially co-planar and connected to the shear plate. The side sill has a lower flange, the lower flange of the side sill being substantially co-planar with a respective one of the distal end portions of the lower flange of the main bolster. In another further feature, the shear plate defines an upper flange of the draft sill whereby the draft sill upper flange, the shear plate and the side sill upper flange are all substantially co-planar. In another feature the machinery space is free of elephant ears.

In a further aspect of the invention there is a railroad freight car having a freight car body for carrying lading, the body being mounted on railroad car trucks for rolling motion in a longitudinal direction along railroad tracks. The car body includes a draft sill having a draft gear pocket for accommodating draft gear, and a shear plate overlying the draft sill and functioning as an upper flange of the draft sill. The draft sill has an inboard end oriented toward a truck center of one of the trucks, and an outboard end terminating at a striker. The draft sill has an underside and an access opening formed in the underside to admit entry of draft gear into the draft gear pocket from below. The car has a draft gear carrier plate. The carrier plate is mounted to the underside of the draft sill beneath the draft gear pocket. The carrier plate is removable to permit installation of the draft gear into the draft gear pocket. The car body has one of (a) an aperture formed in the

shear plate over an inboard end region of the draft sill, the aperture permitting a portion of the draft gear to protrude upwardly therethrough during installation in the draft gear pocket; and (b) a coupler carrier seat defined in the draft sill longitudinally inboard of the striker, and a coupler carrier co-operable therewith, the coupler carrier being removable to permit installation of draft gear in the draft pocket, and, when the coupler carrier is installed, the coupler carrier providing a support for a coupler shank when the coupler shank is connected to the draft gear within the draft sill.

In another feature of that aspect of the invention the freight car has both (a) and (b). In another feature, there is a cover plate for the aperture of the shear plate, the cover plate being removable to permit installation of the draft gear. In still another feature, the draft sill has a pair of vertically oriented, longitudinally running spaced apart side webs. The webs have a greater depth of section adjacent to the striker. The webs have respective first and second apertures formed therein. The first and second apertures define the draft gear retainer seat, and the retainer is a sideways slidable shaft that is movable to extend across the draft sill between the first and second apertures in the draft sill side webs. In a further feature there is a cover plate for the aperture of the shear plate, the cover plate being removable to permit installation of the draft gear. In another further feature the draft sill has a centerplate centered on the truck center, rear draft stops are welded within the draft sill, and at least a portion of each of the rear draft stops extends longitudinally inboard of the truck center. In still another further feature, the car is one in which at least one of (a) the freight car has a truck center to striker plate draft sill length of less than 50 inches; and (b) the freight car has a truck center to coupler pulling face length of less than 65 inches when the draft gear is fully extended in draft. In another feature, the railroad freight car is one in which at least one of (a) the freight car has a truck center to striker plate draft sill length of about 38 inches (+/-2"); and (b) the freight car has a truck center to coupler pulling face length of about 53 inches (+/-2") when the draft gear is fully extended in draft.

These and other aspects and features of the invention may be understood with reference to the description which follows, and with the aid of the illustrations.

BRIEF DESCRIPTION OF THE FIGURES

The description is accompanied by a set of illustrative Figures in which:

FIG. 1 is a general arrangement, isometric view of a railroad freight car according to an aspect of the invention with all ancillary systems removed to leave only primary structure visible;

FIG. 2a is an isometric view of a sidewall of the gondola car of FIG. 1;

FIG. 2b shows a side view of the sidewall of FIG. 2a;

FIG. 2c shows an end view of the sidewall of FIG. 2a;

FIG. 3a shows a perspective view of the end structure of the railroad freight car of FIG. 1;

FIG. 3b is a side view of the structure of FIG. 3a;

FIG. 3c is a detail of the end structure of FIG. 3b, with the near side web of the draft sill removed to show the draft stop, center plate, and coupler relationship.

FIG. 4a is an isometric view of a portion of the door opening mechanism for the railroad car of FIG. 1 in a fully open position;

FIG. 4b is an isometric view of a portion of the door opening mechanism for the railroad car of FIG. 1 in an intermediate position;

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FIG. 4c is a isometric view of a portion of the door opening mechanism for the railroad car of FIG. 1 in a fully closed position;

FIG. 5a is a side view of the door opening mechanism of FIG. 4a;

FIG. 5b is a side view of the door opening mechanism of FIG. 4b;

FIG. 5c is a side view of the door opening mechanism of FIG. 4c;

FIG. 6a is an end view of the door opening mechanism of FIG. 4a;

FIG. 6b is an end view of the door opening mechanism of FIG. 4b; and

FIG. 6c is an end view of the door opening mechanism of FIG. 4c;

FIG. 7a is a perspective view of a secondary lock mechanism for the door opening mechanism of FIG. 4a;

FIG. 7b is a plan view of the mechanism of FIG. 7a;

FIG. 7c is a perspective view of the mechanism of FIG. 7a when the door are open

FIG. 7d is a view similar to FIG. 7c, of the mechanism of FIG. 7a in a deflected condition; and

FIG. 7e is a perspective view of the mechanism of FIG. 7a in a locked position;

DETAILED DESCRIPTION

The description that follows, and the embodiments described therein, are provided by way of illustration of an example, or examples, of particular embodiments of the principles, aspects or features of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings may be taken as being to scale unless noted otherwise.

The terminology used in this specification is thought to be consistent with the customary and ordinary meanings of those terms as they would be understood by a person of ordinary skill in the rail road industry in North America. Following from decision of the CAFC in *Phillips v. AWH Corp.*, the Applicant expressly excludes all interpretations that are inconsistent with this specification, and, in particular, expressly excludes any interpretation of the claims or the language used in this specification such as may be made in the USPTO, or in any other Patent Office, other than those interpretations for which express support can be demonstrated in this specification or in objective evidence of record in accordance with *In re Lee*, (for example, earlier publications by persons not employed by the USPTO or any other Patent Office), demonstrating how the terms are used and understood by persons of ordinary skill in the art, or by way of expert evidence of a person or persons of at least 10 years experience in the industry in North America or in other former territories of the British Empire and Commonwealth.

In terms of general orientation and directional nomenclature, for rail road cars described herein the longitudinal direction is defined as being coincident with the rolling direction of the rail road car, or rail road car unit, when located on tangent (that is, straight) track. In the case of a rail road car having a center sill, be it a stub sill or a straight-through center sill, the longitudinal direction is parallel to the center sill, and parallel to the top chords. Unless otherwise noted, vertical, or upward and downward, are terms that use top of rail, TOR, as a datum. In the context of the car as a whole, the term lateral, or laterally outboard, or transverse, or transversely outboard

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refer to a distance or orientation relative to the longitudinal centerline of the railroad car, or car unit, or of the centerline of a centerplate at a truck center. The term "longitudinally inboard", or "longitudinally outboard" is a distance taken relative to a mid-span lateral section of the car, or car unit. Pitching motion is angular motion of a railcar unit about a horizontal axis perpendicular to the longitudinal direction. Yawing is angular motion about a vertical axis. Roll is angular motion about the longitudinal axis. Given that the rail road car described herein may tend to have both longitudinal and transverse axes of symmetry, a description of one half of the car may generally also be intended to describe the other half as well, allowing for differences between right hand and left hand parts. In this description, the abbreviation kpsi stands for thousand of pounds per square inch. To the extent that this specification or the accompanying illustrations may refer to standards of the Association of American Railroads (AAR), such as to AAR plate sizes, those references are to be understood as at the earliest date of priority to which this application is entitled.

Bottom dumping hopper cars, of which ore cars and coal cars may be examples, may tend to have either longitudinal doors or transverse doors. Longitudinal doors are oriented such that the doors operate on hinges or axes of rotation that are parallel to the direction of travel of the railroad car generally. U.S. Pat. No. 4,250,814 of Stark et al., issued Feb. 17, 1981 and U.S. Pat. No. 3,800,711 of Tuttle, issued Apr. 2, 1974 show cars with longitudinal doors. By contrast, transverse doors are ones in which the axes of rotation of the hinges or other pivots tend to be predominantly cross-wise to the direction of travel, most often perpendicular to it. An example of a transverse door car shown in U.S. Pat. No. 4,843,974 of Ritter et al, issued Jul. 4, 1989.

FIG. 1 shows an isometric view of an example of a rail road freight car 20 that is intended to be representative of a range of rail road cars in which one or more of the various aspects of the present invention may be incorporated. While car 20 may be suitable for a variety of general purpose uses, it may be taken as being symbolic of, and in some ways a generic example of, a flow through car, in which lading is introduced by gravity flow from above, and removed by gravity discharge through gated or valved outlets below. Flow through, or center flow cars may include open topped hopper cars, grain cars, plastic pellet cars, potash cars, ore cars, coal gondolas, and so on. In one embodiment car 20 may be a hopper car such as may be used for the carriage of bulk commodities in the form of a granular particulate, be it in the nature of relatively coarse gravel or fine aggregate in the nature of fine gravel or sand or various ores, ore concentrate or coal. The principle, or primary, structure of car 20 may be symmetrical about both its longitudinal and transverse, or lateral, centerline axes. Consequently, it will be understood that the car has first and second, left and right hand side beams, bolsters and so on.

By way of a general overview, car 20 may have a car body 22 that is carried on trucks 24 for rolling operation along railroad tracks. Car 20 may be a single unit car, or it may be a multi-unit car having two or more car body units, where the multiple car body units may be substantially permanently connected at an articulated connector, or by draw bars, as opposed to by ordinarily releasable AAR couplers. Car body 22, and the various structural members and fittings described herein may be understood to be typically of metal construction, whether welded or Huck(t.m.) bolted, or riveted together, the metal members being most typically steel, stainless steel, or aluminum, as may be appropriate. Some car builders have also used reinforced plastic composites for car

elements, and those materials could also be employed where suitable. The default construction may be taken as being steel, of which the majority may be mild steel having, typically, a 50 kpsi yield. Car body 22 may have a lading containment vessel or shell 26 such as may include an upstanding wall structure 28 which may have a pair of opposed first and second end walls 30, 32, that extend cross-wise, and a pair of first and second side walls 34, 36 that extend lengthwise, the end walls 30, 32 and side walls 34, 36 co-operating to define a generally rectangular form of peripheral wall structure 28. Wall structure 28 may include top chords 38 running along the top of the walls, and side sills 40 running fore-and-aft along lower portions of the side sheets or side sheet assemblies 42 of side walls 34, 36. In some instances, such as that of the illustration of FIG. 1a, car 20 may have stub center sills 44 at either end, in which case side walls 34, 36 may act as deep beams, and may carry vertical loads to main bolsters 90 that extend laterally from the centerplates. In the case of a single, stand alone car unit, draft gear and releasable couplers may be mounted at either end of the stub center sill. In a center flow, or flow through car, the upper portion of the car may typically include means by which to admit lading under a gravity drop system. Such an intake 46, or entryway may be a large rectangular opening such as that bounded by top chords 38.

Car body 22 may include end sheets 48 and side sheets 50. Car 20 of FIG. 1 et seq., is illustrated as a car having a single hopper 52, a single hopper discharge section 54, and an outflow or discharge governor in the nature of a discharge door assembly 56. However, car 20 could, alternatively, be a multiple hopper car. In a multiple hopper car, the car may have laterally extending members or reinforcements, which may be cross-bearers, or cross-bearers with shrouds, or merely shrouds, particularly where the car is a multiple hopper car. These cross-members may run fully across the car from side sill to side sill, and may intersect the center sill, or the center sill shroud as may be. The car may also include upper wall bracing, in the nature of diagonal struts which extend diagonally upwardly and outwardly from the apices of the respective cross-members at the centerline of the car to upper regions of the side walls near or at the top chords; and lateral ties or struts that run across the car from sidewall to side wall to meet the upper ends of the diagonal struts at their wall brackets. Those brackets may be aligned with, and mated through the wall to, the vertical exterior posts that run from the side sill to the top chord and reinforce the walls.

End sheets 48 may be substantially planar slope sheets or slope sheet assemblies that are inclined downwardly in the longitudinally inboard direction to feed the discharge section. Not atypically, each pair of fore- and aft opposed slope sheets may be inclined at equal and opposite angles, and the angles of those sheets may be selected to be somewhat steeper than the free slope angle, or natural talus slope angle of the lading for which the car is designed, such that, when the gates are opened, the lading may tend to flow out, rather than sit at rest.

The primary structure of body 22 of car 20 includes lading containment vessel 26 which is in the nature of hopper 52. Hopper 52 has an upper portion 58 with substantially vertical wall panels, and a lower stationary portion defined by a set of converging sloped walls, namely the side and end slope sheet assemblies 48 and 50. At the lower margin of the sloped walls there is the outflow governor, namely door assembly 56, which, in this instance, may have the form of a pair of first and second, or left and right hand doors 62, 64. This containment structure seats on, and is carried by, a pair of first and second end structures, 66, 68, at either end of the car. End structures 66, 68 are in turn carried by trucks 24. A door operating apparatus or mechanism, or drive train, or transmission, how-

ever it may be termed, and identified generally as 70, is provided to move doors 62, 64 between open and closed positions.

Considering this structure in greater detail, trucks 24 are most immediately surmounted by center plates 72 of longitudinally extending stub sills 44. Stub sills 44 in turn carry laterally extending main bolster arms 74 of main bolster 90. Arms 74 extended perpendicularly away from the centerplate 72, i.e., they are centered on the truck center, CL-Truck. Side sills 40 run lengthwise along the car between, and tie together, the most laterally outboard extremities of main bolster arms 74. A shear plate 76 is mounted in an x-y horizontal plane defining the top cover plate of stub sill 44. Shear plate 76 extends laterally from side sill to side sill, and longitudinally from the fore-and-aft end slope sheet 48 to the laterally extending end sill 78 of the car, which, in this instance may be an upturned flange formed on the longitudinally outboard margin of shear plate 76. In car 20, the primary structure includes an end post 80 and a pair of side or corner posts 82, 84.

End post 80 is rooted in shear plate 76 in line with center sill 44, and may have lateral webs or gussets aligned with the webs of stub sill 44 to provide vertical web continuity across shear plate 76. End post 80 then extends fully between shear plate 76 and top chord 86 of end wall 30 or 32, as may be. Corner posts 82 and 84 are rooted to, and stand upwardly from, the junction of the laterally outboard ends of left and right hand main bolster arms 74 and side sills 40. Posts 82 and 84 extend upwardly from this junction to mate with various elements of the end and side walls, as may be described below.

As described in additional detail below, car 20 has an abnormally short distance from the striker 88 to the truck center, i.e., the CL of centerplate 72. Striker 88 is the vertical planar surrounding face plate at the outboard end of the stub sill 44. In the terminology of the industry, the portion of the center sill 44 (be it a stub center sill or a straight through center sill) that lies longitudinally outboard of the truck center CL-Truck may also be referred to as the draft sill. In car 20, the short draft sill length, identified as L_{88} , leaves an anomalously small space in which to install other systems, such as the brake reservoir and the door operating pneumatic cylinder. Car 20 has an end of car machinery space, indicated generally as 75, that is bounded by shear plate 76 on the bottom, the sloped end wall assembly 30 or 32 of the car on the top, main vertical central end post 80, and main side posts 82, 84 at the ends of main bolster 90. This space may be referred to as having the shape, generally, of a triangular prism and is substantially unobstructed by the primary structure of the car. For the purposes of this description, primary structure is defined as the underframe, including side sills and center sill (i.e., including the draft sill), the side walls, the slope sheets and top chords, the hopper construction including the stationary parts of the discharge section, as well as any cross-bearers, cross-ties, bolsters, shear plates and so on. Primary structure excludes secondary or ancillary structure or systems such as ladders, cat-walks and other safety appliances, brakes, brake rods and brake fittings, air hoses, reservoirs and pneumatic fittings, movable door members, door operating linkages, and so on.

In existing cars, this space, 75, is often occupied or otherwise obstructed by other primary structure, such as so-called "elephant ears". In this context, "elephant ears" are large, substantially triangular planar plates, sometimes provided with central lightening holes, that have one edge fixed along the junction of the center sill webs and the center sill cover plate, and another edge welded to the end slope sheet. The

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third edge is typically a free edge. Often these plates lie in a plane that is oriented at an angle to the vertical—i.e., it leans laterally outboard. Car 20 avoids the use of these “elephant ears” and so provides the large unobstructed space shown in FIG. 1b.

FIGS. 1 and 2a, 2b and 2c, all show the sidewall of the car, indicated generally as 34 or 36. Sidewall 34 and 36 function as short beams of low (e.g., less than 4:1, possibly less than 3:1) length-to-depth ratio. Sidewall 34 or 36 can be seen to have a bottom flange or chord member, namely side sill 40, a top flange or chord member, namely top chord 38, which may have the form of a square or rectangular hollow structural steel tube; and an intermediate shear force transfer web, namely side sheet assembly 42. Side sheet assembly 42 may include an upper sheet portion or member 92 that is welded to the outside face of top chord 38 at a lap joint, and that extends downwardly therefrom; and a lower sheet portion or member 94. Member 94 may have the form of a Z-section, having a first portion, namely an upper flange or leg or margin 96 that extends in a substantially vertical plane and has an uppermost margin that overlaps the lowermost edge or margin of member 92; a second or intermediate portion 98 that runs in an inclined plane sloping inwardly and downwardly on the slope of the hopper side sheets generally, and a third or bottom portion, namely bottom flange, or leg, or margin 100 that extends in a substantially vertical plane downwardly. Sidewall 34 or 36 also includes a central post, or web stiffener, 102 that has a lowermost first portion 104 an intermediate second portion 106, and an uppermost third portion 108.

Side sill 40 includes a channel 110 that is welded toes-inward against the lowermost marginal portion of lower leg 100 to form a closed section. The first or lowermost portion 104 of web stiffener 102 has the form of a quadrilateral gusset having a first edge welded to the upper leg of channel 110, a second edge welded to the vertical margin 100, a third edge welded to the sloping portion 98, and the fourth, laterally outboard, edge being free. As may be noted, portion 104 stands outboard of the sidewall sheet.

Portion 108 is a rectangular web stiffener that is welded to, and extends downwardly from, the underside of top chord 38 along the inside face of vertical web portion 92. Intermediate portion 106 is a web, or plate, or gusset, that is also a quadrilateral, having a first edge that overlaps, and is welded to, the lower margin of portion 108. A second edge is welded to the lower region of vertical web portion 92, and to the upper flange or leg 96. A third edge is welded along the sloped portion 98 of member 94. The fourth edge is free, and faces inwardly into the lading containment space of the hopper. Portions 104 and 106 are co-planar, or substantially co-planar, such that stiffener 102 has web continuity through member 94. The upper margin of the side slope sheet 50 of the hopper discharge section is welded to the lower margin of the inclined or sloped portion 98, such that the structure presents a continuous sloped surface for containing, and then slidably discharging, particulate lading. Expressed differently, the web of the sidewall traverses the sidewall stiffener, commencing on its inboard margin at side sill 40, traverses the web mid-way up the post, and ends along its outboard margin at top chord 38. In this arrangement, the vertical stiffener, 102, acts as the web of a T-section, and the local region of the wall section to which it is joined functions as the flange of that T-section.

In this example, the locus of intersection of the side slope sheet plane P_{94} with the plane of the side wall sheet P_{92} , lies above the level of side sill 40 by a substantial distance, indicated as L_{94} . This distance may lie in the range of $\frac{1}{4}$ to $\frac{1}{2}$ of the distance L_{SW} from side sill 40 to top chord 38, and, in the

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particular may be about $\frac{1}{3}$ of that distance. Further, although the post has stiffening member web continuity in a vertical plane, the wall sheet traverses the stiffening web intermediate the top chord and the side sill, and does so obliquely on the slope of plane P_{94} .

The upper leg of channel 110 forms the upper flange of side sill 40, and the lower leg of channel 110 forms the lower flange of side sill 40. Shear plate 76 forms the top flange of main bolster 90. Main bolster 90 also has a lower or bottom flange 91. In car 20 the upper leg of channel 110 is co-planar or substantially co-planar with, and is connected in flange continuity with, shear plate 76. Similarly, the lower leg of channel 110 is co-planar or substantially co-planar with, and connected in flange continuity with, bottom flange 91 of main bolster 90.

Continuing with the sidewall assembly, the main sheet, namely upper sheet portion 92, ends at the corners, and there are respective first and second end upper web stiffener portions and inwardly stepped plate members 112, which may be termed “ears”. The top edge of each ear is welded to the inside face of top chord 38 in a lap joint. The longitudinally outboard end edge forms a plane to which the vertical end sheet of the end slope sheet wall abuts and is welded. The bottom edge follows the slope of, and is welded to, end slope sheet 48. The forward, transversely outwardly bent edge is welded to the upper end portion of side sheet assembly 42. The lower region of the main sidewall sheet also includes lightening apertures 114, in the space between the corner posts and the slope of the end slope sheets. Finally, the lower portion of region 100 of the main sidewall sheet has longitudinal extensions 116 that are welded to the side edges of the shear panel, namely shear plate 76, outboard of main bolster 90, thereby forming a portion of the peripheral flange of the shear plate.

End walls 30, 32 each include upper and lower sloped surface members 122 and 124, which could be made as a single piece, or as two pieces butt-welded together, as here. Upper member 122 has notches 126 formed therein to accommodate corresponding corner posts 82, 84 as may be, with local reinforcement doublers 128 at the junction. Lower portion 124 tapers in width to match the narrowing width between the sloped side sheets with which it mates. At the upper end of end wall 30 the end wall assembly includes a laterally extending first formed member 130 that has a first, vertical leg 132 that laps the inside face of the top chord 86, and a bent flange 136 that extends initially horizontally, with a distal lip bent upward to mate perpendicularly with the upper margin 138 of the end slope sheet 48. The distal tip of end slope sheet 48 is fillet welded to vertical leg 132. This results in a substantially triangular closed section defining a laterally extending end slope sheet reinforcement beam 140. The ends of this beam abut, are welded to, and are capped by elephant ears 112. Vertical leg 132 also lies against, and is welded to, end post 80.

A formed angle 142 is mounted toes-in at an intermediate height on sloped end wall 48, forming thereby another hollow section laterally extending end sheet reinforcement or beam 148. Vertical leg 144 of angle 142 is substantially aligned with the central web of the corner post (be it 82 or 84) and therefore also with the central web of the main bolster. Another formed angle 150 is welded toes-in to the back of sloped end wall 30 at the level of shear plate, thereby forming yet another slope-sheet reinforcement in the form of a laterally extending beam.

The corner posts 82 and 84 each have a lower corner post flange plate 160 (that includes a lifting lug aperture) that has a bottom tab welded to the outside, or back, of the end of side sill 40 in line with the main bolster, then an angled portion following the angle of the outside edge of the vertically

extending side wall reinforcements, 161, to an upper end at the juncture of the side slope sheet with the side wall vertical leg of the lower side wall sheet. Each end post has two internal reinforcements 154. Each corner post also includes an intermediate member, or web, or gusset, or plate 162, which is considerably wider than intermediate gusset 106, and a substantially triangular inside edge web stiffener 164. Plate 162 is a quadrilateral. A first edge of plate 162 runs along the upward and outward slope of wall extension 166. A second edge runs vertically against the upper leg of wall extension 166. A third upper edge adjacent runs horizontally along lateral reinforcement beam 148. The fourth edge runs vertically downward to and along edge stiffener 164. As such, a vertical post is established.

Considering FIGS. 3a, 3b and 3c, center sill 44 includes a bottom flange or bottom cover plate 165, and a pair of spaced apart webs 168. The central region of shear plate 76 forms the top flange, or top cover plate of the center sill. At its inboard end, the center sill terminates centrally under the bottom lateral reinforcement of the end slope sheet 48. A draft pocket 175 is defined between webs 168, shear plate 76 and bottom cover plate 165 longitudinally inboard of the striker plate.

Center plate 72 is mounted at truck center CL-Truck, in line with main bolster 90 and the corner posts 82, 84. Rear draft stops 172 are welded within the center sill above center plate 72. As seen in FIG. 3c, the inboard end of rear draft stop 172 extends longitudinally inboard of the truck center. While this is known to have been used in at least one single piece, integrally cast draft sill, the inventor is unaware of such a construction in an all-welded fabrication draft sill assembly. The removable draft sill access cover plate, or draft gear carrier plate 174, which is bolted to the draft sill (i.e., the stub sill) bottom flange margins, is mounted immediately longitudinally outboard of center plate 72. Front draft stops 176 arc, in turn, mounted longitudinally outboard of carrier plate 174. In this embodiment there is also a removable member, such as a top leeway or access plate 178, mounted to shear plate 76. Plate 178 is removed when draft gear 180 is removed or installed. On installation, draft gear 180, to which yoke 188 is already mounted, is fed into draft pocket 175 from below, on an angle, whereby the rear corner protrudes upwardly through the opening that is otherwise covered by plate 178. The front end of draft gear 180 is rotated into place, and the rear end is rotated downward. As this occurs, yoke 188 is also raised into place. Plates 178 and 174 are then reinstalled. The shank 182 of the coupler, 184 is inserted, and the coupler key 186 is fed through the slot in front draft stops 176 to link coupler 184, and yoke 188 in the customary manner. It may be noted that coupler 184 combines an AAR Type E shank with and AAR Type F knuckle with a bottom shelf. Draft gear 180 itself has abnormally short travel, namely about 2½ inches deflection before going solid, as compared to a "normal" deflection of over 3" before going solid.

Draft sill webs 164 have, at their longitudinally outboard end an end portion 190 of increased depth of section with a downwardly protruding bulge or horn, such as might be termed a "chin". End portion 190 has an aperture or slot 192 formed therein to permit lateral sliding insertion of a coupler support, carrier or bar 194 immediately behind striker plate 88. Removal of bar 194 permits yoke 188 to be swung into place during installation of draft gear 180. When coupler 184 is installed, the shank may rest on bar 194. Bar 194 is held in place by bolts that secure it relative to webs 164. Overall, a coupler installation of very short length is achieved. In this example, L_{88} may be in the range of less than 50 inches, and in one embodiment may be about 38"±2", from the truck center to the outboard face of striker plate 88. An alternative

expression of the relative compactness of the draft gear is that the length from the truck center to the pulling face of the coupler, when the draft gear is extended in tension, is in the range of less than 65 inches, and in one embodiment is in the range of 53"±2".

Car 20 may also include a door opening mechanism 200. There are left and right hand, or first and second, doors 62, 64. Each door has a proximal, hinged edge 206, and a distal free edge 208. The hinges are carried on hinge fittings welded to mounting brackets depending from the slope sheets and side sills. The hinges run parallel to the longitudinal or lengthwise axis of the car, generally such that doors 62, 64 are longitudinal doors. Each door has the form of a hollow section beam, having a proximal beam 210 along the hinge side, a distal beam 212 along the free edge, internal cross-braces, not shown, and front and back skins or sheets or plates 214, 216. The hinges are indicated as 220, the end closure plates as 222, 224. The doors have door seal members 226, 228 that mutually engage when the doors are moved to a closed position. Seal members 226, 228 are sprung, such that when they are closed they deflect somewhat and in so doing take on a spring pre-load against each other. The door mechanism includes a pair of first and second, matched left and right hand pivot arms 230, 232; a corresponding pair of first and second drag links 234, 236; a shared yoke 238, and a pair of slave links 240, 242 that each pick up on a knuckle fitting 244, 246 of each of respective doors 62, 64. The whole assembly has left and right hand symmetry.

Inasmuch as, when tripped, doors 62, 64 open under the influence of gravity, particularly when assisted by the weight of the lading being discharged, one may consider the motion that occurs as the doors are closed in the sequence of views 4a, 4b, and 4c; 5a, 5b, and 5c; and 6a, 6b and 6c. Knuckles 244 and 246 are constrained by geometry to move in circular arcs of fixed radii in planes perpendicular to the respective axes of rotation of doors 62 and 64, those axes being the hinge axes of their respective hinges 220, which each lie in a plane parallel to the x-z plane of the car centerline. The plane of rotation of knuckles 244, 246 will then tend to be perpendicular to the central x-z plane. Slave links 240 and 242 are each of fixed length; each has an end pivotally connected at a two rotational degree of freedom knuckle, be it 244 or 246, as may be; each of slave links 240 and 242 has another end pivotally connected at a second pivot connection at yoke 238; and slave links 240 and 242 do not transmit a bending moment, and so therefore pull in pure tension. The upper, or near (i.e., proximal), ends of drag links 234, 236 are connected to the distal ends of pivot arms 230, 232 at pivot connections 248, 250, which may, if desired, share a common axis of rotation or pivot pin.

Yoke 238 is constrained by symmetry to pull in an x-z plane, which in the embodiment illustrated is the vertical plane of the centerline of the car. As such, movement of yoke 238 away from the plane of motion of knuckles 244 and 246 will necessarily draw knuckle fittings 244 and 246 closer together, and toward the vertical centerline plane of the car, eventually causing resilient door seals 226, 228 mutually to engage, thus closing the opening. This motion can be achieved by pulling on drag links 234, 236. Each pivot connection of slave links 240, 242 has a single angular degree of freedom. Similarly yoke 238 has an angular degree of freedom about the axis of rotation of the axle, or trunnions, by which it is pivotally mounted to the drag link, or drag links 234, 236. This gives the drag link connection two angular degrees of freedom in total. As the drag links are withdrawn, the slave links pull in tension, finding the natural hypotenuse between the plane of the arc of motion of knuckle fittings 244,

246 and the plane of motion of drag links 234, 236. Since this mechanism operates in tension, pivot connections 248, 250 and knuckle fittings 244, 246 are co-planar, with drag links 234, 236, yoke 238, slave links 240 and 242, and their associated pivot connections also lying in that same plane as well. (See FIGS. 5a, 5b, 5c).

Driving force for this system is provided by an actuator, identified as 260. Actuator 260 may be a pneumatic actuator, which may be charged by the pneumatic system of the train generally, as supplied through the pressurized air connection of the train line. Actuator 260 may include its own reservoir and check valve. Actuator 260 is connected to move a first member, in the nature of a primary driven pivot arm or lever, 262, which is in this instance actually a pair of matched lever arm members, which in turn is pivotally connected to, and drives, a second member in the nature of, a push rod, or, given the symmetrical nature of the assembly, a pair of left and right hand push rods 264 and 266. One or both of push rods 264, 266 may have a secondary member, such as may be an extending arm, or detent, or stop, or abutment, identified as an over-center travel limiter or governor, 268. The far ends of push rods 264, 266 may be connected to either pivot arms 230 (or 232, as may be), or to drag link 234 (or 236, as may be). It may be convenient to connect the far end of push rods 264, 266 at the same pivot connection, or connections 248, 250.

Lever 262 has a first end pivotally mounted to primary structure of car 20 at footings, identified as mounting fixtures, fittings or brackets 270. The drive rod of actuator 260 picks up on lever 262 at an intermediate location, such that lever 262 provides magnification of displacement. Similarly, pivot arms 230, 232 have a first or base end pivotally connected to primary structure at mounting fixtures, fittings, or brackets 272. Actuator 260 is located on the centerline (i.e., in the central x-z plane) of car 20, between and in substance below pivot arms 230, 232. "Below" in this context may be thought of as radially more proximate to the pivot axis P_{270} of brackets 270 than is the pivot axis of connections 248, 250, as well as in the context of being lower than as in closer to Top of Rail. In the past the lever fitting has more commonly been mounted to the slope sheet such that the output pin is lower than the pneumatic cylinder. Turning this arrangement upside down, in effect, and fitting the cylinder may then permit a more compact installation than otherwise. Similarly, the pivot axis, P_{230} , of driven arms 230, 232 is below the output knuckle, i.e., at P_{250} , and is below the actuator cylinder as shown in FIG. 5b in which P_{250} lies below the center line CL_{260} or actuator 260. This may be taken in the sense of being further from the plane of the end slope sheets, identified as P_{48} . Expressed differently, actuator 260 lies between the base or datum pivot point P_{250} of driven arms 230, 232 and the plane P_{48} of end slope sheet 48.

As may be noted, the line of action of drag links 234, 236 has a predominant component that is substantially parallel to plane P_{48} . Expressed differently, at some point during mid-stroke, the line of action will be at least instantaneously parallel to plane P_{48} . Finally, it may be noted that rather than placing actuator 260 on shear plate 76, and orienting actuator 260 such that its longitudinal axis (i.e., the working axis or axis of reciprocation of the actuator), that actuator is itself raised upwardly from the shear plate and oriented to work along a line of action that is tilted downward and longitudinally inboard, the angle of tilt being identified as α_{260} . This angle of inclination lies in the range from horizontal to the angle of inclination of end slope sheet 48, identified in FIG. 5c as α_{48} . Placing the mounts and pivot points under the apparatus, raising the actuator cylinder, orienting it on an incline, and making the line of action or the zone swept by the dra-

glinks in the progressions of FIGS. 4a, 4b and 4c (or 5a, 5b and 5c) tend to correspond to a displacement substantially or predominantly parallel to plane P_{48} , all aid in providing a more compact installation, in particular one that is longitudinally short as may suit the short distance from the truck center to the striker. It is also an installation that may tend to leave space for other car systems, such as the brake system.

This arrangement may be thought of in terms of a four bar, or multi-bar, linkage. The first bar of the linkage may be thought of as being the underframe, and structure rigidly mounted to the underframe. This is the datum, or frame of reference member of the linkage. The second member or linkage component is the first pivot arm, 230 (or 232) having a fixed main pivot point, and an output distal pivot point constrained to move on a fixed radius about main pivot point P_{230} . The fourth component or element of the linkage is the second pivot arm, namely 62 or 64, each of which is a second lever or pivot arm mounted to a pivot axis fixed with respect to the first or datum link, and having a distal connection, in this case also a pivot connection, constrained to move in an arc of constant radius about the base pivot axis. The third linkage is the drag link. Although the drag link is made of two portions that are held together at yoke 238, the geometric symmetry of the assembly constrains both the upper portion of the drag link, (i.e., drag link 234, 236) and the lower portions, (i.e., slave links 240, 242) to be co-planar during closing of the doors. In any case, the single input of the actuator cylinder acting through the over-center links against the first pivot arm (at the distal pivot connection) produces a unique output geometry such that position of the elements is determinate as if it were a four bar linkage.

When the door opening apparatus is retracted to the position shown in FIGS. 4c, 5c and 6c, driven primary pivot arms and the over-center links are driven to a slightly over-center relationship such that the pivot connection between the primary pivot arms and the over center arms lies below a line drawn from the primary pivot axis and the over-center link output connection as axis P_{250} . In this condition tensile force on drag links 234 and 236 (as from weight placed on doors 62, 64, for example) will tend to urge the main driven pivot arms, namely lever 262, counter-clockwise as viewed in FIG. 4c. Motion in this direction is prevented by the over center stop, 268, thereby defining a first lock that prevents inadvertent opening of doors 62, 64 from moving to the open position when actuator 260 is dormant, i.e., inactive. This first lock is released by reversing actuator 260 to open the doors.

Car 20 has a secondary door mechanism, or secondary latching system, identified generally as 300. This secondary latch system, and, indeed, the door closure linkage apparatus of FIGS. 7a-7e, are slightly different from those shown in FIGS. 4a, 5a, and 6a. In latching system 300 there is a latch assembly 302, shown in FIGS. 7a and 7b. Assembly 302 includes a first member, or main member, or plate 304, which performs the function of a body or armature or spider that ties the other various physical elements of the assembly together. Along one edge plate 304 has physical motion constraint fittings, identified as hinge fittings 306, that limit plate 304 (and assembly 302 more generally) to a single degree of freedom, that single degree of freedom limiting plate 304 to motion of any point to motion in a plane perpendicular to the hinge axis, and in particular to pivotal motion in that plane about that axis. To the extent that the hinge axis is substantially or predominantly parallel to the axis of reciprocation of pneumatic actuator 260, that motion can be said to be sideways, or predominantly transverse of cross-wise to that direction of reciprocation.

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Plate 304 has a portion or finger, or arm member 308 extending away from the hinge. In this case, arm member 308 extends arcuately away, and has a bent termination, or end, or lip, or tip, indicated at 310. Another member 312 in the form of a block is mounted, e.g., welded, at the distal end of arm member 308. Member 312 has the same general shape, a dog-leg bend, as tip 310. Member 312 has a first, generally inwardly (i.e., away from the tip) facing surface 314 that defines an abutment 316. Member 312 also has an oblique surface 318 that defines a wear or cam surface, which may be termed a reset cam, or return cam.

Another member 320, which may have the form of a plate or block, is welded to the major portion of the body of plate 304 relatively close to the hinge axis. The axially foremost face of member 322 is relieved—i.e., it does not define a face in a plane perpendicular to the hinge axis—or to the axis of reciprocation of the pneumatic actuator clevis. This face may be arcuate or chamfered, and so defines a first or deflection cam 324. That is, as installed, it lies in the path of actuator clevis 330. When the leading corner of clevis 330 encounters cam 324, plate 304 will tend to be urged to rotate, i.e., pivot, about its axis in the clockwise direction as viewed looking from actuator 260 toward hopper 52. Assembly 302 also includes a motion resisting, or return biasing member in the form of a spring, identified as leaf spring 326 that is anchored at the proximal end to stationary structure of the secondary lock footing, or base, 328 which is welded to shear plate 76. The footprint of base 328 against shear plate 76 is planar. The hinge axis is inclined relative to the plane as shown, the angle of inclination being substantially similar to, and possibly the same as, the mid-stroke angle of inclination of actuator 260 (which, itself, varies slightly during operation). The distal end of spring 326 bears against plate 304 distant from the hinge. Finally, assembly 302 includes reaction force transmission members 332, 334 in the form of welded flat bars that bear against, i.e., abut, the longitudinally outboard face of mounting fitting 270 when the latch is in the engaged position.

In operation, as actuator 260 works, lost motion is taken up in slot 336 of the distal or forward end 338 of the reciprocating actuator ram. Eventually the end of slot 336 engages a pivot pin 340 of bell crank arm 342 and causes driven member 344 (analogous to driven member 262), causing it to rotate counterclockwise as viewed in FIG. 7a. This forces push rods 346, 348 (analogous to push rods 264, 266) to act against connections 248, 250, and hence to force drag links 234, 236 along their retracting path. Since 262, 264, 230 and the car body form a four bar linkage, the output path of connections 248, 250 is determinate and unique.

While this happens, clevis 338 keeps moving rearward to engage reset cam surface 318, with the effect that assembly 302 is urged to rotate out of the way, against the resistance of spring 326 (FIG. 7d). Eventually the trailing portion of clevis 338 clears cam 324, and soon thereafter the most longitudinally inboard edge of driven member 344 clears abutment 316. Assembly 302 then moves under the influence of spring 326 into the locked position shown in FIG. 7e. In this locked position, any moment tending to pivot driven member 344 clockwise is reacted not by the hinge fittings, but rather by the reinforcements, namely members 332, 334. In this locked position driven member 344 and push rods 346, 348 are drawn to, and locked in, their over center position.

When the doors are to be released, actuator 260 moves in the opposite direction. The lost motion of the length of slot 336 reverses, such that the end of clevis 338 bears against the release cam, namely cam surface 324, which causes plate 304 to pivot away, and thus disengages abutment 316, moving it out of the path of driven member 262 against which it would

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otherwise abut. The outboard end of slot 336 then engages pin 340, releasing the over-center hold of driven member 344, and permitting the doors to open under the influence of gravity.

The cams need not necessarily be on the plate, i.e., the latch body, but could be on the clevis, as shown at 350 in FIG. 4c. That is, it is to some extent arbitrary which part is identified as the cam, and which part is identified as the cam follower. The point is that the parts mutually engage such that the one intercepts the other during motion of the actuator cylinder to trip the door opening condition, with the result that the secondary latch is urged to deflect out of the way sideways. In the other direction, of course, the abutment relationship of items 262 and 316 prevents the doors from opening. The apparatus of FIG. 4c works in substantially the same way, and combines both arms of the bell crank driven member 344 into a single driven lever, namely lever 262.

In summary, car 20 has a first lock, the over center lock, operable to prevent movement of the door from the closed position to the open position when the door actuator is inactive. Car 20 also has a second lock, symbolized by latching system 300, operable to prevent movement of the door from the closed position to the open position when the door actuator is inactive if the first lock should fail. The second lock is movable between an engaged position in which it prevents movement of the door to the open position thereof. In moving between the engaged and disengaged positions, the second lock has a displacement that is predominantly cross-wise to the first direction of the reciprocation of the door actuator. Actuator 260 is positioned to reciprocate in the central lengthwise-vertical plane of car 20. Latching system 300 is movable predominantly transverse to the central lengthwise-vertical plane as it pivots in a circumferential direction between the engaged and disengaged positions. The hinge axis lies parallel to the lengthwise vertical plane, and the second lock pivots circumferentially. The second lock is biased toward the engaged position. The lock mechanism can be thought of as having a first fitting, a second fitting and a third fitting. The first fitting is the mounting, 238 by which to connect the lock mechanism to the datum structure. The second fitting is one of a cam or a cam follower for co-operation with a member of the door actuating transmission. The third fitting is the abutment, i.e., 316, that co-operates with a mating part of the door actuating transmission, in this case the side of lever 262. The third fitting is movable between a first position and a second position, in the first position the abutment being presented to obstruct motion of the mating fitting of the door actuating transmission and thereby to prevent the door from moving to an open position thereof. The second fitting is movable between a first position and a second position, in the first position thereof the second fitting being positioned to intercept the member of the door actuating transmission and to be deflected away from the first position toward the second position thereby. The first fitting has a first degree of freedom of motion permitting the first and second fittings to move between their respective first and second positions. The degree of freedom constrains the third fitting to motion predominantly cross-wise to the axial direction. The bias member is a spring having a first end and a second end, the first end being mounted to bear against the body of the lock mechanism, the second end having a foot for reaction against the datum structure, namely shear plate 76. The first degree of freedom of motion is an angular degree of freedom, and is predominantly cross-wise circumferential motion. The axis of rotation is the hinge axis, which is substantially parallel to the axial direction of the door actuating transmission.

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Various embodiments have been described in detail. Since changes in and or additions to the above-described examples may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to those details.

We claim:

1. A railroad hopper car for carrying particulate material, said hopper car comprising:

a hopper;

first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and first and second end slope sheets oriented toward said first and second end sections, said end slope sheets being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, a main bolster extending cross-wise to said draft sill, and a shear plate mounted to said draft sill and to said main bolster, said shear plate extending lengthwise along said draft sill and cross-wise from side to side of said hopper car;

said first end slope sheet of said hopper over hanging said shear plate of said first end section; and

said hopper car being free of primary structure directly above said shear plate of said first end section under said overhang of said first end slope sheet of said hopper, one of:

(a) said first end slope sheet has an upper margin and said hopper car includes an end post extending upwardly from said draft sill to said upper margin of said first end slope sheet; and

(b) said first end slope sheet has an upper margin terminating at an end wall, and said hopper car includes an end post extending upwardly from draft stub sill to said end wall;

said shear plate has a longitudinally outboard margin and said draft sill has a striker located outboard of said longitudinally outboard margin of said shear plate, and said end post is one of:

(a) rooted to said draft sill adjacent to said striker;

(b) rooted to said shear plate adjacent to said longitudinally outboard margin of said shear plate;

said bolster has first and second laterally outboard distal ends, and said hopper car has corner posts extending upwardly from said distal ends of said bolster to said first end slope sheet; and

said hopper car has a machinery space bounded by (a) said first end slope sheet; (b) said shear plate of said first end section; (c) said end post; and (d) said corner posts, and said machinery space is free of any other primary structure.

2. The railroad hopper car of claim 1 wherein said bolster has first and second laterally outboard distal ends, and said hopper car has corner posts extending upwardly from said distal ends of said hopper to said first end slope sheet.

3. The railroad hopper car of claim 1 wherein:

said hopper car has at least one longitudinally hinged discharge door, said discharge door being movable cross-wise between open and closed positions; and

a longitudinally acting pneumatic actuator is at least partially lodged in said machinery space directly above said draft sill.

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4. The railroad hopper car of claim 3 wherein a brake reservoir is also at least partially lodged in said machinery space.

5. The railroad hopper car of claim 1 wherein:

said shear plate is mounted above, and to, said main bolster and defines an upper flange thereof;

said main bolster has a lower flange downwardly spaced from said upper flange, said lower flange terminating at respective distal end portions at either side of said car; said car includes a side sill running along said car between said first and second end sections;

said side sill has an upper flange, said upper flange of said side sill being substantially co-planar with, and connected to, said shear plate; and

said side sill has a lower flange, said lower flange of said side sill being substantially co-planar with a respective one of said distal end portions of said lower flange of said main bolster.

6. The railroad hopper car of claim 5 wherein said shear plate defines an upper flange of said draft sill whereby said draft sill upper flange, said shear plate and said side sill upper flange are all substantially co-planar.

7. A railroad hopper car, said hopper car comprising:

a hopper;

first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and a first end slope sheet oriented toward said first end section, said first end slope sheet being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, a main bolster extending cross-wise to said draft sill, and a shear plate mounted to said draft sill and to said main bolster, said shear plate extending lengthwise along said draft sill and cross-wise from side to side of said hopper car;

said first end slope sheet of said hopper over-hanging said shear plate of said first end section;

first and second side walls running lengthwise along first and second sides of said car, said first end slope sheet of said hopper extending cross-wise between said first and second side walls;

a first laterally extending reinforcement mounted cross-wise to said first end slope sheet adjacent to said shear plate;

said shear plate of said first end section being connected to said first laterally extending reinforcement;

said first end slope sheet of said first end section being connected to said first laterally extending reinforcement;

said first laterally extending reinforcement defining part of a first hollow section beam extending across said hopper car between said first and second side walls;

said hopper car being free of longitudinally oriented elephant ears extending between said draft sill and said end slope sheet;

said hopper car has a first end wall member running cross-wise between said first and second side walls;

said first end slope sheet has an upper margin that meets said first end wall member at a first junction;

said first end wall member extends upwardly from said first junction;

said first end wall member has a lower portion extending downward of said first junction;

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said lower portion of said first end wall member and said upper margin of said first end slope sheet co-operate to define portions of the cross-section of a second hollow section beam extending cross-wise across said hopper car between said first and second side walls.

8. The railroad hopper car of claim 7 wherein said laterally extending reinforcement member includes a first edge mounted cross-wise along said first end slope sheet; a second edge mounted cross-wise along said first end slope sheet and spaced from said first edge, and a third portion mounted across said shear plate of said first end section.

9. The railroad hopper car of claim 7 wherein said laterally extending member has a pair of first and second spaced apart toes, and said laterally extending member is mounted toes-in against said first end slope sheet, whereby said first hollow section beam is defined by said laterally extending reinforcement and said first end slope sheet.

10. The railroad hopper car of claim 7 wherein said laterally extending reinforcement has, when seen in section, a first toe, a second toe, and a back; said laterally extending reinforcement is mounted toes-in against said first end slope sheet; and said back is mounted to said shear plate of said first end section.

11. The railroad hopper car of claim 10 wherein said laterally extending reinforcement is an angle iron mounted toes-in to said first end slope sheet.

12. The railroad hopper car of claim 7 wherein said lower portion of said first end wall member has a lower margin that is bent to meet said upper margin of said first end slope sheet at a location lower than said first junction.

13. The railroad hopper car of claim 7 wherein said first end wall member has an upper margin that terminates at a top chord, said top chord extending from side to side of said hopper car.

14. The railroad hopper car of claim 7 wherein said car includes an upstanding end post, said end post being mounted over said draft sill longitudinally outboard of said main bolster and extending upwardly therefrom to meet said first end wall member.

15. The railroad hopper car of claim 7 wherein an intermediate beam extends across said first end slope sheet between said first and second side walls at a position intermediate said first hollow section beam and said second hollow section beam.

16. The railroad hopper car of claim 15 wherein said intermediate beam includes a cross-wise extending structural member mounted toes-in against said first end slope sheet to define a closed hollow section.

17. The railroad hopper car of claim 7 wherein said first and second side walls of said hopper car define sidewalls of said hopper, and said first and second side walls include end portions that are stepped laterally inboard, and said second hollow section beam extends between said end portions of said first and second side walls that are stepped laterally inboard.

18. A railroad hopper car, said hopper car comprising:

a hopper;
first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and a first end slope sheet oriented toward said first end section, said first end slope sheet being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, a main bolster extending cross-

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wise to said draft sill, and a shear plate mounted to said draft sill and to said main bolster, said shear plate extending lengthwise along said draft sill and cross-wise from side to side of said hopper car;

said first end slope sheet of said hopper over-hanging said shear plate of said first end section;

first and second side walls running lengthwise along first and second sides of said car, said first end slope sheet of said hopper extending cross-wise between said first and second side walls;

a first laterally extending reinforcement mounted cross-wise to said first end slope sheet adjacent to said shear plate;

said shear plate of said first end section being connected to said first laterally extending reinforcement;

said first end slope sheet of said first end section being connected to said first laterally extending reinforcement; said first laterally extending reinforcement defining part of a first hollow section beam extending across said hopper car between said first and second side walls;

said hopper car being free of longitudinally oriented shear webs ears extending between said draft sill and said end slope sheet;

said hopper car has second, and third hollow section beams as well as said first hollow section beam, said first, second and third hollow section beams extending there-across between said first and second side walls thereof; said first end slope sheet has an uppermost margin, and said second hollow section beam runs along said uppermost margin of said first end slope sheet;

said third hollow section beam is located intermediate said first and second hollow section beams;

said hopper car has an end post mounted over said draft sill, said end post being located longitudinally outboard of said main bolster of said first end section;

said end post extends upwardly to meet said second hollow section beam;

said hopper car has first and second side sills running longitudinally along either side thereof, said first and second side walls extending upwardly of said first and second side sills respectively;

said first and second side sills mate with first and second ends of said main bolster of said first end section; and said first and second side sills have upper flanges that mate with said shear plate of said first end section.

19. The railroad hopper car of claim 18 wherein: there is an end wall that extends from sidewall to sidewall; said end wall has an upper portion that has an upper margin terminating at a top chord of said end wall;

said first end slope sheet has an uppermost margin, said uppermost margin of said first end slope sheet meeting said end wall along a first juncture;

said end wall has a lower portion extending below said first juncture, said lower portion being bent to define a portion of said second hollow section beam; and said end post extends past said second hollow section beam along said end wall to mate with said top chord of said end wall.

20. A railroad hopper car, said hopper car comprising:
a hopper;

first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and a first end slope sheet oriented toward said first end section, said first end

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slope sheet being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, a main bolster extending cross-wise to said draft sill, and a shear plate mounted to said draft sill and to said main bolster, said shear plate extending lengthwise along said draft sill and cross-wise from side to side of said hopper car;

said first end slope sheet of said hopper over-hanging said shear plate of said first end section;

first and second side walls running lengthwise along first and second sides of said car, said first end slope sheet of said hopper extending cross-wise between said first and second side walls;

a first laterally extending reinforcement mounted cross-wise to said first end slope sheet adjacent to said shear plate;

said shear plate of said first end section being connected to said first laterally extending reinforcement;

said first end slope sheet of said first end section being connected to said first laterally extending reinforcement;

said first laterally extending reinforcement defining part of a first hollow section beam extending across said hopper car between said first and second side walls;

said hopper car being free of longitudinally oriented elephant ears extending between said draft sill and said end slope sheet;

said main bolster of said first end section of said railroad hopper car has first and second ends at laterally outboard extremities thereof;

said hopper car has first and second corner posts mounted at said first and second ends of said main bolster of said first end section, said corner posts extending upwardly from said main bolster to said first end slope sheet;

said draft sill has a longitudinally outboard end;

an end post stands upwardly of said longitudinally outboard end of said draft sill;

a machinery space is defined above said shear plate, below said first end slope sheet, longitudinally inboard of said end post, and between said corner posts; and

said machinery space is free of any other primary structure.

21. The railroad hopper car of claim 20 wherein:

said hopper has a movable door by which egress of lading is governed;

said hopper car has an actuator and a drive train, said drive train being connected between said actuator and said door, said actuator being operable to move said door; and

said actuator is mounted in said machinery space.

22. The railroad hopper car of claim 21 wherein said first side wall has an aperture formed therein at a location higher than said shear plate, lower than said first end slope sheet, and longitudinally inboard of said first corner post.

23. The railroad hopper car of claim 20 wherein said first and second side walls of said car have openings defined therein longitudinally inboard of said respective corner posts, above said shear plate, and below said first end slope sheet.

24. A railroad hopper car, said hopper car comprising:

a hopper;

first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and a first end slope sheet oriented toward said first end section, said first end

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slope sheet being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, a main bolster extending cross-wise to said draft sill, and a shear plate overlying said draft sill and said main bolster, said shear plate extending along said draft sill and cross-wise from side to side of said hopper car;

said first end slope sheet over-hanging said shear plate of said first end section;

first and second side walls running lengthwise along first and second sides of said car, said first end slope sheet of said hopper extending cross-wise between said first and second side walls;

there being a first end wall extending between said first and second side walls;

said first end slope sheet having an uppermost margin, said uppermost margin meeting said first end wall at a first junction;

said hopper car having a first beam extending cross-wise between said first and second side walls at said first junction of said uppermost margin of said first end slope sheet and said first end wall, said first beam being a beam of hollow section;

said first end wall has an upper portion and a lower portion;

said upper portion of said first end wall extends upwardly of said first junction of said uppermost margin of said first end slope sheet and said first end wall;

said lower portion of said end wall extends downwardly of said first junction of said uppermost margin of said first end slope sheet and said first end wall; and

said lower portion of said first end wall forms part of said first beam;

said draft sill having longitudinally extending draft sill webs;

said first end section being free of longitudinally oriented elephant ears extending upwardly of said draft sill webs to meet said end slope sheet;

said lower portion of said first end wall has a margin, and said margin is bent to mate with said first end slope sheet as a second junction distant from the first junction, said lower portion of said first end wall and said uppermost margin of said first end slope sheet co-operating to define said first beam.

25. The railroad hopper car of claim 24 wherein an end post is mounted over said draft sill outboard of said main bolster, said end post extending upwardly to meet said first beam.

26. The railroad hopper car of claim 25 wherein:

said upper portion of said first end wall extends upwardly of said first junction to end at a top chord; said top chord extends across said hopper car between said first and second side walls; and

said end post extends past said first beam to terminate at said top chord.

27. The railroad hopper car of claim 25 wherein:

said main bolster has first and second ends; and

respective first and second corner posts are mounted to said first and second ends of said main bolster and extend upwardly therefrom.

28. The railroad hopper car of claim 27 wherein: a machinery space is defined above said shear plate, in the lee of said first end slope sheet, longitudinally inboard of said end post and between said first and second corner posts; and said machinery space is free of any other primary structure.

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29. The railroad hopper car of claim 28 wherein:

said first side wall has an aperture formed therein in a location that is longitudinally inboard of said first corner post, above said shear plate, and leeward of said first end slope sheet;

said hopper has a movable gate operable to govern egress of lading from said hopper;

there is an actuator mounted in said machinery space, and a drive train connecting said actuator to said gate.

30. The railroad hopper car of claim 24 wherein a second beam is mounted across said first end slope sheet adjacent said shear plate.

31. The railroad hopper car of claim 30 wherein a third beam is mounted across said first end slope sheet intermediate said first and second beams, and said third beam is formed of a structural member mounted toes-in against said first end slope sheet to define an hollow section.

32. A railroad hopper car, said hopper car comprising: a hopper;

first and second end sections for carriage by respective first and second rail road car trucks for rolling motion along railroad tracks in a longitudinal direction;

said hopper being suspended between said first and second end sections, said hopper having a discharge section through which to release lading, and a first end slope sheet oriented toward said first end section, said first end slope sheet being inclined in the longitudinal direction to feed said discharge section;

said first end section including a draft sill extending in the longitudinal direction, said draft sill having first and second spaced apart longitudinally running draft sill webs and a draft pocket defined therebetween;

said first end section including a main bolster extending cross-wise to said draft sill;

said first end section having a truck center where said main bolster meets said draft sill;

said draft sill having a striker end longitudinally outboard of said truck center;

said first end section including a shear plate;

said shear plate overlying said draft sill webs and said main bolster, said shear plate extending longitudinally along said draft sill and cross-wise from side to side of said hopper car;

said shear plate having an outboard margin running across said car distant from said truck center and proximate said striker end;

said first end slope sheet over-hanging said shear plate of said first end section;

first and second side walls running lengthwise along first and second sides of said car, said first end slope sheet of said hopper extending cross-wise between said first and second side walls;

there being a first end wall extending between said first and second side walls;

said first end slope sheet having an uppermost margin, said uppermost margin meeting said first end wall at a first junction;

said hopper car having a first beam extending cross-wise between said first and second side walls at said first junction of said uppermost margin of said first end slope sheet and said first end wall, said first beam being a beam of hollow section;

said first end wall is surmounted by a cross-wise running top chord;

said first end wall includes a panel extending downwardly from said cross-wise running top chord;

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said first end section includes an end post extending upwardly of said draft sill, said end post being mounted above said draft sill distant from said truck center and proximate said striker end;

said end post extending upwardly to meet said first beam and said top chord;

said first end section being free of longitudinally oriented elephant ears extending upwardly of said draft sill webs of said draft sill to meet said first end slope sheet; and

said hopper car having a second beam extending cross-wise between said first and second side walls, said second beam being a beam of hollow section; and

said second beam being connected to said shear plate.

33. The railroad hopper car of claim 32 wherein a third beam is mounted across said first end slope sheet intermediate said first and second beams.

34. The railroad hopper car of claim 33 wherein said third beam is formed of a structural member mounted toes-in against said first end slope sheet to define an hollow section.

35. The railroad hopper car of claim 32 wherein:

said main bolster has first and second ends; and

respective first and second corner posts are mounted to said first and second ends of said main bolster and extend upwardly therefrom to meet said first end slope sheet.

36. The railroad hopper car of claim 35 wherein:

a machinery space is defined above said shear plate and under said first end slope sheet; and

a door actuator is mounted above said shear plate and under said first end slope sheet.

37. The railroad hopper car of claim 35 wherein:

a machinery space is defined above said shear plate and under said first end slope sheet;

said first side wall has an aperture formed therein in a location that is longitudinally inboard of said first corner post, above said shear plate, and leeward of said first end slope sheet;

said hopper has a movable gate operable to govern egress of lading from said hopper;

there is an actuator mounted in said machinery space, and a drive train connecting said actuator to said gate.

38. The railroad hopper car of claim 32 wherein:

said main bolster has first and second ends; and

respective first and second corner posts are mounted to said first and second ends of said main bolster and extend upwardly therefrom;

said first side wall has an opening formed therein, said opening being located longitudinally inboard of said first corner post, upward of said shear plate, leeward of said first end slope sheet.

39. The railroad hopper car of claim 32 wherein said draft sill has a longitudinally outboard end, and a striker plate mounted at said longitudinally outboard end; and said draft sill has a length between said truck center and said striker plate that is less than 50 inches.

40. The railroad hopper car of claim 32 wherein

said railroad hopper car has first and second end section, and said hopper is carried thereby;

said first and second side walls each have a respective side sill and a top chord;

said first side wall extends from said side sill to said top chord;

said first side wall has a predominantly upwardly running side wall stiffener mounted thereto, said side wall stiffener being located at a longitudinal station intermediate the trucks;

said first side wall having a first region, said first region being a lower region thereof;

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said first side wall having a second region, said second region being an upper region thereof;
 said side wall stiffener having a first portion, said first portion being a lower portion thereof;
 said first portion being mounted to said first region of said first side wall;
 said side wall stiffener having a second portion, said second portion being an upper portion thereof, said second portion being mounted to said second region of said side wall;
 said first portion of said first side wall stiffener being laterally outboard of said first region of said first side wall;
 said second portion of said side wall stiffener being laterally inboard of said second region of said first side wall;
 said side wall having a continuous section between said first and second regions thereof; and
 said side wall stiffener having web continuity between said first and second portions thereof.

41. The railroad hopper car of claim 40 wherein said first and second portions of said side wall stiffener are substantially co-planar, and are substantially vertically aligned when seen in a sectional view looking along the car.

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42. The railroad hopper car of claim 41 wherein said first side wall has a third region intermediate said first and second regions, said third region including a side sheet transition portion passing across said side wall stiffener from an inboard margin thereof to an outboard margin thereof, and said stiffener having vertical web continuity through said transition portion.

43. The railroad hopper car of claim 40 wherein:

said first side wall has a third region intermediate said first and second regions, said third region including a side sheet transition portion passing across said side wall stiffener from an inboard margin thereof to an outboard margin thereof;

said hopper includes first and second sloped side sheets; and

said first sloped side sheet meets said first side wall at said transition portion.

44. The railroad hopper car of claim 43 wherein said first side wall has an overall height from said side sill to said top chord, L, and said transition portion is located a distance above said side sill that is in the range of $\frac{1}{4}$ to $\frac{3}{4}$ L.

* * * * *

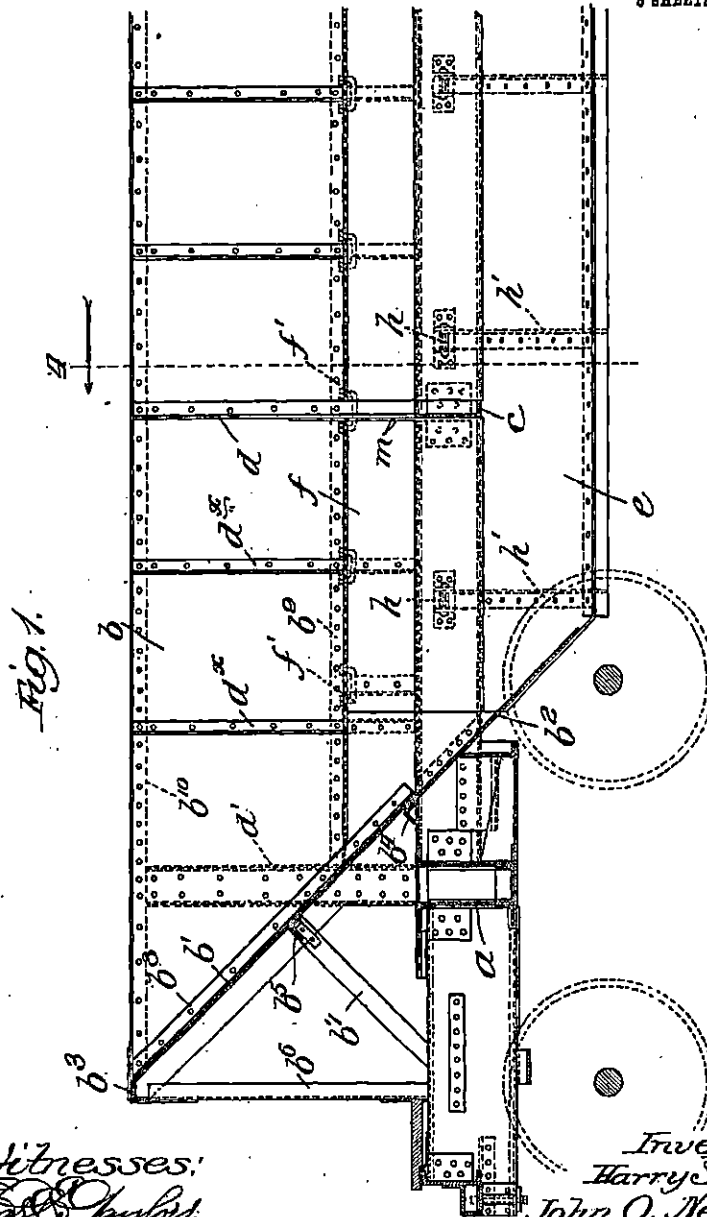
Exhibit 9

H. S. HART & J. O. NEIKIRK.
DUMP CAR.
APPLICATION FILED OCT. 18, 1905.

992,192.

Patented May 16, 1911.

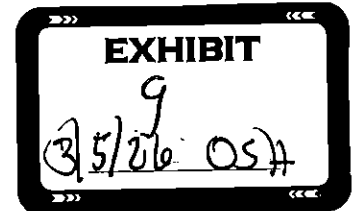
5 SHEETS-SHEET 1.



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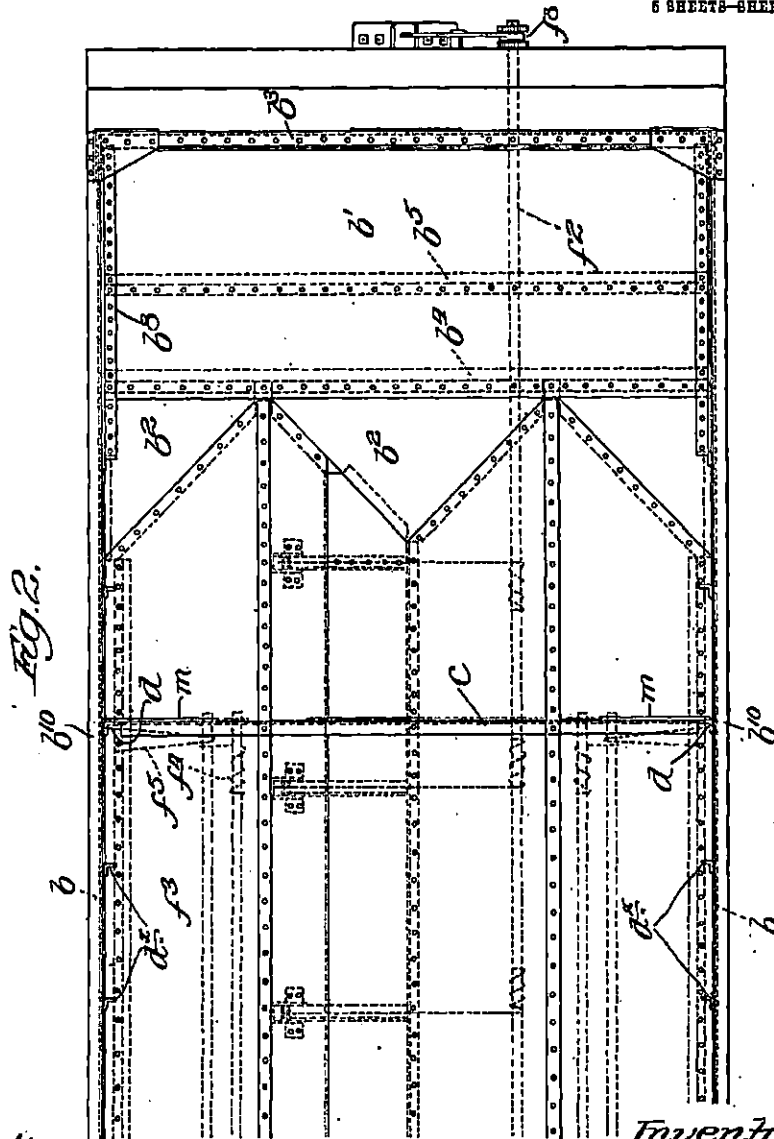
DUMP CAR.

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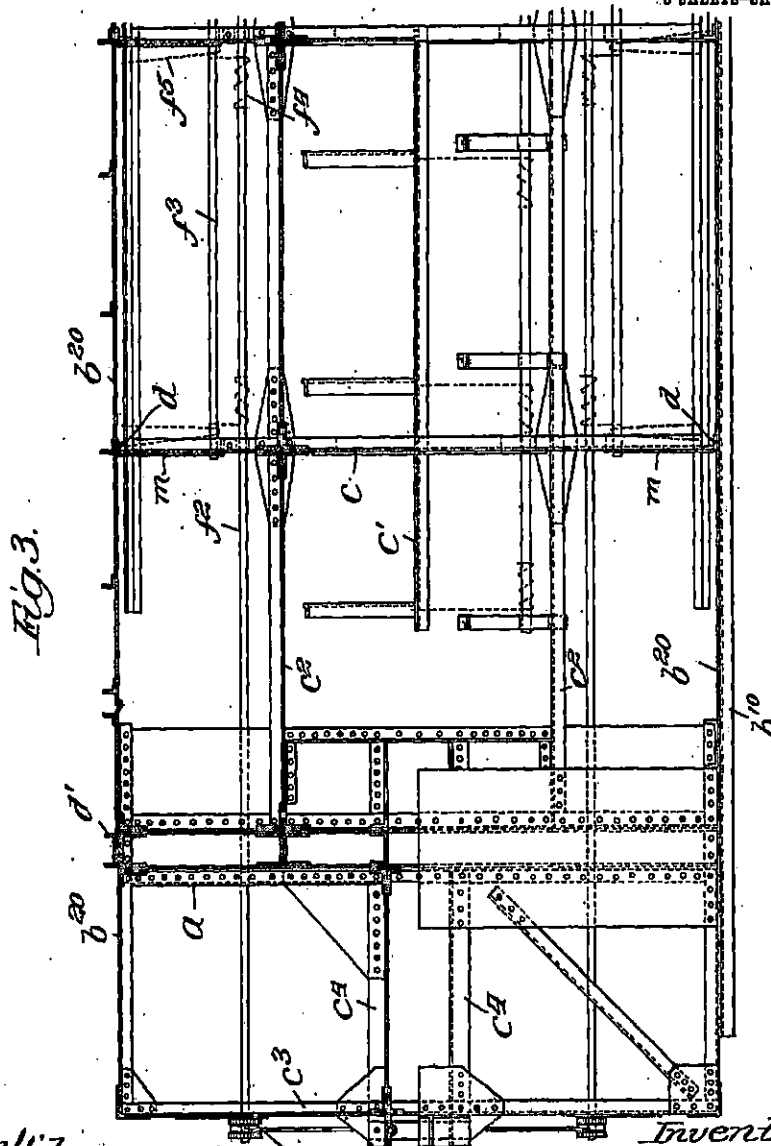
DUMP CAR.

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DUMP CAR.

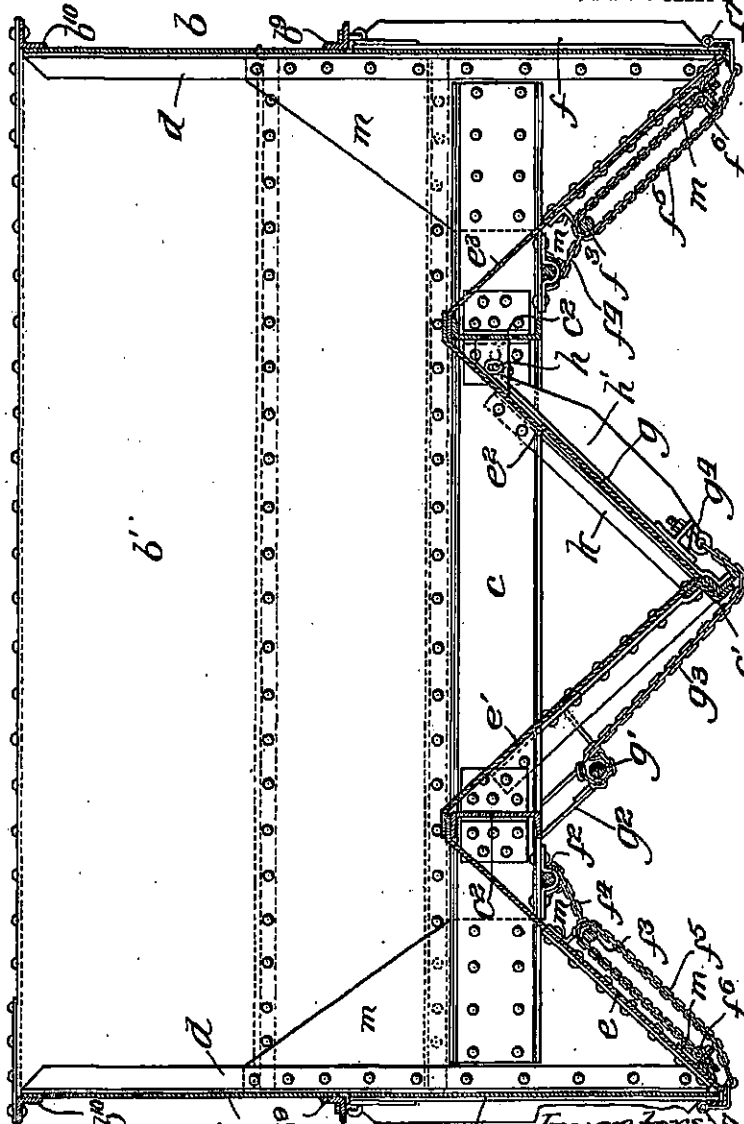
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Fig. 4.



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DUMP CAR.

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5 SHEETS-SHEET 6.

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Fig. 6.

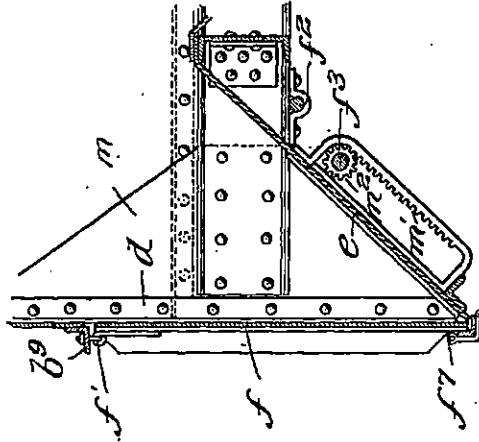
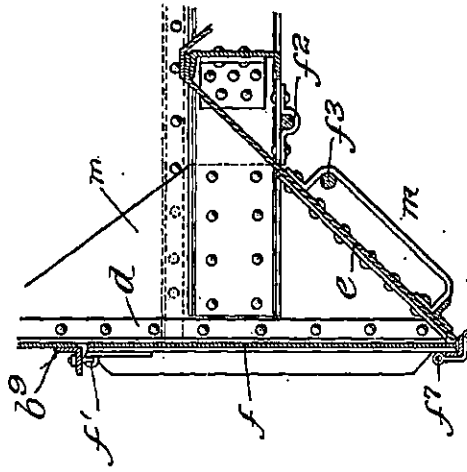


Fig. 5.



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UNITED STATES PATENT OFFICE.

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DUMP-CAR.

992,192.

Specification of Letters Patent.

Patented May 16, 1911.

Application filed October 13, 1908. Serial No. 338,840.

To all whom it may concern:

Be it known that we, HARRY S. HART and JOHN O. NEIKIRK, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Dump-Cars, of which the following is a specification.

Our invention relates to dump cars, especially to cars of the type known as the "Hart convertible car;" and has for its object to provide an improved car of this type in which provision is made for the efficient and rapid unloading of the car and for distributing the load throughout the load sustaining members of the car.

In the accompanying drawings—Figure 1 is a longitudinal elevation, partly in section, of a car embodying our invention. Fig. 2 is a plan view of a portion of one end of our improved car. Fig. 3 is a plan view of a portion of our car, certain parts being removed to show the construction of the underframe. Fig. 4 is a transverse sectional view on the line 4 of Fig. 1. Fig. 5 is a detail view of a part of the door operating mechanism. Fig. 6 is a modified form of the structure shown in Fig. 5.

In carrying out our invention we provide a car the underframe of which comprises bolsters *a*, intermediate cross members *c* and suitable longitudinal sills *c*² connected to the bolsters and to the cross members, as shown. Suitably secured to the bolsters at each side of the car are posts or stakes *d*¹ shown in Figs. 1 and 3 as formed of channel beams and to these posts are connected the plate girder sides *b*, these plate girder sides having a lower longitudinal member *b*⁰ and an upper member *b*¹⁰ formed of channel iron. It will be observed that the lower member *b*⁰ of the plate girder side is supported a suitable distance above the floor level of the car. The plate girder sides are further supported by stakes *d* of angle iron, these stakes extending downwardly below the level of the transverse members, as shown in Fig. 4, and the stakes *d* are suitably connected to the transverse members of the underframe by gusset plates *m*, as shown in Fig. 4. Angle iron brace members *a*¹ further serve to brace the plate girder sides, these members extending between the top and bottom longitudinal angle irons of the sides. The upper angle iron of the plate

girder sides extends beyond the bolster to an upright *b*⁰ hereinafter described.

The bottom of the car is shown as formed of hopper portions comprising a central hopper portion formed by the downwardly and inwardly extending plates *e*¹, *e*² secured at their upper ends to the longitudinal members *c*² of the underframe, one of the plates *e*¹ being secured to the longitudinal bar *c*¹ extending the entire length of the central hopper portion. The other side of the central hopper portion is formed of a similar downwardly and inwardly extending plate *e*² connected at its upper end to the longitudinal member *c*² of the underframe, and by braces *h* to the opposite member of the central hopper portion. The central hopper is provided with doors *g* provided upon their under sides with braces *h*¹. The braces *h*¹ extend above the upper edges of the doors *g* and are hinged to brackets *s* secured to two longitudinal members *c*². By this means the hinges *h* lie beneath the stationary hopper plate *e*² where they are protected from being clogged by the lading transported in the car. Suitable hopper portions are also formed at each side of the central hopper portion by downwardly and outwardly extending plates *e* and *e*³ attached at their upper ends to the longitudinal members *c*² of the underframe and at their lower ends to the lower ends of the stakes *d*¹—clearly shown in Fig. 4. Suitably hinged, as at *f*¹, to the sides of the car, are doors *f* so hinged as to swing outwardly when released. It will be observed that the upper member *b*¹⁰ of the plate girder side extends beyond the end of the supporting post *d*¹ and has connected to its outer end a support *b*⁶, this support *b*⁶ being in turn connected to a short side sill *b*²⁰ extending from the bolster toward the end of the car, and the end sill *c*³ is in turn connected to the short side sills. It will be seen that the end sills are carried or hung from the extension of the side plate girders. Suitable draft beams *c*⁴ are connected to the end sill and to the bolster, as will be readily understood.

It will thus be seen that we have provided a car with hopper portions and doors so arranged as to deposit the load of the car at the sides or at the center, or both, as may be desired.

By supporting the plate girder sides above the floor level of the car, it will be seen that

we provide a suitable space between the lower member of the sides and the floor of the car. We thus provide a wide opening through which the material may be dumped from either side of the car, as will be readily understood from an inspection of Fig. 4. We also provide a car having high sides, which serve to retain the load efficiently and transmit this load to the bolsters by which it is ultimately carried.

In order to operate the side doors, we provide the following mechanism: Winding shafts f^2 are arranged longitudinally of the car and extend through the end sills, where they are provided with any suitable operating device f^3 . We also provide what we term a drop shaft f^4 mounted in suitable inclined guides m . The drop shaft f^4 is connected by a chain f^5 to the winding shaft, and the chain f^5 passes around the drop shaft and is secured at its ends to the hopper bottom and to the side door, respectively, the connection to the door being shown at f^6 and to the hopper bottom at f^7 . By unwinding the chain f^5 the drop shaft is allowed to travel downwardly in its guides, thus permitting the door to open, and it will be observed that as the chain connected to the winding shaft is unwound twice the length of the chain, which is connected to the door, will be released, thus permitting the door to open to that increased extent.

It will be readily understood that the winding shaft and its connection to the drop shaft may be omitted and the drop shaft operated directly by any suitable means. For example, the shaft may be provided with pinions engaging racks upon the guides, as clearly indicated in Fig. 6, the shaft in this instance being, of course, provided with a suitable operating means at its ends.

In order to operate the central door g , we show a winding shaft g^1 mounted in suitable bearings g^2 in the underframe of the car and connected by the chain g^3 to the door, the connection being shown at g^4 . b^1 represents the inclined ends of the car and b^2 the inclined ends of the hopper bottom, the ends of the car being suitably supported by upper and lower transverse brace members b^3 and b^4 , respectively, the upper brace member being supported from the sides of the car and suitably braced by an upright b^5 . The lower portion of the end of the car is secured to a transverse member b^6 , which also serves to support the upper portion of the end of the hopper. Transverse braces b^5 and inclined braces b^7 serve to further strengthen the ends of the car. Suitable metallic pieces b^8 , which may be of angle bar—as shown—serve as supports for the sides of the car ends, as will be readily understood.

It will be seen that we have provided an all-metal ballast or dump car, providing therein means for dumping the load from the

hopper bottom either at the sides or the center of the car in which the load is carried by the plate girder sides and the bolsters.

We claim:

1. A dump car of the class described, having a frame, the load carrying members of which consist of bolsters and plate girder sides, a bottom comprising a series of three hoppers secured to the frame, swinging doors hinged to the sides and forming part of the car side, a swinging door secured to the intermediate hopper, and means for operating the doors.

2. In a car of the class described, the frame of which comprises bolsters and cross ties placed at what is ordinarily the floor level of the car, longitudinal articulated members connecting said bolsters and cross ties, hopper portions supported by said articulated members on each side thereof, and load carrying plate girder members extending longitudinally of the car in a vertical plane and supported at or about the end of the bolsters and having their lower edges disposed above the plane of the bolsters.

3. A car of the class described, having bolsters, supports or posts suitably connected to the bolsters at the ends thereof, side plate girders extending between the posts and supported above the plane of the bolsters, side sills extending from the bolster toward the end of the car, said side sills being hung from an extension of the plate girders, end sills supported by the side sills, stakes secured to said side plate girders projecting below the lower edge thereof, cross members secured to the lower ends of said stakes, and a floor supported by said cross members and stakes.

4. In a car of the class described, a suitable frame, plate girders supported above the plane of the bolsters and carrying said frame, bolsters carrying the plate girders, and three longitudinal hoppers supported by the frame.

5. A dump car of the class described, provided with a swinging door, means for operating the swinging door, comprising a bodily movable shaft and a flexible connection secured at one end to a fixed portion of the car frame and at the other end to the swinging door and engaging the movable shaft at an intermediate point, and means for operating the movable shaft.

6. A dump car of the class described, provided with a swinging door, means for operating the door, comprising a bodily movable shaft supported in the car frame, a flexible connection passing around the shaft and attached at one end to the door and at its other end to the car frame, and means for guiding and operating the shaft.

7. A dump car of the class described, provided with a swinging door, means for operating the door, comprising a bodily movable

shaft supported in the car frame, a winding shaft also journaled in the car frame, a flexible connection secured at one end to the winding shaft and at the other end to the 5 bodily movable shaft, and a flexible connection between the bodily movable shaft and the swinging door.

8. A dump car of the class described, provided with a swinging door, means for operating the door, comprising a bodily movable shaft supported in the car frame, a winding shaft, a flexible connection between the winding shaft and the bodily movable shaft, and a flexible connection secured at one end to the car frame and at the other end to the swinging door and engaging the bodily movable shaft at an intermediate point, substantially as described.

9. In a car of the class described, a central longitudinal hopper, side longitudinal hoppers having downwardly and outwardly inclined bottoms, and plate girder side members supporting said hoppers.

10. In a car of the class described, bolsters, end walls inclining downwardly above said bolsters, draft sills lying wholly outside said end walls, plate girder sides supported by said bolsters, a cross member between said bolsters and supported by said plate girder sides, longitudinal sills intermediate the center and sides of the car and supported by said cross beam, and hoppers sloping downward from said longitudinal sills toward the center and sides of the car, said 35 hoppers being supported by said intermediate longitudinal sills, cross member and plate girder sides.

11. In a car of the class described, bolsters, end walls inclining downwardly above said bolsters, draft sills located wholly outside of said end walls, stakes extending upwardly from the ends of said bolsters, plate girder sides supported by said stakes, a cross beam between said bolsters and supported by said sides, longitudinal sills intermediate the center and sides of the car, said intermediate sills being supported by said cross beam, and a longitudinal central hopper sloping downwardly toward the 50 center of the car between said intermediate sills and supported thereby and by said cross beam.

12. In a car of the class described, bolsters, end walls inclining downwardly above said bolsters, draft sills wholly outside of said end walls, stakes extending upwardly from said bolsters, plate girder sides supported by said stakes above the plane of the bolsters, a cross member supported by said sides, longitudinal sills intermediate the center and sides of the car and supported by said cross member, hopper bottoms between said intermediate sills and between said intermediate sills and the car sides.

13. In a car of the class described, bolsters, end walls inclining downwardly above said bolsters, draft sills wholly outside of said end walls, stakes extending upwardly from said bolsters, plate girder sides supported by said stakes above the plane of the bolsters, a cross member supported by said sides, longitudinal sills intermediate the center and sides of the car and supported by said cross member, hopper bottoms between said intermediate sills and between said intermediate sills and the car sides, and doors hinged to the lower edge of said plate girder sides.

14. In a car of the class described, bolsters, ends sloping downwardly above said bolsters, draft sills wholly outside said ends, plate girder sides supported by said bolsters, longitudinal central and side hoppers, cross members supported by said plate girder sides, longitudinal sills at the junction of said central and side hoppers, said longitudinal sills being supported by said cross members.

15. In a car of the class described, a central longitudinal hopper having sides inclining toward the center of the car, side hoppers each having a bottom section inclining toward the side of the car, bolsters, plate girder sides supported by said bolsters, an underframe between the bolsters supported by said plate girder sides, and doors hinged to the lower edges of said plate girder sides.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."