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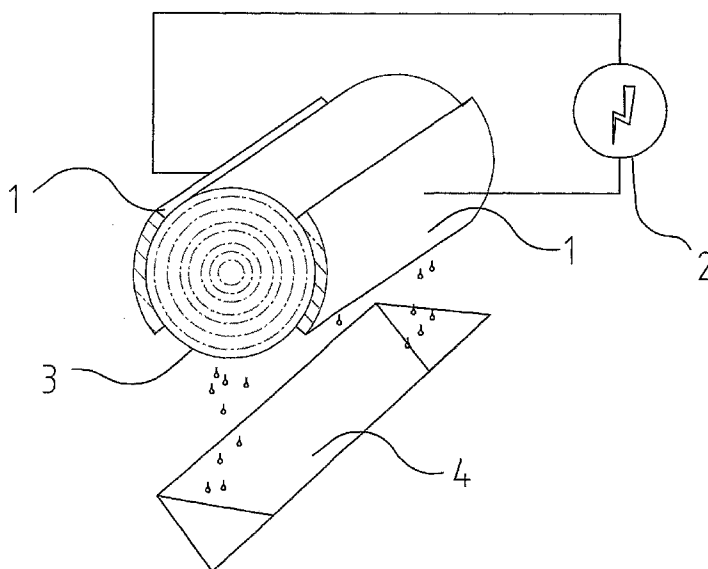
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(54) Title: METHOD AND APPARATUS FOR DRYING OF WOOD



(57) Abstract: The invention relates to a method and apparatus for drying wood by means of vapor. In the method according to the invention the vapor essentially is generated from the wood's (3) own liquid by means of electric energy (2) by conducting the electric energy (2) by means of electrodes (1) directly to the wood (3) to be dried so that the vapor generated first in the center of the wood (3) pushes out the liquids in the wood (3) via the capillaries of the wood. The apparatus according to the invention comprises a current source (2) and electrodes (1) connected thereto built to be brought into contact with the wood (3) to be dried in order to conduct electricity to the wood.

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METHOD AND APPARATUS FOR DRYING WOOD

The invention relates to a method and apparatus for drying wood by means of vapor.

It is previously known to dry wood in quite many different ways, starting from the very traditional outdoor drying. Typically, the industry uses drying plants in which the moisture in the wood is evaporated by means of heat and air flow, and the humid air is removed from the drying space. A high energy consumption is characteristic of these drying plants. Generally, the quality of the drying result could be much better. When aiming at a good drying result, the drying must be carried out quite gently, which, at the same time, signifies a long drying time.

It has been noticed that drying not only is a bottleneck but also a fairly important cost factor in the wood industry. Consequently, many different drying methods have been sketched out, based on various physical phenomena. Negative pressure, positive pressure and the alternation thereof in the drying space have been utilized. Microwaves, ultrasound and different radiations have also been proposed and even tested for the purpose of drying wood. There have been even more attempts but only a few methods have been applied industrially.

The invention aims at providing a method and apparatus by means of which the drying of wood takes place in a faster and more inexpensive way than before. The invention also aims at providing an apparatus which very well can be integrated into many kinds of production lines in the sawmill and wood product industry producing sawn timber, round logs and finished wooden objects.

The invention according to the invention is based on the use of the liquid contained in the wood to conduct electricity through the wood. An electric current is connected to different sides of the wood, the electricity flowing through thus heating the liquid in the wood and converting the liquid into vapor whose high pressure drives the liquid out of the wood via the capillaries of the wood.

At the end, only vapor exits, and even this ceases as the electricity resistance of the wood increases during the drying of the wood. It should be noted that quite a large part of the liquid in the wood is removed from the wood expressly in the form of a liquid, whereby a considerable amount of energy is saved in comparison with the complete evaporation required in many of the previous methods.

The characteristics of the invention will be more apparent from the accompanying claims.

In the following, the invention will be looked at in the light of a preferred exemplary embodiment, which, however, does not restrict the invention.

Figure 1 is a schematic view of an arrangement to carry out the method according to the invention.

In the Figure, numeral 1 denotes electrodes, numeral 2 denotes a current source, numeral 3 denotes the wood to be dried and numeral 4 denotes a trough to collect the liquids in the wood.

In the method according to the invention, the electrodes 1 are set on different sides of the wood 3 to be dried, into contact therewith, and electric energy 2 is conducted by means of the electrodes directly to the wood to be dried. When a high-voltage electric current from the current source 2 is conducted to the wood via the electrodes, the moisture in the wood starts to separate with the heating of the wood. The wood is typically driest at the center, the center thus having the highest electricity resistance. This means that it is the center of the wood 3 that starts to warm up first. As the water in the center evaporates, it drives water out of the wood 3 before it via the capillaries of the wood. The liquid falls into a trough 4 placed below the wood. At the end, there only is left a small amount of vapor, which is hotter and drier at the center of the wood 3 than farther out. The hotter and drier vapor also has a higher pressure and drives out the more humid vapor of the surface layers before it. After the exit of the vapor the wood is dried and has such a high resistance that the current supplied by the current source 2 drops substantially causing an automatic reduction in the energy consumption of the apparatus.

By observing the change in the electric current suitably with an amperemeter it is easy to keep up to date with how the drying proceeds. The drying result can be affected by altering the voltage, an increase in the voltage giving a better drying result. On the other hand, at the beginning of the drying, as a lot of liquid separates from the wood, it may be necessary to even decrease the voltage in order to avoid sparkling. Preferably, the electric voltage used is 200 V to 10 000 V, and preferably a few kilovolts in the range 2 to 7 kV.

The power consumption of the drying can be automatic or self-regulated, the apparatus thus decreasing the power as the wood dries.

In putting into practice it is possible to use quite many different alternatives to carry out the invention. Figure 1 illustrates the drying of a round piece of wood, such as a pole. However, it should have more application in the drying of sawn timber. Then, the electrodes used can be plate-like, and the sawn pieces of wood can lie there between adjacent to each other, spaced by small air gaps through which an air flow can be blown in order to lead out moisture. In the other electrode, lying farther down, or in close proximity thereto, a trough can be built to collect the liquid from which the liquid is let flow away to be recycled. The liquid is very suitable for the purposes of the chemical industry, for drugs and perfumes. If it is desirable to collect the liquids in the wood quite exhaustively, the drying can be arranged to take place in a hydrophobic light liquid, the entire apparatus thus lying in the liquid. Then, the liquids in the wood fall down to the bottom of the basin and are readily collectable therefrom. Naturally, this liquid must be non-conductive and fire-proof.

The electrodes can also be perforated or otherwise permeable to vapor and/or liquid in order to enhance the removal of the vapor and liquid. To assure the flow of electricity, the contact surface of the electrodes with the wood can be provided with a sponge-like surface and a wetting device. If required, the wetting can be performed by using a liquid that is more electrically conductive, such as saline water.

If it is desirable to increase the removal of liquid from the wood, at a given end thereof, the electrode can be divided into several part-electrodes lying one after another and having their power supply arranged into successive impulses, into a "running wave" or the like.

The removal of liquid into a desired direction can also be increased by making the upper electrode, for example, to resemble the belt of a caterpillar tractor, so as to be movable relative to the surface of the wood by means of rotating rollers, or in another way, the electrode thus being moved into the desired direction along the surface of the wood.

If there is extra or cheap heat energy available, the wood to be dried can be pre-heated to some extent, which reduces the electricity costs of the actual drying plant.

The efficiency of the apparatus is expected to be excellent, because no unnecessary warming up of drying chambers or similar spaces takes place and the drying only is exerted on the wood to be dried. Besides, no heat is transferred in pipelines all over the factory area.

As is apparent from the above, it is possible to carry out the invention in many different ways. The invention is, of course, susceptible of use together with the previously known drying methods. Therefore, the invention is not limited to the above-described examples but may vary within the scope of the claims.

CLAIMS

1. A method of drying wood by means of vapor, characterized in that the vapor essentially is generated from the wood's (3) own liquid by means of electric energy (2) by conducting the electric energy (2) by means of electrodes (1) directly to the wood (3) to be dried so that the vapor generated first in the center of the wood (3) pushes out the liquids in the wood (3) via the capillaries of the wood.
2. A method as defined in claim 1, characterized in that a considerable part of the liquids in the wood (3) is removed as liquids, which are collected into a trough (4).
3. A method as defined in claim 1, characterized in that the drying result is controlled by means of voltage and the power consumption in the drying is self-regulated and decreases as the wood the dries.
4. An apparatus for drying wood, characterized in that the apparatus comprises a current source (2) and electrodes (1) connected thereto built to be brought into contact with the wood (3) to be dried in order to conduct electricity to the wood.
5. An apparatus as defined in claim 4, characterized in that the electrodes (1) are permeable to vapor and/or liquid.
6. An apparatus as defined in claim 4, characterized in that at least the other electrode (1) is built to be moved along the surface of the wood (3).
7. An apparatus as defined in claim 4, characterized in that collecting is provided for the liquid separated from the wood, preferably by means of a trough (4) in the lower part of the apparatus.
8. An apparatus as defined in claim 7, characterized in that the trough (4) is large enough to contain such an amount of hydrophobic non-conductive fire-proof liquid that the entire apparatus is suited to operate immersed in the liquid.
9. An apparatus as defined in claim 4, characterized in that the electrode (1) is divided into part-electrodes having an electric current supplied thereto as successive running waves.
10. An apparatus as defined in claim 4, characterized in that the electric voltage used is 200 V to 10 000 V, preferably a few kilovolts.

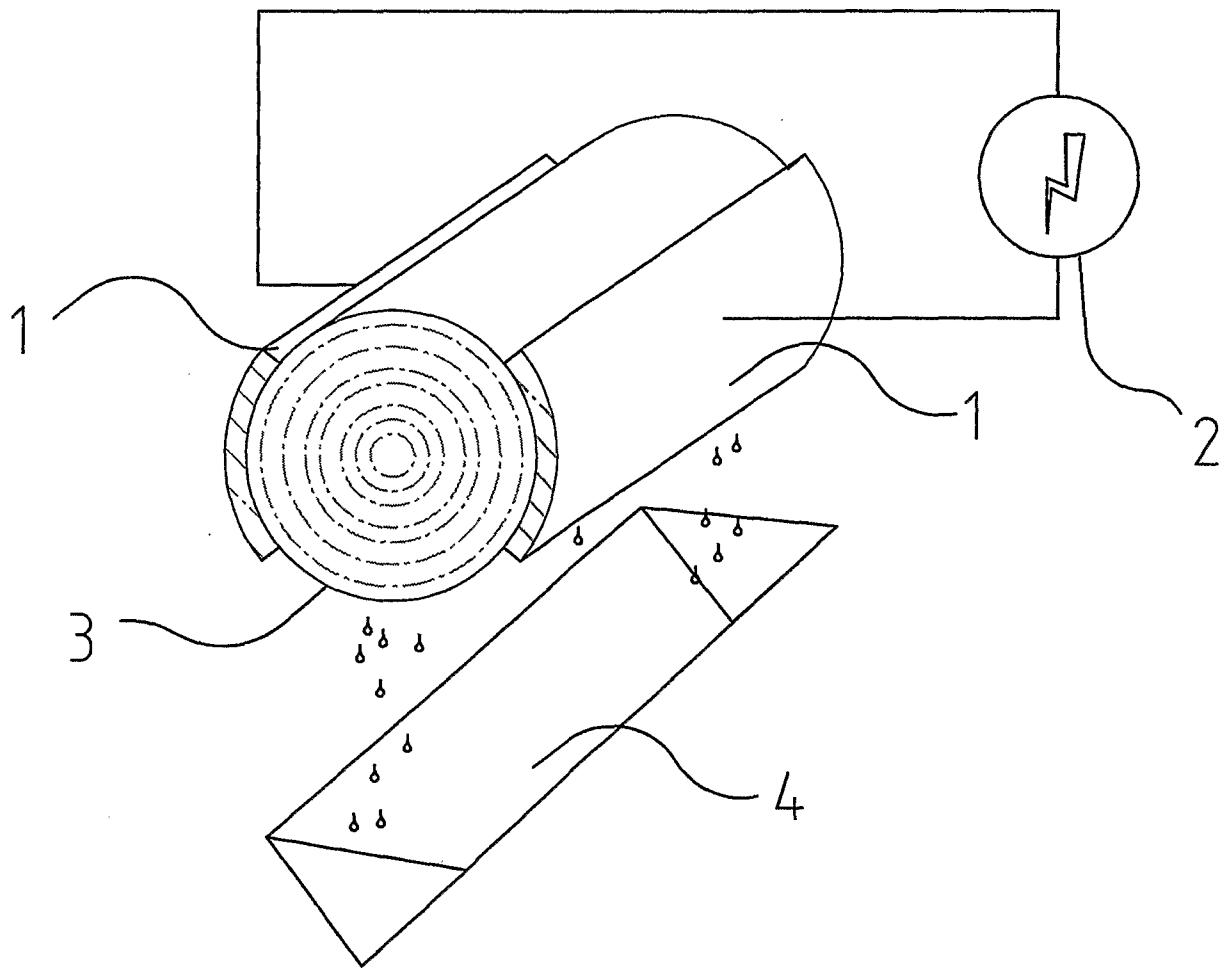


Fig 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2007/000214

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8: F26B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-internal and WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03037107 A2 (REZNIK DAVID) 08 May 2003 (08.05.2003) Fig. 3 and 1A, page 12	4-5, 7-8, 10
Y	Fig. 3	1-3, 5
X	GB 2159613 A (STOCKER ELECTRONICS COMPANY) 04 December 1985 (04.12.1985), Fig. 1-2, page 1 lines 108-130 and page 2 lines 1-12	4, 6, 9
X	JP 2004195931 A (YAMAMOTO VINITA CO LTD) 15 July 2004 (15.07.2004) EPO Patent Abstract of Japan	4
Y		1
Y	FI 117520 B (HITWOOD OY - ARBOREO TECHNOLOGIES LTD OY) 10 August 2002 (10.08.2002), Claim 1	1-3, 5

 Further documents are listed in the continuation of Box C.
 See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

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13 December 2007 (13.12.2007)

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Invention 1: claim 1

Invention 2: claim 4

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2007/000214

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
WO 03037107 A2	08/05/2003	None	
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GB 2159613 A	04/12/1985	None	
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2007/000214

CLASSIFICATION OF SUBJECT MATTER

Int.Cl.
F26B 23/04 (2006.01)