(19) DANMARK

(10) **DK 178526 B1**

(12) PATENTSKRIFT

Patent- og Varemærkestyrelsen

(51) Int.Cl.: ***B 27 K 5/00 (2006.01)*** ***F 26 B 9/06 (2006.01)***

(21) Ansøgningsnummer: **PA 2015 00134**

(22) Indleveringsdato: **2015-03-05**

(24) Løbedag: **2015-03-05**

(41) Alm. tilgængelig: **2016-05-23**

(45) Patentets meddelelse bkg. den: **2016-05-23**

(73) Patenthaver: **DANISH WOOD TECHNOLOGY A/S, c/o Mazanti-Andersen, Korsø Jensen & Partner, Amaliegade 10, 1256 København K, Danmark**

(72) Opfinder: **Claus Holm, Gartnervej 7, 3060 Espergærde, Danmark**
Kell Thomas, Buddingevej 217, 1.th., 2860 Søborg, Danmark

(74) Fuldmægtig: **TROPA ApS, Ågade 97, 1., 8370 Hadsten, Danmark**

(54) Benævnelse: **Method for Treatment of Wood**

(56) Fremdragne publikationer:
EP 612595 A1
EP 373726 A2
US 2004/0025367 A1
GB 2158112 A
US 3090411 A
DK 114049 B
WO 00/58676 A1
US 4654277 A

(57) Sammendrag:
A method for heat treatment of wood (6) is disclosed. The method comprises the step of placing said wood (6) in an airtight tank (4) and heating said wood (6) to a predefined temperature (5 T2, T3). The method comprises the step of pressurising said airtight tank (4) to a predefined pressure (P1) in order to establish a pressurised environment for said wood (6). The predefined pressure (P1) is kept so high that the water in the wood (6) cannot evaporate at the predefined temperature (T2, T3).

Fortsættes ...

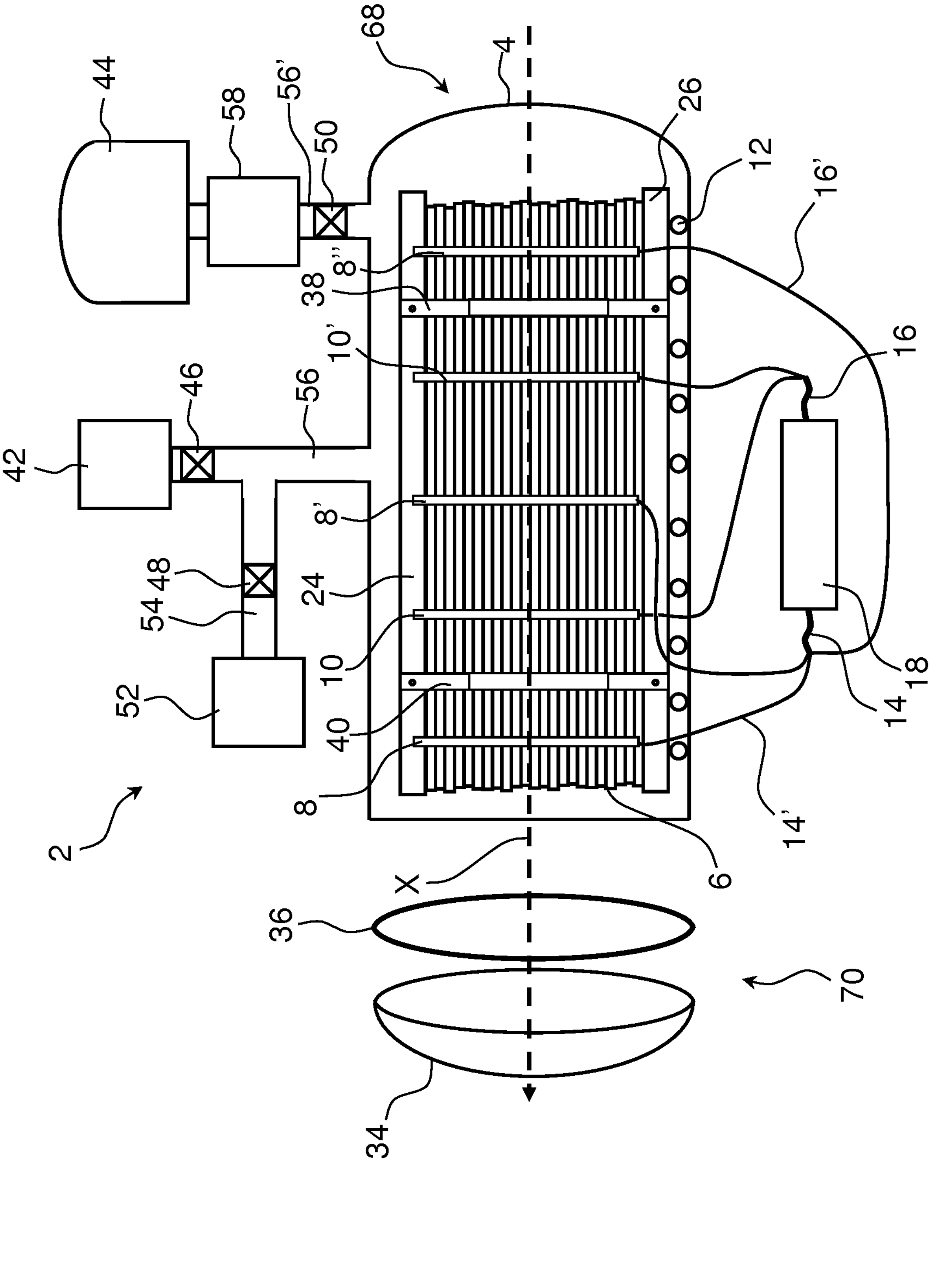

2
4
6
8
8'
8''
10
10'
12
14
14'
16
16'
18
24
26
34
36
38
40
42
44
46
48
50
52
54
56
56'
58
68
70
X

Fig. 3

Method for Treatment of Wood

Field of invention

The present invention relates to a method for heat treatment of wood. The present invention more particularly relates to a method for treating wood in order to make it resistant to microorganisms.

Prior art

Various wood treatment techniques have been developed in order to enhance the properties of wood. By way of example, heat treatment of wood may be applied in order to dry the wood or to make the wood more resistant to microorganisms.

Heat treatment may be used to change the structural properties of wood and therefore several attempts have been made to provide applicable heat treatment methods. It has been found that heat treated wood has a decreased capability to absorb liquid (and thus water). Thermal modification of wood is typically carried out in order to produce chemical reactions in carbohydrates and lignin of the wood.

One common way of heating wood is to submerge the wood into hot oil. This method is associated with several drawbacks. First of all the treated wood contains oil. Secondly, the heating process must be carried out very slowly in order to avoid temperature gradients causing crack formation. Moreover, the process is expensive due to the fact that both the wood, the tank and the oil has to be heated.

Another way of conducting thermal modification of wood is to place the wood in a pressurised steam environment at temperatures in the range 160-190 ºC. This heating process, however, needs to be carried out very slowly in order to avoid temperature gradients causing crack formation.

EP 0 612 595 A1 relates to a method for upgrading low-quality wood to high-quality wood comprising the steps of (a) softening the wood by electrical heating in the presence of an aqueous medium, (b) drying the softened wood e.g. by dielectrically heating, (c) curing the dried wood, and (d) cooling the wood. By this method, the ohmic or dielectrically heating is applied both during the softening step and the drying step.

Thus, there is a need for a method which enables an effective treatment of wood and reduces or even eliminates the above mentioned disadvantages of the prior art.

Summary of the invention

The object of the present invention can be achieved by a method as defined in claim 1. Preferred embodiments are defined in the dependent sub claims, explained in the following description and illustrated in the accompanying drawings.

The method according to the invention is a method for heat treatment of wood, which method comprises the step of placing said wood in an airtight tank and heating said wood to a predefined temperature, wherein the method comprises the step of pressurising said airtight tank to a predefined pressure of 5-27 bar prior to heating the wood beyond a temperature of 100°C.

Hereby it is possible to maintain the water content of the wood during the heating process. Accordingly, the wood will experience a structural change making the wood resistant to microorganisms.

The method comprises the step of placing said wood in an airtight tank. The tank may have any suitable shape and size.

The wood is heated to a predefined temperature high enough to initiate the structural change making the wood resistant to microorganisms.

Heat treatment causes decomposition of the content of the wood, especially hemicellulose. Accordingly, the wood will be less moisture adsorbent. The wood will be more stable and more resistant to fungal attack and to microorganisms.

The heat treatment may be carried out by using any suitable heating means.

The method comprises the step of pressurising the airtight tank to a predefined pressure of 5-27 bar in order to establish a pressurised environment for the wood to prevent the water in the wood from evaporating.

The applied pressure prevents that the mechanical properties of the wood are influenced in a negative direction during the heat treatment (e.g. distortion of the wood). The use of a pressurised environment increases the boiling point of water.

By providing a pressurised environment, damaging effects caused by heat introduced steam pressure, can be reduced or even eliminated.

Conventional thermal modification of wood suffers from the drawback that the heat introduced steam pressure reduces the mechanical properties of the wood.

It may be an advantage that the predefined pressure is kept high as long as the temperature is increased.

By applying the method according to the invention, it is possible to provide wood having a specific (predefined) wood moisture content. This may be accomplished by controlling the applied pressure and temperature.

It may be advantageous that the wood is heated to a predefined temperature by means of electromagnetic radiation provided in the tank.

It may be an advantage that the heating is conducted by electromagnetic radiation by means of one or more electrodes. It is possible to apply several electrodes.

It is possible to apply a first group of electrodes and a second group of electrodes configured to be inserted into a batch of stacked wood in the tank. The groups of electrodes may preferably be electrically connected to a high frequency generator by means of corresponding cables.

It may be beneficial that the predefined temperature is above 140°C, preferably above 150 °C, such as 170-215°C. Temperatures in this range are considered to be very efficient in order to conduct the required structural change of the wood.

The actual pressure level is determined when the heating temperature has been chosen. The heating temperature may depend on the type of wood.

The predefined pressure level is determined on the basis of the required heating temperature in such a way that the water in the wood will not evaporate. This requires that the pressure is kept above a pressure level that depends on the heating temperature.

Due to the fact that the wood is kept in a pressurised tank during the heating process, the water (in the wood) can be heated far beyond the standard 100 °C without boiling. Put in other words, the pressured tank is capable of keeping the water in liquid phase at high temperatures.

It may be advantageous that the method comprises the step of cooling the wood by means of a cooling medium that is filled into the tank after the termination of the heating process.

The cooling medium may be cold air circulated in the tank in order to cool down the wood. Hereby, it is possible to save time and to prevent deformations, such as twisting and bending, of the wood.

It may be an advantage that the method comprises the step of cooling the wood by means of a cooling medium that is stored in a reservoir connected to the tank and filling the cooling medium into the tank by means of a pump.

It may be beneficial that the method comprises the step of applying a substance that reduces the flammability of the wood during the heating process.

It may be advantageous that the substance is a gaseous fire suppression substance suitable for extinguishing fire.

It may be an advantage to use argon or halon, a gaseous fire suppression substance.

It may be beneficial that the method comprises the step of heating the wood in few minutes (e.g. 15 minutes) to several hours, preferably at 15 minutes to 10 hours, such as 1-5 hours. The heating period may depend on the wood spices.

It may be advantageous that the method comprises the step of subjecting the wood to a subsequent drying process after the heating process. Hereby it is possible to both making the wood resistant to microorganisms and provide dry wood.

During the drying process, it is possible to provide a predefined (desired) wood moisture content. This can be done by reducing the pressure according to temperature. By reducing the pressure as the temperature is reduced, it is possible to prevent deformations, such as twisting and bending, of the wood. Deformations could potentially impair the mechanical properties of the wood.

It may be an advantage that the drying process is carried out by heating the wood in a tank pressurised to a pressure that allows for evaporation of the water in the wood.

Description of the Drawings

The invention will become more fully understood from the detailed description given hereof below. The accompanying drawings are provided by way of illustration only. In the accompanying drawings:

Fig. 1 A	shows a first schematic cross-sectional view of an apparatus for heat treatment of wood;
Fig. 1 B	shows a second schematic cross-sectional view of the apparatus shown in Fig. 1 A;
Fig. 2 A	shows a pressure versus time curve of a first method according to the invention;
Fig. 2 B	shows a temperature versus time curve of the first method according to the invention;
Fig. 2 C	shows a pressure versus time curve of a second method according to the invention;

Fig. 2 D shows a temperature versus time curve of the second method according to the invention;

Fig. 2 E shows a pressure versus time curve of a third method according to the invention;

Fig. 2 F shows a temperature versus time curve of the third method according to the invention;

Fig. 2 G shows a pressure versus time curve of a fourth method according to the invention;

Fig. 2 H shows a temperature versus time curve of the fourth method according to the invention;

Fig. 3 shows a schematic cross-sectional view of an apparatus for heat treatment of wood and

Fig. 4 shows a schematic cross-sectional view of another apparatus for heat treatment of wood.

Detailed description of the invention

Referring now in detail to the drawings for the purpose of illustrating preferred embodiments of the present invention, a schematic cross-sectional view of an apparatus 2 is illustrated in Fig. 1 A.

Fig. 1A illustrates a schematic cross-sectional view of an apparatus 2 for heat treatment of wood 6. Fig. 1 B illustrates another schematic cross-sectional view of the apparatus 2 shown in Fig. 1 A.

The heat treatment apparatus 2 comprises a tank 4 having a cylindrically shaped portion 66 extending along the longitudinal axis X of the tank 4. Fig. 1 A illustrates that the cross section of the cylindrically shaped portion 66 is circular. A tube 22 is provided in the top portion of the tank 4. This tube 22 connects the tank 4 with compressor 20 configured to pressurise the tank 4.

A shaft 28 is rotably mounted to the lower portion of the tank 4. Two roller members 12 are rotatably mounted to the shaft 28. Fig. 1 B illustrates that four parallel shafts 28 are provided at the lower portion of the tank 4. These shafts 28 and the roller members 12 attached to them constitute a roller conveyer.

A plurality of wood boards 6 is stacked in the tank 4. The wood boards 6 rest on a lower plate-shaped support member 26 and are sandwiched between the lower support member 26 and an upper plate-shaped support member 24.

A first electrode 8 is provided at the upper support member 24, while a second electrode 10 is provided at the lower support member 26.

The tank 4 comprises a first closed end portion 68 and another end portion 70. An opening is provided at the end portion 70. The end portion 70 comprises a tank door 30 rotably attached to the remaining portion of the tank 4 by means of a joint 32. Accordingly, the tank door 30 can be opened in order to fill wood 6 into the tank 4 or to remove heat treated wood 6 from the tank 4. The use of the roller conveyer 12, 28 eases these processes.

When wood boards 6 have been arranged in the tank 4, and the tank has been closed, the heat treatment may be initiated. The heat treatment is carried out by means of heating by electromagnetic radiation through one or more electrodes.

Although not shown, the electrodes 8, 10 may be electrically connected to a (high frequency) generator configured to generate the required electromagnetic radiation, e.g. within the range 1-40 MHz, such as 10-30 MHz, e.g. about 13.56 MHz. It may be preferred that the frequency of the electromagnetic radiation is approximately 13.56 MHz or approximately 27.12 MHz, since it has been shown that the heating of wood is very efficient at these frequencies.

Generation of heat will, however, not be initiated before the pressure in the tank 4 exceeds a predefined pressure level e.g. between 5-27 bar, such as 20 bar. The predefined pressure level is determined on the basis of the required heating temperature in such a manner that the water in the wood will not boil (change into a gas). This requires that the pressure is kept above a pressure level depending on the heating temperature.

Since the tank 4 is a pressurised chamber, the water (in the wood) can be heated far beyond the standard 100 °C without boiling. In other words, the pressured tank 4 is capable of keeping the water in liquid phase at high temperatures.

The compressor 20 may be controlled by a control member (not shown) e.g. shaped as a control box electrically connected to the compressor 20 and to one or more pressure sensors (not shown).

The heating may be started when the desired pressure is established in the tank 4. Once the desired temperature is reached, this temperature may be maintained for a predefined time period. It is possible to change the temperature and/or pressure in the tank once or several times and maintain a fixed temperature and/or pressure for a predefined time period.

It may be an advantage to arrange a pressure sensor (not shown) in the tank 4 or in the tube 22. A pressure sensor may be applied to detect the pressure and thus to control the wood treatment process.

By using high frequency electromagnetic radiation, it is possible to conduct a homogeneous heating of the wood. Hereby, it is possible to provide a homogeneous wood quality.

Fig. 2 A illustrates a pressure 62 versus time 60 curve 72 of a first method according to the invention. Pressure 62 is plotted against time 60.

The curve 72 has a first section I, in which section I the pressure 62 is kept at a constant level P_1. The curve 72 has a second section II, in which section II the pressure is reduced (linearly) with a constant rate. The duration of the first section I is t_3, while the duration of the second section II is t_4-t_3.

Fig. 2 B illustrates a temperature versus time curve 74 corresponding to the method referred to with reference to Fig. 2 A. The curve 74 comprises a first section I in which the temperature 64 is linearly increased from a first temperature T_1 to a second temperature T_2. When the temperature T_2 has been reached at the time t_1, the temperature T_2 is maintained to time t_2. The constant temperature period is the second section II of the curve 74.

At time t_2 the temperature 64 is linearly decreased until a temperature T_1 is reached at the time t_3. This time period corresponds to the third section III of the curve 74. The temperature T_1 is kept constant in the fourth section IV of the curve 74 extending between time t_3 and time t_4.

When comparing Fig. 2 A and Fig. 2 B one can see that a high pressure P_1 is maintained during the complete high temperature phase (section II). This means that the water in the wood will not evaporate. Accordingly, the desired structural changes of the wood will occur.

Fig. 2 C illustrates a pressure versus time curve 72 of a second method according to the invention.

The curve 72 has a first section I, in which the pressure 62 is kept at a constant level P_1. The curve 72 has a second section II, in which the pressure is reduced with a decreasing rate. The duration of the first section I is t_5, whereas the duration of the second section II is t_6-t_5.

Fig. 2 D illustrates a temperature versus time curve 74 corresponding to the method referred to with reference to Fig. 2 C. The curve 74 comprises a first section I in which the temperature 64 is linearly increased from a first temperature T_1 to a second temperature T_2. When the temperature T_2 has been reached at the time t_1, the temperature T_2 is maintained to time t_2. The constant temperature period is the second section II of the curve 74.

At time t_2 the temperature 64 is linearly increased until a temperature T_3 has been reached at the time t_3. This time period corresponds to the third section III of the curve 74. The temperature T_3 is kept constant in the fourth section IV of the curve 74 extending between time t_3 and time t_4. The temperature 64 is linearly decreased during the fifth section V of the curve 74 extending between time t_4 and time t_5. Hereafter a sixth section VI (between time t_5 and t_6) with a constant temperature T_1 follows.

Fig. 2 E illustrates a pressure 62 versus time 60 curve 72 of a third method according to the invention. Pressure 62 is plotted against time 60.

The curve 72 has a first section I, in which section I the pressure 62 is kept at a constant level P_1. The curve 72 has a second section II, in which section II the pressure is reduced with an increasing rate. The duration of the first section I is t_3, while the duration of the second section II is t_4-t_3.

Fig. 2 F illustrates a temperature versus time curve 74 corresponding to the method referred to with reference to Fig. 2 E. The curve 74 comprises a first section I in which the temperature 64 is increased from a first temperature T_1 to a second temperature T_2. When the temperature T_2 has been reached at the time t_1, the temperature T_2 is maintained to time t_2. The constant temperature period is the second section II of the curve 74.

At time t_2 the temperature 64 is decreased until a temperature T_1 is reached at the time t_3. This time period corresponds to the third section III of the curve 74. The temperature T_1 is kept constant in the fourth section IV of the curve 74 extending between time t_3 and time t_4.

Fig. 2 G illustrates a pressure versus time curve 72 of a fourth method according to the invention.

The curve 72 has a first section I, in which the pressure 62 is kept at a constant level P_1. The curve 72 has a second section II, in which the pressure is reduced with a decreasing rate. The duration of the first section I is t_3, whereas the duration of the second section II is t_4-t_3.

Fig. 2 H illustrates a temperature versus time curve 74 corresponding to the method referred to with reference to Fig. 2 G. The curve 74 comprises a first section I in which the temperature 64 is increased from a first temperature T_1 to a second temperature T_2. When the temperature T_2 has been reached at the time t_1, the temperature 64 is further raised until time t_2. The period is the second section II of the curve 74.

At time t_2 a slight temperature increase is followed by a temperature decrease until a temperature T_1 has been reached at the time t_3. This time period corresponds to the third section III of the curve 74. The temperature T_3 is kept constant in the fourth section IV of the curve 74 extending between time t_3 and time t_4.

The methods explained with reference to Fig. 2 applies a pressure P1 that ensures that the water in the wood does not evaporate all though a high temperature is maintained in the tank. Accordingly, it is possible to provide the desired heat-induced structural changes in the wood.

Fig. 3 illustrates a schematic cross-sectional view of an apparatus 2 for heat treatment of wood 6.

The heat treatment apparatus 2 comprises a tank 4 having a cylindrically shaped portion extending along the longitudinal axis X of the tank 4. A first tube 56 and a second tube 56′ are provided in the top portion of the tank 4. The first tube 56 connects the tank 4 with a reservoir 42 and a compressor 52 via a tube 54. The compressor 52 is configured to pressurise the tank 4.

A valve 48 is provided in the tube 54 between the compressor 52 and the tank 4. The valve is configured to establish and disconnect fluid communication between the compressor 52 and the tank 4. The compressor 52 may be controlled by a control member (not shown) e.g. shaped as a control box electrically connected to the compressor 52 and to one or more pressure sensors (not shown).

Another valve 46 is provided between the reservoir 42 and the tank. The valve 46 is adapted to establish and disconnect fluid communication between the reservoir 42 and the tank 4. The reservoir may contain any fluid of interest e.g. a wood preservation liquid.

A pump 58 is connected to the tube 56′. A valve 50 is provided between the pump 50 and the tank 4. By means of the valve 50 it is possible to establish fluid communication between the tank 4 and the pump 58. On the other hand, by closing the valve 50, it is possible to shut off the connection between the tank 4 and the pump 58. A reservoir 44 is provided above the pump 58. The reservoir 44 is in fluid communication with the pump 58. Accordingly, the pump 58 may be used to pump e.g. a cooling fluid from the reservoir 44 into the tank 4 and to pump the fluid back into the reservoir.

Ten shafts are rotably mounted to the lower portion of the tank 4. A number of roller members 12 are rotatably mounted to the shafts. The shafts and the roller members 12 attached to them constitute a roller conveyer for easing transport of wood into the tank 4 and out of the tank 4.

A plurality of wood boards 6 is stacked in the tank 4. The wood boards 6 are resting on a lower plate-shaped support member 26. The wood boards 6 are sandwiched between the lower support member 26 and an upper plate-shaped support member 24.

A first group of electrodes 8, 8′, 8′′ and a second group of electrodes 10, 10′ have been inserted into the batch of stacked wood 6. The groups of electrodes are electrically connected to a HF (high frequency) generator 18 by cables 14, 14′ and 16, 16′ in such a manner that, when operating the generator 18, the first group 8, 8′, 8′′ has a polarity being opposite to that of the second group 10, 10′. The electrodes 8, 8′, 8′′, 10, 10′ are arranged in such a way that two neighbouring electrodes have opposite polarity.

The electrodes 8, 8′, 8′′, 10, 10′, the associated cables 14, 14′ and 16, 16′ and the HF-generator 18 constitute an electrode system, which is capable of producing electromagnetic radiation in the frequency range of approximately 10 MHz to approximately 30 MHz.

The plate-shaped upper support plate 24 and the lower plate-shaped support plate 26 are connected by a first clamp 38 and a second clamp 40. The clamps 38, 40 provide a compression force pressing the two support plates 24, 26 together. The compression force will counteract deformations, such as twisting and bending, of the wood boards 6 caused by the heating process. The clamps 38, 40, and the upper 24 and lower 26 support plates constitute a compression system configured to prevent deformations of the wood 6 during the heating process.

The tank 4 comprises a first closed end portion 68 and another end portion 70. An opening is provided at the end portion 70. The end portion 70 comprises a detachable tank door 34 configured to be detachably attached to the remaining portion of the tank 4. A sealing member shaped as an O-ring 36 is provided next to the door 34.

The tank door 34 can be removed in order to fill wood 6 into the tank 4 or to remove heat treated wood 6 from the tank 4. The use of the roller members 12 eases these processes.

After arranging the wood boards 6 in the tank 4 and closing the tank, the heat treatment may be initiated. The heat treatment is carried out by means of the electrode system, which is capable of producing electromagnetic radiation in the frequency range of approximately 10 MHz to approximately 30 MHz.

The heat generation will not be initiated before the pressure in the tank 4 exceeds a predefined pressure level e.g. between 5-27 bar, such as 20 bar. Examples of such treatment method are illustrated in Fig. 2.

It may be an advantage to arrange a pressure sensor (not shown) in the tank 4 or in one of the tubes 54, 56. Accordingly, the pressure sensor may be applied to detect the pressure and thus to control the wood treatment process.

By using high frequency electromagnetic radiation, it is possible to conduct a homogeneous heating of the wood. Hereby, it is possible to provide a homogeneous wood quality.

Fig. 4 illustrates a schematic cross-sectional view of an apparatus 2 for heat treatment of wood 6. The apparatus 2 basically corresponds to the apparatus 2 shown in Fig. 3.

The apparatus 2 comprises a tank 4 having a central cylindrically shaped portion extending and two end portions 68, 70. The first end portion 68 is an integrated part of the tank 4. The second end portion 70, however, is configured to be detachably attached to the opposite (open) portion of the tank 4. The second end portion 70 comprises a door 34 and an O-ring 36 adapted to be applied for the purpose of sealingly attach the door 34 to the remaining portion of the tank 4.

A first tube 56 and a second tube 56′ are provided in the top portion of the tank 4. The first tube 56 connects the tank 4 with a reservoir 42 and a compressor 52 via another tube 54. The compressor 52 is adapted to pressurise the tank 4.

A compressor valve 48 is arranged in the tube 54 between the compressor 52 and the tank 4. The compressor valve 48 is configured to establish communication between the compressor 52 and the tank 4 and to disconnect this fluid communication. The compressor 52 may be controlled by any suitable control member (not shown) such as a control box, which is electrically connected to the compressor 52 and optionally to one or more pressure sensors.

A reservoir valve 46 is provided between the reservoir 42 and the tank 4. The reservoir valve 46 is configured to establish communication between the reservoir 42 and the tank 4 and to limit or completely shut off this fluid communication. The reservoir 42 may contain any fluid of interest e.g. a wood preservation liquid. The apparatus 2 may be configured to perform several treatment processes including impregnation of a wood preservation liquid.

A pump 58 is connected to the tube 56'. A pump valve 50 is arranged between the pump 50 and the tank 4. It is possible to establish fluid communication between the tank 4 and the pump 58 by means of the pump valve 50.

Further, by at least partly closing the valve 50, it is possible to decrease the flow or even completely shut off the connection between the tank 4 and the pump 58. A reservoir 44 is provided above the pump 58. The reservoir 44 is arranged in fluid communication with the pump 58. Therefore, the pump 58 can be used to pump e.g. a cooling fluid from the reservoir 44 into the tank 4 and to pump the fluid back into the reservoir 44.

Ten shafts are rotably mounted to the lower portion of the tank 4. A number of roller members 12 are rotatably attached to the shafts. The shafts and the attached roller members 12 constitute a roller conveyer configured to ease the transport of wood into the tank 4 and out of the tank 4.

A plurality of wood boards 6 is stacked in the tank 4. The wood boards 6 are resting on a lower plate-shaped support member 26. The wood boards 6 are sandwiched between the lower support member 26 and an upper plate-shaped support member 24.

A first group of electrodes 8, 8′, 8″ and a second group of electrodes 10, 10′ have been inserted into the batch of stacked wood 6. The groups of electrodes are electrically connected to a HF (high frequency) generator 18 by cables 14, 14′ and 16, 16′ in such a manner that, when operating the generator 18, the first group 8, 8′, 8″ has a polarity being opposite to that of the second group 10, 10′. The electrodes 8, 8′, 8″, 10, 10′ are arranged in such a way that two neighbouring electrodes have opposite polarity.

The electrodes 8, 8′, 8″, 10, 10′, the associated cables 14, 14′ and 16, 16′ and the HF-generator 18 constitute an electrode system, which is capable of producing electromagnetic radiation in the frequency range of approximately 10 MHz to approximately 30 MHz.

The plate-shaped upper support plate 24 and the lower plate-shaped support plate 26 are connected by a first clamp 38 and a second clamp 40. The clamps 38, 40 provide a compression force pressing the two support plates 24, 26 together. The compression force will counteract deformations, such as twisting and bending, of the wood boards 6 caused by the heating process. The clamps 38, 40, and the upper 24 and lower 26 support plates constitute a compression system configured to prevent deformations of the wood 6 during the heating process.

After arranging the wood boards 6 in the tank 4 and closing the tank, the heat treatment may be initiated. The heat treatment is carried out by means of the electrode system, which is capable of producing electromagnetic radiation in the frequency range of approximately 10 MHz to approximately 30 MHz.

The heat generation will not be initiated before the pressure in the tank 4 exceeds a predefined pressure level e.g. between 5-27 bar, such as 20 bar. Examples of such treatment method are illustrated in Fig. 2.

It may be an advantage to arrange a pressure sensor (not shown) in the tank 4 or in one of the tubes 54, 56. Accordingly, the pressure sensor may be applied to detect the pressure and thus to control the wood treatment process.

By using high frequency electromagnetic radiation, it is possible to conduct a homogeneous heating of the wood. Hereby, it is possible to provide a homogeneous wood quality.

List of reference numerals

2	Wood treatment apparatus
4	Tank
6	Wood
8, 8′, 8″, 10, 10″	Electrode
12	Roller member (roller conveyer)
14, 16	Cable
18	HF Generator
20	Compressor
22	Tube
24	Upper support member
26	Lower support member
28	Shaft
30	Door
32	Joint
34	Door
36	Sealing member (O-ring)
38, 40	Clamp member
42, 44	Reservoir
46, 48, 50	Valve
52	Compressor
54, 56, 56′	Tube
58	Pump
60	Time
62	Pressure
64	Temperature
P_1	Pressure
T_1, T_2, T_3	Temperature
t_1, t_2, t_3, t_4, t_5, t_6	Time
X	Longitudinal axis

66	Cylindrical portion
68, 70	End portion
72, 74	Curve
I, II, III, IV, V, VI	Section

Krav

1. Metode til varmebehandling af træ (6), hvilken metode omfatter placering af træet (6) i en lufttæt tank (4) og opvarmning af træet (6) til en forudbestemt temperatur (T_2, T_3), **kendetegnet ved**, at metoden omfatter et trin, hvor den lufttætte tank (4) sættes under tryk til et forudbestemt tryk (P_1) på 5-27 bar forud for opvarmning af træet til en temperatur over 100°C.

2. Metode ifølge krav 1, **kendetegnet ved**, at opvarmningen foregår ved elektromagnetisk stråling ved anvendelse af en eller flere elektroder (8, 8′, 8′′, 10, 10′).

3. Metode ifølge krav 1 eller krav 2, **kendetegnet ved**, at træet opvarmes til en forudbestemt temperatur (T_2, T_3) over 140°C, fortrinsvis over 150 °C, såsom 170-215°C.

4. Metode ifølge et af de foregående krav, **kendetegnet ved**, at metoden omfatter et trin, hvorved af træet (6) køles ved hjælp af et kølemiddel, der påfyldes tanken (4) efter terminering af opvarmnings-processen.

5. Metode ifølge et af de foregående krav, **kendetegnet ved**, at metoden omfatter et trin, hvor et stof, der nedsætter brændbarheden af træet (6), tilføres under opvarmningsprocessen.

6. Metode ifølge krav 5, **kendetegnet ved**, at stoffet er et gasformigt brandhæmmende stof velegnet ved brandslukning.

7. Metode ifølge et af de foregående krav, **kendetegnet ved**, at metoden omfatter et trin, hvorved træet (6) opvarmes i i det mindste nogle få minutter (f.eks. 15 minutes) til op til flere timer, fortrinsvis i 15 minutter til 10 timer, såsom 1-5 timer.

8. Metode ifølge et af de foregående krav, **kendetegnet ved**, at metoden omfatter et trin, hvorved træet (6) underkastes en efterfølgende tørringsproces.

9. Metode ifølge krav 8, **kendetegnet ved**, at tørringsprocessen udføres ved at opvarme træet (6) i tanken (4), ved hvilken process trykket i tanken (4) reduceres i takt med, at temperaturen reduceres.

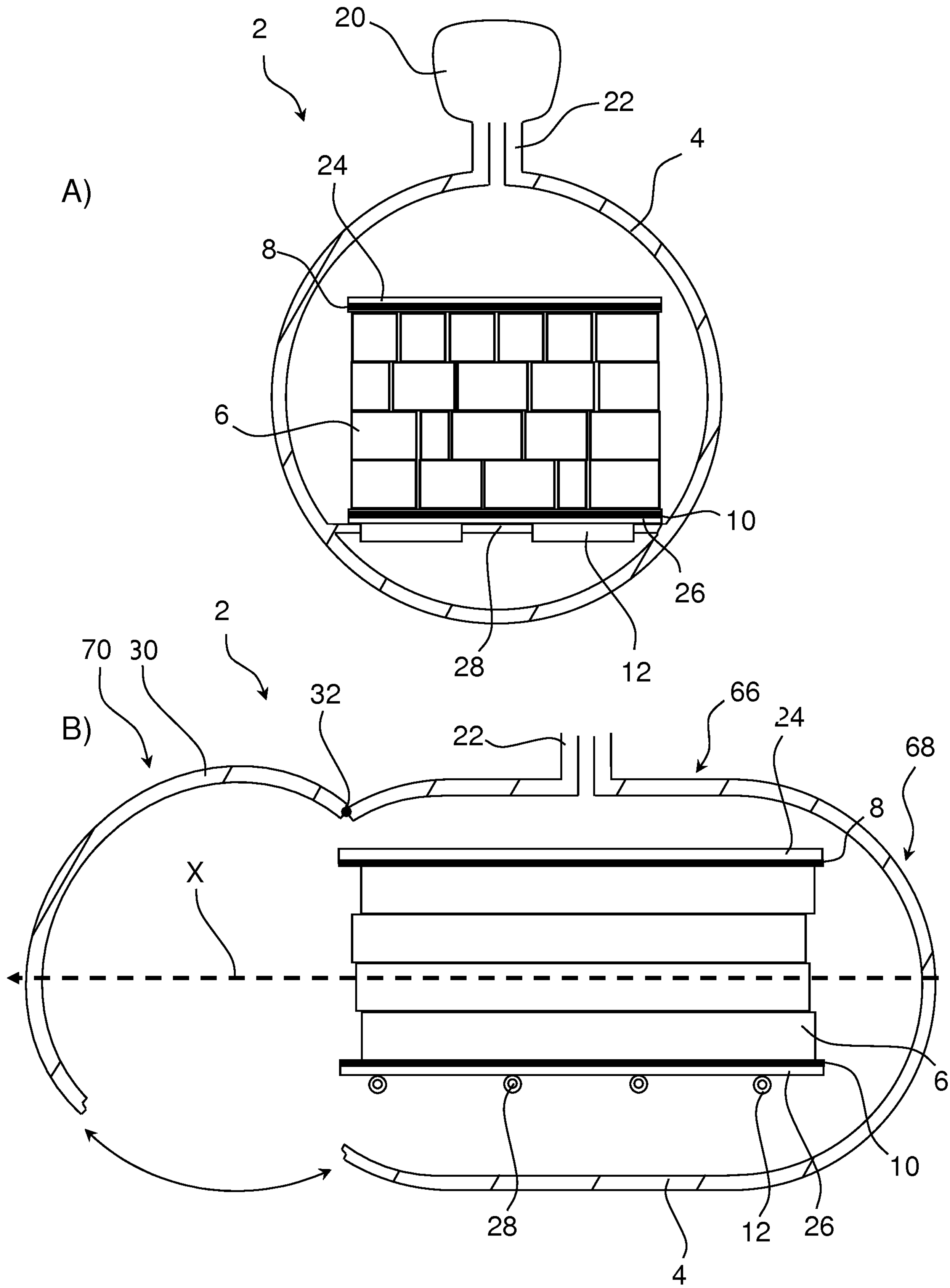


Fig. 1

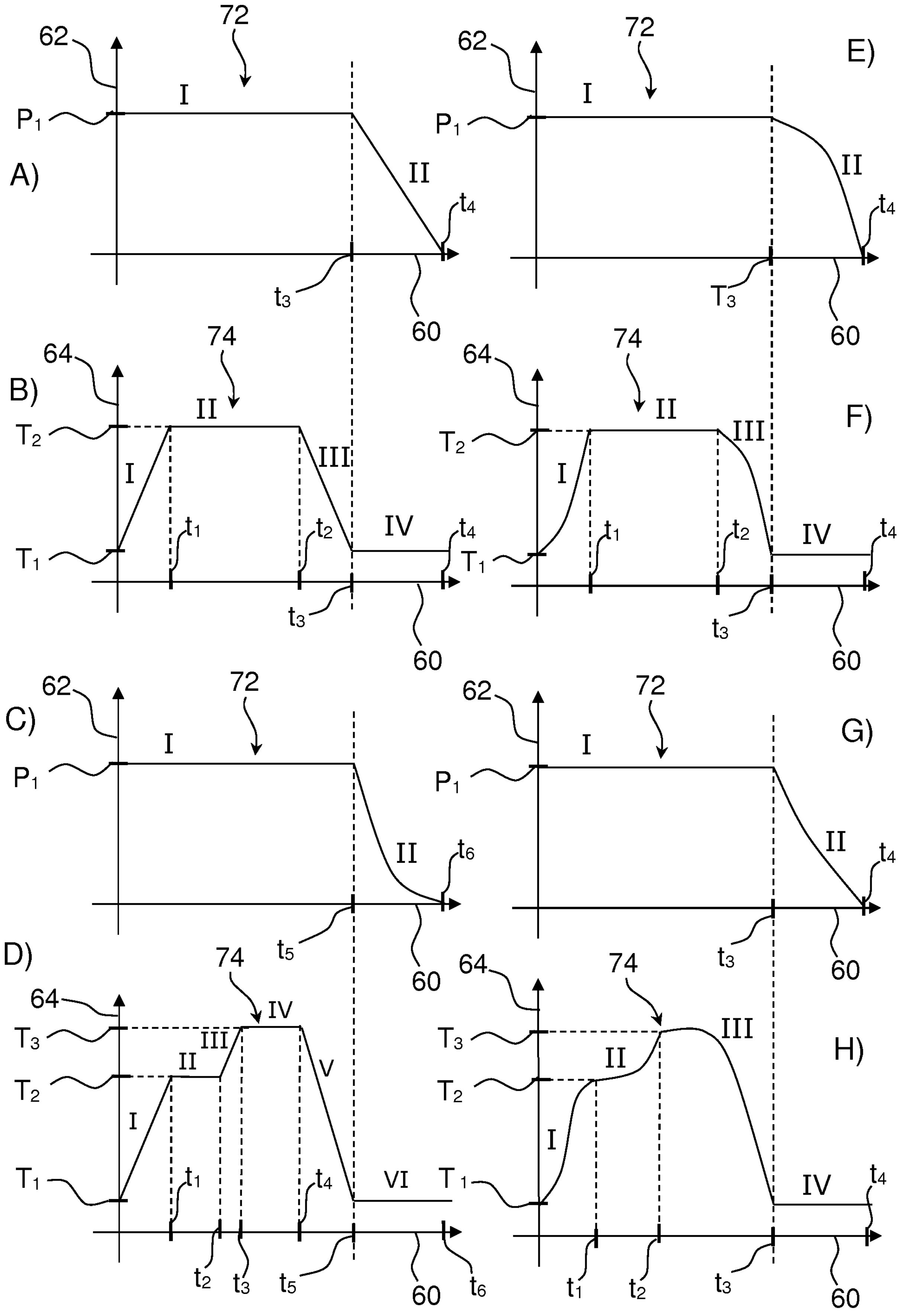
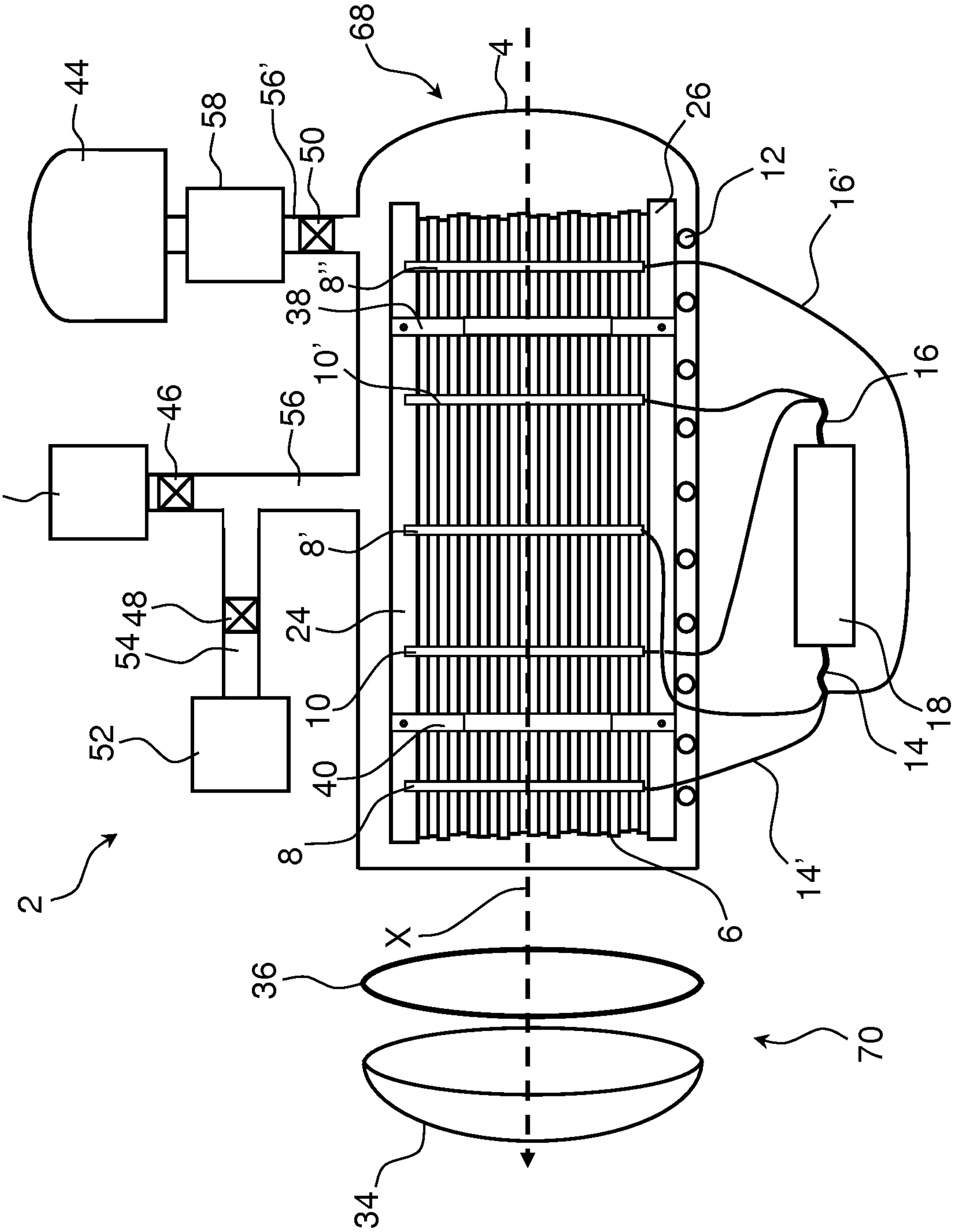

62
72
I
P1
A)
II
t4
t3
60
64
74
B)
T2
II
I
III
t1
t2
IV
T1
t3
60
62
72
C)
I
P1
II
t6
t5
60
D)
74
64
IV
T3
III
II
T2
I
V
T1
t1
t4
VI
t2
t3
t5
60
t6
E)
T3
F)
T1
G)
H)

Fig. 2



2
4
6
8
8'
8''
10
10'
12
14
14'
16
16'
18
24
26
34
36
38
40
42
44
46
48
50
52
54
56
56'
58
68
70
X

Fig. 3

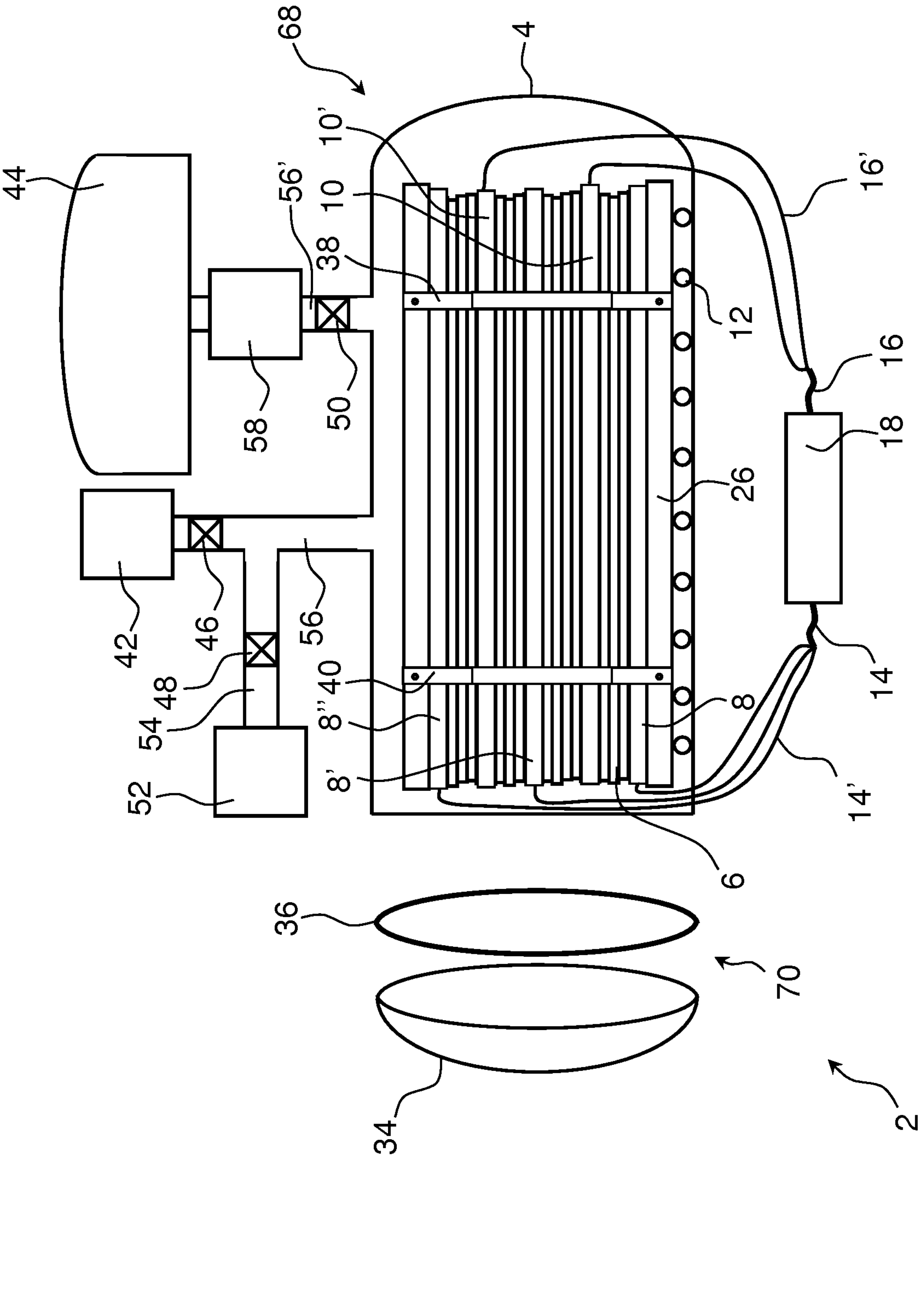

68
4
44
56'
10'
10
38
12
16'
16
58
50
18
26
42
46
56
48
54
8''
40
8
52
8'
14
14'
6
36
70
34
2

Fig. 4