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(71) Applicant *(for all designated States except US)*: **ARCELIK ANONIM SIRKETI** [TR/TR]; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SOYSAL, F. Alper** [TR/TR]; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **OGUZ, Emre** [TR/TR]; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR).

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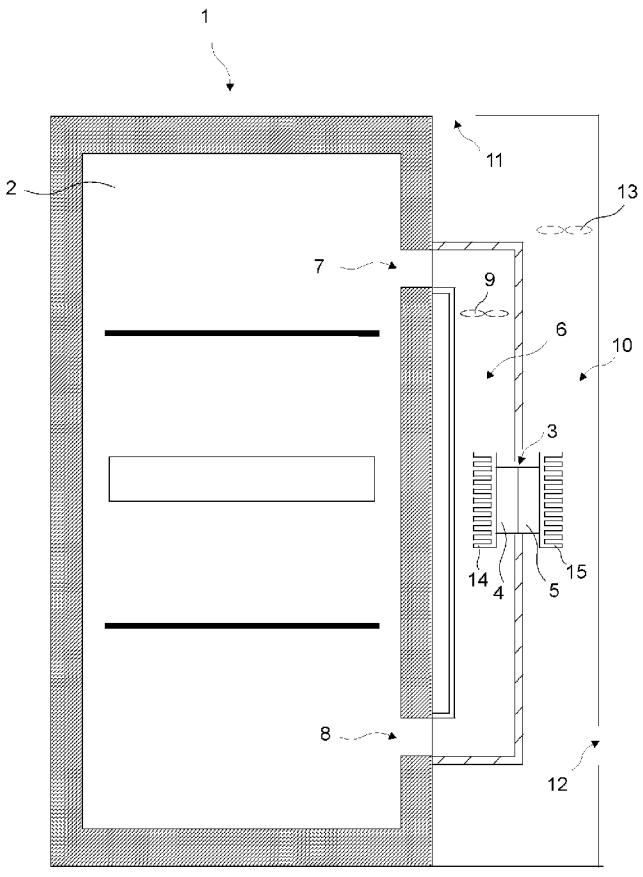
(54) **Title:** A DISHWASHER WITH AN IMPROVED DRYING ARRANGEMENT



(57) **Abstract:** The present invention relates to a dishwasher (1) wherein a thermoelectric unit (3) is utilized having an endothermic part (4) that absorbs heat and an exothermic part (5) that emits heat, the endothermic part (4) of the thermoelectric unit (3) being disposed in a condensation channel (6) and the exothermic part (5) disposed in a cooling channel (10) outside of the condensation channel (6) and providing the humid air in the tub (2) to be condensed swiftly in the condensation channel (6).

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A DISHWASHER WITH AN IMPROVED DRYING ARRANGEMENT

[0001] The present invention relates to a dishwasher wherein the drying effectiveness is increased.

[0002] In dishwashers, some amount of the water used in the washing process evaporates and at the end of the washing cycle high relative humidity values are reached due to the high temperature in the washing tub. Different methods are implemented to prevent the condensing moisture in the tub to leave residual spotting on the dishes that start to cool off at the end of the washing cycle. For example, in the drying phase, the humid air in the tub is passed through a channel made of plastic situated at the side of the tub. The air is circulated within this channel by means of a fan, some of the moisture in the air can be condensed when in contact with the surfaces thereof that are comparably cooler than the inside of the tub; however, all of the moisture in the tub cannot be absorbed and spotting is observed on the washed items at the end of the drying phase due to the residual moisture.

[0003] Furthermore, in the drying process in the dishwashers, thermoelectric units are used that provide the hot or cold effect to be dispersed into the environment depending on the direction of the current applied thereon; however, devices such as condensers and heaters are also required besides the thermoelectric unit to accelerate the drying process.

[0004] In the German patent application no. DE19813924, the explanation is given for a moisture condensation method after washing wherein a Peltier element is used to extract the heat energy from the inside of a work container. The endothermic part of the Peltier element having the capacity of absorbing thermal energy is arranged inside the dishwasher tub, and the exothermic part having the capacity of emanating thermal energy is mounted in the air channel between the tub and the exterior body of the machine. As the Peltier element is operated after the washing cycle, a cold surface is created on the inner surface of the tub and when the temperature of this surface goes below the temperature of condensation point of the humid air in the tub, condensation starts on the cold surfaces. The exothermic part of the Peltier element is mounted inside an air channel, and the air received from the environment with a relatively lower temperature is passed through the heat exchanger with bars disposed on the exothermic part of the thermoelectric unit. In another embodiment of the invention, the endothermic part of the Peltier element is again arranged inside the dishwasher tub, and

the exothermic part is mounted on the other side of the air channel between the tub and the exterior body of the machine. In such an application, since the endothermic part of the Peltier element is inside the tub, it will primarily try to cool the tub walls having high thermal inertia.

[0005] In the German patent application no. DE10334792 a dishwasher with a rinsing container is explained wherein a Peltier element is used for the cooling and drying the air on one side and heating the air on the other side, passing through from the rinsing container, at the drying phase after washing. In the drying cycle, the air in the tub is sent into a channel by means of a fan. The air sent into the channel condenses by first passing through the endothermic part of the Peltier element arranged on this channel and the partially dehumidified air is heated by passing through the exothermic part of the Peltier element. Since the circulated air in contact with the endothermic part of the Peltier element is later heated by being in contact with the exothermic part thereof, the performance of the Peltier element decreases even if the capacity of the circulating air increases in absorbing humidity from the washed items, when it meets the endothermic part again it will condense with more difficulty to leave the moisture.

[0006] In the patent application no. WO2006029953, a drying method for a household appliance in particular dishwasher is explained wherein a Peltier element is used. Condensation is maintained on the inner wall of the tub by means of the endothermic part of the Peltier element being in contact with a plate and the plate in contact with the tub. The exothermic part of the Peltier element is inside an air channel and the air aspirated from inside the tub by means of a blower is heated as it passes through the exothermic part and is sent into the tub. A condenser and a heater are used in the air channel in order to support the condensation and heating of the drying air.

[0007] The aim of the present invention is the realization of a dishwasher wherein drying effectiveness is increased by removing the moisture left in the tub after the washing process.

[0008] The dishwasher realized in order to attain the aim of the present invention is explicated in the claims.

[0009] In the dishwasher of the present invention, a thermoelectric unit is used having an endothermic part absorbing the ambient heat in order to condense the air in the tub for removing the moisture and for drying the washed items, and an exothermic part that emits heat to the surroundings. The thermoelectric unit is mounted inside a condensation channel situated outside the tub that circulates the air received from inside the tub, delivering it again into the tub. The endothermic part of the thermoelectric unit

is disposed inside the condensation channel and the exothermic part is outside the condensation channel, the endothermic part inside the condensation channel is not in contact with the tub.

[0010] The air meeting with the endothermic part of the thermoelectric unit in the condensation channel hence the temperature being lowered is delivered into the tub without reheating, thus the condensation of the air circulating in the cycle is increased by lowering the temperature. Since the exothermic part of the thermoelectric unit is disposed outside the tub such that it is not in contact with the tub, the created cold effect is prevented from decreasing by dispersing to the tub walls.

[0011] A cooling channel is provided on the exterior side of the condensation channel, the inner part formed by the outer walls of the condensation channel and the outer part formed by the outer walls of the dishwasher body, with the exothermic part of the thermoelectric unit situated inside. The ambient air passed through the cooling channel cools the thermoelectric unit by getting in contact with the exothermic part thereof, thus the performance of the thermoelectric unit is increased by providing the desired heat flow.

[0012] The condensation channel and the cooling channel each have an air inlet and an air outlet, the humid air in the tub is passed through the condensation channel by means of a fan and the air of the exterior environment is passed through the cooling channel by means of another fan.

[0013] In the dishwasher of the present invention, furthermore the condensation of the air flowing in the condensation channel is accelerated and the efficiency of the thermoelectric unit is increased by utilizing an endothermic part heat exchanger situated on the endothermic part of the thermoelectric unit and an exothermic part heat exchanger situated on the exothermic part of the thermoelectric unit.

[0014] The dishwasher realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0015] Figure 1 – is the schematic view of a dishwasher.

[0016] The elements illustrated in the figures are numbered as follows:

1. Dishwasher
2. Tub
3. Thermoelectric unit
4. Endothermic part
5. Exothermic part
6. Condensation channel

7. Condensation channel inlet
8. Condensation channel outlet
9. Condensation channel fan
10. Cooling channel
11. Cooling channel inlet
12. Cooling channel outlet
13. Cooling channel fan
14. Endothermic part heat exchanger
15. Exothermic part heat exchanger

[0017] The dishwasher (1) comprises a tub (2) wherein the washing process is carried out, and a thermoelectric unit (3) utilized for condensation of the drying air.

[0018] The thermoelectric unit (3) comprises an endothermic part (4) creating a cold effect by absorbing the ambient heat and an exothermic part (5) that emits heat into the surroundings.

[0019] The dishwasher (1) of the present invention comprises a condensation channel (6) that provides the circulation of the humid air in the tub (2) by delivering it out of the tub (2) and a thermoelectric unit (3) with the endothermic part (4) thereof disposed in the condensation channel (6) such that it is not in contact with the tub (2) and the exothermic part (5) mounted on the wall of the condensation channel (6) such that it will be on the outside of the condensation channel (6).

[0020] In the dishwasher (1) of the present invention, the humid air received from the tub (2) with the condensation channel (6) is condensed by only being in contact with the endothermic part (4) and without being in contact with the exothermic part (5) of the thermoelectric unit (3) and the air leaving the contained moisture at the endothermic part (4) and its temperature lowered is sent into the tub (2) by means of the condensation channel (6) after leaving the endothermic part (4).

[0021] The dishwasher (1) furthermore comprises a condensation channel inlet (7) providing to deliver the humid air from the tub (2) into the condensation channel (6), a condensation channel outlet (8) providing the dehumidified and cooled air to the tub (2) and a condensation channel fan (9) that provides the flow of air in the condensation channel (6).

[0022] In another embodiment of the present invention, the dishwasher (1) comprises a cooling channel (10) situated between the condensation channel (6) and the outer wall of the body, inside which the exothermic part (5) of the thermoelectric unit (3) is disposed, providing the air received from the outer environment to contact with the

exothermic part (5) and the heated air to be sent to the outer environment.

[0023] In this embodiment the dishwasher (1) furthermore comprises a cooling channel inlet (11) for receiving the air from the outer environment into the cooling channel (10), a cooling channel outlet (12) for redelivering the air heated in the cooling channel (10) to the outer environment and a cooling channel fan (13) providing the flow of air in the cooling channel (10).

[0024] In another embodiment of the present invention, the dishwasher (1) comprises an endothermic part heat exchanger (14) disposed on the endothermic part (4) of the thermoelectric unit (3), extending towards the inside of the condensation channel (6), being in contact with the air flowing in the condensation channel (6) to accelerate condensation and an exothermic part heat exchanger (15) situated on the exothermic part (5) of the thermoelectric unit (3) extending towards the inside of the cooling channel (10) and increasing the heat flow of the thermoelectric unit (3) thus increasing the efficiency thereof.

[0025] During the operation of the dishwasher (1), at the start of drying phase relative humidity reaches high values in the tub (2) due to the evaporation of the water in the tub (2) as a result of the high temperature. In the dishwasher (1) of the present invention, the thermoelectric unit (3) is energized as the drying phase starts, while the temperature of the endothermic part (4) is lowered, the temperature of the exothermic part (5) goes up. The hot and cold effects are dispersed in the condensation channel (6) and the cooling channel (10) by utilizing the endothermic part heat exchanger (14) and the exothermic part heat exchanger (15). As the thermoelectric unit (3) is energized, the condensation channel fan (9) and the cooling channel fan (13) are also energized. By means of the condensation channel fan (9) the humid air received from the interior environment of the tub (2) enters the condensation channel (6) through the condensation channel inlet (7) and the moisture contained in the air is condensed as it passes from the endothermic part (4) of the thermoelectric unit (3). The dehumidified air is sent into the tub (2) from the condensation channel outlet (8). Since the temperature inside the tub (2) goes down as long as the cycle continues wherein the air in the tub (2) is in contact with the endothermic part (4) of the thermoelectric unit (3), condensation is accelerated and less energy is required for condensing the air by cooling. Simultaneously with this process, the air aspirated from the outer environment by the cooling channel fan (13) passing through the cooling channel inlet (11) is blown unto the exothermic part (5) of the thermoelectric unit (3) and thus the thermoelectric unit (3) is provided to operate more efficiently. The ambient air heated by cooling the

exothermic part (5) of the thermoelectric unit (3) is delivered into the environment from the cooling channel outlet (12).

[0026] By means of the present invention, since the air meeting with the endothermic part (4) of the thermoelectric unit (3) in the condensation channel (6) thus decreasing in temperature is delivered again into the tub (2) without being heated, the energy required for reaching the required coolness for condensation during the cycle is decreased and since the endothermic part (4) of the thermoelectric unit (3) is not in contact with the body of the tub (2), the created coldness effect is prevented from decreasing by dispersing to the walls of the tub (2). The condensation capability of the circulating air is increased, moisture residue and thus the formation of spots on the washed dishes is prevented by providing to remove the moisture in the tub (2) more effectively. And what's more, since the exothermic part (5) of the thermoelectric unit (3) is cooled by the circulated ambient air in the cooling channel (10), the performance thereof is increased by maintaining the desired heat flow.

Claims

[0001] A dishwasher (1) comprising a tub (2) wherein the washing process is carried out, a thermoelectric unit (3) utilized for condensation of the drying air, having an endothermic part (4) and an exothermic part (5), and a condensation channel (6) that provides the circulation of the humid air in the tub (2) by delivering it out of the tub (2) **and characterizedby** a thermoelectric unit (3) with the endothermic part (4) thereof mounted in the condensation channel (6) without being in contact with the tub (2) and the exothermic part (5) mounted on the wall of the condensation channel (6) such that it stays on the outside of the condensation channel (6), providing the humid air received from the condensation channel (6) and the tub (2) to be condensed by only being in contact with the endothermic part (4) and without being in contact with the exothermic part (5) thereof **and** a condensation channel (6) providing the air leaving the endothermic part (4) to be sent into the tub (2).

[0002] A dishwasher (1) as in Claim 1, **characterizedby** a condensation channel inlet (7) providing to deliver the humid air from the tub (2) into the condensation channel (6), a condensation channel outlet (8) providing the air leaving its moisture in the condensation channel (6) and thus being cooled to be sent into the tub (2) and a condensation channel fan (9) that provides the flow of air in the condensation channel (6).

[0003] A dishwasher (1) as in Claim 1 or 2, **characterizedby** a cooling channel (10) situated between the condensation channel (6) and the outer wall of the body, inside which the exothermic part (5) of the thermoelectric unit (3) is disposed, providing the air received from the outer environment to contact with the exothermic part (5) and the heated air to be sent to the outer environment.

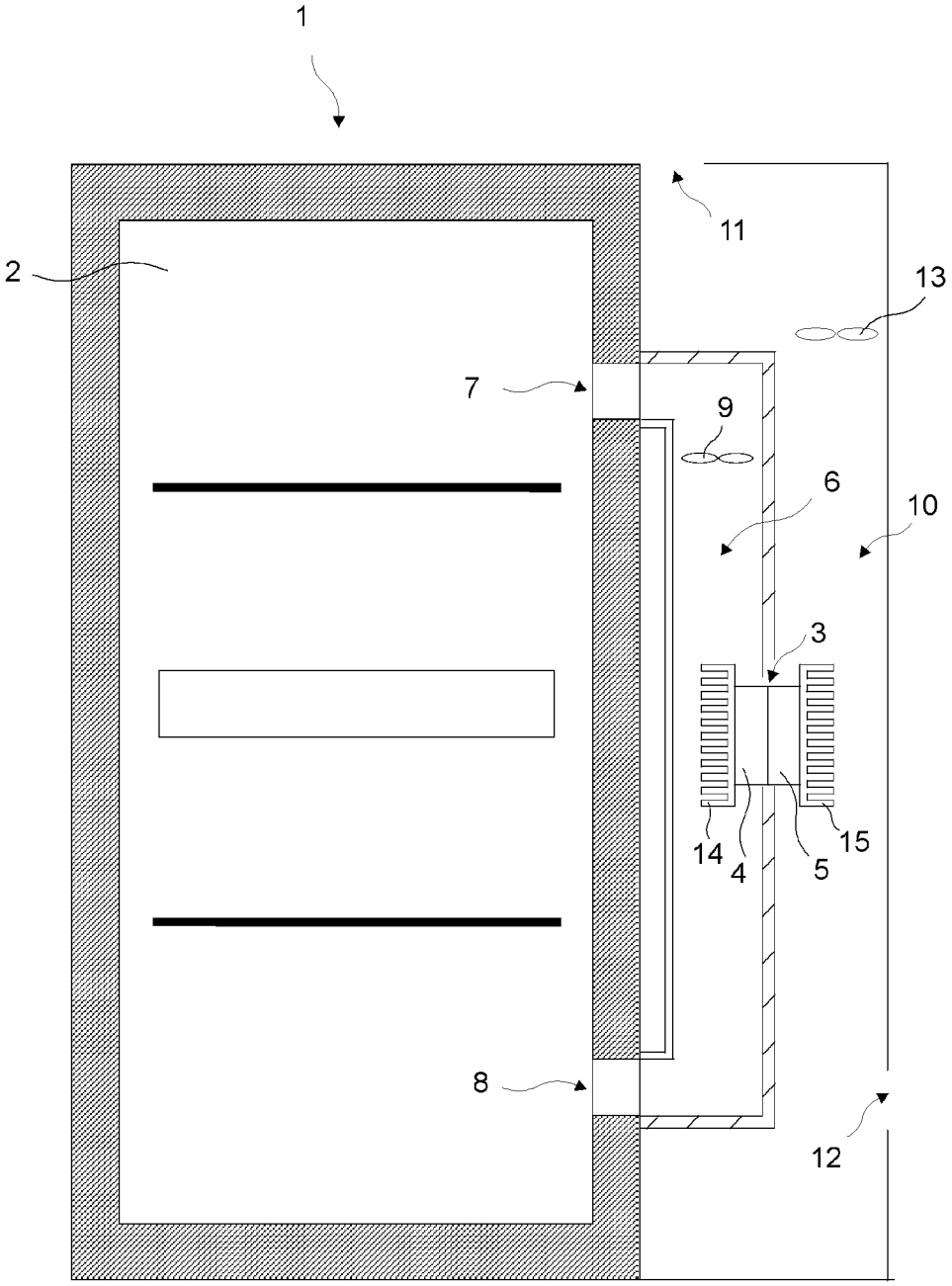
[0004] A dishwasher (1) as in Claim 3, **characterizedby** a cooling channel inlet (11) for receiving the air from the outer environment into the cooling channel (10), a cooling channel outlet (12) for sending the air heated in the cooling channel (10) to the outer environment and a cooling channel fan (13) providing the flow of air in the cooling channel (10).

[0005] A dishwasher (1) as in any one of the above claims, **characterizedby** an endothermic part heat exchanger (14) disposed on the endothermic part (4) of the thermoelectric unit (3), extending towards the inside of the condensation channel (6), and being in contact with the air flowing in the condensation channel (6) to

accelerate condensation.

[0006] A dishwasher (1) as in any one of the above claims, **characterizedby** an exothermic part heat exchanger (15) situated on the exothermic part (5) of the thermoelectric unit (3) extending towards the inside of the cooling channel (10) and increasing the efficiency thereof by increasing the heat flow of the thermo-electric unit (3).

Figure 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/055212

A. CLASSIFICATION OF SUBJECT MATTER
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ADD. H05K7/20

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)
A47L D06F H05K

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 103 34 792 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 24 February 2005 (2005-02-24) cited in the application paragraph [0020] - paragraph [0029]; figure 1	
A	DE 198 13 924 A1 (AEG HAUSGERAETE GMBH [DE]) 30 September 1999 (1999-09-30) cited in the application column 3, line 42 - column 5, line 35; figures 1,2	1-6
A	US 3 036 383 A (EDWARDS FRANKLIN W) 29 May 1962 (1962-05-29) column 2, line 3 - column 3, line 8; figure 3	1-6

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hannam, Martin

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/055212

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2006/029953 A (BSH BOSCH SIEMENS HAUSGERAETE [DE]; CLASSEN EGBERT [DE]; ROSENBAUER MI) 23 March 2006 (2006-03-23) cited in the application the whole document	1-6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2007/055212

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