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Regulation 3.1(2)

AUSTRALIA
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PATENT REQUEST AND NOTICE OF ENTITLEMENT

I MINORU KUBOTA

of Hei 1050-1, Magarikawa, Nishiaritacho, Nishimatsuura-gun, Saga-ken, JAPAN

being the Applicant and Nominated Person, request the grant of a patent for an invention entitled NEGATIVE PRESSURE-DIFFERENCE WATER SUPPLY SYSTEM which is described in the accompanying standard complete specification.

Convention priority is claimed from the following basic application:

Basic Applicant	**Application Number**	**Application Date**	**Country**	**Country Code**
Minoru Kubota	3-285144	30 October 1991	Japan	JP

I am the actual inventor of the invention.

The basic application was the first application made in a Convention country in respect of the invention the subject of this request.

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DATED this 28th day of October 1992a

MINORU KUBOTA
By his Patent Attorney

GRIFFITH HACK & CO

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NEGATIVE PRESSURE-DIFFERENCE WATER SUPPLY SYSTEM

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(56) Prior Art Documents
AU 59078/86 A01G 25/09
AU 40605/78 A01G 25/09
AU 38357/78 A01G 25/09

(57) Claim

1. A negative pressure difference water supplying system, comprising:

a water tank for containing therein water having a water surface at a first level;

a water supplying pipe connected to said water tank and extending through an area to be water-supplied, said water supplying pipe having an inlet end open within said tank under said first level and an outlet end open at a second level lower than said first level, said water supplying pipe extending through a third level higher than said first level; and

said water supplying pipe having connected therein at least one porous tube between said inlet and outlet ends and within said area to be water-supplied for allowing water to penetrate through said porous tube into or out of said porous tube in accordance with a relative water pressure difference between the inside and the outside of said porous tube.

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Regulation 3.2

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ORIGINAL

COMPLETE SPECIFICATION

STANDARD PATENT

Invention Title: NEGATIVE PRESSURE-DIFFERENCE WATER SUPPLY SYSTEM

The following statement is a full description of this invention, including the best method of performing it known to me:

GH&CO REF: P22488-A:RPW:RK

NEGATIVE PRESSURE-DIFFERENCE WATER SUPPLY SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a negative pressure difference water supply system and, more particularly, to a negative pressure difference water supply system in which pressure difference between the inside and the outside of a porous tube is utilized for automatically supplying water for plant cultivation.

In order to properly grow farm plants, a proper amount of water, nutrient elements, sunshine and the like are indispensable and in particular, the water supply is extremely important for the proper growth of the plants because too scarce water kills the plants and too much water causes diseases such as root rot or the like.

The conventional water supply system includes one inwhich a underground water level is provided within soil to supply a suitable amount of water by means of the capillary ascending action, and one in which pressurized porous tubes are embedded within the soil to supply water.

However. these system were turned out to be high in water loss due to downward permeation of water into the soil and difficult to regulate the moisture in the soil by simply adjusting the ground water table, some times resulting in an undesirable over-supplying of water.

Accordingly, a negative pressure difference water supply system which utilizes the negative water pressure difference in the soil as illustrated in Fig. 2 has been proposed. In Fig. 2, the conventional negative pressure difference water supply system comprises a water tank 1 containing water 2 up to a water level 3 which is higher than a ground water table 4. This difference in height corresponds

to a negative pressure Δ h of the water at the level 3. The water tank 1 has connected below the water level 3 thereof one end of a pipe 5 of which the other end is connected to a porous tube 6 made for example of a ceramic or a porcelain. The porous tube 6 is a hollow member having an open end 7 connected to the pipe 5 and a closed end 8. The porous tube 6 is buried within soil 9 at a level 10 higher than the water level 3 within the water tank 1, providing a negative pressure difference hP relative to the level 3. Thus, the negative water head at the porous tube 6 relative to the ground water table 4 is hS, which is the sum of Δ h and hP.

Excluding downward permeation of water by gravitation, water in the soil of farmland normally decreases by absorption of water into farm products and by water consumption through evaporation of water from soil surface.

At that time, the negative pressure hS of water content in the soil 9 increases. When the porous tube 6 buried in the effective area of farm product roots is saturated with water and the water pressure in the porous tube is regulated at a certain negative pressure hP, a negative pressure difference ($\Delta h = |hS - hP|$) arises between the water in the soil and the water in the porous tube 6.

Thus, according to the negative pressure difference water supply system, the moisture tension distribution in the soil can be maintained optimum by suitably regulating the negative pressure within the porous ceramic tube by controlling the water surface level, so that the water loss due to the downward permeation and adverse affects on plants due to the over-supplying of the water can be decreased, and that the water supply can be self-regulated in amount and continuous.

However, in the conventional negative pressure watersupply system as above described, when the ambient temperature increases, the dissolved gas within the water which stays in the porous tube and supply pipe vaporizes to

become bubbles which keep staying in the porous ceramic tube. Therefore, the negative pressure condition maintained by the surface tension of the water in the open pores in the porous ceramic tube is destroyed and also the air outside of the tube is introduced into the ceramic tube due to the negative pressure difference, so that the water supply by the negative pressure difference is totally interrupted.

While it is proposed to connect an air bleeding pump at a junction between the porous ceramic tube and the pipe in order to purge the bubbles, since the ceramic porous tube is embedded within the soil and it is impossible to confirm the presence of the bubbles within the tube, the air bleeding operation must be periodically achieved irrespective of whether or not the ceramic porous tubes actually contain bubbles. This requires much man-hour and energy. Also, since the air pump must be provided one for each ceramic tube, the installation cost becomes extremely high and the entire system becomes very complicated in structure.

SUMMARY OF THE INVENTION

It would be advantageous if at least preferred forms of the present invention provided a negative pressure difference water supply system free from the above-discussed problems of the conventional water supplying system.

It would be advantageous if at least preferred forms of the present invention provided a negative pressure difference water supply system in which water can be supplied automatically in accordance with the necessity.

It would be advantageous if at least preferred forms of the present invention provided a negative pressure difference water supply system which is simple in structure and inexpensive.

It would be advantageous if at least preferred forms of the present invention provided a negative pressure difference water supply system which is simple in maintenance.

According to the present invention there is provided a negative pressure difference water supplying system, comprising:

a water tank for containing therein water having a water surface at a first level;

a water supplying pipe connected to said water tank and extending through an area to be water-supplied, said water supplying pipe having an inlet end open within said tank under said first level and an outlet end open at a second level lower than said first level, said water supplying pipe extending through a third level higher than said first level; and

said water supplying pipe having connected therein at least one porous tube between said inlet and outlet ends and within said area to be water-supplied for allowing water to penetrate through said porous tube into or out of said porous tube in accordance with a relative water pressure difference between the inside and the outside of said porous tube.

The water supply system may comprise a water reservoir for receiving water discharge from the outlet end of the water supply pipe.

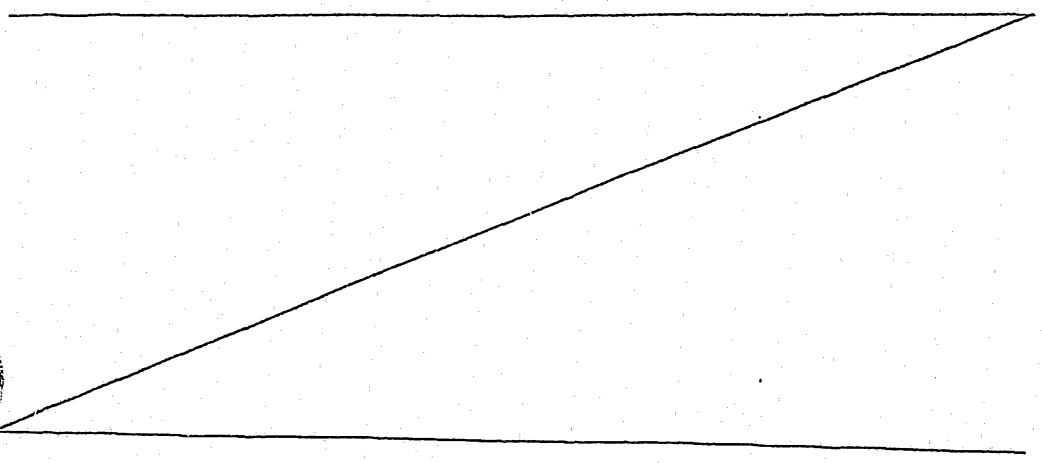
The water supply system may further comprise a circulating pipe connected between the water supplying tank and the water reservoir and a circulating pump connected in the circulating pipe for circulating water between the reservoir to the water supplying tank.

The negative pressure difference water supply system may comprise a single water tank to which an inlet and an outlet of a circulating pipe are connected. The circulating pipe has connected therein at least one porous tube in a region to be irrigated and a circulating pump downstream of the porous tube for sucking water from the tank.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred forms of the present invention will become more readily apparent from the following detailed description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram of one embodiment of



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the negative pressure difference water supply system of the present invention;

Fig. 2 is a schematic diagram of another embodiment of the negative pressure difference water supply system of thepresent invention; and

Fig. 3 is a schematic diagram of the conventional negative pressure difference water supply system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 schematically illustrates one embodiment of the negative pressure difference water supply system. The negative pressure difference water supply system comprises a water supplying tank 11 containing water 12 therein up to a first water surface level 13 and a reservoir tank or a water receiving tank 14 for containing water up to a water level 15 lower than the first level 13. The first and the second tanks 11 and 14 are connected together by a water supplying pipe 16 having connected therein four ceramic porous tubes 17, 18, 19 and 20. The water supplying pipe 16 has an inlet end 21 open within the water supplying tank 11 at a position lower than the first level 13 and an outlet end 23 open at a second level 24 lower than the first level 13 but slightly higher than the water surface level 15 within the second tank 14.

In the illustrated embodiment, the water supplying pipe 16 has a general configuration of an inverted "U" which constitutes a siphon arrangement. In other words, the water supplying pipe 16 extends from the first water tank 11 to the second water tank 14 through a third level 25 higher than the water level 13 within the first tank 11. The ceramic porous tubes 17 to 20 inserted in the water supplying pipe 16 are located in a region 26 in which water is to be supplied by the system of the present invention for allowing water to be supplied through the porous tubes 17 to 20 in accordance with a relative water pressure difference between the inside and

the outside of the porous tubes 17 to 20.

The water supply system further comprises a return pipe 27 connecting the water reservoir tank 14 to the water supply tank 11 for returning the water in the reservoir tank 14 to the higher water supply tank 11 and a circulating pump 28 connected in the return pipe 27 for pumping the water from the reservoir tank 14 to the water supplying tank 11.

In the negative pressure difference water supply system illustrated in Fig. 1, because of the atmospheric pressure difference between the first water surface level 13 and the level 24 at which the outlet end 23 of the pipe 16 opens and discharges the water, negative pressure is generated within the water supplying pipe 16 and the ceramic porous tubes 17 to 20 relative to the water pressure within the tank 11. Therefore, the water 12 within the tank 11 is sucked into the water supplying pipe 16 through the inlet end 21 and flows through the ceramic porous tubes 17 to 20 and is discharged from the outlet end 23 into the reservoir tank 14. Thus, the ceramic porous tubes 17 to 20 are always filled with fresh water which flows through the pipe 16.

Therefore, when the pressure of the water in the porous tubes 17 to 20 is higher than the water pressure in the soil, that is, when the water level in the soil is relatively low and the soil is dry, the water in the porous tubes 17 to 20 seeps from the tubes through the porous tube wall into the surrounding soil. On the other hand, when the water pressure in the soil is higher than the water pressure of the porous tubes 17 to 20, that is, when the water level in the soil is relatively high and the soil contains an excess amount of water, the water in the soil seeps into the porous tubes 17 to 20 to be discharged into the reservoir tank 14. Thus, the water content in the soil is automatically kept at a suitable level without the need for any special operation.

While a pressure difference appears between the ceramic porous tubes 17 to 20 when they are positioned at

different levels as illustrated in Fig. 1, the pressure difference between the respective tubes is compensated for by the water absorbing ability of the plant.

According to the water supply system the flow of water from the water supply tank 11 to the reservoir tank 14 is generated by siphon arrangement which does not need any pressurizing means such as a pump, so that the water seepage into the soil from the porous tubes due to the pressurization of the water by the flow does not take place. Also, the negative pressure difference generated in the porous tubes can be determined at an appropriate value by suitably adjusting the level difference between the water tank and the reservoir tank.

Fig. 2 illustrates another embodiment of the presentinvention in which the negative pressure difference water supply system comprises a single water tank 31. The water supply system also comprises a circulating pipe 32 having inserted therein a plurality of ceramic porous tubes 33similar to those of the previous embodiment. The circulating pipe 32 has an inlet end 34 inserted into the tank 31 and opens under a water level 35 and an outlet end 36 above a water level 35. The circulating pipe 32 has a pump 37 disposed downstream of the porous tubes 33 so that a negative pressure sufficient to suck the water in the tank through the inlet end 34 and to discharge from the outlet end 36 is generated within the pipe 32.

Also in this embodiment, the water in the ceramic porous tubes 33 is allowed to seep out of or into the porous tube through their porous walls according to the pressure difference between the inside and outside of the porous tubes 33.

As has been described, according to the negative pressure difference water supply system gas bubbles formed in the ceramic porous tubes embedded in the soil can automatically be purged by the water

flow within the supply pipes with a relatively simple inexpensive siphon arrangement. In the applicant's pilot farm of about 270 m^2, water supplying pipes have a diameter of 8 mm, and a small pump of 10 watts was sufficient.

The roots of the plant which generally extend in continuous search for water and nutrient elements do not have to expand for a long distance because the water supply is readily available in the vicinity of the plant roots when the negative pressure difference water supply system of the present invention is utilized, so that the amount of soil needed for growing the plant may be small.

An excess amount of water is not supplied to the soil, so that the soil is not hardened due to the over-watering. Therefore, the soil is not hard and has sufficient oxygen supply even after the cultivation, so that a subsequent cultivation can be carried out without the need for plowing.

Also, since the watering is carried out underground in this system, the pathogenic fungi within the soil are not spread by the water splashes of surface watering or rain, thereby decreasing the plant damages by disease.

What is claimed is:

1. A negative pressure difference water supplying system, comprising:

a water tank for containing therein water having a water surface at a first level;

a water supplying pipe connected to said water tank and extending through an area to be water-supplied, said water supplying pipe having an inlet end open within said tank under said first level and an outlet end open at a second level lower than said first level, said water supplying pipe extending through a third level higher than said first level; and

said water supplying pipe having connected therein at least one porous tube between said inlet and outlet ends and within said area to be water-supplied for allowing water to penetrate through said porous tube into or out of said porous tube in accordance with a relative water pressure difference between the inside and the outside of said porous tube.

2. A water supplying system as claimed in claim 1, further comprising a return pipe connecting said outlet end of said water supplying pipe to said water supplying tank and a circulating pump connected in said return pipe for returning the water from said outlet end to said water supplying tank through said return pipe.

3. A water supplying system as claimed in claim 1, further comprising a water reservoir for receiving water discharged from said outlet end of said water supply pipe.

4. A water supplying system as claimed in claim 3, further comprising a circulating pipe connected between said water supplying tank and said water reservoir and a circulating pump connected in said circulating pipe for supplying water from said reservoir to said water supplying tank through said circulating

pipe.

5. A water supplying system as claimed in any one of claims 1 to 4, wherein said porous tube is made of a ceramic material.

6. A water supplying system as claimed in any one of claims 1 to 5, wherein said at least one porous tube comprises a plurality of porous tubes.

7. A water supplying system as claimed in claim 6, wherein said plurality of tubes are positioned at at least two different levels.

8. A negative pressure difference water supplying system, comprising:

a water tank for containing therein water having a surface at a first level;

a water supplying pipe connected to said water tank and extending through an area to be water-supplied, said water supplying pipe having an inlet end open within said water tank, said water supplying pipe extending through a third level higher than said first level;

said water supplying pipe having connected therein at least one porous tube between said inlet and outlet ends and within said area to be water-supplied for allowing water to penetrate through said porous tube into or out of said porous tube in accordance with a relative water pressure difference between the inside and the outside of said porous tube; and

a pump connected in said water supplying pipe downstream of said porous tube.

9. A water supplying system as claimed in claim 8,

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wherein said porous tube is made of a ceramic material.

10. A water supplying system as claimed in claim 8, wherein said at least one porous tube comprises a plurality of porous tubes.

11. A water supplying system as claimed in claim 10,wherein said plurality of porous tubes are positioned at atleast two different levels.

12. A negative pressure difference water supplying system substantially as herein described with reference to the accompanying drawings.

Dated this 28th day of October 1992

MINORU KUBOTA
By his Patent Attorney
GRIFFITH HACK & CO.

ABSTRACT OF THE DISCLOSURE

A negative pressure difference water supplying system comprising a water tank having a water surface at a first level. A water pipe having an inlet end connected to the tank and an outlet end open at a second level lower than the first level extends through a third level higher than the first level. A plurality of ceramic porous tube are connected in the water supplying pipe within the area to be irrigated for allowing water to penetrate through the porous tube wall into or out of the porous tube depending upon the pressure difference between the inside and the outside of the porous tubes. A return pipe with a circulating pump at the downstream side of the porous tubes may be provided for circulating the water through the system. Alternatively, the system may comprise only a single water tank, a circulating pipe having the porous tubes inserted therein and a circulating pump for sucking water from the tank.

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FIG. 1

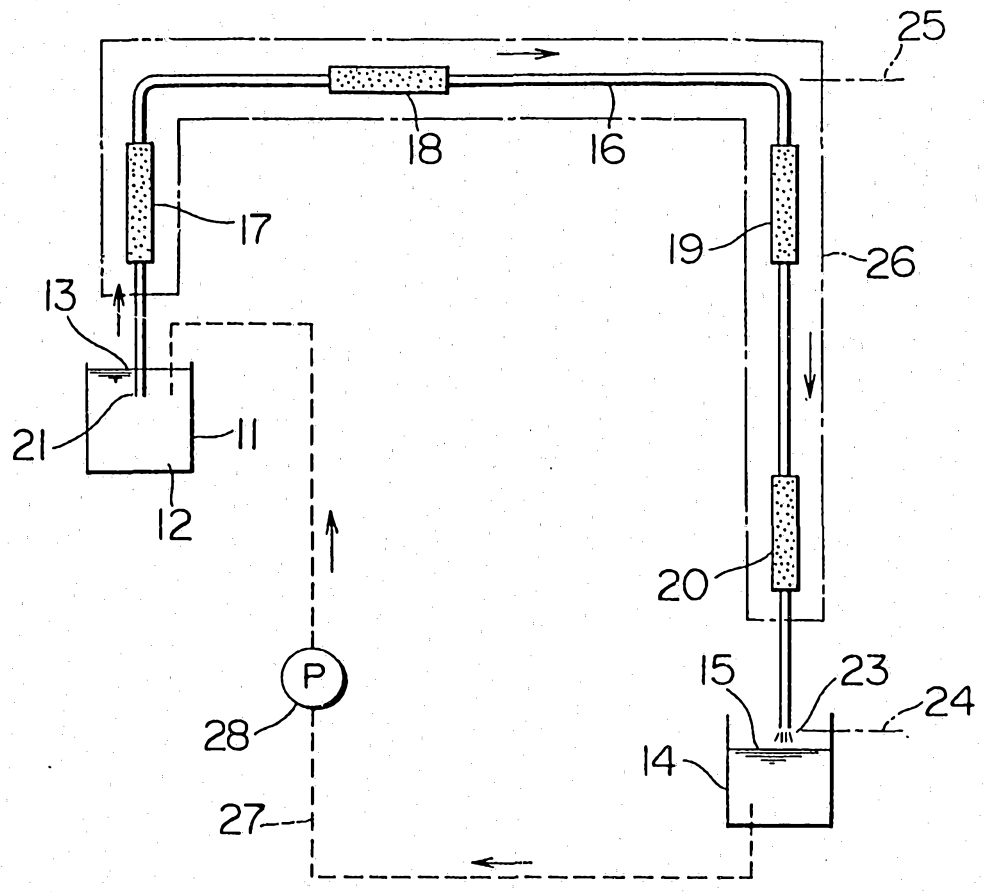


FIG. 2

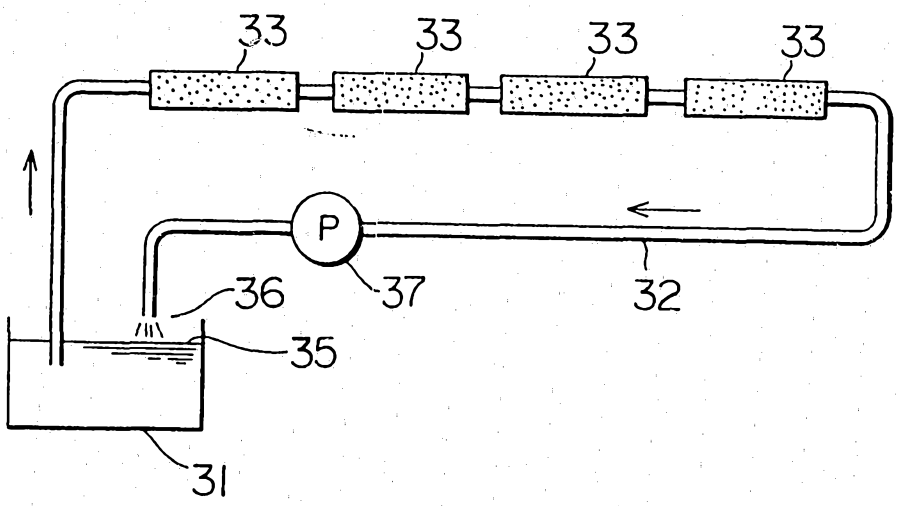


FIG. 3

