CLAIMS

[Claim 1] A fine bubble generating apparatus comprising:

an electrolysis unit that electrolyzes raw water to produce electrolyzed water and cracked gas;

a gas-liquid delivery unit that mixes the electrolyzed water and the cracked gas and delivers mixed liquid;

a first pipe that supplies the electrolyzed water and the cracked gas from the electrolysis unit to the gas-liquid delivery unit in a hermetically sealed state;

a fine bubble generating unit that generates fine bubbles in the mixed liquid supplied from the gas-liquid delivery unit, by high-speed swirling;

a second pipe that supplies the mixed liquid from the gas-liquid delivery unit to the fine bubble generating unit in the hermetically sealed state; and

a pump that is provided in the second pipe and that pumps the mixed liquid to the fine bubble generating apparatus under pressure.

[Claim 2] The fine bubble generating apparatus according to claim 1, wherein the first pipe is configured to contain negative pressure.

[Claim 3] The fine bubble generating apparatus according to claim 1, wherein the first pipe is configured to contain pressure in a range from -15 kPa to 15 kPa.

[Claim 4] The fine bubble generating apparatus according to any of claims 1 to 3, wherein the second pipe is configured to contain positive pressure.

[Claim 5] The fine bubble generating apparatus according to any of claims 1 to 3, wherein the second pipe is configured to contain pressure in a range from -15 kPa to 15 kPa.

[Claim 6] The fine bubble generating apparatus according to any of claims 1 to 5, wherein the gas-liquid delivery unit generates a vortex flow by high-speed swirling.

[Claim 7] The fine bubble generating apparatus according to any of claims 1 to 6, wherein:

the electrolysis unit includes a plurality of electrolysis cells; and

the gas-liquid delivery unit mixes the electrolyzed water and the cracked gas supplied from the plurality of electrolysis cells and delivers the mixed liquid.

[Claim 8] The fine bubble generating apparatus according to any of claims 1 to 7, wherein:

the gas-liquid delivery unit includes

a cylindrical portion that has a cylinder with two base surfaces, a first surface and a second surface, and that causes medium liquid supplied from a

plurality of paths to flow from the first surface toward the second surface,

a plurality of introducing portions that introduce the medium liquid from the first surface or from vicinity of the first surface into the cylindrical portion such that the medium liquid swirls inside the cylindrical portion, and

an outlet port provided at or in vicinity of a center of the second surface.

[Claim 9] A fine bubble generating apparatus comprising:

a gas-liquid delivery unit that delivers mixed liquid in which mixed gas and medium liquid are mixed by swirling agitation;

a first pipe that discharges the delivered mixed liquid;

a pump that discharges the mixed liquid under pressure;

a second pipe that discharges the mixed liquid from the pump; and

a fine bubble generating unit that generates fine bubbles in the mixed liquid supplied from the second pipe, by high-speed swirling under the pressure.

[Claim 10] The fine bubble generating apparatus according to claim 9, wherein the gas-liquid delivery unit swirls at high speed in one direction inside a cylinder.

[Claim 11] The fine bubble generating apparatus according

to claim 10, wherein the gas-liquid delivery unit

has the cylinder with two base surfaces, a first surface and a second surface,

flows the mixed liquid in a direction approximately perpendicular to the first surface toward the second surface while swirling the mixed liquid in an in-plane direction of the first surface, and

supplies the mixed liquid in a rotational direction.

[Claim 12] The fine bubble generating apparatus according to any of claims 9 to 11, further comprising:

a third pipe that is provided in a previous stage of the gas-liquid delivery unit and that supplies the medium liquid to the gas-liquid delivery unit; and

an electrolysis unit that is provided in a previous stage of the third pipe and that electrolyzes raw water to produce a mixture of electrolyzed water and generated gas and supplies the mixture as the medium liquid to the third pipe.

[Claim 13] The fine bubble generating apparatus according to claim 12, wherein the electrolysis unit is a two-compartment electrolysis cell that includes a cathode compartment containing a negative electrode and an anode compartment containing a positive electrode that are separated by a diaphragm.

[Claim 14] The fine bubble generating apparatus according to claim 13, wherein the electrolysis unit includes

a raw water supply port that is provided at or in vicinity of a bottom of the electrolysis unit and that supplies the raw water to the cathode compartment containing the negative electrode, and

an alkaline electrolyzed water outlet port that discharges alkaline electrolyzed water at or in vicinity of a top of the electrolysis unit.

[Claim 15] The fine bubble generating apparatus according to claim 13, wherein the electrolysis unit includes

a raw water supply port that is provided at or in vicinity of a bottom of the electrolysis unit and that supplies the raw water to the anode compartment containing the positive electrode, and

an acidic electrolyzed water outlet port that discharges acidic electrolyzed water at or in vicinity of a top of the electrolysis unit.

[Claim 16] The fine bubble generating apparatus according to claim 15, wherein the electrolysis unit is supplied with an electrolyte solution containing chlorine.