US 20070261412A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0261412 A1

Heine et al. (43) Pub. Date: Nov. 15, 2007

(54) AIR DRYER IN A WIND POWER STATION

(75) Inventors: **Raimo Heine**, Helsinki (FI); **Jaakko Heikonen**, Turku (FI); **Timo Koivuluoma**, Vantaa (FI)

Correspondence Address:
BUCHANAN, INGERSOLL & ROONEY PC
POST OFFICE BOX 1404
ALEXANDRIA, VA 22313-1404 (US)

(73) Assignee: **ABB OY**, Helsinki (FI)

(21) Appl. No.: **11/797,750**

(22) Filed: **May 7, 2007**

(30) **Foreign Application Priority Data**

May 10, 2006 (FI) 20065310

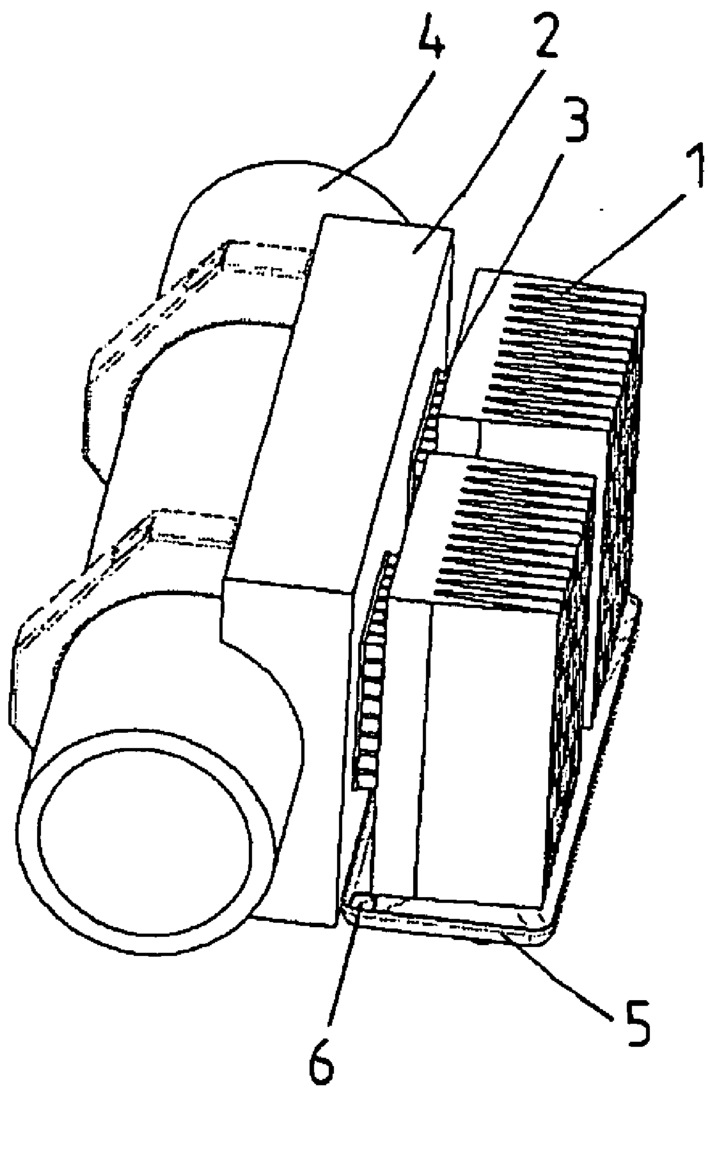
Publication Classification

(51) **Int. Cl.**
F25B 21/02 (2006.01)
F25D 17/06 (2006.01)

(52) **U.S. Cl.** **62/3.4**; 62/93

(57) **ABSTRACT**

The invention relates to an air dryer in a wind power station comprising a frequency converter with liquid cooling, the air dryer comprising a Peltier element (**3**), the first side of which is connected to an element to be cooled (**1**) and the second side to a heat-receiving element (**2**), and while the element to be cooled (**1**) is cooled, humidity condenses on the surface of this element. The air dryer is located inside a frequency converter cabinet and the heat-receiving element (**2**) of the air dryer is connected to contact piping (**4**) for liquid cooling or formed as a part of the piping. The invention also relates to a method for using such an air dryer.



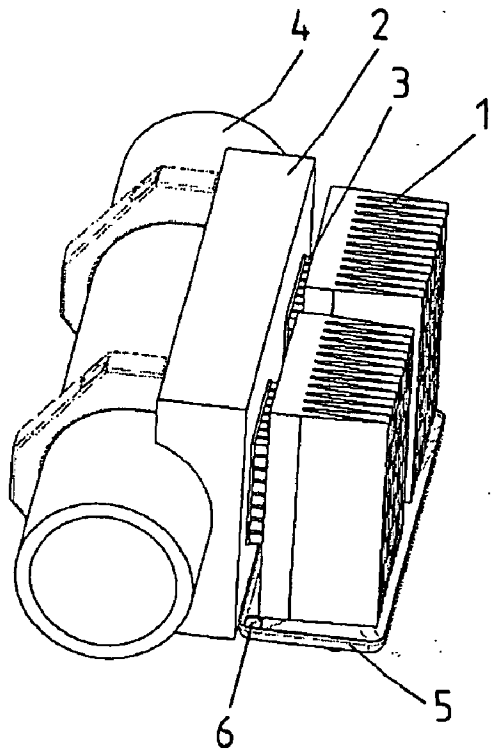


FIG. 1

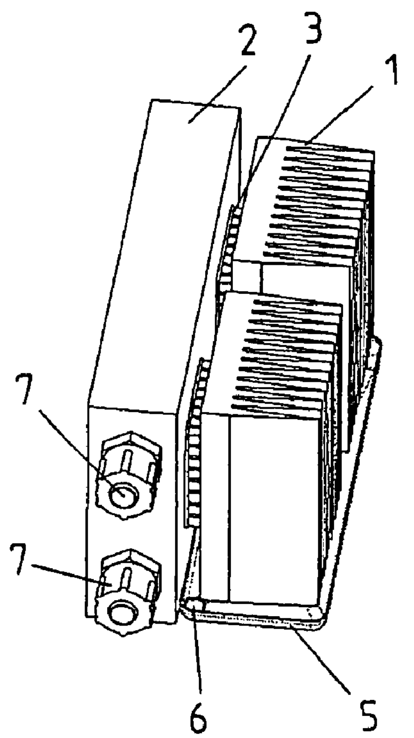


FIG. 2

AIR DRYER IN A WIND POWER STATION

BACKGROUND OF THE INVENTION

[0001] The invention relates to an air dryer in a wind power station comprising a frequency converter with liquid cooling, the air dryer comprising a Peltier element, the first side of which is connected to an element to be cooled and the second side to a heat-receiving element, and while the element to be cooled is cooled, humidity condenses on the surface of this element. The invention also relates to a method for using such an air dryer.

[0002] In wind power stations, frequency converters are located either in the lower part of the tower or in a room which is not typically heated or air-conditioned. Wind power station electronics are cooled in smaller devices of less than 2 MW usually by outside air, but in bigger devices the volume of air becomes so large that liquid cooling must be adopted, by which dissipation power can be conveniently transferred out of the tower.

[0003] When it is foggy, air absorbed by cooled devices is moist, wherefore the moisture resistance of the devices should be good. In air-cooled devices, salt can also enter inside the devices. If entirely closed devices were manufactured and heat was transferred away by means of a liquid, this would have great benefits also in corrosion prevention.

[0004] A fully sealed device cannot, however, be manufactured with reasonable costs. An example of a small-scale application is an air-sealed package, inside of which there is a bag containing a substance absorbing humidity from air. As an alternative for the bag, the device could be closed in entirely dry conditions, but this is often difficult to implement, since really dry air is required, for instance, to prevent humidity from condensing in the device during transportation, which immediately causes problems.

[0005] Also, delivered devices are usually opened, so even though the device would be entirely air-proof and air-sealed, air tightness disappears immediately when the device is opened.

[0006] A previous air drying method in connection with wind power stations is known from publication DE 102 45 103 A1, wherein an electronics cabinet of a wind power station is dried by using a Peltier element. Air is blown via the hot side of the Peltier system and the heated air is transferred to electrical instruments, whereby the hot air binds moisture in itself and flows then to the cold side of the Peltier system, where the humidity condenses and flows finally along a channel out of the device cabinet as condensate water.

[0007] Another known solution is shown in publication U.S. 2005/0002787 A1, which also uses the Peltier system either with or without blowers and wherein as a result of air circulation, humidity condenses on the cold side of the Peltier system. In this implementation, either the entire interior of the wind power station or its engine room is dried, and the condensate water is guided out of a collecting container. In an implementation, the heat-receiving side of the Peltier system is connected to a wall of the wind power station tower or formed by the tower wall itself.

[0008] Publication JP 2003 93829 describes an air dryer utilizing a Peltier element but no blower. Air flow is produced in channels for hot and cold air by the gravity.

[0009] In the previous solutions, it is typical that the entire interior of a wind power station or at least a large part of the interior is kept dry, whereby it is assumed that electricity consumed by the dryer is available all the time.

SUMMARY OF THE INVENTION

[0010] It is an object of the present invention to provide efficient and rapid local dehumidification in the previously mentioned wind power station. This is achieved by a solution of the invention, which is characterized in that the air dryer is located inside a frequency converter cabinet and that the heat-receiving element of the air dryer is connected to contact piping for liquid cooling or formed as a part of the piping.

[0011] The method of the invention is characterized by what is disclosed in the characterizing part of claim **6**.

[0012] Since drying in the present invention is carried out locally only inside the frequency converter cabinet, if needed, drying is very rapid and it does not require much electricity.

[0013] Drying may be started even after a fairly long shutdown in a totally wet space without pre-drying, because the dryer itself is entirely resistant to condensate water.

[0014] Energy is only used during drying, and thus energy is consumed much less than in previous systems with continuous drying. Drying is only needed if the frequency converter cabinet becomes damp in special cases, because normally heat losses of the frequency converter are enough to keep humidity absent.

[0015] The structure of the dryer is simple and reliable, because it does not include movable parts, such as blowers of prior art devices.

LIST OF FIGURES

[0016] The invention will now be described in greater detail with preferred examples and with reference to the attached drawings, in which

[0017] FIG. **1** shows an air dryer of the invention; and

[0018] FIG. **2** shows a second air dryer of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] FIG. **1** shows an air dryer of the invention, consisting of a Peltier system with an element to be cooled **1**, such as a cooling rib set, a heat-receiving element **2** and a Peltier element **3** therebetween, which, during its operation, cools down the element **1** and transfers heat from it to the element **2**.

[0020] The air dryer is located inside a frequency converter cabinet (not shown) of a wind power station, the cabinet being cooled with liquid cooling. The heat-receiving element **2** is attached to the surface of a main water pipe **4** for liquid cooling, to which heat produced in the Peltier element **3** is transferred by means of said element **2**. The element **1** is cooled to a dew temperature, at which air humidity condenses on the surface of the element **1**.

[0021] Under the element **1** there is a channel **5**, in which the condensate water is collected. From the channel **5** the water is then drained out of the cabinet in a controlled manner.

[0022] The use of the air dryer is controlled most preferably by a condensate water sensor **6**, which may be located in the channel **5** or, for instance, in the part of the apparatus that dries most slowly or is the most sensitive to condensate water. A suitable direct-current supply is arranged for the use.

[0023] Other useful implementations for controlling the operation could be

[0024] an arrangement based on a temperature difference between outside and inside air, for instance, or between some components and the cold surface of the air dryer

[0025] an arrangement based on relative humidity, which is the most common application in previous heating arrangements

[0026] an arrangement based on relative humidity and temperatures

[0027] a dew point sensor (preset air is always kept above a certain temperature, the dew point below it)

[0028] an arrangement based on a dew point sensor and temperatures.

[0029] When the temperature of the device is always kept above a certain temperature, such as at +10 degrees, in some manner, e.g. by a thermostat, the dew point sensor may be used for measuring whether the dew point is below this temperature, in which case the device is probably dry. When the temperature is measured, no preset temperature is required. In practice, one dew point sensor and a plurality of temperature measurements could be employed, but this is, however, not very likely, since dew point sensors are still quite expensive.

[0030] All the above operation controls of the air dryer tend to measure the same thing but with different approaches. In principle, the easiest way is to use an arrangement based on temperature differences, but it is cumbersome to measure the temperature of a dryer surface, because, if the surface is wet all the time, it either gets dirty or organic growth develops on it, which complicates the prediction of the surface temperature, i.e. the dew point.

[0031] When relative humidity is measured, it must be measured in a plurality of places or a dew point temperature must be calculated on the basis of it, since temperatures and humidity may vary greatly between the upper and lower parts of the cabinet. Like cheap thermometers, a cheap indicator for relative humidity may be based, for instance, on bi metal strips.

[0032] The implementation shown in FIG. **2** differs from the solution according to FIG. **1** in that the heat-receiving element **2** is arranged in connection with piping **7** branched off the main water pipe **4**. The piping **7** may then be guided through the element **2**, as shown in FIG. **2**. In principle, it is also possible that part of the piping **7** forms the element **2** itself.

[0033] The above description of the invention is only intended to illustrate the basic idea of the invention. A person skilled in the art may, however, modify its details within the attached claims.

1. An air dryer in a wind power station comprising a frequency converter with liquid cooling, the air dryer comprising a Peltier element, the first side of which is connected to an element to be cooled and the second side to a heat-receiving element, and while the element to be cooled is cooled, humidity condenses on the surface of this element, wherein the air dryer is located inside a frequency converter cabinet and that the heat-receiving element of the air dryer is connected to contact piping for liquid cooling or formed as a part of the piping.

2. An air dryer as claimed in claim 1, wherein the heat-receiving element of the air dryer is connected to a surface of a main water pipe.

3. An air dryer as claimed in claim 1, wherein the heat-receiving element of the air dryer is arranged in connection with the piping branched off the main water pipe.

4. An air dryer as claimed in claim 1, wherein the operating energy of the air dryer is direct current.

5. An air dryer as claimed in claim 1, wherein the operation control of the air dryer is implemented by means of a condensate water sensor.

6. A method for drying air in a wind power station comprising a frequency converter with liquid cooling, wherein the drying is carried out by an air dryer comprising a Peltier element, the first side of which is connected to an element to be cooled and the second side to a heat-receiving element, and while the element to be cooled is cooled, humidity condenses on the surface of this element, by locating the air dryer inside a frequency converter cabinet, connecting the heat-receiving element of the air dryer to contact piping for liquid cooling or forming it as a part of the piping, and carrying out the drying only if necessary, without pre-drying.

7. A method as claimed in claim 6, by controlling the drying by means of a condensate water sensor.

* * * * *