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[Title of the invention]

Apparatus for submerging planting panel into liquid

[Field of the invention]

5 The present invention relates to an apparatus for submerging a planting panel planted with plants into liquid such as water, aqueous culture solution, liquid fertilizer, insecticide solution, or others for the purpose of exterminating pests injurious to plants or supplying leaves of plants with liquid fertilizer.

10 [Disclosure of the prior art]

 The inventor of the present invention disclosed earlier a method for exterminating pests provided with organs for tracheal respiration on plants by completely submerging the plants under their attack for a desired period of time in aqueous solution having a certain concentration with no harm to the plants.

15 The inventor also disclosed a device for submerging plants, where hydroponics plants are planted on a planting panel floating on culture liquid in a culture tank, and the planting panel with plants is manually pushed down deep into the culture liquid through a push frame and locked in position at a desired depth with setscrews for a desired period of time.

20 With the prior device, however, manually pushing down a planting panel with plants through a push frame deep into aqueous solution requires much physical effort. This problem is serious especially with a large hydroponics system where a number of planting panels float in a large culture tank.

25 [Objects and summary of the invention]

 An object of the present invention is to make easy the work for pushing down a planting panel with plants deep into liquid. Another object of the present invention is to protect creeping-type plants such as strawberry or others from being damaged when they are moved away or into liquid in a tank.

30 According to one aspect of this invention, there is provided an apparatus for submerging a planting panel with plants into liquid comprising : a tank filled with liquid; a planting panel planted with plants which floats on the

surface of the liquid in said tank; means for supplying or discharging said liquid in the tank so that the surface of said liquid is raised or lowered; and means for temporarily locking said planting panel so as not to raise it to the liquid surface in position at a desired level in said tank when said liquid surface and thereby
5 said planting panel are lowered. This apparatus makes easy the work for submerging a planting panel into liquid. This merit is significant especially for a large hydroponics system where a number of planting panels float on the surface of the liquid in a large tank and they have to be submerged into the liquid.

According to another aspect of this invention, there is provided an
10 apparatus for submerging a planting panel with plants into liquid as above-described, wherein said tank is a box with open top, and said planting panel attaches on its both said ends respectively one end of each of flexible protection films which extend the other end of each thereof out of said tank over the tank wall and are supported so that go out of or come in said tank as said planting
15 panel ascends or descends in said tank. The apparatus protects creeping-type plants such as strawberry or others by protection films from being damaged while they are moved up and down in the tank.

In the apparatuses according to the present invention, "A tank filled with liquid" may be an ordinary culture tank of a hydroponics or a special tank
20 specifically designed only for the purpose of submerging plants.

[Brief description of the drawing]

FIG.1 is a longitudinal section showing one embodiment of an apparatus according to the present invention;

25 FIG.2(a) is an enlarged, cross-sectional view as taken along line A-A of FIG.1;

FIG.2(b) is an enlarged (but partly omitted), front elevational view of a guide pipe of a locking device;

FIG.2(c) is an enlarged, plan view of a ratch;

30 FIG.3 is an enlarged (but partly omitted), cross section showing another embodiment of an apparatus according to the present invention;

FIG.4 is an enlarged, cross-sectional view showing a still another

embodiment of an apparatus according to the present invention;

FIG.5 is an enlarged, cross-sectional view showing a further embodiment of an apparatus according to the present invention; and

FIG.6 is an enlarged, cross-sectional view showing a still further
5 embodiment of an apparatus according to the present invention.

[Detailed description of the embodiments]

EXAMPLE 1:

An embodiment of an apparatus for submerging a planting panel with
10 plants into liquid according to the present invention is described below. FIG.1 shows a hydroponics culture tank1, which is a large oblong box with open top. The culture tank 1 is filled with culture liquid 2, and floating on the surface of the culture liquid 2 are a number of planting panels 3 which are square plates made of foamed styrene as neighbored to each other side by side in the direction
15 of the culture tank's longer axis. Each planting panel 3 has a number of holes in it such that plants are inserted and secured in the holes while their roots are immersed in the culture liquid 2 thereunder.

Now described is a device for supplying or discharging culture liquid which moves the culture liquid 2 in and out of the culture tank 1 through a closed
20 circuit. A storage tank 4 is provided at the side of the culture tank 1 such that it is lower in position than the culture tank 1. A pump 5 is provided on the top of the storage tank 4, and a suction pipe 6 extends vertically from the suction inlet of the pump 5 with its free end near the bottom within the storage tank 4. A supply pipe 7 extends from the outlet of the pump 5 with its free end near the
25 bottom within the culture tank 1. An overflow pipe 10 connects between an overflow port 9 at a higher position in a wall of the culture tank 1 and a return inlet (8) in a wall of the storage tank 4. With this arrangement, the pump 5 sucks the culture liquid in the storage tank 4 into the suction pipe 6 and then forces it through the supply pipe 7 to the culture tank 1. The culture liquid in
30 the culture tank 1 overflows from the overflow port 9 through the overflow pipe 10 back to the storage tank 4, completing a circulation of the culture liquid. The culture tank 1 is also provided with a return outlet 11 at a lower position in its

5 wall. A return pipe 13 provided with a return valve 12 in its middle connects between the return outlet 11 and the overflow pipe 10. The storage tank 4 is also provided with a drain pipe 13' at its bottom.

According to the present invention, a planting panel 3 descends as the level
5 of the culture liquid is decreased and is locked so as not to raise to the liquid surface in position at a desired level. Described below is the construction of a locking device to make this possible. Referring to FIGS. 2(a) and 2(b), for each planting panel 3, a pair of support boards 14 are installed respectively on the outside surfaces of the both side-walls of the culture tank 1. A guide pipe 15 is
10 installed vertically on each support board 14. A pair of ropes 16 are attached to each of the both sides of the bottom of the planting panel 3 such that the planting panel 3 can be pulled down evenly by the four ropes 16. A pair of pulleys 17 are provided on each of the both sides of the bottom of the culture tank 1. Another pair of pulleys 18 are provided on each of the tops of the support
15 boards 14. Said two pairs of the ropes 16 are threaded down and over the pulleys 17, then up along the inside surfaces of the walls, and then down over the pulleys 18. The pair of the ropes 16 as passing the pulleys 18 are combined into a main rope 19. The main ropes 19 are threaded into the guide pipes 15, where they are connected to weights 20.

20 A bracket 21 is attached to each of the guide pipes 15. A solenoid 24 is installed horizontally on each of the brackets 21. A two-prong ratch 22, as shown in FIG. 2(c), extends from each of the movable iron cores of the solenoids 24 through a slit 23 into each of the guide pipes 15. The ratches 22 are normally pulled back by springs 25.

25 The two prongs of each ratch 22 have such a clearance between them that they will not interfere with the main rope 19 but can prevent the weight 20 from going up.

Each of the bracket 21 is installed at such a position that, when the surface of the culture liquid in the culture tank 1 is lowered to a desired level, the ratch
30 22 is directed just above the weight 20.

The bracket 21 may be installed such that its position can be adjusted as the desired level of the culture liquid changes with different types of plants. In

this case, a plurality of slits are provided to cover the range of the changing positions of the bracket 21.

In operation of the above-described apparatus, when the pump 5 is stopped and the return valve 12 is opened, the culture liquid 2 in the culture tank 1 starts flowing through the return pipe 13 into the storage tank 4. As the level of the culture liquid 2 in the culture tank 1 decreases, plants P on the planting panels 3 descend, and the ropes 16 and the main ropes 19 are tucked up by the descending weights 20 in the guide pipes 15.

When the level of the culture liquid 2 in the culture tank 1 is reduced to a desired level, the return valve 12 is closed. Then the solenoids 24 are excited to drive the two-prong ratches 22 through the slits 23 into the guide pipes 15 in their locking positions (as shown in dotted lines in FIG. 2(b)), where the two prongs of the ratches 22 are not interfering with the main ropes 19 but will prevent the weights 20 from going up.

Then the pump 5 is started. The culture liquid in the storage tank 4 is transferred through the suction pipe 6 and the supply pipe 7 into the culture tank 1. While the level of the culture liquid in the culture tank 1 increases, the planting panels 3 are retained in the lower position because the weights 20 are prevented from going up, and eventually the whole plants P are submerged in the culture liquid.

As the pump 5 keeps operating, the culture liquid overflows through the overflow port 9 into the storage tank 4, keeping the level of the culture liquid in the culture tank 1 constant at the height of the overflow port 9, keeping the plants P completely submerged in the culture liquid long enough to exterminate pests provided with organs for tracheal respiration on them.

After a required period of time, the solenoids 24 are de-energized, allowing the springs 25 to pull back the ratches 22, thus allowing the planting panels 3 to ascend to the liquid surface by their buoyancy.

EXAMPLE 2:

In FIG. 3, another embodiment of an apparatus according to the present invention is shown, where the ratches 22 of said EXAMPLE 1 are replaced with a retaining pins 22a fixed on the outside surfaces of both side-walls of a culture

tank 1a. To retain in position main ropes 19a with weights 20a at its free end, one will wind the main ropes 19a around the retaining pins 22a several turns. Other features are substantially similar to those shown in FIGS. 1, 2(a), 2(b) and 2(c).

5 EXAMPLE 3:

Still another embodiment of an apparatus according to the present invention is described below. FIG. 4 shows a culture tank 1b filled with culture liquid 2b, and a number of planting panels 3b with plants Pb floating on the culture liquid 2b and capable of moving up and down in the culture tank 1b. The
10 planting panels 3b are a hollow box made of synthetic resin and have respectively fluid chambers 26b in them. When the fluid chambers 26b are filled with air, the planting panels 3b surface, and when filled with water, they submerge. A long air tube 27b is attached vertically to the top of each of the planting panel 3b such that each fluid chamber 26b connects via the tube 27b up
15 to the atmosphere. A short water supply/discharge tube 28b is vertically inserted through the top of each of the planting panels 3b deep into each fluid chamber 26b. A flexible hose 29b is connected between the upper end of each of the water supply/discharge tubes 28b and a reversible pump 31b with a valve 30b arranged between the hoses 29b and the pump 31b. A supply/discharge pipe
20 32b is attached to the reversible pump 31b with its free end extending down into a water tank 33b.

Suppose that the planting panels 3b are floating on the surface of the culture liquid 2b in the culture tank 1b as shown in FIG. 4. When the valve 30b is opened and the pump 31b is forward-operated, the water in the water tank
25 33b is transferred through the flexible hoses 29b and the water supply/discharge tubes 28b into the fluid chambers 26b. The air in the fluid chambers 26b is expelled by the incoming water out to the atmosphere via the air tubes 27b.

When the fluid chambers 26are filled with water, the planting panels 3b start submerging into the culture liquid 2b. When plants Pb on the planting
30 panels 3b are completely submerged, the reversible pump 31b is stopped and the valve 30b is closed. The plants Pb are kept submerged long enough to exterminate pests with organs for tracheal respiration on plants.

When the valve 30b is opened and the reversible pump 31b reverse-operated, the water in the fluid chambers 26b is discharged to the water tank 33b, and the air is drawn into the fluid chambers 26b via the air tubes 27b. When the fluid chambers 26b are filled with air, the planting panels 3b ascend to the liquid surface. Then the reversible pump 31b is stopped and the valve 30b is closed.

EXAMPLE 4:

In FIG. 5, further embodiment of an apparatus according to the present invention is shown, where a long air supply/discharge tube 34c is attached vertically to the top of each of a number of planting panels 3c and a short liquid tube 37c is attached vertically to the bottom of each of the planting panels 3c. The air supply/discharge tube 34c connects to a fluid chamber 26c of each of the planting panels 3c at its lower end, and its upper end branches into two smaller tubes 35c and 36c. Each of the liquid tube 37c connects to the fluid chamber 26c at its upper end and is open to culture liquid 2c at its lower end. A flexible hose 38c connects between each of the tubes 35c and an air pump 40c with a valve 39c arranged between said hoses 38c and said air pump 40c. Each tube 36c is provided with valve 41c in its middle and its free end is open to the atmosphere.

Suppose that the planting panels 3c are floating on the surface as shown in FIG. 5. When the valves 41c are opened, the culture liquid 2c enters the fluid chambers 26c via the liquid tubes 37c, expelling the air from the fluid chambers 26c through the tubes 36c to the atmosphere. When the fluid chambers 26c are filled with the culture liquid 2c, the planting panels 3c submerge. After a desired period of time, the valves 41c are closed, the valve 39c is opened, and the air pump 40c is operated. The air is forced through the flexible hoses 38c, the tubes 35c and the air supply/discharge tubes 34c into the fluid chambers 26c, expelling the culture liquid 2c there out of them. When the fluid chambers 26c are filled with air, the planting panels 3c surface. Then the air pump 40c is stopped and the valve 39c is closed.

EXAMPLE 5:

Still further embodiment of an apparatus according to the present invention is described below. This example is intended to add some features to the apparatus as shown in FIG. 3, so that strawberry or other creeping-type

plants will not be damaged from fraying at the upper edges of the side-walls of a tank as they submerge and surface repeatedly in it. Referring to FIG. 6, a pair of rolls of flexible protection films 42d of synthetic resin are arranged horizontally above and beyond the both side-walls of a tank 1d. Each roll has a shaft 43d in it
5 as its core and is supported by the shaft 43d. Each shaft 43d is provided with a friction device. A pair of rolls of flexible protection films 42d are partly unrolled and their film ends are connected respectively the both sides of the planting panels 3d.

When the planting panels 3d descend as the level of culture liquid
10 decreases, the protection films 42d on either side are party unrolled from the rolls, carrying any horizontally-grown creeping-type plants safely on it into the tank 1d. When the planting panels 3d are freed to surface, the shafts 43d are rotated and the unrolled parts of the protection films 42d are tucked up.

With another version of the embodiment, a pair of sheets of protection
15 films may be used in place of a pair of rolls of protection films, and rod weights may be used respectively to tension the sheets. Specifically, said sheets of protection films extend over side-walls of a tank, and have their one ends connected respectively to both sides of a number of planting panels, their middle parts guided by guide rolls, and the other ends of them pulled down by the rod
20 weights. When the planting panels start surfacing, the protection films temporarily become loose but are soon tensioned again by the work of the rod weights.

[What is claimed is]

25 1. An apparatus for submerging planting panel planted with plants into liquid comprising:

a tank filled with liquid;

a planting panel planted with plants thereon which floats on the surface of the liquid in said tank;

30 means for supplying or discharging said liquid in the tank so that the surface of said liquid is raised or lowered; and

means for temporarily locking said planting panel so as not to raise it to



the liquid surface in position at a desired level in said tank when said liquid surface and thereby said planting panel are lowered.

2. An apparatus for submerging a planting panel planted with plants into
5 liquid comprising:

a tank filled with liquid;

a planting panel planted with plants which is arranged movable vertically
in said tank, said planting panel having fluid chamber therein and having such
a weight that it ascends to the liquid surface when said chamber is filled with
10 air and descends when said chamber is filled with liquid; and
means for selectively supplying liquid or air into said chamber.

3. An apparatus for submerging a planting panel planted with plants into
liquid as defined in claim 1 or 2, wherein said tank is a box with open top, and
15 said planting panel attaches on its both said ends respectively one end of each of
flexible protection films which extend the other end of each thereof out of said
tank over the tank wall and are supported so that they go out of or come in said
tank as said planting panel ascends or descends in said tank.

This Sheet Has Been Replaced

