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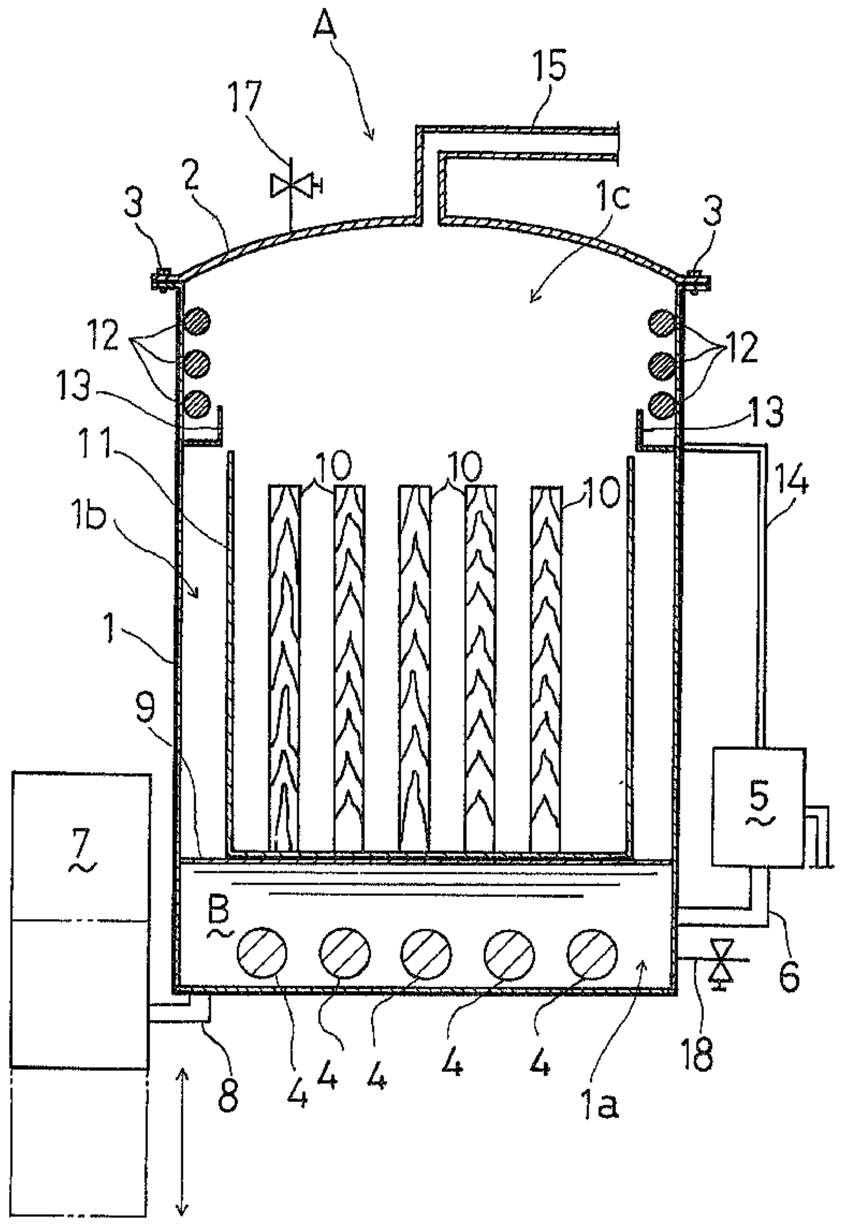
(54) Titre : METHODE DE TRAITEMENT DU BOIS UTILISANT UN SOLVANT ORGANIQUE A BASE DE CHLORE
(54) Title: WOOD TREATMENT USING A CHLORINE-BASED ORGANIC SOLVENT



(57) Abrégé/Abstract:
A wood-treating apparatus for efficiently treating wood with a chlorine-based organic solvent includes: a solvent tank for storing a mixture including a chlorine-based organic solvent and water, which solvent tank is provided with a heater for heating the mixture to generate vapor of chlorine-based solvent and water; a treating chamber which receives vapor from the solvent tank, for containing wood to be treated; and a cooling chamber in communication with the treating chamber, for cooling and condensing the vapor. The treated wood dries rapidly, and can be dyed uniformly. A wood treating method involves vaporizing the mixture and permeating the vapor into the cells of the wood to dissolve the oil and fat contents of the cell membranes, to facilitate the removal of water from the cells.

Abstract

A wood-treating apparatus for efficiently treating wood with a chlorine-based organic solvent includes: a solvent tank for storing a mixture including a chlorine-based organic solvent and water, which solvent tank is provided with a heater for heating the mixture to generate vapor of chlorine-based solvent and water; a treating chamber which receives vapor from the solvent tank, for containing wood to be treated; and a cooling chamber in communication with the treating chamber, for cooling and condensing the vapor. The treated wood dries rapidly, and can be dyed uniformly. A wood treating method involves vaporizing the mixture and permeating the vapor into the cells of the wood to dissolve the oil and fat contents of the cell membranes, to facilitate the removal of water from the cells.

Wood Treatment Using A Chlorine-Based Organic Solvent

The present invention relates to a method and apparatus for defatting, coloring, and drying wood. In the conventional method for treating wood by defatting, drying, and coloring, and so forth, it is difficult to dissolve out such parts of wood as cellulose, hemicellulose, and lignin, which compose its cell membranes. If an attempt is made to abruptly evaporate excess water in wood in a short time, the shape of the wood is notably altered, and it becomes unsuitable to be processed into the designated wood products.

Therefore, it was only possible to perform this treatment by drying wood for as long as one year, while taking care not to alter the shape of wood. Enormous energy and time are expended for the work of drying wood, so that the quantity of treatable products is naturally limited. Furthermore, other problems have arisen. Lignin itself is a material which is difficult to decompose or dissolve, its composition being not chemically clarified. When coloring wood, the dye permeates only to its thin surface layer.

Thus, whether wood is dried by the sun's heat or artificially, reducing the water content of wood to the saturation point of the fibers can be relatively easily done by removing free water that is not confined in cells. However, the free water confined in the cell membranes which are tightly closed by lignin, is not easily removed. Lignin is a chemical component with high molecular phenols as its basic component material.

After a tree has been felled, the poreholes of the false vessels and vessels of wood close, as if acting as

valves, whereby the free water is confined within them. If the surface is abruptly dried, the aforementioned poreholes of the false vessels and vessels close, whereby movement of the free water contained in the lumina is stopped, bringing about a state in which the moisture remaining in the lumina does not evaporate, however high the temperature is raised thereafter, and a surface hardened state is reached.

As above-described, the wood, after the parent tree has been felled, undergoes a process of confining water content in its cells and lumina by means of lignin, etc. Accordingly, the water is not easily evaporated simply by the sun's heat or hot air, without requiring a long time for drying.

In contrast, according to this invention, in order to draw out water from the cell membranes firmly blocked by lignin, the unconfined free water is removed at first by exposing the wood to vapor, pressurized by heating, of a chlorine-based organic solvent such as methylene chloride (CH_2Cl_2) for cleaning by vapor-defatting. The fine molecules of the vapor of the methylene chloride (CH_2Cl_2) solvent liquefy the tough lignin in the cell structure, thereby perforating the cell membranes and undermining the valve action of the poreholes. In that way, outward movement of the confined free water through the perforations of the cells and the porehole valve parts is facilitated.

The perforations of the cells and the collapse of the valve action of the poreholes permit fine molecules of a dye to easily penetrate into the cell membranes, thereby enabling easy coloration deep into the interior of wood.

Heretofore, the techniques for subjecting wood to special treatments for improvements in putrefaction

resistance, durability and designability, etc., while maintaining the proper properties of wood, are believed to be well known. They include such techniques as appear in Japanese Patent Laid-Open Nos. Sho 49-116204, 51-136803 and 61-37402 and Japanese Patent Publication No. Hei 1-38641.

It is an object of the present invention to mitigate the difficulties as above-described. In the following, a means to minimize the problem is described. Thus in wood-treating work, a chlorine-based organic solvent for cleaning by vapor-defatting is vaporized by heating the solvent and water, and permeating the vapor into the wood, thereby liquefying its oil and fat contents and consequently perforating its cell membranes.

The present invention provides a wood-treating method which comprises adding water to a chlorine-based organic solvent for cleaning by vapor-defatting, and then heating the mixture to permeate vapor of the water and of the chlorine-based organic solvent into the wood, thereby dissolving its oil and fat contents and consequently perforating its cell membranes.

It also provides a wood-treating method which comprises hermetically sealing wood and a chlorine-based organic solvent in a pressure container for cleaning by vapor-defatting, to respectively subject them to compression by heating and decompression by cooling, thereby promoting the dissolution of the oil and fat components of the wood by the chlorine-based organic solvent for cleaning by vapor-defatting.

The wood treating method can further comprise drying the treated wood.

The wood treating method can still further comprise coloring wood by permeating a fine-grained dye thereinto.

The present invention also provides a wood-treating apparatus, which may or may not be constructed as an integral unit, comprising a solvent tank, a treating chamber, and a cooling chamber. The solvent tank is filled with a mixture including a chlorine-based solvent and water. The solvent tank includes a heater for heating the mixture to generate vapor of the chlorine-based solvent and the water at the same time. The treating chamber contains the wood to be treated, and receives the vapor of the chlorine-based solvent and water from the solvent tank. The cooling chamber cools and condenses the vapor of the mixture whereby the condensate can be returned to the solvent tank.

More specifically the present invention provides a wood treating method comprising the steps of: providing a mixture including a chlorine-based solvent and water; heating the mixture so that vapors of the methylene chloride solvent and the water are simultaneously generated; confining wood to be treated and the vapor of the mixture in a pressure container which is hermetically sealed with respect to an outer atmosphere so that the wood is in contact with the vapor of the mixture; permeating the vapor of the mixture into cells of the wood; dissolving oil and fat contents in cell membranes of the cells by the vapor thereby creating perforations in the cell membranes; and removing excess water confined in the cells of the wood through the perforations in the cell membranes.

The invention will be described in greater detail with reference to a particular embodiment and to the accompanying drawings thereof, in which:

FIG. 1 is a front sectional view of a treating apparatus for use in performing the wood treating method of this invention having the components housed in one unit;

FIG. 2 is a plan view of the treating apparatus with its top cover removed for use in performing the wood treating method of this invention;

FIG. 3 is a schematic sectional view of the treating apparatus for use in performing the wood treating method of this invention, showing a preparation step for the treating work;

FIG. 4 is a schematic sectional view of the treating apparatus for use in performing the wood treating method of this invention, showing the treating work in progress;

FIG. 5 is a schematic sectional view of the treating apparatus for use in performing the wood treating method of this invention, showing the treating work in progress; and

FIG. 6 is a schematic sectional view of the treating apparatus for use in performing the wood treating method of this invention after accomplishment of the treating work.

In reference to FIGS. 1 and 2, the composition of a treating apparatus for use in exercising the treating method of this invention is described.

A wood treating pressure container A is made of stainless steel and is composed of a cylindrical body 1 and a dome shape top cover 2 placed thereon, the dome shape top cover 2 being mounted on the body 1 by screwing a plurality of closing bolts into a plurality of bolt holes 1e of a flange 1d located at the top of the body 1. The inside of

the body 1 is composed of three compartments which in this particular embodiment are integrally assembled: a solvent tank 1a, a treating chamber 1b and a cooling chamber 1c.

The aforementioned solvent tank 1a is, as shown in FIGS. 1 and 2, arranged under a floor of the body 1 and is fully filled with a methylene chloride solvent B, being a chlorine base organic solvent for cleaning by vapor-defatting. Organic solvents other than methylene chloride (CH_2Cl_2) for cleaning by vapor-defatting are available, such as, trichloroethylene ($CHCl=CCl_2$), perchloroethylene ($CCl_2=CCl_2$), 1,1,1-trichloroethane (CH_3CCl_3) and CCl_2FCClF_2, etc. In this embodiment, methylene chloride (CH_2Cl_2) solvent B is used. A heat supply pipe 4 for heating the methylene chloride solvent B is arranged from outside the tank for uniformly warming the whole of the tank interior. In addition, a solvent return pipe 6 is connected to the solvent tank 1a for returning into the solvent tank 1a the methylene chloride solvent B, which has been recovered by condensation at the cooling chamber 1c and then refined in a water separator 5. Also, a solvent drain pipe 8 is connected to the solvent tank 1a for draining the methylene chloride solvent B out of the solvent tank 1a after accomplishment of the first half of the treating operation; the solvent B then being stored in a solvent storage tank 7.

The aforementioned solvent tank 1a and the treating chamber 1b are partitioned by a drainboard floor 9. Inside the treating chamber 1b, the vapor of the methylene chloride solvent B, which can be heated to vaporize at a low temperature of about 40°C in the solvent tank 1a is accumulated, forming a solvent vapor layer C of methylene chloride. During the treating operation, a highly

ventilative wood transport container 11 holding wood blocks to be treated 10 is mounted on the drainboard floor 9 of the treating chamber 1b. The methylene chloride (CH_2Cl_2) solvent B, which boils at about 40°C, may be readily vaporized and this vapor has the effect of defatting the oil and fat components of wood.

The cooling chamber 1c, provided in such a way as to form a border D between air/vapor over the aforementioned treating chamber 1b, is designed to recover by condensation the excess solvent vapor which has come up from the treating chamber 1b. It is so composed that with the temperature of the cooling chamber 1c always preset not higher than 40°C (the B.P. of methylene chloride solvent B) the vapor of the methylene chloride (CH_2Cl_2) solvent B coming up from the treating chamber 1b condenses there by means of cooling water, accumulates in a condensate and water receiving trough 13, is then fed through a condensate pipe to a water separator installed on one side of the body 1, to be separated, and returned to the solvent tank 1a.

Referring to FIGS. 3 to 6, the treating method of this invention is described hereunder: first, as shown in FIG. 3, a wood transport container 11 holding the wood blocks to be treated 10 is carried in by a crane 16, to be placed on the drainboard floor 9 inside the apparatus body 1 with the cover 2 of the wood treating pressure container A being removed.

Then as shown in FIG. 4, the top cover 2 is screw-fitted to the body by closing bolts 3 to hermetically seal the interior of the wood treating pressure container A. When the power switch for the heat supply pipe 4 is turned ON, the heat from the source is transmitted to the whole of

the heat supply pipe interior, whereby the methylene chloride solvent B inside the solvent tank 1a is heated to vaporize, forming a solvent vapor layer C. Then the solvent vapor infiltrates into the interior of the wood blocks 10 to be treated in the wood transport container 11, which are immersed in the solvent vapor layer C. The free water not confined is thereby expelled out and the vapor dissolves the lignin which firmly blocked the cellulose and hemicellulose composing the cells of wood. This treatment work is continued for several hours. Then, the power switch for the heat supply pipe 4 is turned OFF, and the methylene chloride solvent B inside the solvent tank 1a, which is no longer necessary for the latter half of the treatment work, is transferred into the solvent storage tank 7.

By the above-mentioned treatment, the unconfined water which is contained in the wood blocks to be treated 10 is expelled and the oil and fat components are dissolved, whereby the oil and fat components of wood are eluted by the methylene chloride (CH_2Cl_2) solvent B, together with its water content. As this defatting treatment has been accomplished, the oil and fat parts in the wood are dissolved out, bringing the wood into a state of its cells being perforated and the porehole valves being broken down. Next comes the step of reducing the water content to a predetermined value, as shown in FIG. 5.

In this operating example, the water content is reduced by hot air drying, but this may also be done by the sun's heat. In the case of hot air drying, the drying step of driving the water content out of the interior of the wood by means of hot air is carried out.

This drying step expels the solvent vapor which has infiltrated into the interior of the wood blocks to be treated and drives out the confined free water through the perforated cells after oils and fats have been dissolved out and the porehole valve parts of the false vessels and vessels, etc. For this purpose, a hot air feed pipe 15 located on the top cover 2 is opened, to feed hot air into the interior of the wood treating pressure container A. By this hot air, the solvent and water which have infiltrated into the interior of the wood blocks to be treated 10, are evaporated and the free water, which has been confined inside the cells and in the false vessels and vessels, is also evaporated. By continuing this work for several hours, the solvent of methylene chloride and the confined free water can be completely evaporated from the interior of the treated wood blocks 10.

Upon completion of all treating works, the dome shape top cover 2 is again opened, as shown in FIG. 6, and then the wood transport container 11 is lifted out of the wood treating pressure container A by means of a crane.

During the treating operation, as shown in FIG. 4, the solvent storage tank 7 is moved upward, to hold equal the level of the methylene chloride solvent B in the solvent tank 1a and the solvent storage tank 7. Upon completion of the first half of the treatment work, the solvent storage tank 7 is brought downward, to facilitate recovery of the methylene chloride solvent B from the solvent tank 1a. Then the solvent is recovered through a solvent removal pipe 8.

By this wood treating work, the wood is defatted by the methylene chloride solvent B, the tough lignin in the cell structure is dissolved, thereby perforating the cell

membranes, and the porehole valves of the false vessels and vessels are broken down. In that way, the process of driving out the confined free water through said perforations and porehole valves is facilitated.

Thereafter, the coloring of the wood is accomplished by infiltrating a fine-grained dye through these perforations and poreholes, etc. In the conventional coloring method, the dye failed to penetrate into the interior of the wood because of its cells being firmly bound by lignin. In the method of this invention, as above-described, the methylene chloride solvent B melts out the tough lignin in the cell structure and undermines the valve action of the poreholes, to bring about a state which ensures easy movement of the confined water through said perforations and the porehole valves, thereby enabling coloring the wood with the same dye deep into its interior. The coloring operation with the dye may be performed by dipping in a dye bath the wood blocks which have been subjected to the defatting treatment, but it may also be permeated as a vapor, as above-described, with the fine grains of the dye mixed with the methylene chloride solvent B.

In the wood treating pressure container A of this invention, safety valves 17 and 18 are provided respectively on the top cover 2 and the solvent tank 1a, so that should an abnormal pressure develop in the interior of the wood treating pressure container A during the treating work, they would open to reduce the pressure, thereby keeping its inside pressure always constant. Also, according to this invention, the methylene chloride solvent B and the wood blocks to be treated 10 are hermetically sealed in the interior of the wood treating pressure container A and

heated by a heat supply pipe 4 or otherwise heated by some heat source from outside, thereby to vaporize the methylene chloride solvent B at a rate of about 6 kg/cm^2. The supply of heat to the heat supply pipe 4 is suspended about 1 hour later, to return the methylene chloride solvent B to its aqueous solution and the pressure is lowered to about the atmospheric pressure. The operation of compression by heating for one hour and decompression by cooling for one hour is repeated several times, whereby the defatting treatment by the vapor of the methylene chloride solvent B may be further promoted.

When the methylene chloride solvent B only is put in the solvent tank 1a inside the wood-treating pressure container A and evaporated by heating, it may be vaporized at about 40°C, but because the surfaces of the wood blocks to be treated 10 are hardened at the initial period of the wood treatment, penetration of methylene chloride solvent B into the cells is thwarted. To counter this situation, mixing water in an amount equivalent to about 90% of the methylene chloride solvent in the solvent tank 1a and then heating this mixture to 100°C to 140°C, thereby vaporizing water and the methylene chloride solvent B, is effective.

Thus, by mixing steam and vapor of methylene chloride and permeating the mixture into the wood blocks to be treated 10, the cells of said surfaces of the wood blocks to be treated 10 are opened and through the openings, the vapor of the methylene chloride solvent B is permeated, whereby the effect of promoting the defatting treatment is achieved. When the wood blocks to be treated 10, after being defatted by the methylene chloride solvent B, are dried using hot air, their water content goes down to the equilibrium value

in several hours, but even by drying them with the sun's heat, it takes only about 2 weeks to reduce the water content to the equilibrium value.

As the defatting work of wood has ended with use of the methylene chloride (CH_2Cl_2) solvent and water, the methylene chloride (CH_2Cl_2) solvent and water again return to liquid, but in addition, the oil and fat contents in the wood also remain in this liquid in a separated state. Accordingly, the liquid is in a separated state of three layers of water, oil and fat components, and methylene chloride. Then the oil and fat components of wood may be physically separated, from which can be obtained a natural resin material.

Since the present invention is composed as hereabove described, the following effects are achieved: The vapor of the methylene chloride (CH_2Cl_2) solvent B (a chlorine base organic solvent for cleaning by vapor-defatting) acts on the oil and fat components of wood to defat and dissolve them, thereby partly perforating the cells of wood which contain cell water and breaking down the porehole valves of the false vessels and vessels. In this way, flow of the free water contained therein, which was hitherto difficult to extract, and, conversely, penetration of dye are facilitated. Accordingly, this method can reduce the wood treating time from one year to several days, as compared with the conventional method, thus enabling a large amount of wood to be treated with enormous savings in time and energy.

The wood after being treated, as compared with that before being treated, has a volume that has been expanded, rather than shrunk, and its strength is not significantly reduced.

The methylene chloride solvent, a chlorine base organic solvent for cleaning by vapor-defatting which is used to realize a large cutback on the treatment time, is a highly safe chlorine base solvent which does not injure wood and, moreover, has a low B.P. of 40°C, so that even when feeding hot air into the interior of the wood treating apparatus as a finishing step of the treatment work, or when recovering it by distillation, time and energy are saved.

According to this invention, a fine grained dye also can be mixed with methylene chloride or loaded on the gas of methylene chloride, for it to be carried into the cells of wood. In this way, it has become possible to obtain a wood with a nearly uniform grain color. In the conventional coloring method, wood is colored by dipping in a bath of a molten dye, but the cell's defence is firm, with the wood's lignin remaining unmelted, thus permitting the dye to penetrate only the surface, resulting in a colored layer. Therefore, if the surface of the wood was shaved or otherwise removed, the colored layer was stripped, exposing the former wood grain without the effect of coloration. However, when as in the method of this invention, the wood is dyed, after defatting it with use of a chlorine-based organic solvent for cleaning by vapor-defatting, the coloration can be made deeper by letting the fine grained dye penetrate into the cells, thereby enabling the colored layer to remain even if the surface is shaved.

In this description of the invention, "wood" includes "chips" for the pulp industry.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A wood-treating method comprising the steps of:

forming a mixture of methylene chloride and water;

heating that mixture to a temperature at or above the boiling point of methylene chloride to produce an atmosphere of methylene chloride vapor and water vapor;

confining wood to be treated and said vapor atmosphere together in a hermetically-sealed container, so that upon heating the mixture, the wood is subjected to a pressurized atmosphere of both the methylene chloride and water in a manner which causes the vapor to permeate into the cell structure of the wood and to dissolve oil and fat contents in cell membranes of cells in the cell structure, thereby creating openings in said cell membranes; and

removing water confined in the cells of the wood through those openings.

2. The wood-treating method as defined in claim 1, further including the step of repeatedly subjecting the wood to be treated to an increase in the pressure of the vapor atmosphere from the mixture by heating, and to a reduction in the pressure of the atmosphere caused by suspending the operation of heating the mixture.

3. A wood-treating method as defined in claim 1 or 2, in which water is present in amount equivalent to at least 90% of the methylene chloride, by volume.

4. A wood-treating method as defined in claim 1, 2 or 3, wherein said mixture is heated to a temperature of at least 40°C.

5. A wood-treating method as defined in claim 4, wherein said mixture is heated to a temperature of 100°C to 140°C.

6. A wood-treating method as defined in any one of claims 1 to 5, including the further step of drying the wood which has been treated.

7. A wood-treating method as defined in any one of claims 1 to 6, including the further step of coloring the wood which has been treated by permeating a fine-grained color material into the wood.

8. A wood-treating apparatus, comprising:

a solvent tank to be filled with a mixture including methylene chloride and water, the solvent tank including a heater for heating the mixture to generate vapor of the methylene chloride and of water at the same time; and

a chamber comprised of:

a treating compartment for containing wood to be treated, the treating compartment receiving said vapor of methylene chloride and water from the solvent tank; and a cooling compartment arranged adjacent the treating compartment, for cooling and condensing said vapor of the mixture.

9. A wood-treating apparatus as defined in claim 8, wherein said treating compartment includes an inlet/outlet for loading and unloading the wood into and from said treating compartment.

10. A wood-treating apparatus as defined in claim 8 or 9, wherein said solvent tank, said treating compartment and said cooling compartment are arranged contiguously, and a wall is provided between the solvent tank and the treating compartment which permits said vapor to pass through.

11. A wood-treating apparatus as defined in claim 10, wherein said tank and said chamber are constructed as an integral unit.

12. A wood-treating apparatus as defined in any one of claims 8 to 11, wherein said cooling compartment includes means for returning condensed mixture of methylene chloride and water to said solvent tank.

13. A wood-treating apparatus as defined in any one of claims 8 to 12, wherein wood to be treated is placed in a container for loading into and unloading from said treating compartment.

14. A wood-treating apparatus as defined in any one of claims 8 to 13, wherein said cooling compartment has a cover at the top thereof for hermetically sealing it to increase the pressure of said vapor of methylene chloride and water.

15. The wood-treating apparatus as defined in any one claims 8 to 14, further including a hot-air pipe for providing hot air to wood that has been treated by said vapor of the mixture, to dry the wood.

16. A wood-treating apparatus as defined in any one of claims 8 to 15, wherein the mixture of methylene chloride and water is heated to a temperature of at least 40°C to generate said vapor.

17. A wood-treating apparatus as defined in claim 16, wherein the mixture of methylene chloride and water is heated to a temperature of 100°C to 140°C to generate said vapor.

FIG. 1

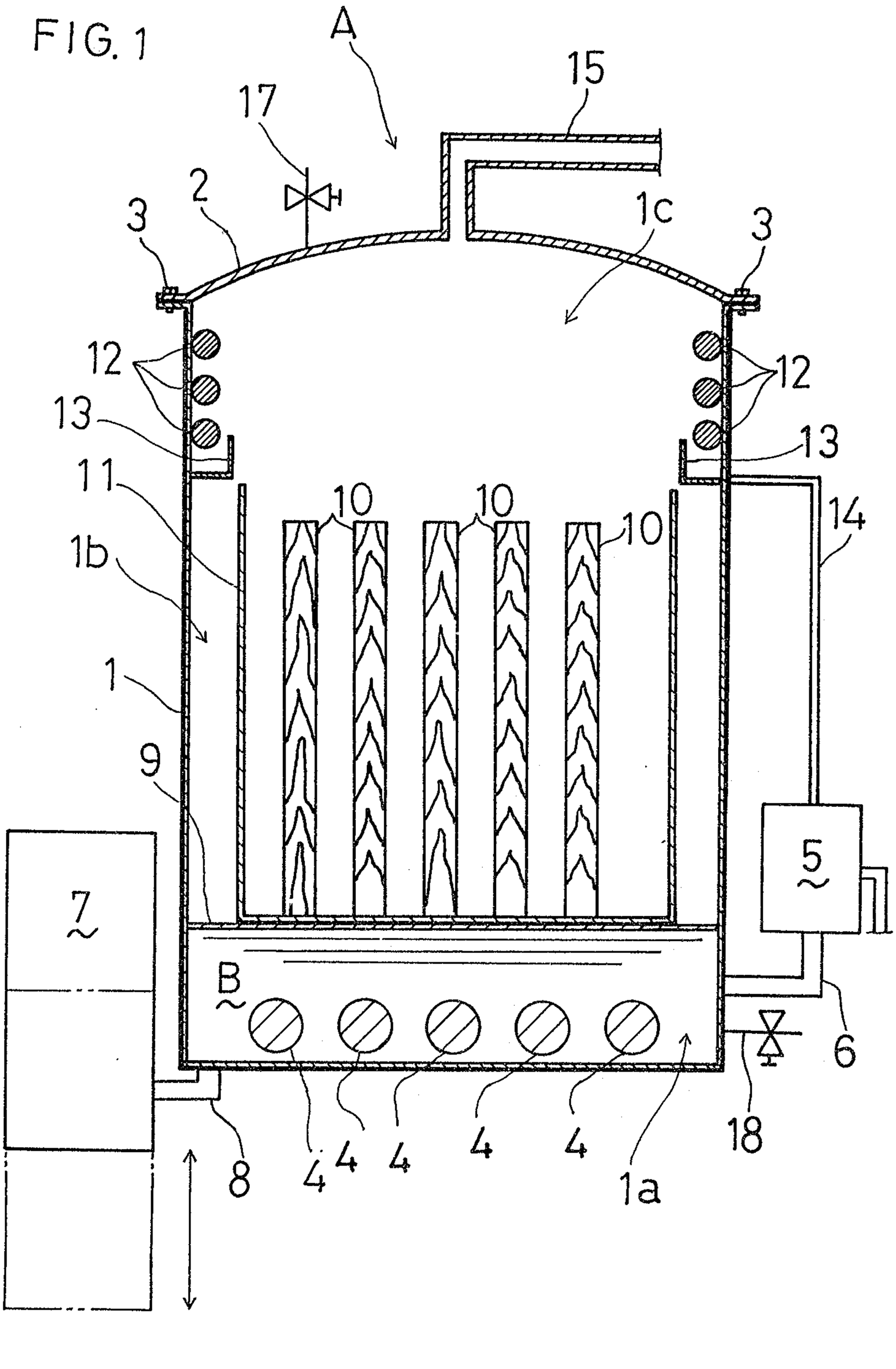


FIG.2

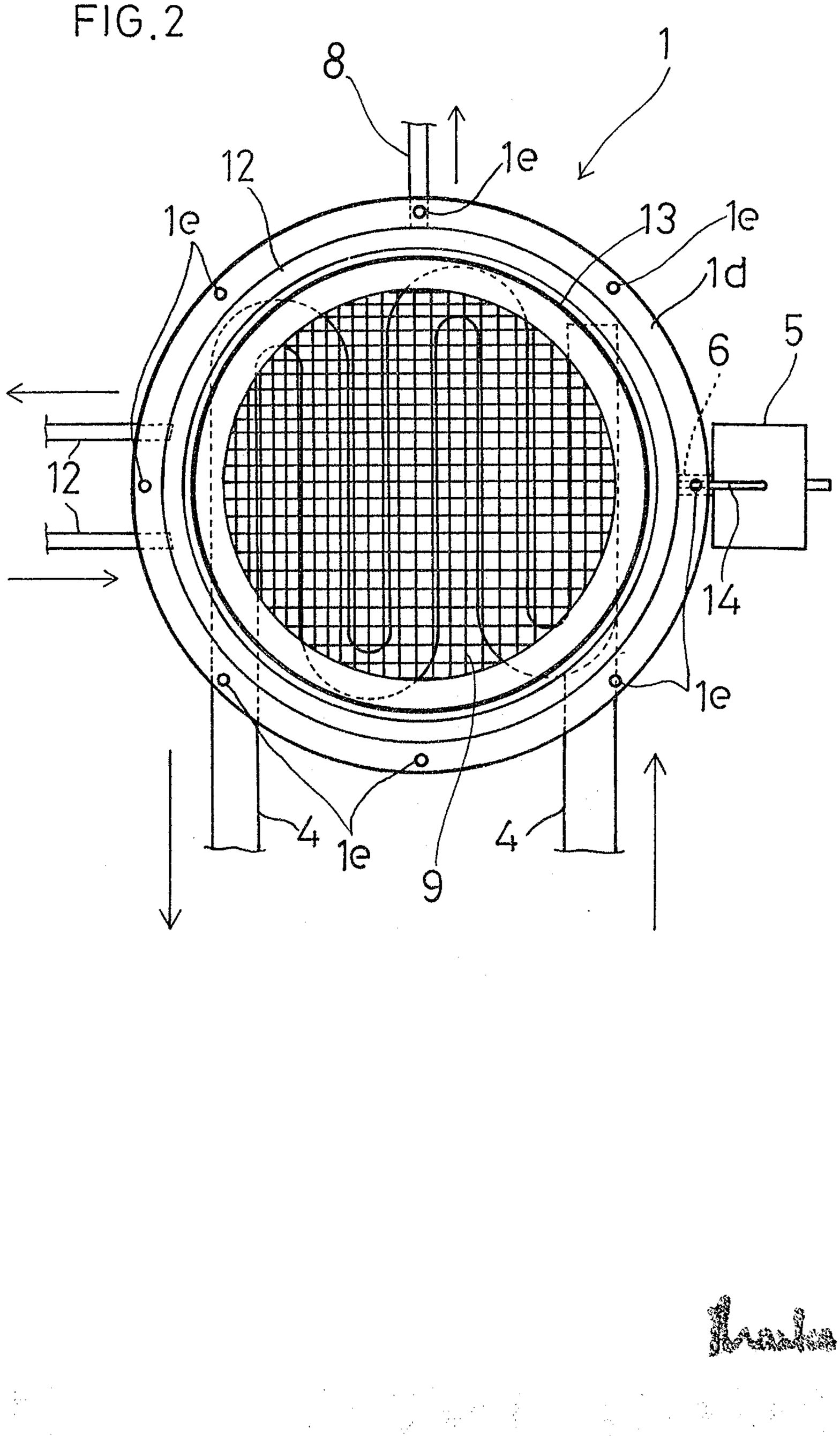


FIG. 3

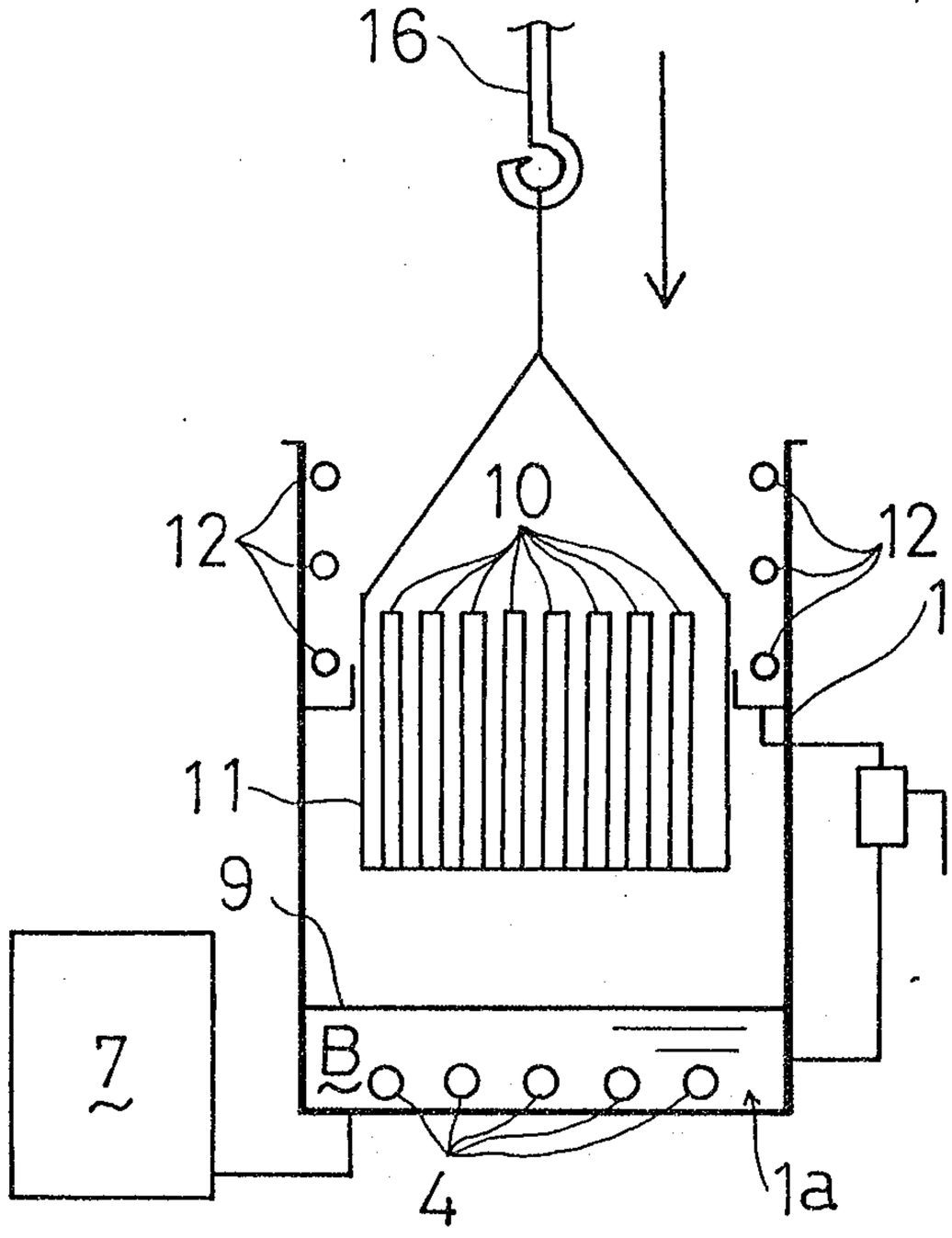


FIG. 4

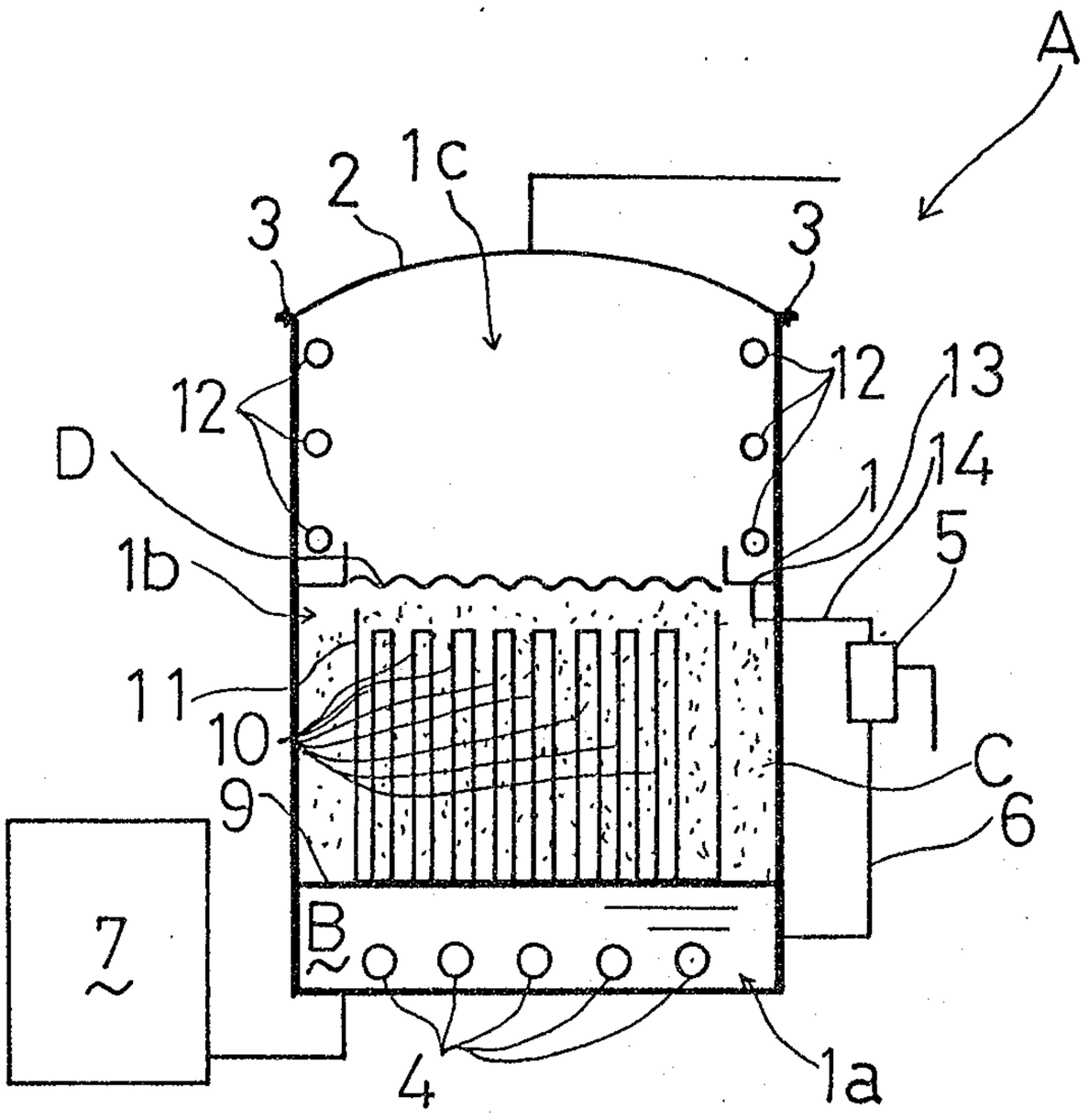


FIG. 5

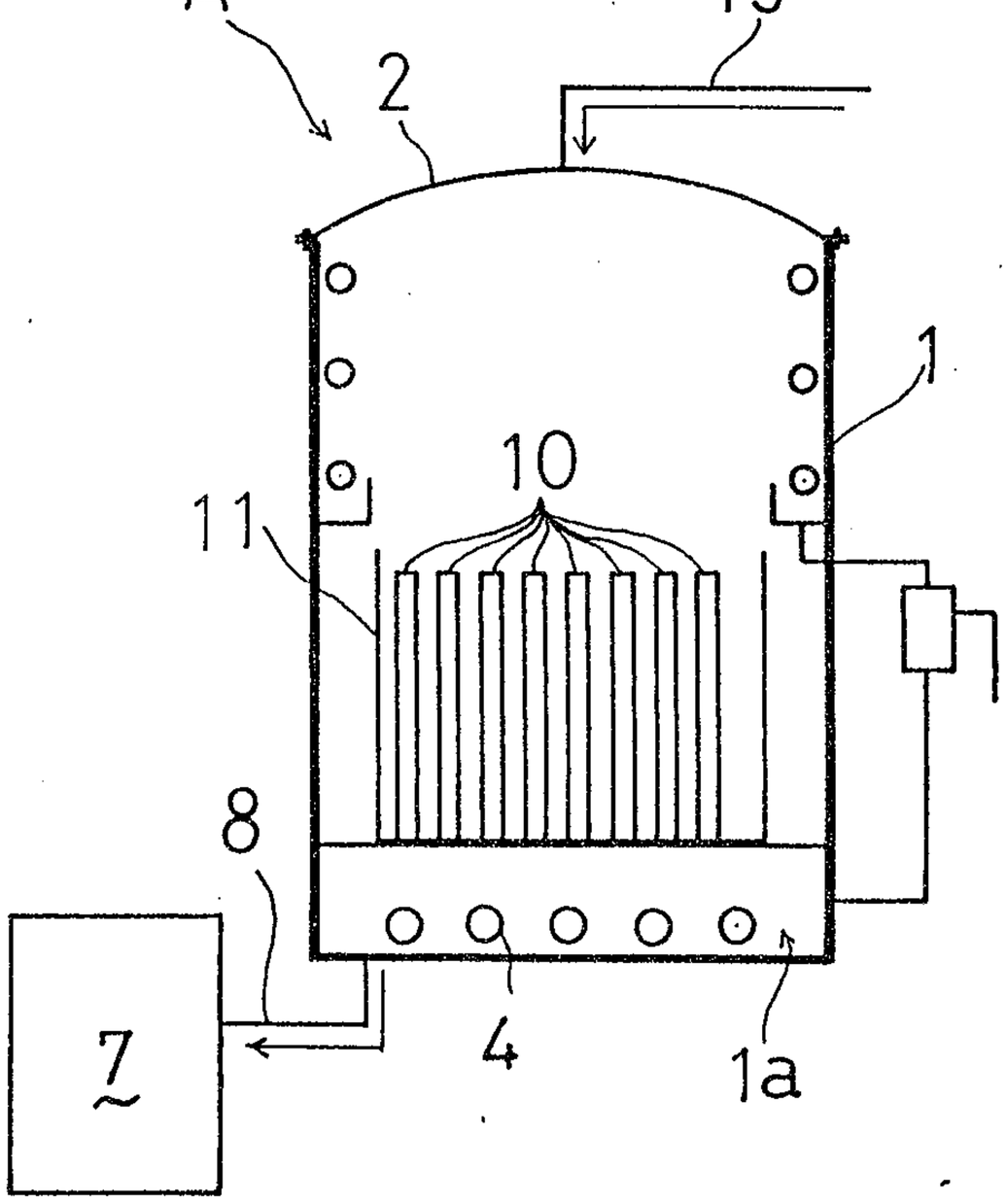
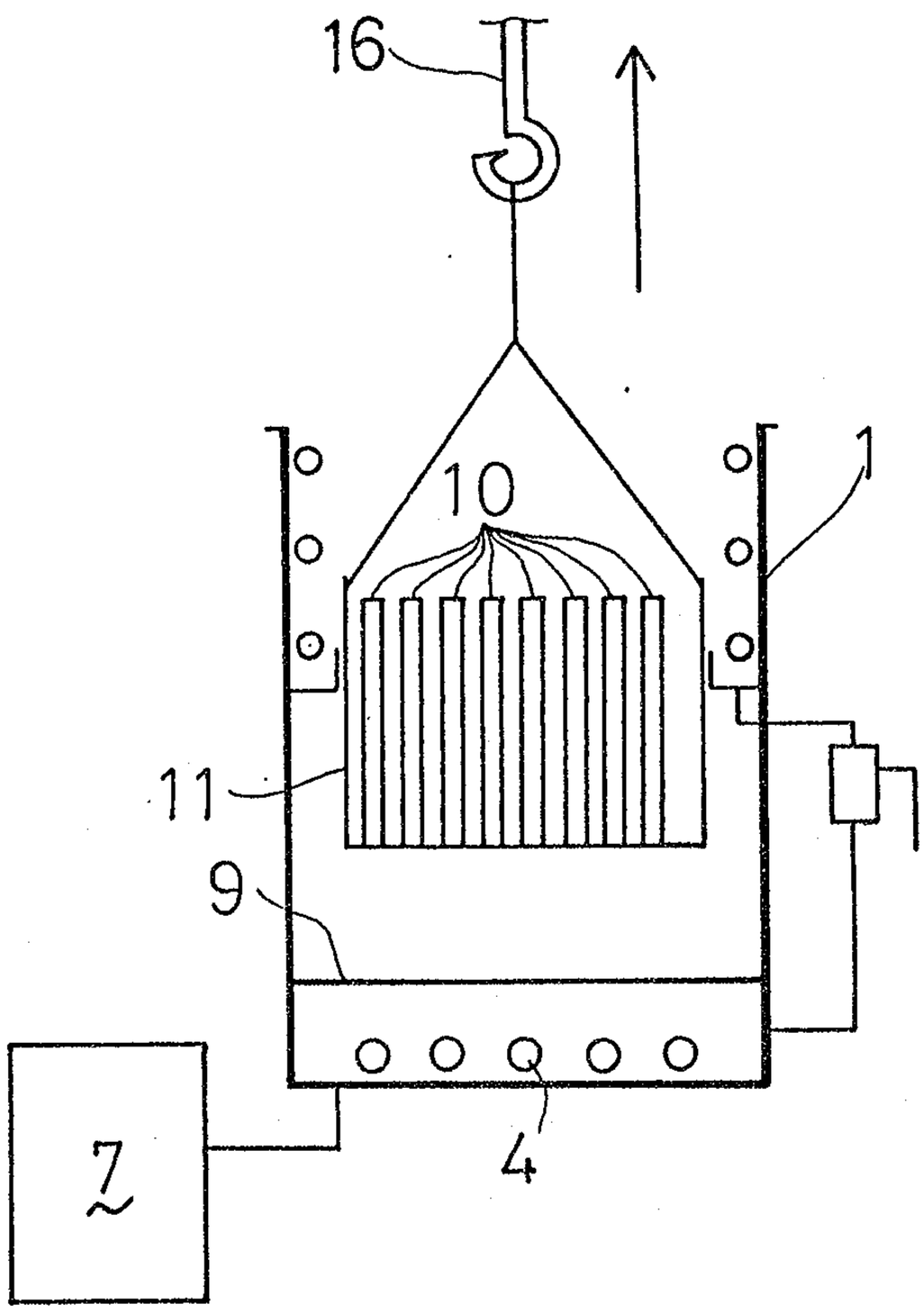
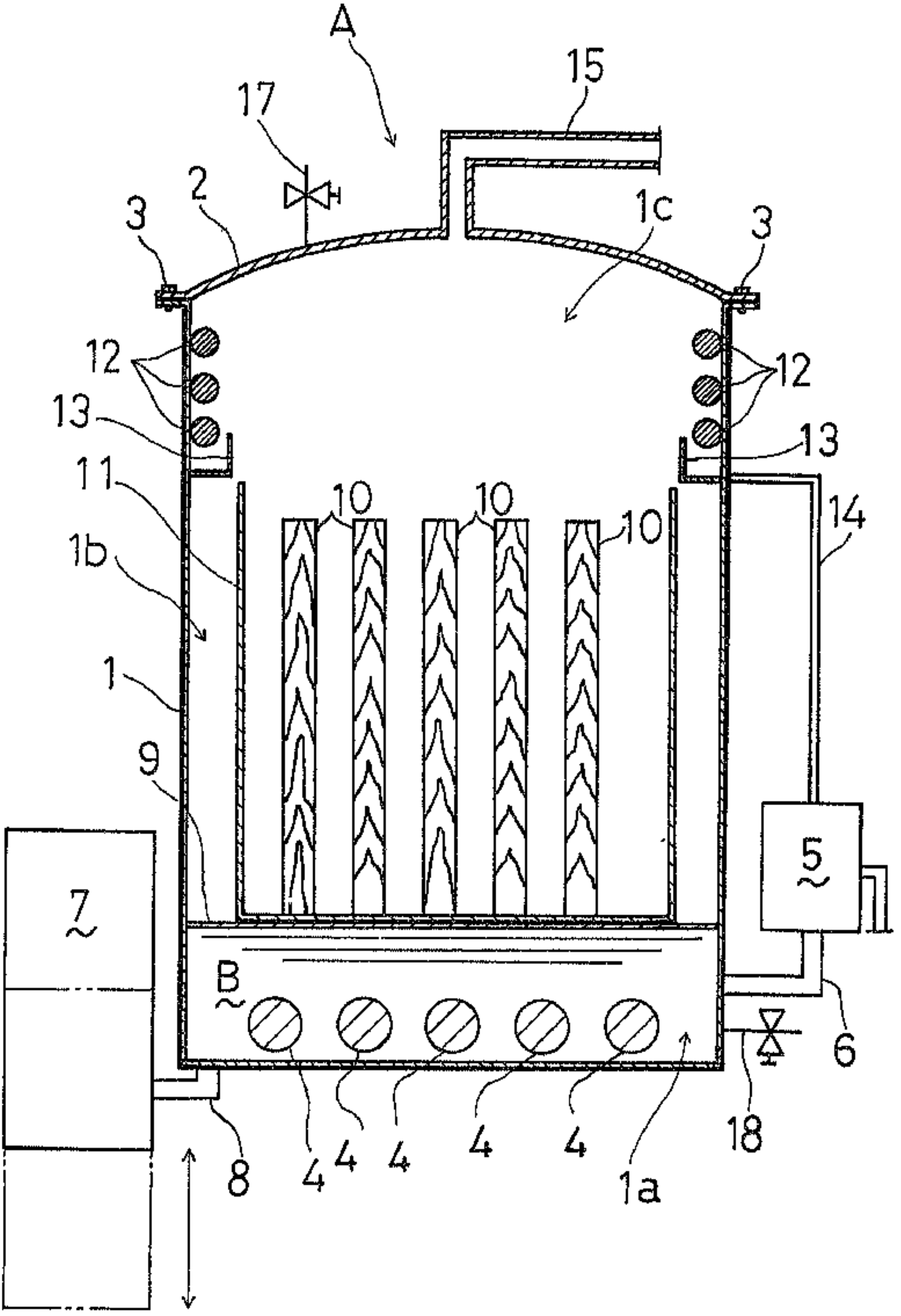


FIG. 6

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