CLAIMS

1. An ultrafine bubble manufacturing unit for manufacturing gaseous ultrafine bubbles contained in water, the ultrafine bubble manufacturing unit comprising:

a casing having a circular cross section;

a supply pipe connected to one end of the casing, extending coaxially with the casing and supplying a mixed fluid of water and a gas;

a fine-reducing block having at least part stored within the casing and including a plurality of swirling flow forming portions each forming a swirling flow of the mixed fluid supplied from the supply pipe into the casing, the fine-reducing block causing the swirling flows formed in the swirling flow forming portions to collide with each other and finely reducing the gas in the mixed fluid so as to generate ultrafine bubble water; and

an emission pipe arranged on a side of the other end of the casing to emit the ultrafine bubble water generated in the fine-reducing block to an outside of the casing.

~~2. The ultrafine bubble manufacturing unit according to claim 1,~~

wherein the fine-reducing block has a cylindrical shape coaxial with the casing, and further wherein the fine-reducing block includes

a first swirling chamber serving as the swirling flow forming portion forming the swirling flow of the mixed fluid around a swirling axis coaxial with the casing,

a second swirling chamber formed on a side distant from the supply pipe with respect to the first swirling chamber and forming the swirling flow of the mixed fluid around the swirling axis coaxial with the casing, the swirling flow swirling in a direction opposite to the swirling flow formed in the first swirling chamber,

a collision chamber causing the swirling flow of the mixed fluid formed in the first swirling chamber and the swirling flow of the mixed fluid formed in the second swirling chamber to collide with each other and

an emission passage guiding, to a side of the emission pipe, the ultrafine bubble water produced by the collision of the swirling flows of the mixed fluid in the collision chamber, and

the emission pipe is coupled to the fine-reducing block to communicate with the emission passage so as to support the fine-reducing block within the casing.

~~3~~2. The ultrafine bubble manufacturing unit according to claim ~~2~~1,

wherein the fine-reducing block includes

a first block component including

the first swirling chamber,

a first introduction path introducing the mixed fluid within the casing into a side of one end of the first swirling chamber in a direction of a tangent to the first swirling chamber and

a first discharge hole formed in the other end of the first swirling chamber and discharging the swirling flow and

a second block component coupled to the first block component and including

the second swirling chamber,

a second introduction path introducing the mixed fluid within the casing into a side of one end of the second swirling chamber in a direction of a tangent to the second swirling chamber,

a second discharge hole formed in the other end of the second swirling chamber opposite the first discharge hole of the first block component and discharging the swirling flow,

a collision chamber surface coupled to the first block component and facing the collision chamber formed between the collision chamber surface and the first block component,

an inflow port formed in the collision chamber surface and making the ultrafine bubble water in the collision chamber flow into the emission passage and

an emission port formed in an end surface on a side opposite to a side having the first block component coupled and discharging the ultrafine bubble water flowing through the emission passage.

~~4~~3. The ultrafine bubble manufacturing unit according to claim ~~3~~2,

wherein the first introduction path and the second introduction path are formed to be inclined with respect to a plane perpendicular to an axis of the fine-reducing block.

~~5~~4. ~~The ultrafine bubble manufacturing unit according to claim 1,~~ An ultrafine bubble manufacturing unit for manufacturing gaseous ultrafine bubbles contained in water, the ultrafine bubble manufacturing unit comprising:

a casing having a circular cross section;

a supply pipe connected to one end of the casing, extending coaxially with the casing and supplying a mixed fluid of water and a gas;

a fine-reducing block having at least part stored within the casing and including a plurality of swirling flow forming portions each forming a swirling flow of the mixed

fluid supplied from the supply pipe into the casing, the fine-reducing block causing the swirling flows formed in the swirling flow forming portions to collide with each other and finely reducing the gas in the mixed fluid so as to generate ultrafine bubble water; and

an emission pipe arranged on a side of the other end of the casing to emit the ultrafine bubble water generated in the fine-reducing block to an outside of the casing,

wherein the fine-reducing block includes

a treatment flow path formed in a direction coaxial with the casing to guide the mixed fluid,

a first eccentric supply path introducing the mixed fluid into an upstream end of the treatment flow path in a direction eccentric to a center axis so as to form the swirling flow, the first eccentric supply path serving as the swirling flow forming portion and

a second eccentric supply path introducing the mixed fluid into a downstream side with respect to the first eccentric supply path of the treatment flow path in a direction eccentric to the center axis and opposite to the first eccentric supply path so as to generate the swirling flow in a direction opposite to the swirling flow formed in the first eccentric supply path and to cause the swirling flows to collide with each other and

the emission pipe is coupled to a downstream end of the treatment flow path in the fine-reducing block.

~~6~~5. An ultrafine bubble water manufacturing device formed with the ultrafine bubble manufacturing unit ~~according to claim 1,~~ comprising:

a casing having a circular cross section;

a supply pipe connected to one end of the casing, extending coaxially with the casing and supplying a mixed fluid of water and a gas;

a fine-reducing block having at least part stored within the casing and including a plurality of swirling flow forming portions each forming a swirling flow of the mixed fluid supplied from the supply pipe into the casing, the fine-reducing block causing the swirling flows formed in the swirling flow forming portions to collide with each other and finely reducing the gas in the mixed fluid so as to generate ultrafine bubble water; and

an emission pipe arranged on a side of the other end of the casing to emit the ultrafine bubble water generated in the fine-reducing block to an outside of the casing,

wherein the ultrafine bubble water manufacturing device comprising:

a first pump pressure feeding raw material water;

a mixer mixing a gas into the raw material water pressure fed from the first pump to form the mixed fluid;

a second pump provided on a downstream side of the mixer;

a branch portion branching the mixed fluid into two paths on a downstream side of the second pump;

a return path connected to the branch portion and having a flow rate adjusting valve and a first ultrafine bubble manufacturing unit of the ultrafine bubble manufacturing units interposed therein, the return path returning water containing ultrafine bubbles of the gas manufactured in the first ultrafine bubble manufacturing unit between the mixer and the second pump; and

an emission path connected to the branch portion and having a second ultrafine bubble manufacturing unit of the ultrafine bubble manufacturing units interposed therein,

the emission path emitting water containing ultrafine bubbles of the gas manufactured in the second ultrafine bubble manufacturing unit.

~~7~~6. An ultrafine bubble water manufacturing device formed with the ultrafine bubble manufacturing unit ~~according to claim 1,~~ comprising:

a casing having a circular cross section;

a supply pipe connected to one end of the casing, extending coaxially with the casing and supplying a mixed fluid of water and a gas;

a fine-reducing block having at least part stored within the casing and including a plurality of swirling flow forming portions each forming a swirling flow of the mixed fluid supplied from the supply pipe into the casing, the fine-reducing block causing the swirling flows formed in the swirling flow forming portions to collide with each other and finely reducing the gas in the mixed fluid so as to generate ultrafine bubble water; and

an emission pipe arranged on a side of the other end of the casing to emit the ultrafine bubble water generated in the fine-reducing block to an outside of the casing,

wherein the ultrafine bubble water manufacturing device comprising:

a first pump pressure feeding the mixed fluid obtained by mixing a gas into raw material water;

a mixer connected between a discharge side and a suction side of the first pump, mixing the gas into the mixed fluid discharged from the first pump and returning the mixed fluid to the suction side of the first pump;

the ultrafine bubble manufacturing unit provided on a downstream side of the first pump;

a second pump connected to a downstream side of the ultrafine bubble manufacturing unit;

a gas-liquid separator connected to a downstream side of the second pump; and

an emission path emitting a liquid separated in the gas-liquid separator.

~~8~~7. The ultrafine bubble water manufacturing device according to claim ~~6~~5 or ~~7~~6, wherein the second pump is a cascade pump.

~~9~~8. The ultrafine bubble water manufacturing device according to claim ~~6~~5, further comprising:

a gas amount adjusting valve adjusting an amount of the gas mixed with the mixer into the raw material water or the mixed fluid.

~~10~~9. The ultrafine bubble water manufacturing device according to claim ~~9~~8, further comprising:

a concentration meter measuring a concentration of the ultrafine bubbles in the water emitted from the emission path; and

a control device controlling the gas amount adjusting valve, the second pump and the flow rate adjusting valve based on a measurement value of the concentration meter.

~~11~~10. The ultrafine bubble water manufacturing device according to claim ~~9~~8, further comprising:

an input portion having a diameter, a concentration and a flow rate of bubbles in bubble water needed to be emitted from the emission path input thereto;

a control device connected to the input portion and connected to the first pump, the second pump, the flow rate adjusting valve and the gas amount adjusting valve; and

a table stored in the control device, the table storing possible values of a load of the first pump, a load of the second pump, a degree of opening of the flow rate adjusting valve and a degree of opening of the gas amount adjusting value and storing a diameter, a concentration and a flow rate of bubbles in bubble water emitted from the emission path corresponding to the possible values,

wherein the control device extracts, based on values input to the input portion, with reference to the table, target values of the load of the first pump, the load of the second pump, the degree of opening of the flow rate adjusting valve and the degree of opening of the gas amount adjusting value, and controls the first pump, the second pump, the flow rate adjusting valve and the gas amount adjusting value so as to achieve the target values.