

## D E S C R I P T I O N

## WATER-BORNE FLOATING FACILITY

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## Technical Field

The present invention relates to a water-borne floating facility that produces ethanol.

## Background Art

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In general, water-borne floating facilities that handle fossil fuels are known. For example, a floating storage regasification unit (FSRU) that suppresses influence on the natural environment has been disclosed (see Patent Literature 1).

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However, alternative fuels to fossil fuels are required from the viewpoint of reducing carbon dioxide emissions, which are feared to affect the global environment.

## Citation List

## Patent Literature

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Patent Literature 1: JP 2020-192895 A

## Summary of Invention

## Technical Problem

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The object of the embodiments of the present invention is to provide a water-borne floating facility for producing ethanol.

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According to one embodiment, a water-borne floating facility comprises: intake means for taking in a plant living in water; crushing means for crushing the plant taken in by the intake means; a plurality of fermentation tanks storing the plant for fermentation; a plant pipe through which the plant crushed by the crushing means is sent to the fermentation tanks; a fermented liquid pipe through which a fermented liquid

produced by the fermentation of the plant is taken out from the fermentation tanks; residue separation means for separating and removing a residue from the fermented liquid; distillation means for distilling the fermented liquid from which the residue is removed by the residue separation means, to produce ethanol; and an ethanol tank storing the ethanol produced by the distillation means.

#### Brief Description of Drawings

FIG. 1 is a side view showing a configuration of a water-borne floating facility according to an embodiment of the present invention.

FIG. 2 is a top view showing a configuration below a deck of the water-borne floating facility according to the present embodiment.

FIG. 3 is a flowchart showing a flow of a bioethanol production method using the water-borne floating facility according to the present embodiment.

FIG. 4 is a flowchart showing a flow of a stability control method for controlling a stability of the water-borne floating facility according to the present embodiment.

FIG. 5 is a configuration diagram showing a configuration of a carbon dioxide fixation system for fixation carbon dioxide in the sea in the water-borne floating facility according to the present embodiment.

#### Mode for Carrying Out the Invention

##### (Embodiment)

FIG. 1 is a side view showing a configuration of a water-borne floating facility 1 according to an embodiment of the present invention. FIG. 2 is a top view showing an internal configuration of the water-borne floating facility 1 according to the present

embodiment. The same portions in the drawings will be denoted by the same reference numerals and duplicate descriptions will be omitted as appropriate.

5 The water-borne floating facility 1 is a facility that produces bioethanol. For example, the water-borne floating facility 1 is a floating production storage and offloading unit (FPSO) that produces bioethanol. Bioethanol may be hereinafter simply referred to as ethanol. The water-borne floating facility 1 may be  
10 configured as a vessel having a propulsion function. The water-borne floating facility 1 may be newly manufactured or modified from an existing vessel. For example, the water-borne floating facility 1 is intended for modification of a very large crude oil  
15 carrier (VLCC). The ship-shaped configuration of the water-borne floating facility 1 will be described here. The fuel for the water-borne floating facility 1 can be self-procured by using ethanol. Incidentally, the fuel for the water-borne floating facility 1 is not limited  
20 to ethanol, and any fuel may be used.

In addition, the water-borne floating facility 1 will be described as a facility that is placed on the sea to produce ethanol using seaweed as a raw material, but is not limited to this. The water-borne floating  
25 facility 1 may be placed on a river or a lake. In addition, the raw material of ethanol is not limited to seaweed or seagrass, but may be any plant as long as it is a plant that inhabits water in the natural world such as the sea, river or lake. For example, the  
30 seaweeds used as the raw material are kelp, wakame seaweed, Hondawara (*Sargassum fulvellum*), Akamoku (*Sargassum horneri*), giant kelp, and the like. Hondawara (*Sargassum fulvellum*), giant kelp, Akamoku

(*Sargassum horneri*), or the like is suitable as the raw material for ethanol since it grows quickly, and can easily be secured as the raw material since it is not suitable for food.

5           The water-borne floating facility 1 comprises a harvesting device 2, a washing unit 3, a pre-crushing storage unit 4, a crusher 5, a first centrifuge 6, a second centrifuge 7, a distillation column 8, and a hull 10. The harvesting device 2, the washing unit 3,  
10       the pre-crushing storage unit 4, the crusher 5, the first centrifuge 6, the second centrifuge 7, and the distillation column 8 are provided on the deck arranged on an upper surface of the hull 10. A plurality of fermentation tanks 11, a residue tank 12, an ethanol  
15       tank 13, pumps 31 and an ethanol pump 34 are provided on the hull 10.

          The water-borne floating facility 1 is mainly controlled using a computer. Any number of computers may be configured and some or all of the computers may  
20       be connected via a network. Each component may incorporate a control computer, and some devices may not be controlled by a computer. For example, the computer includes an integrated automation system (IAS) that monitors and controls the stability of the water-  
25       borne floating facility 1, and a loading computer.

          The harvesting device 2 harvests seaweed, which is the raw material for ethanol, and takes the seaweed into the water-borne floating facility 1. For example, the harvesting device 2 is provided near a bow FP. The  
30       harvesting device 2 may be arranged in any manner and may be any device as long as the device can take seaweed into the water-borne floating facility 1. For example, the harvesting device 2 is a crane-type

device.

The washing unit 3 is a place where a device for washing the seaweed pulled up from the sea with water such as seawater or fresh water is arranged. The washing unit 3 removes deposits of seaweed by washing the seaweed. Incidentally, the washing unit 3 may not be provided. For example, seaweed may be washed manually or using a device carried from the outside of the water-borne floating facility 1.

The pre-crushing storage unit 4 is a place where the seaweed washed by the washing unit 3 is stored. For example, the pre-crushing storage unit 4 is a tank where the seaweed to be crushed is stored. Incidentally, the pre-crushing storage unit 4 may not be provided.

The crusher 5 sequentially takes in the seaweed stored in the pre-crushing storage unit 4 and finely crushes the seaweed. The crusher 5 sends the crushed seaweed to the first centrifuge 6.

The first centrifuge 6 removes water from the seaweed crushed by the crusher 5. The volume of the seaweed is reduced in this manner in order to effectively utilize the capacity of the fermentation tanks 11 provided in the limited space of the hull 10. The seaweed dehydrated by the first centrifuge 6 is stored in the fermentation tanks 11 together with the substance to be fermented. The substances for fermentation are saccharifying yeast and enzyme. The seaweed is thereby fermented in the fermentation tanks 11 for several days (for example, fourteen days) to produce a fermented liquid.

Incidentally, any device other than a centrifuge can be used, and any treatment can be performed on the

seaweed as long as water can be removed from the seaweed. In addition, the substances for fermentation may be changed or added in accordance with the raw material.

5           The second centrifuge 7 removes the residue of the fermented liquid that has been sufficiently fermented in the fermentation tanks 11. Incidentally, any device other than the centrifuge may be used, and any treatment may be performed as long as the residue can  
10 be removed from the fermented liquid.

          The distillation column 8 distills the fermented liquid and finally produces ethanol. Incidentally, any distillation method may be employed and any device or the like may be used for the distillation of the  
15 fermented liquid.

          A specific configuration under the deck of the hull 10 will be described with reference to FIG. 2.

          The hull 10 comprises the plurality of fermentation tanks 11, a residue tank 12, an ethanol  
20 tank 13, a seaweed pipe 21, a fermented liquid pipe 22, an emergency pipe 23, intermediate valves 24 and 25, an emergency valve 26, the pump 31, and valves 32 and 33, and an ethanol pump 34.

          The fermentation tank 11 is a tank for storing the seaweed for a predetermined period in order to ferment  
25 the seaweed. The number of fermentation tanks 11 is determined according to the period of fermentation and the unit period for managing the fermentation. For example, when the minimum number of days for  
30 fermentation of seaweed (minimum number of days required for fermentation) is fourteen days and one fermentation tank 11 is provided for each number of elapsed days for fermentation that is the number of

days elapsed since a seaweed injection date, at least fourteen tanks 11 are required. Since seaweed is injected into the fermentation tanks, the fermentation tanks are desirably painted to prevent corrosion.

5           In addition, the fermentation tanks 11 also function as ballast tanks for controlling the stability of the water-borne floating facility 1. When the fermentation tanks 11 function as ballast tanks, the capacity of all the fermentation tanks 11 may be made  
10           the same. Calculations for stability control can be therefore performed easily.

            Incidentally, one fermentation tank 11 may correspond to the number of elapsed days for fermentation in a range of two or more days, or two or  
15           more fermentation tanks 11 may correspond to the same number of elapsed days for fermentation. In addition, the fermentation tanks 11 may be managed by the elapsed fermentation time (for example, eight hours, twelve  
20           hours, twenty-four hours, thirty-six hours, or the like), which is the elapsed time from the seaweed injection time.

            In addition, an extra fermentation tank 11 may be provided as a spare fermentation tank. For example, a spare fermentation tank 11 may be used all the time to  
25           ferment the seaweed for the number of days exceeding the minimum number of days for fermentation or may be made empty without being used in normal times and used in an emergency (for example, at the stability control).

30           A configuration in which the minimum number of days for fermentation is set to fourteen days, one fermentation tank 11 is provided for each number of elapsed days for fermentation, and one fermentation

tank 11 is provided as a spare fermentation tank will be mainly described below. Therefore, a total of fifteen fermentation tanks 11 are in the water-borne floating facility 1. In addition, seaweed is fermented for fifteen days while the minimum number of days for fermentation is fourteen days.

The residue tank 12 is a tank for storing the residue removed from the fermented liquid. The ethanol tank 13 is a tank where bioethanol produced by the water-borne floating facility 1 is stored. The residue tank 12 and the ethanol tank 13 may be provided at any position on the hull 10 or may be provided on the deck. For example, the residue tank 12 and the ethanol tank 13 are provided on the stern AP side of the hull 10.

The pump 31 is provided in each of the fermentation tanks 11. Each pump 31 is connected to the fermented liquid pipe 22 via the valve 32. The pump 31 is a device for sending the fermented liquid obtained by fermenting the seaweed from the fermentation tank 11 to the second centrifuge 7 via the fermented liquid pipe 22. In addition, the pump 31 may also be used to agitate the contents of the fermentation tank 11, such as the seaweed and the fermented liquid. The fermentation of seaweed is thereby promoted. The pump 31 has a function of sweeping out and circulating the contents of the fermentation tank 11.

Incidentally, the pumps 31 may be concentrated in one place instead of being provided in the respective fermentation tanks 11. For example, a pump chamber may be provided behind the fermentation tanks 11 and the pump 31 may be integrated into this pump chamber. Alternatively, the fermented liquid pipe 22 may be

arranged at the bottom of the fermentation tanks 11.

The ethanol pump 34 is provided in the ethanol tank 13. The ethanol pump 34 is a device for transferring ethanol stored in the ethanol tank 13 overboard. The ethanol pump 34 is used when ethanol is shipped as a product.

The seaweed pipe 21 is connected to each of the fermentation tanks 11 via the valve 33. The seaweed pipe 21 is a pipe for sending seaweed to be fermented into the fermentation tank 11. The seaweed introduced into the seaweed pipe 21 is introduced into the target fermentation tank 11 by opening the valve 33 provided in the pipe to the fermentation tank 11 to which the seaweed is to be sent and closing the other valves 33. An intermediate valve 24 is provided at the central portion in the longitudinal direction of the seaweed pipe 21, but may be omitted.

The fermented liquid pipe 22 is a pipe for taking out the fermented liquid obtained by fermenting the seaweed from the fermentation tanks 11. The pumps 31 provided in the fermentation tank 11 for taking out the fermented liquid and the valves 33 provided in the pipe connecting the fermented liquid pipe 22 are opened to operate the pumps 31. As a result, the fermented liquid stored in a specific fermentation tank 11 is taken out through the fermented liquid pipe 22. An intermediate valve 25 is provided at the central portion of the fermented liquid pipe 22 in the longitudinal direction, but may be omitted.

The emergency pipe 23 is provided to connect an end portion of the seaweed pipe 21 on the bow FP side and an end portion of the fermented liquid pipe 22 on the bow FP side. The emergency valve 26 is provided in

the emergency pipe 23. The emergency valve 26 is normally closed. The seaweed pipe 21 and the fermented liquid pipe 22 are connected by the emergency pipe 23, and the contents of any two fermentation tanks 11 can be transferred to each other, by opening the emergency valve 26. The fermentation tanks 11 are thereby made to function as ballast tanks. Incidentally, a dedicated pipe for mutually transferring the contents of any two fermentation tanks 11 may be provided separately from the seaweed pipe 21 and the fermented liquid pipe 22, instead of the emergency pipe 23.

When an abnormality in the stability of the water-borne floating facility 1 is detected, the stability of the water-borne floating facility 1 is controlled to be restored to a normal stability by transferring part or all of the contents of one of the fermentation tanks 11 to the other fermentation tank 11. Thus, the emergency pipe 23 is used when the contents are transferred between two fermentation tanks 11.

In addition, the contents can be transferred between the two fermentation tanks 11 and, at the same time, the seaweed pipe 21 and the fermented liquid pipe 22 can play an original role of taking in the seaweed or taking out the fermented liquid, by closing at least one of the intermediate valves 24 and 25 of the seaweed pipe 21 and the fermented liquid pipe 22. More specifically, the contents are transferred between the two fermentation tanks 11 using the seaweed pipe 21 and the fermented liquid pipe 22 on the emergency pipe 23 side, and the seaweed is injected into the fermentation tanks 11 or the fermented liquid is taken out from the fermentation tanks 11 using the seaweed pipe 21 or the fermented liquid pipe 22 on a side opposite to the

emergency pipe 23.

A method of producing bioethanol by the water-borne floating facility 1 will be described with reference to FIG. 3.

5           Seaweed which is a raw material for ethanol is harvested by the harvesting device 2 (step S101). For example, a number of seaweed shelves (aquaculture shelves) for cultivating seaweed may be provided near the water-borne floating facility 1. The harvesting  
10       device 2 harvests seaweed by winding a string to which a plurality of seaweed shelves are connected. In addition, by separating the seaweed from the seaweed shelves while leaving the seaweed roots on the seaweed shelves and by returning the seaweed shelves with the  
15       remaining roots to the sea, new seaweed grows from the roots of the seaweed shelves. The seaweed can be thereby repeatedly harvested from the seaweed shelves.

          The harvested seaweed is washed in the washing unit 3 to remove deposits on the seaweed (step S102).  
20       For example, seaweed is washed with fresh water after being washed with seawater. Furthermore, the seaweed may be subjected to a treatment for removing the deposits in addition to washing with water. For example, the deposits are sand, mud, dust, salt, fish  
25       eggs, or the like.

          The seaweed from which the deposits have been removed is temporarily stored in the pre-crushing storage unit 4. The seaweed stored in the pre-crushing storage unit 4 is sequentially taken out and finely  
30       crushed by the crusher 5 (step S103). The seaweed is finely crushed at least to the extent that crushing does not interfere with flowing through the seaweed pipe 21. The seaweed is desirably finely ground to a

fluid state.

The crushed seaweed is dehydrated by the first centrifuge 6 (step S104). As a result, the volume of the seaweed can be reduced by the amount of  
5 dehydration. The dehydrated seaweed is injected into the fermentation tanks 11 together with substances for fermentation such as saccharifying yeast and enzyme (step S105). The substances for fermentation may be injected into the fermentation tanks 11 together with  
10 the seaweed or may be injected into the fermentation tanks 11 separately from the seaweed. The seaweed is thereby fermented in the fermentation tanks 11 (step S106).

After a predetermined period of time (for example,  
15 fourteen days) has passed since the start of fermentation in the fermentation tanks 11, the fermented liquid produced from the seaweed is taken out from the fermentation tanks 11 (step S107). The residue is removed from the taken fermented liquid by  
20 the second centrifuge 7 (step S108). This separation may be gravity separation or pressure separation. The residue separated from the fermented liquid is stored in the residue tank 12. The residue stored in the residue tank 12 may be adjusted and used as fuel for  
25 the water-borne floating facility 1, incinerated as it is in an onboard facility without being adjusted, or transferred overboard as a raw material such as fertilizer.

The fermented liquid from which the residue has  
30 been removed is sent to the distillation column 8 (step S109). The fermented liquid is distilled in the distillation column 8 to produce ethanol (step S110). The concentration of ethanol is set to at least a

concentration (for example, 95%) that can be used as fuel for ships and the like. In addition, in order to increase the purity of ethanol, a treatment such as dehydration may be performed to produce ethanol  
5 (dehydrated ethanol) with a concentration of approximately 99.5% or more.

The ethanol produced in the distillation column 8 is stored in the ethanol tank 13 (step S111). The bioethanol is produced from raw seaweed in this manner.

10 The ethanol stored in the ethanol tank 13 is shipped as a product (step S112). For example, ethanol is transferred to ethanol tankers or onshore facilities. Any method of transferring ethanol overboard may be performed. For example, a pipeline  
15 may be connected to the ethanol tank 13 to allow ethanol to flow through the pipeline. Alternatively, the ethanol tank 13 may be detachable from the hull 10, and ethanol in the ethanol tank 13 may be transported overboard.

20 A stability control method of controlling the stability of the water-borne floating facility 1 will be described with reference to FIG. 4. For example, the stability control is performed by a loading computer. Alternatively, the stability control may be  
25 automatically controlled by IAS based on the calculation results of the loading computer or may be manually controlled remotely using IAS.

First, a method of selecting the fermentation tank 11 into which the seaweed to be fermented is injected  
30 will be described. The selection of the fermentation tank 11 may be performed by any computer or may be performed manually.

If only one fermentation tank 11 is empty, seaweed

is injected into the empty fermentation tank 11. If a plurality of fermentation tanks 11 are empty, one of the plurality of fermentation tanks 11 is selected. In a case where no fermentation tank 11 is empty, the injection of seaweed is stopped or, if there is a margin in the capacity of the fermentation tank 11 into which seaweed is injected most recently, the seaweed is injected into the fermentation tank 11.

For example, when one of the plurality of fermentation tanks 11 is selected, the fermentation tank 11 is determined according to a predetermined order such that the stability of the water-borne floating facility 1 is ideally maintained.

Alternatively, in order to keep the stability of the water-borne floating facility 1 normal, it is determined by computation using a computer which fermentation tank 11 is the best to inject the seaweed into. Incidentally, the selection of the fermentation tank 11 into which the seaweed is to be injected may be performed in any manner and may be determined regardless of the stability of the water-borne floating facility 1.

The yield of seaweed is not constant since it is affected by the natural environment. Accordingly, the amount of contents stored in each fermentation tank 11 is also usually different. For this reason, the stability of the water-borne floating facility 1 may tilt due to the weight of the contents of each fermentation tank 11. Therefore, the stability control of the water-borne floating facility 1 is performed in the following manner.

The computer constantly calculates and monitors a trim indicating a vertical (longitudinal) tilt of the

hull, a heel indicating a horizontal tilt of the hull, and the longitudinal strength (step S201).

When the calculated value of at least one of the trim, heel, and longitudinal strength exceeds a  
5 threshold value, the computer issues an alarm notifying that an abnormality in the stability of the water-borne floating facility 1 has been detected (step S202). The alarm may be accompanied by at least one of display and sound.

10 When issuing an alarm, the computer selects two fermentation tanks 11 to resolve the abnormality in stability (step S203). The computer selects two fermentation tanks 11 whose contents are to be transferred, depending on the type of abnormality such  
15 as trim, heel or longitudinal strength.

If there is an empty fermentation tank 11, the computer selects this fermentation tank 11 with the highest priority as the fermentation tank 11 of transfer destination. If there is no empty  
20 fermentation tank 11, the fermentation tanks with the closer number of elapsed fermentation days (i.e., the seaweed injection date is closer) are selected with priority as the two fermentation tanks 11 to be selected.

25 If the two fermentation tanks 11 have different numbers of elapsed fermentation days, it is necessary to update the number of elapsed fermentation days of the fermentation tank 11 of transfer destination. For example, when the number of elapsed fermentation days  
30 of the fermentation tank 11 of transfer destination is greater than the number of elapsed fermentation days of the fermentation tank 11 of transfer source, the number of elapsed fermentation days of the fermentation tank

11 of transfer destination is updated to the number of elapsed fermentation days of the fermentation tank 11 of transfer source. Otherwise, the number of elapsed fermentation days of the fermentation tank 11 of transfer destination may not be changed.

When determining the two fermentation tanks 11 whose contents are to be transferred, the computer calculates the amount of contents to be transferred between the two fermentation tanks 11 in order to resolve the abnormality that causes the alarm (step S204).

The content of the fermentation tank 11 of transfer destination among the two fermentation tanks 11 needs to have a free capacity to accept the contents. For example, if the two fermentation tanks 11 have the same capacity, if the fermentation tank 11 of transfer source stores the contents of 100% of the capacity, and if the fermentation tank 11 of transfer destination stores the contents of 75% of the capacity, the contents of a maximum of 25% can be transferred. Therefore, if the abnormality is not resolved by transferring the contents within 25%, it is necessary to search for the other two fermentation tanks 11 again. The capacity of the fermentation tank 11 desirably has a margin of approximately 10% of the capacity, as compared to the amount of seaweed to be fermented for a normal day, in consideration of the fact that the fermentation tank 11 is also used for stability control.

After calculating the amount of the transfer content, the computer transfers the calculated amount of the transfer contents from the fermentation tank 11 of transfer source to the fermentation tank 11 of

transfer destination (step S205). The contents can be transferred between the two fermentation tanks 11 by opening the emergency valve 26 provided in the emergency pipe 23.

5           If there is no problem in transferring the contents between the two fermentation tanks 11, at least one of the intermediate valves 24 and 25 of each of the seaweed pipe 21 and the fermented liquid pipe 22 may be closed. As a result, the seaweed pipe 21 or the  
10           fermented liquid pipe 22 on the stern AP side of the closed intermediate valves 24 and 25 can transfer the contents between the two fermentation tanks 11 and, at the same time, send the seaweed or take out the fermented liquid as the original role.

15           After transferring the contents between the two fermentation tanks 11, the computer confirms whether or not the alarm has stopped (i.e., whether the abnormality has been resolved) (step S206). If the alarm has stopped, the computer ends the stability  
20           control for resolving the abnormality in the stability (Yes in step S206). If the alarm has not stopped, the computer selects two fermentation tanks 11 again to resolve the abnormality in the stability (No in step S206, step S203).

25           Incidentally, the transfer of contents between the two fermentation tanks 11 is desirably performed at the minimum number of times. Therefore, the computer may predict the stability of the water-borne floating facility 1 after the contents are transferred, and  
30           select two fermentation tanks 11 such that the abnormality can be resolved by transferring the contents at the minimum number of times.

For example, in a case where two fermentation

tanks 11 are selected to resolve the abnormality in the heel, even if the abnormality in the heel is resolved after the contents are transferred, abnormality may occur in the trim or the longitudinal strength. In this case, two fermentation tanks 11 are desirably selected to prevent all types of abnormalities from occurring after the contents are transferred. In addition, it is considered that all types of abnormalities cannot be stopped unless the contents are transferred between three or more fermentation tanks 11. In this case, the number of times of the transfer of contents can be minimized by simulating the transfer of the contents between the plurality of fermentation tanks 11 in advance using a computer.

The configuration in which a ballast tank dedicated to stability control is not provided, but the fermentation tank 11 functions as a ballast tank used for stability control has been described, but a ballast tank may be provided separately from the fermentation tank 11. In this case as well, the fermentation tank 11 may function as a ballast tank.

In addition, when a dedicated ballast tank is provided, the number of ballast tanks is desirably minimized. For example, if two to four ballast tanks are provided on each of the port and starboard sides, the stability can be controlled. Therefore, when a VLCC or the like is modified, the volumetric efficiency of the water-borne floating facility 1 can be increased by leaving the minimum necessary ballast tanks and using the remaining ballast tanks as the fermentation tanks 11 or the like.

FIG. 5 is a configuration diagram showing a configuration of a carbon dioxide fixation system 40

for fixating carbon dioxide in the sea in the water-borne floating facility 1 according to the present embodiment.

5 The carbon dioxide fixation system 40 comprises a plurality of air vents 41, a pressure control valve 42, a compressor 43, and a carbon dioxide pipe 44.

Each air vent 41 is provided in each fermentation tank 11. When an internal pressure of the fermentation tank 11 becomes a predetermined value or more, which is  
10 set in the air vent 41, the air vent 41 is opened. Carbon dioxide in the fermentation tank 11 is released to the carbon dioxide pipe 44 by opening the air vent 41. When carbon dioxide is released from the fermentation tank 11 and the internal pressure of the  
15 fermentation tank 11 becomes less than the predetermined value set in the air vent 41, the air vent 41 is closed. Carbon dioxide released from each air vent 41 is sent to the compressor 43 through the carbon dioxide pipe 44.

20 Carbon dioxide is produced in the fermentation tank 11 by fermenting the raw materials. The air vent 41 prevents the internal pressure of the fermentation tank 11 from becoming an overpressure state by discharging carbon dioxide produced inside the  
25 fermentation tank 11 to the outside. Therefore, the internal pressure of the fermentation tank 11 is controlled by providing the air vent 41.

The pressure control valve 42 is provided in the carbon dioxide pipe 44 that connects each air vent 41  
30 with the compressor 43. The pressure control valve 42 sends carbon dioxide released from each fermentation tank 11 to the compressor 43 when the internal pressure of the carbon dioxide pipe 44 becomes a set

predetermined value or more. Incidentally, the carbon dioxide released from each fermentation tank 11 may be sent into the compressor 43 after being stored in a tank or the like. In addition, the pressure control valve 42 may also be provided to control the internal pressure of a tank or the like in which carbon dioxide is stored.

The compressor 43 compresses carbon dioxide released from each fermentation tank 11 and releases the carbon dioxide into the sea (under water). The carbon dioxide compressed by the compressor 43 is released through a pipeline having an outlet in the sea. As a result, the carbon dioxide produced in each fermentation tank 11 is fixated in the sea, and the emission of carbon dioxide is suppressed.

According to the present embodiment, bioethanol can be efficiently produced from raw materials, which are plants living in water.

In addition, a ballast tank dedicated to stability control does not need to be provided on the water-borne floating facility 1 by allowing the fermentation tanks 11 for fermenting the plants to function as ballast tanks. Therefore, the space of the water-borne floating facility 1 can be effectively used as compared with the case where a ballast tank dedicated to stability control is provided.

Furthermore, the carbon dioxide produced in the fermentation tanks 11 can be fixated in water in the natural world by providing the carbon dioxide fixation system 40. As a result, the amount of carbon dioxide emitted by the water-borne floating facility 1 can be suppressed. In addition, when seaweed which is a raw material is cultivated in the vicinity of the

water-borne floating facility 1, the growth of the cultivated seaweed can be promoted. Incidentally, even if the carbon dioxide fixation system 40 is not provided, the production of bioethanol in the water-borne floating facility 1 is not hindered.

The present invention is not limited to the above-described embodiments, but constituent elements may be deleted, added or changed. In addition, a new embodiment may be prepared by combining or exchanging constituent elements of a plurality of embodiments. Even if such an embodiment is directly different from the above-described embodiments, the embodiment having the same intention as the present invention is considered to have been described as the embodiment of the present invention, and its descriptions are omitted.

## C L A I M S

1. A water-borne floating facility characterized by comprising:

5 intake means for taking in a plant living in water;

crushing means for crushing the plant taken in by the intake means;

a plurality of fermentation tanks storing the plant for fermentation;

10 a plant pipe through which the plant crushed by the crushing means is sent to the fermentation tanks;

a fermented liquid pipe through which a fermented liquid produced by the fermentation of the plant is taken out from the fermentation tanks;

15 residue separation means for separating and removing a residue from the fermented liquid;

distillation means for distilling the fermented liquid from which the residue is removed by the residue separation means, to produce ethanol; and

20 an ethanol tank storing the ethanol produced by the distillation means.

2. The water-borne floating facility of claim 1, characterized by further comprising:

25 water removing means for removing water from the plant.

3. The water-borne floating facility of claim 1, characterized in that

the plurality of fermentation tanks are used for stability control by transferring contents.

30 4. The water-borne floating facility of claim 3, characterized by further comprising:

a transfer pipe connecting the plant pipe with the fermented liquid pipe to transfer the contents between

the two fermentation tanks.

5. The water-borne floating facility of claim 4, characterized by further comprising:

5 a plant pipe valve provided in the plant pipe to transfer the contents between the two fermentation tanks and simultaneously send the plant to the fermentation tanks.

6. The water-borne floating facility of claim 4, characterized by further comprising:

10 a fermented liquid pipe valve provided in the fermented liquid pipe to transfer the contents between the two fermentation tanks and simultaneously take the fermented liquid from the fermentation tanks.

7. The water-borne floating facility of claim 1, characterized in that

ethanol is used as a fuel.

8. The water-borne floating facility of claim 1, characterized in that

20 the residue separated from the fermented liquid is used as a fuel.

9. The water-borne floating facility of claim 1, characterized in that

the water-borne floating facility is configured in a ship shape.

25 10. The water-borne floating facility of claim 1, characterized by further comprising:

carbon dioxide fixation means for fixation carbon dioxide produced in the fermentation tanks in water.