Feb. 28. 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

Filed March 25, 1950 18 Sheets-Sheet 1

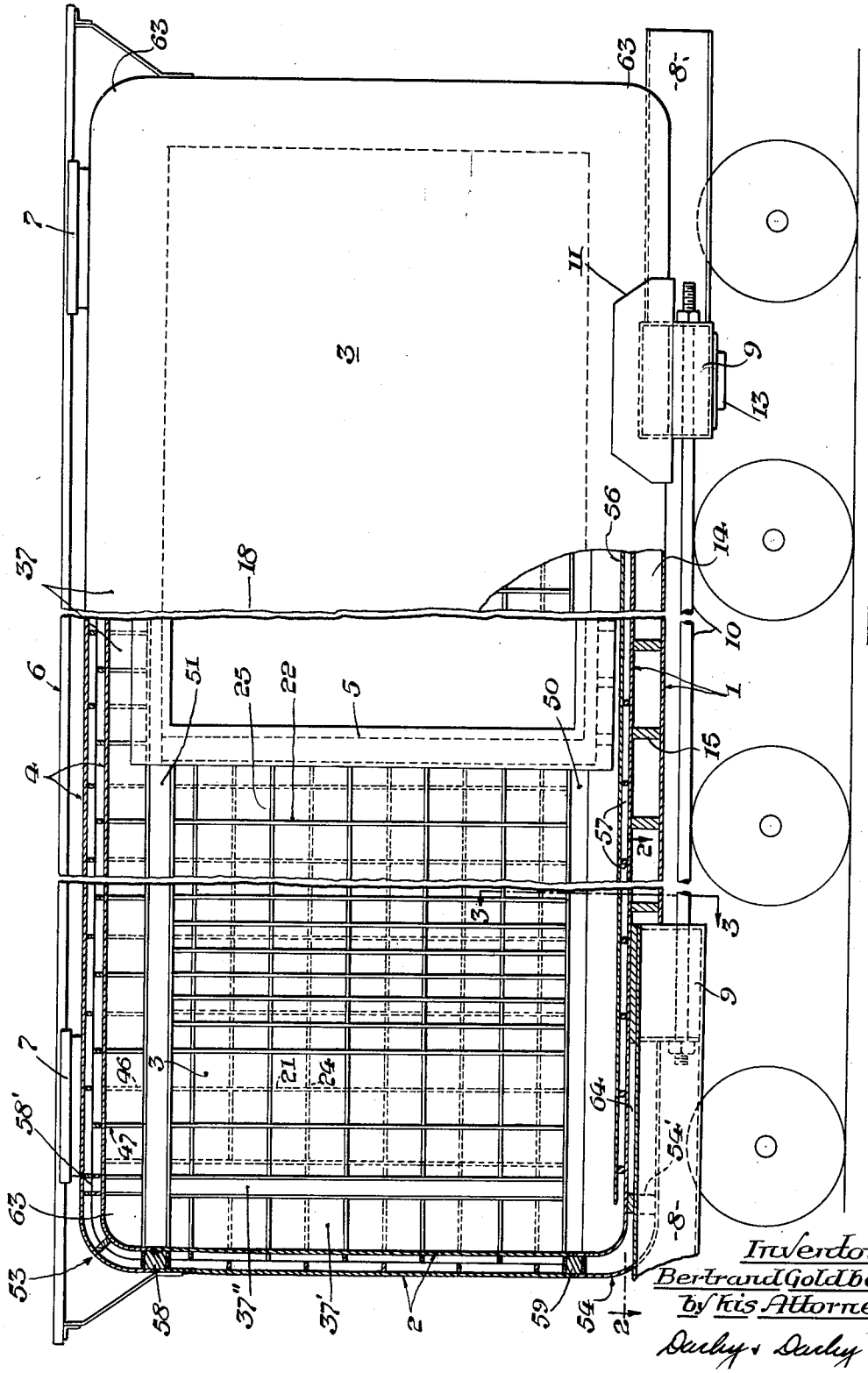

Fig. 1.

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WOOD CELLULAR LAMINATED RAILWAY CAR

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Fig. 2.

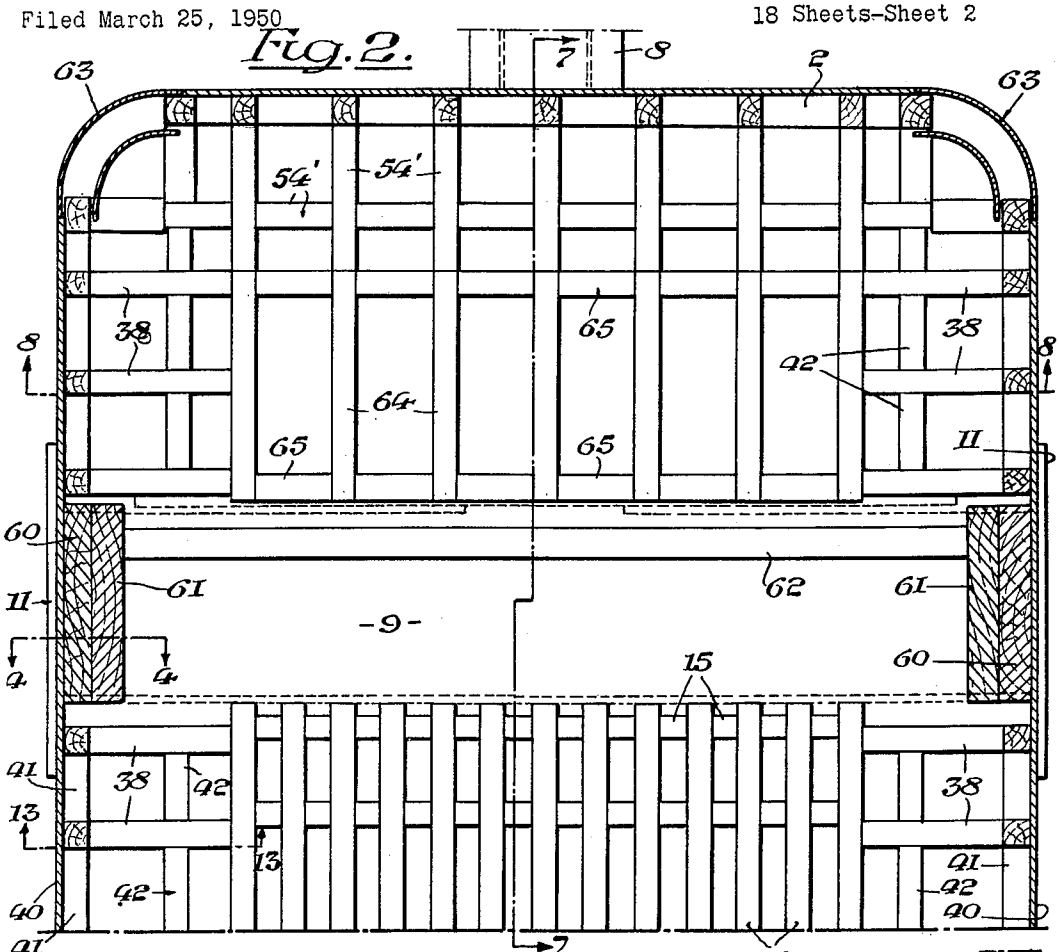


Fig. 3.

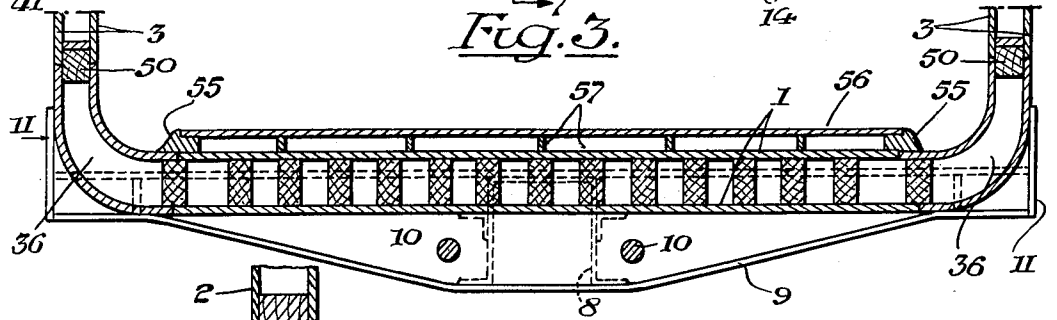
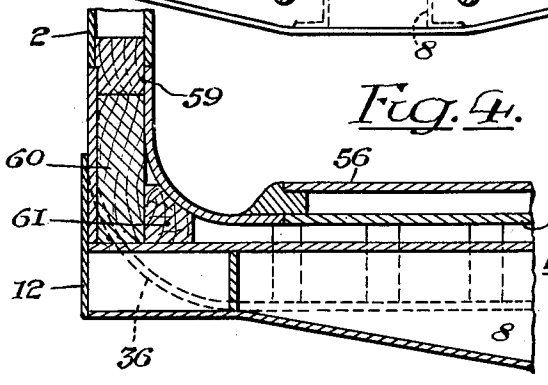


Fig. 4.



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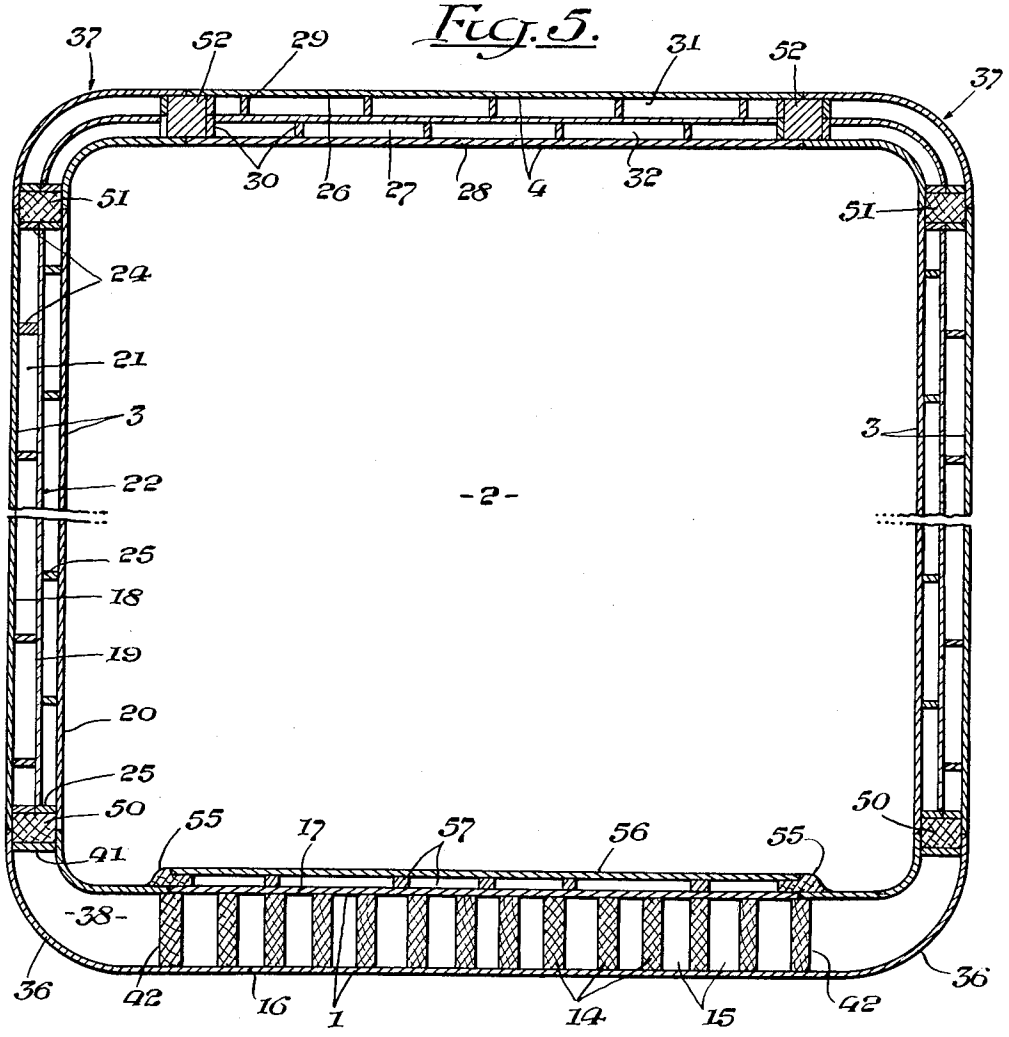
Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

Filed March 25, 1950 18 Sheets-Sheet 3

Fig. 5.



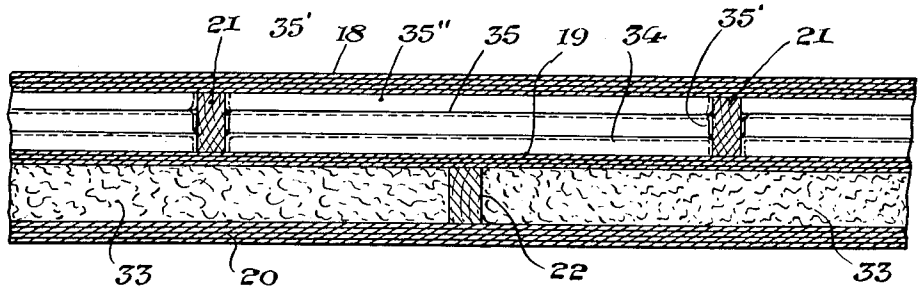


Fig. 6.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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Fig. 7.

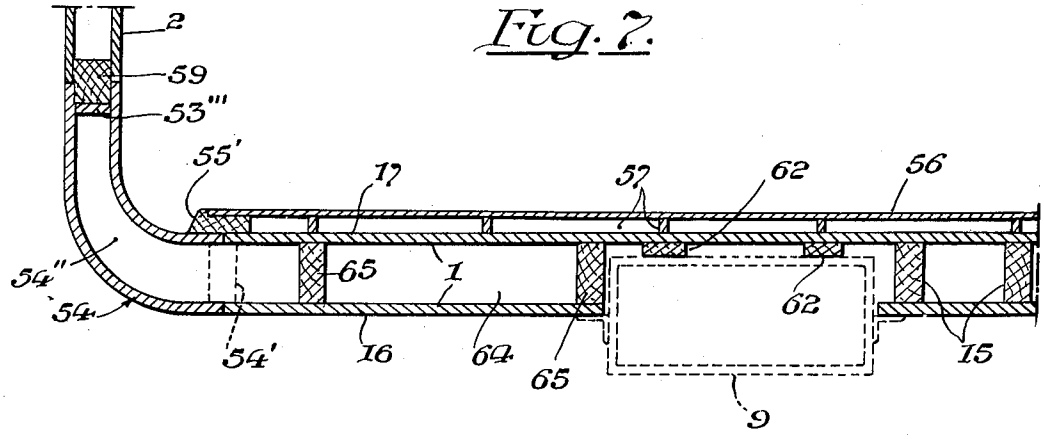


Fig. 8.

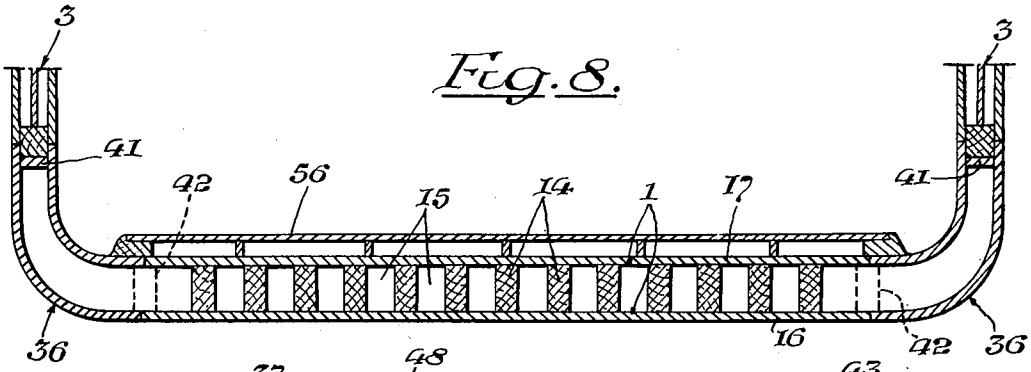
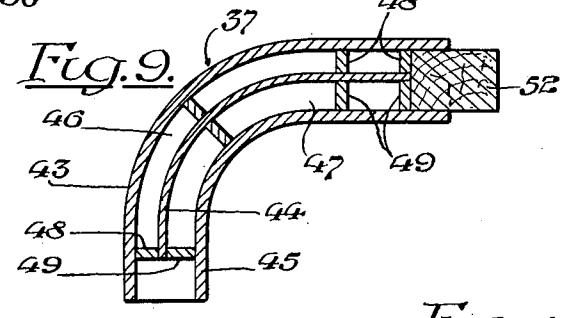


Fig. 9.



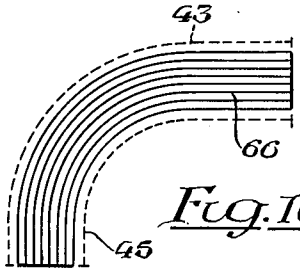
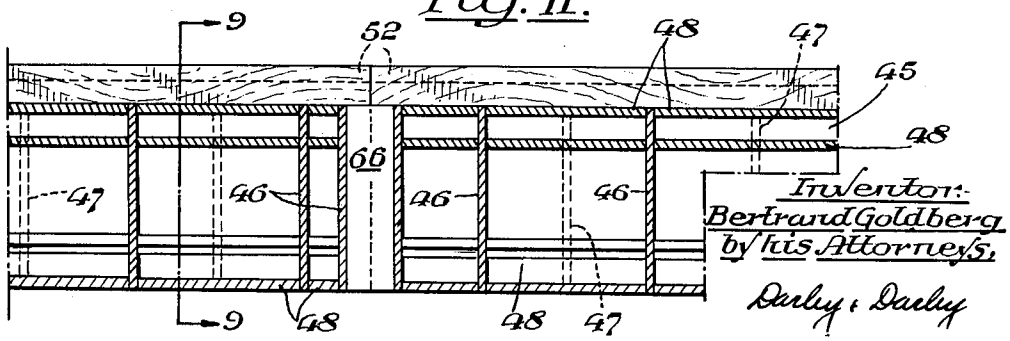


Fig. 10.

Fig. 11.



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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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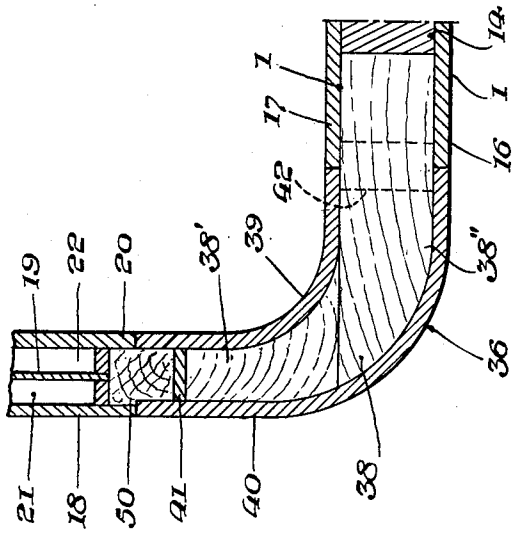

Fig. 13.

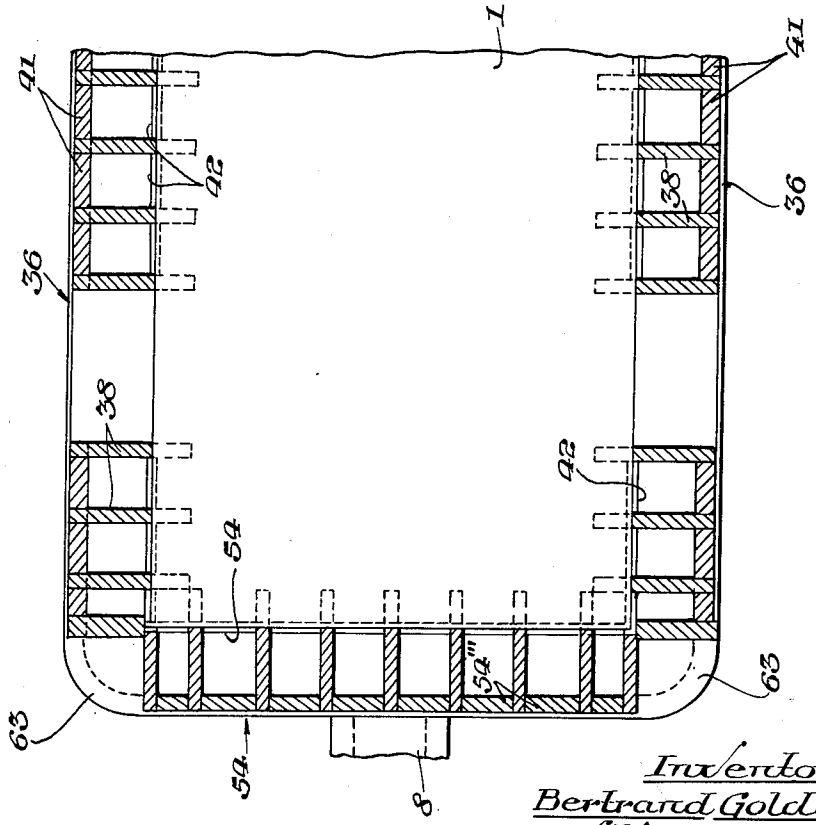

Fig. 12.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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Fig. 17.

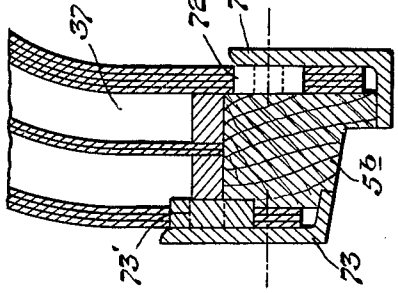


Fig. 18.

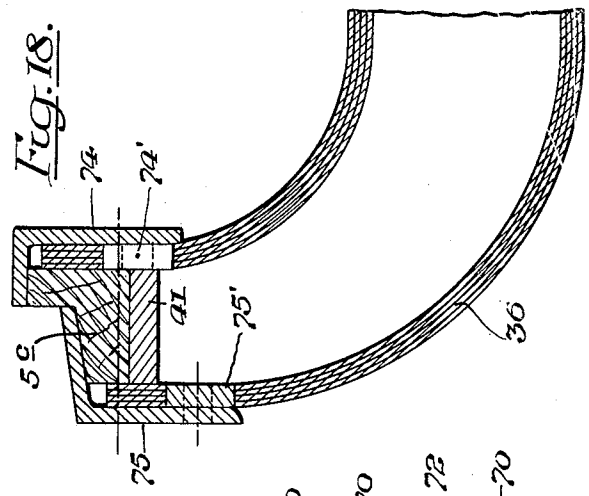


Fig. 15.

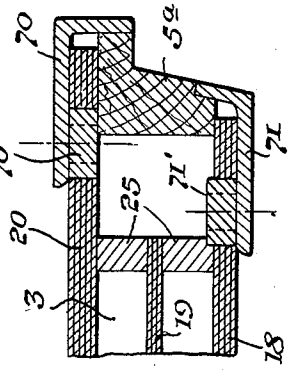


Fig. 16.

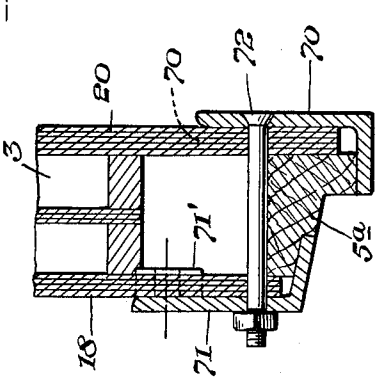
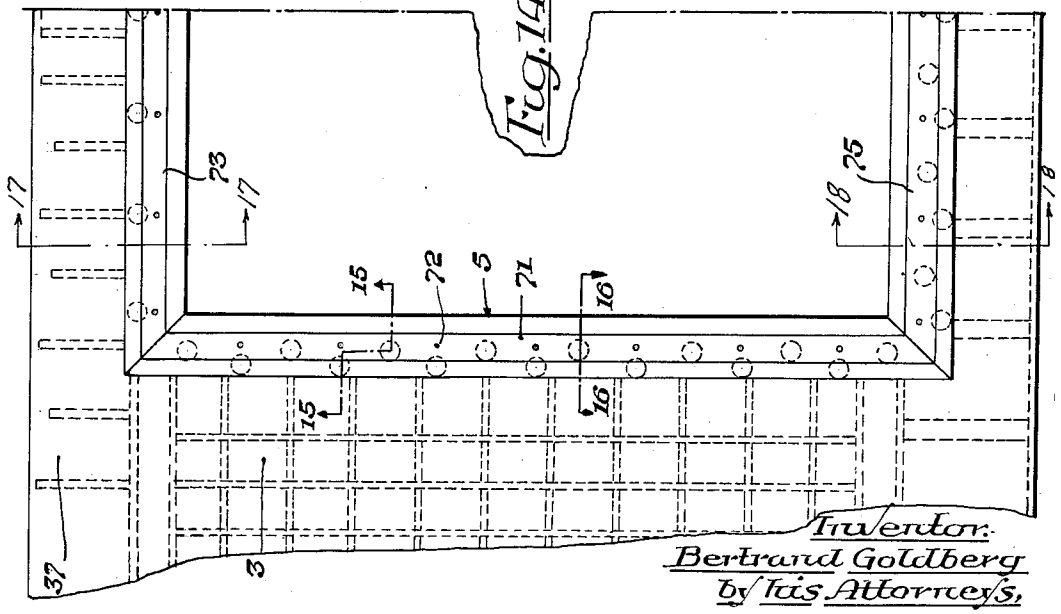


Fig. 14.



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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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Fig. 19.

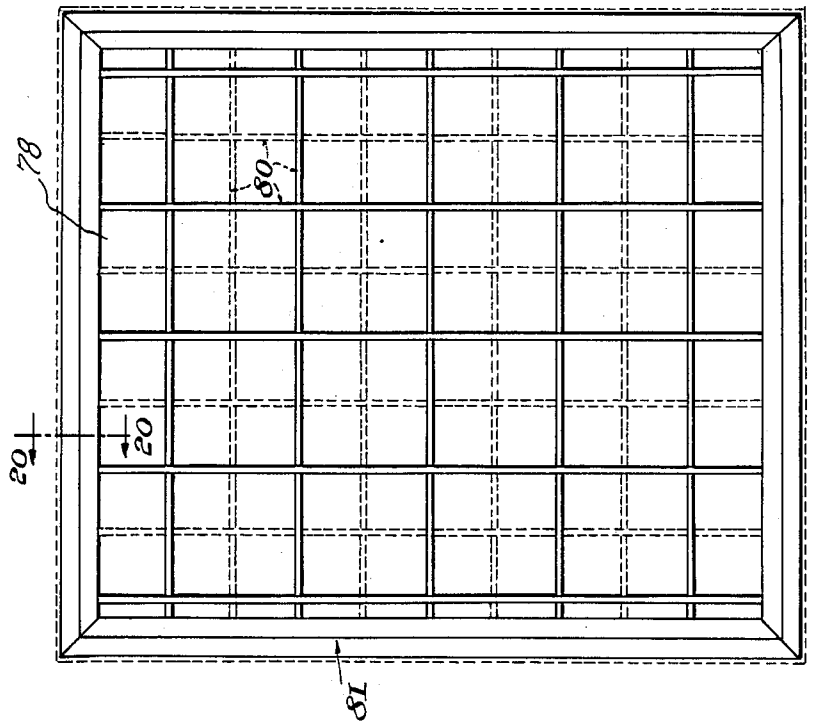
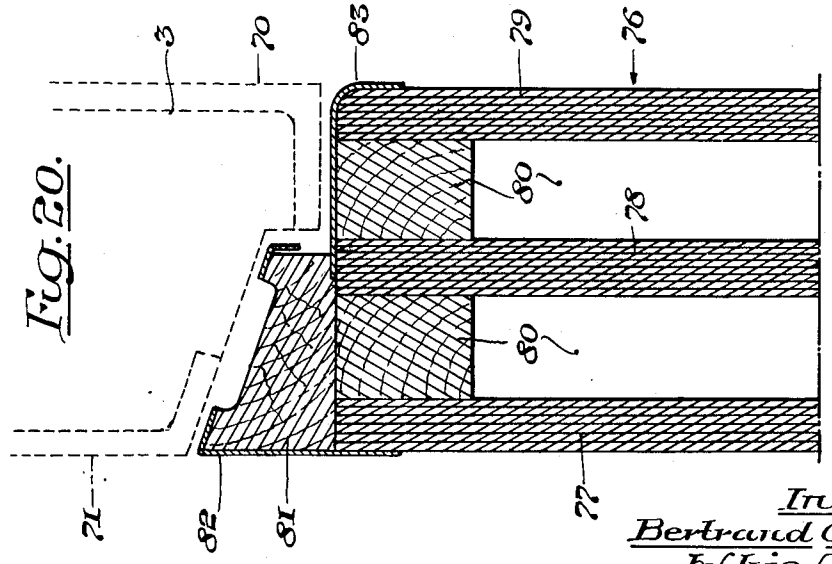


Fig. 20.



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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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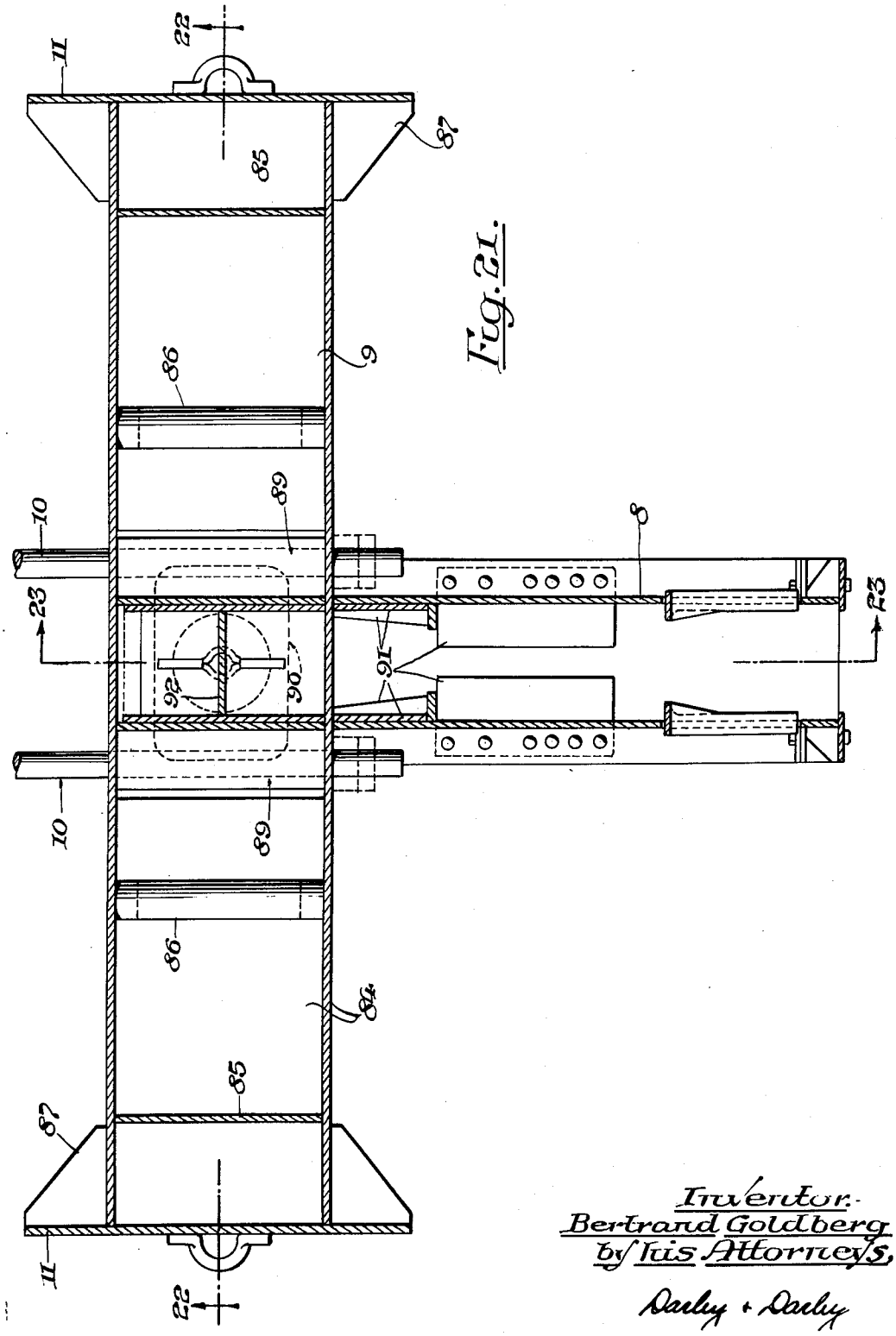

Fig. 21.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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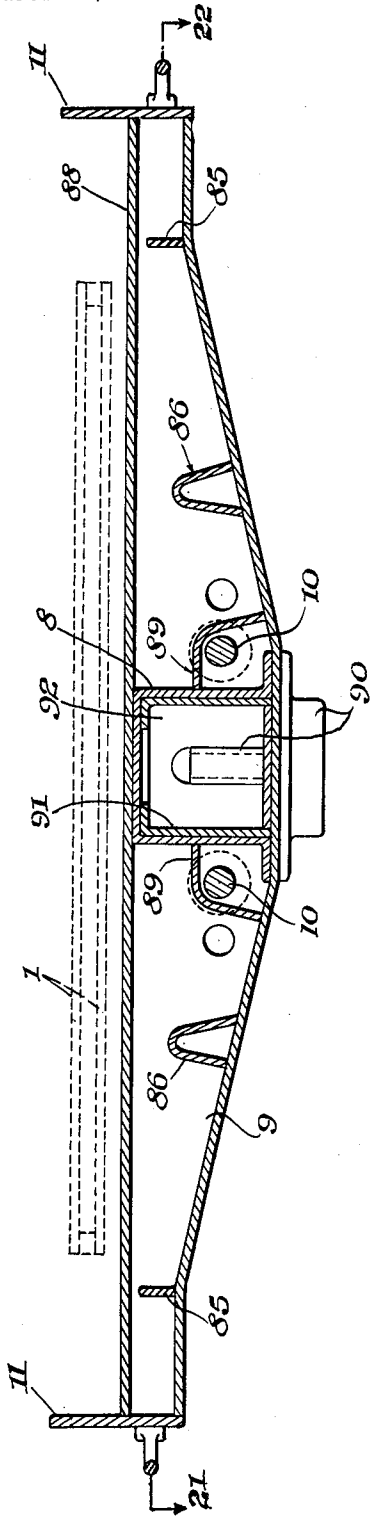

Fig. 22.

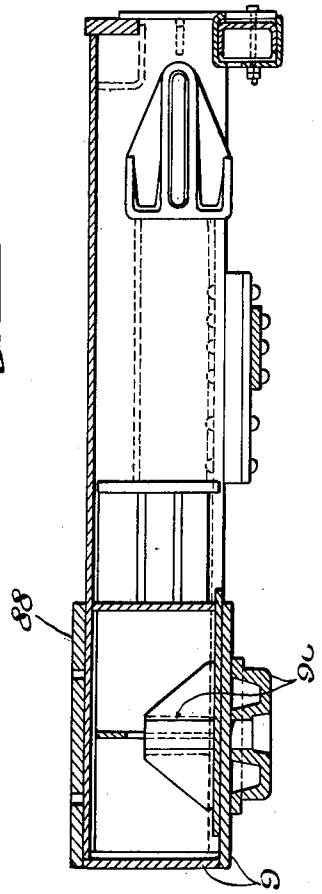

Fig. 23.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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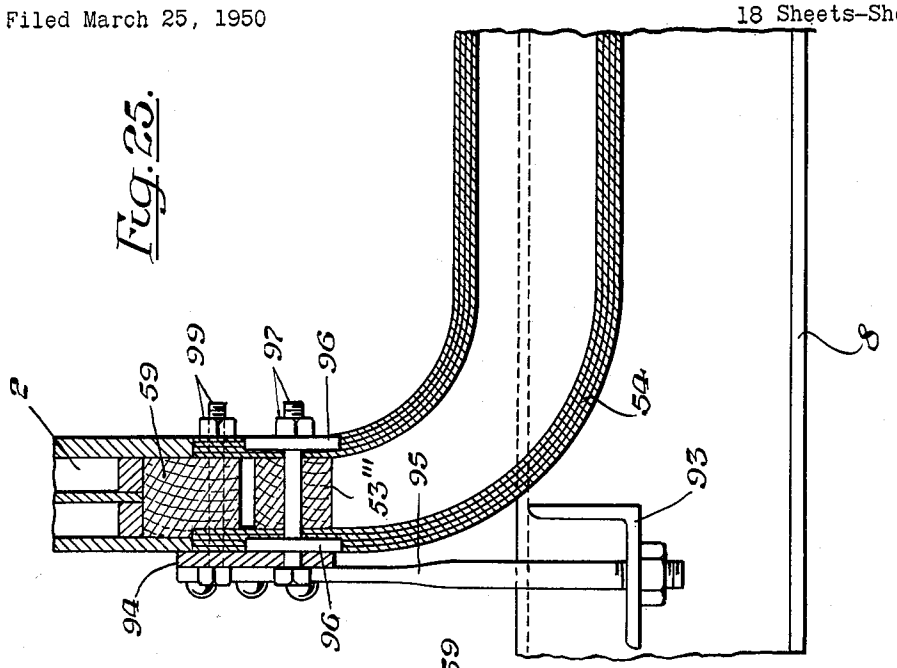
Fig. 25.



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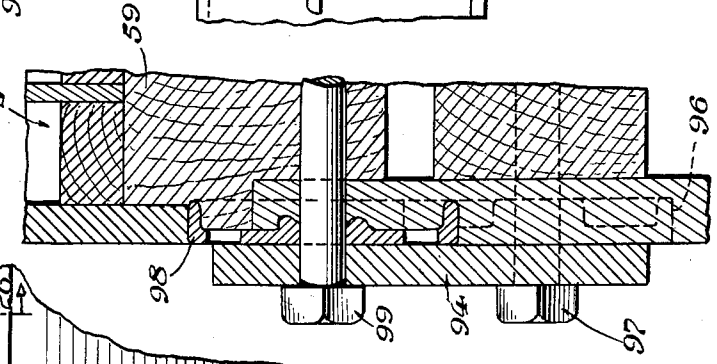

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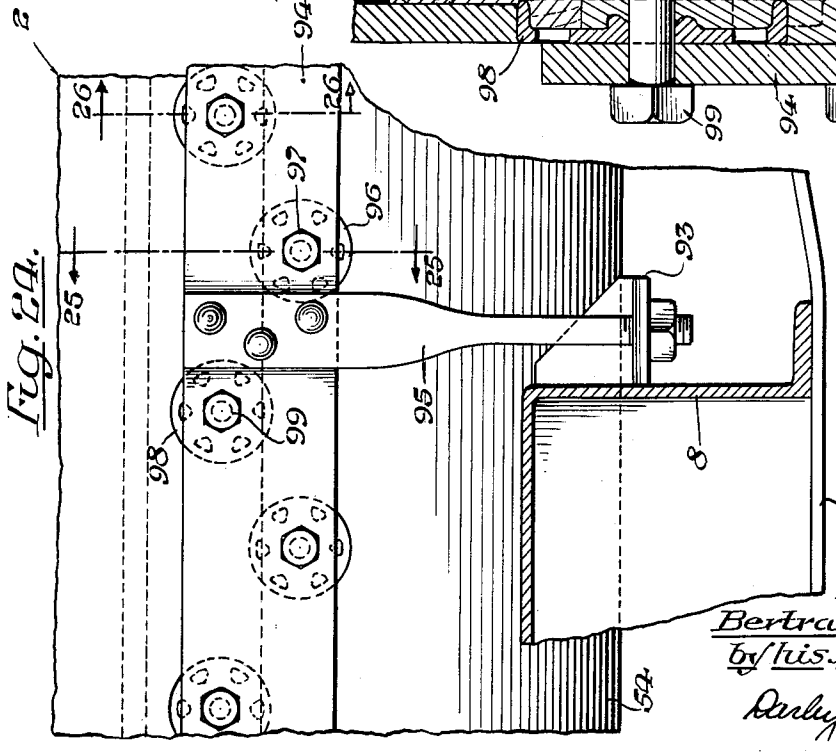

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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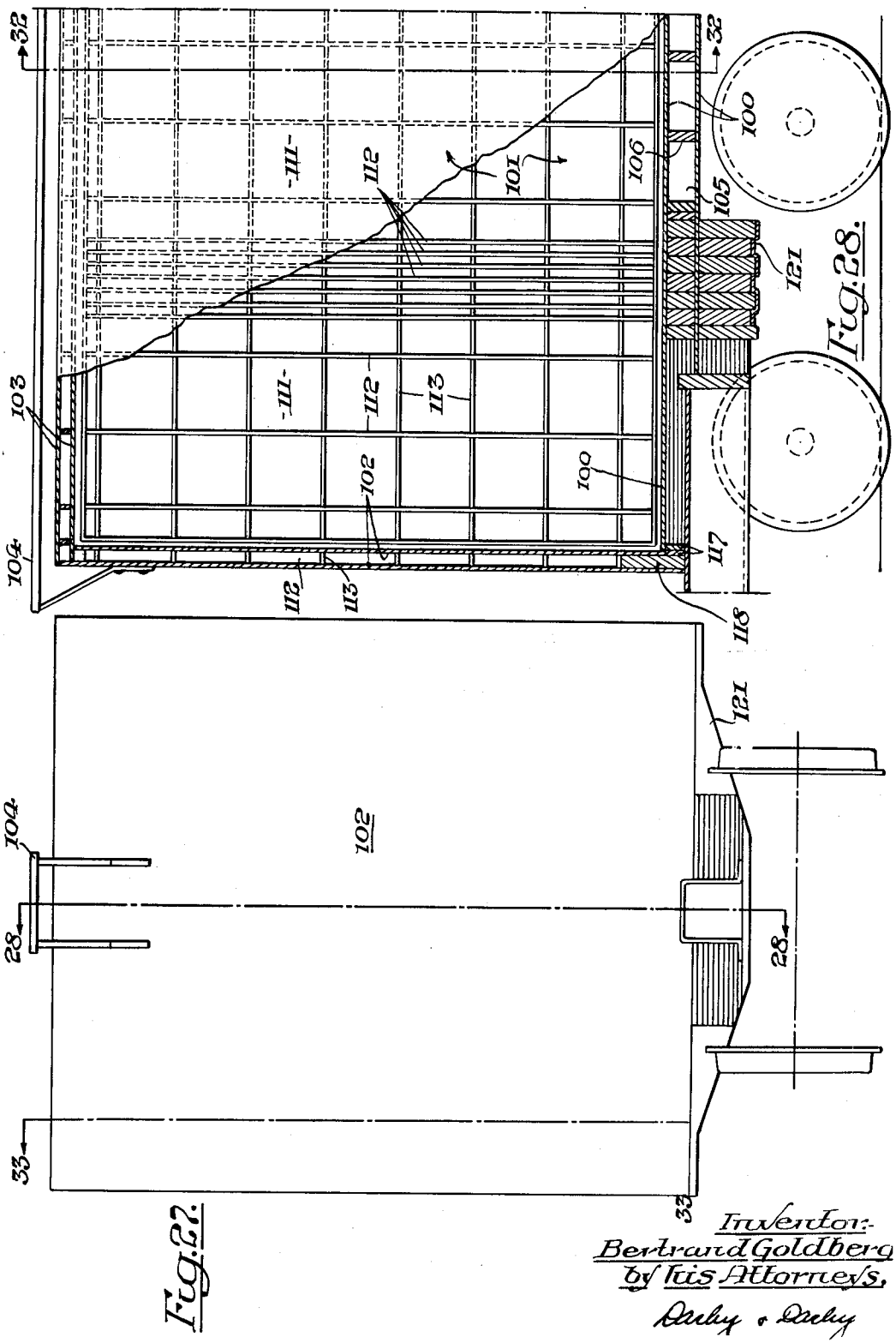

Fig. 28.

Fig. 27.

Inventor:
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WOOD CELLULAR LAMINATED RAILWAY CAR

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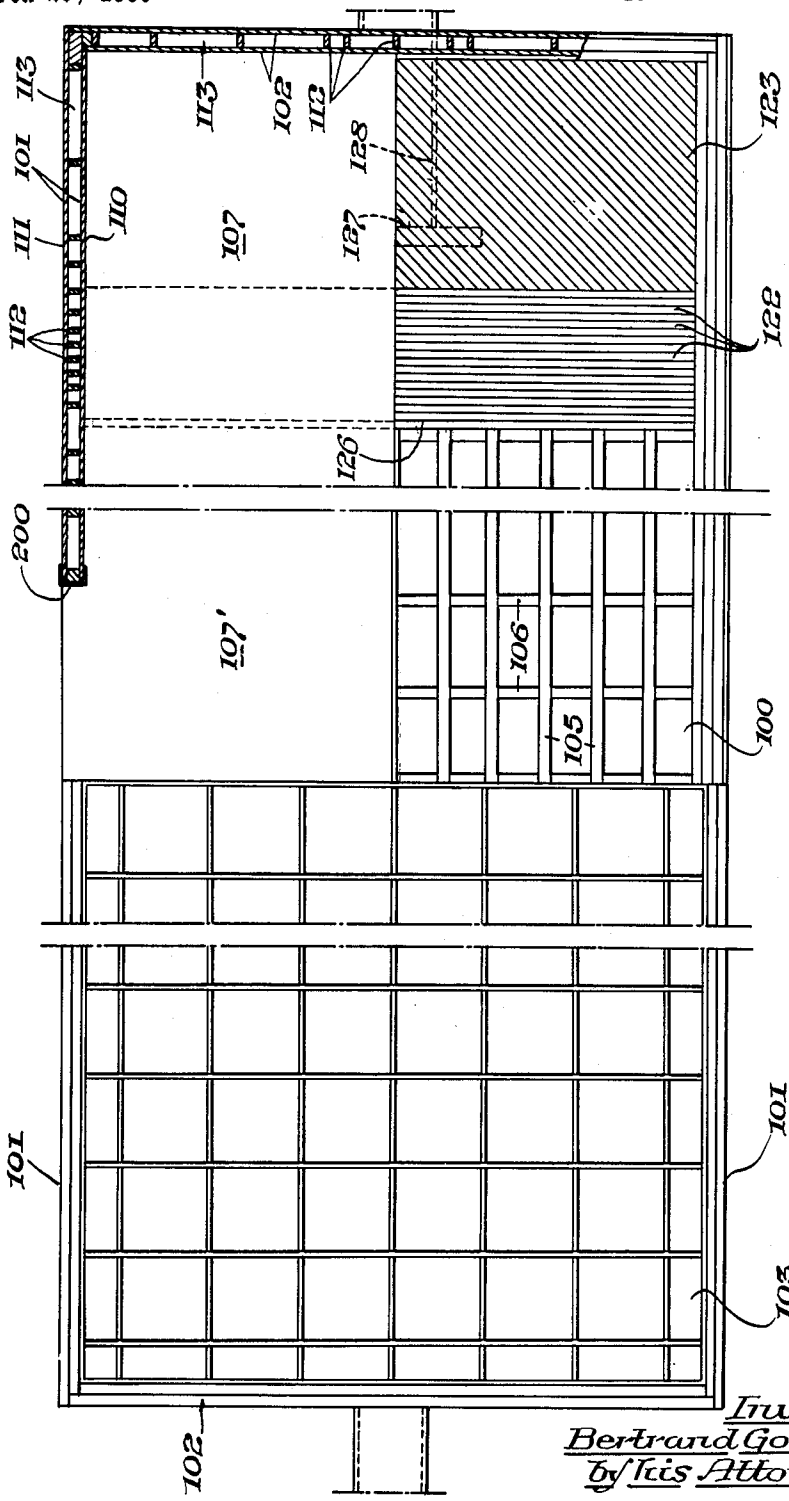

Fig. 29.

Inventor:
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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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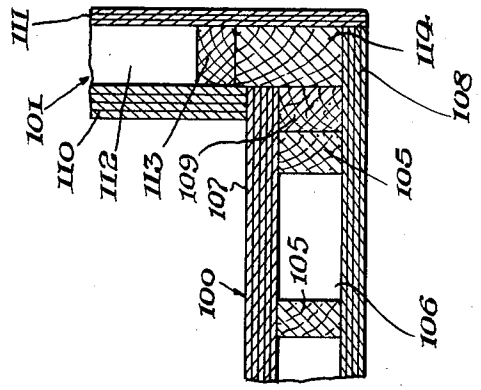

Fig. 31.

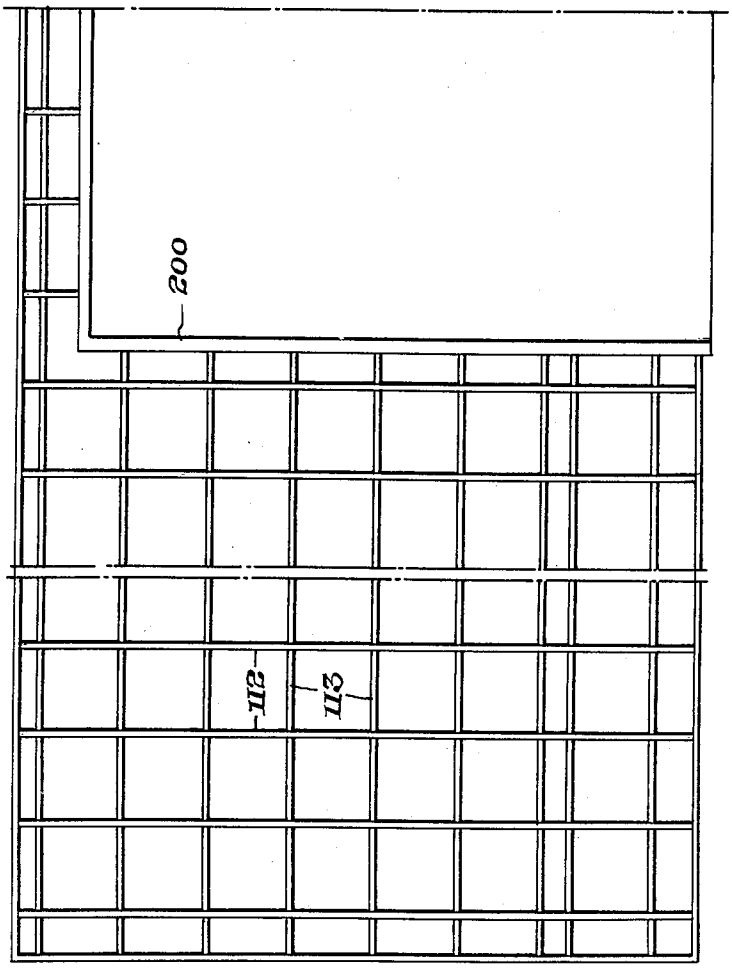

Fig. 30.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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Fig. 34.

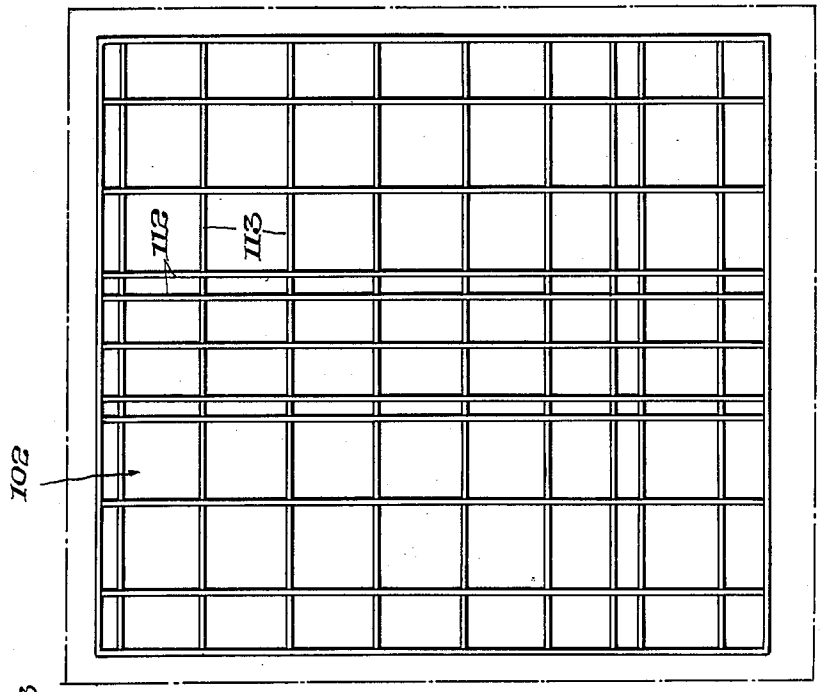


Fig. 33.

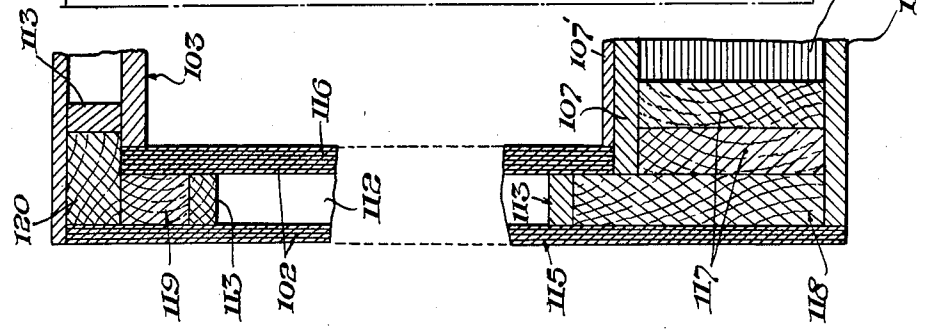
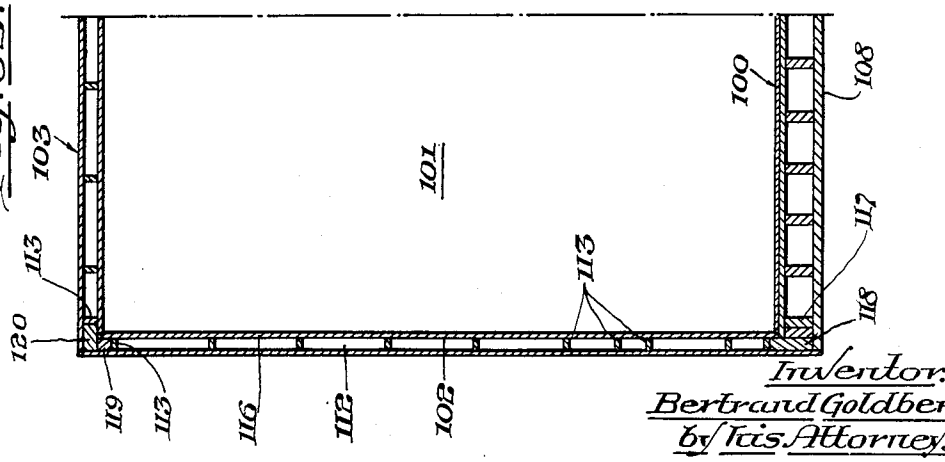


Fig. 32.



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WOOD CELLULAR LAMINATED RAILWAY CAR

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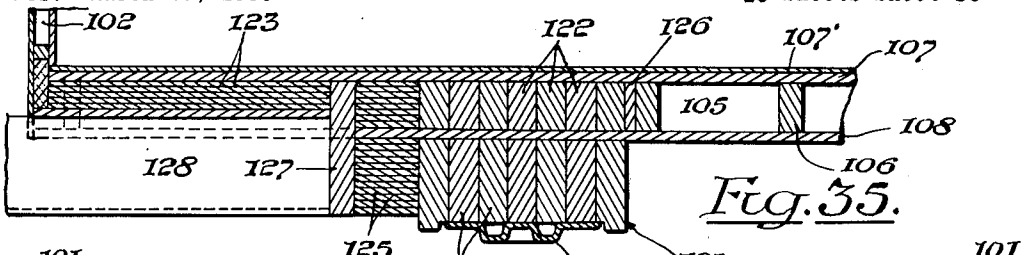

Fig. 35.

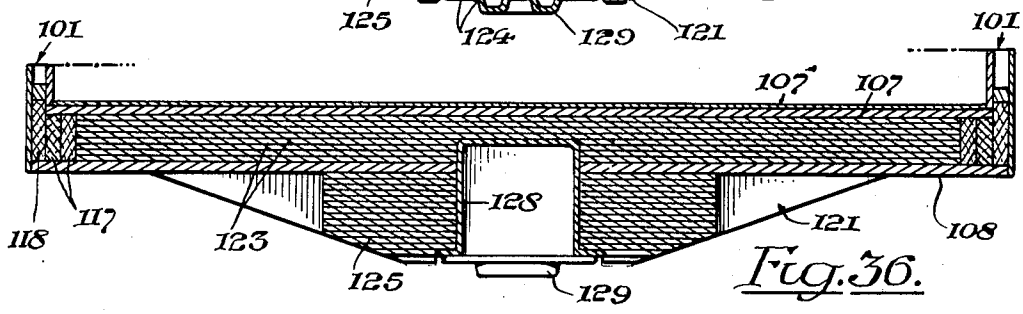

Fig. 36.

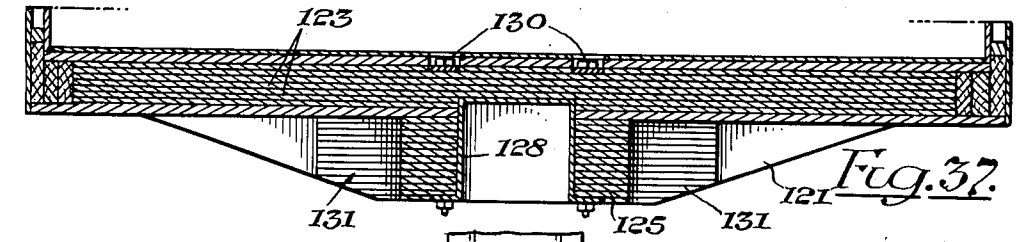

Fig. 37.

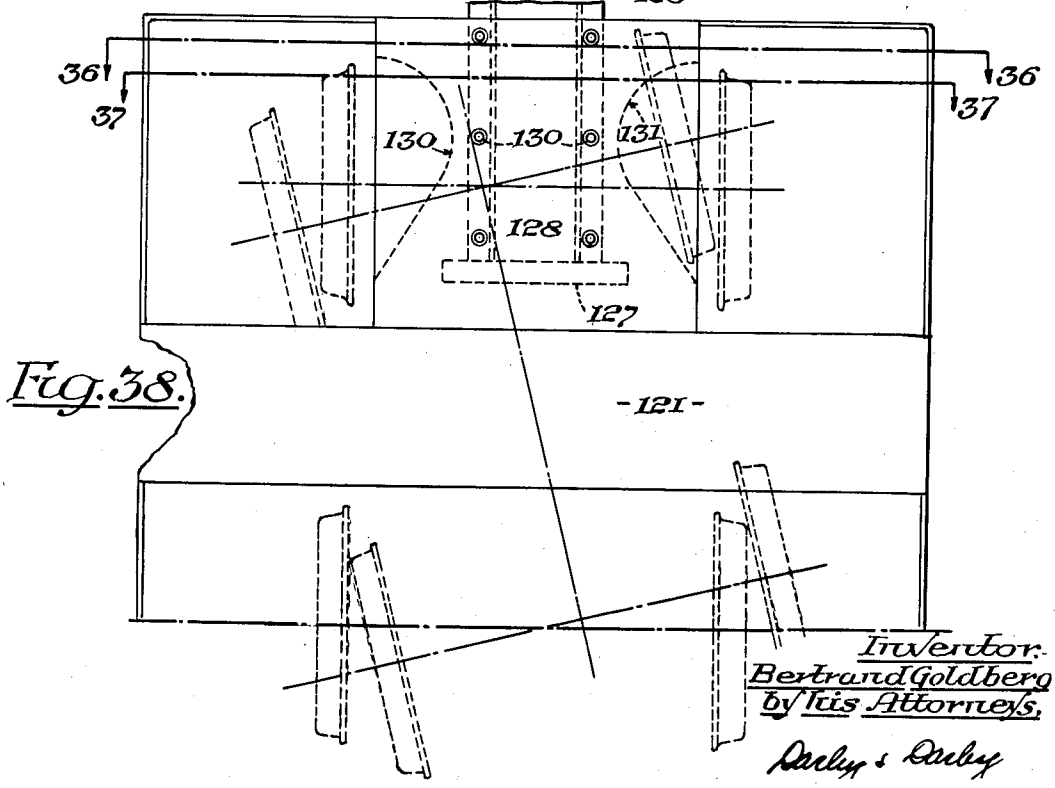

Fig. 38.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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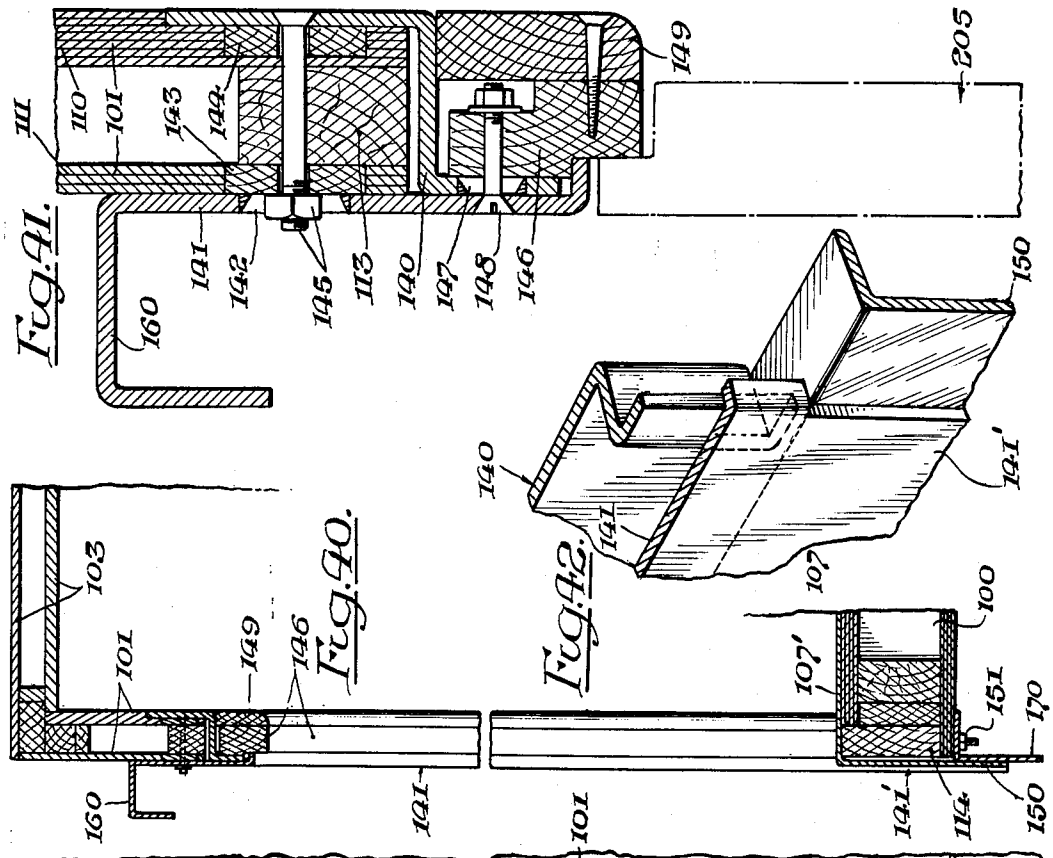

Fig. 1.

Fig. 2.

Fig. 3.

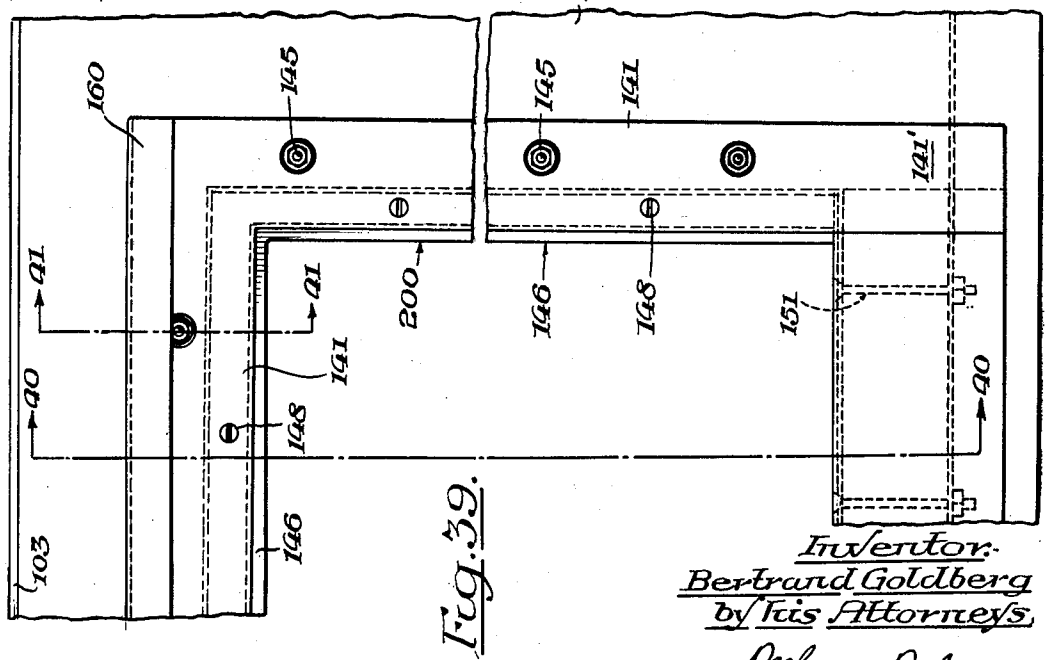

Fig. 39.

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Feb. 28, 1956 B. GOLDBERG 2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

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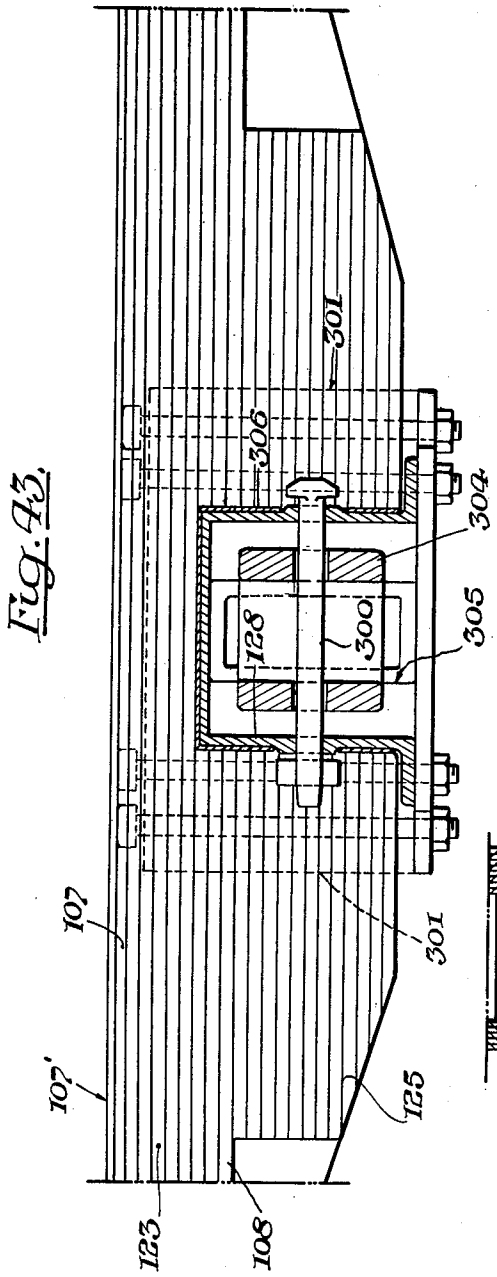

Fig. 43.

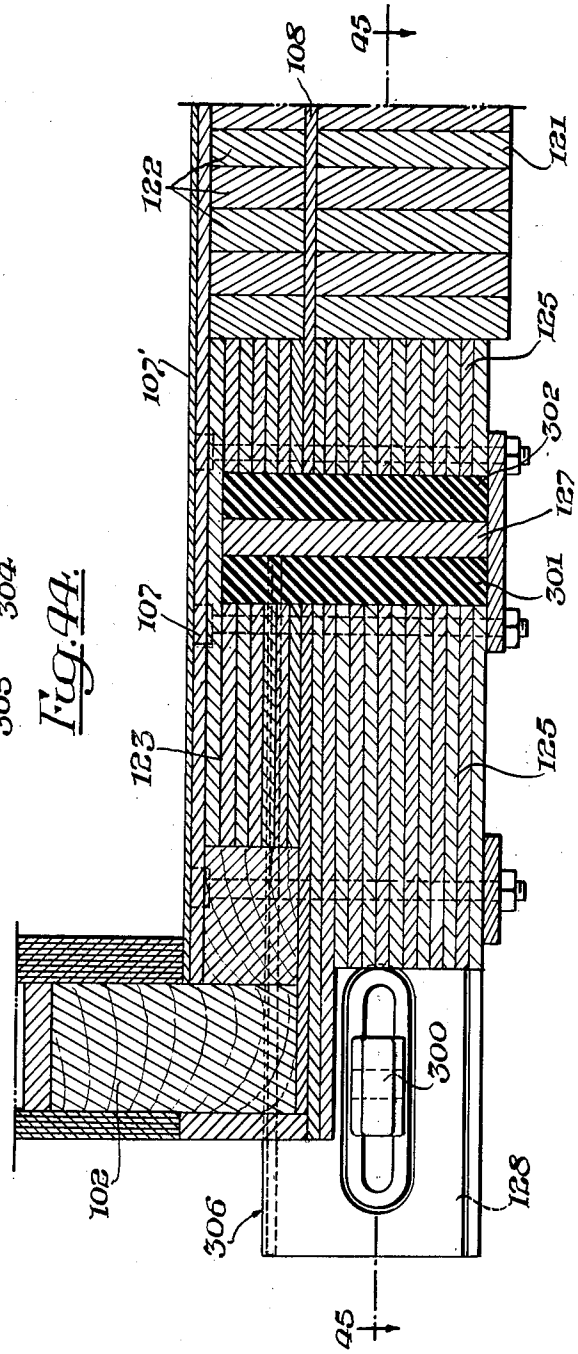

Fig. 44.

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WOOD CELLULAR LAMINATED RAILWAY CAR

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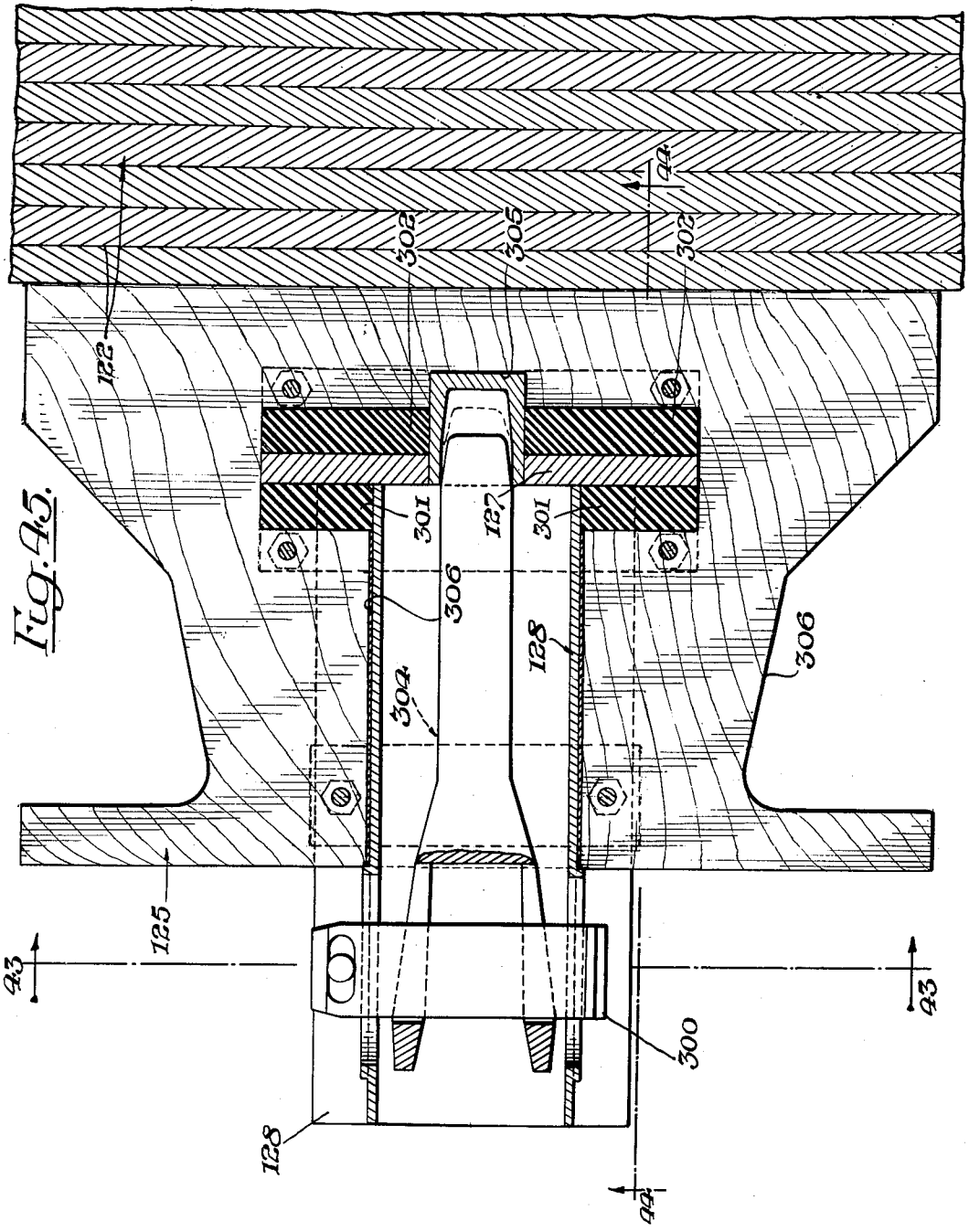

Fig. 45.

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United States Patent Office 2,736,273 Patented Feb. 28, 1956

2,736,273

WOOD CELLULAR LAMINATED RAILWAY CAR

Bertrand Goldberg, Chicago, Ill., assignor, by mesne assignments, to U. S. Industries, Inc., a corporation of Delaware

Application March 25, 1950, Serial No. 151,883

9 Claims. (Cl. 105—404)

This invention relates to railway car construction and involves novel structural combinations and features incident to the construction of a railway car built from a combination of wood, laminated plywood and veneers adhesively bound together.

A broad object of this invention is to produce a railway car of substantially all wood cellular laminated construction, comprising broadly in combination a cell forming wood framing acting as a spacer for inner and outer plywood skins, attached to such framing to form what can be technically termed a shell of stressed-skin or monocoque construction.

A further object of this invention is to provide a railway car of such construction in which all the structural members including the framing and plywood skins are united, in the main by an adhesive, to provide what may be termed a structurally homogeneous shell.

A further object of the invention is to provide a railway car of this type in which loads are transmitted throughout the entire structure without undue local concentration; a load applied at one point of the car finds its way from the floor, for example, through the side walls and into the roof in varying proportions, depending upon the type of load applied.

Another object of the invention is to take advantage of stressed skin construction to insure the efficient use of all material involved in the construction of the car which is to say that every piece of material is structurally in work.

A further object of this invention is to provide a railway car of this type having no center sill, with the resultant advantages of lower cost, less weight, greater load capacity and better distribution of stresses in use.

Another feature of the construction herein disclosed lies in the fact that there are no members in the structure that act in an unsupported manner for a considerable length, with the result that the construction is more rigid for the amount of material used than in the more common type of railway car construction employing the beam and column method of construction.

Other general objects of the invention are to provide a railway car which is smaller and lighter for a given load carrying capacity, as compared with a steel railway car; which is more rugged for the amount of material used; which is less expensive to maintain; which is less likely to be damaged by fire and if so more easily repaired; which is naturally more absorbent of shocks; which is more resilient making it more resistant to damage by external shock as well as to shocks of wear due to lading; which is smaller for a given volume of lading; and which is more resistant to salt air, cinders, acid fumes and the like.

The railway car construction herein disclosed is of equal utility for use in refrigerator cars, as well as in ordinary box cars, and in addition to the above advantages which apply to both equally there are special advantages thereof when employed in a refrigerator car.

Therefore, another object of this invention is to provide a refrigerator car having a thinner wall construction of higher thermal efficiency than a comparable refrigerator car of ordinary construction, and by reason thereof a greater load carrying capacity for a given overall size.

A further advantage of the construction herein disclosed when employed in a refrigerator car is found in the elimination of any substantial conductive paths of heat transfer through the walls thereof.

A more detailed object of the invention is to provide a cellular floor, wall and roof construction for an all wooden cellular laminated refrigerator car, providing pockets containing heat insulating material acting to inhibit the condensation prevalent in cars of conventional construction.

A further object of this invention is to provide a railway refrigerator car so constructed as to facilitate the maintenance of sanitary conditions therein.

Another advantage of this invention when applied to refrigerator cars and resulting from the construction herein disclosed is found in the fact that the car while using permanent ice bunkers, may be constructed to provide the same lading space as provided by an ordinary refrigerator car having collapsible ice bunkers when such bunkers are fully collapsed.

A more detailed object of this invention is to provide either a refrigerator or an ordinary box car built in accordance with the construction herein disclosed with either steel or laminated wood bolsters.

Another detailed object of the invention is to provide an all wood cellular laminated car construction in which the floor of the car is normally under a high compression preload, whereby it is highly resistant to deformation under excessive draw bar pull.

Still another object of the invention is to provide a railway car of substantially all wood cellular laminated construction capable of far greater resistance to impact loads than comparable steel cars.

Another object is to provide an all wood cellular laminated railway car having a longer first class life for first class ladings than a comparable steel car, as well as a longer overall life.

Many other and more detailed objects of the invention will be apparent from the following description of the embodiments of the invention described herein in connection with the attached drawings.

In the accompanying drawings,

Figure 1 is a combination cross-sectional phantom and side view of a refrigerator car constructed in accordance with this invention, showing a portion of the car in elevation;

Figure 2 is a cross-sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a cross-sectional view taken on the line 3—3 of Figure 1;

Figure 4 is a cross-sectional view taken on the line 4—4 of Figure 2;

Figure 5 is a typical transverse cross-sectional view of the car body;

Figure 6 is a typical horizontal cross-sectional view through a side wall, end wall or roof panel;

Figure 7 is a cross-sectional view taken on the line 7—7 of Figure 2 with the flooring surfaces added;

Figure 8 is a transverse cross-sectional view through the floor panel and a portion of the side walls taken on the line 8—8 of Figure 2 with the flooring surfaces added;

Figure 9 is a cross-sectional view taken on the line 9—9 of Figure 11 with the outer skin added, showing the top longitudinal side edge corner construction;

Figure 10 is a side elevational view of the keying member used to join together sections of the construction of Figure 9, as shown in Figure 11;

Figure 11 is a top plan view of the structure of Figure 9 with the top plywood skin removed;

Figure 12 is a diagrammatic plan view of the car floor and the construction at that level showing how the bottom longitudinal corner elements and the bottom transverse corner elements are keyed into the floor panel;

Figure 13 is a cross-sectional view taken on the line 13—13 of Figure 2;

Figure 14 is an outside elevational view of the car construction at a doorway, showing a portion of the door frame;

Figure 15 is a horizontal, cross-sectional view through the side members of the door frame, on the line 15—15 of Figure 14;

Figure 16 is a horizontal, cross-sectional view on the line 16—16 of Figure 14;

Figure 17 is a transverse, cross-sectional view through the door head on line 17—17 of Figure 14;

Figure 18 is a transverse, cross-sectional view through the door sill on line 18—18 of Figure 14;

Figure 19 is an elevational view of the door framing;

Figure 20 is a cross-sectional view on the line 20—20 of Figure 19 with the outer skin and trim strip included, showing diagrammatically the side wall panel at the door opening;

Figure 21 is a cross-sectional view taken on the line 21—21 of Figure 22 of a modified form of bolster and draft sill;

Figure 22 is a cross-sectional view taken on the line 22—22 of Figure 21;

Figure 23 is a cross-sectional view taken on the line 23—23 of Figure 21;

Figure 24 is an enlarged front elevational view of the details of the structure by means of which the draft sill is attached to the end of the car, showing some parts in cross-section;

Figure 25 is a cross-sectional view taken on the line 25—25 of Figure 24;

Figure 26 is a cross-sectional view taken on the line 26—26 of Figure 24;

Figure 27 is an end elevational view, somewhat diagrammatic in form, of a boxcar constructed in accordance with modifications of this invention;

Figure 28 is a cross-sectional view taken on the line 28—28 of Figure 27, showing a portion of the near side of the car in elevation, and a portion of the far wall with its inside plywood skin removed;

Figure 29 is a composite view of the boxcar showing at the lefthand end of the roof framing, at the center a further portion of the roof framing and a portion of the floor framing, and at the right end a plan of a portion of the flooring, a plan of a portion of the bolster and flooring reinforcement, and a portion of the side and end walls in horizontal cross-section;

Figure 30 is an elevational view of a portion of the framing of the side wall of the boxcar;

Figure 31 is a cross-sectional view of the corner construction by the juncture of the floor panel and a side wall panel at a lower side corner of the boxcar;

Figure 32 is a vertical, cross-sectional view through the end wall of the boxcar and a portion of the roof and floor;

Figure 33 is an enlarged cross-sectional view taken on the line 33—33 of Figure 27;

Figure 34 is an elevational view of the framing of an end wall of the boxcar;

Figure 35 is an enlarged longitudinal, central, sectional view through the floor of the boxcar at the draft sill showing the wooden bolster construction and reinforcement in cross-section;

Figure 36 is a cross-sectional, longitudinal view of the wooden bolster construction and reinforcement taken on the line 36—36 of Figure 38;

Figure 37 is a similar view taken on the line 37—37 of Figure 38;

Figure 38 is a diagrammatic plan view of the boxcar flooring at the bolster;

Figure 39 is an elevational view of a portion of the door opening framing of the boxcar;

Figure 40 is a cross-sectional view taken on the line 40—40 of Figure 39;

Figure 41 is a cross-sectional view taken on the line 41—41 of Figure 39;

Figure 42 is a detailed, perspective and cross-sectional view of the construction at the lower corner of the door framing of the boxcar;

Figure 43 is a cross-sectional view taken on the line 43—43 of Figure 45, showing the modification of the wooden bolster structure for the boxcar and comprising a view similar to that of Figure 36;

Figure 44 is a cross-sectional view taken on the line 44—44 of Figure 45 of this modification; and

Figure 45 is a cross-sectional view taken on the line 45—45 of Figure 44 of this modification.

An overall object of this invention is to provide a railway car of wood cellular laminated construction which is as strong as a steel car of the post and beam type of construction, but which is superior to a steel car by reason of the inherent characteristics of wood. These inherent characteristics of wood, when embodied in the novel physical construction herein disclosed, lead at once to the general advantages of providing a smaller and lighter car for the same load carrying capacity as compared with a steel car, incidentally providing a higher internal loading height. Such a car is cheaper to construct, easier to keep clean, maintain and repair. In the case of fire a steel car is readily subject to mass deformation, whereas a fire in a wooden car may easily be localized and the damaged parts repaired. Thus a wooden car is less likely to suffer total damage as compared to a steel car, likely to be destroyed by mass deformation at relatively low temperatures.

A wood car is naturally more absorbent of impact forces, and, therefore, more protective of the lading and of adjacent cars in a train. In refrigerator cars it is better adapted to efficient insulation, requiring less icing for long trips, an important advantage in itself in the economic efficiency of such a car throughout its useful life.

A laminated cellular wood car is not just a little lighter, but is substantially lighter than a steel car of equal load carrying capacity. For example, a forty foot steel refrigerator car has a tare weight of approximately 67,000 pounds, whereas a fifty foot car of the construction herein disclosed has a tare weight of approximately 54,000 pounds. In a refrigerator car this increased length permits the installation of permanent, as distinguished from collapsible, ice bunkers, resulting in a substantial reduction in the original cost of the car. The additional ten foot of length provides with permanent ice bunkers the same lading volume as a forty foot steel refrigerator car having collapsible ice bunkers.

Advantage is taken in a wooden refrigerator car of the natural insulating qualities of the wood construction to provide better refrigeration with less icing during summer to prevent spoilage of perishable products, and to minimize the chances of freezing of such products in winter. Additionally, a wood refrigerator car can be sprayed in the summer with water to cool it by evaporation, especially if the wood has been waterproofed, a desirable practice which cannot be used with steel cars due to the danger of rusting.

As will appear hereinafter, the all wood laminated construction produces a better looking and neater car which can be kept much cleaner on the interior because of the flush surfaces inherent in the construction.

A very important characteristic of the construction herein disclosed is that the stresses are distributed fairly uniformly throughout the skins forming the homogeneous shell, as distinguished from the usual beam and column

construction in which the loads are concentrated in the beams and columns and transmitted from point to point. Furthermore, this construction eliminates the center sill so essential to a car of the beam and column construction in which the center sill acts as the backbone of the entire car. None of the members of the wood car are designed to act as beams. Substantially all of the structural members are joined together by an adhesive in such a manner as to form, as mentioned above, a homogeneous shell of a box girder type. Loads applied at any point in the car find their way in varying but more nearly equalized proportions from the floor through the side walls and into the roof, resulting fundamentally from the use of stressed-skin construction.

The structure of railway cars in accordance with this invention consists basically of two or more sheets of plywood adhesively bound to a series of wooden separators arranged in a cellular pattern. These plywood sections normally take the compression and tension stresses which develop in the resulting box girder construction formed by bonding the plywood sheets to the wooden separating members. The wood separating members usually take their stress in shear. In some instances the wood separating members take compression or tension, and occasionally the plywood sheets take shear. These changes of stress occur primarily in the floor construction where a heavy mass of lumber is used to separate the two layers of plywood in the floor and to absorb the impact shocks. The lumber mass in the floor instead of taking shear stresses, as in the case of the separators in the walls and roofs of the car, take both shear stresses and compression forces. Since a change of stress may occur in the end of the plywood floor of the boxcar where, as will be described, a solid thickness of plywood has been built up with the plies running at an angle of 45 degrees, these layers of plywood are designed to take both compression and shear stresses. Certain stresses occur within the plywood panels forming the walls known as buckling shear and rolling shear, but no attempt will here be made to discuss these principles beyond recognizing that the construction is designed to absorb all of these stresses efficiently.

A thorough understanding of the nature and scope of this invention will be more easily obtained by a detailed description of the two modifications of the invention selected for the purpose of illustrating it herein. The two forms of the invention illustrated in the drawings consist of a refrigerator car shown in Figures 1 to 26 inclusive and a boxcar shown in Figures 27 to 42. It will be understood as the description proceeds that many of the features employed in the refrigerator car can be used in the boxcar and conversely, many of the boxcar features can be used in the refrigerator car. By way of example, the steel bolster and draft sill construction illustrated in connection with the refrigerator car can be used in the boxcar. Likewise the plywood bolster construction illustrated in connection with the boxcar can be used in the refrigerator car. However, for clarity of disclosure the description of each of these cars will be made independently.

As best illustrated in Figures 1 and 5, the car body comprises a floor panel **1**, end panels **2**, side wall panels **3**, and roof panel **4**. Of these panels the construction of each is substantially the same with the exception of the floor panel which is of a special and significantly different construction. Since the car of this invention has no center sill in the conventional sense, the floor panel construction is of necessity devised to be capable of absorbing forces incident to draw bar pull and compressive forces incident to the normal use of the car in a train and including those encountered in collisions. Naturally, of course, the floor panel must be of such strength as to withstand the stresses imposed by the weight of the lading within the car, as well as those noted above incident to the motion of the car when part of a string of cars. The side and end wall panels and roof panel are of a double cellular construction adapted to provide the requisite strength and to facilitate insulation against the transmission of heat therethrough.

However, before describing these various panels and referring to Figure 1, general features of the car will be mentioned. On each side of the car at the center is a door opening which is provided with a door frame **5**, the details of construction of which will be set out in connection with Figures 14 to 18 inclusive. The car is provided with the usual catwalk **6** and icing hatches **7**, the details of neither of which are of any consequence here.

Near each end of the car and extending transversely thereof is a bolster **9** by means of which the car body is connected to the car trucks, not shown. Extending outwardly towards each terminal end of the car from each bolster is a draft sill **8**. Extending between the bolsters are a pair of heavy steel rods **10** which are placed under tension to prestress the longitudinal floor panel timbers to compensate for the elongating effect of the heavy draw bar tension stresses encountered in the use of the car. The outer ends of the bolster and the openings formed in the car body to accommodate them are closed off by cover plates **11** attached to the ends of the bolsters. At **13** is diagrammatically illustrated the bearing socket for the truck pivot pin.

The floor panel **1** consists of a series of heavy wood members **14** extending longitudinally of the floor panel and the car body, between the two bolsters **9**, so as to abut against the opposed faces of the two bolsters. As can best be seen in Figure 2, there are a series of short, transverse members **15** lying between the longitudinal timbers **14** and holding them in spaced relation. The main function of the members **15** is to take the shear stresses in the floor caused by the static loading thereon. Overlying the top and bottom edges of the timbers **14** are the plywood sheets **16** and **17** which, as will be apparent for example from Figure 5, provide a very substantial total gluing area between them and the members **14** and **15**. Each plywood sheet **16** and **17** is preferably built up in accordance with the best plywood construction practice, of a plurality of layers of wood all adhesively bound together, and, for example, should be ¾" thick. No attempt has been made to show this multiple layer construction of the sheets **16** and **17** in the drawings because of the obvious difficulty of proper illustration. At this point it may be noted that full advantage is to be taken of present day developments in the various types of resinous adhesives which are available, as well as in the art of high frequency induction heating to bond the glued surfaces together.

It should be noted that the members **42**, at the bottom of Figure 5, are spacers which do not run throughout the length of the floor panel **1**, as do the timbers **14**. Reference to this will later be made.

Likewise there are no transverse spacing members corresponding to the spacing member **15**, between the spacers **42** and the next adjacent members **14**, as might appear to be the case in Figure 5. Reference to this point will be made hereinafter.

As suitable dimensions for the timbers **14**, they may be 5⅝" deep and 1⅝" wide, and can be placed on 6" centers transversely of the floor panel. The plywood sheets **16** and **17** may be ¾" thick.

As previously mentioned, except for size and the side wall, end wall and roof panels are of quite similar construction. Therefore, the description of one side wall panel will cover both, as well as the end walls. As shown in Figures 1 and 5, each side wall and end panel **2** and **3** consists of two sets of parallel cellular shells. These shells consist of an outer plywood sheet **18**, a central plywood sheet **19** and an inward plywood sheet **20**. As illustrated in Figure 5, the inner sheet **20** is

thicker than the outer sheet **18**. A specifically suitable, but not necessarily limiting thickness for the inner plywood wall **20** is ¾", while the outer plywood wall **18** is ½" thick. It will be noted that the central plywood wall **19** is shown as a single line in Figure 2, but it is to be understood that it too is made up of multiple layers of thin sheets of wood glued together throughout their contact areas, or in other words is made of plywood of suitable thickness, as for example ¼".

A typical section of the side wall, end wall or roof construction is shown in greater detail in Figure 6. The three parallel arranged sheets of plywood **18**, **19** and **20** are held in separated relation by a series of horizontal and vertical spacing strips. The two outermost sheets **18** and **19** are separated by a series of vertical spacers **21** and horizontal spacers **24**. Likewise sheets **19** and **20** are separated by vertical spacers **22** and horizontal spacers **25**. These sets of spacers may intersect in half lap joints, and the result is a series of two sets of rectangular cells which are preferably arranged as between sets in staggered relation, as best seen, for example, in Figure 1, eliminating direct through paths of heat transmission at the points of intersection of the horizontal and vertical spacers. Therefore, there are no direct through paths of heat conduction from one side of the panel to the other. All of these parts are glued together as before. The separators **21**, **24**, **22** and **25** are wooden member of 1"x2" nominal size, ¾"x1⅝" actual size, arranged on 16" centers, providing as a result 16" square cells on each side of the center sheet **19**. The cells formed by the two sets of frames are staggered, as shown, so as to be spaced 8" both horizontally and vertically from each other. Thus, as suggested above, direct thermal conductance through from one side of the panel to the other is avoided. The terminal framing members around all edges of the panels lie within the edges of the sheets **18** and **20** to provide keyways, around the entire periphery of each panel, to which reference will later be made.

As shown in detail in Figure 6, the rectangular cells are provided with suitable insulating material. The innermost set of cells is filled with some suitable fibrous insulating material **33** such as for example rock or glass wool. The outer set of cells is provided with reflective insulating material, as for example aluminum foil. As illustrated, this consists of a pair of pans **34** and **35**. The pans **35** are of shallow rectangular construction consisting of a bottom wall and side edge flanges. The open side of the pans **34** face inwardly of the car body. The pans **35** are similarly constructed except that an opposed pair of edge flanges are turned in the opposite direction from the other opposed pair. Thus the pair of edge flanges **35'** face inwardly of the car body while the remaining pair **35"** face outwardly. The result of this arrangement is to provide a series of three dead air spaces, the center one of which is defined by a pair of reflective surfaces and the outer two are defined on one side by a reflective surface. This construction provides a highly efficient heat insulating construction.

Referring to Figure 5, it will be seen that the bottom edges of the side wall panels **3** are connected to the side edges of the floor panel by exteriorly curved longitudinal corner pieces **36** and that the top edges of the side panels **3** are connected to the side edges of the roof panel **4** by similar corner pieces **37**.

The construction of the corner pieces **36** is shown in detail in Figure 13, and that of the corner pieces **37** is shown in detail in Figure 9. Each is of a built-up construction and each consists of a relatively long member, several of which are keyed together end to end to complete the upper and lower longitudinal corners of the car.

The member **36** consists of a curved rib **38** which is preferably built up of two pieces of lumber **38'** and **38"** glued together in order to use the wood in its most efficient manner in relation to its grain. There are a series of these longitudinally curved ribs for each of the members **36** and over the outer edges of the ribs is glued a plywood sheet **40** and over the inner edges is glued a plywood sheet **39**. Lying between the upper ends of the curved ribs **38** are the spacer blocks **41** which are glued in place so that their upper faces are flush with the upper ends of the ribs **38**, see Figure 2. It will be noted that the sheets **39** and **40** extend beyond the upper ends of the ribs **38** to provide one-half of a keyway to be later referred to. It will also be noted that the sheets **39** and **40** are of the same thickness as the inner sheet **20** of the side wall, or as previously mentioned ¾" thick. This obviously imparts greater strength to the bottom side edges of the car body.

It is also to be noted that the portion **38"** of the rib **38** extends a substantial distance beyond the edges of the sheets **39** and **40**, so that as illustrated in Figure 13, these extending ends may pass between the sheets **16** and **17** of the floor panel **1** and abut at their ends against the outermost longitudinal timber **14** at that edge. Thus when the members **36** are glued into the side edges of the floor panel the sheets **17** and **39** will abut to form a continuous interior surface and the sheets **16** and **40** will abut to form a continuous exterior surface. The extending ends of the ribs **38** provide substantial gluing areas so that the members **36** are glued to the floor panels over very substantial areas, imparting great strength to this joint. As previously suggested, and as is clear from Figure 2, there are a great many of these ribs **38** longitudinally spaced so that the total gluing area is substantial. Right at the joint between the member **36** and the panel **1** are interposed a series of spacer blocks **42** which are glued to the adjoining parts wherever they contact and, therefore, also further strengthen this joint.

The upper longitudinal corner pieces **37** are shown in detail in Figures 9 and 11. They consist of two sets of longitudinally curved ribs **46** and **47** covered with plywood sheets **43** and **45** and between which lies the plywood sheet **44**. Extending longitudinally of these corner pieces are separators **48** and **49**. The separators **48** lie between the sheets **43** and **44** and extend between the ribs **46**. The separators **49** lie between the sheets **44** and **45** and extend between the ribs **47**. As is clear from Figure 11, which is a top plan view of Figure 9 with the outer sheet **43** removed, the sets of curved ribs **46** and **47** are longitudinally staggered. The corner pieces **37** like the corner pieces **36** do not run throughout the full length of the car but are made in sections which are placed together end to end and attached together by a longitudinally curved key members **66** which are glued in place at the butt joint between the two plywood layers as is best seen from Figure 11. The key member **66** is made up of a plurality of sheets of plywood preshaped to the desired curved form and glued together throughout their contacting areas. These key members are rectangular in cross section and lie in the rectangular space formed at the adjoining ends of a pair of corner pieces **37** resulting from the fact that the plywood coverings **43** and **45** extend beyond the terminal ribs **46**, as indicated by the dotted line running longitudinally of the key member **66**, Figure 11. The keyway space is similar to that provided for the key **52** shown in Figure 9, but the key space for the keying member **46** lies in a plane at right angles to the key spaces shown in Figure 9.

The top transveres corner pieces **53** are constructed similarly to the top longitudinal corner pieces **37**, and the bottom transverse corner pieces **54** are constructed similarly to the bottom longitudinal corner pieces **36**, see Figures 1, 5, 7 and 8. The bottom transverse corner pieces **54** consist of a series of longitudinally curved ribs **54"** similar to the built-up ribs **38** and are provided with exterior and interior plywood coverings in the same way. The ends of the ribs extend between the plywood sheets **16** and **17** of the floor panel **1**, as before, and are glued in place in the same way. Separators **54'**, similar to the

separators 42, are used at the joint. Likewise at the other end of the curved pieces 54'' are the separators 53''' corresponding to the spacers 41 of the corner pieces 36.

The upper transverse corner pieces 53 are constructed and assembled just like the corner pieces 37 previously described.

This completes a description of the construction of the floor panel, the side wall panels, the end wall panels, the roof panel and the two types of corner pieces. The above description taken with Figure 5 will show how all these parts are assembled to provide a refrigerator car shell. As has already been indicated, the lower side edge corner pieces 36 are attached along the side edges of the floor panel 1. The bottom transverse corner pieces 54 are similarly attached to the floor panel 1 along its end edges. Said wall panels 3—3 are attached to the upstanding ends of the corner pieces 36 by means of the key members 50. The corner pieces 36 and the side panels are so constructed as to leave a rectangular channel at the butt joint therebetween, and in each of these channels is placed a longitudinally extending rectangular key member 50 which is glued in place, with the result that the plywood coverings for the corner pieces lie flush with the plywood covering sheets of the floor and side wall panels to form smooth continuous interior and exterior surfaces. As shown the corners both internally and externally are continuously rounded, which imparts a pleasant appearance to the structure and insures sanitary conditions on the interior of the car, facilitating cleaning of the car at all corners. The top corner pieces 37 are similarly attached to the side wall panels 3 by means of the longitudinal key members 51, and similarly the roof panel 31 is attached to the corner pieces 37 by the longitudinal keying members 52. Thus both interiorly and exteriorly the plywood coverings are continuous and the corners are rounded.

Similarly the end walls 2 are attached to the bottom transverse corner pieces 54, see for example Figures 1, 4 and 7, by means of the transversely extending key members 59. The top transverse corner members 53 are attached to the end walls 2 by means of the transverse keying members 58. The roof panel 4 is connected to these members by means of the transverse keying members 58'.

By reference to Figure 1 it will be seen that all four vertical corner pieces, of which one is shown in this figure at 37', are constructed like the corner pieces 37 previously described. These vertical corner pieces are interconnected between the side and end wall panels by vertical keying members of which one is shown at 37'', connecting the corner pieces shown with the side wall panel 3.

When the shell is assembled, it will be appreciated that at each of the eight corners thereof there will be an opening which can be described as having the shape of one-eighth of a sphere. These open corners can be filled in by corner pieces of a number of different forms of construction which form no part of this invention. For example, one form may be made of sheet metal as indicated at 63 in several of the figures, see particularly Figure 2.

From the above description it will be seen that the car body is a rugged built-up construction with substantially all parts interconnected by large adhesively bonded areas to form a monocoque structure of great strength.

As is clear from Figures 1, 7 and 12, provision is made in the floor panel for the reception of the built-up steel bolsters 9. The longitudinal timbers 14 extend between the bolsters 9 so that they abut at their ends and are continuous between the bolsters. A pair of large steel rods 10 extend between the bolsters, see Figure 1, which are placed under considerable tension by means of nuts which can draw them up very tight, thereby preloading the longitudinal timbers under considerable compressive forces. The timbers in the floor panel which extend from each bolster to the end of the car are less numerous. They have been given different reference characters in the drawings in order to distinguish them from the timbers 14. They are shown clearly in Figure 2 as the timbers 64. Separators 65 are interposed between them and glued in place. The lesser number of timbers needed at this point results from the fact that only sufficient strength need be imparted to the floor panel 1 at the ends to withstand the stresses of the lading, since impact forces in the car body exit only between the bolsters. The draft sills take the tension and compression stresses of car motion, transmitting them directly to the bolsters of which they are structurally a part, as will be described in greater detail hereinafter.

It will be noted, as is clear from Figure 1, that the number of vertical separators 22 in the side wall panels is considerably increased above the bolster ends, the function of which will also be described later. It will be clear from Figure 4 that extending longitudinally of the side walls at the lower ends of the increased number of separators are the load carrying blocks 60 and 61 which are built into the corner pieces 36 so that the separators at this point rest on the top of the blocks 61 which in turn rest on the ends of the bolster 8. The interruption of the outer surface covering at the corner pieces at the point where the bolster lies, permits of the introduction of the blocks 61 so that they can rest directly on the ends of the bolsters. The blocks 60 further strengthen the structure at this point. Thus, as will be explained later, vertical loads on the separators over the bolster may be transmitted directly to the outer ends of the bolsters.

As is clear from Figure 7, the upper plywood sheet 17 of the floor panel is continuous but the lower plywood sheet 16 is interrupted to provide a space for the bolsters 9, and it is from this point on that the number of longitudinal timbers is reduced to provide the framing which is composed of the timbers 64 and separators 65. As shown in Figure 2, a transverse timber 62 extends between the blocks 61 to fill the space above the bolster 9 and the under surface of the floor panel covering 17, see also Figure 7.

At this point it will be noted that the upper surface of the floor panel 1 is provided with a wear floor 56 which is supported around its periphery by means of the longitudinal spacing strips 55 and the transverse spacing strips 55', see Figures 5 and 7. Likewise this wear floor which may itself be of plywood, is supported by a rectangular grid system of separators 57 extending longitudinally and transversely between the end strips 55' and the side strips 55.

As suggested by Figure 1, the car is provided at each side at its center with side doors. The side doors lie flush in openings which are provided with steel framing members 5 of special form because of the problem of distributing a high concentration of stresses at the door opening into the built-up wall panels. The details of the door framing will be found in Figures 14 to 18 inclusive.

The side wall panels 3 extend to the door opening and are framed by wooden members consisting of the wooden jambs 5^a extending vertically along the sides thereof, the wooden head member 5^b, and the wooden sill member 5^c. The jamb members 5^a define the opening and lie between the inner and outer plies 18 and 20 of the side walls. The head member 5^b lies between the inner and outer sides of the top corner member 37, while similarly the sill member 5^c lies between the plies of the lower side edge member 36. The outer face of the opening is covered by angle iron strips. The jamb strips are indicated at 71, the head strip at 73, and the sill strip at 75. It will be noted that each of the members 5^a, 5^b and 5^c is rabbetted, the edge of each at right angles to the side wall of the car being inclined outwardly, as is clear from the drawings. The flanged strips overlie the corresponding wooden strips, as shown, and fit in shallower rabbets along the edges of these strips with the exception of the angle iron 75. The inturned side of this member overlies the

whole inclined face of the sill member 5c to protect it. The opening is likewise protected on its inner face by the jamb angle irons 70, the head angle iron 72, and the sill angle iron 74. The short side of each of these angle irons overlies the adjacent exposed face of the strips 5a, 5b and 5c, as shown, to provide a protection therefor against damage by the passage of the lading through the door opening. This arrangement leaves an exposed area entirely around the door opening of wood, to provide a seat for the door which fits into the opening, and to interrupt the flow of heat between interior and exterior steel members.

An important feature of the invention involves the provision of a series of inwardly projecting circular lugs attached to the protective angle iron strips just mentioned. Each of these strips has a row of such lugs. The angle iron strip 70 is provided with the inwardly extending lugs 70', the strip 71 with the lugs 71', the strips 72 with the lugs 72', the strip 73 with the lugs 73', the strip 74 with the lugs 74', and the strip 75 with the lugs 75'. These lugs may be integral with, welded to, or otherwise attached to their respective angle iron strips, and are of substantial diameter. They lie with snug fit in circular apertures in the adjacent plywood coverings of the wall, and top and bottom corner members, all as clearly shown in the figures. These lugs or extensions are employed in sufficient number and have sufficient size so as to provide a very substantial bearing area as between them and the adjacent plywood layers. The result is to provide a very excellent construction for stress distribution in the side wall panels at the door opening.

It will be appreciated that the interruption of the continuity of the side walls at the door opening introduces an element of weakness which this construction very effectively overcomes. The lugs of each pair of strips, that is 70 and 71, 72 and 73, and 74 and 75, are offset laterally as between the strips of each pair, as clearly indicated in Figure 14, to further aid in uniform distribution of the loads carried by them over the entire adjacent laminated structure. Each pair of angle iron strips is held in place by a series of bolts, one of which is clearly shown in Figure 16. This bolt 72 extends through from the inner angle iron strip 70 to the outer angle iron strip 71 and is secured in place by means of a nut. A large number of these bolts are distributed along the length of the opening interconnecting the angle iron pairs to insure a very strong and rigid composite frame.

It will be noted that each of the framing timbers 5a, 5b and 5c lies between the adjacent ends of the plywood coverings so that these framing timbers are placed under compression by means of the nuts and bolts 72. These framing timbers act, of course, as spacers to prevent inward deflection of the plywood layers between which they lie.

The door structure is illustrated in Figures 19 and 20. It consists of a panel 76 of the proper size to fit the door frame at the opening and is preferably built up in accordance with the details of construction embodied in the side wall panels of the car. Figure 19 illustrates the framing for such a door, and as indicated it consists of two series of vertical and horizontal separators 80 arranged to form the previously described rectangular cellular structure with the cells of one set staggered with respect to the cells of the other set. As shown in Figure 20, these two sets of framing members lie on opposite sides of a plywood panel 78 and the outer faces of the framing members are covered by the plywood cover sheets 77 and 79. Thus it will be seen that the complete door unit 76 is structurally quite similar to the side wall panels.

As shown in Figure 20, the peripherial edge of the door panel 76 is provided with wooden strips 81 attached around its edge by gluing, or with any other suitable fastening means. These strips are covered with a protective metal strip 82, as is the remaining peripherial edge of the door panel, as indicated at 83. The end face of the strip 81 is inclined so as to have a mating fit with the door opening seat. It is proposed for this invention to use an available type of door hanger structure for the door panel, which permits the door panel to move outwardly of the opening parallel thereto until it clears the side of the car, and to then be moved longitudinally of the car away from the door opening to leave the opening completely unobstructed. This door fixture forms no part of this invention, and, therefore, has not been illustrated in the drawings.

The bolster construction is shown in more detail in Figures 21, 22 and 23. The bolster consists of a box girder which may be an integral member or built up of plates suitably fastened together, as for example by welding.

Figure 22 shows the elevational shape of the bolster, and it will be seen from that figure and Figure 21 that the front and back plates of the channel member are transversely braced at a number of points. Near its ends are the transverse bracing plates 85. Nearer the center are the U-shaped braces 86, and still nearer to the center are the curved braces 89. The front wall of the bolster has a rectangular opening through which the draft sill 8 passes so that the end of the sill abuts against the rear wall of the bolster, as shown in Figure 21. The draft sill 8 consists of a U-shaped beam member having strengthening flanges at its terminal longitudinal edges. It is secured in the bolster preferably by welding, and is reinforced by the cross braces 89 welded thereto. It will be noted that the cross braces 89 are at the region of the holes through which the tension rods 10 pass, thereby strengthening the bolster against collapse. The end plates 11 previously mentioned are welded to the terminal ends of the bolster 9, and as shown in Figure 21 project substantially beyond the sides and top of the bolster. The projecting ends are reinforced by triangular gusset plates 87. The top of the bolster is closed by a heavy plate 88, which likewise may be welded in place. Within the draft sill is a rectangular shaped reinforcement 91 of boxlike construction, and within it is a transversely extending reinforcing plate 92. The truck pivot pin journal is diagrammatically illustrated at 90. The other details of construction of the bolster and draft sill illustrated in the drawings are concerned primarily with the usual draft or coupling gear by means of which adjacent cars are connected together, and since these details form no part of this invention, no further reference will be made thereto.

For review it may be noted by referring to Figures 1 and 3, for example, that the boxcar body rests on the bolsters, as previously described, and is held against transverse movement thereon by means of the upwardly extending plates 11 at the ends of the bolster.

Since each draft sill extends a considerable distance from the bolster, it is necessary to connect it to the end of the car to overcome the downward resultant from impact forces and a fixture suitable for this purpose is illustrated in detail in Figures 24, 25 and 26. The channel 8 is provided with a pair of reinforced lugs 93 at each side to which tie bolts 95 are secured. These tie bolts are riveted to a heavy steel strip 94, which in turn is attached to the adjacent end of the car. In order to distribute the forces which are transmitted through the tie bolts into the car body a series of pairs of timber connectors 96 and 98 are employed. These timber connectors are disc-like in form and each has an annular flange which is adapted to seat in a circular groove in the adjacent end wall of the car body. The plate 94 overlies the timber connectors 96 and 98 which are arranged in parallel lines, as is clear from Figure 24. Two series of bolts and nuts 97 and 99 pass through the plate 94, and the pairs of timber connectors 96 and 98, and of course, serve to secure these parts to the adjacent end wall of the car housing. The series of bolts 99 engage the end wall at the transverse keying member 59 so that all parts are under compression without distortion, and similarly the series of bolts 97 engage the end wall through

spacers 53'''. The timber connectors 96 and 98 provide areas for distributing the forces to be transmitted from the draft sill into the car body sufficiently large so as not to overload the wooden structure at the points of attachment. This arrangement prevents the draft sill from tending to rotate downwardly away from the car body under stresses encountered in the use of the car.

At this point it is a good place to mention the fact illustrated in Figures 13 and 25, that in those cases where the adjoining plywood coverings, for purposes of strength, are of different thicknesses, as for example at the corner pieces 36 and 54, the keys 58 and 59 are not quite rectangular in shape, but are provided along one side with a rabbet to accommodate the extra thickness of the heavier covering. This insures a smooth surface at such joints.

The boxcar embodying the features of this invention employs wooden bolsters as distinguished from steel bolsters previously described for the refrigerator car. For emphasis it will be apparent to those skilled in the art, as the description of this form of the invention proceeds, that the steel bolster previously described could be used in the boxcar as could the wooden bolster of the boxcar be used in the refrigerator car.

The boxcar consists of a floor panel 100, side wall panels 101, end wall panels 102, and roof panel 103. The catwalk is diagrammatically illustrated at 104.

The floor panel, in the area between the bolsters, consists of a series of heavy longitudinal parallel wood members 105 held in proper spaced relation and together with the transversely extending spacers 106 forming a grid adhesively bound to and between the top plywood sheet 107 and the bottom plywood sheet 108 (see Figures 29 and 31). The spacers 106, like the spacers 15, absorb the shear stresses imposed by the lading. Extending transversely of the longitudinal timbers 105 and abutting them at each end, is a group of heavy timbers 122 (see Figure 35) which lie between the plywood sheets 107 and 108 and are glued thereto as well as to each other. Interposed between the ends of the longitudinal members 105 and the transverse members 122 is a continuous transversely extending strip 126 of suitable non-compressible material such as a compressed form of plywood. Extending the remaining length of the floor panel from the outer side of each of the sets of members 122 are a series of reinforcing plywood sheets 123 glued together in superposed relation and filling the space between the top and bottom sheets 107 and 108 of the floor panel. As indicated in Figure 29, each alternate sheet is built into this stack so that its grain runs at approximately 45 degrees to the longitudinal axis of the floor panel, the grain of alternate sheets extending on opposite sides of that axis.

As is clear from Figures 36 and 37, the plywood sheets 123 fill up the space solidly between the sheets 107 and 108. It will also be seen that the plywood reinforcing filler 123 is cut out to form a recess to receive the top of the draft sill 128 from each end of the floor panel towards the bolsters, see Figure 28.

As indicated in Figures 29, 32 and 33, the upper sheet 107 of the floor panel is preferably thicker than the lower sheet to provide a sufficiently strong load carrying surface and is overlaid with the wear sheet 107', of suitable fibrous material such as Masonite. The outermost member 105 along each side of the floor panel, as indicated in Figure 31, is set inwardly of the edge of the top sheet 107 to provide a space for a reinforcing timber 109 which is positioned to be glued to a keying member 114 which is also glued at its lower face to the sheet 108, which extends beyond the edge of sheet 107 to provide the necessary gluing surface. The side wall panels 101 each consist of a framework of separating members comprising the vertical strips 112 and the horizontal strips 113 which intersect with a half lap joint, as previously mentioned, to divide the space defined by the sheets 110 and 111 into a plurality of rectangular cells, as is clear from Figure 28. Over the bolster, as shown in this figure, the number of vertical separators 112 is substantially increased for a purpose to be described later.

Glued to the opposite sides of this framework is the plywood sheet 110 forming the internal wall of the car body, and the plywood sheet 111 forming its outer face. As in the case of the floor panel, the sheets 110 are thicker than the sheets 111 to form a sufficiently strong covering to withstand the strains placed thereon by the lading. As is clear from Figure 31, the lowermost horizontal separator 113 is positioned so that it may be glued to the keying member 114 to form a very solid corner joint. The corner joint, illustrated in this figure, comprises the construction at the longitudinal lower side corners of the car.

As shown in Figures 28 and 34, the end wall panels 102 are similarly constructed and at the center the number of vertical separators 112 is increased to accommodate the staggered joints of plywood skins. The end wall framing, as shown in Figure 33, is covered by the outer plywood sheet 115 and the thicker inner plywood sheet 116, like the side wall construction previously described. The roof panel 103 is similarly constructed and no further description thereof is necessary.

As shown in Figure 33, the corner joint at the transverse lower corners of the car is different from that at the lower side corners. It will be seen that the plywood reinforcing stack 123 terminates a sufficient distance short of the end edges of the floor panel inner sheet 107 to provide space for the reinforcing timbers 117 which are glued in place between the sheets 107 and 108 and to the ends of the plywood stacks 123. A keying member 118 is glued to the outermost face of the outermost member 117 and to the projecting ends of the sheets 108 and 116. The keying block 118 extends upwardly between the cover sheets 115 and 116 of the end wall panel 102, and is glued to the lowermost horizontal separator 113 and along its face to the outer sheet 115. With this arrangement it will be seen that the vertical separating members 112 rest directly on the top edge of the keying member 118. One of the upper transverse corners connecting the top panel with the end wall panels is also shown in this figure. It will be seen that this glue joint is somewhat similar to that shown in Figure 31. A keying member 119 is glued between the two sheets of the end wall panel, to the horizontal separator 113, and to the keying timber 120 which is also glued to the separator 113 and cover sheets of the roof panel.

As shown in Figure 35, the complete bolster includes a series of transversely extending integrally glued timbers 124 lying below the group of timbers 122. It will be noted that the number of timbers in each of the groups 122 and 124 are the same and that they are glued in position in vertical alignment. The lower surface of the timbers 122 is provided with a bearing member 129 for the pivot pin of the truck. This laminated group of timbers together provides the wooden bolster generally indicated by the reference character 121. Below the plywood block 123 is another glued up plywood block 125 which in turn is glued to the lower surface of the sheet 108 and the adjacent timber of the group 124. As shown it is recessed to fit around the draft sill channel 128, as shown in Figure 36. A steel plate 127 is interposed between the end of the draft sill 128 and the stack 125 at the end of the recess provided for the draft sill. This plate also extends up into a recess formed in the plywood stack 123, and provides an abutment plate for transmitting the compression forces from the draft sill 128 into the wooden structure thus provided.

As shown in Figures 37 and 38, the draft sill channel 128 is attached in its recess in the plywood stacks by means of a series of nuts and bolts 130 which extend therethrough. Since the plywood stack 125 extends downwardly into the space in which the truck wheels must move during their pivoting action, suitably shaped cavities 131 are cut out of this stack so as not to interfere with the pivoting movement of the trucks.

Each side wall of the car, as indicated in Figure 30, is provided with a door opening which is framed by a suitable framing construction indicated generally by the reference numeral 200. The details of construction of this door frame are illustrated in Figures 39 to 42 inclusive.

The surface coverings and framing members of the side wall panels are interrupted to provide a rectangular opening of the desired size which is preferably designed so that a vertical separator 112 lies at each side of the opening and a horizontal separator 113, see Figure 41, lies across the top of the opening. On the inner face of the side wall and extending around the opening are L-shaped metal strips 140, one wing of which lies in the rabbet in the edge of the inner plywood sheets 110, so that it will lie flush with the inner surface of the car and the other wing is positioned so that its outer face lies substantially in the plane of the outer surface of the outside plywood sheet 111. Secured to the outer face of sheet 111 so as to extend around the opening are the cover strips 141 which extend into the door opening, as is clear from the figures, so as to lie parallel and in contact with the adjacent wings of the strips 140. The strips 141 have a series of circular blocks 143 welded to their inner faces which lie in snug fitting circular openings in the plywood sheets 11. Similarly the strips 140 are provided with circular projections 144 which lie in similar openings in the inner sheet 110. A series of these blocks are provided and nuts and bolts 143 are passed through the strips 140 and 141, projections 143 and 144, and the separator 113 so that all parts may be firmly clamped together. The wings of the strips 140 which contact the strips 141 are provided with a series of apertures 147 through which these two members are welded together. Wooden seating strips 146 extend along the sides and top of the opening to provide a seat for the door 205, as is clear from Figure 41. These wooden strips are bolted to the strips 141, as indicated at 148. An interior trim strip 149 is in turn secured by screws or other suitable fastening devices to the seating strips 146.

At the sill of the door opening is an angle iron sill strip 150 having its shorter wing overlying the keying member 114 at that point and flush with the wear surface sheet 107'. The longer wing of this angle iron extends downwardly over the face of the key timber 114 and is welded to an angle iron 170. These two angle irons are bolted to the key timber 114 by means of the nuts and bolts 151.

As indicated in Figures 39 and 42 particularly, the short inturned flange of each of the strips 141 is cut away from the top of the sill angle iron 150 to the end of the strips 141 to provide extensions 141' which overlie the angle iron 150 and to which it may be secured in any suitable way, as by welding.

As will be seen from the drawings, this method of trimming the door opening fully protects all of the side wall edges which define the opening and also provides a strengthening structure for the wall at the opening. It also provides a seating strip 146 around three sides of the opening against which the door 205 may be sealed. It may be noted that the details of construction of the door are considered of no importance in this invention.

It will also be noted that the strip 141 which extends across the top of the door is provided with a downwardly opening U-shaped extension 160 which is intended to form part of the supporting structure for the door which is to be of the type which moves outwardly in a plane parallel to the door opening until it clears it, and is then moved in its own plane to one side of the door opening. This supporting structure for the door likewise forms no part of this invention.

As in the case of the refrigerator car, the wooden shell comprising the body of the boxcar is of a rigid built-up laminated monocoque construction. The body is substantially entirely of wooden members held together with relatively large bonding areas. The walls, floor and roof consist of single unitary panels which are connected together by simple glued jonits employing keying members which provide exceedingly strong corners. The corner construction for the longitudinal upper corners is the same as that for the longitudinal lower corners, as illustrated in Figure 31. It is also unique that the bolsters for this car are of built-up laminated wood members to form exceedingly strong members. It will be noted that the compression and tension forces incident to the use of such a car in a train are transmitted by the draft sills into the floor reinforcement and associated parts, and from them into the heavy longitudinal floor timbers 105.

In the case of each car it is to be noted that the weight of the lading on the floor panels is transmitted through the side walls to the roof and from the roof to the bolsters down through the reinforcing in the side walls over the bolsters provided by the increased number of vertical separators 112. In the case of both the refrigerator and boxcars the framing separator members in the side walls are increased in number to assist in taking the load under compression caused by the lading, being supported as they are on the bolsters at their lower ends.

Thus the effect is that of a box girder suspended by these framing members resting on the bolsters and the lading in turn carried by the floor through the side walls.

The main features of the modifications of Figures 43 to 45 inclusive consist of the provision of resilient cushioning pads such as rubber blocks, positioned on opposite sides of the impact abutment plate 127. The reinforced plywood construction and the wooden bolster construction are substantially the same as that previously described in connection with Figures 33 to 38 inclusive. In the modification, the recess in the plywood reinforcing 123–125 in which the sill abutment plate 127 is mounted is enlarged to provide a space on each side thereof to receive the resilient cushioning pads 301 and 302. As clearly illustrated in Figure 45, the pad 301 has an aperture through which the end of the center sill 128 may project into contact with the steel plate 127. As indicated at 305, the steel plate 127 and the cushioning pad 302 have an aperture 305 of less width into which the draft yoke 304 may project under impact. Its normal position is indicated in Figure 45 in full line and its extreme innermost position under impact is shown in dotted position to indicate the function of the recess 305. In this particular illustration the draft key is shown at 300. In the modification it will be noted, especially from Figures 43 and 45, that the various layers of plywood laminations exposed in the recess are enclosed within a metal sheathing 306, within which the draft sill 128 lies.

The arrangement of framing members and plywood covering sheets is such as to effect a more uniform distribution of the forces created by the lading of the car in motion throughout the entire body of the car without substantial concentration thereof at any one point. The greatest concentration of lading forces is at the reinforced separators over the bolsters which take these loads in compression. This arrangement is especially adapted to absorb stresses of this type with a minimum of strain thereon.

What is claimed is:

1. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, said corner members being of laminated construction in-

cluding curved ribs attached at one end in the case of the lower corner members of the housing to the floor panel, and key members interconnecting the other corner members with said panels respectively.

2. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, said floor panel consisting of wooden members extending longitudinally of said housing and plywood sheets attached to the exposed faces of said wooden members, and the corner members at the lower longitudinal edges of said housing comprising a plurality of longitudinally curved ribs having plywood sheet coverings attached thereto, said ribs extending beyond their cover sheets at one end and adhesively bound between the plywood sheets of the floor panel.

3. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, a pair of steel bolsters attached to the under side of said housing towards each end thereof, and draft sills connected to said bolsters and extending to the ends of the housing, said floor panel including a plurality of heavy wood members extending between said bolsters and abutting them.

4. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, a pair of steel bolsters attached to the underside of said housing towards each end thereof, draft sills connected to said bolsters and extending to the ends of the housing, said floor panel including a plurality of heavy timbers extending between said bolsters and abutting them, and tension rods interconnecting said bolsters to place said timbers under compression.

5. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, an opposite pair of said wall panels consisting of a plurality of spaced plywood sheets and separator members lying between said sheets and connected thereto, said pair of panels having door openings therein, metal framing members lying on opposite sides of said panels at said openings and a plurality of lugs attached to said framing members and lying in apertures in the adjacent plywood sheets, and means for attaching said metal members to said panels.

6. A stressed skin vehicle body comprising a homogeneous wooden shell of laminated cellular construction having a unitary laminated cellular panel forming the floor thereof, said panel being composed in part of a plurality of heavy wooden members extending longitudinally of the shell, a pair of bolsters extending transversely of the shell near each end thereof and abutting the ends of said longitudinal members, draft sills extending outwardly to the ends of the car and abutting said bolsters respectively at one end, and means for securing the outer end of each draft sill to the end of said shell.

7. In the combination of claim 6, tension members extending between said bolsters to preload said wooden members under compression.

8. In the combination of claim 6, said last means including tension members secured to each of the draft sills, plates to which the tension members are anchored, bolts for securing said plates to said shells, and timber connectors surrounding said bolts and lying in apertures in said shell to distribute the forces transmitted therethrough.

9. A vehicle body adapted to be load and form sustaining when supported by a pair of spaced longitudinal points near its respective ends comprising a homogeneous shell of wood laminated cellular construction, consisting of unitary laminated floor, wall and roof panels, and separate unitary corner members interconnecting the proximal edges of said panels to form a complete monocoque housing, each of said panels having at least two plywood skins united by spacing members adhesively bound therebetween throughout their areas of contact, said floor panel comprising a plurality of spaced plywood sheets, the spacing members of the floor panel extending longitudinally of the shell between said sheets and attached thereto, said spacing members being interrupted towards each end of the car, bolsters lying in the spaces at the points of interruption of said spacing members, and draft sills attached to said bolsters and extending outwardly to the respective ends of said shell.

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