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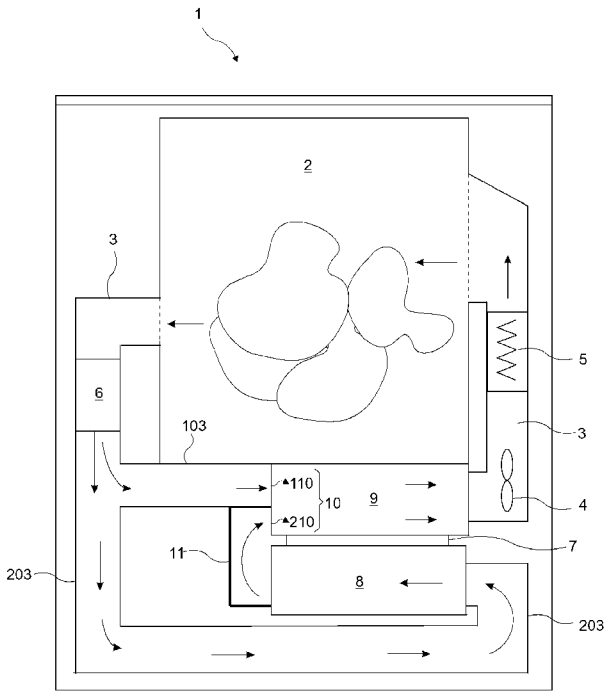
(54) **Title**: A LAUNDRY DRYER COMPRISING A THERMOELECTRIC HEAT PUMP

Figure 1



(57) **Abstract**: The laundry dryer (1) of the present invention comprises a drum (2) wherein the laundry is placed, a drying channel (3) wherein the drying air is circulated, a fan (4) that provides the circulation of the drying air in the drying channel (3), a heater (5) that heats the drying air, a thermoelectric heat pump (7) that has at least one cold side (8) cooling the drying air passing thereover and at least one hot side (9) heating the drying air passing thereover and a first drying channel (103) that delivers some of the drying air leaving the drum (2) to the hot side (9) and that is connected to the drying channel (3) and a second drying channel (203) that delivers some of the drying air leaving the drum (2) to the cold side (8) and that is connected to the drying channel (3).

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Description

A LAUNDRY DRYER COMPRISING A THERMOELECTRIC HEAT PUMP

[0001] The present invention relates to a laundry dryer comprising a thermoelectric heat pump.

[0002] In the state of the art laundry dryers, the drying air sucked from the outer environment is passed over the laundry by means of a fan and the laundry is dehumidified. Afterwards, the humid drying air is passed over the condenser and leaves its water vapor. The drying air dehumidified is then heated by being passed over the heater, thus it is delivered unto the laundry in a hot and dry state. This process is repeated in a closed cycle and the laundry is provided to be dried at the end of the process. In laundry dryers generally air cooled type condensers are used. The air sucked from the outer environment is delivered to the condenser and thus the drying air passing through the condenser is provided to be condensed by being cooled. In the state of the art laundry dryers, furthermore thermoelectric heat pumps are used in addition to the condenser and the heater. The thermoelectric heat pumps have a hot side that provides the drying air to be heated and supports the main heater, and a cold side that provides the drying air to be cooled and condensed and supports the condenser. In the process of laundry drying, the drying air is cooled a little while being passed over the condenser and then is passed over the thermoelectric heat pump. Thus, the process of dehumidifying the drying air is realized in two stages. Similarly, the heating process is also realized in two stages. The drying air, which is dehumidified by passing over the condenser and the cold side of the thermoelectric heat pump, is heated a little by being passed over the hot side of the thermoelectric heat pump and afterwards the heating process is completed by the drying air being passed over the main heater.

[0003] However, in the laundry dryers that contain the heater, the condenser and the thermoelectric heat pump together, pressure-loss problems occur since the path that the drying air circulates is long. The pressure of the drying air decreases, especially while it passes over the heat exchangers that provide the heat transfer to be performed at the hot and cold sides of

the thermoelectric heat pump and the speed of the drying air decreases due to the decreasing pressure. As per the operating principle of the thermoelectric heat pump, in order that the hot side operate efficiently, the air flow passing thereover should be at high speeds. In case that air at low speed passes over the hot side of the thermoelectric heat pump, the efficiency of the hot side decreases. The efficiency of the hot side decreasing causes the efficiency of the cold side to decrease and decreases the condensation efficiency. Since the condensation process is realized at the cold side instead of the hot side, in order that the cold side operates efficiently, the air passing thereover should be at low speed.

[0004] In the International Patent Application No. WO2007141166, one of the state of the art embodiments for solving these problems, a laundry dryer is described, wherein the drying air leaving the drum is passed over the condenser and is guided parallel to the hot and cold sides of the heat pump by means of a separator.

[0005] In the European Patent Application No. EP2004901, a laundry dryer is described, wherein the drying air is guided from the cold side of the thermoelectric heat pump to the hot side thereof by means of a separator.

[0006] The aim of the present invention is the realization of a laundry dryer which comprises a thermoelectric heat pump, the efficiency of which is increased by decreasing the pressure losses that occur in the drying cycle

[0007] In the laundry dryer realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, the entire drying air leaves the drum and is cooled by being passed over the condenser that is placed prior to the thermoelectric heat pump in the drying channel. Some of the air passed over the condenser is passed over the hot side of the thermoelectric heat pump, and the remainder of the air is passed first over the cold side of the thermoelectric heat pump, then over the hot side of the thermoelectric heat pump.

[0008] The laundry dryer of the present invention comprises a first drying channel that guides some of the drying air leaving the condenser directly to the hot side of the thermoelectric heat pump without passing over the cold side of the thermoelectric heat pump, and a second drying channel that guides

the remainder of the air that does not enter into the first drying channel, to the cold side of the thermoelectric heat pump. The laundry dryer furthermore comprises a guide that guides the drying air leaving the cold side to the hot side. The drying air that directly enters into the hot side and the drying air that is transferred from the cold side to the hot side by means of the guide join at the hot side. Thus, the entire drying air leaving the drum is provided to be passed over the hot side of the thermoelectric heat pump.

[0009] The flow path of the drying air that is passed over the condenser and directly guided to the hot side by means of the first drying channel, is shortened, thus pressure losses that may occur due to the distance are prevented. Moreover, by means of the drying air that leaves the condenser in a cooled state, technical problems that may occur due to the increase in heat at the hot side of the thermoelectric heat pump are prevented. The flow path of the drying air that flows through the second drying channel is increased, and it is provided to pass over the cold side at a lower speed. Thus, the condensation efficiency is provided to be increased in compliance with the operating principle of the cold side of the thermoelectric heat pump.

[0010] The laundry dryer of the present invention comprises a condenser that is placed into the drying channel prior to the first drying channel and the second drying channel.

[0011] In an embodiment of the laundry dryer of the present invention, two condensers are used, that are positioned as spaced apart. The first condenser is placed almost at the outlet of the drum, in the drying channel in the vertical direction so that their inlet openings face the same direction as the drying air, and the second condenser is mounted into the second drying channel so that their inlet openings face the same direction as the drying air. Both condensers are positioned prior to the thermoelectric heat pump.

[0012] In another embodiment of the present invention, the first condenser is positioned in the first drying channel and the second condenser into the second drying channel so as to be parallel to the first condenser, both prior

to the thermoelectric heat pump.

[0013] In the laundry dryer of the present invention, the distance covered by the drying air, especially by the drying air directly delivered to the thermoelectric heat pump is decreased, thus the number of pressure losses that may occur at the hot side is decreased. Moreover, by means of placing the condenser prior to the thermoelectric heat pump, an additional space is obtained, that provides the heights of the heat exchangers of the cold and hot sides of the thermoelectric heat pump located at the lower part of the drum, to be increased.

[0014] The laundry dryer 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 an embodiment of a laundry dryer.

[0016] Figure 2 – is the schematic view of another embodiment of a laundry dryer.

[0017] Figure 3 – is the schematic view of another embodiment of a laundry dryer.

[0018] The elements illustrated in the figures are numbered as follows:

1. Laundry dryer
2. Drum
3. 103, 203 Drying channel
4. Fan
5. Heater
6. 106. Condenser
7. Thermoelectric heat pump
8. Cold side
9. Hot side
10. 110, 210. Inlet opening
11. Guide

[0019] The laundry dryer (1) of the present invention comprises a drum (2) wherein the laundry is placed, a drying channel (3) wherein the drying air is circulated, a fan (4) that provides the circulation of the drying air in the drying channel (3), a heater (5) that heats the drying air, a thermoelectric heat pump (7) that has a cold side (8) cooling the drying air passing thereover and a hot side (9) heating the drying air passing thereover and a first drying channel (103) that delivers some of the drying air leaving the

drum (2) to the hot side (9) and that is connected to the drying channel (3) and a second drying channel (203) that delivers some of the drying air leaving the drum (2) to the cold side (8) and that is connected to the drying channel (3).

[0020] The laundry dryer (1) furthermore comprises at least one condenser (6, 106) wherein the entire drying air leaving the drum (2) is passed thereover to be cooled, that is placed into the drying channel (3) prior to the thermoelectric heat pump (7) so that its inlet opening faces the same direction as the flow direction of the drying air and a guide (11) that separates the inlet opening (10) of the hot side (9) as the upper inlet opening (110) and the lower inlet opening (210) and that guides the drying air that circulates the cold side (8) to the hot side (9) through the lower inlet opening (210) (Figure1).

[0021] In the present embodiment, the entire drying air leaving the drum (2) is passed over the condenser (6, 106) placed into the drying channel (3) to be cooled. Some of the air leaving the condenser (6, 106) is directed to the first drying channel (103), and the remainder of the air that does not enter into the first drying channel (103) moves through the second drying channel (203). The first drying channel (103) is positioned close the outlet of the drum (2), and the drying air moving therethrough is directly delivered to the hot side (9) of the thermoelectric heat pump (7) through the upper inlet opening (110) without passing over the cold side (8). Thus, the flow path of the drying air is shortened and possible pressure losses are decreased. Moreover, by means of the drying air of which the temperature is decreased by being passed over the condenser (6), the number of technical problems that may occur in the hot side (9) is decreased, thus providing the hot side (9) to operate more efficiently.

[0022] The drying air that leaves the condenser (6, 106) and moves through the second drying channel (203), is, after passing over the cold side (8) from end to end, guided to the lower inlet opening (210) by means of the guide (11), and is directed to the hot side (9) of the thermoelectric heat pump (7). The distance covered by the drying air that is directed to the cold side (8) of the thermoelectric heat pump (7) is increased, and due to the increased

distance, the speed of the drying air is decreased, and the drying air is provided to pass over the cold side (8) of the thermoelectric heat pump (7) at high speed. Thus, the condensing efficiency of the cold side (8) is improved. Moreover, since the condenser (6, 106) is placed prior to the thermoelectric heat pump (7), an additional space is obtained, that provides the heights of the heat exchangers of the hot side (9) and the cold side (8) located at the lower part of the drum (2), to be increased.

[0023] The drying air that leaves the cold side (8) to be guided to the hot side (9) through the lower inlet opening (210) joins with the drying air that is directly guided to the hot side (9) and then completes the cycle by passing over the main heater (5). Thus, the entire drying air leaving the drum (2) is provided to be passed over the hot side (9) of the thermoelectric heat pump (7), thus providing the hot side (9) to operate more efficiently.

[0024] In an embodiment of the present invention, the laundry dryer (1) comprises a condenser (106) that is placed in the drying channel (3) prior to the first drying channel (103) and the second drying channel (203).

[0025] In another embodiment of the present invention, two condensers (6, 106) positioned as spaced apart are used. The first condenser (6) is placed into the drying channel (3) almost at the outlet of the drum (2) so that its inlet opening faces the same direction as the drying air, and the second condenser (106) is positioned prior to the cold side (8) of the thermoelectric heat pump (7) in the second drying channel (203) so that their inlet openings face the same direction (Figure 2).

[0026] Some of the drying air leaving the first condenser (6) moves through the first drying channel (103) and directly enters into the hot side (9) through the upper inlet opening (110). The remainder of the drying air that does not enter into the first drying channel (103) is guided to the second drying channel (203) and cooled by being passed over the second condenser (106). The drying air leaving the second condenser (106) then passes the cold side (8) of the thermoelectric heat pump (7) from end to end. The cold side (8) is provided to operate more efficiently with the drying air being cooled one more time before entering into the cold side (8).

[0027] The drying air leaving the cold side (8) is directed towards the lower inlet

opening (210) of the hot side (9) by means of the guide (11), leaves the hot side (9) by mixing with the drying air that is directly guided to the hot side (9), and completes its cycle by passing over the main heater (5).

[0028] In another embodiment of the present invention, the first condenser (6) is placed in the first drying channel (103) prior to the hot side (9) of the thermoelectric heat pump (7) so that its inlet opening faces the same direction as the flow direction of the drying air, and the second condenser (106) is placed in the second drying channel (203) prior to the cold side (8) of the thermoelectric heat pump (7) so that its inlet opening faces the same direction as the flow direction of the drying air (Figure 3).

[0029] Some of the drying air leaving the drum (2) is passed over the first condenser (106) to be directly guided to the hot side (9) through upper inlet opening (110), and the remainder of the drying air passes over the second condenser (106) and then passes over the cold side (8) from end to end, then enters into the hot side (9) through the lower inlet opening (210) by means of the guide (11).

[0030] It is to be understood that the present invention is not limited by the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments. These should be considered within the scope of the protection postulated by the claims of the present invention.

Claims

1. A laundry dryer (1) of the present invention comprising a drum (2) wherein the laundry is placed, a drying channel (3) wherein the drying air is circulated, a fan (4) that provides the circulation of the drying air in the drying channel (3), a heater (5) that heats the drying air, a thermoelectric heat pump (7) that has a cold side (8) cooling the drying air passing thereover and a hot side (9) heating the drying air passing thereover and a first drying channel (103) that delivers some of the drying air leaving the drum (2) to the hot side (9) and that is connected to the drying channel (3) and a second drying channel (203) that delivers some of the drying air leaving the drum (2) to the cold side (8) and that is connected to the drying channel (3).

   characterized by

   - at least one condenser (6, 106) wherein the entire drying air leaving the drum (2) is passed thereover to be cooled, that is placed into the drying channel (3) prior to the thermoelectric heat pump (7) so that its inlet opening faces the same direction as the flow direction of the drying air and
   - a guide (11) that separates the inlet opening (10) of the hot side (9) as the upper inlet opening (110) and the lower inlet opening (210) and that guides the drying air that circulates the cold side (8) to the hot side (9) through the lower inlet opening (210).
2. A laundry dryer (1) as in Claim 1, **characterized by** a first drying channel (103) that directly delivers some of the drying air leaving the condenser (6, 106) to the hot side (9) of the thermoelectric heat pump (7) through the upper inlet opening (110).
3. A laundry dryer (1) as in Claim 2, **characterized by** a second drying channel (203) that directs the remainder of the drying air that leaves the condenser (6, 106) and that does not enter into the hot side (9), to the cold side (8) of the thermoelectric heat pump (7).
4. A laundry dryer (1) as in any one of the claims 1 to 3, **characterized by** the condenser (6) that is placed in the drying channel (3) prior to the first drying channel (103) and the second drying channel (203).
5. A laundry dryer (1) as in any one of the claims 1 to 3, **characterized by** a first condenser (6) that is placed in the drying channel (3) and a second condenser

(106) that is placed in the second drying channel (203).

6. A laundry dryer (1) as in any one of the claims 1 to 3, **characterized by** a first condenser (6) that is placed in the first drying channel (103) prior to the hot side (9) of the thermoelectric heat pump (7) and a second condenser (106) that is placed in the second drying channel (203) prior to the cold side (8) of the thermoelectric heat pump (7).

Figure 1

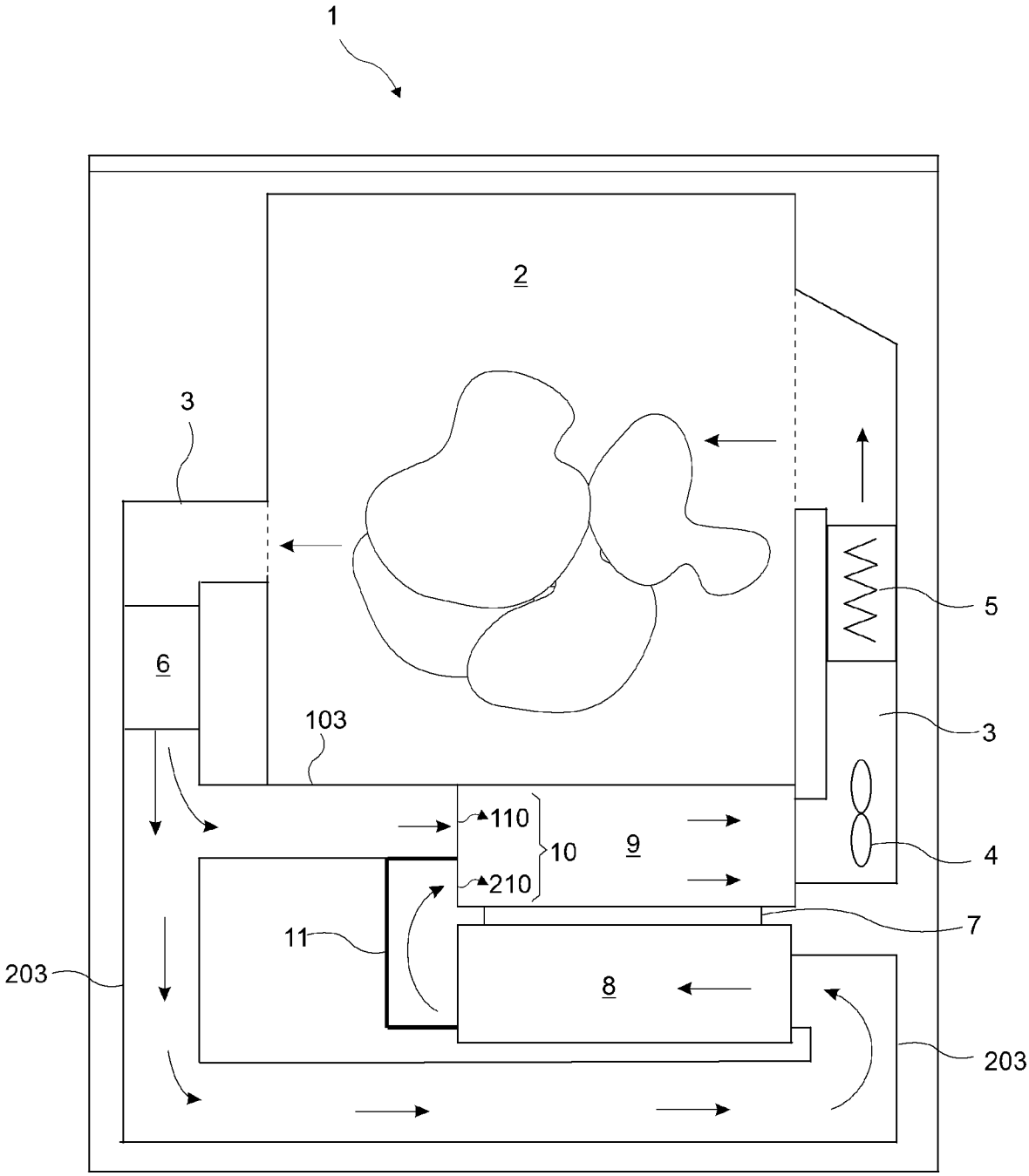

Figure 2

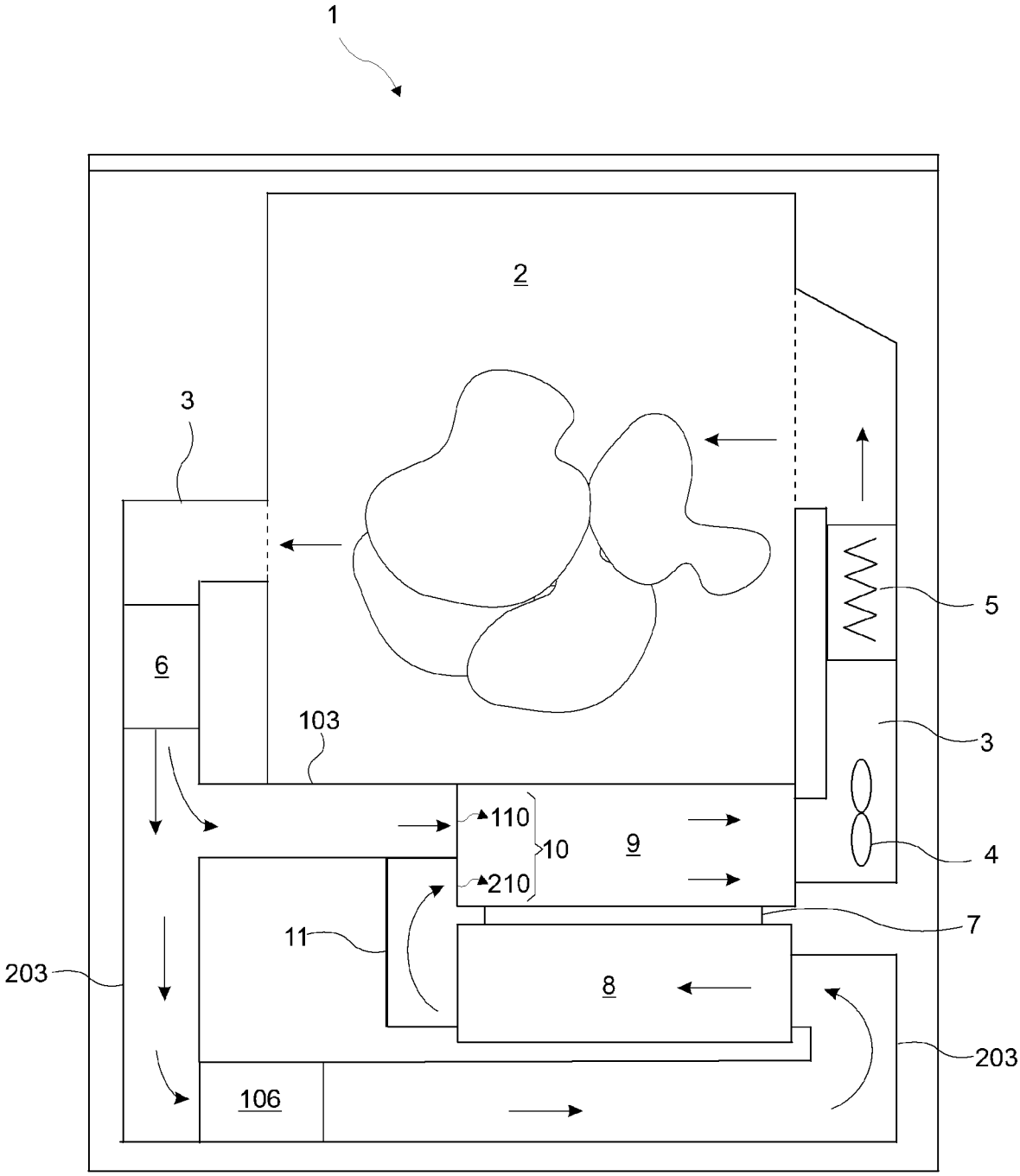

Figure 3