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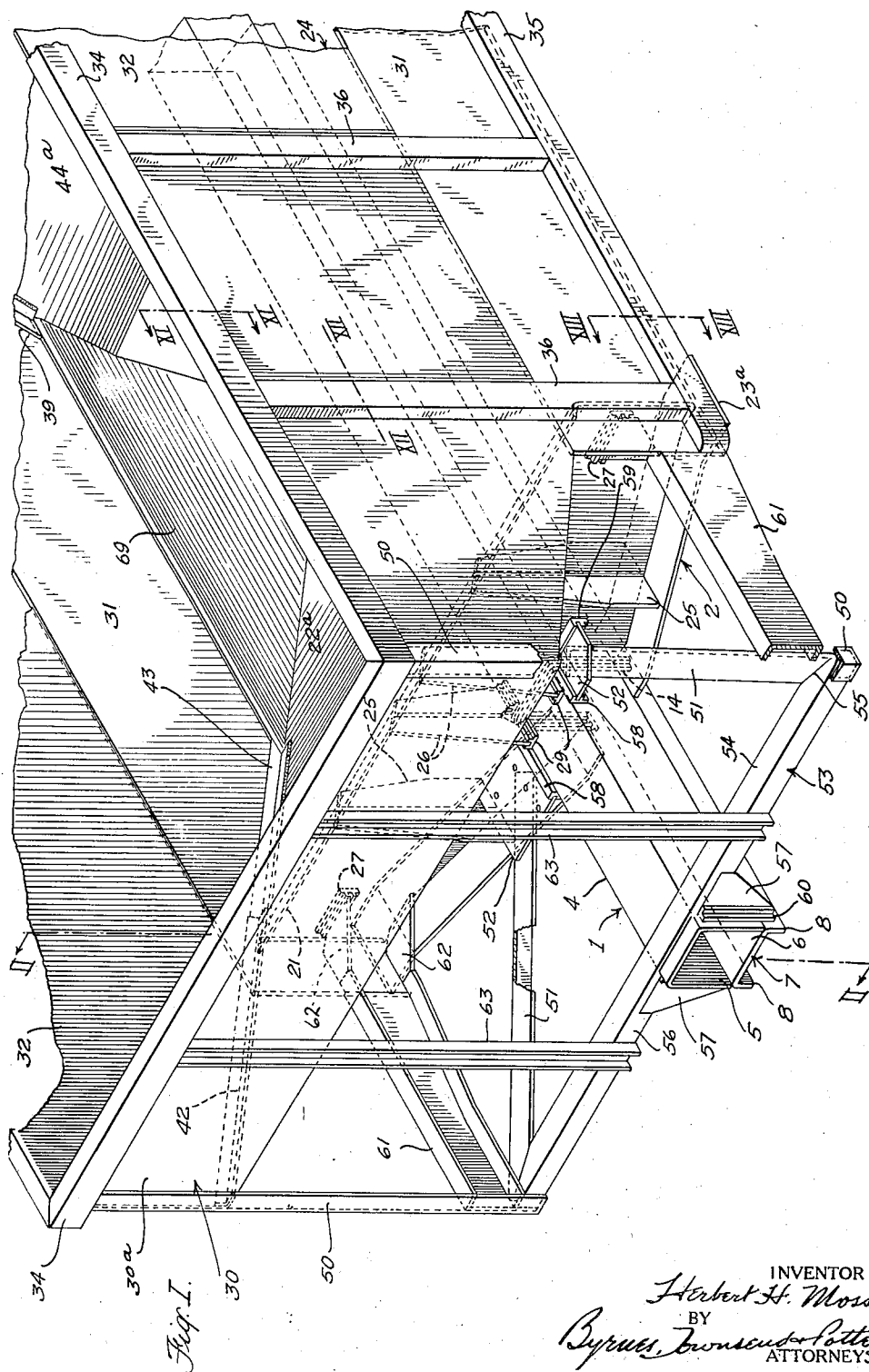
H. H. MOSS

2,140,268

WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

Filed June 18, 1930

7 Sheets-Sheet 1



Dec. 13, 1938.

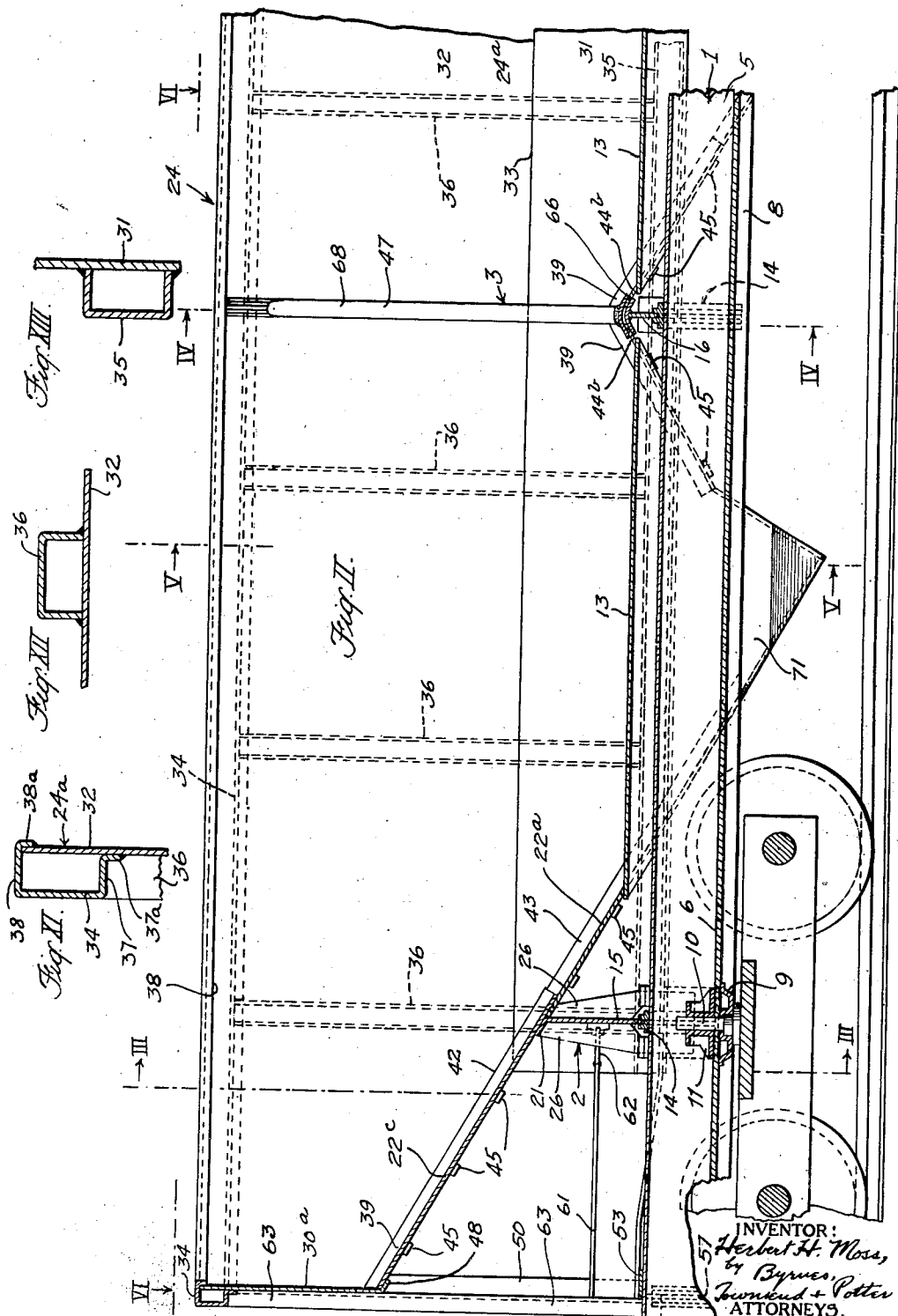
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WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

Filed June 18, 1930

7 Sheets-Sheet 2



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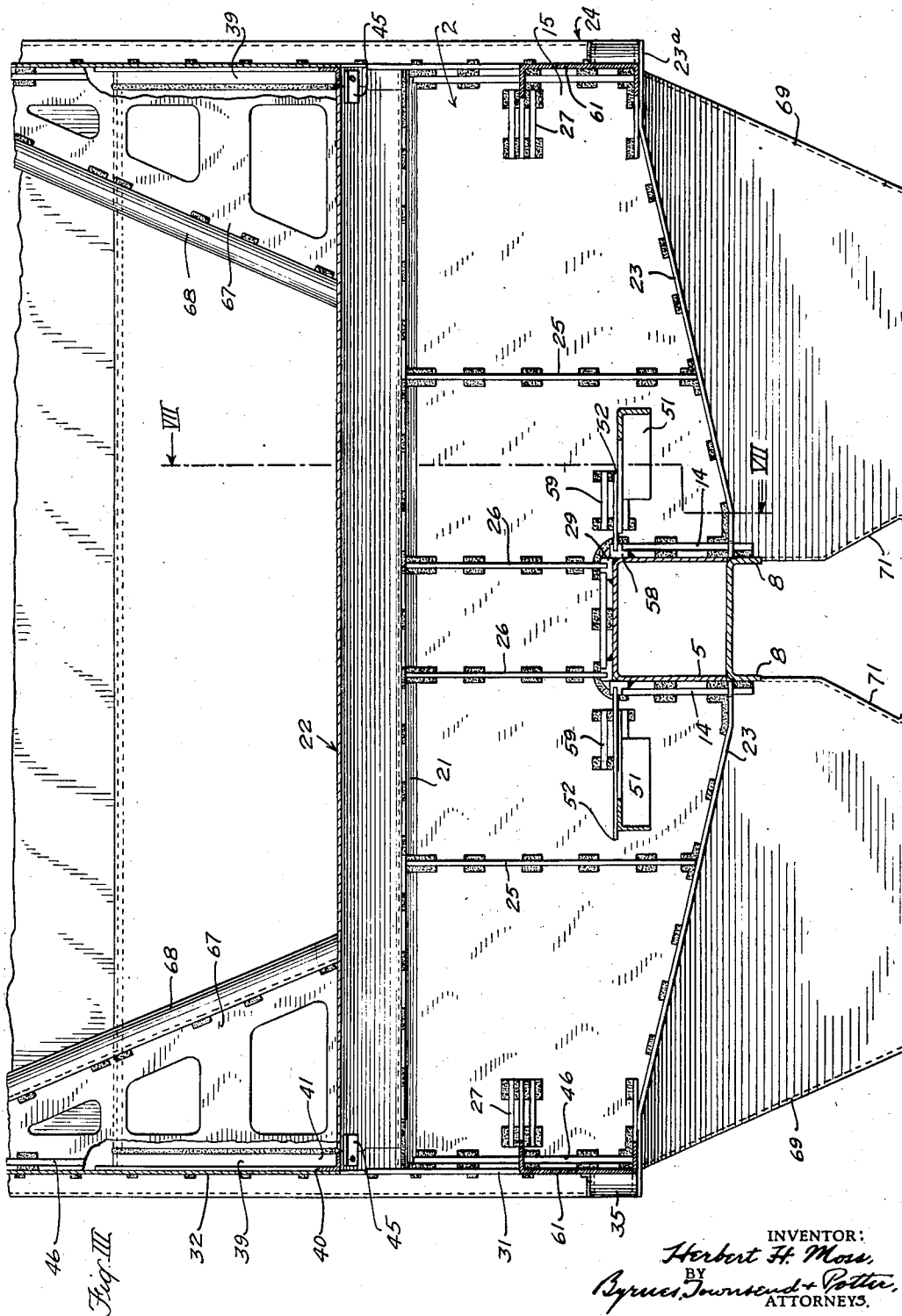
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WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

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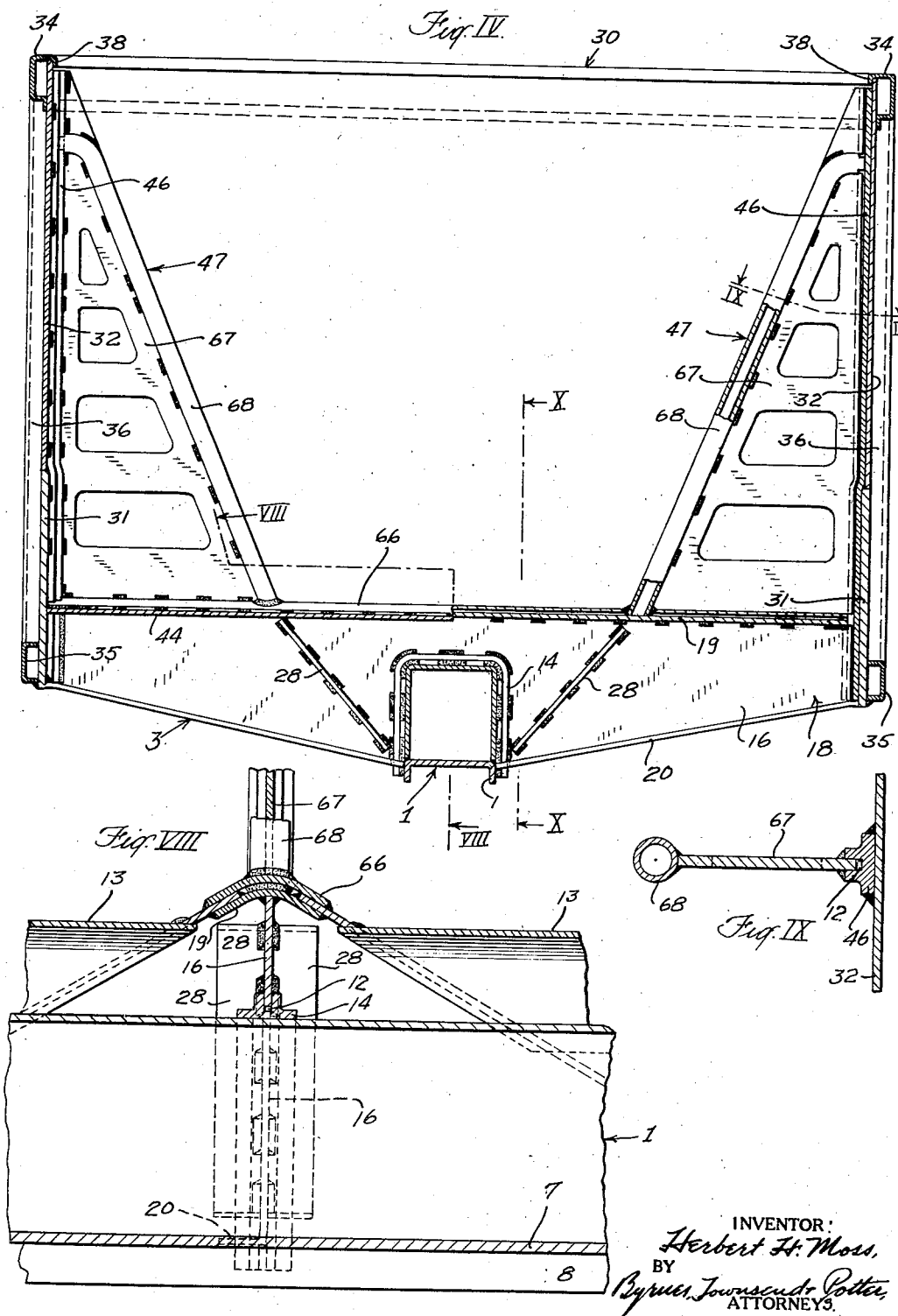
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WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

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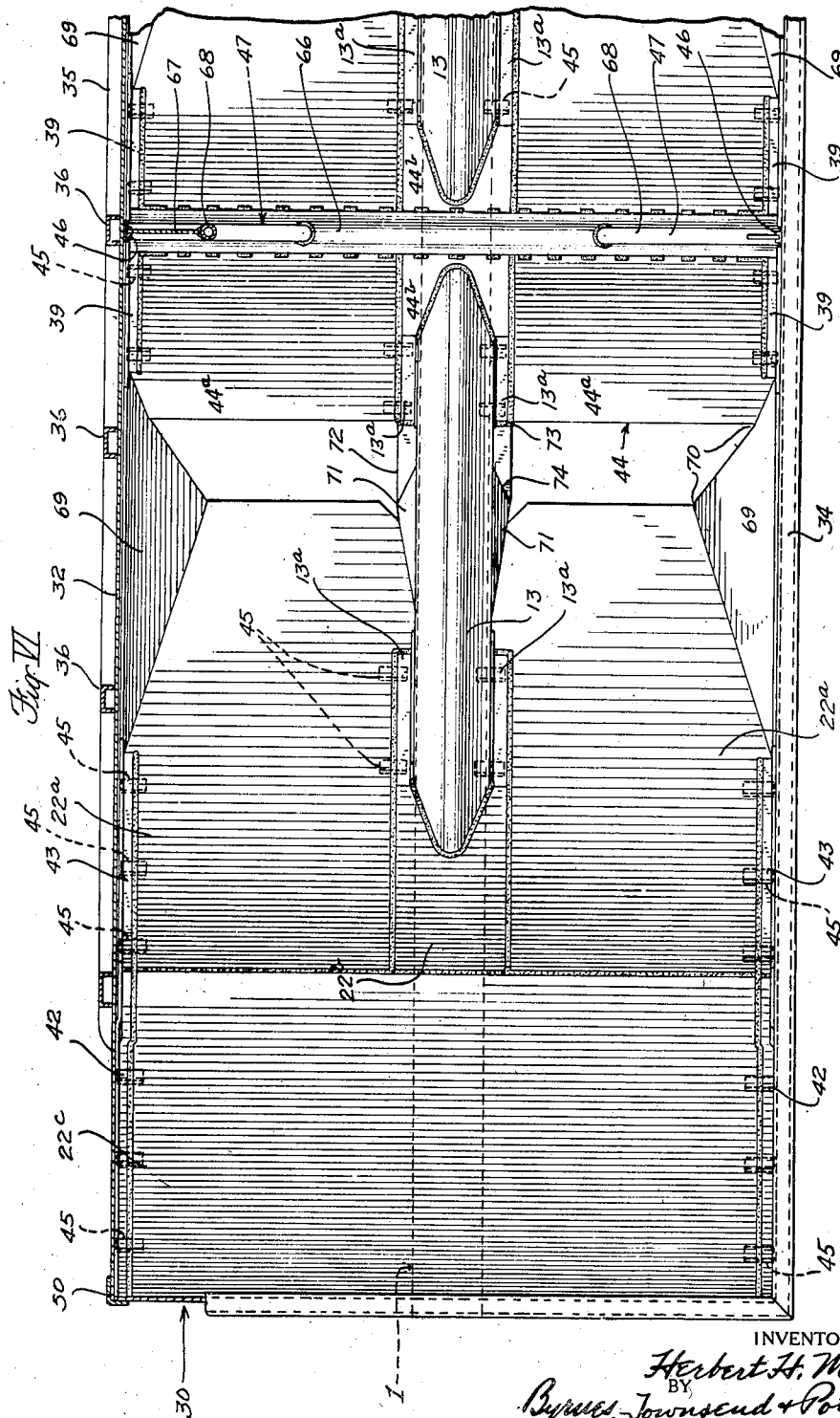
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WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

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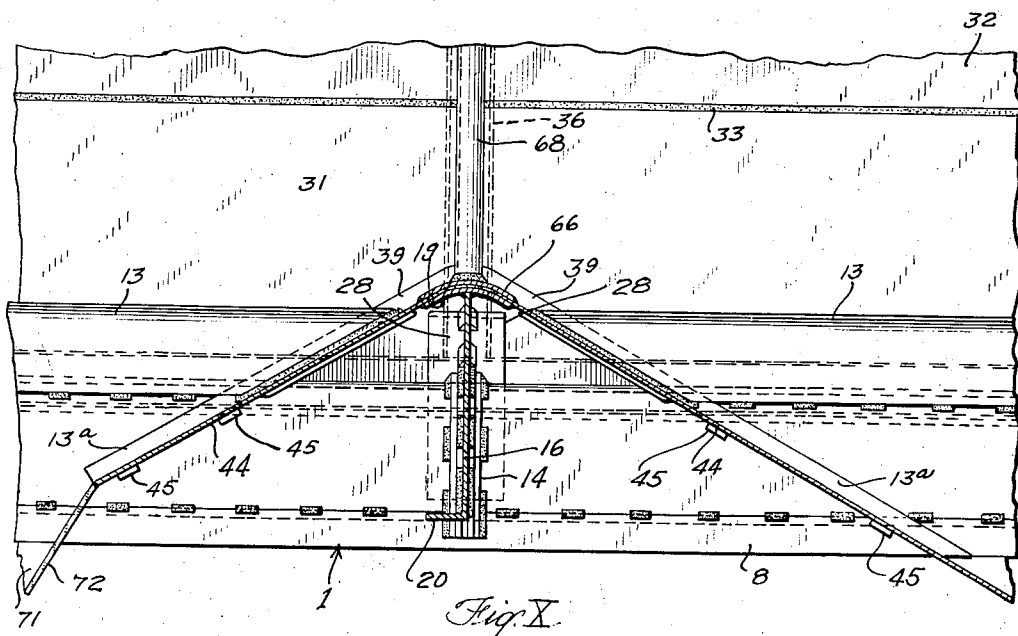
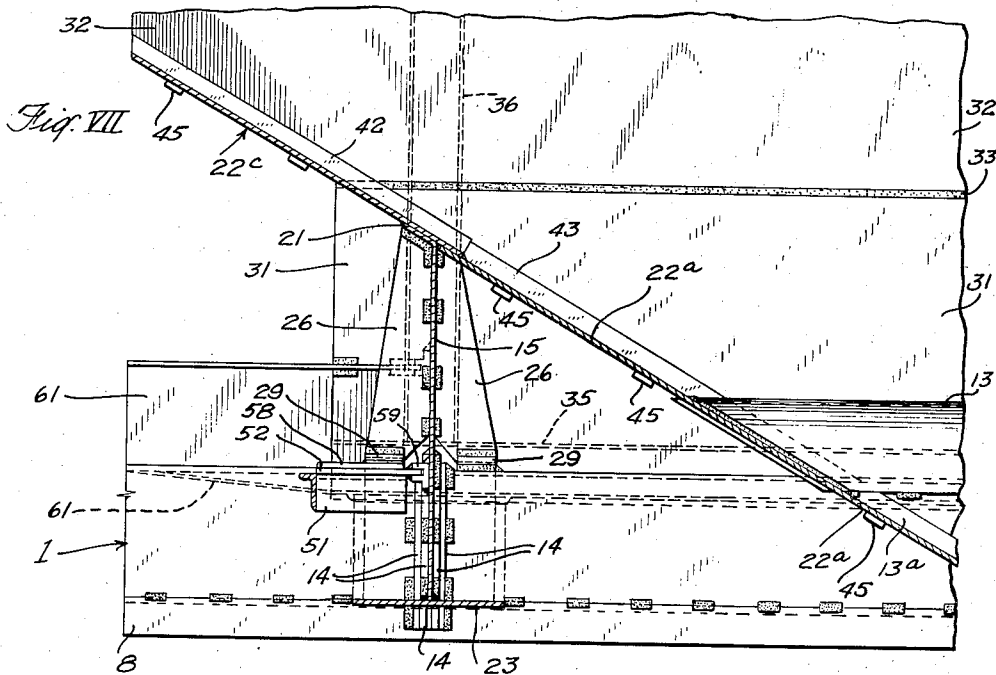
H. H. MOSS

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WELDED METAL CAR AND METHOD OF ASSEMBLING SAME

Filed June 18, 1930

7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,140,268

WELDED METAL CAR AND METHOD OF
ASSEMBLING SAMEHerbert H. Moss, Brooklyn, N. Y., assignor, by
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Application June 18, 1930, Serial No. 462,081

30 Claims. (Cl. 105—249)

My invention relates to a welded metal car and a method of constructing and assembling same, and it relates particularly to the open railway freight car of the hopper or gondola type.

Heretofore, railway freight cars of the hopper and gondola type have usually been made of a number of parts, which have been riveted to each other and to the frame either individually or in small units. In such constructions it is not possible to utilize the gross section strength of the parts due to a reduction of the section area caused by the necessary rivet holes. Also, it is not possible to obtain such rigidity of parts at the joints which will enable the joints to retain their original rigidity under repeated stress of varying intensity due to impacts encountered in operating service. Sooner or later the riveted joints become loose and as a result of this action the composite strength of the car is lowered and the life of the car is shortened.

Furthermore, where riveting is employed to fasten the parts together, the parts must be so designed that they will accommodate the riveting operations. Often times in designing these parts, it is necessary to dispose the materials in planes which have low engineering utility from the standpoint of strength and furthermore as a riveted construction requires that one part be lapped over another, numerous ledges or obstructions are formed which are undesirable from the standpoint of operation and of the life of the parts of the car.

Furthermore, the unit efficiency of riveted construction as practiced in present day freight car construction is very low as compared to the efficiency of the full or gross section of the individual parts. This fact makes it necessary to carry excess metal throughout the life of the car in order to make the joint sufficiently strong to withstand the service imposed upon it.

It has been impracticable to make the seams of a riveted car so that moisture and corrosive materials carried in the body of cars cannot collect in them. In new constructions some of the seams may be moisture-proof but after the car has been in service, such seams open up due to vibrations received incident to the service and allow the corrosive materials to enter and attack them.

It has been proposed to manufacture freight cars having their parts welded together. Such proposals have embodied a relatively large number of parts and have required a relatively large amount of weld metal to unite the parts along the extensive seams. Also, the materials of the parts have not been so disposed that they have been utilized to the best advantage from an engineering standpoint. In such construction where the amount of linear welding is great, the weight of the car, the labor and cost of welding

is increased in proportion to the length of the seams.

One of the objects of my invention is to simplify the parts of a car.

Another object of my invention is to utilize the strength of the necessary parts of the car to a greater extent.

Another object of my invention is to reduce the dead weight of the car without reducing the load capacity.

Another object of my invention is to construct a car having a rigidly connected super-structure integral with the underframe.

Another object of my invention is to reduce the number of parts and the length of welded seams.

Another object of my invention is to reduce the tendency of corrosion within the seams.

Another object of my invention is to provide a type of car construction in which position-welding is reduced to a minimum.

Another object of my invention is to eliminate all interior projections or ledges capable of catching and retaining cargo material after the car has been unloaded.

Another object of my invention is to perfect a process for rapidly and efficiently assembling the parts of the car.

The foregoing and other objects of my invention will be more clearly understood from the following description and accompanying drawings of one form of my invention in which:

Figure I is an isometric view of a portion of the car body.

Figure II is a longitudinal vertical section of a portion of the car on the line II—II in Figure I.

Figures III, IV and V are enlarged transverse vertical sections, respectively, on lines III—III, IV—IV and V—V in Figure II.

Figure VI is a top plan view of the portion of the car shown in Figure II.

Figure VII is a sectional view on line VII—VII in Figure III.

Figures VIII, IX and X are sectional views on lines VIII—VIII, IX—IX and X—X, respectively, in Figure IV; and

Figures XI, XII and XIII are cross sections of the side sheet top chord, the side stake and side sill, respectively, on lines XI—XI, XII—XII and XIII—XIII, respectively in Figure I.

To illustrate my invention, an all metal freight car of the hopper type is shown in the drawings and described herein. As shown in Figs. I and II, the principal members of the underframe of the car are the center sill 1 and the cross supports comprising the bolsters 2 and the cross-bearer member 3. The center sill 1, comprising two channel members, forms the backbone of the car. The upper channel member 4 is welded along the edges of its flanges 5 to the edges of the web 6 of the lower channel member 7.

It will be noted that the center sill is adapted to extend the entire length of the car and that its cross section is of tubular form which provides greater strength per unit weight than other hollow center sills of the usual I section or non-tubular sections that have heretofore been employed in car structures. The flanges 5 of the upper channel member 4 are made relatively deep in order to provide strength against bending under the load and also to provide a housing in the end of the sill for the draft gear (not shown). The flanges 8 of the lower channel member 7 are relatively narrow, and provide in combination with its web 6 a socket for the thrust bearing 9 which receives the pintle pin 10. The pintle pin 10 projects through the web 6 and it is received by a bearing plate or center casting 11 which is secured within the center sill to the top of the web 6 of the lower channel member 7 between the flanges 5 of the top channel member 4.

The principal cross-support members of the underframe comprise the bolster and the cross-bearers which, though substantially identical in their design and function, are herein separately described. These members are so constructed and welded together that parts which are apt to set up injurious stresses in the underframe members due to contraction after being welded are not directly welded to the center sill 1. In carrying this principle into effect, as shown in Figs. VII and VIII strips of metal 14 of angular cross section and preferably having chambers or grooves 12 therein to receive members to be joined to the center sill 1 are first welded at appropriate places to the center sill before it is placed under any load. The metal strips are made in the form of a T or an L as may be required and are provided with a channel groove 12 along the stem of the T or one leg of the L depending upon which may be used for the particular joint to be formed. As shown in Fig. VI, a material shed 13 and angle irons 13a to which the floor plates are secured are also welded to the center sill at this time.

To facilitate the welding of the members which are welded directly to the center sill, and to prevent distortion of the metal due to contraction as a result of the welding heat, these members are clamped to the center sill with the aid of a jig and welded in place while they are so clamped.

As shown in Figs. II, III, IV and VIII, T strips 14 are bent into the form of a U and are welded transversely across the top and sides of the center sill 1 to receive the bolster and cross-bearer diaphragms 15 or 16 in the grooves 12 of the strips 14.

The bolsters 2 and the cross-bearer members 3 comprising the diaphragm 16, and the top and bottom flanges 19 and 20 are preferably built up of parts and then assembled on the center sill 1 in individual units.

As best shown in Figs. III and VII, the top of the bolster diaphragm 15 has an upwardly inclined flange 21 formed on it to provide a support for the end floor plate 22. The center bottom edge of the diaphragm 15 is provided with a notch therein to receive the center sill and to fit into the groove 12 in the U shaped T strip 14. A tie or brace plate 23 is welded to the bottom edge of the diaphragm 15 on each side of the notch and the outer ends 23a of the plates 23 extend beyond the end of the diaphragm 15 to provide a support for the car

sides 24. A stiffener plate member 25 is welded to the diaphragm 15 transversely thereof between the tie plate 23 and the top flange 21 on each side of the notch. Two other short stiffener members 26 extending between the top of the notch and the top flange 21 are welded to the diaphragm 15. A short T strip 27 may be welded to the diaphragm 15 near each of its ends to form part of the union between the sides 24 of the car and the bolsters 2.

As shown in Figs. IV, VIII and X, the cross-bearer member comprises a diaphragm 16 which has a flange 20 formed on the bottom edge of it. The diaphragm 16 is notched to receive the center sill 1 in a manner similar to the bolster diaphragm 15. A double slope crown flange 19 is welded along the top edge of the cross-bearer diaphragm. Stiffener or stress transferring members 28 may be welded diagonally along the side of the diaphragm between the bottom and top flanges 20, and 19.

Upon completion of the bolsters 2 and the cross-bearers 3 they are assembled on the center sill 1 by slipping the notch in the members downwardly over the center sill so that the inner edges of the notches fit into the grooves 12 in the U shaped T strips 14 that have been previously welded to the center sill and so that the ends of the intermediate stiffener members 26 on the bolster diaphragms 15 fit within the groove in the L shaped strips 29 which are welded to the top of the sill 1. The diaphragms 15, 16 and the stiffeners 26 may then be welded to the T and L strips 14 and 29 along the edges of the grooves therein. The inner ends of the tie plate members 23 are also welded to the center sill opposite the web 6 of the center sill bottom channel 7.

It is preferred to build the sides 24 and ends 30 of the car as separate units and then assemble each as a unit on the underframe and weld these units together and to the underframe.

The parts of the girder sides 24 may be assembled in a large jig and clamped in place for welding. In this process (see Fig. II) the side sheets 24a comprising a relatively thick bottom plate 31 and a thinner top plate 32 are placed side by side on the jig and are butt welded together along the longitudinal seam 33. A side sheet of this construction however, is not necessary as the side sheets may be constructed of a single plate having either varying or constant thickness. The side sheet stiffeners comprising the top chord 34, the side sill 35 and the side stakes 36 are secured in the jig and welded to the side plates 31, 32. These stiffener members are made in the form of channels. The edges of the channel members forming the side stakes 36 and side sills 35 are welded to the side sheets along the edges of the flanges of the members on the open side of the channels. When so welded the side stakes and side sills form hollow members for bracing the car side sheets 24a. In order to protect all seams from the corrosive action of materials such seams that may be exposed to the seepage of corrosive materials from above are protected with a continuous weld. All other welds may be either continuous or intermittent depending upon the strength of the weld desired. In accordance with this principle the edges of the side stakes 36 may be intermittently welded, and the top edges of the side sill 35 should be continuously welded to the side sheets 24a.

The top chord 34 is specially designed to resist deformation, and to avoid the collection of moisture and other corrosive materials. As shown in

Fig. XI, the bottom flange 37 of the top chord 34 is bent downwardly so that this bent portion 37a rests flat against the side sheet 24a. The other flange 38 of the top chord 34 is bent inwardly and downwardly so that it overhangs the top edge of the top side plate 32 and this bent portion 38a extends along the inside of the top edge of the plate. Both of these bent portions 37a and 38a may be welded to the side plate with an intermittent weld. The outside bent portion 37a is first welded to the top plate 32. Then the assembled side of the car may be reversed and the inside bent portion 38a may then be welded to the inside of the side plate. The bent portions 37a and 38a may be omitted where they are not required to prevent the chord from being deformed under a vertical load. In this case the top chord flanges 37 and 38 may be straight and they may be welded directly to the top of the side sheet 24a, the side sheet thereby forming a continuation of one side of the rectangular hollow top chord, as well as one side of the side sill 35 and of each rectangular hollow stake 36.

While the sides 24 of the car are in this position, as shown in Figs. II and III angle irons 39 may be welded to the inside of each of the side sheets. One leg 40 of the angle irons 39 rest flat against the side sheets 24a and it is arranged at an angle to conform to the slope of the floor plates 22. The other leg 41 of the angle irons 39 extends inwardly from the side sheet to provide an edge to which the outer edge of the floor plates 22 may be welded. A set of such angle irons 39 are welded to each end of each of the side sheets 24a to which the end floor plates 22 are attached. This set of angle irons 39 comprises two irons 42, 43, the ends of which are joined and overlap at the top of the bolster diaphragm 15. Other sets of angle irons 39 are welded to the bottom side plate 31 at appropriate places to provide a projecting edge to which the outer edges of the floor ridge plates 44 may be welded. Cleats 45 are tack welded to the bottom legs 41 of the angle irons 39 to support the floor plates while they are being welded to it. As shown in Fig. IV, the channeled T strips 46 may also be welded to the inside surfaces of the side of the car at the necessary intervals to provide a socket for the webs of the cross-bearer reinforcing arms 47, and cross-bearer and bolster diaphragms 15 and 16.

As shown in Fig. II, each end 30 of the car comprises a sheet of metal 30a having an inwardly inclined flange 48 formed on its lower edge. The flange 48 extends downwardly to conform to the slope of the floor plate 22. The end sheet 30a is provided with a top chord 34 of the same shape as the side sheet top chord 34 and it is welded to the top of the end sheet in the same manner.

Having constructed the ends and sides of the car they are assembled on the underframe as units and are welded to each other and to the underframe. The sides 24 are first placed in position with their bottom ends resting on the projecting end 23a of the bolster tie plate 23. The channels in the T strips 46 which are welded to the sides of the car are fitted over the ends of the bolster and cross-bearer diaphragms 15 and 16. The ends 30 of the car are then placed in position and held by clamps or other suitable means to the ends of the sides 24 and then the corner seams formed by the ends and sides are welded to unite these members. The T strips 46 on the sides of the car may then be welded to the ends of the bolster and cross-bearer diaphragms 15 and 16.

As shown in Fig. I, the ends 30 of the car are provided with vertical supports 50 for transmitting the load to the underframe and they are also provided with braces 51 for transmitting corner and side impacts to the center sill 1. To facilitate the assembling of the corner braces 51, the corner brace plates 52 and the end sill 53 and to reduce the amount of overhead welding on these parts they are assembled as a unit in a jig. The end sill 53 and corner braces 51 are made from a single angle bar having the upper leg 54 of the angle so notched at the ends of the end sill 53 that the ends of the bar can be bent in the form shown in Fig. I to form the corner braces 51. The bar is placed in a jig with the ends of the top leg of the angle of the braces 51 resting on the corner brace plates 52. The corner seam 55 at the ends of the end sills 53 are then welded and the opposite end of the braces 51 are welded to the plates 52. The side leg 56 of the end sill 53 is notched to receive the width of the center sill 1 and the end sill brace plates 57.

This assembly is now placed on the center sill 1 and the corner brace-plates 52 on the end of the corner braces 51 are slipped into the channels in the L strips 58, 59 that have been previously welded to the side of the center sill 1 and the bolster diaphragm 15. The end sill brace plates 57 are then slipped into the channels 12 in the vertical T strips 60 welded to each side of the end of the center sill 1 and the upper edge of the plates 57 are fitted into the notch provided for it in the end sill 52. The brace plates 52 and 57 may now be welded into the sockets into which they have been inserted.

The corner brace plate 52 having holes therein also serves as a mounting for a brake cylinder (not shown).

A short channel brace 61 extends from each end of the bottom side plate 31 of the side sheets to each end of the end sill 53. The brace 61 is welded at its ends to the end sill 53 and to the bottom side plate 31. The welded joint at the end of the side plate 31 is formed in part with corner brace plates 62 which extend between and are welded to the bolster diaphragm 15, the bottom side plate 31 and the end of the channel brace 61. The T strips 27 on the end of the bolster diaphragm 15 form a socket for one edge of the upper plate 62 and this edge is welded to these strips.

Each corner of the car is supported by the angle iron 50 which extends downwardly along the outside corner of the car. One end of these irons 50 is welded to the corner formed by the ends 30 and sides 24 of the car and the other end is welded to the corner formed by the short channel brace 61 and the end of the end sill 53. Intermediate supports 63 are welded to the end sheets 30a at one end of the supports and to the end sill 53 at the other end of the supports.

The floor of the car may now be inserted. For economy in cutting and convenience in assembling, the end floor plate 22, is preferably made in several parts as shown in Figs. V and VI, although it may be made in one piece and dropped in the car as a unit. The lower part of the end floor plate is made in three sections. The side sections 22a are dropped in place so that their side edges rest upon the cleats 45 on the side sheet angle bars 39 and the center sill angle bars 13a and so that their top edges abut against the top edge of the bolster diaphragms 15. The edges of these sections 22a are butt welded to the edges of the angle irons 39 and 13a and to

the top edge of the bolster diaphragm 15. The center floor plate section 22b fits in between the side floor plate sections 22a and a notch is cut in the bottom edge of the plate so that it fits snugly over the center sill material shed 13. The adjacent edges of the plates are butt welded together and the top edge of the center plate is welded to the bolster diaphragm and the bottom edge is welded to the material shed 13 and to the angle irons 13a.

The top section 22c of the floor plate is dropped into place so that its upper edge rests upon the inwardly turned flange 48 on the bottom of the end sheet 30a to which it is welded with a fillet weld. As shown in Fig. VII, the bottom edge of this section 22c overlaps the bottom sections 22a and 22b of the floor plate and rests upon and is welded underneath to the edge of the upwardly turned flange 21 on the bolster diaphragm 15. The bottom edge of the top section 22c is also welded to the top surface of the bottom floor sections 22a and 22b, and its side edges are butt welded to the angle irons 39 on the side sheet 24a. As shown in Figs. VI and X, a floor ridge plate 44 extends downwardly on each side of the cross-bearer diaphragm 16. These plates 44 may be made in one piece but they are preferably made in three sections 44a, and 44b which are welded together and to the angle irons 39 on the side sheets 24a and the angle irons 13a on the center sill 1 and to the material shed 13 in a manner similar to that in which the bottom sections 22a and 22b of the end floor plates 22 are welded to the corresponding parts.

A downwardly curved ridge crown plate 66, having a concave or hollow underside preferably conforming with the shape of the flange 19, overlaps the top edges of the adjacent ridge floor plates 44. The ridge crown plate 66 extends across the inside of the car and its edges are welded to the top surfaces of the ridge floor plates 44 with an intermittent fillet weld.

As shown in Figs. IV and V, the cross-bearer reinforcing arms 47 which brace the sides of the car comprise a web 67 and a tubular stiffener or stress transferring member 68 extending in substantially the same direction as the member 28. These parts may be individually welded to the car or they may be assembled and then welded to the car as a unit. It is preferred to weld the web 67 along its inclined edge to the stiffener 68 with intermittent fillet welds and then weld the assembly to the car as a unit. The upper end of the stiffener 68 is notched to receive the stem of the T strip 46 which is welded vertically to the inside of the car side. The ridge crown plate 66 is provided with a hole just above the intersection of the prolongation of the stress transferring member 28 to receive the lower end of the stiffener 68 which is inserted in the hole and rests upon the crown flange 19 of the cross-bearer 3. The vertical edge of the cross-bearer arm web 67 fits into the channel 12 in the stem of the T strip 46 which has been welded to side sheet 24a. The lower edge of the web 67 is supported by the ridge crown plate 66. The edges of the web 67 which extend along the stem of the T strip 46 and the ridge crown plate 66 are welded to these members with intermittent fillet welds. The ends of the web stiffener 68 are welded to the ridge crown plate 66 and to the stem of the T strip 46 with a continuous weld. In Fig. VIII the lower weld is shown extended to the cross-bearer crown flange 19. The structure just described transfers the lateral stresses from

the sides of the car through the stress transferring members 68 and 28 to the center sill 1.

As shown in Figs. V and VI, several pairs of cargo discharge openings which may be closed by doors of the usual type (not shown) are provided in the bottom of the car, either between oppositely inclined floor ridge plates 44 or between the end floor plates 22 and the opposite ridge plate 44. The throat of the openings is made to converge towards the mouth by extending the lower ends of the floor plates 22 and 44 below the bottom edge of the side plates 31 and by cutting the edges of these extensions adjacent to the side plates 31 so that they converge downwardly towards each other. One of the floor plates extends downwardly further than the opposite plate and the extending edges of the longer plate adjacent to the center sill are cut so that they diverge away from the sill. An opening is provided between the ends of the short and long plates for the discharge of the cargo material.

The outer side of each hopper throat is formed by an outside hopper sheet 69 which is welded at the top to the lower inside edge of the side plate 31. The sheet 69 is bent inwardly until it abuts against the inwardly converging edges of the floor plate extensions and it is welded to the floor plates 22 and 44 along the seam 70 formed at the junction of hopper sheet 69 and the floor plates.

The inner sides of the respective hopper throats are formed by inside hopper sheets 71 which are butt welded to the bottom edge of each of the center sill flanges 8. It will be noted that this is the only member which is directly welded to the center sill after the assembly of the main parts of the car on the center sill is begun. In this instance however, the welding can be done without causing any distortion in the center sill due to the fact that one edge of metal is being welded to another and the welding heat is not absorbed with sufficient rapidity to cause distortion as in the case where welding is done on a flat surface. The sheets 71 are bent towards the sides 30a of the car until they contact with the diverging edges of the longest floor plate extensions on each side of center sill 1 and they are welded to these edges of the floor plates. The mouth of the discharge opening may be partially closed by a narrow plate 72 extending from the lower end of the angle iron 13a on the center sill 1 to the line of the lower edge of the lower extending floor plate. This plate 72 is welded to the end of the angle iron 13a with a butt weld 73 and to the inside hopper sheets 71 with a fillet weld 74.

While I have shown only one modification of my invention, it is to be understood that changes in the details shown may be made without departing from the scope of my invention as defined in the appended claims.

I claim:

1. A welded railway car having side and end load retaining walls, sloping floor plates connecting said walls, a hollow center sill penetrating said floor plates, hollow ridge members extending transversely of the car and supporting certain of said floor plates, and braces connecting the side walls and center sill.

2. A welded railway car having side and end load retaining walls, sloping floor plates connecting said walls, a hollow center sill penetrating said floor plates, hollow ridge members extending transversely of the car and support-

ing certain of said floor plates, and braces connecting the side walls and center sill and extending between said ridge supported floor plates.

3. In a welded railway car including load retaining end walls, bolsters, side wall girders comprising upper and lower plates respectively connecting said end walls and bolsters, a continuous hollow center sill connecting said bolsters, sloping floor plates connecting said bolsters, sill, and wall members, and side wall braces extending inwardly and beneath certain of said floor plates for connection with the center sill.

4. A welded railway car having load retaining side walls, floor plates forming a rigid connection between said walls, a center sill beneath said floor plates, braces adapted to transmit stresses in a substantially straight path from said car side walls to said center sill, said braces having an upper portion and a lower portion, said upper portion extending inwardly and downwardly from said car side walls to said floor plates, and said lower portion being positioned diagonally between said upper portion and said sill and being adapted to transmit stresses from the lower end of said upper portion of said braces to said center sill.

5. A hopper car comprising girder side walls, a pair of bolsters, and load retaining end walls, sloping floor plates uniting said walls and bolsters, a continuous hollow center sill and penetrating said floor plates and bolsters, certain of said floor plates constituting ridges transversely of the car above the center sill for connecting the girder sides intermediate said bolsters, and tie plates between said ridges and center sill, all of said members being united by welding.

6. A car body comprising a center sill, a cross-bearer supported by said center sill, side sheets supported by the end of said cross-bearer, said cross-bearer comprising a diaphragm having a notch therein which closely fits over said center sill, a stiffener member secured to said diaphragm on opposite sides of said sill and extending angularly upward from the side of said center sill to substantially the top of said diaphragm, and a brace connected to the top portion of each side sheet and to the top of said cross-bearer at a point adjacent to the top of said stiffener member.

7. A car body comprising in combination a center sill and underframe cross supports each having a diaphragm provided with a notch to receive said center sill, a metal strip having a base portion welded across the top and sides of said center sill, said strip having a longitudinally extending channel therein and said diaphragms fitting into said channels and being welded thereto.

8. A car body structure comprising in combination a center sill, metal strips extending transversely of said center sill and welded thereto, each of said strips having a longitudinal channel therein, underframe cross supports having diaphragms, said diaphragms having an edge portion extending into said channel and a fillet weld extending along the line of contact between the side of said diaphragm and the top of said channel.

9. A car body comprising a center sill, a cross-bearer carried by said center sill, a top flange on said cross-bearer, adjacent ends of two ridge floor plates supported on said flange, and a cover plate covering the seam between the adjacent ends of said floor plates and having its longitudinal edges welded to said floor plates.

10. A car body comprising a center sill, a cross-bearer having a diaphragm carried by said center sill, a downwardly curved crown flange welded to the top of said diaphragm along the crown of said flange, a downwardly inclined floor plate on each side of said diaphragm and supported on said crown flange, and a downwardly curved crown plate covering the seam between said floor plates and having its longitudinal edges welded to said floor plates.

11. A hopper car comprising car ends and sides, a center sill and cross-bearer, a downwardly sloping cross-ridge floor plate supported at its upper end by said cross-bearer and welded thereto, a downwardly sloping end floor plate, a metal strip welded to said center sill and car side opposite the inner and outer edge of each of said floor plates, said floor plates having their inner and outer edges butt welded to the adjacent one of said strips, an outside hopper sheet welded along its upper edge to the car side and along its lower downwardly sloping edges to the outside edge of the cross-ridge floor plate and the end floor plate, an inside hopper sheet welded to said center sill along its upper edge and to the end floor plate along its downwardly sloping edge.

12. A hopper car comprising girder side walls, a pair of bolsters, and load retaining end walls, sloping floor plates connecting said walls and bolsters, a continuous hollow center sill penetrating said floor plates and bolsters, outside and inside hopper sheets depending from said girder sides and center sill respectively, and defining with said floor plates the discharge openings upon opposite sides of and below the center sill, all of said members being united by welding, doors controlling said openings, and door locking means.

13. A metal car structural joint comprising a bolster diaphragm having a flange on its top edge, a section of a floor plate in the plane of said flange and welded to the juncture of said flange and said diaphragm, and a second section of a floor plate resting upon the top of said flange and overlapping said first section of floor plate, a welded seam uniting the edge of said flange to the bottom surface of said second section, and a welded seam uniting the overlapping edge of said second section of floor plate to the top surface of said first section of floor plate.

14. A method of securing floor plates to the car sides and end sills of a metal car comprising welding angle irons to the side sheets and center sill, welding cleats to the projecting legs of said angle irons, resting the edges of said floor plates on said cleats and welding the edges of said floor plates to the edge of the projecting leg of the angle iron.

15. A car body comprising the combination of a center sill, a cross-bearer secured to said center sill by a welded connection, and side sheets welded to said cross-bearer, said cross-bearer comprising a diaphragm, a downwardly curved crown plate welded to the top of said diaphragm along the crown of said plate, and a brace welded to said crown plate and adjacent the top of said side sheets.

16. A car body comprising the combination of a center sill having a bottom cross web, a frame cross support having a diaphragm secured to said center sill by welded connections, a pair of metal plates having their top faces welded along the length of the bottom edge of said diaphragm and generally perpendicular thereto and each of said plates having one of their end edges welded to

said center sill in the plane of said bottom cross web, said plates thereby acting as a diaphragm flange and a tie plate of continuous section.

17. A car comprising the combination of a center sill having a cross web, an underframe cross support having a diaphragm notched to receive said center sill, a welded connection extending between the borders of said notch and said center sill, and a flange on the bottom edge of said diaphragm extending from each side of said center sill and welded thereto opposite said cross web.

18. A metal car side comprising a metal sheet, a hollow rectangular top chord surmounting said sheet and welded thereto, a hollow rectangular side sill welded to said sheet, and channel-shaped side stakes extending between said top chord and side sill, the edges of the flanges of said side stakes being welded to said side sheets to form hollow rectangular reinforcing members having one side co-planar with one side of said rectangular top chord and said rectangular side sill.

19. A metal car side comprising one or more reinforced metal sheets, a plurality of metal strips extending vertically down the inside of said car side, each of said strips having a base portion welded to the inside of said sheets and a longitudinal channel in the top portion of said strips adapted to receive the diaphragm of a brace member.

20. A car body having side and end load retaining walls, said end wall having an inwardly turned flange on its lower edge, an angle bar having an inwardly projecting leg resting upon said flange and having an upwardly extending leg welded to the inside of the opposite sides of said side walls, and a floor plate resting on said flange and having an edge extending along the longitudinal edges of said inwardly projecting leg and welded thereto, said floor plate also being welded to said flange.

21. A railway car side comprising a metal side wall; a top chord; a side sill; and vertical stakes between and bearing against said chord and said sill; said chord, sill and side stakes being metal channels of substantially the same depth, edges of the flanges of said chord and said sill being welded to one face of said side wall and the edges of the flanges of said stakes being welded to the same face of said side wall.

22. A method of constructing a railway car side having a metal side wall, a channel-shaped top chord, a channel-shaped side sill, and channel-shaped vertical stakes, all such channel-shaped members being of substantially the same depth and of a metal which method comprises positioning the top chord and the side sill adjacent and along opposite edges of said side wall, with the open sides of said chord and said sill opposite the same face of said side wall and the flanges thereof engaging said side wall; uniting the edges of said flanges to said side wall by welds extending lengthwise of said flanges; positioning said vertical stakes between and perpendicular to said chord and said sill, with the open sides of said stakes opposite said face of said side wall and the edges of the flanges thereof engaging said face; and uniting said stakes to said side wall by welds extending lengthwise of such stake flanges.

23. In a car body, the combination of a center sill; an underframe cross support comprising a unitary diaphragm having a notch extending

into the lower edge thereof intermediate the ends of said edge, the bottom and lateral edges of said notch being parallel respectively to the top and side surfaces of said center sill; and means symmetrically securing said diaphragm to said center sill comprising a metal strip disposed between said surfaces and the edges of said notch and welded to said center sill and to said diaphragm.

24. In a car body, the combination of a center sill having unitary top and side walls, and a bottom web welded to said side walls; an underframe cross support comprising a unitary diaphragm having a notch extending into the lower edge thereof intermediate the ends of said edge, the bottom and lateral edges of said notch being parallel respectively to the top and side walls of said center sill, and said notch edges being symmetrically secured to the walls of said center sill and to said bottom web; and tie plates severally symmetrically welded to the lower edge of said diaphragm at opposite sides of said notch and joined by said bottom web.

25. In a car body, the combination of a center sill; an underframe cross support comprising a diaphragm secured to said center sill; and a crown plate extending lengthwise of said diaphragm and covering the upper edge thereof, said crown plate having a center portion secured to said edge and side portions severally inclined downwardly from each side of said edge.

26. A car body construction as claimed in claim 25, in combination with floor plates severally secured to the downwardly inclined portions of said crown plate.

27. A car side comprising a metal side sheet; a reinforcing metal channel having its flanges welded to said sheet along and adjacent its top edge; a reinforcing metal channel having its flanges welded to said sheet along and adjacent its bottom edge; and reinforcing metal channels extending transversely of and bearing against the top and bottom channels and having their flanges welded to said sheet, the open sides of all of said channels facing the same side of said sheet.

28. A metal car side as claimed in claim 27 in which each of said channels consists of a U-shaped sheet metal member, the flanges of which are of the same height.

29. A railway car under-frame comprising a center sill; a center casting secured within said sill and located between the side walls thereof; and a bolster having a diaphragm provided with a notch into which the center sill is received; said diaphragm having a bottom flange extending from each side of said sill opposite said center casting; and the ends of said flanges adjacent to said sill being butt welded thereto so that the center casting is in a line between said ends.

30. A railway car under-frame comprising a center sill; a center casting secured within said sill and located between the side walls thereof; a bolster having a diaphragm provided with a notch into which the center sill is received; a combination center brace plate, tie plate and bolster bottom flange having its top surface welded to the bottom edge of said diaphragm and having its end adjacent to said sill butt welded to the side walls of said sill within the plane of the bottom wall of said center sill on a line substantially opposite said center casting.

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