

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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Date of mailing
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FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 23/60192

International filing date (day/month/year)

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06 January 2022 (06.01.2022)

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IPC - INV. H05K 7/20, F25B 25/00 (2023.01)

ADD.

CPC - INV.

H05K 7/208, H05K 7/20309, F25B 25/005, H05K 7/20318

ADD.

Applicant MUNTERS CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US
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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:



the international application in the language in which it was filed.



a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐

forming part of the international application as filed.

b. ☐

furnished subsequent to the international filing date for the purposes of international search (Rule 13ter.1(a)),
☐ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.

4. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established to the extent that a meaningful opinion could be formed without a WIPO Standard ST.26 compliant sequence listing.

5. Additional comments:

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	11-14, 16-17, 19-30, 33-34, 38	YES
	Claims	1-10, 15, 18, 31-32, 35-37	NO
Inventive step (IS)	Claims	13-14, 33-34, 38	YES
	Claims	1-12, 15-32, 35-37	NO
Industrial applicability (IA)	Claims	1-38	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-10, 15, 18, 31-32, and 35-37 lack novelty under PCT Article 33(2) as being anticipated by US 2021/0368647 A1 to Munters Corporation (hereinafter "Munters '647").

Regarding claim 1, Munters '647 teaches a cooling system (110, Fig 1; para [0032]) comprising: an evaporator (212, Fig 4; para [0035]) containing a primary cooling medium (202, Fig 4; para [0035]), the evaporator being configured to receive a process fluid (para [0008]) and, when receiving the process fluid, extract heat from the process fluid to cool the process fluid and to change the phase of the primary cooling medium from liquid to gas (para [0008]); a passive condenser (214, Fig 4; para [0008]) having an outer surface and being fluidly coupled to the evaporator (para [0008]), the passive condenser being configured to have an airstream directed over the outer surface thereof (para [0008]), and, when the airstream is directed over the outer surface of the passive condenser, the passive condenser is configured (i) to receive the primary cooling medium in the gas phase from the evaporator, (ii) to transfer heat from the primary cooling medium, (iii) to change the phase of the primary cooling medium from gas to liquid, and (iv) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]); a heat exchanger (216, Fig 4; para [0008]) fluidly coupled to the evaporator (para [0008]) and configured to have a secondary cooling medium selectively provided thereto (para [0008]) such that:

(a) when the secondary cooling medium is provided to the heat exchanger, at least some of the primary cooling medium in the gas phase switches from being received by the passive condenser to the heat exchanger without operating any valves located between the evaporator and the passive condenser and between the evaporator and the heat exchanger (para [0008]) and the heat exchanger is configured (i) to receive the primary cooling medium in the gas phase from the evaporator, (ii) to transfer heat from the primary cooling medium, (iii) to change the phase of the primary cooling medium from gas to liquid, and (iv) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]); and

(b) when the secondary cooling medium is not provided to the heat exchanger, the heat exchanger does not supply the primary cooling medium in the liquid phase to the evaporator (para [0008]); a liquid line (liquid refrigerant line 224, Fig 4; para [0037]) fluidly connecting the evaporator to each of the passive condenser and the heat exchanger to supply the primary cooling medium (liquid phase 204, Fig 4; para [0037]) in the liquid phase to the evaporator from at least one of the passive condenser and the heat exchanger (para [0037]); and a pump (618, Fig 12; para [0108]) located in the liquid line and configured to pump the primary cooling medium in the liquid phase to the evaporator (Fig 21; para [0107], [0108]), wherein the passive condenser (214, Fig 4) is arranged in parallel with the heat exchanger (216, Fig 4) relative to the fluid flow of the primary cooling medium (202, Fig 4; para [0040]).

Regarding claim 2, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the process fluid is air (para [0092]).

Regarding claim 3, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the process fluid is a liquid [0092].

Regarding claim 4, Munters '647 teaches the cooling system of claim 1. Munters '647 further teaches an electronics system (100, para [0095]), comprising:

at least one electronics component (103, para [0095]) cooled by a dielectric; and the cooling system (110, Fig 12; para [0095]) according to claim 1, wherein the cooling system cools the dielectric.

Regarding claim 5, Munters '647 teaches the electronics system according to claim 4. Munters '647 further teaches wherein the process fluid is the dielectric (para [0092]).

Regarding claim 6, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the secondary cooling medium (208, para [0038]) is a refrigerant of a direct expansion cooling system, the direct expansion cooling system including a compressor (232, Fig 1; para [0038]) and an expansion valve (236, Fig 4; para [0038]).

- Continued in Supplemental Box -

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In case the space in any of the preceding boxes is not sufficient.

Continuation of:

- Box V.2. Citations and explanations -

Regarding claim 7, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the secondary cooling medium is chilled water or a chilled water and glycol mixture (para [0037]).

Regarding claim 8, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein, when the secondary cooling medium is provided to the heat exchanger, some of the primary cooling medium is received by both the passive condenser (para [0008]) and the heat exchanger (i) to transfer heat from the primary cooling medium, (ii) to change the phase of the primary cooling medium from gas to liquid, and (iii) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]).

Regarding claim 9, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches comprising a refrigerant receiver (234, Fig 4; para [0038]) configured to accumulate excess primary cooling medium, the refrigerant receiver being located in the liquid line upstream of the pump (618, Fig 21) and downstream of the heat exchanger (616, Fig 21; para [0109], [0110]).

Regarding claim 10, Munters '647 teaches the cooling system according to claim 9. Munters '647 further teaches wherein the refrigerant receiver (234, Fig 21; para [0038]) is located at an elevation that is vertically lower than the bottom of the heat exchanger (616, Fig 21; para [0038], [0109], [0110]).

Regarding claim 15, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the passive condenser (214, Fig 4; para [0043]) includes an outlet configured to supply the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the inlet of the evaporator is fluidly connected to the outlet of the passive condenser by the liquid line (Fig 4; para [0043]), and wherein the outlet of the passive condenser is located at an elevation higher than the inlet of the evaporator by a distance of six feet (1.8 m) or less (para [0062]).

Regarding claim 18, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the heat exchanger (216, Fig 4; para [0037]) includes an outlet configured to supply the primary cooling medium in the liquid phase (para [0037]), wherein the inlet of the evaporator is fluidly connected to the outlet of the heat exchanger by the liquid line (Fig 4; para [0043]), and wherein the outlet of the heat exchanger is located at an elevation higher than the inlet of the evaporator by a distance of six feet (1.8 m) or less (Fig 4; para [0062]; see wherein location of condenser 214 is 2 feet about evaporator, and wherein heat exchanger is shown to be less distance to evaporator than condenser).

Regarding claim 31, Munters '647 teaches a cooling system (110, Fig 1; para [0032]) comprising: an evaporator (212, Fig 4; para [0035]) containing a primary cooling medium (202, Fig 4; para [0035]), the evaporator being configured to receive a process fluid (para [0008]) and, when receiving the process fluid, extract heat from the process fluid to cool the process fluid and to change the phase of the primary cooling medium from liquid to gas (para [0008]);

a plurality of passive condensers (para [0048], see discussion of condensers 214a-d), each passive condenser having an outer surface and being fluidly coupled to the evaporator (para [0008]), the passive condenser being configured to have an airstream directed over the outer surface thereof (para [0008]), and, when the airstream is directed over the outer surface of the passive condenser, the passive condenser is configured (i) to receive the primary cooling medium in the gas phase from the evaporator, (ii) to transfer heat from the primary cooling medium, (iii) to change the phase of the primary cooling medium from gas to liquid, and (iv) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]);

at least one heat exchanger (216, Fig 4; para [0008]) fluidly coupled to the evaporator (para [0008]) and configured to have a secondary cooling medium selectively provided thereto (para [0008]) such that:

(a) when the secondary cooling medium is provided to the at least one heat exchanger, at least some of the primary cooling medium in the gas phase switches from being received by the passive condenser to the at least one heat exchanger without operating any valves located between the evaporator and the passive condenser and between the evaporator and the heat exchanger (para [0008]) and the at least one heat exchanger is configured (i) to receive the primary cooling medium in the gas phase from the evaporator, (ii) to transfer heat from the primary cooling medium, (iii) to change the phase of the primary cooling medium from gas to liquid, and (iv) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]); and

(b) when the secondary cooling medium is not provided to the at least one heat exchanger, the heat exchanger does not supply the primary cooling medium in the liquid phase to the evaporator (para [0008]); a liquid line (liquid refrigerant line 224, Fig 4; para [0037]) fluidly connecting the evaporator to each passive condenser of the plurality of passive condensers (214a-d, Fig 6; para [0043]) and the at least one heat exchanger to supply the primary cooling medium (liquid phase 204, Fig 4; para [0037]) in the liquid phase to the evaporator from at least one of the plurality of passive condensers and the at least one heat exchanger (para [0037]); and a pump (618, Fig 12; para [0108]) located in the liquid line and configured to pump the primary cooling medium in the liquid phase to the evaporator [Fig 21; (para [0107], [0108]), wherein at least one passive condenser of the plurality of passive condensers (214, Fig 4) is arranged in parallel with the at least one heat exchanger relative to the fluid flow of the primary cooling medium (202, Fig 4; para [0040]), wherein the passive condenser is arranged in parallel with the heat exchanger (216, Fig 4) relative to the fluid flow of the primary cooling medium (202, Fig 4; para [0040]).

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In case the space in any of the preceding boxes is not sufficient.

Continuation of:

- Preceding Supplemental Box of V.2. Citations and explanations -

Regarding claim 32, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches wherein the passive condensers of the plurality of passive condensers are arranged in parallel with each other relative to the fluid flow of the primary cooling medium (para [0048], see discussion of condensers 214a-d).

Regarding claim 35, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches wherein the secondary cooling medium is a refrigerant of a direct expansion cooling system, the direct expansion cooling system including a compressor (232, Fig 1; para [0038]) and an expansion valve (236, Fig 4; para [0038]).

Regarding claim 36, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches wherein, when the secondary cooling medium is provided to the at least one heat exchanger, some of the primary cooling medium is received by each of the passive condensers of the plurality of passive condensers (para [0008], [0048]) and the at least one heat exchanger (i) to transfer heat from the primary cooling medium, (ii) to change the phase of the primary cooling medium from gas to liquid, and (iii) to supply the primary cooling medium in the liquid phase to the evaporator (para [0008]).

Regarding claim 37, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches comprising a plurality of heat exchangers (216e-h, Fig 6; para [0068]), each heat exchanger of the plurality of heat exchangers being arranged in parallel with each passive condenser of the plurality of passive condensers relative to the fluid flow of the primary cooling medium (Fig 6; para [0068]).

Claims 16-17 and 19-28 lack an inventive step under PCT Article 33(3) as being obvious over Munters '647.

Regarding claim 16, Munters '647 teaches the cooling system according to claim 15. Munters '647 further teaches comprising a vapor line (vapor pipe, Fig 4; para 0035) fluidly connecting the evaporator to each of the passive condenser and the heat exchanger to supply the primary cooling medium in the gas phase from the evaporator to at least one of the passive condenser and the heat exchanger (para [0035]). However, Munters '647 does not specifically teach wherein the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line have an equivalent linear feet (meters) that is 225 equivalent linear feet (69 m) or more. Notwithstanding, Munters '647 teaches wherein the cooling system is positioned on racks throughout a data center (para 0032). Additionally, variation of dimensions is within the purview of a person of ordinary skill in the art depending on desired design specifications. Accordingly, it would be obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line have an equivalent linear feet (meters) that is 225 equivalent linear feet (69 m) or more so as to design for a cooling system requiring related dimensions.

Regarding claim 17, Munters '647 makes obvious the cooling system according to claim 16. However, Munters '647 does not specifically teach wherein the equivalent linear feet (meters) of the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line is 150 equivalent linear feet (46 m) or more. Notwithstanding, Munters '647 teaches wherein the cooling system is positioned on racks throughout a data center (para 0032). Additionally, variation of dimensions is within the purview of a person of ordinary skill in the art depending on desired design specifications. Accordingly, it would be obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the equivalent linear feet (meters) of the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line is 150 equivalent linear feet (46 m) or more so as to design for a cooling system requiring related dimensions.

Regarding claim 19, Munters '647 makes obvious the cooling system according to claim 18. Munters '647 further comprising a vapor line (vapor pipe, Fig 4; para 0035) fluidly connecting the evaporator to each of the passive condenser and the heat exchanger to supply the primary cooling medium in the gas phase from the evaporator to at least one of the passive condenser and the heat exchanger (para [0035]). However, Munters '647 does not specifically teach wherein the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line have an equivalent linear feet (meters) that is 225 equivalent linear feet (69 m) or more. Notwithstanding, Munters '647 teaches wherein the cooling system is positioned on racks throughout a data center (para 0032). Additionally, variation of dimensions is within the purview of a person of ordinary skill in the art depending on desired design specifications. Accordingly, it would be obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line have an equivalent linear feet (meters) that is 225 equivalent linear feet (69 m) or more so as to design for a cooling system requiring related dimensions.

Regarding claim 20, Munters '647 makes obvious the cooling system according to claim 19. However, Munters '647 does not specifically teach wherein the equivalent linear feet (meters) of the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line is 150 equivalent linear feet (46 m) or more. Notwithstanding, Munters '647 teaches wherein the cooling system is positioned on racks throughout a data center (para 0032). Additionally, variation of dimensions is within the purview of a person of ordinary skill in the art depending on desired design specifications. Accordingly, it would be obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the equivalent linear feet (meters) of the evaporator, the passive condenser, the heat exchanger, the liquid line, and the vapor line is 150 equivalent linear feet (46 m) or more so as to design for a cooling system requiring related dimensions.

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Regarding claim 21, Munters '647 teaches the cooling system according to claim 1. However, Munters '647 does not specifically teach wherein the evaporator is positioned at a level higher than at least one of the passive condenser and the heat exchanger. Notwithstanding, Munters '647 teaches wherein a pump may be used to control the flow with respect to effects of gravity (para [0005]). As such, the inference that the evaporator may be positioned at a level higher than at least one of the passive condenser and the heat exchanger since a pump may be used to control the effects of gravity would be obvious to one of ordinary skill in the art. Accordingly, it would have been obvious to a person of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the evaporator is positioned at a level higher than at least one of the passive condenser and the heat exchanger given the inference that a pump may be used to control effects of gravity to thereby allow for positioning of components at higher levels.

Regarding claim 22, Munters '647 teaches the cooling system according to claim 1. Munters '647 does not specifically teach wherein the pump is a variable speed pump. However, Munters '647 teaches variable speed of fans to control flow rate of process fluid (para [0091], [0092]). Munters '647 also teaches the cooling system using a pump for circulation of process fluid (para [0093]). As such, it would have been obvious to a person of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the pump is a variable speed pump to facilitate control of flow rate.

Regarding claim 23, Munters '647 makes obvious the cooling system according to claim 22. Munters '647 does not specifically teaches further comprising a controller operatively coupled to the pump to control the speed of the pump. Notwithstanding, Bouche teaches a controller coupled to components of the cooling system to control the flow rate of the process fluid (para [0054], [0091]-[0093]). As such, it would be obvious to a person of ordinary skill in the art to configure a cooling system as in Munters '647 to further comprise a controller operatively coupled to the pump to control the speed of the pump so as to control a component that would modulate the flow rate of the process fluid.

Regarding claim 24, Munters '647 makes obvious the cooling system according to claim 23. Munters '647 further teaches comprising a temperature sensor (122, Fig 6; para [0053]), the controller (240, Fig 6; para [0053]) being communicatively coupled to the temperature sensor to receive temperature information (para [0053]). However, Munters '647 does not specifically teach the controller being configured to control the speed of the pump based on the temperature information. Notwithstanding, Bouche teaches a controller coupled to components of the cooling system to control the flow rate of the process fluid (para [0054], [0091]-[0093]). As such, it would be obvious to a person of ordinary skill in the art to configure a controller as in Munters '647 to control the speed of the pump based on the temperature information to facilitate enhanced control of the flow rate.

Regarding claim 25, Munters '647 teaches the cooling system according to claim 1. Munters '647 does not specifically teach wherein the evaporator, the passive condenser, the heat exchanger, and the pump are integrated into a single unit. However, Munters '647 teaches the system wherein all components are integrated into one system that is contained within a single data center (Figs 1 and 20; para [0032], [0109]). Further, variation in size of containment is within the purview of one of ordinary skill in the art. Accordingly, it would be obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the evaporator, the passive condenser, the heat exchanger, and the pump are integrated into a single unit depending on the variation of size desired.

Regarding claim 26, Munters '647 makes obvious the cooling system according to claim 25. Munters '647 does not specifically teach wherein the evaporator and the passive condenser are positioned relative to each other such that the overall height of the single unit is 14 feet (4.27 m) or less. Notwithstanding, variation of positioning is within the purview of one of ordinary skill in the art depending on desired design specifications. As such, it would have been obvious to a person of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the evaporator and the passive condenser are positioned relative to each other such that the overall height of the single unit is 14 feet (4.27 m) or less (para [0032]) depending on the design specifications desired.

Regarding claim 27, Munters '647 makes obvious the cooling system according to claim 25. Munters '647 further teaches comprising a process fluid inlet fluidly connected to the evaporator and a process fluid outlet fluidly connected to the evaporator (see process fluid loop 140 into and out of evaporators 212k and 212l, Fig 12; para [0093]).

Regarding claim 28, Munters '647 makes obvious the cooling system according to claim 25. Munters '647 further teaches wherein the process fluid inlet is a return air opening capable of being connected to a return air duct and a process fluid outlet is a supply air opening capable of being connected to a supply air duct (see process fluid loop 140 into and out of evaporators 212k and 212l, Fig 12; para [0090]-[0093]).

Claims 11-12 lack an inventive step under PCT Article 33(3) as being obvious over Munters '647 in view of US 2009/0158757 A1 (Marsala).

Regarding claim 11, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the passive condenser (214, Fig 4; para [0043]) includes an outlet configured to supply the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), and wherein the inlet of the evaporator is fluidly connected to the outlet of the passive condenser by the liquid line (Fig 4; para [0043]).

--Claim 11 to be continued--

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--Claim 11 continued--

Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the passive condenser to the inlet of the evaporator. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein the inlet of the evaporator (18, Fig 1A; para [0021]) is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the passive condenser (28, Fig 1A; para [0021]) to the inlet of the evaporator (see Fig 1A, wherein pump 12 is used to distribute the cooling medium; para [0018]). Accordingly, it would have been obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the inlet of the evaporator is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the passive condenser to the inlet of the evaporator as in Marsala so as to provide for variation in component locations depending on design specifications.

Regarding claim 12, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the heat exchanger (216, Fig 4; para [0037]) includes an outlet configured to supply the primary cooling medium in the liquid phase (para [0037]), and

wherein the inlet of the evaporator is fluidly connected to the outlet of the heat exchanger by the liquid line (Fig 4; para [0043]).

Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the heat exchanger to the inlet of the evaporator. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein the inlet of the evaporator (18, Fig 1A; para [0021]) is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the heat exchanger (condenser 28, Fig 1A; para [0021]) to the inlet of the evaporator (see Fig 1A, wherein pump 12 is used to distribute the cooling medium; para [0018]). Accordingly, it would have been obvious to one of ordinary skill in the art to configure a cooling system as in Munters '647 wherein the inlet of the evaporator is located at an elevation where gravity and natural circulation are not sufficient to move the primary cooling medium from the outlet of the heat exchanger to the inlet of the evaporator as in Marsala so as to provide for variation in component locations depending on design specifications.

Claims 29-30 lack an inventive step under PCT Article 33(3) as being obvious over Munters '647 in view of US 9,945,142 B2 to Maselli et al. (hereinafter "Maselli").

Regarding claim 29, Munters '647 makes obvious the cooling system according to claim 28. However, Munters '647 does not specifically teach a multi-level data center, comprising:

a plurality of floors including a first floor and a second floor, the second floor being higher than the first floor;

a plurality of racks holding electronic components positioned on the second floor; and

the cooling system according to claim 28, wherein the return air opening is connected to the return air duct to receive air from the plurality of racks positioned on the second floor and the supply air opening is connected to the supply air duct to supply air to the plurality of racks positioned on the second floor.

Notwithstanding, Munters '647 teaches a data center (100, Fig 1; para [0032]) with a plurality of racks (102, Fig 1; para [0032]). and Maselli teaches a multi-level data center with a plurality of floors (10, Fig 5; col 5, ln 25-57). Further, variation in positioning of components is within the purview of one of ordinary skill in the art depending on desired design specifications. As such, it would have been obvious to a person of ordinary skill in the art to combine a cooling system as in Munters '647 with a multi-level data center as in Maselli comprising a plurality of floors including a first floor and a second floor, the second floor being higher than the first floor; a plurality of racks holding electronic components positioned on the second floor; and the cooling system according to claim 28, wherein the return air opening is connected to the return air duct to receive air from the plurality of racks positioned on the second floor and the supply air opening is connected to the supply air duct to supply air to the plurality of racks positioned on the second floor depending on the design specifications desired.

Regarding claim 30, Munters '647 teaches the cooling system according to claim 1. Munters '647 does not specifically teach a multi-level data center, comprising:

a plurality of floors including a first floor and a second floor, the second floor being higher than the first floor;

a plurality of racks holding electronic components positioned on the second floor; and

the cooling system according to claim 1, wherein the evaporator is positioned on the second floor and the passive condenser and the heat exchanger are positioned lower than the second floor. Notwithstanding, Munters '647 teaches a data center (100, Fig 1; para [0032]) with a plurality of racks (102, Fig 1; para [0032]). and Maselli teaches a multi-level data center with a plurality of floors (10, Fig 5; col 5, ln 25-57). Further, variation in positioning of components is within the purview of one of ordinary skill in the art depending on desired design specifications. As such, it would have been obvious to a person of ordinary skill in the art to combine a cooling system as in Munters '647 with a multi-level data center as in Maselli comprising a plurality of floors including a first floor and a second floor, the second floor being higher than the first floor, a plurality of racks holding electronic components positioned on the second floor, and the cooling system according to claim 1, wherein the evaporator is positioned on the second floor and the passive condenser and the heat exchanger are positioned lower than the second floor depending on the design specifications desired.

Claims 13-14, 33-34, and 38 meet the criteria as set forth by PCT Article 33(2)-(3) as having novelty and an inventive step because the prior art fails to teach or fairly suggest the claimed subject matter.

The prior art is exemplified by (1) Munters '647 and (2) Marsala.

- Continued in Supplemental Box -

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 23/60192

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

- Preceding Supplemental Box of V.2. Citations and explanations -

Regarding claim 13, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the passive condenser (214, Fig 4; para [0043]) includes an outlet configured to supply the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), and wherein the inlet of the evaporator is fluidly connected to the outlet of the passive condenser by the liquid line (Fig 4; para [0043]). Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation higher than the outlet of the passive condenser. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein a pump is used to distribute cooling medium from the outlet of a condenser to the inlet of an evaporator (Fig 1A; para [0018], [0021]). However, the prior art does not disclose/teach individually nor fairly suggest in combination a system wherein the inlet of the evaporator is located at an elevation higher than the outlet of the passive condenser.

Regarding claim 14, Munters '647 teaches the cooling system according to claim 1. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the heat exchanger (216, Fig 4; para [0037]) includes an outlet configured to supply the primary cooling medium in the liquid phase (para [0037]), and wherein the inlet of the evaporator is fluidly connected to the outlet of the heat exchanger by the liquid line (Fig 4; para [0043]). Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation higher than the outlet of the heat exchanger. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein a pump is used to distribute cooling medium from the outlet of a heat exchanger to the inlet of an evaporator (Fig 1A; para [0018], [0021]). However, the prior art does not disclose/teach individually nor fairly suggest in combination a system wherein the inlet of the evaporator is located at an elevation higher than the outlet of the heat exchanger.

Regarding claim 33, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein each passive condenser of the plurality of passive condensers (214, Fig 6; para [0043], [0048]) includes an outlet configured to supply the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), and wherein the inlet of the evaporator is fluidly connected to the outlet of each passive condenser of the plurality of passive condensers by the liquid line (Fig 6; para [0043], [0048]). Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation higher than the outlet of each passive condenser of the plurality of passive condensers. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein a pump is used to distribute cooling medium from the outlet of a condenser to the inlet of an evaporator (Fig 1A; para [0018], [0021]). However, the prior art does not disclose/teach individually nor fairly suggest in combination a system wherein the inlet of the evaporator is located at an elevation higher than the outlet of each passive condenser of the plurality of passive condensers.

Regarding claim 34, Munters '647 teaches the cooling system according to claim 31. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein the at least one heat exchanger (216, Fig 4; para [0037]) includes an outlet configured to supply the primary cooling medium in the liquid phase (para [0037]), and wherein the inlet of the evaporator is fluidly connected to the outlet of the at least one heat exchanger by the liquid line (Fig 4; para [0043]). Munters '647 does not specifically teach wherein the inlet of the evaporator is located at an elevation higher than the outlet of the at least one heat exchanger. Notwithstanding, Munters '647 teaches various angles and locations of components but with a preference that would enable gravity flow. Further, Marsala teaches a cooling system wherein a pump is used to distribute cooling medium from the outlet of at least one heat exchanger to the inlet of the evaporator inlet of an evaporator (Fig 1A; para [0018], [0021]). However, the prior art does not disclose/teach individually nor fairly suggest in combination a system wherein the inlet of the evaporator is located at an elevation higher than the outlet of the at least one heat exchanger.

Regarding claim 38, Munters '647 in view of Marsala teaches the cooling system according to claim 37. Munters '647 further teaches wherein the evaporator (212, Fig 4; para [0043]) includes an inlet configured to receive the primary cooling medium in the liquid phase (204, Fig 4; para [0043]), wherein each heat exchanger of the plurality of heat exchangers (216e-h, Fig 6; para [0068]) includes an outlet configured to supply the primary cooling medium in the liquid phase (para [0037], [0050]), and wherein the inlet of the evaporator is fluidly connected to the outlet of each heat exchanger of the plurality of heat exchangers by the liquid line (Fig 6; para [0050]). Neither Munters '647 nor Marsala specifically teaches wherein the inlet of the evaporator is located at an elevation higher than the outlet of each heat exchanger of the plurality of heat exchangers. Notwithstanding, Munters '647 teaches a plurality of heat exchangers (Fig 6; para [0037], [0043]). Additionally, Marsala teaches wherein a pump is used to distribute cooling medium from the outlet of a heat exchanger to the inlet of an evaporator (Fig 1A; para [0018], [0021]). However, the prior art does not disclose/teach individually nor fairly suggest in combination a system wherein the inlet of the evaporator is located at an elevation higher than the outlet of each heat exchanger of the plurality of heat exchangers.

Claims 1-38 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.