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(12) **United States Patent** (10) Patent No.: **US 7,396,441 B2**
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(54) **FLOW-THROUGH OXYGENATOR**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 7 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 10/372,017, filed on Feb. 21, 2003, now Pat. No. 6,689,262.

(60) Provisional application No. 60/358,534, filed on Feb. 22, 2002.

(51) **Int. Cl.**
C25B 1/02 (2006.01)
C25B 1/04 (2006.01)
C02F 1/00 (2006.01)

(52) **U.S. Cl.** **204/278**; 204/242; 204/275.1; 204/232; 204/286.1; 204/554; 204/660; 205/633; 205/742; 210/243; 210/748

(58) **Field of Classification Search** 205/628–639, 205/742; 204/242, 245, 275.1, 278.5, 290.1, 204/232, 278, 286.1, 554, 660; 210/243, 210/748

See application file for complete search history.

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(57) **ABSTRACT**

An oxygen emitter which is an electrolytic cell is disclosed. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. A flow-through model for oxygenating flowing water is disclosed. The use of supersaturated water for enhancing the growth of plants is disclosed. Methods for applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture are described. The treatment of waste water by raising the dissolved oxygen with the use of an oxygen emitter is disclosed.

17 Claims, 8 Drawing Sheets

Stabilizing and connections hardware 4

Enclosure tube 3
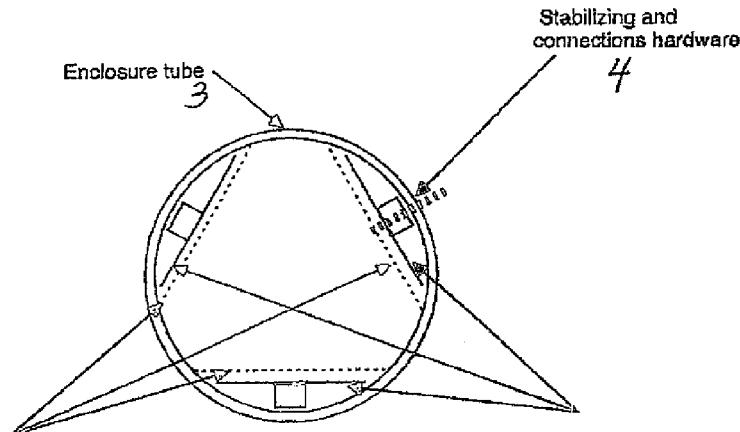
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Fig. 1B

Fig. 1A

TEMP CONTROLLED TIMER

5
8
7
4
1
3
2
6
9

Fig. 2B

OFF ON

10

BUTTON

BUTTON
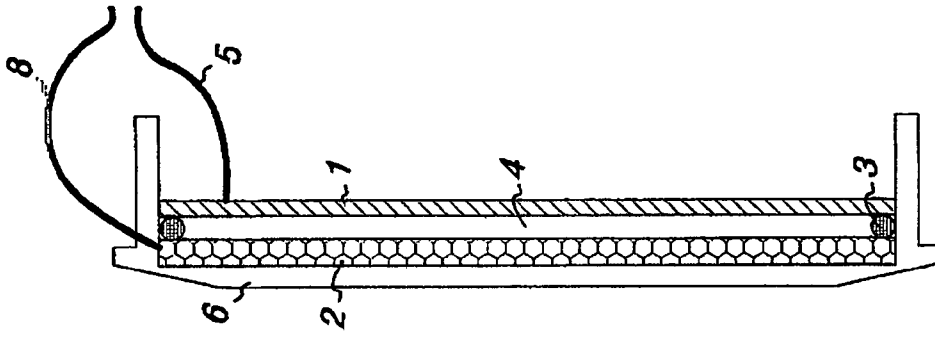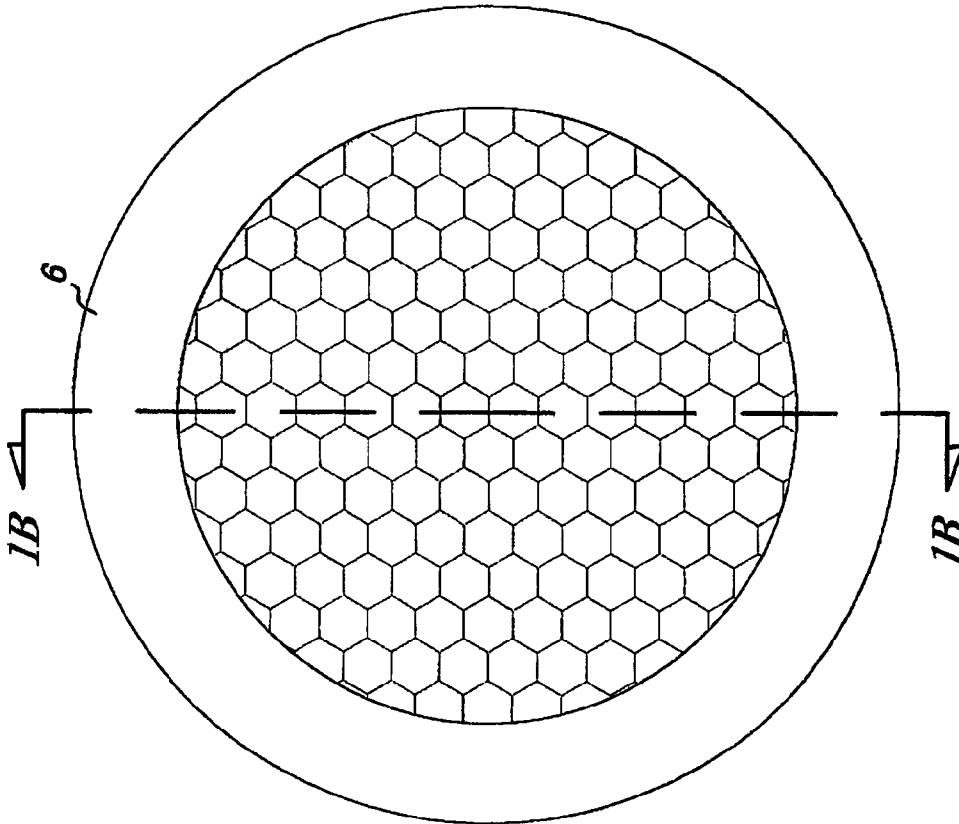
Fig. 2A

Fig. 3

DOCKET ALARM
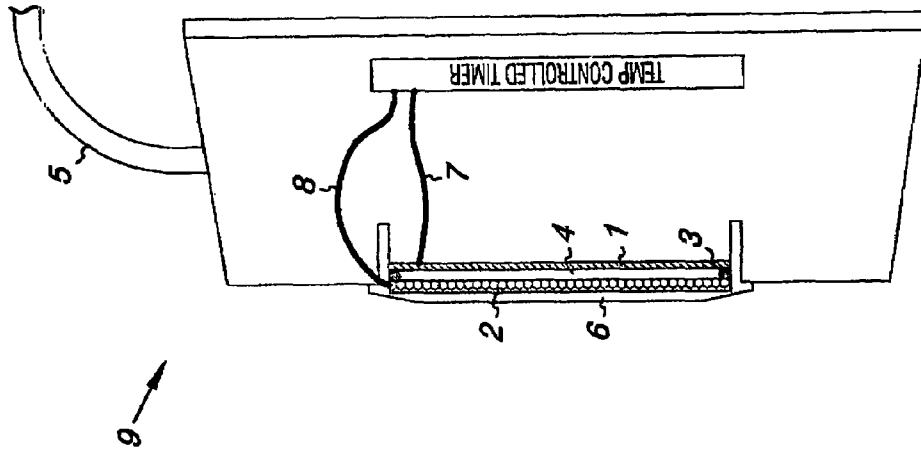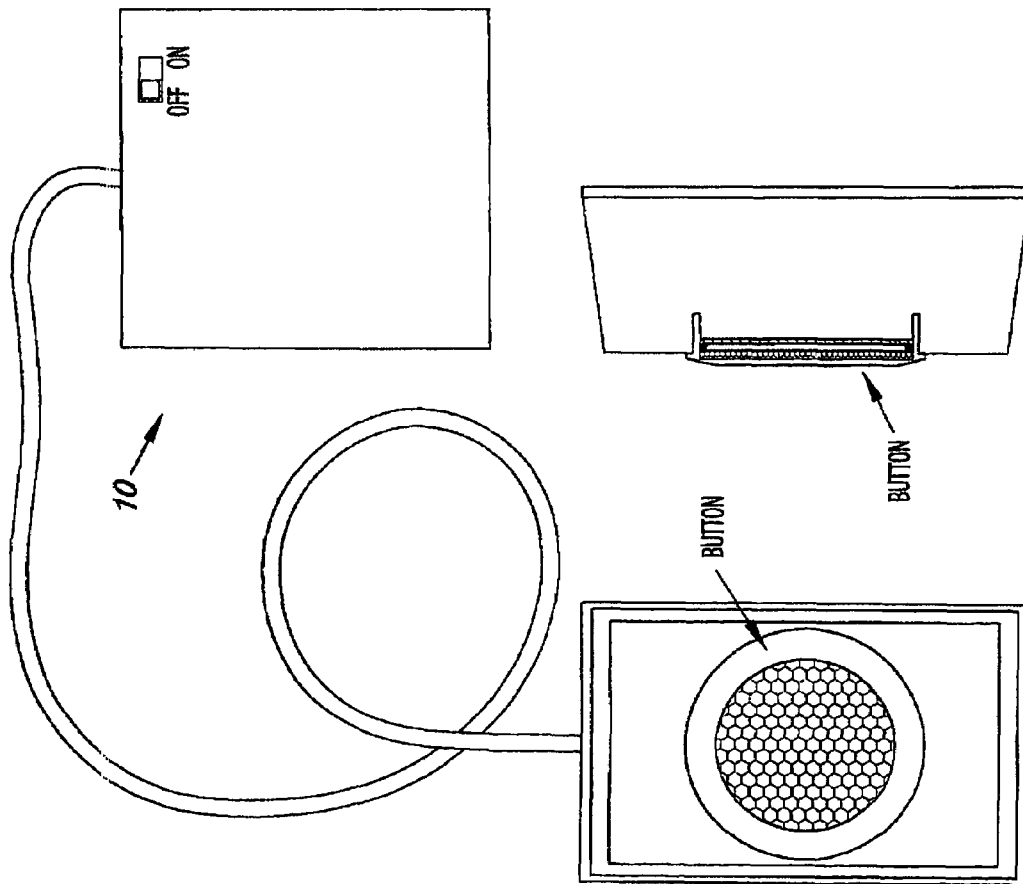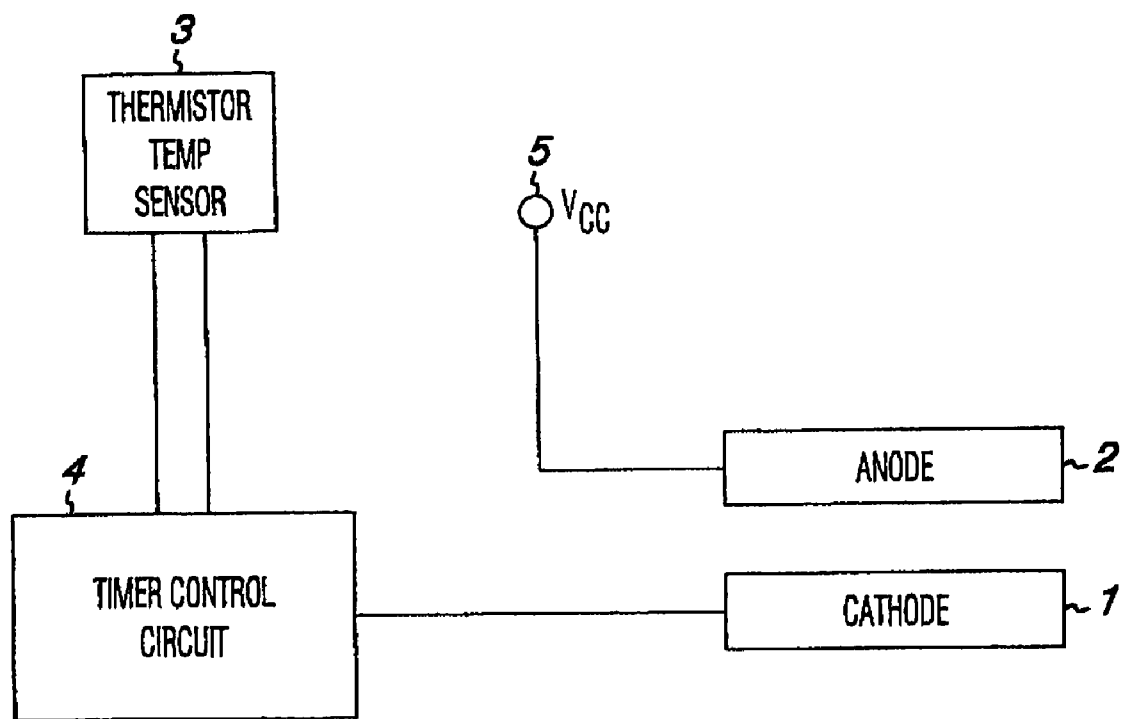
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