US 20160348955A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2016/0348955 A1**

Ren et al. (43) **Pub. Date: Dec. 1, 2016**

(54) **COMBINATION REFRIGERATOR-FREEZER WITH DIVIDING AIR-IMPERMEABLE AIR-TO-AIR HEAT EXCHANGER**

(71) Applicants: **Liqun Ren**, Dallas, TX (US); **Norman Craig Glaze**, Dallas, TX (US)

(72) Inventors: **Liqun Ren**, Dallas, TX (US); **Norman Craig Glaze**, Dallas, TX (US)

(73) Assignee: **H&K International**, Mesquite, TX (US)

(21) Appl. No.: **14/952,529**

(22) Filed: **Nov. 25, 2015**

Related U.S. Application Data

(60) Provisional application No. 62/166,455, filed on May 26, 2015.

Publication Classification

(51) **Int. Cl.**

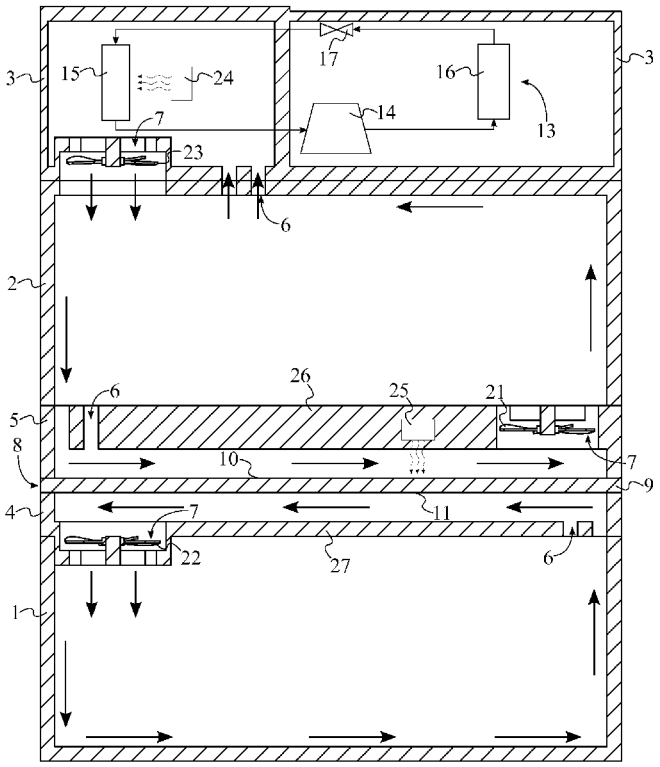
F25D 17/08	(2006.01)
F25D 11/02	(2006.01)
F25B 13/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F25D 17/08*** (2013.01); ***F25B 13/00*** (2013.01); ***F25D 11/02*** (2013.01)

(57) **ABSTRACT**

A combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger is a system for cooling a refrigerator compartment and a freezer compartment utilizing a single cooling system and without mixing or exchanging air between the refrigerator compartment and the freezer compartment. Cold air is generated by the cooling system and circulated into the freezer compartment and into a freezer airflow compartment where the cold air cools an air-to-air heat exchanger. Warmer air circulating through a refrigerator airflow compartment positioned opposite to the freezer airflow compartment is cooled by the air-to-air heat exchanger and is in turn able to cool the refrigerator compartment. A control unit is utilized to control the temperatures within the refrigerator compartment and the cooling compartment and to ensure that the system is not active while defrosting is in progress. A first defroster and a second defroster are utilized to prevent key components from icing up.



SECTION A-A

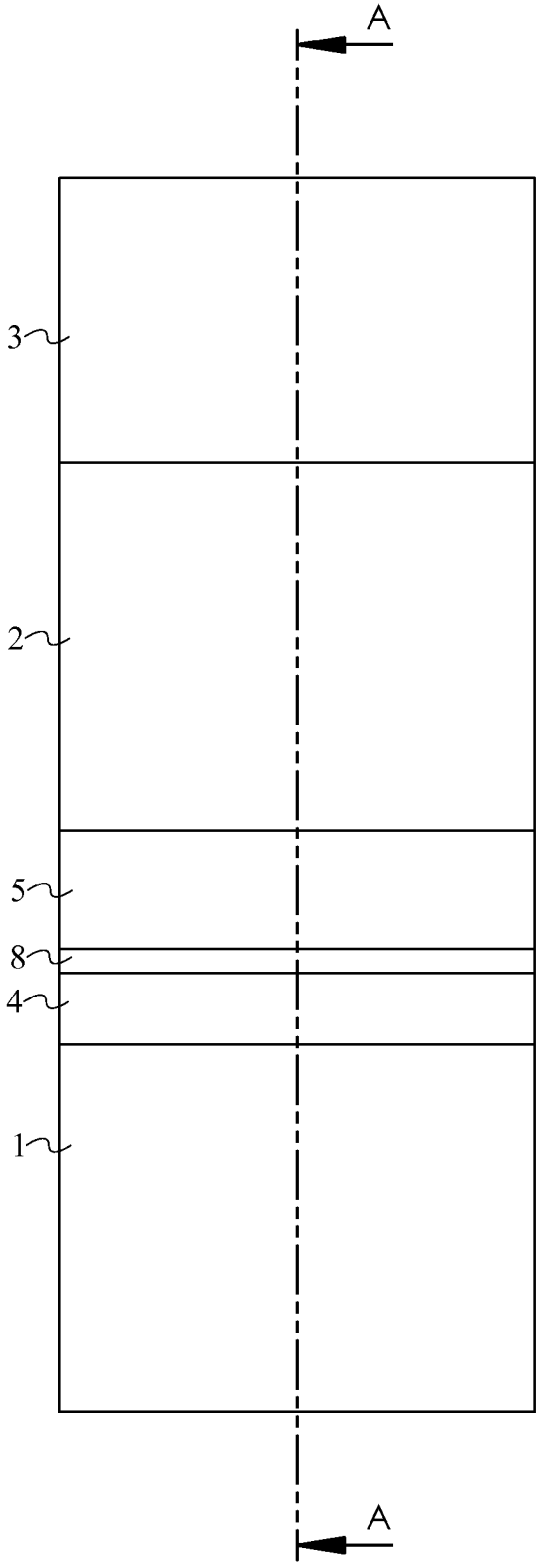
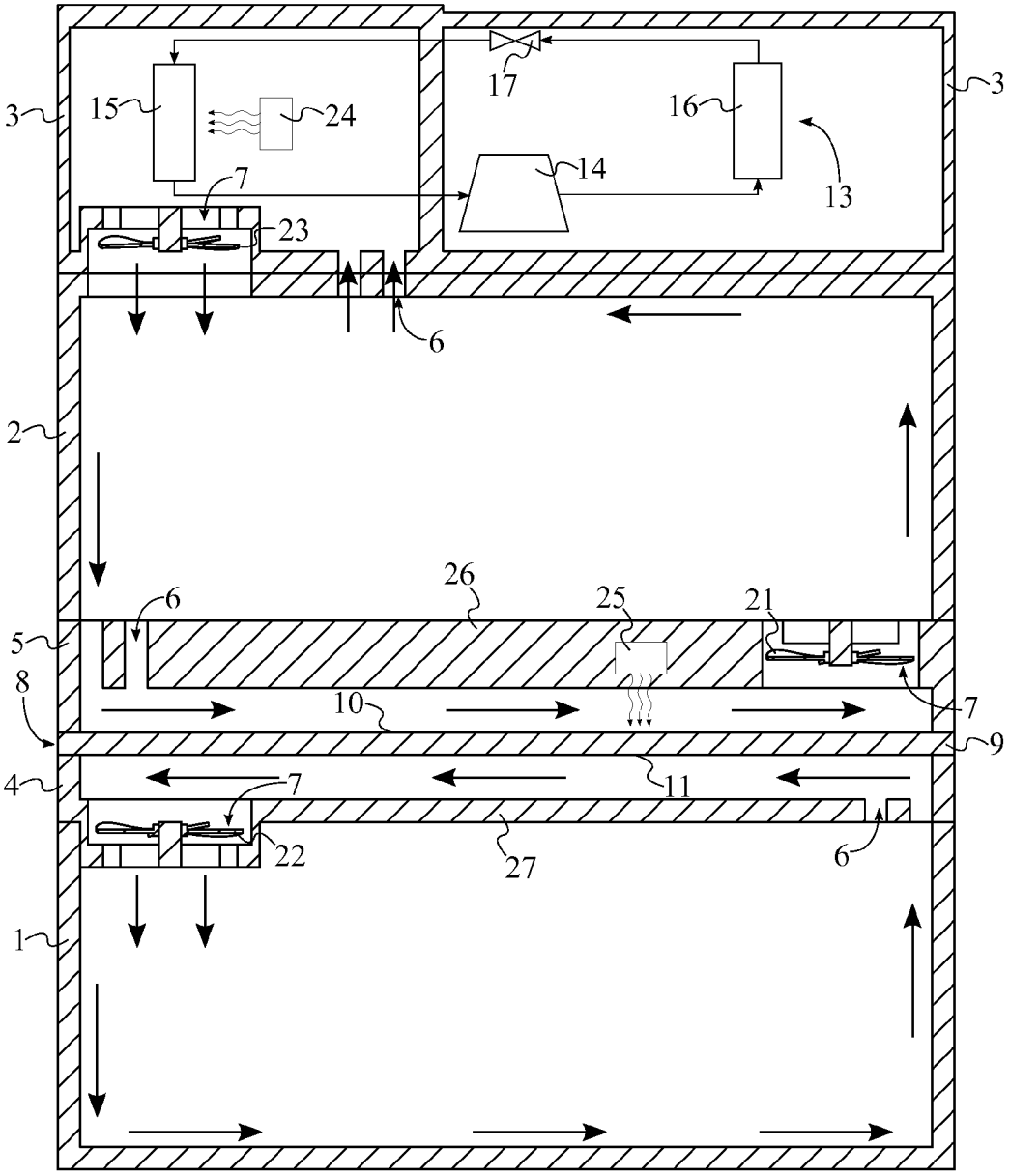


FIG. 1



SECTION A-A

FIG. 2

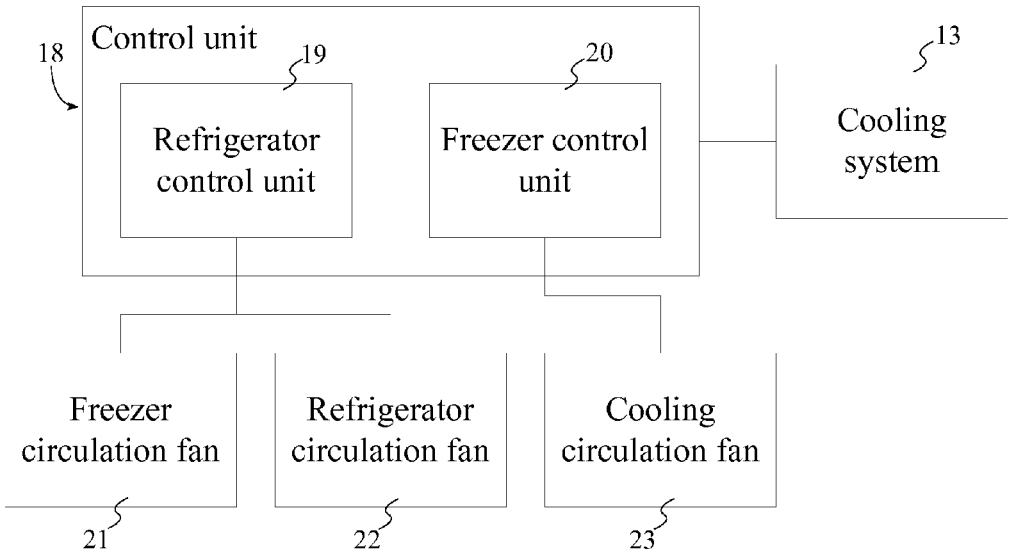
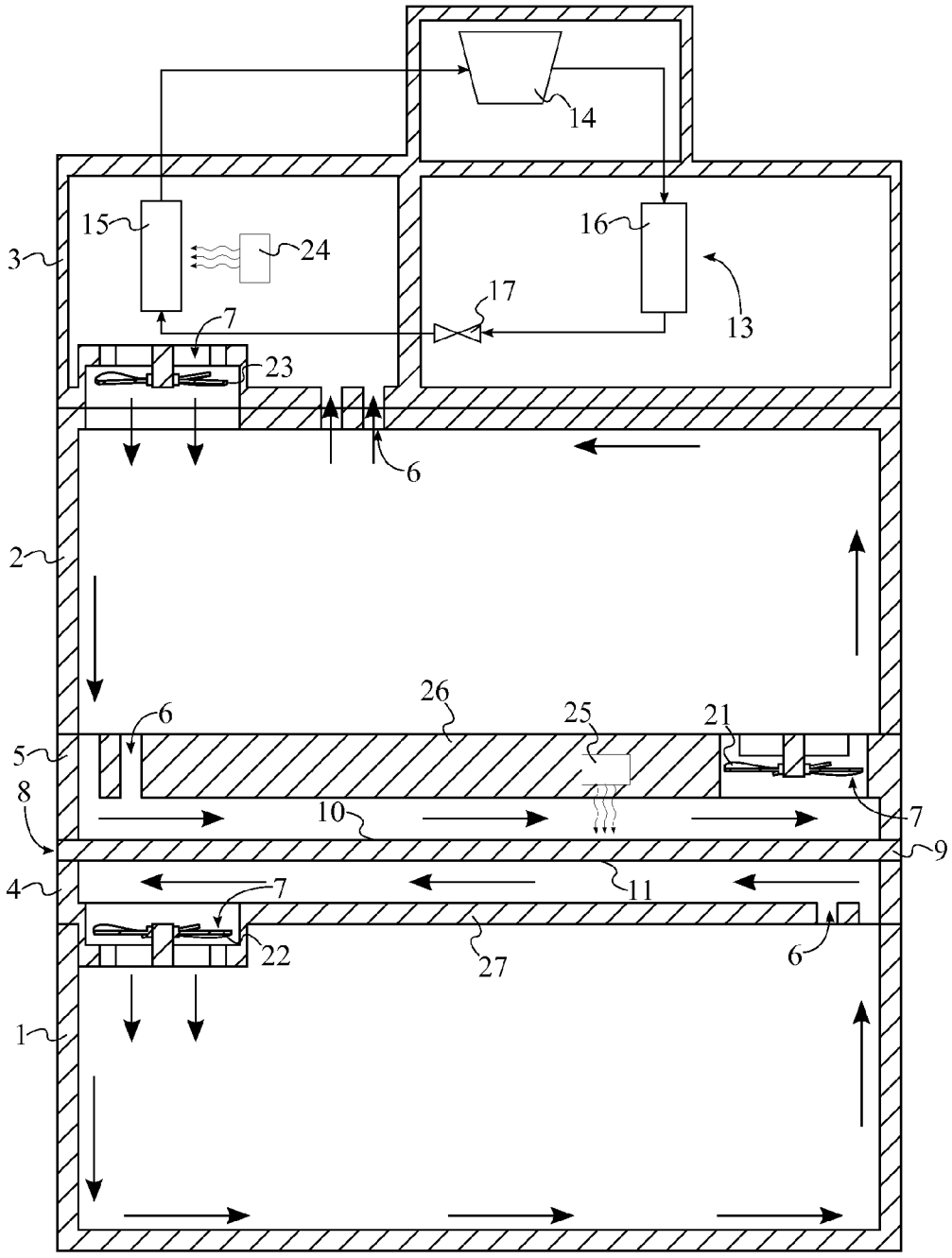

18
Control unit
19
20
13
Refrigerator control unit
Freezer control unit
Cooling system
Freezer circulation fan
Refrigerator circulation fan
Cooling circulation fan
21
22
23

FIG. 3



SECTION A-A

FIG. 4

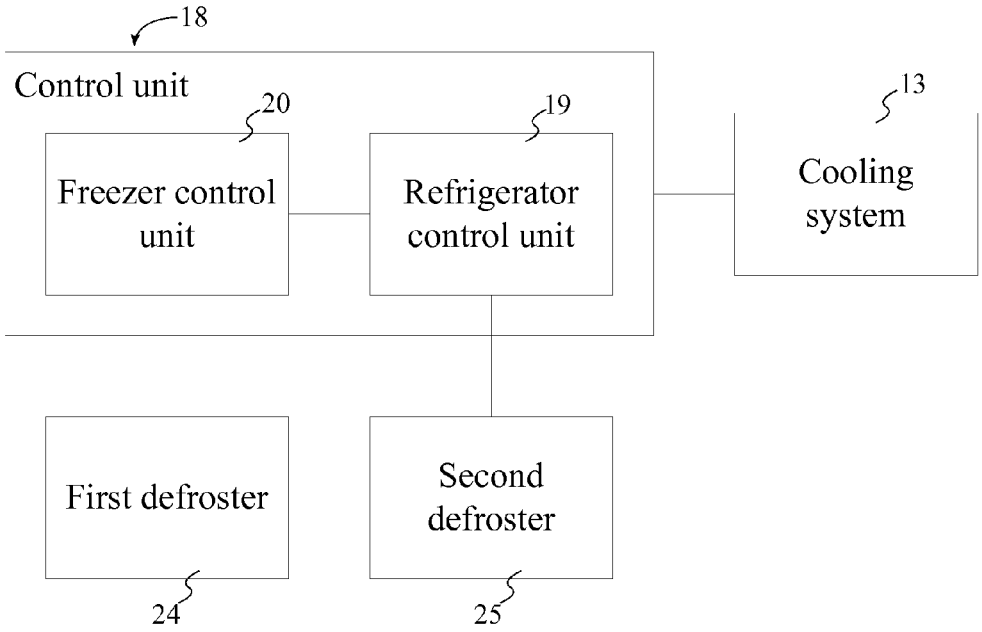

18
Control unit
20
19
13
Freezer control unit
Refrigerator control unit
Cooling system
First defroster
Second defroster
24
25

FIG. 5

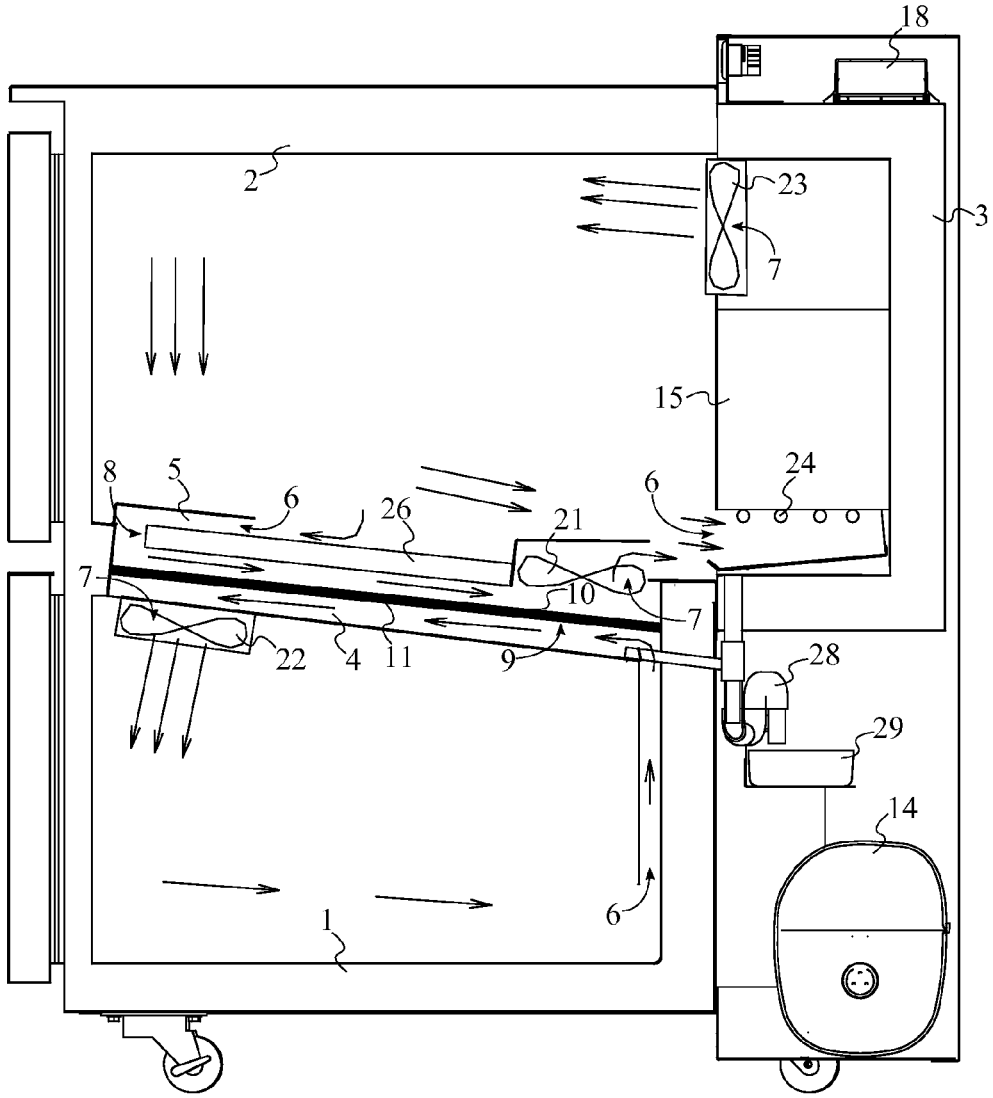


FIG. 6

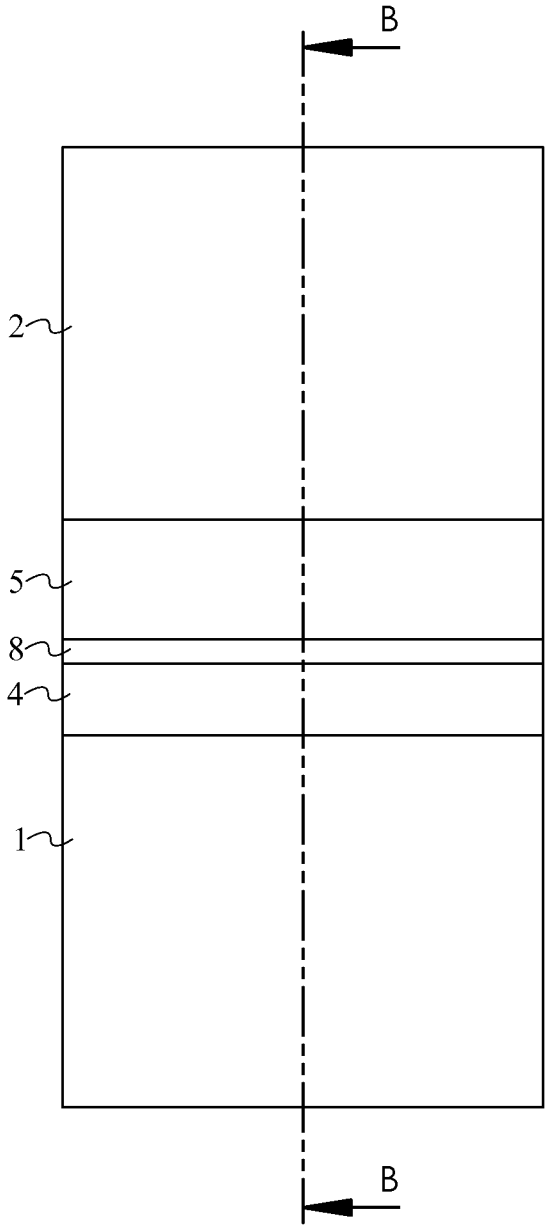
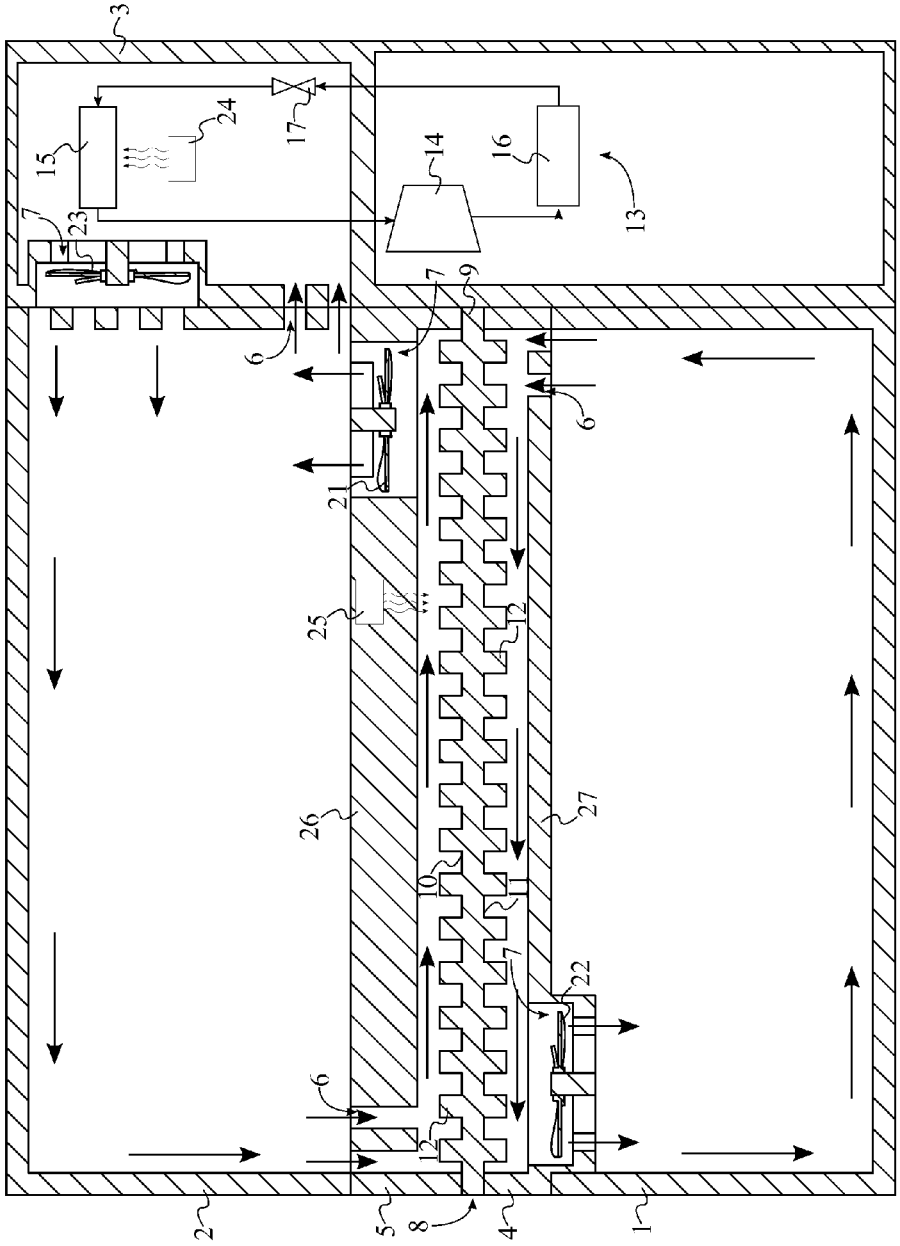


FIG. 7



SECTION B-B

FIG. 8

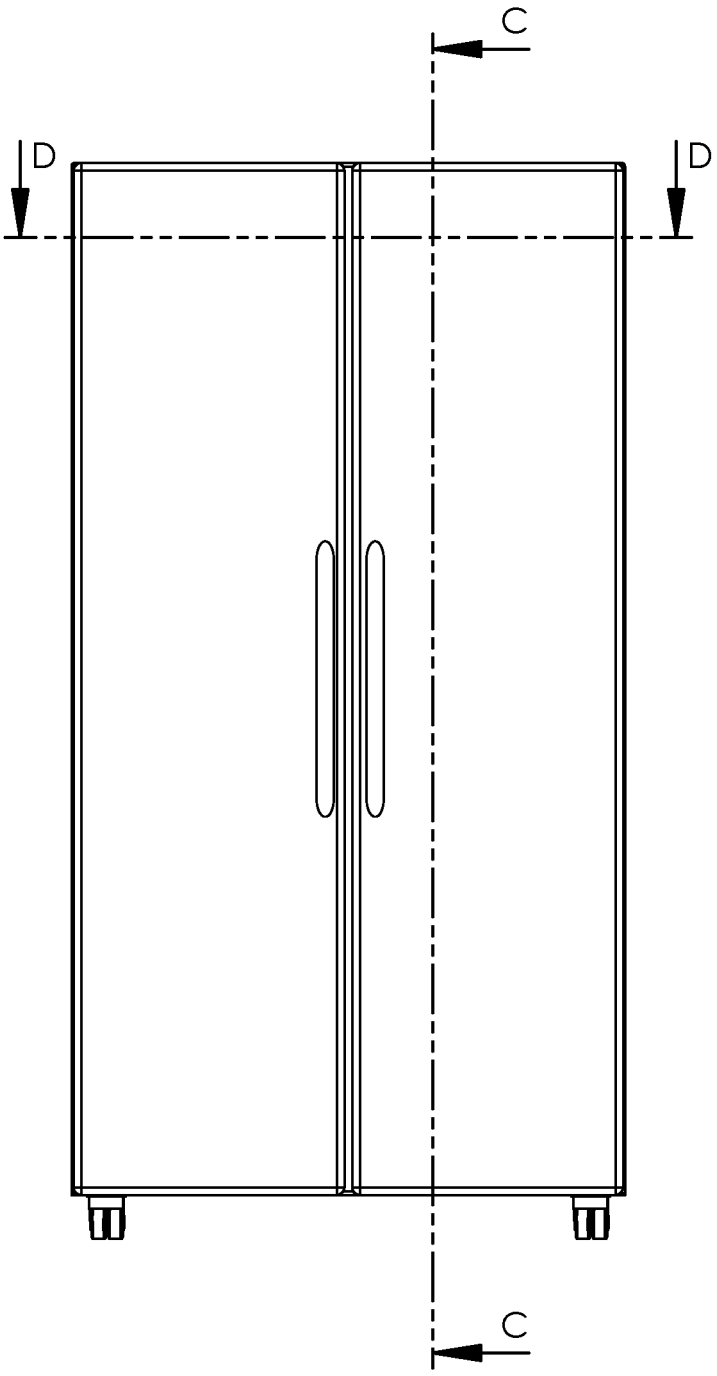
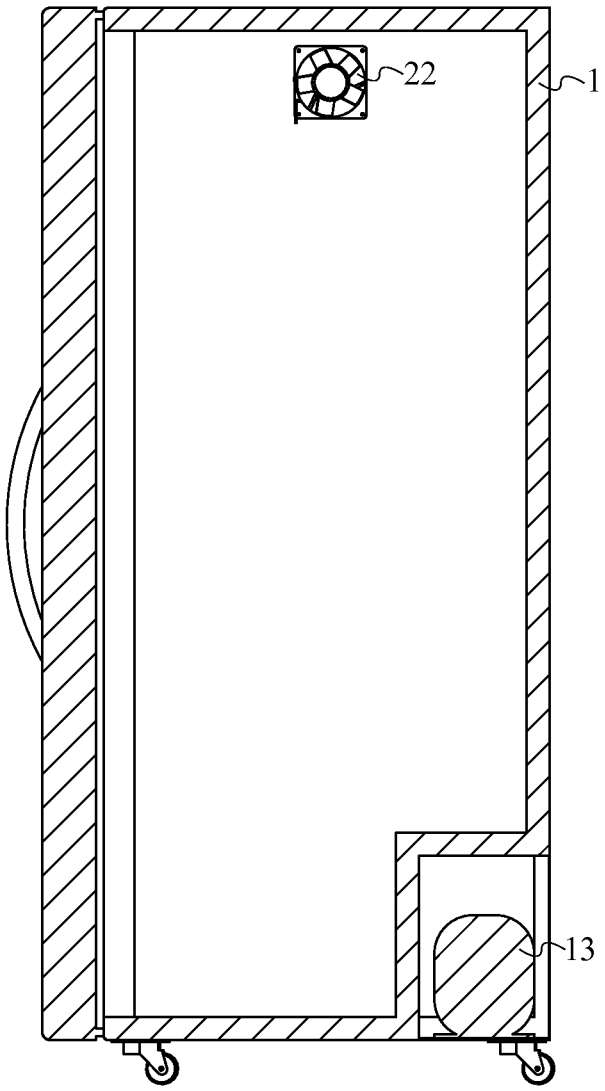
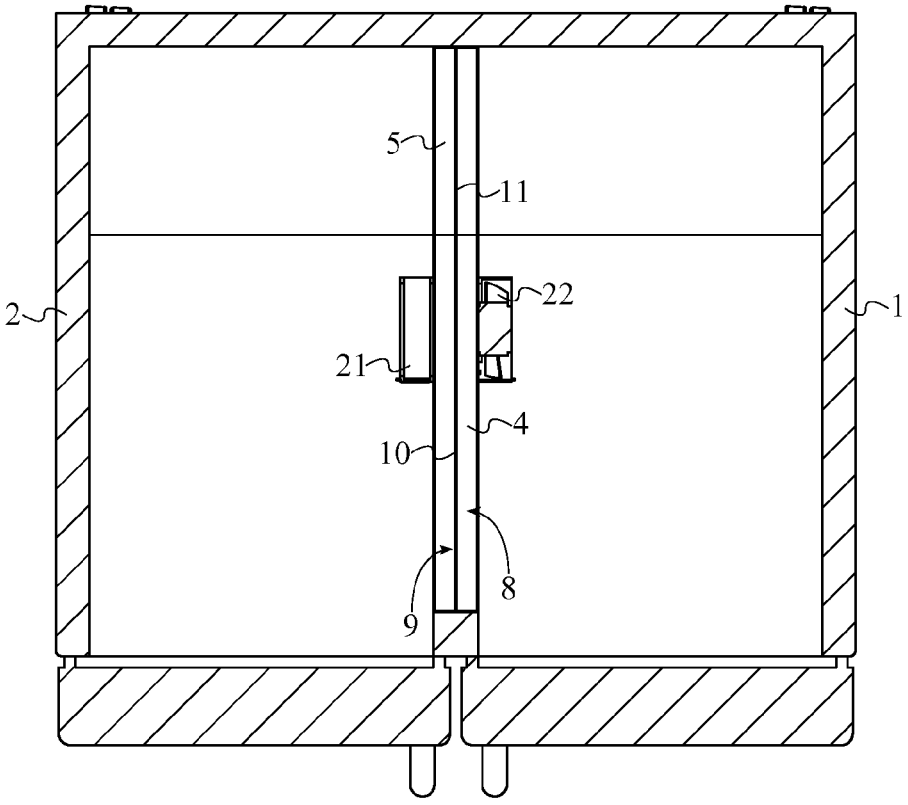


FIG. 9



SECTION C-C

FIG. 10



SECTION D-D

FIG. 11

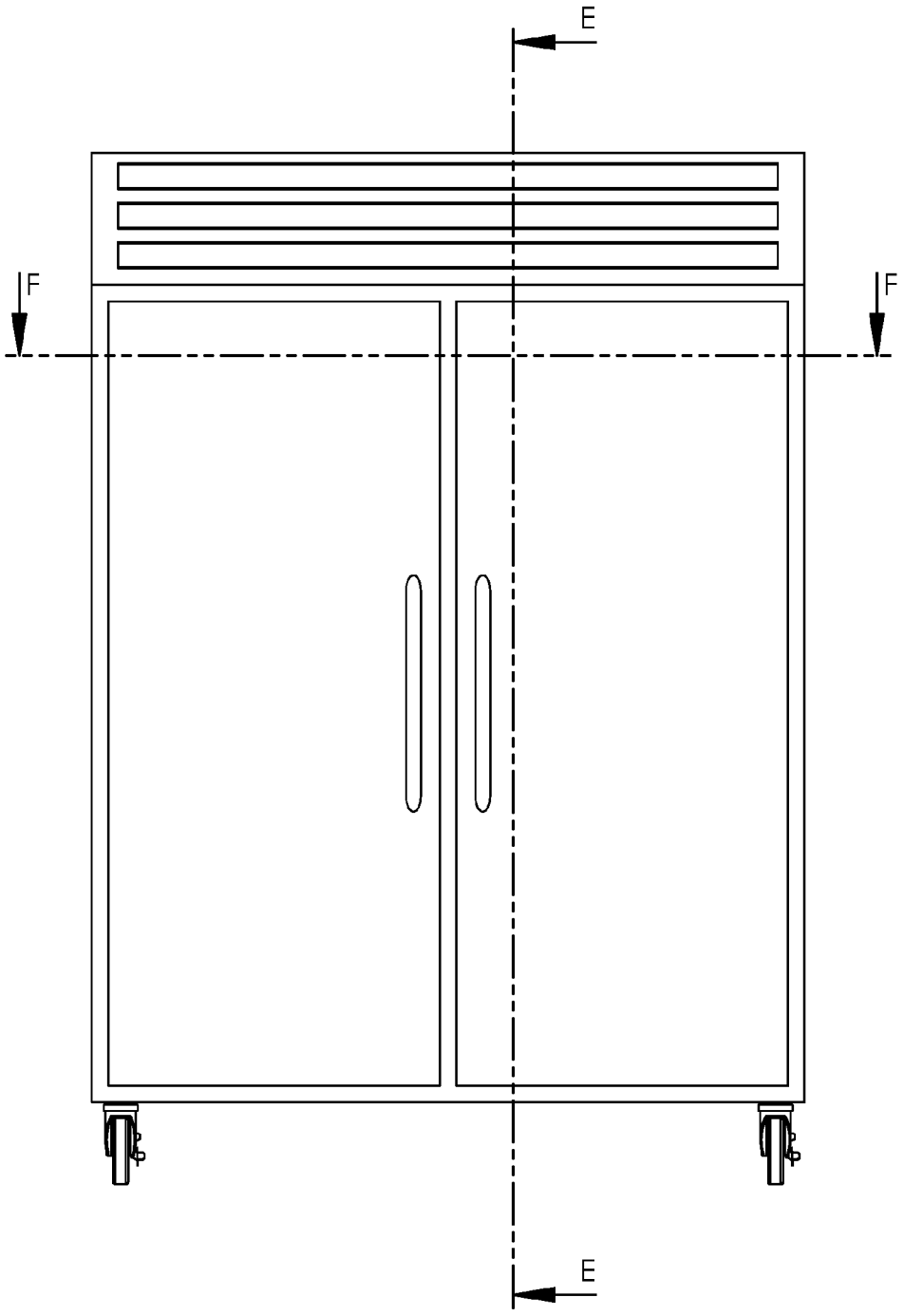
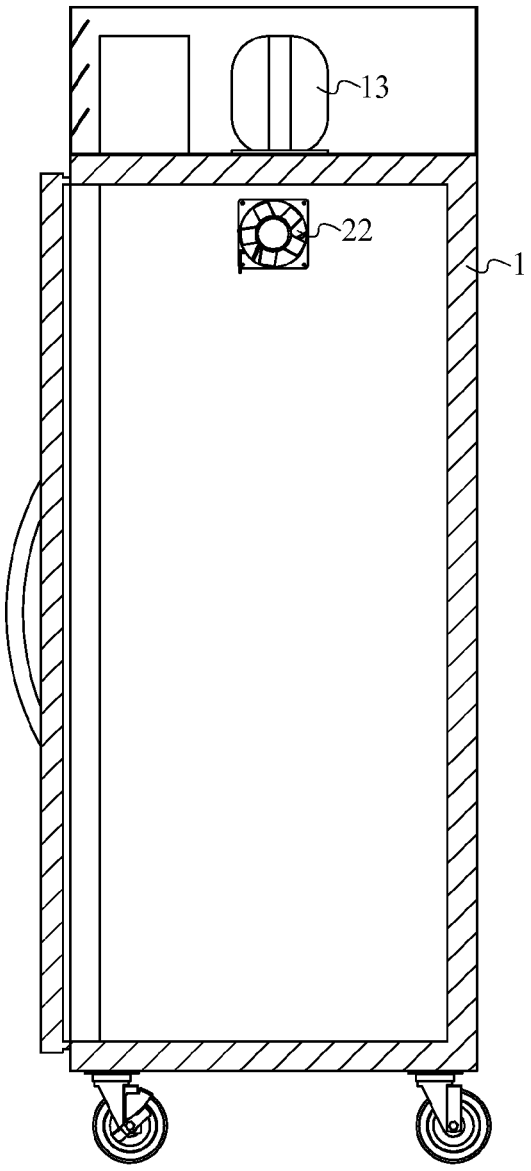
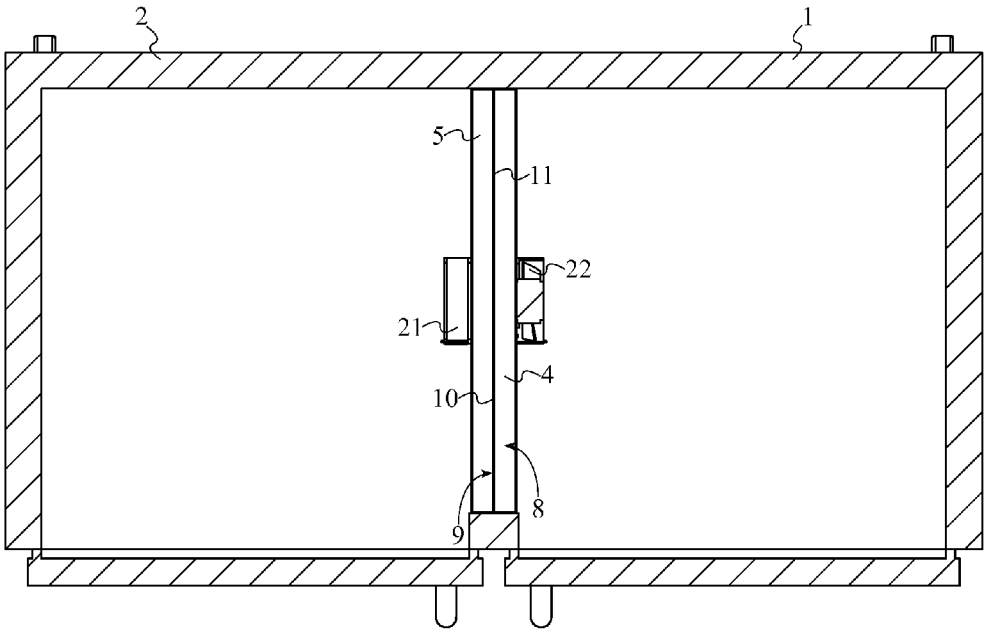


FIG. 12



SECTION E-E

FIG. 13



SECTION F-F

FIG. 14

COMBINATION REFRIGERATOR-FREEZER WITH DIVIDING AIR-IMPERMEABLE AIR-TO-AIR HEAT EXCHANGER

[0001] The current application claims a priority to the U.S. Provisional Patent application serial number 62/166,455 filed on May 26, 2015.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a combination refrigerator-freezer. More specifically, the present invention is a combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger that prevents any mixture of air between the refrigerator and the freezer. The present invention utilizes a single cooling system to cool the freezer while the refrigerator is cooled via the heat exchanger.

BACKGROUND OF THE INVENTION

[0003] Conventional combination refrigerator-freezers utilize a single or dual compressor system in order to cool the refrigerator compartment and the freezer compartment. In a single compressor configuration, a single compressor and a single evaporator are utilized to cool both the refrigerator compartment and the freezer compartment. This is generally accomplished by cooling the freezer compartment to a desired temperature. A circulation fan directs cold air from the freezer compartment to the refrigerator compartment through a duct in between the freezer compartment and the refrigerator compartment, thus cooling the refrigerator compartment. A thermostat is utilized to adjust the amount of cold air that is transferred from the freezer compartment to the refrigerator compartment. However, because air and moisture are mixed between the freezer compartment and the refrigerator compartment, temperature control can tend to be imprecise. Additionally, the significantly drier and lower temperature air from the freezer compartment causes food products in the refrigerator compartment to become dehydrated and rapidly lose freshness. Furthermore, because air from the freezer compartment is being utilized to cool the refrigerator compartment, there may be wide variations in temperature within the freezer compartment and the refrigerator compartment themselves. This is due to the fact that air traveling from the freezer compartment to the refrigerator compartment is unable to instantaneously cool the entire refrigerator compartment, leaving areas of the refrigerator compartment warmer than others for periods of time. Within a dual compressor system, the freezer compartment and the refrigerator compartment are each cooled by its own compressor and evaporator independently. The use of a dual compressor system allows for stable and consistent temperatures within both the freezer compartment and the refrigerator compartment. The effectiveness of a dual compressor system is offset by the fact that a dual compressor system is more expensive, more complex, and requires more physical space to implement.

[0004] The present invention is a combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger. The present invention enables the use of a cooling system consisting of a single compressor and a single evaporator in order to cool both a refrigerator compartment and a freezer compartment. The present invention enables cooling of both the refrigerator compartment and the freezer compartment without mixing air between the two compartments. An air-to-air heat exchanger is positioned in between the refrigerator compartment and the freezer compartment to prevent air from mixing between the two compartments. The freezer compartment is cooled by the cooling system and cold air within the freezer compartment is continuously circulated throughout the freezer compartment and directed along a first surface of the air-to-air heat exchanger. Air within the refrigerator compartment is continuously circulated and directed along a second surface of the air-to-air heat exchanger. The air within the refrigerator compartment may thus be cooled as the air passes along the second surface of the air-to-air heat exchanger and is circulated throughout the refrigerator compartment. The present invention additionally includes defrost heaters that prevent essential components of the present invention from icing up. Cooling operation is suspended while defrosting occurs in order to ensure that the freezer compartment and the refrigerator compartment are not undergoing cooling during defrosting operations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1** is a diagrammatic side view of an embodiment of the present invention.

[0006] FIG. **2** is a cross-sectional diagrammatic view of an embodiment of the present invention taken along line A-A of FIG. **1**.

[0007] FIG. **3** is a diagrammatic overview depicting electronic connections between the control unit, the cooling system, the freezer circulation fan, the refrigerator circulation fan, and the cooling circulation fan.

[0008] FIG. **4** is a cross-sectional diagrammatic view of an embodiment of the present invention taken along line A-A of FIG. **1**.

[0009] FIG. **5** is a diagrammatic overview depicting electronic connections between the control unit, the cooling system, the first defroster, and the second defroster.

[0010] FIG. **6** is an internal diagrammatic view of an embodiment of the present invention.

[0011] FIG. **7** is a side view of an embodiment of the present invention.

[0012] FIG. **8** is a cross-sectional diagrammatic view of an embodiment of the present invention taken along line B-B of FIG. **6**.

[0013] FIG. **9** is a front view of a residential embodiment of the present invention.

[0014] FIG. **10** is a cross-sectional view of the residential embodiment of the present invention taken along line C-C of FIG. **9**.

[0015] FIG. **11** is a cross-sectional view of the residential embodiment of the present invention taken along line D-D of FIG. **9**.

[0016] FIG. **12** is a front view of a commercial embodiment of the present invention.

[0017] FIG. **13** is a cross-sectional view of the commercial embodiment of the present invention taken along line E-E of FIG. **12**.

[0018] FIG. **14** is a cross-sectional view of the commercial embodiment of the present invention taken along line F-F of FIG. **13**.

DETAIL DESCRIPTIONS OF THE INVENTION

[0019] All illustrations of the drawings are for the purpose of describing selected versions of the present invention and are not intended to limit the scope of the present invention.

[0020] The present invention is a combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger. A diagrammatic overview of the present invention is shown in FIGS. **1-3**. The present invention comprises a refrigerator compartment **1**, a freezer compartment **2**, a cooling compartment **3**, a refrigerator airflow compartment **4**, a freezer airflow compartment **5**, an air-to-air heat exchanger **8**, a cooling system **13**, and a control unit **18**. The present invention is able to cool both the refrigerator compartment **1** and the freezer compartment **2** via the single cooling system **13**. No air is exchanged between the refrigerator compartment **1** and the freezer compartment **2**, eliminating drastic temperature fluctuations within the refrigerator compartment **1**. Additionally, no moisture is exchanged between the refrigerator compartment **1** and the freezer compartment **2**, preventing food products within the refrigerator compartment **1** from being dehydrated and losing freshness.

[0021] With continued reference to FIGS. **1-3**, the freezer compartment **2** is the compartment in which products such as perishable food items are cooled at a temperature below the freezing point of water. The refrigerator compartment **1** is the compartment in which products are cooled at a temperature above the freezing point of water. The cooling compartment **3** houses some or all subcomponents of the cooling system **13** and provides cold air to the freezer compartment **2**. The cold air is produced by the cooling system **13** and is circulated through the freezer compartment **2**. The cooling compartment **3** is adjacently connected to the freezer compartment **2**, allowing the cold air to flow directly from the cooling compartment **3** to the freezer compartment **2**. Various subcomponents of the cooling system **13** may or may not be contained within the cooling compartment **3**. The freezer airflow compartment **5** serves as a conduit through which the cold air from the cooling compartment **3** is able to pass after circulating through the freezer compartment **2**. Similarly the refrigerator airflow compartment **4** serves as a conduit through which air from the refrigerator compartment **1** is able to pass after circulating through the refrigerator compartment **1**. The air-to-air heat exchanger **8** is connected in between the refrigerator airflow compartment **4** and the freezer airflow compartment **5**. Additionally, the air-to-air heat exchanger **8** is in thermal contact with the refrigerator airflow compartment **4** and the freezer airflow compartment **5**. Because of this, the cold air passing through the freezer airflow compartment **5** is able to cool the air-to-air heat exchanger **8**, in turn cooling the warmer air circulating through the refrigerator airflow compartment **4** and cooling the refrigerator compartment **1**. The air-to-air heat exchanger **8** additionally prevents air from the freezer airflow compartment **5** and air from the refrigerator airflow compartment **4** from being mixed. The refrigerator compartment **1** may thus be cooled without any air being exchanged between the freezer compartment **2** and the refrigerator compartment **1**. The specific arrangement of the refrigerator compartment **1**, the refrigerator airflow compartment **4**, the freezer compartment **2**, the freezer airflow compartment **5**, and the cooling compartment **3** may vary across embodiments of the present invention.

[0022] The control unit **18** is responsible for regulating the temperatures within the freezer compartment **2** and the refrigerator compartment **1**. The control unit **18** is electronically connected to the cooling system **13** as shown in FIG. **3**, enabling the control unit **18** to activate, deactivate, and otherwise control the cooling system **13** during operation of the present invention. The control unit **18** is able to disable the cooling system **13** during a defrost cycle in order to ensure that the cooling system **13** is not producing cold air while other areas of the present invention are being defrosted. The control unit **18** may include an electronic display as well as input means such as buttons and knobs to allow the user to adjust the settings of the present invention. Furthermore, the control unit **18** may include additional components such as temperature sensors to monitor the temperatures of various regions of the present invention.

[0023] Airflow within the present invention is depicted in FIG. **2**. The refrigerator airflow compartment **4**, the freezer airflow compartment **5**, and the cooling compartment **3** each comprise an inlet **6** and an outlet **7**. The inlet **6** and the outlet **7** allow air to circulate through the refrigerator airflow compartment **4**, the freezer airflow compartment **5**, and the cooling compartment **3**. However, as previously discussed, no air is exchanged between the refrigerator compartment **1** and the freezer compartment **2** nor between the refrigerator airflow compartment **4** and the freezer airflow compartment **5**. The cooling compartment **3** is in fluid communication with the freezer compartment **2** through the inlet **6** of the cooling compartment **3** and the outlet **7** of the cooling compartment **3**. Cold air from within the cooling compartment **3** is thus able to flow into the freezer compartment **2**, circulate within the freezer compartment **2**, and then reenter the cooling compartment **3**. The freezer compartment **2** is in fluid communication with the freezer airflow compartment **5** through the inlet **6** of the freezer airflow compartment **5** and the outlet **7** of the freezer airflow compartment **5**. As such, air is circulated through the freezer compartment **2** and the freezer airflow compartment **5** through the inlet **6** of the freezer airflow compartment **5** and the outlet **7** of the freezer airflow compartment **5**. The cold air passes from the freezer compartment **2** and into the freezer airflow compartment **5** where the cold air is able to cool the air-to-air heat exchanger **8**.

[0024] With continued reference to FIG. **2**, the refrigerator compartment **1** is in fluid communication with the refrigerator airflow compartment **4** through the inlet **6** of the refrigerator airflow compartment **4** and the outlet **7** of the refrigerator airflow compartment **4**. Warmer air (relative to the cold air produced by the cooling system **13**) is circulated through the refrigerator compartment **1** and the refrigerator airflow compartment **4** through the inlet **6** of the refrigerator airflow compartment **4** and the outlet **7** of the refrigerator airflow compartment **4**. The warmer air is able to pass from the refrigerator compartment **1** into the refrigerator airflow compartment **4**. The warmer air circulating through the refrigerator airflow compartment **4** is cooled as the air-to-air heat exchanger **8** is cooled by the cold air circulating through the freezer airflow compartment **5**. Again, no air is exchanged between the refrigerator compartment **1** and the freezer compartment **2** nor between the refrigerator airflow compartment **4** and the freezer airflow compartment **5**.

[0025] The cooling system **13** comprises a compressor **14**, an evaporator **15**, a condenser **16**, and a metering device **17**. The compressor **14**, the evaporator **15**, the condenser **16**, and

the metering device **17** are the mechanical components of the cooling system **13** that are utilized during a conventional refrigeration cycle to cool the freezer compartment **2**. The compressor **14** is in fluid communication with the condenser **16**. A refrigerant is compressed into a hot gaseous form by the compressor **14** and is routed to the condenser **16**. The condenser **16** removes heat from the hot compressed gas refrigerant and the hot compressed gas refrigerant is condensed into a liquid. The condenser **16** is in fluid communication with the metering device **17**. The liquid refrigerant is routed from the condenser **16** to the metering device **17**. The metering device **17** serves to restrict the flow of the liquid refrigerant, causing a pressure drop and facilitating the evaporation of the liquid refrigerant. The metering device **17** may be an expansion valve or a capillary tube. The metering device **17** is in fluid communication with the evaporator **15**, allowing the liquid refrigerant to be pressure dropped and routed to the evaporator **15**. The liquid refrigerant is evaporated back into gas form in the evaporator **15**. As the refrigerant is evaporated, the liquid absorbs heat from the surrounding area. The evaporator **15** is in fluid communication with the compressor **14**, enabling the refrigerant to return to the compressor **14**, completing the refrigeration cycle. The compressor **14**, the evaporator **15**, the condenser **16**, and the metering device **17** may be positioned within the cooling compartment **3** as shown in FIG. **2**. Alternatively, various subcomponents of the cooling system **13**, such as the compressor **14**, may be positioned external to the refrigerator compartment **1**, the freezer compartment **2**, and the cooling compartment **3**, as shown in FIG. **4**. The cooling compartment **3** may be compartmentalized in order to separately enclose the subcomponents of the cooling system **13**.

[0026] Again with reference to FIG. **2** and FIG. **3**, the present invention further comprises a freezer circulation fan **21**, a refrigerator circulation fan **22**, and a cooling circulation fan **23**. The freezer circulation fan **21** facilitates airflow from the freezer airflow compartment **5** and the freezer compartment **2**. The freezer circulation fan **21** is mounted into the outlet **7** of the freezer airflow compartment **5**, allowing air within the freezer airflow compartment **5** to exit back into the freezer compartment **2**. Similar to the freezer circulation fan **21**, the refrigerator circulation fan **22** generates airflow from the refrigerator airflow compartment **4** to the refrigerator compartment **1**. The refrigerator circulation fan **22** is mounted into the outlet **7** of the refrigerator airflow compartment **4**, allowing the warmer air that is cooled by the air-to-air heat exchanger **8** within the refrigerator airflow compartment **4** to exit back into and cool the refrigerator compartment **1**. The cooling circulation fan **23** forces cold air generated by the cooling system **13** into the freezer compartment **2**. The cooling circulation fan **23** is mounted into the outlet **7** of the cooling compartment **3**, adjacent to the evaporator **15**. As such, cold air generated during a conventional refrigeration cycle by the cooling system **13** is forced into the freezer compartment **2** by the cooling circulation fan **23**. The freezer circulation fan **21**, the refrigerator circulation fan **22**, and the cooling circulation fan **23** are electronically connected to the control unit **18** as shown in FIG. **3**, enabling the control unit **18** to activate and deactivate the freezer circulation fan **21**, the refrigerator circulation fan **22**, and the cooling circulation fan **23** as needed. The control unit **18** is able to disable the freezer circulation fan **21**, the refrigerator circulation fan **22**, and the cooling circulation fan **23** during a defrost cycle in order to halt air circulation within the present invention while the present invention is underdoing defrosting. However, during normal operation of the present invention, the freezer circulation fan **21**, the refrigerator circulation fan **22**, and the cooling circulation fan **23** are continuously run. This ensures that air is constantly circulating through the refrigerator compartment **1**, the refrigerator airflow compartment **4**, the freezer compartment **2**, the freezer airflow compartment **5**, and the cooling compartment **3**.

[0027] Again with reference to FIG. **2**, the present invention further comprises a first defroster **24** and a second defroster **25** that are utilized during a defrost cycle for the present invention. The defrost cycle is able to prevent the evaporator **15** and the air-to-air heat exchanger **8** from becoming iced up during operation of the present invention. The first defroster **24** is positioned adjacent to the evaporator **15** while the second defroster **25** is positioned adjacent to the air-to-air heat exchanger **8**. The first defroster **24** and the second defroster **25** are thus able to prevent ice from forming on the evaporator **15** and the air-to-air heat exchanger **8** and compromising the functionality of the present invention. The present invention is not limited with respect to the specific type of defroster utilized for the first defroster **24** and the second defroster **25**. For example, the first defroster **24** for the evaporator **15** may be a hot gas defrost system or an electrical heater. The second defroster **25** for the air-to-air heat exchanger **8** may be an electrical defroster. Alternatively, an off cycle may be implemented during defrosting in which the cooling system **13** is deactivated.

[0028] As shown in FIG. **5**, the control unit **18** comprises a refrigerator control unit **19** and a freezer control unit **20**. The refrigerator control unit **19** and the freezer control unit **20** regulate the temperature and the cooling of the refrigerator compartment **1** and the freezer compartment **2**, respectively. The refrigerator control unit **19** is electronically connected to the refrigerator circulation fan **22** and the freezer circulation fan **21**, allowing the refrigerator control unit **19** to activate the refrigerator circulation fan **22** and the freezer circulation fan **21** to enable cooling of the refrigerator compartment **1** or deactivate the refrigerator circulation fan **22** and the freezer circulation fan **21** to cease cooling during defrosting. Similarly, the freezer control unit **20** is electronically connected to the cooling circulation fan **23**, allowing the freezer control unit **20** to activate the cooling circulation fan **23** to enable cooling of the freezer compartment **2** or deactivate the cooling circulation fan **23** to cease cooling during defrosting. The refrigerator control unit **19** is electronically connected to the freezer control unit **20** while the first defroster **24** and the second defroster **25** are electronically connected to the freezer control unit **20** and the refrigerator control unit **19**, respectively. The first defroster **24** and the second defroster **25** are able to commence defrosting together, but may complete defrosting separately. The refrigerator control unit **19** and the freezer control unit **20** are interlocked in order to ensure that cooling operations do not resume while defrosting is underway in another area of the present invention. This is due to the fact that the time required for defrost cycles may vary for different areas of the present invention. The control unit **18** is thus able to prevent the cooling system **13**, the refrigerator circulation fan **22**, the freezer circulation fan **21**, and the cooling circulation fan **23** from operating simultaneously with the first defroster **24** and the second defroster **25**. Because the refrigerator control unit **19** and the freezer control unit **20** are interlocked, the control

unit **18** is able to ensure that all defrost cycles have completed before resuming operation of the cooling system **13**.

[0029] Again referring to FIG. **2**, the present invention further comprises a first insulation panel **26** and a second insulation panel **27**. The first insulation panel **26** is connected in between the freezer compartment **2** and the freezer airflow compartment **5**. This reduces cooling of the air-to-air heat exchanger **8** when cold air is circulating through the freezer compartment **2**, thereby reducing the freezing of the air-to-air heat exchanger **8**. The second insulation panel **27** is connected in between the refrigerator compartment **1** and the refrigerator airflow compartment **4**. The second insulation panel **27** is thus able to minimize cooling of the air-to-air heat exchanger **8** from the refrigerator compartment **1**, allowing the refrigerator compartment **1** to be cooled more effectively.

[0030] With reference to FIG. **6**, the present invention further comprises at least one runoff drain pipe **28** and a runoff drain pan **29**. The at least one runoff drain pipe **28** and the runoff drain pan **29** are utilized to catch and remove runoff from the air-to-air heat exchanger **8** and the evaporator **15** during defrosting. The at least one runoff drain pipe **28** is thus positioned adjacent to the air-to-air heat exchanger **8** and the evaporator **15**, allowing runoff to enter the at least one runoff drain pipe **28**. The runoff drain pan **29** is positioned adjacent to the at least one runoff drain pipe **28** in order to collect runoff exiting the at least one runoff drain pipe **28**.

[0031] The air-to-air heat exchanger **8** may take a number of forms across various embodiments of the present invention. However, the present invention is not limited with respect to the specific design of the air-to-air heat exchanger **8**. Most commonly, the air-to-air heat exchanger **8** comprises a plate **9** as shown in FIG. **2**. A first surface **10** of the plate **9** is in thermal contact with the freezer compartment **2** and is cooled by cold air circulating through the freezer airflow compartment **5**. A second surface **11** of the plate **9** is in thermal contact with the refrigerator airflow compartment **4**, allowing warmer air circulating through the refrigerator airflow compartment **4** to be cooled by the air-to-air heat exchanger **8**. In the embodiment of the present invention shown in FIG. **7** and FIG. **8**, the air-to-air heat exchanger **8** further comprises a plurality of fins **12**. The plurality of fins **12** is able to improve the efficiency of the air-to-air heat exchanger **8** and is evenly distributed across the first surface **10** and the second surface **11**. The plurality of fins **12** is thus positioned within both the freezer airflow compartment **5** and the refrigerator airflow compartment **4**.

[0032] Two example embodiments of the present invention are shown in FIGS. **9-14**. The example shown in FIGS. **9-11** is an embodiment of the present invention designed for use in residential applications. The example shown in FIGS. **12-14** is an embodiment of the present invention designed for use in commercial applications.

[0033] The use of a single cooling system **13** in lieu of a dedicated system for both the refrigerator compartment **1** and the freezer compartment **2** provides a number of benefits to the present invention when compared to conventional refrigeration systems. Because only a single system is in use, the present invention does not require more physical space as is required for a dual system. The single system offers a reduction in cost as well. Additionally, because there is no air exchanged between the freezer compartment **2** and the refrigerator compartment **1**, both the freezer compartment **2** and the refrigerator compartment **1** may be cooled evenly and be cooled more consistently without fluctuations in temperature. There is no moisture exchanged between the freezer compartment **2** and the refrigerator compartment **1** as well, preventing food items within the present invention from being dehydrated and losing freshness.

[0034] Although the present invention has been explained in relation to its preferred embodiment, it is understood that many other possible modifications and variations can be made without departing from the spirit and scope of the present invention as hereinafter claimed.

What is claimed is:

1. A combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger comprises:

a freezer compartment;

a refrigerator compartment;

a cooling compartment;

a freezer airflow compartment;

a refrigerator airflow compartment;

an air-to-air heat exchanger;

a cooling system;

a control unit;

the refrigerator airflow compartment, the freezer airflow compartment, and the cooling compartment each comprise an inlet and an outlet;

the cooling compartment being adjacently connected to the freezer compartment;

the cooling compartment being in fluid communication with the freezer compartment through the inlet of the cooling compartment and the outlet of the cooling compartment;

the freezer compartment being in fluid communication with the freezer airflow compartment through the inlet of the freezer airflow compartment and the outlet of the freezer airflow compartment, wherein air is circulated through the freezer compartment and the freezer airflow compartment through the inlet of the freezer airflow compartment and the outlet of the freezer airflow compartment;

the air-to-air heat exchanger being connected in between the refrigerator airflow compartment and the freezer airflow compartment;

the air-to-air heat exchanger being in thermal contact with the refrigerator airflow compartment and the freezer airflow compartment;

the refrigerator compartment being in fluid communication with the refrigerator airflow compartment through the inlet of the refrigerator airflow compartment and the outlet of the refrigerator airflow compartment, wherein air is circulated through the refrigerator compartment and the refrigerator airflow compartment through the inlet of the refrigerator airflow compartment and the outlet of the refrigerator airflow compartment; and

the control unit being electronically connected to the cooling system.

2. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:

a freezer circulation fan;

a refrigerator circulation fan;

a cooling circulation fan;

the cooling system comprises a compressor, an evaporator, a condenser, and a metering device;

the compressor being in fluid communication with the condenser;
the condenser being in fluid communication with the metering device;
the metering device being in fluid communication with the evaporator;
the evaporator being in fluid communication with the compressor;
the freezer circulation fan being mounted into the outlet of the freezer airflow compartment;
the refrigerator circulation fan being mounted into the outlet of the refrigerator airflow compartment;
the cooling circulation fan being mounted into the outlet of the cooling compartment, adjacent to the evaporator; and
the freezer circulation fan, the refrigerator circulation fan, and the cooling circulation fan being electronically connected to the control unit.

3. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **2** further comprises:
the compressor, the evaporator, the condenser, and the metering device being positioned within the cooling compartment.

4. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **2** further comprises:
the compressor being positioned external to the refrigerator compartment, the freezer compartment, and the cooling compartment.

5. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:
a first defroster;
a second defroster;
the first defroster being positioned adjacent to an evaporator of the cooling system; and
the second defroster being positioned adjacent to the air-to-air heat exchanger.

6. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:
a first defroster ;
a second defroster;
the control unit comprises a refrigerator control unit and a freezer control unit;
the refrigerator control unit being electronically connected to the freezer control unit;
the first defroster and the second defroster being electronically connected to the freezer control unit and the refrigerator control unit, respectively;
the refrigerator control unit being electronically connected to a refrigerator circulation fan and a freezer circulation fan; and
the freezer control unit being electronically connected to a cooling circulation fan.

7. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:
a first insulation panel;
a second insulation panel;
the first insulation panel being connected in between the freezer compartment and the freezer airflow compartment; and
the second insulation panel being connected in between the refrigerator compartment and the refrigerator airflow compartment.

8. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:
at least one runoff drain pipe;
a runoff drain pan;
the at least one runoff drain pipe being positioned adjacent to the air-to-air heat exchanger and an evaporator of the cooling system; and
the runoff drain pan being positioned adjacent to the at least one drain pipe.

9. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **1** further comprises:
the air-to-air heat exchanger comprises a plate;
a first surface of the plate being in thermal contact with the freezer airflow compartment; and
a second surface of the plate being in thermal contact with the refrigerator airflow compartment.

10. The combination refrigerator-freezer with dividing air impermeable air-to-air heat exchanger as claimed in claim **9** further comprises:
the air-to-air heat exchanger further comprises a plurality of fins; and
the plurality of fins being evenly distributed across the first surface and the second surface.

11. A combination refrigerator-freezer with dividing air impermeable air-to-air heat exchanger comprises:
a freezer compartment;
a refrigerator compartment;
a cooling compartment;
a freezer airflow compartment;
a refrigerator airflow compartment;
an air-to-air heat exchanger;
a cooling system;
a control unit;
a first defroster ;
a second defroster;
the refrigerator airflow compartment, the freezer airflow compartment, and the cooling compartment each comprise an inlet and an outlet;
the control unit comprises a refrigerator control unit and a freezer control unit;
the cooling compartment being adjacently connected to the freezer compartment;
the cooling compartment being in fluid communication with the freezer compartment through the inlet of the cooling compartment and the outlet of the cooling compartment;
the freezer compartment being in fluid communication with the freezer airflow compartment through the inlet of the freezer airflow compartment and the outlet of the freezer airflow compartment, wherein air is circulated through the freezer compartment and the freezer airflow compartment through the inlet of the freezer airflow compartment and the outlet of the freezer airflow compartment;
the air-to-air heat exchanger being connected in between the refrigerator airflow compartment and the freezer airflow compartment;

the air-to-air heat exchanger being in thermal contact with the refrigerator airflow compartment and the freezer airflow compartment;

the refrigerator compartment being in fluid communication with the refrigerator airflow compartment through the inlet of the refrigerator airflow compartment and the outlet of the refrigerator airflow compartment, wherein air is circulated through the refrigerator compartment and the refrigerator airflow compartment through the inlet of the refrigerator airflow compartment and the outlet of the refrigerator airflow compartment;

the control unit being electronically connected to the cooling system;

the refrigerator control unit being electronically connected to the freezer control unit;

the first defroster and the second defroster being electronically connected to the freezer control unit and the refrigerator control unit, respectively;

the refrigerator control unit being electronically connected to a refrigerator circulation fan and a freezer circulation fan; and

the freezer control unit being electronically connected to a cooling circulation fan.

12. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **11** further comprises:

a freezer circulation fan;

a refrigerator circulation fan;

a cooling circulation fan;

the cooling system comprises a compressor, an evaporator, a condenser, and a metering device;

the compressor being in fluid communication with the condenser;

the condenser being in fluid communication with the metering device;

the metering device being in fluid communication with the evaporator;

the evaporator being in fluid communication with the compressor;

the freezer circulation fan being mounted into the outlet of the freezer airflow compartment;

the refrigerator circulation fan being mounted into the outlet of the refrigerator airflow compartment;

the cooling circulation fan being mounted into the outlet of the cooling compartment, adjacent to the evaporator; and

the freezer circulation fan, the refrigerator circulation fan, and the cooling circulation fan being electronically connected to the control unit.

13. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **12** further comprises:

the compressor, the evaporator, the condenser, and the metering device being positioned within the cooling compartment.

14. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **12** further comprises:

the compressor being positioned external to the refrigerator compartment, the freezer compartment, and the cooling compartment.

15. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **11** further comprises:

a first defroster;

a second defroster;

the first defroster being positioned adjacent to an evaporator of the cooling system; and

the second defroster being positioned adjacent to the air-to-air heat exchanger.

16. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **11** further comprises:

a first insulation panel;

a second insulation panel;

the first insulation panel being connected in between the freezer compartment and the freezer airflow compartment; and

the second insulation panel being connected in between the refrigerator compartment and the refrigerator airflow compartment.

17. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **11** further comprises:

at least one runoff drain pipe;

a runoff drain pan;

the at least one runoff drain pipe being positioned adjacent to the air-to-air heat exchanger and an evaporator of the cooling system; and

the runoff drain pan being positioned adjacent to the at least one drain pipe.

18. The combination refrigerator-freezer with dividing air-impermeable air-to-air heat exchanger as claimed in claim **11** further comprises:

the air-to-air heat exchanger comprises a plate;

a first surface of the plate being in thermal contact with the freezer airflow compartment; and

a second surface of the plate being in thermal contact with the refrigerator airflow compartment.

19. The combination refrigerator-freezer with dividing air impermeable air-to-air heat exchanger as claimed in claim **18** further comprises:

the air-to-air heat exchanger further comprises a plurality of fins; and

the plurality of fins being evenly distributed across the first surface and the second surface.

* * * * *