United States Patent

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[54] **FLEXIBLE HOLD STRUCTURE IN CONTAINERSHIP**
13 Claims, 10 Drawing Figs.

[52] U.S. Cl. 114/72
[51] Int. Cl. B63b 25/00
[50] Field of Search 114/72, 73; 214/15

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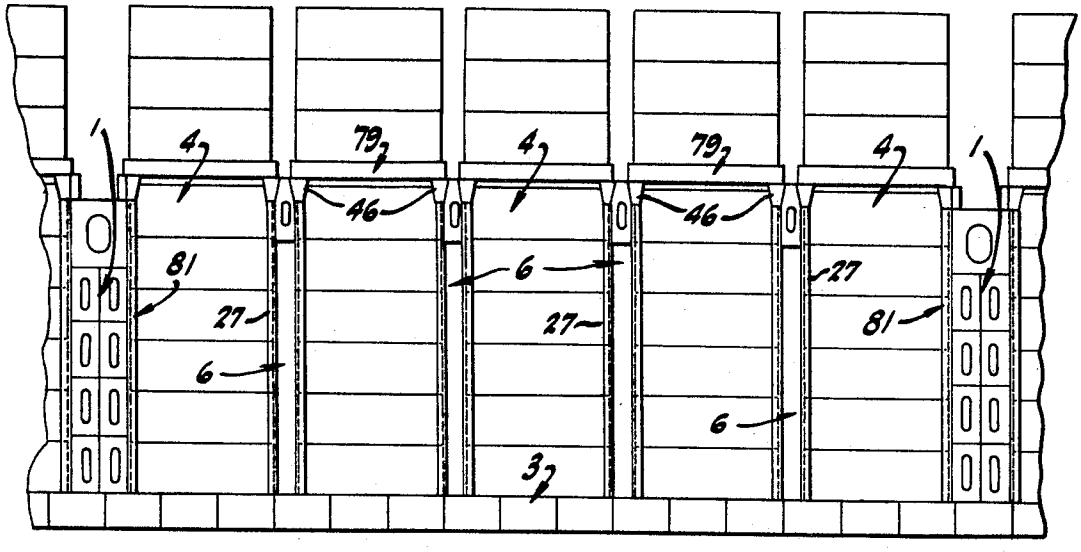
ABSTRACT: Hold structure in a containership providing vertically disposed cell frames adapted to be supported within a hold different distances apart to receive therebetween cargo containers, including means on said frames to hold stacks of said containers spaced apart and against lateral shifting relative to each other and to the hold of the ship. Said cell frames are of generally skeleton structure readily lifted and moved by dockside cranes to adjusted positions.



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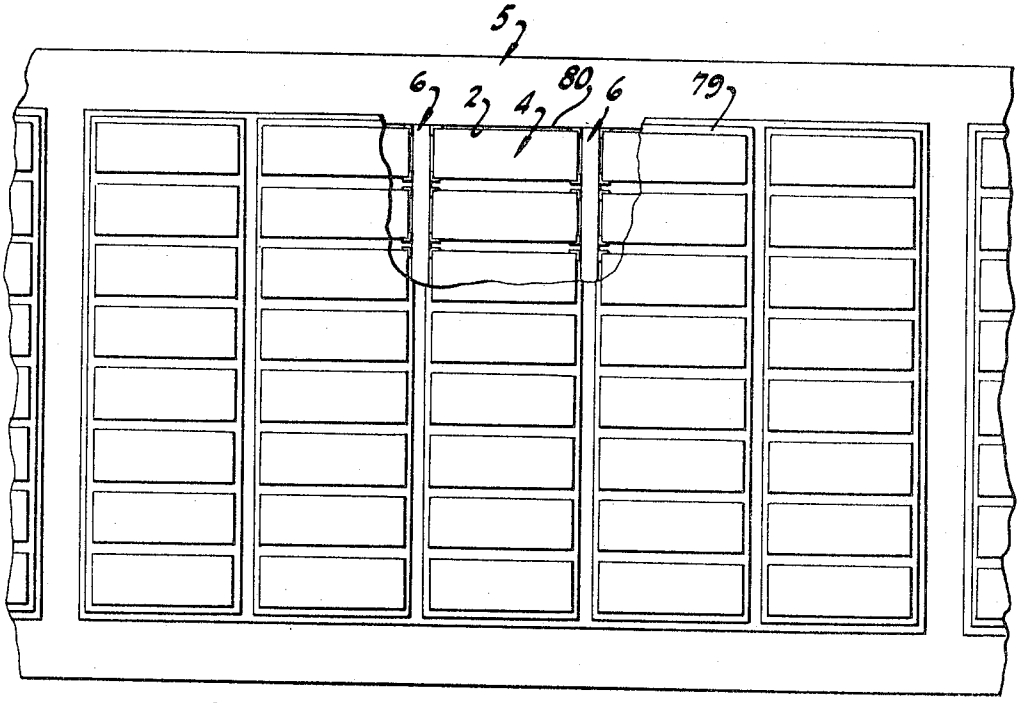

FIG. 2

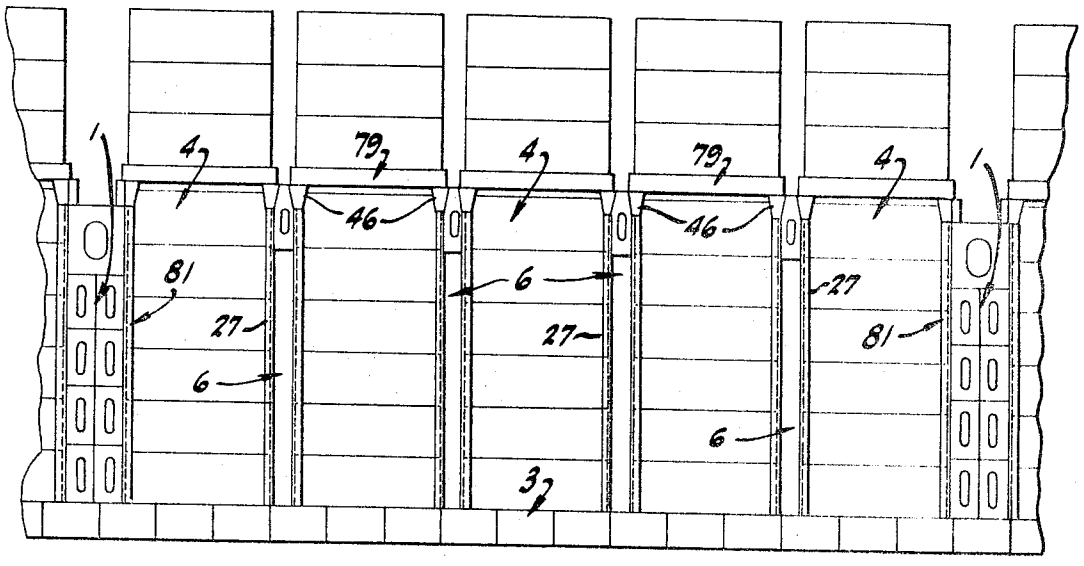

FIG. 1

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FIG. 3

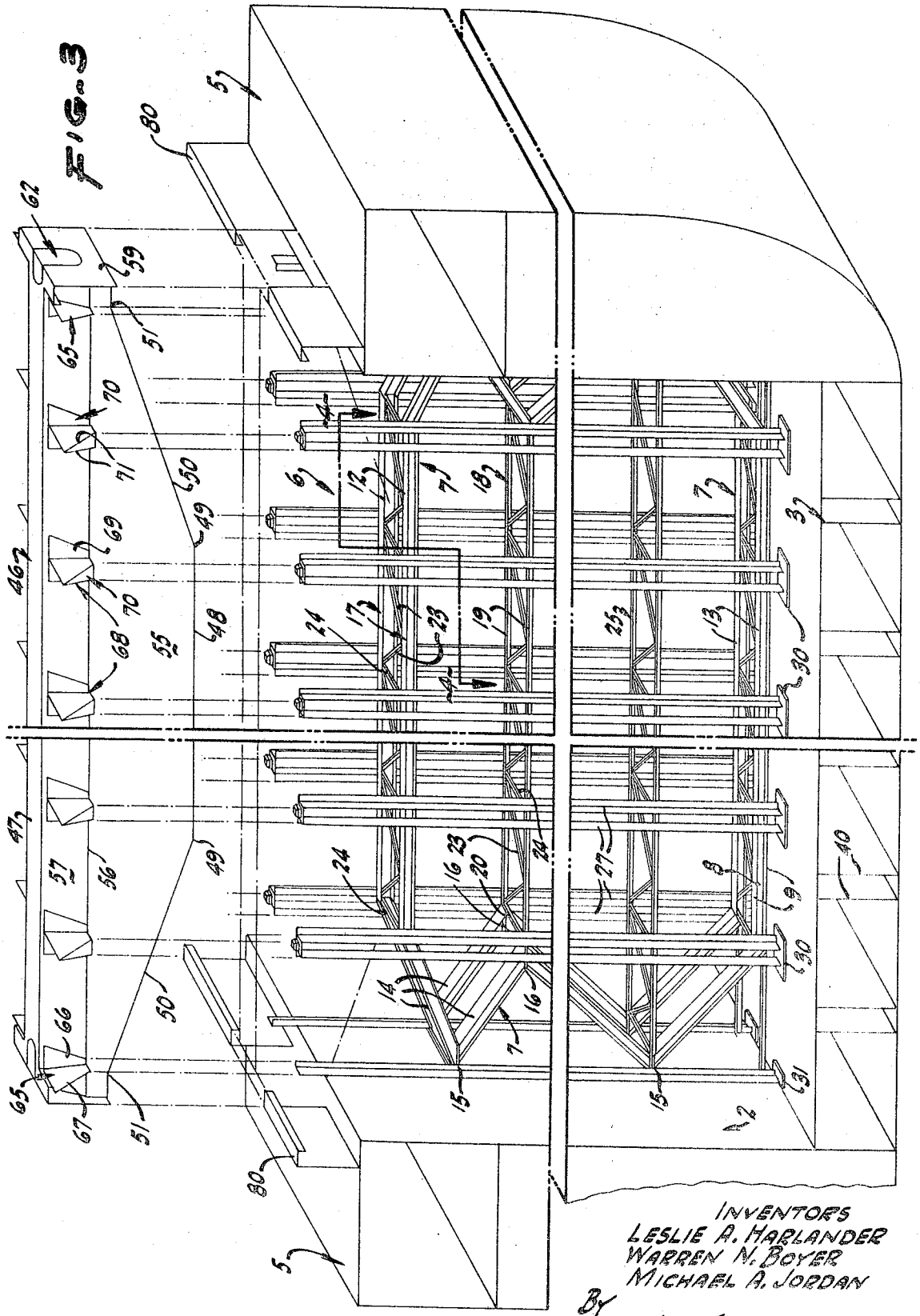

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FIG. 4

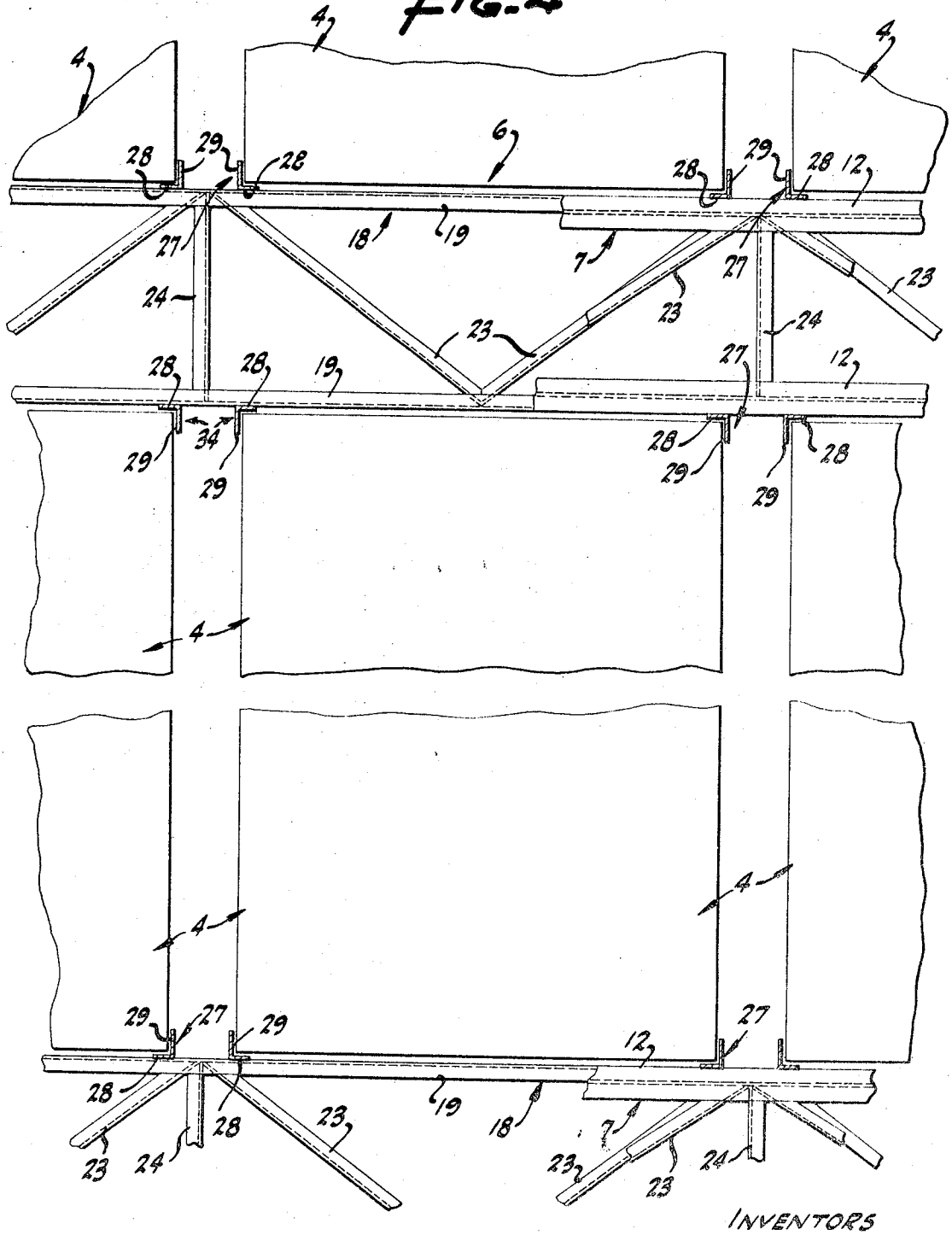

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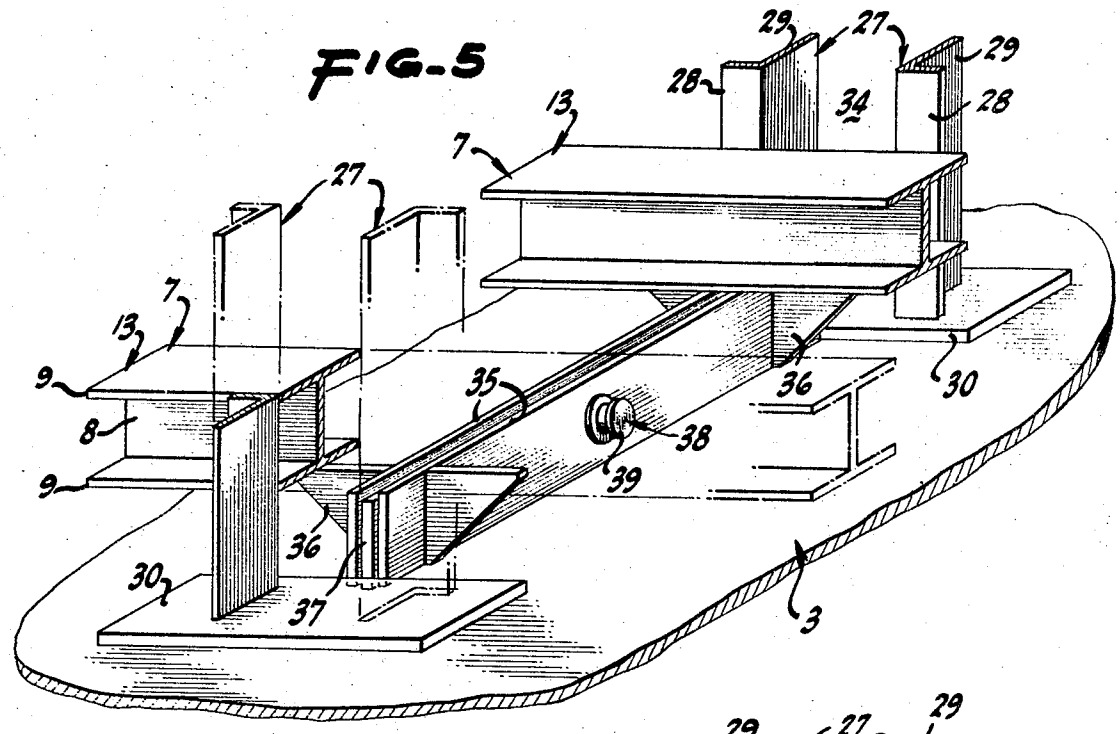
FIG-5



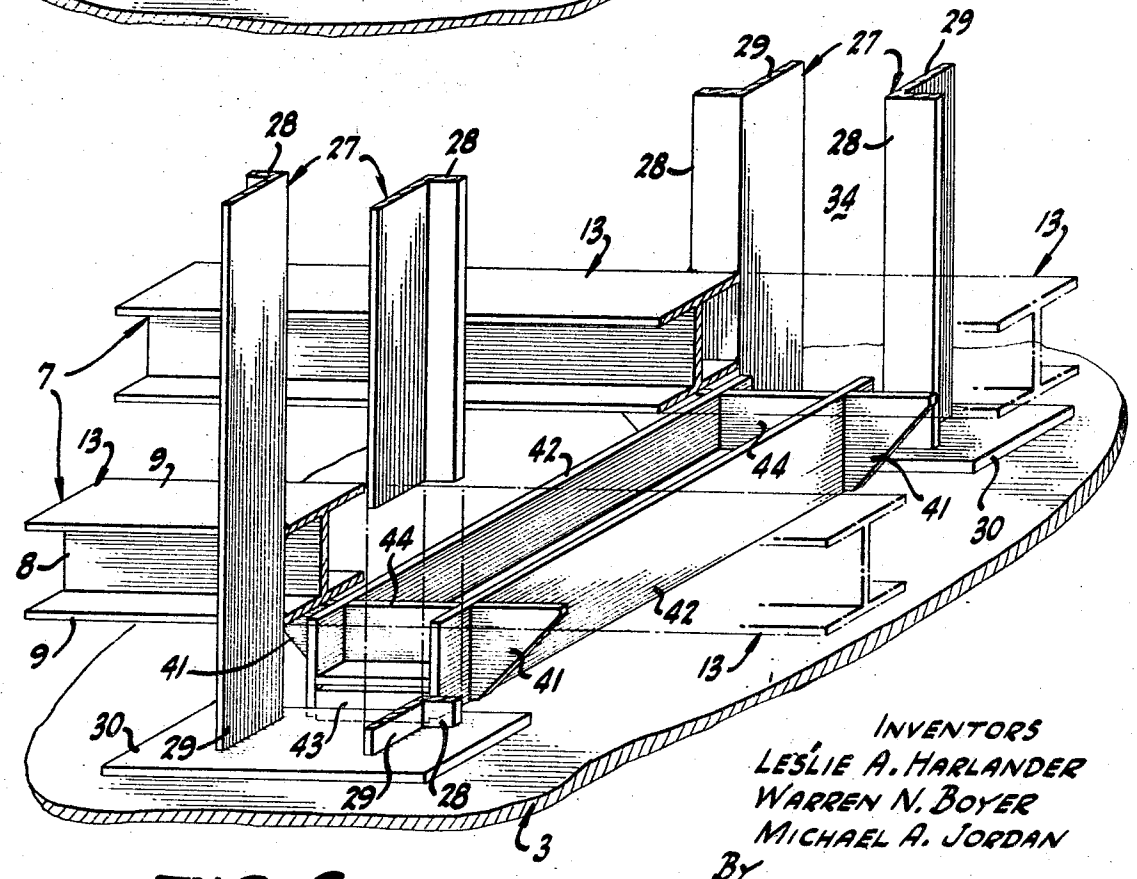


FIG-6

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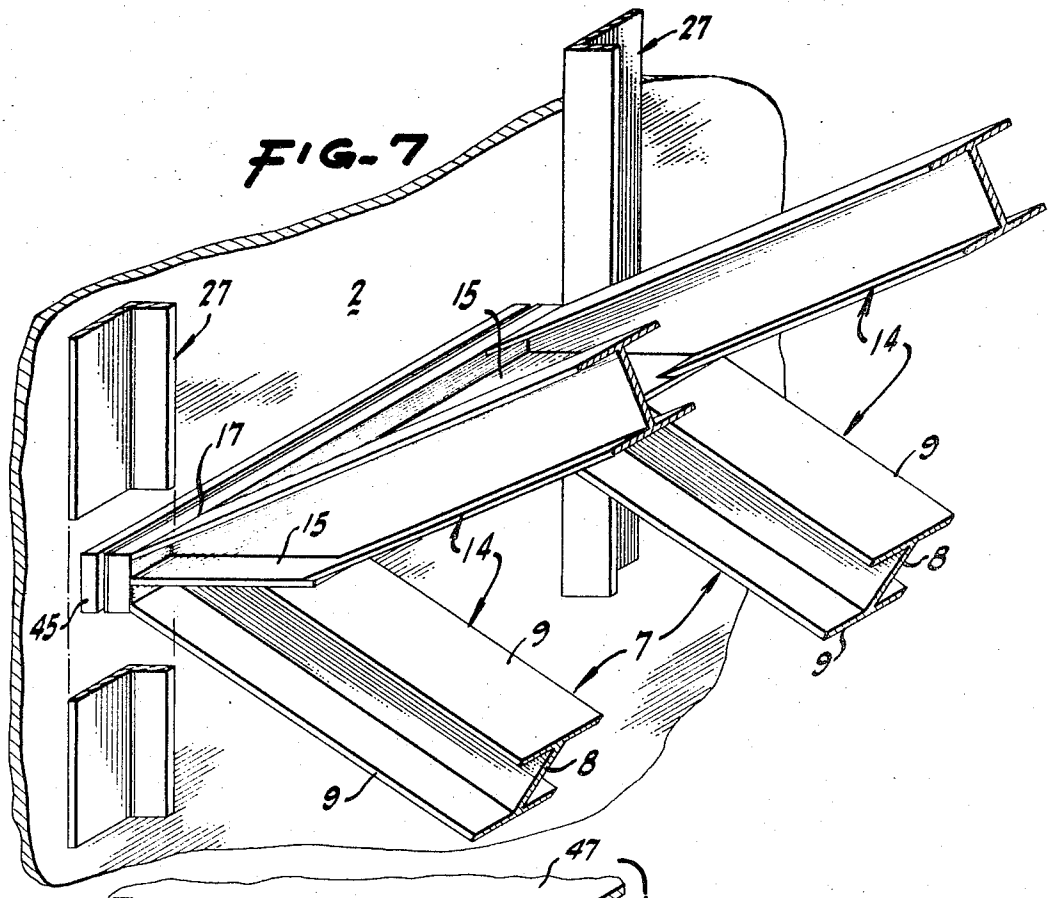
FIG-7



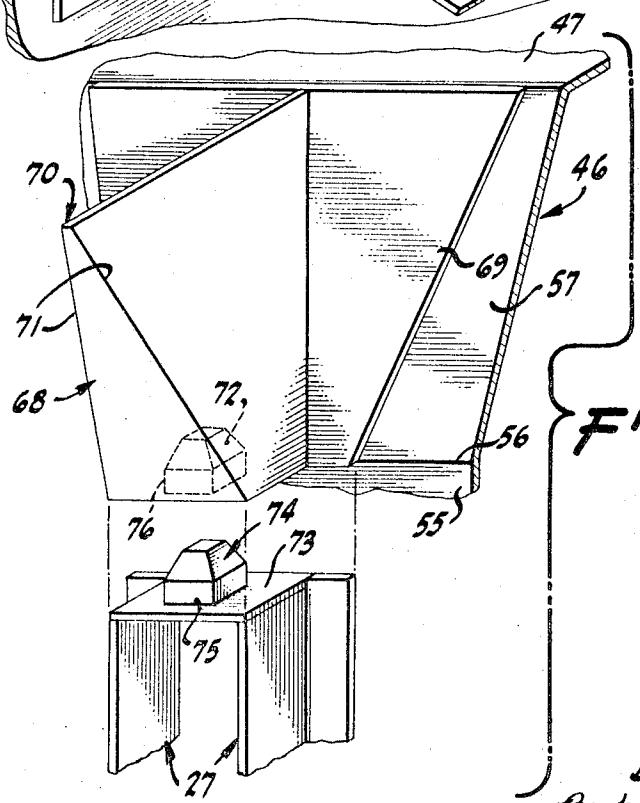


FIG-10

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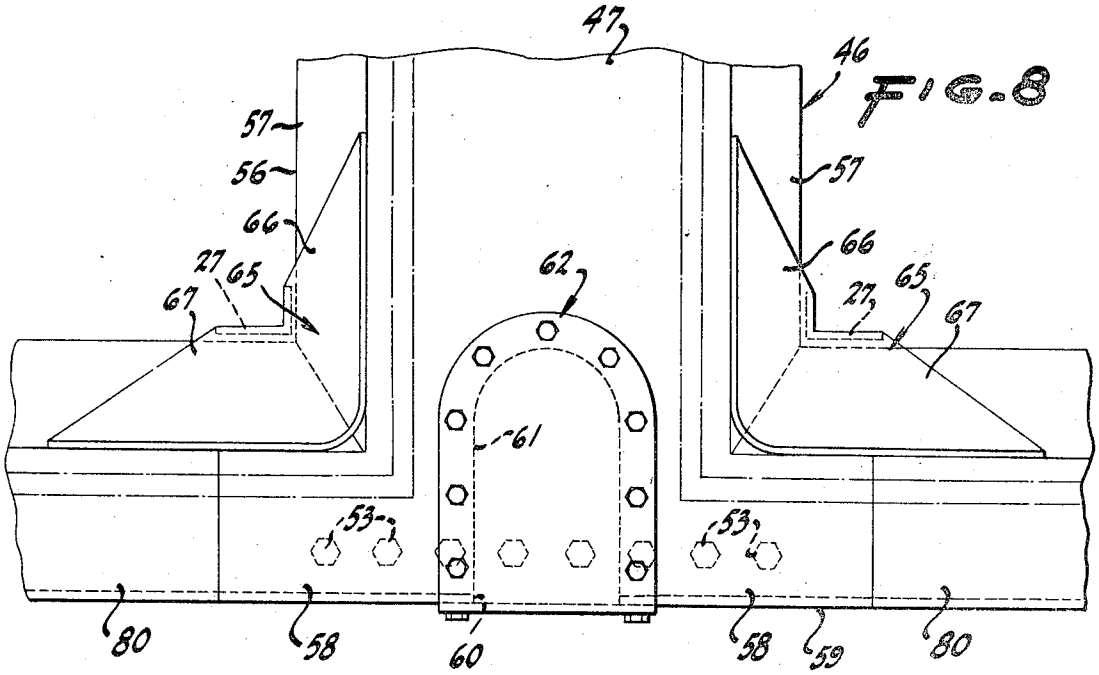

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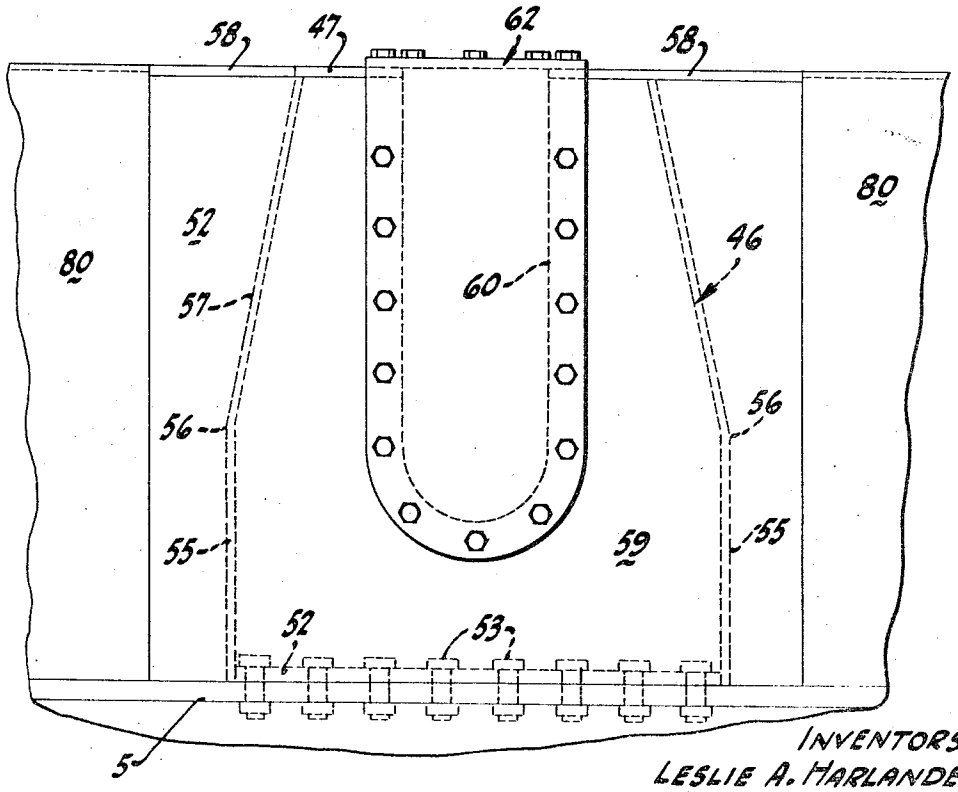

FIG-9

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FLEXIBLE HOLD STRUCTURE IN CONTAINERSHIP

BACKGROUND OF THE INVENTION

At the present time, cargo containers for transoceanic transport in ships are of different lengths, such as 20, 24, 30, 35, and 40, feet, although the widths are the same. These dimensions are related to laws regulating the maximum length and width of loads that may be transported on the highways, and by the users or owners of the containers or containerships.

A containership designed for only one length of containers is restricted to containers of that length, or, when specifically provided for, containers of lengths that are even multiples of that length. Thus, a containership having means for holding stacks of containers of 20-foot lengths may be suitable for containers of 40-foot lengths or for mixtures of the two lengths. Because of the variety of container lengths in use, the limitation to a single size or even multiple imposes a severe restriction on the economic usefulness of the ship.

With the present invention, structure is provided that is adapted to be readily lifted and moved by conventional dockside cargo cranes for adapting the hold to receive and to guide containers of different lengths and to hold them in stacks.

The problem in ships for holding stacks of containers against shifting is different from that in land vehicles, due to the vastly greater area in the hold of a ship and to the distortions occurring in the hull of a ship, particularly the vertical movement of the bottom under the influences of the sea at different times and places. In the present invention the cell structure is such as to permit vertical flexibility while providing portable cell frame truss work for maintaining the stacks of containers against lateral and fore and aft shifting in the hold.

In containerships, cargo carried in containers is supported on the deck or hatch covers, and in the present invention the structure is such as to provide beams extending between and rigidly, but releasably, supported on and secured to sides of the hull and which beams carry the deck load and also function to hold the cell frame truss work in position, and to thereby contribute to holding the containers in the hold against said shifting, in a fore and aft and transverse direction.

SUMMARY

The cell structure in the hull of a ship provided by the present invention comprises vertically disposed frames of generally rectangular outline adapted to be positioned in spaced, opposed relation in parallel planes that are perpendicular to the longitudinal axis of the ship. Each frame is of truss structure adapted to provide strength with lightness, and includes elongated vertical pairs of cell guides located on the fore and aft faces of each cell frame. Each pair of cell guides receives one of the ends of the rectangular cargo containers of a vertical stack. Opposedly facing pairs of said cell guides on the adjacent cell frames receive opposite ends of a horizontal row of containers that extends from side-to-side of a hold.

Means is provided for releasably holding said cell frames at various longitudinal positions in the hold of a ship while permitting a sufficient degree of movement in the plane of each frame, relative to the walls of the hold to prevent detrimental strains on the frame due to movement of said walls under the influence of the sea. Thus, flexibility is provided which enables positioning the frames different distances apart for holding vertical stacks of cargo containers of different lengths in the hold of a ship and which permits vertical movement of the containers into and out of this hold between opposed pairs of said guides through the open upper opening of the hold.

Means are also provided for supporting a deckload over the containers and frames in a hold and to make that support completely independent of movement of the cell frames, while said frames are affixed in said hold.

Another object of the invention is to provide means adapted to be adjustably positioned in the hold of a ship for positioning cargo containers of different lengths in said hold in stacks and rows extending transversely and longitudinally of the ship, and which means is adapted to have such freedom of movement as is required to adjust to changes in the hull configuration due to temperature differentials and loads imposed upon the hull as a result of the vessels' attitude, motions, container and cargo masses, ballast masses, sea loads, and other forces which may distort the alignment of the ships' hull girders.

An added object of the invention is the provision of container-positioning means adapted to be removably and releasably positioned within the hold of a ship for positioning cargo containers of different lengths in said hold in stacks and rows extending transversely and longitudinally of said ship, and which means is constructed in a manner so as to restrain the transmission of unnecessary and detrimental forces to the hull, as a result of container and cargo masses in conjunction with the vessels' attitude and motions.

Other objects and advantages will appear in the description and drawings.

DESCRIPTION OF DRAWINGS

FIG. 1 is a semidiagrammatic view of a portion of the side of a ship broken away to show the interior and the positions of the cell frame truss work within a hold, the coaming, hatch covers, and the bottom of the hull being shown in single lines.

FIG. 2 is a top plan view of the portion shown in FIG. 1, partly broken away to show the transverse beams and the positions of the containers within the hold relative to said beams and cell frames.

FIG. 3 is an exploded isometric view of one cell frame truss work within the hold of a ship, with the crossbeam that is adapted to be releasably secured to the deck shown spaced above the cell frame structure. The portion of the hull in which the cell frame is adapted to be positioned is diagrammatically indicated in single lines, and the view is broken in height to accommodate it to the sheet.

FIG. 4 is a fragmentary enlarged cross-sectional view at line 3–3 showing a portion of a pair of spaced cell frames showing a container in one of the cells formed by said pair.

FIG. 5 is a fragmentary enlarged, isometric view showing part of the bottom of the hold, and the structure for supporting one part of a cell frame thereon. A portion of the outer frame of a cell frame is shown and certain portions of said frame are deleted for purpose of clarity.

FIG. 6 is a fragmentary, enlarged, isometric view showing part of the bottom of the hold and structure along the longitudinal center line of the bottom for supporting a cell frame structure, part of the cell frame is shown and other parts are deleted for clarity.

FIG. 7 is an enlarged, fragmentary, isometric view showing part of one sidewall of the hold, and part of the cell frame including structure providing engageable plates on said sidewall and cell frame.

FIG. 8 is a fragmentary top plan view showing one end of a transverse box beam adapted to be releasably secured at its ends to the deck of the ship.

FIG. 9 is a fragmentary end view of the beam of FIG. 8.

FIG. 10 is an enlarged, exploded, fragmentary, perspective view of the means on each crossbeam and on the guide strips of the cell frames for guiding a container onto each cell, a portion of the beam and a portion of a pair of guide strips being shown.

DESCRIPTION OF THE INVENTION

In a containership of the type illustrated, most of the hold area is adapted for receiving cargo containers. These normally are of b 8 1 -foot width, although they can be of other widths and the concept is not effected if they are of another dimension. The height and length may also vary.

A containership normally is divided by transverse watertight bulkheads 1 into different holds. The side boundaries of the hold are formed by longitudinal bulkheads, designated 2 (FIG. 3), and the inner bottom, or tank top, 3. Between the hold and the side and bottom shell of the ship are a series of watertight

tanks, which may be used for fuel, liquid cargo or ballast. These tanks serve to improve the watertight integrity of the ship, and in a containership utilize space not suitable for container stowage.

The terms, "longitudinal bulkheads" and "sidewalls," used with reference to the longitudinal bulkheads 2, are intended to be synonymous, and the term "inner bottom" and "bottom" or "bottom wall" of the hold are also intended to be synonymous; hence, the walls of a hold include the transverse bulkheads 1, longitudinal bulkheads 2 and inner bottom 3.

The cargo containers, irrespective of their lengths, are generally designated 4 (FIGS. 1, 2), and are rectangular. Normally said containers are horizontally elongated and arranged with their longitudinal axes parallel with the longitudinal axis of the ship.

Hatch openings are constructed in an upper deck 5 (FIG. 3) through which containers are lowered into the hold, the upper open side of the hold extends from one longitudinal bulkhead to the other, and from one transverse bulkhead 1 to one that is opposite thereto.

The length of each hold, as seen in FIGS. 1, 2 is many times the length of a container 4 and what may be called a "cell" is the structure for positioning and supporting each vertical stack of containers spaced from an adjacent stack. A "cell frame" is a vertical truss work frame that is adapted to extend between the longitudinal bulkheads 2 of the hold in a transverse vertical plane positioned normal to the longitudinal axis of the ship. Each such frame is generally designated 6 (FIGS. 1—4), and forms a generally planar vertical spacer between parallel adjacent pairs of horizontal rows of containers that extend from side-to-side of a hold. Adjacent pairs of cell frames are at the opposite ends of the containers in each row thereof extending transversely of the hold, and said frames are provided with means for spacing the containers in each row from each other. Said frames are not connected to each other nor are they rigidly secured to the walls of the hold, as will hereafter appear.

Each cell frame 6 comprises a pair of corresponding parallel, spaced, opposed outer frames generally designated 7 (FIG. 3) each of which may be of I-beam construction, and which outer frames 7 are in side-by-side relation in vertical planes disposed at right angles to the longitudinal axis of the ship when each cell frame 6 is positioned in a hold. The webs 8 of said I-beams are vertical with their flanges 9 horizontal (FIGS. 5, 6, 7).

The upper runs 12 and the lower runs 13 of the outer frames 7 of each cell frame 6 extend horizontally and approximately from side-to-side of a hold in the ship when the cell frame is in the hold, whereas the opposite sides of each outer frame are of corresponding zigzag truss structure (FIG. 3) in which a series of connected zig and zag sections 14 provide vertically aligned outer apices 15 in horizontally aligned pairs, and inner vertically aligned apices 16. The upper horizontally aligned outer pair of apices 15 is welded to the terminal end portions of horizontal bearing plate 17 (FIG. 7).

Horizontally extending and horizontally disposed truss webs or frames 18 of open work truss structure extend between the zigzag sections of the opposite sides of the outer frames 7. Each truss frame 18 comprises a pair of horizontal, parallel, angle strips 19 (FIG. 4) that are welded at their ends to a horizontal strip 20 that, in turn, is welded or rigidly secured at its ends to a pair of horizontally aligned apices 15, 16 of adjoining zigzag sections 14 (FIG. 3). Truss members 23 (FIG. 4) between angle strips 19 extend obliquely relative to the latter and are welded at their ends to said strips, while angle strips 24, parallel to end strips 20, connect said strips 19, extending between pairs of truss members 23 at uniformly spaced intervals.

The uppermost zig sections of the vertically extending lateral sides of the outer frames 7, and the lowermost zag sections thereof are, respectively angular extensions of the upper and lower runs 12, 13 of said outer frames 7. The upper runs 12 of the outer frames 7 of each cell frame are connected by truss members 23 and strips 24 corresponding to truss members 23 and strips 24 that connect the angle strips 19 of each truss web 18.

Truss webs 25 (FIG. 3) corresponding to the truss webs 18, except longer, extend at their ends into the reentrant angles defined by the adjoining pairs of zigzag sections 14 at the outer apices 15, except the uppermost pairs, and are welded to said end strips that extend between the ends of the angle strips 19, which, in turn, are welded to the outer frame members 7 in said reentrant angles.

The right-angle strips 19 of each cell frame are so positioned that one leg of each strip extends horizontally into the space between said strips while the outermost vertical surface of the other legs, relative to said space, are in the same vertical planes as the oppositely outwardly facing edges of the pairs of flanges of the I-beam defining the outer frames 7 of each cell frame.

Equally spaced pairs of vertical angle strips 27 are in a horizontal row at each of the opposite sides of each cell frame 6. The legs or sides 28 of the angle strips of each pair extend toward each other while the other legs 29 project oppositely outwardly of the cell frame in directions fore and aft of the ship when the cell frames are in a hold (FIG. 4).

Strips 27 may be called cell guide strips, or cell guides, the spacing between the sides or legs 29 of each pair being slightly greater than the width of the container 4 so that four vertical corners of a container will readily be received in the angles defined by the sides 28, 29 of four of said strips when the cell frames of an adjacent pair are spaced longitudinally of the axis of the ship a distance slightly greater than the length of the containers between adjacent pairs of cell frames.

Said legs or sides 28 of the angle strips 27 are welded to the legs of the flanges 9 of the I-beams that are directed approximately outwardly of the pair of outer frames 7. The end strips 27 of the row thereof are welded to said flanges approximately at or adjacent to the apices 15 of the zigzag sides of the outer frames 7.

The strips 27 that are between said end frames are also welded to the angle strips 19 of the truss webs 18.

The upper end portions of the cell guide strips 27 project above the upper level of the upper runs 12 of each cell frame a substantial distance, and the lower end portions also project downwardly below the lowermost level of the lower runs 13. Rectangular, horizontal metal foot plates 30 are respectively welded to the lower ends of the adjacent pair of guide strips 27 of each of the pairs between which container 4 is adapted to be received by and project laterally therefrom so as to form a seat for the containers 4 at their corners when a container is held between an adjacent pair of cell frames 6 and the latter are in the hold of a ship (FIG. 3).

The single end strips 27 of each row each has a similar foot plate 31.

The pairs of spaced guide strips 27 are spaced from each other a relatively short distance as at 34 (FIG. 4), which may be approximately 12 inches. One of such spaces in the arrangement illustrated in FIG. 4 is positioned at a distance from each side of the hold equal to approximately one-quarter of the total distance between such sides. FIG. 5 shows a detail of the structure at each such space, in which a pair of horizontally elongated, parallel, spaced opposed plates 35 disposed with their sides vertical, extend normal to and below the lower runs 13 of the outer frames 7 and are welded along their upper edges to said lower runs. Brackets 36 extending laterally outwardly from the pair of plates extend below said lower runs 13 and are welded thereto.

Plates 35 of each pair thereof are adapted to receive therebetween a similarly extending vertical plate 37 that is welded to the bottom 3 of the hull, and which plate is adapted to extend between the foot plates 30, or foot pads.

The plates 35, 37 have aligned openings in which a pin 38 is adapted to be removably positioned for releasable securement in said holes by any suitable means such as a cotter pin or nut on one projecting end and the opposite end of each pin may be

formed with a head 39 (FIG. 5) for grasping to withdraw the pin. The terminal ends of plates 35, 37 do not extend into spaces 34 or over the foot pads 30 but are at the latter.

It should be noted that the foot pads 30 are positioned directly over the longitudinal girders 40 that are within the ship's double bottom structure, (FIG. 1) so that the vertical stack loads are transmitted via said foot pads and inner bottom 3 directly to said girders 40.

Another of the spaces 34 between the adjacent vertical cell guides of an adjacent pair thereof is centrally between the sides of the hold. FIG. 6 shows a detail of this structure, in which a pair of horizontally elongated, parallel spaced plates 42, similar to plates 35, but more widely spaced, have their sides vertical, and are welded along the upper edges of their end portions to the lower sides of the lower runs 13 of the outer frames 7 of each cell frame. These strips may also have brackets 41 corresponding to brackets 36 which are also welded to the undersides of said lower runs 13, and spacer plates 44 disposed between said plates 42 are welded to the latter and hold said plates in spaced relation.

A flat horizontally extending and horizontally disposed plate 43 is welded to the bottom 3 of the hold in a position to extend between the plates 42 and the foot plates 30. The plates 42 and 43 are not secured together.

By the foregoing structure, each cell frame is adapted to be supported on the bottom of the hull 1 with the foot plates 30, 31 resting on said bottom but unsecured thereto. The pins 38 secure the frames at their lower ends against fore and aft movement of said lower ends relative to the hull but, in their respective positions, there is no undesirable tension placed on the cell frames due to movement of the bottom of the hold under the force of water against the hull. The centrally positioned pair of plates 42 cooperate with the plate 43 an foot pads 30 to hold the lower portions of the cell frames in position both transversely and longitudinally of the ship without being secured to the bottom of the hold. Thus, the lower transverse and fore and aft loads are transmitted to the hull structure through the cell frame and plates 37, 43.

The longitudinal bulkheads or sidewalls 2 of the hold have horizontal strips 45 welded thereto, (FIG. 7) opposite to each of the pairs of the outer apices 15 of the outer frames 7 of each cell frame 6, which strips 45 function to prevent the metal strips 17 that are welded to said outer frames from engaging the sides of the hold. It is seen that outer frames 7 of each cell frame are spaced from the side and bottom walls of the hold, and also, said strips 45, in combination with each cell frame may function to transmit the container loads to the hull, without securement of the frames to the hull. A plurality of said strips 45 in alignment longitudinally of the hull may be provided on the longitudinal bulkheads at different distances, or said strips may be continuous.

The upper end portions of the cell guide strips 27 that project above the outer frame members 7 of each cell frame, are adapted to extend across opposite sides of a horizontal transverse box girder 46 (FIGS. 1, 3). Said girder extends thwartship of the hold at a right angle to the longitudinal axis of the ship. Each girder 46 is of greater vertical dimension than horizontal intermediate its terminal end portions, and its upper wall 47 is straight and horizontal from end-to-end. Bottom wall 48 of said girder is parallel with the upper wall 47 to knuckles 49 where they extend slantingly upwardly as at 50 (FIG. 3) to points 51 where they join the lower surface of generally horizontally disposed plates 52 (FIG. 9) that, in turn, are adapted to extend over the deck 5 at opposite sides of the hull (FIG. 9) and are releasably bolted to said deck by bolts 53.

In cross-sectional contour, the bottom wall 48 of the girder 46 is wider than top wall 47 and the opposite sidewalls 55 (FIG. 9) extend parallel upwardly to knuckles 56 and convergently upwardly from the latter, as at 57 (FIG. 9), to the upper wall 47.

The opposite end portions of upper wall 47 of the girder 46 each include horizontal oppositely outwardly projecting extensions 58 (FIG. 8). Vertical plates 59 are respectively welded to the end edges of the girders from plates 52 upwardly, thereby closing said ends of the girder, which plates also extend the overall width of the top wall 47 including extensions 58 (FIG. 9).

Each closure plate 52 is formed with a vertical slot 60 (FIG. 9)that continues horizontally at 61 (FIG. 8) into the top wall 47 of the girder 46. An angle cover plate 62 is bolted to each end plate 52 and top wall 47 to cover slot 60, 61. When plate 62 is removed, ready access is had to bolts 53 for releasing each girder for movement thereof along the deck to different positions, for rebolting to the deck, the latter being formed with openings for said bolts at different distances according to the lengths of containers to be loaded between cell frames, as will later be described more in detail.

At the ends of each girder 46 are guide members generally designated 65 (FIGS. 3, 8), which members are rigid on the girder, and each member may be a casting having a pair of adjoining walls 66, 67 at a right angle to each other respectively secured against the inclined portion 57 of the girder and to an extension 58 of the girder (FIG. 8). These members 65 may be at opposite sides of the girder and walls 66, 67 terminate at their lower edges spaced above, and in vertical alignment with the terminating upper edges of the end cell guide strips 27 of the rows thereof at opposite sides of the cell frames. The walls 66, 67 extend slantingly outwardly from their lower edges, whereby the corner of a container being loaded may slide down the slanted walls 66, 67 and into the angle formed by the adjoining sides of the angle strips 27.

Along opposite sides of the inclined upper portions 57 of each girder are other guide members generally designated 68, which are in pairs, with each pair in alignment at said opposite sides, and said pairs are spaced apart longitudinally of the girder distances approximately equal to the width of a container.

Each member 68 comprises a casting or fabricated plate having a wall 69 that has the same inclination as each of the upper slanted side surfaces 57 of the girder, and which is secured against one of said side surfaces by welding or any other suitable manner, (FIG. 10).

A projection 70 on each wall 69 projects laterally outwardly therefrom and outwardly of the girder 46, which projection has divergently downwardly inclined gable surfaces 71. Wall 69 and surfaces 71 terminate at their lower ends spaced above, but in vertical alignment with the upper edges of the adjacent cell guide strips 27 of adjacent pairs of the latter, so that the adjacent corners of a container lowered into a cell formed by each multiple of four of said cell guide strips at each side of a cell frame will be guided by the surfaces 71 and wall 69 of guide members 65 into each cell.

The lower side of each projection 70 is formed with a downwardly opening recess 72 (FIG. 10) having convergently upwardly extending sides, while a horizontal plate 73 connecting the upper ends of the adjacent cell guide strips 27 of each adjacent pair of said guide strips has a generally conical upwardly projection 74 therein that is adapted to extend into the recess 72. The surfaces of projections 74 are substantially complementary to the surfaces of each recess 72. The sides 75 around the base of each projection 74, and the lower portions 76 of the sides of each recess 72 are vertical to permit vertical movement between each girder 46 and each member 70 while the tapered surfaces above said base and lower portions 76 function to guide the upper ends of the vertical guide strips 27 into alignment with the lower edges of each member 70. It is to be clearly understood that the girders do not rest on the cell frames or cell guide strips, but the cell frames are retained in positions in the hold by said girders against substantial movement longitudinally of the axis of the hold. Projections 74 do not fully seat in the recesses 72, but are proportioned to permit vertical movement of the cell frames relative to the girders 46 above and below a mean position, adequate to retain the sides 75 of the projections in contact with sides 76 of recesses 72 so as to transmit and distribute the container loads imposed

on the cell frames to the upper deck, or hull, by way of the girders, and to provide for alignment and horizontal restraint of the upper ends of the cell frames.

Conventional hatch covers generally designated **79** (FIGS. **1**, **2**) are supported on the girders **46** and on coaming **80** that are lightly welded to the lateral edges of the end plates **59** of the girders **46** and to the horizontal upper lateral edges of extensions **52** and to the deck to close the spaces between the adjacent pairs of girders **46** to preclude ingress of water to the holds. Containers **4** may be supported on the hatch covers themselves (FIG. **1**) and releasably secured thereto in any suitable manner.

Ordinarily at least one of the bulkheads **1** of each hold has vertical cell guides **81** secured thereto (FIG. **1**) which cell guides will cooperate with the adjacent cell frame for positioning and holding stacks of containers between them, while a cell frame **6** may be positioned at the other bulkhead **1**, and adjustments of one or more of the cell frames may be made relative to the side of the bulkhead **1** having said cell guide strips **81** thereon. Or a cell frame may be removed without effecting the load carrying and hold-stiffening girders **46**.

Girders **46** are readily moved to positions corresponding to the desired positions of the cell frames. In any event and in any of the adjusted positions flexibility in the respective planes of the cell frames between the walls of the hold and girders **46** and the cell frames is permitted.

The truss structure of the cell frames provides strength in the cell frame combined with lightness and economy of material, and the method or manner of securing the cell frames **6** and girders **46** in their adjusted positions is simple, inasmuch as pins or bolts **38** form the only means required for securing the cell frames to the bottom of the hold and girders **46**, which are releasably bolted at their ends to the deck by bolts **53**, are not secured to the cell frames, yet the girders position the upper ends of the cell frames and hold the latter in their positions, and upon disconnecting any of the deck girders **46** from the hull, and lifting it, the cell frame therebelow is free to be lifted, except for the easily releasable pins **38**.

Features inherent in the cell structure of the present design include the ability of the cell structure to rack in a transverse plane when the longitudinal bulkheads become skew in relation to the inner bottom and the deck girder **46** associated therewith. Also, the cell frames have the ability to wrap from their initial plane, and the base of each cell frame can follow the transverse deflections of the vessels' inner bottom while still transmitting the container stack loads, by way of foot pads **30**, to the longitudinal girders **40** in the double bottom of the hull.

The transverse deck beams **36** obviously provide transverse structural ties between each side of a ship's hull at the vessels' upper deck, and at the same time they provide supports for the ends of the hatch covers, which covers, in turn, support the sea and deck container loads and carry the guides for entry of the cell frames into the hold.

It is to be understood that such changes in construction and arrangement of parts, dimensions, etc. may be made, as prove expedient and fall within the scope of the appended claims.

We claim:

1. Cell structure for positioning and supporting horizontal rows of rectangular cargo containers vertically in a hold in the hull of a ship, which hold has longitudinal bulkheads defining the opposed sides of said hold, and an inner bottom defining the bottom of said hold, and an open upper side, said structure comprising:

a. a plurality of adjacent pairs of spaced, opposed corresponding cell frames, each including a horizontal row of pairs of horizontally spaced, vertically elongated, parallel cell guides rigid therewith on opposite sides thereof, including end guides adjacent to and unsecured to said sides of said hold when in the latter;

b. said cell frames each having side, lower and upper edges respectively adapted to be positioned adjacent to said longitudinal bulkheads, inner bottom, and the level of said open upper side of said hold with said frames disposed in vertical planes normal to the longitudinal axis of said ship, and with said side edges unsecured to said bulkheads;

c. said pairs of cell guides in said rows on opposite sides of each frame being in opposed relation on each adjacent pair of cell frames for receiving between adjacent pairs of opposed cell guides the opposite ends of such cargo containers in vertical stacks to support said stacks vertically and in spaced relation against movement thwartship and fore and aft of said ship when said cell frames are supported in said hold in said planes in container supporting positions with the ends of the containers in said stacks between the cell guides of opposed pairs;

d. upper and lower frame-positioning means respectively engageable with each of said frames at its upper and lower edges and respectively securable to said longitudinal bulkheads and to said inner bottom different distances apart in a direction longitudinally of said hold for positioning and releasably holding said frames within said hold in spaced opposed relation normal to the longitudinal axis of said ship different distances apart for supporting containers of different lengths between each adjacent pair of frames with the stacks of such containers in rows extending from one side of the hold to the other and with their ends between pairs of said cell guides, when said cell frames are in said container supporting positions; and

e. means for so securing said upper and lower frame-positioning means to said bulkheads and said inner bottom at said different distances.

2. In cell structure as defined in claim **1**; said upper positioning means for each frame including a transverse girder having opposite end portions for releasable securement to said longitudinal bulkheads and upward extensions of the cell guides at opposite sides of the girder thereabove for holding the upper portion of said frame against movement fore and aft of the hold, said frames including said cell guides being free from securement to said girders whereby said girders will be free for lifting from said frames and free from the weight of the latter, and said frames will be free for vertical movement relative to said girders under the influence of loads imposed upon said cell frames as a result of container and cargo masses in conjunction with the ship's attitude and motions, when said girders are secured to said bulkheads and said frames are in said container supporting positions supporting said containers.

3. In cell structure as defined in claim **2**; container supporting means rigidly secured to each cell frame along the lower edge thereof for support on but free from securement to said inner bottom for supporting each cell frame and the stacks of containers supported vertically by said cell frames thereon; whereby the weight of said cell frames and containers will be supported on said inner bottom entirely independently of the transverse girder at the upper ends thereof when said cell frames are in said hold with said containers therebetween.

4. In cell structure as defined in claim **1**; said upper positioning means for each frame including a transverse girder having opposite end portions engageable with said longitudinal bulkheads for said securement thereto, and separate means respectively rigid on each girder and on the frame positioned thereby free from securement to each other and engaging each other against fore and aft and thwartwise movement when said frames are in container-supporting positions and said girder is secured to said longitudinal bulkheads, said means being free from each other for vertical relative movement between said frames and girders.

5. In cell structure as defined in claim **4**; said separate means on each girder and on the frame positioned thereby comprising complementarily formed vertically telescopically interfitting members, respectively rigid on said frame and girder.

6. Cell structure adapted to be removably positioned within a hold of a ship having opposed sidewalls, a bottom wall, and

having an open upper side to be closed by a hatch cover, and a transverse deck girder extending across said open side, which cell structure is adapted to extend thwartship from one of said sidewalls to the other in positions normal to the longitudinal axis of said ship, and from said bottom wall to said open upper end, for positioning one of the ends of rectangular cargo containers of a horizontal row of vertical stacks thereof in said hold at each of the opposite sides of said cell structure and for holding the containers of each stack upright in vertical alignment, including:

a. a vertically disposed cell frame of generally rectangular outline having side, lower, and upper edges respectively adapted to be positioned adjacent said sidewalls, bottom wall, and the level of said open upper side, and having opposite sides respectively facing fore and aft of said hold in vertical planes normal to the longitudinal axis of a ship when said cell frame is in said hold;

b. said cell frame including a horizontal row of pairs of horizontally spaced, vertically elongated parallel cell guides on each of said opposite sides thereof for receiving said one of the ends of said cargo containers of one of said vertical stacks thereof between each pair of said guides, for restraining said containers against movement thwartship;

c. frame-supporting means on said cell frame for supporting the same at its lower end on said bottom wall; and

d. positioning means on the upper end of said cell frame adapted to engage said transverse deck beam for holding said cell frame at its upper end against movement of the latter in a direction fore and aft of said ship but free from securement to said deck beam for permitting relative vertical movement between said beam and frame when said frame is vertical in said hold below said transverse beam.

7. In a cell structure as defined in claim 6;

said side, upper, and lower edges of said cell frame including a pair of corresponding outer frames in spaced opposed relation defining said outline of said cell frame, and the portions of said outer frames defining said side edges being of truss formation providing a generally vertically extending series of adjacent, zigzag sections joined at their ends providing a plurality of outer and inner apices relative to the inside of said cell frame at the junctures between said adjacent sections;

said cell frame further including horizontally elongated and horizontally disposed truss frames extending between and secured to said sections at their said inner and outer apices, and having opposite edges along opposite sides of said cell frame; and

one of said pairs of cell guides at each of said opposite sides of said cell frame being secured to one of said outer frames along the upper and lower edges of said cell frame and to said truss frames along one of their said opposite edges and said cell frame including said cell guides being free from securement to said sidewalls when said frames are positioned in said hold in container supporting position.

8. In combination with a hold in the hull of a ship for holding cargo containers, which hold has an inner bottom, longitudinal bulkheads defining the opposed sidewalls of said hold at opposite sides of said ship, and an open upper side to be covered by a removable, load-supporting hatch cover:

a. a plurality of adjacent pairs of vertically disposed, spaced, opposed cell frames of generally rectangular outline in container-supporting positions in parallel vertical planes normal to the longitudinal axis of said ship, each cell frame having side, lower, and upper edges respectively adjacent said longitudinal bulkheads, inner bottom wall and open upper side, and having opposite lateral sides respectively facing fore and aft of said hold, and said cell frames being supported on said inner bottom wall;

b. said cell frames including a horizontal row of pairs of horizontally spaced vertically elongated cell guides on each of said opposite lateral sides projecting therefrom, with the guides of the pairs thereof on said cell frames being in alignment in a direction fore and aft of said hold for receiving the opposite ends of rectangular cargo containers of vertical stacks thereof between the pairs of aligned guides on the opposed lateral sides of each adjacent pair of cell frames, each row of cell guides on said frame including end cell guides adjacent to said bulkheads free from securement thereto;

c. frame-positioning means respectively on said hull and on said cell frames for releasably positioning said cell frames at their upper and lower edges below said open upper side of said hold spaced longitudinally of said hull for vertical lowering and removal of said cargo containers into and out of said hold with the opposite ends of said containers adjacent the opposed sides of adjacent pairs of said frames and between the cell guides of the pairs thereof that are in alignment fore and aft of said ship whereby the adjacent pairs of said cell frames and said cell guides will hold said containers in stacks against movement of the cell frames and container and cargo masses longitudinally and transversely of said hold;

d. said frame-positioning means including deck girders extending over and supported on and secured to said bulkheads at their ends and disposed over said cell frames in positions extending across the open upper side of said hold and free from securement to said frames for supporting the weight of cargo above said cell frames independently of said cell frames, said cell frames having a limited vertical movement relative to said deck girders.

9. In combination as defined in claim 8; said frame-positioning means including members on said inner bottom and on said frames along the lower edges thereof at points spaced at opposite sides of a point centrally between said longitudinal bulkheads, and means for removably securing said members together thereby removably securing said cell frames to said inner bottom.

10. In the combination as defined in claim 8; said frame-positioning means adjacent to said lower edges of said cell frames being removably connected with said inner bottom for holding said cell frames to said inner bottom.

11. In the combination as defined in claim 8;

separate securing means for adjustably securing said frame-positioning means at the upper and lower ends of said frame to said hull at opposite sides of the open upper side of said hold in vertical planes at different positions fore and aft of said strip in said hold for varying the distance between adjacent frames for supporting containers of different lengths; and

said cell frames being free from said bulkheads along their side edges from attachment to said longitudinal bulkheads and free from securement to the cell positioning means at the upper edges of said frames and said frames being free for vertical movement in opposite directions relative to said longitudinal bulkheads and said last-mentioned cell positioning means under the influence of loads imposed upon said cell frames as a result of container and cargo masses in conjunction with the ship's attitude and motions.

12. In combination as defined in claim 8;

said hull having an outer bottom spaced below said inner bottom and spaced longitudinal girders between said inner and said outer bottom in side-by-side relation extending longitudinally of said ship; and

container-supporting means on the lower ends of said frames secured to the lower ends of said guides and unsecured to said inner bottom but supported directly on said inner bottom for supporting the cargo containers disposed at their ends between pairs of guides on said frames and for supporting said frames on said inner bottom, said container supporting means being positioned on said inner bottom substantially directly over said longitudinal girders whereby the weight of the containers on said inner bottom wall will be directly over said longitudinal girders.

13. In combination as defined in claim 8; bearing plates rigid on said longitudinal bulkheads adjacent to said frames for sliding engagement with the sides of said frames adjacent to said end guides to restrict horizontal movement of said frames transversely of the ship.