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[54]	Title:	FLOATING SHELTER	
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[57]	Abstract:	An object is to provide a floating shelter including a buoyant body configured to float up in the event of a tsunami, wherein the floating shelter 1 can achieve quick floating-up of the buoyant body 2 and surely protect evacuees. In the floating shelter including the buoyant body 2 configured to float up in the event of the tsunami W, the buoyant body 2 has a buoyant body front face 10 facing a tsunami upstream side F which is an upstream side in a propagation direction of the tsunami W, and the buoyant body front face 10 is formed such that: the buoyant body front face 10 is inclined to the tsunami upstream side F; and an angle formed between the buoyant body front face 10 and an undisturbed water level is 5o or more and less than 90o.	

buoyant body 2 from the tsunami W is small and it is difficult to achieve quick start of the floating-up of the buoyant body 2. Meanwhile, if the formed angle θ_1 is small, the size of the buoyant body 2 increases and selecting of an installation location is difficult. Note that the shape of the buoyant body front face 10 is not limited to an inclined surface. The buoyant body front face 10 can be any shape which can convert part of hydrodynamic force of the tsunami W to lift force and may be, for example, a streamlined shape (ship-like shape).

10 [0023]

The buoyant body 2 has raising beams 13 installed on a buoyant body bottom face 12. The raising beams 13 are preferably formed of a flat plate object parallel to the propagation direction of the tsunami W. It is preferable to set the height of the buoyant body top face 14 higher than the height of a front end of the tsunami by installing the raising beams 13. Specifically, the height of the buoyant body top face 14 is set to be at a height of about 1 to 1.5 m above the ground surface 9. Here, contact surfaces of the raising beams 12 and the ground surface 9 are not in surface contact but are in a contact state close to line contact. Due to this configuration, even when rubbles and the like gather below the buoyant body bottom face 12 after the end of tsunami, the raising beams 13 of the buoyant body can destroy the rubbles by utilizing the weight of the buoyant body and be reinstalled on the ground surface.

[0024]

Next, the tower front face 20 of each of the anchoring towers 3 is described. The tower front face 20 is formed such that: the tower front face 20 is inclined to the tsunami downstream side R which is the downstream side in the

propagation direction of the tsunami W; and an angle θ_2 formed between the tower front face 20 and the undisturbed water level is 5° or more and less than 90° . The formed angle θ_2 is set to be preferably 35° or more and less than 75° , more preferably 50° or more and less than 70° .

[0025]

Moreover, in each anchoring tower 3, the tower front face 20 is preferably disposed substantially at a midpoint between the tsunami upstream side F and the tsunami downstream side R of the buoyant body 2, or on the tsunami upstream side F of the midpoint. Specifically, the anchoring guide 11 is preferably configured to be disposed substantially at the midpoint between the tsunami upstream side F and the tsunami downstream side R of the buoyant body 2, or on the tsunami upstream side F of the midpoint. This configuration can suppress inclination of the buoyant body 2 which may occur when the buoyant body 2 floats up.

[0026]

Next, a floating-up operation of the buoyant body 2 in the event of the tsunami W is described. The tsunami W reaches the floating shelter 1 from the tsunami upstream side F and first collides into the buoyant body front face 10. The propagation direction of the tsunami W colliding into the buoyant body front face 10 is changed downward (toward the ground surface 9) and the tsunami W passes through spaces between the raising beams 13 on the buoyant body bottom face 12 and flows to the tsunami downstream side R of the floating shelter 1. Due to this collision with the tsunami W, the buoyant body 2 receives upward force in the vertical direction and starts to float up.

[0027]

Fig. 3 shows a state where the buoyant body 2 floats up. The buoyant body 2 starts to float up due to the collision with the tsunami W and then floats up by buoyancy which the buoyant body 2 receives from the tsunami W. At this time, the
5 buoyant body 2 floats up along the inclination of the tower front face 20 while being carried to the tsunami downstream side R. Reference numeral d denotes the distance by which the buoyant body 2 is carried to the tsunami downstream side R and reference numeral 8 denotes the water level. When the buoyant
10 body 2 floats up, contact between the anchoring guide (tsunami upstream side) 11 of the buoyant body 2 and the tower front face 20 is maintained. Meanwhile, a tsunami downstream side anchoring guide 16 is in a state where contact with the anchoring tower 3 is canceled.

15 [0028]

Here, it is preferable to use lubricious material such as nylon in at least one of the anchoring guide (tsunami upstream side) 11 and the tower front face 20. This is because the buoyant body 2 can smoothly float up along the anchoring
20 tower 3 in this configuration.

[0029]

The following operations and effects can be obtained from the configuration described above. First, the configuration in which the inclination is formed in the buoyant body front
25 face 10 can provide the floating shelter 1 which achieves quick floating-up of the buoyant body 2. This is because the buoyant body 2 can start to float up by utilizing the force of the tsunami W colliding into the buoyant body front face 10.

30 [0030]

Secondly, the configuration in which the inclination is

formed in the tower front faces 20 can suppress inclination (rolling) of the buoyant body 2 to the tsunami upstream side F and the tsunami downstream side R in the floating-up of the buoyant body 2 (see the arrows S in Fig. 3). This is because
5 the buoyant body 2 floats up while being carried by the tsunami W by the distance d and the tsunami upstream side F of the buoyant body 2 is thus prevented from being pushed upward in the vertical direction. The suppression of the inclination of the buoyant body 2 can improve the safety of evacuees having
10 moved onto the buoyant body.

[0031]

Thirdly, the configuration in which the buoyant body 2 floats up quickly without inclining can prevent the tsunami W from reaching the buoyant body top face and improve the safety
15 of the evacuees having moved onto the buoyant body.

[0032]

Fig. 4 shows an outline of a floating shelter 1A in another embodiment of the present invention. The floating shelter 1A can be configured to include anchoring wires (or
20 anchoring chains) 5 instead of the anchoring towers 3. One end of each of the anchoring wires 5 is fixed to the ground surface on the tsunami upstream side F of a buoyant body 2A by an anchor 30 and the other end is fixed to the buoyant body 2A. The anchoring wires 5 are preferably set to a state where
25 a tension force whose value is equal to or smaller than a predetermined value is acting thereon before the event of the tsunami. This allows the buoyant body 2A to float up while being carried to the tsunami downstream side R in the event of the tsunami W. This configuration can suppress the
30 inclination of the buoyant body 2A to the tsunami upstream side F and the tsunami downstream side R. Moreover, even in

a case where the water level is high after the end of the tsunami, it is possible to release connection of the anchoring wires 5 and move the buoyant body 2A to a safe location with a tugboat or the like.

5 [0033]

Moreover, the buoyant body 2A is preferably configured to include a wave barrier 15 on an end portion of the buoyant body top face 14 on the tsunami upstream side F. This configuration can prevent a case where the buoyant body 2A receives the tsunami W on the buoyant body top face 14, thereby causing the weight of the buoyant body 2A to increase and making the floating-up of the buoyant body 2A impossible. In other words, the buoyant body 2A can quickly and surely float up in the event of the tsunami W.

15 [0034]

Furthermore, the floating shelter 1A is preferably configured to include wave dissipating members 6 on the tsunami upstream side F of the buoyant body 2A. This configuration can reduce the speed of the tsunami W. The wave dissipating members 6 can be wave dissipating blocks, buildings, or the like which serve as a resistance reducing the moving speed of the tsunami W. Here, if the speed of the tsunami W is high, the tsunami W may reach the buoyant body top face 14 before the buoyant body 2A starts to float up by receiving upward force in the vertical direction obtained by receiving the tsunami W on the buoyant body front face. If the tsunami W reaches the buoyant body top face 14, it is difficult for the buoyant body 2A to float up due to its weight.

30 [0035]

Fig. 5 shows a cutaway cross-sectional view of a buoyant

body 2B of a floating shelter 1B in another embodiment of the present invention. The buoyant body 2B has a buoyant body bottom face 12B configured to come in contact with the tsunami W. The buoyant body bottom face 12B is preferably formed such
5 that: the buoyant body bottom face 12B is inclined in such a way that the tsunami downstream side R thereof is lower than the tsunami upstream side F thereof; and a normal line of the buoyant body bottom face 12B extends to the tsunami upstream side F. The buoyant body bottom face 12B is formed such that
10 an angle θ_3 formed between the buoyant body bottom face 12B and the undisturbed water level is more than 0° and is 15° or less. The formed angle θ_3 is set to be preferably more than 0.5° and 10° or less, more preferably, more than 2° and 5° or less. The buoyant body bottom face 12B can be any shape which
15 can convert part of hydrodynamic force of the tsunami W to lift force and may be, for example, a streamlined shape (ship-like shape). In this configuration, a phenomenon in which the buoyant body bottom face 12B is sucked by a water flow (pressure reduction below the buoyant body bottom face 12B)
20 does not occur and quick floating-up of the buoyant body 2B can be achieved.

[0036]

More preferably, the buoyant body bottom face 12B of the buoyant body 2B shown in Fig. 5 is formed as a flat surface
25 passing an end portion of the buoyant body top face 14 on the tsunami upstream side F and an end portion of the buoyant body bottom face 12B on the tsunami downstream side R. Specifically, the buoyant body 2B is formed to have a cross section (see Fig. 5) whose shape is almost a triangle having
30 a hypotenuse connecting the end portion of the buoyant body top face 14 on the tsunami upstream side F and the end portion

of the buoyant body bottom face 12B on the tsunami downstream side R. In this configuration in which the buoyant body front face and the buoyant body bottom face are formed as an integral surface, although the buoyancy is reduced, the buoyant body
5 2B can be greatly improved in a floating performance in the arrival of the tsunami.

[0037]

Note that a stopping plate 17 can be installed in the end portion of the buoyant body bottom face 12B on the tsunami
10 downstream side R. The stopping plate 17 is a plate-shaped object extended downward from the buoyant body bottom face 12B and is installed to serves as a resistance against the tsunami W flowing from the tsunami upstream side F. The configuration in which the stopping plate 17 is installed reduces the flow
15 speed of the tsunami W below the buoyant body bottom face 12B and increases pressure below the buoyant body bottom face 12B. Accordingly, pressure causing the buoyant body 2B to float up can be generated. The stopping plate 17 only needs to be installed to serve as a resistance against the tsunami W and
20 an inclination direction thereof and the like are not limited to those in the example illustrated in Fig. 5.

[0038]

As described above, the floating shelters 1, 1A, and 1B can quickly float up with the inclination thereof suppressed,
25 in the event of the tsunami W. Accordingly, the safety of evacuees and the like on the buoyant body top face can be improved. Note that adoption of the anchoring towers, the anchoring wires, the wave barrier, and other configurations described above can be arbitrary selected and determined
30 depending on the installation location of the floating shelters 1, 1A, and 1B. For example, both of the anchoring

towers 3 and the anchoring wires 5 can be adopted simultaneously. Adoption of both of the anchoring towers 3 and the anchoring wires 5 is particularly effective in a case where the anchoring towers 3 are installed in a location where there is a height limit.

[0039]

Moreover, the buoyant body top face can be used for takeoff and landing of a helicopter and the like. Furthermore, a configuration in which an electric power generation facility is installed inside the buoyant body can be employed. In this configuration, it is possible to use electric power and the like for communication in a case where contact with surrounding areas is lost in the event of the tsunami. In addition, in a case where the buoyant body is constructed from blocks, blocks in outer edge portion of the buoyant body can be constructed as a cushion portion while blocks in a center portion of the buoyant body can be constructed as a facility such a warehouse. In this configuration, the buoyant body has a double hull structure and possibility of being damaged by a tsunami or floating debris can be reduced.

EXPLANATION OF REFERENCE NUMERALS

[0040]

- 1 floating shelter
- 2 buoyant body
- 25 3 anchoring tower
- 10 10 buoyant body front face
- 11 anchoring guide
- 12 buoyant body bottom face
- 13 raising beams
- 30 14 buoyant body top face
- 15 15 wave barrier

20 tower front face
W tsunami
F tsunami upstream side
R tsunami downstream side

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DESCRIPTION

FLOATING SHELTER

TECHNICAL FIELD

[0001]

5 The present invention relates to a floating shelter including a buoyant body configured to float in the event of a tsunami.

BACKGROUND ART

[0002]

10 As a measure against a tsunami, there is a floating shelter configured to be installed in a land area in normal circumstances and float at the arrival of a tsunami (see Patent Document 1 for example). Fig. 6 shows an example of the floating shelter. Part A of Fig. 6 shows a floating shelter
15 1X in the normal circumstances while Part B of Fig. 6 shows the floating shelter 1X at the arrival of the tsunami. The floating shelter 1X includes multiple anchoring piles 3X driven deep into the ground and a buoyant body 2X movable along the anchoring piles 3X in the vertical direction. In a
20 case where tsunami warning or the like is issued, evacuees 50 evacuate onto the buoyant body 2X by using steps 51. The buoyant body 2X is configured to float up from the ground surface 9 by buoyancy when the tsunami arrives.

[0003]

25 The following operations and effects can be obtained from this configuration. First, since the buoyant body 2X is configured to float at the arrival of the tsunami, for example, even in a case where a tsunami reaching a height of 5 m from the ground surface 9 occurs, the float 2X can protect the
30 evacuees 50 by floating up 5 m (see Part B of Fig. 6). Secondly, since the float 2X is installed on the ground surface

9 and is located close to the ground surface 9, evacuation is facilitated (see Part A of Fig. 6). Specifically, the evacuees 50 can escape harm by simply climbing the steps 51 equipped in the buoyant body 2X even in a tsunami reaching a second or 5 third floor of a building.

[0004]

However, the floating shelter 1X described above has several problems. First, the floating shelter 1X has a problem that the buoyant body 2X does not float up or floats up slowly 10 at the arrival of the tsunami and thus cannot sufficiently protect the evacuees. This is because the buoyant body cannot float up until the water level sufficiently rises and buoyancy is generated. Accordingly, in some cases, the buoyant body is swallowed by the tsunami before floating up and cannot 15 sufficiently protect the evacuees.

[0005]

Secondly, the floating shelter 1X has a problem that the buoyant body 2X and the anchoring piles 3X of the floating shelter are destroyed at the arrival of the tsunami. This is 20 because the buoyant body and the anchoring piles receive force in a horizontal direction due to an impact of the tsunami.

[0006]

Thirdly, the floating shelter 1X has a problem that the evacuees may be caught by the tsunami even if the evacuees 25 evacuate onto the buoyant body. This is because the buoyant body is swallowed by the tsunami before floating up when a tsunami with a height exceeding a top face of the buoyant body arrives. Note that, when the tsunami reaches the buoyant body top face, it is difficult for the buoyant body to float due 30 to the weight thereof.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0007]

Patent Document 1: Japanese patent application Kokai publication No. 2006-112089

5 SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0008]

The present invention has been made in view of the problems described above and an object thereof is to provide
10 a floating shelter including a buoyant body configured to float in the event of a tsunami, wherein the floating shelter can achieve quick floating-up of the buoyant body and surely protect evacuees.

MEANS FOR SOLVING THE PROBLEM

15 [0009]

A floating shelter of the present invention for achieving the object described above is a floating shelter comprising a buoyant body configured to float up in an event of a tsunami, characterized in that the buoyant body has a buoyant body
20 front face facing a tsunami upstream side which is an upstream side in a propagation direction of the tsunami, and the buoyant body front face is formed such that: the buoyant body front face is inclined to the tsunami upstream side; and an angle formed between the buoyant body front face and an undisturbed
25 water level is 5° or more and less than 90° .

[0010]

This configuration allows the buoyant body to float up more quickly by using force of the tsunami colliding into the buoyant body front face. In other words, kinetic energy
30 generated when the tsunami collides into the buoyant body front face can be used as energy for lifting the buoyant body.

[0011]

The floating shelter described above is characterized in that the floating shelter further comprises anchoring towers disposed respectively near both side faces of the buoyant body which are parallel to the propagation direction of the tsunami, the anchoring towers each have a tower front face facing the tsunami upstream side, the tower front face is formed such that: the tower front face is inclined to a tsunami downstream side which is a downstream side in the propagation direction of the tsunami; and an angle formed between the tower front face and the undisturbed water level is 5° or more and less than 90° , and the buoyant body has an anchoring guide configured to come in contact with the tower front face, and is configured to float up while moving to the tsunami downstream side along an inclination of the tower front face in the event of the tsunami.

[0012]

This configuration allows the buoyant body to float up quickly. Moreover, since the buoyant body is configured to float up while being carried to the tsunami downstream side, a generation amount of inclination of the buoyant body in the floating-up thereof can be suppressed.

[0013]

The floating shelter described above is characterized in that the buoyant body has a buoyant body bottom face facing a ground surface, and the buoyant body bottom face is formed such that: the buoyant body bottom face is inclined in such a way that a tsunami downstream side thereof is lower than the tsunami upstream side thereof; and an angle formed between the buoyant body bottom face and the undisturbed water level is more than 0° and 15° or less. Due to this configuration,

kinetic energy generated when the tsunami passes under the buoyant body bottom face can be used as energy for lifting the buoyant body.

[0014]

5 The floating shelter described above is characterized in that the buoyant body includes a wave barrier installed on a top face of the buoyant body, along an end portion of the buoyant body on the tsunami upstream side. This configuration allows the buoyant body to float up quickly. This is because
10 the configuration can prevent a case where the tsunami reaches the buoyant body top face and the weight of the buoyant body is thereby increased. Moreover, the safety of evacuees on the buoyant body can be improved.

EFFECTS OF THE INVENTION

15 [0015]

In the floating shelter of the present invention, it is possible to provide a floating shelter which can achieve quick floating-up of the buoyant body and surely protect evacuees.

BRIEF DESCRIPTION OF THE DRAWINGS

20 [0016]

[Fig. 1] Fig. 1 is a schematic view of a floating shelter in an embodiment of the present invention.

[Fig. 2] Fig. 2 is a side view of the floating shelter in the embodiment of the present invention.

25 [Fig. 3] Fig. 3 is a side view of the floating shelter in the embodiment of the present invention.

[Fig. 4] Fig. 4 is a schematic view of a floating shelter in another embodiment of the present invention.

30 [Fig. 5] Fig. 5 is a cutaway cross-sectional view of a floating shelter in yet another embodiment of the present invention.

[Fig. 6] Fig. 6 is a side view of a conventional floating shelter.

MODES FOR CARRYING OUT THE INVENTION

[0017]

5 A floating shelter in an embodiment of the present invention is described below with reference to the drawings. Fig. 1 shows an outline of the floating shelter 1 in the embodiment of the present invention. The floating shelter 1 includes a buoyant body 2, anchoring towers 3, and at least
10 one connection slope 4.

[0018]

The buoyant body 2 has a buoyant body front face 10 facing a tsunami upstream side F which is an upstream side in a propagation direction of a tsunami W. The buoyant body front
15 face 10 is formed such that: buoyant body front face 10 is inclined to the tsunami upstream side F; and a normal line of the buoyant body front face 10 extends toward a ground side. Moreover, the buoyant body 2 includes at least one anchoring
20 body which are parallel to the propagation direction of the tsunami W.

[0019]

The anchoring towers 3 of the floating shelter 1 are fixed to the ground surface to be disposed near the both side
25 faces of the buoyant body which are parallel to the propagation direction of the tsunami W. The anchoring towers 3 each have a tower front face 20 facing the tsunami upstream side F. The tower front face 20 is inclined to a tsunami downstream side R which is a downstream side in the propagation direction of
30 the tsunami W, in such a way that a normal line of the tower front face 20 extends upward. Here, the anchoring guide 11

of the buoyant body 2 is preferably configured to come in contact with the tower front face 20.

[0020]

5 The connection slope 4 of the floating shelter 1 is disposed on at least on one of the side faces of the buoyant body 2 which are parallel to the propagation direction of the tsunami W. The connection slope 4 is used so that the evacuees, vehicles, and like can move onto the buoyant body, and is disposed not to be parallel but to be preferably
10 substantially orthogonal to the propagation direction of the tsunami W. This configuration can prevent a case where the tsunami W climbs the evacuation slope 4 and reaches a buoyant body top face 14.

[0021]

15 Fig. 2 shows a side view of the floating shelter 1. The buoyant body front face 10 into which the tsunami W collides is described with reference to the drawing. The buoyant body front face 10 is formed such that: the buoyant body front face 10 is inclined to the tsunami upstream side F; and an angle
20 $\theta 1$ formed between the buoyant body front face 10 and an undisturbed water level (plane parallel to the ground surface 9) is 2° or more and less than 90° . The formed angle $\theta 1$ is set to be preferably 5° or more and less than 60° , more preferably to be 10° or more and less than 45° .

25 [0022]

The buoyant body front face 10 is configured to cause the buoyant body 2 to quickly float up by using a reaction force obtained by deflecting the motion of the tsunami W from the tsunami upstream side F to the tsunami downstream side R toward
30 the ground surface 9. Accordingly, if the formed angle $\theta 1$ is large, force acting upward in the vertical direction on the

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CLAIMS

1. A floating shelter comprising a buoyant body configured to float up in an event of a tsunami,

5 the buoyant body has a buoyant body front face facing a tsunami upstream side which is an upstream side in a propagation direction of the tsunami, and

the buoyant body front face is formed such that: the buoyant body front face is inclined to the tsunami upstream side; and an angle formed between the buoyant body front face and an undisturbed water level is 5° or more and less than 90° ,

characterized in that,

the floating shelter further comprises anchoring towers
15 disposed respectively near both side faces of the buoyant body which are parallel to the propagation direction of the tsunami,

the anchoring towers each have a tower front face facing the tsunami upstream side,

20 the tower front face is formed such that the tower front face is inclined to a tsunami downstream side which is a downstream side in the propagation direction of the tsunami; and an angle formed between the tower front face and the undisturbed water level is 5° or more and less than 90° , and

25 the buoyant body has an anchoring guide configured to come in contact with the tower front face, and is configured to float up while moving to the tsunami downstream side along an inclination of the tower front face in the event of the tsunami.

30

2. The floating shelter according to claim 1 characterized

in that

the buoyant body bottom face is formed such that; the
buoyant body bottom face is inclined in such a way that a
tsunami downstream side thereof is lower than the tsunami
5 upstream side thereof; and an angle formed between the buoyant
body bottom face and the undisturbed water level is more than
0 degrees and is 15 degrees or less.

3. The floating shelter according to claim 1 or 2,
10 characterized in that the buoyant body includes a wave barrier
installed on a top face of the buoyant body, along an end
portion of the buoyant body on the tsunami upstream side.

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Fig.1

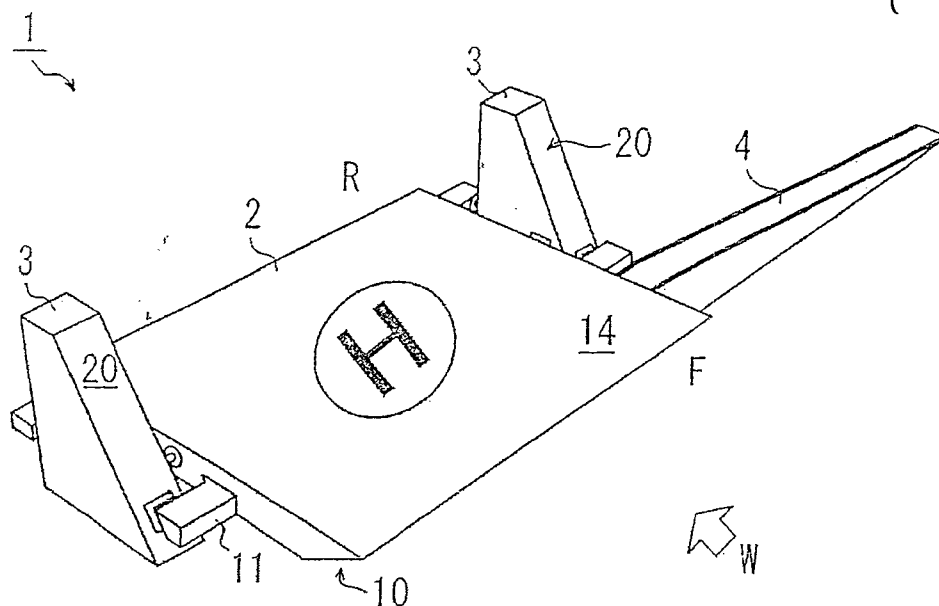
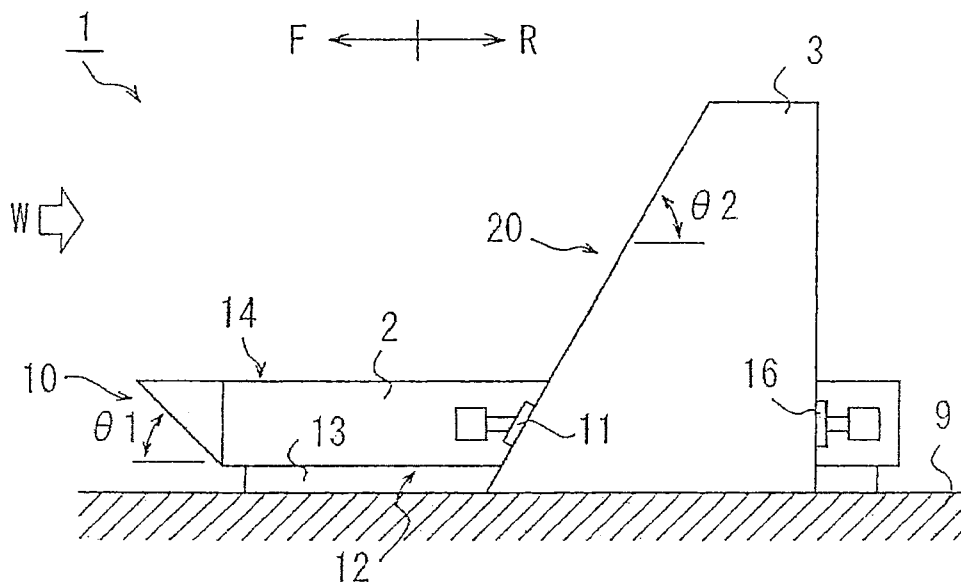


Fig.2



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Fig. 5

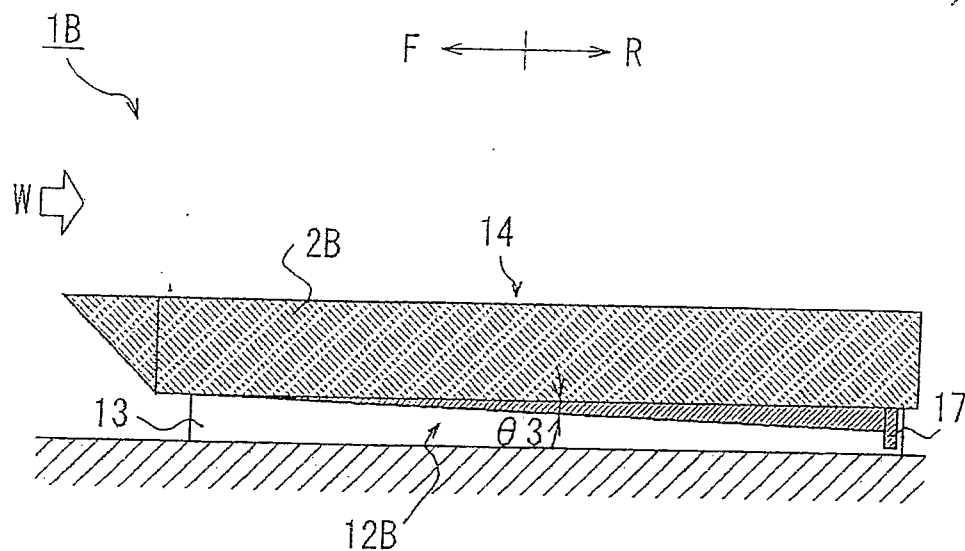
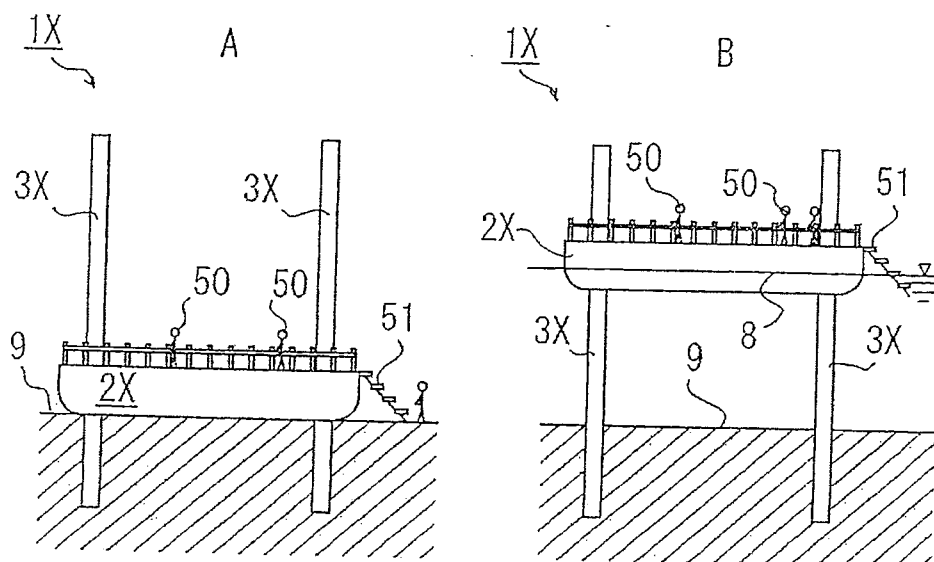


Fig. 6



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