

[54] **FLOATING STABLE TERMINAL**

[75] Inventor: Ernst G. Frankel, Cambridge, Mass.

[73] Assignee: Interstate Oil Transport Co.,
Philadelphia, Pa.

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[58] Field of Search 114/230, 0.5 R, 0.5 D, 43.5

[56] **References Cited**

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Primary Examiner—Trygve M. Blix

Attorney—Chittick, Pfund, Birch, Samuels & Gauthier

[57]

ABSTRACT

A horizontal bank of structurally tied, horizontally extending, usually submerged storage cylinders. An above water, horizontal wing structure fitted for berthing ships alongside. A plurality of rows of vertical struts joining the cylinder bank and wing structure, and providing therebetween slips for docking barges. Means for cargo storage and transfer. Provision for ballasting of the struts and storage cylinders. Support facilities for the berthed ships.

25 Claims, 8 Drawing Figures

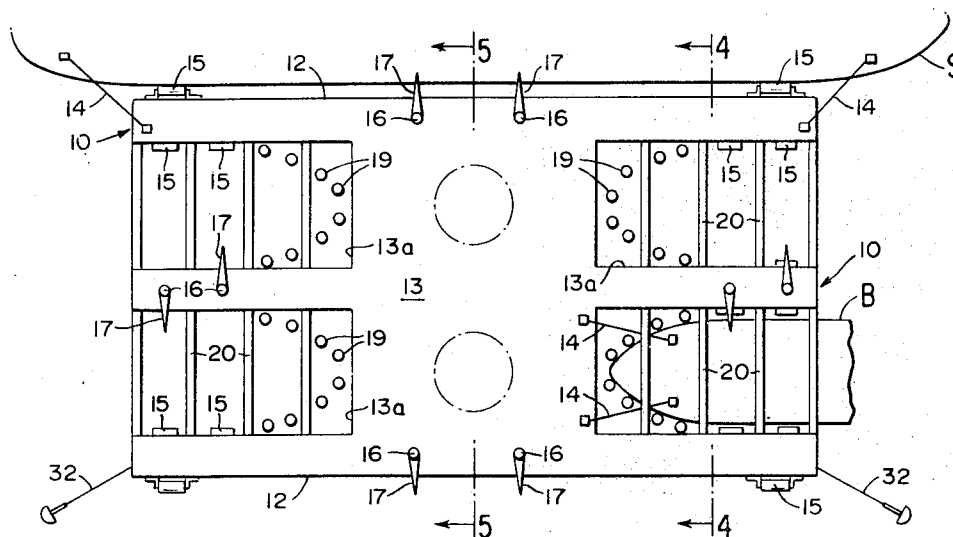


FIG. 1

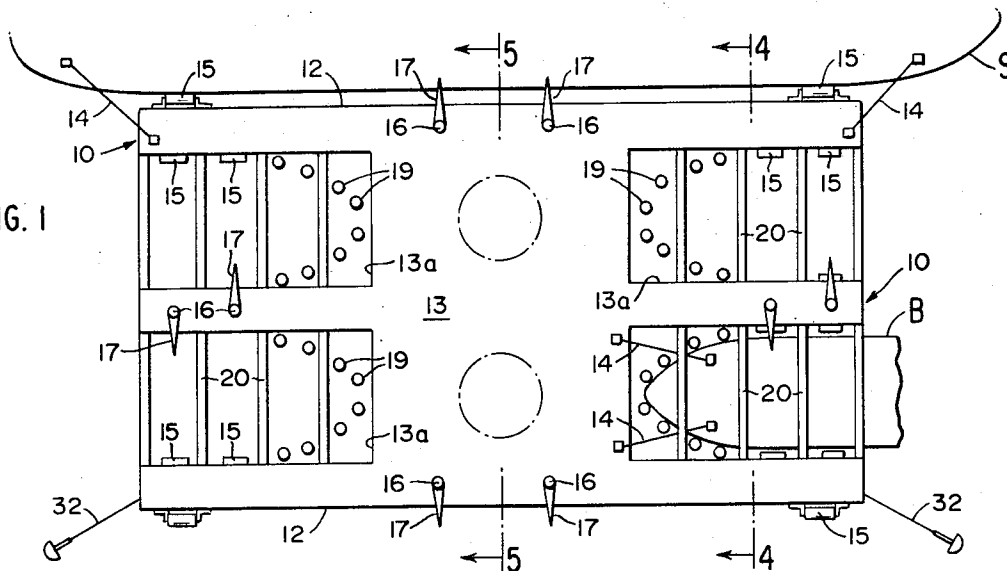


FIG. 2

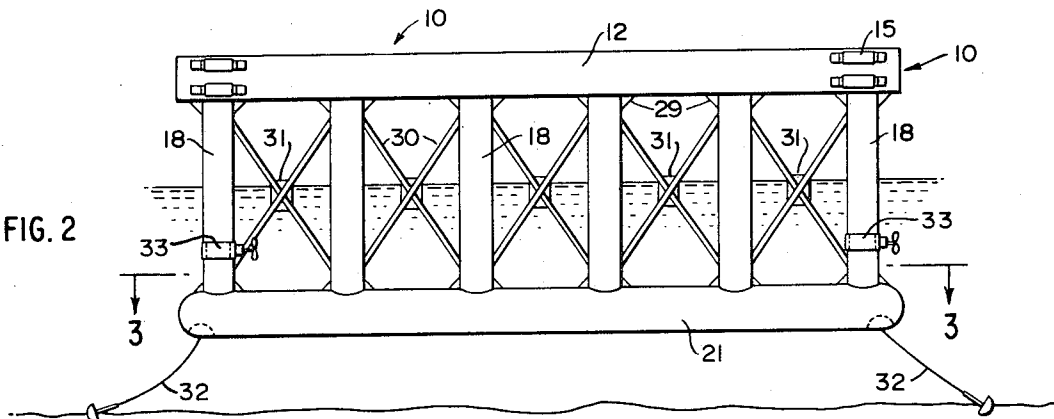
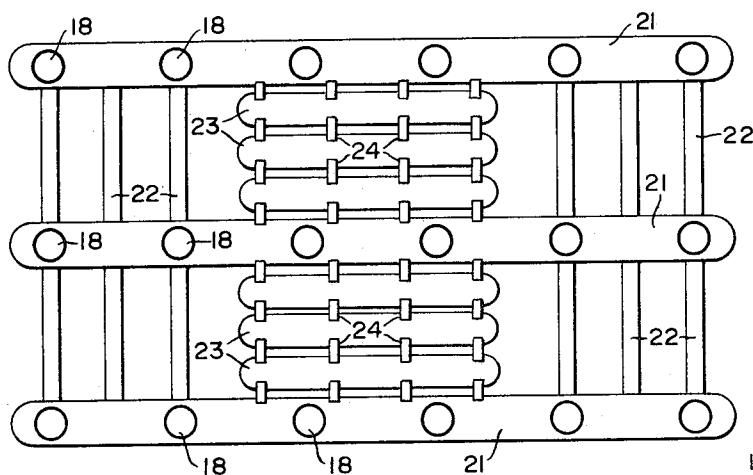
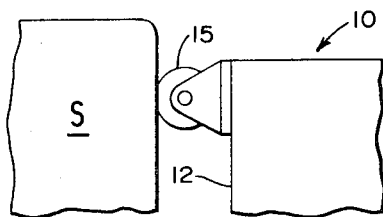
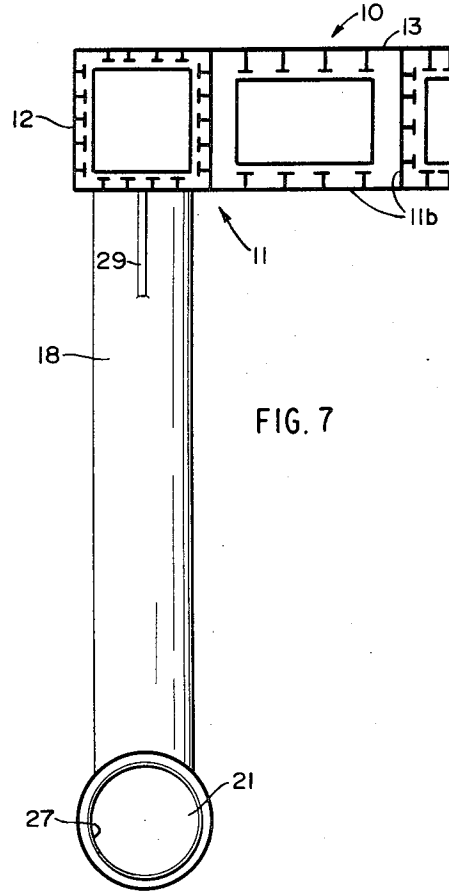
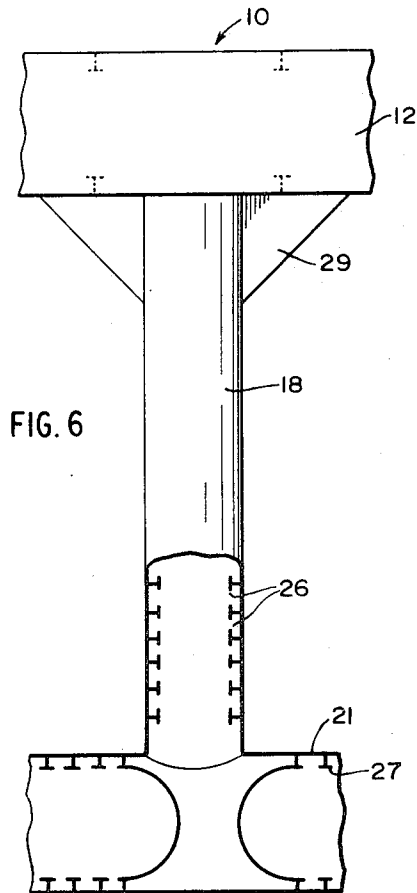
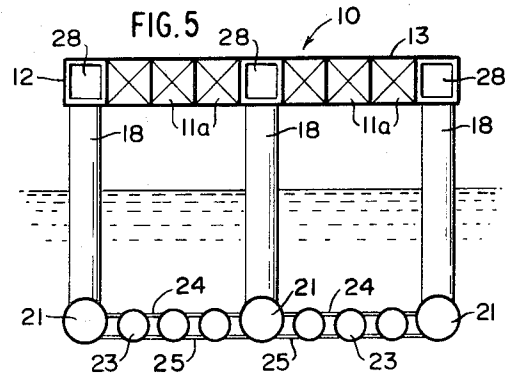
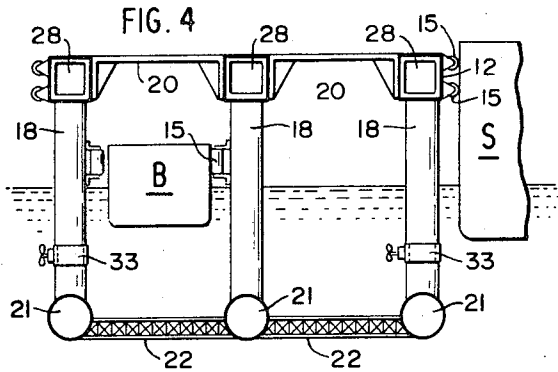


FIG. 3



INVENTOR
 ERNST G. FRANKEL
 BY *Attick, Pfund, Rich,*
Sommers, & Galtchick
 ATTORNEYS



INVENTOR
 ERNST G. FRANKEL
 BY *Chittick, Spund, Birch,*
Samuels, & Gustafson
 ATTORNEYS

FLOATING STABLE TERMINAL

FIELD OF THE INVENTION

This invention relates to the new field of deep water ship berths and piers adapted to be located closer to the main ocean trade routes, and to be connected to inland transportation systems by pipelines, causeways, barges, conveyors or other interface vehicle or device. The development of the new field here concerned arises in part from the deeper draft of ships, as flowing from the economies of their larger size; in part from the phenomenally increased cost of maintaining channels of even moderate draft to ship handling facilities developed in sheltered waters of limited depths; and in further part from the locating of numerous ports adjacent to continental or other under water shelves which restrict water depths even in open waters adjacent to the port entrance.

DESCRIPTION OF THE PRIOR ART

The prior devices known to applicant as purportedly for the new field here concerned include monomoors anchored to the sea bottom and connected to the shore or to other monomoors by flexible submarine pipelines. These monomoors are normally anchored rigidly in position and have the disadvantage of potential casualties to and short life time of flexible hose connection to the off loading ship and/or the loading tank farm or monomoor.

The prior apparatus has further included artificial islands constructed on shoals, with piers of pilings or concrete blocks. Also, steel islands such as "Texas Tower" structures have been sought to be adapted to the deep water terminal purpose.

However, all the heretofore proposed fixed island or other rigid structures have the disadvantages of high cost and permanent location; liability to minimum/maximum draft conditions; fixed storage capability; and compromise as opposed to optimum year round location, considering environmental factors such as current and waves.

The following prior patents have been referred to applicant.

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BRIEF SUMMARY OF THE INVENTION

The invention apparatus comprises a floating island structure or deep water ship terminal which is less costly and more flexible and adaptable than those hereinbefore described, and which can be anchored or free floating in a convenient location. The invention structure provides a safe berth for tankers, bulk carriers, or any type of ship, and with built-in floating storage and off loading as well as loading facilities for the transfer of cargo from ship to ship, from ship to barge, and from ship to pipeline. The floating terminal hereof is self positioning, and adapted to be relocated depending upon the draft requirements, the geographical considerations, or seasonal variation in wind, current, and waves. The terminal also is fittable with any

hydraulic or other effective fendering system assuring safe berthing of large ships alongside, and assuring also a reduction in impact loading.

The invention terminal novelly affords self-contained ferry type slips for the safe berthing of barges therewithin, and with freedom of relative vertical motion. The floating terminal hereof further has means for varying its draft, as well as its beam, length and depth, and independently the relation between its water plane area and displacement.

The invention terminal provides still further a platform of practically zero vertical motion in any degree of freedom, and with stability maintained effectively for wide ranges of change in the valuation of the foregoing parameters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a top plan of the floating stable platform terminal;

FIG. 2 is a side elevation thereof;

FIG. 3 is a bottom plan;

FIGS. 4 and 5 are vertical sections along the lines 4—4 and 5—5 respectively of FIG. 1;

FIGS. 6 and 7 are larger scale views detailing the wing structure, supporting strut, and cargo tank constructions; and

FIG. 8 is a detail of the fendering system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the drawings, the floating island structure, or floating stable platform terminal, comprises a platform or wing assembly 10, having a rigid core structure 11 enclosed by flat plates or panels forming the wing sides 12 and top or deck 13. The core structure 11 may be built up of girders 11a, FIG. 5, or it may be of bulkhead-web construction 11b, FIG. 7, or otherwise. The platform or wing assembly 10 is of one or more ship or tanker lengths in its lengthwise or longitudinal dimension or direction, and in the lateral or widthwise dimension is of a proportion to accommodate one or more ferry-barge slips, FIGS. 1, 4, and 5.

The floating platform or wing assembly 10 hereof is variously fitted for its several floating terminal capabilities, and which may include cargo handling, and helicopter landing, as well as the mentioned berthing of ships S and barges B, FIGS. 1, 4, and 8. And for the berthing purpose the terminal hereof is provided, within the wing 10 and/or otherwise, with all support facilities for a moored ship, from bunkers, fresh water, to reefer, and also general stores.

For the berthing or docking of ships the platform 10 is provided with an hydraulic or other fendering system arranged as conventionally, to assure safe berthing of one or more tankers or other ships alongside, and which may comprise a suitable number and disposition of constant tension mooring winches and lines 14, together with the usual roller or other bumpers 15.

By its accommodating one or more helicopter or STOL ports or landing areas 16, FIG. 1, the platform is afforded the efficient supply of relief crews, and performance as well of other exchanges or communications by air.

With respect to cargo handling, the novel terminal hereof is fitted more particularly with means for transfer of solid or liquid cargo or ballast between moored or berthed ships and/or barges, or between ship or barge and terminal, or between terminal and shore. For such cargo handling the service facilities will typically include cranes and loading arms as may be conventional, and are therefore schematically shown at 16, 17, FIG. 1.

The invention terminal further comprises a network or lengthwise-beamwise array, and more particularly two or more parallel, lengthwise rows, of vertical struts or cylinders 18, joined at their upper ends to the underside of the platform 10. In accordance with the invention, the struts 18 are longitudinally spaced over the length of the terminal to afford wanted strength, stability and storage chamber access, and in rows of a vertical height or depth, and lateral or horizontal spacing, such as to define and enclose one or more self-contained or ferry type slips for safe berthing of barges B, FIG. 2, and in which the barges have freedom of relative vertical movement, as shown.

The barge slips, herein shown for illustration as four in number are further defined by roller bumpers 15 and/or other fenders 19, FIG. 1, the bumpers and/or fenders mounted and supported as conventionally in barge-bow-conformant, slip-nose-defining array, as shown, FIG. 1. For convenience of barge cargo transshipment, the deck or wing structure top may be recessed at 13a, FIG. 1, and braced thereat by girders 20, FIGS. 1 and 4, spanning across the slip-uncovering deck openings at suitable, cargo-admitting intervals.

This invention novelly provides, in combination and connection with the platform 10 and struts 18, a number of usually submerged, watertight, horizontally disposed, terminal-stabilizing storage and/or ballast tanks, chambers or cylinders 21. As herein embodied, the storage-ballast chambers 21 comprise lengthwise projecting, uniformly proportioned cylinders, of substantially the length of the platform 10, provided with rounded end closures as shown, FIG. 3, and rigidly joined to and so as to form tees with the lower terminals of the slip enclosing struts 18, FIGS. 2 and 6.

The platform-length storage or ballast tanks or cylinders 21 are laterally joined and rigidified by trusses or the like 22, FIGS. 3 and 4, spanning between them at suitable intervals, which may include or coincide with the transverse planes of their intersection with the struts 18.

As herein embodied, the invention terminal further comprises one or more series of shorter, smaller, storage-ballast cylinders 23, FIGS. 3 and 5, paralleling the cylinders 21 and ordered in closely spaced lateral banks spanned and strengthened by transverse overlying and underlying plate girders 24, 25 joined thereto and to cylinders 21, as shown, FIGS. 3 and 5. The shorter cylinders 23 are herein shown to extend equally-oppositely of the longitudinal center of the terminal, over approximately half its length, and intermediate the barge slips.

In accordance with the invention, the array of cylinders 21, 23 serves to substantially increase the storage capacity of the terminal, and more particularly is usable, in the case of some at least, for the storage of liquid cargo. Further, the terminal storage capacity comprises

the struts 18 and also the wing structure 10, as well as cylinders 21, 23, all defining volumes usable for ballasting the terminal, as with water, and/or for storage of liquid or flowable cargo.

To this end, it will be appreciated, all cylindrical parts, and more particularly the struts 18 and cylinders 21, 23, may be reinforced by ring and/or bulkhead type stiffeners 26, FIG. 6, that may define in the struts 18 and cylinders 21, 23, inner or double walls 27, FIG. 7, affording access trunks from the above water wing structure to the storage and/or ballast cylinders for ducts, pipes, conduits, and human access.

And in the wing structure 10 the described bulkhead-web or girder construction may enclose storage chambers 28, FIGS. 4 and 5, which chambers 28 are herein seen to parallel cylinders 21 and overlie struts 18, with which they may communicate.

By its provision of extensive and flexible storage capacity, as just described, the stable platform terminal hereof, it will be appreciated, can be ballasted to achieve varying drafts to provide better sea and position keeping; improved adaptation to berthing of tankers, bulk carriers, and other ships and barges; and reduced motion response. The stable platform terminal hereof is seen also to be distinguished by a quite small water plane area in relation to its displacement, this tending to negligible motion of the platform 10 even in severe weather. As a result of its advantageous ballasting and plane-displacement ratio as above described, the stable terminal hereof is uniquely characterized by greatly reduced and/or dampened vertical movement (heave, pitch, or roll) response to wave motion. Further, the platform terminal is made very stable in the longitudinal as well as transverse plane, and is accorded a low center of gravity in relation to its center of buoyancy, which permits large top loads to be placed on the deck.

Uniquely under this invention, then: by proper selection of its length, width and depth; by proper determination of its water plane area-displacement ratio; and by proper increase of its mass and inertia by ballasting of its vertical struts and particularly its horizontal storage tanks, the floating terminal is accorded: stability in the longitudinal as well as in the transverse plane; a low center of gravity in relation to its center of buoyancy; a large top side and deck loading capability; and a substantially zero vertical motion response to wave motion.

The transverse, interconnected bank of ballast-buoyancy cylinders 23 is herein shown as but not restricted to the structural tying by plates or girders 24 and 25 in overlying and underlying engagement therewith. The overlying plates 24 underlie the self contained barge slips, and are shown as having endwise-abutting engagement with the intermediate and outer struts 18, as well as with the cylinders 23. The lower girders 25, extending similarly in endwise-abutting or tangential engagement with the undersides of the cylinders 21, 23, FIG. 3, combine with the upper plates 24 to fix the cylinders 21, 23 in the indicated transverse, level, ordering or configuration, the same generally strengthening and rigidifying the cylinder bank, and thereby the terminal.

The invention terminal may be still further strengthened and stiffened by brackets 29 at the wing-

strut intersections, FIGS. 6 and 7, and by conventional or other bracing 30 lengthwise crisscrossing between the struts 18. The crisscrossed bars or other braces 30 may in turn be stiffened and rigidified by the provision at their intersections of plate girders 31 or the like, FIG. 2.

Further in accordance with the invention, the floating terminal hereof can be positioned for sea-keeping, as by anchors 32, which may be four in number, and housed at the corner extremes of the submerged cylinders 21, FIGS. 1 and 2. Also for position keeping, or for moving the terminal into position, the same may be equipped with, say, two or four propulsors 33, FIG. 2, which may be propeller or jet, and mounted on and for swinging about the four corner struts 18, thereby according, superior speed, direction, and turning control to the terminal.

Thus the platform terminal hereof provides an improved deep water ship terminal for tankers, bulk carriers, and other ships which can be anchored or free floating in a convenient location. The invention terminal provides a safe berth for such ships, in that, depending on wave and current conditions, it can be anchored, or be operated, as just described, to move into position alongside such a ship.

In addition to accommodating one or more tankers or other type ships at berths along at least its longer sides, the floating stable platform hereof has been further shown to provide self-contained slips for docking barges therewithin, between its two or more rows of vertical struts. And it will be understood still further that the terminal can be connected to shore or underwater storage by submarine pipelines.

I claim:

1. A deep water ship terminal adapted to be anchored or free flowing and/or to be connected by pipe lines to shore or underwater storage, and comprising, in combination:

- a. a number of usually submerged, horizontally disposed, watertight, terminal stabilizing storage and/or ballast tanks;
- b. means for structurally tying said tanks in a generally parallel, laterally spaced, level banked array;
- c. an above-water, horizontal wing structure proportioned to accommodate one or more tankers or other ships at berths along at least its longer sides;
- d. a plurality of parallel rows of vertical struts interconnecting said wing structure and at least some of said tanks,
- said strut rows spaced to define self-contained slips for safe berthing of barges; and
- u. concentric inside cylinders comprised in at least some of said vertical struts and providing access trunks from said wing to said tanks for ducts, pipes, conduits, and human access;
- said tanks and struts supplying to the terminal substantial storage capacity, and
- said tanks and struts supplying also substantial ballast volumes controllable to achieve varying drafts, and controllable more generally to provided: better sea and position keeping; improved adaptation to berthed tankers, bulk carriers and other ships and barges; and reduced motion response.

2. A deep water ship terminal according to claim 1, and

e. hydraulic or other mooring and/or fendering means associated with said wing structure for safe berthing of large ships alongside.

3. A deep water ship terminal according to claim 1, and

f. loading and off loading facilities for transfer of cargo via the terminal between ship and ship, or between ship and barge, or between ship and pipeline.

4. A deep water ship terminal according to claim 1, wherein said vertical struts comprise cylinders of uniform length and proportion, and

g. bracket means at and rigidifying the junctures of said cylinders with said wing structure.

5. A deep water ship terminal according to claim 1, and

h. roller bumper and/or other fender means supported within said struts to engage said barges, and thereby further defining said slips.

6. A deep water ship terminal according to claim 1, and

i. truss means spanning between said tanks and joined to said struts, and wherein said struts are of a length to accord freedom of relative vertical movement to said barges above said truss means.

7. A deep water ship terminal according to claim 1, wherein said horizontal tanks comprise cylinders terminating in rounded, projecting end closures.

8. A deep water ship terminal according to claim 1, wherein said horizontal tanks comprise cylinders of uniform section and of substantially the length of said wing structure.

9. A deep water ship terminal according to claim 1, wherein said struts and tanks define storage and/or ballast volumes, and

j. means for charging and discharging liquid cargo and/or water to and from said volumes.

10. A deep water ship terminal according to claim 1, wherein said horizontal storage tanks comprise one or more series of closely spaced, shorter cylinders spanning between said strut rows, and

k. transverse girder means joined to said shorter and to said strut-joined cylinders, said girder means ordering and strengthening said shorter cylinders in lateral banks.

11. A deep water ship terminal according to claim 10, wherein said shorter cylinder banks extend equally-oppositely of the longitudinal center of the terminal and intermediate said barge slips.

12. A deep water ship terminal according to claim 1, and

l. terminal strengthening and stiffening braces or guys criss-crossed between said struts.

13. A deep water ship terminal according to claim 12, and

m. girders at and stiffening the intersections of said braces or guys.

14. A deep water ship terminal according to claim 1, and

n. means carried by said tanks for anchoring the terminal.

15. A deep water ship terminal according to claim 1, and

o. propulsor means carried by said struts or tanks for maintaining or moving the terminal into position.

16. A deep water ship terminal according to claim 1, wherein said wing structure comprises

- p. a rigid core structure,
- q. panel sides, and
- r. a top or deck.

17. A deep water ship terminal according to claim 16, wherein said wing core structure is built up of girders.

18. A deep water ship terminal according to claim 16, wherein said wing core structure is of bulkhead-web construction.

19. A deep water ship terminal according to claim 16, wherein said deck is recessed to provide openings uncovering said barge slips, and wherein said wing structure further comprises

- s. girders spanning across the slip-uncovering deck openings at suitable, cargo-admitting intervals.

20. A deep water ship terminal according to claim 16, wherein said wing structure further comprises

- t. ballast-storage tanks provided within said core structure.

21. A deep water ship terminal according to claim 1, wherein said struts and tanks are reinforced by longitudinal ring or bulkhead type stiffeners.

22. A deep water ship terminal according to claim 1, wherein the arrangement and ballasting of said horizontal tanks is to provide a very large added mass and vertical inertia, reducing to substantially zero the vertical movement response of the terminal to wave motion.

23. A deep water ship terminal according to claim 1, wherein the terminal is constructed and arranged to have a very small water plane area for displacement, yielding negligible motion in severe weather.

24. A deep water ship terminal according to claim 1, wherein the terminal is constructed and arranged to have a low center of gravity in relation to its center of buoyancy, permitting heavy loads to be placed on said wing structure.

25. A deep water ship terminal according to claim 15, wherein said propulsors are at least two propulsors incorporated into the bottom of the four corner struts or the extreme ends of the outboard of said horizontal tanks and operable for position keeping and also for moving the terminal into position.

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