United States Patent Application Publication 20250261331
Kind Code A1
Publication Date August 14, 2025
Inventor(s) Maloney; Jerome A. et al.

EMERGENCY COOLING SYSTEM

Abstract

An emergency cooling system for a cabinet may include an exhaust assembly frame comprising one or more exhaust apertures. The emergency cooling system for the cabinet may include one or more flaps configured to reversibly engage the one or more exhaust apertures. The one or more flaps may be coupled via a hinge to the frame. The weight of the one or more flaps may biases the one or more flaps toward a closed position.

Inventors: **Maloney; Jerome A. (Sugar Grove, IL), Sprague; Peter M. (Big Rock, IL), Elkins; Jin H. (Auburn, AL), Podemski; Matthew A. (Auburn, AL)**

Applicant: **VERTIV CORPORATION** (Westerville, OH)

Family ID: **1000008461856**

Appl. No.: **19/037959**

Filed: **January 27, 2025**

Related U.S. Application Data

us-provisional-application US 63553324 20240214

Publication Classification

Int. Cl.: **H05K7/20** (20060101)

U.S. Cl.:

CPC **H05K7/20181** (20130101); **H05K7/20145** (20130101); **H05K7/20209** (20130101); **H05K7/20736** (20130101); **H05K7/20827** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] The present application claims priority to U.S. Provisional Patent Application No. 63/553,324, filed Feb. 14, 2024, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to cooling systems for cabinets, and more particularly for emergency cooling systems for power/equipment cabinets.

BACKGROUND

[0003] Telecommunication and computing industries rely on cooling systems to keep temperature-sensitive equipment (e.g., servers, computers) operating under rated or normal environmental conditions. For vital systems, independently operating backup cooling systems, such as backup cooling systems for power/equipment cabinets (e.g., server cabinets), are also employed so that proper cooling can be maintained when the main cooling systems have failed. However, backup cooling systems can be difficult to employ, particularly if the backup cooling system is to be added to a legacy system (e.g., retrofitting). Backup cooling systems can also be expensive, requiring complex components. Accordingly, it may be advantageous to have a backup cooling system for power/equipment cabinets that are easy to employ and/or retrofit.

SUMMARY

[0004] Accordingly, the present disclosure is directed to an emergency cooling system for a cabinet. The emergency cooling system may include an exhaust assembly. The exhaust assembly may include an exhaust assembly frame that includes one or more exhaust apertures. The exhaust assembly may further include one or more flaps configured to reversibly engage the one or more exhaust apertures. The exhaust assembly is configured so that at least one of airflow or air pressure within the cabinet biases the one or more flaps into an open position. When the one or more flaps are in a closed position, the one or more exhaust apertures or the one or more flaps may be positioned at an angle relative to normal, such as an angle within a range of 2° to 15°.

[0005] In one or more embodiments, the emergency cooling system may further include an environmental control unit. The environment control unit may include one or more cooling fans, a temperature sensor, and at least one processor. The at least one processor may be communicatively coupled to the one or more cooling fans, the temperature sensor, and a primary cooling system. The processor may be configured to determine an operating status of the primary cooling system, receive temperature sensor data, and activate the one or more fans based on at least one of the operating status of the primary cooling system of the temperature sensor data, wherein turning on the one or more fans results in the airflow or the air pressure within the cabinet that biases the one or more flaps into the open position.

[0006] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not necessarily restrictive of the present disclosure. The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate subject matter of the disclosure. Together, the descriptions and the drawings serve to explain the principles of the disclosure.

[0007] In embodiments, an emergency cooling system for a cabinet is disclosed. In embodiments, the emergency cooling system includes an environmental control unit, the environmental control unit including: one or more cooling fans; a temperature sensor; at least one processor communicatively coupled to the one or more cooling fans, the temperature sensor, and a primary cooling system, wherein the at least one processor is configured to: determine an operating status of the primary cooling system; receive temperature sensor data; and activate the one or more fans based on at least one of the operating status of the primary cooling system of the temperature

sensor data; and an exhaust assembly including: an exhaust assembly frame including one or more exhaust apertures; and one or more flaps configured to reversibly engage the one or more exhaust apertures.
[0008] In embodiments, a method for retrofitting a cabinet with an emergency cooling system is disclosed. In embodiments, the method, includes: replacing a panel of a cabinet with an exhaust panel assembly; removing a primary cooling system from a door of the cabinet and replacing the door with a new door that includes intake component of an emergency cooling system; reassembling the primary cooling system to the new door; and mounting an environmental control unit and connecting any cables from the environmental control unit to one or more fans, alarm systems, or power systems of the cabinet.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0009] The numerous advantages of the disclosure may be better understood by those skilled in the art by reference to the accompanying figures.
[0010] FIG. **1** illustrates a perspective view of a cabinet that includes an emergency cooling system (ECS), in accordance with one or more embodiments of the disclosure.
[0011] FIG. **2** illustrates a perspective view of the cabinet of FIG. **1** with a panel opened, in accordance with one or more embodiments of the disclosure.
[0012] FIG. **3** illustrates a reverse perspective view of the cabinet of FIG. **1**, in accordance with one or more embodiments of the disclosure.
[0013] FIG. **4** illustrates a perspective view of an exhaust assembly for the ECS, in accordance with one or more embodiments of the disclosure.
[0014] FIG. **5**A illustrates a perspective view of an exhaust assembly for the ECS that includes an exhaust panel, in accordance with one or more embodiments of the disclosure.
[0015] FIG. **5**B illustrates a side view of the cabinet and exhaust assembly, with flaps configured in a closed position, in accordance with one or more embodiments of the disclosure.
[0016] FIG. **5**C illustrates a side view of the cabinet and exhaust assembly, with flaps configured in an open position, in accordance with one or more embodiments of the disclosure.
[0017] FIG. **6** illustrates a partially exploded view of a cabinet panel and the intake components of an emergency cooling system, in accordance with one or more embodiments of the disclosure.
[0018] FIG. **7** illustrates a cabinet that is to be retrofitted with an emergency cooling system, in accordance with one or more embodiments of the disclosure.
[0019] FIG. **8** illustrates a process flow diagram depicting a method for retrofitting a cabinet with an emergency cooling system, in accordance with one or more embodiments of the disclosure.
[0020] FIG. **9** illustrates a block diagram depicting a schematic of the power and data connectivity of the emergency cooling system and a primary cooling system of a cabinet, in accordance with one or more embodiments of the disclosure.
DETAILED DESCRIPTION
[0021] Before explaining one or more embodiments of the disclosure in detail, it is to be understood that the embodiments are not limited in their application to the details of construction and the arrangement of the components or steps or methodologies set forth in the following description or illustrated in the drawings. In the following detailed description of embodiments, numerous specific details may be set forth in order to provide a more thorough understanding of the disclosure. However, it will be apparent to one of ordinary skill in the art having the benefit of the instant disclosure that the embodiments disclosed herein may be practiced without some of these specific details. In other instances, well-known features may not be described in detail to avoid unnecessarily complicating the instant disclosure.

[0022] As used herein a letter following a reference numeral is intended to reference an embodiment of the feature or element that may be similar, but not necessarily identical, to a previously described element or feature bearing the same reference numeral (e.g., **1**, **1***a*, **1***b*). Such shorthand notations are used for purposes of convenience only and should not be construed to limit the disclosure in any way unless expressly stated to the contrary.

[0023] Further, unless expressly stated to the contrary, "or" refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by any one of the following: A is true (or present), and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0024] In addition, the use of "a" or "an" may be employed to describe elements and components of embodiments disclosed herein. This is done merely for convenience and "a" and "an" are intended to include "one" or "at least one," and the singular also includes the plural unless it is obvious that it is meant otherwise.

[0025] Finally, as used herein any reference to "one embodiment" or "embodiments" means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment disclosed herein. The appearances of the phrase "in embodiments" in various places in the specification are not necessarily all referring to the same embodiment, and embodiments may include one or more of the features expressly described or inherently present herein, or any combination or sub-combination of two or more such features, along with any other features which may not necessarily be expressly described or inherently present in the instant disclosure.

[0026] Disclosed is an emergency cooling system (ECS) for power/equipment cabinets, such as server cabinets. The ECS operates independently from any external or internal primary cabinet cooling system. The ECS includes componentry for producing airflow (e.g., fan) and a passive system for operating an exhaust system (e.g., an exhaust assembly) that "opens up" upon the presence of airflow or increased air pressure within the cabinet. In some embodiments, the ECS includes only the exhaust assembly. In some embodiments, the exhaust assembly is configured to be installed or retrofitted within a legacy/prebuilt cabinet.

[0027] In embodiments, as illustrated in FIG. **1**, a cabinet **90** that includes an ECS **100** is presented. The cabinet **90** may be any type of cabinet for storing powered equipment, telecommunication equipment, or computer equipment. For example, the cabinet **90** may be configured as a server cabinet that stores computer hardware. The cabinet **900** may include a top panel **108** one or more side panels **112***a-b*, and one or more doors **116***a-b*. The cabinet **90** may include an intake side **120** (e.g., at door **116***a*) and an exhaust side **124** (e.g., at door **116***b*). The ECS **100** may include intake components **128** (e.g., integrated into the intake side **120**) and exhaust components **132** (e.g., integrated into the exhaust side **124**). The cabinet **90** may also include a primary cooling system **136**.

[0028] The ECS **100** may include one or more fans **204***a-c*, as shown in FIG. **2**. When turned on, the one or more fans **204***a-c* cause airflow within the cabinet **90**, bringing in outside air from the intake side **120**, and moving the air toward the exhaust side **124** (e.g., through a storage space **206** of the cabinet **90**). The movement of air by the one or more fans **204***a-c* may also cause an increase in air pressure within the cabinet **90** (e.g., as compared to the air pressure outside of the cabinet **90**). Movement of air through the cabinet **90** may be guided via one or more fan ducts **208**. The ECS **100** may further include an environmental control unit **212** that includes one or more processors that control one or more aspects of the ECS **100**. The ECS **100** may further include one or more temperature sensors **216** that can sense a temperature within the cabinet **90**.

[0029] Details of the exhaust components **132** are illustrated in FIGS. **3-5**. The exhaust components **132** of the ECS **100** include an exhaust assembly **304** (e.g., an external panel **305** of the exhaust assembly **304** visible in FIG. **3**. When the one or more fans **204***a-c* of the ECS **100** are activated, air **306** is moved from inside the cabinet **90** to outside the cabinet **90** through the exhaust assembly

304 via an exhaust opening **308**.

[0030] The exhaust assembly **304** includes a housing **404** that comprises the external panel **305**, a top housing panel **408**, side housing panels **412***a-b*, and a frame **416**. The frame includes one or more exhaust apertures **420***a-b* that are engaged (e.g., can be closed off by) one or more flaps **424***a-b*. The one or more flaps **424***a-b* function to reversibly engage the exhaust apertures **420***a-b* similar to a duct louver or louver blade. When the one or more flaps **424***a-b* engage the exhaust apertures **420***a-b*, the exhaust assembly **304** is in a closed position, with air inhibited from entering into the housing **404** from the storage space **206** of the cabinet **90**. The exhaust assembly **304** in the closed position is illustrated in FIG. **4**. When the exhaust assembly **304** is in the open position, the one or more flaps **424***a-b* disengage at least partially from the exhaust apertures **420***a-b* allowing air **306** from the storage space **206** of the cabinet **90** to enter the housing **404** and exit through the exhaust opening **308**. The one or more flaps **424***a-b* may be operatively coupled to the frame **416** or frame elements via any connectors that allow the one or more flaps **424***a-b* to reversibly engage the exhaust apertures **420***a-b* including but not limited to a hinge **426***a-b*, such as a hinge **426***a-b* that couples to a top side **428***a-b* of the one or more flaps **424***a-b*. The exhaust assembly **304** may include any number of flaps **424**. For example, the exhaust assembly **304** may include a single flap **424**. In another example, the exhaust assembly **304** may include two flaps **424**. In another example, the exhaust assembly **304** may include three flaps **424**. In another example, the exhaust assembly **304** may include four flaps **424**.

[0031] In embodiments, when exhaust assembly **304** is configured in a closed position (e.g., the one or more flaps **424***a-b* stopping or inhibiting airflow through the exhaust apertures **420***a-b*), airflow and/or increases in air pressure produced by the one or more fans **204***a-c* may then cause the exhaust assembly **304** to change configuration to an open position, with the one or more flaps **424***a-b* allowing air to pass through the exhaust apertures **420***a-b* and out the exhaust opening **308**. The difference in air pressure (e.g., between the storage space **206** and the air outside the cabinet) required to move the one or more flaps **424***a-b* away from the exhaust apertures **420***a-b* may be less than 7 kPa (e.g., less than 1 psi), may be in a range between 7 kPa and 14 kPa, may be in a range between 14 kPa and 28 kPa, may be in a range between 28 kPa and 56 kPa, or may be in a range between 56 kPa and 112 kPa. The exhaust assembly **304** is configured as a passive system, with no elements besides airflow or differences in air pressure providing the force to move the one or more flaps from a closed position to an open position. The design of the passive exhaust assembly **304** provides advantages over a comparable mechanical exhaust system in terms of cost, complexity, and reliability.

[0032] In embodiments, the exhaust assembly **304** is attached to the cabinet **90** via an exhaust panel assembly **500** that includes an exhaust panel **504**, as shown in FIG. **5**A. The exhaust panel **504** includes a window **508** that permits air **306** to enter into the exhaust assembly **304**.

[0033] In embodiments the one or more flaps **424***a-b* are biased into the closed position via a weight of the one or more flaps **424***a-b*, as shown in FIGS. **5**B and **5**C. For example, the weight of the one or more flaps **424***a-b* may provide enough force (e.g., the one or more flaps **424***a-b* aided by gravity) to keep the exhaust assembly **304** in the closed position when the one or more fans **204***a-c* are turned off, as shown in FIG. **5**B. In another example, the weight of one or more flaps **424***a-b* may provide enough force to keep the exhaust assembly **304** in the closed position when one or more fans **204***a-c* are turned off, and the primary cooling system **136** is operational. Once the one or more fans **204***a-c* are turned on, the airflow and/or increased air pressure opens the one for more flaps **424***a-c* to an open position, as shown in FIG. **5**C.

[0034] In embodiments, the one or more exhaust apertures **420***a-b* and/or the one or more flaps **424***a-b* (e.g., in the closed position) are positioned at an angle **512** relative to normal (e.g., such as relative to the surface of the door **116***b* or side panel **112***a-b* of the cabinet **90**). By placing the one or more exhaust apertures **420***a-b* and/or the one or more flaps **424***a-b* at the angle **512** relative to normal, the weight of the one or more flaps **424***a-b* biases against the one or more exhaust apertures **420***a-b*, positioning the one or more flaps **424***a-b* in the closed position when the one or more fans are turned off. The greater the angle **512**, the greater the effect of the weight of the one or more flaps **4241**-*b* upon the one or more exhaust apertures **420***a-b*.

[0035] In embodiments, the angle **512** of the one or more exhaust apertures **420***a-b* and or the one or more flaps **424***a-b* in the closed position relative to normal may include a range of 1° to 20°, a range of 2° to 15°, a range of 3° to 10°, a range of 4° to 10°, a range of 4° to 10°, or a range of 4° to 8°. For example, the angle **512** of the one or more exhaust apertures **420***a-b* and or the one or more flaps **424***a-b* in the closed position relative to normal may include a range from 5° to 10°. In embodiments, the angle **512** of the one or more exhaust apertures **420***a-b* and or the one or more flaps **424***a-b* in the closed position relative to normal may be approximately or substantially 3°, may be approximately or substantially 4°, may be approximately or substantially 5°, may be approximately or substantially 6°, may be approximately or substantially 7°, may be approximately or substantially 8°, may be approximately or substantially 9°, may be approximately or substantially 10°, may be approximately or substantially 11°, or may be approximately or substantially 12°.

[0036] Details of the intake components **128** of the ECS **100** are illustrated in FIG. **6**. The intake components **128** include a filter **604** (e.g., a hydrophobic box filter) that is positioned adjacent to the one or more fans **204***a-c* (e.g., the one or more fans moving or drawing air through the filter **604**). The intake components may include a shroud **608** that is positioned over the filter **604** and configured to protect the filter **604**, and one or more elements that secure the filter **604** and shroud **608** to the intake side **120** including but not limited to a filter shroud clamp **612** (e.g., configured to clamp the shroud to the primary cooling system **136**), filter clamp brackets **616**, and filter support brackets **620**.

[0037] In embodiments, an outmoded cabinet **700** can be retrofitted with one or more elements of the ECS **100** (e.g., the ECS **100** configured as a retrofit kit), such as an outmoded cabinet **700** that includes a primary cooling system **136** but does not include an ECS **100** or an exhaust assembly **304**, as illustrated in FIG. **7**. For example, an upper rear panel **704** can be removed and replaced with the exhaust assembly **500** of FIG. **5**A. In another example, one or more intake components **128** of the ECS **100** can be integrated into the intake side **120** of the outmode cabinet **700** (e.g., below the primary cooling system **136**).

[0038] In embodiments, a method **800** of retrofitting the ECS **100** onto the outmoded cabinet **700** is disclosed, as illustrated in FIG. **8**. In embodiments, the method includes a step **804** of replacing the upper rear panel **704** of the cabinet **90** with the exhaust panel assembly **500** of the ECS **100**. The exhaust panel assembly **500** includes the exhaust panel **504** and the exhaust assembly **304**. The exhaust panel assembly **500** may be preassembled.

[0039] In embodiments, the method **800** includes a step **808** of removing the primary cooling system **136** from the door **116***a* and replacing the door **116***a* with a new door that includes the intake components **128** of the ECS **100**. The intake components may be preassembled to the door **116***a*. In embodiments, the method includes a step **812** of reassembling the primary cooling system **136** upon the new door.

[0040] In embodiments, the method includes a step **816** of mounting the environmental control unit **212** and connecting any cables from the environmental control unit **212** to the one or more fans **204***a-c* and any alarm systems and power systems of the cabinet **90**. Because the cabinet **90** utilizes the exhaust assembly, there are no electrical or mechanical connections that need to be made between the exhaust assembly **304** and the environmental control unit **212**, greatly simplifying the retrofit process.

[0041] A schematic of power and data connectivity of the ECS **100** and the primary cooling system **136** is shown in FIG. **9**. The environmental control unit **212** may be communicatively coupled at any time to one or more of the temperature sensor **216** (e.g., thermometer) and the one or more fans **204***a-c* as well as the primary cooling system **136**, and may be coupled to the power systems **904** and alarm systems **908** of the primary cooling system. The environmental control unit **212** and/or ECS **100** may also include one or more processors **912**, memory **916**, and a communication interface. The one or more processors **912** are communicatively coupled to the electrical and sensor components of the ECS **100** (e.g., the one or more fans **204***a-c*, temperature sensor **216**) and the primary cooling system **136**. We note that there is no electrical (e.g., wireline) or wireless communication between the ECS **100** and the exhaust assembly **304**.

[0042] In embodiments, the ECS **100** is configured to operate (e.g., activate or “turn on” the one or more fans **204***a-c*) if the primary cooling system **136** fails or becomes non-operational. Once the primary cooling system **136** fails or becomes non-operational, the ECS **100** provides the necessary cooling until the primary cooling system **136** can be repaired or replaced. The ECS **100** can operate independently of the primary cooling system **136**. The ECS **100** may detect primary cooling system **136** failure in at least one of two or more methods. For example, the ECS **100** may detect damage or failure of the primary cooling system **136** via communication with the primary cooling system **136**. For instance, the ECS **100** may receive an alarm signal, a loss of power signal, or an interruption of a signal from the primary cooling system **136**, indicating a failure of the primary cooling system **136**. In another example, the ECS **100** may detect a higher-than-normal temperature from the temperature sensor **216** (e.g., the temperature sensor may be monitoring a cold air return of the primary cooling system **136**. Once the failure is detected, the ECS **100** will initiate the one or more fans **204***a-c*, which will cause air movement or an increase in air pressure that causes one or more flaps of the exhaust assembly **304** to move from the closed position to the open position, allowing air to escape the cabinet **90**.

[0043] In embodiments, the ECS **100**, the cabinet **90**, or the primary cooling system **136** includes a dry contact “HVAC FAIL” alarm that activates for any event that disables the primary cooling system **136** or a cooling system outside of the cabinet **90**). The alarm may be “normally closed”, but will open if the primary cooling system **136** or outside system loses power. The ECS **100** may also include a dip switch setting (e.g., on the environmental control unit **212**).

[0044] In embodiments, the ECS **100** may be configured to activate when the temperature sensor **216** (e.g., communicating locally or remotely (wirelessly) with the environmental control unit **212**) when the temperature sensor **216** reaches a threshold temperature, such as 45 degrees C. Once activated, the one or more fans **204***a-c* may operate at full speed for an entire period of operation of the ECS **100**. The environmental control unit **212** may also be configured to deactivate power to the primary cooling system **136** (e.g., via a power relay). For example, a high-temperature reading by the temperature sensor **216** may indicate that the primary cooling system **136** is malfunctioning, prompting the ECS **100** to deactivate power to the primary cooling system **136** and activate the one or more fans **204***a-c*. The ECS **100** may be configured to turn off once the temperature sensor gives a reading below a predetermined threshold (e.g., below 25 degrees C.). The ECS **100** may then reactivate if the higher temperature or primary cooling system failure reoccurs.

[0045] In embodiments, the ECS **100** may be configured to generate an alarm upon a failure of one or more components of the ECS **100** or the primary cooling system **136**. For example, the ECS **100** may be configured to generate an ECS failure alarm if one or more of the fans **204***a-c*, temperature sensor **216**, or environmental control unit **212** are determined to be faulty. In another example, the ECS **100** may be configured to generate a primary cooling system failure alarm. In another example, the ECS **100** may be configured to generate an ECS **100** ON/OFF alarm, indicating the status of the operation (e.g., active or inactive) of the ECS **100**. In another example, the environmental control unit is configured to operate the one or more fans **204***a-c* if the alarm system is activated.

[0046] The at least one processor **912** may be implemented as any suitable processor(s), such as at least one general purpose processor, at least one central processing unit (CPU), at least one image processor, at least one graphics processing unit (GPU), at least one field-programmable gate array (FPGA), and/or at least one special purpose processor configured to execute instructions for performing (e.g., collectively performing if more than one processor) any or all of the operations disclosed throughout.

[0047] The communication interface **920** can be operatively configured to communicate with one or more processors **912** and other components of the ECS **100**. For example, the communication interface **920** can be configured to retrieve data from the temperature sensor **216** or other components of the ECS **100** or primary cooling system **136**, transmit data for storage in the memory **916**, retrieve data from storage in the memory **916**, and so forth. The communication interface **920** can also be communicatively coupled with the one or more processors **912** and/or ECS and primary cooling system elements to facilitate data transfer between the ECS and primary cooling system elements.

[0048] Those having skill in the art will recognize that the state of the art has progressed to the point where there is little distinction left between hardware and software implementations of aspects of systems; the use of hardware or software is generally (but not always, in that in certain contexts the choice between hardware and software can become significant) a design choice representing cost vs. efficiency tradeoffs. Those having skill in the art will appreciate that there are various vehicles by which processes and/or systems and/or other technologies described herein can be implemented (e.g., hardware, software, and/or firmware), and that the preferred vehicle will vary with the context in which the processes and/or systems and/or other technologies are deployed. For example, if an implementer determines that speed and accuracy are paramount, the implementer may opt for a mainly hardware and/or firmware vehicle; alternatively, if flexibility is paramount, the implementer may opt for a mainly software implementation; or, yet again alternatively, the implementer may opt for some combination of hardware, software, and/or firmware. Hence, there are several possible vehicles by which the processes and/or devices and/or other technologies described herein may be implemented, none of which is inherently superior to the other in that any vehicle to be utilized is a choice dependent upon the context in which the vehicle will be deployed and the specific concerns (e.g., speed, flexibility, or predictability) of the implementer, any of which may vary. Those skilled in the art will recognize that optical aspects of implementations will typically employ optically oriented hardware, software, and/or firmware.

[0049] The foregoing detailed description has set forth various embodiments of the devices and/or processes via the use of block diagrams, flowcharts, and/or examples. Insofar as such block diagrams, flowcharts, and/or examples contain one or more functions and/or operations, it will be understood by those within the art that each function and/or operation within such block diagrams, flowcharts, or examples can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. In one embodiment, several portions of the subject matter described herein may be implemented via Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), digital signal processors (DSPs), or other integrated formats. However, those skilled in the art will recognize that some aspects of the embodiments disclosed herein, in whole or in part, can be equivalently implemented in integrated circuits, as one or more computer programs running on one or more computers (e.g., as one or more programs running on one or more computer systems), as one or more programs running on one or more processors (e.g., as one or more programs running on one or more microprocessors), as firmware, or as virtually any combination thereof, and that designing the circuitry and/or writing the code for the software and/or firmware would be well within the skill of one of skill in the art in light of this disclosure. In addition, those skilled in the art will appreciate that the mechanisms of the subject matter described herein are capable of being distributed as a program product in a variety of forms, and that an illustrative embodiment of the subject matter described herein applies regardless of the particular type of signal bearing medium used to actually carry out the distribution. Examples of a signal bearing medium include, but are not limited to, the following: a recordable type medium such as a floppy disk, a hard disk drive, a Compact Disc (CD), a Digital Video Disk (DVD), a digital tape, a computer memory, etc.; and a transmission type medium such as a digital and/or an analog communication medium (e.g., a fiber optic cable, a waveguide, a wired communications link, a wireless communication link, etc.).

[0050] In a general sense, those skilled in the art will recognize that the various aspects described herein, which can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or any combination thereof, can be viewed as being composed of various types of "electrical circuitry." Consequently, as used herein "electrical circuitry" includes, but is not limited to, electrical circuitry having at least one discrete electrical circuit, electrical circuitry having at least one integrated circuit, electrical circuitry having at least one application-specific integrated circuit, electrical circuitry forming a general purpose computing device configured by a computer program (e.g., a general purpose computer configured by a computer program which at least partially carries out processes and/or devices described herein, or a microprocessor configured by a computer program which at least partially carries out processes and/or devices described herein), electrical circuitry forming a memory device (e.g., forms of random access memory), and/or electrical circuitry forming a communications device (e.g., a modem, communications switch, or optical-electrical equipment). Those having skill in the art will recognize that the subject matter described herein may be implemented in an analog or digital fashion or some combination thereof.

[0051] Those having skill in the art will recognize that it is common within the art to describe devices and/or processes in the fashion set forth herein, and thereafter use engineering practices to integrate such described devices and/or processes into data processing systems. That is, at least a portion of the devices and/or processes described herein can be integrated into a data processing system via a reasonable amount of experimentation. Those having skill in the art will recognize that a typical data processing system generally includes one or more of a system unit housing, a video display device, a memory such as volatile and non-volatile memory, processors such as microprocessors and digital signal processors, computational entities such as operating systems, drivers, graphical user interfaces, and applications programs, one or more interaction devices, such as a touch pad or screen, and/or control systems including feedback loops and control motors (e.g., feedback for sensing position and/or velocity; control motors for moving and/or adjusting components and/or quantities). A typical data processing system may be implemented utilizing any suitable commercially available components, such as those typically found in data computing/communication and/or network computing/communication systems.

[0052] As used throughout and as would be appreciated by those skilled in the art, "at least one non-transitory computer-readable medium" or "memory" may refer to as at least one non-transitory computer-readable medium (e.g., e.g., at least one computer-readable medium implemented as hardware; e.g., at least one non-transitory processor-readable medium, at least one memory (e.g., at least one nonvolatile memory, at least one volatile memory, or a combination thereof; e.g., at least one random-access memory, at least one flash memory, at least one read-only memory (ROM) (e.g., at least one electrically erasable programmable read-only memory (EEPROM)), at least one on-processor memory (e.g., at least one on-processor cache, at least one on-processor buffer, at least one on-processor flash memory, at least one on-processor EEPROM, or a combination thereof), or a combination thereof), at least one storage device (e.g., at least one hard-disk drive, at least one tape drive, at least one solid-state drive, at least one flash drive, at least one readable and/or writable disk of at least one optical drive configured to read from and/or write to the at least one readable and/or writable disk, or a combination thereof), or a combination thereof).

[0053] The herein described subject matter sometimes illustrates different components contained within, or connected with, different other components. It is to be understood that such depicted architectures are merely exemplary, and that in fact many other architectures can be implemented which achieve the same functionality. In a conceptual sense, any arrangement of components to achieve the same functionality is effectively "associated" such that the desired functionality is achieved. Hence, any two components herein combined to achieve a particular functionality can be

seen as “associated with” each other such that the desired functionality is achieved, irrespective of architectures or intermedial components. Likewise, any two components so associated can also be viewed as being “operably connected”, or “operably coupled”, to each other to achieve the desired functionality, and any two components capable of being so associated can also be viewed as being “operably couplable”, to each other to achieve the desired functionality. Specific examples of operably couplable include but are not limited to physically mateable and/or physically interacting components and/or wirelessly interactable and/or wirelessly interacting components and/or logically interacting and/or logically interactable components.
[0054] While particular aspects of the present subject matter described herein have been shown and described, it will be apparent to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from the subject matter described herein and its broader aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as are within the true spirit and scope of the subject matter described herein. Furthermore, it is to be understood that the invention is defined by the appended claims.
Emergency Cooling System

Claims

1. An emergency cooling system for a cabinet comprising: an exhaust assembly comprising: an exhaust assembly frame comprising one or more exhaust apertures; and one or more flaps configured to reversibly engage the one or more exhaust apertures.
2. The system of claim 1, wherein the one or more flaps are coupled via a hinge to the frame.
3. The emergency cooling system of claim 1, wherein a weight of the one or more flaps biases the one or more flaps toward a closed position.
4. The emergency cooling system of claim 1, further comprising: an environmental control unit, the environmental control unit comprising: one or more fans; a temperature sensor; at least one processor communicatively coupled to the one or more fans, the temperature sensor, and a primary cooling system, wherein the at least one processor is configured to: determine an operating status of the primary cooling system; receive temperature sensor data; and activate the one or more fans based on at least one of the operating status of the primary cooling system of the temperature sensor data, wherein turning on the one or more fans causes an airflow or an increased air pressure within the cabinet that biases the one or more flaps into an open position.
5. The emergency cooling system of claim 4, wherein the at least one processor is configured to activate the one or more fans if the operating status of a primary cooling system comprises a failure.
6. The emergency cooling system of claim 4, wherein the at least one processor is configured to activate the one or more fans if the temperature sensor data comprises a temperature reading above a predetermined threshold.
7. The emergency cooling system of claim 1, wherein the one or more exhaust apertures or the one or more flaps are positioned at an angle relative to normal in a range of 2° to 15° when the one or more flaps are arranged in a closed position.
8. The emergency cooling system of claim 1, wherein the one or more exhaust apertures or the one or more flaps are positioned at an angle relative to normal of approximately 10° when the one or more flaps are arranged in a closed position.
9. The emergency cooling system of claim 4, further comprising a filter configured to filter air moved by the one or more fans.
10. The emergency cooling system of claim 9, wherein the filter is hydrophobic.
11. The emergency cooling system of claim 9, further comprising a shroud positioned over the filter and configured to protect the filter.

12. The emergency cooling system of claim 11, further comprising a filter shroud clamp configured to clamp the shroud to a primary emergency cooling system.

13. The emergency cooling system of claim 4, wherein the environmental control unit further includes or is coupled to an alarm system, wherein the environmental control unit is configured to operate the one or more fans if the alarm system is activated.

14. An emergency cooling system for a cabinet comprising: an environmental control unit, the environmental control unit comprising: one or more cooling fans; a temperature sensor; at least one processor communicatively coupled to the one or more cooling fans, the temperature sensor, and a primary cooling system, wherein the at least one processor is configured to: determine an operating status of the primary cooling system; receive temperature sensor data; and activate the one or more fans based on at least one of the operating status of the primary cooling system of the temperature sensor data; and an exhaust assembly comprising: an exhaust assembly frame comprising one or more exhaust apertures; and one or more flaps configured to reversibly engage the one or more exhaust apertures.

15. The emergency cooling system of claim 14, wherein the at least one processor is configured to activate the one or more fans if the operating status of primary cooling system comprises a failure.

16. The emergency cooling system of claim 14, wherein the at least one processor is configured to activate the one or more fans if the temperature sensor data comprises a temperature reading above a predetermined threshold.

17. The emergency cooling system of claim 14, wherein a weight of the one or more flaps biases the one or more flaps toward a closed position.

18. The emergency cooling system of claim 14, wherein the emergency cooling system is configured as a retrofit kit.

19. The emergency cooling system of claim 14, wherein the one or more exhaust apertures or the one or more flaps are positioned at an angle relative to normal in a range of 2° to 15° when the one or more flaps are arranged in a closed position.

20. A method for retrofitting a cabinet with an emergency cooling system, comprising: replacing a panel of a cabinet with an exhaust panel assembly of an emergency cooling system; removing a primary cooling system from a door of the cabinet and replacing the door with a new door that includes an intake component of the emergency cooling system; reassembling the primary cooling system to the new door; and mounting an environmental control unit and connecting one or more cables from the environmental control unit to one or more fans, alarm systems, or power systems of the cabinet.