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Canadian Intellectual Property Office

CA 3207754 A1 2024/02/08

(21) 3 207 754

(12) **DEMANDE DE BREVET CANADIEN**
CANADIAN PATENT APPLICATION

(13) **A1**

(22) **Date de dépôt/Filing Date:** 2023/07/27

(41) **Mise à la disp. pub./Open to Public Insp.:** 2024/02/08

(30) **Priorités/Priorities:** 2022/08/08 (US63/396,127); 2023/07/26 (US18/226,532)

(51) **Cl.Int./Int.Cl.** ***F25B 9/00*** (2006.01), ***B60H 1/32*** (2006.01), ***F25B 41/00*** (2021.01), ***H02B 1/56*** (2006.01), ***H02K 9/00*** (2006.01), ***H05K 7/20*** (2006.01), *H02P 27/04* (2016.01)

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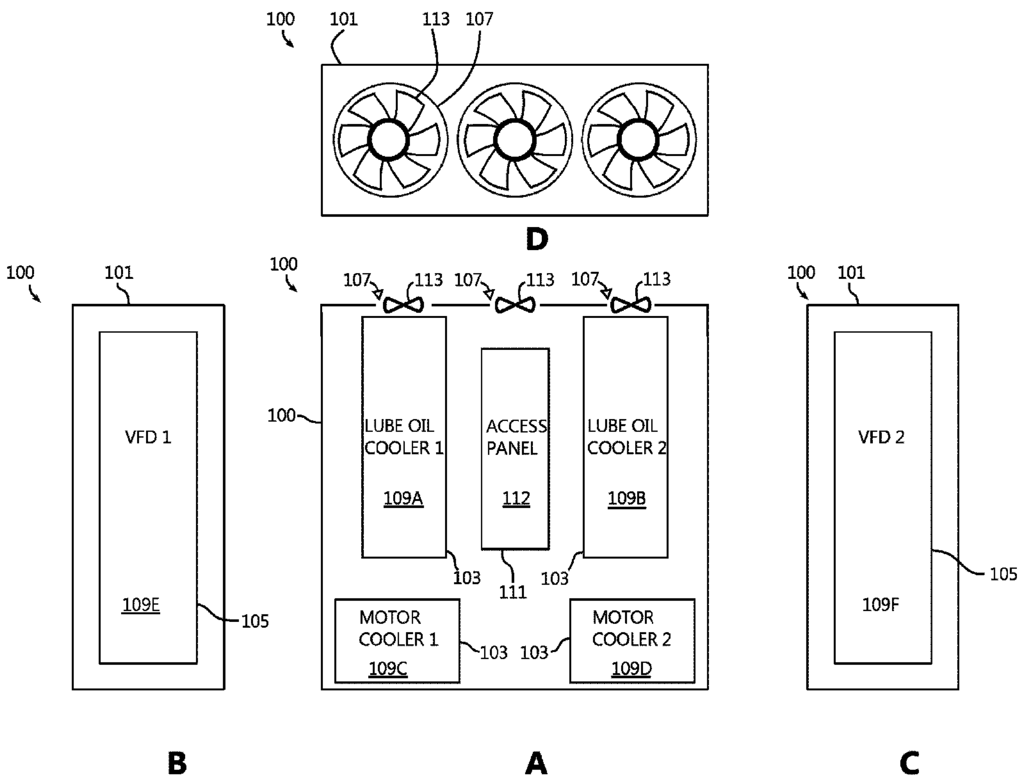
(54) **Titre : SYSTEME DE REFROIDISSEMENT INTEGRE MODULAIRE**
(54) **Title: MODULAR INTEGRATED COOLING SYSTEM**



(57) **Abrégé/Abstract:**
A modular integrated cooling system includes an enclosure, the enclosure including an outlet top opening and two or more inlet face openings. The modular integrated cooling system includes a fan positioned at the outlet top opening. The modular integrated cooling system includes two or more cooling cores positioned within the enclosure, each cooling core positioned at a corresponding inlet face opening.

Abstract

A modular integrated cooling system includes an enclosure, the enclosure including an outlet top opening and two or more inlet face openings. The modular integrated cooling system includes a fan positioned at the outlet top opening. The modular integrated cooling system includes two or more cooling cores positioned within the enclosure, each cooling core positioned at a corresponding inlet face opening.

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MODULAR INTEGRATED COOLING SYSTEM

Cross-Reference to Related Applications

[0001] This application is a nonprovisional application which claims priority from U.S. provisional application number 63/396,127, filed August 8, 2022, which is incorporated by reference herein in its entirety.

Technical Field/Field of the Disclosure

[0002] The present disclosure relates generally to cooling systems, and specifically to integrated thermal control systems.

Background of the Disclosure

[0003] Equipment such as motors, variable frequency drives (VFDs), internal combustion engines, and pumps generate heat and may require cooling systems adapted to regulate the temperature thereof. In some cases, closed loop fluid-cooling systems may be used. In other cases, fluids such as oils may be circulated through cooling systems to remove heat therefrom before returning to the piece of equipment that uses the fluid. Traditionally, each piece of equipment requires its own cooling system with an independent heat exchange element such as a radiator that is operated independently. The positioning of a cooling system and heat exchange element for each piece of equipment may lead to ill effects including, for example, hot air recirculation, excess noise pollution, inefficient space usage, and requiring independent controllers for each such system.

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Summary

[0004] The present disclosure provides for a modular integrated cooling system. The modular integrated cooling system may include an enclosure, the enclosure including an outlet top opening and two or more inlet face openings. The modular integrated cooling system may include a fan positioned at the outlet top opening. The modular integrated cooling system may include two or more cooling cores positioned within the enclosure, each cooling core positioned at a corresponding inlet face opening.

[0005] The present disclosure also provides for a fracking system. The fracking system may include a pump, a motor, a VFD; and a modular integrated cooling system. The modular integrated cooling system may include an enclosure, the enclosure including an outlet top opening and three or more inlet face openings. The modular integrated cooling system may include a fan positioned at the outlet top opening. The modular integrated cooling system may include a lube oil cooler positioned within the enclosure at a first inlet face opening of the three or more inlet face openings and operatively coupled to the pump. The modular integrated cooling system may include a motor cooler positioned within the enclosure at a second inlet face opening of the three or more inlet face openings and operatively coupled to the motor. The modular integrated cooling system may include a VFD cooler positioned within the enclosure at a third inlet face opening of the three or more inlet face openings and operatively coupled to the VFD.

[0006] The present disclosure further provides for a method for cooling a plurality of coolant liquids from a fracking system. The method includes providing a modular integrated cooling system. The modular integrated cooling system includes an enclosure, the enclosure including

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an outlet top opening and two or more inlet face openings and a fan positioned at the outlet top opening. The method also includes positioning at least one fan in the outlet top opening and positioning a cooling core through each of the inlet face openings, wherein the cooling cores are one or more of a lube oil cooler, a motor cooler, or a VFD cooler. In addition, the method includes operating the at least one fan to draw air through the inlet face openings and discharge the air through the outlet top opening, transferring the liquid coolant through each of the cooling cores, and cooling the liquid coolant.

Brief Description of the Drawings

[0007] The present disclosure is best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

[0008] FIG. 1 depicts a perspective view of a modular integrated cooling system consistent with at least one embodiment of the present disclosure.

[0009] FIG. 1A depicts a front elevation view of the modular integrated cooling system of FIG. 1.

[0010] FIG. 1B depicts a side elevation view of the modular integrated cooling system of FIG. 1.

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[0011] FIG. 1C depicts a side elevation view of the modular integrated cooling system of FIG. 1.

[0012] FIG. 1D depicts a top view of the modular integrated cooling system of FIG. 1.

[0013] FIG. 2 depicts a perspective view of a modular integrated cooling system consistent with at least one embodiment of the present disclosure.

[0014] FIG. 3 depicts a schematic view of a cooling core of a modular integrated cooling system consistent with at least one embodiment of the present disclosure.

[0015] FIG. 4 depicts a perspective view of a fracking trailer including a modular integrated cooling system consistent with at least one embodiment of the present disclosure.

[0016] FIG. 5 depicts a schematic view of the fracking trailer of FIG. 4.

Detailed Description

[0017] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

[0018] FIGS. 1 and 1A-1D depict modular integrated cooling system 100 consistent with at least one embodiment of the present disclosure. Modular integrated cooling system 100 may

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include enclosure 101 used to house and support one or more cooling cores used as part of cooling systems of one or more corresponding systems. As used herein, a "cooling core" refers to the volume of space within enclosure 101 designated for temperature exchange from a cooling system or fluid positioned within the cooling core to air flowing through enclosure 101 which removes excess temperature by sending it into the atmosphere. In some embodiments, a cooling core may be a container housing the main components of a cooling system including, for example and without limitation, one or more of a radiator, heat exchanger, evaporator, motors, pumps, etc.

[0019] In some embodiments, enclosure 101 may include one or more openings including inlet face openings 103 positioned on a front face of enclosure 101 or on side faces of enclosure 101, referred to herein as inlet side face openings 105, and outlet top openings 107. Inlet face openings 103 and inlet side face openings 105 may be positioned to allow air to enter enclosure 101 and pass through cooling cores 109a-f. For example and without limitation, cooling cores may include lube oil coolers 109a, 109b; motor coolers 109c, 109d; VFD coolers 109e, 109f. Other nonlimiting examples of cooling cores include cooling cores associated with engine systems, alternate power generation systems, or energy storage systems. In some embodiments, cooling cores may include any form of liquid to air cooling system. In some embodiments, enclosure 101 may include access panel 111 positioned to allow access to equipment or controllers 112 positioned within enclosure 101.

[0020] In some embodiments, outlet top openings 107 may be positioned to allow air to exit enclosure 101. In some such embodiments, one or more fans 113 may be positioned within enclosure 101 such that fans 113 pull air into enclosure 101 through any inlet face openings 103

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and inlet side face openings 105 and blow the air out of enclosure 101 through outlet top openings 107. As air passes through enclosure 101, relatively cool air may enter enclosure 101, pass through cooling cores 109a-f drawing heat therefrom, and exit as relatively hot air through outlet top openings 107, thus providing forced convective cooling to cooling cores 109a-f.

[0021] In some embodiments, cooling cores may be arranged vertically and horizontally within enclosure 101 by, for example and without limitation, positioning cooling cores on racks or shelves built into enclosure 101. Air entering enclosure 101 may enter substantially horizontally and be expelled substantially vertically through outlet top openings 107. Such an arrangement may, for example and without limitation, allow for a more efficient airflow, fan variation, larger surface area for each cooling core, and may reduce hot air recirculation, noise pollution, unit footprint, and the requirement for using multiple individual radiator controllers and installations for each heater core. Additionally, safety may be improved by reducing the risk of horizontal projectile debris due to the location of outlet top openings 107, reducing the need for protective materials such as mesh guards typically required for horizontal fan installations.

[0022] In some embodiments, as shown in FIGS. 1 and 1A-1D, enclosure 101 may be substantially rectilinear and form a rectangular prism. In other embodiments, enclosure 101 may be formed in another shape conducive to contain any cooling cores positioned therein and to suit the intended installation point of modular integrated cooling system 100. For example, FIG. 2 depicts modular integrated cooling system 100’ including enclosure 101’ having a trapezoidal cross section. In such an embodiment, inlet side face openings 105 may be formed with a larger area, thereby allowing a larger corresponding cooling core to be used therewith.

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[0023] FIG. 3 depicts cooling core 109 suitable for use with modular integrated cooling system 100. Cooling core 109 may include one or more inlet lines 115 positioned to receive a relatively hot fluid from a piece of equipment cooling core 109 is used to cool and one or more outlet lines 117 positioned to return relatively cold fluid to the piece of equipment. Fluid as used herein may be any fluid to be thermally conditioned by cooling core 109 and may include, for example and without limitation, coolant, lubricating oil, etc.

[0024] Cooling core 109 may include coolant pump 119, which may be driven by coolant pump motor 121. Coolant pump 119 may pump fluid from the piece of equipment via inlet lines 115, through cooling core 109, and back to the piece of equipment via outlet lines 117. In some embodiments, cooling core 109 may include cooler 123, which may be used to transfer heat from the fluid to the air passing through cooling core 109 as discussed above. Cooler 123 may include, for example and without limitation, one or more of a radiator, heat exchanger, evaporator.

[0025] In some embodiments, cooling core 109 may include heater 125 and changeover valve 127 such that fluid may be passed through cooler 123 or heater 125 depending on whether cooling or heating is desired. Cooling core 109 may further include one or more filters 129, gauges 131, pressure relief valves 133, and pressure sensors 135 coupled to inlet lines 115 and outlet lines 117.

[0026] FIG. 4 depicts an example of an integrated piece of equipment 200 with a plurality of subsystems with which modular integrated cooling system 100 may be used. Although equipment 200 is depicted and described as a fracking trailer herein, one of ordinary skill in the

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art with the benefit of this disclosure will recognize that this description is merely an example used to exemplify the operation of modular integrated cooling system 100 with various pieces of equipment and is not intended to limit the scope of the embodiments described by this disclosure.

[0027] Equipment 200 may include, for example and without limitation, one or more of pumps 201a, 201b; motors 203a, 203b, transformer enclosure 205, VFD 207, and motor control enclosure 209. In some embodiments, each component of equipment 200 may include a corresponding cooling core of modular integrated cooling system 100. For example, as discussed above with respect to FIG. 1, pumps 201a, 201b may circulate lube oil to lube oil coolers 109a, 109b, respectively, of modular integrated cooling system 100. Motors 203a, 203b and/or motor control enclosure 209 may circulate cooling fluid such as a coolant to motor coolers 109c, 109d of modular integrated cooling system 100. VFD 207 may include multiple VFDs, each of which circulates coolant to VFD coolers 109e, 109f of modular integrated cooling system 100. Coolant may similarly be circulated for transformer enclosure 205, though not depicted herein. As these various fluids circulate through modular integrated cooling system 100, each is cooled by the corresponding cooling core 109a-f and returned to the corresponding piece of equipment at a cooler temperature, thereby removing heat from pumps 201a, 201b; motors 203a, 203b, transformer enclosure 205, VFD 207, and motor control enclosure 209.

[0028] In some embodiments, components of modular integrated cooling system 100 may be operated or controlled by controller 112 as shown in FIG. 1. For example, controller 112 may control the operation of fans 113. Controller 112 may base fan speed on, for example and without limitation, the temperature within enclosure 101 as measured by one or more

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temperature sensors. Although depicted as within enclosure 101, controller 112 may be located outside enclosure 101 without deviating from the scope of this disclosure.

[0029] The foregoing outlines features of several embodiments so that a person of ordinary skill in the art may better understand the aspects of the present disclosure. Such features may be replaced by any one of numerous equivalent alternatives, only some of which are disclosed herein. One of ordinary skill in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. One of ordinary skill in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the present disclosure.

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Claims:

1. A modular integrated cooling system comprising:

   an enclosure, the enclosure including an outlet top opening and two or more inlet face openings;

   a fan positioned at the outlet top opening; and

   two or more cooling cores positioned within the enclosure, each cooling core positioned at a corresponding inlet face opening.

2. The modular integrated cooling system of claim 1, wherein a first cooling core of the two or more cooling cores is positioned vertically above a second cooling core of the two or more cooling cores.

3. The modular integrated cooling system of claim 1, wherein a cooling core of the two or more cooling cores is a lube oil cooler, motor cooler, or VFD cooler.

4. The modular integrated cooling system of claim 1, wherein a cooling core of the two or more cooling cores comprises a radiator, heat exchanger, evaporator, motor, or pump.

5. The modular integrated cooling system of claim 4, wherein each of the two or more cooling cores are adapted to cool a liquid coolant.

6. The modular integrated cooling system of claim 1, wherein the enclosure further comprises an access panel.

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7. The modular integrated cooling system of claim 6 further comprising a controller positioned behind the access panel.

8. The modular integrated cooling system of claim 6, wherein the controller is adapted to control a fan speed of the fan based on a temperature inside the enclosure.

9. The modular integrated cooling system of claim 1, wherein the enclosure is a rectangular prism or has a trapezoidal cross section.

10. The modular integrated cooling system of claim 1 having no mesh guards.

11. The modular integrated cooling system of claim 1, wherein each cooling core includes:

a coolant pump;

a coolant motor, the coolant motor driving the coolant pump; and

a cooler, the cooler in fluid connection with the coolant pump.

12. The modular integrated cooling system of claim 1, wherein the cooler is a radiator, heat exchanger, or evaporator.

13. A fracking system comprising:

a pump;

a motor;

a VFD; and

a modular integrated cooling system comprising:

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an enclosure, the enclosure including an outlet top opening and three or more inlet face openings;

a fan positioned at the outlet top opening;

a lube oil cooler positioned within the enclosure at a first inlet face opening of the three or more inlet face openings and operatively coupled to a pump;

a motor cooler positioned within the enclosure at a second inlet face opening of the three or more inlet face openings and operatively coupled to the motor; and

a VFD cooler positioned within the enclosure at a third inlet face opening of the two or more inlet face openings and operatively coupled to the VFD.

14. The fracking system of claim 13, wherein the lube oil cooler, motor cooler, or VFD cooler is a radiator, heat exchanger, or evaporator.

15. A method for cooling a plurality of coolant liquids from a fracking system comprising:

providing a modular integrated cooling system, the modular integrated cooling system including:

an enclosure, the enclosure including an outlet top opening and two or more inlet face openings; and

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a fan positioned at the outlet top opening;

positioning at least one fan in the outlet top opening;

positioning a cooling core through each of the inlet face openings, wherein the cooling cores are one or more of a lube oil cooler, a motor cooler, or a VFD cooler;

operating the at least one fan to draw air through the inlet face openings and discharge the air through the outlet top opening;

transferring the liquid coolant through each of the cooling cores; and

cooling the liquid coolant.

16. The method of claim 15 further comprising:

measuring a temperature inside the enclosure;

a fan speed of the fan based on the temperature measured.

17. The method of claim 15 further comprising after cooling the liquid coolant transferring the liquid coolant to the lube oil cooler, the motor cooler, or the VFD cooler.

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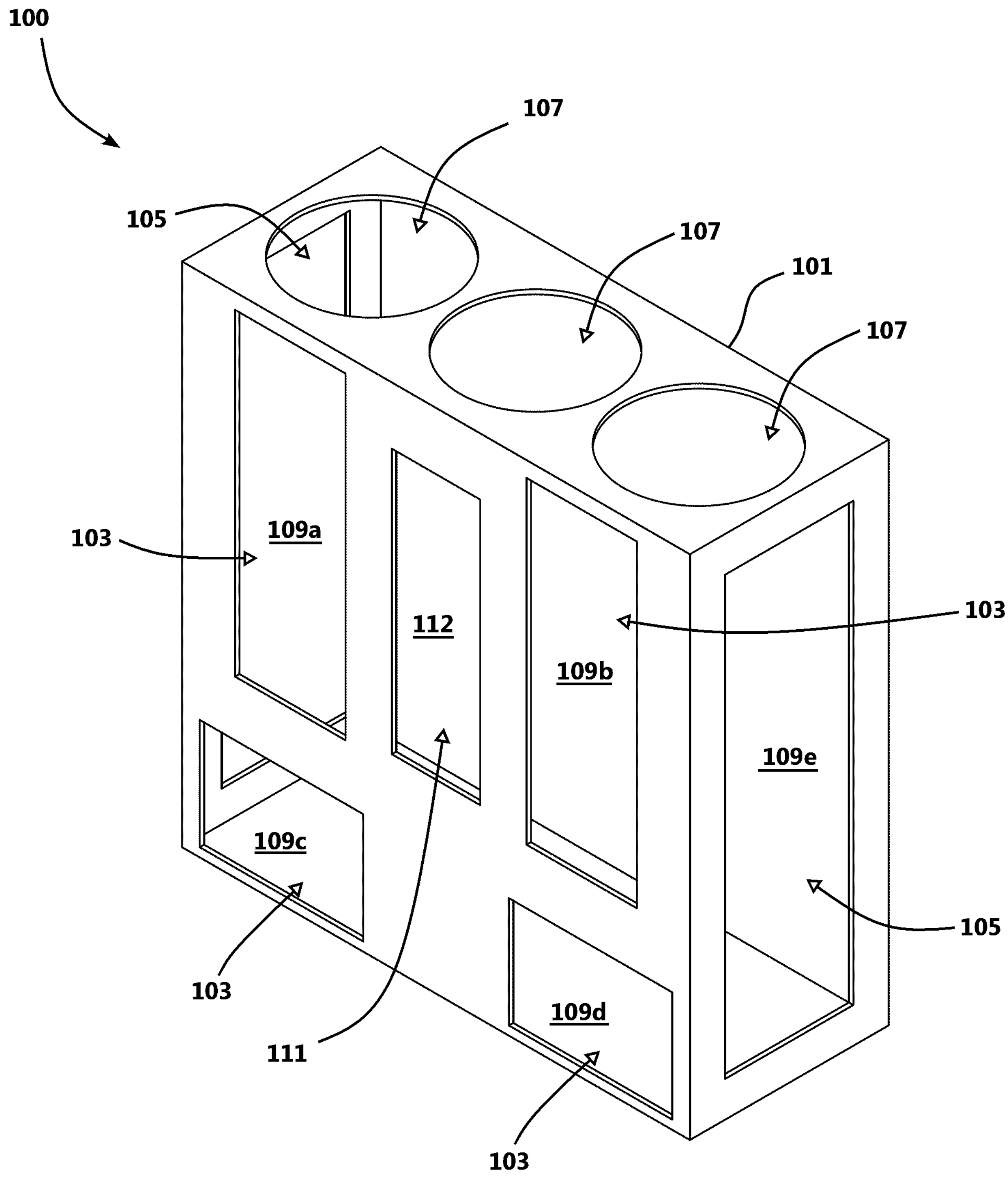

Fig. 1

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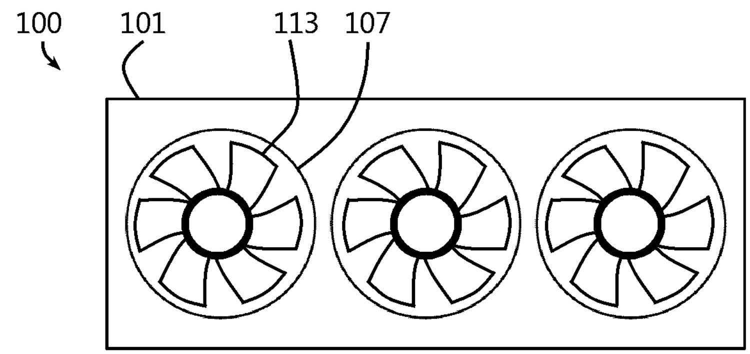

Fig. 1D

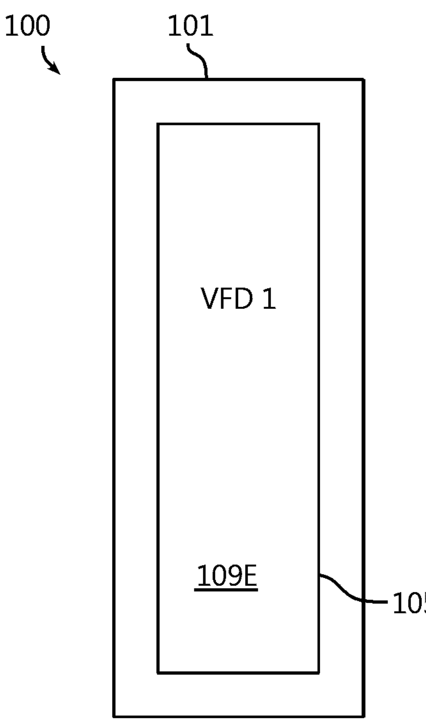

Fig. 1B

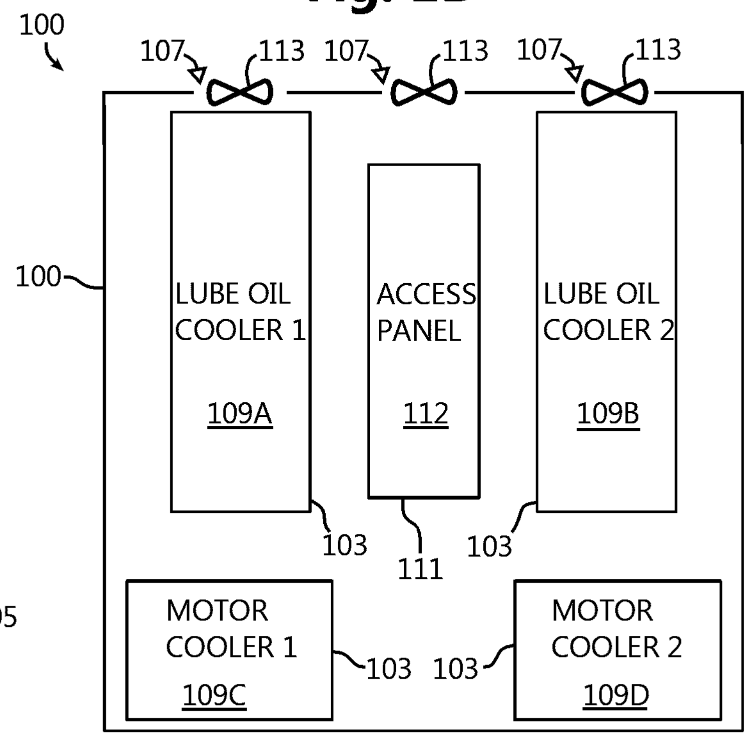

Fig. 1A

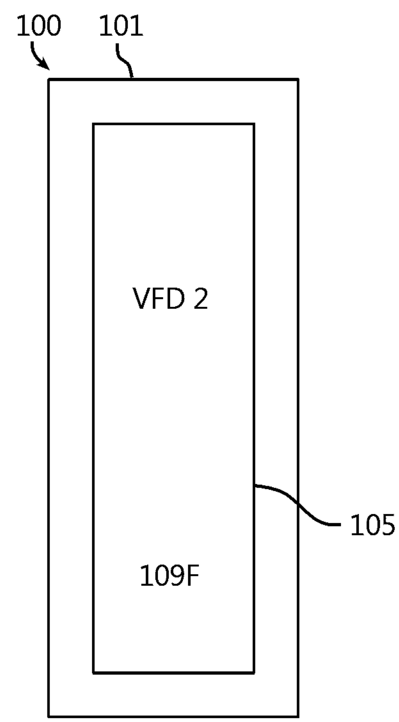

Fig. 1C

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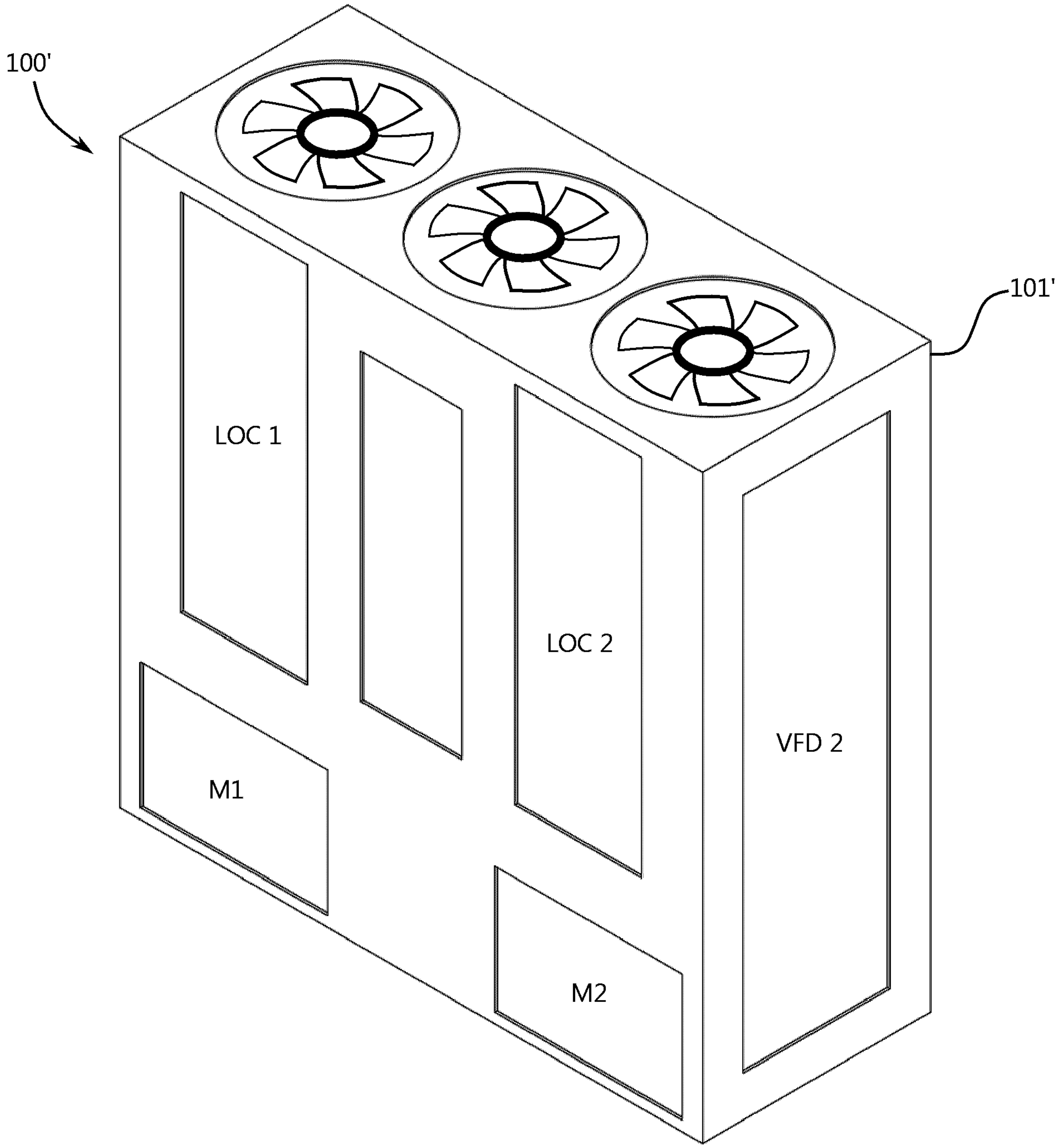

Fig. 2

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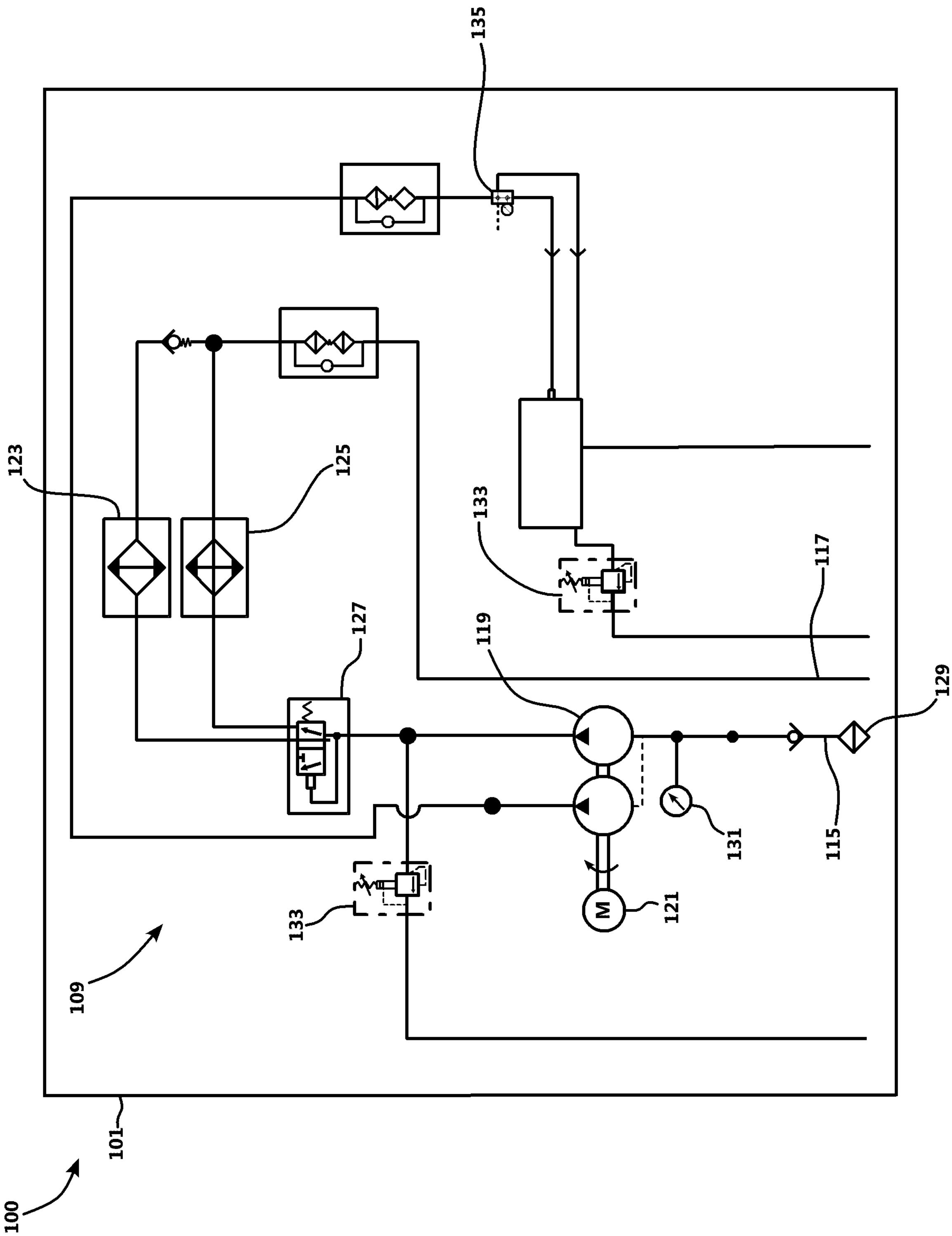

Fig. 3

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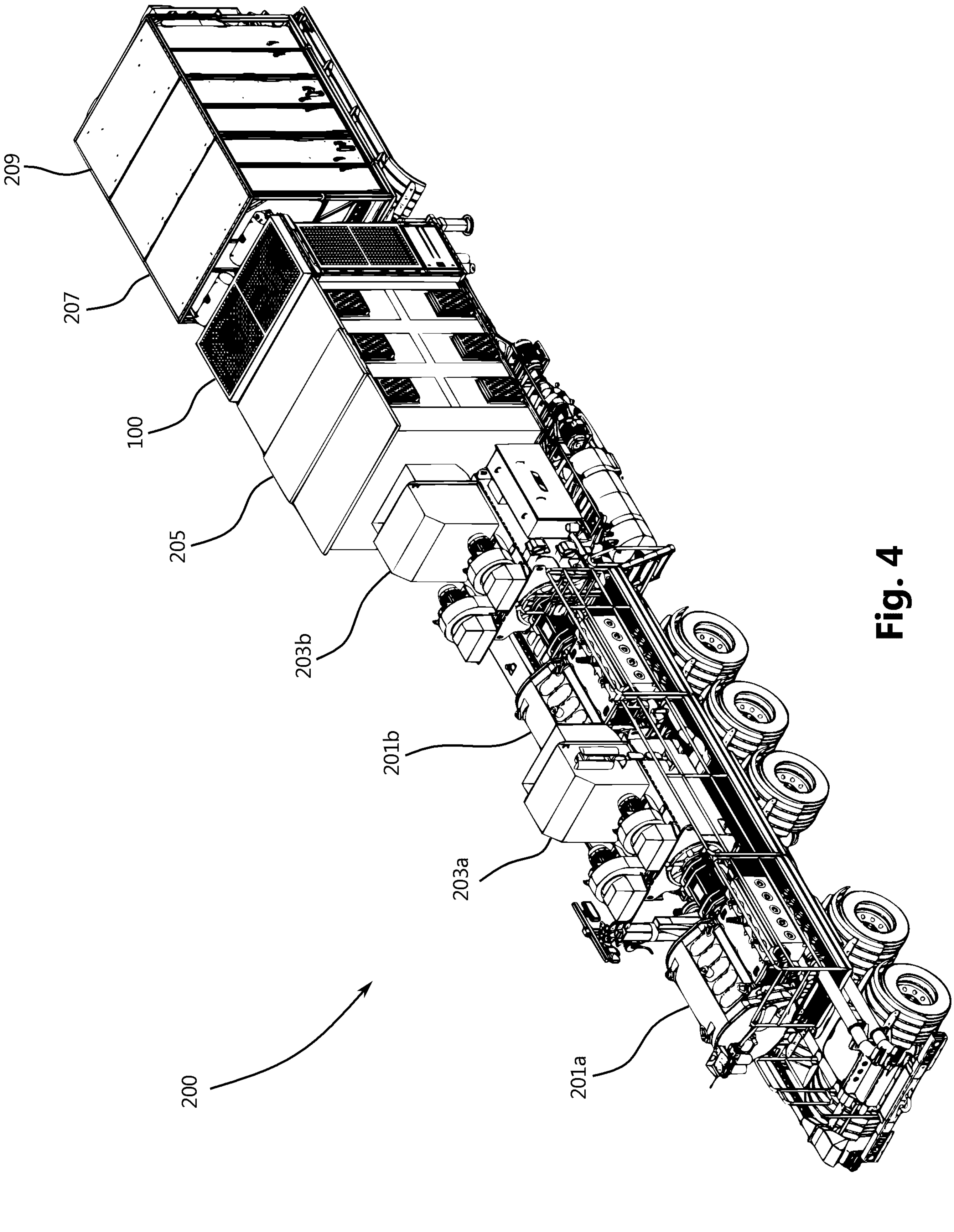

Fig. 4

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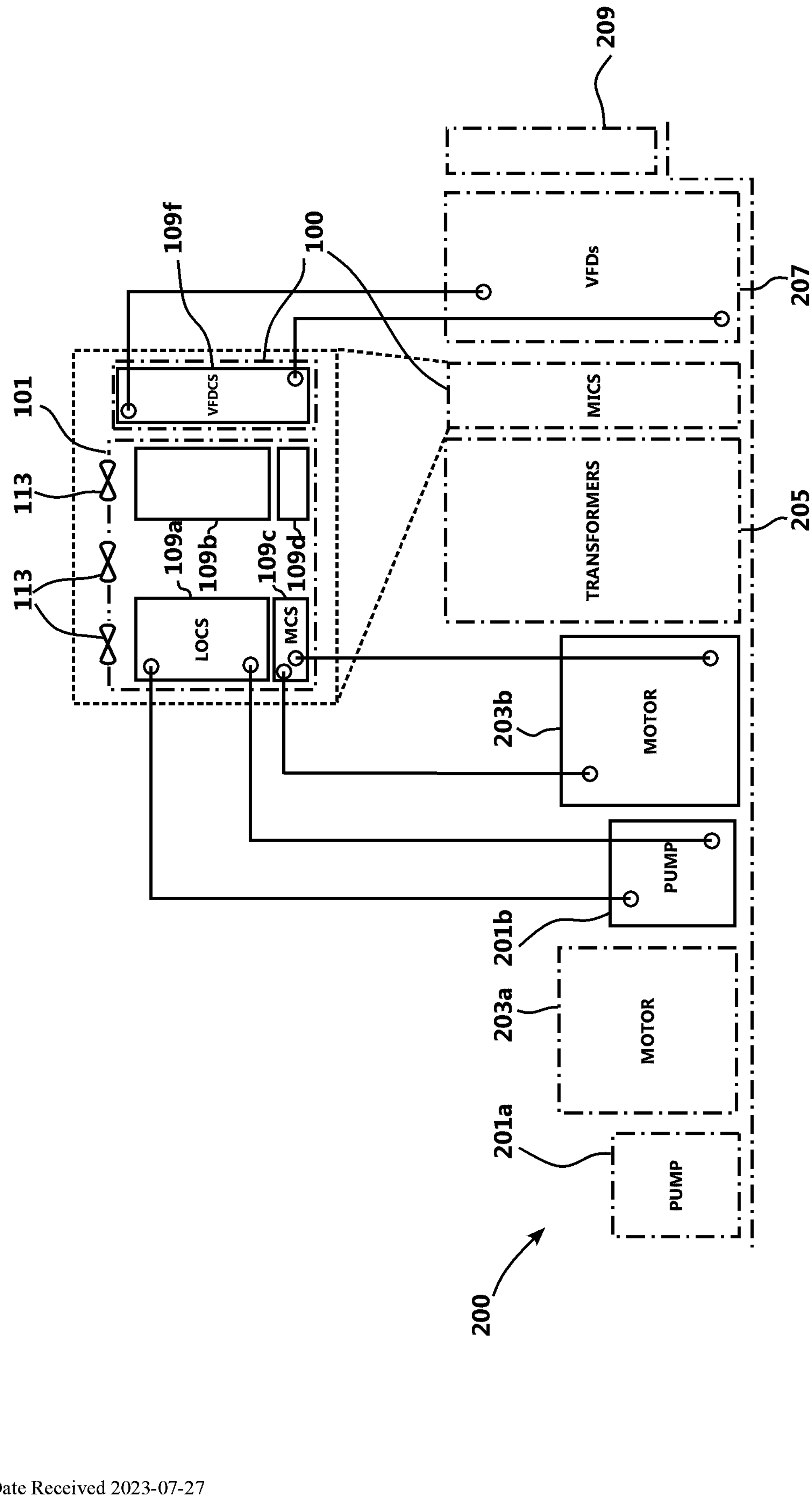

Fig. 5

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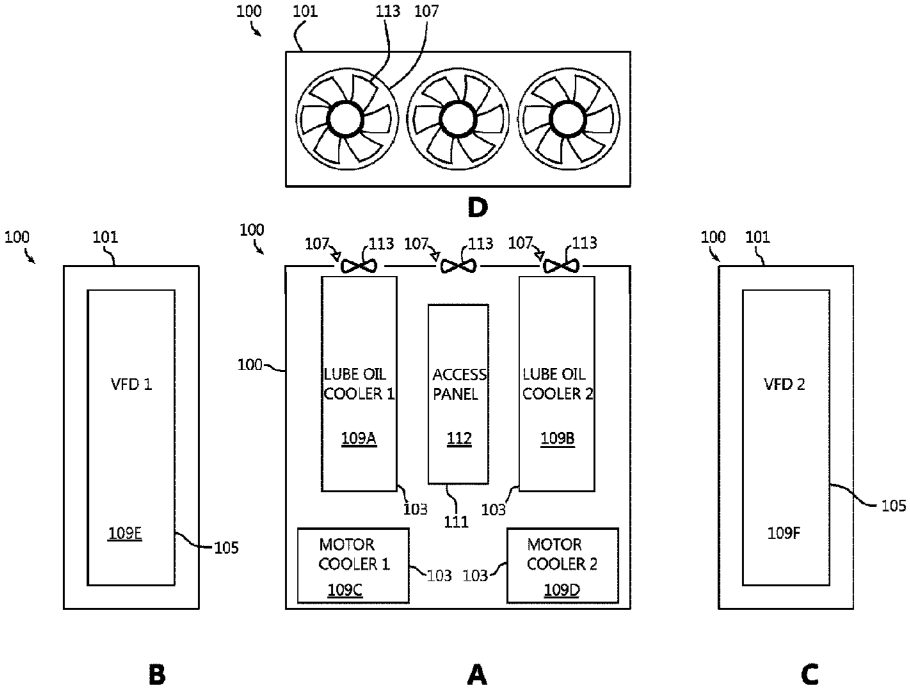
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