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(54) **A VEHICLE FERRY HAVING ENHANCED FLOODING SURVIVAL CAPABILITY COMBINED WITH UNIMPEDED FLOW OF RO-RO TRAFFIC.**

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GB-A- 2 206 544

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Description

This invention relates to a vehicle ferry vessel having enhanced flooding survival capability, combined with unimpeded flow of RO-RO traffic.

It is known to provide a ferry vessel with a continuous main vehicle deck some distance, referred to as freeboard, above the waterline to which deck all of the transverse watertight subdivision bulkheads in the lower hull extend. To comply with International Maritime Organisation regulations, damage resulting in the flooding of one or more of the compartments between the subdivision bulkheads shall not result in the vessel settling deeper and/or listing to Port or to Starboard beyond seven degrees at which angle the margin line, being a line 75 millimetres below the main deck edge, shall not be immersed. It is an essential feature of efficient RollOn - Roll Off vehicle ferries that stern doors, alternatively stern and bow doors, shall provide ready access to the full lengths of lanes of traffic with the minimum of obstructions. The combination of existing I.M.O. regulations and the provision of unobstructed traffic lanes typically lead to the design of the vehicle deck space being an open space, or through deck, extending from stern door to bow doors. Whilst ferry vessels built to I.M.O. regulations and meeting through traffic flow requirements are satisfactory in an undamaged, or unflooded, vessel there are serious shortcomings when flooding of the main vehicle deck occurs due to side collision, breaching of bow or stern door, or other cause. The presence of seawater, especially large areas of flooding,, creates a "free surface" effect which can rapidly destroy the vessel's transverse stability resulting in a capsize situation.

The obvious solution of extending the subdivision transverse watertight bulkheads upwards to the upper deck level to break-up the main vehicle deck area, and the provision of watertight doorways in the bulkheads in line with the lanes of RO-RO traffic, results in time delays during loading and unloading of the vessel together with substantial loss of useable lane lengths due to interruptions of the vehicle flows. Such delays and space loss seriously detract from the economics of RO-RO ferry operations.

The present invention seeks to provide a vehicle ferry vessel with enhanced stability against capsize whilst not detracting from the uninterrupted vehicle lane lengths so vital for efficient RO-RO operations.

Accordingly, the invention provides a ferry vessel having in the main vehicle deck space twin side casings extending longitudinally, which casings have at their forward and after extremities large watertight doors co-planar with the casings, and capable of being closed by power operation to seal the gaps between the casing ends and shipside structures adjacent the bow and stern doors. The casings, which are permanent watertight structures, in combination with

the longitudinally closing doors, effectively divide the vessel into three longitudinal watertight compartments with minimal effect upon RO-RO traffic whilst effectively reducing the areas of deck liable to flooding following damage or other cause.

An increase in freeboard is achieved by extending upwards the tops of the transverse subdivision bulkheads in the form of a stepped "U", being high outboard and low inboard. The depth of the "U" step may be shallow in the order of one metre, or deep in the order of two and a quarter metres. The main vehicle deck extends fore and aft over the tops of the bulkheads giving raised side decks outboard of the casings, and a lower centre deck between the casings. Whilst some loss of vehicle height is unavoidable in the lanes outboard of the casings, displaced cars can be located in the upper superstructure which is not an uncommon practice. The stepped deep "U" formation provides useable cabin and storeroom spaces below the raised side decks, also the deep stepped "U" formation raises the margin line substantially approximately doubling the angle of heel before immersion of the deckedge and consequent commencement of flooding of the vehicle deck.

Additional to use for cabins and storerooms, the spaces below the raised side decks Port and Starboard provide ideal locations for one, or more, sets of power operated floodgates which would be positioned adjacent transverse subdivision bulkheads. The outboard floodgates in the form of single panels rise vertically to act as waterbarriers thus dividing the outboard longitudinal compartments into two, or more, small areas. The centre floodgate, or floodgates, each comprise single panels moving horizontally inboard from Port and Starboard to engage with a pillar at the centreline which rises vertically from the main deck, thereby dividing up the floodable area of the centre longitudinal compartment.

Viz - a - viz prior art vehicle ferries, a ferry vessel of the invention has increased freeboard and raised margin line; has the "free surfaces" of floodwaters much reduced; has large reserves of outboard buoyancy to provide righting moment and to maintain a damaged vessel at an angle of loll; has additional hull structure to reduce the depth of penetration of a side collision; and the effects of transverse slippage of vehicles at large angles of heel are reduced.

The foregoing benefits are achieved with only a very small rise, if any, in the vessel's centre of gravity; with minimal effect upon conventional ship structure; and without impediment to existing lifesaving appliances practice.

A preferred embodiment of the invention will now be described, though by way of illustration only, with reference to the accompanying drawings in which :-

Figure 1 is a transverse section through a prior art vehicle ferry having one centre casing.

Figures 2 and 3 are respectively the top plan

views at the main vehicle deck and upper vehicle deck levels of the ferry shown in Figure 1.

Figure 4 is a transverse section through a prior art ferry having twin casings separated athwartships.

Figures 5 and 6 are respectively the top plan views at the main vehicle deck and upper vehicle deck levels of the ferry shown in Figure 4

Figures 7 and 8 are respectively the top plan views at the main vehicle deck and upper vehicle deck levels of the ferry shown in Figures 4, 5, and 6, with the casings extended fore and aft, and with the addition of large watertight doors to divide the vehicle decks into three watertight compartments athwartships.

Figure 9 is a transverse section of a vehicle ferry having twin casings and the main vehicle deck levels, forming the tops of the transverse subdivision watertight bulkheads of the lower hull, of stepped shallow "U" formation.

Figure 10 is a transverse section of a vehicle ferry having twin casings and the main vehicle deck levels of stepped deep "U" formation.

Figures 11 and 12 are respectively the top plan views at the main vehicle deck and upper vehicle deck levels of the ferry shown in Figure 10.

Figure 13 is a diagram showing in perspective the side casing and preferred watertight door arrangement.

Figure 14 is the same transverse section as Figure 10 with the addition of floodgates.

Figures 15 and 16 are respectively the top plan views at the main vehicle deck and upper vehicle deck levels of the ferry shown in Figure 14, with floodgates and all longitudinal doors closed.

Figure 17 is a transverse section of a medium sized vehicle ferry having a single vehicle deck of stepped deep "U" formation.

Figure 18 is a transverse section of a small vehicle ferry having a single vehicle deck of stepped deep "U" formation.

Vehicle ferries of prior art customarily have in their vehicle deck spaces a longitudinally disposed casing located across, or close to, the centreline of the vessel which, amongst other functions, serves to house the propulsion engine exhaust pipes to the funnel; encloses access stairways for passengers and crew; and provides support for hoistable car decks. Alternatively it is known to provide twin casings to Port and Starboard instead of a single centreline casing.

Prior art ferries having single and twin casings, respectively on Sheets 1/8 and 2/8, together with vehicle ferries of the invention on Sheets 3/8 through 8/8, are shown on the accompanying drawings in which the main vehicle deck 1 extends from the bow doors 2 to the stern door 3. Casings 4 extend upwardly from the main vehicle deck 1 to, and through, the upper vehicle deck 5 which on large vehicle ferries is

normally a vehicle deck having at the forward and after ends of the superstructure watertight access doors, respectively 6 and 7.

The raised side decks 8 of the main vehicle deck 1 in the preferred embodiment of the invention slope down at their ends in the form of fixed ramps 9 to the level of the centre main vehicle deck 1. The vessel is provided with large doors 10 arranged to roll or fold substantially longitudinally in the preferred embodiment of the invention, which close watertight to the shipside structure adjacent the bow doors 2 and stern door 3.

On large vehicle ferries having upper vehicle decks, similar large watertight doors 11 close watertight to the superstructure adjacent the forward door 6 and the after door 7. To facilitate free traffic flow over the ramps 9 leading to, and from, the raised side decks 8, each ramp is preferably provided with a hinged section shown lowered to working position 12, and stowed 13 clear outboard of doors 10.

The spaces below the raised side decks in a ferry vessel having stepped deep "U" formation of the tops of the transverse subdivision bulkheads house one, or more, sets of floodgates. Each set of floodgates comprises vertically rising single panels 15 outboard to divide the floodable area of the outboard vehicle decks 8 into the smaller areas 8a and 8f, and horizontally inward moving panels 16 in conjunction with rising centreline pillar 17 to divide the floodable area of the centre vehicle deck 1 into reduced areas 1a and 1f. The height of the centre floodgates does not interfere with hoistable car deck sections 18.

Claims

1. A vehicle ferry vessel with bow and or stern doors (2,3) and having twin permanent side casings 4 arranged watertight athwartships and located longitudinally to Port and to Starboard of the vessel's centreline, together with two or four large watertight doors (10) of proximately the same height as the casings and each door of sufficient length when closed to bridge the gap between the fore, and or aft, extremity of the casing (4) and the forward, and or after, shipside structure adjacent the bow, and or stern, door.
2. On a ferry vessel having twin permanent side casings (4) as in Claim 1 and having a stern door and no bow door, or *vice-versa*, only two large watertight doors (10) fitted at the extremities of the side casings adjacent the stern, or bow, door whilst the opposite ends of the casings continued forward, or aft, as permanent structures to merge with the shipside thus obviating any gaps athwartships.

3. A ferry vessel as in Claims 1 or 2 in which most of the transverse subdivision watertight bulkheads in the lower hull terminate at their top edges in a stepped substantially "U" formation which may be shallow or deep and having the high levels (8) at the shipsides outboard of the side casings and the low level (1) inboard of the longitudinal side casings, such step preferably of depth to permit the spaces outboard of the longitudinal casings to be utilised for cabins and store-rooms.
4. A ferry vessel as claimed in the preceeding claims in which the higher side parts of the stepped "U" formation (8) enclose at one or more locations along the length of the vessel and adjacent one or more of the transverse hull subdivision bulkheads, a system of inwardly and upwardly closing watertight floodgates (16,16,17) arranged to cause minimum obstruction to the loading or unloading of RO-RO traffic.

Patentansprüche

1. Eine Autofaehre mit Bug- und/oder Hecktueren (2,3) und mit zweifachem Seitengehaeuse (4) wasserdicht dwarsschiffs arrangiert und laengs zum Backbord und Steuerbord der Schiffsmittle angelegt: mit zwei oder vier grossen wasserdichten Tueren (10) von ungefaehr der gleichen Hoehe wie das Gehaeuse: jede Tuer lang genug, um die Luecke bei geschlossenem Zustand zwischen dem Vorder-und/oder Achterdeck am aeuussersten Ende des Gehaeuses zu ueberbruecken (4): die Vorderseite und/oder Rueckseite des Schiffsseitenbaus grenzt an die Bug und/oder Hecktuer.
2. Auf ein Schiff, welches mit zweifachem Seitengehaeuse (4), wie unter Punkt 1.. und mit Hecktueren aber ohne Bugtueren, oder umgekehrt ausgeruestet ist: zwei grosse wasserdichte Tueren (10), angebracht an das aeuusserste Ende des Seitengehaeuses, angrenzt an die Heck-oder Bugtuer: man vermeidet jegliche Luecken dwarsschiffs indem die gegenueberliegenden Seiten des Gehaeuses konstruktional nach vorne oder hinten verlaufen, sodass sich die Schiffsseiten verbinden.
3. Ein Schiff, wie schon in Punkt 1, und 2, erwaeht, in welche die meisten wasserdichten Schottn des unteren Rumpfes am oberen Ende in einer stufenfoermigen "U" Formation aufhoeren, welches flach oder tief sein kann: der Hoehenpegel (8) ist an der Schiffsseite am aeuusseren Seitengehaeuse und der Tiefstand (1) im inneren des

laengsseitigen Gehaeuses: diese Stufe muss wenn moeglich tief genug sein, um Platz fuer Kabinen und Vorratskammern ausserhalb des laenglichen Gehaeuses zu lassen.

4. Ein Schiff, wie in den Vorgaengen erwaeht, in welche die hoeheren Scitenteile der stufenfoermigen "U" Formation (8) eine oder mehrere Stellen laengs des Schiffes an einem oder mehreren Schottn, umgeben: ein System, an welche wasserdichte Schleusentore (16,16,17) angeordnet sind, die man nach innen und oben schliessen kann, um ein Minimum an Hindernissen beim Ent- und Verladen der Fahrzeuge zu verursachen.

Revendications

1. Un ferry porte-vehicules à manutention horizontale ayant une porte d'étrave et/ou une porte arrière (2,3) et deux cloisons de muraille permanentes (4) disposées étanches transversalement et placées longitudinalement à bâbord et à tribord de l'axe du navire, ainsi que deux ou quatre grandes portes étanches (10) d'environ la même hauteur que les cloisons, chaque porte étant assez longue pour relier les bords de la brèche entre les extrémités de l'avant et/ou de l'arrière de la cloison et de l'avant et/ou de l'arrière de la structure du bordé du navire contiguë à la porte d'étrave et/ou la porte arrière.
2. Sur un transbordeur ayant deux cloisons de muraille (4) tel que décrit au Droit numero 1 ci-dessus, et avec une porte arrière mais sans porte d'étrave, ou vice versa, seulement deux grandes portes étanches (10) installées à l'extrémité de la cloison de muraille, contiguë soit à la porte d'étrave, soit à la porte arrière, tandis que les bouts opposés des cloisons continuées soit vers l'avant, soit vers l'arrière, comme structures permanentes pour rejoindre les bordés du navire, évitant ainsi des brèches transversales.
3. Un transbordeur tel que décrit au Droits 1 et 2 ci-dessus, à bord duquel la plupart des cloisons étanches de compartimentage transversal de la partie inférieure de la coque se terminent sur leur bord supérieur en décrochement en forme d'"U" assez prononcé, qui pourrait être soit faible, soit profond, et ayant les hauts niveaux (8) sur les bordés du navire à l'extérieur des cloisons de muraille, et le bas niveau (1) à l'intérieure des cloisons de muraille longitudinales, lequel décrochement de préférence suffisamment profond pour permettre l'utilisation des locaux à l'extérieur des cloisons longitudinales pour faire des cabines et

des magasins.

4. Un transbordeur tel que défini dans les Droits précédents, sur lequel les parties supérieures du côté du décrochement en forme d'"U" (8) enferment à un ou plusieurs endroits le long du navire, et contigu à une ou plusieurs des cloisons de compartimentage transversale de la coque, un système de portes écluses étanches (16,16,17), qui ouvrent vers l'intérieur ou vers le haut, disposées de façon à réduire au minimum les obstacles au chargement et déchargement des véhicules.

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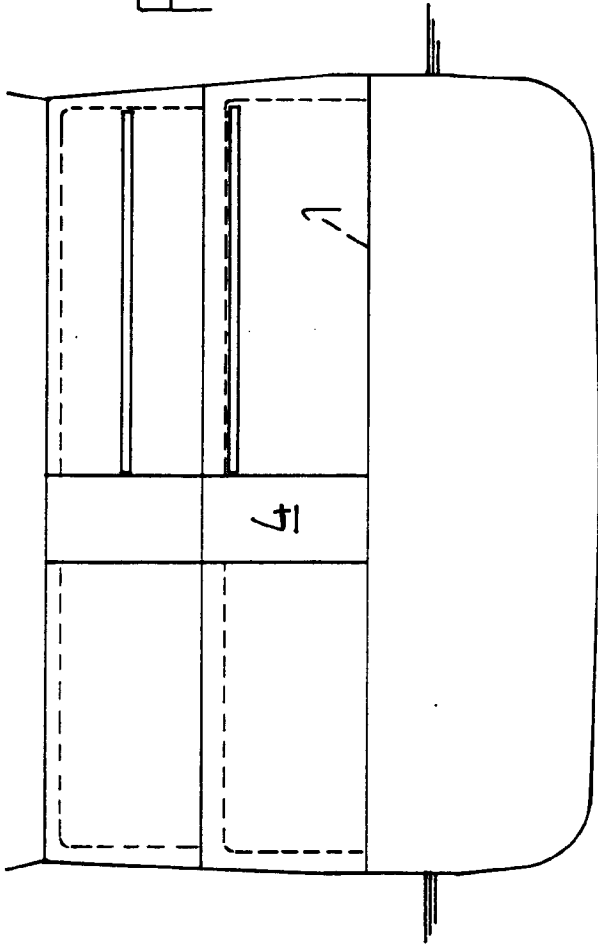


FIG. 1

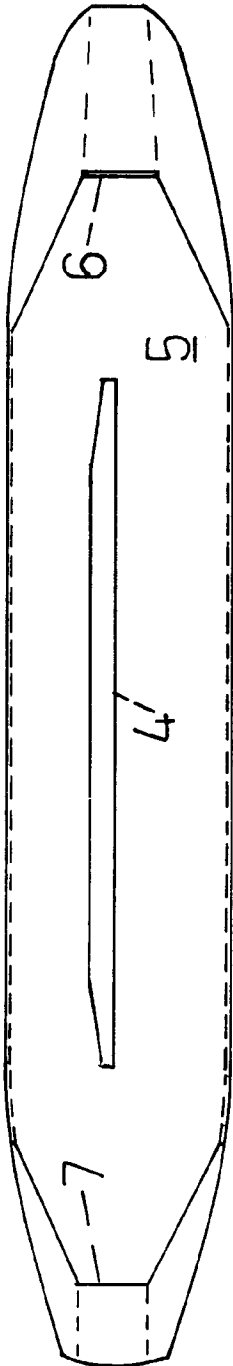


FIG. 2

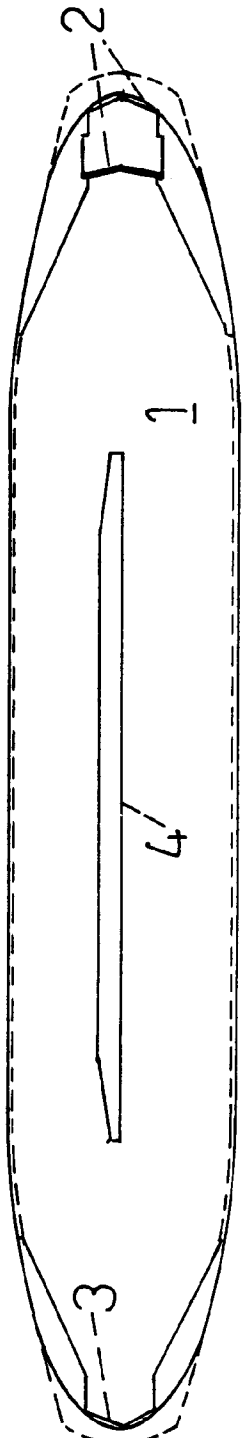


FIG. 3

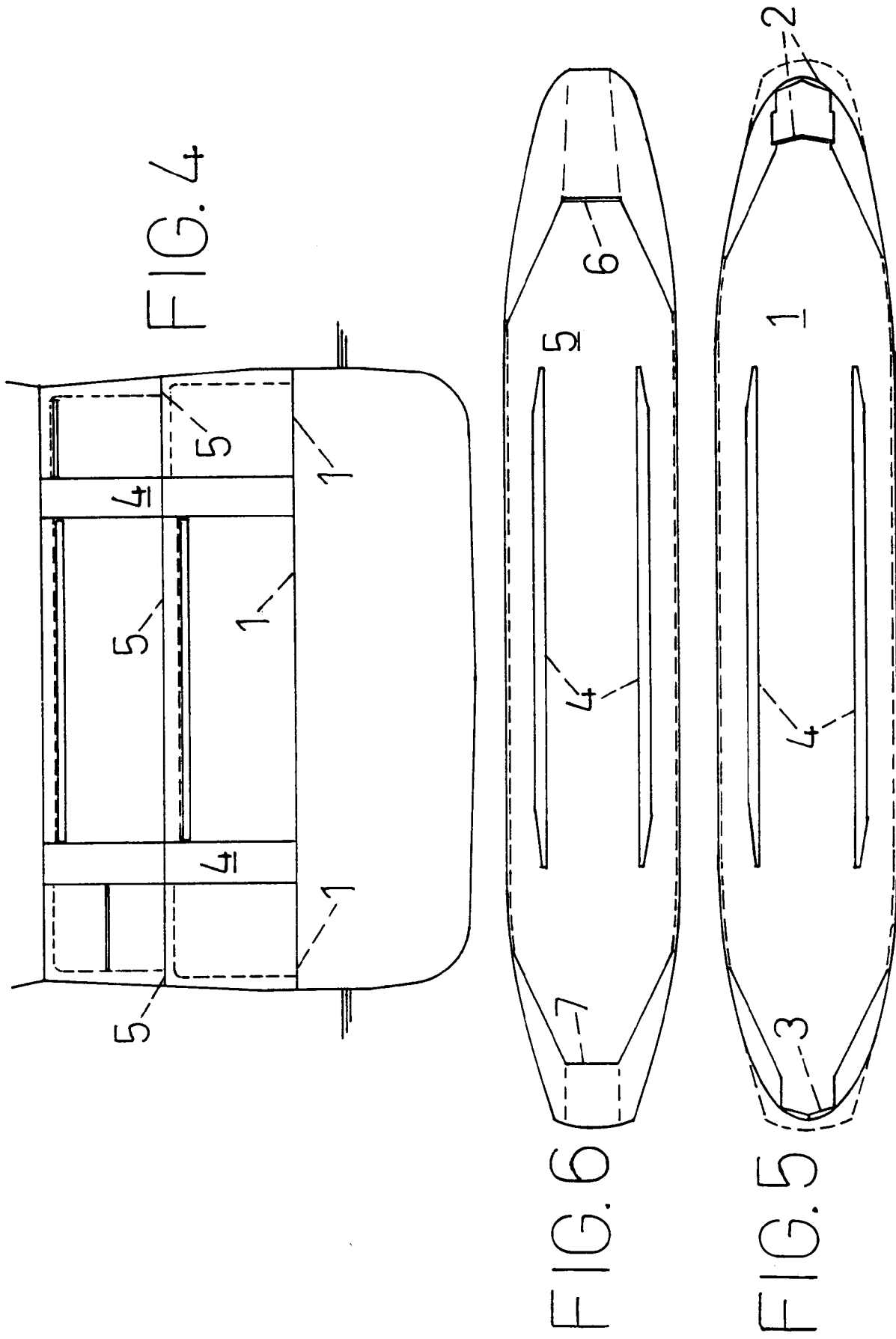
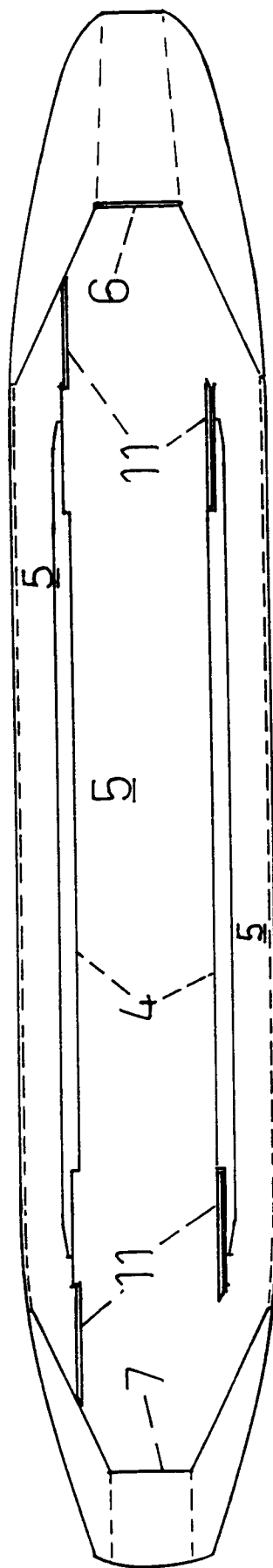
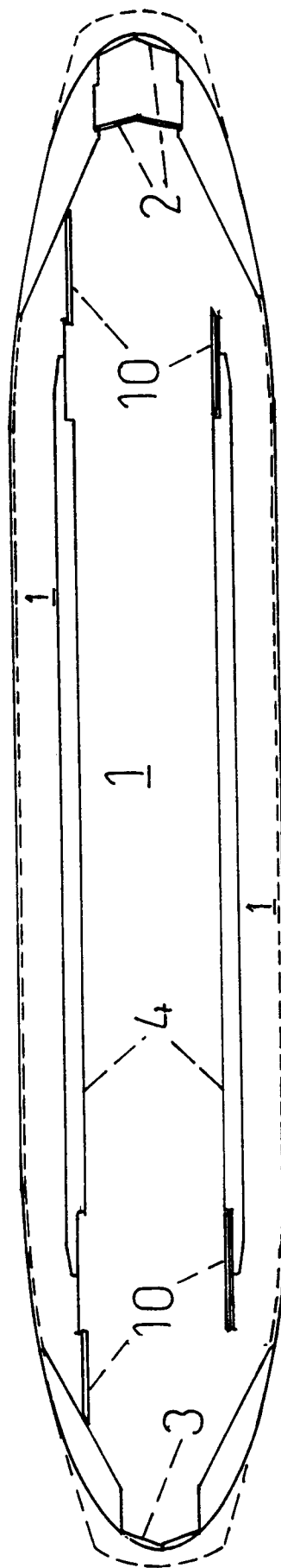


FIG. 8



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FIG. 7



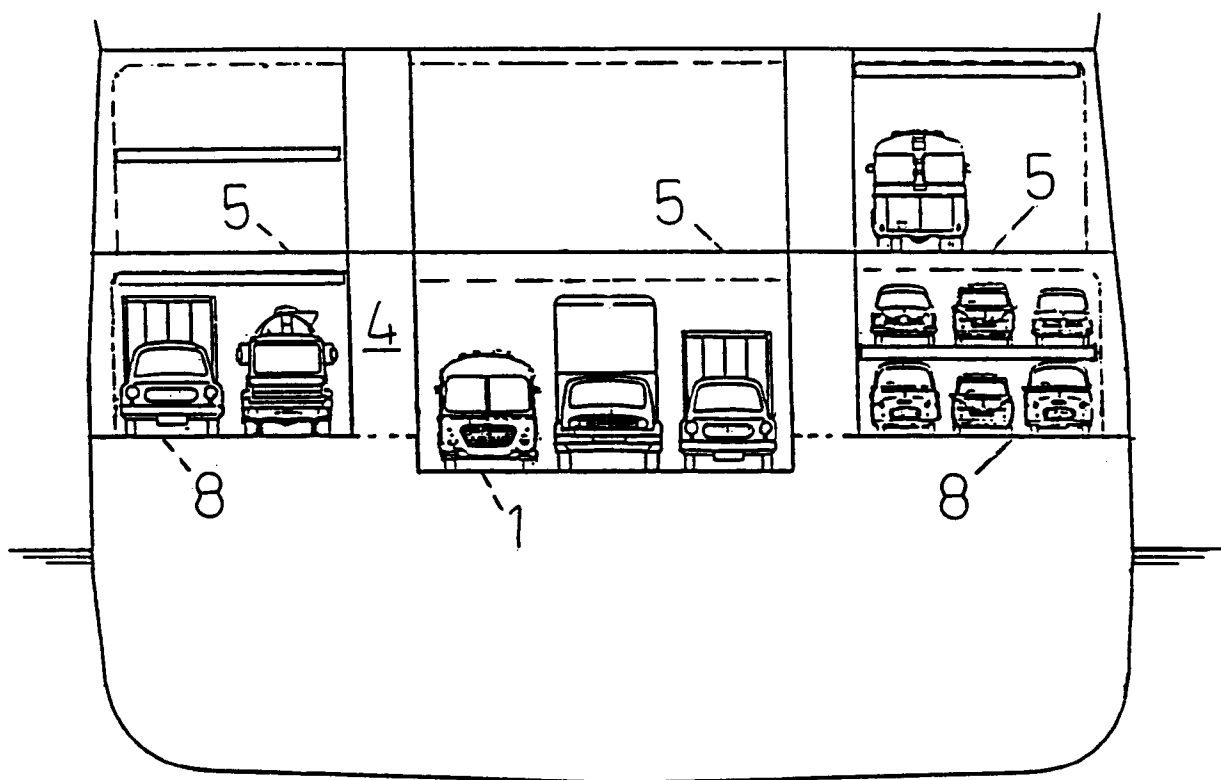


FIG. 9

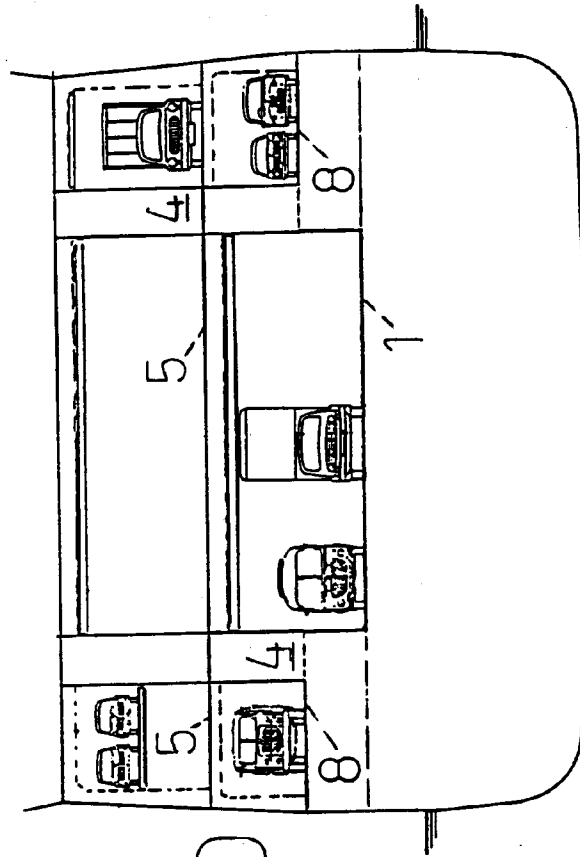


FIG. 10

FIG. 12

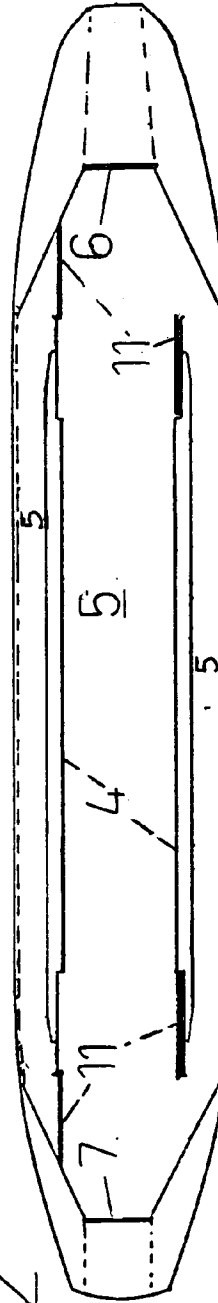
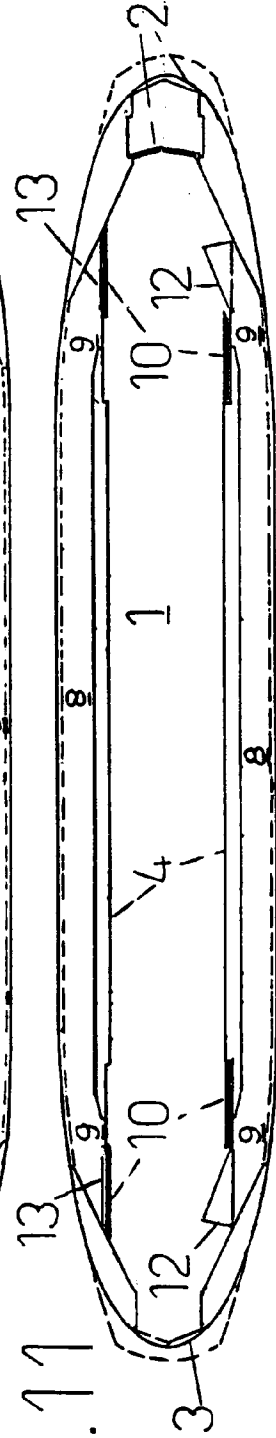
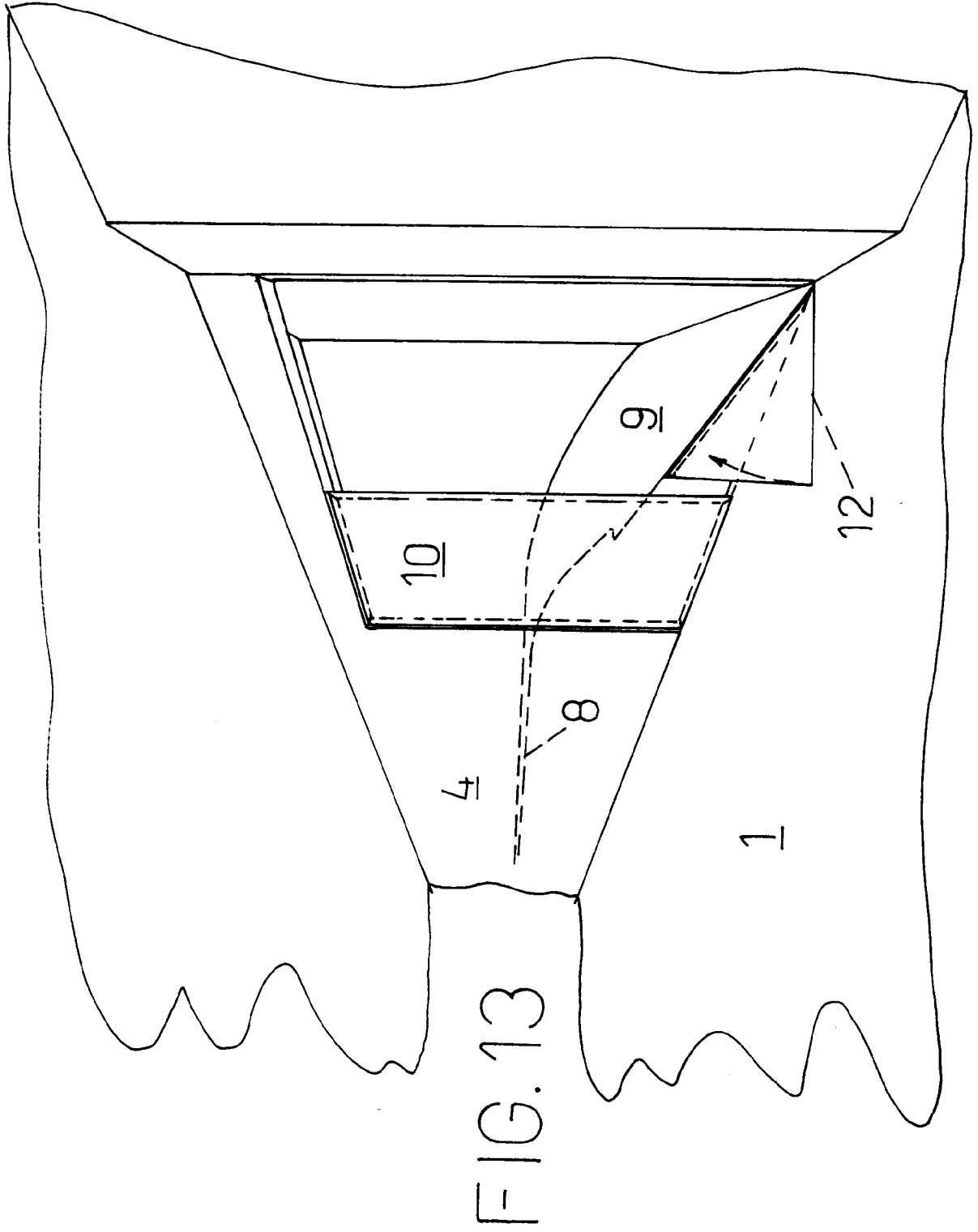


FIG. 11





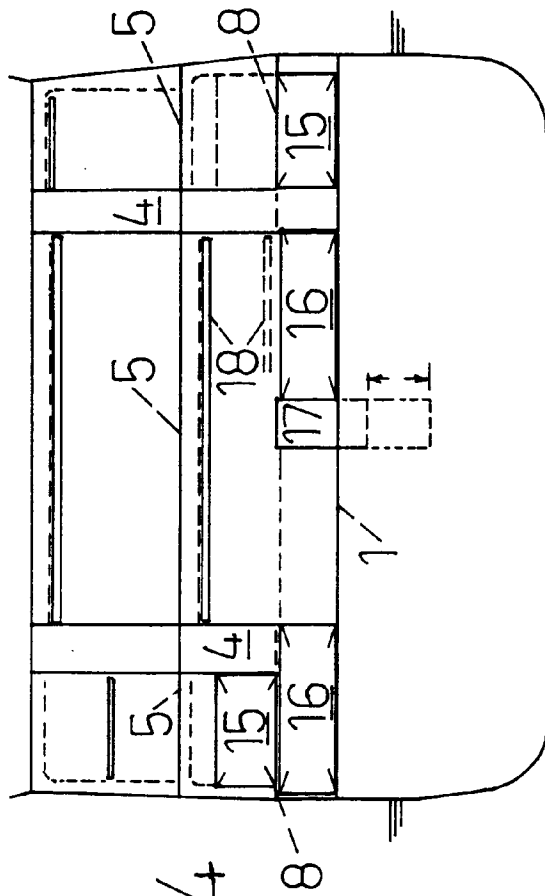


FIG. 14

FIG. 16

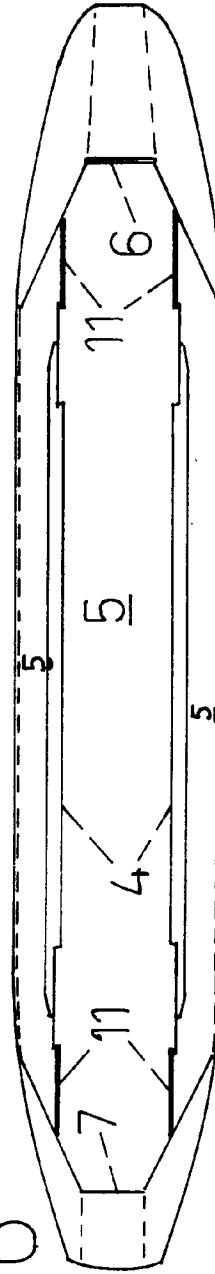


FIG. 15

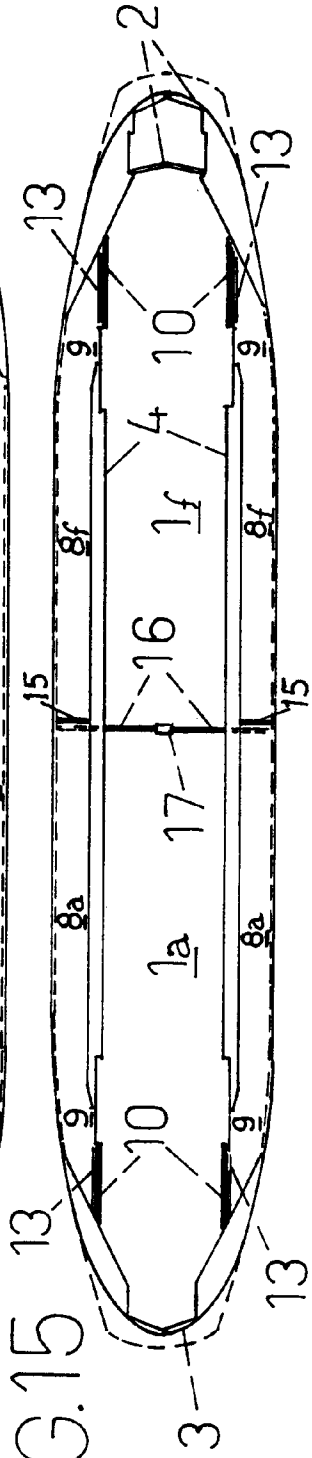


FIG.17

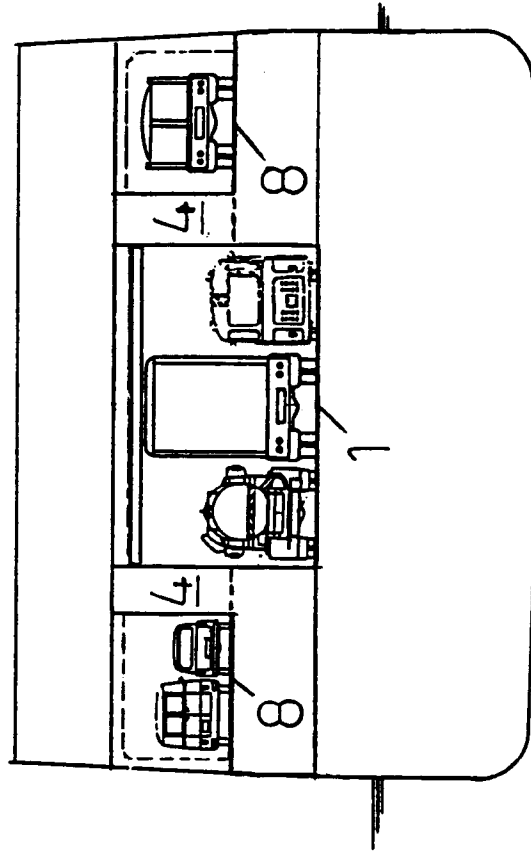


FIG.18

