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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) **International Patent Classification** 5 :
B63B 1/10, 21/02

A1

(11) **International Publication Number:** **WO 94/25334**

(43) **International Publication Date:** 10 November 1994 (10.11.94)

(21) **International Application Number:** PCT/EP94/01355

(22) **International Filing Date:** 28 April 1994 (28.04.94)

(30) **Priority Data:**

G 93 06 371.7 U	28 April 1993 (28.04.93)	DE
P 43 18 691.2	4 June 1993 (04.06.93)	DE

(81) **Designated States:** AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

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(54) **Title:** WATERCRAFT

(57) **Abstract**

The watercraft comprises at least one deck (1, 1') for accommodating passengers, buoyancy bodies (4) of elongated shape located in the water below said deck (1, 1') and connected with said deck (1, 1'), drive assemblies (7) with which said buoyancy bodies (4) are associated, and a control cab (6) arranged above said deck (1, 1'), from which cab the watercraft is controlled. In order to use the watercraft in particular as a "water bus" which enables quick embarkation and disembarkation of passengers, said deck (1, 1') is formed as a separate structural element having a dimension transversely to the travelling direction that corresponds to the dimension in the travelling direction; a plurality of buoyancy bodies (4) is provided, said buoyancy bodies being underwater to a large extent and being connected to said deck (1, 1') via a supporting construction (3) supporting the latter one in the transverse direction; said buoyancy bodies (4) have associated with them a multiplicity of drive assemblies (7) each being separately controllable; and at least some of said buoyancy bodies (4) can be flooded and freed for controlling the buoyancy and/or the lifting momentum.

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WATERCRAFT

The invention relates to a watercraft according to the pre-characterizing portion of Claim 1.

Conventional watercraft of this type as a rule have a buoyancy body formed by an elongated hull and fused with the ship's decks to form a constructional unit, such that the size of the deck areas is determined by the horizontal area of cross-section of the elongated hull. This shape of the ship involves the considerable drawback that, when the ship is moving through the water, some water motion increasing as the travelling speed grows is caused by the bow wave and the

stern wave, such that rivers or canals, in particular nearby populated banks, must be navigated only in a relatively slow and therefore time-consuming manner. Moreover, landing manoeuvres are too time-consuming, and the embarkation and disembarkation of passengers takes up an extremely long time. Therefore, such known watercraft are just as little suited for use as ferry boats travelling only relatively short distances between each landing place, i. e. as "water buses", as are catamarans or trimarans, i. e. watercraft having two or three hulls, respectively, or hybrid ship constructions having two buoyancy bodies extending in spaced relationship in the longitudinal direction and having planes which act as dynamic buoyancy elements and transversely connect said buoyancy bodies with each other.

The invention is based on the object of improving the watercraft specified initially above such that a higher manoeuvrability and a reduction in the generation of waves, and thereby in water motion, is achieved and that as a consequence its use in particular as a "water bus" on water surfaces which enables quick embarkation and disembarkation of passengers is made possible, in order to create a traffic connection between parts of towns or villages.

The watercraft according to the invention by which this object is achieved is characterized by the features set out in the characterizing portion of Claim 1.

The watercraft according to the invention for the first time offers the possibility of being used as a water bus, in particular for fast transportation of big crowds of people on calm waters, mainly between parts of towns situated at the water. The supporting structure provided between the deck and the buoyancy bodies is in the form of a space framework. A plurality of rods are interconnected at the ends via junction elements so as to form a steel frame. This framework has only

a relatively low water resistance which in particular is distributed over the whole width of the watercraft. Owing to these rods and to the fact that the buoyancy bodies are arranged to a large extent under water, the bow waves and the stern waves developing in conventional watercraft are nearly completely avoided. Moreover, the fact that the buoyancy bodies have associated with them separately actuatable drive assemblies ensures high manoeuvrability which even allows a "turning on the spot", which quite favourably affects the carrying out of landing manoeuvres, thereby creating an essential precondition for the use of the inventive watercraft as a water bus. The plurality of drive assemblies ensures not only the high manoeuvrability but also guarantees that, in the event of one of the drive assemblies becoming damaged, the manoeuvrability is maintained. Besides, it is possible for the watercraft to be moved in the forward and backward directions.

The deck of the water bus according to the invention has a dimension transverse to the travelling direction that corresponds to the dimension in the travelling direction. Thereby a size is achieved that enables the transport of up to thousand people. In this configuration, the deck may have a round shape. Under production aspects, however, a polygonal shape, preferably a twenty-angled shape, is of advantage. The docking stages designed for the use of the watercraft each have an approximately semicircular recess the inner diameter of which corresponds to the outside diameter of the deck. This construction ensures that after a quick landing manoeuvre has been carried out, a particularly extensive deck region is available for speedy embarkation and disembarkation, with the consequence that the watercraft can drive on in a short time. In this connection it is advantageous if the one half of the semicircular central recess in the docking stage is reserved to passengers leaving the ship, and the other half to passengers going on board at the same time.

Each docking stage is swivelling about a horizontal axis relative to the banks or coast, which allows the docking stage to be lifted and lowered in accordance with the respective water level or rise of tide.

Any docking stages of considerable length are equipped with people conveyors, in order to further speed up the embarkation and disembarkation process.

In order to avoid that any step to be paid attention to during embarkation and disembarkation is formed between the surface of the docking stage and the deck, the level of the docking stage can be adapted to that of the deck by partly flooding its swimming bodies or by pumping in air for freeing the water in the swimming bodies, respectively. The required pumps or valves, respectively, can be operated by remote control from the watercraft in order to achieve a particularly quick correction of the docking stage level.

To adjust the deck level of the watercraft relative to the water surface, at least some of the underwater buoyancy bodies, which are floodable more or less by temporarily opening a valve and thus by admitting water, can be freed by feeding in air being under pressure while the valve is opened correspondingly, thereby increasing the buoyancy and/or the lifting momentum.

This flooding and freeing, respectively, of the buoyancy bodies is carried out by the Captain or any other operator instructed to do so in accordance with the given requirements. The desired depth of immersion and thus the distance between the deck and the water surface can automatically be kept constant by the provision of measuring means for determining the framework immersion depth and for adjusting the compressed-air supply depending on the deviation of the determined measuring value from a predetermined control value.

To provide the desired trim, compressed air can be supplied, separately and independently, to at least the front and the back buoyancy bodies of each row of buoyancy bodies.

At least some of the buoyancy bodies are provided directly below the lowermost framework junctions and connected therewith resiliently. In order to achieve a particularly smooth sailing of the ship, above all if the water surface is agitated, at least some of the buoyancy bodies are connected with the space framework, with shock absorbers being connected therebetween.

An exemplifying embodiment of the invention is illustrated in the drawing and will be described in detail hereinbelow. Shown are,

in Fig. 1, a schematic longitudinal section through the watercraft in accordance with a first embodiment of the invention, with buoyancy bodies being arranged only in one plane, of which the ones to the left of the axis are shown in a side view and the ones to the right of the axis are shown in a front view,

in Fig. 2, a schematic view of a longitudinal section through the watercraft in accordance with a second embodiment of the invention, with buoyancy bodies being arranged in two planes above each other and in staggered relationship,

in Fig. 3, a schematic side view of the watercraft with the docking stage according to the invention as designed for the watercraft,

in Fig. 4, a schematic top plan view of the watercraft shown in Fig. 3 with the associated docking stage,

in Fig. 5, a schematic cross-sectional view of the watercraft in the region of a buoyancy body, on a larger scale, and

in Fig. 6, a schematic sectional view in the region of the deck edge, to illustrate a main profile made of elastic material and fixed at the watercraft, to which main profile a counter-profile provided at the docking stage corresponds.

As seen in the drawing, each illustrated watercraft has at least one deck 1, 1'. In each of the illustrated examples, there are provided two decks 1, 1' for accommodating loads, in particular in the form of passengers. Each of said decks 1, 1' therefore is in the form of a passenger cabin and constructed as a separate structural element preferably composed of aluminum parts. The deck 1, 1' is connected, via a supporting construction preferably in the form of a space framework 3 formed by thin rods which are joined by means of ball connections, to a plurality of closed elongated buoyancy bodies 4 most of which are underwater during operation of the watercraft. These buoyancy bodies 4 guarantee the buoyancy necessary for holding the deck 1, 1' at a distance from the water surface 5. In the longitudinal direction the buoyancy bodies 4 are preferably subdivided into several compartments. Both in the longitudinal and the transverse direction they project with respect to the decks 1, 1' above them to such an extent that any overturn is prevented. On the underside of the lowermost deck 1 there is mounted a safety swimming body 2 extending essentially over the whole area and preferably having the shape of a calotte shell.

The illustrated watercraft includes a drive assembly formed by a plurality of assemblies 7 with which the buoyancy bodies 4 are associated and which each are separately controllable from a control cab 6 located on the deck 1, 1'. Said control cab 6 overtops the deck 1, 1' of the watercraft

in the center thereof so as to guarantee free sight in all directions. Additionally provided video cameras make it possible to monitor regions being covered up by the deck.

As seen in Figs 1 and 2, the deck 1, 1' has a dimension transverse to the travelling direction that corresponds to the dimension in the travelling direction, resulting in a particularly large deck surface. As can be taken from Fig. 4, a practically round shape of the deck 1, 1' is quite beneficial, in particular if the docking stage 8 designed for the use of the watercraft has a semi-circular central recess 9 the inner diameter of which corresponds to the outside diameter of the deck 1, 1'. Under production aspects, an approximately round, viz. polygonal shape - e. g. a twenty-angled shape - is quite advantageous.

Each docking stage 8 is swivelling about a horizontal axis 11 relative to the banks or coast 10 whereby its front portion with the recess 9 can follow the rise of tide. For this purpose, the docking stage 8 is supported on swimming bodies 4' which similarly to the buoyancy bodies 4 of the watercraft can be flooded and freed in order to render the docking stage 8 flexible in height. Advantageously, the docking stage 8 has a length ensuring that the region with the recess 9 is beyond the breakers. To speed up passenger transport, each docking stage 8 advantageously is provided with band conveyors 12, 13 working in opposite directions. The section of the front portion of the docking stage 8 that is right to the midline is reserved to the embarkation or the loading of the watercraft, whereas the section being left to the midline is reserved to the disembarkation or unloading.

As seen in Fig. 6, a main profile 14 made of elastic material is fixed in the region of the outer edge of the deck 1 of the watercraft, to which main profile a counter-profile 15 fixed at the docking stage 8 corresponds. The main profile

14 has a hollow space which can be put under pressure by supply of gas. The buoyancy bodies 4' of the landing bridge 8, like the buoyancy bodies 4 of the watercraft, can be flooded or, by supplying compressed air through the Captain or automatically, can be freed so that the landing bridge reaches the same level as the watercraft whereby the main profile 14 and the counter-profile 15 can take the position with respect to each other shown in Fig. 6. The ship and the landing bridge are held in this position with the aid of electromagnetic two-part coupling means 16, 16', of which the first part 16 is fixed near the main profile 14, whereas the second part 16' is fixed directly opposite near the counter-profile 15.

In the same way as mentioned above in conjunction with the buoyancy bodies 4' of the landing bridge 8, at least some of the underwater buoyancy bodies 4 of the watercraft can be flooded more or less by temporarily opening a valve thereby admitting water. The buoyancy of these buoyancy bodies 4 is thereby reduced. The buoyancy bodies 4 can again be freed by supplying compressed air from a compressed-air reservoir while the valve is correspondingly opened, and the buoyancy is increased accordingly. Also the level of the deck 1, 1' relative to the water surface 5 can be controlled by hand through corresponding control of the valve. Advantageously, however, measuring means are provided for determining the framework immersion depth and for adjusting the compressed-air supply depending on the deviation of the determined measuring value from a predetermined control value.

As seen in Figs 1 and 2, a plurality of buoyancy bodies 4, one behind the other, have a length corresponding to the dimension of the deck 1, 1' in the travelling direction or exceeding it only slightly. In order to reduce the generation of waves when the ship is moving through the water, the buoyancy bodies 4, as shown in Fig. 2, are arranged in a

plurality of planes, preferably two planes, in staggered relationship.

Each buoyancy body 4 consists of transportable sections, i. e. of structural members that can relatively easily be transported overland to the place of assembly or use and connected there with each other. Advantageously, the sections of each buoyancy body 4 can be screwed together. Due to the uncomplicated assembly, no dockyard is required. A big crane on the banks will be sufficient to enable quick assembly.

To guarantee the desired trim of the watercraft, compressed air can be applied to at least the front and back buoyancy bodies 4 independently of each other.

At least some of the buoyancy bodies 4 are provided directly below the lowermost framework junctions 17 and connected therewith resiliently, for example via hydraulic springs, to thereby keep away any motor vibrations from the passenger rooms in the deck region. As seen in Fig. 5, some of the buoyancy bodies 4 are connected to the space framework 3 with shock absorbers 18 being connected therebetween.

Each buoyancy body 4 has associated with it a pair of drive assemblies 7 in the form of tubular turbines. As seen in Fig. 5, each assembly 7 is mounted on one of the two sides of the buoyancy body 4. The outside of the tubular turbine drive assemblies is fitted with wing-shaped or fin-shaped projections 19 for stabilization purposes in the event of water or wave motion.

The turbines are supplied with energy from an internal combustion engine which is mounted in some of the buoyancy bodies 4. Associated with each internal combustion engine are hose pipes and rigid lines (not shown in the drawing), respectively, for the supply of fuel on the one hand and for

air inlet and outlet on the other hand. The air inlet pipes and in particular the air outlet pipes end at a substantial distance above the deck 1, 1', advantageously above the control cab 6. The accessibility of the internal combustion engines for maintenance purposes is guaranteed by water-tightly closing doors 20 on the upper side of the buoyancy bodies 4.

Instead of internal combustion engines for driving the turbines, turbine-electric motor units may as well be used as the drive assemblies 7. In such case, the current is generated by and supplied from an internal combustion engine driven generator provided below the deck 1, 1'.

CLAIMS

1. A watercraft comprising at least one deck (1, 1') for accommodating loads, in particular passengers, buoyancy bodies (4) of elongated shape located in the water below said deck (1, 1') and connected with said deck (1, 1'), drive assemblies (7) with which said buoyancy bodies (4) are associated, and a control cab (6) arranged above said deck (1, 1'), from which cab the watercraft is controlled, **characterized in that** said deck (1, 1) is formed as a separate structural element having a dimension transversely to the travelling direction that corresponds to the dimension in the travelling direction; a plurality of buoyancy bodies (4) is provided, said buoyancy bodies being underwater to a large extent and being connected to said deck (1, 1') via a supporting construction (3) supporting the latter one in the transverse direction; said buoyancy bodies (4) have associated with them a multiplicity of drive assemblies (7) each being separately controllable; and at least some of said buoyancy bodies (4) can be flooded and freed for controlling the buoyancy and/or the lifting momentum.

2. The watercraft according to Claim 1, **characterized in that** said supporting construction provided between said deck (1, 1') and said buoyancy bodies (4) is in the form of a space framework (3).

3. The watercraft according to Claim 1 or 2, **characterized in that** a safety swimming body (2) is mounted at the underside of the lowermost deck (1), said safety swimming body extending essentially over the whole area and preferably having the shape of a calotte shell.

4. The watercraft according to anyone of Claims 1 to 3 as well as a docking stage (8) designed for said watercraft, **characterized in that** the watercraft in the region of its

deck (1, 1') has a round, preferably polygonal shape, and said docking stage (8) has an approximately semicircular central recess (9) the inner diameter of which corresponds to the outside diameter of said deck (1, 1') of the watercraft.

5. The watercraft according to Claim 4, **characterized in that** at least the portion of the docking stage (8) having said semicircular recess (9) rests upon buoyancy bodies (4') being located in the water and determining the docking stage level above the water and is connected via at least one horizontal swivelling axis (11') to the banks (10).

6. The watercraft according to Claim 4 or 5, **characterized in that** between the watercraft and the docking stage (8) a main profile (14) made of elastic material is provided, said main profile being fixed at one of the two elements, e. g. the watercraft, and extending in a horizontal plane, with a counter-profile (15) being provided at the other element corresponding thereto.

7. The watercraft according to Claim 6, **characterized in that** associated with said main profile (14) and said counter-profile (15) is at least one electromagnetic coupling device (16, 16') which can be switched on during embarkation and disembarkation thereby holding the watercraft in fixed contact with said docking stage (8).

8. The watercraft according to anyone of Claims 1 to 7, **characterized in that** for the purpose of freeing said buoyancy bodies (4) compressed air is provided and the compressed-air supply is adjusted depending on the immersion depth of said supporting construction (3).

9. The watercraft according to anyone of Claims 1 to 8, **characterized in that** said buoyancy bodies (4) are arranged in a plurality of planes one above the other.

10. The watercraft according to Claim 9, **characterized in that** said buoyancy bodies (4) are arranged in two planes in staggered relationship.

11. The watercraft according to anyone of Claims 1 to 10, **characterized in that** each buoyancy body (4) consists of transportable sections that can be interconnected at the place of use.

12. The watercraft according to anyone of Claims 1 to 11, **characterized in that** at least the front and the back buoyancy bodies (4) of a row of buoyancy bodies are separated from each other, and the compressed air is supplied independently to said separate buoyancy bodies to ensure the desired trim.

13. The watercraft according to anyone of Claims 1 to 12, **characterized in that** at least some of said buoyancy bodies (4) connected with said space framework (3) are provided directly below the lowermost framework junctions (17) and are connected therewith resiliently.

14. The watercraft according to anyone of Claims 1 to 13, **characterized in that** at least some of said buoyancy bodies (4) are connected with said space framework (3) with shock absorbers (18) being connected therebetween.

Fig.1

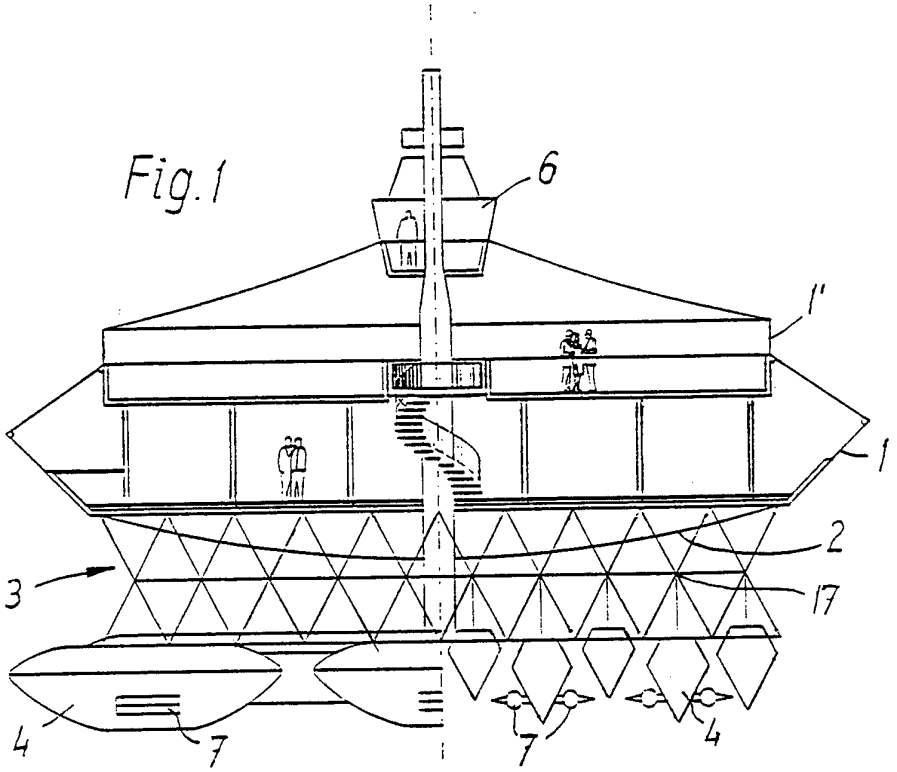


Fig.2

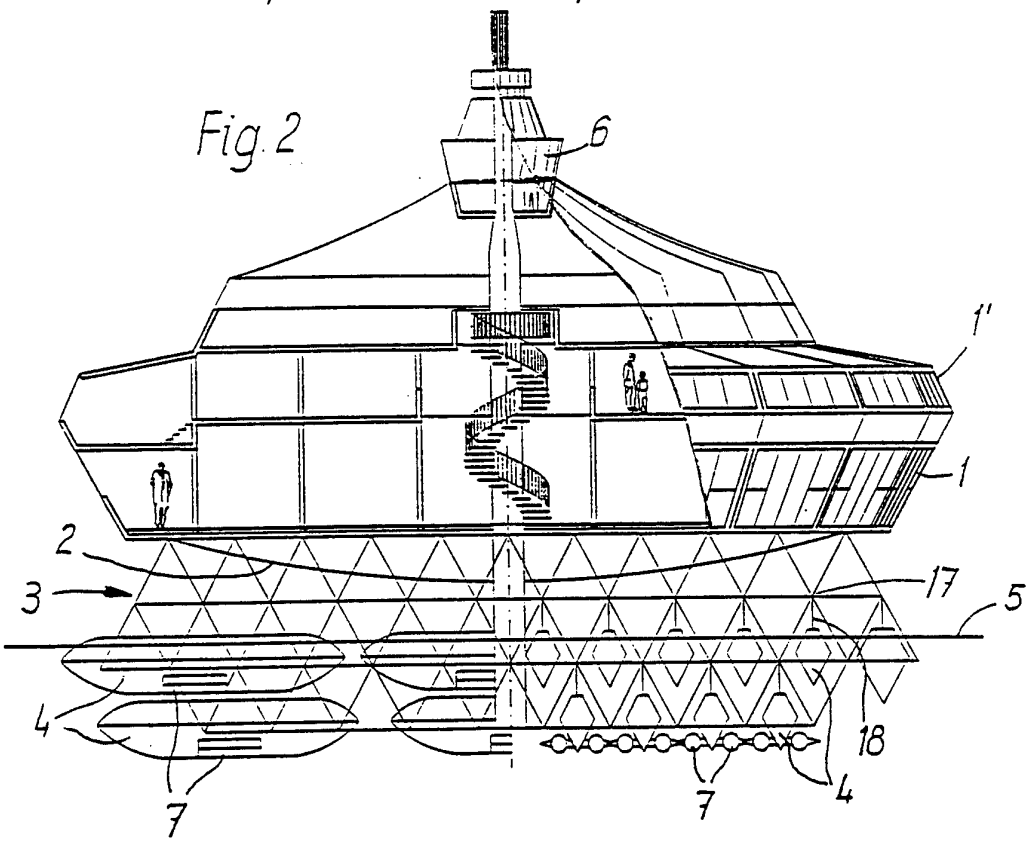


Fig.3

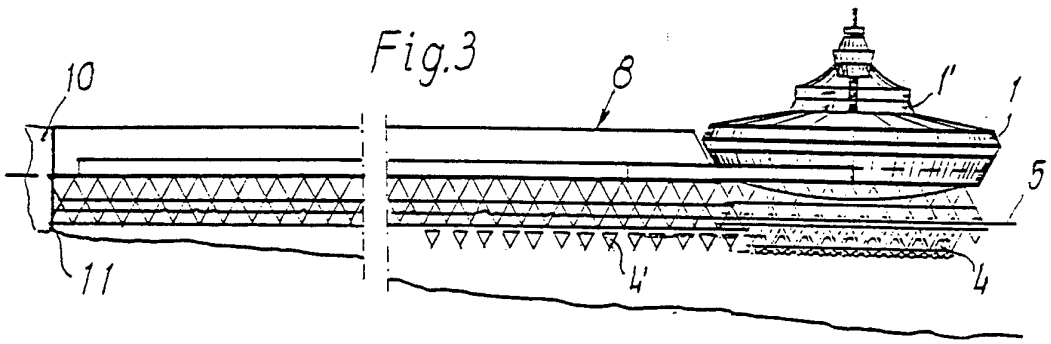


Fig.4

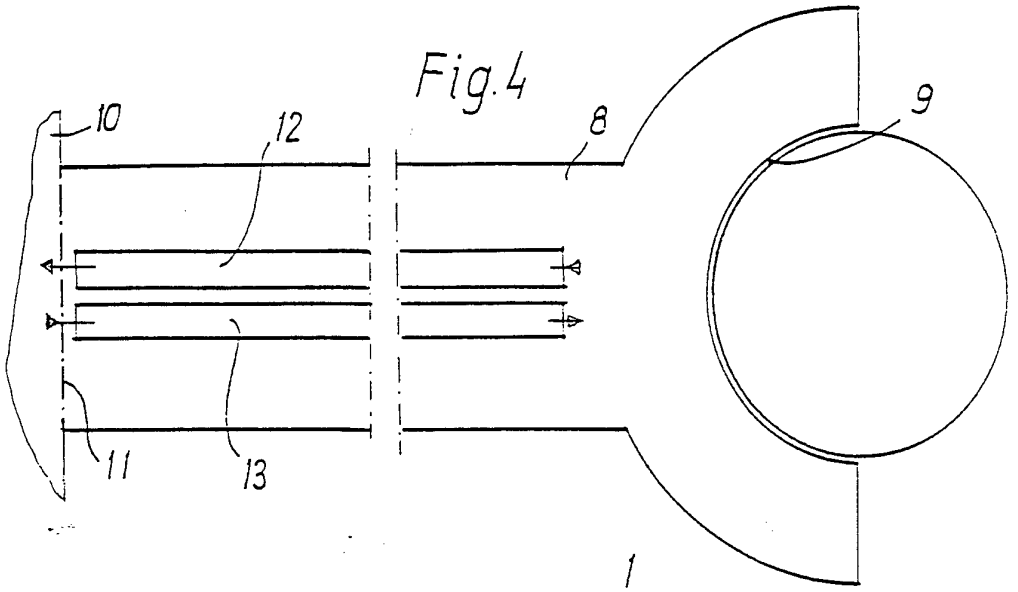
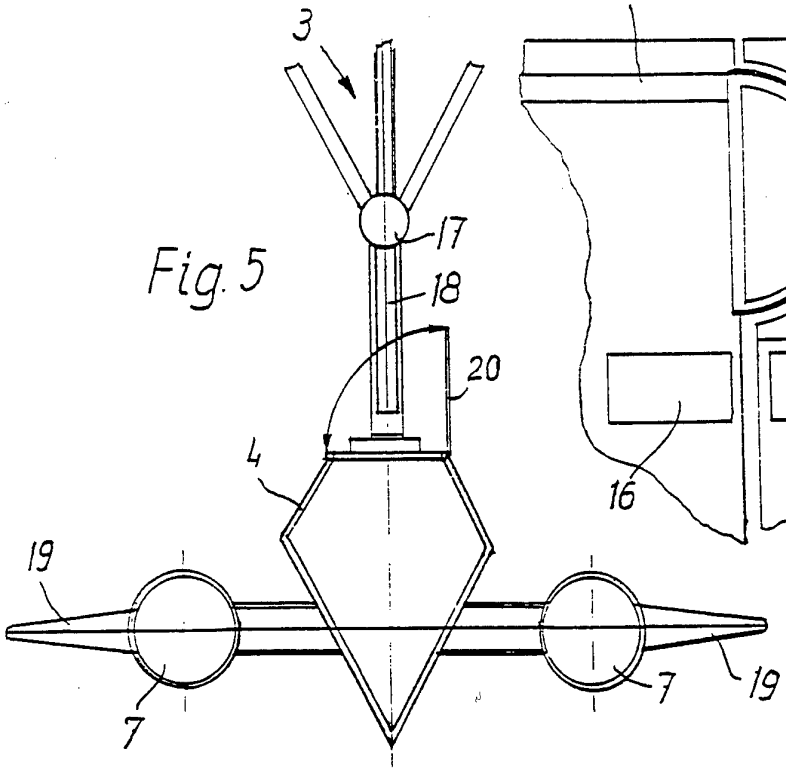


Fig.5



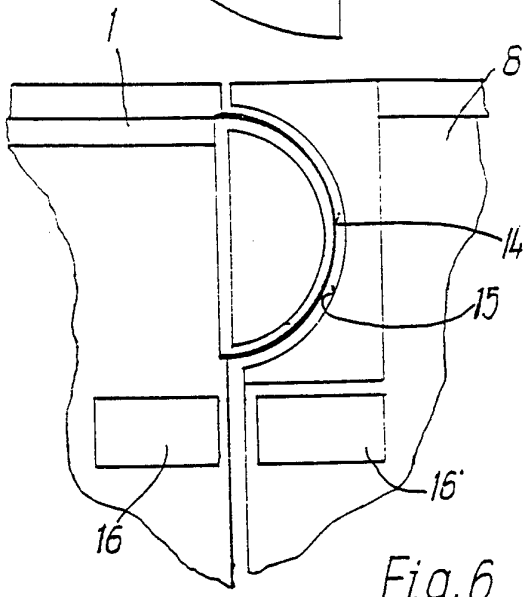


Fig.6

INTERNATIONAL SEARCH REPORT

Inter ial Application No
PCT/EP 94/01355

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B63B1/10 B63B21/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO,A,91 11359 (HYDRO CORPORATION) 8 August 1991 see page 4, line 24 - page 15, line 31; figures 1-14	1,2,7,8 3-7,9-14
Y	US,A,3 581 692 (MORTELLITO) 1 June 1971 see column 4, line 31 - line 46; figures 1-5	4-7
Y	US,A,3 430 595 (TULLENERS) 4 March 1969 see figures 1-3	9,13,14
Y	US,A,2 159 410 (TURKOVICH) 23 May 1939 see page 1, line 42 - line 53; figures 1-4	3
Y A	US,A,2 052 991 (STACK) 1 September 1936 see the whole document	10 1,9

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE,A,37 37 806 (POLETTI ET AL) 1 June 1988 see abstract; figures 1-3	7
Y	FR,A,493 503 (KOIRANSKI) 12 August 1919 see figures 1-5	11
Y	GB,A,2 159 114 (WORLEY ENGINEERING LTD) 27 November 1985 see figure 7	12
A	US,A,3 395 666 (MOISDON) 6 August 1968 see the whole document	1
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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter .ial Application No
PCT/EP 94/01355

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