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(54) **DRAIN PIPE**

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Description

TECHNICAL FIELD

[0001] The present invention concerns a marine structure comprising a drain pipe adapted to guide fluid from the marine structure to a body of water at least partially surrounding the marine structure.

BACKGROUND OF THE INVENTION

[0002] It is conventional in oil and/or gas drilling and production to collect rainwater from the decks of a marine structure, such as a sea-going vessel or an offshore facility. Typically, a plurality of drains is arranged throughout one or more decks of the marine structure, especially on portions of the decks which are open and therefore exposed to the weather. Since the rainwater washes any spilled oil or grease off of the deck and into the drains, the collected rainwater may be passed through a filter or treatment facility in order to separate any oil or grease from the collected rainwater before it is guided to a body of water that at least partially surrounds the marine structure.

[0003] Drain pipes are used to guide the collected rainwater to the body of water that at least partially surrounds the marine structure in order to prevent people that are on, or in the vicinity of the marine structure from being hit or splashed by the fluid stream that is drained from the marine structure and/or to prevent objects, structures and/or apparatus on, or in the vicinity of the marine structure from being damaged by the fluid stream drained from the marine structure.

[0004] In addition, or instead, a drain pipe may be used for distributing additional fluids *inter alia* operational fluids - such as cooling water, ballast water or bilge water - from the marine structure to the body of water that at least partially surrounds the marine structure.

[0005] A drain pipe is normally fixedly attached to a supporting member of a marine structure, such as a support leg of an offshore facility for example, by a plurality of connecting means that are welded to the marine structure. Water waves, underwater currents and the wind can however exert substantial forces on the drain pipe and the marine structure, which may damage the marine structure and in the worst case, may cause the drain pipe to become detached from the marine structure.

[0006] Document US-A-6 398 951 discloses all the features of the preamble of claim 1.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide an improved drainage system for a marine structure.

[0008] This object is achieved by a marine structure comprising a supporting member that comprises a wall at least partially delimiting the supporting member such that an inner side of the wall is arranged to at least partially

delimit an inner volume of the supporting member and an outer side of the wall is arranged to face the ambient environment of the supporting member, said marine structure further comprising a drain pipe adapted to guide fluid along its inside from the marine structure to a body of water at least partially surrounding the marine structure, wherein at least a portion of the outer side of the wall partially delimits the drain pipe, i.e. at least a portion of the outer side of the wall constitutes part of the periphery of the drain pipe.

[0009] Such a marine structure provides a robust drainage system that is simple to construct, repair and maintain.

[0010] The expression "to guide fluid" is intended to mean that fluid is arranged to flow along the inside of the drain pipe although the fluid is not necessarily in contact with the drain pipe as it is guided therethrough.

[0011] According to an embodiment of the invention the supporting member is arranged to be located at least partially in the body of water that at least partially surrounds the marine structure. The supporting member may however be located above the water level of the body water.

[0012] According to another embodiment of the invention the drain pipe comprises a fluid inlet and a fluid outlet, the fluid inlet being adapted to be located above the water level of the body of water that at least partly surrounds the marine structure and the fluid outlet being adapted to be located under the water level.

[0013] It should be noted that the drain pipe of a marine structure according to any of the embodiments of the invention may comprise a plurality of fluid inlets and/or a plurality of fluid outlets, whereby the expressions "the fluid inlet/outlet" as used in this document is intended to mean one of the plurality of fluid inlets/outlets in such a case.

[0014] According to a further embodiment of the invention the drain pipe further comprises an opening to the ambient environment located between the fluid inlet and the fluid outlet, in order to facilitate inspection of the drain pipe and to provide ventilation for any gas that may be drawn into or produced inside the drain pipe. Such an opening may extend all the way from the fluid inlet to the fluid outlet. The drain pipe may also or instead comprise a plurality of openings.

[0015] According to an embodiment of the invention the drain pipe further comprises a removable cover to prevent the flow of fluid into the drain pipe. Alternatively, the cover may comprise a filter means to prevent the flow of undesired material into the drain pipe.

[0016] According to another embodiment of the invention the drain pipe is constituted by one member plate only. The member plate may for example have a substantially C- or U-shaped cross section whereby one of the ends of the member plate is attached to the outer side of the wall of the supporting member.

[0017] It should be noted that a member plate may have a cross section of any shape and that a drain pipe

according to any of the embodiments of the present invention need not necessarily have a uniform cross section along its entire length, i.e. uniform as regards its shape and/or area.

[0018] According to an alternative embodiment of the invention the drain pipe comprises at least two member plates, each of which is attached to the supporting member. The drain pipe may for example comprise only two member plates, each having a substantially C-, U- or L-shaped cross section.

[0019] According to a further embodiment of the invention the drain pipe comprises a third member plate having a substantially T- or + -shaped cross section.

[0020] It should be noted that a drain pipe according to the present invention may have a length of up to 50 m or more. A drain pipe may therefore comprise a plurality of member plates arranged longitudinally end to end with or without a gap therebetween. The specifications that the drain pipe comprises "one member plate only" or "only two member plates" is intended to mean not only that the whole drain pipe comprises only one or two member plates but also that the periphery of a drain pipe, when viewed in cross section, comprises one or two member plates only; the remainder of the periphery being made up by the outer side of the wall of the supporting member and optionally one or more openings.

[0021] According to an embodiment of the invention the drain pipe is attached to the supporting member by one or more weld joints, preferably continuous weld joints, which preferably extend substantially along the entire length of drain pipe.

[0022] According to another embodiment of the invention the marine structure further comprises a hoisting arrangement with a lift, that is able to carry one or more human beings and/or repair/maintenance equipment/material. The lift is adapted to be raised and lowered within at least a portion of the drain pipe or along the outside of at least a portion of the drain pipe to facilitate mounting, maintenance and/or repair work. Preferably, the marine structure comprises guide means for guiding the lift in the drain pipe.

[0023] According to a further embodiment of the invention the marine structure is a semi-submersible unit comprising a deck structure and a float, wherein the supporting member is a support column extending between the deck structure and the float. According to an embodiment of the invention the float comprises an opening beneath the drain pipe such that a pump may be lowered there-through.

[0024] According to another embodiment of the invention the drain pipe also comprises a housing that at least partially surrounds at least one pipe, such as a pipe connected to a pump, or some other part of the marine structure.

[0025] According to a further embodiment of the invention the drain pipe comprises at least one portion that extends substantially vertically when the drain pipe is mounted on the supporting member. Alternatively, the

entire drain pipe is arranged to extend substantially vertically when it has been mounted on the supporting member.

[0026] According to a further embodiment of the invention, the drain pipe comprises at least one section that extends substantially non vertically when the drain pipe is mounted on said supporting member. The drain pipe comprises at least one section having an interior surface and in that at least one surface of the interior surface is arranged with an angle α for orienting the fluid towards the surface. This enables the drain pipe to have a smaller cross section, i.e. a reduced cross section area, as a natural air passage is formed within the drain pipe 30. The surface is advantageously arranged with an angle α of 5° or more.

[0027] According to an embodiment of the invention the drain pipe comprises an upper portion with an upper portion cross sectional area and a lower portion with a lower portion cross sectional area. The lower portion is adapted to be located between the upper portion and the body of water at least partially surrounding the marine structure. The lower portion cross sectional area is smaller than the upper portion cross sectional area to facilitate the flow of fluid into the drain pipe. As such, since the cross sectional area of the drain pipe is reduced as the drain pipe extends downwardly - i.e. towards the body of water - the flow rate in the drain pipe increases and the flow may be advantageously oriented in the drain pipe so as to obtain a maximum flow rate at or below the lower portion of the drain pipe. Moreover, the smaller still water portion cross sectional area may reduce the loads acting on the drain pipe as compared to a drain pipe with a uniform cross sectional area.

[0028] According to another embodiment of the invention the drain pipe comprises guiding means to guide fluid entering the drain pipe and/or fluid already flowing in the drain pipe towards said outer side of the wall of the supporting member.

[0029] According to a further embodiment of the invention the outer side of the wall forms at least two, preferably three, side walls for the drain pipe.

[0030] The marine structure according to the present invention may be an oil platform (also called oil rig), a gas platform, a drilling platform, seabed mining apparatus, a marine biology laboratory, power plant, a crane platform, sea-going vessel or any other structure located in a body of water, such as a sea, ocean, lake or river, or adjacent thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The present invention will hereinafter be further explained by means of non-limiting examples with reference to the appended schematic figures where;

- | | |
|----------|---|
| Figure 1 | shows a side view of part of a marine structure according to the prior art, |
| Figure 2 | shows an overhead view of a deck |

of the marine structure shown in figure 1,
 Figure 3 shows a side view of part of a marine structure according to an embodiment of the invention,
 Figures 4 to 6 show top views of parts of marine structures according to embodiments of the invention,
 Figures 7 & 8 show a drain pipe of a marine structure according to an embodiment of the invention,
 Figure 9 shows part of a marine structure according to an embodiment of the invention, and
 Figures 10 & 11 show a drain pipe of a marine structure according to an embodiment of the invention.
 Figures 12-14 show a drain pipe of a marine structure according to an embodiment of the invention.

[0032] It should be noted that the drawings have not been drawn to scale and that the dimensions of certain features have been exaggerated for the sake of clarity.

DETAILED DESCRIPTION OF EMBODIMENTS

[0033] Figure 1 shows a part of a marine structure 10 according to the prior art. The marine structure comprises a supporting member 12 that is located at least partially in a body of water 22 and a drain pipe 14 that is arranged to drain fluid from a deck structure 16 which for example holds the necessary equipment used for either a drilling operation or the processing of crude oil and gas. Fluid (i.e. liquid or gas) collected, used or produced on the marine structure 10 enters a drainage channel 17, such as a scupper, in the deck 14 which guides the fluid into a fluid inlet 18 of the drain pipe 14. The fluid exits the drain pipe 14 via a fluid outlet 20 that is located below the water level of the body of water 22 that surrounds the marine structure 10. The drain pipe 14 is attached to the outer wall 24 of the supporting member 12 by connecting means 26 arranged along the length of the drain pipe.

[0034] Figure 2 shows the part of the marine structure 10 shown in figure 1 from above. The drain pipe 14, connecting means 26 and supporting member 12 are subjected to impact and drag forces from waves, underwater current and the wind, which forces are represented by the block arrow in figure 2, which forces may damage the marine structure 10. It should be noted that the block arrow in figure 2 represents the resultant force F on the drain pipe 14 at a given point in time. The drain pipe 14 may of course be subjected to forces acting in any direction.

[0035] Figures 3 and 4 show a marine structure 10 according to the present invention from the side and from above respectively. The marine structure 10 comprises a supporting member 12 that comprises a wall at least

partially delimiting the supporting member such that an inner side 28 of the wall is arranged to at least partially delimit an inner volume of the supporting member 12. The inner volume of the supporting member 12 may be hollow or at least partially filled. An outer side 24 of the wall is arranged to face the ambient environment of the supporting member 12.

[0036] The marine structure 10 further comprises a drain pipe 30 adapted to guide fluid from the marine structure 10 to a body of water 22 at least partially surrounding the marine structure 10 and located directly below the fluid inlet 18 in the illustrated embodiment. The fluid inlet 18 of the drain pipe 30 is preferably located at a vertical distance H below the deck 16 so that any gases drawn into or produced in the drain pipe 30 may be vented to the atmosphere and not transported to the deck 16.

[0037] The fluid outlet 20 of the drain pipe 30 shown in figures 3 and 4 is located below the water level of the body of water 22. The fluid outlet 20 may however be located at, or above the water level. The drain pipe 30 according to the invention may also comprise a plurality of fluid outlets 20 located above and below the water level as well as a plurality of water inlets 18. The drain pipe 30 may for example be arranged to receive fluid from a plurality of decks 16 of the marine structure 10. Purely by way of example, the drain pipe 30 may be adapted to receive fluid from an outlet 31, such as a ballast and/or a drain outlet, discharging from the supporting member 12 at a level below a deck 16 of the marine structure 10.

[0038] It should be noted that the drain pipe 30 according to any of the embodiments of the present invention may be adapted to receive fluid from any part of a marine structure 10, and not only from decks 16 of the marine structure.

[0039] At least a portion of the outer side 24 of the wall of the supporting member 12 partially delimits the drain pipe 30. The drain pipe's periphery (when viewed in cross section) is namely constituted by two plate members 30a and 30b, a portion of the outer side 24 of the wall of the supporting member 12 and an opening 32 that extends all the way from the fluid inlet 18 to the fluid outlet 20 of the drain pipe 30. Each of the two plate members 30a and 30b is attached to the supporting member 12 of the marine structure 10 by means of weld joints 33 that preferably extend substantially along the entire length L of the drain pipe 30. The drain pipe 30 or a drain pipe member plate may however be connected to a supporting member by any suitable means and in any suitable way.

[0040] Figure 5 shows an alternative embodiment of the Figure 4 marine structure 10 wherein the drain pipe 30 comprises a third member plate 30c having a substantially T-shaped cross section. As such, the Figure 5 drain pipe 30 in fact comprises two conduits for distribution liquid from the marine structure 10 to the ambient water. In further embodiments of the marine structure 10, the drain pipe 30 may comprise a plurality of T-shaped plates or partitional plates of any other type (not shown)

between the first 30a and the second 30b member plates such that three or more conduits (not shown) are formed. A plurality of conduits may be arranged to merge by providing the partitional plates with openings.

[0041] Figure 6 shows an alternative embodiment of the invention in which the drain pipe 30 is located entirely inside the supporting member 12 in a cavity that is partially delimited by the outer side 24 of the wall of the supporting member 12. In other words, the outer side 24 of the wall partially forms at least two, preferably three, side walls for the drain pipe 30. Such a structure will protect the drain pipe 30 from damage from waves, underwater currents and the wind and will decrease drainage system space requirements.

[0042] Figure 7 shows a drain pipe 30 according to an embodiment of the invention. The drain pipe 30 comprises one member plate 30a only. The member plate 30a has a substantially U-shaped cross section and comprises a plurality of openings 32. It is arranged to be fixedly attached to a supporting member 12 of a marine structure 10 so that the outer side 24 of the wall of the supporting member 12 constitutes the part of the periphery of the drain pipe 30 extending between the two ends of the U-shaped plate member 30a. The drain pipe 30 is arranged to extend substantially vertically when attached to the supporting member 12. The drain pipe 30 may however comprise one or more non-vertical sections.

[0043] The length L of the drain pipe 30 may range from 10 m to 100 m or more and may therefore comprise a plurality of member plates 30a such as the one shown in figure 7.

[0044] The drain pipe 30 according to the present invention may comprise a cover (not shown) to prevent water from entering the fluid inlet 18 of the drain pipe 30. The cover or a fluid inlet 18 may comprise a filter means or a grating in order to prevent objects from falling into the drain pipe 30.

[0045] It should be noted that the drain pipe according to any of the embodiments of the invention may comprise one or more filter means and/or treatment facilities located anywhere upstream or downstream of the drain pipe 30 or along the drain pipe 30. It should also be noted that the drain pipe may comprise means to guide at least part of the fluid flowing through the drain pipe 30 to another part of the marine structure 10, such as from apparatus on a higher deck of a marine structure to apparatus on a lower deck.

[0046] The drain pipe 30 according to the present invention may comprise an upper portion with an upper portion cross sectional area $A(u)$ and a lower portion with a lower portion cross sectional area $A(s)$, the lower portion cross sectional area $A(s)$ being smaller than the upper portion cross sectional area $A(u)$ as indicated by the dotted lines in figure 7. The lower portion is adapted to be located between the upper portion and the body of water 22 at least partially surrounding the marine structure 10. A drain pipe 30 may comprise such an upper portion only at the uppermost part of the drain pipe 30 by its fluid inlet,

or if a drain pipe 30 comprises a plurality of drain pipe sections such as that shown in figure 7, a plurality of drain pipe sections may comprise such upper portions. Purely by way of example, if a drain pipe 30 only comprises one upper portion, the lower portion may be located at approximately one third of the length of the drain pipe 30 below the upper portion.

[0047] Preferably, the ratio of the upper portion cross sectional area $A(u)$ and the lower portion cross sectional area $A(s)$ (i.e. $A(u)/A(s)$) is within the range 1.5 - 4, more preferred within the range 1.8 - 2.5. Most preferred the aforesaid ratio is approximately 2.

[0048] The drain pipe 30 according to the present invention may comprise steel, plastic or any other suitable material and may include a physically and/or chemically reinforced section Y that is arranged to be located in an area that is subjected to greater forces than other parts of the drain pipe. A reinforced section Y may for example be arranged to be located in the splash zone (i.e. the area where waves of a sea, ocean, river or lake strike the drain pipe), which area may optionally be free of openings 32. The reinforced section Y may for example comprise a stronger metal grade or thicker metal and be coated with a rust or corrosion-resistant paint.

[0049] The marine structure 10 according to the present invention may comprise a hoisting arrangement (not shown) with a lift which lift is adapted to be raised and lowered within at least a portion of the drain pipe 30 or along the outside of at least a portion of the drain pipe 30. The drain pipe 30 of the present invention may namely have a diameter ranging from 1 to 5 m up to 15 m. Preferably, the marine structure 10 comprises guide means (not shown) for guiding the lift in the drain pipe 30. It should be noted that the hoisting arrangement may be detachable such that it may be placed in a storage location at a distance from the drain pipe 30 when the hoisting arrangement is not used.

[0050] Figure 8 shows a drain pipe 30 according to an embodiment of the invention in which the drain pipe 30 comprises guiding means 35 to guide fluid towards the outer side 24 of the wall of the supporting member 12 which constitutes part of the periphery of the drain pipe 30. The guiding means 35 may for example comprise funnel means to ensure that fluid entering the drain pipe 30 and fluid that splashes away from the outer side 24 of the wall of the supporting member 12 as it flows through the drain pipe 30 is directed towards the outer side 24 of the wall of the supporting member 12. One or more openings 32 may be arranged at the side of the drain pipe 30 which is furthest from the outer side 24 of the wall of the supporting member 12 in order to facilitate inspection of the inside of the drain pipe 30 and to vent gases therefrom.

[0051] Figure 9 shows part of a semi-submersible marine structure a float 34 from the side, wherein the supporting member to which a drain pipe 30 is attached is a support column extending between a deck of the marine structure and the float 34. The float 34 may comprise an

opening 36 beneath the drain pipe 30 such that a pump 38 may be lowered therethrough and into the water under the float 34 or surrounding the float 34. The drain pipe 30 shown in figure 9 comprises an integrally formed housing 40 that at least partially surrounds at least one pipe 42. Alternatively the housing 40 may be releasably or non-releasably connected to the drain pipe 30. Figure 10 shows the drain pipe 30 and housing 40 from above. In the illustrated embodiment the housing 40 is attached to the supporting member 12.

[0052] It should be noted that the outer side 24 of the wall of the supporting member 12 has been shown as a flat surface in the illustrated embodiment. The outer side 24 of the wall of the supporting member 12 need not however be a flat surface.

[0053] When the drain pipe 30 is mounted on a support column, the ratio of the support column cross sectional area A_C and the lower portion cross sectional area $A(s)$ (i.e. $A_C/A(s)$) is preferably more than 10, more preferred more than 20.

[0054] Figure 11 shows a fluid outlet of the drain pipe 30 according to an embodiment of the invention. The drain pipe 30 comprises a guide plate 44 that directs water exiting the drain pipe 30 at an angle. Since the fluid outlet of the drain pipe 30 in the illustrated embodiment is located above the water level the marine structure 10 may comprise a splash guard 46 to prevent people and/or other objects or part of the structure from being hit or splashed by the stream of fluid exiting the drain pipe 30. The splash guard 46 may be attached to a float 34 of a marine structure 10, a drain pipe 30 or any other part of a marine structure 10.

[0055] Further modifications of the invention within the scope of the claims would be apparent to a skilled person. For example, the supporting member 12 need not necessarily be vertical as shown in the illustrated embodiments. The drain pipe 30 according to the present invention could for example be connected to a float 34 and to a deck structure 16 of a marine structure 10.

[0056] In an embodiment according to the present invention, at least parts of the drain pipe 30 can be arranged non-vertically, i.e. arranged with an angle with respect to the normal 40. The normal 40 is illustrated in figure 12. It is to be understood that the term vertically and normal is with respect to the still water line, the still water line is in this respect horizontal. The still water line is shown in figure 12 as the operational draught 46. The operational draught being the draught that the marine structure has during normal operation. If the marine structure is a semi submersible rig, the operational draught is the draught the semi submersible rig has during its stationary operations, which operations can be extracting oil or natural gas for example. The drain pipe 30 comprises an interior surface 41 formed by at least a portion of the outer side 24 of the wall, which partially delimits the drain pipe 30. It is advantageous if at least a part of the interior surface 41 of the drain pipe 30 is arranged with an angle α with respect to the normal 40.

[0057] Figure 12 shows the drain pipe 30 having at least parts of the interior surface 41 arranged with an angle α of 10° with respect to the normal 40, forming a tilting surface 42. The tilting surface 42, i.e. tilted with respect to the normal 40, and enables a high flow of fluid, e.g. a flow of water, to flow down the drain pipe 30. The fluid is oriented towards the tilted surface 42 of the interior surface 41 of the drain pipe 30. As the fluid is oriented towards the tilted surface 42 during drainage, a natural passage for air is formed within the drain pipe 30, enabling the falling fluid to fall with a high velocity. This passage is generally referred to as a splash zone, see figure 14. The drain pipe 30 extends from the deck structure 16 and the box bottom, to the proximity of the float 34, as shown in figure 13.

[0058] A fluid collecting tank 55 is initially collecting different fluids which are to be removed from the marine structure. The fluid collecting tank 55 is in fluid communication with the drain pipe 30 or is transcending to the drain pipe 30. An access trunk is arranged through the deck structure 16. As is indicated, the drained fluid, in this case water such as sea water, cleaning water and cooling water or the like, access the fluid collecting tank 55 with a flow of $3 \text{ m}^3/\text{s}$. As the fluid flow downwards, in this case towards the operational draught level 46, the velocity of the fluid increases. In the proximity of section A, the velocity of the water is about 6 m/s, at section B about 10 m/s, at section C about 14 m/s. Further indicated at sections A, B and C are the approximate cross section dimensions, section A having a cross section of about $1,2 \text{ m} \times 0,6 \text{ m}$, section B $1,0 \text{ m} \times 0,5 \text{ m}$, section C $0,85 \text{ m} \times 0,5 \text{ m}$. Hence the drain pipe 30 has a cross section area which is reduced along the length of the drain pipe 30, in the shown embodiment with a continuous reduction, although a step wise reduction of the cross section area is also possible.

[0059] As is seen in figure 12, at least 50 % of the total length of the drain pipe 30 is arranged with an angle α with respect to the normal 40. At least 70 % or more of the length of the drain pipe 30 above the operational draught 46 is arranged with an angle α with respect to the normal.

[0060] The angle α is advantageously 5° or more, more advantageously between $5-25^\circ$, even more advantageously $5-20^\circ$ or more advantageously $10-20^\circ$, with respect to the normal 40.

[0061] The drain pipe 30 can have vertical portions, as described above, and non vertical portions. The drain pipe 30 can also have portions of different angles, e.g. at least a first portion having an angle α of 5° or more and a second portion having an angle α of $10-25^\circ$, with respect to the normal 40. Further, a first and a second opposing surface 43, 44 of the interior surface 41 drain pipe 30 can be either parallel or non parallel. As shown in figure 12, a first part 43 of the interior surface 41 can be vertical, while a second part 44 of the interior surface 41 is substantially non vertical, e.g. arranged with an angle α of 5° or more.

[0062] As mentioned, it is advantageous if the area of the cross section of the drain pipe 30 is subsequently decreasing. As the velocity of the fluid increases, the area of the cross section can be reduced, improving the structural integrity of the drain pipe 30. Hence, the closer to the float 34, the smaller the area of the cross section. Although optionally the area of the cross section is substantially constant between the operational draught level and the transit level. This is mainly due to that the flow through the drain pipe 30, when the marine structure is at transit level as shown in figure 13, is generally smaller than when the marine structure is in the operational draught level, as shown in figure 12.

[0063] Shown in figure 12, in the proximity of section D, a plurality of arrows illustrate the flow of the falling water when entering the sea water, i.e. the level of operational draught 46. Due to the inertia of the falling water, the water continues a portion in the drain pipe 30 below the surface of the operational draught until the water is dispersed in the sea water. It should be noticed that the length of the drain pipe 30 can be adapted to extend a small portion past the operational draught 46 of the marine structure. Hence the drain pipe 30 does not need to extend to the proximity of the float 34. A drain pipe extending to the proximity of the float 34 is only required during transit conditions for the marine structure. Transit conditions can be when transporting the marine structure, during maintenance or the like.

[0064] Figure 13 shows the lower part of the supporting member 12 arranged with a float 34. Figure 13 shows the support member, in this case the column, during transit. During transit, the draught of the marine structure, in this case the semi submersible rig, is significantly less than the operational draught, as indicated by the water line. As is noticed, the drain pipe 30 is arranged with a bend 50, and at least a second portion of the drain pipe 30 having a different angle α , than a first portion. The drain pipe 30 is covered at the bend 50 from the ambient environment, to prevent the falling fluid from escaping the drain pipe 30. In figure 12 and 13, the drain pipe 30 is partly open to the ambient environment. The discharge, indicated in figure 13 with an arrow and an approximate flow velocity for the water. It should be noted that the flow velocities, flows and dimensions are none limiting and of exemplifying nature only.

[0065] Figure 14 shows different cross sections A, B, C, D, E, F and G at different sections of the drain pipe 30, the sections are indicated in figures 12-13. The dotted section of the drain pipe being an alternative route for the drain pipe. As is noticed, the area of the cross sections A-C are subsequently decreasing as the drain pipe extends towards the level of the operational draught 46 and the float 34. The cross sections D-G are advantageously constant as these are generally below the level of the operational draught 46 and generally only used during transit conditions for the marine structure. The cross sections A-C are shown with a water area 48, which due to the tilting surface 42 orients and collects the fluid, and

with a splash zone 47. The splash zone 47 enables air to be collected and prevents the fluid from being disrupted during the high velocity transportation or falling. The cross section of the drain pipe 30 is substantially rectangular. Further seen in figure 14, the drain pipe 30 comprises a plurality of openings 51 which connects the interior of the drain pipe 30 with the ambient environment.

10 Claims

1. A marine structure (10) comprising a supporting member (12) that comprises a wall at least partially delimiting said supporting member (12) such that an inner side (28) of said wall is arranged to at least partially delimit an inner volume of said supporting member (12) and an outer side (24) of said wall is arranged to face the ambient environment of said supporting member (12), said marine structure (10) further comprising a drain pipe (30) adapted to guide fluid from said marine structure (10) to a body of water (22) at least partially surrounding said marine structure (10), **characterized in that** at least a portion of said outer side (24) of said wall partially delimits said drain pipe (30), at least a portion of the outer side (24) of the wall constituting a part of the periphery of the drain pipe (30).
2. The marine structure (10) according to claim 1, wherein said supporting member (12) is arranged to be located at least partially in said body of water (22).
3. The marine structure (10) according to claim 1 or 2, wherein said drain pipe (30) comprises a fluid inlet (18) and a fluid outlet (20), said fluid inlet being adapted to be located above the water level of said body of water (22) and said fluid outlet (20) being adapted to be located under said water level.
4. The marine structure (10) according to claim 3, wherein said drain pipe (30) further comprises an opening (32) to the ambient environment located between said fluid inlet (18) and said fluid outlet (20), in order to facilitate inspection of said drain pipe (30).
5. The marine structure (10) according to claim 4, wherein said opening extends all the way from said fluid inlet (18) to said fluid outlet (20).
6. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) further comprises a cover.
7. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) is comprises one member plate (30a) only.
8. The marine structure (10) according to claim 7,

wherein said member plate (30a) has a substantially C- or U-shaped cross section.

9. The marine structure (10) according to any one of claims 1-7, wherein said drain pipe (30) comprises at least two member plates (30a, 30b), each of which is attached to said supporting member (12). 5
10. The marine structure (10) according to claim 9, wherein said drain pipe (30) comprises two member plates (30a, 30b), each having a substantially C-, U- or L-shaped cross section. 10
11. The marine structure (10) according to claim 9 or 10, wherein said drain pipe (30) comprises a third member plate (30c) having a substantially T- or + -shaped cross section. 15
12. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) is attached to said supporting member (12) by one or more weld joints (33), preferably continuous weld joints, that extend substantially along the entire length (L) of drain pipe (30). 20
13. The marine structure (10) according to any one of the preceding claims, wherein it further comprises a hoisting arrangement with a lift which lift is adapted to be raised and lowered within at least a portion of said drain pipe (30) or along the outside of at least a portion of said drain pipe (30). 25
14. The marine structure (10) according to any one of the preceding claims, wherein said marine structure (10) is a semi-submersible unit comprising a deck structure (16) and a float (34), wherein said supporting member (12) is a support column extending between said deck structure (16) and said float (34). 30
15. The marine structure (10) according to claim 14, wherein said float (34) comprises an opening (36) beneath the drain pipe (30) such that a pump (38) may be lowered therethrough. 35
16. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) also comprises a housing (40) that at least partially surrounds at least one pipe (42). 40
17. The marine structure (10) according to claim 16 when dependent on claim 15, wherein said at least one pipe (42) is connected to said pump (38). 45
18. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) comprises at least one section that extends substantially vertically when the drain pipe (30) is mounted on said supporting member (12). 50

19. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) comprises at least one section that extends substantially non vertically when the drain pipe (30) is mounted on said supporting member (12).

20. The marine structure (10) according to claim 19, wherein said drain pipe (30) comprises at least one section having an interior surface (41) and in that at least one surface (42) of said interior surface (41) is arranged with an angle α for orienting said fluid towards said surface (42).

21. The marine structure (10) according to claim 20, wherein said surface (42) is arranged with an angle α of 5° or more.

22. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) comprises a upper portion with a upper portion cross sectional area (A(u)) and a lower portion with a lower portion cross sectional area (A(s)), said lower portion being adapted to be located between said upper portion and said body of water (22) at least partially surrounding said marine structure (10), said lower portion cross sectional area (A(s)) being smaller than said upper portion cross sectional area (A(u)).

23. The marine structure (10) according to any one of the preceding claims, wherein said drain pipe (30) comprises guiding means (35) to guide fluid towards said outer side (24) of the wall of the supporting member (12).

24. The marine structure (10) according to any one of the preceding claims, wherein said outer side (24) of said wall forms at least two, preferably three, side walls for said drain pipe (30).

Patentansprüche

1. Seebauwerk (10), welches ein Stützelement (12) umfasst, das eine Wand umfasst, die mindestens teilweise das Stützelement (12) so begrenzt, dass eine Innenseite (28) der Wand so angeordnet ist, dass sie mindestens teilweise ein Innenvolumen des Stützelements (12) begrenzt, und dass eine Außenseite (24) der Wand so angeordnet ist, dass sie der Umgebung des Stützelements (12) zugewandt ist, wobei das Seebauwerk (10) weiterhin ein Abflussrohr (30) umfasst, das so ausgeführt ist, dass Fluid vom Seebauwerk (10) einem Wasserkörper (22) zugeleitet wird, der teilweise das Seebauwerk (10) umgibt, **dadurch gekennzeichnet, dass** mindestens ein Abschnitt der Außenseite (24) der Wand das Abflussrohr (30) teilweise begrenzt, wobei mindestens ein Abschnitt der Außenseite (24) der Wand einen

Teil des Umfangs des Abflussrohrs (30) darstellt.

2. Seebauwerk (10) nach Anspruch 1, bei dem das Stützelement (12) so angeordnet ist, dass es sich mindestens teilweise im Wasserkörper (22) befindet. 5
3. Seebauwerk (10) nach Anspruch 1 oder 2, bei dem das Abflussrohr (30) einen Fluideinlass (18) und einen Fluidauslass (20) umfasst, wobei der Fluideinlass so ausgeführt ist, dass er sich über dem Wasserspiegel des Wasserkörpers (22) befindet, und wobei der Fluidauslass (20) so ausgeführt ist, dass er sich unter dem Wasserspiegel befindet. 10
4. Seebauwerk (10) nach Anspruch 3, bei dem das Abflussrohr (30) weiterhin eine Öffnung (32) zur Umgebung umfasst, die sich zwischen dem Fluideinlass (18) und dem Fluidauslass (20) befindet, um eine Inspektion des Abflussrohrs (30) zu ermöglichen. 15
5. Seebauwerk (10) nach Anspruch 4, bei dem sich die Öffnung über die gesamte Strecke vom Fluideinlass (18) hin zum Fluidauslass (20) erstreckt. 20
6. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) weiterhin eine Abdeckung umfasst. 25
7. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) nur eine Elementplatte (30a) umfasst. 30
8. Seebauwerk (10) nach Anspruch 7, bei dem die Elementplatte (30a) einen im Wesentlichen C- oder U-förmigen Querschnitt hat. 35
9. Seebauwerk (10) nach einem der Ansprüche 1 bis 7, bei dem das Abflussrohr (30) mindestens zwei Elementplatten (30a, 30b) umfasst, die jeweils am Stützelement (12) befestigt sind. 40
10. Seebauwerk (10) nach Anspruch 9, bei dem das Abflussrohr (30) zwei Elementplatten (30a, 30b) umfasst, die jeweils einen im Wesentlichen C-, U- oder L-förmigen Querschnitt haben. 45
11. Seebauwerk (10) nach Anspruch 9 oder 10, bei dem das Abflussrohr (30) eine dritte Elementplatte (30c) umfasst, die einen im Wesentlichen T- oder +-förmigen Querschnitt hat. 50
12. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) am Stützelement (12) durch eine oder mehrere Schweißnähte (33), vorzugsweise durchgehende Schweißnähte, befestigt ist, die sich im Wesentlichen über die gesamte Länge (L) des Abflussrohrs (30) erstrecken. 55

13. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem es weiterhin eine Hubwerkanordnung mit einer Liftvorrichtung umfasst, wobei die Liftvorrichtung so ausgeführt ist, dass sie mindestens innerhalb eines Abschnitts des Abflussrohrs (30) oder entlang der Außenseite von mindestens einem Abschnitt des Abflussrohrs (30) angehoben oder abgesenkt werden kann.
14. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Seebauwerk (10) eine Halbtauchereinheit ist, die eine Deckkonstruktion (16) und einen Schwimmkörper (34) umfasst, wobei das Stützelement (12) eine Stützsäule ist, die sich zwischen der Deckkonstruktion (16) und dem Schwimmkörper (34) erstreckt.
15. Seebauwerk (10) nach Anspruch 14, bei dem der Schwimmkörper (34) eine Öffnung (36) unter dem Abflussrohr (30) umfasst, so dass dadurch eine Pumpe (38) abgesenkt werden kann.
16. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) auch ein Gehäuse (40) umfasst, das mindestens teilweise mindestens ein Rohr (42) umgibt.
17. Seebauwerk (10) nach Anspruch 16, soweit von Anspruch 15 abhängig, bei dem das mindestens ein Rohr (42) mit der Pumpe (38) verbunden ist.
18. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) mindestens einen Bereich umfasst, der sich im Wesentlichen vertikal erstreckt, wenn das Abflussrohr (30) am Stützelement (12) montiert ist.
19. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) mindestens einen Bereich umfasst, der sich im Wesentlichen nicht-vertikal erstreckt, wenn das Abflussrohr (30) am Stützelement (12) montiert ist.
20. Seebauwerk (10) nach Anspruch 19, bei dem das Abflussrohr (30) mindestens einen Bereich mit einer Innenfläche (41) umfasst, und wobei mindestens eine Fläche (42) der Innenfläche (41) mit einem Winkel α angeordnet ist, um das Fluid hin zur Fläche (42) auszurichten.
21. Seebauwerk (10) nach Anspruch 20, bei dem die Fläche (42) mit einem Winkel α von 5° oder mehr angeordnet ist.
22. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) einen Oberabschnitt mit seiner Querschnittsfläche (A(u)) und einen Unterabschnitt mit seiner Quer-

schnittsfläche (A(s)) hat, wobei der Unterabschnitt so ausgeführt ist, dass er sich zwischen dem Oberabschnitt und dem Wasserkörper (22) befindet, der mindestens teilweise das Seebauwerk (10) umgibt, und wobei die Unterabschnitt-Querschnittsfläche (A(s)) kleiner als die Oberabschnitt-Querschnittsfläche (A(u)) ist.

23. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem das Abflussrohr (30) ein Führungsmittel (35) umfasst, um Fluid hin zur Außenseite (24) der Wand des Stützelements (12) zu leiten.
24. Seebauwerk (10) nach einem der vorstehend aufgeführten Ansprüche, bei dem die Außenseite (24) der Wand mindestens zwei, vorzugsweise drei Seitenwände für das Abflussrohr (30) bildet.

Revendications

1. Structure marine (10) comprenant un élément de support (12) présentant une paroi qui délimite au moins partiellement ledit élément de support (12), de telle sorte qu'un côté intérieur (28) de ladite paroi soit agencé de manière à délimiter au moins partiellement un volume intérieur dudit élément de support (12), et qu'un côté extérieur (24) de ladite paroi soit agencé de manière à faire face à l'environnement ambiant dudit élément de support (12), ladite structure marine (10) comprenant en outre un tuyau de drainage (30) adapté pour guider un fluide à partir de ladite structure marine (10) jusqu'à un corps d'eau (22) qui entoure au moins partiellement ladite structure marine (10), **caractérisée en ce qu'**au moins une partie dudit côté extérieur (24) de ladite paroi délimite partiellement ledit tuyau de drainage (30), au moins une partie du côté extérieur (24) de la paroi constituant une partie de la périphérie du tuyau de drainage (30).
2. Structure marine (10) selon la revendication 1, dans laquelle ledit élément de support (12) est agencé de manière à être situé au moins partiellement dans ledit corps d'eau (22).
3. Structure marine (10) selon la revendication 1 ou 2, dans laquelle ledit tuyau de drainage (30) comprend une entrée de fluide (18) et une sortie de fluide (20), ladite entrée de fluide étant adaptée pour être située au-dessus du niveau d'eau dudit corps d'eau (22), et ladite sortie de fluide (20) étant adaptée pour être située en dessous dudit niveau d'eau.
4. Structure marine (10) selon la revendication 3, dans laquelle ledit tuyau de drainage (30) comporte en outre une ouverture (32) vers l'environnement am-

biant qui est située entre ladite entrée de fluide (18) et ladite sortie de fluide (20), dans le but de faciliter une inspection dudit tuyau de drainage (30).

5. Structure marine (10) selon la revendication 4, dans laquelle ladite ouverture s'étend sur la totalité de la distance entre ladite entrée de fluide (18) et ladite sortie de fluide (20).
6. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend en outre un couvercle.
7. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) est constitué d'une plaque d'élément (30a) seulement.
8. Structure marine (10) selon la revendication 7, dans laquelle ladite plaque d'élément (30a) présente une section transversale sensiblement en forme de C ou de U.
9. Structure marine (10) selon l'une quelconque des revendications 1 à 7, dans laquelle ledit tuyau de drainage (30) comprend au moins deux plaques d'élément (30a, 30b) dont chacune est attachée audit élément de support (12).
10. Structure marine (10) selon la revendication 9, dans laquelle ledit tuyau de drainage (30) comprend deux plaques d'élément (30a, 30b) qui présentent chacune une section transversale sensiblement en forme de C, de U ou de L.
11. Structure marine (10) selon la revendication 9 ou 10, dans laquelle ledit tuyau de drainage (30) comprend une troisième plaque d'élément (30c) qui présente une section transversale sensiblement en forme de T ou de croix.
12. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) est attaché audit élément de support (12) par un ou plusieurs joint(s) soudé(s) (33), de préférence des joints soudés continus, qui s'étendent sensiblement le long de la totalité de la longueur (L) du tuyau de drainage (30).
13. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle elle comprend en outre un agencement de levage comprenant un élévateur, ledit élévateur étant adapté pour être élevé et abaissé à l'intérieur d'au moins une partie dudit tuyau de drainage (30) ou le long de l'extérieur d'au moins une partie dudit tuyau de drainage (30).

14. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ladite structure marine (10) est une unité semi-submersible qui comprend une structure de pont (16) et un flotteur (34), dans laquelle ledit élément de support (12) est une colonne de support qui s'étend entre ladite structure de pont (16) et ledit flotteur (34). 5
15. Structure marine (10) selon la revendication 14, dans laquelle ledit flotteur (34) comporte une ouverture (36) en dessous du tuyau de drainage (30), de telle sorte qu'une pompe (38) puisse être abaissée à travers celle-ci. 10
16. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend également un boîtier (40) qui entoure au moins partiellement au moins un tuyau (42). 15
17. Structure marine (10) selon la revendication 16 lorsqu'elle dépend de la revendication 15, dans laquelle ledit au moins un tuyau (42) est connecté à ladite pompe (38). 20
18. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend au moins une section qui s'étend sensiblement verticalement lorsque le tuyau de drainage (30) est monté sur ledit élément de support (12). 25
19. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend au moins une section qui s'étend sensiblement de façon non verticale lorsque le tuyau de drainage (30) est monté sur ledit élément de support (12). 30
20. Structure marine (10) selon la revendication 19, dans laquelle ledit tuyau de drainage (30) comprend au moins une section qui présente une surface intérieure (41), et en ce qu'au moins une surface (42) de ladite surface intérieure (41) est agencée avec un angle α pour orienter ledit fluide en direction de ladite surface (42). 35
21. Structure marine (10) selon la revendication 20, dans laquelle ladite surface (42) est agencée avec un angle α de 5°, ou plus. 40
22. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend une partie supérieure présentant une aire de section transversale de partie supérieure (A(u)) et une partie inférieure présentant une aire de section transversale de partie inférieure (A(s)), ladite partie inférieure étant adaptée pour être située entre ladite partie supérieure et ledit corps d'eau (22) en entourant au moins partiellement ladite structure marine (10), ladite aire de section transversale de partie inférieure (A(s)) étant plus petite que ladite aire de section transversale de partie supérieure (A(u)). 45
23. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit tuyau de drainage (30) comprend des moyens de guidage (35) pour guider le fluide en direction dudit côté extérieur (24) de la paroi de l'élément de support (12). 50
24. Structure marine (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit côté extérieur (24) de ladite paroi forme au moins deux, de préférence trois parois latérales pour ledit tuyau de drainage (30). 55

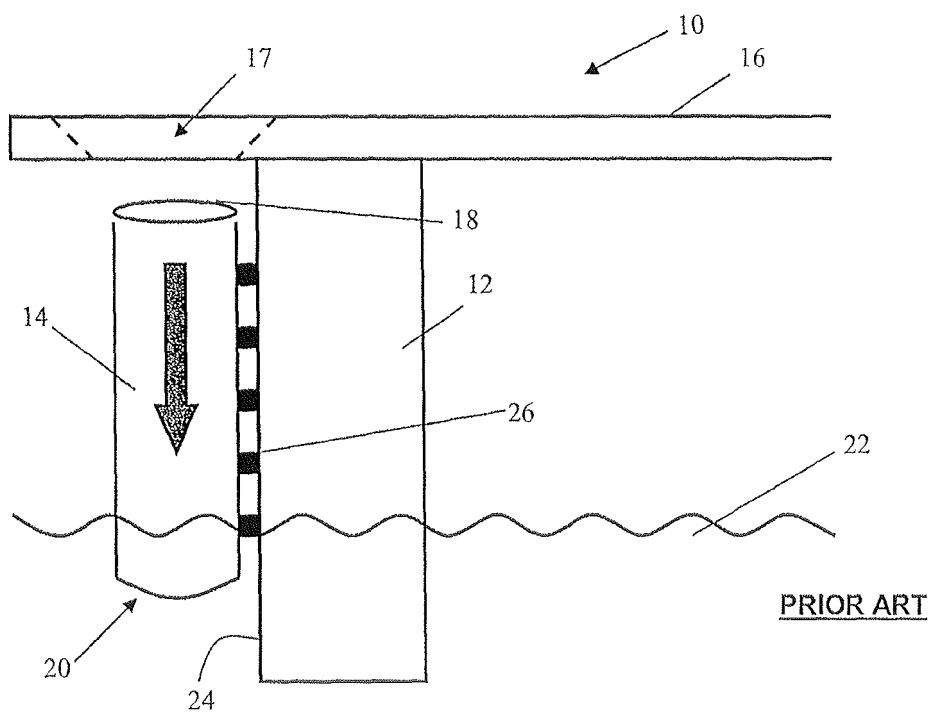


Fig. 1

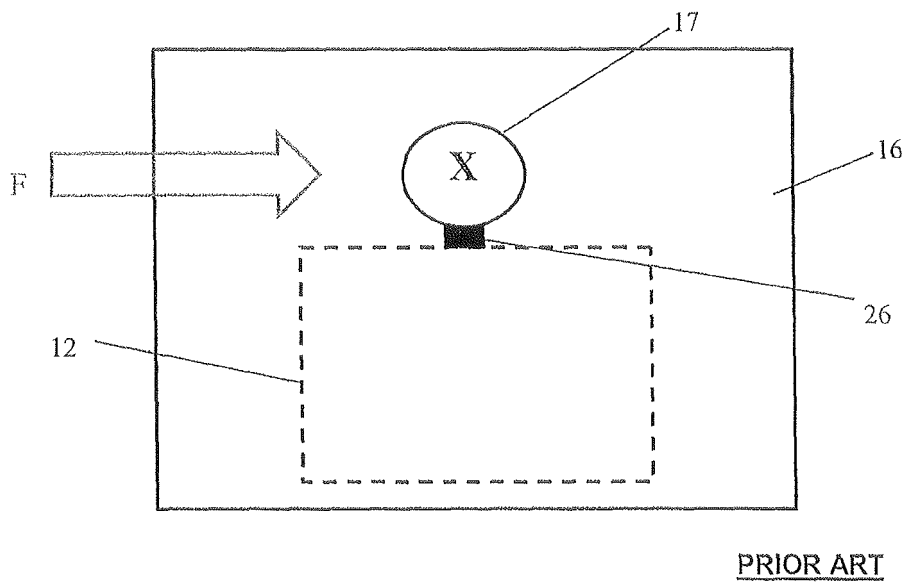


Fig. 2

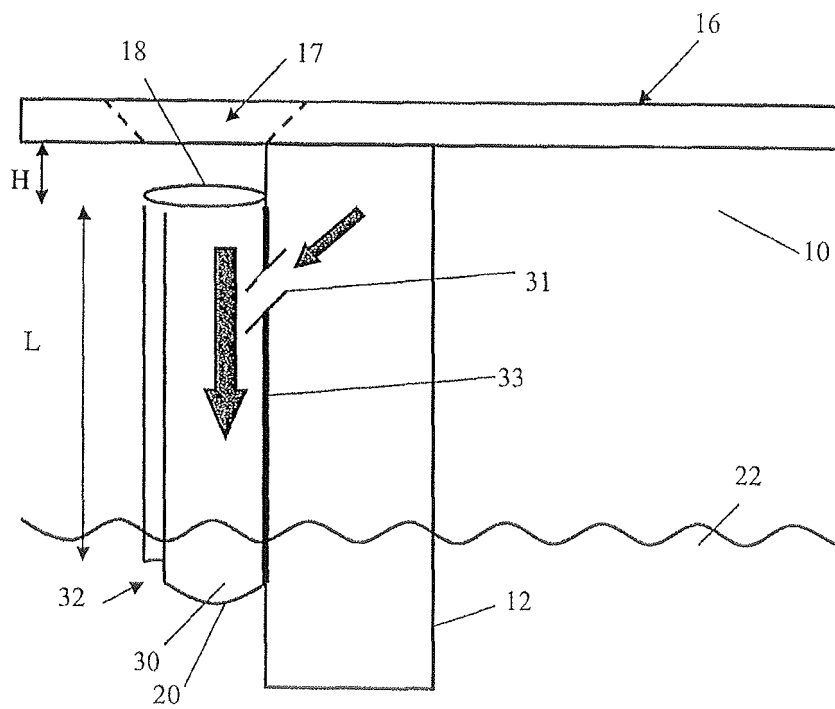


Fig. 3

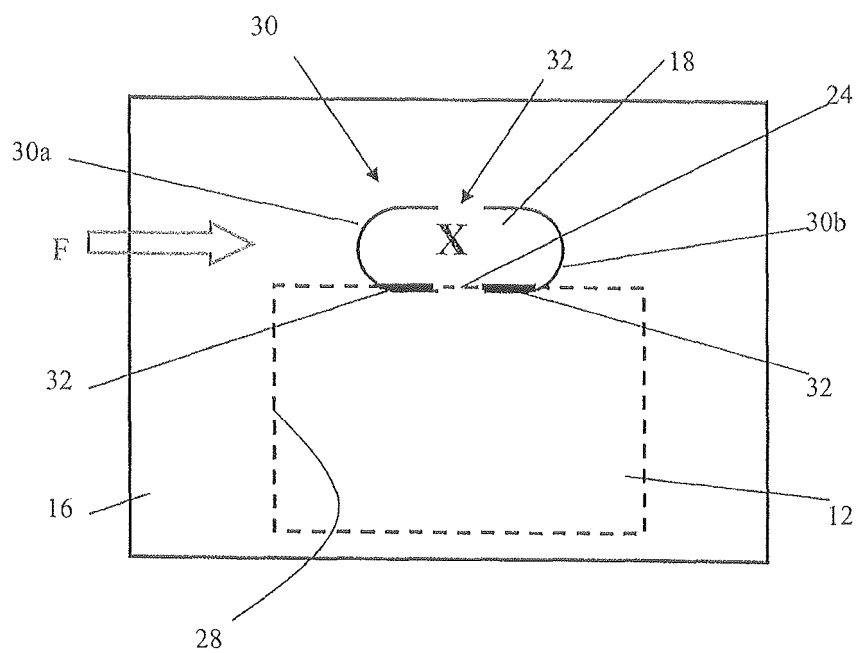


Fig. 4

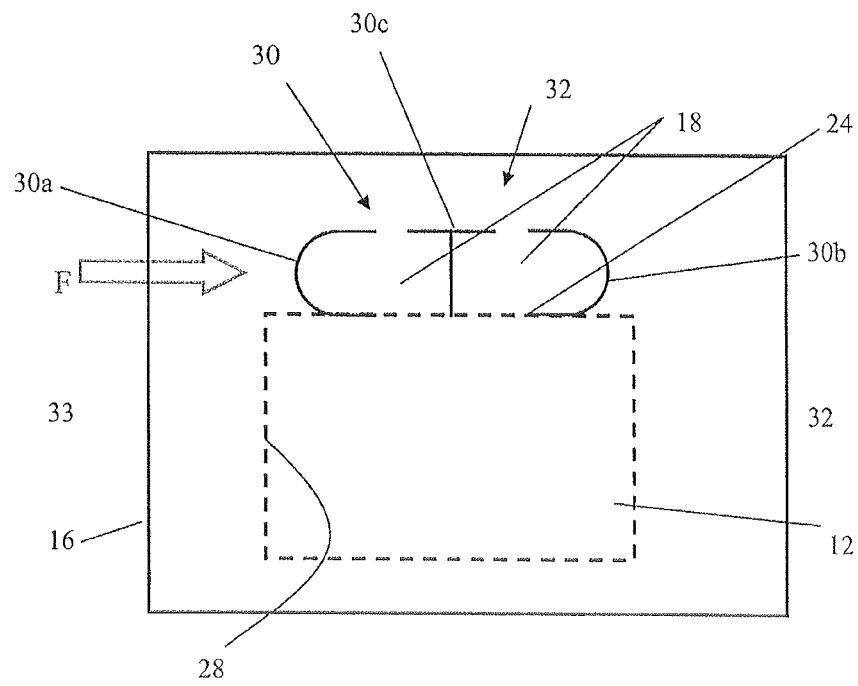


Fig. 5

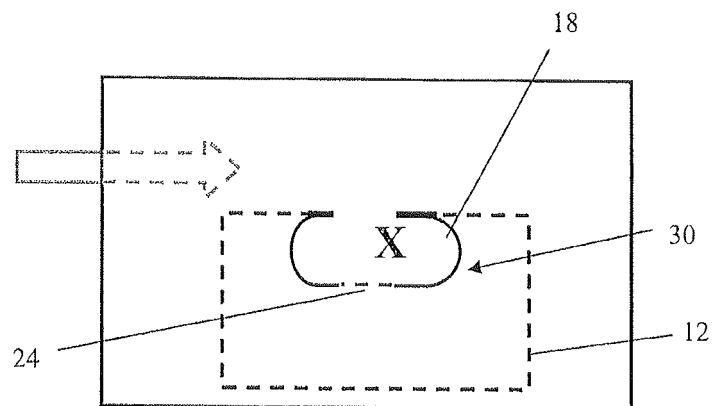


Fig. 6

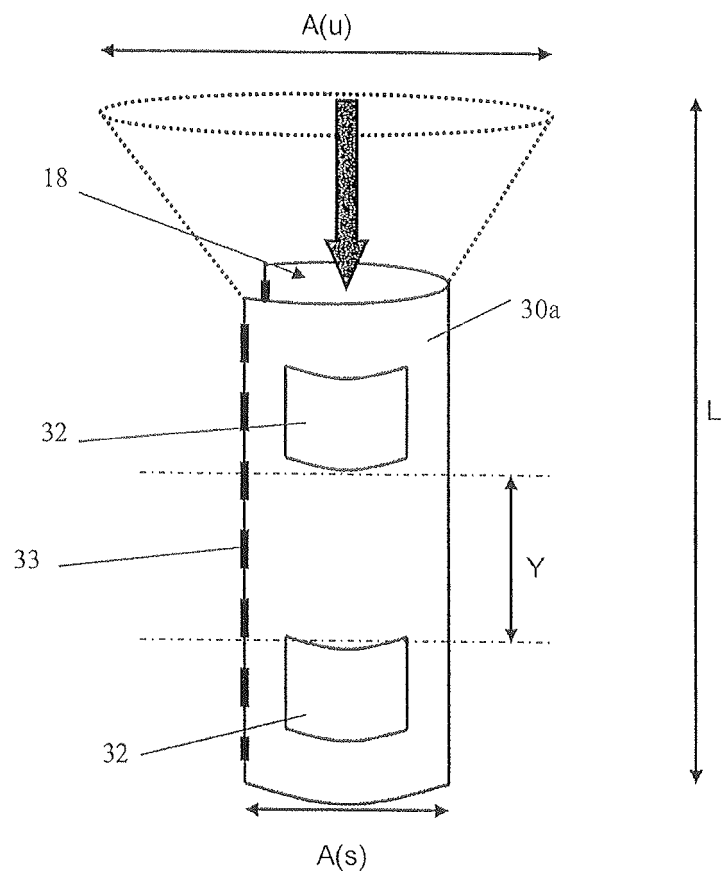


Fig. 7

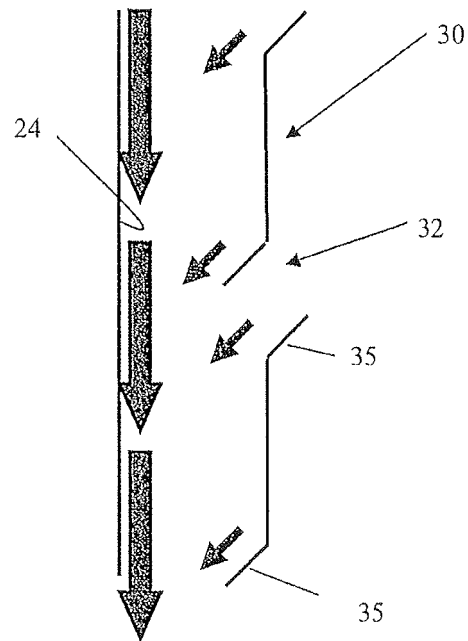


Fig. 8

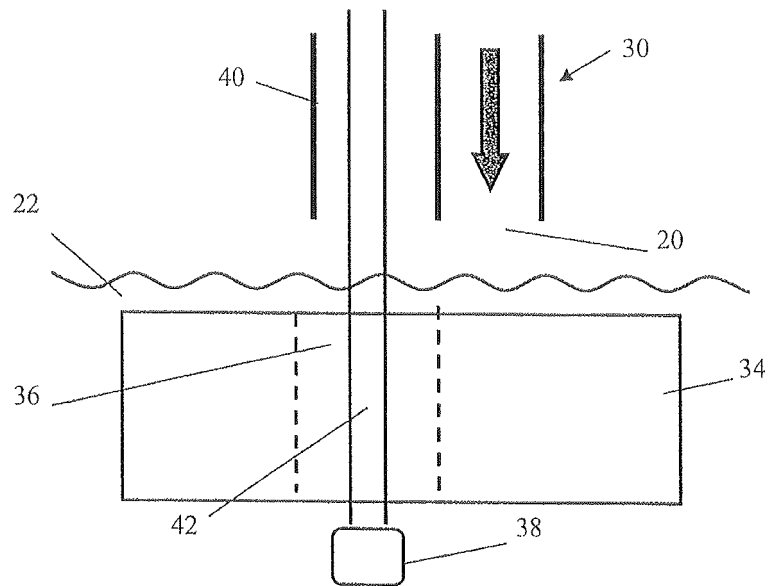


Fig. 9

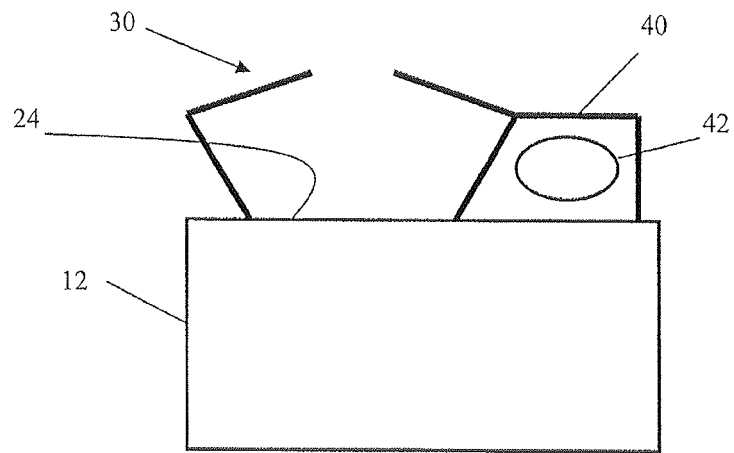


Fig. 10

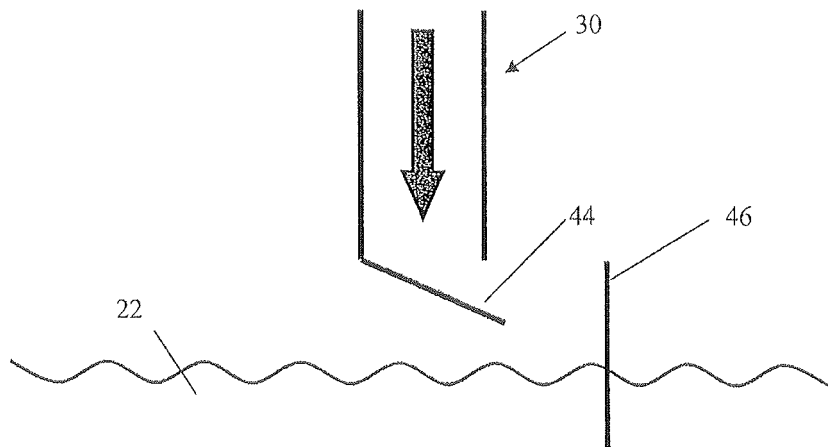


Fig. 11

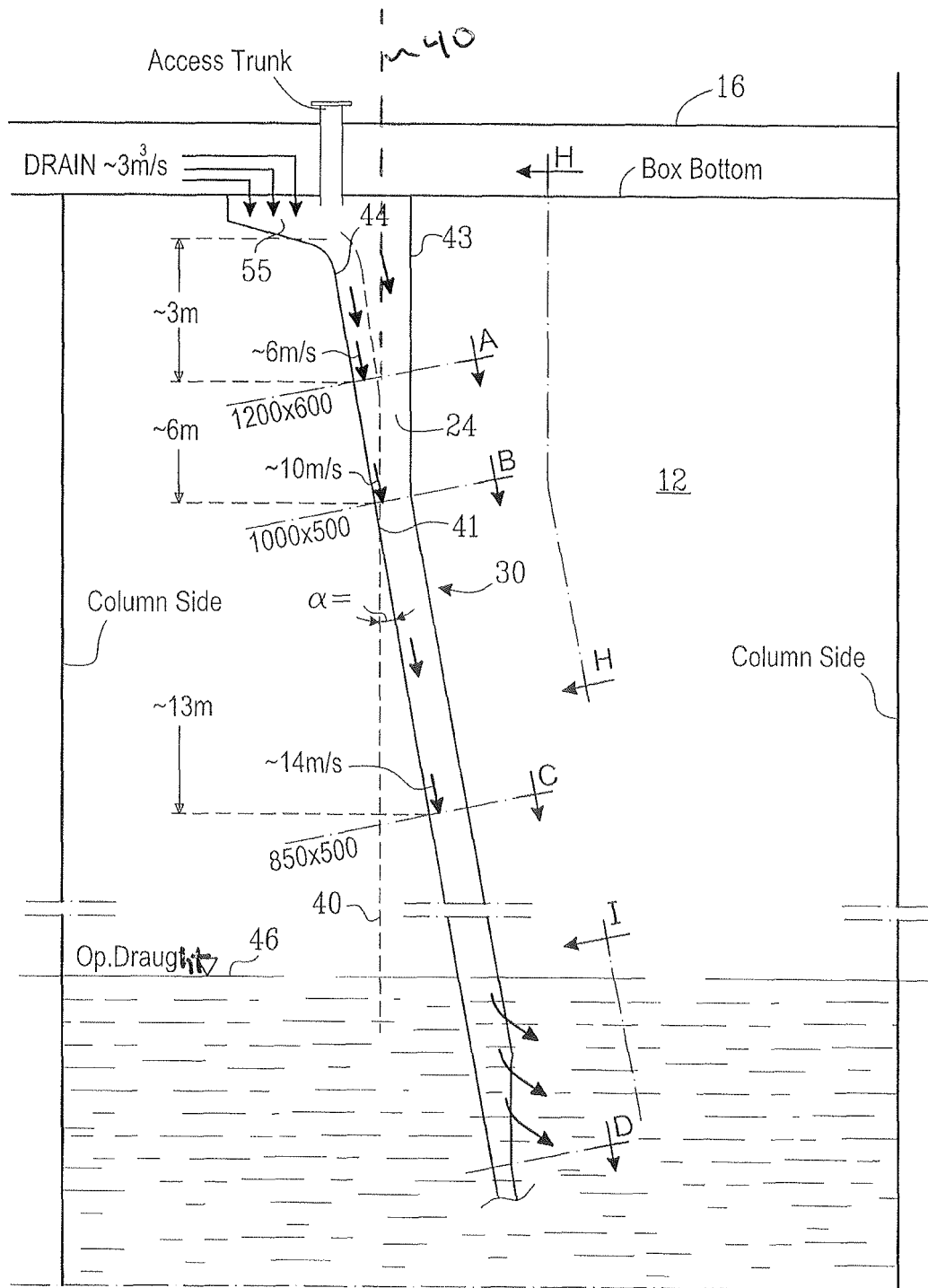


Fig.12

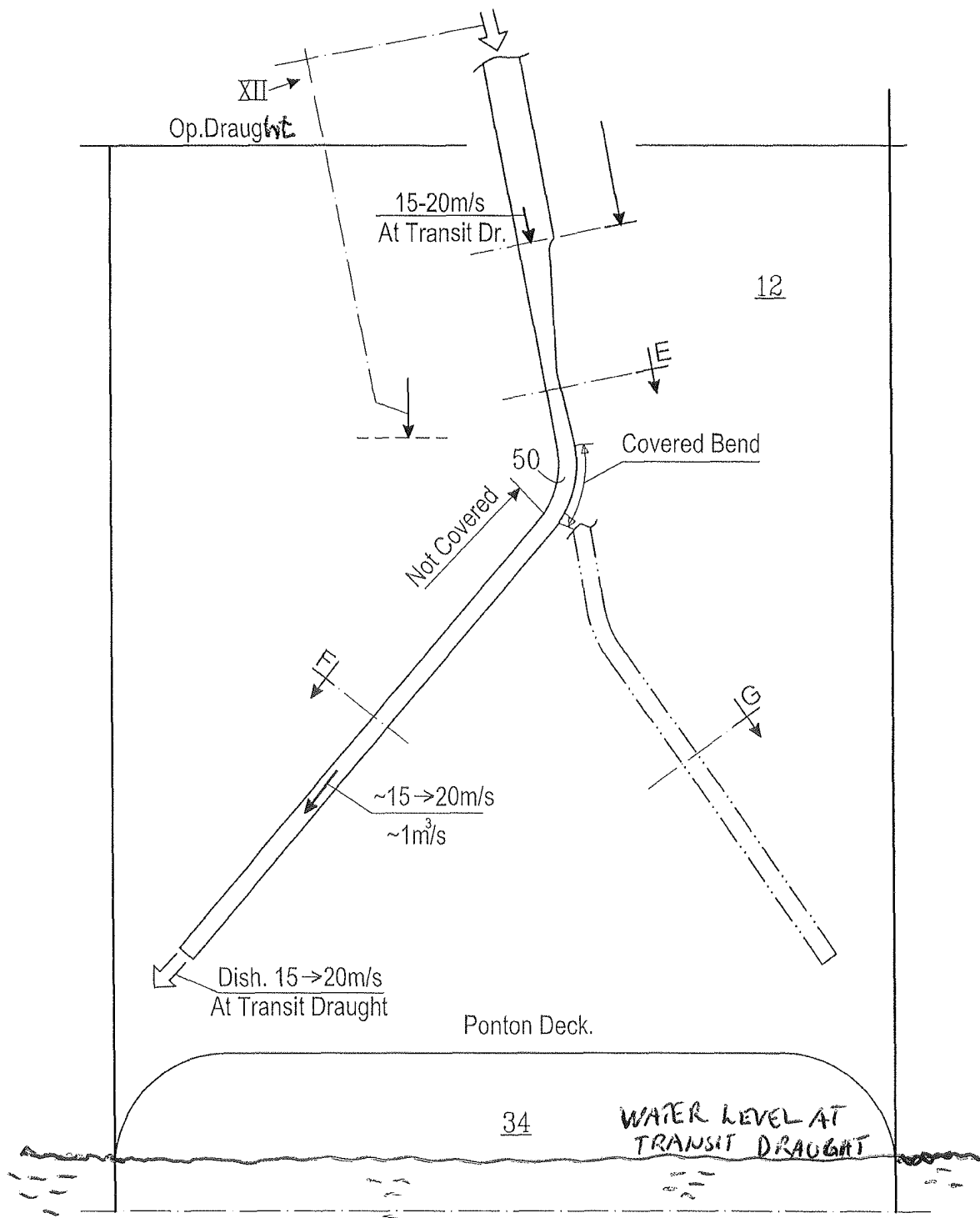


Fig. 13

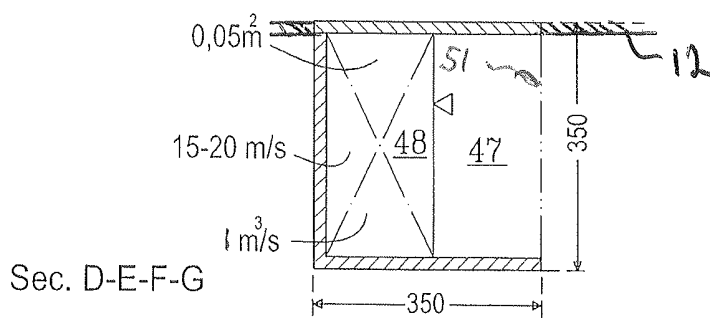
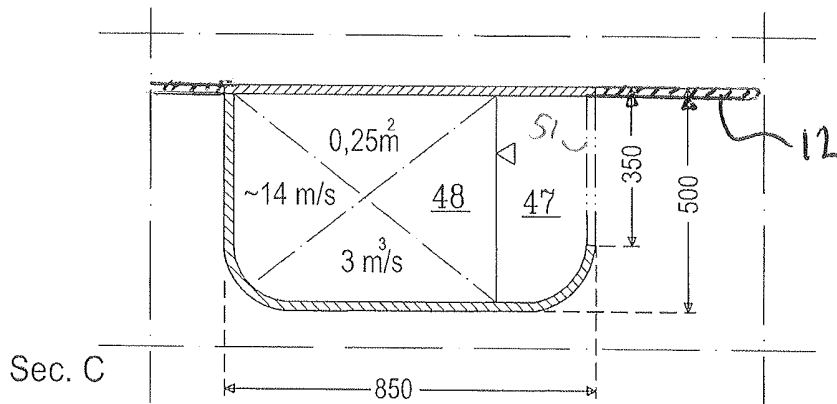
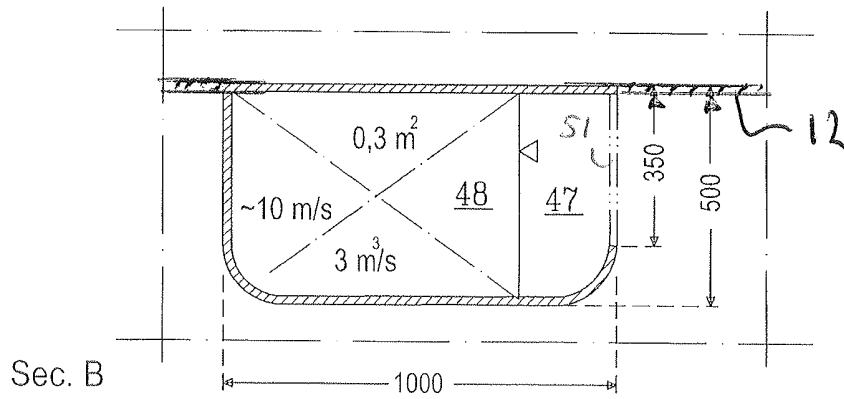
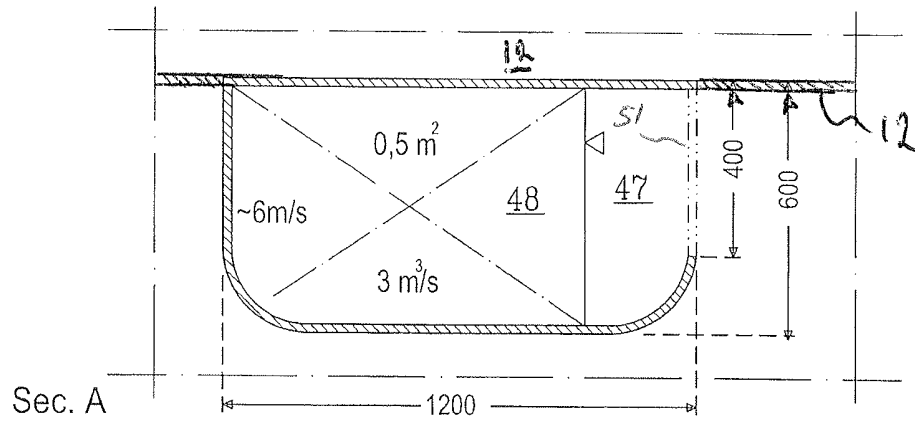


Fig. 14

FLOW IN TRANSIT CONDITION

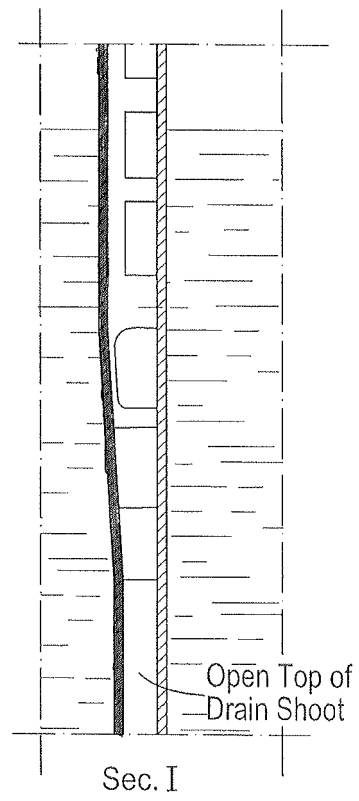
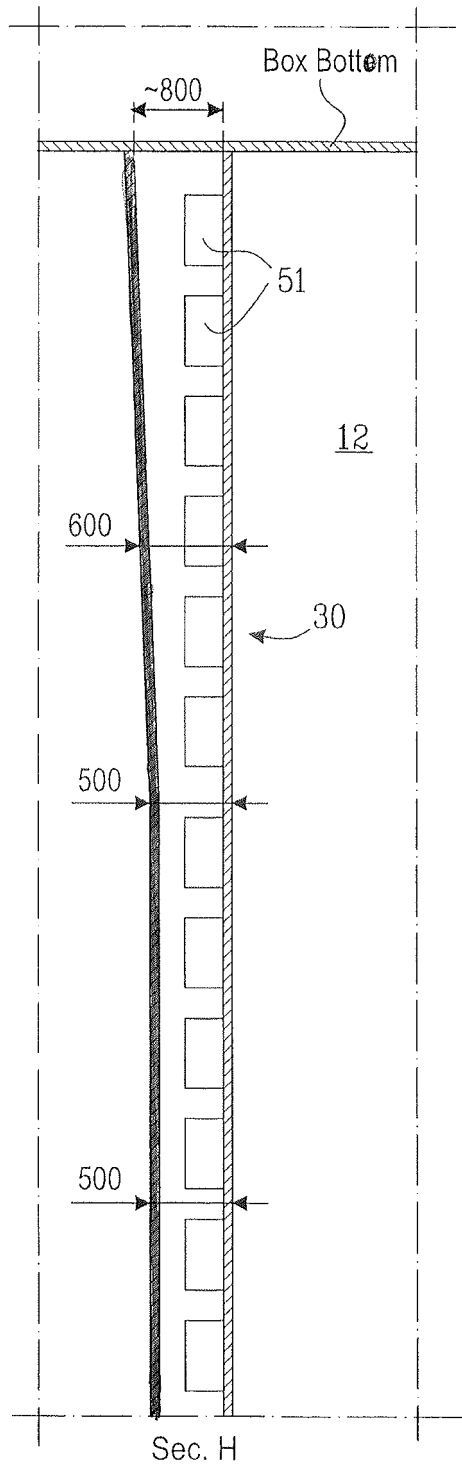


Fig.14 Cont.

REFERENCES CITED IN THE DESCRIPTION

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