April 14, 1964 W. B. WILKINS 3,128,897

CARGO CONTAINER CONSTRUCTION

Filed March 9, 1962 3 Sheets-Sheet 1

Fig. 1

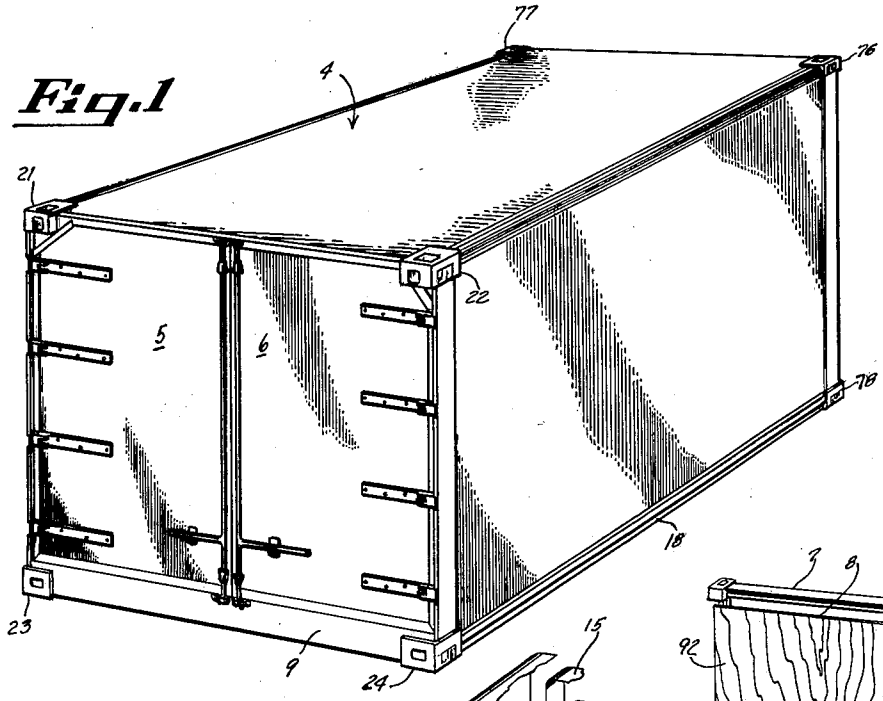
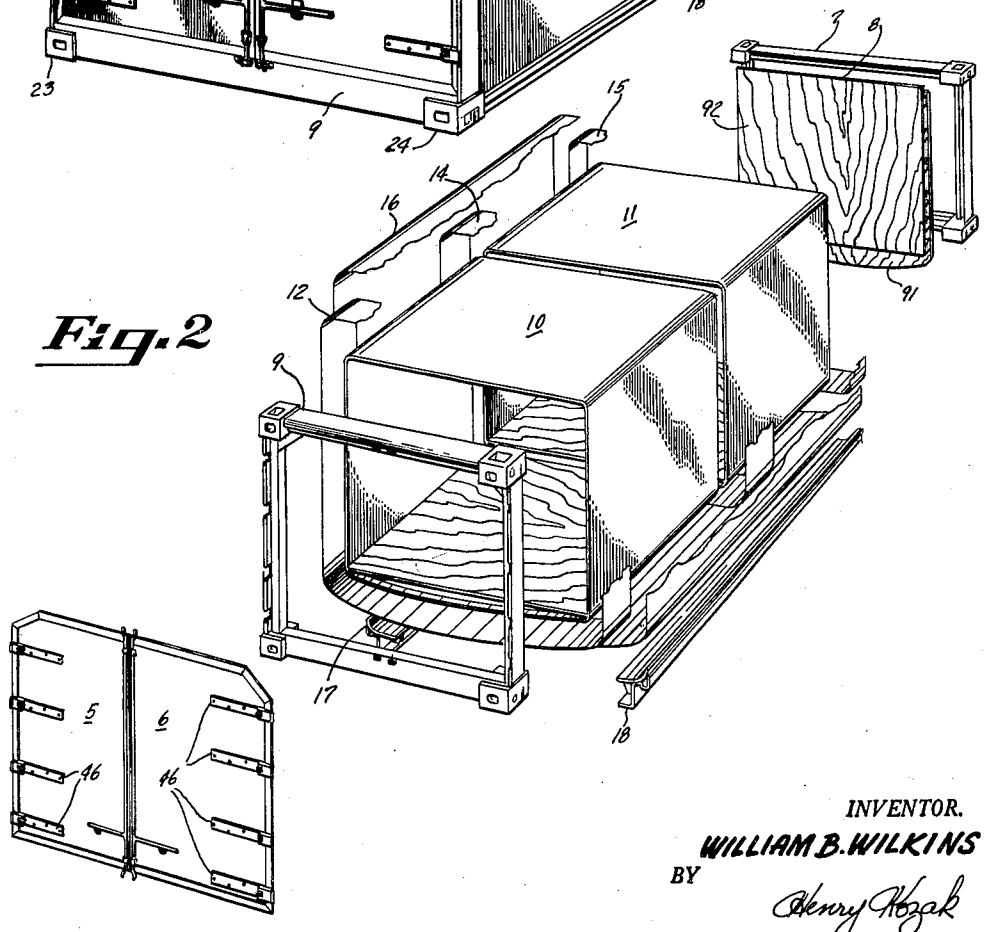


Fig. 2



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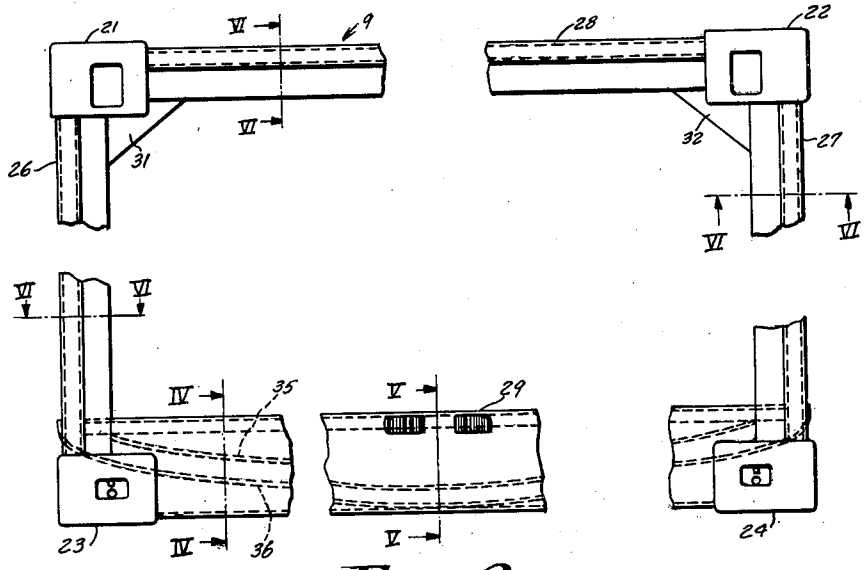


Fig. 3

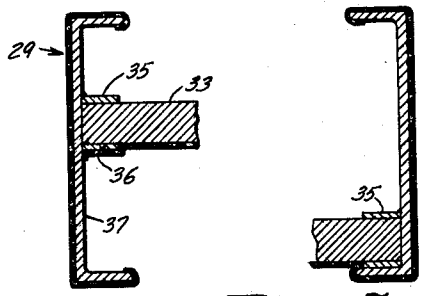


Fig. 4 Fig. 5

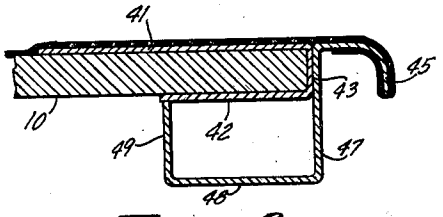


Fig. 6

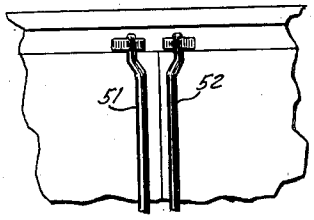
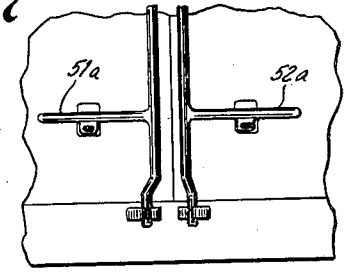


Fig. 7



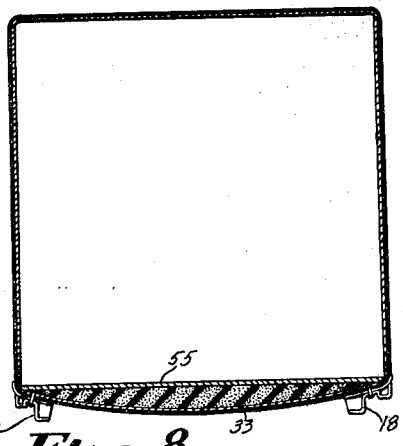


Fig. 8

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CARGO CONTAINER CONSTRUCTION

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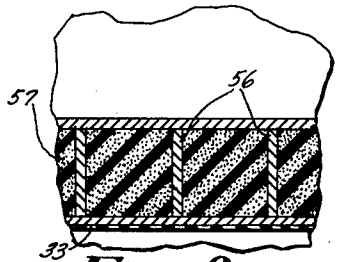


Fig. 9

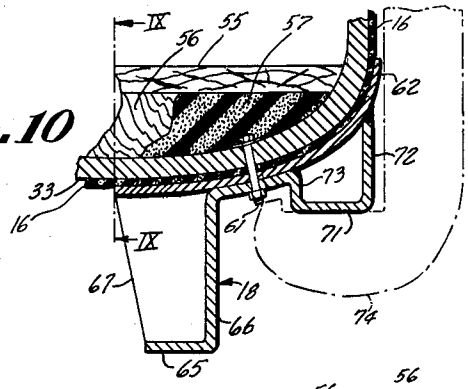
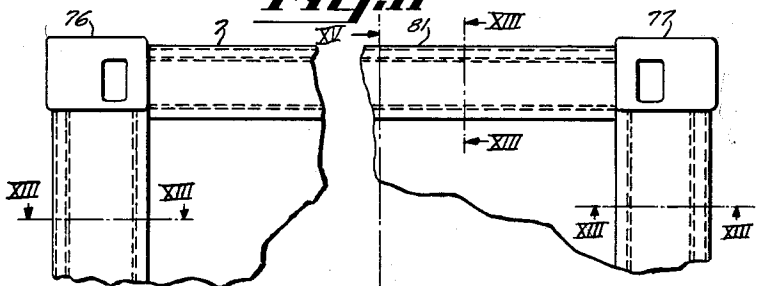


Fig. 10

Fig. 11



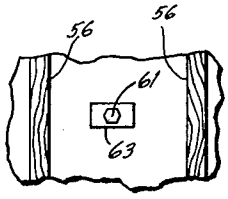
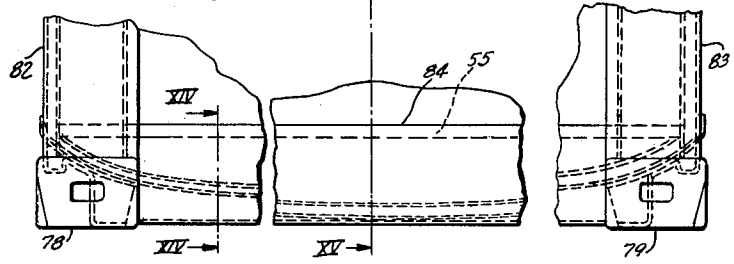


Fig. 12



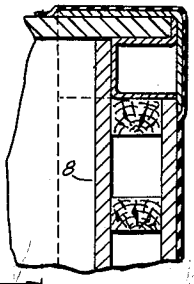
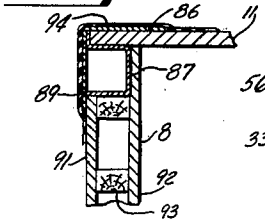


Fig. 13



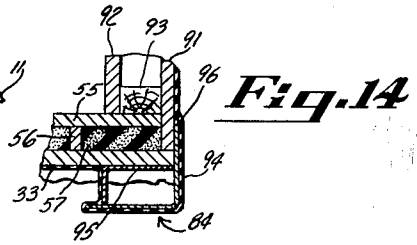


Fig. 14

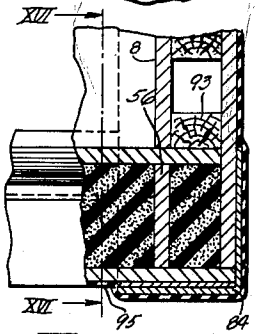


Fig. 15

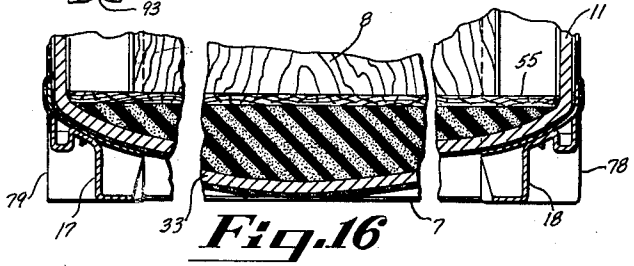


Fig. 16

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3,128,897

CARGO CONTAINER CONSTRUCTION

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Filed Mar. 9, 1962, Ser. No. 178,741
13 Claims. (Cl. 220—1.5)

This invention relates to cargo containers adapted for being transported by highway, railway, sea, and air carriers and contemplates containers which may be permanently mounted on a carrier as well as those adapted for being lifted from carrier to carrier.

The primary object of this invention is to construct heavy duty containers of low-cost, non-metallic materials in lengths of up to 40 feet or more and of carrying capacity up to 30 tons or more. These materials are intended to achieve substantial reduction in container cost as measured by the costs of present substantially all-metal containers.

It is an object to achieve, at least for certain uses, greater interior space utilization in proportion to exterior dimensions of the containers through the use of non-metallic components.

An object ancillary to the foregoing objects is to utilize wound laminar structures and to provide a method of construction for incorporating the same into large cargo containers.

Briefly speaking, the invention resides in rigid box-like receptacles which have many uses but in one preferred use with respect to which the invention herein is described, take the form of large cargo containers. Such a container comprises: (1) a substantially rigid tubular wall of continuous, integral cross section having a longitudinal sub-floor portion of concave-convex transverse cross section normally forming the underside of the container; (2) a pair of rigid end frames of high-strength material, such as a metal or reinforced glass fabric, adapted for attachment to opposite ends of the tubular wall; (3) means attaching each frame to each of opposite marginal edge portions of the wall, e.g., flanges or webs of the frames forming grooves receiving said edge portions and an adhesive material bonding the flanges or webs to the edge portions; (4) truss structure at the bottom of the container comprising a floor of sheet material such as plywood bridging the concave inner surface of the sub-floor portion of the tubular wall; and (5) rigid tie material, such as girders, ribs, and resinous foams in secured relation with both the floor and sub-floor portion acting to unite the floor, sub-floor portion, and the tie material into a truss-like unit.

In the drawing in respect to which the invention is described in detail below:

FIG. 1 is a perspective view of a cargo container constructed in accordance with this invention.

FIG. 2 is an exploded view in perspective with merely fragmentary illustration of some components of the cargo container of FIG. 1.

FIG. 3 is a vertically and horizontally shortened fragmentary elevation of the door-supporting frame of the container shown in the foreground of FIG. 2.

FIG. 4 is a vertical cross section of the frame of FIG. 3 taken along line IV—IV.

FIG. 5 is a vertical cross section of the horizontal member taken along line V—V of the frame of FIG. 3.

FIG. 6 is a transverse section applicable to the coupler in the top horizontal transverse member and both vertical members of the frame of FIG. 3 taken along line VI—VI.

FIG. 7 is a fragmentary, vertically shortened rear elevation of the container of FIG. 1 illustrating the doors thereof in closed, secured relation with the circumscribing frame.

FIG. 8 is a transverse cross section of the container of the previous figures as viewed toward its permanently closed front end wall.

FIG. 9 is a fragmentary longitudinal cross section taken along line IX—IX of FIG. 10 illustrating the lower truss structure of the container.

FIG. 10 is a fragmentary enlarged view of a portion of the cross section illustrated in FIG. 8.

FIG. 11 is a horizontally and vertically shortened fragmentary elevation of the front end frame of the container shown in the background of FIG. 2.

FIG. 12 is a fragmentary view in plan exposing an area of the upper surface of the sub-floor portion of the wall shown in FIG. 10.

FIG. 13 is a fragmentary cross section of the container taken along line XIII—XIII of FIG. 11 illustrating the manner in which the top and side portions of the longitudinal wall of the container join with the end frame of FIG. 11.

FIG. 14 is an elevation in longitudinal cross section through a lower portion of the front end frame as taken along line XIV—XIV of FIG. 11.

FIG. 15 is a fragmentary vertically shortened elevation in cross section of the lower front end portion of the container taken along its central vertical longitudinal axis.

FIG. 16 is a horizontally shortened transverse elevation in cross section of a lower portion of the container taken along line XVI—XVI of FIG. 15.

The description of the invention which now follows is concerned essentially with a single embodiment illustrated generally in FIGS. 1 and 2 in the form of a cargo container 4. The foreground end of the container is adapted for opening and closing by a pair of doors 5, 6 analogous to the doors on the rear end of a highway truck or trailer body. This end of the container, for convenience, will be designated herein as the rear "open" end, and the background end, formed by a frame 7 and end wall 8, as the front end or "blind" end.

As shown in the exploded view of FIG. 2, the container comprises, proceeding from foreground to background, the doors 5 and 6; a rear-end door-supporting frame 9; a pair of tubular wall units 10, 11 normally in end-to-end abutting joined relationship; a lamina 12 for joining the frame 9 and the wall unit 10, a lamina 14 for joining the wall units 10 and 11, a lamina 15 for joining the frame 7 to the wall unit 11; the frame 7; the front wall 8; and a lamina 16 which may be cemented to the entire outer longitudinal surface of the container as formed by the aforementioned components. The use of one or more overall lamina 15 may render the use of laminae 12 and 15 optional. The front end wall 8 of the container is joined to the frame along an inner periphery thereof, as described hereinafter. The container, in its preferred form, further comprises a pair of relatively spaced, parallel runners or rails 17 and 18 attached with their lengths extending lengthwise of the container to opposite sides of the undersurfaces of the wall units 10 and 11. The portions of the wall units 10, 11 to which the rails 17 and 18 are attached are hereinafter known as the "sub-floor" portions of these wall units.

FIGS. 3 to 6 are concerned primarily with illustration of the rear or door-supporting frame 9. This frame has upper corner members 21 and 22 recessed from their upward facing surfaces for automatic coupling with a hoisting-crane spreader. Frame 9 further comprises lower corner members 23 and 24 recessed upwardly from respective undersurfaces to receive tie-down fixtures of a motor truck, flat car, or other support. The upper and lower corner members of this frame and also the front frame 7 are further useful in the stacking of containers wherein the cavities of the lower members of both

frames of one container are brought into registry with the cavities of the upper members of another container on which the first container is placed and the containers may be connected and secured together by adapters extending into each pair of adjacent cavities by known devices.

When the frame is fabricated of metal, the corner members are normally secured to side posts **26** and **27**, the girder **28** and the sill **29** by welding. The cross section of the posts and the girder is illustrated by FIG. 6. The frame posts are constructed to withstand high column loading resulting from container stacking, and the severe beam or lateral loading imposed thereon as lading tumbles or leans against the side wall of the container under certain service conditions.

The frame **9** is further reinforced by gussets **31** and **32** welded in the upper dihedral angles of the frame. The sill **29** is relatively wide as compared to the girder in a vertical direction and vertically coextensive with the entire sub-floor portion **33** of the tubular wall unit **10**. This is necessary in order to provide a base or support along substantially the entire width of the frame for a pair of parallel curvate flanges **35** and **36** which project forwardly from the vertical web **37** of the sill. The flanges are spaced approximately the thickness of the wall unit **10** to establish a recess therebetween within which a rear marginal edge of the sub-floor wall portion **33** is received. The curvature of the flanges follows the transverse contour of this sub-floor portion as shown in FIG. 3.

As hereinbefore mentioned, the posts **26**, **27** and the girder **28** are approximately of the same cross section as shown in FIG. 6. In each case, these members consist of an outer web **41** in parallel spaced relation with a web **42**. Both of these webs are bridged by another web **43** to form a recess for receiving a rear end marginal portion of the wall unit **10**. As shown, the webs **41** and **42** have a spacing approximately equal to the thickness of the wall unit **10**. The wall edge portion is secured within the frame by an adhesive of the types hereinafter discussed. Posts **26** and **27**, and the girder **28** further comprise a curvate flange **45** appearing in FIG. 6 as an extension of the web **41**. As a part of girder **28**, the flange **45** is useful as a weather shield and as a protection for external hardware of the doors **5** and **6**. The flange further completes the total length of the container and thus cooperates with aligning arms on a crane pick-up spreader for guiding the coupling mechanism of the spreader into proper registry with the upper corner members of the frames **7** and **9**. In so functioning, the flange **45** keeps the aligning arms of the spreader out of contact with rear door surfaces and the door hardware.

On the posts **26** and **27**, the flange **45** is notched at several places to receive hinges **46** of the doors. Preferably, the hinge portions mounted on the frame **9** are welded to the flange **45** to receive support therefrom. The posts **26**, **27**, and the girder **28** further comprise webs **47**, **48** and **49** which form a box section with web **42** to further strengthen respective members in both column and beam loading.

The doors **5** and **6** are secured to the frame in closed position by the conventional arrangement shown in FIGS. 1 and 7 wherein lock-rods **51** and **52** terminate at upper and lower ends in cranks. Upon rotation of the rods, the cranks move into and out of respective L-shaped recess therefor in the girder **28** and the sill **29**. Handle-levers **51***a* and **52***a* facilitate manual rotation of the lock-rods.

FIGS. 8, 9, 10, 12, 16, and 17 illustrate details in the construction of the lower truss-structure of the wall units **10** and **11**. FIG. 8 is a transverse cross section of the container applicable to substantially any portion thereof between the frames **7** and **9**. The sides and top of the container are shown as flat-sided and the sub-floor portion **33** of concave-convex transverse contour. The sub-floor portion **33** is bridged by a floor **55** extending approximately between lines of juncture of the sub-floor portion with opposite lateral wall portions of either wall unit. In order to establish the lower portion of either wall unit **10** or **11** as a truss structure of great strength, the floor **55** and the sub-floor portion **33** are united and supported relative to each other as portions of a rigid unit within the wall unit by rigid tie-means. The tie-means shown comprises a plurality of ribs **56**, and a resinous foam material **57** filling the interstices between the ribs, the floor, and the sub-floor portion. The ribs **56** are spaced in a regular pattern longitudinally in the container with their lengths aligned in a transverse direction. The floor, the ribs and the sub-floor portion are bonded together at substantially all points of contact by an adhesive.

The rigid resinous spongy material **57** is of a nature forming a bond with the surfaces of the floor, ribs and wall portion **33**. Some materials suitable for this purpose are discussed hereinbelow. As the materials forming the floor, ribs, and sub-floor portion contemplated in the practice of this invention may be subject to degeneration from fungus, bacteria, etc., a primary purpose of the material **57** is to provide an impervious barrier to moisture entering the sub-floor region through openings such as result from fracturing or piercing the floor or sub-floor wall portion by nails, handling equipment, and lading.

The container includes a pair of rails **17** and **18** which have the functions of strengthening the container, providing under-support when resting on a flat surface, and providing surfaces for receiving lifting equipment such as the grapples of a straddle truck. FIG. 10 illustrates the rail **18**, exemplary also of rail **17**, as secured to the underside of the sub-floor portion **33** exteriorly of its outer weatherproofing and reinforcement lamina **16**. The lamina comprises preferably glass fabric permeated by an adhesive type resin, such as epoxide or polyester composition. The rail **18** is secured to the exterior of the wall **10** by means such as a plurality of bolts **61** extending through the container-conforming web **62** from the interior surface of the sub-floor portion **33**. A metallic washer or cleat **63** increases the bearing area of the bolt on the wall portion. The rail is also bonded to the lamina **16** by an adhesive.

The rails **17** and **18** are an optional feature, and when used, contribute to the truss strength of the container bottom in its longitudinal direction, and when end portions thereof extend into abutment with the lower corner fittings of the frames **7** and **9** and are welded thereto, contribute substantially to the twist resistance of the container as a whole. When connected in this manner, the frames **7** and **9** and the runners **17** and **18** constitute a skeleton metal framework cooperating with the assembly of non-metal components of the container to provide a composite structure of great shock resistance and load carrying capacity. The metal and non-metal assemblies, when connected in the manner just described, thus substantially complement each other.

In the form illustrated, rails **17** and **18** embody the features which render the container more versatile with respect to handling. Preferably, its downwardmost extremity, i.e., the horizontal web **65** is in a plane containing the undersurfaces of the lower corner members of both frames **7** and **9**. This arrangement enables the container to have maximum bearing support from its rail-frame assembly when placed on a planate surface. The web **65** and the vertical web **66** connected therewith are established in a lateral direction of the container by a plurality of spaced reinforcing webs **67** welded to webs **62**, **65**, and **66**. Either rail **17** or **18** comprises another downward facing web **71** merging with a vertical web **72**. The latter lies approximately in the plane of the adjacent side surface of the container. The web **71** is downward with respect to the adjacent section of the sub-floor portion **33**

to provide an inward-facing vertical web **73** permitting application of a lifting implement to the undersurface of the web **71** by lifting means such as straddle-carrier grapple **74** drawn in dotted outline in FIG. 10. This type of handling obviously requires that the rails **17** and **18** be arranged in two-step construction in order to utilize the bottom surface (web **65**) as a primary load bearing surface of the container.

FIGS. 11 to 16 are concerned with front end structure of the container and primarily with the design of the frame **7** and its connection with the tubular wall unit **11**. As the embodiment being described contemplates merely one end of the container comprising doors, the frame **7** is designed as part of a permanently enclosed front portion of the container.

The frame **7**, in a manner similar to the frame **9**, comprises upper corner castings or members **76**, **77** and lower corner members **78** and **79**. It comprises also a girder **81** merging with the upper corner members by, e.g., a weldment, posts **82** and **83** which merge in upper and lower corner members on respective sides, and a sill **84** fixedly joined to the post **83** and member **79** at one side and the post **82** and member **78** at the other side. The posts **82** and **83** and the girder **81** are of similar cross section as indicated by FIG. 13 wherein the member in each case comprises a web **86** spaced with respect to a box section **87** comprising other webs to receive the front edge portion of the wall **11**.

FIG. 13 is also illustrative of the manner in which the composite front wall **8** of the container is supported along the inner periphery of the frame. That is to say, the posts **82** and **83** and the grider **81** provide a flange **89** in the extreme front end of the container having a rearwardly facing surface against which the wall **8** is seated. The latter is of sandwich type, preferably of plywood or other non-metallic construction, comprising laminae **91**, **92** and spacing elements **93**. The lamina **91** is glued against the flange **89** and the entire outer surface of the container is overlaid by a lamina **94** comprising glass fabric or other fibrous material permeated by an adhesive bonding the fabric-adhesive material to all portions of the frame, adjoining areas of the wall **8**, and the wall **11**.

The manner in which the wall **8** connects with the floor and sub-floor structure is illustrated in FIGS. 14 and 15. Noteworthy is that the inner lamina **92** of the wall **8** terminates at the upper surface of the floor **55** in a glue joint whereas the other lamina **91** of the wall extends further downward and terminates in a glue joint with the sub-floor **33**. The sub-floor is adhesively joined to and rests upon a curvate web **95** of the still. The lamina **91** of the front wall rests against and overlaps a considerable portion of the front vertical web **96** of the sill **84** and is supported thereby. Here again, all exterior surfaces of the frame and the adjacent areas of the front wall **8** are overlain by a fabric-adhesive lamina, such as the lamina **94**, **5**, or **16**, functioning to reinforce joints of various components of the container and to add material to the strength of the container as a whole.

The wall units **10**, **11** may each be formed from one continuous sheet of paper or other thin sheet material wrapped under tension short of tearing the paper about a mandrel in superimposed laminae to a desired thickness of the wall. For cargo containers, a practical thickness falls in the range of ¾ to 1 inch. In the winding of the walls of the units **10**, **11**, the paper receives a light coating of an adhesive in its travel from a supply roll to the mandrel.

The adhesive is selected with regard to its influence on the physical properties of the wall, its cost, and the intended service of the container. For example, ordinary cargo service will entail high imperviousness to moisture in order to maintain dimensional stability of the wall and the dry strength of the paper, freedom from decay, and freedom from frost damage. Other considerations are extremes in temperature, fungus resistance, rigidity without brittleness, and toughness, i.e., resistance to scarring and piercing.

Suitable adhesives for joining the paper laminae include compositions containing such resins as an epoxy, isocyanate (polyurethane), polyamide, polyamide-epoxy, melamine, polyester-elastomer, resorcinol, or urea resin. One material preferred from this group because of its relatively low cost and ease of application is a low-viscosity liquid urea-formaldehyde composition. After winding the adhesive carrying paper into one of the tubular walls of the units **10**, **11**, the wall is cured under pressure, e.g., 20 p.s.i., and temperature, e.g., 200–250° F.

For joining the wall units to the metal frames **7**, **9** or other metal components, adhesives based on resinous compositions which include a resin such as an epoxy, isocyanate (polyurethane), phenolic-epoxy or polyamide-epoxy, are preferred. In the practice of the invention to date, liquid or paste type, 100% reaction epoxies curing at room temperatures have been preferred in making the paper-to-metal joints of the container. Epoxy adhesives of this general description are commercially available.

As a preferred practice, glass fabric impregnated with a liquid polyester resin is applied in overlapping relation with the wall units **10**, **11** to butt-join these wall units (see lamina **14**) and, also, to cover the top, bottom, and sides of the container (see laminar sheath **16**). Either lamina may be constructed as a plurality of layers of resin-impregnated fabric. The so-called unsaturated polyesters have excellent adhesion for the surfaces of the paper lamina of the units **10** and **11** and in a typical instance, involve application thereto of a mixture comprising the unsaturated reaction product (unsaturated polyesters) of a dihydric alcohol and dibasic acid (either one or both being unsaturated), a polymerizable monomer such as styrene, and a catalyst such as a peroxide. The laminae thus applied to the basic rigid components of the container are then subject to pressure (e.g., 20 pounds per square inch) and temperature (e.g., 275° F.) to cure or crosslink the unreacted resinous composition in situ. Non-woven glass fabrics may be used in the resin-fabric laminae wherein the fibers are oriented or arranged at random in accordance with the stress requirements of those portions of the container incorporating the laminae.

Paper, as referred to herein, is intended in its usual sense as a web of cellulose fibers sized with the usual filler found in a heavy brown wrapping paper of good tear-strength. The paper or other non-woven fabric, however, may be sized during its manufacture with moisture-proof, synthetic resinous materials to increase its tear strength and resistance to moisture. The invention also contemplates generally flexible thin sheet materials, such as any woven fabrics or films, which may be wrapped into a wall of laminae jointed by an adhesive.

The invention has been described with respect to a practical and proven mode of incorporating metal and non-metal components into a serviceable cargo container of low cost. The invention embraces, in a more generic sense, receptacles which are adapted for a variety of uses, such as prefabricated buildings or building portions, subterranean fall-out shelters, and truck bodies.

The terms and expressions which have been employed are used as terms of description and not of limitation and there is no intention of excluding any equivalents of the invention described or of the portions thereof as fall within the scope of the claims.

What is claimed is:

1. A container wall unit comprising:

(A) a substantially rigid tubular wall comprising: in any transverse cross section thereof, a sheet of thin gauge material wrapped upon itself as a plurality of superimposed laminae which forms said wall in an integral contiguous seamless cross section, said wall having a sub-floor portion of inwardly-concave outwardly-convex contour along said cross section nor-

mally disposed below the remainder of the wall and any adhesive joining said laminae; and

(B) truss structure wherein said sub-floor portion is a tension member, the truss structure comprising;

(1) a planate floor bridging the inner convex surface of said sub-floor portion and joining therewith at its extremities and cooperating therewith as a compression member; and

(2) tie means disposed between, and joined rigidly with, said sub-floor portion and the floor to support one in fixed relation with the other.

2. The container wall unit of claim 1 wherein said thin-gauge sheet material is paper-coated with said adhesive.

3. The container unit of claim 1 wherein: said cross tie means comprises longitudinally-spaced transversely-extending ribs bonded substantially along all surfaces abutting said floor and said sub-floor portion.

4. A cargo container comprising:

(A) a substantially rigid tubular wall comprising,

(1) in any transverse cross section thereof, a sheet of thin gauge material wrapped upon itself as a plurality of superimposed laminae which forms said wall in an integral continuous seamless cross section,

said wall having a sub-floor portion of inwardly-concave outwardly-convex contour along said cross section normally disposed below the remainder of the wall, and

(2) an adhesive joining said laminae; and

(B) truss structure wherein said sub-floor portion is a tension member, the truss structure comprising,

(1) a planate floor bridging the inner-convex surface of said sub-floor portion, and being rigidly connected therewith at its extremities and cooperating therewith as a compression member; and

(2) tie means disposed between, and joined rigidly with, the floor portion and the sub-floor to support one in fixed relation with the other;

(C) a pair of rigid end frames adapted for attachment to opposite ends of said tubular wall; and

(D) means attaching each frame to opposite end edge portions of the wall.

5. The cargo container of claim 4 wherein:

said tie means comprises longitudinally-spaced transversely extending ribs joined with the floor and the sub-floor portion at substantially all points of contact by an adhesive.

6. The cargo container of claim 4 comprising:

connecting laminae of glass fabric permeated by an adhesive in overlapping relation with end portions of the wall unit and the frames with said adhesive joining the laminae to the frames; and

an adhesive material joining said frames to end portions of said wall along any overlapping and abutting surfaces of the frames and the wall.

7. The cargo container of claim 4 wherein: each lower corner of said end frames terminates downwardly in a horizontal plane passing under said sub-floor portion; and the container comprises a pair of support rails equi-spaced with respect to, and on opposite sides of, a longitudinal center plane of the container; said rails being secured to the underside of said sub-floor portion with their undersurfaces approximately in said plane.

8. The cargo container of claim 7 wherein: said rails extend between, and are integrally connected with, lower corner portions of said frames on the same side of said vertical plane.

9. The cargo container of claim 7 wherein: the upper corner portions of each frame comprise receptacle type members for connecting a lifting means; and the lower corner portions of each frame comprise receptacle type members opening downwardly for connecting the container with tie-down means.

10. The cargo container of claim 7 wherein: one of the frames supports an end wall closing one end of the container; and the other frame supports lower door means in hinged relation therewith for closing the other end of the container.

11. The cargo container of claim 7 wherein: said tie means comprises longitudinally spaced, transversely extending ribs; and rigid synthetic resin foam-like material filling the spaces circumscribed by the ribs, the floor, and said sub-floor portions; said foam material, ribs, floor, sub-floor portion, and rails forming a unitary truss-like assembly.

12. The cargo container of claim 7 wherein: each rail has a downwardly facing surface disposed above said horizontal plane for access thereto by container lifting means.

13. The cargo container of claim 12 wherein: the undersurfaces of the corner portions and the rail at each side of said vertical plane are serially connected to provide substantially a single downward facing surface in said horizontal plane thereby adapting the container for support on a lower conveyor.

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