

ACTIVELY COOLED CONTAINER

Related Applications

- 5 **[0001]** This application claims the benefit of provisional patent application serial number 63/090,432, filed October 12, 2020, the disclosure of which is hereby incorporated herein by reference in its entirety.

Field of the Disclosure

- 10 **[0002]** The present disclosure relates to systems and methods related to actively cooled containers.

Background

- 15 **[0003]** Current methods for refrigerated/frozen product storage & transportation in grocery, supply chain, delivery, and other perishable cold chain applications are: Phase-change material (i.e. "ice" packs: Paraffin, water-ice, glycol, Dry-ice, etc.); Refrigerated Trucks/Containers used in shipping and over-the-road applications; Large scale cooling of warehouse location using conventional HVAC to cold chain compliant temperatures. Improved systems and methods for cooled product storage are needed.
- 20

Summary

- 25 **[0004]** Systems and methods for modular power and access control for actively cooled containers are provided. In some embodiments, a mobile and/or stationary, modular, power system/dock for perishable storage/transport containers with active cooling functionality is provided to maintain a controlled internal temperature for extended periods. In some embodiments, this active cooling can include: thermoelectric (TEC), Stirling-cooler; and/or vapor compression. This can be in support of refrigerated or frozen cargos in (but not limited to) Cold chain, grocery (food), Pharma, Medical applications, or
- 30 specialized customer requirements. The power system is useable with either

mains, locally generated, and/or battery power. In some embodiments, the system includes a proximity sensor and/or switching system to control timing of power application and power removal to the food storage cooler to eliminate risk of arcing or shock.

- 5 **[0005]** In some embodiments, the dock has access control locking features that secure the actively cooled storage/transport device from unauthorized removal. In some embodiments, this enables remote utilization and unattended delivery drop-off and pickup while maintaining the unit in a fully powered condition to preserve the integrity of perishable goods.
- 10 **[0006]** Those skilled in the art will appreciate the scope of the present disclosure and realize additional aspects thereof after reading the following detailed description of the preferred embodiments in association with the accompanying drawing figures.

15 Brief Description of the Drawing Figures

[0007] The accompanying drawing figures incorporated in and forming a part of this specification illustrate several aspects of the disclosure, and together with the description serve to explain the principles of the disclosure.

- [0008]** Figure 1 illustrates an example insulated container with active
20 refrigeration system, according to some embodiments of the current disclosure;

[0009] Figure 2 illustrates a power System for Perishable storage container. (AC Mains power shown), according to some embodiments of the current disclosure;

- [0010]** Figure 3 illustrates an active container power configuration for left-hand
25 or right-hand docking, according to some embodiments of the current disclosure;

[0011] Figure 4 illustrates example electrical contacts and proximity sensor (Magnetic and Hall-effect shown), according to some embodiments of the current disclosure;

- [0012]** Figure 5 illustrates a generic automated warehouse/racking kept at
30 room temperature, according to some embodiments of the current disclosure;

[0013] Figure 6 illustrates a secure local/remote dock diagram, according to some embodiments of the current disclosure; and

[0014] Figure 7 illustrates a rack implementation with docking/locking rails, according to some embodiments of the current disclosure.

5

Detailed Description

[0015] The embodiments set forth below represent the necessary information to enable those skilled in the art to practice the embodiments and illustrate the best mode of practicing the embodiments. Upon reading the following

10 description in light of the accompanying drawing figures, those skilled in the art will understand the concepts of the disclosure and will recognize applications of these concepts not particularly addressed herein. It should be understood that these concepts and applications fall within the scope of the disclosure and the accompanying claims.

15 **[0016]** The present disclosure relates to an insulated container that features an active cooling system i.e. (thermoelectric, vapor-compression, Stirling, etc.) installed directly into the cooler in a removable or built-in module). Figure 1 illustrates an example insulated container with active refrigeration system, according to some embodiments of the current disclosure. Additional details can
20 be found in International Patent Application serial number PCT/US2020/067172, filed December 28, 2020, the disclosure of which is hereby incorporated herein by reference in its entirety; and U.S. Patent Application Serial Number 17/135,420, filed on December 28, 2020, the disclosure of which is hereby
25 incorporated herein by reference in its entirety. Both of these claim priority to Provisional Patent Application Serial Number 62/953,771, filed December 26, 2019.

[0017] Additional details regarding the use of these insulated containers can be found in Provisional Patent Application Serial Number 63/244,518, filed September 15, 2021.

30 **[0018]** Direct or filtered AC or DC power applied through Power System with minimal internal losses is discussed below. Figure 2 illustrates a power System

for Perishable storage container. (AC Mains power shown), according to some embodiments of the current disclosure.

- [0019]** Potential sources are (but not limited to): Mains power (typically 90-240V at 50Hz or 60Hz); Photovoltaic (PV); Vehicle power bus (Typically 12-48VDC); Battery system; Micro-turbine (wind).

[0020] Power transfer implementation includes but is not limited to: Magnetic coupling; Direct contact.

[0021] Wireless transmission

- 10 **[0022]** Figure 3 illustrates an active container power configuration for left-hand or right-hand docking, according to some embodiments of the current disclosure.

[0023] Figure 4 illustrates example electrical contacts and proximity sensor (Magnetic and Hall-effect shown), according to some embodiments of the current disclosure. The proximity sensor is used to time application and removal of power to the container with no need for manual intervention. In some embodiments, dual input contacts allow for left-hand or right-hand docking to facilitate cargo access in multiple applications. Integrated contacts can allow for direct connection and/or stand-alone battery module to be securely docked/affixed to container for self-powered applications.

- 20 **[0024]** These embodiments could potentially be used in (but not limited to): Robotic warehouse/racking systems where manual plug/unplug of the container is not feasible and/or desirable; Manual systems where minimum employee interaction time is needed; Mobile delivery platforms to extend safe delivery ranges; Remote deployment dock/racks. Figure 5 illustrates a generic automated warehouse/racking kept at room temperature, according to some embodiments of the current disclosure.

[0025] Some embodiments feature optional security functions to enable remote, unattended, drop-off and/or pickup. Figure 6 illustrates a secure local/remote dock diagram, according to some embodiments of the current disclosure. Figure 7 illustrates a rack implementation with docking/locking rails, according to some embodiments of the current disclosure.

[0026] Current methods for refrigerated/frozen product storage & transportation in grocery, supply chain, delivery, and other perishable cold chain applications are:

- 5 * Phase-change material (i.e. "ice" packs: Paraffin, water-ice, glycol, Dry-ice, etc.)
 - Active cooling provides indefinite holdover as long as power is available from any source
 - Greater tolerance for economy (longer term) shipping options
 - 10 ○ Greater tolerance for extended shipping periods to remote locations
- * Refrigerated Trucks/Containers, used in shipping and over-the-road applications
 - 15 ○ Modular, actively cooled containers provide more efficient use of space and minimize energy requirements for partial loads
 - Minimized risk of compromising order integrity
 - Individualized monitoring and logging and temperature data
 - Multiple temperature options
 - 20 * Large scale cooling of warehouse location using conventional HVAC to cold chain compliant temperatures
 - Modular, self-contained, actively cooled containers (incorporating TEC, VC, Stirling, etc.) for commercial refrigerated/frozen food storage enables point of need cold
 - 25 chain compliance, efficient use of space, and ability to maintain active cold chain compliance while transporting goods outside of the warehouse.
 - A fast, automatic and simple method of power application & removal improves robotic and manual movement of the
 - 30 active coolers. It removes manual steps of plugging and unplugging the cooler.

- Security and access control features enable extended remote deployment.

[0027] Those skilled in the art will recognize improvements and modifications to the preferred embodiments of the present disclosure. All such improvements and modifications are considered within the scope of the concepts disclosed herein and the claims that follow.

[0028] Embodiments

10 **[0029]** Embodiment 1: An actively cooled container comprising one or more of: modular power; active cooling; and an access control system.

[0030] Embodiment 2: Embodiment 1 wherein the active cooling comprises thermoelectric (TEC), Stirling-cooler; and/or vapor compression.

15 **[0031]** Embodiment 3: Any of Embodiments 1-2 wherein power system is useable with either mains, locally generated, and/or battery power.

[0032] Embodiment 4: Any of Embodiments 1-3 further comprising: a proximity sensor and/or switching system to control timing of power application and power removal.

20 **[0033]** Embodiment 5: Any of Embodiments 1-4 further comprising: access control locking features that secure the actively cooled container from unauthorized removal.

[0034] Embodiment 6: Any of Embodiments 1-5 wherein remote utilization and unattended delivery drop-off and pickup is enabled while maintaining the actively cooled container in a fully powered condition to preserve the integrity of perishable goods.

25

Claims

1. An actively cooled container comprising:
a modular power subsystem;
5 an active cooling subsystem; and
an access control subsystem.
2. The actively cooled container of claim 1 wherein the active cooling
subsystem comprises one or more of the group consisting of: a thermoelectric
10 cooler (TEC), a Stirling-cooler; and a vapor compression subsystem.
3. The actively cooled container of any of claims 1 to 2 wherein the modular
power subsystem is useable with one or more of the group consisting of: mains
power, locally generated power, and battery power.
15
4. The actively cooled container of any of claims 1 to 3 further comprising: a
proximity sensor and/or a switching system to control timing of power application
and power removal.
- 20 5. The actively cooled container of any of claims 1 to 4 further comprising:
access control locking features that secure the actively cooled container from
unauthorized removal.
6. The actively cooled container of any of claims 1 to 5 wherein remote
25 utilization and unattended delivery drop-off and pickup is enabled while
maintaining the actively cooled container in a fully powered condition to preserve
integrity of perishable goods.
7. A dock for accepting an actively cooled container comprising:
30 a power subsystem; and
an access control subsystem.

8. The dock of claim 7 wherein the access control subsystem secures the actively cooled container from unauthorized removal from the dock.
- 5 9. The dock of any of claims 7 to 8 wherein the actively cooled container includes the features of any of claims 1 to 6.