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APPLICATION NUMBER: *18/443,555*
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS

As the below named inventor, I hereby declare that:

This declaration is directed to: [X] The attached application, or

[ ] United States application or PCT international application number filed on

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: Tung Le Date (Optional) : _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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LEGAL NAME OF INVENTOR

Inventor: Quoc Anh Do Nguyen Date (Optional) : _____

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LEGAL NAME OF INVENTOR

Inventor: Thinh Quan Nguyen Date (Optional) : _____

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Chinh Huu Tran Date (Optional) : _____

Signature: _____

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AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS

BACKGROUND

[0001] This specification relates to technology for aquaculture.

[0002] Aquaculture refers to the breeding, cultivation, and harvesting of aquatic organisms in controlled water environments. It encompasses the entire process of cultivating aquatic products from seedlings under artificial breeding management systems. Recirculating aquaculture systems have been used in aquaculture to enable water conservation and reduced environmental impacts by processing water efficiently for cultivation of aquatic organisms. A recirculating aquaculture system may use one or more aquaculture boxes as cultivators. Aquaculture boxes can serve as the designated space for the survival of cultured aquatic products, and the conditions they offer often play a crucial role in the cultivation process. The quality and output of aquatic products are significantly influenced by the aquaculture boxes, making them a critical component in many cultivation equipment.

SUMMARY

[0003] This specification describes an aquaculture system that implements ball valve mechanisms for breeding, cultivation and harvesting of crustaceans.

[0004] In general, one innovative aspect of the subject matter described in this specification can be embodied in a device for aquaculture. The device includes an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage. The aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box includes one or more drain holes configured to drain water from the aquaculture box, a box connector configured to connect a valve to a first drain hole of the one or more drain holes, where the box connector is located at the lower end, the valve connected to the first drain hole through the box connector, where the valve includes a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage, and a buoyant ball movable between the first drain hole and the first drain pipe, where the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and where the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage.

[0005] Another innovative aspect of the subject matter described in this specification can be embodied in a system for aquaculture. The system includes multiple devices, where each device includes an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage. The aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box includes one or more drain holes configured to drain water from the aquaculture box, a box connector configured to connect a valve to a first drain hole of the one or more drain holes, where the box connector is located at the lower end, the valve connected to the first drain hole through the box connector, where the valve includes a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage, and a buoyant ball movable between the first drain hole and the first drain pipe, where the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and where the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage. The system further includes multiple water delivery pipes configured to deliver water to each of the devices and multiple water collection pipes configured to collect water from each of the devices.

[0006] The foregoing and other embodiments can each optionally include one or more of the following features, alone or in combination.

[0007] In some implementations, the buoyant ball may seal the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

[0008] In some implementations, the lower end is smaller than the upper end, and the upper end and the lower end are connected by at least one inclined angles configured to drain water at the lowest end at the water draining stage.

[0009] In some implementations, a crustacean may be harvested in the aquaculture box. The crustacean may be a crab, and food may be supplied to the crab after the water storing stage and prior to the water draining stage.

[0010] In some implementations, the aquaculture box may include a cover configured to be placed over the upper end and a cover lock configured to lock the cover over the upper end.

[0011] In some implementations, the one or more drain holes may include a second drain hole connected to a second drain pipe. Water in the interior of the aquaculture box may flow out of the

second drain hole through the second drain pipe based on a water level of water of the interior of the aquaculture box being higher than the height of the second drain pipe during the water storing stage. The second drain pipe may extend into the interior of the aquaculture box.

[0012] In some implementations, the device may include a ball seal located between the first drain hole and the buoyant ball configured to further enable sealing the first drain hole.

[0013] In some implementations, the device may include a ball block configured to prevent the buoyant ball from covering the first drain pipe such that waste materials associated with the food can drain from the first drain pipe.

[0014] In some implementations, the system may include a waste drain pipe configured to collect water from the water collection pipes, where a set of water collection pipes of the plurality of water collection pipes may be connected to the waste drain pipe by one or more connectors.

[0015] In some implementations, the system may include a surface drain pipe configured to collect excess water from the water collection pipes, where a second set of water collection pipes of the plurality of water collection pipes may be connected to the surface drain pipe by one or more connectors. The surface drain pipe is further configured to collect excess water from the water collection pipes based on the positive pressure of the box body of each of the aquaculture boxes.

[0016] In some implementations, the multiple devices may be arranged in one or more rows.

[0017] Particular embodiments of the subject matter described in this specification can be implemented so as to realize one or more of the following technical advantages.

[0018] Conventional recirculating aquaculture systems (RASs) include mechanisms for harvesting crustaceans by circulating water through multiple aquaculture devices of a system, where each device holds a crustacean, such as a crab. However, current systems do not implement unidirectional water flow through the multiple devices, which can result in disease transmission between devices and inefficient waste removal. Additionally, current systems that use valve mechanisms for water drainage require a system to manually open the valve of each aquaculture device in a system. For example, traditional valves include a ball valve, a butterfly valve, or a knife gate valve, which must increase in size in order to allow the flow of large amounts of water.

[0019] In contrast, the system described implements a ball valve mechanism in each aquaculture box to ensure unidirectional water flow. The ball valve mechanism allows a ball to seal a water drain pipe, such that water from another aquaculture box cannot enter the aquaculture box, while allowing waste to flow out of the aquaculture box. Thus, the ball valve mechanism can prevent

disease from spreading between aquaculture boxes and the ball valve mechanism can efficiently remove waste. Additionally, the ball valve mechanism retains food during feeding, which improves feeding efficiency, and the shape of the aquaculture box allows for efficient removal of waste by implementing different angles.

[0020] In particular, the system uses a single ball valve mechanism to activate the ball valves of each of the aquacultures in the system. For example, to control the water flow of 100 boxes without letting the water flow from one box to another, which can cause the spread of disease, the system allows for each of the ball valves to be opened by a single mechanism, rather than having to open each ball valve for each box manually. Thus, the described system increases water draining efficiency and reduces latency to a fraction of conventional systems that include manually opening the ball valve for each aquaculture box. Additionally, the efficiency of the ball valve mechanism allows for the size of the ball valve mechanism to be relatively small, reducing an amount of material needed for the system.

[0021] The details of one or more embodiments of the subject matter of this specification are set forth in the accompanying drawings and the description below. Other features, aspects, and advantages of the subject matter will become apparent from the description, the drawings, and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a diagram of an example aquaculture system that includes multiple aquaculture boxes.

[0023] FIGs. 2A-2E are example diagrams of an aquaculture box in the aquaculture system.

[0024] FIGs. 3A-3F are example diagrams of a ball valve mechanism for the aquaculture box.

[0025] FIG. 4 is a flow diagram of an example process for storing and draining water for the aquaculture box.

[0026] Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0027] FIG. 1 shows an example system 100 for aquaculture. The system 100 is an example of an aquaculture system for harvesting crustaceans, such as crabs, giant freshwater prawn, mantis shrimp, lobsters, horseshoe crabs, giant isopods, or Babylonia areolata.

[0028] The system is a recirculating aquaculture system that circulates water through multiple aquaculture boxes using a ball check valve mechanism. In particular, the system 100 unidirectionally directs water through the system using a ball valve mechanism in each aquaculture box. For example, harvesting the crabs can include feeding by inputting food into the aquaculture box, such that the water output of the aquaculture box includes waste from the food, resulting in the need for the water to circulate unidirectionally in order to provide clean water to each aquaculture box and to prevent aquaculture boxes from spreading waste or disease to other aquaculture boxes in the system 100.

[0029] The system 100 collects the water output of each aquaculture box to recirculate the water through the system 100 after cleaning the water. The system 100 includes multiple aquaculture boxes 102 that each include a box connector 116. Additionally, the system includes a main input water pipe 120, one or more row input water pipes 104, and a frame 106. The frame 106 is configured to support each of the one or more pipes of the system 100. The frame 106 can be made of material to reduce corrosion from saltwater, such as stainless steel aluminum. In some implementations, the system 100 further includes a waste drain pipe 108, a surface drain pipe 110, multiple main connectors 112, multiple row connectors 114, multiple box connectors 116, and multiple row output water pipes 118.

[0030] Each aquaculture box 102 is configured to store and drain water for harvesting of one or more crabs. The system 100 can use the main input water pipe 120 to supply water to each of the aquaculture boxes using one or more row input water pipes 104. For example, multiple aquaculture boxes 102 can be arranged in rows, and the system 100 can supply water to each row of aquaculture boxes 102 using the row input water pipe 104 for the particular row.

[0031] Additionally, each aquaculture box 102 is connected to a row output water pipe 118 by the box connector 116. For example, each row of the aquaculture boxes 102 can be connected to a same row output water pipe 118 by respective box connectors 116, and the system can drain water from each of the aquaculture boxes 102 to the respective row output water pipe 118 via the box connector 116. In some cases, the row output water pipe 118 can drain water from one or more aquaculture boxes 102 to the waste drain pipe 108, and, in some other cases, the row output water pipe 118 can drain water from one or more aquaculture boxes 102 to the surface drain pipe 110.

[0032] The system uses the waste drain pipe 108 and the surface drain pipe 110 to collect the water output of each of the aquaculture boxes 102, where the waste drain pipe 108 and the surface drain

pipe 110 are connected to each row of the aquaculture boxes 102 by a main connector 112. The main connector 112 can be a t-shaped connector. In particular, the waste drain pipe 108 can collect water from each of the aquaculture boxes 102 that includes waste (e.g., food spillage), and the surface drain pipe 110 can collect excess water from each of the aquaculture boxes 102 and drain the excess water to a box max level control pipe 122 in order to maintain water equilibrium, as described in further detail below with reference to FIGs. 2 and 3. The surface drain pipe 110 can redirect the water through the system 100. In some cases, the water is treated (e.g., cleaned) prior to reentering the system 100.

[0033] The ball valve mechanism (e.g., the ball check valve mechanism) can hold water in the aquaculture box 102 during a water storing stage while preventing water from other aquaculture boxes to enter the aquaculture box, and the ball valve mechanism can drain water and waste from the aquaculture box during a water draining stage. In particular, the aquaculture box 102 includes a box waste drain pipe, where each box waste drain pipe is connected to the waste drain pipe 108 by the box connector 116. In some examples, the aquaculture box further includes a box surface drain pipe that is connected to the surface drain pipe 110 and the box max level control pipe 122 by the box connector 116, as described in further detail with reference to FIGs. 2 and 3.

[0034] Thus, the ball valve mechanism prevents food spillage during feeding and acts as a valve during a water draining stage by implementing a water-tight seal mechanism that does not allow water from other aquaculture boxes (e.g., adjacent aquaculture boxes) from entering the aquaculture box 102 during the water storing stage. In particular, the ball valve mechanism includes a buoyant ball that seals a drain hole (e.g., a box waste drain hole) of the aquaculture box 102 during the water storing stage based on a water level (e.g., an amount of water) that is drained from another aquaculture box 102 (e.g., another aquaculture box 102 in the same row). By preventing waste from entering, the ball valve mechanism ensures that the water in each aquaculture box 102 is clean and lessens the probability that the water contains disease, which can improve the water circulation of the system and enhance the harvesting of crustaceans.

[0035] FIG. 2A shows a diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0036] As described above, the aquaculture box 102 is used to harvest one or more crustaceans as part of an aquaculture system 100 by using a ball valve mechanism to store and drain water through a box waste drain pipe of the box 102 during a water storing stage and a water draining stage of the system.

[0037] The aquaculture box 102 includes a box extension 202, a box cover 204, a box body 206, a box waste drain hole 208, a ball valve mechanism 210, a box base 212, and a box waste drain pipe 214.

[0038] The box extension 202 is modifiable, such that the height of the aquaculture box 102 can accommodate various crustacea species. The box cover 204 is configured to cover the aquaculture box 102 to hold a crustacean (e.g., a crab) in the box. In some examples, the box cover 204 can be made from transparent material (e.g., transparent plastic) to allow for observation of the crab.

[0039] The box cover 204 can be placed over the box body 206 or over the box extension 202. The box cover is configured to prevent the crab from escaping the aquaculture box 102. The box cover 204 can be made of plastic.

[0040] The box body 206 can be shaped to allow for efficient flow of water through the bottom of the box 102. For example, the box body 206 can be rectangular, spherical, cone-shaped, or a combination thereof. In particular, the box body 206 can include one or more slopes in its shape to allow for water to flow downwards and through the box waste drain hole 208and out of the box waste drain pipe 214 to the waste drain pipe 108 of the system. The box body 206 can be made of plastic. The box body 206 is connected to the box base 212.

[0041] The box waste drain hole 208 is a hole in the box body 206 that is configured to allow water, such as water including food waste, to flow out of the box 102 to the box base 212 using the ball valve mechanism 210 while not allowing water from an adjacent aquaculture box 102 to enter through the box waste drain pipe 214.

[0042] In particular, during the water storing stage, the ball valve mechanism 210 can seal water from entering through the box waste drain pipe 214, and during the water draining stage, the ball valve mechanism 210 allow water and waste to drain from the box waste drain hole 208 and out of the box waste drain pipe 214, as described in further detail with reference to FIG. 3. The box waste drain pipe 214 can be connected to a row output water pipe 118 of the system by a box connector 116.

[0043] FIG. 2B shows a top view of the box body of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0044] As shown in FIG. 2B, a crustacean can be placed inside of the box body 206 for harvesting prior to the water storing stage and the water draining stage. After the crustacean is placed in the box body 206, the system can supply water to the box body 206 via a row input water pipe during the water storing stage. The crustacean can then be fed. The food can drain to the bottom of the box body 206, and the system can use the ball valve mechanism to allow water, which can include the food waste, to drain out of the box body 206 during the water draining stage, as described in further detail with reference to FIGs. 3 and 4.

[0045] FIG. 2C shows a bottom view of the box body of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0046] During the water storing stage, the system can use the ball valve mechanism 210 to ensure that water from an adjacent aquaculture box 102 does not enter the box body 206 through the box waste drain hole 208 by sealing the box waste drain hole 208. During the water draining stage, the system uses the ball valve mechanism 210 to allow water to flow out of the box body 206 through the box waste drain hole 208.

[0047] The box body 206 includes a box body connector 216, a connector guide 218, a box contour 220, a box support structure 222, and a box surface drain pipe 224. The box body connector 216 connects the box body 206 to the box base 212, and the ball valve mechanism 210 can be inside of the box body connector 216. The connector guide 218 ensures that the box body 206 is aligned with the box base 212. The box contour 220 is a ridge along the top of the box body 206. The box contour 220 is configured to allow a person to hold the box body 206, to remove the box body 206 from the box base 212, or both. The box support structure 222 can include one or more supports (e.g., stilts) protruding from the box body 206 that are configured to enable the box body 206 to stand upright. The box support structure 222 can include a box stand that is configured to enable the box body 206 to stand upright on a flat surface.

[0048] In some examples, the box surface drain pipe 224 is configured to allow excess water to drain out of the box body 206 based on a water level of the water in the box body 206, as described in further detail below with reference to FIG. 3. In the case where the box 102 does not include the box surface drain pipe 224, the system can drain the water through the box waste drain pipe 214 in order to lower the water level of the water in the box body 206. In particular, the system can leverage the positive flow of the box body 206 to allow the water to drain out of the box 102 in order to prevent spread of disease through the water. In this case, the system can control (e.g., determine) the maximum level of water inside the box body 206 by the height of the box surface drain pipe 224 and the box max level control pipe 122, as the box max level control pipe 122 and the box body 206 function as communicating vessels. In particular, the box max level control pipe 122 can be u-shaped, which results in water draining from the surface drain pipe 224 through the box max level control pipe 122 and to the surface drain pipe 110.

[0049] FIG. 2D shows a diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0050] The aquaculture box 102 is configured to store and drain water during a water storing stage and a water draining stage using the ball valve mechanism 210. The ball valve mechanism 210 can include a seal 228, a seal connector 230, and the buoyant ball 232. In particular, the seal 228 is located inside of the seal connector 230, and the seal connector 230 is placed between the box waste drain hole 208 and the box waste drain pipe 214, such that the seal connector 230 is connected to the box base 212 by a box base connector.

[0051] The buoyant ball 232 is configured to float in order to seal the aquaculture box 102 by keeping input water inside the box and keeping external water (e.g., water from other aquaculture boxes 102) from entering the box 102. Additionally, the ball valve mechanism allows waste to flow out of the box 102, as the ball 232 does not block the waste from exiting the box 102 through the box waste drain pipe 214, as described in further detail with reference to FIG. 3. In particular, the ball 232 is filled with air, which allows the ball to float. In some other examples, the ball 232 can be made of material that is less dense than water to allow the ball to float. Additionally, the surface of the ball 232 can be made from a particular material such that waste does not stick (e.g., adhere) to the ball 232 and is instead passed through the box waste drain pipe 214.

[0052] During the water storing stage, the ball 232 can seal (e.g., lock) water from entering through the box waste drain pipe 214 by being in contact with the seal 228. For example, the seal 228 can be a flexible water-tight seal that can include one or more O-rings to ensure that water cannot enter the aquaculture box, as described in further detail below with reference to FIG. 3. During the water draining stage, the ball can detach from the seal 228 in order to allow water and waste to drain from the box waste drain pipe 214, as described in further detail with reference to FIG. 3.

[0053] In some examples, the aquaculture box 102 can include the box surface drain pipe 224 that is connected to a box surface drain hole 226, which is configured to allow excess water to drain out of the box body 206, as described in further detail below with reference to FIG. 3.

[0054] FIG. 2E shows an isometric diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0055] In some implementations, the aquaculture box 102 can further include an observation hole 234, an input water hole 239, a cover lock 238, and a box base connector 240.

[0056] The box cover 204 can include an observation hole 234 and an input water hole 236. The observation hole 234 can be configured to allow for observation of the crab. In some cases, food can be inserted into the box 102 through the observation hole 234. The input water hole 236 is configured to allow water, such as water from a row input water pipe 104, to enter the aquaculture box 102.

[0057] The cover lock 238 connects the box cover 204 to the box body 206. The cover lock 238 is configured to prevent the box cover 204 from being opened from the inside, such that the box cover 204 can only be opened from the outside.

[0058] The box base connector 240 is configured to connect with the seal connector 230 to keep the ball in contact with the seal 228 during the water storing stage.

[0059] FIG. 3A shows a diagram of an example water draining mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the water draining mechanism for the aquaculture box 102.

[0060] The aquaculture box 102 can further include one or more box slopes 304.

[0061] In some examples, the aquaculture box 102 includes the box surface drain pipe 224 configured to control the water level inside the box body 206 in order to prevent the box 102 from overflowing with water. The box surface drain pipe 224 can be any height within the box body 206, and in the case that the box 102 includes the box extension 202, the box surface drain pipe 302 can be extended to be a taller height.

[0062] In particular, the box surface drain pipe 224 is configured to keep water in the box body 206 at a particular water level by draining water above the height of the box surface drain pipe 214 through the box surface drain hole 226 during the water storing stage. In this case, the water can flow through the box surface drain hole 226, and the system can collect the excess water at the surface drain pipe 110.

[0063] The box body 206 can include one or more box slopes 304, such as box slope 304-A and box slope 304-B, which allow the input water to flow through the through the box waste drain hole 208 and out of the box waste drain pipe 214. In some examples, the box slope 304-A and the box slope 304-B can be of different angles. For example, the box slope 304-B can be more than 60 degrees such that waste (e.g., food) does not stick to the inside of the box and flows out of the box through the box waste drain pipe 214.

[0064] The box base stand 306 is connected to the frame 106 of the system. The box base stand 306 is configured to hold the box 102 and to provide support for the structure. The box base stand 306 can be made of stainless steel.

[0065] FIG. 3B shows a diagram of an example ball valve mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the ball valve mechanism for the aquaculture box 102.

[0066] The aquaculture box 102 implements the ball valve mechanism using the ball 232 and the seal 228 based on a ball fall prevention mechanism 318. During the water-storing stage, the ball 232 covers the seal 218 such that water from another aquaculture box cannot enter the box 102 through the box waste drain pipe 214 using the ball fall prevention mechanism 318. During the water draining stage, the ball 232 detaches from the seal 228 to allow water and waste to flow out of the box 102 using the ball fall prevention mechanism 318. The ball fall prevention mechanism

318 prevents the ball 232 prevents the ball from falling past a certain point in order to allow water and waste to flow out of the box waste drain pipe 214.

[0067] In particular, during the water-storing stage, water from another box can enter the present box 102 through the box waste drain pipe 214 as the other box is in the water draining stage. As the water from the other box enters the box waste drain pipe 214, the ball 232 floats in the water and comes into contact with the seal 228 at seal contact point 310. The seal contact point 310 is the point at which the ball 232 seals the water from entering the box waste drain hole 208and from entering the box body 206. In particular, in some examples, the seal 228 is configured to change shape by expanding in order to prevent water from entering the box body 206. The seal 228 can be made of silicone, rubber, or a combination thereof. In some examples, the seal 228 includes an O-ring 312 to ensure that the seal 228 is water-tight by being in contact with the seal connector 230.

[0068] During the water draining stage, the ball 232 detaches from the seal and moves downward. In this case, the ball fall prevention mechanism 318 prevents the ball from covering box waste drain pipe 214, such that waste and water can flow out of the box 102. The ball fall prevention mechanism 318 can include one or more bended edges, which allow waste to flow freely out of the box waste drain pipe 214.

[0069] FIGs. 3C and 3D shows a diagram of an example ball fall prevention mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the ball valve mechanism for the aquaculture box 102.

[0070] The ball valve mechanism 210 controls the motion of the ball 232 using the ball fall prevention mechanism 318, which includes a ball block 320 and a box waste drain pipe reducer 322. The ball block 320 can be an angled ridge protruding from the box waste drain pipe 214 that blocks the ball from falling and completely covering the box waste drain pipe 214. The box waste drain pipe reducer 322 can be located in the box waste drain pipe 214 with a sloping shape. The box waste drain pipe reducer 322 reduces the size of the box waste drain pipe 214 and is configured to efficiently allow for waste to flow out of the box waste drain pipe 214

[0071] For example, as shown in FIG. 3C, during a water storing stage, the ball 232 can be floating based on water entering the box 102 through the box waste drain pipe 214. However, the ball 232

blocks the water from entering the box 102 by sealing the box waste drain hole 208. Then, as shown in FIG. 3D, during a water draining stage, the ball 232 can fall downwards towards the box waste drain pipe 214 to allow waste and water to flow out of the box waste drain pipe 214. However, the ball fall prevention mechanism 318 does not allow the ball to completely fall to the box waste drain pipe 214, and thus, the ball fall prevention mechanism 318 is configured to prevent the ball 232 from sealing the box waste drain pipe 214 and to allow for water to drain out of the box 102.

[0072] FIG. 3E shows a top view of the box base of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0073] The box base 212 is connected to the box body 206 by the box base connector 240, which includes the ball fall prevention mechanism 318, as described above. Additionally, the box base 212 is connected to the box surface drain pipe 224, which allows excess water to flow out of the box 102, as described above. In some examples, the box base 212 includes a guide spacer 324, which is configured to align spacing between the box body 206 and the box base 212.

[0074] FIG. 3F shows an isometric view of the box base of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0075] The box base 212 can have a box base slope 328 configured to allow water to flow out of the box 102 through the box waste drain pipe 214. The box base slope 328 can be a slope of that is less than the slope of the box body shape to allow water and waste to flow through the box 102. The box base 212 can also include the box base stand 306 configured to support the box 102. In some examples, the box base stand 306 includes box base support 330 configured to provide increased support for the box 102 to stand upright and to sustain water weight in the box body 206.

[0076] FIG. 4 is a flow diagram of an example process for storing and draining water for the aquaculture box.

[0077] For each aquaculture box of the system, a crustacean is placed in the aquaculture box, and the system supplies water to the aquaculture box (402). The system can supply water to the aquaculture box using an input water pipe.

[0078] During the water storing stage, the buoyant ball of the aquaculture box moves to the first drain hole and seals the first drain hole to prevent water from flowing out of the box (404). The ball seals the box waste drain hole. In particular, the ball prevents water from the box base (e.g., water from another box that may contain waste and/or disease) from entering the box body by coming into contact with the seal.

[0079] In some cases, the box can include a surface drain pipe that can control the water level of the box body as input water enters the box. In particular, based on the water level of the box base being higher than the height of the surface drain pipe, water can flow into box surface drain hole and out of the box through the box surface drain pipe. In this way, the box 102 can control the water level of the box, and the system can collect the excess water using the box surface drain pipe.

[0080] The crustacean is then fed (404). The food can be put into the box body through the box cover or through the observation hole in the box cover. Once the crustacean has been fed, the waste or the remaining food can flow to the bottom of the box body 206 based on the slopes of the box body 206. After feeding, the system is configured to enter a water draining stage, as keeping the food inside the box body for an extended period of time can lead to disease or pollution of water in the box.

[0081] During the water draining stage, the buoyant ball detaches from the first drain hole and moves towards the first drain pipe (406). In particular, the ball detaches from the seal that is covering the first drain pipe, and the ball moves downward towards the box waste drain pipe, allowing water to drain out of the box. The ball fall prevention mechanism (e.g., ball block) ensures that the ball does not cover the box waste drain pipe, such that waste can flow out of the box, and the system can collect the waste in the waste drain pipe. Thus, the system can then clean the water (e.g., remove the waste), and the system can redirect the clean water back into the system, ensuring a unidirectional clean water system for each of the aquaculture boxes.

[0082] In some examples, the box can be removed and replaced with another box. In particular, a crab can be moved from a first box to a second box in order to protect the crab (e.g., provide a clean environment for the crab). For example, the system can be configured to allow the box body to be separated from the box base by disconnecting the box body connector. In this case, water can flow through the box base once the box body is removed, and the ball valve mechanism can continue to seal the water such that water does not exit the box body.

[0083] To replace the box body, the system is configured such that a new box body can be connected to the box base using the box body connector. In this case, the box base stand, the connector guide, and the guide spacer allow for proper alignment of the box body with the box base. By properly aligning the box body with the box base, the system can connect the box body and provide a clean box for the crustacean, which can aid in decreasing disease. In some cases, such as when the box body is not fully connected with the box base, the O ring of the seal can prevent water from leaking into the box through the box waste drain hole.

[0084] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any invention or on the scope of what may be claimed, but rather as descriptions of features that may be specific to particular embodiments of particular inventions. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially be claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0085] Similarly, while operations are depicted in the drawings and recited in the claims in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results.

[0086] Particular embodiments of the subject matter have been described. Other embodiments are within the scope of the following claims. For example, the actions recited in the claims can be performed in a different order and still achieve desirable results. As one example, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results.

[0001] What is claimed is:

CLAIMS

1. A device for aquaculture, the device comprising:

an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage, the aquaculture box forming an upper end opposite a lower end, wherein the interior of the aquaculture box comprises:

one or more drain holes configured to drain water from the aquaculture box; and

a box connector configured to connect a valve to a first drain hole of the one or more drain holes, wherein the box connector is located at the lower end;

the valve connected to the first drain hole through the box connector, wherein the valve comprises:

a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage; and

a buoyant ball movable between the first drain hole and the first drain pipe, wherein the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and wherein the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage.

2. The device of claim 1, wherein the buoyant ball seals the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

3. The device of claim 1, wherein the lower end is smaller than the upper end, and wherein the upper end and the lower end are connected by at least one inclined angle configured to drain water at the lowest end at the water draining stage.

4. The device of claim 1, wherein a crustacean is harvested in the aquaculture box.

5. The device of claim 6, wherein the crustacean is a crab, and wherein food is supplied to the crab after the water storing stage and prior to the water draining stage.

6. The device of claim 1, wherein the aquaculture box further comprises:

a cover configured to be placed over the upper end; and

a cover lock configured to lock the cover over the upper end.

7. The device of claim 1, wherein the one or more drain holes further comprises a second drain hole connected to a second drain pipe.

8. The device of claim 7, wherein water in the interior of the aquaculture box flows out of the second drain hole through the second drain pipe based on a water level of water of the interior of the aquaculture box being higher than the height of the second drain pipe during the water storing stage.

9. The device of claim 8, wherein the second drain pipe extends into the interior of the aquaculture box.

10. The device of claim 1, further comprising:

a ball seal located between the first drain hole and the buoyant ball configured to further enable sealing the first drain hole.

11. The device of claim 5, further comprising:

a ball block configured to prevent the buoyant ball from covering the first drain pipe such that waste materials associated with the food can drain from the first drain pipe.

12. A system for aquaculture, the system comprising:

a plurality of devices, each device comprising:

an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage, the aquaculture box forming an upper end opposite a lower end, wherein the interior of the aquaculture box comprises:

one or more drain holes configured to drain water from the aquaculture box; and

a box connector configured to connect a valve to a first drain hole of the one or more drain holes, wherein the box connector is located at the lower end;

the valve connected to the first drain hole through the box connector, wherein the valve comprises:

a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage; and

a buoyant ball movable between the first drain hole and the first drain pipe, wherein the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and wherein the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage;

a plurality of water delivery pipes configured to deliver water to each of the plurality of devices; and

a plurality of water collection pipes configured to collect water from each of the plurality of devices.

13. The system of claim 12, wherein the system further comprises an input water pipe configured to supply water to each of the water delivery pipes.

14. The system of claim 12, wherein the system further comprises a waste drain pipe configured to collect water from the water collection pipes, wherein a set of water collection pipes of the plurality of water collection pipes is connected to the waste drain pipe by one or more connectors.

15. The system of claim 12, wherein the system further comprises a surface drain pipe configured to collect excess water from the water collection pipes, wherein a second set of water collection pipes of the plurality of water collection pipes is connected to the surface drain pipe by one or more connectors.

16. The system of claim 15, wherein the surface drain pipe is further configured to collect excess water from the water collection pipes based on the positive pressure of the box body of each of the aquaculture boxes.

17. The system of claim 12, wherein the plurality of devices are arranged in one or more rows.

18. The system of claim 12, wherein the buoyant ball seals the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

19. The system of claim 12, wherein a crustacean is harvested in the aquaculture box.

20. The system of claim 19, wherein the crustacean is a crab, and wherein food is supplied to the crab after the water storing stage and prior to the water draining stage.

ABSTRACT

Systems and apparatus for an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage are described. In one aspect, the aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box comprises one or more drain holes configured to drain water from the aquaculture box. The valve is connected to the first drain hole, where the valve comprises a first drain pipe configured to drain water and waste material from the box during the water draining stage, and a buoyant ball configured to move between the first drain hole and the first drain pipe to prevent water from flowing out of the box during the water storing stage and to detach from the first drain hole and move toward the first drain pipe at the water draining stage.

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February 16, 2024

Attorney Docket No.: 57556-0002001

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Presented for filing is a new patent application for prioritized examination of:

Inventor(s): TUNG LE, QUOC ANH DO NGUYEN, THINH QUAN NGUYEN AND CHINH HUU TRAN

Title: AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS

Enclosed are the following papers, including those required to receive a filing date under 37 CFR 1.53(b):

	Pages
Specification	15
Claims	4
Abstract	1
Declaration	4
Drawing(s)	8

Enclosures:

— Application Data Sheet, 9 pages.
— Information disclosure statement, 1 page.
PTO-1449, 1 page.
References, 7 item.
— Power of Attorney, 2 pages.
— Certification of Micro Entity Status, 1 page.— Certification and Request for Prioritized Examination (Track One), 2 pages

The applicant certifies its micro entity status under 37 CFR 1.29.

Basic Filing Fee	$64
Search Fee	$140
Examination Fee	$160
Publication fee	$0
Track One processing fee	$28

Track One prioritized examination fee			$840
Total Claims 20	over 20	**0 x $20**	$0
Independent Claims 2	over 3	**0 x $96**	$0
Fee for Multiple Dependent claims			$0
Application size fee for each 50 pages over 100 Total Sheets: 28 x .75 - 100/50 = 0 x			$0
Total Filing fee			$1232

Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the attorney docket number shown above.

I hereby authorize the USPTO to communicate in response to email communications from the undersigned and practitioners under Customer No. 26191 in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via email. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03).

If this application is considered to be incomplete, or if a telephone conference would otherwise be helpful, call the undersigned at +1 (212) 641-2318.

Send all correspondence to:

26191
Customer Number

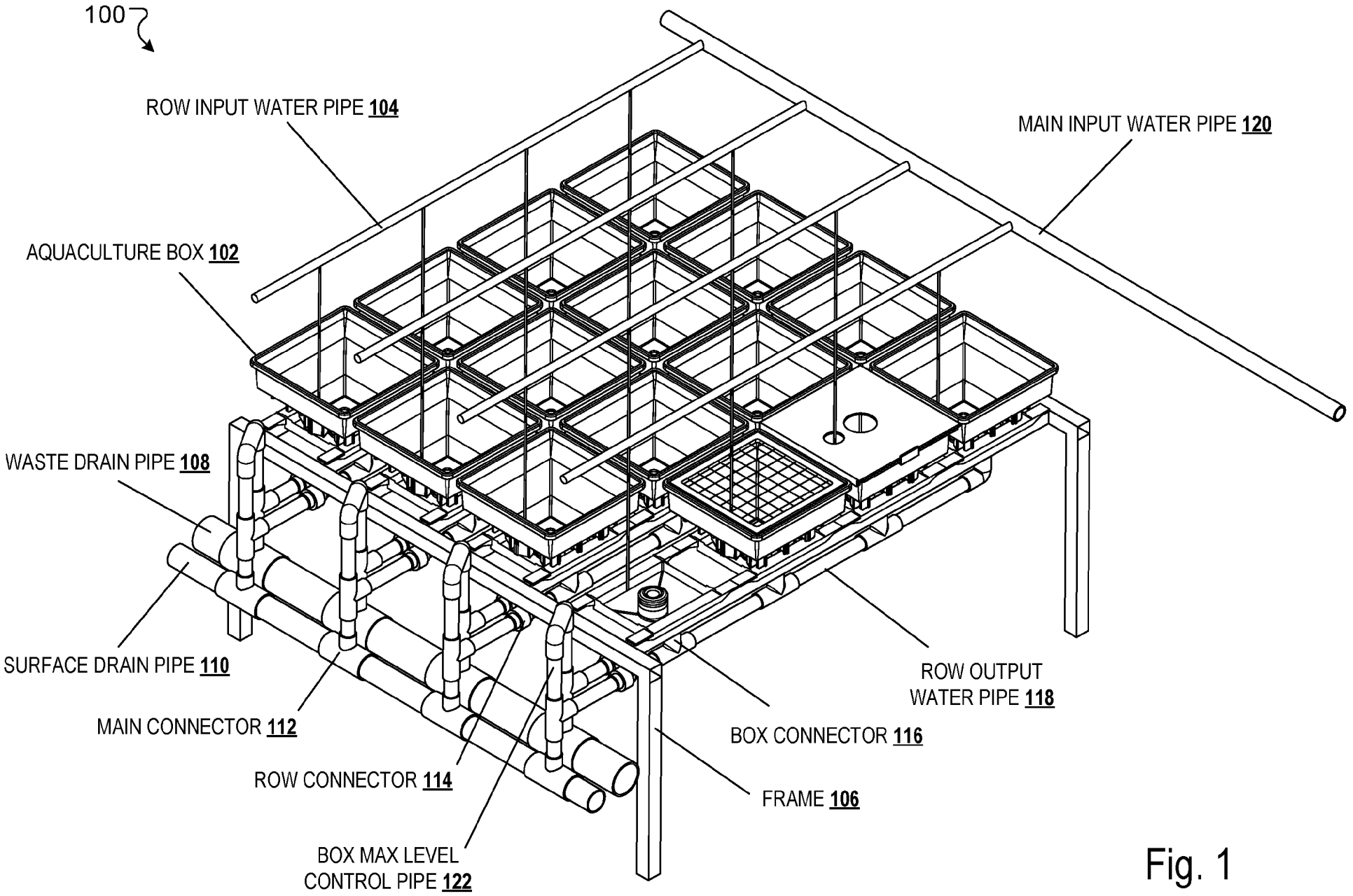
Respectfully submitted,

/Kim Thien Bui/

Kim Thien Bui
Registration No. 76,843

Enclosures

KTB/gzm
101031818.doc


100
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MAIN INPUT WATER PIPE 120
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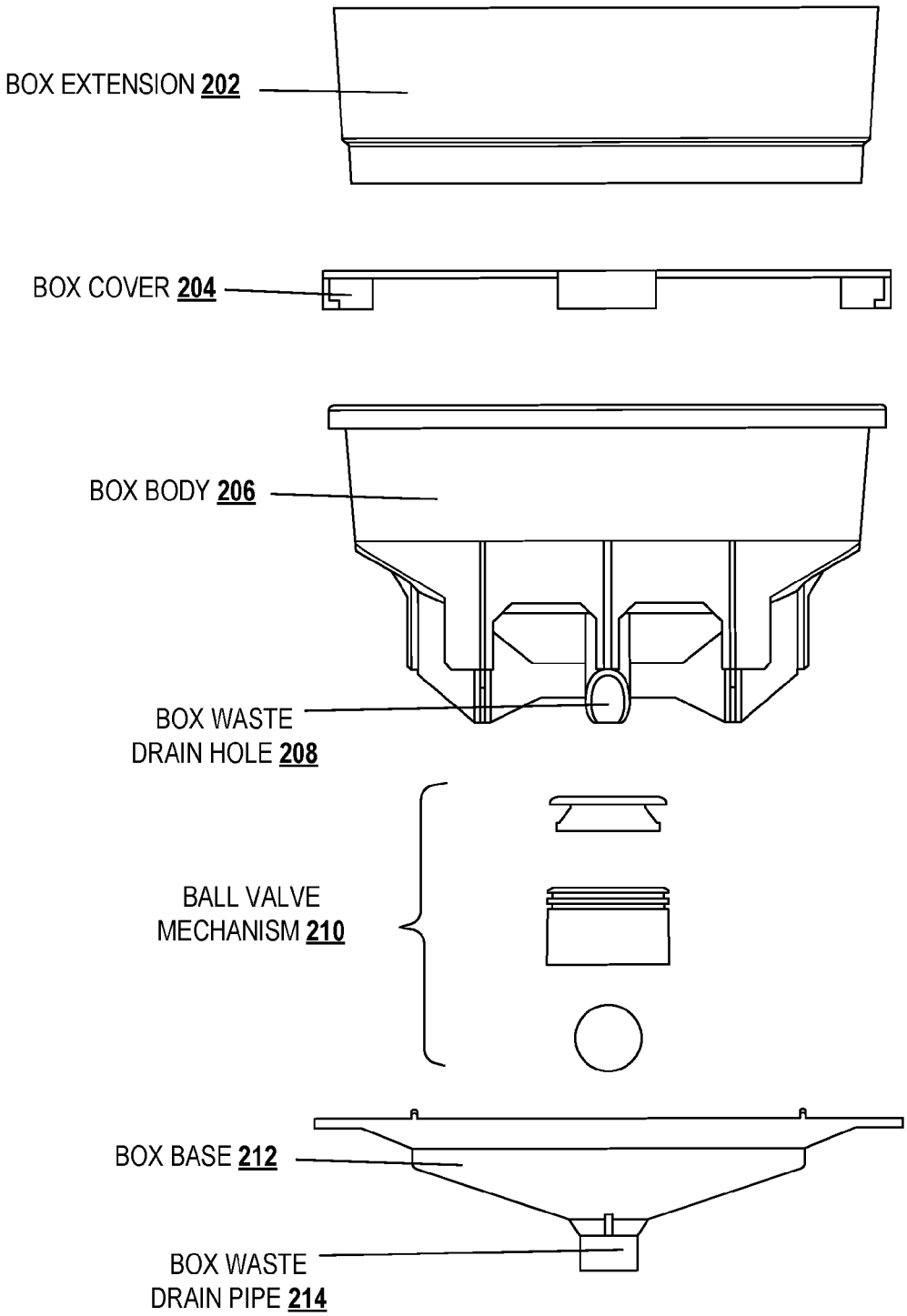
WASTE DRAIN PIPE 108
SURFACE DRAIN PIPE 110
MAIN CONNECTOR 112
ROW CONNECTOR 114
BOX MAX LEVEL CONTROL PIPE 122
ROW OUTPUT WATER PIPE 118
BOX CONNECTOR 116
FRAME 106

Fig. 1


BOX EXTENSION 202
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BOX BODY 206
BOX WASTE DRAIN HOLE 208
BALL VALVE MECHANISM 210
BOX BASE 212
BOX WASTE DRAIN PIPE 214

Fig. 2A

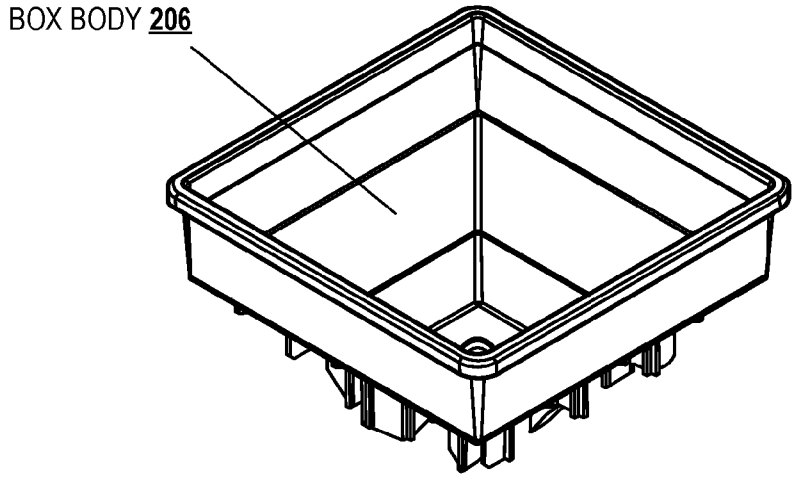
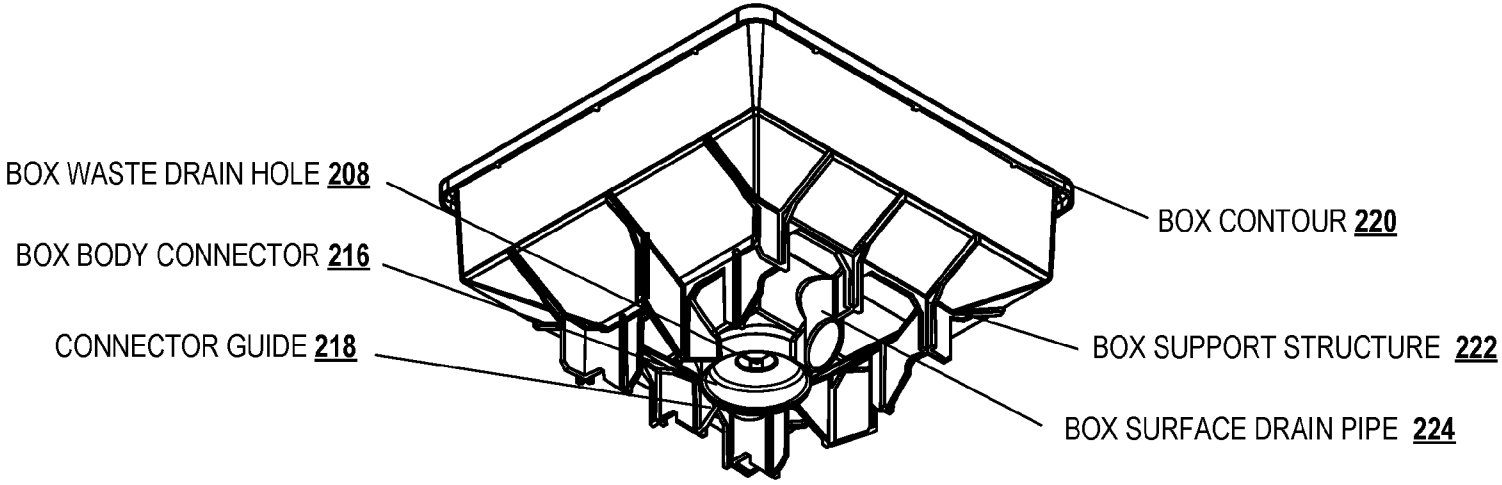

BOX BODY 206

Fig. 2B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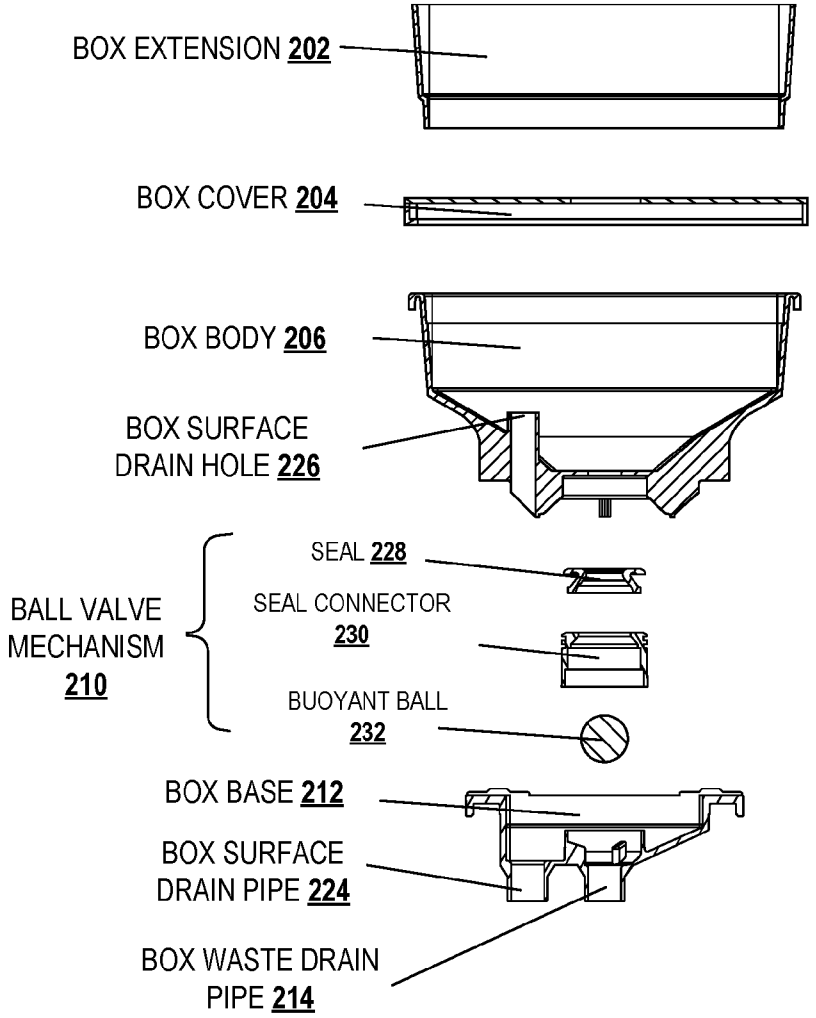
BOX BODY CONNECTOR 216
CONNECTOR GUIDE 218
BOX CONTOUR 220
BOX SUPPORT STRUCTURE 222
BOX SURFACE DRAIN PIPE 224

Fig. 2C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BOX COVER 204
BOX BODY 206
BOX SURFACE DRAIN HOLE 226
BALL VALVE MECHANISM 210
SEAL 228
SEAL CONNECTOR 230
BUOYANT BALL 232
BOX BASE 212
BOX SURFACE DRAIN PIPE 224
BOX WASTE DRAIN PIPE 214

Fig. 2D

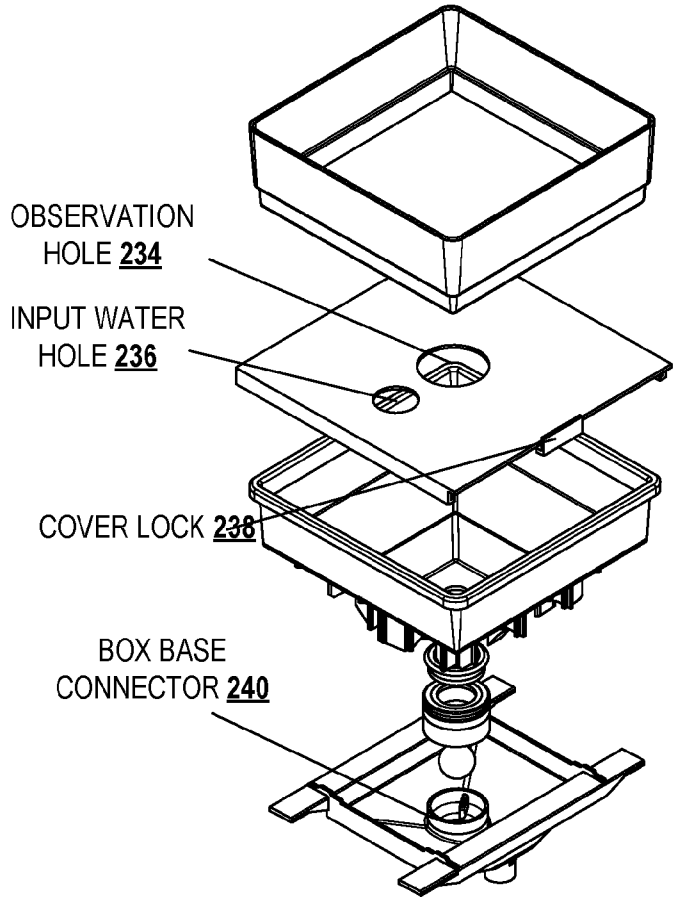

OBSERVATION HOLE 234
INPUT WATER HOLE 236
COVER LOCK 238
BOX BASE CONNECTOR 240

Fig. 2E

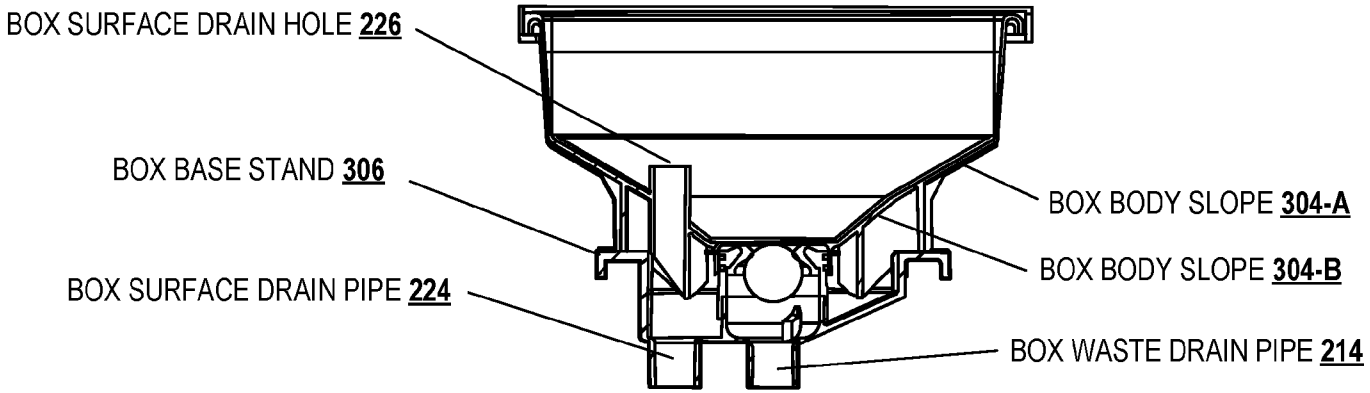
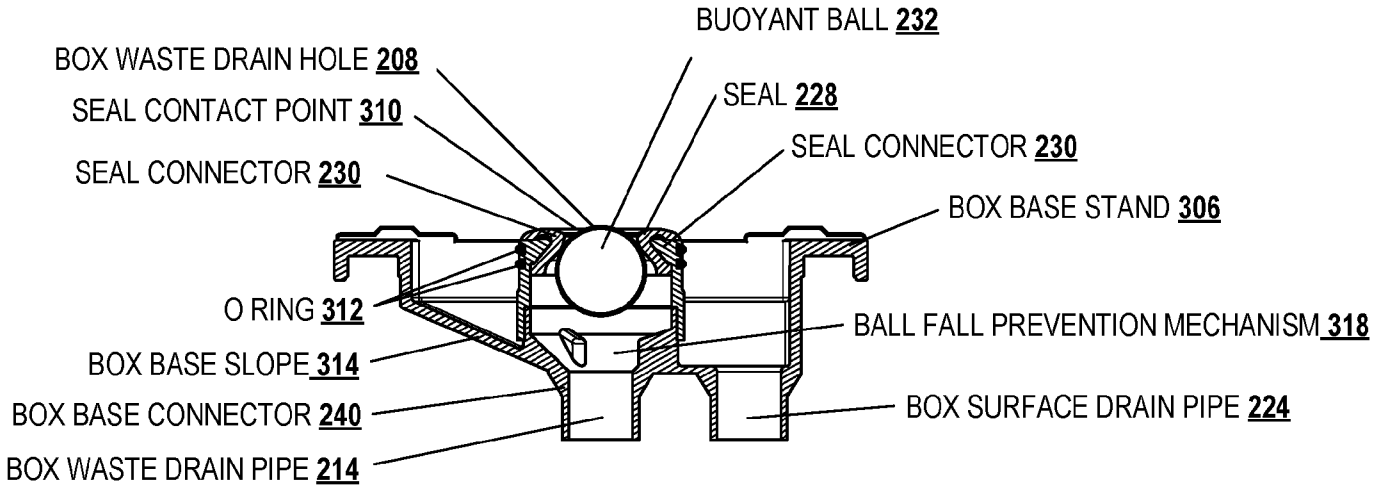

BOX SURFACE DRAIN HOLE 226
BOX BASE STAND 306
BOX SURFACE DRAIN PIPE 224
BOX BODY SLOPE 304-A
BOX BODY SLOPE 304-B
BOX WASTE DRAIN PIPE 214

Fig. 3A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SEAL CONTACT POINT 310
SEAL CONNECTOR 230
SEAL 228
SEAL CONNECTOR 230
BOX BASE STAND 306
O RING 312
BOX BASE SLOPE 314
BOX BASE CONNECTOR 240
BOX WASTE DRAIN PIPE 214
BALL FALL PREVENTION MECHANISM 318
BOX SURFACE DRAIN PIPE 224

Fig. 3B

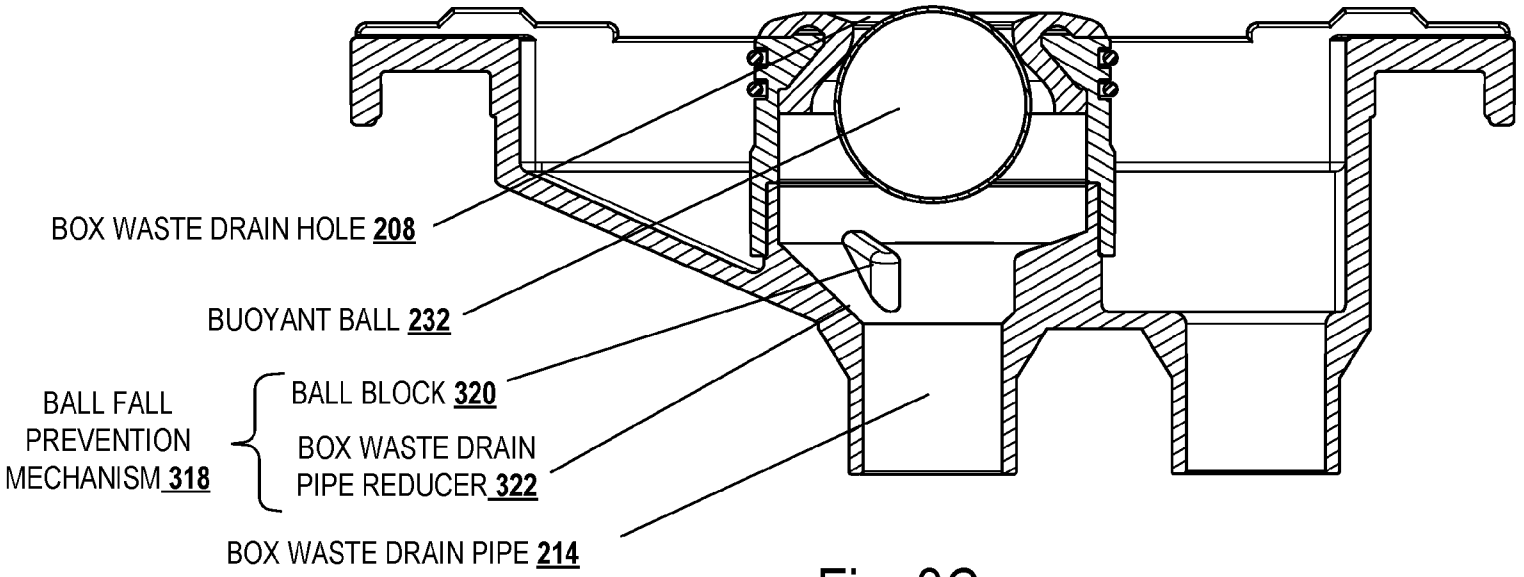

BOX WASTE DRAIN HOLE 208
BUOYANT BALL 232
BALL FALL PREVENTION MECHANISM 318
BALL BLOCK 320
BOX WASTE DRAIN PIPE REDUCER 322
BOX WASTE DRAIN PIPE 214

Fig. 3C

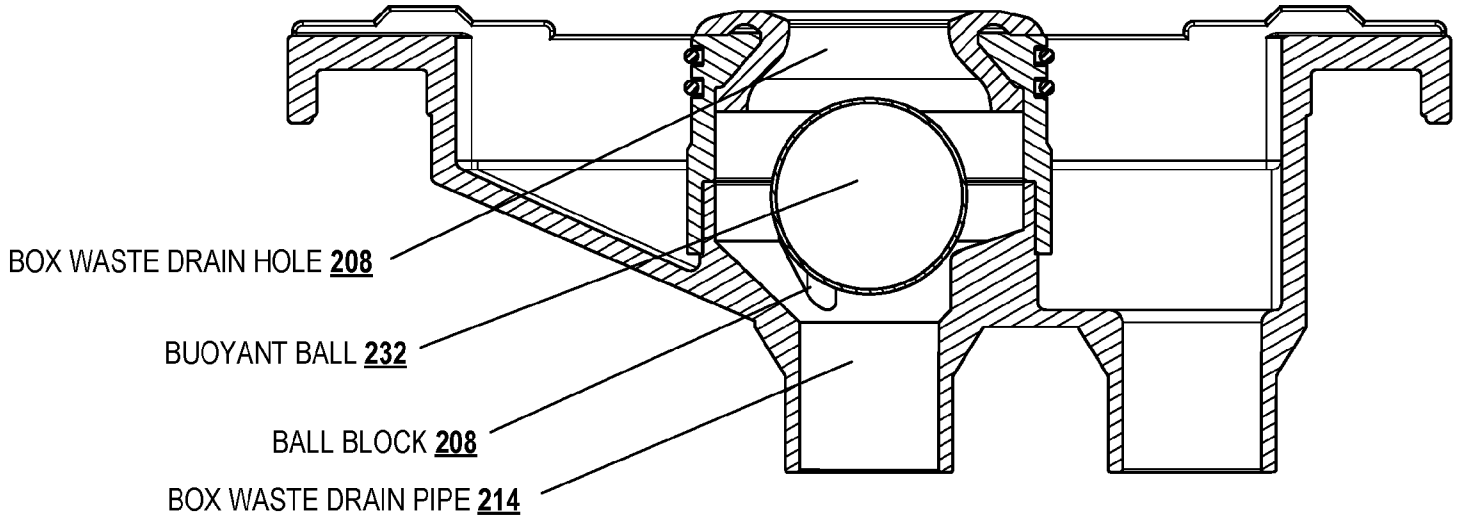

BOX WASTE DRAIN HOLE 208
BUOYANT BALL 232
BALL BLOCK 208
BOX WASTE DRAIN PIPE 214

Fig. 3D

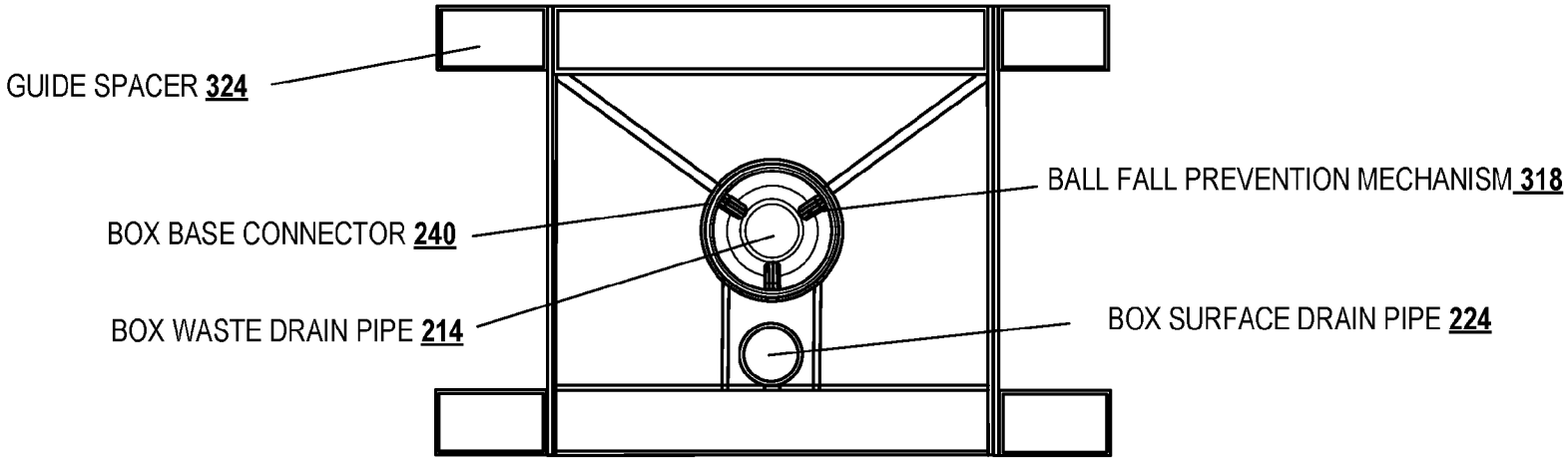
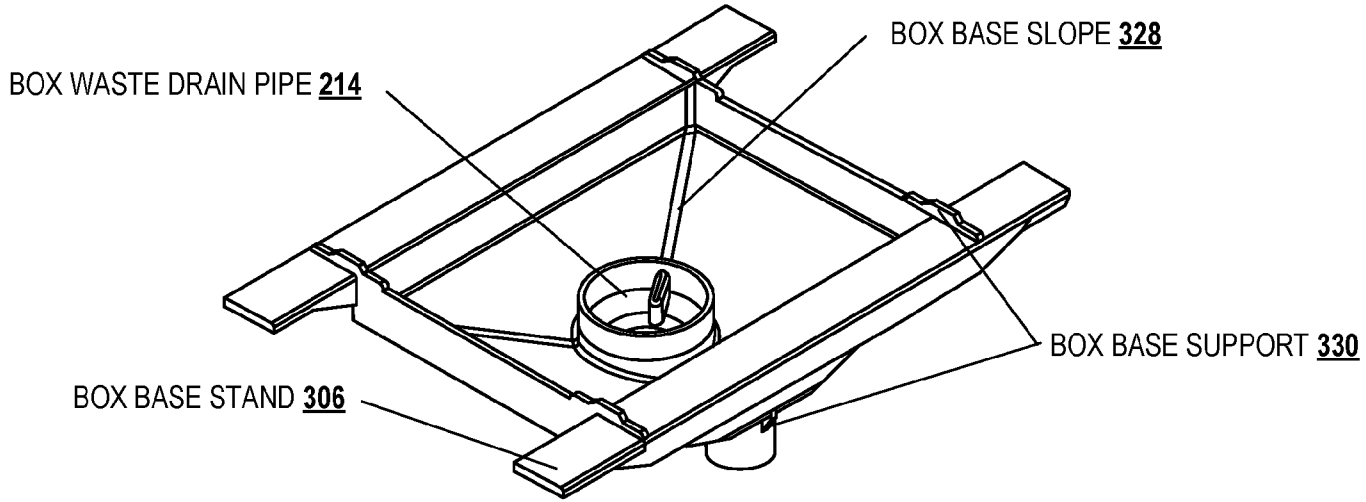

GUIDE SPACER 324
BALL FALL PREVENTION MECHANISM 318
BOX BASE CONNECTOR 240
BOX WASTE DRAIN PIPE 214
BOX SURFACE DRAIN PIPE 224

Fig. 3E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BOX WASTE DRAIN PIPE 214
BOX BASE SUPPORT 330
BOX BASE STAND 306

Fig. 3F

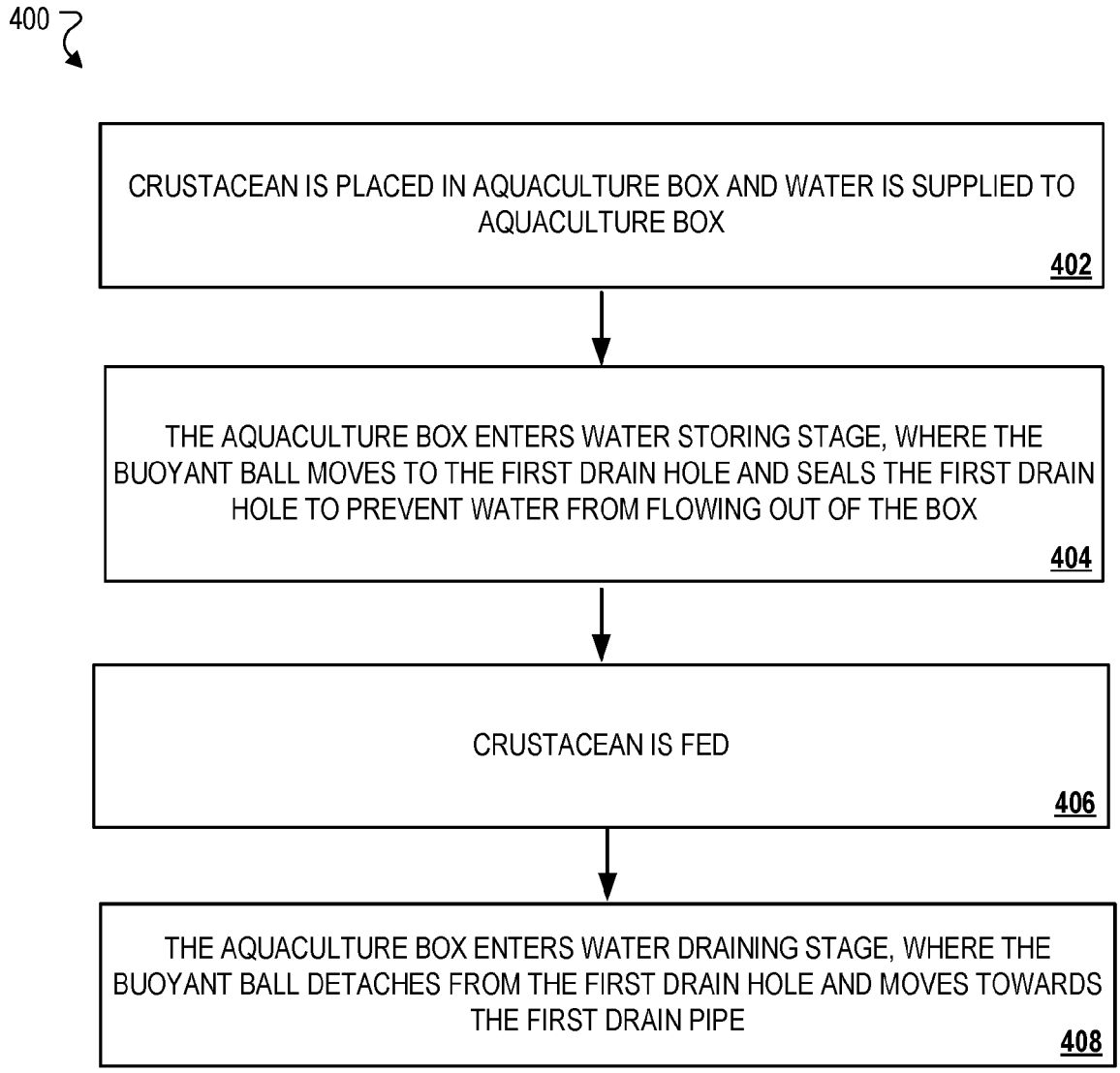
400
CRUSTACEAN IS PLACED IN AQUACULTURE BOX AND WATER IS SUPPLIED TO AQUACULTURE BOX
402
THE AQUACULTURE BOX ENTERS WATER STORING STAGE, WHERE THE BUOYANT BALL MOVES TO THE FIRST DRAIN HOLE AND SEALS THE FIRST DRAIN HOLE TO PREVENT WATER FROM FLOWING OUT OF THE BOX
404
CRUSTACEAN IS FED
406
THE AQUACULTURE BOX ENTERS WATER DRAINING STAGE, WHERE THE BUOYANT BALL DETACHES FROM THE FIRST DRAIN HOLE AND MOVES TOWARDS THE FIRST DRAIN PIPE
408

Fig. 4

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/443,555	**02/16/2024 11:42:23 AM Z ET**	**57556-0002001**

Title of Invention

AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7065	FILED BY	Gina Maldonado
PATENT CENTER #	64346421	FILING DATE	-
CUSTOMER #	26191	FIRST NAMED INVENTOR	Tung Le
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Kim Bui

Documents

TOTAL DOCUMENTS: 18

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
57556-0002001aiaADS.pdf	9	Application Data Sheet	2174 KB
57556-0002001RequestTrackOne.pdf	1	Track One Request	136 KB
57556-0002001_Declaration_Signed.pdf	4	Oath or Declaration filed	265 KB
57556-0002001CertMicroEntity.pdf	2	Certification of Micro Entity (Gross Income Basis)	81 KB
57556-0002001FINAL Application-APP.TEXT.docx	20	Application body structured text document	54 KB

Warning: Bookmarks were found and have been removed. The claims appear to contain an improper dependency with at least one claim that does not depend on a previous

claim. Please review and revise if necessary. The claims appear to contain a claim that depends on an improper claim. Please review and revise if necessary.

57556-0002001 Drawings.pdf		8	Drawings-only black and white line drawings	168 KB
57556-0002001TRL_PrioritizedExam.pdf		2	Transmittal of New Application	95 KB
57556-0002001IDSw1449.pdf		2	-	173 KB
57556-0002001IDSw1449-TRAN.LET.pdf	(1-1)	1	Transmittal Letter	49 KB
57556-0002001IDSw1449-IDS.pdf	(2-2)	1	Information Disclosure Statement (IDS) Form (SB08)	119 KB
57556-0002001TRL_POAX.pdf		2	Miscellaneous Incoming Letter	292 KB
FOR_CN202285873.pdf		13	Foreign Reference	1142 KB
FOR_CN215188868.pdf		13	Foreign Reference	4417 KB
FOR_CN112425549.pdf		13	Foreign Reference	4817 KB
FOR_CN210202948.pdf		6	Foreign Reference	2384 KB
FOR_CN109275616.pdf		12	Foreign Reference	4422 KB
FOR_CN105494195.pdf		6	Foreign Reference	462 KB
57556-0002001FINALApplication.pdf		20	Auxiliary PDF of Application	154 KB
FOR_CN104304143.pdf		8	Foreign Reference	713 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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57556-0002001FINALApplication.pdf	F2C67CD768E8CDF4217702C9DBFBDF97F0211D8F5AA1963A 5D8B55DB324A513ECD1DD7669A913773FF0520B1297E6B621 93C8ACBD1C05921AA39CC1B50769454
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Tung		Le	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Address 2			
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Postal Code	2176	**Country**	AU

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Address 2			
City	Pleiku City, Gia Lai	**State/Province**	
Postal Code		**Country**	VN

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Thinh	Quan	Nguyen	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Mailing Address of Inventor:

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Address 2	Mang Thit district		
City	Vinh Long Province	**State/Province**	
Postal Code		**Country**	VN

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chinh	Huu	Tran	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Khanh Hoa	Country of Residence	VN

Mailing Address of Inventor:

Address 1	Dong Mon 2, Dien Khanh town		
Address 2	Dien Khanh		
City	Khanh Hoa	**State/Province**	
Postal Code		**Country**	VN

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	26191		
Email Address	apsi@fr.com	Add Email	Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Application Information:

Title of the Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS		
Attorney Docket Number	57556-0002001	**Small Entity Status Claimed** ☒	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	8	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix
	Tung		Le	

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City	New South Wales	**State/Province**	
Country	AU	Postal Code	2176
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country [i]		Postal Code	
Phone Number		Fax Number	
Email Address			

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Signature:

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NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Kim Thien Bui/			Date (YYYY-MM-DD)	2024-02-16
First Name	Kim Thien	Last Name	Bui	Registration Number	76843

Additional Signature may be generated within this form by selecting the Add button. Add

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	57556-0002001
	Application Number	
Title of Invention	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS	

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Application Number	
Filing Date	
First Named Inventor	Tung Le
Title	AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS
Art Unit	
Examiner Name	
Attorney Docket Number	57556-0002001

SIGNATURE of Applicant or Patent Practitioner

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Applicant Name (if Applicant is a juristic entity)			

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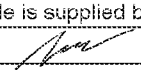
Signature		Date (Optional)	
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AQUACULTURE SYSTEMS WITH BALL VALVE MECHANISMS

BACKGROUND

[0001] This specification relates to technology for aquaculture.

[0002] Aquaculture refers to the breeding, cultivation, and harvesting of aquatic organisms in controlled water environments. It encompasses the entire process of cultivating aquatic products from seedlings under artificial breeding management systems. Recirculating aquaculture systems have been used in aquaculture to enable water conservation and reduced environmental impacts by processing water efficiently for cultivation of aquatic organisms. A recirculating aquaculture system may use one or more aquaculture boxes as cultivators. Aquaculture boxes can serve as the designated space for the survival of cultured aquatic products, and the conditions they offer often play a crucial role in the cultivation process. The quality and output of aquatic products are significantly influenced by the aquaculture boxes, making them a critical component in many cultivation equipment.

SUMMARY

[0003] This specification describes an aquaculture system that implements ball valve mechanisms for breeding, cultivation and harvesting of crustaceans.

[0004] In general, one innovative aspect of the subject matter described in this specification can be embodied in a device for aquaculture. The device includes an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage. The aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box includes one or more drain holes configured to drain water from the aquaculture box, a box connector configured to connect a valve to a first drain hole of the one or more drain holes, where the box connector is located at the lower end, the valve connected to the first drain hole through the box connector, where the valve includes a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage, and a buoyant ball movable between the first drain hole and the first drain pipe, where the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and where the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage.

[0005] Another innovative aspect of the subject matter described in this specification can be embodied in a system for aquaculture. The system includes multiple devices, where each device includes an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage. The aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box includes one or more drain holes configured to drain water from the aquaculture box, a box connector configured to connect a valve to a first drain hole of the one or more drain holes, where the box connector is located at the lower end, the valve connected to the first drain hole through the box connector, where the valve includes a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage, and a buoyant ball movable between the first drain hole and the first drain pipe, where the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and where the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage. The system further includes multiple water delivery pipes configured to deliver water to each of the devices and multiple water collection pipes configured to collect water from each of the devices.

[0006] The foregoing and other embodiments can each optionally include one or more of the following features, alone or in combination.

[0007] In some implementations, the buoyant ball may seal the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

[0008] In some implementations, the lower end is smaller than the upper end, and the upper end and the lower end are connected by at least one inclined angles configured to drain water at the lowest end at the water draining stage.

[0009] In some implementations, a crustacean may be harvested in the aquaculture box. The crustacean may be a crab, and food may be supplied to the crab after the water storing stage and prior to the water draining stage.

[0010] In some implementations, the aquaculture box may include a cover configured to be placed over the upper end and a cover lock configured to lock the cover over the upper end.

[0011] In some implementations, the one or more drain holes may include a second drain hole connected to a second drain pipe. Water in the interior of the aquaculture box may flow out of the

second drain hole through the second drain pipe based on a water level of water of the interior of the aquaculture box being higher than the height of the second drain pipe during the water storing stage. The second drain pipe may extend into the interior of the aquaculture box.

[0012] In some implementations, the device may include a ball seal located between the first drain hole and the buoyant ball configured to further enable sealing the first drain hole.

[0013] In some implementations, the device may include a ball block configured to prevent the buoyant ball from covering the first drain pipe such that waste materials associated with the food can drain from the first drain pipe.

[0014] In some implementations, the system may include a waste drain pipe configured to collect water from the water collection pipes, where a set of water collection pipes of the plurality of water collection pipes may be connected to the waste drain pipe by one or more connectors.

[0015] In some implementations, the system may include a surface drain pipe configured to collect excess water from the water collection pipes, where a second set of water collection pipes of the plurality of water collection pipes may be connected to the surface drain pipe by one or more connectors. The surface drain pipe is further configured to collect excess water from the water collection pipes based on the positive pressure of the box body of each of the aquaculture boxes.

[0016] In some implementations, the multiple devices may be arranged in one or more rows.

[0017] Particular embodiments of the subject matter described in this specification can be implemented so as to realize one or more of the following technical advantages.

[0018] Conventional recirculating aquaculture systems (RASs) include mechanisms for harvesting crustaceans by circulating water through multiple aquaculture devices of a system, where each device holds a crustacean, such as a crab. However, current systems do not implement unidirectional water flow through the multiple devices, which can result in disease transmission between devices and inefficient waste removal. Additionally, current systems that use valve mechanisms for water drainage require a system to manually open the valve of each aquaculture device in a system. For example, traditional valves include a ball valve, a butterfly valve, or a knife gate valve, which must increase in size in order to allow the flow of large amounts of water.

[0019] In contrast, the system described implements a ball valve mechanism in each aquaculture box to ensure unidirectional water flow. The ball valve mechanism allows a ball to seal a water drain pipe, such that water from another aquaculture box cannot enter the aquaculture box, while allowing waste to flow out of the aquaculture box. Thus, the ball valve mechanism can prevent

disease from spreading between aquaculture boxes and the ball valve mechanism can efficiently remove waste. Additionally, the ball valve mechanism retains food during feeding, which improves feeding efficiency, and the shape of the aquaculture box allows for efficient removal of waste by implementing different angles.

[0020] In particular, the system uses a single ball valve mechanism to activate the ball valves of each of the aquacultures in the system. For example, to control the water flow of 100 boxes without letting the water flow from one box to another, which can cause the spread of disease, the system allows for each of the ball valves to be opened by a single mechanism, rather than having to open each ball valve for each box manually. Thus, the described system increases water draining efficiency and reduces latency to a fraction of conventional systems that include manually opening the ball valve for each aquaculture box. Additionally, the efficiency of the ball valve mechanism allows for the size of the ball valve mechanism to be relatively small, reducing an amount of material needed for the system.

[0021] The details of one or more embodiments of the subject matter of this specification are set forth in the accompanying drawings and the description below. Other features, aspects, and advantages of the subject matter will become apparent from the description, the drawings, and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a diagram of an example aquaculture system that includes multiple aquaculture boxes.

[0023] FIGs. 2A-2E are example diagrams of an aquaculture box in the aquaculture system.

[0024] FIGs. 3A-3F are example diagrams of a ball valve mechanism for the aquaculture box.

[0025] FIG. 4 is a flow diagram of an example process for storing and draining water for the aquaculture box.

[0026] Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0027] FIG. 1 shows an example system 100 for aquaculture. The system 100 is an example of an aquaculture system for harvesting crustaceans, such as crabs, giant freshwater prawn, mantis shrimp, lobsters, horseshoe crabs, giant isopods, or Babylonia areolata.

[0028] The system is a recirculating aquaculture system that circulates water through multiple aquaculture boxes using a ball check valve mechanism. In particular, the system 100 unidirectionally directs water through the system using a ball valve mechanism in each aquaculture box. For example, harvesting the crabs can include feeding by inputting food into the aquaculture box, such that the water output of the aquaculture box includes waste from the food, resulting in the need for the water to circulate unidirectionally in order to provide clean water to each aquaculture box and to prevent aquaculture boxes from spreading waste or disease to other aquaculture boxes in the system 100.

[0029] The system 100 collects the water output of each aquaculture box to recirculate the water through the system 100 after cleaning the water. The system 100 includes multiple aquaculture boxes 102 that each include a box connector 116. Additionally, the system includes a main input water pipe 120, one or more row input water pipes 104, and a frame 106. The frame 106 is configured to support each of the one or more pipes of the system 100. The frame 106 can be made of material to reduce corrosion from saltwater, such as stainless steel aluminum. In some implementations, the system 100 further includes a waste drain pipe 108, a surface drain pipe 110, multiple main connectors 112, multiple row connectors 114, multiple box connectors 116, and multiple row output water pipes 118.

[0030] Each aquaculture box 102 is configured to store and drain water for harvesting of one or more crabs. The system 100 can use the main input water pipe 120 to supply water to each of the aquaculture boxes using one or more row input water pipes 104. For example, multiple aquaculture boxes 102 can be arranged in rows, and the system 100 can supply water to each row of aquaculture boxes 102 using the row input water pipe 104 for the particular row.

[0031] Additionally, each aquaculture box 102 is connected to a row output water pipe 118 by the box connector 116. For example, each row of the aquaculture boxes 102 can be connected to a same row output water pipe 118 by respective box connectors 116, and the system can drain water from each of the aquaculture boxes 102 to the respective row output water pipe 118 via the box connector 116. In some cases, the row output water pipe 118 can drain water from one or more aquaculture boxes 102 to the waste drain pipe 108, and, in some other cases, the row output water pipe 118 can drain water from one or more aquaculture boxes 102 to the surface drain pipe 110.

[0032] The system uses the waste drain pipe 108 and the surface drain pipe 110 to collect the water output of each of the aquaculture boxes 102, where the waste drain pipe 108 and the surface drain

pipe 110 are connected to each row of the aquaculture boxes 102 by a main connector 112. The main connector 112 can be a t-shaped connector. In particular, the waste drain pipe 108 can collect water from each of the aquaculture boxes 102 that includes waste (e.g., food spillage), and the surface drain pipe 110 can collect excess water from each of the aquaculture boxes 102 and drain the excess water to a box max level control pipe 122 in order to maintain water equilibrium, as described in further detail below with reference to FIGs. 2 and 3. The surface drain pipe 110 can redirect the water through the system 100. In some cases, the water is treated (e.g., cleaned) prior to reentering the system 100.

[0033] The ball valve mechanism (e.g., the ball check valve mechanism) can hold water in the aquaculture box 102 during a water storing stage while preventing water from other aquaculture boxes to enter the aquaculture box, and the ball valve mechanism can drain water and waste from the aquaculture box during a water draining stage. In particular, the aquaculture box 102 includes a box waste drain pipe, where each box waste drain pipe is connected to the waste drain pipe 108 by the box connector 116. In some examples, the aquaculture box further includes a box surface drain pipe that is connected to the surface drain pipe 110 and the box max level control pipe 122 by the box connector 116, as described in further detail with reference to FIGs. 2 and 3.

[0034] Thus, the ball valve mechanism prevents food spillage during feeding and acts as a valve during a water draining stage by implementing a water-tight seal mechanism that does not allow water from other aquaculture boxes (e.g., adjacent aquaculture boxes) from entering the aquaculture box 102 during the water storing stage. In particular, the ball valve mechanism includes a buoyant ball that seals a drain hole (e.g., a box waste drain hole) of the aquaculture box 102 during the water storing stage based on a water level (e.g., an amount of water) that is drained from another aquaculture box 102 (e.g., another aquaculture box 102 in the same row). By preventing waste from entering, the ball valve mechanism ensures that the water in each aquaculture box 102 is clean and lessens the probability that the water contains disease, which can improve the water circulation of the system and enhance the harvesting of crustaceans.

[0035] FIG. 2A shows a diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0036] As described above, the aquaculture box 102 is used to harvest one or more crustaceans as part of an aquaculture system 100 by using a ball valve mechanism to store and drain water through a box waste drain pipe of the box 102 during a water storing stage and a water draining stage of the system.

[0037] The aquaculture box 102 includes a box extension 202, a box cover 204, a box body 206, a box waste drain hole 208, a ball valve mechanism 210, a box base 212, and a box waste drain pipe 214.

[0038] The box extension 202 is modifiable, such that the height of the aquaculture box 102 can accommodate various crustacea species. The box cover 204 is configured to cover the aquaculture box 102 to hold a crustacean (e.g., a crab) in the box. In some examples, the box cover 204 can be made from transparent material (e.g., transparent plastic) to allow for observation of the crab.

[0039] The box cover 204 can be placed over the box body 206 or over the box extension 202. The box cover is configured to prevent the crab from escaping the aquaculture box 102. The box cover 204 can be made of plastic.

[0040] The box body 206 can be shaped to allow for efficient flow of water through the bottom of the box 102. For example, the box body 206 can be rectangular, spherical, cone-shaped, or a combination thereof. In particular, the box body 206 can include one or more slopes in its shape to allow for water to flow downwards and through the box waste drain hole 208and out of the box waste drain pipe 214 to the waste drain pipe 108 of the system. The box body 206 can be made of plastic. The box body 206 is connected to the box base 212.

[0041] The box waste drain hole 208 is a hole in the box body 206 that is configured to allow water, such as water including food waste, to flow out of the box 102 to the box base 212 using the ball valve mechanism 210 while not allowing water from an adjacent aquaculture box 102 to enter through the box waste drain pipe 214.

[0042] In particular, during the water storing stage, the ball valve mechanism 210 can seal water from entering through the box waste drain pipe 214, and during the water draining stage, the ball valve mechanism 210 allow water and waste to drain from the box waste drain hole 208 and out of the box waste drain pipe 214, as described in further detail with reference to FIG. 3. The box waste drain pipe 214 can be connected to a row output water pipe 118 of the system by a box connector 116.

[0043] FIG. 2B shows a top view of the box body of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0044] As shown in FIG. 2B, a crustacean can be placed inside of the box body 206 for harvesting prior to the water storing stage and the water draining stage. After the crustacean is placed in the box body 206, the system can supply water to the box body 206 via a row input water pipe during the water storing stage. The crustacean can then be fed. The food can drain to the bottom of the box body 206, and the system can use the ball valve mechanism to allow water, which can include the food waste, to drain out of the box body 206 during the water draining stage, as described in further detail with reference to FIGs. 3 and 4.

[0045] FIG. 2C shows a bottom view of the box body of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0046] During the water storing stage, the system can use the ball valve mechanism 210 to ensure that water from an adjacent aquaculture box 102 does not enter the box body 206 through the box waste drain hole 208 by sealing the box waste drain hole 208. During the water draining stage, the system uses the ball valve mechanism 210 to allow water to flow out of the box body 206 through the box waste drain hole 208.

[0047] The box body 206 includes a box body connector 216, a connector guide 218, a box contour 220, a box support structure 222, and a box surface drain pipe 224. The box body connector 216 connects the box body 206 to the box base 212, and the ball valve mechanism 210 can be inside of the box body connector 216. The connector guide 218 ensures that the box body 206 is aligned with the box base 212. The box contour 220 is a ridge along the top of the box body 206. The box contour 220 is configured to allow a person to hold the box body 206, to remove the box body 206 from the box base 212, or both. The box support structure 222 can include one or more supports (e.g., stilts) protruding from the box body 206 that are configured to enable the box body 206 to stand upright. The box support structure 222 can include a box stand that is configured to enable the box body 206 to stand upright on a flat surface.

[0048] In some examples, the box surface drain pipe 224 is configured to allow excess water to drain out of the box body 206 based on a water level of the water in the box body 206, as described in further detail below with reference to FIG. 3. In the case where the box 102 does not include the box surface drain pipe 224, the system can drain the water through the box waste drain pipe 214 in order to lower the water level of the water in the box body 206. In particular, the system can leverage the positive flow of the box body 206 to allow the water to drain out of the box 102 in order to prevent spread of disease through the water. In this case, the system can control (e.g., determine) the maximum level of water inside the box body 206 by the height of the box surface drain pipe 224 and the box max level control pipe 122, as the box max level control pipe 122 and the box body 206 function as communicating vessels. In particular, the box max level control pipe 122 can be u-shaped, which results in water draining from the surface drain pipe 224 through the box max level control pipe 122 and to the surface drain pipe 110.

[0049] FIG. 2D shows a diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0050] The aquaculture box 102 is configured to store and drain water during a water storing stage and a water draining stage using the ball valve mechanism 210. The ball valve mechanism 210 can include a seal 228, a seal connector 230, and the buoyant ball 232. In particular, the seal 228 is located inside of the seal connector 230, and the seal connector 230 is placed between the box waste drain hole 208 and the box waste drain pipe 214, such that the seal connector 230 is connected to the box base 212 by a box base connector.

[0051] The buoyant ball 232 is configured to float in order to seal the aquaculture box 102 by keeping input water inside the box and keeping external water (e.g., water from other aquaculture boxes 102) from entering the box 102. Additionally, the ball valve mechanism allows waste to flow out of the box 102, as the ball 232 does not block the waste from exiting the box 102 through the box waste drain pipe 214, as described in further detail with reference to FIG. 3. In particular, the ball 232 is filled with air, which allows the ball to float. In some other examples, the ball 232 can be made of material that is less dense than water to allow the ball to float. Additionally, the surface of the ball 232 can be made from a particular material such that waste does not stick (e.g., adhere) to the ball 232 and is instead passed through the box waste drain pipe 214.

[0052] During the water storing stage, the ball 232 can seal (e.g., lock) water from entering through the box waste drain pipe 214 by being in contact with the seal 228. For example, the seal 228 can be a flexible water-tight seal that can include one or more O-rings to ensure that water cannot enter the aquaculture box, as described in further detail below with reference to FIG. 3. During the water draining stage, the ball can detach from the seal 228 in order to allow water and waste to drain from the box waste drain pipe 214, as described in further detail with reference to FIG. 3.

[0053] In some examples, the aquaculture box 102 can include the box surface drain pipe 224 that is connected to a box surface drain hole 226, which is configured to allow excess water to drain out of the box body 206, as described in further detail below with reference to FIG. 3.

[0054] FIG. 2E shows an isometric diagram of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0055] In some implementations, the aquaculture box 102 can further include an observation hole 234, an input water hole 239, a cover lock 238, and a box base connector 240.

[0056] The box cover 204 can include an observation hole 234 and an input water hole 236. The observation hole 234 can be configured to allow for observation of the crab. In some cases, food can be inserted into the box 102 through the observation hole 234. The input water hole 236 is configured to allow water, such as water from a row input water pipe 104, to enter the aquaculture box 102.

[0057] The cover lock 238 connects the box cover 204 to the box body 206. The cover lock 238 is configured to prevent the box cover 204 from being opened from the inside, such that the box cover 204 can only be opened from the outside.

[0058] The box base connector 240 is configured to connect with the seal connector 230 to keep the ball in contact with the seal 228 during the water storing stage.

[0059] FIG. 3A shows a diagram of an example water draining mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the water draining mechanism for the aquaculture box 102.

[0060] The aquaculture box 102 can further include one or more box slopes 304.

[0061] In some examples, the aquaculture box 102 includes the box surface drain pipe 224 configured to control the water level inside the box body 206 in order to prevent the box 102 from overflowing with water. The box surface drain pipe 224 can be any height within the box body 206, and in the case that the box 102 includes the box extension 202, the box surface drain pipe 302 can be extended to be a taller height.

[0062] In particular, the box surface drain pipe 224 is configured to keep water in the box body 206 at a particular water level by draining water above the height of the box surface drain pipe 214 through the box surface drain hole 226 during the water storing stage. In this case, the water can flow through the box surface drain hole 226, and the system can collect the excess water at the surface drain pipe 110.

[0063] The box body 206 can include one or more box slopes 304, such as box slope 304-A and box slope 304-B, which allow the input water to flow through the through the box waste drain hole 208 and out of the box waste drain pipe 214. In some examples, the box slope 304-A and the box slope 304-B can be of different angles. For example, the box slope 304-B can be more than 60 degrees such that waste (e.g., food) does not stick to the inside of the box and flows out of the box through the box waste drain pipe 214.

[0064] The box base stand 306 is connected to the frame 106 of the system. The box base stand 306 is configured to hold the box 102 and to provide support for the structure. The box base stand 306 can be made of stainless steel.

[0065] FIG. 3B shows a diagram of an example ball valve mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the ball valve mechanism for the aquaculture box 102.

[0066] The aquaculture box 102 implements the ball valve mechanism using the ball 232 and the seal 228 based on a ball fall prevention mechanism 318. During the water-storing stage, the ball 232 covers the seal 218 such that water from another aquaculture box cannot enter the box 102 through the box waste drain pipe 214 using the ball fall prevention mechanism 318. During the water draining stage, the ball 232 detaches from the seal 228 to allow water and waste to flow out of the box 102 using the ball fall prevention mechanism 318. The ball fall prevention mechanism

318 prevents the ball 232 prevents the ball from falling past a certain point in order to allow water and waste to flow out of the box waste drain pipe 214.

[0067] In particular, during the water-storing stage, water from another box can enter the present box 102 through the box waste drain pipe 214 as the other box is in the water draining stage. As the water from the other box enters the box waste drain pipe 214, the ball 232 floats in the water and comes into contact with the seal 228 at seal contact point 310. The seal contact point 310 is the point at which the ball 232 seals the water from entering the box waste drain hole 208and from entering the box body 206. In particular, in some examples, the seal 228 is configured to change shape by expanding in order to prevent water from entering the box body 206. The seal 228 can be made of silicone, rubber, or a combination thereof. In some examples, the seal 228 includes an O-ring 312 to ensure that the seal 228 is water-tight by being in contact with the seal connector 230.

[0068] During the water draining stage, the ball 232 detaches from the seal and moves downward. In this case, the ball fall prevention mechanism 318 prevents the ball from covering box waste drain pipe 214, such that waste and water can flow out of the box 102. The ball fall prevention mechanism 318 can include one or more bended edges, which allow waste to flow freely out of the box waste drain pipe 214.

[0069] FIGs. 3C and 3D shows a diagram of an example ball fall prevention mechanism for the aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the ball valve mechanism for the aquaculture box 102.

[0070] The ball valve mechanism 210 controls the motion of the ball 232 using the ball fall prevention mechanism 318, which includes a ball block 320 and a box waste drain pipe reducer 322. The ball block 320 can be an angled ridge protruding from the box waste drain pipe 214 that blocks the ball from falling and completely covering the box waste drain pipe 214. The box waste drain pipe reducer 322 can be located in the box waste drain pipe 214 with a sloping shape. The box waste drain pipe reducer 322 reduces the size of the box waste drain pipe 214 and is configured to efficiently allow for waste to flow out of the box waste drain pipe 214

[0071] For example, as shown in FIG. 3C, during a water storing stage, the ball 232 can be floating based on water entering the box 102 through the box waste drain pipe 214. However, the ball 232

blocks the water from entering the box 102 by sealing the box waste drain hole 208. Then, as shown in FIG. 3D, during a water draining stage, the ball 232 can fall downwards towards the box waste drain pipe 214 to allow waste and water to flow out of the box waste drain pipe 214. However, the ball fall prevention mechanism 318 does not allow the ball to completely fall to the box waste drain pipe 214, and thus, the ball fall prevention mechanism 318 is configured to prevent the ball 232 from sealing the box waste drain pipe 214 and to allow for water to drain out of the box 102.

[0072] FIG. 3E shows a top view of the box base of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0073] The box base 212 is connected to the box body 206 by the box base connector 240, which includes the ball fall prevention mechanism 318, as described above. Additionally, the box base 212 is connected to the box surface drain pipe 224, which allows excess water to flow out of the box 102, as described above. In some examples, the box base 212 includes a guide spacer 324, which is configured to align spacing between the box body 206 and the box base 212.

[0074] FIG. 3F shows an isometric view of the box base of an example aquaculture box. The aquaculture box is an example of an aquaculture box in which the components and techniques described below are implemented. For example, a system, e.g., the system of FIG. 1, appropriately configured in accordance with this specification, can implement the aquaculture box 102.

[0075] The box base 212 can have a box base slope 328 configured to allow water to flow out of the box 102 through the box waste drain pipe 214. The box base slope 328 can be a slope of that is less than the slope of the box body shape to allow water and waste to flow through the box 102. The box base 212 can also include the box base stand 306 configured to support the box 102. In some examples, the box base stand 306 includes box base support 330 configured to provide increased support for the box 102 to stand upright and to sustain water weight in the box body 206.

[0076] FIG. 4 is a flow diagram of an example process for storing and draining water for the aquaculture box.

[0077] For each aquaculture box of the system, a crustacean is placed in the aquaculture box, and the system supplies water to the aquaculture box (402). The system can supply water to the aquaculture box using an input water pipe.

[0078] During the water storing stage, the buoyant ball of the aquaculture box moves to the first drain hole and seals the first drain hole to prevent water from flowing out of the box (404). The ball seals the box waste drain hole. In particular, the ball prevents water from the box base (e.g., water from another box that may contain waste and/or disease) from entering the box body by coming into contact with the seal.

[0079] In some cases, the box can include a surface drain pipe that can control the water level of the box body as input water enters the box. In particular, based on the water level of the box base being higher than the height of the surface drain pipe, water can flow into box surface drain hole and out of the box through the box surface drain pipe. In this way, the box 102 can control the water level of the box, and the system can collect the excess water using the box surface drain pipe.

[0080] The crustacean is then fed (404). The food can be put into the box body through the box cover or through the observation hole in the box cover. Once the crustacean has been fed, the waste or the remaining food can flow to the bottom of the box body 206 based on the slopes of the box body 206. After feeding, the system is configured to enter a water draining stage, as keeping the food inside the box body for an extended period of time can lead to disease or pollution of water in the box.

[0081] During the water draining stage, the buoyant ball detaches from the first drain hole and moves towards the first drain pipe (406). In particular, the ball detaches from the seal that is covering the first drain pipe, and the ball moves downward towards the box waste drain pipe, allowing water to drain out of the box. The ball fall prevention mechanism (e.g., ball block) ensures that the ball does not cover the box waste drain pipe, such that waste can flow out of the box, and the system can collect the waste in the waste drain pipe. Thus, the system can then clean the water (e.g., remove the waste), and the system can redirect the clean water back into the system, ensuring a unidirectional clean water system for each of the aquaculture boxes.

[0082] In some examples, the box can be removed and replaced with another box. In particular, a crab can be moved from a first box to a second box in order to protect the crab (e.g., provide a clean environment for the crab). For example, the system can be configured to allow the box body to be separated from the box base by disconnecting the box body connector. In this case, water can flow through the box base once the box body is removed, and the ball valve mechanism can continue to seal the water such that water does not exit the box body.

[0083] To replace the box body, the system is configured such that a new box body can be connected to the box base using the box body connector. In this case, the box base stand, the connector guide, and the guide spacer allow for proper alignment of the box body with the box base. By properly aligning the box body with the box base, the system can connect the box body and provide a clean box for the crustacean, which can aid in decreasing disease. In some cases, such as when the box body is not fully connected with the box base, the O ring of the seal can prevent water from leaking into the box through the box waste drain hole.

[0084] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any invention or on the scope of what may be claimed, but rather as descriptions of features that may be specific to particular embodiments of particular inventions. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially be claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0085] Similarly, while operations are depicted in the drawings and recited in the claims in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results.

[0086] Particular embodiments of the subject matter have been described. Other embodiments are within the scope of the following claims. For example, the actions recited in the claims can be performed in a different order and still achieve desirable results. As one example, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results.

[0087] What is claimed is:

CLAIMS

1. A device for aquaculture, the device comprising:

an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage, the aquaculture box forming an upper end opposite a lower end, wherein the interior of the aquaculture box comprises:

one or more drain holes configured to drain water from the aquaculture box; and

a box connector configured to connect a valve to a first drain hole of the one or more drain holes, wherein the box connector is located at the lower end;

the valve connected to the first drain hole through the box connector, wherein the valve comprises:

a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage; and

a buoyant ball movable between the first drain hole and the first drain pipe, wherein the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and wherein the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage.

2. The device of claim 1, wherein the buoyant ball seals the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

3. The device of claim 1, wherein the lower end is smaller than the upper end, and wherein the upper end and the lower end are connected by at least one inclined angle configured to drain water at the lowest end at the water draining stage.

4. The device of claim 1, wherein a crustacean is harvested in the aquaculture box.

5. The device of claim 6, wherein the crustacean is a crab, and wherein food is supplied to the crab after the water storing stage and prior to the water draining stage.

6. The device of claim 1, wherein the aquaculture box further comprises:

a cover configured to be placed over the upper end; and

a cover lock configured to lock the cover over the upper end.

7. The device of claim 1, wherein the one or more drain holes further comprises a second drain hole connected to a second drain pipe.

8. The device of claim 7, wherein water in the interior of the aquaculture box flows out of the second drain hole through the second drain pipe based on a water level of water of the interior of the aquaculture box being higher than the height of the second drain pipe during the water storing stage.

9. The device of claim 8, wherein the second drain pipe extends into the interior of the aquaculture box.

10. The device of claim 1, further comprising:

a ball seal located between the first drain hole and the buoyant ball configured to further enable sealing the first drain hole.

11. The device of claim 5, further comprising:

a ball block configured to prevent the buoyant ball from covering the first drain pipe such that waste materials associated with the food can drain from the first drain pipe.

12. A system for aquaculture, the system comprising:

a plurality of devices, each device comprising:

an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage, the aquaculture box forming an upper end opposite a lower end, wherein the interior of the aquaculture box comprises:

one or more drain holes configured to drain water from the aquaculture box; and

a box connector configured to connect a valve to a first drain hole of the one or more drain holes, wherein the box connector is located at the lower end;

the valve connected to the first drain hole through the box connector, wherein the valve comprises:

a first drain pipe positioned below the first drain hole, wherein the first drain pipe is configured to drain water and waste material from the box during the water draining stage; and

a buoyant ball movable between the first drain hole and the first drain pipe, wherein the buoyant ball is configured to move to the first drain hole and seal the first drain hole to prevent water from flowing out of the box during the water storing stage, and wherein the buoyant ball is configured to detach from the first drain hole and move toward the first drain pipe at the water draining stage;

a plurality of water delivery pipes configured to deliver water to each of the plurality of devices; and

a plurality of water collection pipes configured to collect water from each of the plurality of devices.

13. The system of claim 12, wherein the system further comprises an input water pipe configured to supply water to each of the water delivery pipes.

14. The system of claim 12, wherein the system further comprises a waste drain pipe configured to collect water from the water collection pipes, wherein a set of water collection pipes of the plurality of water collection pipes is connected to the waste drain pipe by one or more connectors.

15. The system of claim 12, wherein the system further comprises a surface drain pipe configured to collect excess water from the water collection pipes, wherein a second set of water collection pipes of the plurality of water collection pipes is connected to the surface drain pipe by one or more connectors.

16. The system of claim 15, wherein the surface drain pipe is further configured to collect excess water from the water collection pipes based on the positive pressure of the box body of each of the aquaculture boxes.

17. The system of claim 12, wherein the plurality of devices are arranged in one or more rows.

18. The system of claim 12, wherein the buoyant ball seals the first drain hole at the water storing stage based on a water level of water drained from another aquaculture box at the water draining stage of the other aquaculture box.

19. The system of claim 12, wherein a crustacean is harvested in the aquaculture box.

20. The system of claim 19, wherein the crustacean is a crab, and wherein food is supplied to the crab after the water storing stage and prior to the water draining stage.

ABSTRACT

Systems and apparatus for an aquaculture box configured to store water at a water storing stage and to drain water and waste material at a water draining stage are described. In one aspect, the aquaculture box forms an upper end opposite a lower end, where the interior of the aquaculture box comprises one or more drain holes configured to drain water from the aquaculture box. The valve is connected to the first drain hole, where the valve comprises a first drain pipe configured to drain water and waste material from the box during the water draining stage, and a buoyant ball configured to move between the first drain hole and the first drain pipe to prevent water from flowing out of the box during the water storing stage and to detach from the first drain hole and move toward the first drain pipe at the water draining stage.