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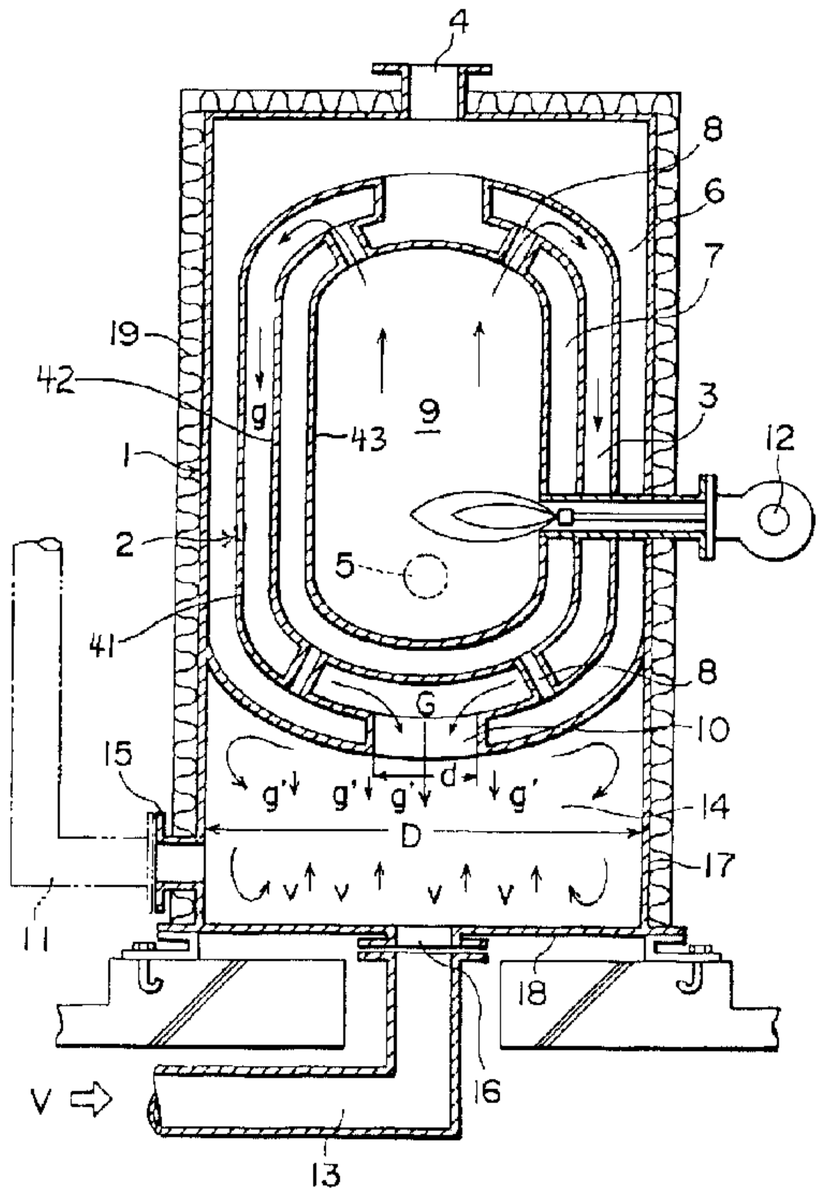
(54) Title: LIQUID HEATING APPARATUS



(57) Abrégé/Abstract:
In a liquid heating apparatus according to the present invention, an internal drum is arranged at a space from and in an external drum, a combustion gas descending chamber is provided therebetween, an outer water chamber having a hot water outlet port and a water supply port in the upper and lower sections thereof is provided outside the combustion gas descending chamber, an inner water chamber communicating with communicating tubes in the upper and lower sections to the outer water chamber is provided inside the combustion gas descending chamber, a combustion chamber communicating to the combustion gas descending chamber in the upper section is provided inside the internal drum, and exhaust port is provided under the combustion gas descending chamber, a smoke collecting chamber having a larger cross-sectional area than that of said exhaust port is provided under the exhaust port, and a smoke exhaust port is provided in this smoke collecting chamber.

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ABSTRACT

In a liquid heating apparatus according to the present invention, an internal drum is arranged at a space from and in an external drum, a combustion gas descending chamber is provided therebetween, an outer water chamber having a hot water outlet port and a water supply port in the upper and lower sections thereof is provided outside the combustion gas descending chamber, an inner water chamber communicating with communicating tubes in the upper and lower sections to the outer water chamber is provided inside the combustion gas descending chamber, a combustion chamber communicating to the combustion gas descending chamber in the upper section is provided inside the internal drum, and exhaust port is provided under the combustion gas descending chamber, a smoke collecting chamber having a larger cross-sectional area than that of said exhaust port is provided under the exhaust port, and a smoke exhaust port is provided in this smoke collecting chamber.

LIQUID HEATING APPARATUS

[Background of the Invention]

This invention relates to a liquid heating apparatus, such as a boiler, utilizing an ascendant/descendant flowing system of a combustion gas.

The liquid heating apparatuses as described above include, for instance, one that this applicant proposed in Japanese Utility Model Publication No. 15168/1956, and the apparatus is as shown in FIGS. 1 and 2. In this apparatus, an internal drum 22 comprising a dual wall is arranged in and at a space from an external drum 21 comprising a dual wall. A combustion gas descending chamber 23 is provided therebetween. An outer water chamber 26, having a hot water outlet port 24 and a water inlet port 25, in the upper and lower sections thereof respectively is provided outside this combustion gas descending chamber 26. An inner water chamber 27, in communication with the outer water chamber 26 via the upper and lower communicating tubes 23, is provided inside the combustion gas descending chamber 23. A combustion chamber 29, in communication with the combustion gas descending chamber 23 in the upper section thereof, is provided in the internal drum 22. An exhaust port 30 is provided under the combustion gas descending chamber 23. A flue 33 is in communication with this exhaust port 30, and a combustor 32 is detachably mounted through the inner and outer water chambers 26 and 27. It should be noted that the numeral 34 indicates a clearing port. In the liquid heating apparatus as described above, the combustion gas successively rated by the combustor 32 goes up in the combustion chamber 29, the radiant heat being absorbed therein, and then the combustion is inverted in the upper section thereof and flows down through the combustion gas descending chamber 23 at a flow velocity g (m/sec), the flow velocity being increased to a velocity G (m/sec) at the exhaust port 30, and is exhausted to the flue 33. During this process, the combustion gas rapidly

raises temperature of the liquid by delivering the heat through radiation or contact to the liquid in the inner and outer water chambers 26 and 27 and raising the heat exchange rate between the combustion gas and the liquid, and at the same time the descending fluidity is raised and the combustion efficiency is improved, so that incomplete combustion is advantageously prevented.

Although the conventional type of liquid heating apparatus provides the advantage as described above, it has the following problem: namely, the liquid heating apparatus as described above has a flow path, for a combustion gas in the combustion gas descending chamber 23, which is narrow so that delivery of heat is efficiently carried out through contact by the combustion gas. In other words:

(1) The combustion gas flowing down in the narrow flow path flows laterally at a substantially right angle with the flow velocity G as described above under the exhaust port 30 via the flue 33 communicated to the exhaust port 30, and furthermore flows upwardly at substantially right angles outside the external drum 21, thus an extremely large air exhaust resistance is generated. This air exhaust resistance prevents the combustion gas from flowing smoothly, and the expected effect cannot be achieved, which is a problem to be solved.

(2) If cross-sectional areas of the exhaust port 30 and the flue 33 are made larger to solve this problem, i.e., by allowing a smooth flow of the combustion gas to overcome the large exhaust resistance, disturbance occurs at a flow velocity of V (m/sec) from an exhaust port of the flue 33 as indicated by the arrow mark in FIG. 2. If the relation between the flow velocity V is higher than the flow velocity G of the combustion gas ($V < G$), normal combustion is maintained, but in case of $V > G$, disturbance

occurs in the combustion chamber 29, which prevents normal combustion. When fire occurs, the draft power in the flue 33 is generally expressed by the equation of Df ∝ H x (Tgm - To) (wherein Df is draft power, H is height, Tgm is an average temperature in the flue 33, and To is a temperature of peripheral air). In the case of the flue 33 having a large cross-sectional area, a quantity of heat radiated from the surface of the flue increases and the draft power is lost, giving a poor influence over combustion. When combustion is stopped, external air comes in from an opened exit of the flue 33, having a large cross-sectional area, which cools a heat insulation gas residing in the apparatus and generates convection therein. Then, the heat insulation gas is exhausted via the flue 33 to the outside and the temperature decreases. In such a system, as an automatic hot water supply system, the combustor 9 operates to restart unnecessary heating, which results in a waste of energy and increase of the running cost. Also, the combustion state in the apparatus becomes so unstable as to interrupt combustion in the combustor 32, or to generate oscillating combustion, as well as to generate noise. These are other problems to be solved.

[Summary of the Invention]

An object of the present invention is to solve the problems in the conventional type of liquid heating apparatuses as described above by providing a liquid heating apparatus wherein: a combustion gas can smoothly flow without generating a large exhaust resistance when the combustion gas is exhausted; an external disturbance can hardly come into a flue from the exhaust port even if cross-sectional areas of the exhaust port and the flue are not increased; and, accordingly,

an external disturbance does not enter the combustion gas descending chamber, or the combustion chamber, to disturb the combustion state or generate noise therein.

In order to achieve the objects as described above, there is provided a liquid heating apparatus according to the present invention wherein: an internal drum is arranged in an external drum; the internal drum consists of an external vessel, intermediate vessel and internal vessel; the internal vessel constitutes a combustion chamber; an outer water chamber is formed between the external drum and the external vessel; a combustion gas descending chamber is formed between the outer vessel and the intermediate vessel; an inner water chamber is formed between the intermediate vessel and internal vessel; a hot water outlet port connecting the outer water chamber with outside of the apparatus is provided at an upper section of the external drum; a water supply port connecting the outer water chamber with the outside of the apparatus is provided at the lower section of the external drum; the combustion chamber is in communication with the combustion gas descending chamber via upper of communicating tubes and is also in communication with the combustion descending chamber via an exhaust port; the exhaust port being opened to a smoke collecting chamber provided at a lower section of the external drum; and the smoke collecting chamber having a larger cross-sectional area than that of said exhaust port. The smoke exhaust port may be provided in the side section or at the bottom of the smoke collecting chamber.

In the liquid heating apparatus according to the present invention as described above, a combustion gas flowing upward in the combustion chamber is inverted at the top and descends through the combustion gas descending chamber, and during this process the combustion gas supplies a liquid inside the inner and outer water chambers with heat. Thus, the descending fluidity is improved with the raised combustion efficiency which prevents incomplete combustion and raises the temperature

of the liquid by raising the heat exchange rate between the combustion gas and the liquid. Thus, the flow velocity of the combustion gas, exhausted at a high velocity from the exhaust port to the smoke collecting chamber, is reduced because the cross-sectional area of said smoke collecting chamber is larger than that of the exhaust port, a portion of the dynamic pressure, according to the difference, changes to a static pressure, which maintains the discharge pressure to the exhaust port. For this reason, when an external disturbance comes into the smoke collecting chamber from an exhaust port of the flue, the flow velocity decreases and the external disturbance is dispersed and weakened.

[Brief Description of the Drawings]

In the accompanying drawings:

FIG.1 is a cross section of a conventional type of liquid heating apparatus like that according to the present invention, viewed from the front side in the longitudinal direction;

FIG. 2 is a cross section of the same taken along the line 2-2 in FIG. 1; and

FIG. 3 is a cross section of a liquid heating apparatus according to an embodiment of the present invention, viewed from the front side in the longitudinal direction.

[Description of the Preferred Embodiment]

In the embodiment of the present invention shown in FIG. 3, the numeral 1 indicates an external drum comprising a dual wall. An internal drum 2, comprising an external vessel 41, intermediate vessel 42 and internal vessel 43, is arranged at a space from and in the external drum 1. A combustion gas descending chamber 3 is provided therebetween. An outer water chamber 6 having a hot water outlet port 4 and a water supply port 5 in the upper and lower sections thereof respectively is provided outside the combustion gas descending chamber 3. An inner water chamber 27 communicating with communicating tubes

8 in the upper and lower sections thereof to the outer water chamber 6 is provided inside the combustion gas descending chamber. A combustion chamber 9 communicating in the upper section to the combustion gas descending chamber 3 is provided inside the internal drum 2. An exhaust port 10 is provided under the combustion gas descending chamber 3. A flue 13 is communicated to this exhaust port 10, and a combustor 12 is detachably mounted through the inner and outer water chambers 6 and 7. In this type of a liquid heating apparatus, like the conventional one as described above, a combustion gas flowing up in the combustion chamber 9 is inverted at the top and descends through the combustion gas descending chamber 3, an during this process the combustion gas adequately supplies a liquid inside the inner and outer water chambers 6 and 7 with heat. The descending fluidity is improved with the raised combustion efficiency thereby preventing incomplete combustion and raising the heat exchange rate between the combustion gas and the liquid. Thus, the temperature of the liquid is rapidly raised.

In this invention, an external wall of the external drum 1 is extended downward to form a smoke collecting chamber 14 therein with the extended peripheral wall 17. Smoke exhaust ports 15 and 16 are provided in the peripheral wall 17 and the bottom wall 18 of the smoke collecting chamber 14, and flues 11 and 13 are detachably mounted on the smoke exhaust ports 15 and 16. It should be noted that the peripheral wall may be formed as a separated body from the external drum and mounted to the external drum 1, and either one of the smoke exhaust ports 15 and 16 may be omitted. With the construction as described above, a cross-sectional area D of the smoke collecting chamber 14 is larger than a cross-sectional area of the exhaust port 10, and results of an experiment show that the relation between them should preferably be the one expressed by the equation of $D \geq \sqrt{1.5} \times d$. In the liquid heating

apparatus having the construction as described above, when a combustion gas flows down at a high flow velocity g through the combustion gas descending chamber 3 with the flow velocity increased to the flow velocity G at the exhaust port 30, and is discharged from the exhaust port 10 to the smoke collecting chamber 14, the flow velocity g is reduced to g'; g' is lower than g because a cross-sectional area of said smoke collecting chamber 14 is larger than that of the exhaust port 10, and the dynamic pressure, according to the difference, is changed to a static pressure which maintains a discharge pressure to the exhaust port 10. If a external disturbance having the flow velocity of V comes into the smoke collecting chamber 14 from the exhaust port of the flue 33, the flow velocity V is reduced to a flow velocity v which is smaller than V, the external disturbance being dispersed and weakened. It should be noted that the numeral 19 in the figure indicates a heat insulating material which covers the external drum 1.

The present invention is as described above and, according to the present invention, an internal drum is arranged at a space from, and inside, an external drum. A combustion gas descending chamber is provided therebetween. An outer water chamber having a hot water outlet port and a water supply port in the upper and lower sections thereof is provided outside the combustion gas descending chamber. An inner water chamber communicating with communicating tubes in the upper and lower sections thereof to the outer water chamber is provided inside the combustion gas descending chamber. A combustion chamber communicating to the aforesaid combustion gas descending chamber in the upper section is provided inside the internal drum. An exhaust port is provided under the combustion gas descending chamber. A smoke collecting chamber having a larger cross-sectional area than said exhaust port is provided under the aforesaid exhaust port. A smoke exhaust port is provided in this smoke collecting chamber. The smoke exhaust chamber may be provided in the side section or at the bottom of the

smoke collecting chamber, so that the combustion gas can flow smoothly without generating a large exhaust resistance when the combustion gas is exhausted. Also, so that an external disturbance can hardly enter from the exhaust port of the flue even if cross-sectional areas of the exhaust port and the flue are not expanded and, accordingly, the external disturbance does not enter the combustion gas descending chamber nor the combustion chamber as it is. This prevents energy from being wasted, the running costs from increasing, and disruption of combustion in the combustor due to unstable combustion conditions in the apparatus. Generation of oscillating combustion and noise is also thereby prevented.

WE CLAIM:

1. A liquid heating apparatus wherein an internal drum (2) is arranged in an external drum (1), the internal drum (2) consists of external vessel (41), intermediate vessel (42) and internal vessel (43), the internal vessel (43) constitutes a combustion chamber (9), an outer water chamber (6) is formed between the external drum (1) and the external vessel (41), a combustion gas descending chamber (3) is formed between the outer vessel (41) and the intermediate vessel (42), an inner water chamber (7) is formed between the intermediate vessel (42) and internal vessel (43), a hot water outlet port (4) connecting the outer water chamber (6) with outside of the apparatus is provided at an upper section of the external drum (1), a water supply port (5) connecting the outer water chamber (6) with the outside of the apparatus is provided at the lower section of the external drum (1), the combustion chamber (9) is in communication with the combustion gas descending chamber (3) via upper of communicating tubes (8) and is also in communication with the combustion descending chamber (3) via an exhaust port (10), the exhaust port (10) being opened to a smoke collecting chamber (14) provided at a lower section of the external drum (1), and the smoke collecting chamber (14) having a larger cross-sectional area than that of said exhaust port (10).

2. A liquid heating apparatus as claimed in Claim 1 wherein the relation between cross-sectional area D of the smoke collecting chamber and cross-sectional area d of the exhaust port is expressed by the equation of $D \geq \sqrt{1.5} \times d$.

3. A liquid heating apparatus as claimed in Claim 1 or 2 wherein the exhaust port is provided in a side section or at a bottom of the smoke collecting chamber.

4. A liquid heating apparatus as claimed in any one of Claims 1 to 3, wherein the external drum is covered with a heat insulating material.

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FIG. 1
(PRIOR ART)

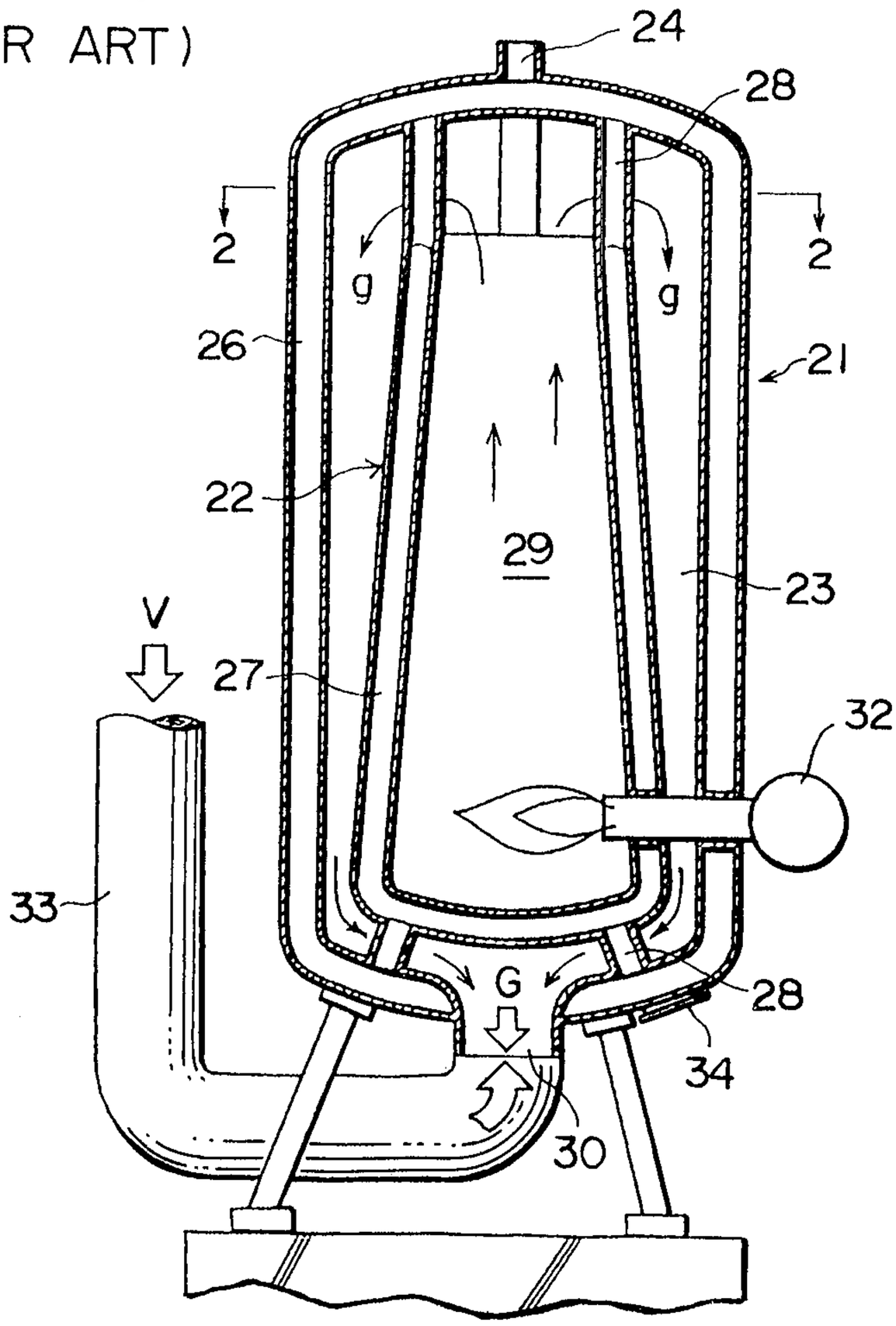


FIG. 2
(PRIOR ART)

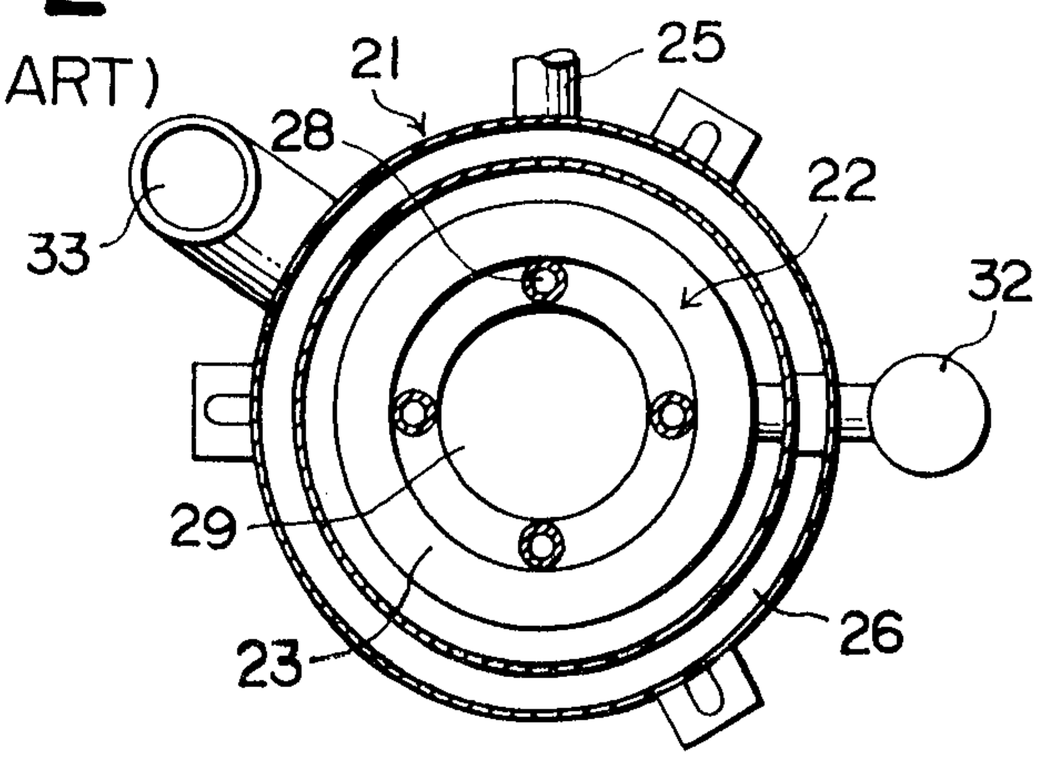
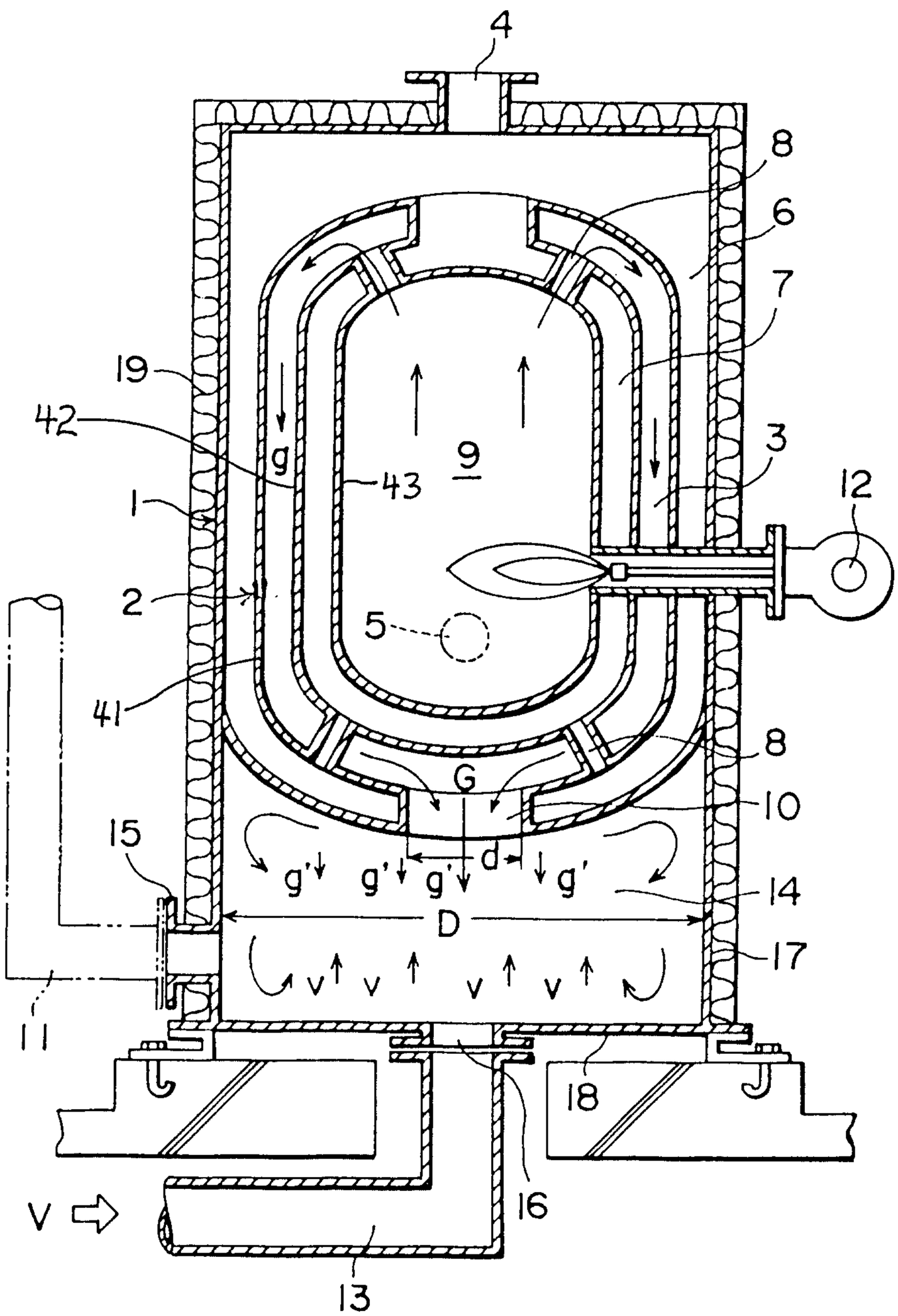
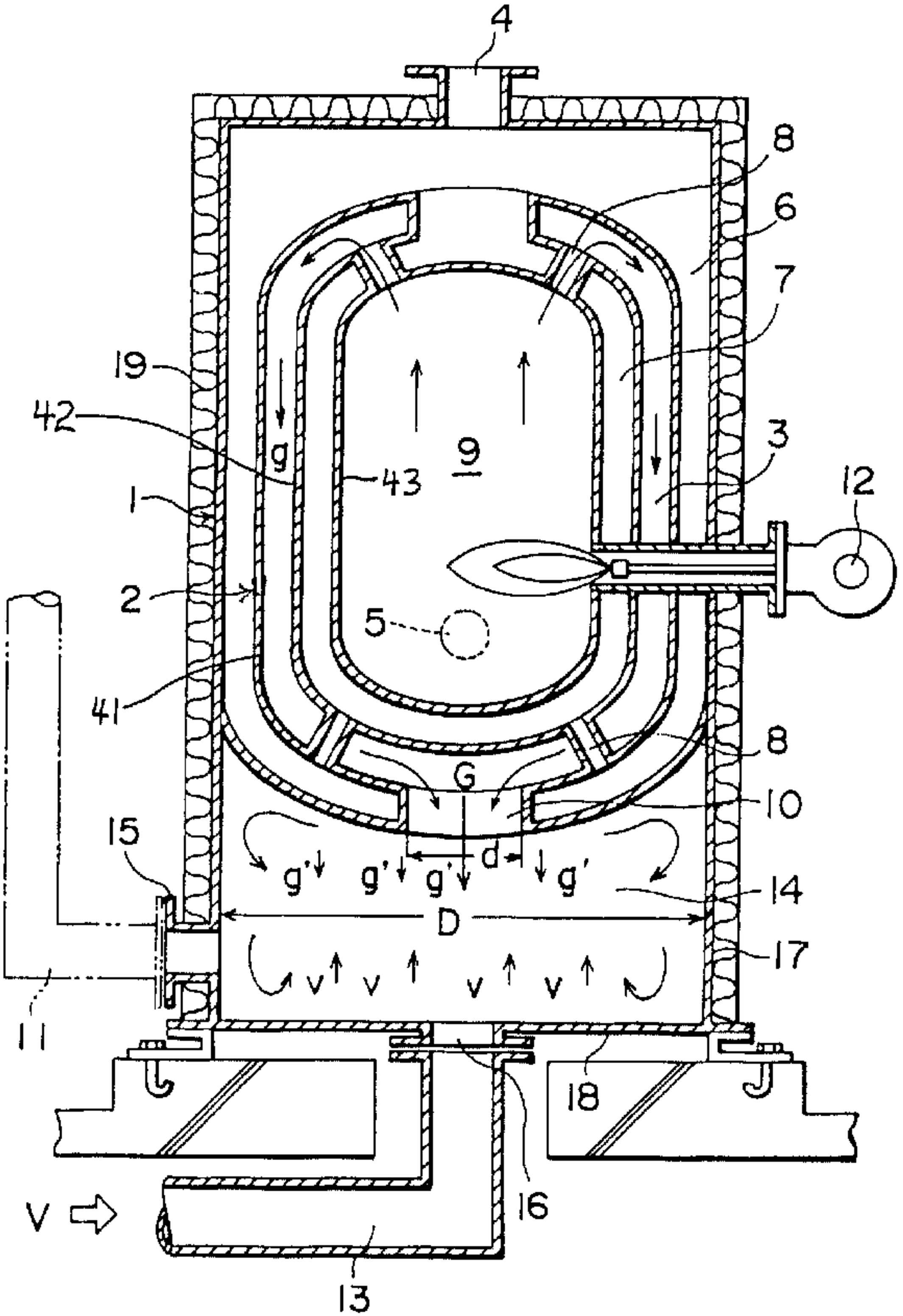


FIG. 3

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