

REFRIGERATED CONTAINER PROVIDED WITH VENTILATION SYSTEM

BACKGROUND

[0001] Products such as produce or meat may be shipped relatively long distances and may be placed within refrigerated containers. These refrigerated containers are specifically designed for conditioning an interior space with refrigerated air for an extended period of time. These refrigerated containers utilize a refrigeration unit that circulates cooled air inside the interior space through evaporator fans, which direct the air from the front of the container to the rear. Refrigerant from the refrigeration unit may leak inside the refrigerated container.

SUMMARY

[0002] Disclosed is a refrigerated container that includes an interior space and a ventilation system. The interior space is defined by a floor, a top disposed opposite the floor, a front wall extending between the floor and the top, a rear wall disposed opposite the front wall and extending between the floor and the top, and a pair of side walls extending between the floor and the top and extending between the front wall and the rear wall. The ventilation system includes a vent door that is movably disposed on at least one of the floor, the front wall, and a side wall of the pair of side walls. The vent door is movable between a closed position and an open position.

[0003] Also disclosed is a refrigerated container that includes a front wall extending between a floor and a top, a rear wall disposed opposite the front wall and extending between the floor and the top, and a pair of side walls extending between the floor and the top and extending between the front wall and the rear wall. The refrigerated container also includes a ventilation system that includes an injection port and a vent port. The injection port extends through at least one of the front wall, the rear wall, and a side wall of the pair of side walls. The vent port is spaced apart from the injection port. The vent port extends through at least one of the front wall, the rear wall, and a side wall of the pair of side walls.

[0004] Further disclosed is a ventilation system that includes a leak sensor, a controller, and at least one of an injection port and a vent door. The leak sensor is disposed within an interior space of a refrigerated container and is arranged to provide a signal indicative of a concentration of a refrigerant within the interior space. The controller is arranged to receive the signal. At least one of the injection port and the vent door is disposed on at least one of a floor, a front wall, and a side wall of the refrigerated container.

[0005] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The subject matter of the present disclosure is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the present disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0007] FIG. 1 is a partial perspective view of a refrigerated container employing a ventilation system;

[0008] FIG. 2 is a partial schematic view of the ventilation system in a closed position;

[0009] FIG. 3 is a partial schematic view of the ventilation system in an open position;

[0010] FIG. 4 is a partial schematic view of a refrigerated container employing a ventilation system;

[0011] FIG. 5 is a partial schematic view of a ventilation system in a closed position; and

[0012] FIG. 6 is a partial schematic view of the ventilation system in an open position.

DETAILED DESCRIPTION

[0013] Referring now to the Figures, where the present disclosure will be described with reference to specific embodiments, without limiting same, it is to be understood that the disclosed embodiments are merely illustrative of the present disclosure that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present disclosure.

[0014] Referring to the figures, a refrigerated trailer or a refrigerated container 10 may be provided with a refrigeration system 12 that provides conditioned air or cooled air 14 to an interior space 16 of the refrigerated container 10. The refrigeration system 12 may be adapted to operate using a refrigerant 18 such as a low global warming potential refrigerant

including A1, A2, A2L, A3, etc. The refrigerant 18 may leak into the interior space 16 of the refrigerated container 10, as shown in FIG. 4. The refrigerant 18 may present a hazard should the concentration of the leaked refrigerant within the confined space exceed a threshold level. The threshold level may be a lower flammability limit of the refrigerant 18. A ventilation system 20 may be provided to mitigate leakage of the refrigerant by venting the leaked refrigerant to an external environment.

[0015] Referring to FIGS. 1 and 4, the interior space 16 of the refrigerated container 10 is defined by a floor 30, a front wall 32, a rear wall 34, a top wall 36, and a pair of side walls 38. The floor 30 extends between proximal ends of the front wall 32, the rear wall 34, and the pair of side walls 38. The floor 30 is spaced apart from and is disposed opposite the top wall 36. The front wall 32 extends between first ends of the floor 30 and the top wall 36. The rear wall 34 is disposed opposite the front wall 32 and extends between second ends of the floor 30 and the top wall 36. The top wall 36 extends between distal ends of the front wall 32, the rear wall 34, and the pair of side walls 38. The top wall 36 is disposed opposite the floor 30. The pair of side walls 38 extend between the floor 30 and the top wall 36 and the pair of side walls extend between the front wall 32 and the rear wall 34.

[0016] Referring to FIGS. 1-3, the ventilation system 20 is arranged to mitigate leakage of the refrigerant 18 from within the interior space 16 by allowing the refrigerant 18 to vent or escape through the floor 30, the front wall 32, and/or a sidewall of the pair of side walls 38. The ventilation system 20 includes a baffle or a vent door 50, a leak sensor 52, an actuator 54, and a controller 56.

[0017] The vent door 50 may be movably disposed on at least one of the floor 30, the front wall 32, or a side wall of the pair of side walls 38. The vent door 50 is movable between a closed position, as shown in FIGS. 2 and 5, and an open position, as shown in FIGS. 3 and 6. The vent door 50 is shown as hingedly moving between the closed position and the open position, however the vent door 50 may move between the closed position and the open position in a variety of ways, such as a sliding motion, hinged motion, folding motion, pivoting motion, or other motion that selectively opens and closes the vent door 50 of the refrigerated container 10 that permits or facilitates the venting of the refrigerant 18 from the interior space 16.

[0018] In at least one embodiment, a flow equalization area 58 may be defined by at least one of the floor 30, the front wall 32, and a sidewall of the pair of side walls 38. The flow equalization area 58 may be disposed proximate the vent door 50 or opening within the refrigerated container 10 that receives the vent door 50.

[0019] The leak sensor 52 is arranged to provide a signal indicative of a concentration of a refrigerant that may be present within the interior space 16. The leak sensor 52 may be disposed within the interior space 16, proximate the floor 30.

[0020] The actuator 54 is arranged to facilitate movement of the vent door 50 between the closed position and the open position. The actuator 54 may include a first lock member 60 that is disposed on a surface of the vent door 50 and a second lock member 62 that is disposed on a surface of the refrigerated container 10.

[0021] The actuator 54 may facilitate the vent door 50 to open by gravity due to the disengagement of the first lock member 60 from the second lock member 62. The first lock member 60 engages or interfaces with the second lock member 62, to inhibit the vent door 50 from moving from the closed position towards the open position. The first lock member 60 disengages from the second lock member 62, to facilitate the vent door 50 moving from the closed position towards the open position. In such an arrangement the first lock member 60 and the second lock member 62 may be components of a mechanical lock, a magnetic lock, or the like.

[0022] The actuator 54 may drive or move the vent door 50 from the closed position towards the open position, such that the first lock member 60 may be a motor having a drive member that drives a driven member of the second lock member 62, or vice versa.

[0023] The controller 56 may be provided with the refrigeration system 12 or may be a standalone controller. In at least one embodiment, the controller 56 may be provided as a standalone controller that is in communication with the refrigeration system 12.

[0024] The controller 56 is in communication with the leak sensor 52 and the actuator 54, and in some embodiments the controller 56 is also in communication with the vent door 50. The controller 56 is provided with input communication channels that are arranged to receive the signal from the leak sensor 52 and in some embodiments a pressure sensor. The controller 56 is provided with output communication channels that are arranged to provide signals or commands to the actuator 54 or to the vent door 50 to facilitate movement of the vent door 50 from the closed position towards the open position.

[0025] The controller 56 is provided with at least one processor that is programmed to perform control logic, control algorithms, or functions to command the actuator 54 to facilitate the movement of the vent door 50 from the closed position towards the open position based on the signal indicative of the concentration levels of refrigerant 18 within the interior space 16 of the refrigerated container 10. The control logic, control algorithm, or functions may be performed as a closed loop control system.

[0026] The controller 56 is programmed to output for display, via the output communication channels, an indicator, responsive to the signal from the leak sensor 52 being indicative of a concentration of the refrigerant 18 within the interior space 16 being greater than a threshold concentration.

[0027] The arrangement of the ventilation system 20 as shown in FIGS. 1 -3, facilitates the ventilation of the refrigerant 18 from within the interior space 16 of the refrigerated container 10 without the use of a fan or other fresh air exchange. The ventilation system 20 enables refrigerant 18 that may collect near the floor 30 of the refrigerated container 10 to vent to an external environment via gravity. The opening of the vent door 50 facilitates the migration of the refrigerant 18 towards the opening that the vent door 50 selectively opens and closes.

[0028] Referring to FIG. 4, the ventilation system 20 may include an injection port 70, a relief device or a vent port 72, a compressor 74, a pressure sensor 76, the leak sensor 52, and the controller 56.

[0029] The injection port 70 extends through at least one of the front wall 32, the rear wall 34, the top wall 36, and a sidewall of the pair of side walls 38. The injection port 70 is arranged to facilitate a fluid flow such as air from an external environment into the interior space 16 of the refrigerated container 10.

[0030] The vent port 72 is spaced apart from the injection port 70 and is disposed proximate the floor 30. In such an arrangement, the vent port 72 may also extend through at least one of the front wall 32, the rear wall 34, the top wall 36, and a sidewall of the pair of side walls 38. The vent port 72 is arranged to facilitate the ventilation of the refrigerant 18 that may be present within the interior space 16 of the refrigerated container 10. The vent port 72 is normally in a closed position and acts as a ventilation device or pressure relief device to prevent the refrigerated container 10 from exceeding an internal pressure threshold. In at least one embodiment, the vent port 72 may be a ventilation fan.

[0031] The compressor 74 is fluidly connected to the injection port 70 and is arranged to inject air into the interior space 16 of the refrigerated container 10 through the injection port 70.

[0032] The pressure sensor 76 is in communication with the controller 56. The pressure sensor 76 is arranged to provide a signal indicative of a pressure within the interior space 16 of the refrigerated container 10.

[0033] The controller 56 is arranged to receive the signal indicative of the concentration of the refrigerant within the interior space 16 from the leak sensor 52. The

controller 56 is programmed to output for display an indicator, via the output communication channels, responsive to the signal being indicative of the concentration of the refrigerant within the interior space 16 being greater than a threshold concentration. In at least one embodiment, the indicator may be an auditory signal, a message to an operator indicating the concentration of the refrigerant 18 within the interior space 16 being greater than a threshold concentration. In at least one embodiment, the indicator may also notify an operator to connect the compressor 74 to the injection port 70 and apply an airflow through the injection port 70 to pressurize the refrigerated container 10 with air.

[0034] The controller 56 is programmed to command the compressor 74, via the output communication channels, to supply or apply an airflow through the injection port 70 and into the interior space 16, responsive to the signal being indicative of the concentration of the refrigerant 18 within the interior space 16 being greater than a threshold concentration.

[0035] Responsive to the signal provided by the pressure sensor 76 being indicative of a pressure within the interior space 16 being greater than a threshold pressure, the vent port 72 opens, facilitating at least a portion of the refrigerant 18 from within the interior space 16 to vent through the vent port 72 to an external environment.

[0036] In at least one embodiment, should the vent port 72 be a ventilation fan, the controller 56 may command the ventilation fan be operated, via the output communication channels, responsive to the pressure within the interior space 16 being greater than a threshold pressure or responsive to the signal being indicative of a concentration of the refrigerant 18 within the interior space 16 being greater than a threshold concentration.

[0037] The compressor 74 may continue to apply an airflow into the interior space 16 through the injection port 70 at least until the atmosphere within the interior space 16 improves by the concentration of the refrigerant 18 falling below a threshold concentration.

[0038] The arrangement of the ventilation system 20 as shown in FIG. 4, provides positive pressure ventilation to vent the refrigerant 18 from within the interior space 16 of the refrigerated container 10 into an external environment. The arrangement of the ventilation system 20 replaces the refrigerant 18 from within the interior space 16 of the refrigerated container 10 with fresh air.

[0039] Referring to FIGS. 5 and 6, aspects of the embodiments shown in FIGS. 1-4 may be combined. In such an embodiment, the ventilation system 20 includes the vent door 50, the leak sensor 52, the actuator 54, the controller 56, the injection port 70, and the compressor 74.

[0040] The controller 56 is arranged to receive the signal from the leak sensor 52. The controller 56 is programmed to command the compressor 74, via the output communication channels, to apply an airflow through the injection port 70 and into the interior space 16, responsive to the signal being indicative of a concentration of the refrigerant 18 within the interior space 16 being greater than a threshold concentration. The controller 56 is programmed to command the actuator 54, via the output communication channels, to facilitate the movement of the vent door 50 from the closed position towards the open position, responsive to at least one of the signal from the leak sensor 52 being indicative of a concentration of refrigerant 18 within the interior space 16 being greater than a threshold concentration and/or the signal from the pressure sensor 76 being indicative of a pressure within the interior space 16 being greater than a threshold pressure.

[0041] The arrangement of the ventilation system 20 as shown in FIGS. 5 and 6, facilitates positive pressure ventilation of the refrigerant 18 from the interior space 16 to an exterior environment as well as gravity fed ventilation through the vent door 50.

[0042] While the present disclosure has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the present disclosure is not limited to such disclosed embodiments. Rather, the present disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the present disclosure. Additionally, while various embodiments of the present disclosure have been described, it is to be understood that aspects of the present disclosure may include only some of the described embodiments or the described embodiments may be combined so as to provide further embodiments. Accordingly, the present disclosure is not to be seen as limited by the foregoing description.