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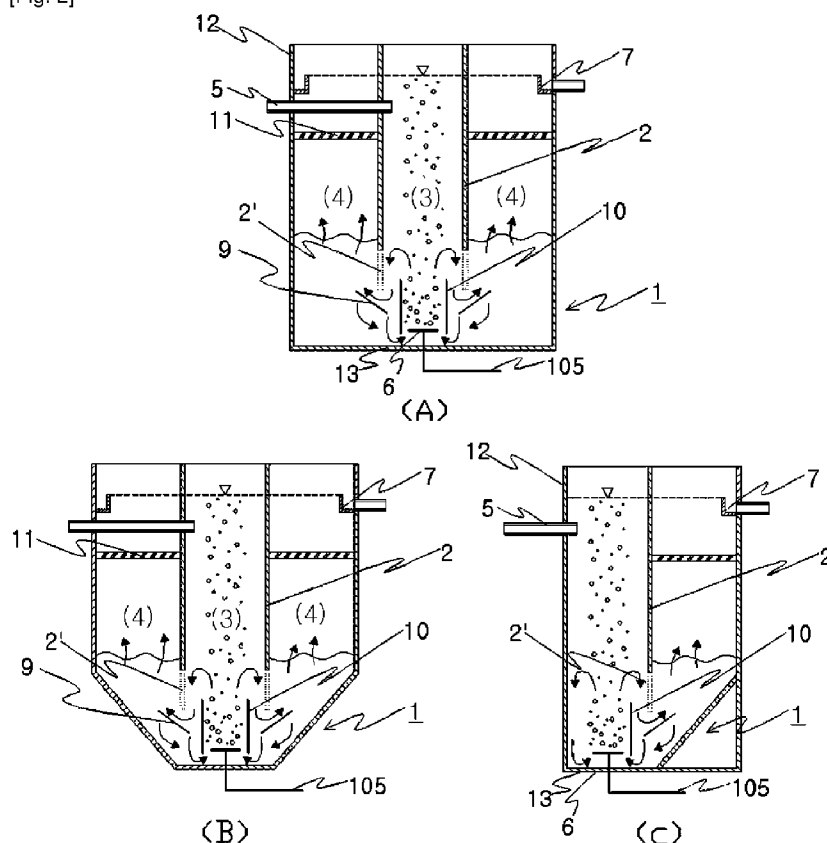
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(54) Title: A SETTLING TANK HAVING AN AERATION PART IN ITS INNER SPACE

[Fig. 2]



(57) Abstract: Disclosed therein
is a settling apparatus having an
aeration tank built therein. The
settling apparatus includes: (A)
a main body having an outer wall
and a base; (B) an aeration tank
and a settling tank divided from
each other by a partition, which is
opened at a lower portion thereof,
inside the main body; (C) sewage
inducing means connected to the
aeration tank; (D) at least one
air diffusing means mounted in a
lower portion of the aeration tank;
and (E) treated water discharging
means mounted on an upper
portion of the settling tank. The
settling apparatus can be used
in substitute for a conventional
cuboid (rectangular) or cylindrical
settling tank in a sewage treatment
process, and hence, it can save
equipment expenses and operating
expenses since it does not need a
return of sludge and mechanisms
and operating devices to collect the
sludge to the center or the front end
thereof.

Description

A SETTLING TANK HAVING AN AERATION PART IN ITS INNER SPACE

Technical Field

- [1] The present invention relates to a settling apparatus having an aeration tank built therein, and more particularly, to a settling apparatus, which includes an aeration tank integrally embedded in a central portion or on a side of a settling tank without the need of a power machine (hereinafter, referred to as "scraper") for collecting microorganisms (hereinafter, referred to as "sludge") and a return pump for returning the sludge to the aeration tank.

Background Art

- [2] As shown in FIG. 1, a typical settling apparatus serves to settle sludge by gravity and discharge treated water (supernatant) through a wier after staying introduced sewage (including the sludge). The settled sludge is collected to a front end or the center of a settling tank by a scraper, and then, returned to an (organism) aeration tank by a pump and some sludge is wasted as a surplus sludge. While the amount of the return sludge is 20 to 100 percent of a normal inflow amount, the return sludge increases a load of suspended solids to thereby have an influence on efficiency of the settling tank since the return sludge is ultimately re-introduced into the settling tank. Particularly, when the inflow amount of the introduced water is changed greatly, since the amount of the inflow water of the settling tank is increased due to the return sludge and the inflow amount, it has an adverse influence on a settling performance. The sludge exceeding a treatment capacity of the settling tank is discharged through the wier to thereby deteriorate the quality of water.

- [3] In a conventional sewage treatment system having an aeration tank and a settling tank, which are separated from each other, the height of a sludge layer of the settling tank is sensitive to a change in the inflow amount of the introduced water. Accordingly, a little increase of the sludge layer by the change in the inflow amount of the introduced water may cause deterioration in the quality of discharged water. Furthermore, the conventional sewage treatment system has several problems in that it must keep a predetermined difference in water level since the aeration tank and the settling tank are separated from each other, and in that it requires devices and energies for collecting and returning the sludge.

- [4] Korean Patent No. 0382810 discloses a technology for preventing deterioration in

quality of outflow water since a settling tank has a sludge storing capacity to some extent even though the sludge layer rises. However, since the treatment system has to simultaneously accept the amount of returned sludge and the inflow amount of the introduced water, it has a limitation in guaranteeing the quality of water according to a change in the inflow amount.

Disclosure of Invention

Technical Problem

[5] Accordingly, the present invention has been made in an effort to solve the above-mentioned problems occurring in the prior arts, and it is an object of the present invention to provide a settling apparatus having an aeration tank built therein, which includes a settling tank and an aeration tank integrated with the settling tank without the need of a scraper for collecting sludge.

[6] Another object of the present invention is to provide a settling apparatus having an aeration tank built therein, which performs only an internal return without any external return, thereby minimizing consumption of facilities and energies.

Technical Solution

[7] Hereinafter, in order to avoid confusion, sewage to be treated is defined as waste water, water which is under treatment is defined as treating water, and water to be discharged after treatment is defined as treated water or supernatant.

[8] To achieve the above objects, the present invention provides a settling apparatus having an aeration tank built therein comprising: (A) a main body having an outer wall and a base; (B) an aeration tank and a settling tank divided from each other by a partition, which is opened at a lower portion thereof, inside the main body; (C) sewage inducing means connected to the aeration tank; (D) at least one air diffusing means mounted in a lower portion of the aeration tank; and (E) treated water discharging means mounted on an upper portion of the settling tank.

[9] That is, the settling apparatus according to the present invention includes an aeration tank and a settling tank divided from each other by a partition, which is opened at a lower portion thereof, and air diffusing means mounted in a lower portion of the aeration tank, so that sewage introduced into the aeration tank is circulated due to aeration by the air diffusing means and treated water is discharged through the discharging means from the upper portion of the settling tank.

[10] In the present invention, the outer wall, the base and the partition may be made of materials generally used in typical water treatment systems, for instance, concrete,

synthetic resin or metal.

- [11] The aeration tank and the settling tank may be respectively located at right and left sides of the main body, but it is preferable that the aeration tank is located at the center of the main body and the settling tank is located outside the aeration tank.
- [12] In the present invention, the settling apparatus has a circular or a rectangular plane, and in this instance, the partition may be in a cylindrical form or a polyhedral form. That is, the aeration tank is located at the center of the main body and the settling tank surrounds the aeration tank by the cylindrical or polyhedral partition.
- [13] In the meantime, the partition may be in a plate form. Particularly, in case where the surface of the settling apparatus is formed in a rectangular shape, it is preferable that the aeration tank is located at the central portion of the main body and the settling tank is located outside the aeration tank by the two plate-type partitions formed at both sides of the main body.
- [14] When an internal denitrification occurs in sludge, it may cause sludge floatation phenomenon and the sludge may be discharged to the discharging means. In order to prevent the above phenomena, an inclined wall, laminar flow means and water current inducing means may be mounted additionally to circulate the sludge smoothly.
- [15] That is, the inclined wall is mounted between the outer wall and the base so that the sludge settled in the settling tank can lower smoothly and circulated to the inside of the aeration tank.
- [16] Furthermore, the laminar flow means for regulating water current between the aeration tank and the settling tank is mounted beneath the partition to circulate treating water between the aeration tank and the settling tank smoothly.
- [17] Moreover, it is preferable that the water current inducing means is mounted outside the air diffusing means to induce and control a circulation of the water current and sludge when bubbles rise by the air diffusing means of the aeration tank.
- [18] In this instance, forms of the laminar flow means and the water current inducing means are dependent upon the forms of the partition. That is, in case where the partition is in the cylindrical form, it is preferable that the laminar flow means is in an opened reverse-conical form and the water current inducing means is in a cylindrical form. Additionally, in case where the partition is in the plate form, it is preferable that also the laminar flow means and the water current inducing means are all in the plate form.
- [19] A barrier for promoting the discharge of the treated water and restraining the discharge of the sludge is mounted on the upper portion of the settling tank.

- [20] The barrier may be fabricated through a method that a supporter having a plurality of drain holes formed inclinedly or a plurality of water-permeable holes formed on upper and lower portions thereof is filled with floating filter media.
- [21] In the meantime, it is preferable that the partition is variable in its height for a case that treatment conditions are changed according to changes in an inflow amount or component characteristics of sewage. One or all of the two partitions may be variable in height, and those skilled in the art can easily select one from related techniques in connection with the above.
- [22] For instance, while the partition lowers to reduce the internal circulation of the sludge (aeration tank ↔ settling tank) in case where the height of a sludge layer of the settling tank excessively lowers according to a change of the conditions, the partition rises to increase the internal circulation of the sludge in case where the sludge layer rises excessively.

Advantageous Effects

- [23] The settling apparatus according to the present invention can be used in substitute for a conventional cuboid (rectangular) or cylindrical settling tank in a sewage treatment process, and hence, it can save equipment expenses and operating expenses since it does not need mechanisms and operating devices to collect the sludge at the center or the front end thereof.
- [24] Moreover, the settling apparatus according to the present invention can provide good economical efficiency and treatment efficiency owing to saving of energy since the quality of treated water can be greatly improved through filtering of the sludge layer.

Brief Description of the Drawings

- [25] FIG. 1 is a view of a conventional settling tank.
- [26] FIG. 2 is a sectional view showing examples of a settling apparatus having an aeration tank built therein according to the present invention.
- [27] FIG. 3 is a plan view showing the examples of the settling apparatus having the aeration tank therein according to the present invention.
- [28] FIG. 4 is a conceptual view of a sewage treatment system, to which the settling apparatus having the aeration tank therein according to the present invention is applied.
- [29] FIG. 5 is a conceptual view of a nitrogen and phosphorus treatment system, to which the settling apparatus having the aeration tank therein according to the present invention is applied.

- [30] <Explanation of essential reference numerals in drawings>
- [31] 1: settling apparatus having an aeration tank therein (main body)
- [32] 2 partition
- [33] 3: aeration tank 4 settling tank
- [34] 5: sewage inducing means 6: air diffusing means
- [35] 7: treated water discharging means (wier)
- [36] 8: inclined wall 9: laminar flow means
- [37] 10: water current inducing means
- [38] 11: barrier 12 outer wall
- [39] 13: base
- [40] 101: inflow line 102 internal return line
- [41] 103: outflow line 104 sludge drawing line
- [42] 105: air supply line 106: settling reactor
- [43] 108: aeration tank 109: anaerobic tank

Mode for the Invention

- [44] Reference will be now made in detail to the preferred embodiment of the present invention with reference to the attached drawings.
- [45] FIG. 2 is a sectional view showing examples of a settling apparatus having an aeration tank built therein according to the present invention, and FIG. 3 is a plan view showing the examples of the settling apparatus. FIGS. 2 and 3 illustrate also unessential parts, for instance, laminar flow means 9, water current inducing means 10, and a barrier 11.
- [46] As shown in the drawings, the settling apparatus having the aeration tank therein according to the present invention includes: a main body 1 having an outer wall 12 and a base 13; an aeration tank 3 and a settling tank 4 divided by a partition 2, which is opened at a lower portion thereof, inside the main body 1; sewage inducing means 5 connected to the aeration tank 3; at least one air diffusing means 6 mounted in a lower portion of the aeration tank 3; and treated water discharging means 7 mounted on an upper portion of the settling tank 4.
- [47] The sewage inducing means 5 may adopt a typical pipe, a perforated drain pipe having a plurality of holes formed on the wall surface of the pipe, or a pipe body constructed through a combination of the pipe and the perforated drain pipe may be adopted. Furthermore, as shown in FIG. 2, the sewage inducing means 5 can be mounted in such a way that it penetrates a side wall of the main body 1 or locked at the inner center of the main body 1.

- [48] The treated water discharging means 7 may adopt a pipe, or a discharge pipeline and a wier having a projecting jaw, which are mounted on an upper face of the settling tank 4 as shown in FIG. 1. The wier may be mounted along an outer wall 12 or the partition 2 formed on the upper portion of the main body or at the center of the settling tank 4.
- [49] FIG. 2(A) shows an example that an inclined wall 8 is not formed, FIGS. 2(B) and 2(C) show examples that the inclined wall 8 is formed. An inclination angle may be changed according to a width of the settling tank 4, preferably, 20° to 70°. Moreover, FIGS. 2(A) and 2(B) show examples that the aeration tank 3 is located at the center of the main body 1 and the settling tank 4 is located outside the aeration tank 3, and FIG. 2(C) shows an example that the aeration tank 3 and the settling tank 4 are respectively located on right and left sides of the main body 1.
- [50] In the settling apparatus according to the present invention, treating water (mixture of water and sludge), from which pollutants are removed by microorganisms, in the aeration tank 3 is introduced into the settling tank 4 through the lower portion of the partition 2. Sludge performs auto-flocculation in the lower portion of the settling part 4 to form a sludge layer to thereby improve the quality of the finally treated water since the sludge layer serves as a filtering layer when the treating water passes therethrough. In the introduced treating water, the sludge is settled and the separated treating water is discharged through the treated water discharging means 7. Since the settled sludge is aerated and moved and circulated into the aeration tank 3 due to a flow of water, and hence, it provides a sludge return effect. In prior arts, microorganisms (sludge) settled and concentrated in the settling tank are returned to the aeration tank 3 by using separate devices and energies. However, in the settling apparatus according to the present invention, the return of the microorganisms (sludge) is automatically achieved due to power of water current through an aeration action of the aeration tank 3.
- [51] The sludge rising together with some of the treating water is filtered by the barrier 11, and the sludge accumulated on the barrier 11 is sunk to the lower portion of the settling apparatus by self-weight.
- [52] In FIG. 3(A), the main body 1 of the settling apparatus has a rectangular plane and includes the cuboid aeration tank 3 formed at the center thereof and the settling tank 4 formed at both sides of the aeration tank 3 by means of the two plate-type partitions 2. In FIG. 3(B), the main body 1 of the settling apparatus has a circular plane and includes the circular aeration tank 3 formed at the center of the main body 1 and the settling tank 4 surrounding the aeration tank 3 by means of the circular partition 2. Of course, the form of the aeration tank 3 shown in FIG. 3(A) and the form of the aeration

tank 3 shown in FIG. 3(B) may be exchanged for each other.

[53] As described above, the partition 2 may be vertically movable. In FIG. 2, that the partition 2 is downwardly movable is indicated into a dotted line (the reference numeral 2' designates a partition indicated by the dotted line).

[54] In case where the partition 2 is in a plate form as shown in FIG. 3(A), also the inclined wall 8, the laminar flow means 9, the water current inducing means 10 and the barrier 11 must be in a plate form or a rectangular form corresponding to the form of the partition 2. In addition, in case where the plane form of the partition 2 is circular as shown in FIG. 3(B), also the plane forms of the laminar flow means 9, the water current inducing means 10 and the barrier 11 must be circular.

[55] According to the present invention, a surface loading rate of the settling apparatus having the aeration tank therein reaches $5 \text{ m}^3/\text{m}^2 \cdot \text{day}$, and it means that the settling apparatus can properly treat an increase of the inflow amount of the introduced sludge even though the inflow amount is increased up to seven times of the minimum treatment capacity.

[56] In the meantime, in case where the organic concentration of sewage exceeds a level to be treated by the embedded air diffusing means 6, it can be settled by an aeration tank additionally mounted on the front end of the settling apparatus of the present invention. (Shown in FIG. 4).

[57] The settling apparatus having the aeration tank therein according to the present invention may be used alone according to conditions of the sewage to be treated, or used in combination with various water treatment devices, which were known before.

[58] FIG. 4 conceptually shows a sewage treatment system, in which the settling apparatus having the aeration tank therein according to the present invention, a settling reactor, and an additional aeration tank are combined with one another, wherein FIG. 4(A) is a conceptually sectional view of the sewage treatment system and FIG. 4(B) is a conceptually plan view of the sewage treatment system.

[59] FIG. 5 conceptually shows a nitrogen/phosphorus treatment system in which the settling apparatus having the aeration tank therein according to the present invention, a settling reactor, and an anaerobic tank are combined with one another.

[60] Since detailed structures and operations of the systems shown in FIGS. 4 and 5 can be obtained from the description of the present invention and contents of the prior arts, detailed descriptions thereof will be omitted.

Industrial Applicability

[61] As described above, the settling apparatus according to the present invention can

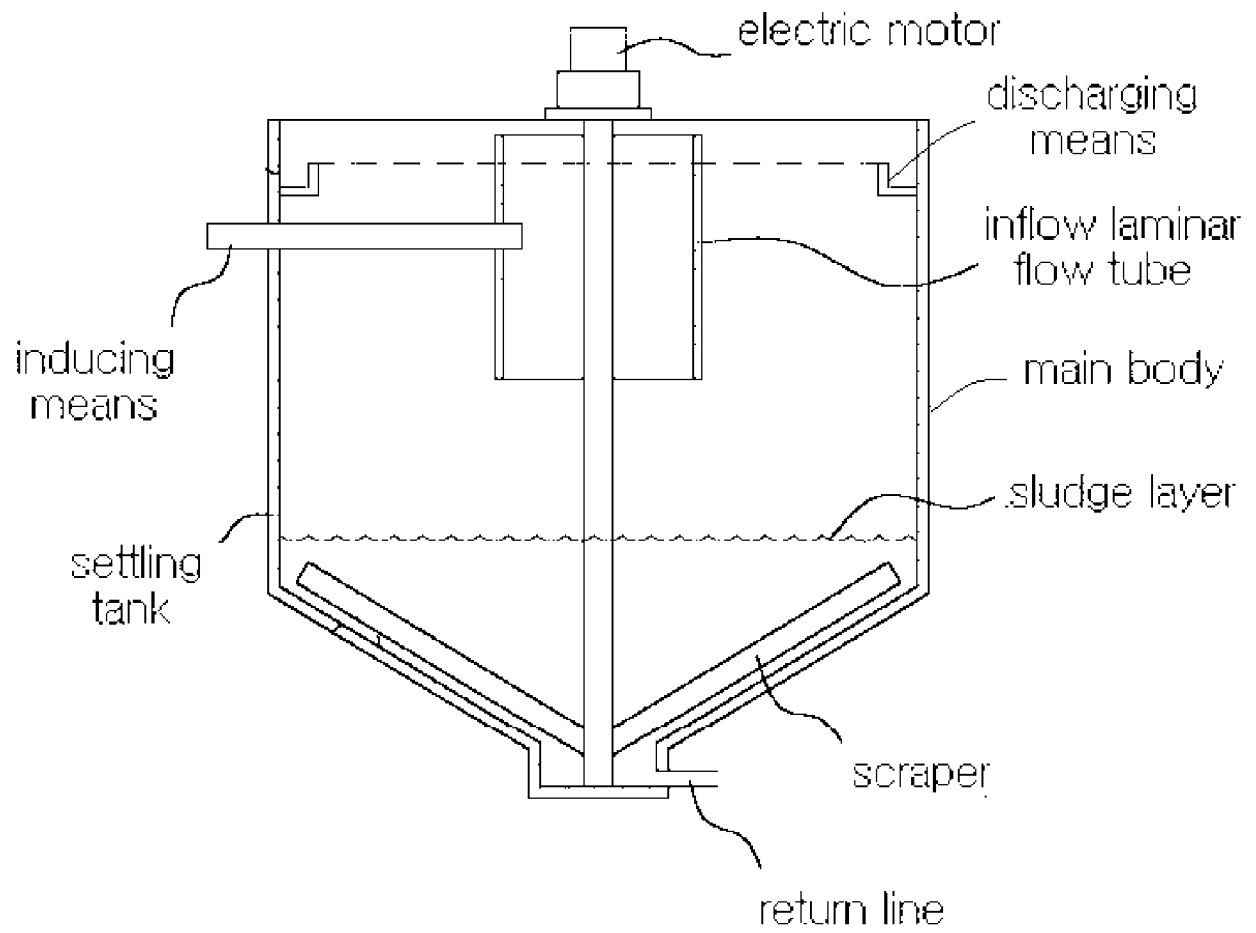
substitute for the cuboid (rectangular) settling tank or the circular settling tank, and can provide excellent economical efficiency since it can greatly improve the quality of water of the treating water through filtering and save equipment expenses and operating expenses.

Claims

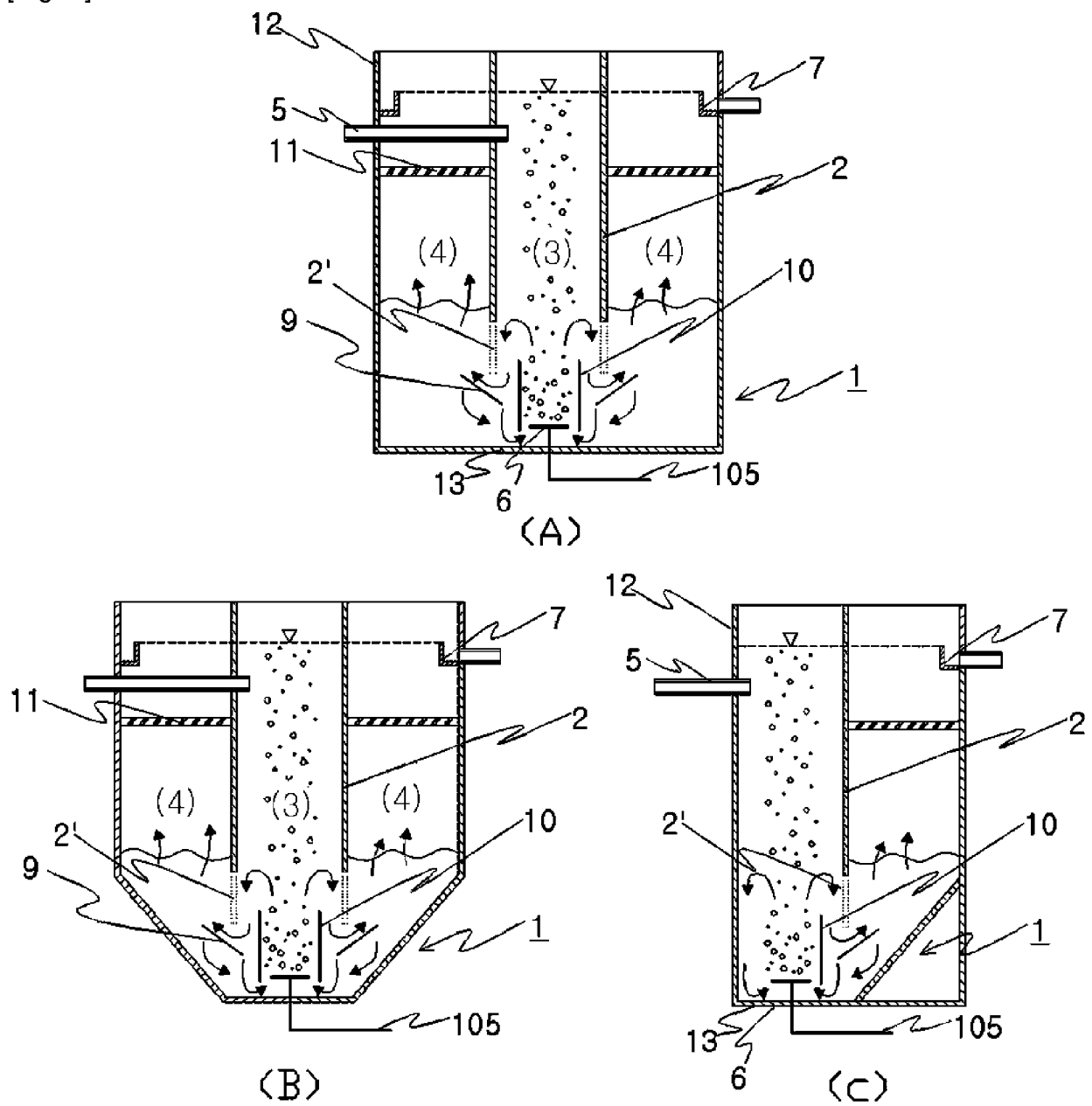
- [1] A settling apparatus having an aeration tank built therein, comprising:
a main body (1) having an outer wall (12) and a base (13);
an aeration tank (3) and a settling tank (4) divided from each other by a partition (2), which is opened at a lower portion thereof, inside the main body (1);
sewage inducing means (5) connected to the aeration tank (3);
at least one air diffusing means (6) mounted in a lower portion of the aeration tank (3); and
treated water discharging means (7) mounted on an upper portion of the settling tank (4).
- [2] The settling apparatus according to claim 1, wherein the aeration tank (3) is located at the center of the main body and the settling tank (4) is located outside the aeration tank.
- [3] The settling apparatus according to claim 2, wherein the main body (1) and the partition (2) of the settling apparatus are formed in cylindrical or polyhedral shape.
- [4] The settling apparatus according to claim 2, wherein a horizontal section of the main body (1) is formed in rectangular shape.
- [5] The settling apparatus according to one of claims 1 to 4, wherein an inclined wall (8) is mounted between the outer wall (12) and the base (13) of the settling tank (4).
- [6] The settling apparatus according to any one of claims 1 to 4, wherein laminar flow means (9) for regulating water current between the aeration tank (3) and the settling tank (4) is mounted beneath the partition (2).
- [7] The settling apparatus according to claim 5, wherein laminar flow means (9) for regulating water current between the aeration tank (3) and the settling tank (4) is mounted beneath the partition (2).
- [8] The settling apparatus according to any one of claims 1 to 4, wherein water current inducing means (10) for controlling water current when the aeration tank (3) performs aeration by the air diffusing means (6) is mounted outside the air diffusing means (6).
- [9] The settling apparatus according to claim 5, wherein water current inducing means (10) for controlling water current upon the aeration of the aeration tank (3) by the air diffusing means (6) is mounted outside the air diffusing means (6).

- [10] The settling apparatus according to any one of claims 1 to 4, wherein a barrier (11) for discharging treated water smoothly and restraining a discharge of sludge is mounted in an upper portion of the settling tank (4).
- [11] The settling apparatus according to claim 5, wherein a barrier (11) for discharging treated water smoothly and restraining a discharge of sludge is mounted in an upper portion of the settling tank (4).
- [12] The settling apparatus according to one of claims 1 to 4, wherein the partition (2) is controllable in its height.
- [13] The settling apparatus according to claim 5, wherein the partition (2) is controllable in its height.

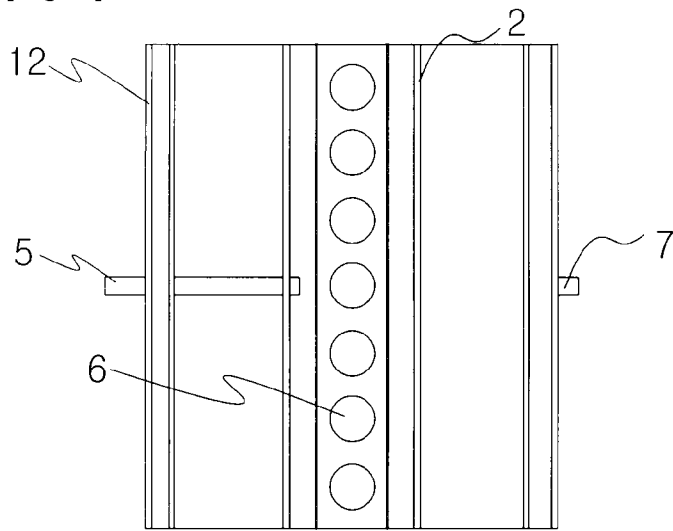
[Fig. 1]



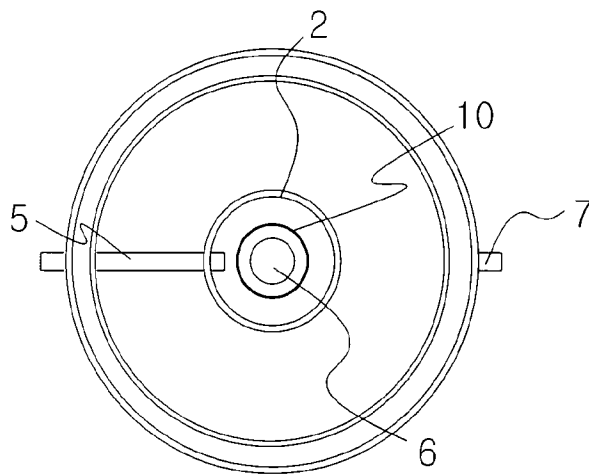
[Fig. 2]



[Fig. 3]

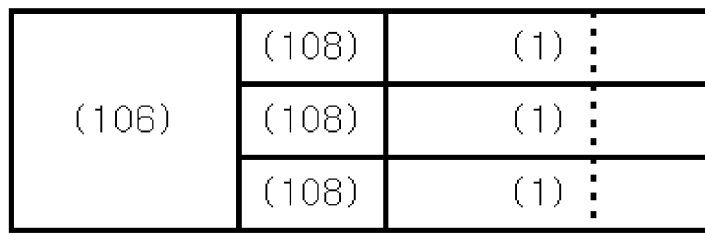
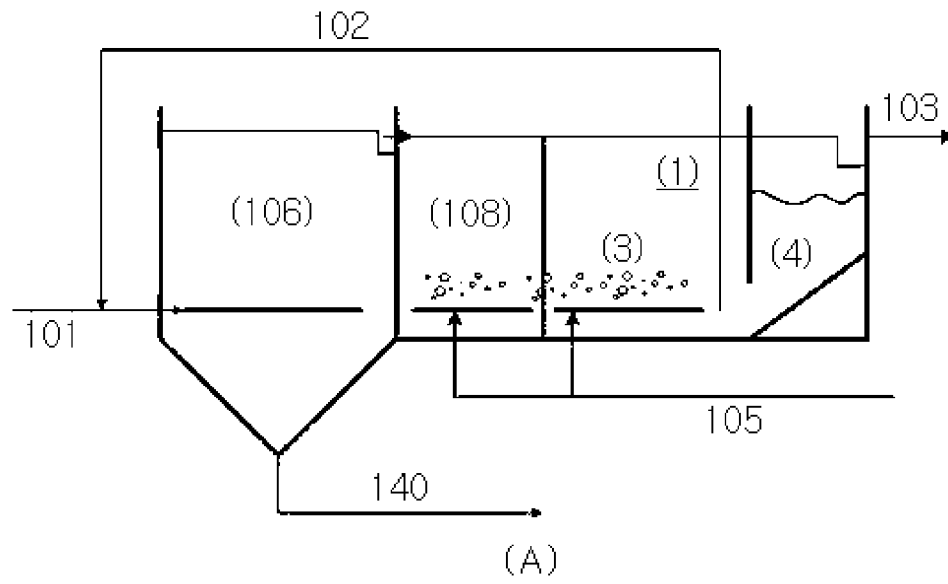


(A)



(B)

[Fig. 4]



[Fig. 5]

