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CATAMARAN-TYPE MARINE CRAFT

The invention relates to a catamaran-type marine craft comprising two hulls which are arranged spaced apart and substantially parallel to one another, which extend in the direction of travel and which have top portions; a connection structure connecting said two hulls together at said top portions; and a transverse deck sealing said connection structure at a bottom portion thereof. The invention can fundamentally also be used with multiple hulled marine craft with more than two floats.

In particular the invention relates to a catamaran-type air cushion craft comprising two hulls or floats arranged spaced apart and parallel to one another and which extend in the direction of travel, with the cross-section of the hulls broadening from the bottom to the top and with the hulls being connected together at the top by a deck structure; resilient skirts arranged at the stem and at the stern between the hulls, with the skirts extending at least approximately to the water surface and bounding, together with the hulls, an air chamber between the base of the deck structure and the surface of the water; main propulsion units which drive thrust means disposed in the stern

1 region of the hulls; and fans which blow air sucked
from the outside into the bounded air chamber beneath
the floor of the deck structure to lift the marine
5 craft from travel in the displacement mode to travel in
the air cushion mode.

Such marine craft are particularly suited for air
cushion operation because the floats or hulls, which
10 are still somewhat submerged during travel in the air
cushion mode, represent a trouble-free sealed lateral
boundary of the air chamber for the air cushion, so
that resilient skirts only need to be arranged at the
stem and at the stern between the hulls to additionally
15 bound the relevant air chamber towards the stem and the
stern.

The disadvantage of such known catamaran air cushion
craft (Naval Engineers Journal, May 1984, pages 77 to
20 93) is the fact that they are primarily laid out for
ideal air cushion operation whereas travel in the
displacement mode represents, in the final resort, an
undesired state of travel adopted for example only
during manoeuvring in harbour, on failure of the air
25 cushion drive, or in heavy seas, and which is only
provided because it cannot be avoided in the cited
circumstances.

In a known catamaran-type air cushion craft the hulls
30 have a significantly broadened hull section, which is
in particular broadened out in step-like manner and
which extends along a substantial fraction of their
total length, substantially above the displacement
float region which is submersed during travel in the
35 displacement mode. The significantly broadened hull
section serves to accommodate the main propulsion
units, with the deck structure being attached to the
top end region of the broadened hull sections. In this

1 way it is ensured that travel in the displacement mode
is a state of travel of equal value to travel in the
5 air cushion mode in which ideal conditions are present
both from the point of view of economy and from the
point of view of stability and travel comfort. An ideal
behaviour of a catamaran-type air cushion marine craft
also in the displacement mode of travel is of
particular significance when the marine craft is used
10 as a warship, because the sinking of the marine craft
from travel in the air cushion mode into the
displacement mode makes it more difficult to locate
from a distance.

15 The present invention now seeks to provide a
catamaran-type marine craft which has a particularly
stable connecting structure which is stiff against all
the forces which occur due to movement of the sea, in
particular bending and torsional forces, and which, in
20 addition to its function as a basic stabilising body
for the entire marine craft, also makes it possible to
carry all the important built-in structures of the
marine craft which are not accommodated in the hulls,
which are in particular especially broad at the top, in
25 a simple but nevertheless reliable manner.

The marine craft of the invention should be extremely
economical to manufacture, to operate, to convert and
to repair, should require only a small crew, should
30 have good seagoing ability and should also be able to
stay at sea for a relatively long time. The range
should at least correspond to medium requirements. A
broad speed spectrum with a large variation in
displacement should also be ensured. The draft of the
35 marine craft should be average to small. The invention
is in particular intended for catamaran-type marine
craft up to a displacement of approximately 600 tons.

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In order to satisfy this object the invention provides that the connection structure comprises a plurality of trussed girders arranged parallel to each other transverse to the direction of travel; that said plurality of transverse trussed girders comprises at least first and second pairs of transverse trussed girders with the transverse trussed girders of each pair being spaced apart from each other in the direction of travel by a distance sufficient to provide a transversely extending passageway sufficiently large for persons; in that some of said girders are spaced apart in the direction of travel from an adjacent one of said girders by a distance sized to provide a space for accommodating a row of containers disposed transverse to the direction of travel; that a row of containers and at least one longitudinal passageway are provided in said space, with said longitudinal passageway extending in the direction of travel and defining a passageway for persons, and with said containers and said longitudinal passageway being carried by the adjacent ones of said plurality of girders; and that said transversely extending passageways provide access to said at least one longitudinal passageway and to said containers.

In this arrangement the girders conveniently define hollow cavities for accommodating service and supply lines.

The thought underlying the invention is thus to be seen in the fact that the two hulls are not as it were stably connected with one another by complete deck structures but instead by quite special double transverse trussed girders which however, apart from the function of accommodating all the forces which occur at and between the hulls, also have hollow cavities for transverse passageways and take on a

1 further function in that they carry the containers and
longitudinal passage and supply elements which are
suspended between them.

5 It will be understood that the term double transverse
trussed girder as used herein means a girder which
consists of two single transverse trussed girders
arranged at a small distance in the longitudinal
10 direction of the ship and rigidly connected together,
with the width and the height of the double transverse
trussed girders being such that a transverse passage
appropriate to the size of average people can be
arranged in the interior. This double construction
15 results, on the one hand, in excellent stability of the
marine craft against bending and twisting forces and
provides, on the other hand, a hollow cavity extending
in the transverse direction in which it is possible to
accommodate not only passageways through which people
20 can walk but also hollow cavities for the laying of
lines which must be laid between the two hulls, or also
lead from the hulls or containers to the bridge or to
other units within the marine craft.

25 Because of the high bending and torsional stiffness of
the double transverse trussed beams it is sufficient,
in accordance with a particular preferred embodiment,
for the connecting structure to include a single
transverse trussed girder arranged between said first
30 and second adjacent pairs of transverse trussed
girders. As the single transverse trussed girders are
lighter and less complicated to manufacture it is
possible in this way to manufacture a very stable
ship's structure with reduced weight and cost.

35 It is particularly advantageous if a pair of transverse
trussed girders and single transverse trussed girders
are alternately mounted in the direction of travel

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1 between the hulls.

5 For the economical manufacture of air cushion craft in
accordance with the invention it is expedient if the
distances between adjacent transverse trussed girders
spaced to receive a row of containers are identical. In
this way standardised containers can be arranged at any
desired positions between the transverse trussed
10 girders and can, if necessary, also be interchanged.
This embodiment thus enables in particular the
economical manufacture of series ships with a modular
construction.

15 The construction is preferably such that the containers
and the longitudinal passageway elements are mounted at
the front and rear sides in each case to a transverse
trussed girder. All the container and longitudinal
passageway elements are thus suspended, in accordance
with the invention, at the connection structure at only
20 two sides which is useful for economical installation
and removal and which considerably reduces the cost and
effort of securing these components.

25 More economical installation and removal is also served
by a further embodiment which is characterised in that
the containers and the longitudinal passageway elements
are introducable from at least one side in the
transverse direction into their position between two
adjacent transverse trussed girders. In this manner the
30 ship's structure consisting of the hulls and transverse
trussed girders can be completed as a basic structure
while the containers and the passageway elements are
manufactured in parallel at other places of
manufacture. After the basic structure of the ship has
35 been completed then, in accordance with the present
preferred embodiment, all the built-in structures can
be introduced and installed into the basic ship's

1 structure in the shortest possible time.

5 It is expedient for good bending stiffness and
connection stiffness for each transverse trussed girder
to have a top chord, a bottom chord and trusses or
struts arranged therebetween. In order to provide the
required passageways in the longitudinal direction of
10 the ship and to simultaneously ensure good stability
each transverse trussed girder should have, in
accordance with a further preferred embodiment of the
invention, trussed sections and passage sections.

15 In order to be able to exploit the entire height
between the top and bottom chords for the arrangement
of passageways which can be walked through, line
carrying passages are expediently provided in the top
and/or bottom chords so that the lines can be laid
between the top and bottom chords outside of the
20 intermediate space.

25 As already mentioned the double transverse trussed
girders are expediently assembled from two single
transverse trussed girders which are spaced apart in
the direction of travel of the ship. In this
arrangement the single transverse trussed girders are
preferably identical with the single transverse trussed
girders which are arranged between each double
transverse trussed girder. This makes economical
30 manufacture of both the single and double transverse
trussed girders possible.

35 In order to realise torsionally stiff double transverse
trussed girders, which can however be walked through,
longitudinal connectors are provided at transverse
intervals at the top and at the bottom between the
pairs of single transverse trussed girders which
jointly form each double transverse trussed girder.

1 Furthermore, the invention envisages, for the provision
of a particularly torsionally stiff basic ship's hull,
5 that sequential transverse trussed girders spaced apart
by a distance for accommodating a row of containers are
connected rigidly together by longitudinal beams
extending in the direction of travel. The longitudinal
beams are, in this arrangement, expediently arranged in
10 each case only at the top and at the bottom of the
transverse trussed girders in such a way that the
containers and the longitudinal passageway elements can
be introduced between them from the side. In this
manner the longitudinal beams can also be fixedly
15 installed before the built-in structures are
introduced. A basic ship's structure which resists all
loadings due to sea motion is thus realised in this way
before any passage elements or containers are
introduced.

20 In order to improve the stability of the basic
structure removable vertical supports are arranged, in
accordance with a further embodiment, between the upper
and lower longitudinal beams at the sides of the craft.
The installation and removal of the passageway elements
25 and containers from the side is made possible by the
removability of the vertical supports.

30 In an air cushion marine craft the lowermost deck which
merely serves for sealing is also made air- and
gas-tight.

35 Although intermediate decks and longitudinal transverse
walls could fundamentally be built into the marine
craft of the invention, it is however preferred, and an
important feature of the invention, for no deck plates
to be provided in the connection structure other than
the lowermost transverse deck, which only serves for

1 sealing, at specific positions between the containers and the longitudinal passageways, and at upper deck surfaces.

5 Moreover, the connection structure should not be provided with longitudinal walls extending in the direction of travel or with transverse bulkheads other than intermediate walls arranged at certain specific
10 positions between the containers and the longitudinal passage and supply elements and at the outer sides of the connection structure.

15 The basic structure thus in practice represents a fundamental skeleton which is stable in every manner and in which the containers, passageway elements and pipe elements are suspended, preferably damped against oscillation and shock.

20 The connection structure is preferably sealed off in water-tight manner at the sides, at the front and at the rear by panels. The mentioned basic skeleton is thus permeable in the interior in the transverse longitudinal and vertical directions and is merely
25 sealed off at the outer surfaces by the panels and also at the top and bottom by transverse decks.

30 An advantageous further development of this embodiment is characterised in that the side panels are so subdivided that they can be removed sectionwise for the introduction or removal of the containers and the passageway elements from the side.

35 The catamaran-type marine craft of the invention is preferably so constructed that the hulls have an inwardly directed projection in the upper region on which the transverse trussed girders and the lowermost deck are mounted at the top.

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This arrangement should in particular be so contrived that the projection is, at a maximum, approximately equally as wide or slightly less wide than the broadest part of the hull which lies beneath it.

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This embodiment is of particular significance because a relatively large width is available here for the connection of the transverse trussed girders with, in particular, the transverse bulkheads of the floats or hulls, which is of assistance for the stability of the whole ship's structure. In particular the free space between the hulls which still has to be bridged by the transverse trussed girders is considerably reduced by this construction.

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A preferred dimensional rule for achieving a particularly good connection and stability is characterised in that the projection is at a maximum approximately just as wide as, or somewhat less wide than, the broadest position of the part of the hull lying beneath it. In order to accommodate as large a part as possible of the forces which occur between the hulls in the region above the hulls at least one trussed section and one passage section are provided, in accordance with a preferred embodiment of the invention, at the side vertically above the associated hull.

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A particularly favourable ratio between the width of the support surface on the hulls and the space between the hulls then exists when from 40 to 55%, in particular 45 to 50% of the length of each transverse trussed girder is arranged in the region above the intermediate space between the hulls, with the rest being arranged vertically above the hulls.

1 If the marine craft of the invention is to have a
higher superstructure then upper pairs of transverse
trussed girders or single transverse trussed girders
5 can, in accordance with a particularly preferred
embodiment, be mounted on the transverse trussed
girders and be of similar construction but shorter.

10 In this arrangement the invention expediently provides
that the upper, transverse trussed girders are still so
long that they extend into the region vertically above
the hulls. The upper transverse trussed girders are
thus supported in their end regions vertically on the
15 hulls via the transverse trussed girders which lie
beneath them, which serves for the transmission of
forces in a manner, which does not load the individual
components and welded connections to too great a
degree.

20 Transverse rails for the running in and running out,
and optionally for the securing of the containers
and/or the longitudinal passageway elements are, in
accordance with a further embodiment, provided at the
front and/or stern sides of the transverse trussed
25 girders for the simple introduction of the containers
and other elements from the side.

30 In connection with this embodiment the containers
and/or longitudinal passageway elements should be
provided with liftable and lowerable rollers engageable
with the associated transverse rails.

35 Although simple catwalks could fundamentally be
installed in the double transverse trussed girders, so
that they can be walked through, it is preferred for
the double transverse trussed girders to contain
transverse passageway elements which are preferably
closed on all sides. In other words tube-like

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passageways which can be walked through and which are closed on all sides are built-into the double transverse trussed girders.

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In order to obtain problemfree transitions between transverse and longitudinal passageways at the desired positions longitudinal passageway connections are arranged, in accordance with a preferred further development of the invention, at the transverse
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passageway elements in the region of the passage sections. With this arrangement longitudinal passageways are expediently attached to the longitudinal passageway connections.

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In order to obtain access to containers which are capable of being walked through from the individual passageways, openings to adjoining containers should, in accordance with a preferred embodiment of the invention, branch off from the transverse passageway
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elements and/or from the longitudinal passageway elements.

The container openings are expediently constructed as passage elements. In particular, these passage elements
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should be resiliently constructed or arranged to ensure the required play for relative movement.

While the horizontal communication paths are formed in or between the transverse trussed girders, vertical
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communication paths are provided, in accordance with a preferred further development of the invention, between containers which are arranged above one another and which, for this purpose, preferably have appropriate

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openings at the top or at the bottom through which for example ladders or stairways can be passed.

It is of particularly significance in connection with the present invention, for the containers, the transverse passageways and the longitudinal passageways to be resiliently suspended on the transverse trussed girders. The construction of a marine craft in accordance with the invention is particularly suited for such resilient suspension because all chambers through which people can walk or which are taken up by shock-sensitive apparatus and systems must in any case be suspended from the rigid basic structure. For the purpose of resilient suspension it is only necessary for shock dampers to be incorporated in the suspension elements in order to ensure the desired shock damping throughout.

In order to provide a ship's superstructure of modular construction the containers and the longitudinal passage and supply elements expediently have a unit dimension corresponding to the spacing of the transverse trussed girders. Furthermore, it is expedient for the containers to have the standardised dimension or an integral multiple of this standardised dimension in the sideways direction. With this arrangement provision can in particular be made for the containers to be provided with one, two and three times the unit dimension.

The invention will now be described in the following by way of example with reference to the drawings which show:

Fig. 1 a schematic partly sectioned sideview of a catamaran-type air cushion craft in accordance with the invention,

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- 1 Fig. 2 a partly sectioned schematic plan view
of the catamaran-type air cushion craft
of Fig. 1 on the line II-II of Fig. 1,
- 5 Fig. 3 a partly sectioned schematic plan view
of the catamaran-type air cushion craft
of Fig. 1 on the line III-III of Fig. 1,
- 10 Fig. 4 a schematic cross-section of a catamaran-
type air cushion craft in accordance with
the invention,
- 15 Fig. 5 a schematic perspective illustration of
a double transverse trussed girder 217
with a single transverse trussed girder 218
attached thereto at a distance,
- 20 Fig. 6 a front view of a single transverse
trussed girder 218 or 231 in accordance
with the invention, with the illustration
being broken away at the right hand side,
- 25 Fig. 7 a section on the line VII-VII in Fig. 6,
- 30 Fig. 8 a twice interrupted or broken away front
view of a double transverse trussed girder
217 or 230 in accordance with the invention,
- 35 Fig. 9 a section on the line IX-IX of Fig. 8,
- Fig. 10 a schematic fragmentary view similar to
Fig. 9 to illustrate the movability and
fixability of the container 214 on a
double transverse trussed girder 217,
- Fig. 11 a view in the direction of the arrow XI
in Fig. 10,

Fig. 12 a schematic view in the direction of the arrow XII in Fig. 10,

5 Fig. 13 a schematic perspective view of a transverse passageway 234 with longitudinal passageway connections 235,

10 Fig. 14 a schematic perspective view analogous to Fig. 13 of a further advantageous embodiment,

Fig. 15 the detail XV of Fig. 14 in an enlarged sectional view,

15 Fig. 16 a cross-section of a container 214'' containing a vertical communication path with laterally attached longitudinal passageway elements 236 shown in a partially sectioned representation,

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Fig. 17 a partially sectioned schematic side-view of two double transverse trussed girders 217, 230 arranged above one another with containers 214'' suspended thereon, with the containers 214'' containing a vertical communication path 239,

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30 Fig. 18 a schematic perspective view of a preferred longitudinal passageway element, and

35 Fig. 19 a perspective view of a further embodiment of a longitudinal passageway element such as can be arranged between two transverse trussed girders which follow one another in the longitudinal direction of the craft, i.e. in the direction of travel.

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In the following description the same reference numerals are always used for the same components or for components which correspond to one another.

5 As seen in Figs. 1 to 4 a catamaran-type air cushion craft in accordance with the invention has two floats or hulls 211 which are parallel to one another and which, together with front and rear air sealing skirts 242, 243 which extend between them and also a lower transverse
10 deck 216, bound an air cushion chamber 210 above the low lying air cushion waterline 207 or the displacement mode waterline 208 or an intermediate waterline, for example 206 lying therebetween. At their top sides the floats 211 are connected with one another by a double
15 transverse trussed girder 217. On some of the double transverse trussed girders 217 there are secured upper double transverse trussed girders 230 which are shorter in length and disposed symmetrically to the central longitudinal axis 205 of the ship. In addition the
20 floats 211 are connected at the top by single transverse trussed girders 218. Upper single transverse trussed girders 231 of shorter length are secured on some of the single transverse trussed girders 218 symmetrically to the central longitudinal axis 205 of the ship.

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Between each pair of double transverse trussed girders 217 of the lower storey 203 (Fig. 1) there is disposed, as seen in the longitudinal direction of the ship in accordance with Figs. 1 to 5, a single transverse
30 trussed girder 218. In the upper storey 204 an upper single transverse trussed girder 231 is provided at the first, third and fourth positions and a single upper double transverse trussed girder 230 is only provided at the second position.

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Each double transverse trussed girder 217, 230 consists of two single trussed transverse girders arranged at a

small spacing in the longitudinal direction of the ship and rigidly connected to one another. These double transverse trussed girders are built-up from a constructional point of view in exactly the same way as the single transverse trussed girders 218, 231.

As can be seen in particular from Figs. 4 to 9 the single transverse trussed girders 218, 230 and the single girders of the double transverse trussed girders 217, 230 consist of a top chord 221 and a bottom chord 222 between which struts or trusses 223 are arranged. The trusses 223 extend however in the width direction of the ship only over trussed sections 219 between which longitudinal passage sections 220 are provided, through which the horizontal communication paths extending in the longitudinal direction of the ship can be laid.

As seen in Figs. 4 and 5 longitudinal passages 224 for conduits are provided in the upper and lower chords 221, 222, preferably in the region of the longitudinal passage sections 220.

As seen in Fig. 4 there are both longitudinal passage sections 220 with door openings 238 for the purpose of access to the containers which have yet to be described, and passageway openings 238' from which longitudinal passageways branch off which extend over practically the whole length of the storey.

As seen in Figs. 1 to 8 transverse hollow cavities 212 for passageways are left within each double transverse trussed girder 217 or 230 in which transverse passageways 234 which are closed all around their periphery in accordance with Fig. 9 can be suspended via resilient shock absorbers or vibration dampers 240, with the width and height of the transverse passageways 234 being dimensioned so that people can walk comfortably

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through them.

Inside the double transverse trussed girders 217, 230 there are provided line accommodating cavities 213, 213' at the top and at the bottom, as seen in Fig. 9, with a subdivision expediently taken place in such a way that the liquid and gas conveying lines are laid in the lower line accommodating cavity, while the electrical lines are laid in the upper line accommodating cavity 213'.

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As seen in Figs. 1 to 3 a double transverse trussed girder 217 and a single transverse trussed girder 218 are in each case arranged one behind the other in the lower storey 203 at uniform intervals in the longitudinal direction of the ship, so that a total of four transverse hollow cavities 212 with transverse passageways 234 arranged therein (Figs. 9, 17) are present. In the upper storey on which the bridge module is secured there is located only one upper double transverse trust girder 230, while the remaining transverse trussed girders are upper single transverse trussed girders 231.

At the top the basic body defined by the transverse trussed girders 217, 218, 230, 231 is closed or clad in water-tight manner by transverse decks 209 at positions where at the top there is no storey located thereabove (for example 204 or 241). Bulwarks 244, which are only indicated in broken lines in Fig. 1, extend all around the upper transverse deck 209.

As seen in Figs. 1 to 3 the longitudinal intermediate spaces A between sequential transverse trussed girders 217, 218 or 230, 231 are all of the same length so that correspondingly dimensioned standardised containers 214 can be arranged therebetween. The height of each container 214 corresponds essentially to the height of

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the transverse trussed girders 217, 218, 230, 231.

The breadth of the containers 214 also corresponds, in accordance with Fig. 2, to a unit measure, however
5 containers 214' which are twice as broad, or containers 214" which are three times as broad, can also be provided.

As seen in Figs. 5 to 12 transverse rails 232 are
10 arranged at the bottom on the transverse trussed girders 217, 218, 230, 231 at the side facing the containers 214, but also in non-illustrated manner at the top, along which, as seen in Figs. 1 to 3, 5, 10 to 12 running rollers 233 provided at the stem and stern of
15 the containers 214 can roll.

The running rollers 233 can be extended downwardly or retracted by means of hydraulically actuated lifting devices 245 (Figs. 10 to 12).
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On retracting the rollers the containers 214 sink, in accordance with Figs. 10 to 12, onto solid foundations 246 which can also include vibration dampers 240'.

25 As seen in Figs. 1 to 3 and 5 the rails 232 extend along the entire length of the transverse trussed girders 217, 218, 230, 231. In Figs. 1 to 3 the transverse rails 232 are only schematically illustrated at some positions.

30 As seen in Figs. 2 and 3 longitudinal passageways 215 are arranged between the transverse trussed girders 217, 218, 230, 231 and the containers 214 and, in conjunction with the transverse cavities 212 represent the horizontal communication
35 paths.

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As seen in Fig. 4 a continuous air-tight transverse deck 216 extends beneath the transverse trussed girders 217, 218 between the floats 211. Transverse deck 216 merely serves for sealing purposes and takes on practically no support or stabilising functions.

As can be seen particularly clearly from Fig. 5 the two single transverse trussed girders which together form the double transverse trussed girder 217 or 230 are connected with one another at the top and at the bottom by longitudinal connectors 225 to form a torsionally stiff constructional unit.

The spaced apart double and single transverse trussed girders 217, 218 and 230, 231 are connected together in the longitudinal direction by longitudinal girders 226 which however are only provided at the top and at the bottom so that the containers 214 and the longitudinal passage and supply elements 215 can be introduced from the side. Vertical supports 227 arranged at the centre between the transverse trussed girders 217, 218 for stabilisation are removable in order to enable the passage of the containers to the inner space.

The basic skeleton which is formed in this way is closed off in water-tight manner at the outside by panels 228.

As can be seen particularly clearly from Fig. 5 no deck is present in certain regions above the lower storey 203 formed by the transverse trussed girders 217, 218. There the narrower and shorter upper storey 204 is attached. In similar manner no intermediate deck is present between the upper storey 204 and the bridge module of Fig. 1. Accordingly, vertical passageways are present between the individual girders 217, 218, 226 which can be exploited in a manner which will be described later to provide vertical communication paths. In other

respects the upper surfaces which border on the external atmosphere are clad by water-tight transverse decks 209 which can be walked on.

- 5 As seen in Fig. 4 the floats 211 have laterally inwardly projecting projections 229 in the upper half, or in the upper third which substantially broaden the support base for the transverse trussed girders 217, 218, and considerably reduce the space which must be freely
10 bridged by the transverse trussed girders 217, 218 or by the sealing deck 216.

The largest width B below the inner projection 219 is, as seen in Fig. 4, somewhat larger than the width of the
15 projections 229 directly beneath the transverse trussed girders 217, 218 attached to the transverse bulkheads of the floats 211.

As seen in Fig. 13 the box-like transverse passageways
20 234 which are resiliently arranged within the double transverse trussed girders 217, 230 are provided with longitudinal passageway connections 235 at the positions where longitudinal passage elements and supply elements 215 branch off. Whereas Fig. 13 shows a rigid
25 longitudinal passageway connection 235, Figs. 14 and 15 show a way in which a movable attachment of the longitudinal passage and supply elements 215 is possible to a certain degree, for example for movement through a few centimeters. For this purpose a round rubber 247 is
30 laid around the actual longitudinal passage connection 235 onto which a connection frame 248 is pushed from the longitudinal passage side.

The adjoining longitudinal passageway element 236 in the
35 longitudinal direction of the ship (Figs. 14, 18, 19) is likewise surrounded at its end facing the transverse passageway 234 by a round rubber 249 onto which the

1 connection frame 248 is likewise pushed. At the floor a
movable transition member 250 is provided between the
longitudinal passage connection 235 and the
5 longitudinal passageway 236. In this way, depending on
the design of the thickness of the round rubbers 247,
249 and of the gap between the connection frame 248 and
the longitudinal passage connection 235 of the
longitudinal passageway element 236, relative movements
10 of up to 7 cm can be compensated for.

Fig. 16 shows a cross-section through a container 214''
having a communication path in the form of a stairway
239. Longitudinal passageway elements 236 are attached
15 to the container 214'' via lateral openings 251 and
resilient intermediate pieces 237 so that the interior
of the container 214'' can be entered through the
openings and the intermediate pieces 237.

20 As seen in Fig. 17 the stairway 239 extends through
horizontal openings 252, 253 in the floor or in the
ceiling of two containers 214'', which lie above one
another, so that in this way a vertical communication
path is ensured between the two storeys 203, 204 which
25 are defined by the transverse trussed girders 217, 218
and 230, 231.

Fig. 17 indicates, in the same way as Figs. 7 and 9,
how the containers 214, 214', 214'', 214''' can be
resiliently braced via lateral outriggers 254 and
30 resilient members 255 on the transverse rails 233, or
on other counter-supports, after they have been brought
into position by means of running rollers 233 or in
some other manner.

35 Figs. 18 and 19 show two embodiments of longitudinal
passageway elements 236 which are arranged as
longitudinal passageways 215 between sequential

1 transverse trussed girders 217, 218, 230, 231, and
which can be connected with the longitudinal passageway
connections 235.

5 Fig. 18 shows a connection by means of a connection
frame 248 as is illustrated in detail in Fig. 14.
Individual shorter sections of longitudinal passageway
elements 236 can be connected with one another by
10 connection frames 256 to larger units in the
longitudinal direction.

By way of example removable installation and repair
covers 257 can be arranged in the ceilings of the
15 longitudinal passageway elements 236. Openings 237 for
the passage of containers are moreover provided in the
sidewalls of the longitudinal passageway elements 236.

As seen in Fig. 19 two sections of a longitudinal
20 passageway element 236 are connected with one another
into a larger constructional unit by a rigid and
integral frame 256'.

In accordance with the invention the transverse trussed
25 girders 217, 218 are so dimensioned that six
standardised containers can be suspended alongside one
another and so that room still remains for two
longitudinal passageway elements 236 with a passageway
width of 1.2 m. As a result of this modular raster
30 arrangement a simple structure results which offers a
whole range of possibilities of variation both in
length, in width and also in height.

It is also of particular significance that each
35 transverse trussed girder 217, 218, 230, 231 has the
height of a storey 203, 204 within the ship's
superstructure whereby the possibility of the building
of a second storey is possible, simply by arranging two

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transverse trussed girders above one another. If necessary, a third or fourth storey could also be provided in corresponding manner.

- 5 The cladding of the structure against the weather by means of the panels 228 and the transverse decks 209, 216 preferably takes place with the aid of light auxiliary girders which are attached to the connection beams. The panels 228 are mounted at an angle, i.e.
- 10 angled in the longitudinal direction of the ship. Furthermore, the length of the panels should correspond to the distance between the centres of the transverse trussed girders which follow one another. The panel width is predetermined by the height of the storey with
- 15 account being taken, if necessary, of an intended side inclination of the outer walls.

The interior of the watercraft of the invention is thus built-up entirely on modular principles. There remains

20 only a few small systems, merely in the side hulls or floats 211, which are locally assembled; in the same way the connection lines for fluids, gases and electricity are installed in the customary manner.

- 25 The introduction of the containers 214 preferably takes place from the side along the transverse rails 232, with the containers 214 first being moved on the running rollers 233 and then being lowered in position and being connected via resilient intermediate members 240', 255
- 30 securely to the transverse trussed girders 217, 218, 230, 231. The containers 214 are in this manner resiliently suspended. If one requires larger chambers then two containers 214 can be rigidly connected together to form a unit 214', whereby one can omit the
- 35 adjoining sidewalls of the two containers 214.

By carrying out the system of the invention in consequential manner the entire inner chamber used by humans and also the space taken up by the sensitive technical apparatus is protected against shock and vibration. In the event of an underwater explosion this type of assembly results, in combination with the likewise shock-absorbing air cushion in a high quality inherent protection for the marine craft.

10 As seen in Fig. 2 a space 258 is left free between the two frontmost side containers 214 in which, for example, a deck weapon can be mounted, with a corresponding platform being provided.

15 The transverse trussed girders 217, 218, 230, 231 are preferably executed as welded steel constructions, can however also consist of glass fibre reinforced plastic, in particular for light craft.

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Claims

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1. Catamaran-type marine craft comprising two hulls which are arranged spaced apart and substantially parallel to one another, which extend in the direction of travel and which have top portions; a connection structure connecting said two hulls together at said top portions; and a transverse deck sealing said connection structure at a bottom portion thereof, characterised in that said connection structure comprises a plurality of trussed girders (217, 218) arranged parallel to each other transverse to the direction of travel; in that said plurality of transverse trussed girders (217, 218) comprises at least first and second pairs of transverse trussed girders (217), with the transverse trussed girders of each pair (217) being spaced apart from each other in the direction of travel by a distance sufficient to provide a transversely extending passageway (212) sufficiently large for persons; in that some of said girders are spaced apart in the direction of travel from an adjacent one of said girders by a distance (A) sized to provide a space for accommodating a row of containers (214, 214', 214", 214''') disposed transverse to the direction of travel; in that a row of containers (214, 214', 214", 214''') and at least one longitudinal passageway (215) are provided in said space, with said longitudinal passageway (215) extending in the direction of travel and defining a passageway for persons, and with said containers (214, 214', 214", 214''') and said longitudinal passageway (215) being carried by the adjacent ones of said plurality of girders (217, 218); and in that said transversely extending passageways (212) provide access to said at least one longitudinal passageway (215) and to said containers (214, 214', 214", 214''').

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2. A marine craft in accordance with claim 1, characterised in that said girders define hollow cavities (213, 213') for accommodating service and supply lines.
3. A marine craft in accordance with either of claims 1 or 2, characterised in that the connection structure includes a single transverse trussed girder (218) arranged between said first and second adjacent pairs of transverse trussed girders (217).
4. A marine craft in accordance with any one of the preceding claims, characterised in that pairs of transverse trussed girders (217) and single transverse trussed girders (218) are alternately mounted in the direction of travel between the hulls (211).
5. A marine craft in accordance with one of the preceding claims, characterised in that the distances (A) between adjacent transverse trussed girders (217, 218) spaced to receive a row of containers are identical.
6. A marine craft in accordance with one of the preceding claims, characterised in that a plurality of longitudinal passageways (215) are provided in the form of longitudinal passageway elements (236) and in that the containers (214, 214', 214'', 214''') and the longitudinal passageway elements (236) can be introduced from at least one side in the transverse direction into their position between two adjacent transverse trussed girders (217, 218).
7. A marine craft in accordance with one of the preceding claims, characterised in that each transverse trussed girder (217, 218) has a top



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chord (221), a bottom chord (222) and trusses (223) arranged therebetween.

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8. A marine craft in accordance with one of the preceding claims, characterised in that each transverse trussed girder (217, 218) has trussed sections (219) and passage sections (220).

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9. A marine craft in accordance with claim 7 or claim 8, characterised in that line carrying passages (224) are provided in the top chord and/or in the bottom chord (221, 222).

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10. A marine craft in accordance with one of the preceding claims, characterised in that each pair of transverse trussed girders (217) is put together from two single transverse trussed girders which are spaced apart in the direction of travel of the ship, thus forming double transverse trussed girders (217).

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11. A marine craft in accordance with claim 10, characterised in that longitudinal connectors (225) extending in the direction of travel are provided at transverse intervals at the top and the bottom between the pairs of single transverse trussed girders of each double transverse trussed girder.

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12. A marine craft in accordance with one of the preceding claims, characterised in that sequential transverse girders (217, 218) spaced apart by a distance (A) for accommodating a row of containers are connected rigidly together by longitudinal beams (226) extending in the direction of travel.

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- 1 13. A marine craft in accordance with claim 12,
characterised in that in each case longitudinal
beams (226) are only arranged at the top and the
5 bottom of the transverse trussed girders (217, 218)
in such a way that the containers (214) and the
longitudinal passageway elements (236) can be
introduced between them from the side.
- 10 14. A marine craft in accordance with claim 12 or claim
13, characterised in that removable vertical
supports (227) are arranged between upper and lower
longitudinal beams (226) at the sides of the craft.
- 15 15. A marine craft in accordance with one of the
preceding claims, characterised in that the
connection structure has a plurality of storeys
forming a plurality of decks but that no deck
plates are provided in the connection structure
20 other than the lowermost transverse deck (216),
which only serves for sealing, at specific
positions between the containers (214) and the
longitudinal passageways (215), and at upper deck
surfaces.
- 25 16. A marine craft in accordance with one of the
preceding claims, characterised in that said
connection structure is not provided with
longitudinal walls extending in the direction of
travel or with transverse bulkheads other than
30 intermediate walls arranged at certain specific
positions between the containers (214) and the
longitudinal passageway elements (236) and at the
outer sides of the connection structure.
- 35 17. A marine craft in accordance with one of the
preceding claims, characterised in that the
connection structure is sealed off in water-tight



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manner at the sides, at the front and at the rear by panels (228).

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18. A marine craft in accordance with claim 17, characterised in that the side panels (228) are so subdivided that they can be removed in sections for the lateral introduction or removal of containers (214).

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19. A marine craft in accordance with one of the preceding claims, characterised in that the hulls (211) have an inwardly directed projection (229) in the upper region on which the transverse trussed girders (217, 218) and the lowermost transverse deck (216) are mounted at the top.

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20. A marine craft in accordance with claim 19, characterised in that the projection (229) is, at the maximum, approximately as wide as or slightly less wide than the broadest part of the hull (211) lying beneath it.

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21. A marine craft in accordance with claim 8 and claim 19 or claim 20, characterised in that at least one trussed section (219) and one passage section (220) are provided at the side vertically above the associated hull (211).

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22. A marine craft in accordance with one of the preceding claims, characterised in that 40 to 55%, in particular 45 to 50% of the length of each transverse trussed girder (217, 218) is arranged in the region above the intermediate space between the hulls (211), with the rest being arranged vertically above the hulls (211).

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1 23. A marine craft in accordance with one of the
preceding claims, characterised in that upper pairs
5 of transverse trussed girders (230) and single
transverse trussed girders (231) are mounted on the
transverse trussed girders (217, 218) and are of
similar construction but shorter.

10 24. A marine craft in accordance with claim 23,
characterised in that said upper transverse trussed
girders (230, 231) are sufficiently long that they
extend into the region vertically above the hulls
(211).

15 25. A marine craft in accordance with one of the
preceding claims, characterised in that transverse
rails (232) for the running in and running out, and
optionally for the securing of the containers
(214), and/or of the longitudinal passageway
20 elements (236), are provided at the front and/or
rear sides of the transverse trust girders (217,
218, 230, 231).

25 26. A marine craft in accordance with claim 25,
characterised in that the containers (214) and/or
the longitudinally passageway elements (236) are
provided with liftable and lowerable rollers (233)
engageable with the associated transverse rails
(232).

30 27. A marine craft in accordance with one of the
preceding claims, characterised in that the pairs
of transverse trussed girders (217, 230) contain
transverse passageway elements (234).

35 28. A marine craft in accordance with claim 8 and claim
27, characterised in that longitudinal passageway
connections (235) are arranged on the transverse



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passageway elements (234) in the region of the passage sections (220).

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29. A marine craft in accordance with claim 28, characterised in that longitudinal passageway elements (236) are connected to the longitudinal passage connections (235).

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30. A marine craft in accordance with one of the claims 27 to 29, characterised in that openings (237) to the adjoining containers (214) branch off from the transverse passageway elements (234) and/or from the longitudinal passageway elements (236).

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31. A marine craft in accordance with claim 30, characterised in that the container openings are constructed as passage elements (237) forming a resilient transition to the associated longitudinal passageway elements (236).

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32. A marine craft in accordance with one of the preceding claims, wherein said connection structure extends over a plurality of decks, characterised in that vertical communication paths (239) are provided between containers (214) which are arranged above one another.

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33. A marine craft in accordance with one of the preceding claims, characterised in that the containers (214), the transverse passageway elements (234) and the longitudinal passageway elements (236) are resiliently suspended on the transverse trussed girders (217, 218, 230, 231).

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34. A marine craft in accordance with one of the preceding claims, characterised in that the containers (214) have a unit dimension or an

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integral multiple of this unit dimension in the transverse direction.

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35. A marine craft in accordance with claim 34, characterised in that the containers (214, 214', 214", 214"') are provided with one, two and three times the unit dimension.

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36. A marine craft in accordance with one of the preceding claims, characterised in that one or more containers are omitted and in that a platform is provided in their place on which, or at which, a standardised operating system such as a weapon, a position finding apparatus or the like is arranged.

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37. A marine craft in accordance with one of the preceding claims, characterised in that the basic skeleton formed by the transverse trussed girders (217, 218, 230, 231) and the longitudinal beams (226) is clad at the top by a transverse deck (209) in a water-tight manner so that it can be walked on but only where there is no adjoining upper storey (204) or bridge module (241).

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38. A marine craft substantially as herein described with reference to and as illustrated in the accompanying drawings.

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