



(12)

EUROPEAN PATENT APPLICATION  
published in accordance with Art. 153(4) EPC

(43)

Date of publication:  
04.07.2018 Bulletin 2018/27

(51)

Int Cl.:  
F25D 17/06 (2006.01)

(21)

Application number: 16838410.5

(86)

International application number:  
PCT/CN2016/086186

(22)

Date of filing: 17.06.2016

(87)

International publication number:  
WO 2017/032150 (02.03.2017 Gazette 2017/09)

(84)

Designated Contracting States:  
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR  
Designated Extension States:  
BA ME  
Designated Validation States:  
MA MD

(30)

Priority: 26.08.2015 CN 201510534154

(71)

Applicant: Qingdao Haier Joint Stock Co., Ltd  
Qindao, Shandong 266101 (CN)

(72)

Inventors:  
 • TAO, Haibo  
Qingdao  
Shandong 266101 (CN)

• NIE, Shengyuan  
Qingdao  
Shandong 266101 (CN)

• WANG, Ke  
Qingdao  
Shandong 266101 (CN)

• LIU, Jianru  
Qingdao  
Shandong 266101 (CN)

(74)

Representative: dompatent von Kreisler Selting  
Werner -  
Partnerschaft von Patent- und Rechtsanwälten  
mbB  
Deichmannhaus am Dom  
Bahnhofsvorplatz 1  
50667 Köln (DE)

(54)

REFRIGERATOR

(57)

The present invention provides a refrigerator, comprising a storage compartment, a refrigeration air passage configured to supply refrigeration air and a top air passage. The top air passage is provided at a top wall of the storage compartment, comprises a rear end air inlet, a front end air inlet and a mixed air outlet opening downwards, and is configured to receive refrigeration air blown from the refrigeration air passage via the rear end air inlet, receive return air returning from the storage compartment via the front end air inlet, and allow the refrigeration air and the return air to flow into the storage compartment in a mixed manner via the mixed air outlet. The refrigerator of this invention comprises a top air passage which allows refrigeration air to mix with return air with a relatively high temperature in the storage compartment and supplies the mixed air to the storage compartment, so that the refrigeration output/temperature in the storage compartment is evenly distributed, realizing quick, even and efficient refrigeration.

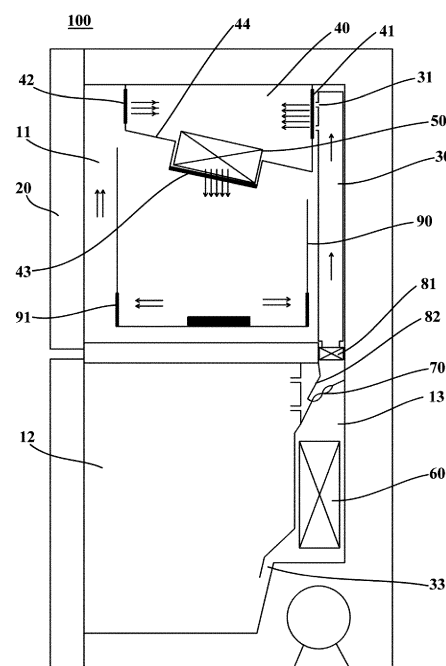


Fig. 1

## Description

### TECHNICAL FIELD

[0001] The present invention is related to the field of freezing and refrigeration technologies, and more particularly, to a refrigerator.

### BACKGROUND

[0002] Air-cooled refrigerators can maintain the freshness of food, extend food storage time and improve food safety, so they become essential home appliances. However, in current air-cooled refrigerators, usually the air supply passage is arranged at the rear part of a storage compartment. After cooled air is blown, it sinks. As a result, the temperature at the front part of the storage compartment is relatively high, while the temperature at the rear part thereof is relatively low, causing uneven temperatures. The front part of the storage compartment is close to the door and heat leak can easily occur. Accordingly, the temperature at the front part of the storage compartment will be even higher, which is unfavorable for storing food. How to realize even temperature distribution in the storage compartment of a refrigerator is an urgent problem for improving the refrigeration effect of refrigerators.

### SUMMARY

[0003] This invention aims to overcome at least one defect of existing refrigerators, and provides a novel refrigerator. The refrigerator can efficiently realize even temperature distribution in the storage compartment.

[0004] Accordingly, this invention provides a refrigerator, comprising: a storage compartment and a refrigeration air passage configured to supply refrigeration air. In particular, the refrigerator further comprises: a top air passage that is provided at a top wall of the storage compartment, comprises a rear end air inlet, a front end air inlet and a mixed air outlet opening downwards, and is configured to receive refrigeration air blown from the refrigeration air passage via the rear end air inlet, receive return air returning from the storage compartment via the front end air inlet, and allow the refrigeration air and the return air to flow into the storage compartment in a mixed manner via the mixed air outlet.

[0005] Optionally, the refrigeration air passage communicates with a rear space of the storage compartment to supply refrigeration air to the storage compartment.

[0006] Optionally, the refrigerator further comprises a cooling chamber provided with an air outlet connected with the refrigeration air passage; a cooling device provided in the cooling chamber to cool the air passing the cooling chamber; a blower provided at the air outlet of the cooling chamber; and a return air passage connecting a lower space of the storage compartment and the cooling chamber, such that a part or all of the air in the storage

compartment enters the cooling chamber via the return air passage and enters the refrigeration air passage after being cooled by the cooling device.

[0007] Optionally, the refrigerator further comprises another storage compartment provided below the storage compartment and in front of the cooling chamber; another refrigeration air passage connecting the air outlet of the cooling chamber and the another storage compartment; and another return air passage connecting the another storage compartment and the cooling chamber.

[0008] Optionally, the refrigerator further comprises a movable air supply hood provided at an outer side of the air outlet of the cooling chamber and configured to provide an opening allowing the refrigeration air to flow into the refrigeration air passage when closing the air outlet of the cooling chamber.

[0009] Optionally, the refrigerator further comprises an air door configured to controllably close or open the refrigeration air passage.

[0010] Optionally, the refrigerator further comprises a top blower configured to blow the refrigeration air and the return air to the storage compartment in a mixed manner via the mixed air outlet.

[0011] Optionally, the refrigerator further comprises a top air passage cover plate mounted at a lower surface of the top wall of the storage compartment to form the top air passage.

[0012] Optionally, the top air passage cover plate comprises: a web portion extending upwards from its rear end to its front end and provided with a through hole; and an air aperture portion extending downwards from an edge of the through hole, having a lower end opening acting as the mixed air outlet, and having the blower mounted therein.

[0013] Optionally, the refrigerator further comprises a refrigeration air passage cover plate mounted at a front surface of the rear wall of the storage compartment to form the refrigeration air passage, and provided with multiple refrigeration air outlets to provide the refrigeration air to the storage compartment and/or the top air passage.

[0014] The refrigerator of this invention comprises a top air passage which allows refrigeration air to mix with return air with a relatively high temperature in the storage compartment and supplies the mixed air to the storage compartment, so that the refrigeration output/temperature in the storage compartment is evenly distributed, realizing quick, even and efficient refrigeration. In addition, the top air passage enables the refrigeration air path in the storage compartment to change from a single circulation process to a multiple circulation process, realizing even temperature distribution in the storage compartment.

[0015] Further, the refrigeration air passage in the refrigerator of this invention can directly supply refrigeration air to the storage compartment, considerably improving the refrigeration efficiency of the refrigerator.

[0016] The above and other objects, advantages and

features of the invention will be understood by those skilled in the art more clearly with reference to the detailed description of the embodiments of this invention below with reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]** The followings will describe some embodiments of this invention in detail in an exemplary rather than restrictive manner with reference to the accompanying drawings. The same reference signs in the drawings represent the same or similar parts. Those skilled in the art shall understand that these drawings are only schematic ones of this invention, and may not be necessarily drawn according to the scales. In the drawings:

Fig. 1 is a schematic drawing of a refrigerator according to an embodiment of this invention;

Fig. 2 is a schematic drawing of a refrigerator according to another embodiment of this invention; and

Fig. 3 is a schematic drawing of a refrigerator according to yet another embodiment of this invention.

## DETAILED DESCRIPTION

**[0018]** Fig. 1 is a schematic drawing of a refrigerator 100 according to an embodiment of this invention. As shown in Fig. 1, the embodiment of this invention provides a refrigerator 100. The refrigerator 100 may typically comprise a storage compartment 11 for storing food, a refrigeration air passage 30 for providing refrigeration air to the storage compartment 11, and a door 20 for closing the storage compartment 11. In particular, the refrigerator 100 may further comprise: a top air passage 40. The top air passage 40 is provided at a top wall of the storage compartment 11, comprises a rear end air inlet 41, a front end air inlet 42 and a mixed air outlet 43 opening downwards, and is configured to receive refrigeration air blown from the refrigeration air passage 30 via the rear end air inlet 41, receive return air returning from the storage compartment 11 via the front end air inlet 42, and allow the refrigeration air and the return air to flow into the storage compartment 11 in a mixed manner via the mixed air outlet 43 so as to increase the refrigeration speed in the storage compartment 11. Specifically, when the refrigerator 100 works, the top air passage 40 allows the refrigeration air from the refrigeration air passage 30 to merge and mix with the return air close to the door 20 of the storage compartment 11 and having a relatively high temperature, and blow the mixed air substantially vertically downwards to the storage compartment 11, making the temperature in the storage compartment 11 more even.

**[0019]** In some embodiments of this invention, the refrigerator 100 further comprises a top blower 50 provided at the mixed air outlet 43 and configured to blow the re-

frigeration air and the return air to the storage compartment 11 in a mixed manner via the mixed air outlet 43 so as to improve the air supply efficiency. The top blower 50 may be an axial blower. In some alternative embodiments of this invention, a blower may be provided at each air inlet of the top air passage 40 to blow air into the top air passage 40. In other alternative embodiments of this invention, each air inlet may directly receive air flow blown from other air passages.

**[0020]** In some embodiments of this invention, the refrigerator 100 may further comprise a top air passage cover plate 44 mounted at a lower surface of the top wall of the storage compartment 11 to form the top air passage 40. Specifically, the top air passage cover plate 44 may be mounted at the lower surface of the top wall of the storage compartment 11, and comprises a web portion 441 with a through hole provided therein and an air aperture portion 442. The web portion 441 extends upwards from its rear end to its front end, and an included angle between the web portion and the horizontal plane may be 5 to 30 degrees. The air aperture portion 442 extends downwards in a direction perpendicular with the web portion 441 from an edge of the through hole, so that the mixed air outlet 43 is slightly inclined forwards, guaranteeing a low temperature environment at the door 20 of the refrigerator 100. The top blower 50 may be installed in the air aperture portion 442. In other alternative embodiments of this invention, the top air passage cover plate 44 may be mounted at an upper surface of the top wall of the storage compartment 11 to form the top air passage 40. Or the top air passage 40 may be directly formed in the top wall of the storage compartment 11.

**[0021]** Further, the refrigerator 100 may further comprise two end cover plates each having an air inlet. The two end cover plates may be mounted at the two sides of the top air passage cover plate 44 respectively.

**[0022]** Fig. 2 is a schematic drawing of a refrigerator according to another embodiment of this invention. As shown in Fig. 2, in the refrigerator 100 of this embodiment, the refrigeration air passage 30 communicates with a rear space of the storage compartment 11 to supply refrigeration air to the storage compartment 11. Specifically, in some embodiments, the refrigerator 100 may further comprise a refrigeration air passage cover plate mounted at a front surface of the rear wall of the storage compartment 11 to form the refrigeration air passage 30. The refrigeration air passage cover plate is provided with multiple refrigeration air outlets 31 to provide the refrigeration air to the storage compartment 11 and/or the top air passage 40. For example, the surfaces on which some refrigeration air outlets 31 of the multiple refrigeration air outlets 31 are located abut against the end surface of the rear end air inlet 41 of the top air passage 40 to allow the refrigeration air to enter the top air passage 40. Alternatively, the surfaces on which some refrigeration air outlets 31 of the multiple refrigeration air outlets 31 are located may be spaced from the end surface of the rear end air inlet 41 of the top air passage 40 by a predetermined

clearance to allow the refrigeration air to enter the top air passage 40. The some refrigeration air outlets and the rear end air inlet 41 of the top air passage 40 are located inside the storage compartment 11. The remaining refrigeration air outlets 31 of the multiple refrigeration air outlets 31 may supply refrigeration air to the storage compartment 11. In some alternative embodiments of this invention, the refrigeration air passage cover plate may be mounted at a rear surface of the rear wall of the storage compartment 11 to form the refrigeration air passage 30, and the rear wall of the storage compartment 11 is provided with multiple refrigeration air outlets 31.

**[0023]** In some embodiments of this invention, the refrigerator 100 may further comprise a cooling chamber 13, a cooling device 60, a blower 70 and a return air passage. The cooling chamber 13 is provided with an air outlet connected with the refrigeration air passage 30. The cooling device 60 is provided in the cooling chamber 13 to cool the air passing the cooling chamber. The cooling device 60 may be an evaporator of a compression refrigeration system. The blower 70 may be arranged at the air outlet. The return air passage connects a lower space of the storage compartment 11 and the cooling chamber 13 such that a part or all of the air in the storage compartment 11 enters the cooling chamber 13 via the return air passage and enters the refrigeration air passage 30 after being cooled by the cooling device 60.

**[0024]** In some embodiments of this invention, to facilitate picking and placing of articles, the refrigerator 100 may further comprise a drawer 90 for receiving the articles 92, such as beef, water melons and beverages. The drawer 90 can be operably inserted into the storage compartment 11 and pulled out of the same. In other words, the drawer 90 is installed inside the storage compartment 11. Optionally, lower parts of the front and rear walls of the drawer 90 comprises ventilation holes 91, so that the air flow flowing out of the mixed air outlet 43 can easily flow out of the drawer 90 via the ventilation holes 91 of the drawer 90 after exchanging heat with the articles 92 inside the drawer 90. Further, the air flowing out of the ventilation holes 91 of the front wall of the drawer 90 may return to the front end air inlet 42 of the top air passage 40 for circulation. The air flowing out of the ventilation holes 91 of the rear wall of the drawer 90 may return to the return air passage for circulation.

**[0025]** In some embodiments of this invention, the refrigerator 100 may further comprise another storage compartment 12, which may be arranged blow the storage compartment 11. For example, the storage compartment 11 may be a refrigeration compartment, and the another storage compartment 12 may be a freezing compartment. Further, a quick freezing compartment may be provided between the storage compartment 11 and the another storage compartment 12. The cooling chamber 13 may be arranged behind the another storage compartment 12. The refrigerator 100 further comprises another refrigeration air passage 32 connecting the air outlet of the cooling chamber 13 and the another storage com-

partment 12, and another return air passage 33 connecting the another storage compartment 12 and the cooling chamber 13.

**[0026]** In some embodiments of this invention, as shown in Fig. 3, the refrigerator 100 may further comprise an air door 81 and a movable air supply hood 82. The air door 81 is configured to controllably close or open the refrigeration air passage 30. The movable air supply hood 82 is provided at an outer side of the air outlet of the cooling chamber 13 and configured to provide an opening allowing refrigeration air to flow into the refrigeration air passage 30 when closing the air outlet of the cooling chamber 13. That is, when the movable air supply hood 82 closes the air outlet of the cooling chamber 13, the another refrigeration air passage 32 connected with the another storage compartment 12 can be closed, so that the refrigeration air passage 30 is not blocked.

**[0027]** The refrigerator 100 of the embodiments of this invention may have multiple working modes. The multiple working modes may comprise the following working modes: an independent working mode of the storage compartment 11, an independent working mode of the another storage compartment 12, a joint working mode, a quick refrigeration mode and another joint work mode. In the independent working mode of the storage compartment 11, the movable air supply hood 82 is closed, the air door 81 is opened, the blower 70 works while the top blower 50 does not work, so that the storage compartment 11 works independently. In the independent working mode of the another storage compartment 12, the movable air supply hood 82 is opened, the air door 81 is closed, the blower 70 works while the top blower 50 does not work, so that the another storage compartment 12 works independently. In the joint working mode, the movable air supply hood 82 is opened, the air door 81 is opened, the blower 70 works while the top blower 50 does not work, so that the two storage compartments 11, 12 work jointly. In the quick refrigeration mode, the movable air supply hood 82 is closed, the air door 81 is opened, and both the blower 70 and the top blower 50 work, so that quick refrigeration can be performed in the storage compartment 11. As shown in Fig. 1, the arrows in this figure represent the flow directions of air flow. To prevent excessive temperature rise in the another storage compartment 12, after the quick refrigeration mode operates for a certain period, the refrigerator automatically exits from this mode. In the another joint work mode, the movable air supply hood 82 is opened, the air door 81 is opened, and both the blower 70 and the top blower 50 work, so that quick refrigeration can be performed in the storage compartments 11, 12. As shown in Fig. 3, the arrows in this figure represent the flow directions of air flow.

**[0028]** Although multiple embodiments of this invention have been illustrated and described in detail, those skilled in the art may make various modifications and variations to the invention based on the content disclosed by this invention or the content derived therefrom without

departing from the spirit and scope of the invention. Thus, the scope of this invention should be understood and deemed to include these and other modifications and variations.

## Claims

### 1. A refrigerator, comprising:

a storage compartment;  
a refrigeration air passage configured to supply refrigeration air; and  
a top air passage that is provided at a top wall of the storage compartment, comprises a rear end air inlet, a front end air inlet and a mixed air outlet opening downwards, and is configured to receive refrigeration air blown from the refrigeration air passage via the rear end air inlet, receive return air returning from the storage compartment via the front end air inlet, and allow the refrigeration air and the return air to flow into the storage compartment in a mixed manner via the mixed air outlet.

### 2. The refrigerator of claim 1, wherein the refrigeration air passage communicates with a rear space of the storage compartment to supply refrigeration air to the storage compartment.

### 3. The refrigerator of claim 1, further comprising:

a cooling chamber provided with an air outlet connected with the refrigeration air passage;  
a cooling device provided in the cooling chamber to cool the air passing the cooling chamber;  
a blower provided at the air outlet of the cooling chamber; and  
a return air passage connecting a lower space of the storage compartment and the cooling chamber, such that a part or all of the air in the storage compartment enters the cooling chamber via the return air passage and enters the refrigeration air passage after being cooled by the cooling device.

### 4. The refrigerator of claim 3, further comprising:

another storage compartment provided below the storage compartment and in front of the cooling chamber;  
another refrigeration air passage connecting the air outlet of the cooling chamber and the another storage compartment; and  
another return air passage connecting the another storage compartment and the cooling chamber.

### 5. The refrigerator of claim 3, further comprising: a movable air supply hood provided at an outer side of the air outlet of the cooling chamber and configured to provide an opening allowing the refrigeration air to flow into the refrigeration air passage when closing the air outlet of the cooling chamber.

### 6. The refrigerator of claim 3, further comprising: an air door configured to controllably close or open the refrigeration air passage.

### 7. The refrigerator of claim 1, further comprising: a top blower configured to blow the refrigeration air and the return air to the storage compartment in a mixed manner via the mixed air outlet.

### 8. The refrigerator of claim 7, further comprising: a top air passage cover plate mounted at a lower surface of the top wall of the storage compartment to form the top air passage.

### 9. The refrigerator of claim 8, wherein the top air passage cover plate comprises:

a web portion extending upwards from its rear end to its front end and provided with a through hole; and  
an air aperture portion extending downwards from an edge of the through hole, having a lower end opening acting as the mixed air outlet, and having the blower mounted therein.

### 10. The refrigerator of claim 1, further comprising: a refrigeration air passage cover plate mounted at a front surface of the rear wall of the storage compartment to form the refrigeration air passage, and provided with multiple refrigeration air outlets to provide the refrigeration air to the storage compartment and/or the top air passage.

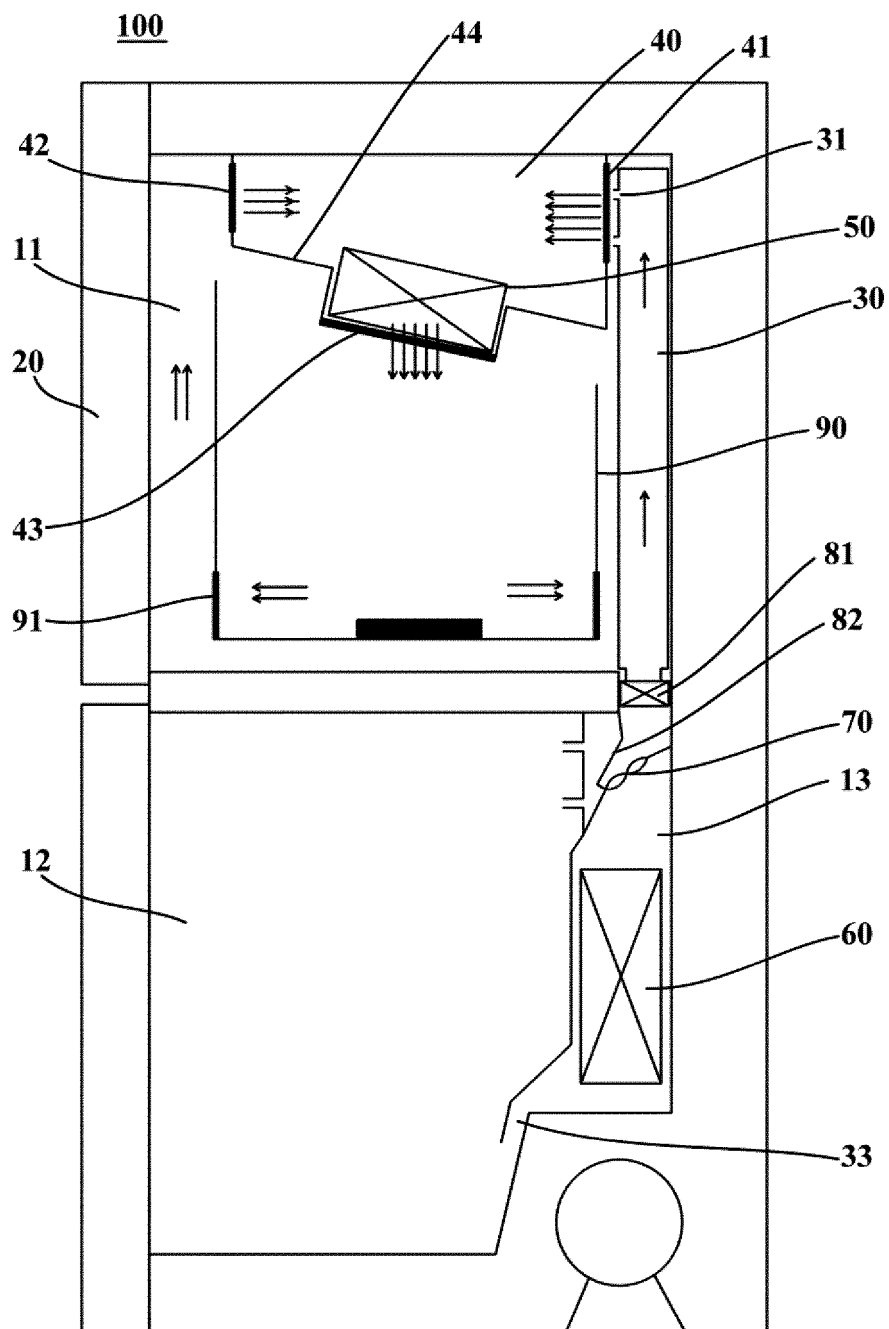


Fig. 1

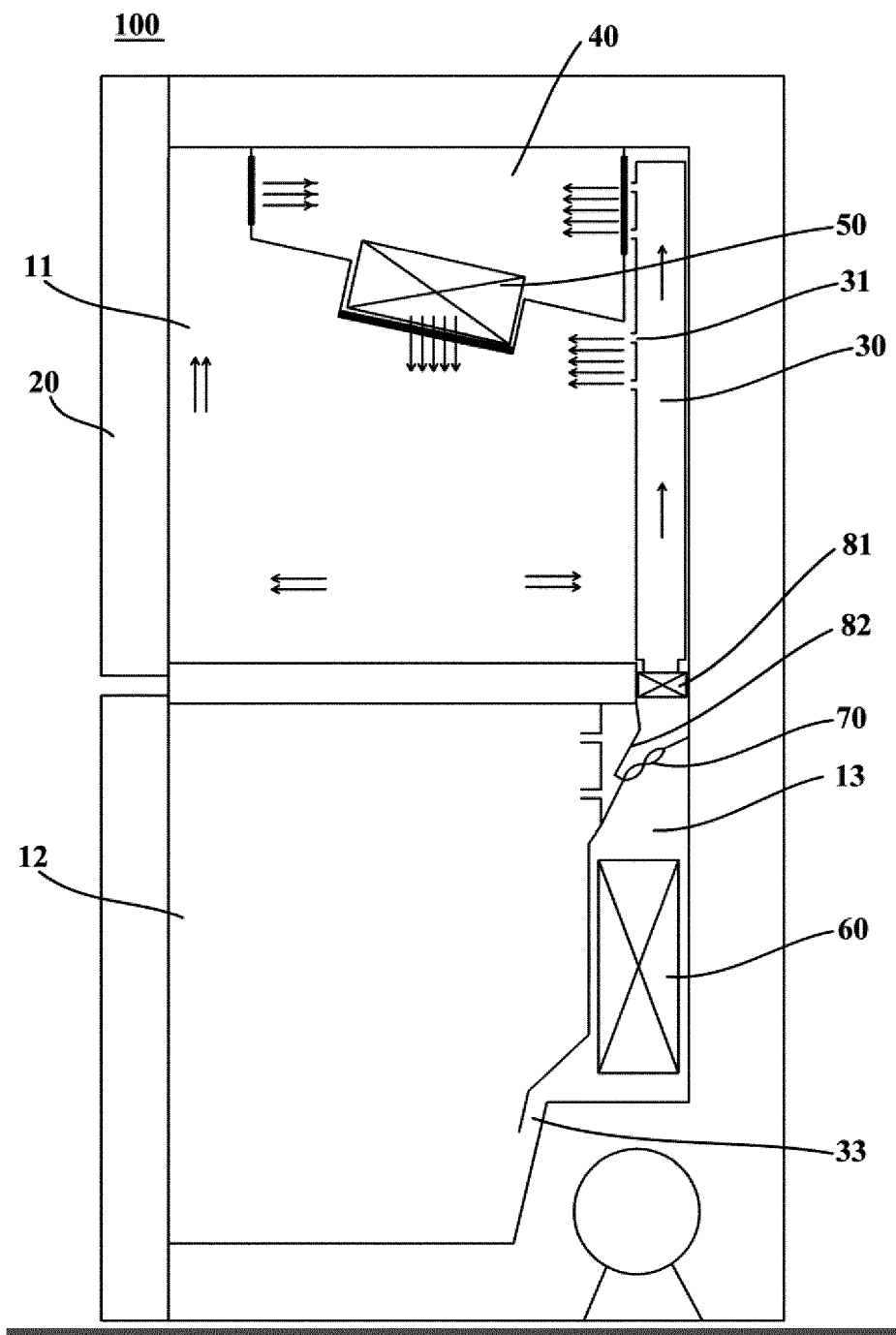


Fig. 2

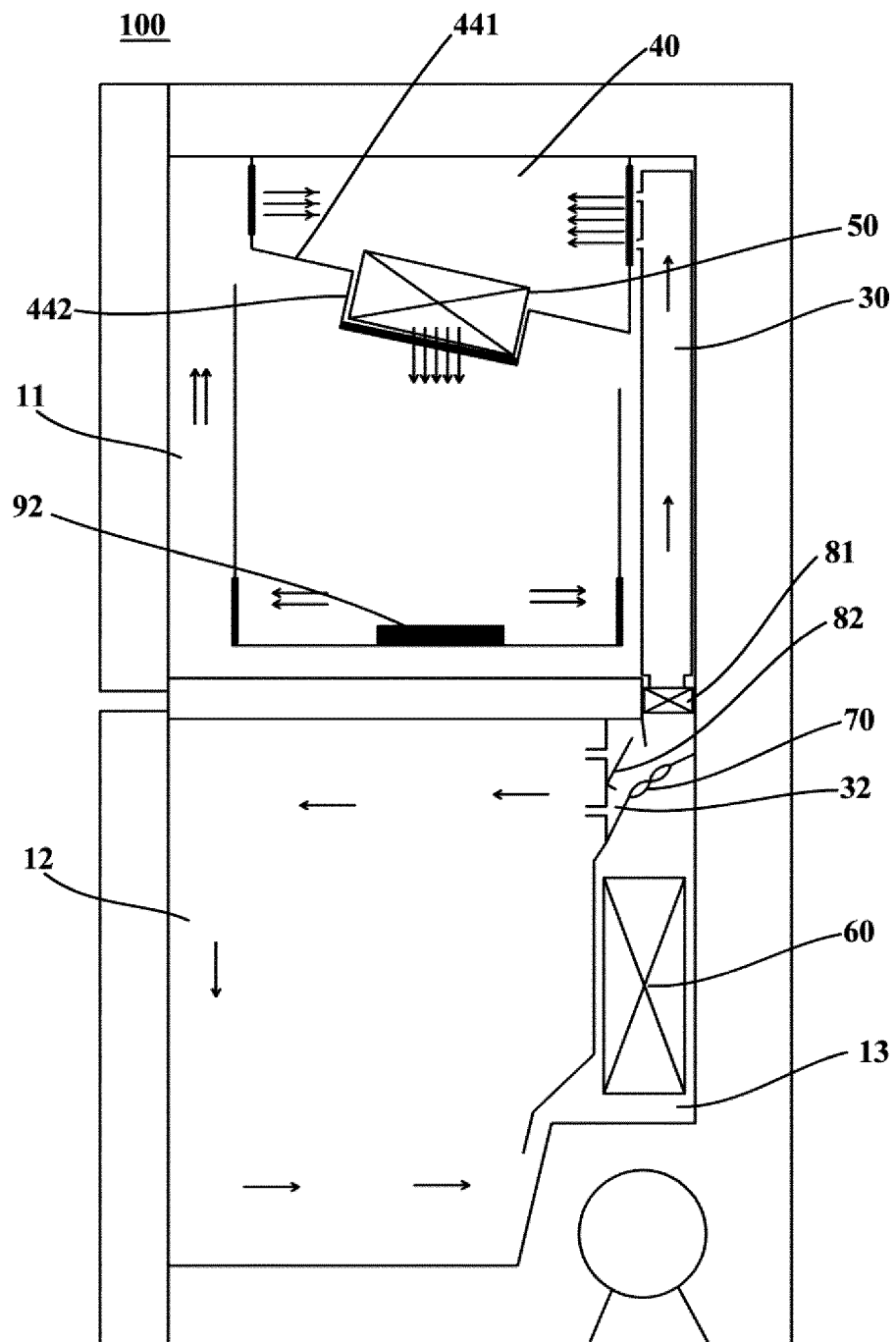


Fig. 3



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN2016/086186

## A. CLASSIFICATION OF SUBJECT MATTER

F25D 17/06 (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)

F25D

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 practicable, search terms used)

CNABS, CNTXT, CNKI, VEN: refrigerator?, fridge?, air, wind, mix+, combin+

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 105042989 A (QINGDAO HAIER SPECIAL REFRIGERATOR CO., LTD. et al.) 11 November 2015 (11.11.2015) claims 1-10	1-10
PX	CN 204923644 U (QINGDAO HAIER SPECIAL REFRIGERATOR CO., LTD. et al.) 30 December 2015 (30.12.2015) claims 1-10	1-10
PX	CN 105042994 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 11 November 2015 (11.11.2015) description, paragraphs [0026]-[0039] and figures 1 and 2	1-10
PX	CN 204923645 U (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 30 December 2015 (30.12.2015) description, paragraphs [0026]-[0039] and figures 1 and 2	1-10
X	CN 102506539 A (UNIV TIANJIN COMMERCE) 20 June 2012 (20.06.2012) description, pages 1 and 2 and figure 1	1, 7-9
Y	CN 102506539 A (UNIV TIANJIN COMMERCE) 20 June 2012 (20.06.2012) description, pages 1 and 2 and figure 1	2-6, 10

☒ 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	

Date of the actual completion of the international search  
08 August 2016

Date of mailing of the international search report  
21 September 2016

Name and mailing address of the ISA/CN  
State Intellectual Property Office of the P. R. China  
No. 6, Xitucheng Road, Jimenqiao  
Haidian District, Beijing 100088, China  
Facsimile No. (86-10) 62019451

Authorized officer  
ZHANG, Linying  
Telephone No. (86-10) 62084194

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN2016/086186

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 102538339 A (HAIER GROUP CO., LTD. et al.) 04 July 2012 (04.07.2012) description, paragraphs [0029]-[0036] and figures 4-7	2-6, 10
X	CN 202420084 U (UNIV TIANJIN COMMERCE) 05 September 2012 (05.09.2012) description, pages 1 and 2 and figure 1	1, 7-9
Y	CN 202420084 U (UNIV TIANJIN COMMERCE) 05 September 2012 (05.09.2012) description, pages 1 and 2 and figure 1	2-6, 10
A	CN 101551189 A (UNIV TIANJIN COMMERCE) 07 October 2009 (07.10.2009) the whole document	1-10
A	CN 102937355 A (SUZHOU SAMSUNG ELECTRONICS CO.) 20 February 2013 (20.02.2013) the whole document	1-10
A	US 2012047922 A1 (LEE SANG JIN et al.) 01 March 2012 (01.03.2012) the whole document	1-10

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**  
 Information on patent family members

 International application No.  
 PCT/CN2016/086186

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 105042989 A	11 November 2015	None	
CN 204923644 U	30 December 2015	None	
CN 105042994 A	11 November 2015	None	
CN 204923645 U	30 December 2015	None	
CN 102506539 A	20 June 2012	None	
CN 102538339 A	04 July 2012	None	
CN 202420084 U	05 September 2012	None	
CN 101551189 A	07 October 2009	CN 101551189 B	30 May 2012
CN 102937355 A	20 February 2013	CN 102937355 B	19 August 2015
US 2012047922 A1	01 March 2012	KR 20120023272 A	13 March 2012
		EP 2426450 A2	07 March 2012