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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

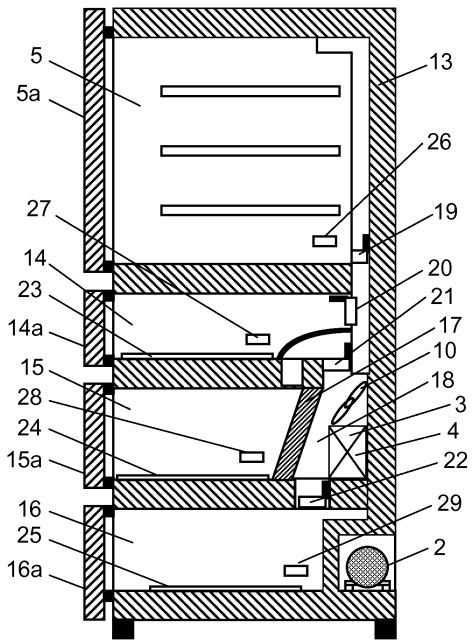
(72) Inventors:
- **NISHIMURA, Kouichi**
  Osaka 540-6207 (JP)
- **HIRAI, Tsuyoki**
  Osaka 540-6207 (JP)
- **KITANO, Tomoaki**
  Osaka 540-6207 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) REFRIGERATOR

(57) In refrigerator (13) including a plurality of switching storage compartments (14, 15, 16), when a set temperature of switching storage compartment (14) is switched from a low temperature side to a high temperature side, damper (20) for switching storage compartment (14) is closed, and heater (23) inside switching storage compartment (14) is operated.

FIG. 1



EP 3 306 241 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator in which a temperature in at least one storage compartment is switchable from a freezing temperature zone to a refrigerating temperature zone.

BACKGROUND ART

[0002] Conventionally, a temperature in a refrigerator is set to preset temperature zones for respective storage compartments, a temperature is adjustable in a freezing compartment only within a range of a freezing temperature zone, and a temperature is adjustable in a refrigerating compartment only within a range of a refrigerating temperature zone.

[0003] However, recently, due to diversity in a lifestyle, foodstuffs purchased by a user are also becoming diverse. Accordingly, there is an increasing need to change a storage volume in a desired temperature zone within a preset temperature zone by switching the temperature zone in the storage compartment.

[0004] Accordingly, a refrigerator has been developed in which a temperature zone in a storage compartment can be switched from a freezing temperature zone to a refrigerating temperature zone or from the refrigerating temperature zone to the freezing temperature zone (see PTL 1, for example).

[0005] The conventional refrigerator described above is hereinafter described with reference to the drawings.

[0006] FIG. 4 is a longitudinal cross-sectional view for describing conventional refrigerator 100 described in PTL 1. FIG. 5 is a front view of a switching compartment and a periphery of the switching compartment of conventional refrigerator 100. In FIG. 4 and FIG. 5, refrigerator 100 is provided with cooling system 104 which includes compressor 102, a condenser, a pressure reducing part, and evaporator 103. Refrigerator 100 includes refrigerating compartment 105, switching compartment 106, freezing compartment 107, and vegetable compartment 108, and openings of front surfaces of these compartments are hermetically sealed by openable doors 105a, 106a, 107a, 108a, respectively.

[0007] Evaporator 103 is accommodated in cooling compartment 109 disposed on a back surface of freezing compartment 107. Cooling fan 110 is provided above evaporator 103, and circulates cool air generated by evaporator 103 in refrigerator 100.

[0008] Switching damper 111 is provided on a back surface of switching compartment 106, and switching damper 111 introduces cool air circulated by cooling fan 110 into an inside of switching compartment 106 or interrupts the introduction of such cooling air. Heater 112 is provided on a bottom surface of switching compartment 106, and heater 112 heats an inside of switching compartment 106.

[0009] During operation of refrigerator 100, cool air generated by evaporator 103 is circulated inside refrigerator 100 by cooling fan 110 so that the respective storage compartments are maintained at predetermined temperatures.

[0010] At this time, to maintain the inside of switching compartment 106 at a set temperature, blowing-off of cool air into switching compartment 106 is controlled by opening or closing of switching damper 111.

[0011] In this case, when temperature setting of switching compartment 106 is changed from freeze setting to refrigeration setting, electricity is supplied to heater 112 so that the inside of switching compartment 106 is heated, whereby switching compartment 106 can be quickly brought into a refrigerating temperature zone thus maintaining qualities of stored foods or the like.

[0012] However, in the conventional configuration described above, in the case where the switching damper is brought into an open state when electricity is supplied to the heater, heat from the heater flows into other storage compartments through the damper and becomes a thermal load thus giving rise to a drawback that power consumption of the refrigerator is increased.

[0013] Further, since the heater heats only a wall of a bottom surface of the switching compartment so that the switching compartment is heated by a natural convection, only the bottom surface is overheated and there is a drawback that a temperature at the center of switching compartment is hardly raised to a target temperature.

Citation List

Patent Literature

[0014] PTL 1: Japanese Patent No. 3,361,038

SUMMARY OF THE INVENTION

[0015] The present invention have been made in view of the above-mentioned conventional drawbacks, and a refrigerator according to one example of an exemplary embodiment of the present invention includes: a storage compartment defined by a heat insulating wall; a cooling compartment in which a cooler is accommodated; a cooling fan which supplies cool air from the cooling compartment to the storage compartment; and a plurality of dampers provided in a discharge air passage which makes the cooling compartment and the storage compartment communicate with each other. In the refrigerator according to one example of the exemplary embodiment of the present invention, the storage compartment has a switching storage compartment in which a temperature inside the switching storage compartment is switchable by an opening and closing control of the plurality of dampers. The refrigerator according to one example of the exemplary embodiment of the present invention is configured such that when a set temperature in the switching storage compartment is switched from a low

temperature to a high temperature, a switching-storage-compartment damper is closed, and a heater provided inside the switching storage compartment is operated by the control unit.

[0016] With such a configuration, heat generated by a heater is interrupted by the damper and hence, there is no possibility that other storage compartments are heated. Accordingly, the increase of power consumption can be suppressed.

[0017] The refrigerator according to one example of the exemplary embodiment of the present invention may be configured such that when a set temperature in the switching storage compartment is switched from a low temperature to a high temperature, the dampers other than the damper for the switching storage compartment are closed and the damper for the switching storage compartment is opened, and the heater and the cooling fan are operated by the control unit.

[0018] With such a configuration, a temperature in the switching compartment can be quickly raised and hence, degrading of freshness of stored products can be prevented.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

FIG. 1 is a longitudinal cross-sectional view of a refrigerator according to a first exemplary embodiment and a second exemplary embodiment of the present invention.

FIG. 2 is a flowchart for describing an operation of the refrigerator according to the first exemplary embodiment of the present invention.

FIG. 3 is a flowchart for describing an operation of the refrigerator according to the second exemplary embodiment of the present invention.

FIG. 4 is a longitudinal cross-sectional view of a conventional refrigerator.

FIG. 5 is a front view of a switching compartment and a periphery of the switching compartment of the conventional refrigerator.

DESCRIPTION OF EMBODIMENTS

[0020] Exemplary embodiments according to the present invention are hereinafter described with reference to the drawings. The present invention is not limited by these exemplary embodiments.

(First exemplary embodiment)

[0021] FIG. 1 is a longitudinal cross-sectional view of a refrigerator according to a first exemplary embodiment of the present invention. FIG. 2 is a flowchart showing an operation of the refrigerator according to the first exemplary embodiment of the present invention.

[0022] In FIG. 1, refrigerator 13 is provided with cooling system 4 which includes compressor 2, condenser, pressure reducing part, and evaporator 3. Refrigerator 13 includes refrigerating compartment 5, first switching compartment 14, second switching compartment 15, and third switching compartment 16 (hereinafter, first switching compartment 14, second switching compartment 15, and third switching compartment 16 may be collectively referred to as switching storage compartments 14, 15, 16), and openable doors 5a, 14a, 15a, 16a are disposed on front surface openings of the respective switching compartments.

[0023] Evaporator 3 is accommodated in cooling compartment 18 which is thermally insulated from the inside of second switching compartment 15 by heat insulating wall 17 behind second switching compartment 15. Cooling fan 10 is disposed above evaporator 3, and cool air generated by evaporator 3 is circulated in refrigerator 100 by cooling fan 10.

[0024] In the respective storage compartments, i.e., refrigerating compartment 5, first switching compartment 14, second switching compartment 15, and third switching compartment 16, there are disposed refrigerating compartment damper 19, first switching damper 20, second switching damper 21, and third switching damper 22 for introducing cool air circulated by cooling fan 10 into the inside of the respective storage compartments and interrupting the introduction of such cool air. On bottom surfaces inside the respective storage compartments, i.e., first switching compartment 14, second switching compartment 15, and third switching compartment 16, there are disposed first heater 23, second heater 24, and third heater 25, respectively, and first to third heaters 23 to 25 heat first switching compartment 14, second switching compartment 15, and third switching compartment 16, respectively.

[0025] Further, refrigerating compartment thermistor 26, first thermistor 27, second thermistor 28, and third thermistor 29 are respectively disposed in refrigerating compartment 5, first switching compartment 14, second switching compartment 15, and third switching compartment 16 for controlling temperatures of refrigerating compartment 5, first switching compartment 14, second switching compartment 15, and third switching compartment 16, respectively.

[0026] The operation and effect of the refrigerator having the above-mentioned configuration are hereinafter described.

[0027] During operation of refrigerator 13, cool air generated by evaporator 3 is circulated inside refrigerator 13 by cooling fan 10 so that the respective storage compartments are maintained at predetermined temperatures.

[0028] At this time, first switching compartment 14, second switching compartment 15, and third switching compartment 16 can be maintained in temperature zones ranging from a freezing temperature zone around minus 20 degrees to a refrigerating temperature zone around 5 degrees by opening or closing of first switching damper 20, second switching damper 21, and third switching

damper 22.

[0029] Next, the operation when set temperatures of first switching compartment 14, second switching compartment 15, and third switching compartment 16 are switched to temperatures higher than temperatures at that point of time is described with reference to a flowchart shown in FIG. 2.

[0030] In this embodiment, for simplifying the description, the description is made only of a switching control of first switching compartment 14. However, substantially the same effect can also be obtained by substantially the same operation for any of first switching compartment 14, second switching compartment 15, and third switching compartment 16.

[0031] When a set temperature of first switching compartment 14 is switched to a temperature higher than a temperature at that point of time (in FIG. 2, described as a current temperature) (S1, S2), firstly, first switching damper 20 is closed by a control unit (S3), and electricity is supplied to first heater 23 so that the inside of first switching compartment 14 is heated (S4).

[0032] When a temperature detected by first thermistor 27 (in FIG. 2, described as a detected temperature) becomes a predetermined value T1 or more (S5), the supply of electricity to first heater 23 is interrupted by control unit (S6), and first switching damper 20 is normally controlled (S7).

[0033] Accordingly, a temperature of first switching compartment 14 can be quickly raised to a target temperature by first heater 23, and since first switching damper 20 is closed, there is no possibility that warm air in first switching compartment 14 flows to other storage compartments and hence, there is no possibility that a thermal load of refrigerator 13 is increased.

[0034] In this exemplary embodiment, T1 can be changed according to an outside air temperature, a set temperature of another storage compartment, or the like. For example, by setting T1 to a lower value as an outside air temperature or the set temperature of another storage compartment becomes higher, a stable temperature control can be performed.

[0035] In this exemplary embodiment, the configuration is exemplified in which evaporator 3 is disposed behind second switching compartment 15. However, evaporator 3 may be disposed behind any storage compartment. Accommodation of evaporator 3 inside one storage compartment brings about advantageous effects that a duct can be simplified, and a storage volume can be increased.

[0036] In this exemplary embodiment, the case is exemplified where the refrigerator includes three switching storage compartments, i.e., first switching compartment to third switching compartment. However, it is needless to say that the refrigerator can obtain substantially the same effect as long as the refrigerator has one or more switching storage compartments.

[0037] In this exemplary embodiment, the description has been made by taking as an example the case where first heater 23, second heater 24, and third heater 25 are disposed on bottom surfaces of first switching compartment 14, second switching compartment 15, and third switching compartment 16, respectively. However, first heater 23, second heater 24, and third heater 25 may be disposed on side wall surfaces or ceilings. By additionally disposing heaters on the side wall surfaces, the ceilings, or the like, a temperature rising speed can be increased. However, in such a case, power consumption is increased.

[0038] In this exemplary embodiment, second heater 24 is disposed on a surface of heat insulating wall 17. Accordingly, when second switching compartment 15 is set to a refrigerating temperature, it is possible to suppress the cooling of the inside of second switching compartment 15 through heat insulating wall 17 from cooling compartment 18 by second heater 24. Accordingly, a thickness of heat insulating wall 17 can be made thin so that a storage volume of second switching compartment 15 can be increased.

(Second exemplary embodiment)

[0039] Next, a refrigerator according to a second exemplary embodiment of the present invention is described.

[0040] FIG. 3 is a flowchart showing an operation of the refrigerator according to the second exemplary embodiment of the present invention.

[0041] The operation when set temperatures of switching storage compartments 14, 15, 16 are switched to temperatures higher than temperatures at that point of time is described based on a flowchart of FIG. 3.

[0042] For simplifying the description, the description is made only of a switching control of first switching compartment 14. However, substantially the same effect can also be obtained by substantially the same operation for any of the switching storage compartments, i.e., first switching compartment 14, second switching compartment 15, and third switching compartment 16.

[0043] When a set temperature of first switching compartment 14 is switched to a temperature higher than a temperature at that point of time (in FIG. 3, described as a current temperature) (S11, S12), firstly, refrigerating compartment damper 19, second switching damper 21, third switching damper 22 are closed by a control unit, and first switching damper 20 is opened by the control unit (S13). Electricity is supplied to first heater 23 (S14), and cooling fan 10 is operated (S15).

[0044] When a temperature detected by first thermistor 27 (in FIG. 3, described as a detected temperature) becomes a predetermined value T1 or more (S16), the supply of electricity to first heater 23 is interrupted by control unit (S17), and the respective dampers and cooling fan 10 are normally controlled (S18).

[0045] With such an operation, a temperature of first switching compartment 14 can be further quickly raised to a target temperature by first heater 23, and since re-

frigerating compartment damper 19, second switching damper 21, and third switching damper 22 are closed, there is no possibility that warm air in first switching compartment 14 flows to other storage compartments and hence, there is no possibility that a thermal load of refrigerator 13 is increased.

[0046] The operation in the first exemplary embodiment and the operation in the second exemplary embodiment can be performed case by case depending on an operation state of compressor 2. That is, during operation of compressor 2 (when evaporator 3 is cooled), the operation in the first exemplary embodiment is performed. When compressor 2 is stopped (when evaporator 3 is not cooled), the operation in the second exemplary embodiment is performed. Accordingly, a temperature of first switching compartment 14 can be further efficiently raised.

[0047] Further, a temperature of first switching compartment 14 may be increased by making use of a defrosting heater disposed in proximity to evaporator 3.

[0048] As described above, the refrigerator according to one example of the exemplary embodiment of the present invention includes: the storage compartment defined by the heat insulating wall; the cooling compartment in which the cooler is accommodated; the cooling fan which supplies cool air from the cooling compartment to the storage compartment; and the plurality of dampers provided in the discharge air passage which makes the cooling compartment and the storage compartment communicate with each other. The storage compartments include the switching storage compartments in which indoor temperatures can be switched by controlling opening/closing of the plurality of dampers. The refrigerator is configured such that when a set temperature in the switching storage compartment is switched from a low temperature side to a high temperature side, a switching-storage-compartment damper is closed, and a heater inside the switching storage compartment is operated. With such a configuration, other storage compartments are not heated by heat of the heater for raising a temperature of the switching compartment, and it is possible to provide a refrigerator having low power consumption.

[0049] Further, the refrigerator according to one example of the exemplary embodiment of the present invention may be configured such that when a set temperature of the switching storage compartment is switched from a low temperature side to a high temperature side, the dampers other than the damper for the switching storage compartment are closed, and the damper for the switching storage compartment is opened, thus operating the heater and the cooling fan. With such a configuration, it possible to obtain a refrigerator having high freshness keeping performance in which heat of a heater can be circulated in a desired switching storage compartment by a cooling fan, and a temperature of the desired switching storage compartment can be quickly raised.

INDUSTRIAL APPLICABILITY

[0050] As described above, the present invention provides a refrigerator which can quickly raise a temperature of a switching storage compartment without increasing a thermal load of other storage compartments when a temperature of the switching storage compartment is switched from a low temperature to a high temperature, thus enhancing heat insulation property. Accordingly, the present invention is widely applicable to a refrigerator and other refrigerating equipment in general which respectively include a storage compartment in which a temperature in the storage compartment can be switched.

REFERENCE MARKS IN THE DRAWINGS

[0051]

3: evaporator
5: refrigerating compartment
5a: door
10: cooling fan
13: refrigerator
14: first switching compartment
14a, 15a, 16a: door
15: second switching compartment
16: third switching compartment
17: heat insulating wall
18: cooling compartment
19: refrigerating compartment damper
20: first switching damper
21: second switching damper
22: third switching damper
23: first heater
24: second heater
25: third heater
26: refrigerating compartment thermistor
27: first thermistor
28: second thermistor
29: third thermistor

Claims

1. A refrigerator comprising:

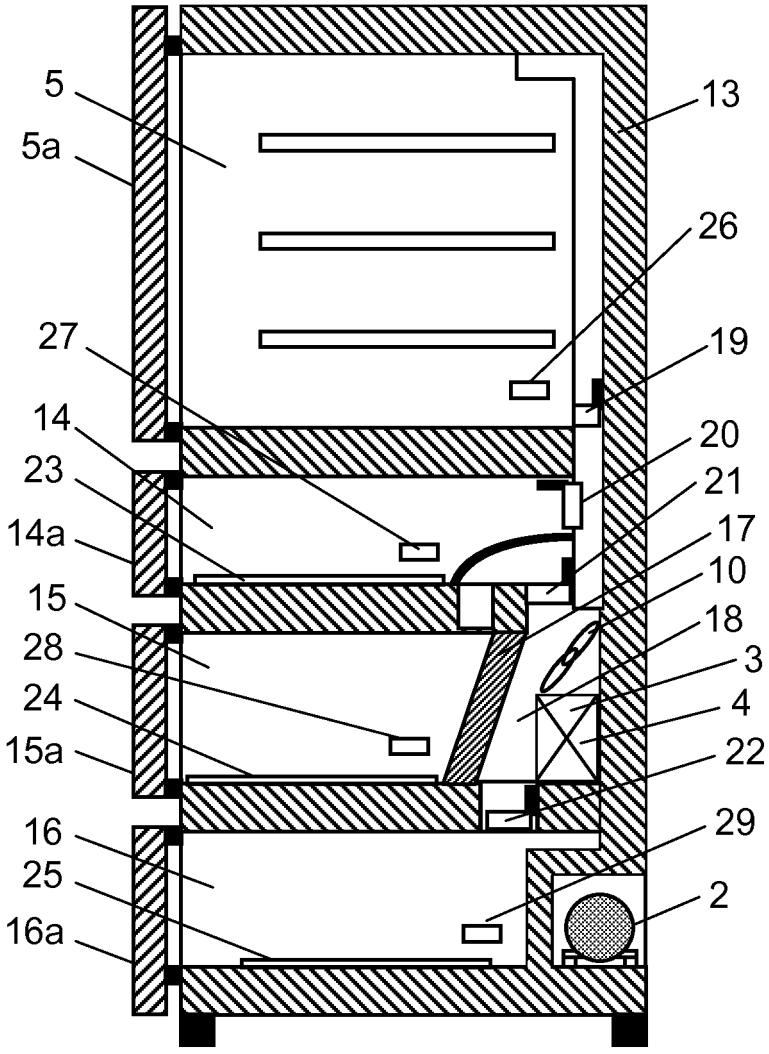
a storage compartment defined by a heat insulating wall;
a cooling compartment in which a cooler is accommodated;
a cooling fan which supplies cool air from the cooling compartment to the storage compartment; and
a plurality of dampers provided in a discharge air passage which makes the cooling compartment and the storage compartment communicate with each other,
wherein the storage compartment has a switch-

ing storage compartment in which a temperature inside the switching storage compartment is switchable by an opening and closing control of the plurality of dampers, and
when a set temperature in the switching storage compartment is switched from a low temperature to a high temperature, a damper for the switching storage compartment out of the plurality of dampers is closed, and a heater inside the switching storage compartment is operated.

2. A refrigerator comprising:

a storage compartment defined by a heat insulating wall;
a cooling compartment in which a cooler is accommodated;
a cooling fan which supplies cool air from the cooling compartment to the storage compartment; and
a plurality of dampers provided in a discharge air passage which makes the cooling compartment and the storage compartment communicate with each other,
wherein the storage compartment has a switching storage compartment in which a temperature inside the switching storage compartment is switchable by an opening and closing control of the plurality of dampers, and
when a set temperature in the switching storage compartment is switched from a low temperature to a high temperature, out of the plurality of dampers, dampers other than adamper for the switching storage compartment are closed and the damper for the switching storage compartment is opened, and the heater and the cooling fan are operated.

FIG. 1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5a
13
26
27
19
14
20
23
21
14a
17
10
15
18
28
3
24
4
15a
22
16
29
25
2
16a

FIG. 2

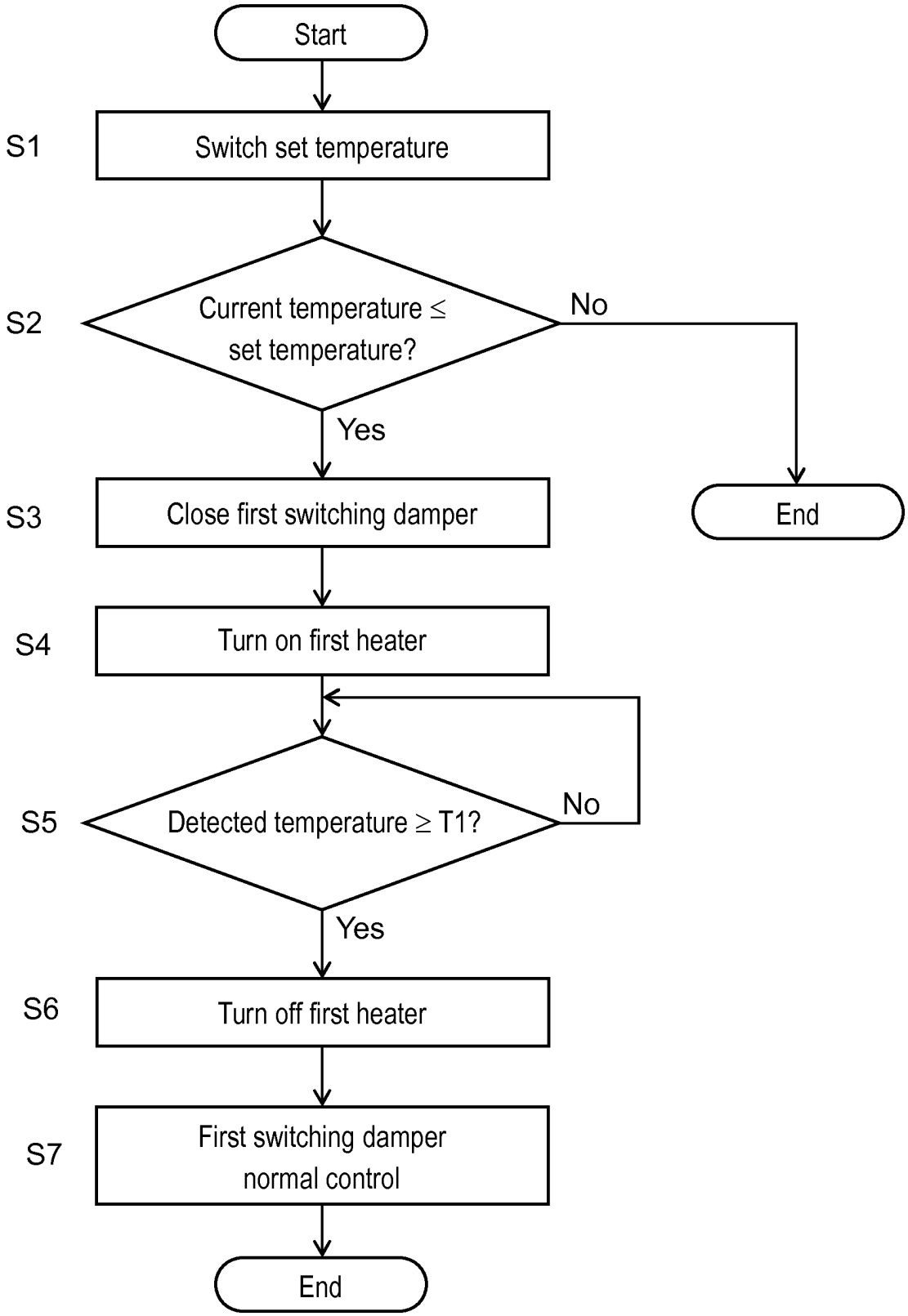

Start
S1
Switch set temperature
S2
Current temperature ≤ set temperature?
No
Yes
End
S3
Close first switching damper
S4
Turn on first heater
S5
Detected temperature ≥ T1?
No
Yes
S6
Turn off first heater
S7
First switching damper normal control
End

FIG. 3

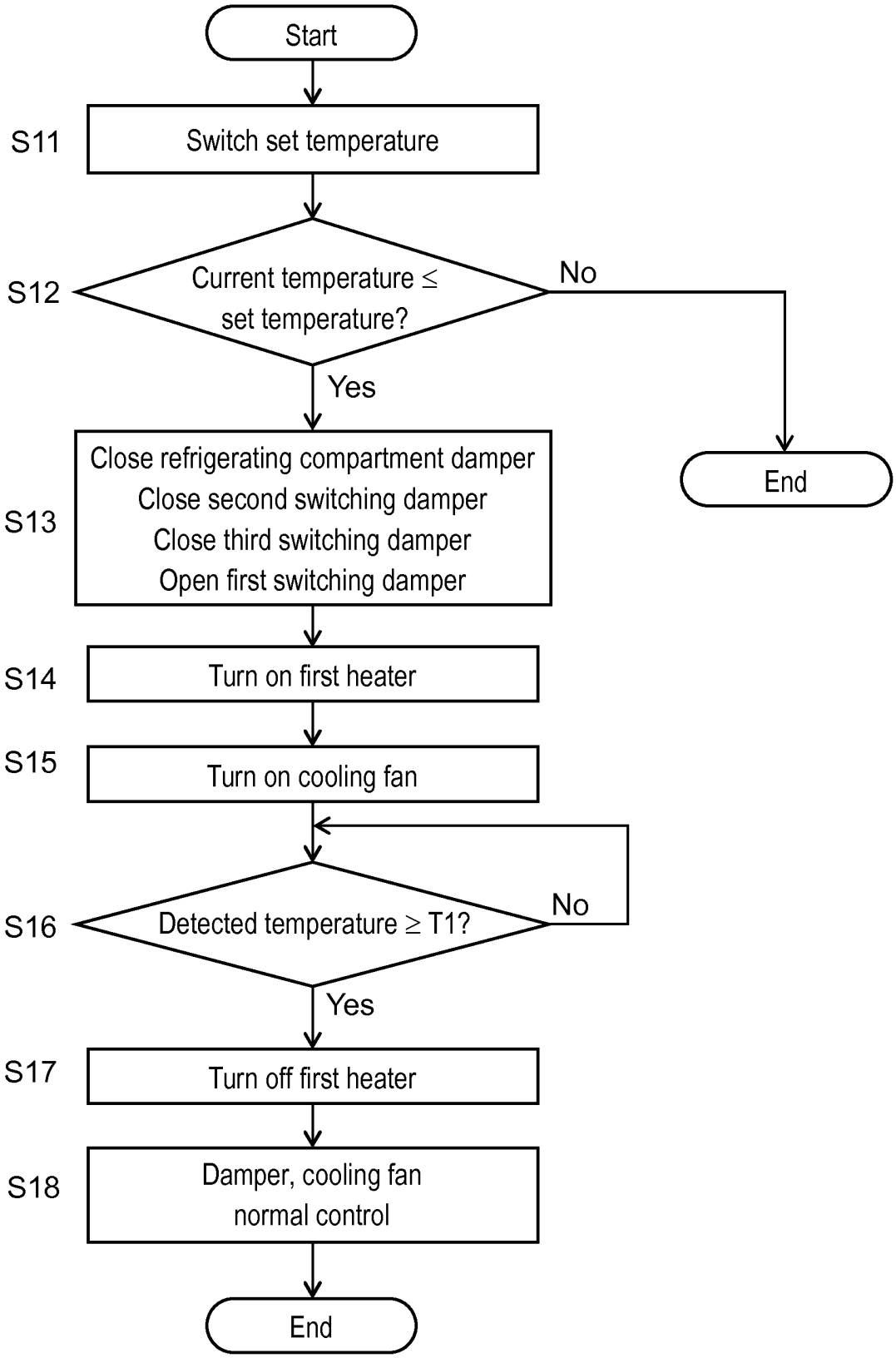
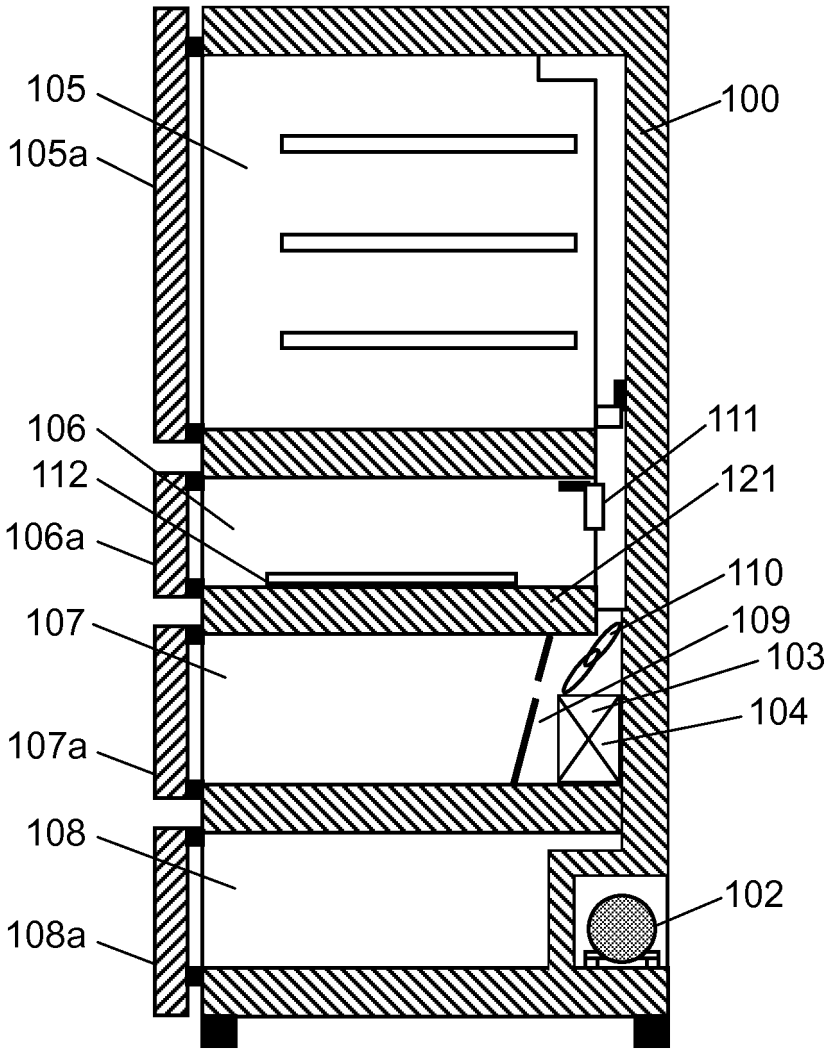

Start
S11
Switch set temperature
S12
Current temperature ≤ set temperature?
No
End
Yes
S13
Close refrigerating compartment damper
Close second switching damper
Close third switching damper
Open first switching damper
S14
Turn on first heater
S15
Turn on cooling fan
S16
Detected temperature ≥ T1?
No
Yes
S17
Turn off first heater
S18
Damper, cooling fan normal control
End

FIG. 4


105
105a
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106a
111
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110
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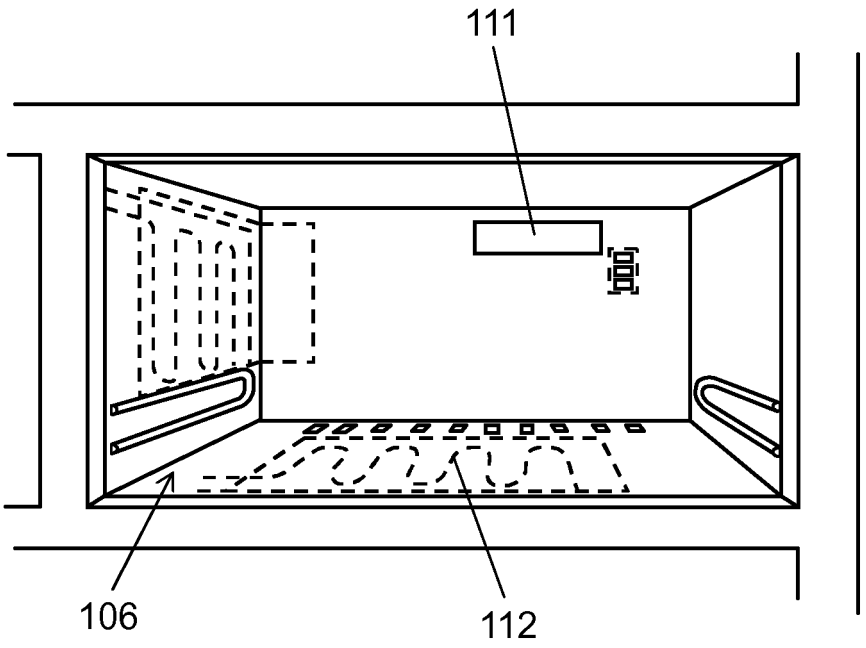
103
104
107
107a
108
108a
102

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/002603

A. CLASSIFICATION OF SUBJECT MATTER
F25D11/02(2006.01)i, *F25D11/00*(2006.01)i, *F25D17/08*(2006.01)i

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)
F25D11/02, F25D11/00, F25D17/08

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-214684 A (Sharp Corp.), 17 August 2006 (17.08.2006), paragraphs [0001] to [0076]; fig. 1 to 11 (particularly, 0063 to 0065; fig. 4 to 7) & US 2008/0047294 A1 paragraphs [0001] to [0128]; fig. 1 to 11 & US 2009/0235684 A1 & WO 2006/064601 A1 & EP 1826515 A1 & RU 2007126841 A	1-2
Y	JP 2006-90686 A (Toshiba Corp.), 06 April 2006 (06.04.2006), claims 1 to 2; paragraphs [0001] to [0039]; fig. 1 to 6 (Family: none)	1-2

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July 2016 (26.07.16)	02 August 2016 (02.08.16)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/002603

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-332242 A (Toshiba Corp.), 15 December 1998 (15.12.1998), paragraphs [0001] to [0106]; fig. 1 to 14 (particularly, 0028 to 0047, 0095 to 0098; fig. 1 to 8, 14) & TW 493727 U & CN 1201131 A	2
A	JP 3-207975 A (Hitachi, Ltd.), 11 September 1991 (11.09.1991), specification, page 2, upper left column, line 3 to page 4, upper right column, line 20; fig. 1 to 3 (particularly, page 2, upper right column, lines 4 to 7; page 3, lower left column, lines 7 to 16; fig. 1 to 3) (Family: none)	1-2
A	JP 2003-172573 A (Samsung Electronics Co., Ltd.), 20 June 2003 (20.06.2003), paragraphs [0001] to [0019]; fig. 1 to 7 & US 2003/0097850 A1 paragraphs [0001] to [0042]; fig. 1 to 7 & EP 1314940 A1 & DE 60212925 D & DE 60212925 T & KR 10-2003-0043223 A & CN 1421666 A	1-2

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/002603

Found in claim 2 is the description of "being constructed to operate the heating unit and the cooling fan."

However, since no "heating unit" is mentioned prior to "the heating unit," it is not clear what is referred to by "the heating unit"

Consequently, the invention of claim 2 is unclear.

Note that as described in claim 1, the finding of the invention of claim 2 was made by interpreting "the heating unit" as referring to "the heating unit inside the switchable storage chamber," and then the international search report was created.

Form PCT/ISA/210 (extra sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3361038 B **[0014]**