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(54) **FRESH AIR BOX**

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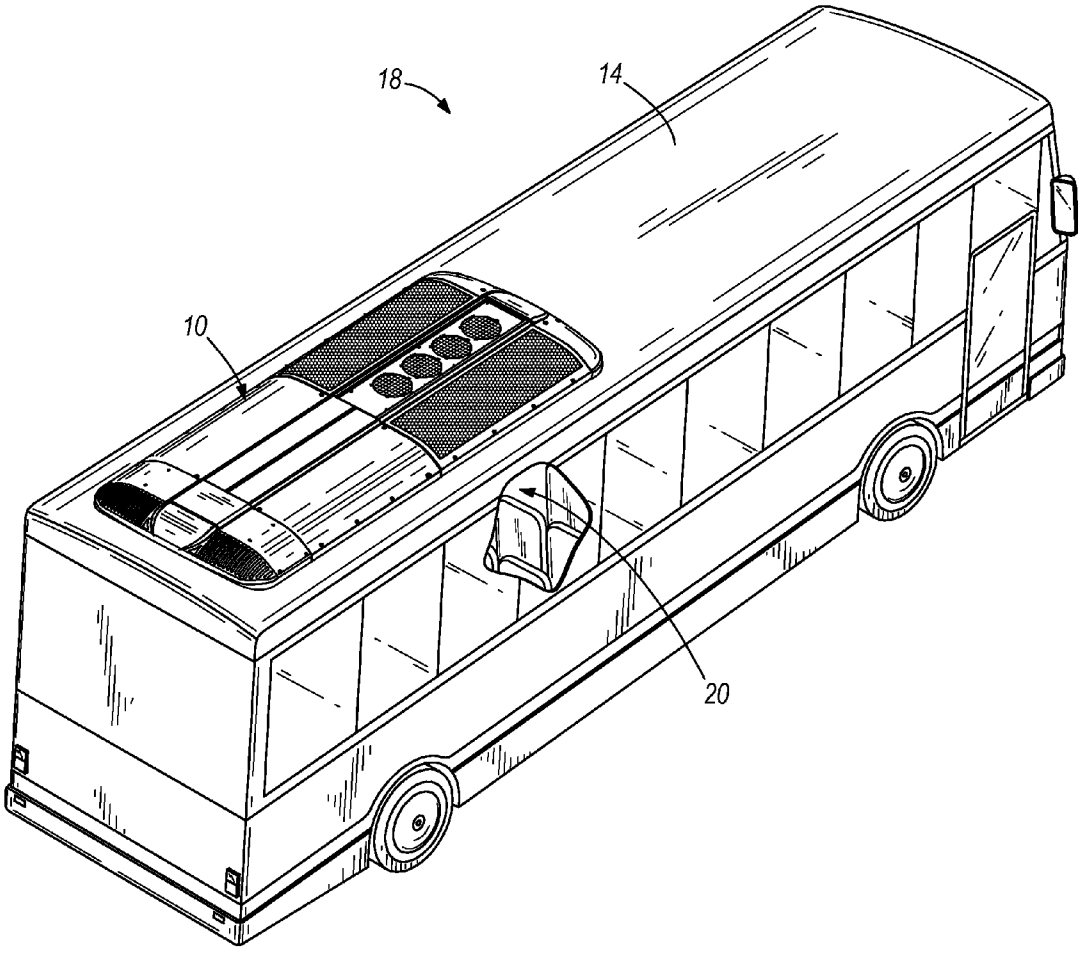
(57) **ABSTRACT**

A rooftop temperature control unit for a vehicle having a conditioned space includes a housing defining a plenum and including an air inlet. The plenum is configured to receive an inflow of outdoor air from outside of the vehicle through the air inlet. The outdoor air defines an outdoor air temperature. A heat exchanger assembly is coupled to the housing and in fluid communication with the plenum. The heat exchanger assembly is configured to receive a first portion of the outdoor air from the plenum, to cool the first portion to a temperature below the outdoor air temperature, and to discharge the cooled first portion into the conditioned space. A blower is configured to receive a second portion of the outdoor air from the plenum and to discharge the second portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature.



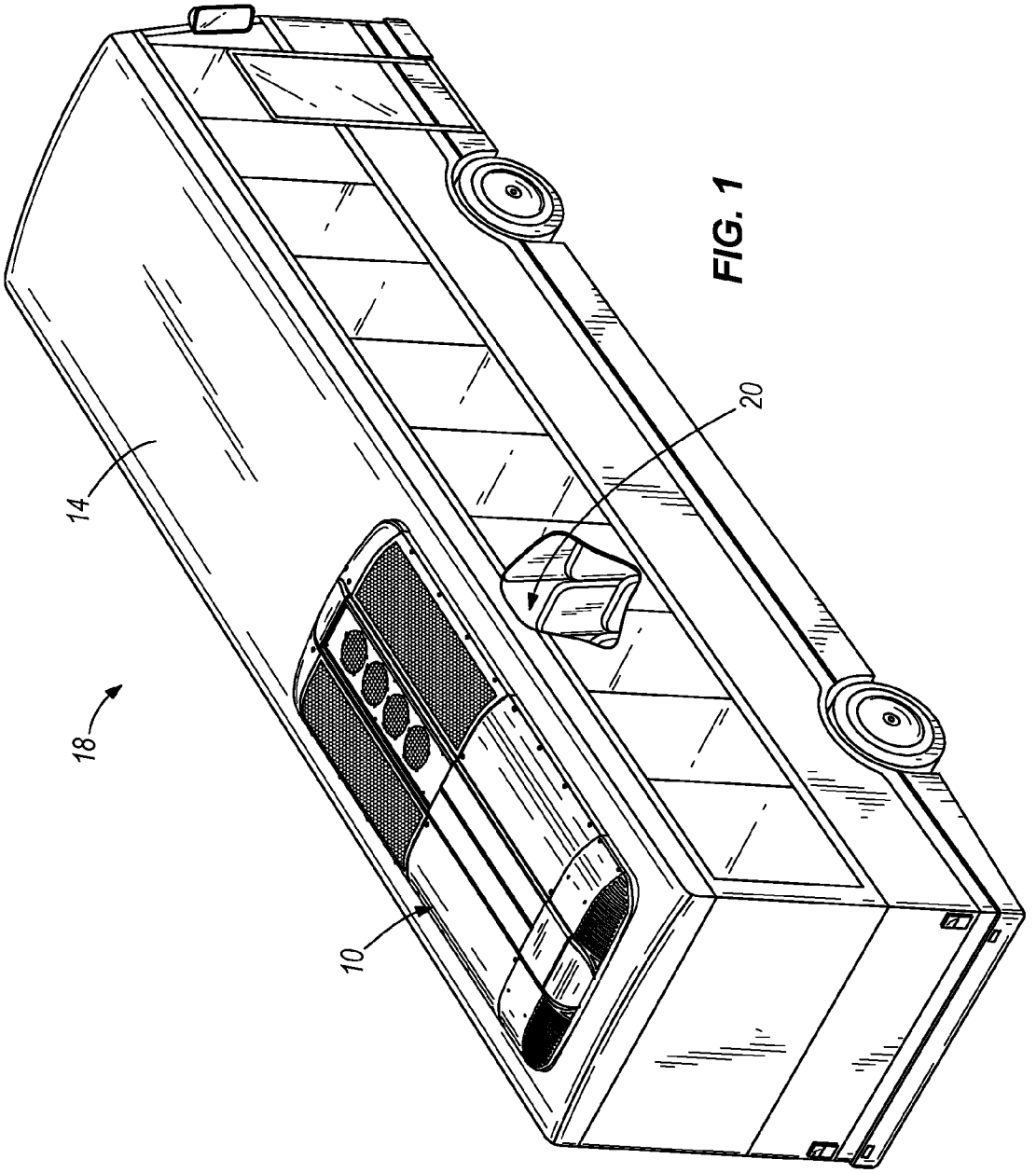
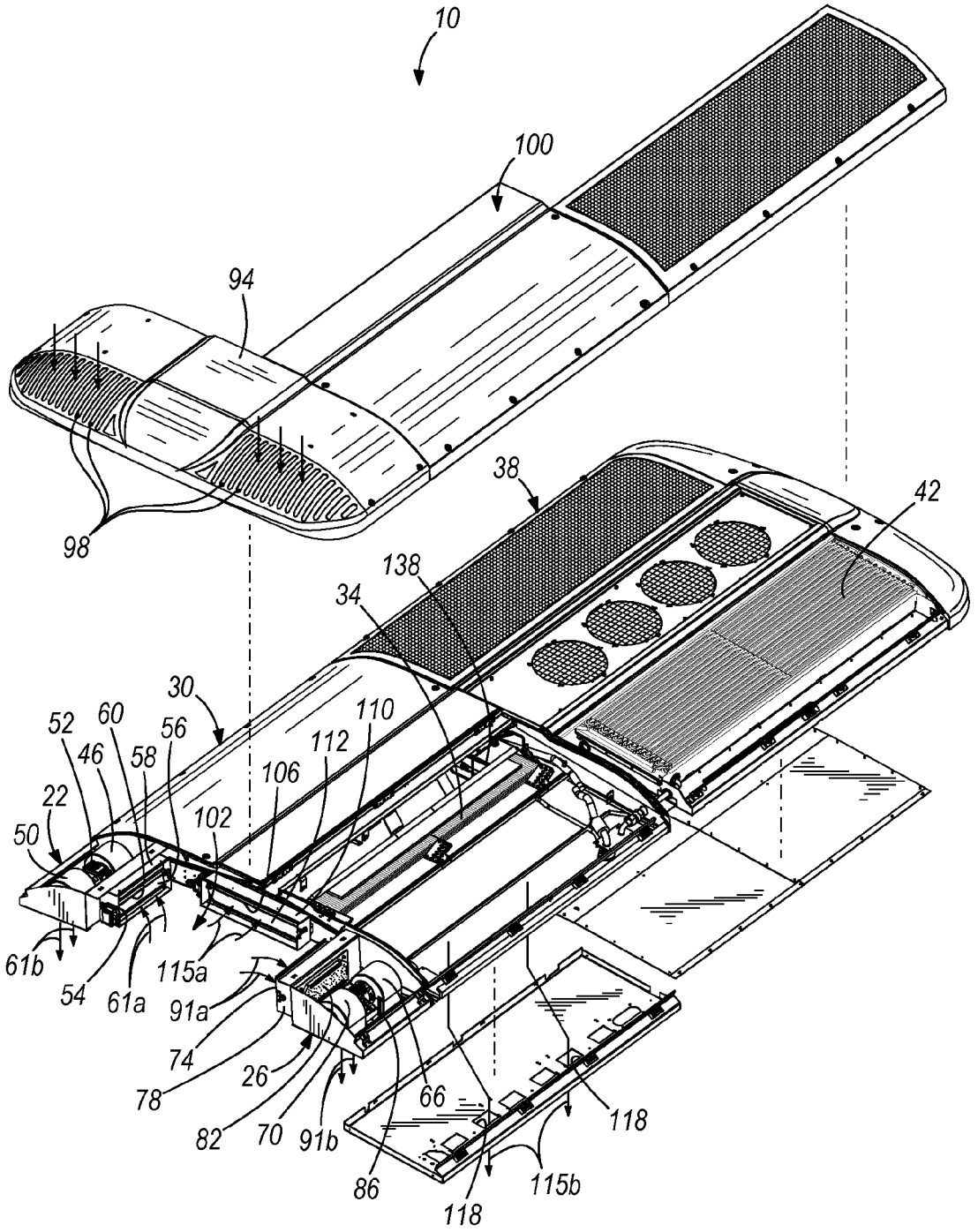


FIG. 1


10
100
94
98
38
42
138
34
30
52
60
46
58
56
110
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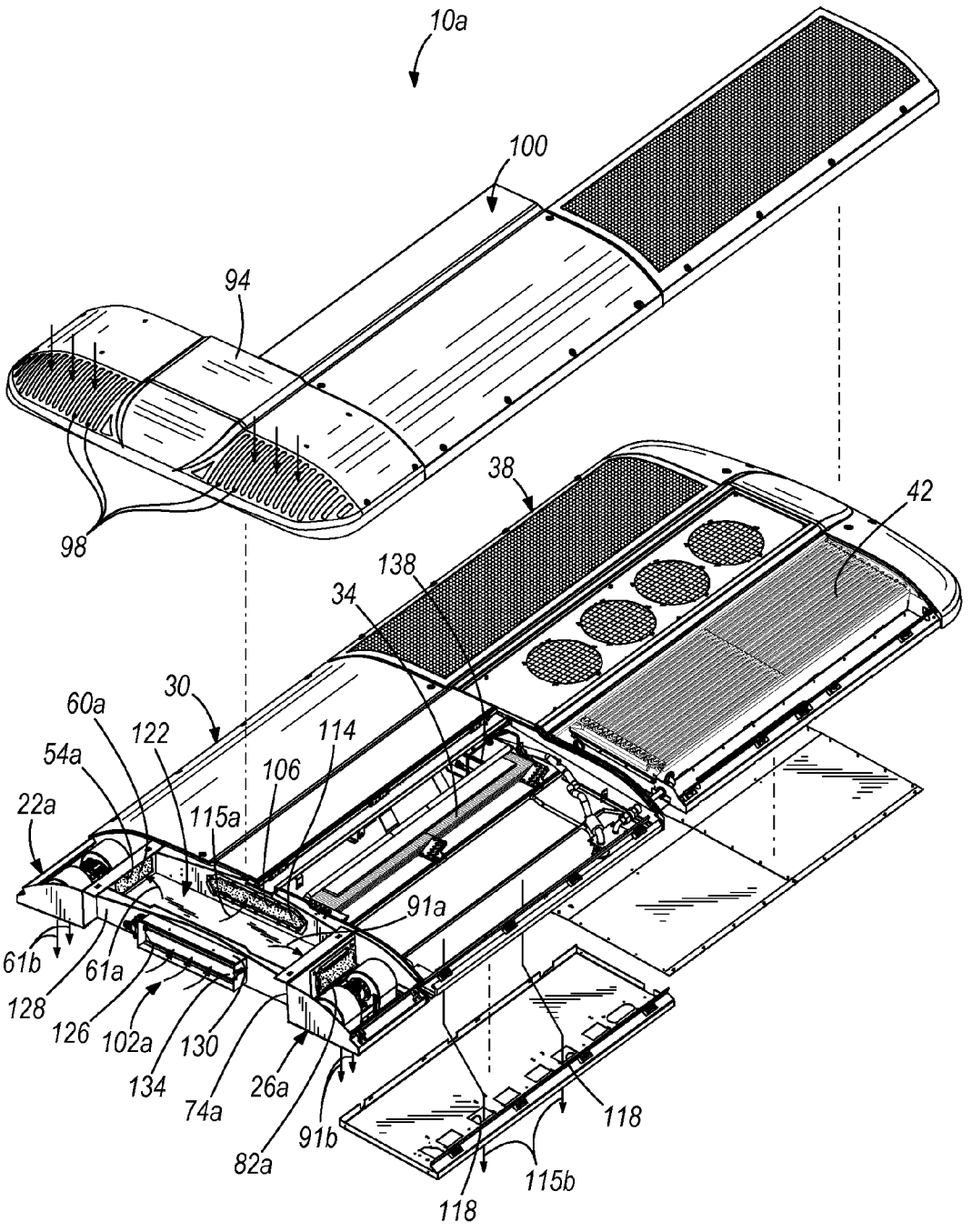
106
102
22
50
61b
54
61a
115a
91a
74
78
26
82
70
91b
66
86
118
115b
118

FIG. 2


10a
100
94
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38
42
138
34
30
60a
122
114
54a
106
22a
115a
91a
61b
61a
128
126
102a
130
134
74a
26a
82a
91b
118
115b
118

FIG. 3

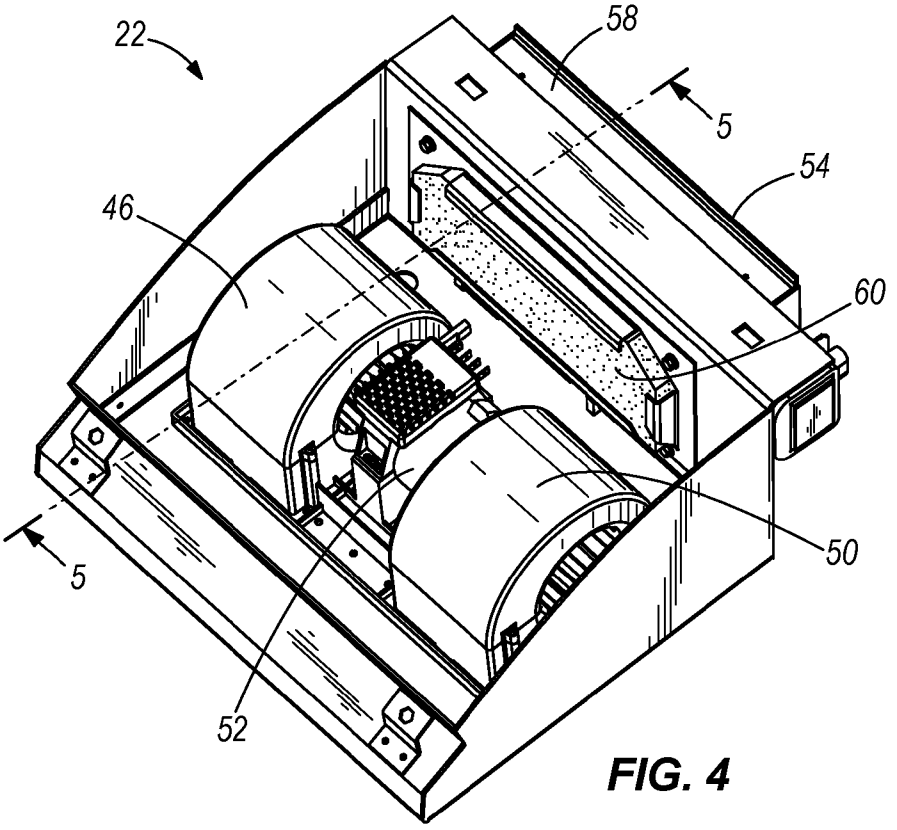

FIG. 4

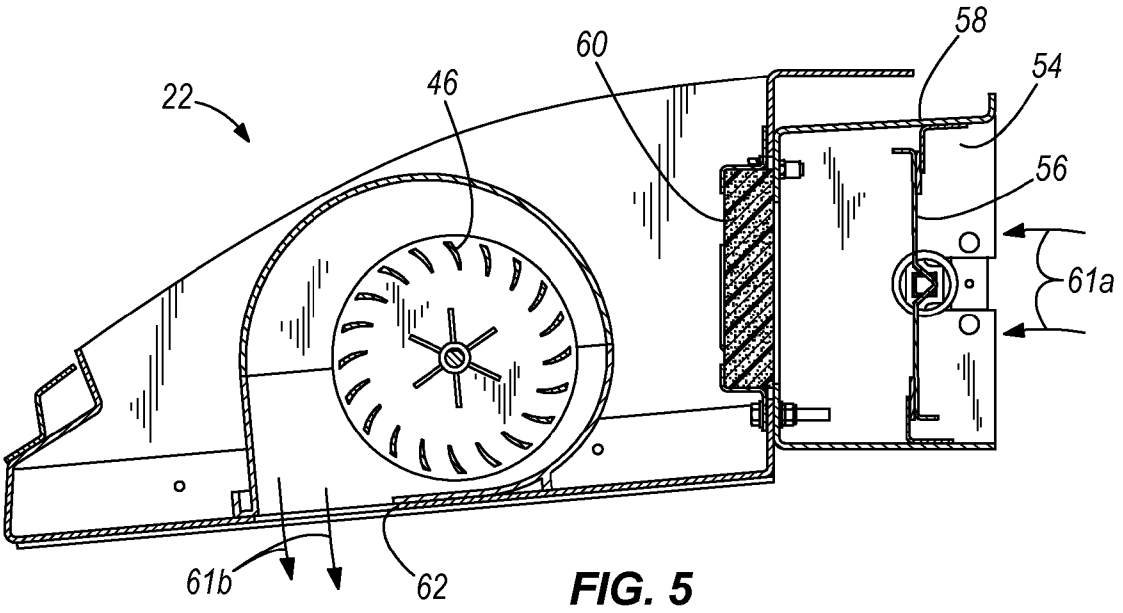

FIG. 5

FRESH AIR BOX

BACKGROUND

[0001] The present invention relates to a rooftop temperature control unit for a vehicle, in particular a bus.

[0002] Typical rooftop temperature control units for busses provide cooling to a conditioned space, or cabin, within the bus. A heat exchanger within the temperature control unit cools return air, which is directed back to the conditioned space. Some rooftop temperature control units include an opening through which fresh outdoor air enters the temperature control unit by natural flow to be cooled by the heat exchanger. The introduction of fresh air improves air quality in the conditioned space, but the natural flow of the fresh air is difficult to control.

SUMMARY

[0003] In one embodiment, the invention provides a rooftop temperature control unit for a vehicle having a conditioned space. The rooftop temperature control unit includes a housing defining a plenum and including an air inlet. The plenum is configured to receive an inflow of outdoor air from outside of the vehicle through the air inlet. The outdoor air defines an outdoor air temperature. A heat exchanger assembly is coupled to the housing and in fluid communication with the plenum. The heat exchanger assembly is configured to receive a first portion of the outdoor air from the plenum, to cool the first portion to a temperature below the outdoor air temperature, and to discharge the cooled first portion into the conditioned space. A blower is coupled to the housing and in fluid communication with the plenum, the blower configured to receive a second portion of the outdoor air from the plenum and to discharge the second portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature.

[0004] In another embodiment, the invention provides a method of operating a rooftop temperature control unit for a vehicle having a conditioned space. The method includes receiving an inflow of outdoor air from outside of the vehicle through an air inlet of a housing and into a plenum defined by the housing, receiving with a heat exchanger assembly a first portion of the outdoor air from the plenum, cooling with the heat exchanger assembly the first portion to a temperature below an outdoor air temperature, discharging with the heat exchanger assembly the cooled first portion into the conditioned space, receiving with a blower a second portion of the outdoor air from the plenum, and discharging with the blower the second portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature.

[0005] Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a perspective view of a bus having a rooftop temperature control unit embodying the invention.

[0007] FIG. **2** is an exploded perspective view of the temperature control unit of FIG. **1**.

[0008] FIG. **3** is an exploded perspective view of a second construction of the temperature control unit of FIG. **1**.

[0009] FIG. **4** is a perspective view of a fresh air compartment of the temperature control unit of FIG. **1**.

[0010] FIG. **5** is a cross section of the fresh air compartment taken along line **5-5** of FIG. **4**.

DETAILED DESCRIPTION

[0011] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings.

[0012] FIG. **1** illustrates a temperature control unit **10** embodying the invention mounted to the rooftop **14** of a bus **18**. The temperature control unit **10** communicates with a conditioned space **20** inside the bus **18** by providing temperature-controlled air to the conditioned space **20**. It is to be understood that the temperature control unit **10** may be employed in any vehicle, but is preferably employed in a bus. Furthermore, the temperature control unit **10** may be mounted to any portion of the vehicle and is not limited to being mounted on the roof **14**.

[0013] FIG. **2** is an exploded view of a first construction of the temperature control unit **10**. The temperature control unit **10** includes a first compartment or fresh box **22**, a second compartment or fresh box **26**, an evaporator compartment **30** containing an evaporator **34** and an evaporator blower (not shown), and a condenser compartment **38** containing a condenser **42**. An evaporator assembly includes the evaporator compartment **30** housing the evaporator **34** and evaporator blower. The evaporator **34** and the condenser **42** belong to an air conditioning system (not shown in its entirety) including a compressor, expansion modules and fluid conduits forming a refrigeration circuit, as is commonly known in the art. Therefore, the air conditioning system will not be explained in further detail.

[0014] With reference to FIG. **4**, the first compartment **22** contains first and second blowers **46**, **50** and includes a first compartment inlet **54** and a first compartment damper **58** coupled to the first compartment inlet **54**. The first compartment damper **58** includes a moveable plate **56** to adjust the inflow of air to the first compartment **22** through the first compartment inlet **54**. A first dust filter **60** is coupled to the first compartment inlet **54** and is positioned substantially within the first compartment **22** to filter the inflow of air into the first compartment **22**. The first and second blowers **46**, **50** are coupled to a first motor **52** for synchronized rotation with the first motor **52**. The motor **52** preferably runs at multiple speeds to operate the blowers **46**, **50** at multiple speeds. For example, the motor **52** may run the blowers **46**, **50** at a high speed, a low speed and off. Preferably, the motor **52** runs the blowers **46**, **50** at a plurality of non-zero speeds. In other constructions, the first compartment **22** may contain fewer or more blowers and the blowers may be coupled to separate

motors for separately controlled rotation. In the illustrated construction, the first and second blowers **46**, **50** are centrifugal fans. In other constructions, other types of blowers, such as fans and other devices that move air, may be employed. Also in other constructions, the first dust filter **60** may be positioned substantially outside of the first compartment **22** or just partially within the first compartment **22**.

[0015] FIG. **5** is a cross-section of the first compartment **22** through the first compartment inlet **54** and the first blower **46**. The inflow and outflow of air through the first compartment **22** is indicated by arrows **61***a*, **61***b*. Air enters the first compartment **22** through the first compartment damper **58** and passes through the first compartment inlet **54** and the first dust filter **60**. The first dust filter **60** substantially prevents dust and debris from entering the first compartment **22**. The air is then drawn by the first blower **46** and the second blower **50** (FIG. **4**) and directed through a first compartment outlet **62** into a bus duct (not shown) and into the conditioned space **20**. The air drawn into and expelled from the first compartment **22** and into the conditioned space **20** is at a temperature equal to or greater than the outdoor air temperature. In other words, outdoor air is drawn into the plenum **102**, drawn into the first compartment **22** and discharged to the conditioned space **20** without passing through a heat exchanger for cooling the outdoor air. The direction of the outflow **61***b* from the first compartment **22** is substantially perpendicular to the direction of the inflow **61***a* to the first compartment **22**.

[0016] It is to be understood that the second compartment **26** is substantially identical to the first compartment **22** in the illustrated construction. However, different reference numerals are used in FIG. **2** to distinguish the first compartment **22** from the second compartment **26**. Although FIGS. **4-5** are labeled with reference numerals corresponding to the first compartment **22**, the description of FIGS. **4-5** above could be used to describe the second compartment **26** as well. Therefore, separate figures including reference numerals corresponding to the second compartment **26** will not be provided as it is to be understood that the description above of the first compartment **22** with respect to FIGS. **4-5** can be applied to the second compartment **26**. However, the first and second compartments **22**, **26** may be constructed differently and still fall within the scope of the invention.

[0017] With reference to FIG. **2**, the second compartment **26** contains third and fourth blowers **66** and **70**, respectively, and includes a second compartment inlet **74** and a second compartment damper **78** coupled to the second compartment inlet **74**. The second compartment damper **78** includes a moveable plate **80** to adjust the inflow of air to the second compartment **26** through the second compartment inlet **74**. A second dust filter **82** is coupled to the second compartment inlet **74** and is positioned substantially within the second compartment **26** to filter the inflow of air into the second compartment **26**. The third and fourth blowers **66**, **70** are coupled to a second motor **86** for synchronized rotation with the second motor **86**. The motor **86** preferably runs at multiple speeds to operate the blowers **66**, **70** at multiple speeds. For example, the motor **86** may run the blowers **66**, **70** at a high speed, a low speed and off. Preferably, the motor **86** runs the blowers **66**, **70** at a plurality of non-zero speeds. In other constructions, the second compartment **26** may contain fewer or more blowers and the blowers may be coupled to separate motors for separately controlled rotation. In the illustrated construction, the third and fourth blowers **66**, **70** are centrifugal fans. In other constructions other types of blowers, such as fans and other devices that move air, may be employed. Also in other constructions, the second dust filter **82** may be positioned substantially outside of the second compartment **26** or just partially within the second compartment **26**.

[0018] The inflow and outflow of air through the second compartment **26** is indicated by arrows **91***a*, **91***b*. Air enters the second compartment **26** through the second compartment damper **78** and passes through the second compartment inlet **74** and the second dust filter **82**. The second dust filter **82** substantially prevents dust and debris from entering the second compartment **26**. The air is then drawn by the third blower **66** and the fourth blower **70** and directed through a second compartment outlet **90** into a bus duct (not shown) and into the conditioned space **20**. The air drawn into and expelled from the second compartment **26** and into the conditioned space is at a temperature equal to or greater than the outdoor air temperature. In other words, outdoor air is drawn into the plenum **102**, drawn into the second compartment **26** and discharged to the conditioned space **20** without passing through a heat exchanger for cooling the outdoor air. The direction of the outflow **91***b* from the second compartment **26** is substantially perpendicular to the direction of the inflow **91***a* to the second compartment **26**.

[0019] The first compartment **22** and the second compartment **26** are enclosed on the top by a fresh air cover **94** having a fresh air inlet **98**. The fresh air inlet **98** includes a plurality of elongated openings that allow fresh outdoor air from outside of the bus **18** to enter a plenum **102** inside the temperature control unit **10**. A housing, generally indicated with the numeral **100** and including the fresh air cover **94**, defines the plenum **102**. The plenum **102** is a space inside the housing **100** that serves as a holding chamber for air that is to be distributed to the conditioned space **20**. The fresh outdoor air enters the first and second compartments **22**, **26** from the plenum **102** by way of the first and second compartment inlets **54**, **74** and the first and second compartment dampers **58**, **78** positioned inside the temperature control unit **10** adjacent the plenum **102**. In other constructions, the fresh air inlet **98** may include one or more openings of any shape and size. In yet other constructions, the first and second compartment inlets **54**, **74** and the first and second compartment dampers **58**, **78** may be positioned in the cover **94** in direct communication with fresh outdoor air for the direct passage of fresh outdoor air into the first and second compartments **22**, **26**.

[0020] The inflow of fresh outdoor air into the plenum **102** and into the first compartment **22** and the second compartment **26** is controlled by the positions of the first and second compartment dampers **58**, **78** and by the speed of the first and second blowers **46**, **50**. When the dampers **58**, **78** are closed, the inflow of air into the first and second compartments **22**, **26** is minimal or non-existent. When the blowers **46**, **50**, **66**, **70** are not operating, the inflow of air into the first and second compartments **22**, **26** is minimal or non-existent. Preferably, the blowers **46**, **50**, **66**, **70** do not operate when the dampers **58**, **78** are closed. Furthermore, the outflow of air from the first and second compartments **22**, **26** into the conditioned space **20** is also minimal or non-existent when the inflow is minimal or non-existent. When the blowers **46**, **50**, **66**, **70** are operating, the inflows and outflows of air increase with increasing speed of the blowers **46**, **50**, **66**, **70** and decrease with decreasing speed of the blowers **46**, **50**, **66**, **70**. Preferably, the dampers **58**, **78** are at least partially open when the blowers **46**, **50**, **66**, **70** are operating. The inflow and outflow

also increase as the dampers **58**, **78** are moved to a more open position and decrease as the dampers **58**, **78** are moved to a less open position.

[0021] Also positioned inside the temperature control unit **10** is an evaporator compartment inlet **106** and an evaporator compartment damper **110**. The evaporator compartment inlet **106** is positioned between the plenum **102** and the evaporator compartment **30**. The evaporator compartment **30** is positioned adjacent the first compartment **22**, the second compartment **26** and the plenum **102** and also adjacent the condenser compartment **38** at an opposite end. The evaporator compartment inlet **106** provides a passage for fresh outdoor air into the evaporator compartment **30** from the plenum **102**. The evaporator compartment damper **110** includes a moveable plate **112** to adjust the inflow of air to the evaporator compartment **30** through the evaporator compartment inlet **106**. A third dust filter **114** is positioned within or adjacent the evaporator compartment inlet **106** to filter the inflow of air into the evaporator compartment **30**.

[0022] Air enters the evaporator compartment **30** from the plenum **102** by way of the evaporator compartment inlet **106** and the evaporator compartment damper **110**, as indicated generally by arrows **115***a*. The air flows around the evaporator **34** and is cooled by the evaporator **34**. The cooled air exits the evaporator compartment **30** by way of an evaporator compartment outlet **118** and is directed into a bus duct (not shown) and into the conditioned space **20**. The outflow of air is indicated generally by arrows **115***b*. The cooled air is mixed with fresh outdoor air from the first compartment outlet **62** and the second compartment outlet **90** in the bus duct (not shown), if the outflow of fresh outdoor air is present.

[0023] The inflow and outflow of air in the evaporator compartment **30** depends on the evaporator blower and the evaporator compartment damper **110**. Air enters the evaporator compartment **30** from the plenum **102** by way of the evaporator compartment inlet **106** and the evaporator compartment damper **110**, as indicated generally by arrows **115***a*. When the evaporator blower is not operating, the inflow of air into the evaporator compartment **30** is minimal or non-existent. The evaporator compartment damper **110** is preferably closed when the evaporator blower is not operating. When the evaporator blower is operating and the evaporator compartment damper **110** is at least partially open, the inflow and outflow increases with increasing speed of the evaporator blower and decreases with decreasing speed of the evaporator blower.

[0024] A second construction of the temperature control unit **10** is illustrated in FIG. **3** and is generally indicated with the numeral **10***a*. The same reference numerals are used for individual components that are unchanged from the construction of FIG. **2**, and a successive letter, such as "a", is appended to reference numerals referring to structure that exists in both the first and the second constructions but that is changed with respect to the first construction. The first compartment **22** and the second compartment **26** are enclosed on the top by the fresh air cover **94** having the fresh air inlet **98**. The fresh air inlet **98** includes a plurality of elongated openings that allow fresh outdoor air from outside of the bus **18** to enter a plenum **102***a* inside the temperature control unit **10***a*. The fresh outdoor air enters an intermediate plenum **122** from the plenum **102***a* by way of an intermediate plenum inlet **126** positioned on a partition **128** inside the temperature control unit **10***a* adjacent the plenum **102***a*. The intermediate plenum **122** is separated from the plenum **102***a* by the partition **128**. An intermediate plenum damper **130** is coupled to the intermediate plenum inlet **126** and includes a moveable plate **134** for adjusting the inflow of air into the intermediate plenum **122**. In other constructions, the intermediate plenum inlet **126** may be positioned in the cover **94** in direct communication with fresh outdoor air for the direct passage of fresh outdoor air into the intermediate plenum **122**.

[0025] In the construction of FIG. **3**, the first and second compartment inlets **54**, **74**, and dust filters **60**, **82** are shifted slightly with respect to the blowers **46**, **50**, **66**, **70**, toward the evaporator compartment **30**. Thus, the first and second compartment inlets and dust filters are referenced with the numerals **54***a*, **74***a*, **60***a*, **82***a* in FIG. **3**. Furthermore, the first and second compartments are referenced with the numerals **22***a*, **26***a*. The shift is to accommodate the division of the plenum **102***a* and the intermediate plenum **122**. In this construction, there are no dampers coupled to the first and second compartment inlets **54***a*, **74***a* or to the evaporator compartment inlet **106**. The first and second compartment inlets **54***a*, **74***a* and the evaporator compartment inlet **106** are positioned downstream of the intermediate plenum inlet **126** and the intermediate plenum damper **130**.

[0026] In the construction of FIG. **3**, the inflow of air into the temperature control unit **10***a* is controlled by the intermediate plenum damper **130**. The inflow of air into the first and second compartments **22***a*, **26***a* depends on the blowers **46**, **50**, **66**, **70**, as the first and second compartment inlets **54**, **74** are without dampers. When the blowers **46**, **50**, **66**, **70** are not operating, the inflow of air into the first and second compartments **22***a*, **26***a* is minimal or non-existent. Furthermore, the outflow of air from the first and second compartments **22***a*, **26***a* into the conditioned space **20** is also minimal or non-existent. When the blowers **46**, **50**, **66**, **70** are operating, the respective inflows and outflows of air increase with increasing speed of the blowers **46**, **50**, **66**, **70** and decrease with decreasing speed of the blowers **46**, **50**, **66**, **70**. Similarly, the inflow and outflow of air in the evaporator compartment **30** depends on the evaporator blower as the evaporator compartment inlet **106** is without a damper. Air enters the evaporator compartment **30** from the intermediate plenum **122** by way of the evaporator compartment inlet **106**, as indicated generally by arrows **115***a*. When the evaporator blower is not operating, the inflow of air into the evaporator compartment **30** is minimal or non-existent. When the evaporator blower is operating, the inflow and outflow increases with increasing speed of the evaporator blower and decreases with decreasing speed of the evaporator blower.

[0027] The evaporator compartment inlet **106** is positioned between the intermediate plenum **122** and the evaporator compartment **30**. The evaporator compartment **30** is positioned adjacent the first compartment **22**, the second compartment **26** and the intermediate plenum **122** and also adjacent the condenser compartment **38**.

[0028] It is to be understood that in other constructions, the first and second compartments **22**, **26** may be separate from the temperature control unit **10** and effectively define a second temperature control unit. That is, the first temperature control unit would include the evaporator and condenser compartments **30**, **38**, and the second temperature control unit would include the first and second compartments **22**, **26** or **22***a*, **26***a*, the plenum **102** or **102***a* and the intermediate plenum **122**, if applicable. The first and second temperature control units could be mounted to the vehicle **18** at different locations. Furthermore, each of the first and second compartments **22**, **26** could be separate. Each of the first and second

compartments **22**, **26** could have separate plenums and be mounted to the vehicle **18** at different locations.

[0029] A control module **138** is positioned in the evaporator compartment **38** to control the positions of the dampers **58**, **78**, **110** (in the construction illustrated in FIG. **2**) and **130** (in the construction illustrated in FIG. **3**) and to control the speed of the first and second compartment blower motors **52**, **86** and the evaporator blower. An operator control module (not shown) is positioned in the driver's cab of the bus **18** and allows the operator to control the temperature control unit **10**. For example, the operator may enter a setpoint temperature that is a desired temperature within the conditioned space **20**. The operator control module is coupled to the control module **138**, which adjusts the positions of the dampers **58**, **78**, **110** and **130**, the speed of the first and second compartment blower motors **52**, **86** and the evaporator blower, and the operation of the air conditioning system including whether the compressor (not shown) is on or off, in order to reach or maintain the setpoint temperature.

[0030] A first temperature sensor (not shown) is positioned outside the bus **18** to measure an outdoor ambient temperature of fresh air outside of the bus **18**. A second temperature (not shown) is positioned inside the conditioned space **20** to measure a cabin temperature of the conditioned space **20**. The control module **138** compares the outdoor ambient temperature to the cabin temperature and the setpoint temperature to determine whether the outdoor ambient temperature is cooler than the cabin temperature and the setpoint temperature.

[0031] If the outdoor ambient temperature is lower than the cabin temperature or the setpoint temperature, then the control module **138** operates blowers **46**, **50**, **66**, **70** by operating the blower motors **52**, **86** to blow outdoor air through the first and second compartments **22**, **26** and into the conditioned space **20**. All or a part of the cooling capacity comes from fresh air. Preferably, the blowers **46**, **50**, **66**, **70** are operated at a high speed. Furthermore, the control module **138** opens the dampers **58**, **78** to allow a first portion of outdoor air to pass through the respective compartment **22**, **26** into the conditioned space **20**. A second portion of outdoor air may simultaneously enter the evaporator compartment **20** by way of the evaporator compartment inlet **106** and the evaporator compartment damper **110** to be cooled by the evaporator **34** and directed to the conditioned space **20** by the evaporator blower.

[0032] If the outdoor ambient temperature is lower than the cabin temperature or the setpoint temperature by a predetermined amount, the control module **138** prevents the air conditioner from cooling the conditioned space **20**. The predetermined amount is an amount such that the capacity of the fresh outdoor air is enough to keep the cabin temperature close to the setpoint temperature without using the air conditioner. In this case, all of the cooling capacity comes from fresh outdoor air. Preferably, the control module **138** shuts off the compressor (not shown), effectively shutting off the air conditioner to prevent the air conditioner from cooling the conditioned space **20**. The control module **138** may also or alternatively close the evaporator compartment damper **110** and/or shut off the evaporator blower to effectively shut off the air conditioner to prevent the air conditioner from cooling the conditioned space **20**. Other means may also be employed.

[0033] The control module **138** may also vary the speed of the blower motors **52**, **86** (and thus the blowers **46**, **50**, **66**, **70**) depending on the difference between the outdoor ambient temperature and the cabin temperature or the setpoint temperature. If the outdoor ambient temperature is higher than the cabin temperature and the setpoint temperature, the control module **138** runs the blower motors **52**, **86** (and thus the blowers **46**, **50**, **66**, **70**) at a low speed to direct a first portion of outdoor air to the conditioned space **20** to maintain air quality, or shuts them off. Furthermore, the air conditioning system runs when the outdoor ambient temperature is higher than the cabin temperature and the setpoint temperature. A second portion of outdoor air enters the evaporator compartment **20** by way of the evaporator compartment inlet **106** and the evaporator compartment damper **110** to be cooled by the evaporator **34** and directed to the conditioned space **20** by the evaporator blower.

[0034] Furthermore, when the outdoor ambient temperature is higher than the cabin temperature and the setpoint temperature, and with respect to the first construction of the temperature control system **10**, the first and second compartment dampers **58**, **78** are open when the blowers **46**, **50**, **66**, **70** are running Conversely, the first and second compartment dampers **58**, **78** are closed when the blowers **46**, **50**, **66**, **70** are not running The blowers **46**, **50**, **66**, **70** are shut off when the outdoor ambient temperature is higher than the cabin and setpoint temperatures by a predetermined amount to prevent a large loss in cooling capacity. Similarly, the evaporator compartment damper **110** is closed when the outdoor ambient temperature is higher than the cabin and setpoint temperatures by a predetermined amount to prevent a large loss in cooling capacity. In this case, the evaporator compartment **30** receives and cools only return air from the conditioned space **20**.

[0035] With respect to the second construction of the temperature control system **10***a*, when the outdoor ambient temperature is higher than the cabin temperature and the setpoint temperature the intermediate plenum damper **130** is open when the blowers **46**, **50**, **66**, **70** are running. When the blowers **46**, **50**, **66**, **70** are not running, however, the intermediate plenum damper **130** may be open or completely closed depending on whether fresh air is desired in the conditioned space **20** to improve air quality. In some instances, the outdoor ambient temperature may be too high and may affect the cooling capacity of the system **10** too greatly. In such instances, the intermediate plenum damper **130** is completely closed to prevent warmer outdoor air from entering the conditioned space. In such instances, only return air is received and cooled by the evaporator **34**.

[0036] In other constructions, the flow of fresh outdoor air into the conditioned space **20** can be controlled manually.

[0037] Thus, the invention provides, among other things, a temperature control system **10**, **10***a* that effectively utilizes the cooling capacity of fresh outdoor air. Various features and advantages of the invention are set forth in the following claims.

What is claimed is:

1. A rooftop temperature control unit for a vehicle having a conditioned space, the rooftop temperature control unit comprising:

a housing defining a plenum and including an air inlet, the plenum configured to receive an inflow of outdoor air from outside of the vehicle through the air inlet, the outdoor air defining an outdoor air temperature;

a heat exchanger assembly coupled to the housing and in fluid communication with the plenum, the heat exchanger assembly configured to receive a first portion of the outdoor air from the plenum, to cool the first

portion to a temperature below the outdoor air temperature, and to discharge the cooled first portion into the conditioned space; and

a blower coupled to the housing and in fluid communication with the plenum, the blower configured to receive a second portion of the outdoor air from the plenum and to discharge the second portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature.

2. The rooftop temperature control unit of claim **1**, wherein the blower can be operated at a plurality of non-zero speeds.

3. The rooftop temperature control unit of claim **1**, further comprising a controller that operates the blower dependent upon a comparison of a cabin temperature of the conditioned space and the outdoor air temperature.

4. The rooftop temperature control unit of claim **3**, wherein the controller operates the blower at a first non-zero speed when the outdoor air temperature is colder than the cabin temperature.

5. The rooftop temperature control unit of claim **1**, further comprising a controller that operates the blower dependent upon a desired setpoint temperature of the conditioned space, a measured temperature of the conditioned space, and the outdoor air temperature.

6. The rooftop temperature control unit of claim **5**, wherein the controller operates the blower at a first non-zero speed when the measured outdoor air temperature is colder than at least one of the desired setpoint temperature and the measured temperature of the conditioned space.

7. The rooftop temperature control unit of claim **6**, wherein the controller operates the blower at a second speed lower than the first non-zero speed when the outdoor air temperature is warmer than the desired setpoint temperature and the measured temperature of the conditioned space.

8. The rooftop temperature control unit of claim **1**, wherein the housing includes a first compartment in fluid communication with the plenum and containing the heat exchanger assembly, a second compartment in fluid communication with the plenum and containing the blower, a first damper disposed between the plenum and the first compartment and configured to adjust the inflow of the first portion into the first compartment, and a second damper disposed between the plenum and the second compartment and configured to adjust the inflow of the second portion into the second compartment.

9. The rooftop temperature control unit of claim **8**, further comprising a second blower coupled to the housing and in fluid communication with the plenum, the blower configured to receive a third portion of the outdoor air from the plenum and to discharge the third portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature, and wherein the housing includes a third compartment in fluid communication with the plenum and containing the second blower, and a third damper disposed between the plenum and the third compartment and configured to adjust the inflow of the third portion into the third compartment.

10. The rooftop temperature control unit of claim **1**, wherein the housing includes a first compartment in fluid communication with the plenum and containing the heat exchanger assembly, a first inlet disposed between the plenum and the first compartment, a second compartment in fluid communication with the plenum and containing the blower, a second inlet disposed between the plenum and the second compartment, and a damper disposed upstream of the plenum for adjusting the inflow of outside air into the plenum, wherein the first inlet and the second inlet are downstream of the damper.

11. The rooftop temperature control unit of claim **10**, further comprising a second blower coupled to the housing and in fluid communication with the plenum, the blower configured to receive a third portion of the outdoor air from the plenum and to discharge the third portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature, and wherein the housing includes a third compartment in fluid communication with the plenum and containing the second blower, a third inlet disposed between the plenum and the third compartment, wherein the third inlet is downstream of the damper.

12. The rooftop temperature control unit of claim **1**, wherein the blower is configured to discharge the second portion into the conditioned space without passing the second portion through a heat exchanger.

13. A method of operating a rooftop temperature control unit for a vehicle having a conditioned space, the method comprising:

receiving an inflow of outdoor air from outside of the vehicle through an air inlet of a housing and into a plenum defined by the housing;

receiving with a heat exchanger assembly a first portion of the outdoor air from the plenum;

cooling with the heat exchanger assembly the first portion to a temperature below an outdoor air temperature;

discharging with the heat exchanger assembly the cooled first portion into the conditioned space;

receiving with a blower a second portion of the outdoor air from the plenum; and

discharging with the blower the second portion into the conditioned space at a temperature equal to or greater than the outdoor air temperature.

14. The method of claim **13**, further comprising:

measuring the outdoor air temperature;

measuring a cabin temperature of air in the conditioned space;

comparing the outdoor air temperature to at least one of the cabin temperature and the setpoint temperature; and

operating the blower at a first non-zero speed when the outdoor air temperature is lower than one of the cabin temperature and the setpoint temperature.

15. The method of claim **13**, further comprising operating the blower at a second speed lower than the first non-zero speed when the outdoor air temperature is higher than one of the cabin temperature and the setpoint temperature.

16. The method of claim **13**, further comprising stopping the heat exchanger assembly from cooling the first portion when the outdoor ambient temperature is lower than one of the cabin temperature and the setpoint temperature.

17. The method of claim **13**, further comprising:

opening a damper of the housing;

receiving the inflow of outdoor air from outside of the vehicle through the damper and into the plenum.

18. The method of claim **13**, further comprising:

opening a first damper of the housing;

receiving with the heat exchanger assembly the first portion from the plenum through the first damper;

opening a second damper of the housing; and

receiving with the blower the second portion from the plenum through the second damper.

19. The method of claim **13**, further comprising controlling a speed of the blower between a plurality of non-zero speeds depending on a difference between the outdoor air temperature and one of a cabin temperature and a setpoint temperature.

20. The method of claim **13**, discharging with the blower the second portion into the conditioned space without passing the second portion through a heat exchanger.

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