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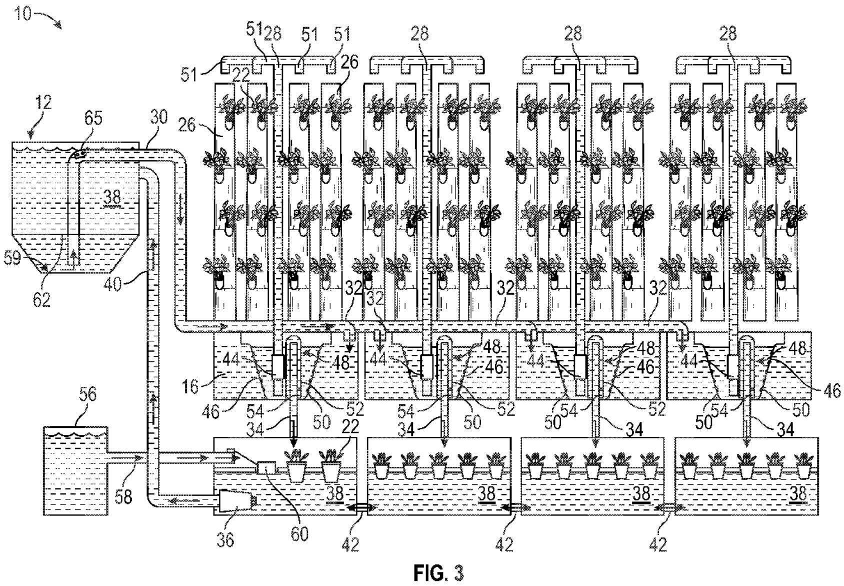

FIG. 3

(57) Abstract: An aquaponics system for growing plants may include a tank configured to hold at least one aquatic animal species and nutrient-rich water. The tank may include an outlet pipe and an inlet pipe. The outlet pipe may branch into a first and second delivery pipe. The aquaponics system may include first and second upper-level growth media bins and first and second lower-level float bins. The first and second delivery pipes may deliver the nutrient-rich water to the first and second upper-level growth media bins, respectively. The first and second lower-level float bins may receive the nutrient-rich water from the first and second upper-level growth media bins, respectively.

[Continued on next page]

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AQUAPONICS SYSTEM

BACKGROUND OF THE INVENTION

Production of food on farms may be threatened by population expansion, climate change, land damage, urbanization, energy shortages, and water shortages. Also, food safety and avoidance of breakouts of E. coli, Salmonella, *etc.* is also a growing concern. Pesticides may poison the food chain and potentially cause illness or death.

SUMMARY OF THE INVENTION

According to an aspect of an embodiment, an aquaponics system for growing plants may include a tank configured to hold one or more aquatic animal species and nutrient-rich water. Nutrients in the nutrient-rich water, such as nitrogen, phosphorus, potassium, *etc.*, may result from feces of the at least one aquatic animal species and/or may be added to the aquaponics systems. The nutrients may facilitate plant growth. In some embodiments, the tank may include an outlet pipe and/or an inlet pipe. In some embodiments, the nutrient-rich water may enter an end of the outlet pipe disposed at least proximate to a feces collection area of the tank and may exit the tank under pull of gravity and without a pump.

In some embodiments, the aquaponics system may include one or more growth media bins. In some embodiments, the nutrients may be added directly to the growth media bins. Growth media within the growth media bins may include any variety of growth media for facilitating plant growth. In some embodiments, the growth media may facilitate growth of microgreens. In these and other embodiments, the growth media may include lava rock and/or worms. In some embodiments, the outlet pipe of the tank may deliver the nutrient-rich water to the growth media bins. In some embodiments, the outlet pipe may branch into multiple delivery pipes, which may each deliver the nutrient-rich water to a different growth media bin.

In some embodiments, the aquaponics system may include one or more hydroponic or float bins. In some embodiments, each of the float bins may include a float element configured to float in the nutrient-rich water in the corresponding float bin and to hold one or more plants above the nutrient-rich water for root access. In some embodiments, the float element may include one or more holes configured to hold containers of the plants. In some embodiments, the float element may include a polystyrene foam board, which may be encapsulated in plastic.

In some embodiments, the aquaponics system may include one or more downwardly extending pipes and one or more upwardly extending pipes. In some embodiments, each of the growth media bins may include an end of a particular downwardly extending pipe and/or an end of a particular upwardly extending pipe. In some embodiments, each of the downwardly extending pipes may be configured to deliver the nutrient-rich water from a particular growth media bin to a particular float bin.

In some embodiments, the aquaponics system may include one or more growth towers, which may be aeroponic. In some embodiments, the nutrient-rich water may cascade down an inside of the growth towers in a continuous and/or intermittent flow. In some embodiments, the growth towers may be configured to hang above the growth media bins. In some embodiments, the growth towers may hang above the growth media bins such that the growth towers contact the growth media bins or are spaced apart from the growth media bins. In some embodiments, the growth towers may hang at various heights above the growth media bins, for example, 0.5 inches to 3 inches above the growth media bins. In some embodiments, each of the upwardly extending pipes may be configured to deliver the nutrient-rich water from a particular growth media bin to one or more particular growth towers via a pump. In these and other embodiments, the particular growth media bin may be configured to collect excess of the nutrient-rich water delivered to the particular growth towers that drips down the particular growth towers. In some embodiments, the nutrient-rich water may drip on a top or another portion of the growth towers. Additionally or alternatively, the nutrient-rich water may mist on the top or another portion of the growth towers.

In some embodiments, the float bins may include one or more pumps. In some embodiments, a single pump disposed in a particular float bin may be configured to pump the nutrient-rich water from the float bins through the inlet pipe to the tank. In some embodiments, the particular float bin in which the single pump is disposed may be closest to the tank compared to any other float bins. In some embodiments, each of the float bins may be fluidly connected, such as, for example, by one or more connector pipes, such that water level equilibrium is maintained between the float bins. In some embodiments, the float bins may be filled or partially filled with the nutrient-rich water.

In some embodiments, the aquaponics system may include a three-level system, with the growth media bins, the float bins, and the growth towers disposed at different heights or levels. In some embodiments, the growth media bins may be disposed between the growth towers and the float bins. In some embodiments, one or more of the following may be arranged in rows: the growth media bins, the float bins, and the growth towers. In some embodiments, a particular growth media bin disposed at an upper-level of the aquaponics system may be aligned with or correspond to a particular float bin at a lower-level of the aquaponics system and/or the growth towers may be disposed above the upper-level. In some embodiments, the particular float bin aligned with the particular growth media bin may receive the nutrient-rich water from the particular growth media bin.

In some embodiments, the nutrient-rich water may circulate in a first loop between the tank, the upper level that includes the growth media bins, and the lower level that includes the float bins. In further detail, in some embodiments, the nutrient-rich water may be configured to flow from the tank through the outlet pipe to a particular growth media bin, from the particular growth media bin to a particular float bin, and from the particular float bin through the inlet pipe back to the tank in the first loop. Depending on a number of growth media bins and float bins in the aquaponics system, a number of first loops may vary. For example, in response to the aquaponics system including a first and second growth media bin and a first and second float bin, the nutrient-rich water may be configured to flow from the tank through the outlet pipe to the first growth media bin, from the first growth media bin to the first float bin, and from the first float bin through the inlet pipe back to the tank in one first loop. In another first loop, the nutrient-rich water may be configured to flow from the tank through the outlet pipe to the second growth media bin, from the second growth media bin to the second float bin, and from the second float bin through the inlet pipe back to the tank. In some embodiments, each of the first loops may share a single pump. In some embodiments, the nutrient-rich water may be configured to flow through multiple first loops simultaneously. In some embodiments, the multiple first loops may be partially overlapping.

In some embodiments, the nutrient-rich water may circulate in a second loop between the upper level and the growth towers. In further detail, in some embodiments, the nutrient-rich water may be configured to flow from a particular growth media bin to one or more growth towers and back to the particular growth media bin in a second loop. Depending on a number of growth media bins in the aquaponics system, a number of second loops may vary. In some embodiments, each of the second loops may include one or more pumps. In some embodiments, each of the second loops may include a single pump, which may increase efficiency of the aquaponics system. In some embodiments, the nutrient-rich water may be configured to flow through multiple second loops simultaneously. In some embodiments, the multiple second loops may be non-overlapping. In some embodiments, a portion of a first loop overlaps with a portion of a second loop.

In some embodiments, each of the growth media bins may include an inner wall that may surround the end of the upwardly extending pipe and/or the end of the downwardly extending pipe. In some embodiments, the inner wall may surround the pump configured to deliver the nutrient-rich water from a particular growth media bin to one or more particular growth towers via a particular upwardly extending pipe. In some embodiments, the nutrient-rich water may be delivered to the growth towers continuously or intermittently. In some embodiments, a sensor or other means may activate a nutrient addition system In some embodiments, the inner wall may surround a siphon mechanism, which may include the downwardly extending pipe. In some embodiments, the delivery pipes may deliver the nutrient-rich water outside of the inner walls of the growth media bins. In some embodiments, the inner wall may be configured to separate the end of the upwardly extending pipe and/or the end of the downwardly extending pipe from the growth media disposed in the growth media bin. For example, the inner wall may include one or more holes sized to allow the nutrient-rich water to flow through the inner wall but not to allow the growth media, such as lava rocks and/or worms, for example, to flow through the inner wall. In some embodiments, the upwardly extending pipes may draw the nutrient-rich water from inside or within a perimeter of the inner wall. In some embodiments, the pH of the nutrient-rich water may be adjusted via a delivery system of a buffer solution or buffer material to the inner wall. In some embodiments, the pH of the nutrient-rich water may be detected via the pH delivery system when the nutrient-rich water passes through the downwardly extending pipe. For example, the pH delivery system may include one or more analyte sensing electrodes or analyte sensing systems positioned within a fluid pathway of the nutrient-rich water, wherein the sensing electrodes and/or sensing system is configured to monitor the pH of the nutrient-rich water in real-time. Additionally or alternatively, in some embodiments, the pH is adjusted via another delivery system to one or more of the float bins.

Any number of siphon mechanisms may be used in the aquaponics system. In some embodiments, the siphon mechanism of a particular growth media bin may be configured to continually deliver the nutrient-rich water to a particular float bin when the nutrient-rich water in the particular growth media bin is at or above a particular level. In further detail, in some embodiments, the siphon mechanism may include a cap configured to cover the end of the downwardly extending pipe and to seal the downwardly extending pipe underneath the cap except for one or more small openings in a lower portion of the cap. In some embodiments, in response to a level of the nutrient-rich water falling below at least a portion of the small openings and exposing at least a portion of the small openings to air, the siphon mechanism may be configured to stop delivering the nutrient-rich water to the particular float bin. In some embodiments, as the particular growth media bin fills with the nutrient-rich water from the tank and/or one or more growth towers, the small openings may become covered with the nutrient-rich water such that no air can enter the cap, and the siphon mechanism may begin again to deliver the nutrient-rich water to the float bin.

In some embodiments, the aquaponics system may include a water source coupled with one or more of the float bins. In some embodiments, the water source may be configured to raise a water level in the float bins. In some embodiments, the water source may include an outlet pipe, which may be coupled with a particular float bin, such as, for example, the float bin closest to the tank and/or the water source. In some embodiments, an inlet valve of the outlet pipe of the water source may be configured to open to let water from the water source into the particular float bin in response to a level of the nutrient-rich water in the particular float bin being low. In some embodiments, the inlet valve is configured to turn the water on when a filler float or ball float falls.

In some embodiments, the growth towers may be connected directly to a greenhouse and harvested above the growth media bins and/or the float bins. In some embodiments, the growth towers may be attached to an overhead conveyor mechanism, which may be attached to the greenhouse structure. In some embodiments, the conveyor mechanism may be used to transport the growth towers between a planting area and a harvesting area.

In some embodiments, a bin support structure configured to hold the growth media bins and/or the float bins may be extended upwards to create a framework for the conveyor mechanism to attach. In some embodiments, one or more of the growth towers may be attached or linked together to form a train. In some embodiments, the overhead conveyor mechanism may move automatically to a new location via motors or other means implemented. In some embodiments, after harvesting, the growth towers may go through a manual or automatic cleaning system before returning to the planting or propagation area.

In some embodiments, the support structure of the growth media bins and the float bins is extended upward and utilized as the support structure of the greenhouse. In some embodiments, the greenhouse is free standing and not connected to the support structure. In some embodiments, the aquaponics system is not enclosed in a greenhouse or part of the greenhouse.

BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments will be described in and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a perspective view of an example aquaponics system, according to some embodiments;

Figure 2 is a perspective view of multiple example aquaponics systems, according to some embodiments;

Figure 3 is a cross-sectional view of the aquaponics system of Figure 1, according to some embodiments;

Figure 4A is a cross-sectional view of an example inner wall and siphon mechanism, according to some embodiments;

Figure 4B is a cross-sectional view of the inner wall and the siphon mechanism of Figure 4A, according to some embodiments;

Figure 5 is an upper perspective of the inner wall and siphon mechanism of Figure 4, according to some embodiments;

Figure 6 is an upper perspective view of the inner wall and siphon mechanism of Figure 4 with a cap of the siphon mechanism removed, according to some embodiments;

Figure 7 is a perspective view of an example support structure, according to some embodiments;

Figure 8 is an upper perspective view of the aquaponics system of Figure 1 with the growth towers removed, according to some embodiments;

Figure 9 is an upper perspective view of an example growth media bin, according to some embodiments;

Figure 10 is an upper perspective view of an example float bin, according to some embodiments;

Figure 11 is a perspective view of an example tank, according to some embodiments;

Figure 12 is a perspective view of an example outlet pipe, inlet pipe, and water source pipe, according to some embodiments;

Figure 13 is a cross-sectional view of a portion of the aquaponics system of Figure 1, according to some embodiments;

Figure 14 is a cross-sectional view of a portion of the aquaponics system of Figure 1, according to some embodiments;

Figure 15 is an engineered drawing of an example inner wall, according to some embodiments;

Figure 16 is an engineered drawing of a portion of an example siphon mechanism, according to some embodiments;

Figure 17 is an engineered drawing of an example float bin, according to some embodiments;

Figure 18 is an engineered drawing of the float bin of Figure 17, according to some embodiments;

Figure 19 is a lower perspective view of the float bin of Figure 17, according to some embodiments;

Figure 20 is an engineered drawing of another example bin, according to some embodiments;

Figure 21 is a lower perspective view of the bin of Figure 20, according to some embodiments;

Figure 22 is an engineered drawing of an example longitudinal beam of the support structure of Figure 7, according to some embodiments;

Figure 23 is an engineered drawing of an example cross beam of the support structure of Figure 7, according to some embodiments;

Figure 24 is an engineered drawing of an end portion of the support structure of Figure 7, according to some embodiments;

Figure 25 is an upper perspective drawing of a portion of an example aquaponics system, according to some embodiments;

Figure 26A is an upper perspective view of an example support mechanism, according to some embodiments;

Figure 26B is a cross-sectional view of the support mechanism of Figure 26A, according to some embodiments;

Figure 26C is a top view of an example conveyor system, according to some embodiments; and

Figure 26D is an upper perspective of the support structure of Figure 7, according to some embodiments.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates generally to aquaponics systems and related methods. Referring now to Figure 1, in some embodiments, an aquaponics system 10 for growing plants may include a tank 12 configured to hold one or more aquatic animal species and nutrient-rich water. Nutrients in the nutrient-rich water, such as nitrogen, phosphorus, potassium, *etc.*, may result from feces of the at least one aquatic animal species and may facilitate plant growth. In some embodiments, the aquatic animal species may include fish.

In some embodiments, the aquaponics system may include one or more growth media bins 14. Growth media 16 within the growth media bins 14 may include any variety of growth media 16 for facilitating plant growth. In some embodiments, the growth media 16 may facilitate growth of microgreens. In these and other embodiments, the growth media 16 may include lava rock and/or worms. In some embodiments, the growth media bins 14 may include one or more plants 22 in containers 23 disposed in the growth media 16. In some embodiments, the containers 23 may be partially or completely buried in the growth media 16. In some embodiments, bottoms of the containers 23 may be open and/or include a moisture wicking surface such that containers 23 for the plants may fill and drain as the growth media bins 14 fill and drain.

In some embodiments, the aquaponics system 10 may include one or more hydroponic or float bins 18. In some embodiments, each of the float bins 18 may include a float element 20 configured to float in the nutrient-rich water in the corresponding float bin 18 and to hold one or more plants 22 partially submerged in the nutrient-rich water. In some embodiments, the float element 20 may include one or more holes 24 configured to hold containers of the plants 22. In some embodiments, the float element 20 may include a polystyrene foam board encapsulated in plastic.

In some embodiments, the aquaponics system 10 may include one or more aeroponic growth towers. In some embodiments, the nutrient-rich water may be continuously or intermittently provided via to the growth towers 26. In some embodiments, the growth towers 26 may be configured to hang above the growth media bins 14. In some embodiments, the growth towers 26 may hang from one or more other structures. In some embodiments, the growth towers 26 may hang from a conveyor, as will be explained later in further detail. In some embodiments, the growth towers 26 may be elongated and/or vertical. The growth towers 26 may be constructed of any number of materials. In some embodiments, the growth towers 26 may be constructed of one or more materials, including but not limited to, wood, metal, composite materials, bamboo, plastic, glass, and fiberglass. In some embodiment, growth towers 26 is constructed of a material that compatible for extended exposure to water, and which is compatible for plant growth. For example, in some embodiments growth towers 26 are constructed of a material that does not leach chemicals that are harmful to plant or aquatic life. In some embodiments, the growth towers 26 may include open access tops for watering. In some embodiments, gravity may pull water down to water each of the plants 22 of the growth towers 26. In some embodiments, the plants 22 may be disposed in pockets of the growth towers 26. In some embodiments, a support mechanism to support the growth tower provides the ability to spin or swivel the tower, as will later be described bin in further detail with respect to Figure 26A-B.

In some embodiments, each of the upwardly extending pipes 28 may deliver the nutrient-rich water to the growth towers 26 and may be configured to drip the nutrient-rich water on a top or another portion of the growth towers 26. Additionally or alternatively, the upwardly extending pipe 28 may be configured to provide a mist on the top or another portion of the growth towers 26. In some embodiments, the upwardly extending pipe 28 may be configured to provide a small stream and/or a coarse spray to the top or another portion of the growth towers 26. In some embodiments, each upwardly extending pipe 28 may be configured to deliver the nutrient-rich water from a particular growth media bin 14 to one or more particular growth towers 26 via a pump. In these and other embodiments, the particular growth media bin 14 may be configured to collect excess of the nutrient-rich water delivered to the particular growth towers 26 that drips down the particular growth towers 26. In some embodiments, the nutrient-rich water may continuously or intermittently drip down insides of the growth towers 26, and/or central openings extending along lengths of the growth towers 26 to water the plants 22 of the growth towers 26.

In some embodiments, the aquaponics system 10 may include a three-level system, with the growth media bins 14, the float bins 18, and the growth towers 26 disposed at different heights or levels. In some embodiments, the growth media bins 14 may be disposed between the growth towers 26 and the float bins 18. In some embodiments, one or more of the following may be arranged in rows: the growth media bins 14, the float bins 18, and the growth towers 26. In some embodiments, a particular growth media bin 14 disposed at an upper-level of the aquaponics system 10 may be aligned with or correspond to a particular float bin 18 at a lower-level of the aquaponics system 10 and/or the growth towers 26 may be disposed above the upper-level. In some embodiments, the particular float bin 18 aligned with the particular growth media bin 14 may receive the nutrient-rich water from the particular growth media bin 14.

In some embodiments, the aquaponics system 10 may include grow lights 31 disposed above the growth media bins 14 and/or the float bins 18. The aquaponics system 10 illustrated in Figure 1 includes 4 float bins 18 and 4 growth media bins 14. However, the aquaponics system 10 may include any number of float bins 18 and/or growth bins 14.

Referring now to Figure 2, in some embodiments, multiple aquaponics systems 10 may be disposed next to each other. In some embodiments, the multiple aquaponics systems 10 may be separated from each other such that if one of the multiple aquaponics systems 10 experiences a problem, the other multiple aquaponics systems 10 are not affected. Any number of aquaponics systems 10 may be disposed together in various locations, such as, for example, a greenhouse, a basement, *etc*. For example, 96 aquaponics systems 10 may be disposed in a greenhouse, which may be for example, 55,000 square feet. In some embodiments, the 96 aquaponics systems together may include 241,152 holes 24 for the plants 22, 21,504 square feet of growth media bins 14, and 70,000 pounds of fish in the tanks 12.

Referring now to Figure 3, in some embodiments, an outlet pipe 30 of the tank 12 may deliver the nutrient-rich water to the growth media bins 16. In some embodiments, the outlet pipe 30 may branch into multiple delivery pipes 32, which may each deliver the nutrient-rich water 38 to a different growth media bin 14. In some embodiments, the outlet pipe 30 may branch into the multiple delivery pipes 32 at a splitter.

In some embodiments, the aquaponics system 10 may include one or more downwardly extending pipes 34 and the one or more upwardly extending pipes 28. In some embodiments, each of the growth media bins 14 may include an end of a particular downwardly extending pipe 34 and/or an end of a particular upwardly extending pipe 28. In some embodiments, each of the downwardly extending pipes 34 may be configured to deliver the nutrient-rich water 38 from a particular growth media bin 14 to a particular float bin 18.

In some embodiments, the float bins 18 may include one or more pumps. In some embodiments, a single pump 36 disposed in a particular float bin 18 may be configured to pump the nutrient-rich water 38 from the float bins 18 through an inlet pipe 40 to the tank 12, which may increase efficiency of the aquaponic system 10. In some embodiments, the particular float bin 18 in which the single pump 36 is disposed may be closest to the tank 12 compared to any other float bins 18. In some embodiments, each of the float bins 18 may be fluidly connected, such as, for example, by one or more connector pipes 42, such that an equilibrium is maintained between the float bins 18 and water levels are approximately equal in each of the float bins 18. In some embodiments, the float bins 18 may be filled or partially filled with the nutrient-rich water 38.

In some embodiments, the nutrient-rich water 38 may circulate in a first loop between the tank 12, the upper level that includes the growth media bins 14, and the lower level that includes the float bins 18. In further detail, in some embodiments, the nutrient-rich water 38 may be configured to flow from the tank 12 through the outlet pipe 30 to a particular growth media bin 14, from the particular growth media bin 14 to a particular float bin 18, and from the particular float bin 18 through the inlet pipe 40 back to the tank 12 in the first loop. In some embodiments, additional nutrients may be added at the outlet pipe 30 as water flows to the growth media bins 14.

Depending on a number of growth media bins 14 and float bins 18 in the aquaponics system 10, a number of first loops may vary. For example, in response to the aquaponics system 10 including first and second growth media bins and first and second float bins, the nutrient-rich water 38 may be configured to flow from the tank 12 through the outlet pipe 30 to the first growth media bin, from the first growth media bin to the first float bin, and from the first float bin through the inlet pipe 40 back to the tank 12 in one first loop. In another first loop, the nutrient-rich water 38 may be configured to flow from the tank 12 through the outlet pipe 30 to the second growth media bin, from the second growth media bin to the second float bin, and from the second float bin through the inlet pipe 40 back to the tank 12. In some embodiments, each of the first loops may share the single pump 36. In some embodiments, the nutrient-rich water 38 may be configured to flow through multiple first loops simultaneously.

In some embodiments, the nutrient-rich water 38 may circulate in a second loop between the upper level and the growth towers 26. In further detail, in some embodiments, the nutrient-rich water 38 may be configured to flow from a particular growth media bin 14 to one or more growth towers 26 and back to the particular growth media bin 14 in a second loop. Depending on a number of growth media bins 14 in the aquaponics system 10, a number of second loops may vary. In some embodiments, each of the second loops may include one or more pumps. In some embodiments, each of the second loops may include a single pump 44, which may increase efficiency of the aquaponics system. In some embodiments, the nutrient-rich water 38 may be configured to flow through multiple second loops simultaneously.

In some embodiments, each of the growth media bins 14 may include an inner wall 46 that may surround the end of the upwardly extending pipe 28 and/or the end of the downwardly extending pipe 34. In some embodiments, the inner wall 46 may surround the pump 44 configured to deliver the nutrient-rich water 38 from a particular growth media bin 14 to one or more particular growth towers 26 via a particular upwardly extending pipe 28. In some embodiments, the inner wall 46 may surround a siphon mechanism 48, which may include the downwardly extending pipe 34.

In some embodiments, the delivery pipes 32 may deliver the nutrient-rich water 38 outside of the inner walls 46 of the growth media bins 14. In some embodiments, the inner wall 46 may be configured to separate the end of the upwardly extending pipe 28 and/or the end of the downwardly extending pipe 34 from the growth media 16 disposed in the growth media bin 14. For example, the inner wall 46 may include one or more holes 50 sized to allow the nutrient-rich water 38 to flow through the inner wall 46 but not to allow the growth media 16, such as lava rocks and/or worms, for example, to flow through the inner wall 46. In some embodiments, the upwardly extending pipes 28 may draw the nutrient-rich water 38 from inside or within a perimeter of the inner wall 46.

In some embodiments, each of the upwardly extending pipes 28 may include multiple delivery pipes 51. In some embodiments, each of the upwardly extending pipes 28 may branch into the multiple delivery pipes 51 at a splitter. In some embodiments, each of the multiple delivery pipes 51 may deliver the nutrient-rich water 38 to a particular set of growth towers 26, such as, for example, the set of growth towers 26 disposed over a single growth media bin 14.

Any number of siphon mechanisms may be used in the aquaponics system 10. Referring now to Figure 4A, in some embodiments, the siphon mechanism 48 of a particular growth media bin 14 is configured to intermittently deliver the nutrient-rich water 38 to a particular float bin 18 when the nutrient-rich water 38 in the particular growth media bin 14 is at or above a particular level. In further detail, in some embodiments, the siphon mechanism 48 may include a cap 52 configured to cover the end of the downwardly extending pipe 34 and to seal the downwardly extending pipe 34 underneath the cap 52 except for one or more small openings 54 in a lower portion of the cap 52. In some embodiments, in response to a level of the nutrient-rich water 38 falling below at least a portion of the small openings 54 and exposing at least a portion of the small openings 54 to air, the siphon mechanism 48 may be configured to stop delivering the nutrient-rich water 38 to the particular float bin 18. In some embodiments, as the particular growth media bin 14 fills with the nutrient-rich water 38 from the tank 12 and/or one or more growth towers 26, the small openings 54 may become covered with the nutrient-rich water 38 such that no air can enter the cap 52, and the siphon mechanism 48 may begin again to deliver the nutrient-rich water 38 to the float bin.

As illustrated in Figure 4B, in some embodiments, supplemental nutrients may be placed or delivered inside the inner wall 46 via a nutrient addition system, which may include a nutrient delivery line 53. In some embodiments, a sensor 55 may be disposed within the inner wall 46 may activate the nutrient addition system. In some embodiments, the sensor 55 may activate the nutrient addition system in response to a particular nutrient or nutrients being below a threshold value in water contacting the sensor 55. In some embodiments, the inner wall 46 may surround the siphon mechanism 48, which may include the downwardly extending pipe 34.

In some embodiments, the nutrient delivery line 53 may be disposed in various locations in the aquaponics system 10. For example, the nutrient delivery line 53 may be configured to add the supplemental nutrients to the outlet pipe 30 and an end of the nutrient delivery line 53 may be disposed within the outlet pipe 30.

In some embodiments, a pH delivery system 57 may be activated when water is exiting the downward extended pipe into the float bins 18. In some embodiments, a pH of the nutrient-rich water may be adjusted via the pH delivery system 57, which may be disposed within and/or along the inner wall 46. In some embodiments, the pH of the nutrient-rich water may be detected via the pH delivery system 57 when the nutrient-rich water passes through the downwardly extending pipe. Additionally or alternatively, in some embodiments, the pH may be adjusted via the pH delivery system 57 or another pH delivery system to one or more of the float bins.

Figure 5 illustrates the inner wall 46 and the siphon mechanism 48, according to some embodiments. Figure 6 illustrates the inner wall 46 and siphon mechanism 48 with the cap 52 of the siphon mechanism 48 removed, according to some embodiments. In some embodiments, the siphon mechanism 48 may be replaced with a valve in the inner wall, which may allow the nutrient-rich water into the float bins 18 or may return the nutrient-rich water to the tank 12. In some embodiments, the valve may be coupled with a timer, switch, float, or automated system that controls opening and closing of the valve.

Referring back to Figure 3, in some embodiments, the aquaponics system 10 may include a water source 56 coupled with one or more of the float bins 18. In some embodiments, the water source 56 may be configured to raise a water level in the float bins 18. In some embodiments, the water source 56 may include an outlet or water source pipe 58, which may be coupled with a particular float bin 18, such as, for example, the float bin 18 closest to the tank 12 and/or the water source 56. In some embodiments, an inlet valve of the water source pipe 58 of the water source 56 may be configured to open to let water from the water source 56 into the particular float bin 18 in response to a level of the nutrient-rich water 38 in the particular float bin 18 being low. In some embodiments, the inlet valve is configured to turn the water on when a filler float 60 or ball float falls.

In some embodiments, the nutrient-rich water 38 may enter an end of the pipe disposed at least proximate to a feces collection area 59 , of the tank 12 and may exit the tank 12 under pull of gravity and without a pump. In some embodiments, the tank 12 may include a screen62, which may prevent the aquatic species from getting sucked into the outlet pipe 30. In some embodiments, the inlet pipe 40 and/or the outlet pipe 30 may create a current within the tank 12, which may allow the aquatic species to build muscle and taste better when eaten. In some embodiments, the aquaponics system 10 may include a ultra-violet ("UV") filter 61 and/or a crystal filter 63. In some embodiments, the UV filter 61 and/or the crystal filter 63 may filter the nutrient-rich water prior to arrival of the nutrient-rich water back at the tank 12.

In some embodiments, the screen 62 may separate the end of the outlet pipe 30 from the aquatic animal species or foreign objects other than nutrient-rich water and waste from the aquatic animal species. In some embodiments, a bottom of the tank 12 may include any number of shapes. For example, the bottom of the tank 12 may be flat, rounded, or cone-shaped. In some embodiments, the screen 62 across the outlet pipe may provide useful with a particular tank 12 that includes a flat, rounded, or cone-shaped bottom, as objects may otherwise easily collect in the bottom of the tank 12. In some embodiments, the outlet pipe 30 may be protected from foreign objects entering the outlet pipe 30 by a screen across an end of the outlet pipe 30 disposed within the tank 12.

In some embodiments, to break the siphon effect and prevent the tank 12 from draining completely, a top portion of the outlet pipe 30 may include a cap 65 that includes one or more holes. In some embodiments, the inner wall may surround a valve mechanism which may allow water into the lower float bins or may return water to the tank.

Referring now to Figure 7, in some embodiments the growth media bins 14 and/or the float bins 18 may be supported by a support structure 64.

Referring now to Figure 8, in some embodiments, the outlet pipe 30 of the tank 12 may branch into multiple delivery pipes 32, which may each deliver the nutrient-rich water 38 to a different growth media bin 14. In some embodiments, the outlet pipe 30 may branch into the multiple delivery pipes 32 at a splitter.

Referring now to Figure 9, in some embodiments, the inner wall 46 may include the holes 50, which may allow the nutrient-rich water 38 to flow through the inner wall 46, which may be covered by a lid 66. Figure 10 illustrates an example float bin 18, according to some embodiments. As illustrated in Figures 9-10, in some embodiments, the growth media bins 14 and/or the float bins 18 may include one or more grooves which may direct flow to a central location where the nutrient-rich water 28 may be transferred to another level in the aquaponics system 100.

Referring now to Figure 11, in some embodiments, the outlet pipe 30 of the tank 12 may branch into the multiple delivery pipes 32 at a splitter 67. In some embodiments, the outlet pipe 30 may include an outlet port valve 68 and/or a flush port 70, which may allow flushing out of all or a portion of the aquaponics system 10 as needed. A water source pipe 72 coupled with the water source 56 may be disposed at various locations. In some embodiments, the water source pipe 72 may extend parallel and/or in close proximity to the inlet pipe 40 and/or the outlet pipe 30.

In some embodiments, if a particular float bin 18 and/or a particular growth media bin 14 aligned with each other and connected by a particular downwardly extending pipe 34 experience a problem, such as an infection, a valve 74 on the particular delivery pipe 32 extending to the particular growth media bin 14 may be shut off, preventing flow of the nutrient-rich water 38 from the tank 12 to the particular growth media bin 14. Additionally, in some embodiments, the single pump 36 may also be turned down, which may facilitate isolation of the particular float bin 18 and/or the particular growth media bin 14 from any other float bins 18 and/or growth media bins 14 while the problem is solved or a repair is made.

Referring now to Figure 12, in some embodiments, an inlet valve of the water source pipe 58 of the water source 56 may be configured to open to let water from the water source 56 into the particular float bin 18 in response to a level of the nutrient-rich water 38 in the particular float bin 18 being low. In some embodiments, the inlet valve is configured to turn the water on when a filler float 60 or ball float falls.

Figure 13 is a cross-sectional view of a portion of the aquaponics system 100, according to some embodiments. Figure 14 is a cross-sectional view of a portion of the aquaponics system 100, according to some embodiments. Figure 15 is an engineered drawing of a particular inner wall 46, according to some embodiments. In some embodiments, the inner wall 46 may be part of a bucket. Figure 16 is an engineered drawing of a portion of a particular siphon mechanism 48 having a cap 52, according to some embodiments. Figure 17 is an engineered drawing of a particular float bin 18, according to some embodiments. Figure 18 is an engineered drawing of the particular float bin 18, according to some embodiments. Figure 19 is a lower perspective view of the particular float bin 18, according to some embodiments. Figure 20 is an engineered drawing of another example bin, according to some embodiments. In some embodiments, the particular bin may include a float bin 18 or a growth media bin 14. Figure 21 is a lower perspective view of the bin of Figure 20, according to some embodiments. Figure 22 is an engineered drawing of an example longitudinal beam of the support structure 64, according to some embodiments. Figure 23 is an engineered drawing of an example cross beam of the support structure 64, according to some embodiments. Figure 24 is an engineered drawing of an end portion of the support structure 64. Figure 25 is an upper perspective drawing of a portion of a particular aquaponics system 100, according to some embodiments.

Referring now to Figures 26A-26B, in some embodiments, the growth towers 26 may be attached to a conveyor, which may be attached to the greenhouse. In some embodiments, the conveyor may be elevated or overhead.

In some embodiments, a support mechanism 80 coupled to one or more growth towers 26 may provide the ability to spin or swivel the growth towers 26, as illustrated, for example, in Figures 26A-26B. In some embodiments, the support mechanism 80 may include a hook and/or clevis. In some embodiments, the support mechanism 80 may be configured to attach the growth towers 26 to a conveyor trolley 82 of the conveyor.

Figure 26C illustrates an example conveyor 85. In some embodiments, the conveyor 85 may be used to transport the growth towers and/or the aquaponics system 10 between one or more of the following areas: a planting area 84, a harvesting area 86, and a cleaning area 88. In some embodiments, the conveyor 85 may provide a loop within a greenhouse and/or outside of a greenhouse. In some embodiments, the growth towers 26 may be harvested above the growth media bins 14 and/or the float bins 18.

In some embodiments, one or more of the growth towers 26 may be attached or linked together to form a train. Referring now to Figure 26D, in some embodiments, the conveyor 85 may automatically move the growth towers 46 and/or the aquaponics system 10 to a new location via motors or other means implemented. In some embodiments, after harvesting, the growth towers 26 may go through a manual or automatic cleaning system before returning to the propagation or planting area 84. In some embodiments, the conveyor 85 may include a rope or similar structure.

In some embodiments, the support structure 64, which may be configured to hold the growth media bins 14 and/or the float bins 18, may be extended upwards to create a framework for the conveyor to attach. In some embodiments, the support structure 64 is extended upward and utilized as the support structure of the greenhouse 90. In some embodiments, the greenhouse 90 is free standing and not connected to the support structure 64. In some embodiments, the aquaponics system 10 is not enclosed in a greenhouse 64 or part of the greenhouse 64. In some embodiments, the growth towers 26 and/or aquaponics system 10 may be connected directly to a greenhouse.

CLAIMS

1. An aquaponics system for growing plants, comprising:

a tank configured to hold one or more aquatic animal species and nutrient-rich water, wherein the tank includes an outlet pipe and an inlet pipe;

a growth media bin, wherein the outlet pipe delivers the nutrient-rich water to the growth media bin;

a downwardly extending pipe and an upwardly extending pipe, wherein an end of the downwardly extending pipe and an end of the upwardly extending pipe are disposed within the growth media bin;

a float bin that includes a pump, wherein the downwardly extending pipe is configured to deliver the nutrient-rich water from the growth media bin to the float bin, wherein the pump is configured to pump the nutrient-rich water from the float bin through the inlet pipe to the tank; and

an growth tower configured to hang above the growth media bin, wherein the upwardly extending pipe is configured to deliver the nutrient-rich water from the growth media bin to the growth tower via another pump, wherein the growth media bin is configured to collect excess of the nutrient-rich water delivered to the growth tower that drips down the growth tower.

2. The aquaponics system of claim 1, wherein the nutrient-rich water is configured to flow from the tank through the outlet pipe to the growth media bin, from the growth media bin to the float bin, and from the float bin through the inlet pipe back to the tank in a first loop, wherein the nutrient-rich water is configured to flow from the growth media bin to the growth tower and back to the growth media bin in a second loop, and wherein the pump is an only pump in the first loop.

3. The aquaponics system of claim 1, further comprising one or more additional growth media bins, one or more additional float bins, and one or more additional growth towers, wherein the float bin and the one or more additional float bins are fluidly connected and the pump is further configured to pump the nutrient-rich water from the one or more additional float bins through the inlet pipe to the tank.

4. The aquaponics system of claim 1, wherein the aquaponics system includes a three level system with the growth media bin, the float bin, and the growth tower disposed at different heights.

5. An aquaponics system for growing plants, comprising:

a tank configured to hold at least one aquatic animal species and nutrient-rich water, wherein the tank includes an outlet pipe and an inlet pipe, wherein the outlet pipe branches into a first and second delivery pipe;

first and second upper-level growth media bins, wherein the first and second delivery pipes deliver the nutrient-rich water to the first and second upper-level growth media bins, respectively;

first and second lower-level float bins, wherein the first and second lower-level float bins receive the nutrient-rich water from the first and second upper-level growth media bins, respectively; and

a pump disposed within the first lower-level float bin and configured to pump the nutrient-rich water from the first and second lower-level float bins through the inlet pipe back to the tank.

6. The aquaponics system of claim 5, further comprising a first plurality of growth towers configured to hang above the first upper-level growth media bin and a second plurality of growth towers configured to hang above the second upper-level growth media bin, wherein a first pipe transports the nutrient-rich water upwardly from the first upper-level growth media bin, wherein a second pipe transports the nutrient-rich water upwardly from the second upper-level growth media bin, wherein the nutrient-rich water is configured to drip on a top of each of the first plurality of the growth towers and each of the second plurality of growth towers, wherein the pump is a first pump, wherein the first pipe is coupled with a second pump, wherein the second pipe is coupled with a third pump.

7. The aquaponics system of claim 5, wherein the outlet pipe comprises a siphon, wherein the nutrient-rich water enters an end of the siphon, wherein the end of the siphon is disposed at least proximate to a feces collection area of the tank.

8. The aquaponics system of claim 7, wherein the feces collection area is disposed at a bottom of the tank and below a grate of the tank.

9. The aquaponics system of claim 5, wherein the first upper-level growth media bin includes a first inner wall surrounding a first siphon mechanism and separating the first siphon mechanism from first growth media disposed within the first upper-level growth media bin, wherein the first delivery pipe delivers the nutrient-rich water outside the first inner wall, wherein the first inner wall includes one or more holes through which the nutrient-rich water may flow, wherein the first siphon mechanism is configured to continually deliver the nutrient-rich water to the first lower-level float bin when the nutrient-rich water in the first upper-level growth media bin is at or above a particular level; and

wherein the second upper-level growth media bin includes a second inner wall surrounding a second siphon mechanism and separating the second siphon mechanism from second growth media disposed within the second upper-level growth media bin, wherein the second delivery pipe delivers the nutrient-rich water outside the second inner wall, wherein the second inner wall includes one or more holes through which the nutrient-rich water may flow, wherein the second siphon mechanism is configured to continually deliver the nutrient-rich water to the second lower-level float bin when the nutrient-rich water in the second upper-level growth media bin is at or above a particular level.

10. The aquaponics system of claim 5, further comprising a first plurality of growth towers configured to hang above the first upper-level growth media bin and a second plurality of growth towers configured to hang above the second upper-level growth media bin, wherein a first pipe transports the nutrient-rich water upwardly from the first upper-level growth media bin, wherein a second pipe transports the nutrient-rich water upwardly from the second upper-level growth media bin, wherein the nutrient-rich water is configured to drip on a top of each of the first plurality of the growth towers and each of the second plurality of growth towers, wherein the first pipe draws the nutrient-rich water from inside the first inner wall, wherein the second pipe draws the nutrient-rich water from inside the second inner wall.

11. The aquaponics system of claim 10, wherein the first pipe is coupled with a first pump disposed inside the first inner wall, wherein the second pipe is coupled with a second pump disposed inside the second inner wall.

12. The aquaponics system of claim 5, wherein the first lower-level float bin includes a first floating element configured to hold one or more first plants partially submerged in the nutrient-rich water in the first lower-level float bin,

wherein the second lower-level float bin includes a second floating member configured to hold one or more second plants partially submerged in the nutrient-rich water in the second lower-level float bin.

13. The aquaponics system of claim 12, wherein the first and second floating members include plastic encapsulated polystyrene foam boards, wherein the plastic encapsulated polystyrene foam boards include holes configured to hold containers of the first and second plants.

14. The aquaponics system of claim 5, wherein the growth media in the first and second upper-level growth media bins includes lava rock or other media and worms.

15. The aquaponics system of claim 5, wherein the first lower-level float bin is closer to the tank than the second lower-level float bin, wherein the first lower-level float bin and the second lower-level float bin are connected via a connector pipe.

16. The aquaponics system of claim 5, further comprising a water source that includes another outlet pipe, wherein the other outlet pipe is coupled with the first lower-level float bin, wherein an inlet valve of the other outlet pipe is configured to open to let water into the first lower-level float bin from the second water source in response to a level of the nutrient-rich water being low.

17. An aquaponics system for growing plants, comprising:

a tank configured to hold at least one aquatic animal species and nutrient-rich water;

a first level that includes one or more growth media bins;

a second level that includes one or more hydroponic bins; and a third level that includes one or more growth towers,

wherein the nutrient-rich water circulates between the tank, the first level, and the second level in one or more first loops, wherein the nutrient-rich water circulates between the first level and the third level in one or more second loops.

18. The aquaponics system of claim 17, wherein each of the one or more first loops share a single pump.

19. The aquaponics system of claim 17, wherein each of the multiple second loops includes a single pump.

20. A system or method as recited in the disclosure and/or any of the drawings.

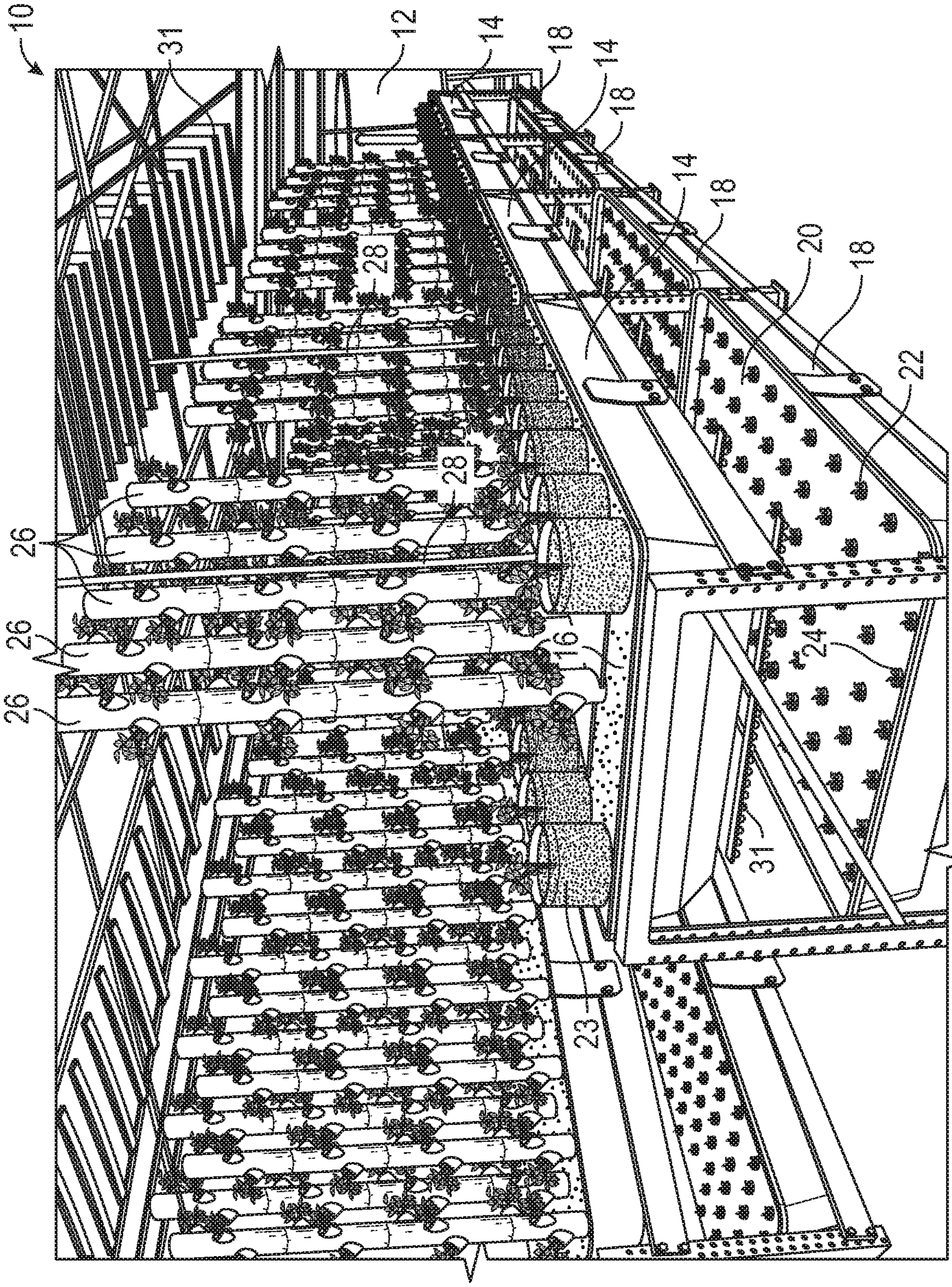

FIG. 1

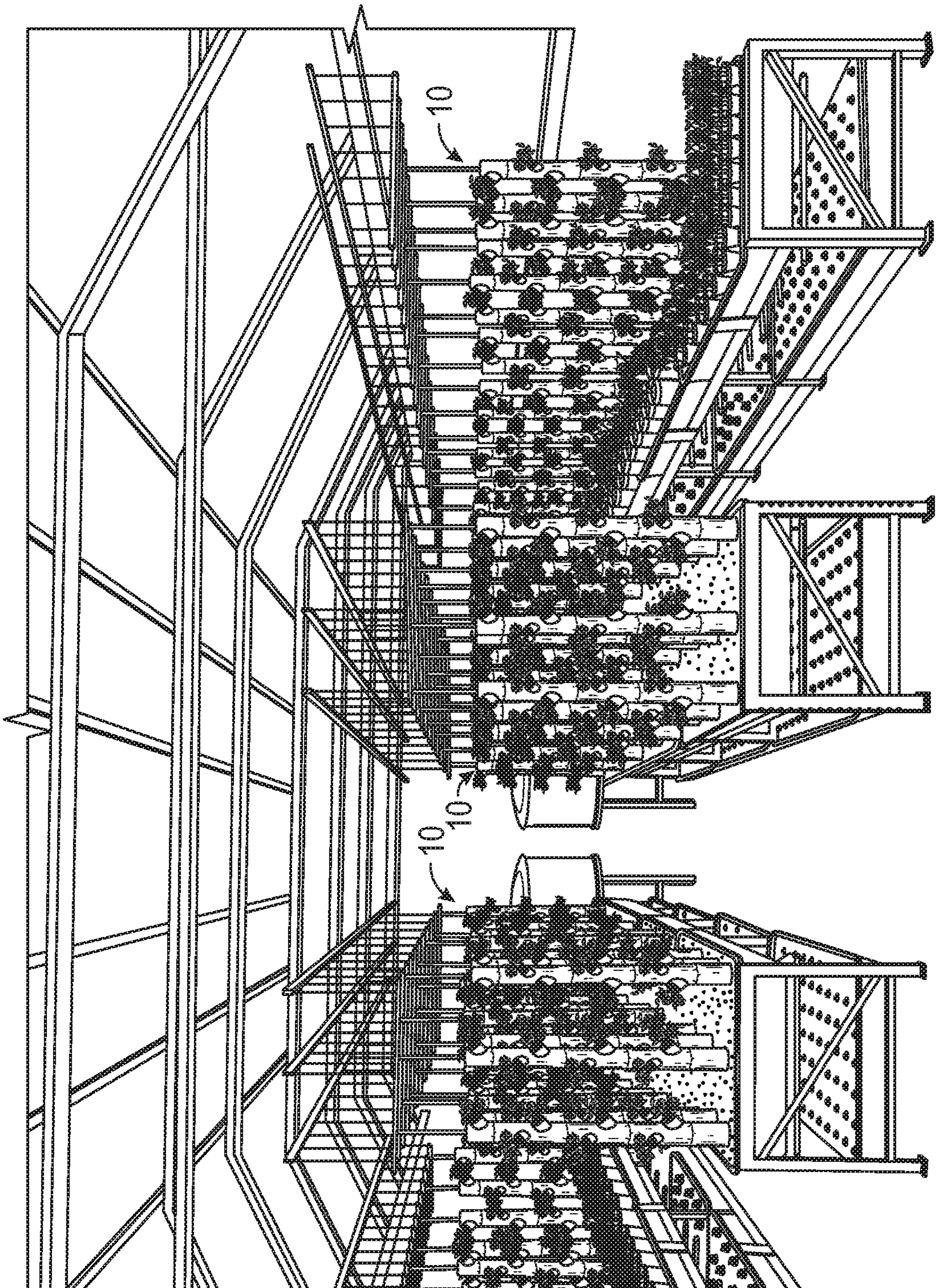

FIG. 2

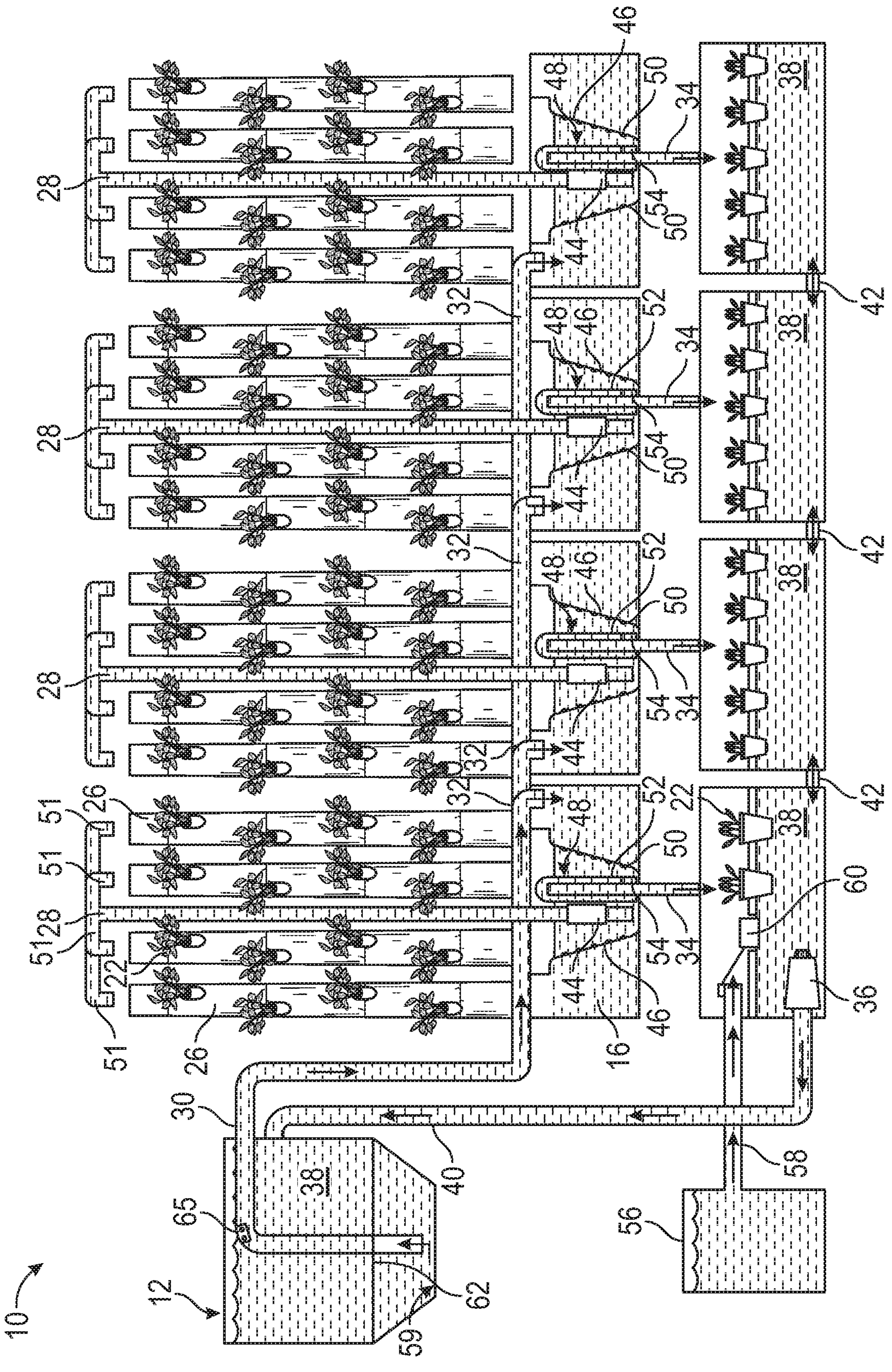
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FIG. 3

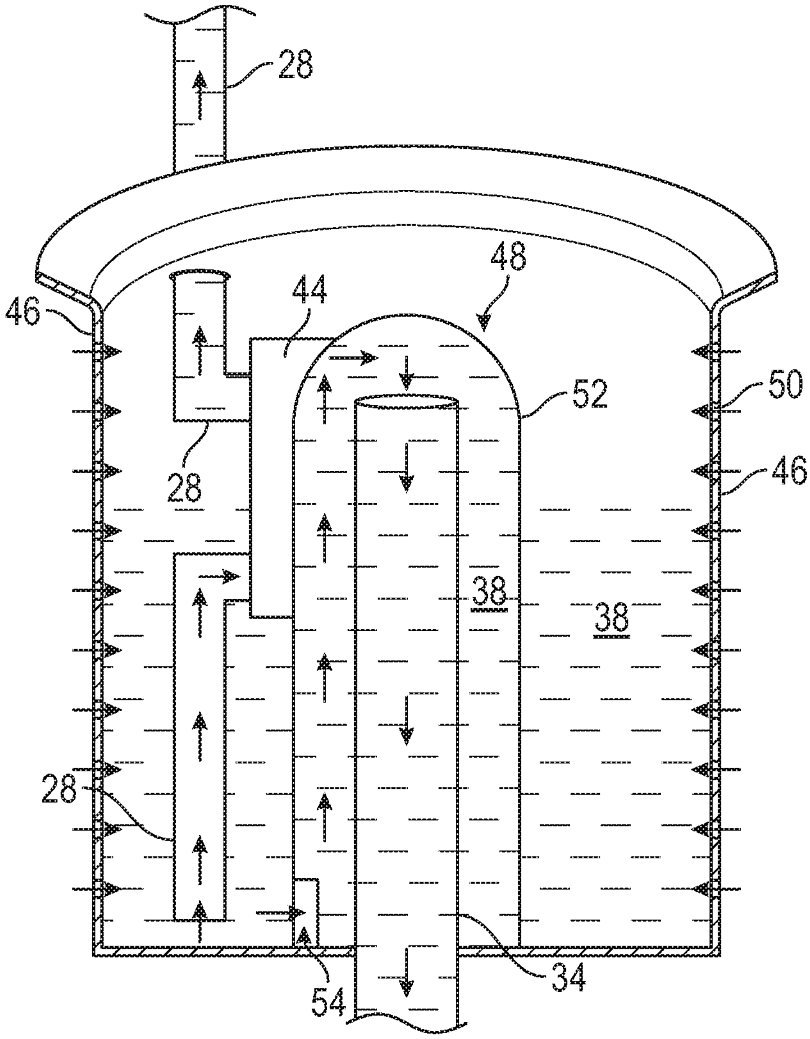

FIG. 4A

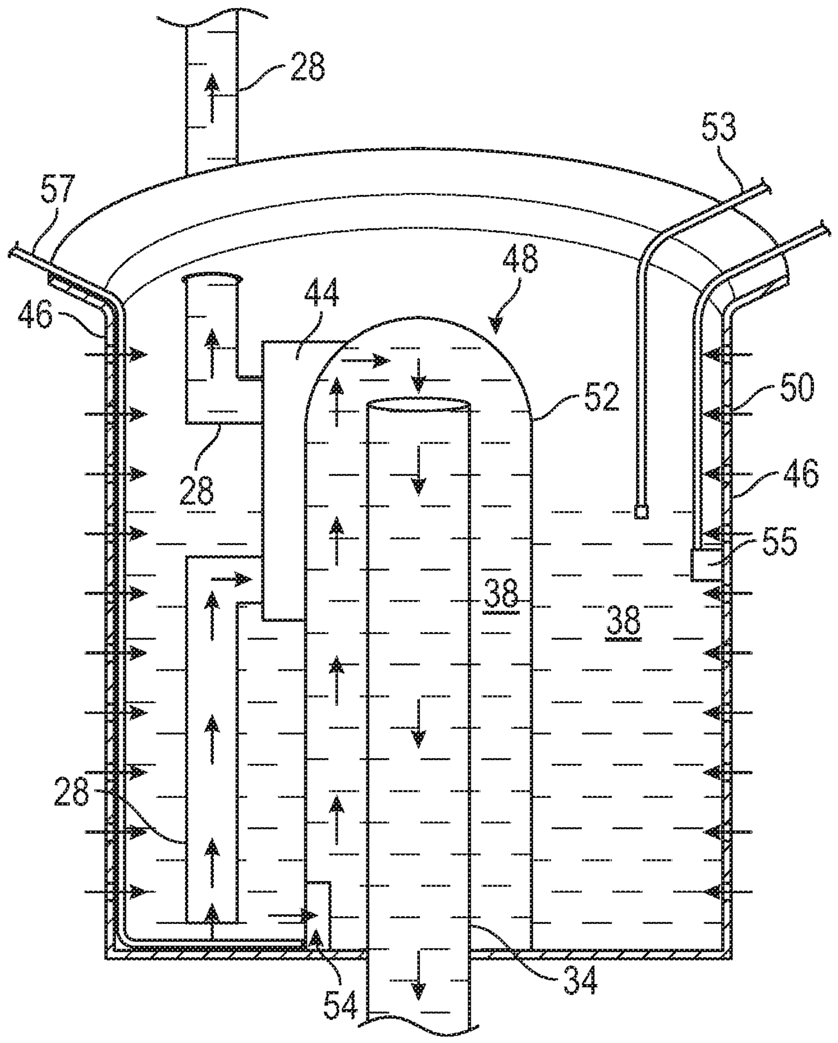

FIG. 4B

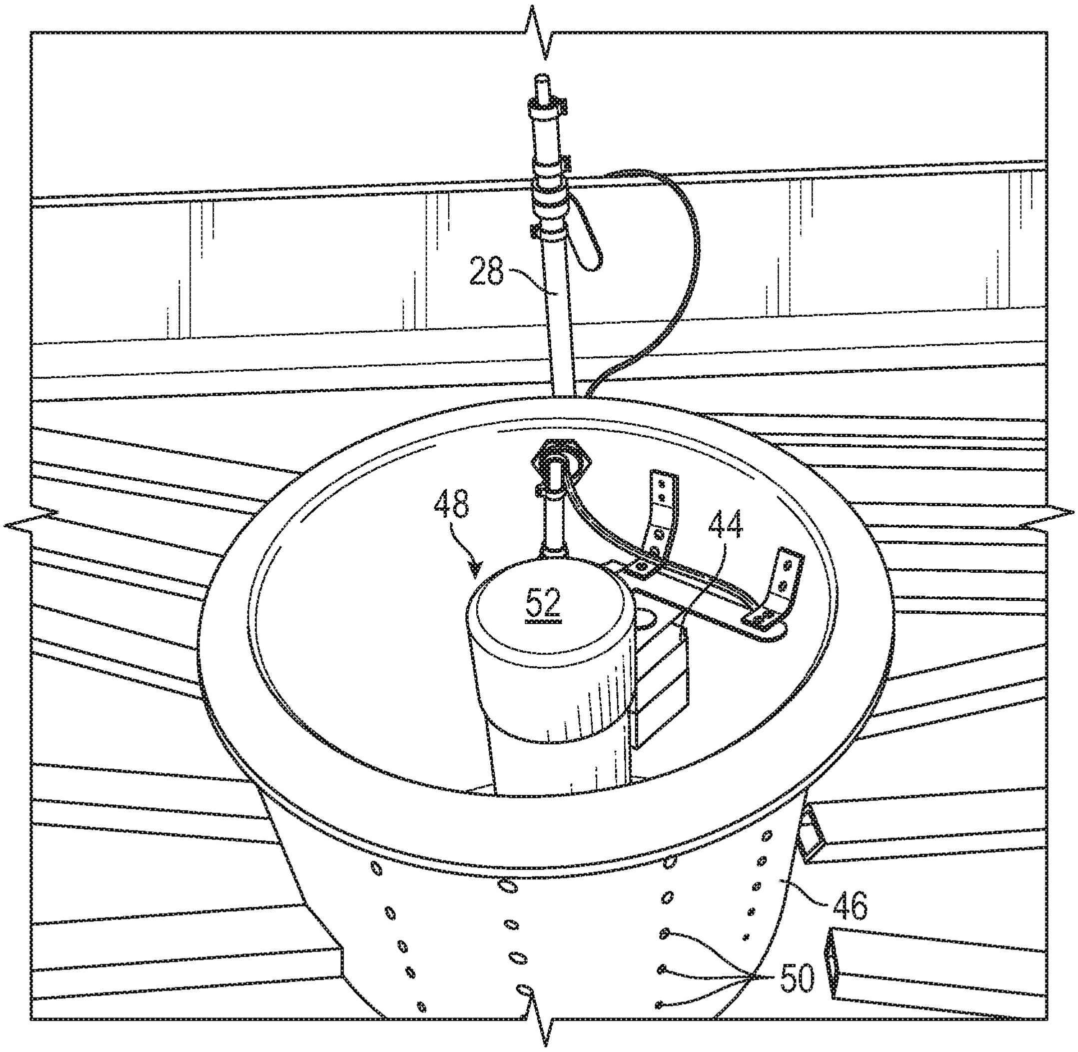

FIG. 5

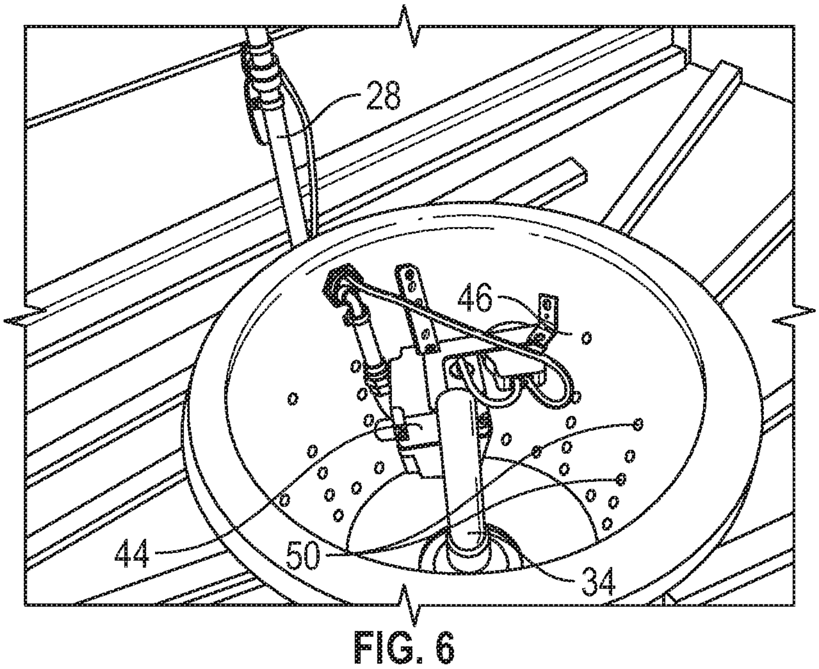

FIG. 6

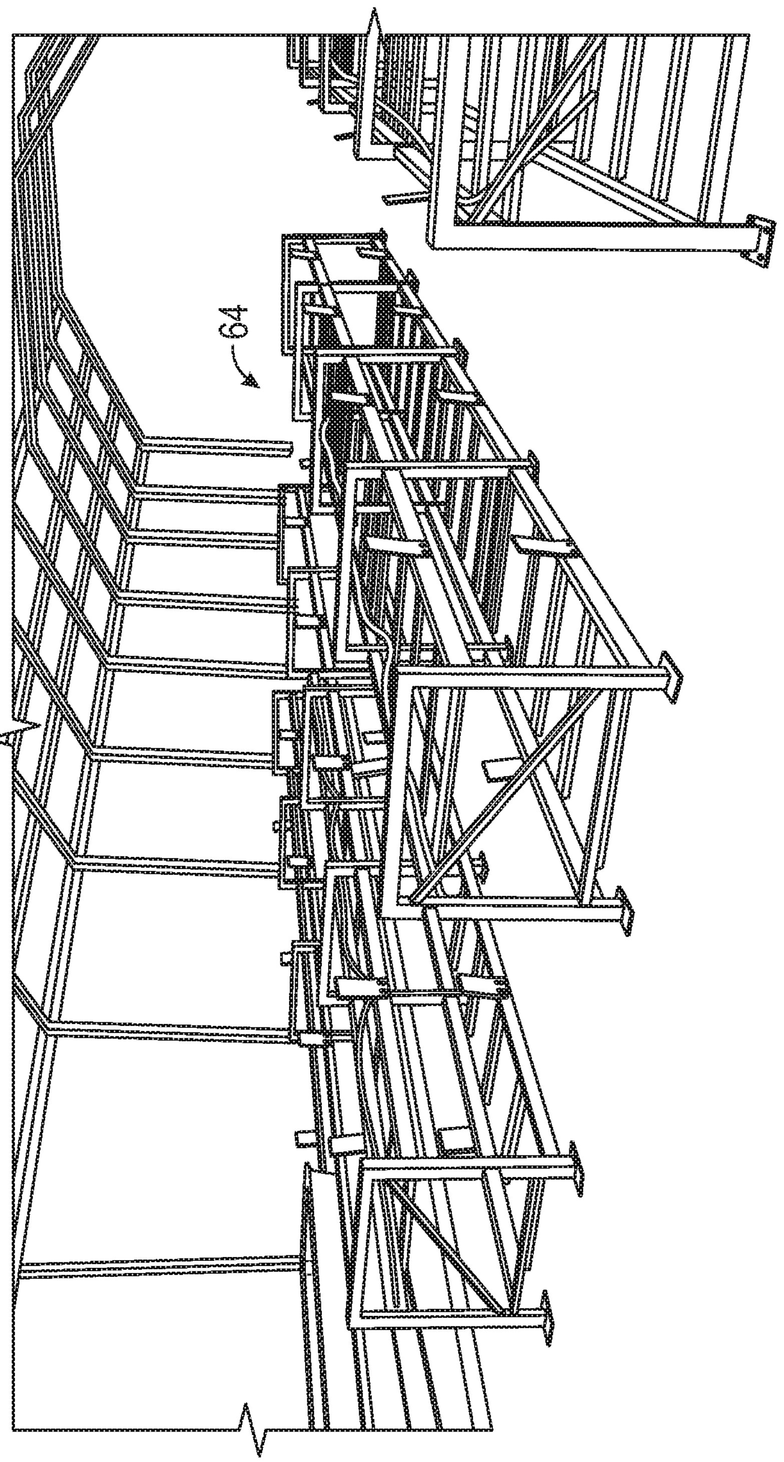

FIG. 7

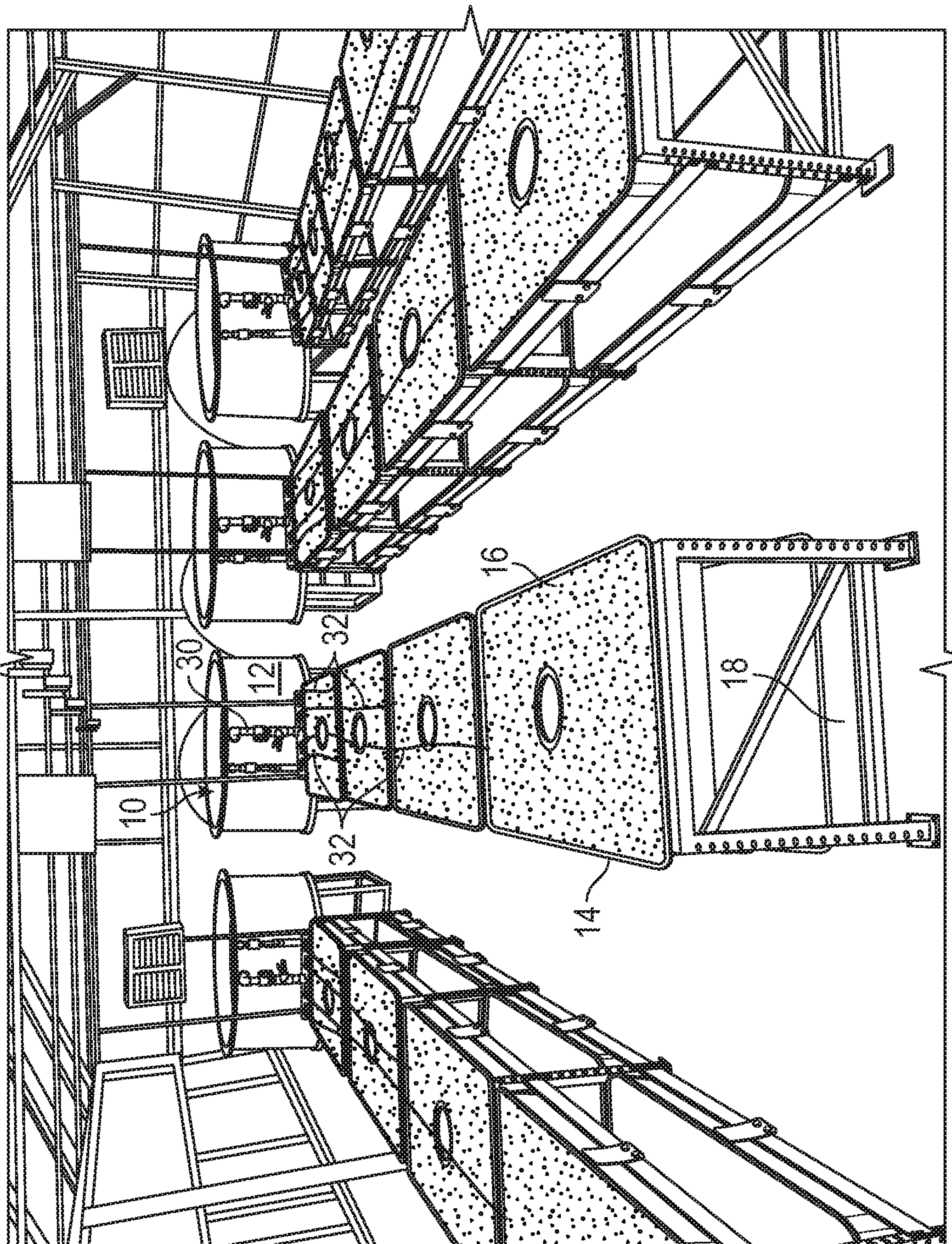

FIG. 8

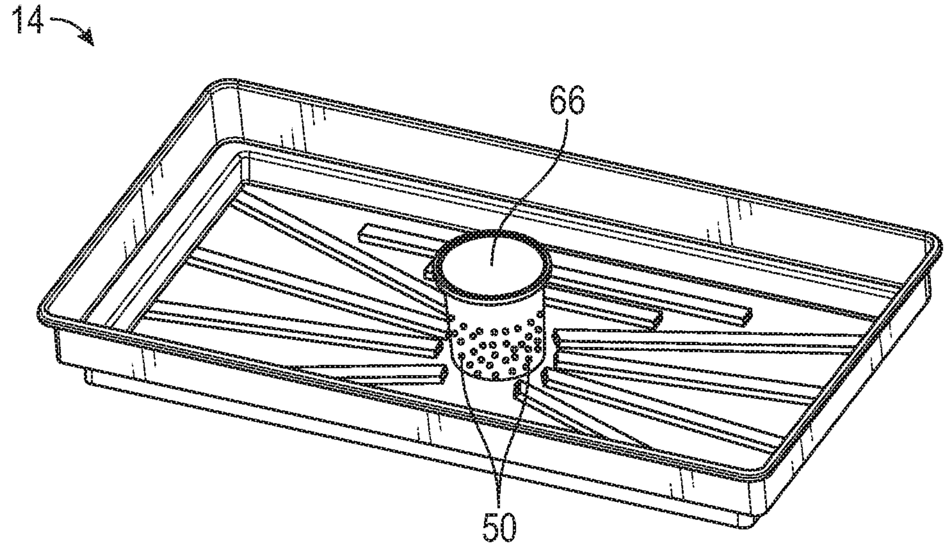

FIG. 9

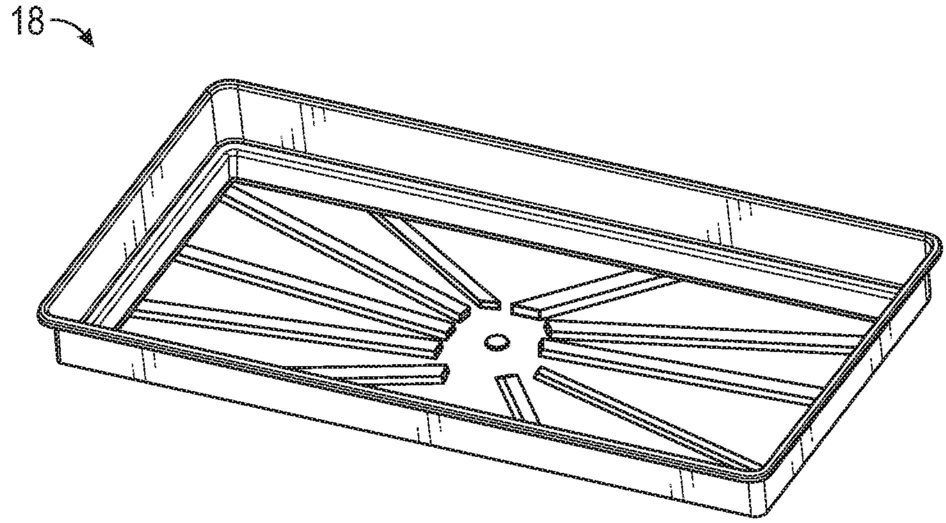

FIG. 10

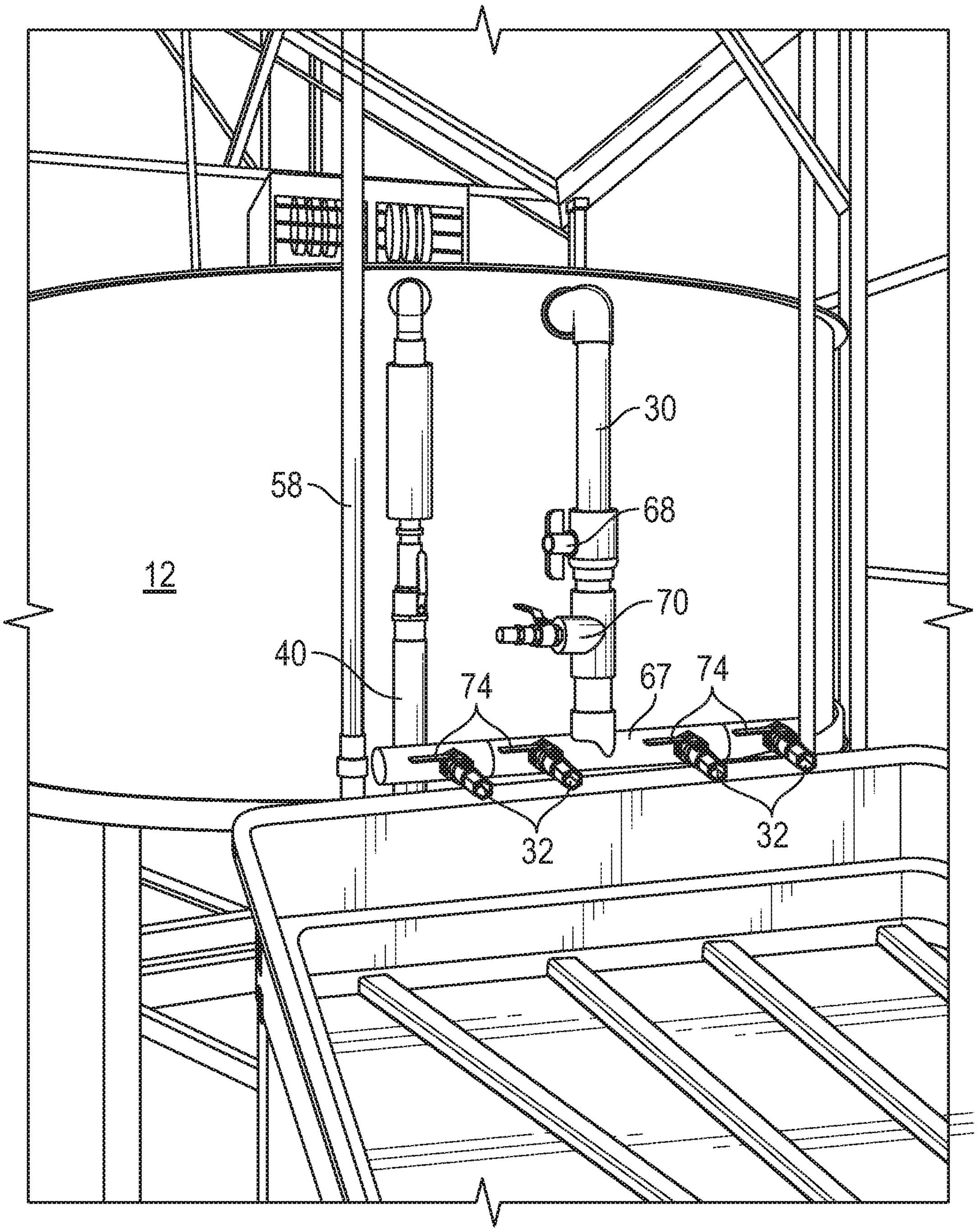

FIG. 11

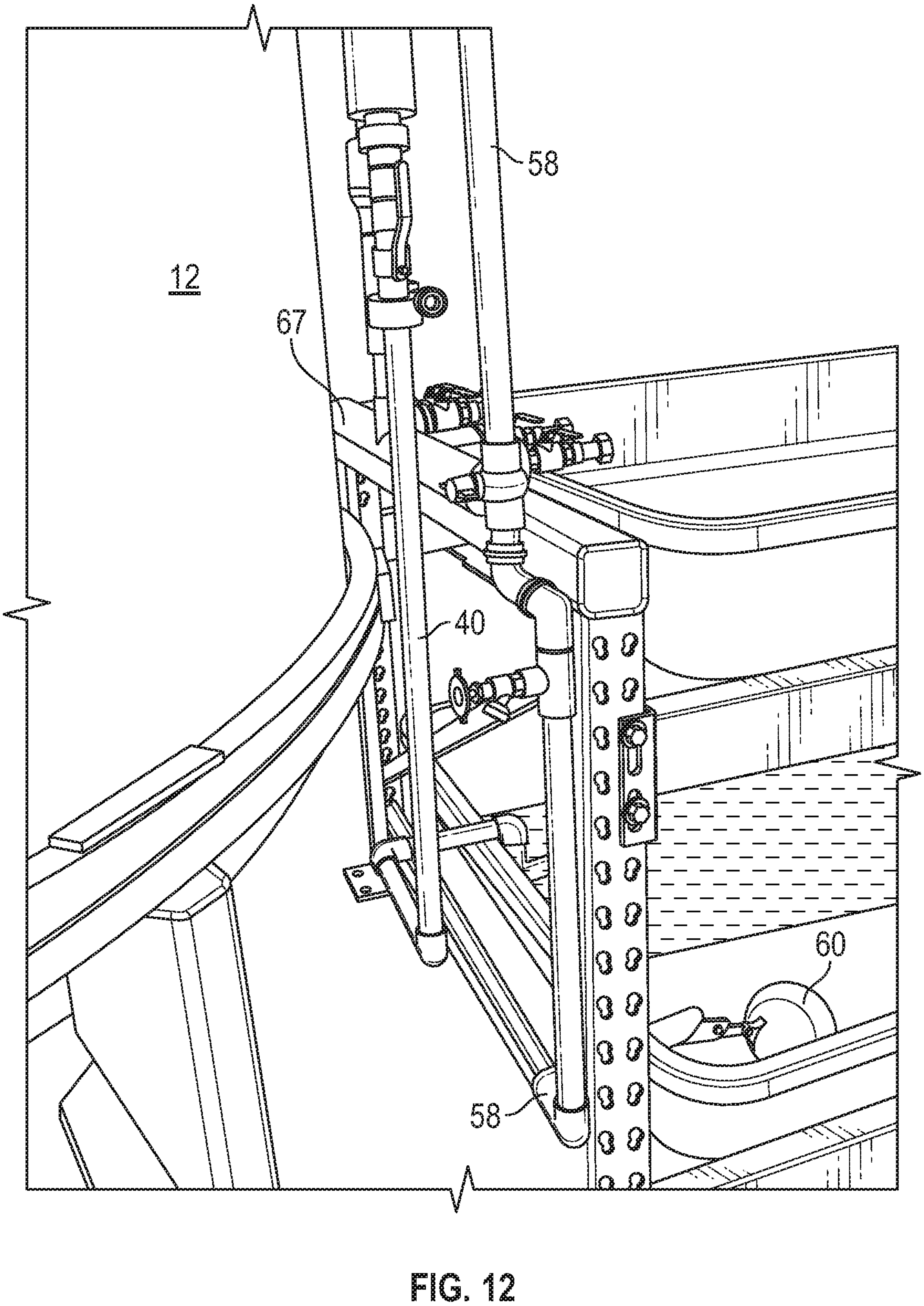

FIG. 12

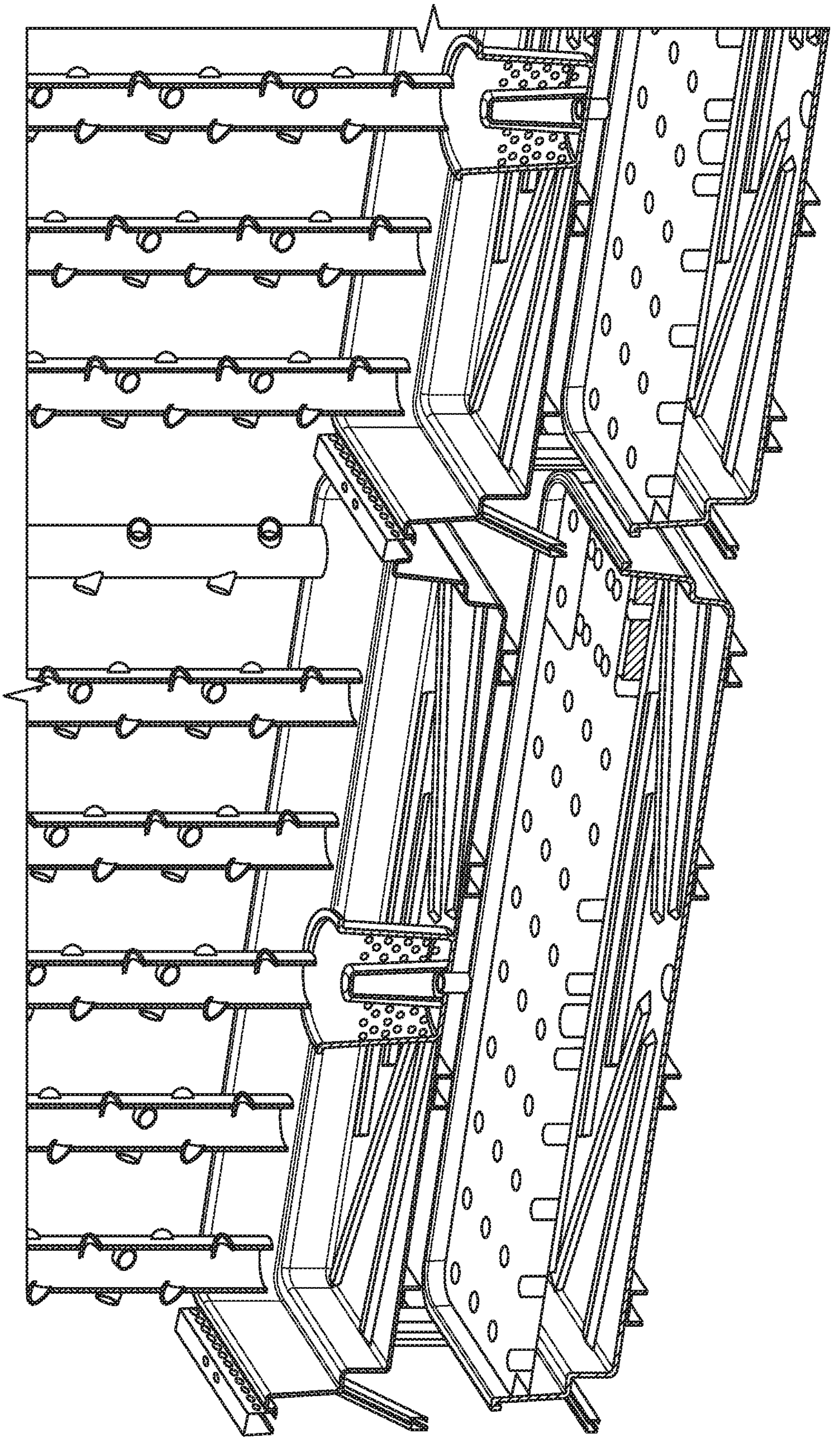

FIG. 13

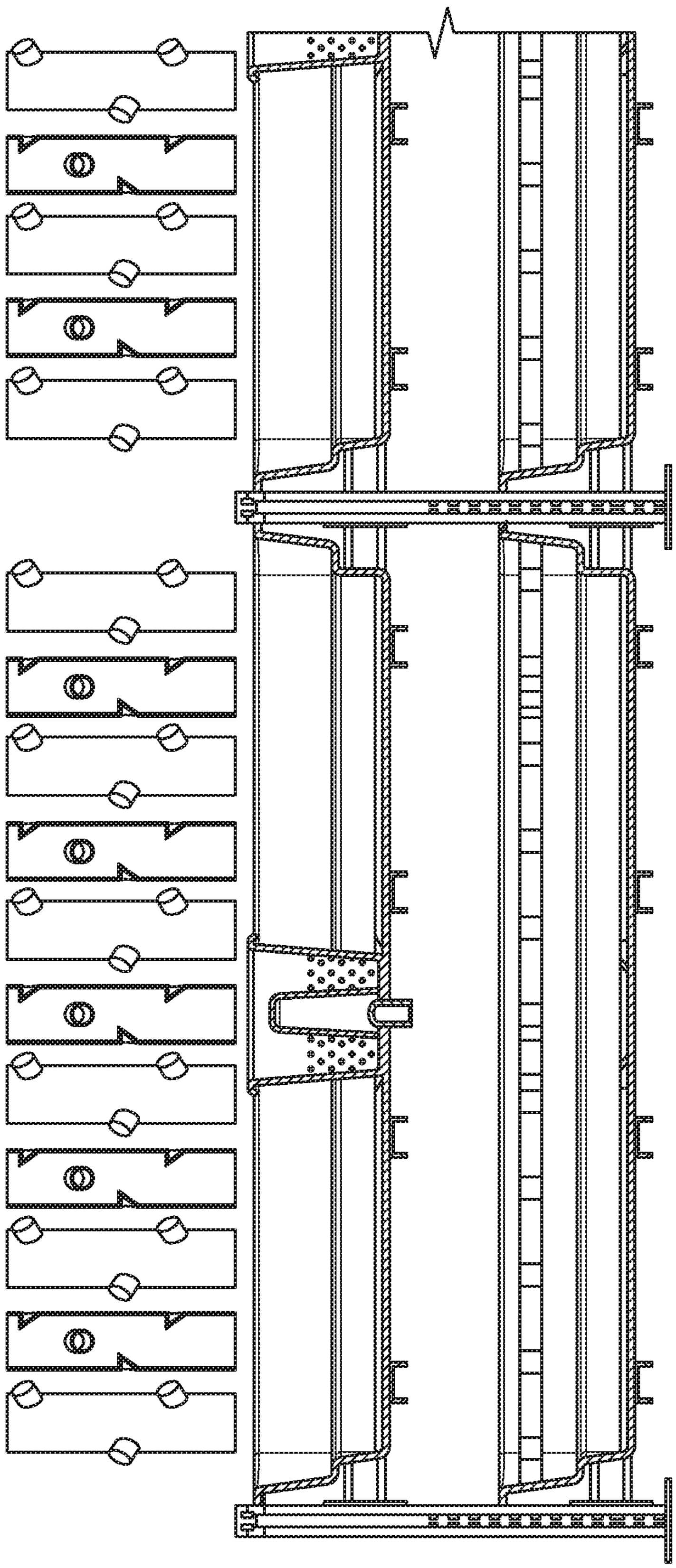

FIG. 14

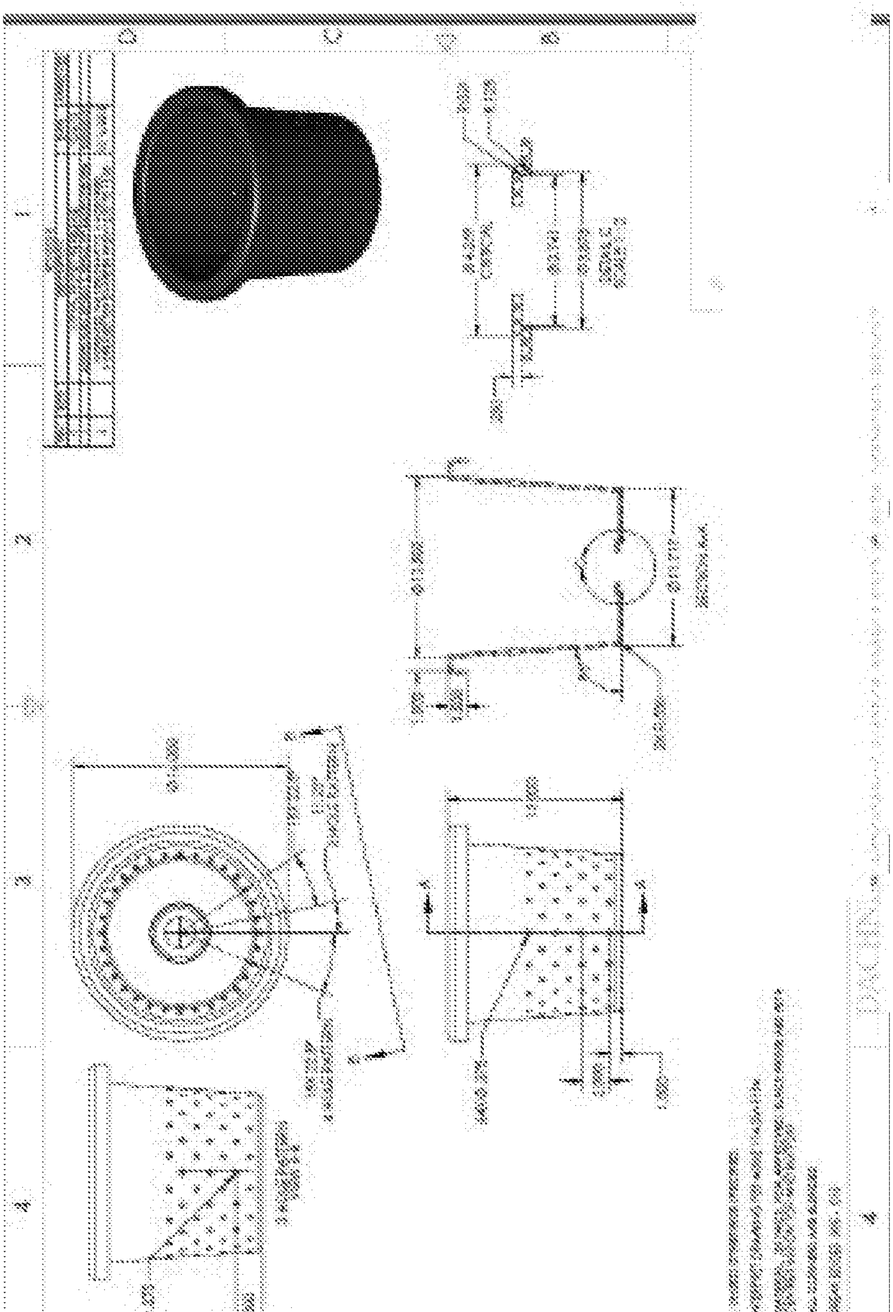

FIG. 15

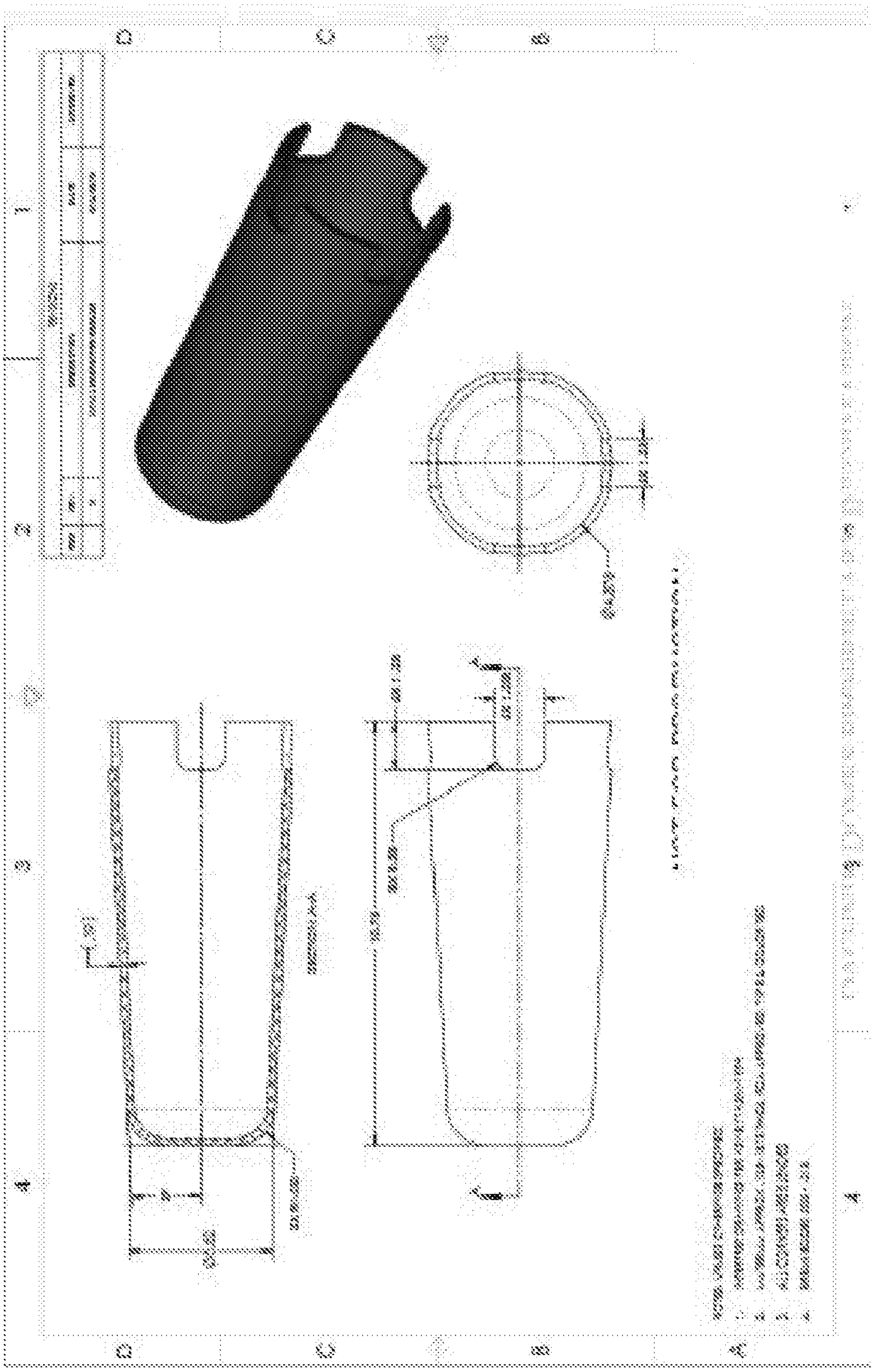

FIG. 16

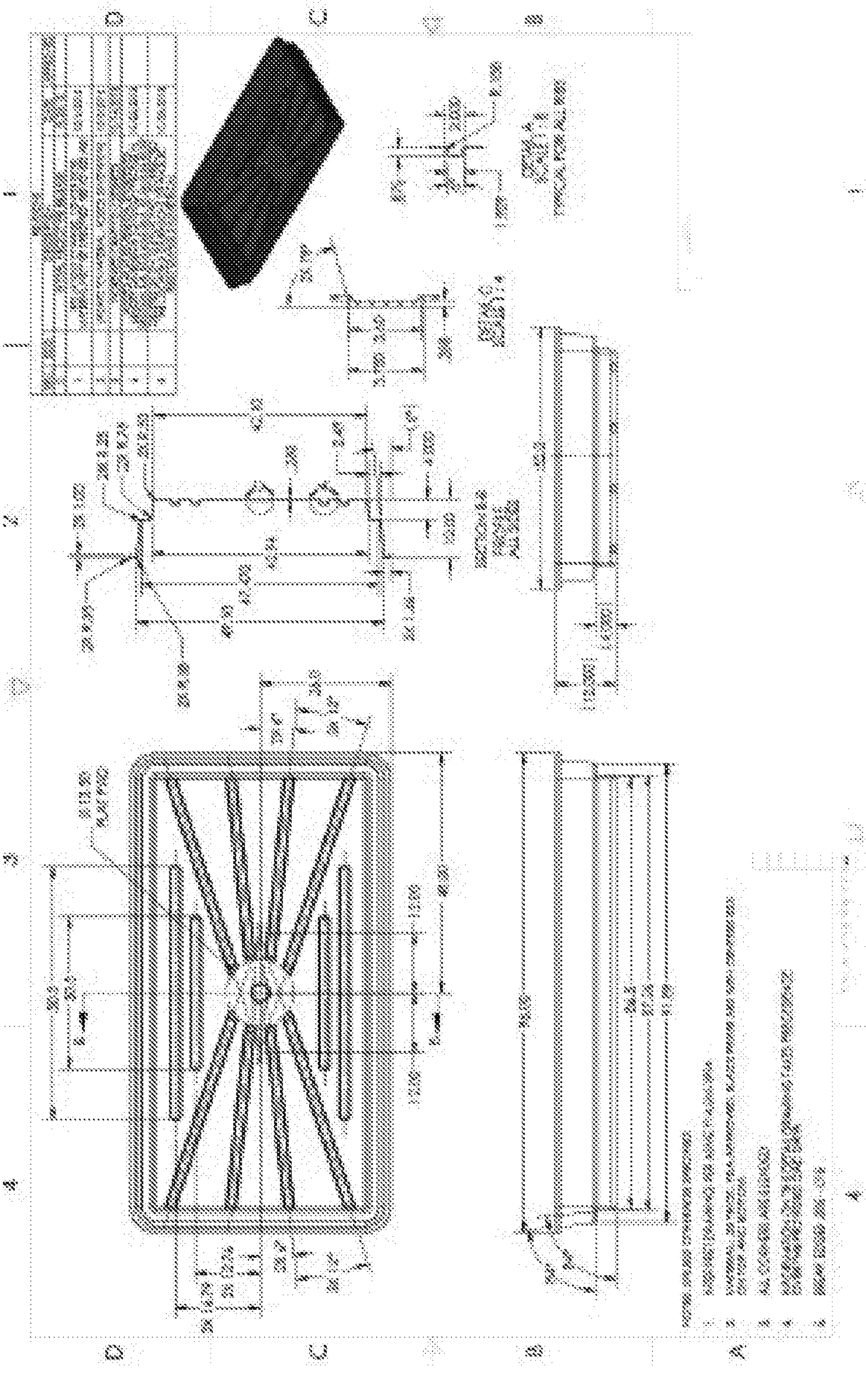

FIG. 17

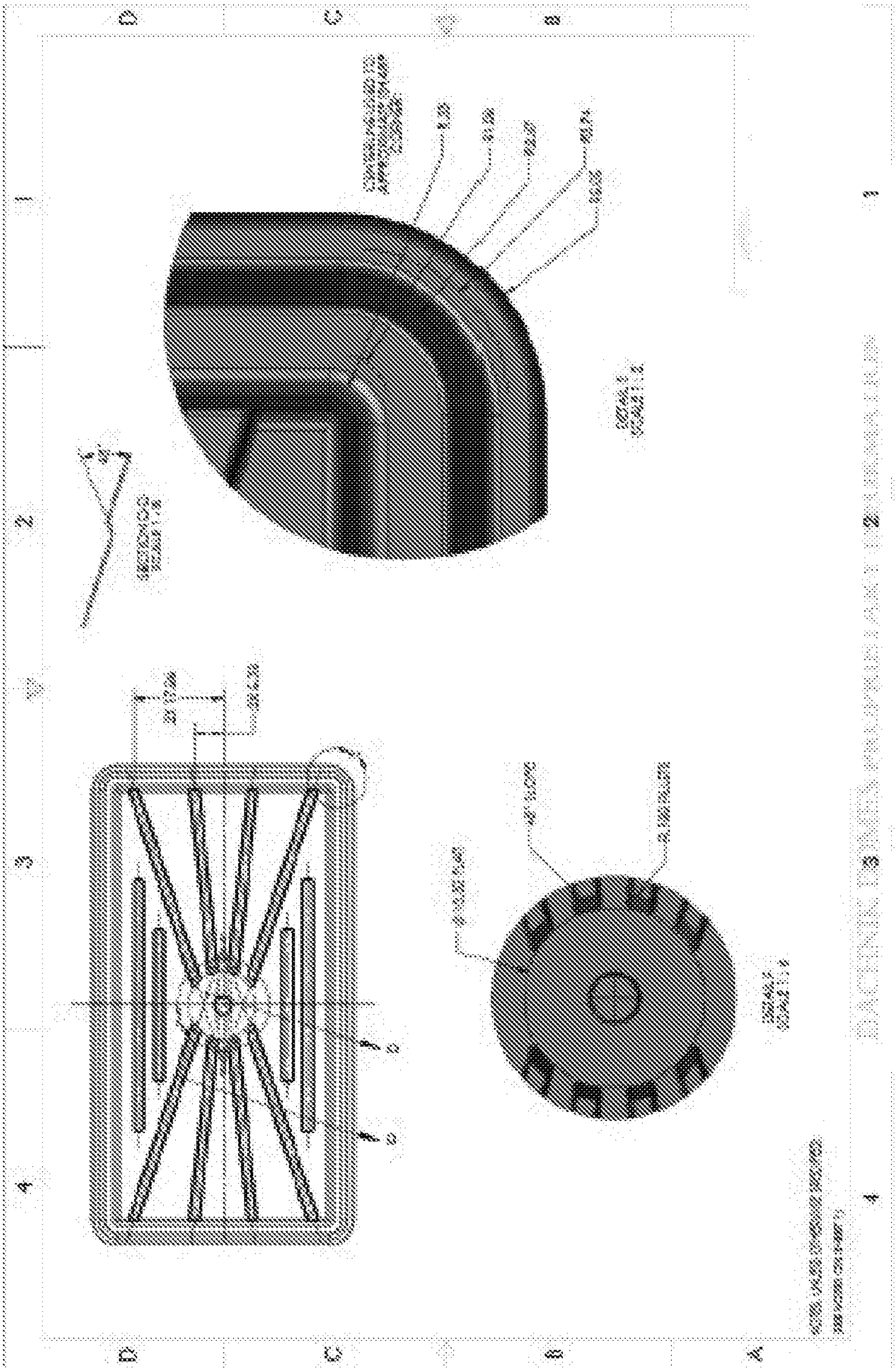

FIG. 18

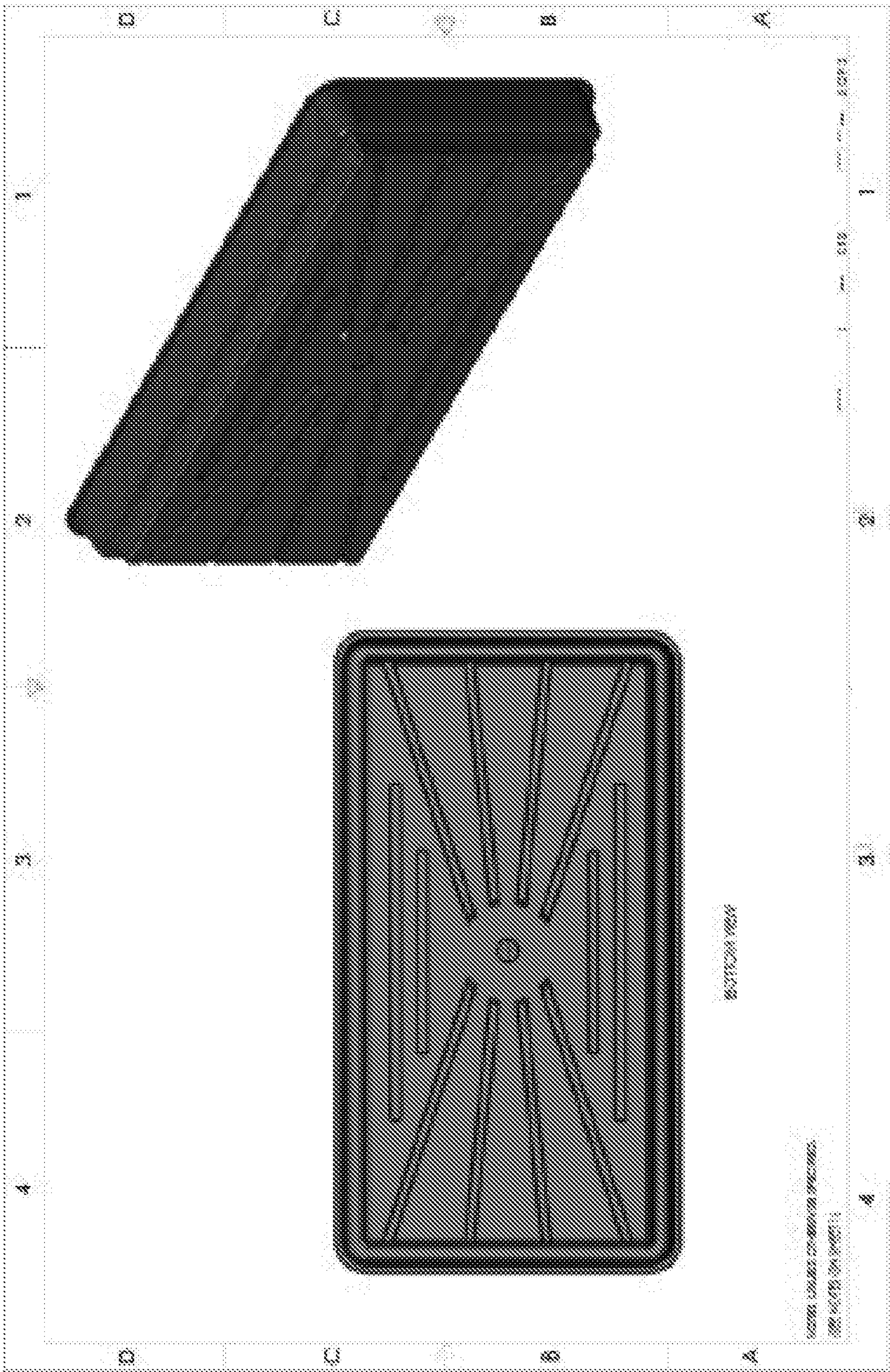

FIG. 19

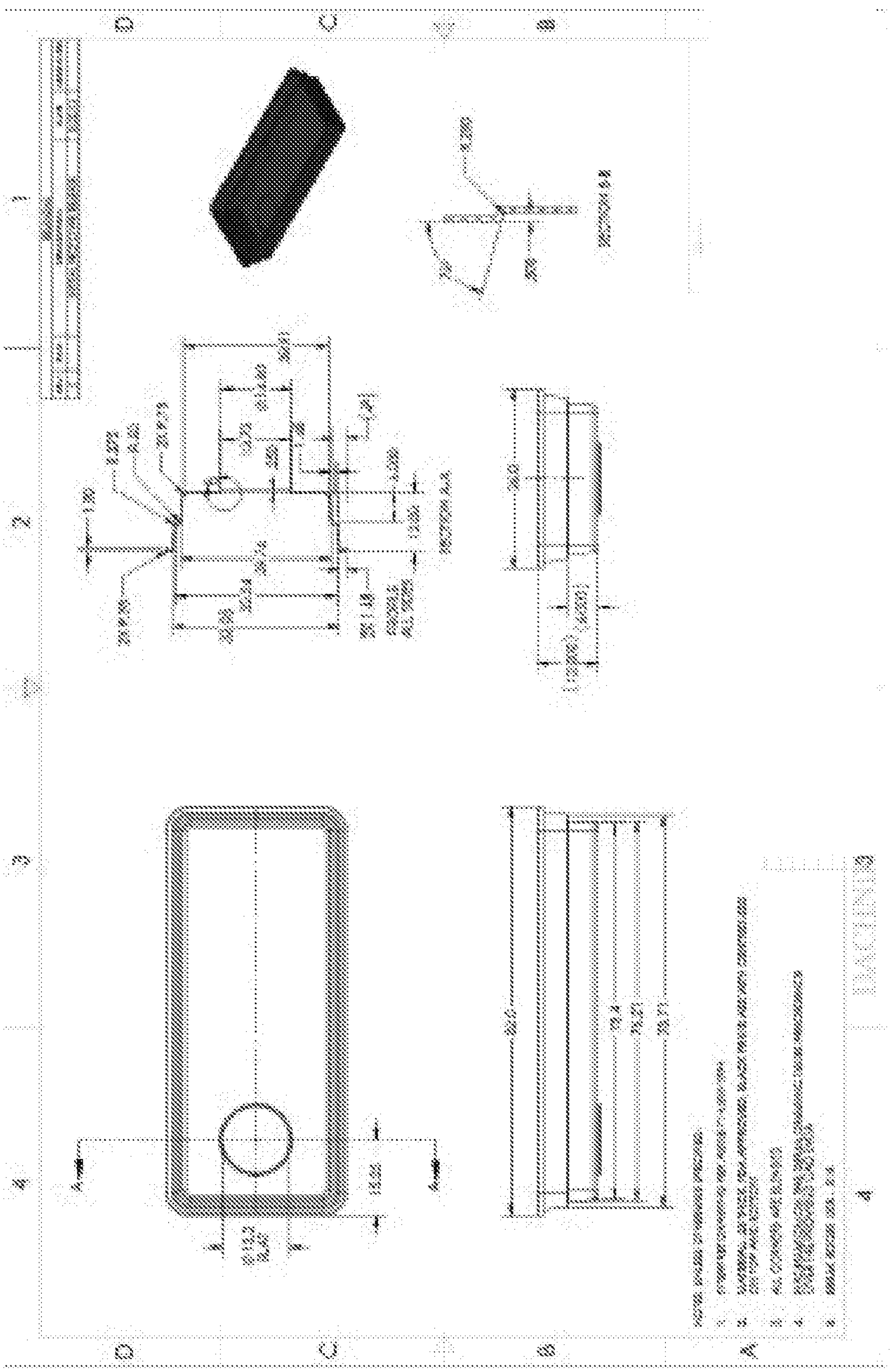

FIG. 20

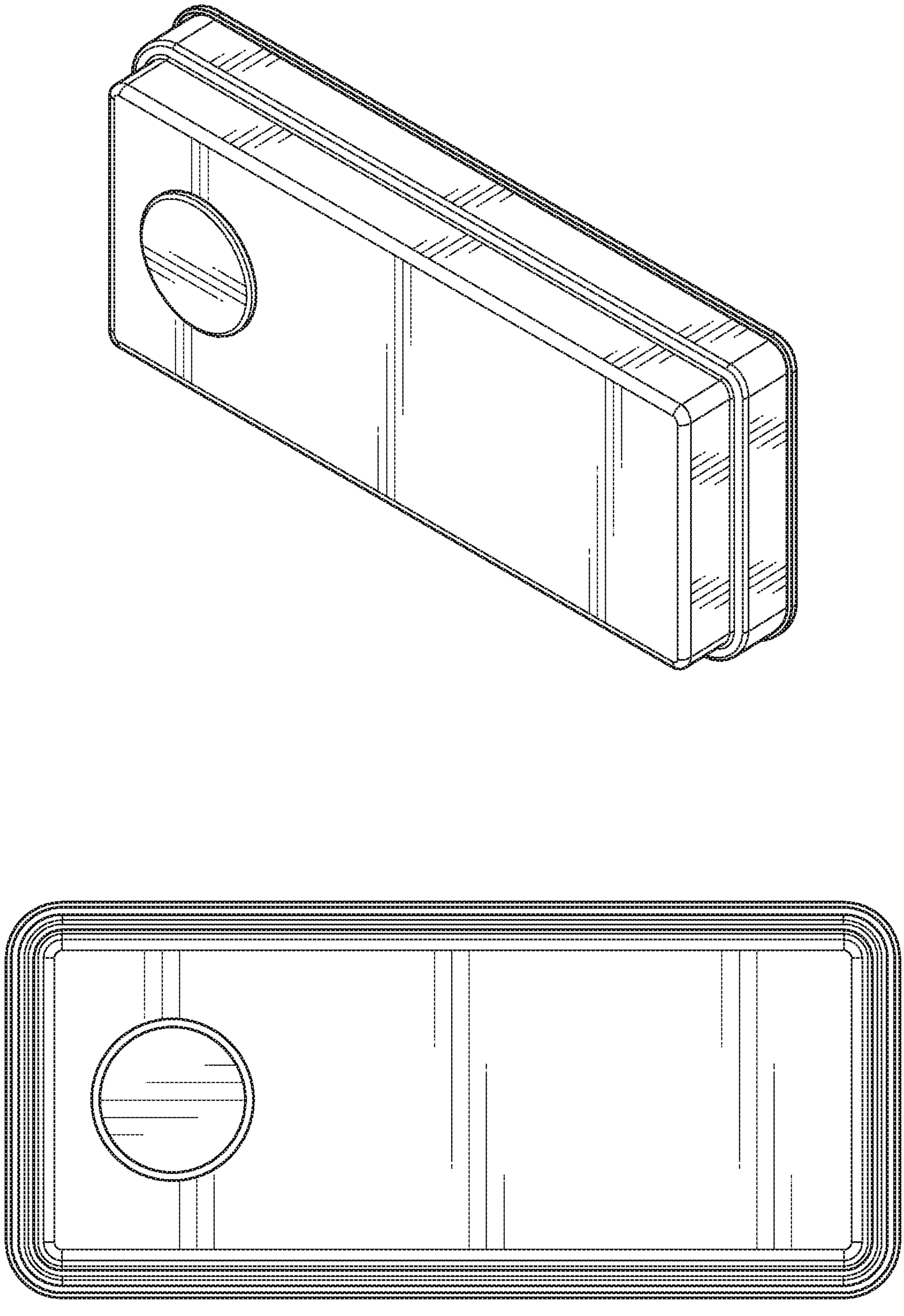

FIG. 21

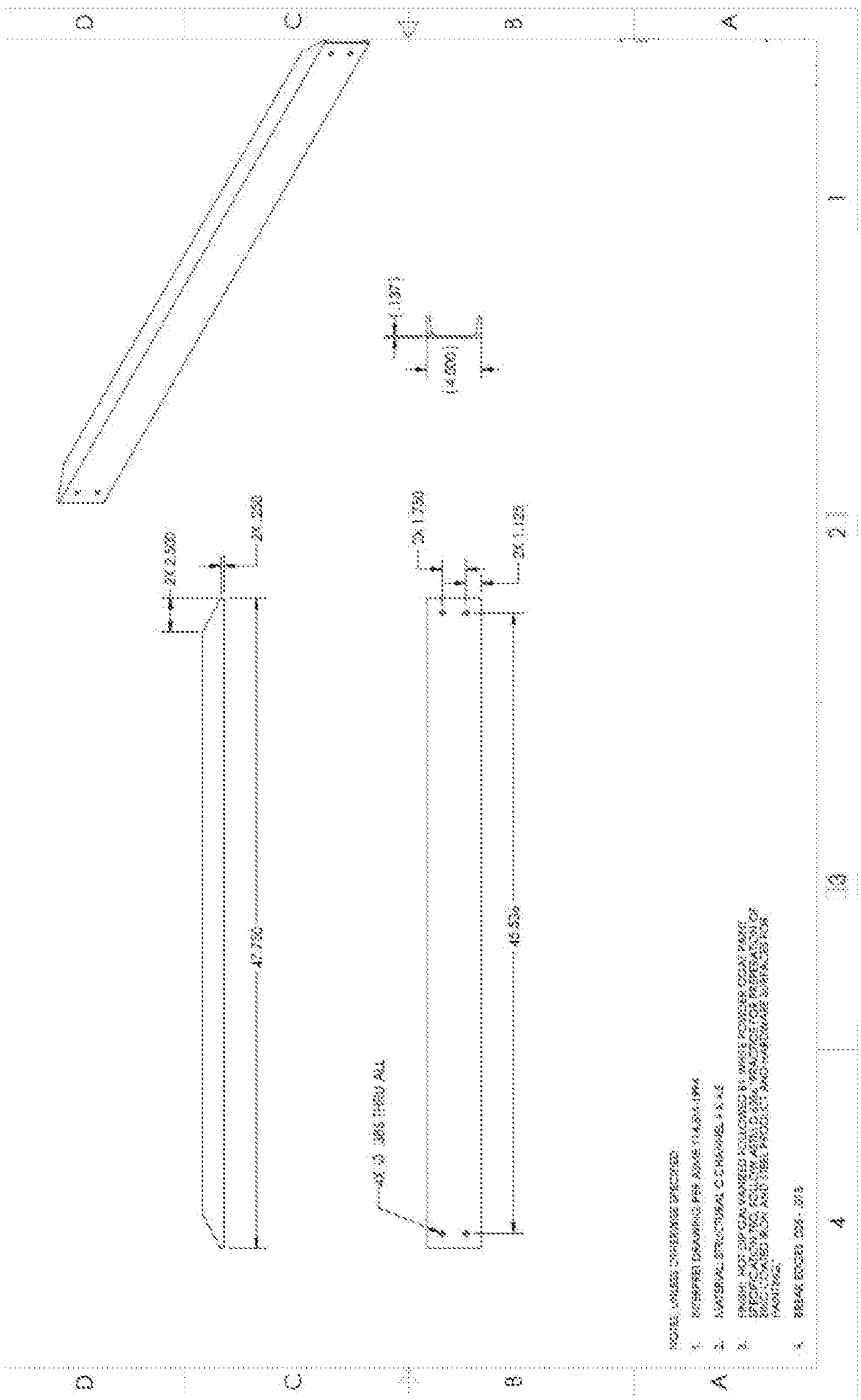

FIG. 22

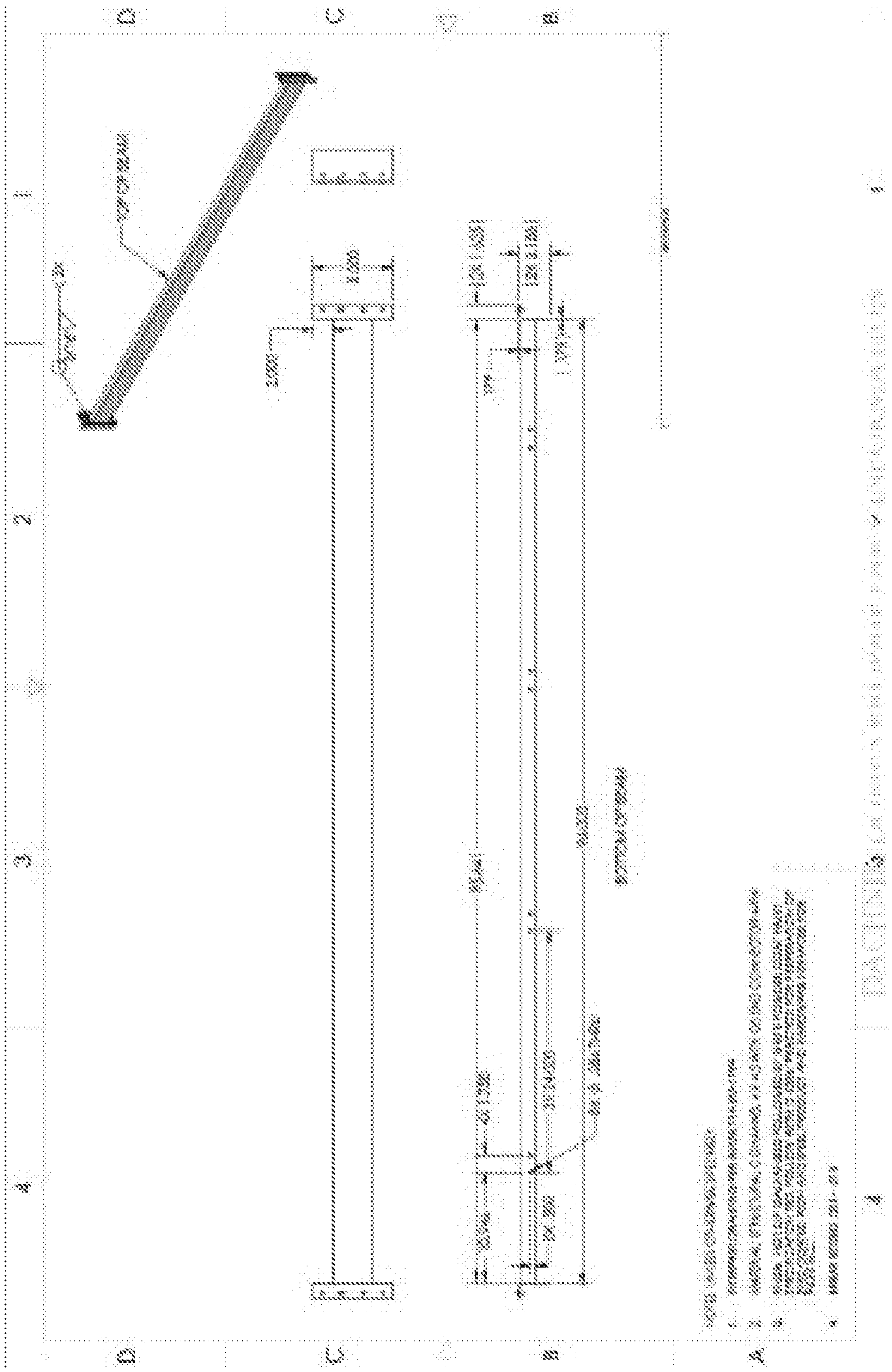

FIG. 23

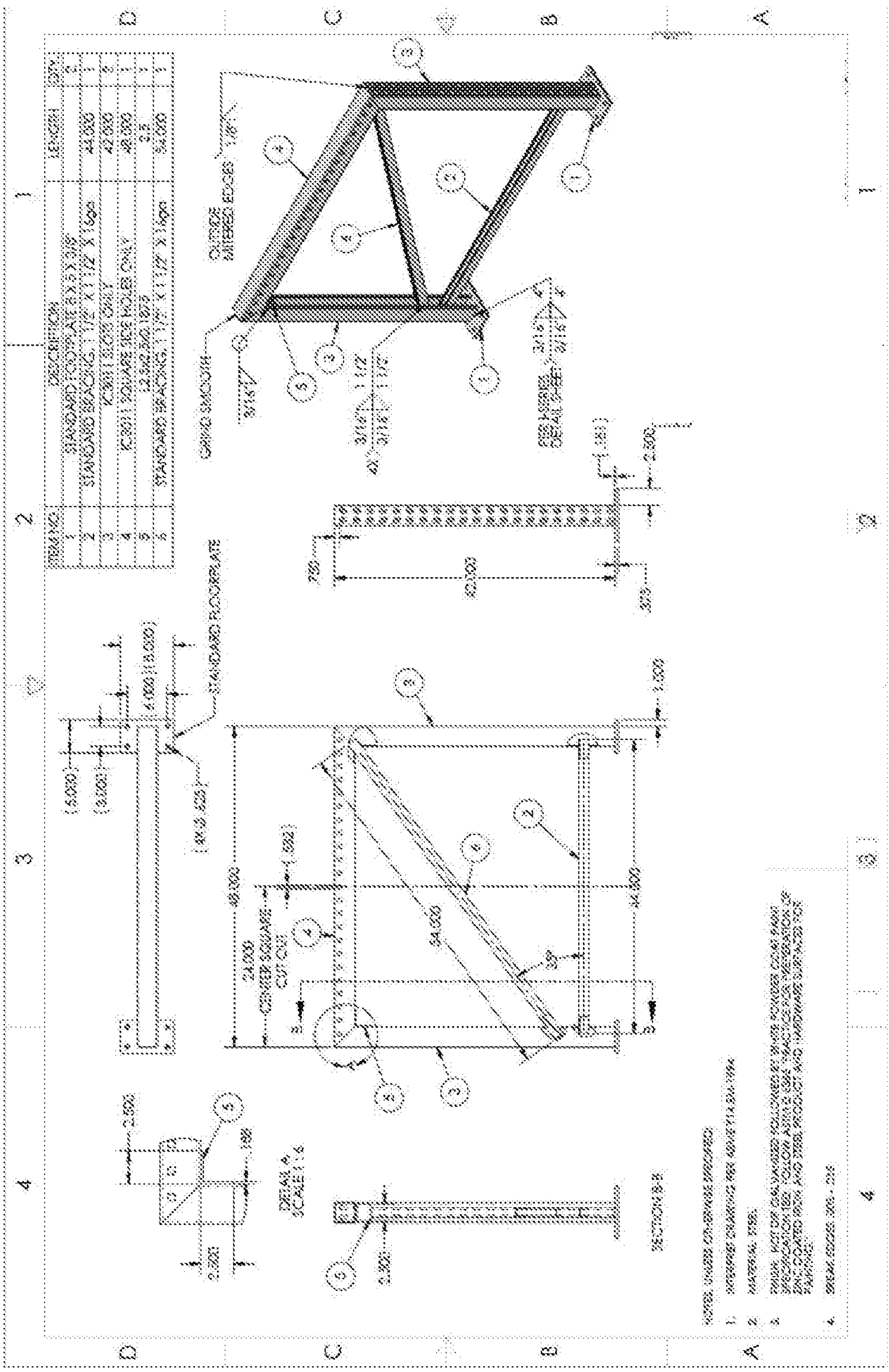

FIG. 24

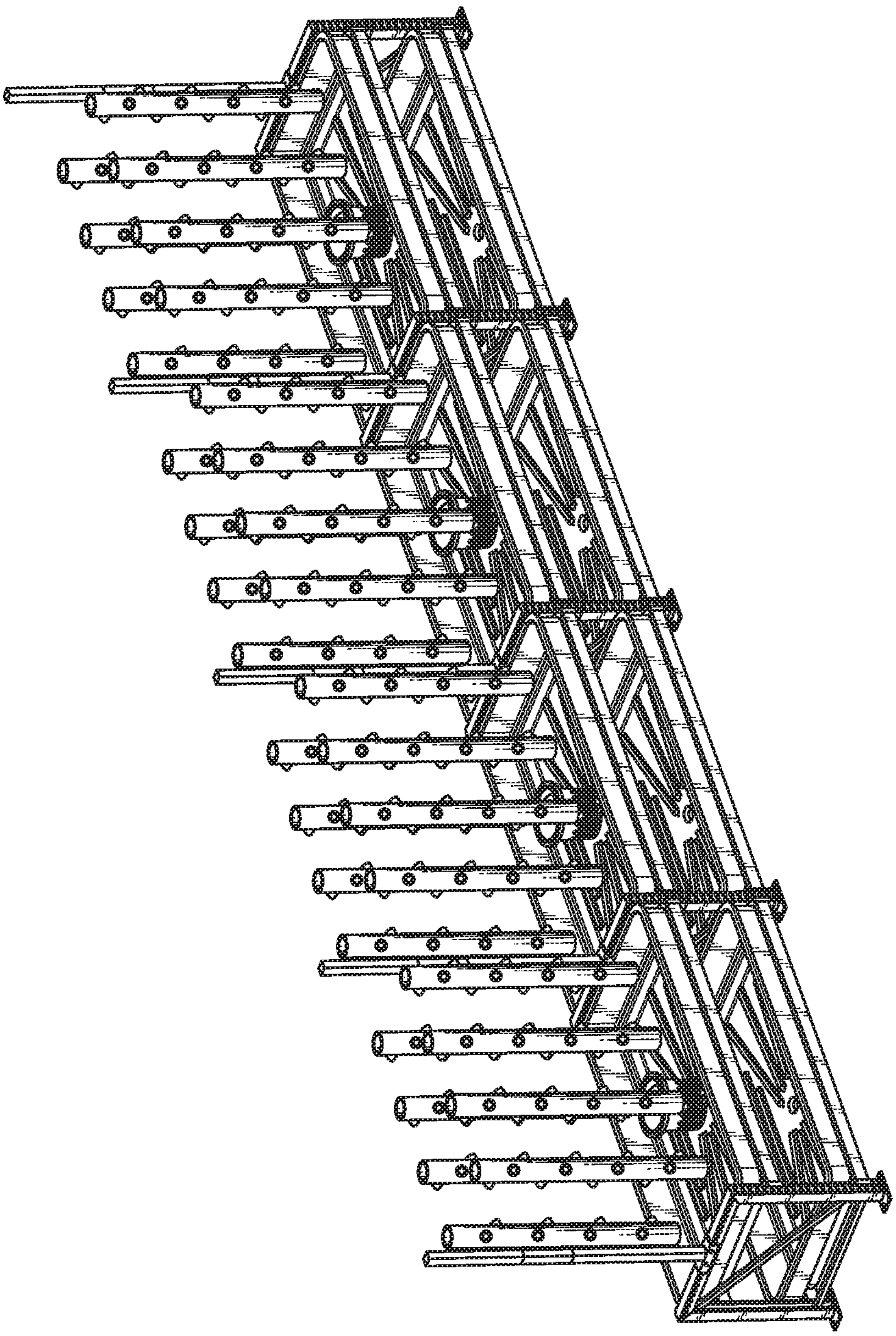

FIG. 25

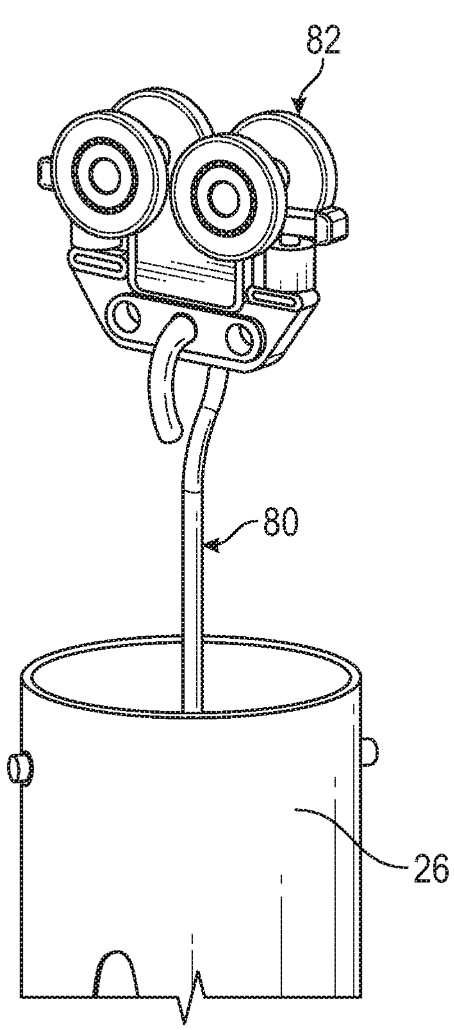

FIG. 26A

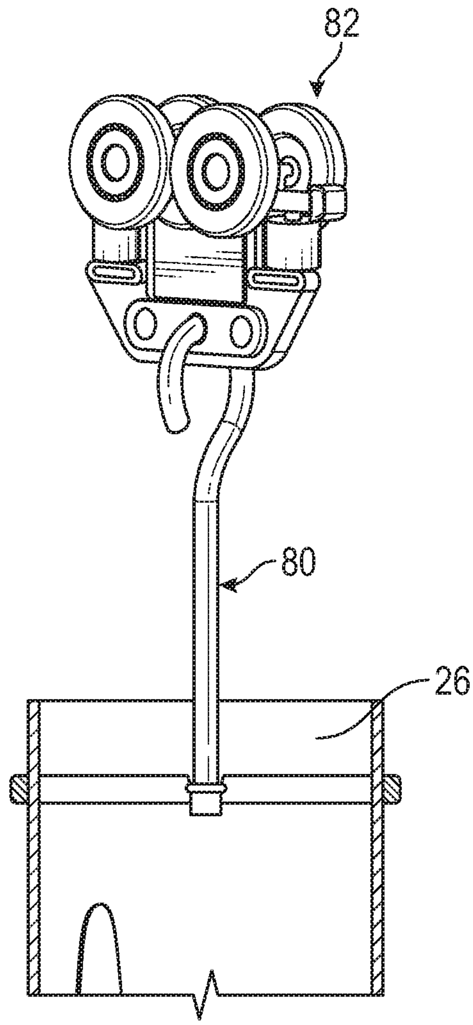

FIG. 26B

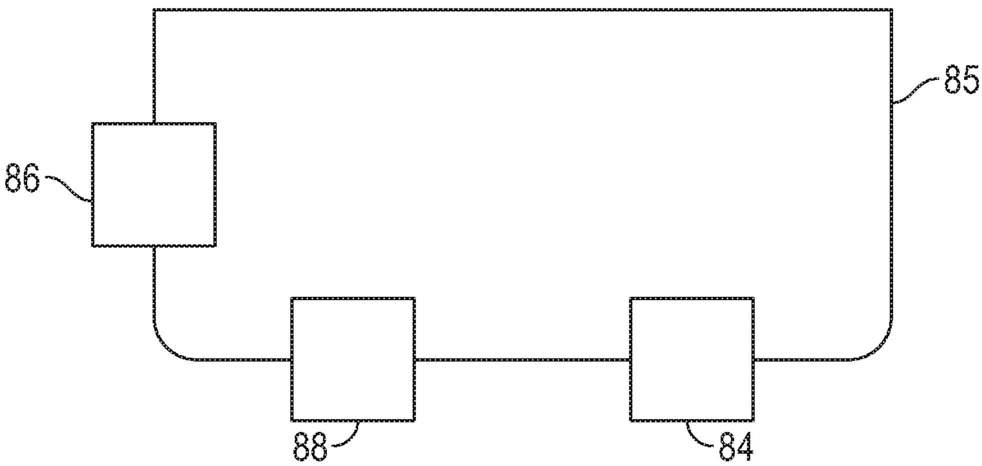

FIG. 26C

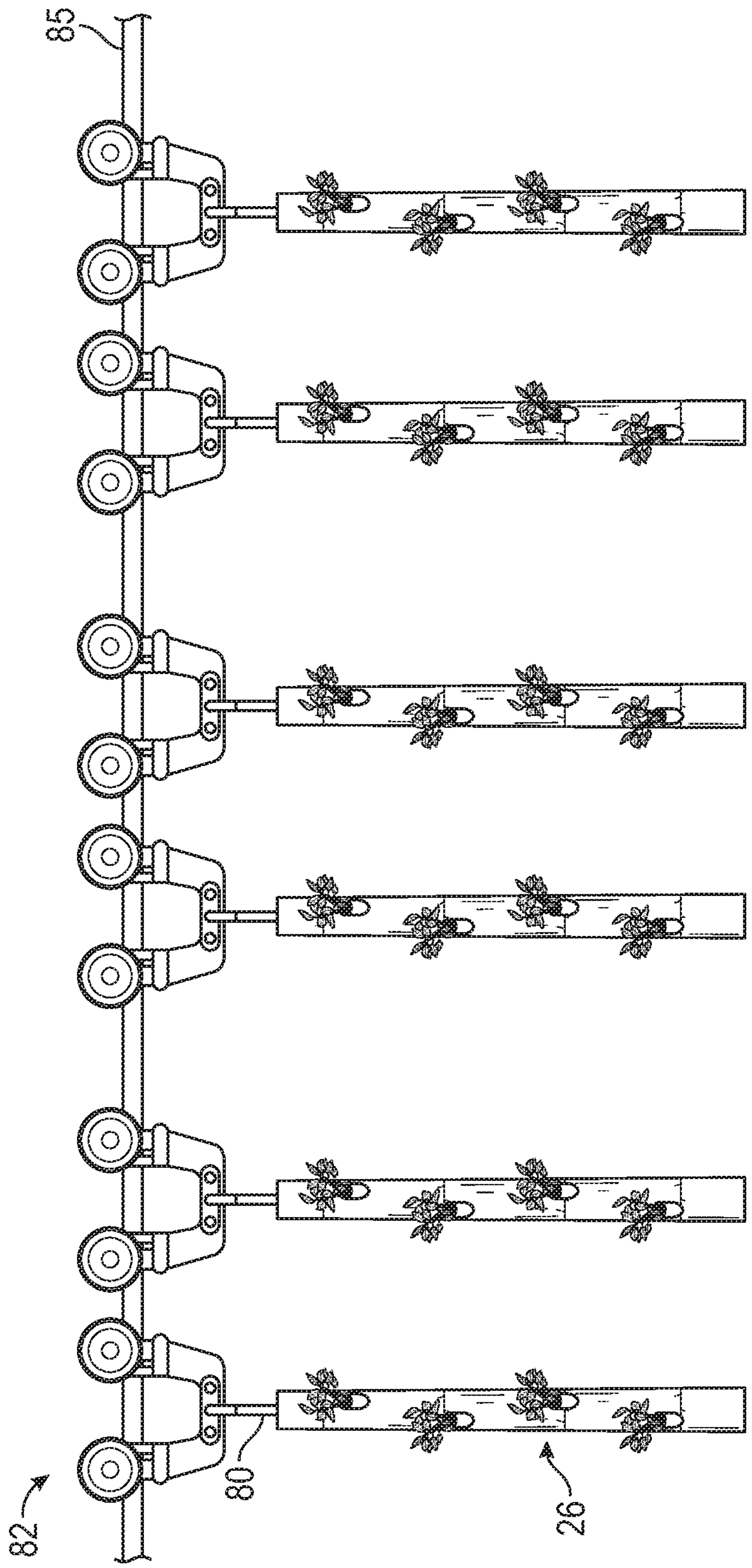

FIG. 26D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/34064

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A01G 31/02 (2017.01)
CPC - A01G 31/02

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	"Dachnik Domes and Aquaponics system at Progressive Plants" (Progressive Plants) 12 March 2016 (12.03.2016) [online] retrieved from <URL: https://www.youtube.com/watch?v=TafXF7JS9c8> entire document, especially snapshot 1:08, 2:30, 2:31, 2:44, 2:51; video demonstration 1:00-1:33, 1:38-1:42, 1:55-2:20, 2:30-2:40	1-4
Y	US 2013/0047508 A1 (Toone et al.) 28 February 2013 (28.02.2013), entire document, especially para [0024]; fig 2	1-4
A	US 2014/0223819 A1 (Coghlan) 14 August 2014 (14.08.2014), entire document	1-4
A	US 2015/0230438 A1 (Barber) 20 August 2015 (20.08.2015), entire document	1-4
A	US 2013/0160363 A1 (Whitney et al.) 27 June 2013 (27.06.2013), entire document	1-4
A	US 2014/0208647 A1 (Carpenter) 31 July 2014 (31.07.2014), entire document	1-4
A	US 2006/0032128 A1 (Bryan, III) 16 February 2006 (16.02.2006), entire document	1-4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 2017	23 OCT 2017

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 20
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claim 20 is an omnibus type claim, not drafted in accordance with Rule 6.2(a).

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-4 directed to an aquaponics system for growing plants comprising: a downwardly extending pipe.

Group II: Claim 5-19 directed to an aquaponics system for growing plants comprising: first and second upper-level growth media bins.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

--- see extra sheet ---

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-4

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Box III. This International Searching Authority found multiple inventions in this international application, as follows:

SPECIAL TECHNICAL FEATURES

The invention of Group I includes the special technical feature of a downwardly extending pipe and an upwardly extending pipe, wherein an end of the downwardly extending pipe and an end of the upwardly extending pipe are disposed within the growth media bin, wherein the downwardly extending pipe is configured to deliver the nutrient-rich water from the growth media bin to the float bin; and a growth tower configured to hang above the growth media bin, wherein the upwardly extending pipe is configured to deliver the nutrient-rich water from the growth media bin to the growth tower via another pump, wherein the growth media bin is configured to collect excess of the nutrient-rich water delivered to the growth tower that drips down the growth tower, not required by the claims of Group II.

The invention of Group II includes the special technical feature of wherein the outlet pipe branches into a first and second delivery pipe; first and second upper-level growth media bins, wherein the first and second delivery pipes deliver the nutrient-rich water to the first and second upper-level growth media bins, respectively; first and second lower-level float bins, wherein the first and second lower-level float bins receive the nutrient-rich water from the first and second upper-level growth media bins, respectively; and a pump disposed within the first lower-level float bin and configured to pump the nutrient-rich water from the first and second lower-level float bins through the inlet pipe back to the tank, not required by the claims of Group I.

COMMON TECHNICAL FEATURES

Groups I-II share the common technical features of a tank configured to hold at least one aquatic animal species and nutrient-rich water, wherein the tank includes an outlet pipe and an inlet pipe, a growth media bin, wherein the outlet pipe delivers the nutrient-rich water to the growth media bin; a float bin that includes a pump, wherein the float bin receives the nutrient-rich water from the growth media, wherein the pump is configured to pump the nutrient-rich water from the float bin through the inlet pipe to the tank; and a growth tower. However, this shared technical feature does not represent a contribution over prior art as being obvious over ?Dachnik Domes and Aquaponics system at Progressive Plants? to Progressive Plants (hereinafter "Progressive") in view of US 2013/0047508 A1 to Toone et al. (hereinafter ?Toone?).

Progressive discloses a tank configured to hold at least one aquatic animal species and nutrient-rich water (white tank that holds koi fish and nutrient rich water, see video demonstration 1:55-2:20), wherein the tank includes an outlet pipe and an inlet pipe(inlet and outlet pipes stemming from the tank, see snapshot 2:30), a growth media bin, wherein the outlet pipe delivers the nutrient-rich water to the growth media bin (growth media bins containing potted plants on the second level of the system, in between the towers above and the float bins below, with the outlet pipe delivering nutrient rich water, see video demonstration 1:25-1:33; 2:30-2:40); a float bin, wherein the float bin receives the nutrient-rich water from the growth media (float bins on lower level shown with white floating material capable of delivering nutrient-rich water from the growth media bin to the float bin, see video demonstration 1:38-1:42; alternative views of float bins on lower level, see snapshots 1:08, 2:31); and a growth tower (hanging growth towers, see video demonstration 1:20-1:30), but Progressive does not specifically teach a pump, wherein the pump is configured to pump the nutrient-rich water from the float bin through the inlet pipe to the tank. However, Toone teaches an aquaponics system for growing plants (fig 2), comprising: a pump, wherein the pump is configured to pump nutrient-rich water from a bin through a pipe to a separate section of the aquaponics system (pump 120 pumps nutrient rich water through pipe 122 to upper tray 106, para [0024]; fig 2). Accordingly, it would have been obvious to one of ordinary skill in the art that Progressive would have modified by the teachings of Toone as claimed in order to provide pumping means to deliver nutrient rich water from the terminal float bin to the tank via the inlet pipe.

As the common technical features were known in the art at the time of the invention, these cannot be considered special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.