DUAL-TEMPERATURE-ZONE AND MULTI-MODE INTELLIGENT REFRIGERATED ASSEMBLY FOR LOGISTICS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure is based on and claims priority to Chinese Patent Application No. 202420560990.3, filed on March 22, 2024, the entire contents of which are hereby incorporated into the present disclosure by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of refrigeration technologies for refrigerated containers, and in particular to a dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics.

BACKGROUND

[0003] Transportation operations of logistics companies are characterized by diverse types of goods, uneven quantities of goods, and varied points of origin for transportation, etc., which cause considerable difficulties in regional dispatching, use of cargo containers, and overall management. In the process of carrying out transportation operations, goods from different customers are consolidated, and different goods usually have different temperature requirements.

[0004] Refrigerated containers having different temperatures proposed in related arts are mainly conventional mechanically refrigerated containers. Each different temperature zone of such a refrigerated container requires to separately provide a corresponding evaporator, and the evaporators are used to adjust the temperatures to meet the temperature requirements of the different temperature zones. However, although increasing the number of evaporators can achieve the purpose of adjustment to meet different temperature requirements, the cost and weight increase, and energy consumption increases, further affecting total quantity of goods transported and transportation range.

SUMMARY

[0005] Embodiments of the present application aim to provide a dual-temperature-zone and multi-mode intelligent refrigerated container for logistics that has low cost, low weight, and a plurality of temperature zones and accommodates various different operating modes.

[0006] To solve the above technical problems, embodiments of the present disclosure provide a dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics, including a refrigerated container configured to be provided on a truck; a vertical heat-insulating partition plate arranged vertically in the refrigerated container, and the vertical heat-insulating partition plate divides an internal cavity the refrigerated container into a first temperature zone and a second

temperature zone along a length direction of the refrigerated container, the vertical heat-insulating partition plate has an inter-zone communication opening; the refrigerated container has a first external communication opening at a position corresponding to the first temperature zone; and the refrigerated container has a second external communication opening at a position corresponding to the second temperature zone; a cold-storage plate and a cold-storage unit arranged on a surface on a side of the refrigerated container within the first temperature zone opposite the vertical heat-insulating partition plate, an inter-zone temperature regulating fan for guiding and conveying air in the first temperature zone into the second temperature zone installed in the inter-zone communication opening; a first-temperature-zone temperature regulating fan for guiding and conveying air in the first temperature zone to the outside of the refrigerated container installed in the first external communication opening; a second-temperature-zone temperature regulating fan for guiding and conveying air in the second temperature zone to the outside of the refrigerated container installed in the second external communication opening; and temperature sensors arranged on inner walls of the refrigerated container at positions corresponding to the first temperature zone and the second temperature zone, respectively.

[0007] In some embodiments, the dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics further includes a control device and a temperature display device arranged outside the refrigerated container, and the inter-zone temperature regulating fan, the first-temperature-zone temperature regulating fan, the second-temperature-zone temperature regulating fan, the temperature sensors, and the temperature display device are each connected to the control device.

[0008] In some embodiments, the cold-storage plate is installed flat on an inner wall on the side of the refrigerated container.

[0009] In some embodiments, an area of the cold-storage plate exceeds 80% of an area of the inner wall of the refrigerated container on which the cold-storage plate is installed.

[0010] In some embodiments, the inter-zone temperature regulating fan is adjacent to a lower portion of the vertical heat-insulating partition plate.

[0011] In some embodiments, the first external communication opening and the second external communication opening are provided in a top wall of the refrigerated container.

[0012] In some embodiments, two separate container doors are provided on side walls of the refrigerated container at positions corresponding to the first temperature zone and the second temperature zone, respectively, and the two separate container doors are located at the same side of the refrigerated container.

[0013] The refrigerated container according to embodiments of the present application has the following beneficial effects.

[0014] The cold-storage plate is installed in an upright orientation along the vertical direction

on the inner wall surface of the refrigerated container and occupies little space, thereby allowing space utilization within the first temperature zone to be maximized. In addition, since the cold-storage plate is charged to be cooled in advance using energy from an external alternating-current power supply, energy consumption is lower and transportation costs are lower than that when energy from an engine of a refrigerated truck is used.

[0015] Using a set of cold-storage plates in combination with a plurality of fans can meet the different refrigeration requirements of two temperature zones. Compared with use of a plurality of evaporators in the related arts, in the present application, not only the cost is lower, but the overall weight is also reduced, and the corresponding transportation energy consumption is also lower, allowing a total quantity of goods transported and transportation range to be increased.

[0016] The combined use of the cold-storage plate and a plurality of fans enables various different operating modes to be implemented between the two temperature zones by controlling the switching on and off of the plurality of fans, thereby meeting different usage requirements, with characteristics such as simple control, low cost, and good practicality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The following drawings are intended only to schematically illustrate and explain the present disclosure, and do not limit the scope of the present disclosure.

[0018] FIG. 1 is a partially sectioned perspective view of a refrigerated assembly according to an embodiment of the present disclosure.

[0019] FIG. 2 is a front sectional view of a refrigerated assembly according to an embodiment of the present disclosure.

[0020] FIG. 3 is a schematic diagram illustrating an operating principle of a refrigerated assembly according to an embodiment of the present disclosure in a first operating mode.

[0021] FIG. 4 is a schematic diagram illustrating an operating principle of a refrigerated assembly according to an embodiment of the present disclosure in a second operating mode.

[0022] FIG. 5 is a structural block diagram of a refrigerated assembly according to an embodiment of the present disclosure.

[0023] Reference numerals: 1, refrigerated container; 2, vertical heat-insulating partition plate; 3, first temperature zone; 4, second temperature zone; 5, cold-storage plate; 6, inter-zone temperature regulating fan; 7, first-temperature-zone temperature regulating fan; 8, second-temperature-zone temperature regulating fan.

DETAILED DESCRIPTION

[0024] The present disclosure is further described below with reference to the drawings and embodiments. In the following detailed description, certain exemplary embodiments of the present

disclosure are described by way of illustration only. Undoubtedly, those of ordinary skill in the art can recognize that the described embodiments may be modified in various different ways without departing from the spirit and scope of the present disclosure. Accordingly, the drawings and the description are illustrative in nature, rather than intended to limit the scope of protection of the claims.

[0025] As shown in FIGS. 1 and 2, the dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to an embodiment of the present disclosure includes a refrigerated container 1 configured to be provided on a truck. A vertical heat-insulating partition plate 2 is arranged vertically in the refrigerated container 1. The vertical heat-insulating partition plate 2 divides the internal cavity the refrigerated container 1 into a first temperature zone 3 and a second temperature zone 4 along a length direction of the refrigerated container 1. A surface on a side of the refrigerated container 1 within the first temperature zone 3 opposite the vertical heat-insulating partition plate 2 is provided with a cold-storage plate 5 and a cold-storage unit. The vertical heat-insulating partition plate 2 is provided with an inter-zone communication opening. An inter-zone temperature regulating fan 6 for guiding and conveying air in the first temperature zone 3 into the second temperature zone 4 is installed in the inter-zone communication opening.

[0026] The refrigerated container 1 is provided with a first external communication opening at a position corresponding to the first temperature zone 3. A first-temperature-zone temperature regulating fan 7 for guiding and conveying air in the first temperature zone 3 to the outside of the refrigerated container 1 is installed in the first external communication opening. The refrigerated container 1 is provided with a second external communication opening at a position corresponding to the second temperature zone 4. A second-temperature-zone temperature regulating fan 8 for guiding and conveying air in the second temperature zone 4 to the outside of the refrigerated container 1 is installed in the second external communication opening. Temperature sensors are provided on inner walls of the refrigerated container 1 at positions corresponding to the first temperature zone 3 and the second temperature zone 4 respectively, for detecting the temperature of the first temperature zone 3 and the temperature of the second temperature zone 4, respectively.

[0027] A control device and a temperature display device are also provided outside the refrigerated container 1. The inter-zone temperature regulating fan 6, the first-temperature-zone temperature regulating fan 7, the second-temperature-zone temperature regulating fan 8, the temperature sensors, and the temperature display device are each connected to the control device.

[0028] In embodiments of the present disclosure, the refrigerated container 1 may adopt a container body structure having a thermal insulation effect as used in the related arts, and the vertical heat-insulating partition plate 2 may be a thermal insulation board to achieve the purpose of heat insulation.

[0029] In some embodiments, the cold-storage plate 5 is installed flat on an inner wall on the

side of the refrigerated container 1 (i.e., the right inner side wall in FIG. 1). An area of the cold-storage plate 5 exceeds 80% of an area of the inner wall of the refrigerated container 1 on which the cold-storage plate 5 is installed. The cold-storage plate 5 and the vertical heat-insulating partition plate 2 are arranged opposite each other. Since the cold-release area of the cold-storage plate 5 is relatively large, the refrigeration effect is relatively good, and refrigeration effect of the first temperature zone 3 and the second temperature zone 4 can be achieved. In embodiments of the present disclosure, the cold-storage plate 5 has a flat rectangular housing and is installed in an upright orientation along the vertical direction on the inner wall surface of the refrigerated container 1, which occupies little space, thereby allowing space utilization within the first temperature zone 3 to be maximized. In addition, since the cold-storage plate 5 is charged to be cooled in advance using energy from an external alternating-current power supply, energy consumption is lower and transportation costs are lower than that when energy from an engine of a refrigerated truck is used.

[0030] The cold-storage plate provides refrigeration by utilizing the cooling capacity stored after the cold-storage medium in the cold-storage plate 5 is frozen. Before transportation, the cold-storage unit may first be connected to an external power supply to charge the cold-storage medium in the cold-storage plate 5 with cold, namely, to cool and freeze the cold-storage medium. During use, heat absorption by melting of the cold-storage medium is utilized to continuously release cold into the refrigerated container 1. The cold-storage plate 5 utilizes prestored cooling energy. Compared with the method in the related art in which a compressor is frequently switched on and off for cooling, temperature fluctuations in the refrigerated container 1 using the cold-storage plate 5 are smaller, and a constant temperature can be maintained.

[0031] In the refrigerated container according to embodiments of the present disclosure, using a set of cold-storage plates in combination with a plurality of fans can meet the different refrigeration requirements of two temperature zones. Compared with the use of a plurality of evaporators in the related art, in the present disclosure, not only the cost is lower, but the overall weight is also reduced, and the corresponding transportation energy consumption is also lower, allowing a total quantity of goods transported and transportation range to be increased.

[0032] Since cold air has a greater density than warm air, cold air tends to sink. Therefore, providing the inter-zone temperature regulating fan 6 adjacent to a lower portion of the vertical heat-insulating partition plate 2, i.e., providing the inter-zone temperature regulating fan 6 in a lower portion of the vertical heat-insulating partition plate 2 can shorten the time required for cold air to enter the second temperature zone 4.

[0033] The first external communication opening and the second external communication opening are provided in the top wall of the refrigerated container 1 and do not interfere with other structures. In addition, to prevent rainwater from entering the first external communication opening

and the second external communication opening, a semi-enclosed rain shield may be provided above an outer wall of the refrigerated container 1 at positions corresponding to the communication openings. The rain shield not only covers the communication openings from above, but also allows gas flow.

[0034] Two separate container doors are provided on side walls of the refrigerated container 1 at positions corresponding to the first temperature zone 3 and the second temperature zone 4, respectively. The two separate container doors are located at the same side of the refrigerated container 1. The two separate container doors correspond to the first temperature zone 3 and the second temperature zone 4 respectively, so that the first temperature zone 3 and the second temperature zone 4 can be opened separately to meet different loading and unloading requirements.

[0035] The inter-zone communication opening, the first external communication opening, and the second external communication opening have small diameters. Fans are respectively installed at the communication openings to achieve air circulation and air replenishment. When the fans are not operating, there is no forced airflow; so although the communication openings are open at this time, the effect on the internal refrigeration requirements is relatively small and may be disregarded.

[0036] In the field of refrigerated containers, frozen transport generally refers to transportation at a temperature of -20 to -10 °C; refrigerated transport generally refers to transportation at a temperature of -5 to 8 °C; and ambient-temperature transport generally refers to transportation at a temperature of 20 to 25 °C. It can thus be seen that it is sufficient for the temperature inside the refrigerated container 1 to be within a certain temperature range. Therefore, the temperature sensors may be provided at a position midway along the up-down direction inside the refrigerated container 1, so that the temperature data thus detected are representative.

[0037] The operating principle and operation of the refrigerated assembly according to embodiments of the present disclosure are described below.

[0038] By controlling the switching on and off of a plurality of fans, the control device can implement the following operating modes. A structural block diagram of the refrigerated assembly is shown in FIG. 5.

[0039] First operating mode refers to that when the first temperature zone 3 is a frozen-goods compartment, and the second temperature zone 4 is an ambient-temperature cargo compartment.

[0040] In the first operating mode, the first-temperature-zone temperature regulating fan 7 is switched off, the inter-zone temperature regulating fan 6 is switched off, and the second-temperature-zone temperature regulating fan 8 is switched on. At this time, the cold-storage plate 5 releases cold normally, and the temperature zoning effect and temperature maintenance capability for the first temperature zone 3 and the second temperature zone 4 are achieved by utilizing the thermal insulation and heat isolation properties of the refrigerated container 1. Referring to FIG. 3, the temperature sensors in the first temperature zone 3 and the second temperature zone 4

are used to monitor temperature fluctuations within the temperature zones and transmit the data to the control device. The control device then controls the switching on and off of each fan to adjust the temperature fluctuations.

[0041] Second operating mode refers to that when the first temperature zone 3 is a frozen-goods compartment, and the second temperature zone 4 is a refrigerated-goods compartment.

[0042] In the second operating mode, the first-temperature-zone temperature regulating fan 7 is switched off, the inter-zone temperature regulating fan 6 is switched on, and the second-temperature-zone temperature regulating fan 8 is switched off. The cold-storage plate 5 releases cold as usual, and the temperature zoning effect and temperature maintenance capability for the first temperature zone 3 and the second temperature zone 4 are achieved by utilizing the thermal insulation and heat isolation properties of the refrigerated container 1. Referring to FIG. 4, when the temperature of the second temperature zone 4 is too low, the inter-zone temperature regulating fan 6 is switched off and the second-temperature-zone temperature regulating fan 8 is switched on to raise the temperature; when the temperature of the second temperature zone 4 reaches the required level, the inter-zone temperature regulating fan 6 is switched off, and the properties of the container body are utilized for thermal insulation; when the temperature of the second temperature zone 4 is too high, the inter-zone temperature regulating fan 6 is used again to transfer cold air from the first temperature zone 3 into the second temperature zone 4.

[0043] Third operating mode refers to that when the first temperature zone 3 is a frozen-goods compartment, and the second temperature zone 4 is a frozen-goods compartment.

[0044] In the third operating mode, the first-temperature-zone temperature regulating fan 7 is switched off, the inter-zone temperature regulating fan 6 is switched on, and the second-temperature-zone temperature regulating fan 8 is switched off. The cold-storage plate 5 is charged with cold as usual, the inter-zone temperature regulating fan 6 remains switched on, and the temperature sensors in the first temperature zone 3 and the second temperature zone 4 are used to monitor temperature fluctuations within the temperature zones.

[0045] Fourth operating mode refers to that when the first temperature zone 3 is an ambient-temperature cargo compartment, and the second temperature zone 4 is an ambient-temperature cargo compartment.

[0046] In the fourth operating mode, the first-temperature-zone temperature regulating fan 7 is switched on, the inter-zone temperature regulating fan 6 is switched on, and the second-temperature-zone temperature regulating fan 8 is switched on. The cold-storage plate 5 is not charged with cold, and the temperature sensors in the first temperature zone 3 and the second temperature zone 4 are used to monitor temperature fluctuations within the temperature zones.

[0047] In the corresponding operating mode, the temperature sensors monitor the temperature inside the temperature zones and transmit the temperature data to the control device. The control

device can control the switching on and off of the corresponding fans to adjust temperature fluctuations within the internal temperature zones and meet the temperature requirements of the corresponding operating mode.

[0048] In the refrigerated assembly according to embodiments of the present disclosure, the combined use of the cold-storage plate 5 and a plurality of fans enables various different operating modes to be implemented between the two temperature zones, thereby meeting different usage requirements, with characteristics such as simple control, low cost, and good practicality.

[0049] The basic principles, main features, and advantages of the present disclosure have been shown and described above. Those skilled in the art should understand that the present disclosure is not limited to the above embodiments. The above embodiments and the descriptions in the specification merely illustrate the principles of the present disclosure. Various changes and improvements may also be made to the present disclosure without departing from the spirit and scope of the present disclosure, and such changes and improvements fall within the scope of protection sought by the present disclosure. The scope of protection sought by the present disclosure is defined by the appended claims and their equivalents.

CLAIMS

1. A dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics, comprising:

a refrigerated container configured to be provided on a truck;

a vertical heat-insulating partition plate arranged vertically in the refrigerated container; wherein the vertical heat-insulating partition plate divides an internal cavity of the refrigerated container into a first temperature zone and a second temperature zone along a length direction of the refrigerated container; the vertical heat-insulating partition plate has an inter-zone communication opening; the refrigerated container has a first external communication opening at a position corresponding to the first temperature zone; and the refrigerated container has a second external communication opening at a position corresponding to the second temperature zone;

a cold-storage plate and a cold-storage unit arranged on a surface on a side of the refrigerated container within the first temperature zone opposite the vertical heat-insulating partition plate;

an inter-zone temperature regulating fan for guiding and conveying air in the first temperature zone into the second temperature zone installed in the inter-zone communication opening;

a first-temperature-zone temperature regulating fan for guiding and conveying air in the first temperature zone to outside of the refrigerated container installed in the first external communication opening;

a second-temperature-zone temperature regulating fan for guiding and conveying air in the second temperature zone to the outside of the refrigerated container installed in the second external communication opening; and

temperature sensors arranged on inner walls of the refrigerated container at positions corresponding to the first temperature zone and the second temperature zone, respectively.

2. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 1, further comprising a control device and a temperature display device arranged outside the refrigerated container, wherein the inter-zone temperature regulating fan, the first-temperature-zone temperature regulating fan, the second-temperature-zone temperature regulating fan, the temperature sensors, and the temperature display device are each connected to the control device.

3. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 1, wherein the cold-storage plate is installed flat on an inner wall on the side of the refrigerated container.

4. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 3, wherein an area of the cold-storage plate exceeds 80% of an area of the inner wall of the refrigerated container on which the cold-storage plate is installed.

5. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 1, wherein the inter-zone temperature regulating fan is adjacent to a lower portion of the vertical heat-insulating partition plate.

6. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 1, wherein the first external communication opening and the second external communication opening are provided in a top wall of the refrigerated container.

7. The dual-temperature-zone and multi-mode intelligent refrigerated assembly for logistics according to claim 1, wherein two separate container doors are provided on side walls of the refrigerated container at positions corresponding to the first temperature zone and the second temperature zone, respectively, and the two separate container doors are located at the same side of the refrigerated container.