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(71) Applicant and

(72) Inventor: **KANG, Nam** [KR/KR]; Regencyvill Apt.
501-202, Busong-dong 669 Iksan-si, Jeollabuk-do
570-973 (KR).

(74) Agent: **KIM, Sung-gyu**; 4th Fl. Jangan Bldg., 827-3 Yok-
sam-dong, Kangnam-gu, Seoul 135-080 (KR).

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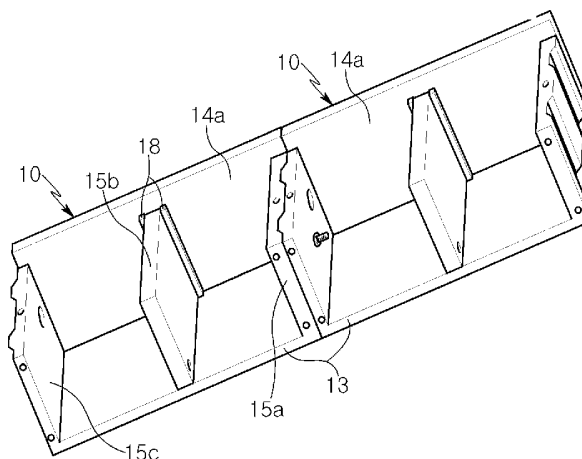
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(54) Title: FISHWAY BLOCK



(57) Abstract: The present invention relates to a fishway block, capable of allowing even fish having poor swimming ability to easily migrate upstream and downstream by reducing the speed of water flow. The fishway block comprises a bottom panel (13), sidewall panels (14a, 14b) installed at respective sides of the bottom panel (13), and a plurality of dividing panels (15a, 15b, 15c) installed to cross the bottom panel (13) between the sidewall panels (14a, 14b), the dividing panels (15a, 15b, 15c) having respective water-passing holes (16a, 16b, 16c), through which fish can pass, in which locations of the water-passing holes (16a, 16b, 16c) having different heights, so that the trail of the locations form a zigzag pattern, and the size of the water-passing hole formed near a lower end portion of the dividing panel is smaller than the size of the water-passing hole formed near an upper end portion of the dividing panel. The fishway block further includes a fishway size control mechanism for adjusting the size of a fishway and a water level control mechanism.

WO 2006/071010 A1

Description

FISHWAY BLOCK

Technical Field

- [1] The present invention relates to a fishway block. More particularly, the present invention relates to a fishway block installed in a dam, a bank or a reservoir in order to slow down the speed of water flow and allow fish to easily migrate upstream or downstream by swimming over, around or through dams, waterfalls, culverts and other obstructions.

Background Art

- [2] Generally, a fishway is required to be installed on a crossing structure such as a dam or a crossbar structured to cross a river, a brook, a stream or other watercourses. According to the Fisheries Resources Protection Decree in Korea, a fishway is required to be installed in order to conserve ecosystems and allow fish to migrate when a crossing structure that crosses a river or a stream is constructed, referring to the Enforcement Decree of the Inland Fishery Act which relates to the prohibition of fishway blocking.
- [3] Conventional fishways installed under the Fisheries Resources Protection Decree are just a simple structure that is installed in a dam or a crossbar to allow water to flow downstream through the dam or the crossbar.

Disclosure of Invention

Technical Problem

- [4] The conventional fishways are a simple structure that allows water to flow downstream from the upper stream to the lower stream of a river through a blocking structure such as a dam or a crossbar. Accordingly, there is the probability that fish can not migrate upstream along the conventional fishway when the difference in water levels is too large or the speed of water flow is too high despite the difference in water levels being small.
- [5] Accordingly, a fish inhabitation site such as a fish spawning pool can be installed in a dam, instead of a fishway. However, the water level can be abruptly increased and can exceed safety levels during the rainy season, so that several tens of thousands of tons of water can be discharged from a dam, resulting in damage to the fishery inhabitation site. In conclusion, the conventional fishways are not effective due to related technical obstacles.

Technical Solution

- [6] In order to achieve the above objects, according to one aspect of the present invention, there is provided a fishway block having the following features.

- [7] First, the fishway block includes one or more dividing panels crossing a river and having respective water-passing holes, the water-passing holes of the dividing panels being submerged in water, so that the speed of water flow in a fishway is reduced. As a result, even fish having poor swimming ability are able to easily migrate downstream and upstream thanks to the fishway block.
- [8] Second, the fishway block comprises a bottom panel, sidewall panels and dividing panels which are separately prepared because they are heavy, so that the fishway block can be easily assembled, disassembled and carried in the state of being disassembled.
- [9] Third, the fishway block is able to slow down water flow and reduce the amount of water flowing through fishways because the locations and sizes of the water-passing holes in the dividing panels are varied. Further, the fishway block can reduce loss of reservoir water from the stored water.
- [10] Fourth, the fishway block includes a fishway size control mechanism for adjusting the size of a fishway, i.e. the size of the water passing-hole, in the dividing panel, through which fish migrate downstream and upstream, and a water level control mechanism for adjusting the level of water stored in compartments formed between the respective adjacent dividing panels, thereby being capable of maintaining the level of water stored in the compartments between the respective adjacent dividing panels even though a small amount of water is introduced into the compartments by adjusting the sizes of the water-passing holes of the respective dividing panels and adjusting the levels of water stored in the compartments. Accordingly, the fishway block is able to actively accommodate environmental changes such as the speed of water flow in the river, and keeps a fishway always open even if the amount of water flowing into the fishway block is small.
- [11] Fifth, the fishway block further includes a water flow speed reduction member disposed in front of the foremost dividing panel or between adjacent dividing panels, in order to primarily slow down the speed of water flowing into the fishway block, thereby being capable of allowing even fish having poor swimming ability to easily pass.
- [12] Sixth, the fishway block includes a heater on surfaces of the sidewall panels, the dividing panel, and the water flow speed reduction member to prevent water from freezing in a fishway during the winter or in frigid areas, thereby preventing rupture of the fishway block.

Advantageous Effects

- [13] As is apparent from the above descriptions, the fishway block according to the present invention has the following advantages.
- [14] First, the locations of water-passing holes in adjacent dividing panels are varied,

that is, the heights of the locations of the water-passing holes have a zigzag arrangement. Further, a water flow speed reduction member is provided in front of the foremost dividing panel and between dividing panels. Thanks to these structures, the speed of water flow is remarkably lowered because water flows after the water has been temporarily stored in the compartment between the adjacent dividing panels, so that even fish having poor swimming ability can migrate upstream and downstream.

[15] Second, when water overflows along the upper end of a dividing panel having a water-passing hole formed near the lower end of the dividing panel, the water stored in the downstream side compartment falls by an interval, thereby generating air bubbles. As a result, sufficient oxygen is provided to the creatures in water and an environment in which microorganisms can live is established.

[16] Third, since the dividing panels and the sidewall panels have respective pulling-rings, it is easy to install the fishway block. Further, adjacent fishway blocks are securely coupled by bolts, so that the fishway blocks can be easily installed and securely fixed on an installation surface.

[17] Fourth, in the case where the sidewall panels and the dividing panels are separately prepared and then assembled, the fishway blocks are easily loaded and unloaded from a transportation truck, and can be effectively transported. Further, because partial replacement is possible, maintenance of the fishway block is easy.

[18] The primarily feature of the fishway block according to the present invention is to maintain the speed of water flow constant and slow in order to allow fish having poor swimming ability to migrate upstream and downstream.

[19] Further, since the fishway block has a heater covering selected portions of the sidewall panels, the dividing panels and the water flow speed reduction members, freezing rupture of the fishway block, which is caused by water freezing in cold weather or in frigid regions, is prevented.

Brief Description of the Drawings

[20] FIG. 1 is a perspective view illustrating a fishway block according to one embodiment of the present invention;

[21] FIG. 2 is a perspective view illustrating the fishway block shown in FIG. 1, wherein two fishway blocks are coupled to each other in order to lengthen a passage for a fishway;

[22] FIG. 3 is a perspective view illustrating the fishway blocks shown in FIG. 2, in which sidewall panes are cut away from the fishway blocks;

[23] FIG. 4 is a cross-sectional view illustrating the fishway block, taken along the line passing through the center of a water-passing hole;

[24] FIG. 5 is a perspective view illustrating the fishway block in the state of being

installed on a crossbar;

[25] FIG. 6 is a view illustrating the fishway block in the state of being lifted by a crane;

[26] FIGS. 7 to 9 are views illustrating fishway blocks according to other embodiments of the present invention;

[27] FIGS. 10 and 11 are views illustrating a portion of a fishway block according to a further embodiment of the present invention;

[28] FIG. 12 is a cross-sectional view illustrating the fishway block, taken along line A-A in FIG. 11;

[29] FIG. 13 is a perspective view illustrating the fishway block shown in FIG. 10, from which a sidewall panel and a fishway size control mechanism have been removed;

[30] FIG. 14 is an exploded view illustrating the fishway block shown in FIG. 13, in particular, illustrating the fishway size control mechanism;

[31] FIG. 15 is an exploded view illustrating the fishway block shown in FIG. 9, in particular, illustrating the fishway size control mechanism and a water level control mechanism;

[32] FIG. 16 is a view illustrating the fishway block shown in FIG. 10, the fishway block in the state of being installed; and

[33] FIG. 17 is a view illustrating the fishway block according to a still further embodiment of the present invention.

Best Mode for Carrying Out the Invention

[34] In order to achieve the above objects of the present invention, there is provided a fishway block comprising a bottom panel, sidewall panels parallel with each other and standing on respective sides of the bottom panel, and a plurality of dividing panels disposed on the bottom panel, each extending from either of the sidewall panels to the other, and having a water-passing hole.

[35] The locations of the water-passing holes of adjacent dividing panels are varied, and a trail of the locations has a zigzag pattern, in which the size of the water-passing hole formed near a lower end of the dividing panel is smaller than the size of the water-passing hole formed near an upper end of the dividing panel, thereby preventing water from overflowing. The locations of the water-passing holes form a zigzag pattern when viewed from a vertical direction and from a horizontal direction.

[36] Each of the dividing panels has an upper end portion which is bent in one direction in order to increase the amount of reservoir water in a compartment formed between adjacent dividing panels in the case that the fishway block is installed on a steeply sloped surface.

[37] The sidewall panels are integrated with the bottom panel into a single body, but the dividing panels are prepared separately from the sidewall panels and the bottom panel.

The dividing panels are assembled by inserting the dividing panels into guide depressions formed on inner surfaces of the respective sidewall panels. Alternatively, all of the bottom panel, the sidewall panels, and the dividing panels can be separately prepared and then assembled, or they can be integrated into a single body by manufacturing the fishway block using a molding cast.

[38] The outermost dividing panels have an insertion depression and an insertion protrusion, respectively, on respective outer surfaces such that adjacent fishway blocks are coupled in an insertion joint manner. The insertion depression and the insertion protrusion preferably have a wedge shape, so that penetration holes, the water-passing holes and the sidewall panels are aligned when the insertion depression and the insertion protrusion are joined.

[39] In order to securely couple the adjacent fishway blocks, the outermost dividing panels disposed at end portions of the sidewall panels have respective penetration holes, and the adjacent fishway blocks are coupled by passing a bolt through the penetration holes of the abutting dividing panels.

[40] Each of the sidewall panels is higher than the dividing panels, so that water overflows only along ends of the dividing panels and flows through the water-passing holes in the dividing panels but does not overflow over upper ends of the sidewall panels, that is, the water does not deviate from the watercourse.

[41] A pulling-ring is formed on each of the dividing panels and the sidewall panels to enable easy lift of the dividing panels and the sidewall panels, for assembly work, or to lift the assembled fishway block during installation. The pulling-rings may be detachable or nondetachable.

[42] The sidewall panels, each has a bracket with a bolt hole used to fix the fishway block to a sloped surface of a crossbar using an anchor in a simple manner.

[43] The fishway block can be connected to a pipe having a water discharging capacity sufficient to ensure that water does not overflow over the upper end of the dividing panel while the water-passing hole of the foremost dividing panel is submerged in water.

[44] The fishway block further includes a fishway size control mechanism disposed on the dividing panel for adjusting the size of a fishway which is the passage through which fish migrate upstream and downstream, in particular the size of the water-passing hole of the dividing panel. The fishway size control mechanism comprises a guide formed around the water-passing hole, a water gate that moves up and down along the guide, thereby being capable of completely closing or partially or fully opening the water-passing hole, a vertical standing member extending upward from the upper end of the water gate and having threads on the outer surface thereof, and a pair of bevel gears installed on the upper end portion of the dividing panel.

- [45] The fishway block further includes a water level control mechanism for adjusting the size of a watercourse groove formed at an upper end portion of the dividing panel. The water level control mechanism comprises a guide formed around the watercourse groove formed at an upper end portion of the dividing panel, a water gate installed to be moved up and down to adjust the height of the bottom of the watercourse groove, a standing member extending upward from an upper end portion of the water gate and having threads on the outer surface thereof, and a pair of bevel gears installed on an upper end portion of the dividing panel.
- [46] The dividing panel having both a water-passing hole and a watercourse groove formed on the vertical straight line can include both the water level control mechanism and the fishway size control mechanism. The fishway block includes two water gates, the sizes of the water-passing hole and the watercourse groove of which are adjustable, two standing members extending upward from respective upper ends of the respective gates and having threads on the outer surface thereof, and a pair of bevel gears for separately controlling the two water gates.
- [47] The fishway block further includes a deceleration motor connected to the shaft of a bevel gear, thereby rotating the bevel gear forward and reverse.
- [48] The fishway block further includes a water flow speed reduction member disposed in front of the foremost dividing panel or in a compartment between adjacent dividing panels, for primarily reducing the speed of water flowing toward the dividing panel.
- [49] The water flow speed reduction member has a stepped shape and is disposed to face the direction of water flow.
- [50] The fishway block further includes a sheet heater on surfaces of the sidewall panels, the dividing panels and the water flow speed reduction members in order to prevent freezing rupture in winter or in frigid zones. The sheet heater is prepared by mixing ultra-fine carbon fiber, protoplasm pulp and high purity synthetic ceramic powder, processing the mixture into an insulation coating paper 1mm thickness or less and providing a pair of electrodes to the insulation coating paper.

Mode for the Invention

- [51] Hereafter, embodiments of the present invention will be described with reference to the accompanying drawings.
- [52] FIG. 1 illustrates a fishway block according to one embodiment of the present invention, FIG. 2 illustrates the fishway blocks shown in FIG. 1, in which the fishway blocks are united to lengthen a watercourse in the fishway block, FIG. 3 illustrates the fishway blocks shown in FIG. 2, from which sidewall panels of the fishway blocks are eliminated, and FIG. 4 illustrates a cross-section of the fishway block, taken along the line passing through the center of a water-passing hole.

- [53] As illustrated in above drawings, the fishway block 10 comprises the bottom panel 13, sidewall panels 14a and 14b disposed at both sides of the bottom panel 13, and a plurality of dividing panels 15a, 15b, and 15c installed between the sidewall panels 14a and 14b to cross the bottom 13. The dividing panels 15a, 15b and 15c have respective water-passing holes 16a, 16b and 16c.
- [54] Among the dividing panels 15a, 15b and 15c, the outermost dividing panels 15a and 15c disposed at respective ends of the sidewall panels 14a and 14b are integrated with the bottom panel 13 into a single body. The sidewall panels 14a and 14b are closely coupled to sides of the dividing panels 15a and 15c and the bottom panel 13 by a coupling member 17.
- [55] The dividing panel 15b is disposed between the dividing panels 15a and 15c. That is, the dividing panel 15b is disposed in the middle portion of the sidewall panels 14a and 14b, not at the end portions of the sidewall panels 14a and 14b. The dividing panel 15b is coupled to the sidewall panels 14a and 14b in a sliding manner. That is, both side ends of the dividing panel 15b are inserted into respective insertion guides formed on respective inner surfaces of the sidewalls 14a and 14b, and then the side ends of the dividing panel 15b are fixed in the respective guides 18. Referring to FIGS. 1 to 5, the guides 18 are protrusions formed on inner surfaces of the sidewall panels 14a and 14b, but the guides 18 can be depressions.
- [56] The bottom panel 13, the sidewall panels 14a and 14b, and the dividing panels 15a, 15b and 15c are selectively separately prepared but all elements of the bottom panel, the sidewall panels 14a and 14b and the dividing panels 15a, 15b and 15c are separately prepared. In order to assemble the fishway block, in the first step, the bottom panel 13 is disposed on the base surface. Next, the sidewall panels 14a and 14b are erected on both sides of the bottom panel 13, and the dividing panels 15a and 15c are coupled to respective ends of the sidewall panels 14a and 14b by the coupling means 17.
- [57] Some or all of the elements of the fishway block can be separately prepared, and then all of the elements can be assembled to form the fishway block. Alternatively, all of the elements of the fishway block can be integrated into a single body by manufacturing the fishway block through a molding method using a mold having a shape corresponding to the entire fishway block.
- [58] The water-passing holes 16a, 16b and 16c of the dividing panels 15a, 15b and 15c are disposed to form a zigzag pattern. That is, the locations and sizes of the water-passing holes 16a, 16b and 16c of the adjacent dividing panels 15a, 15b and 15c are different. The locations of the water-passing holes 16a, 16b and 16c are different when viewed both from a vertical direction and a horizontal direction.
- [59] For example, the sizes of the water-passing holes 16a and 16c of the dividing

panels 15a and 15c disposed at the end portions of the sidewall panels 14a and 14b are larger than the size of the water-passing hole 16b of the middle dividing panel 15b. The water-passing holes 16a and 16c of the dividing panels 15a and 15c are formed near upper ends of the respective dividing panels 15a and 15c, but the water-passing hole 16b is formed near the lower end of the dividing panel 15b.

[60] Each of the dividing panels 15a, 15b and 15c has a pulling-ring 19 which is detachable. The pulling-ring 19 is used to lift up and move the dividing panels 15a, 15b and 15c using a rope 30 and a crane 31 when assembling and disassembling the dividing panels 15a, 15b and 15c. Each of the sidewall panels 14a and 14b and the bottom panel 13 may also have a pulling-ring 19. The pulling-rings 19 can be detachably installed or undetachably fixed to the dividing panels 15a, 15b and 15c, the sidewall panels 14a and 14b and the bottom panel 13.

[61] The outermost dividing panels 15a and 15c of the sidewall panels 14a and 14b have a depression 21 and a protrusion 22, respectively, on the outer surfaces thereof so that a plurality of fishway blocks can be coupled in series in such a manner that the protrusion 22 of the dividing panel 15c of a first fishway block is inserted into the corresponding depression 21 of the dividing panel 15c of a second fishway block. The outermost dividing panels 15a and 15c have respective penetration holes 23, so that the fishway blocks are securely united by passing a coupling means 24 through the penetration holes 23 of the dividing panels 15a and 15c.

[62] The depression 21 and the protrusion 22 are wedge-shaped, so that the penetration holes 23, the water-passing holes 16a and 16c and the sidewall panels 14a and 14b are aligned when the depression 21 and the protrusion 22 are joined.

[63] Hereinafter, the method of installing the above described fishway block will be described.

[64] Referring to FIG. 5, a pipe 26 is installed beneath a crossbar 25 lower than the lowest level of reservoir water, and one or more fishway blocks 10 are coupled to one end portion of the pipe 26 on the downstream side of the crossbar 25. In this instance, foundation work for installation of the fishway blocks 10 is performed on the sloped surface of the crossbar on the downstream side. However, in the case that the crossbar is made of concrete, additional foundation work is not necessary.

[65] Next, referring to FIG. 6, a rope 30 is inserted through the pulling-rings 19 of the dividing panels 15a, 15b and 15c and the rope is pulled by a crane 31 to lift up the dividing panels 15a, 15b and 15c, in order to install the dividing panels 15a, 15b and 15c on the sloped surface of the downstream side of the crossbar 25. In this instance, two or more fishway blocks 10 are connected in series such that the direction of water flow is the same as the length direction of the fishway blocks 10.

[66] A number of the fishway blocks 10 can be carried to the site and piled up on a

stacking area. Since the fishway blocks 10 are heavy, it is difficult to carry the fishway blocks 10 using human force. Accordingly, the fishway blocks 10 are carried by heavy equipment such as a crane from the stack field to an installation site, and then installed.

[67] The fishway blocks 10 assembled in the manner described above are coupled to one another in such a manner that the depression 21 of either of the dividing panel 15a and 15c disposed at the end portions of the sidewall panels 14a and 14b in a first fishway block 10 engages with the protrusion 22 of the other one of the dividing panels 15a and 15c in a second fishway block 20. When the protrusion 22 of the dividing panel 15c is inserted into the depression 21 of the dividing panel 15a, the water-passing holes 16a and 16c and the penetration hole 23 are aligned in a straight line.

[68] After the fishway blocks 10 are joined, a bolt 24 serving as the coupling means is inserted to pass through the penetration holes 23 of the dividing panels 15a and 15c to maintain the tight coupling of the fishway blocks 10, so that the fishway blocks 10 are united like a single body. If more secure coupling is needed, an anchor can also be provided at a lower end portion of the bottom panel 13 or the sidewall panels 14a and 14b of the fishway blocks 10.

[69] After installation of the fishway blocks 10, the pipe 26 installed lower than the lowest level of the reservoir water is opened to allow water to flow downstream through the pipe 26. At this time, the water discharge capacity of the pipe 26 is the same as or less than the water discharge capacity of the water-passing holes 16a and 16c. The water discharge capacity of the pipe 26 is controlled such that water discharged from the pipe 26 can overflow over the upper end of the dividing panel 15a.

[70] After installation of the fishway blocks 10, if water flows from the upstream side to the downstream side of the crossbar 25 through the pipe 26, the water is stored in compartments formed between the adjacent dividing panels 15a, 15b and 15c. As a result, water flows through the water-passing holes 16a, 16b and 16c at low speed. Accordingly, fish on the downstream side can migrate upstream along the sloped watercourse due to the fishway block 10.

[71] In particular, even fish having poor swimming ability can migrate downstream and upstream through the dividing panels 15a, 15b and 15c of the fishway block 10.

[72] Referring to FIG. 5, the fishway block 10 is installed on the sloped surface of the crossbar 25, and the height and horizontal locations of the water-passing holes 16a, 16b and 16c of the respective dividing panels 15a, 15b and 15c are different from one another. That is, the water-passing holes 16a, 16b and 16c are disposed in a zigzag pattern. The location and size of the water-passing hole 16b in the middle dividing panel 15b is lower and smaller than the other water-passing holes 16a and 16c, but the location and size of the water-passing hole 16c of the dividing panel 15c disposed to the rearward side of the middle dividing panel 15b are higher and larger than that of

the water-passing hole 16b of the dividing panel 15b. That is, the water-passing holes 16b and 16c form a step.

[73] Accordingly, water discharged from the pipe 26 can flow downstream through only the water-passing hole 16b of the dividing panel 15b in the state that the water-passing hole 16a of the dividing panel 15a is submerged in water. That is, water flowing downstream through the water-passing hole 15b is temporarily blocked by the dividing panel 15b, forming back flow, thereby being temporarily stored, and then flows downstream through the water-passing hole 16b of the dividing panel 15b.

[74] The water-passing hole 16b is disposed at a location higher than the water-passing hole 16c. Accordingly, if the water flowing out of the water-passing hole 16b is stored in a compartment between the dividing panels 15b and 15c, the water-passing hole 16b is submerged in water, so that the flow of the water is slowed down. Water pressure is generated corresponding to the difference in a water level of the water stored in the compartment between the dividing panels 15a and 15b and the water level in the water stored in the downstream side compartment between the dividing panels 15b and 15c. The water pressure affects the speed of water flow. Accordingly, as the water pressure decreases, the flow of the water slows down.

[75] Accordingly, since a small amount of water flows through the water-passing hole 16b in the dividing panel 15b, as much water is stored in the upstream side compartment between the dividing panels 15a and 15b as much is reservoiried in the downstream side compartment between the dividing panels 15b and 15c. At this time, since more water flows through the upstream side water-passing hole 16a than through the downstream side water-passing hole 16b, the water level in the compartment between the dividing panels 15b and 15c increases due to the excessive amount of water, resulting in overflow water over the dividing panel 15b, thereby the overflowing water is introduced into the compartment between the dividing panels 15b and 15c.

[76] According to the operation principle described above, since the water is stored and stagnates in the compartments between the dividing panels 15a, 15b and 15c, and the speed of the water flowing through the water-passing holes 16a, 16b and 16c is remarkably lowered, even fish having poor swimming ability can migrate upstream and downstream through the crossbar 15, passing through the water-passing holes 16a, 16b and 16c.

[77] In the above description, the fishway blocks 10 are realized as a complete product. However, the fishway block 10 can be realized as separate elements including the bottom panel 14, the sidewall panels 14a and 14b, and the dividing panels 15a, 15b and 15c. The elements of the fishway block 10 are separately carried to the installation site, and are assembled and installed onsite using a crane. Since the fishway block 10 is prepared in the state of being divided into the bottom panel 14, the sidewall panels 14a

and 14b, and the dividing panels 15a, 15b and 15c, the weight of the fishway block 10 is also divided, and it is easier to load, carry, and unload the fishway block 10 in comparison with the case of dealing with the whole fishway block 10.

[78] FIG. 7 and FIG. 8 illustrate a fishway block according to another embodiment of the present invention. Referring to FIG. 7, side ends of the dividing panels 15a, 15b and 15c and the sidewall panels 14a and 14b have a vertical profile regardless of the angle of the sloped surface on which the fishway block 10 is to be installed. Referring to FIG. 8, the upper end of each of the dividing panels 15a, 15b and 15c is bent in one direction, thereby having a protrusion 28 structured to protrude upstream in order to maximize the water level of the reservoir water in the compartment provided between the dividing panels 15a, 15b and 15c when the fishway block 10 is installed on the steeply sloped surface.

[79] According to the other embodiment shown in FIG. 7 and FIG. 8, even if the crossbar on which the fishway block is installed has a steep slope, the amount of water stored in compartments provided between adjacent dividing panels 15a, 15b and 15c is maximized due to the vertically disposed dividing panels 15a, 15b and 15c and the protrusions 28 provided on the upper ends of the respective dividing panels 15a, 15b and 15c. Thanks to this structure, the operational effects and advantages of the fishway block 10 are enhanced.

[80] FIG. 9 illustrates a fishway block according to a further embodiment of the present invention. According to this embodiment, the fishway block 10 is longer one than the fishway blocks 10 according to the above described embodiments, and there are three middle dividing panels 15b between the outermost dividing panels 15a and 15c. Water-passing holes 16b in the three middle dividing panels 15b form a zigzag pattern in the same way as the zigzag pattern is formed by the water-passing holes 16a, 16b and 16c of the dividing panels 15a, 15b and 15c of the fishway block shown in FIG. 7 and FIG. 8. Each of the sidewall panels has a bracket 33 having a bolt hole 34 at its lower end portion so that the sidewall panels can be fixed to the sloped surface of the crossbar using an anchor bolt.

[81] According to the further embodiment, the length of the fishway block can be adjusted according to the size of the installation site of the fishway block, and the sidewall panels 14a and 14b can be easily secured to the sloped surface of the crossbar by the anchor bolt through the bolt hole 34 of the bracket 33 provided to a lower end portion of each of the sidewall panels 14a and 14b.

[82] FIGS. 11 to 16 illustrate a fishway block 100 according to a still further embodiment of the present invention. Referring to FIGS. 11 to 16, the fishway block 100 comprises a bottom panel 130, sidewall panels 141 and 142 provided at side ends of the bottom panel 130, and a plurality of dividing panels 151, 152, 153 and 154

disposed on the bottom panel 130, extending from either side wall panel 141 toward the other sidewall panel 142 and parallel with to one another. The dividing panels 151, 152, 153 and 154 include respective sub-dividing panels 251, 252, 253 and 254, and water-passing holes 161, 162, 163 and 164 are formed on the respective sub-dividing panels 251, 252, 253 and 254 to allow fish to migrate therethrough. The sidewall panels 141 and 142, in contact with side ends of the sub-dividing panels 251, 252, 253 and 254 and the dividing panels 151, 152, 153 and 154, have guide protrusions 143 and 144. The guide protrusions 143 must be structured to be airtight when the sub-dividing panels 251, 252, 253 and 254 are inserted between the guide protrusions 143 and 144, so that water does not leak through the gap that is usually formed between the guide protrusions 143 and 144 and the sub-dividing panels 251, 252, 253 and 254.

[83] The sub-dividing panels 251, 252, 253 and 254 have respective fishway control mechanisms for controlling the size of fishways, for examples the sizes of the water-passing holes 161, 162, 163 and 164. Each of the fishway control mechanisms comprises a first guide 261 disposed around the corresponding water-passing hole 161, 162, 163 or 164, a first water gate 262 installed to move up and down along the first guide 261, thereby completely closing or partially or fully opening the corresponding water-passing hole 161, 162, 163 or 164, a vertically standing member 263 extending upward from the first water gate 262 and having screw threads on the outer surface thereof, and a pair of bevel gears 264 installed on an upper end portion of the sub-dividing panels 251 and 253 for elevating the vertically standing member 263 up and down.

[84] The sub-dividing panel 251 is made of concrete like the bottom panel 130, the sidewall panels 141 and 142 and the dividing panels 151, 152, 153 and 154, or is made of an anti-corrosion treated metal. The first water gate 262 is made of a metal plate which is anti-corrosion treated and is structured so as to protrude from the corresponding sub-dividing panel 251, 252, 253 or 254 as little as possible.

[85] In order to lift the first water gate 262 up and down, a handle installed on the first bevel gear 264 is rotated forwards or backwards. As the first water gate 262 moves up and down, the opening degree of the water-passing holes 161 and 163 is adjusted. Further, the first water gate 262 can be connected to a deceleration motor (not shown) that can rotate forward and reverse. If the deceleration motor is connected to a shaft of the bevel gear 264, the elevation of the water gate is easily controlled.

[86] The sub-dividing panels 252 and 254 having the water-passing holes 162 and 164 formed near respective lower ends of the sub-dividing panels 252 and 254 have respective watercourse grooves 255 and 256 having a predetermined depth and extending from upper ends to a predetermined depth. The sub-dividing panels 252 and 254 have respective water level control mechanisms for controlling the depth of the

water course grooves 255 and 256. Accordingly, the sub-dividing panels 252 and 254, having the respective water level control mechanisms, and the sub-dividing panels 252 and 254, having both the respective water-passing holes 162 and 164, and the respective water course grooves 255 and 256, have both of the water level control mechanism and the fishway size control mechanism.

[87] The fishway block 100 further includes a second guide 271 disposed around the water course grooves 255 and 256 formed at upper end portions of the dividing panels 252 and 254, a second water gate 272 installed to move in the vertical direction along the second guide 271 and installed to completely close or partially or fully open the water-passing holes 162 and 164, a third water gate 273 for controlling the height of the bottom of the watercourse grooves 255 and 256, second and third vertically standing members 274 and 275 extending upward from the second and third water gates 272 and 273, respectively, and having screw threads on the outer surfaces thereof, and a pair of bevel gears including a second bevel gear 276 and a third bevel gear 277, installed on upper ends of the dividing panels 252 and 254 for elevating the second and third vertically standing members 274 and 275 up and down, in the case that the sub-dividing panels 252 and 254 have respective water level control mechanisms and respective fishway size control mechanisms.

[88] The fishway block 100 includes a water flow speed reduction member 300 disposed in front of the foremost dividing panel 151 or in a compartment between the adjacent dividing panels 151 and 152, 152 and 153, or 153 and 154. The water flow speed reduction member 300 can slow down the flow of water introduced into the dividing panels 151, 152, 153 and 154 in the first place, and the water flow speed reduction member 300 is preferably structured to be step-shaped, and is disposed against the water running direction.

[89] According to the further embodiment of the present invention, referring to FIG. 16, the water upstream of the crossbar is primarily slowed down by colliding with the water flow speed reduction member installed in front of the foremost dividing panel 151, and then the water-passing hole 161 in the dividing panel 151 is submerged in water. After the water-passing hole 161 is submerged in water, the water flows downstream only through the water-passing hole 161 into a compartment between the dividing panels 151 and 152. The water flowing toward the dividing panel 152 collides with the water flow speed reduction member 302, temporarily flows backward, and then is stored in the compartment between the dividing panels 151 and 152, so that the water speed is rapidly reduced and the water flows through the water-passing hole 152 of the dividing panel 152 toward the dividing panel 153.

[90] In this instance, since the water-passing hole 163 is disposed at a position being higher than the upper end portion of the dividing panel 152 or the water-passing hole

162, as the water flows toward the dividing panel 153 through the water-passing hole 162 and the water is stored in a compartment between the dividing panels 152 and 153, the water-passing hole 162 is submerged in water after some time lapses, resulting in reduction of the speed of water flow. That is, due to water pressure corresponding to the difference between levels of water in the compartment between the dividing panels 151 and 152 and water in the compartment between the dividing panels 152 and 153, the flow of water passing through the water-passing hole 162 slows down. In this instance, since the amount of water introduced into the compartment between the dividing panels 151 and 152 through the water-passing hole 161 of the dividing panel 151 is greater than the amount of water flowing out of the compartment through the water-passing hole 162 of the dividing panel 152, the difference between the amounts of water increases the water level in the compartment provided between the dividing panels 152 and 153.

[91] In this instance, if the amount of water introduced into the compartment between the dividing panels 151 and 152, and the compartment between the dividing panels 152 and 253 is too small, the water-passing holes 162 and 163 cannot be submerged in water, so that a fishway is not formed. In this instance, the fishway size control mechanism and the water level control mechanism installed on the sub-dividing panels 251, 252, 253 and 254 are controlled such that a large amount of water is stored in the compartments between adjacent dividing panels 251, 252, 253 and 254 so that the water-passing holes 161, 162, 163 and 164 are completely submerged in water, and as small amount of water as possible flows through the water-passing holes 161, 162, 163 and 164.

[92] The operation of the fishway size control mechanism will be described below. First, the first and second bevel gears 264 and 276 installed on upper portions of the water-passing holes 161, 162, 163 and 164 are rotated, so that the first and second vertically standing members 263 and 274 of the first and second water gates 262 and 267 move up and down, adjusting the size of the water-passing holes 161, 162, 163 and 164. As described above, since the amount of water being introduced into the fishway block is small, the first and second water gates 262 and 274 stepwisely close the water-passing holes 161, 162, 163 and 164 such that the sizes of the water-passing holes 161, 162, 163 and 164 of the dividing panels 251, 252, 253 and 254 are relatively decreased.

[93] That is, since the water-passing holes 161, 162, 163 and 164 are partially closed and the amount of water flowing downstream is small, the water is stored in the compartments formed between adjacent dividing panels 151 and 152, 152 and 153, and 153 and 154. As a result, the water-passing holes 161, 162, 163 and 164 are completely immersed in water. In this instance, even if the water gathers in the compartment

between the dividing panels 152 and 153, there is the possibility that the water-passing hole 161 of the dividing panel 151 is not completely under in water. Accordingly, the heights of the bottoms of the watercourse grooves 255 and 256 of the dividing panels 252 and 254 are controlled by using the water level control mechanisms such that the water-passing hole 161 of the dividing panel 151 is completely submerged in water.

[94] The operation of the water level control mechanism is similar to the operation of the fishway size control mechanism except that the heights of the bottoms of the water course grooves 255 and 256 are adjusted by moving the third water gate 273 up and down, instead of moving the first and second water gates.

[95] As described above, it is possible to submerge the water-passing holes 161 and 163 of the dividing panels 251 and 253 in water by adjusting the sizes of the water-passing holes 161, 162, 163 and 164 of the dividing panels 251, 252, 253 and 254 and the sizes of the watercourse grooves 255 and 256, thereby being capable of submerging all the water-passing holes 161, 162, 163 and 164 of the dividing panels 251, 252, 253 and 254 in water.

[96] Accordingly, since the amount of water flowing out of the compartment between the dividing panels 251 and 252 through the water-passing hole 162 of the dividing panel 252 is smaller than the amount of water introduced into the compartment between the dividing panels 251 and 252 through the water-passing hole 161 of the dividing panel 251, the same amount of water gathers in the compartment between the dividing panels 152 and 153 as the amount of water gathered in the compartment between the dividing panels 253 and 254. Further, since the amount of water flowing through the water-passing hole 161 of the dividing panel 251 is larger than the amount of water flowing through the water-passing hole 162 of the dividing panel 252, the difference between the amounts of water increases the water level in the compartment between the dividing panels 151 and 152, thereby the water stored in the compartment ultimately overflows over the dividing panel 152 through the watercourse groove 255 formed at an upper end portion of the dividing panel 252 and is introduced into the compartment between the dividing panels 152 and 153.

[97] Thanks to the above described operating principle of the fishway block, since water is gathered and stored in the compartments formed between the respective adjacent dividing panels 151 and 152, 152 and 153, and 153 and 154, the flow of the water in the water-passing holes 161, 162, 163 and 154 of the respective dividing panels 251, 252, 253 and 254 greatly slows down. Accordingly, even fish having poor swimming ability can migrate upstream and downstream through the fishway block, in particular through the water-passing holes 161, 162, 163 and 164.

[98] FIG. 17 illustrates a fishway block according to an embodiment of the present invention. Referring to FIG. 17, a sheet heater partially or completely covers the water

flow speed reduction members 301, 302, 303 and 304, the dividing panels 251, 252, 253 and 254, and the sidewall panels 141 and 142, in order to prevent freezing rupture of the fishway block, which can be caused when water freezes during winter or in frigid zones. The heater is preferably a carbon fiber heater manufactured in such a manner that ultra-fine carbon fiber, protoplasm pulp, and highly pure compound ceramic power are mixed, the mixture is processed into a special sheet 1mm thick or less using directional disperse technology, and a pair of electrodes is formed on the sheet and coated with an insulating material.

[99] Thanks to the heater, water does not freeze in the fishway block while cold weather persists during the winter or in frigid zones, so that the fishway block does not rupture in freezing weather.

[100] As described above, the sizes of water-passing holes in the dividing panels, and the heights of the bottoms of the watercourse grooves formed on upper ends of the dividing panels are adjusted such that the flow of water is adequately slowed down. Further, the distance between the dividing panels can be also adjusted such that the flow of water is adequately slowed down. Still further, the height of the water flow speed reduction member disposed between the dividing panels can be adjusted in order to slow down the flow of water.

[101] In the above description, the fishway block is installed on the sloped surface of the downstream side of the crossbar. However, even if the fishway block is installed on the side of a brook and a valley having a flat bottom and fast water flow, the same operation and effects can be achieved.

[102] Although a preferred embodiment of the present invention has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claim.

Industrial Applicability

[103] In the fishway block according to the present invention, a fishway course of the fishway block can be lengthened and the flow of water therein can be slowed down. Accordingly, the fishway block can allow fish to easily migrate upstream and downstream when the fishway block is installed on a cross structure such as a dam or a crossbar in a river or a watercourse having fast water flow and a steeply sloped bottom.

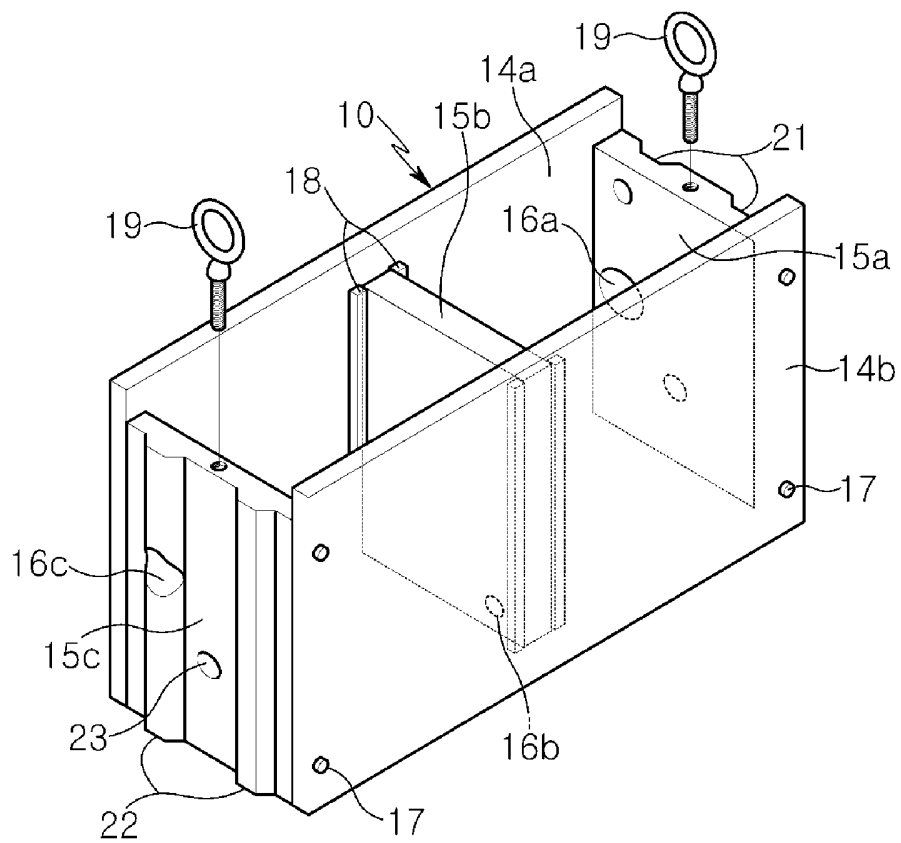
Claims

- [1] A fishway block comprising:
a bottom panel;
sidewall panels installed parallel to each other on respective sides of the bottom panel; and
one or more dividing panels installed to extend from either sidewall panel to the other sidewall panel, on the bottom panel, each dividing panel having a water-passing hole.
- [2] The fishway block as claimed in claim 1, wherein locations of the water-passing holes in the respective dividing panels form a zigzag pattern and a size of the water-passing hole formed near a lower end of the corresponding dividing panel is smaller than that of the water-passing hole near an upper end of the corresponding dividing panel, in order to slow down flow of water introduced into compartments formed between respective adjacent dividing panels.
- [3] The fishway block as claimed in claim 1, wherein the locations of the water-passing holes form a zigzag pattern in a horizontal direction and in a vertical direction, so that flow of water introduced into the compartments formed between dividing panels is slowed down and the water is gathered and reservoired in the compartments formed between the dividing panels.
- [4] The fishway block as claimed in claim 1, wherein upper ends of the sidewalls are higher than upper ends of the dividing panels, so that water overflowing over the upper ends of the dividing panels is prevented from flowing out of the fishway block over the sidewalls, and fish do not deviate from a watercourse.
- [5] The fishway block as claimed in claim 1, wherein the dividing panels have protrusions at respective upper ends, so that an amount of water that can be stored in the compartments formed between the dividing panels is increased when the fishway block is installed on a sloped surface.
- [6] The fishway block as claimed in claim 1, wherein one of the outermost dividing panels has an insertion depression and another of the outermost dividing panels has a protrusion which can be inserted into the insertion depression.
- [7] The fishway block as claimed in claim 1, wherein the outermost dividing panels have respective penetration holes, so that adjacent fishway blocks can be coupled by a coupling means which passes through the penetration holes.
- [8] The fishway block as claimed in claim 1, wherein the sidewall panels have respective brackets having respective bolt holes by which the sidewall panels can be securely fixed to a sloped surface of a crossbar using respective anchors.
- [9] The fishway block as claimed in claim 1, wherein all or some of the bottom

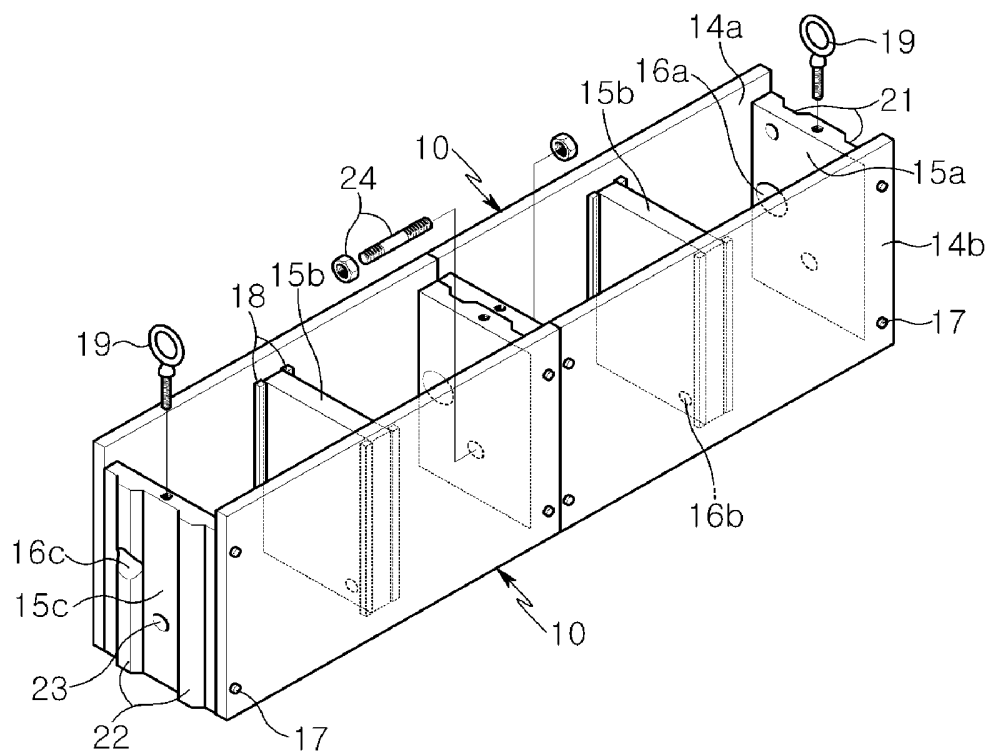
- panel, the sidewall panels, and the dividing panels are separately prepared.
- [10] The fishway block as claimed in claim 1 or 9, wherein at least the dividing panels are separately prepared and the sidewall panels have respective sliding guides on respective inner surfaces such that the dividing panels can be installed by being inserted in the sliding guides.
- [11] The fishway block as claimed in claim 1, wherein the dividing panels and the sidewall panels have respective pulling rings which are installed in a detachable manner or an integrated manner.
- [12] The fishway block as claimed in claim 9, wherein the dividing panels and the sidewall panels are coupled and fixed by a coupling means.
- [13] The fishway block as claimed in claim 1, wherein sides of the dividing panels and the sidewall panels are perpendicular to a horizontal direction regardless of an angle of a sloped installation surface of the fishway block.
- [14] The fishway block as claimed in claim 1, wherein fishway size control mechanisms are provided to the dividing panels in order to adjust the sizes of the water-passing holes, each being a passage through which fish can migrate upstream and downstream.
- [15] The fishway block as claimed in claim 14, wherein the fishway size control mechanism comprises:
a guide formed on the surface of the dividing panel near the water-passing hole in a vertical direction, the guide including two bars parallel to each other,
a water gate installed to be able to move up and down along the guide, thereby being capable of completely closing and partially or fully opening the water-passing hole,
a vertical standing member having screw threads on the outer surface thereof and extending upward from an upper end of the water gate; and
a pair of bevel gears installed at an upper end of the dividing panel in order to elevate the standing member up and down.
- [16] The fishway block as claimed in claim 1, wherein the dividing panels have respective watercourse grooves having a predetermined depth at respective upper ends thereof and have respective water level control mechanisms.
- [17] The fishway block as claimed in claim 16, wherein each of the water level control mechanisms comprises:
a guide formed on the surface of the dividing panel at both sides of the watercourse groove, in which two bars of the guide are parallel to each other;
a water gate installed to move up and down along the guide in order to adjust a height of the bottom of the watercourse groove, a standing member extending upward from an upper end of the water gate and having screw threads on the

- outer surface thereof, and a pair of bevel gears installed on an upper end portion of the dividing panel for elevating the vertical standing member up and down .
- [18] The fishway block as claimed in claim 14 or 16, wherein the dividing panel has both the fishway size control mechanism and the water level control mechanism, and the water-passing hole and the watercourse groove are formed on the same vertical straight line in the dividing panel, and the fishway block includes: two water gates for adjusting the sizes of the water-passing hole and the watercourse groove, respectively; two vertical standing members extending upward from upper ends of the respective water gates; and a pair of bevel gears that can separately elevate the two vertical standing members.
- [19] The fishway block as claimed in claim 14 or 16, further including a deceleration motor connected to a shaft of a bevel gear as to automatically rotate the bevel gear in forward and reverse directions.
- [20] The fishway block as claimed in claim 1, wherein a portion of the dividing panel near the water-passing hole is realized in a sub-dividing panel which can be detachably installed in the dividing panel.
- [21] The fishway block as claimed in claim 20, wherein the sub-dividing panel is made of concrete, like the bottom panel, the sidewall panels and the dividing panels, or is made of anti-corrosion treated metal.
- [22] The fishway block as claimed in claim 1, further comprising a water flow speed reduction member disposed in front of the foremost dividing panel or in a compartment formed between adjacent dividing panels for primarily slowing down the speed of water flow.
- [23] The fishway block as claimed in claim 22, wherein the water flow speed reduction member has a stepped shape which faces a direction of water flow.
- [24] The fishway block as claimed in claim 1 or claim 22, further comprising a heater on the surfaces of the sidewall panels, the dividing panels and the water flow speed reduction member for preventing water from freezing in winter or in frigid zones.
- [25] The fishway block as claimed in claim 1, wherein the fishway block is connected to a pipe having a water discharging capacity equal to that of the water-passing hole of the foremost dividing panel disposed on a downstream side of an installation place, the water-passing hole being submerged in water, so that water does not overflow over the upper end thereof when the fishway block is installed.

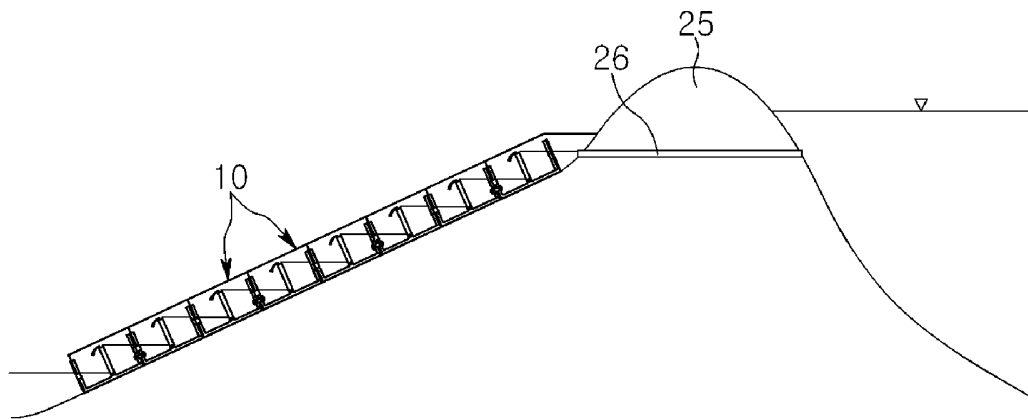
[Fig. 1]



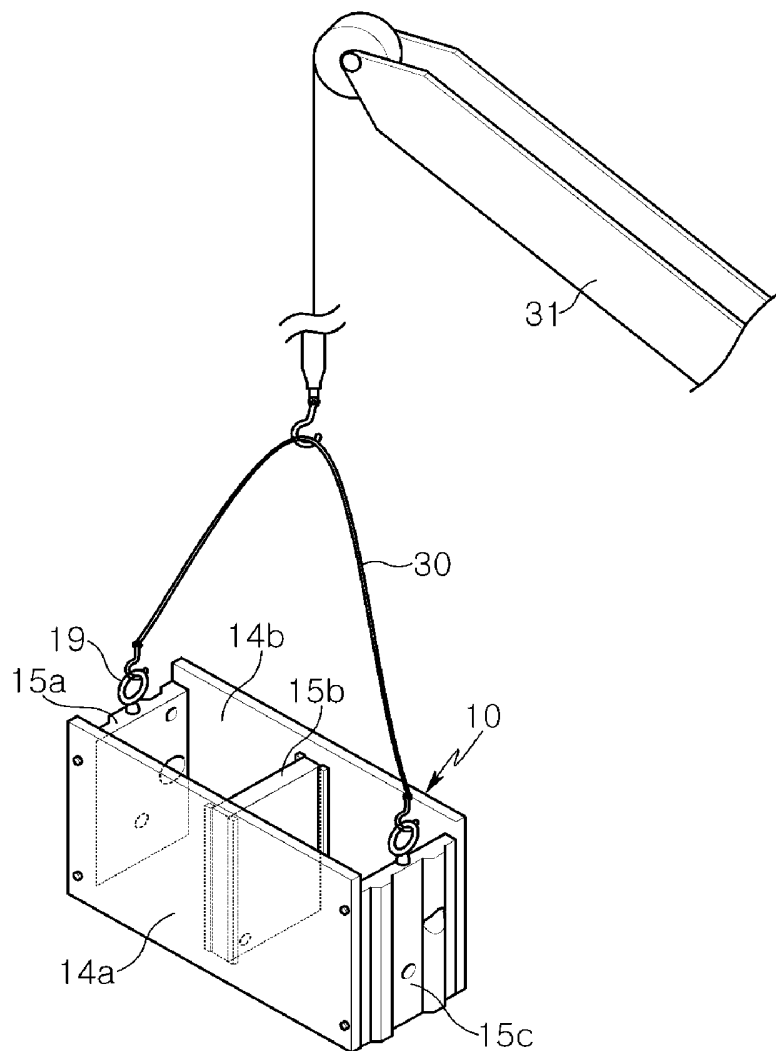
[Fig. 2]



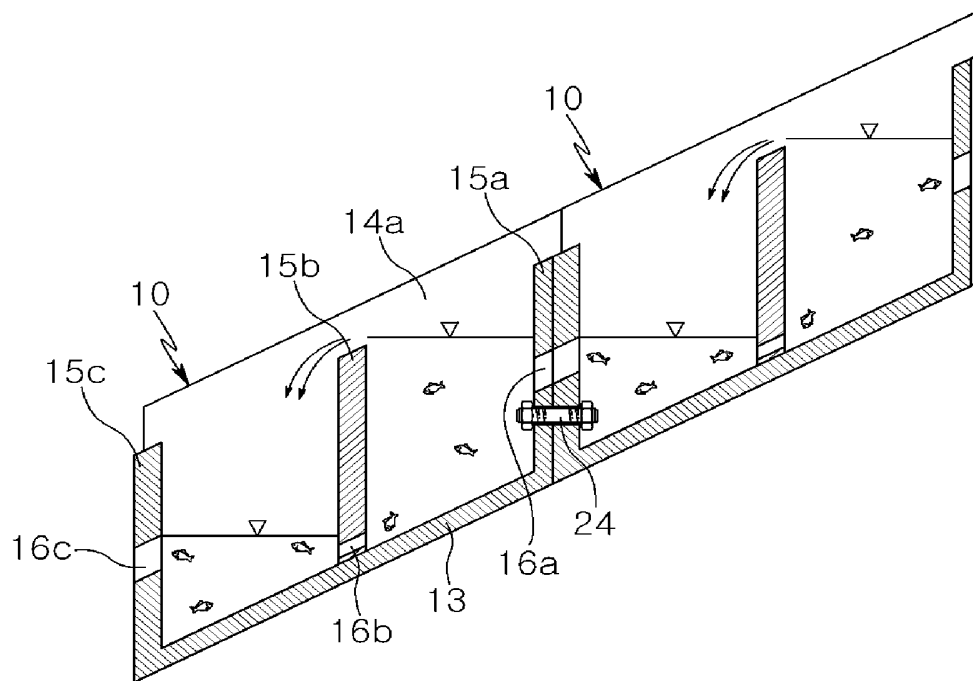
[Fig. 5]



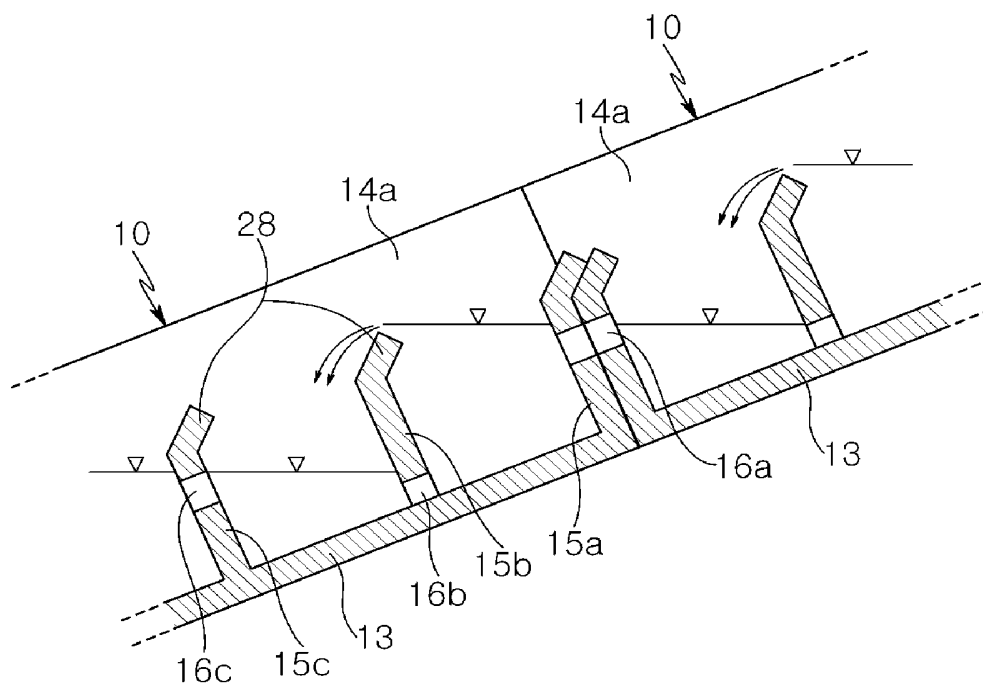
[Fig. 6]



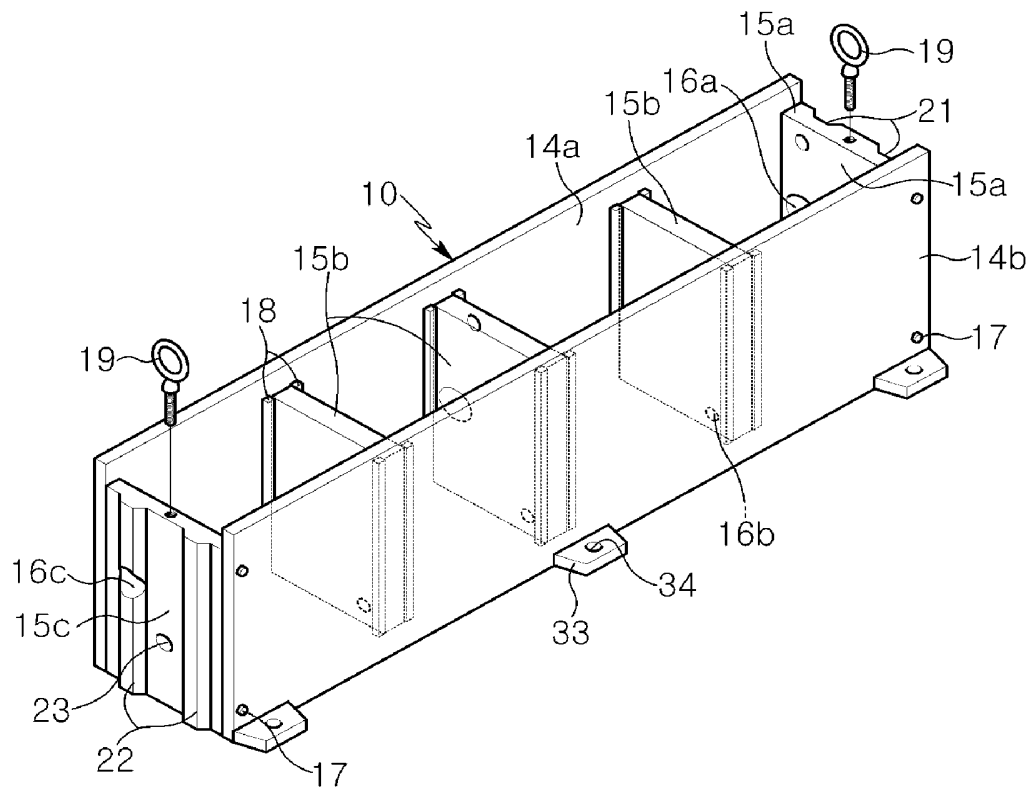
[Fig. 7]



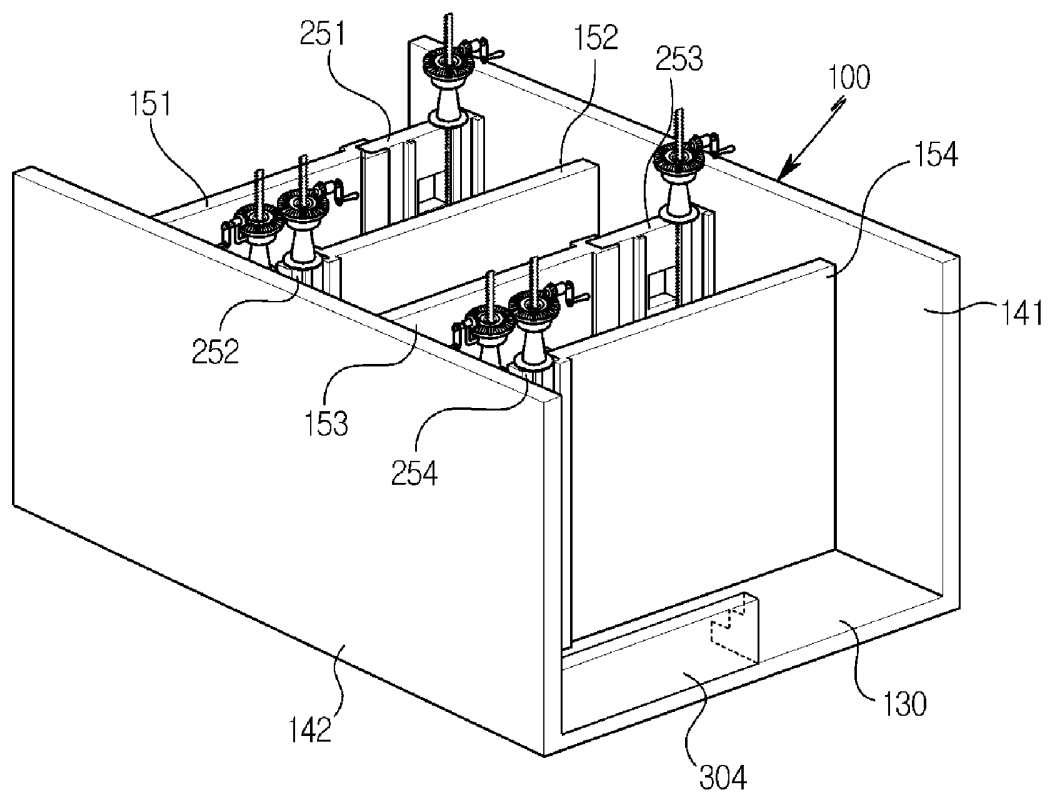
[Fig. 8]



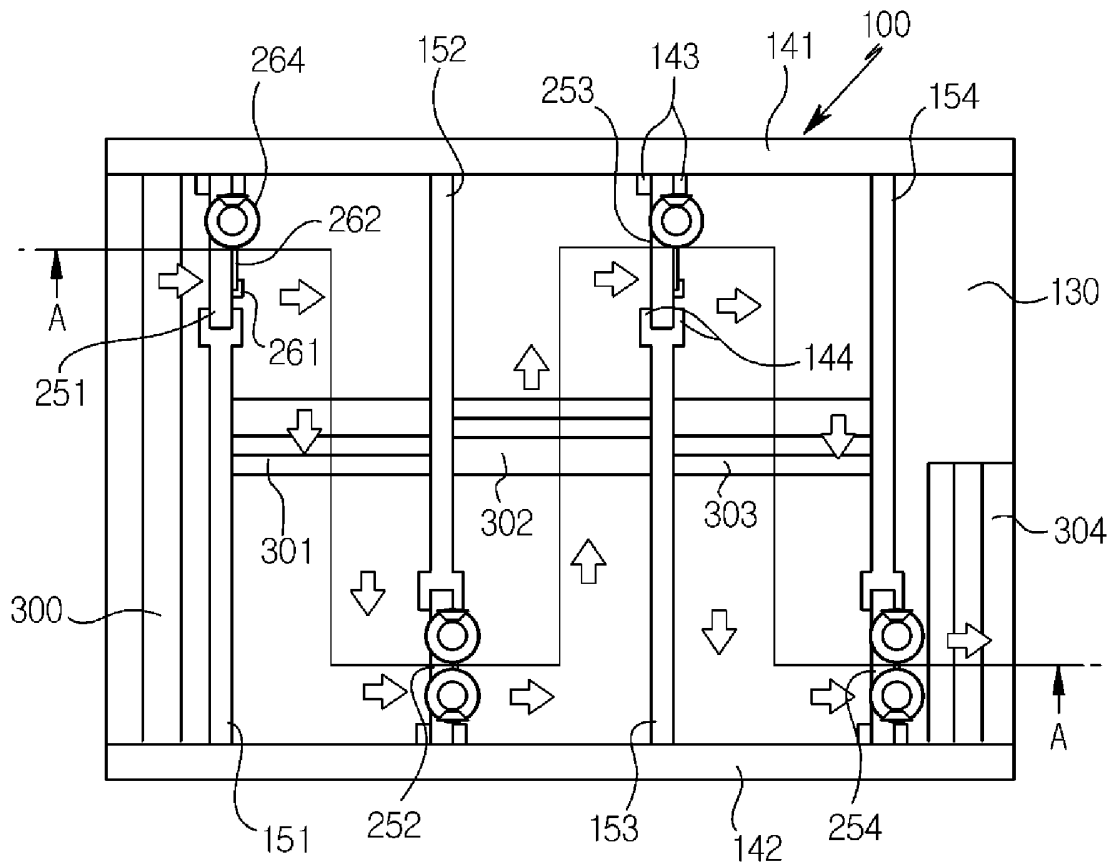
[Fig. 9]



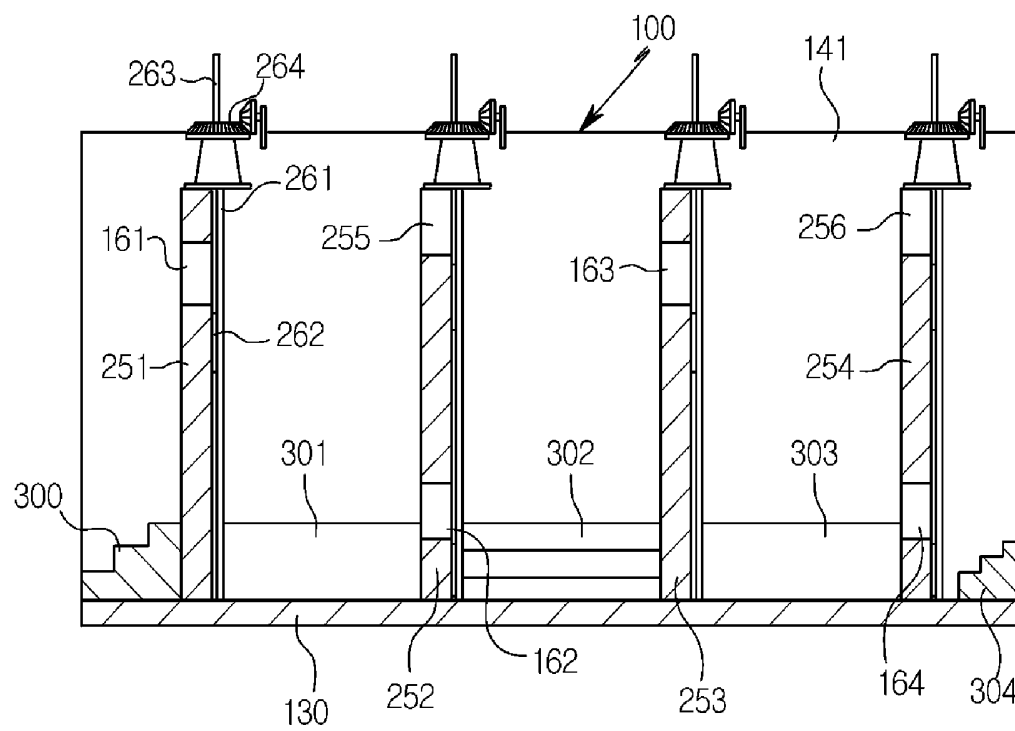
[Fig. 10]



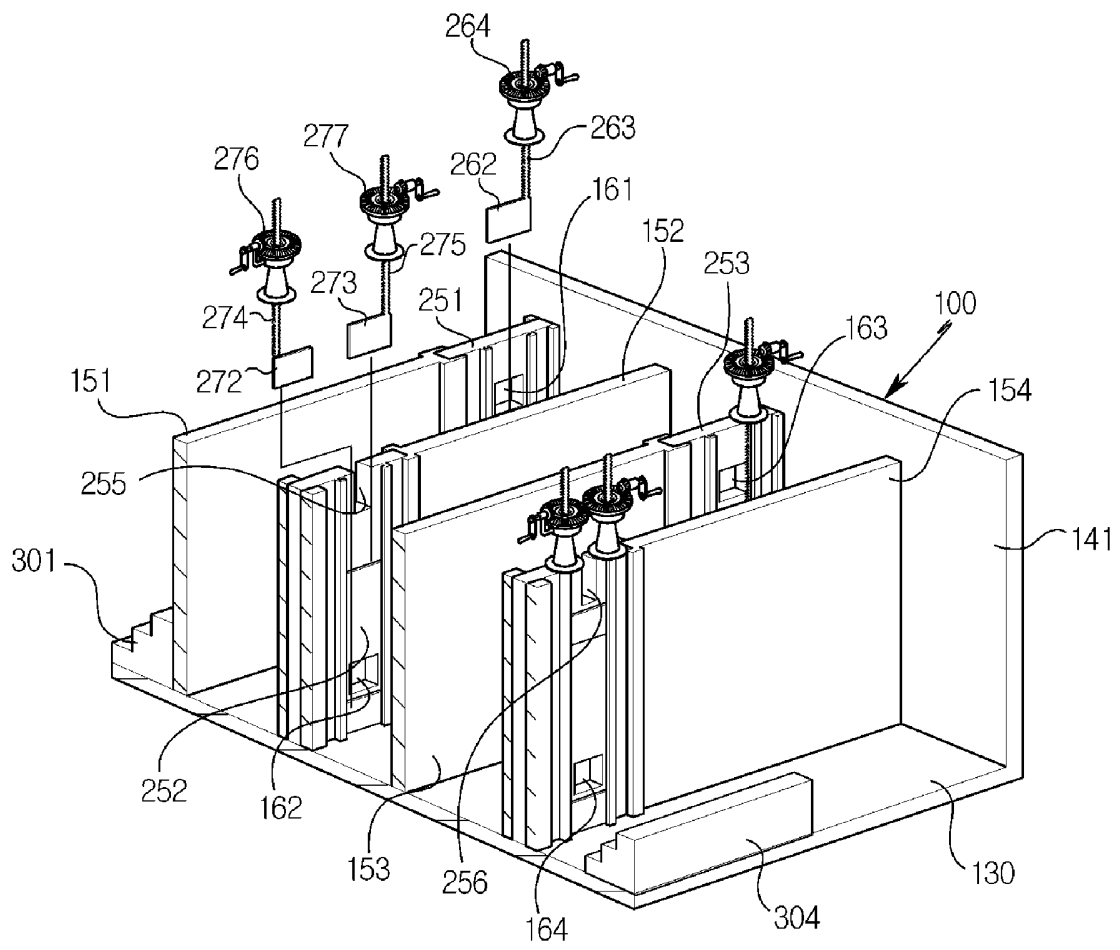
[Fig. 11]



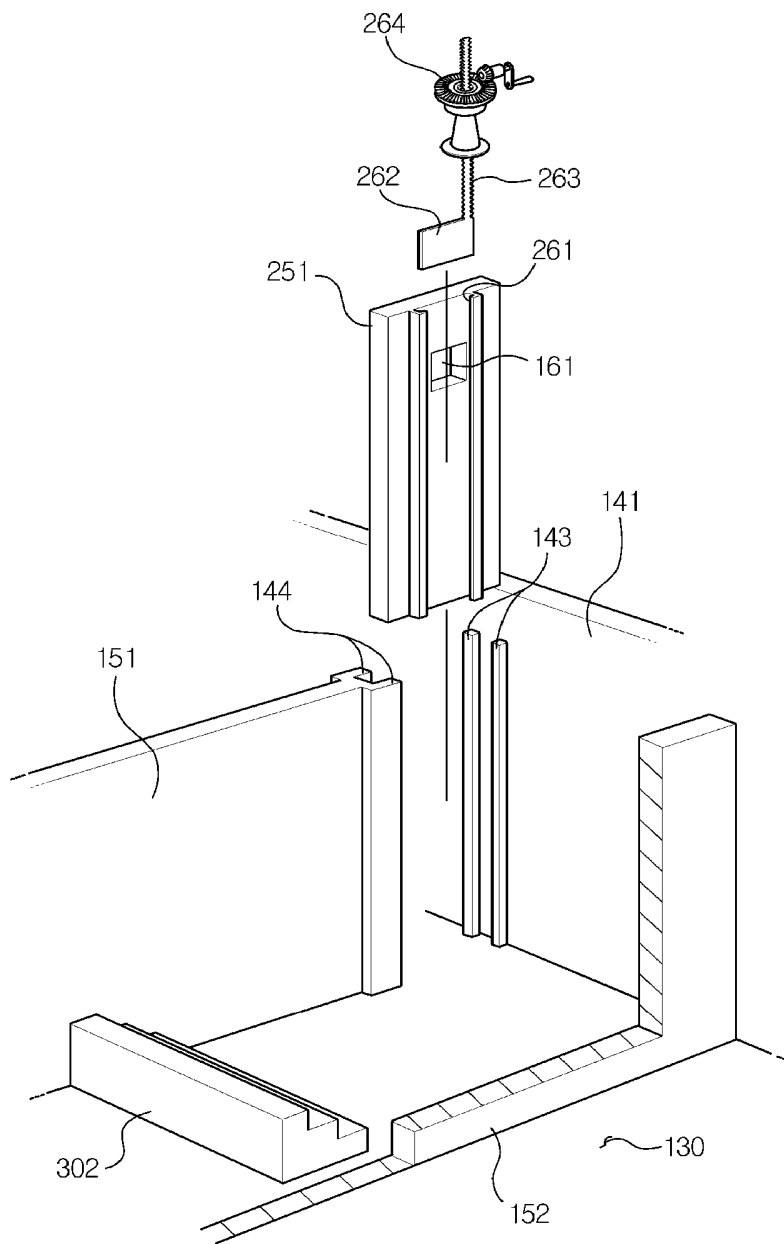
[Fig. 12]



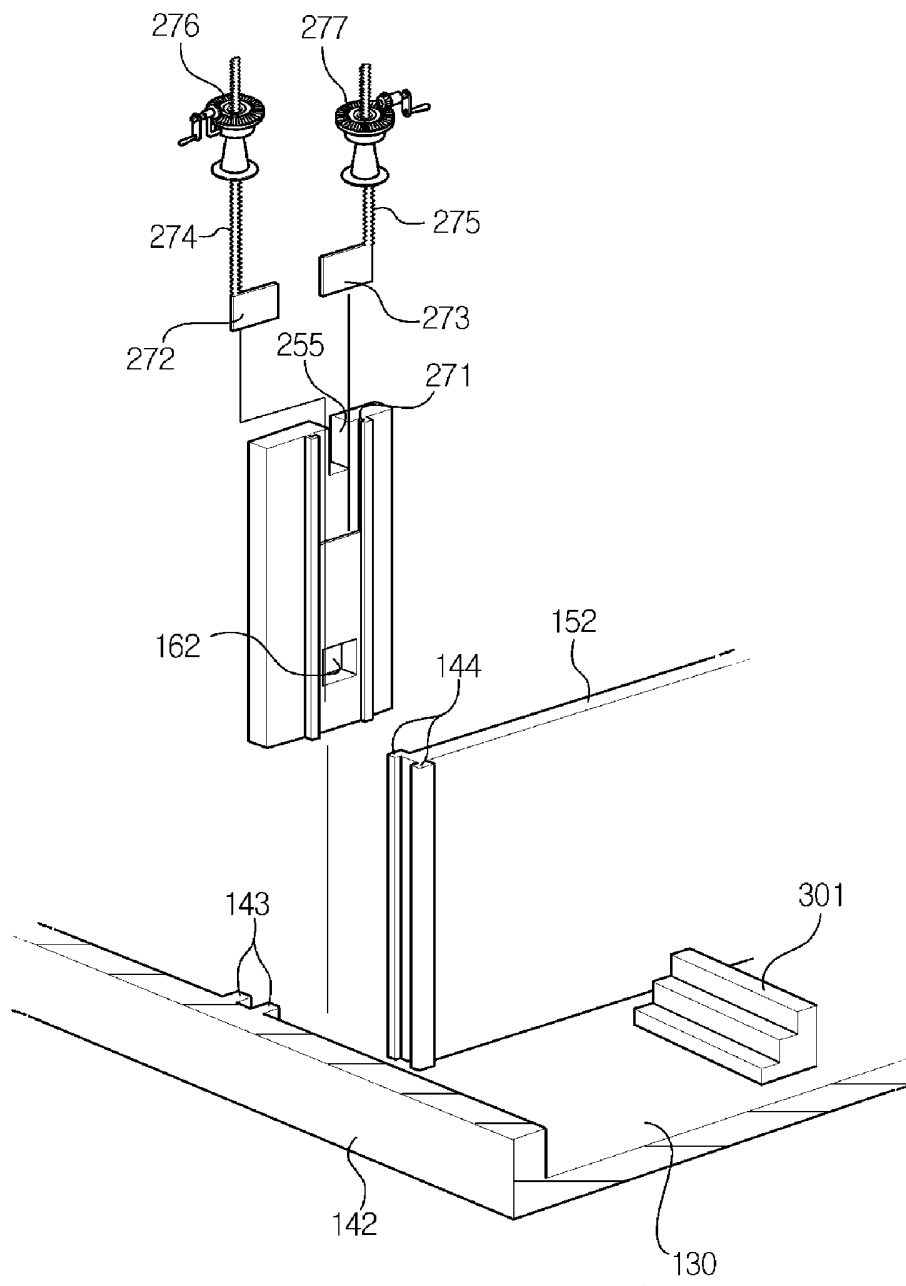
[Fig. 13]



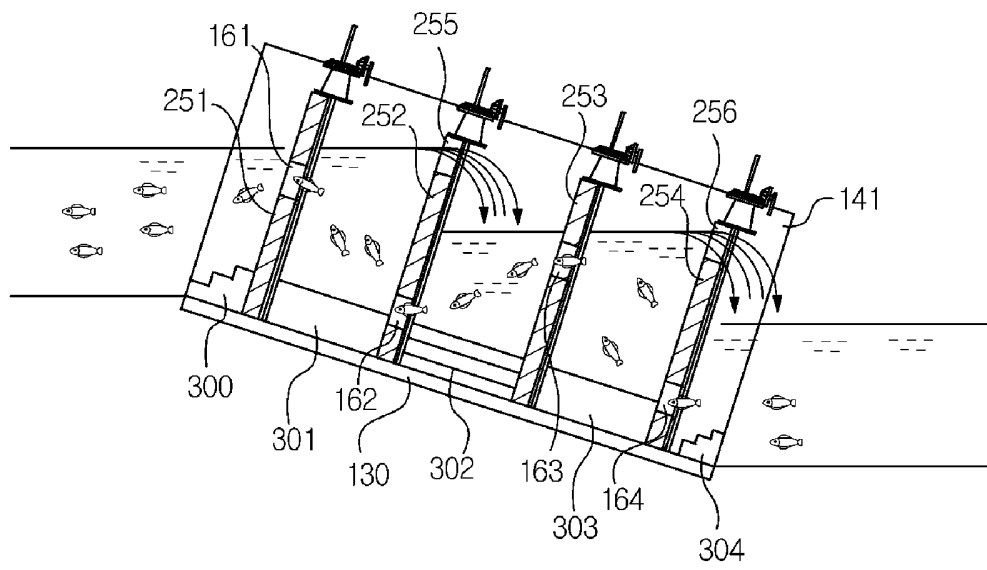
[Fig. 14]



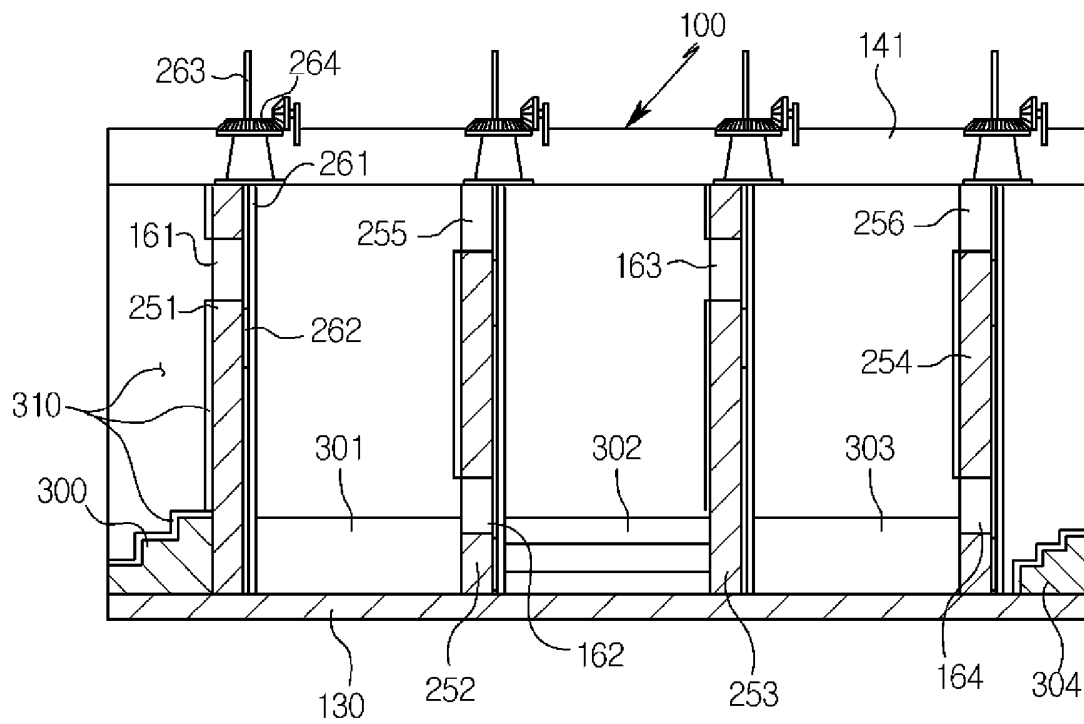
[Fig. 15]



[Fig. 16]



[Fig. 17]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/004223**A. CLASSIFICATION OF SUBJECT MATTER*****E02B 8/08(2006.01)i***

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8 E02B

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

KR.JP : classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

24 MARCH 2006 (24.03.2006)

Date of mailing of the international search report

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Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

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Authorized officer

LEE, Kee Wan

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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