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(54) **SYSTEM POWERING ELECTRONIC EQUIPMENT VIA A 24 VAC SIGNAL WIRE**

(71) Applicant: **Ademco Inc.**, Golden Valley, MN (US)

(72) Inventor: **Steve C. Nichols**, Plymouth, MN (US)

(73) Assignee: **Ademco Inc.**, Golden Valley, MN (US)

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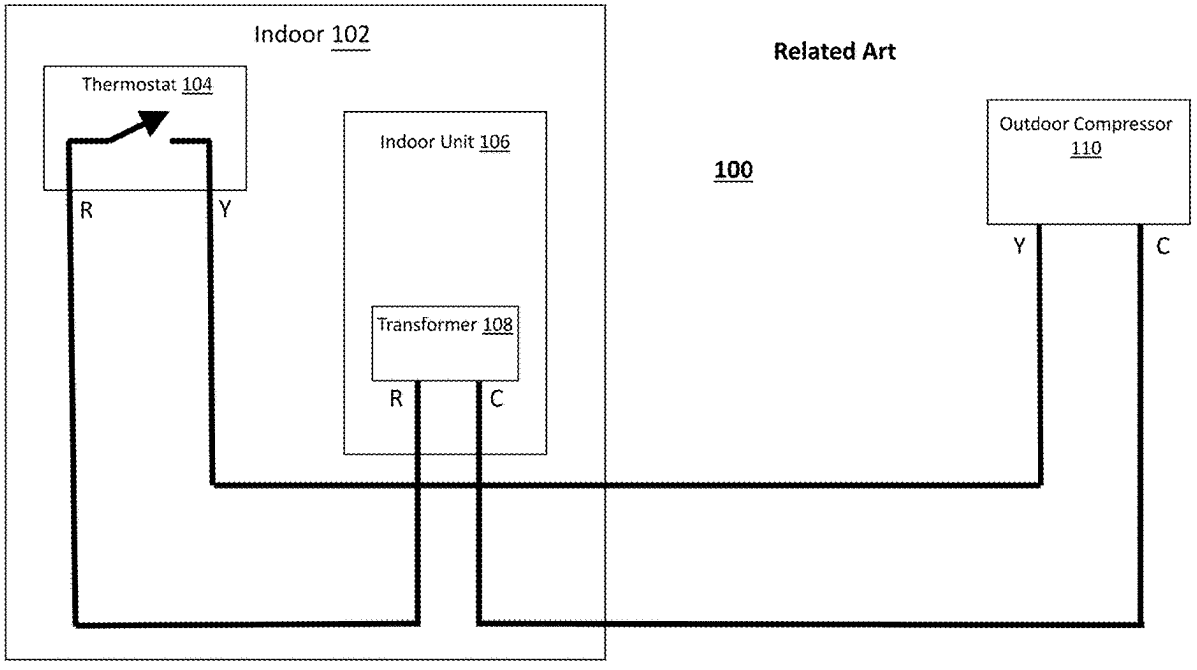
(57) **ABSTRACT**

Disclosed are systems that provide novel capabilities and component configurations for a climate system at a location, which can be a residential forced air cooling or heat pump, and the like. The disclosed system provides the ability for power to be provided to inherent system circuitry and components when there is no power input, which can be according to system needs, requirements, requests and/or other real-world events that cause such climate system to operate.



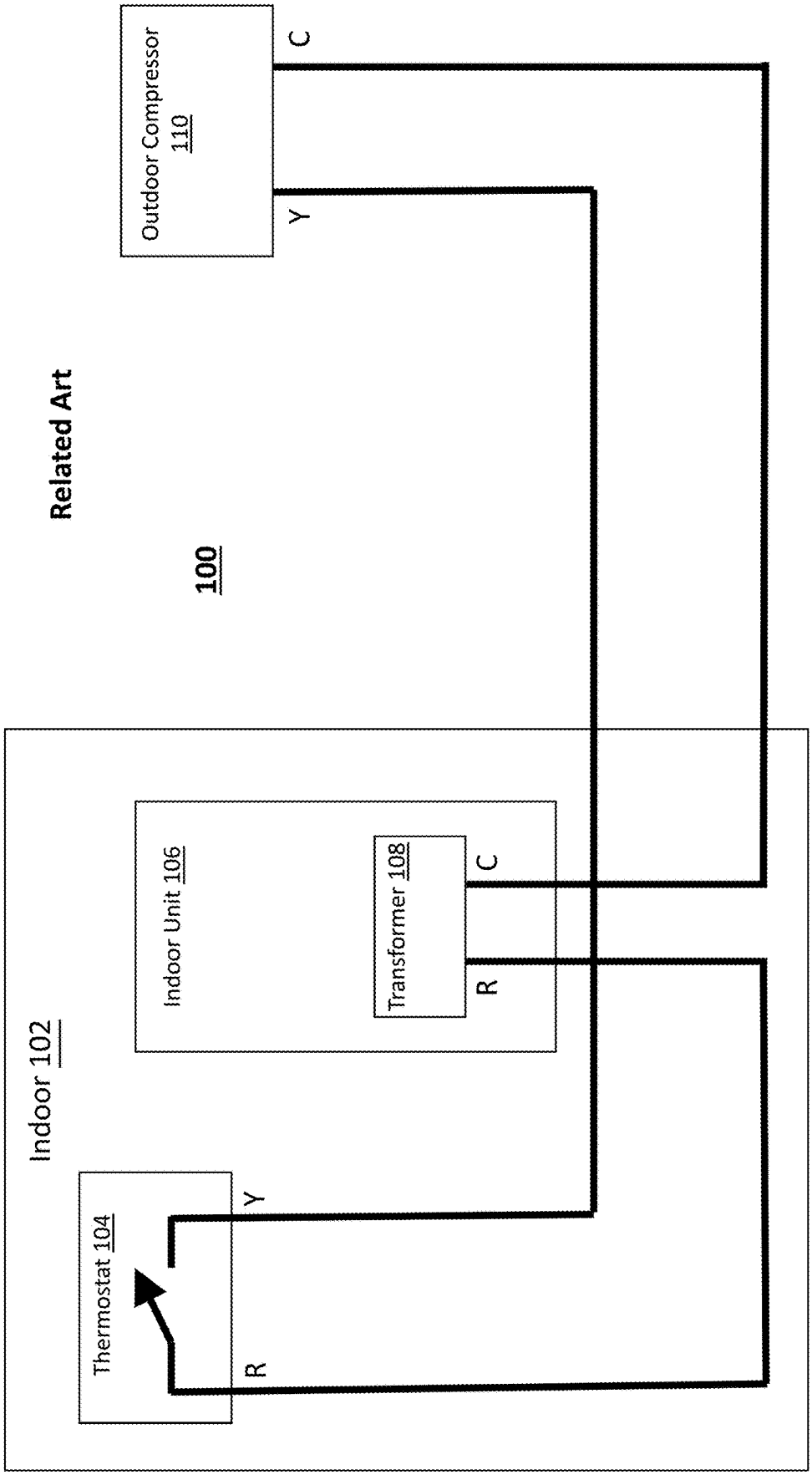

Outdoor Compressor 110
C
Y
Related Art
100
Indoor 102
Indoor Unit 106
Transformer 108
C
R
Thermostat 104
Y
R

FIG. 1

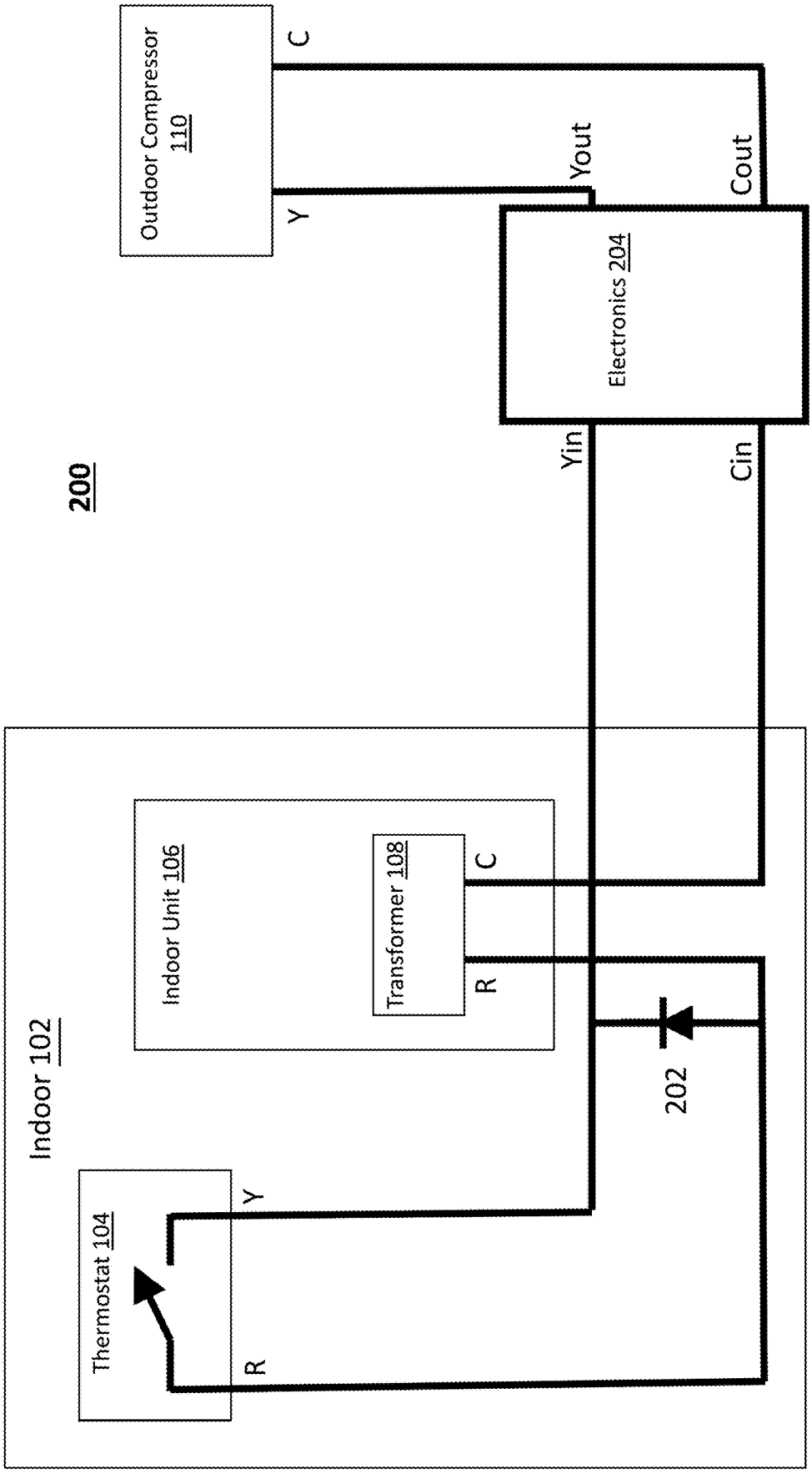

200
Outdoor Compressor 110
C
Y
Yout
Cout
Electronics 204
Yin
Cin
Indoor 102
Indoor Unit 106
Transformer 108
C
R
202
Thermostat 104
Y
R

FIG. 2

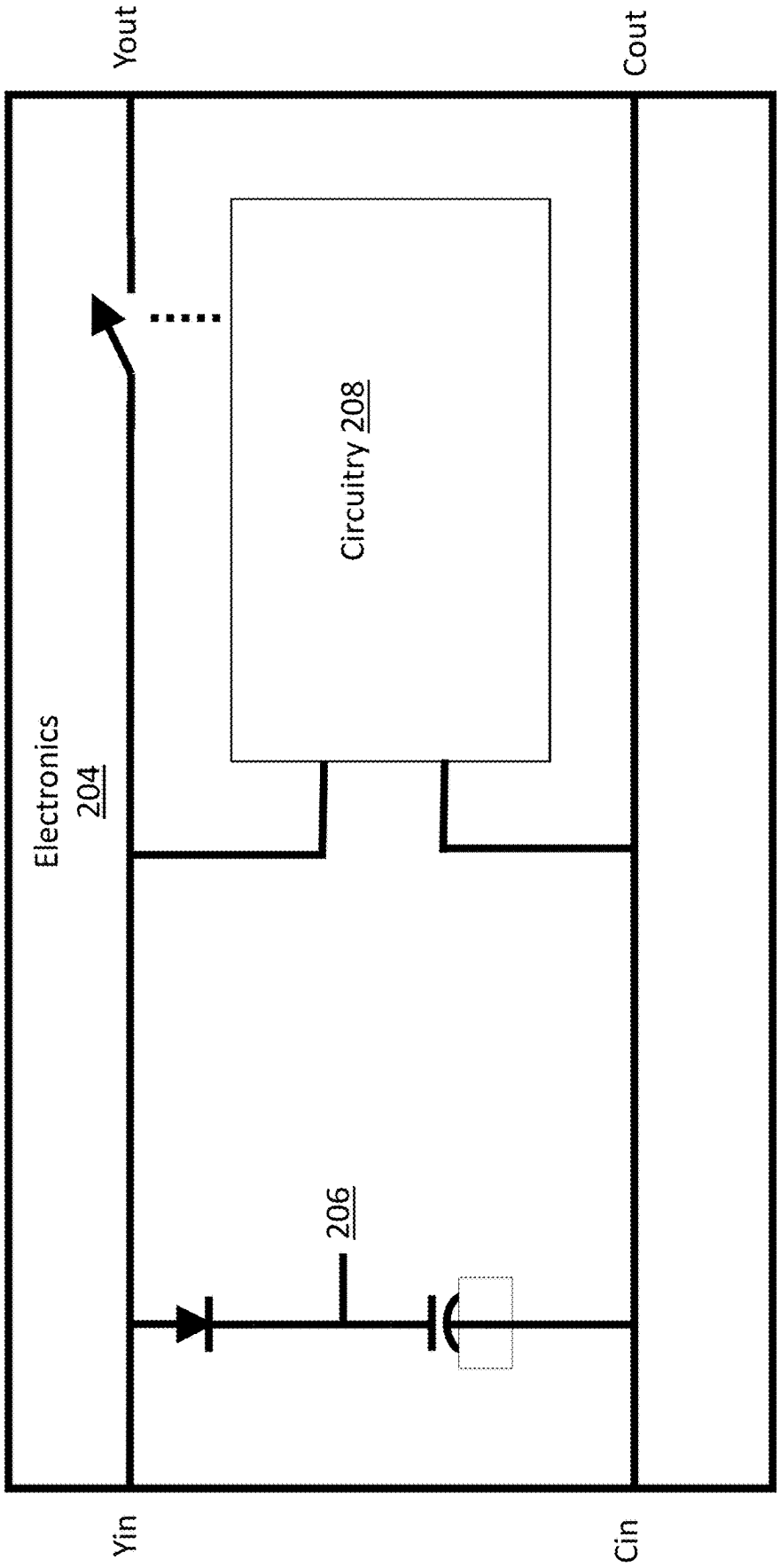


FIG. 3

SYSTEM POWERING ELECTRONIC EQUIPMENT VIA A 24 VAC SIGNAL WIRE

RELATED APPLICATION(S)

[0001] This application claims priority to and the benefit of U.S. Provisional Patent Application No. 63/552,842, filed Feb. 13, 2024, the contents of which is incorporated by reference in its entirety.

FIELD OF THE DISCLOSURE

[0002] The present disclosure is directed to a novel system configuration for power electronic equipment via a 24 VAC signal wire.

SUMMARY OF THE DISCLOSURE

[0003] Residential forced air cooling and heat pump applications play a crucial role in maintaining comfortable indoor environments within locations (e.g., homes, offices, and the like). In forced air cooling systems, a central air conditioner circulates refrigerant through a compressor, evaporator coil, and condenser coil to absorb and release heat. The cooled air is then distributed through a network of ducts using a blower fan, reaching various rooms in the house through vents. This method is effective in swiftly cooling entire homes, providing relief during hot weather.

[0004] Heat pump systems offer a versatile solution for both cooling and heating needs. These systems use a reversible refrigeration cycle, extracting heat from the outdoor air (even in cold temperatures) and transferring it inside during winter, and expelling indoor heat to the exterior during summer. Heat pumps operate efficiently, as they move heat rather than generating it, making them an energy-efficient choice for year-round climate control.

[0005] Whether acting as an air conditioner or a heater, both forced air cooling and heat pump systems offer homeowners the flexibility to maintain a pleasant and consistent indoor environment throughout the changing seasons.

[0006] To that end, an outdoor compressor in a residential forced air cooling or heat pump application is typically controlled by a 24 VAC signal on two wires running from the indoor unit to the outdoor compressor. To turn the compressor on, 24 VAC is applied to the wires. In some embodiments, there may be other electronic devices that could be used in the same location as the outdoor compressor, for example, an outdoor temperature sensor or a device that measures the instantaneous current consumption of the compressor from which diagnostics can be performed.

[0007] Conventional powering these devices typically requires connecting to line voltage, which requires a licensed technician, or using batteries which must eventually be replaced. Power can be obtained from the 24 VAC signal when there is a call for cooling, but there is no power available on the wires when the call goes away.

[0008] Accordingly, as discussed herein, the disclosed systems provide novel capabilities and component configurations for a climate system at a location, which can be a residential forced air cooling or heat pump application (e.g., a heating, ventilation, and air conditioning (HVAC system, for example). The disclosed system provides the ability for power to be provided to inherent system circuitry and components when there is no power input, which can be according to system needs, requirements, requests and/or other real-world events that cause such climate system to operate.

[0009] According to some embodiments, disclosed is a system, which can be any type of a climate system (e.g., forced air, HVAC, and the like) that includes a compressor; a controller; and a transformer, wherein the transformer is configured to receive a first signal from the controller to enable the compressor; wherein in response to receiving the first signal, the transformer is configured to output a full wave alternating current power signal. The system further includes an electronic device in electrical communication with the compressor and the transformer; and a diode connected in electrical communication with the controller and the transformer; wherein the diode is configured to provide a half wave alternating current power signal to the electronic device when the first signal is not present; wherein the electronic device is configured to monitor for an input voltage that is less than a specified negative voltage; and wherein in response to the input voltage being less than the specified negative voltage, the electronic device is configured to output a power signal to the compressor.

DESCRIPTIONS OF THE DRAWINGS

[0010] The features and advantages of the disclosure will be apparent from the following description of embodiments as illustrated in the accompanying drawings, in which reference characters refer to the same parts throughout the various views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating principles of the disclosure:

[0011] FIG. **1** is a block diagram of an example configuration within which the systems and methods disclosed herein could be implemented according to some embodiments of the present disclosure;

[0012] FIG. **2** is a block diagram of an example configuration within which the systems and methods disclosed herein could be implemented according to some embodiments of the present disclosure; and

[0013] FIG. **3** is a block diagram illustrating components of an exemplary system according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0014] The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, which form a part hereof, and which show, by way of non-limiting illustration, certain example embodiments. Subject matter may, however, be embodied in a variety of different forms and, therefore, covered or claimed subject matter is intended to be construed as not being limited to any example embodiments set forth herein; example embodiments are provided merely to be illustrative. Likewise, a reasonably broad scope for claimed or covered subject matter is intended. Among other things, for example, subject matter may be embodied as methods, devices, components, or systems. Accordingly, embodiments may, for example, take the form of hardware, software, firmware or any combination thereof (other than software per se). The following detailed description is, therefore, not intended to be taken in a limiting sense.

[0015] Throughout the specification and claims, terms may have nuanced meanings suggested or implied in context

beyond an explicitly stated meaning. Likewise, the phrase "in one embodiment" as used herein does not necessarily refer to the same embodiment and the phrase "in another embodiment" as used herein does not necessarily refer to a different embodiment. It is intended, for example, that claimed subject matter include combinations of example embodiments in whole or in part.

[0016] In general, terminology may be understood at least in part from usage in context. For example, terms, such as "and", "or", or "and/or," as used herein may include a variety of meanings that may depend at least in part upon the context in which such terms are used. Typically, "or" if used to associate a list, such as A, B or C, is intended to mean A, B, and C, here used in the inclusive sense, as well as A, B or C, here used in the exclusive sense. In addition, the term "one or more" as used herein, depending at least in part upon context, may be used to describe any feature, structure, or characteristic in a singular sense or may be used to describe combinations of features, structures or characteristics in a plural sense. Similarly, terms, such as "a," "an," or "the," again, may be understood to convey a singular usage or to convey a plural usage, depending at least in part upon context. In addition, the term "based on" may be understood as not necessarily intended to convey an exclusive set of factors and may, instead, allow for existence of additional factors not necessarily expressly described, again, depending at least in part on context.

[0017] The present disclosure is described below with reference to block diagrams and operational illustrations of methods and devices. It is understood that each block of the block diagrams or operational illustrations, and combinations of blocks in the block diagrams or operational illustrations, can be implemented by means of analog or digital hardware and computer program instructions. These computer program instructions can be provided to a processor of a general purpose computer to alter its function as detailed herein, a special purpose computer, ASIC, or other programmable data processing apparatus, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, implement the functions/acts specified in the block diagrams or operational block or blocks. In some alternate implementations, the functions/acts noted in the blocks can occur out of the order noted in the operational illustrations. For example, two blocks shown in succession can in fact be executed substantially concurrently or the blocks can sometimes be executed in the reverse order, depending upon the functionality/acts involved.

[0018] Certain embodiments and principles will be discussed in more detail with reference to the figures.

[0019] With reference to FIG. **1**, system **100** is depicted which provides a depiction of the current state of the art. System **100** provides the conventional wiring for an outdoor compressor in a central forced air system. System **100** includes indoor **102** components and outdoor components: outdoor compressor **110**. Indoor components include thermostat **104** (e.g., referred to a controller) and indoor unit **106**, which includes transformer **108**.

[0020] As depicted, the indoor unit **106** is where the forced air blower is located. Indoor unit **106** includes a transformer **108**, which can be a 24 VAC transformer whose output terminals are typically labeled R and C. The R terminal is wired to the thermostat **104**, which contains a switch that closes when the thermostat wants the outdoor compressor to turn on. When that switch closes, 24 VAC is applied to the thermostat's Y terminal. That terminal is typically then wired back through the indoor unit **106** and on to the outdoor compressor **110**. When 24 VAC is applied to the Y terminal, a contactor internal to the compressor **110** closes which supplies high voltage power to the compressor motor and fan.

[0021] By way of example, with FIG. **1** as the backdrop, in a central forced air system, the wiring for the compressor typically involves several components to ensure proper operation. The compressor, which is a vital part of the system, is usually wired to the thermostat, the condenser fan motor, and the power source. The thermostat serves as the control point for the system, signaling the compressor to turn on or off based on the temperature settings. The wiring from the thermostat connects to a control board or relay panel, which then sends signals to the compressor to initiate cooling when needed. Additionally, there are typically safety switches and pressure sensors wired into the system to prevent damage from overheating or excessive pressure buildup. The power source provides the electrical energy necessary to operate the compressor and other components of the central air system. Overall, the wiring configuration ensures that the compressor functions efficiently and safely to maintain comfortable indoor temperatures.

[0022] Turning to FIG. **2**, depicted is a novel configuration of the system **100**, as depicted via system **200**. System **200** includes the components of system **100**, and the inclusion of diode **202** and electronics **204**. As provided herein, the disclosed configuration of system **200** provides a modified wiring configuration which provides the ability for power to be provided to inherent system circuitry and components when there is no power input, which can be according to system needs, requirements, requests and/or other real-world events that cause such climate system to operate.

[0023] As depicted in FIG. **2**, near the indoor unit **106**, a diode **202** is connected between the R and Y terminals, which, according to some embodiments, provides half wave power to electronics **204** (e.g., the outdoor electronics) when the thermostat **104** is not calling for the compressor **110**. According to some embodiments, when the thermostat **104** calls for compressor **110**, a full wave 24 VAC is provided to the electronics **204**.

[0024] In FIG. **3**, depicted is a non-limiting example of the internal circuitry in electronics **204**. According to some embodiments, component **206** (e.g., a diode and capacitor) create a half wave direct current (DC) supply voltage for the electronics **204**, regardless of whether the thermostat **104** is calling for compressor **110** or not. In some embodiments, when the thermostat **104** is not calling for compressor **110**, the Yin terminal never has a negative voltage. In some embodiments, when the thermostat **104** calls for compressor **110**, the Yin terminal oscillates between positive and negative voltage at the line frequency, typically 60 Hz.

[0025] According to some embodiments, circuitry **208** is provided, which detects when the Yin terminal goes below a specified negative voltage which is a trigger to turn on the relay to connect Y_{in} to Y_{out} for a period of time that spans the line frequency oscillations. In some embodiments, for example, this means that when the thermostat **104** calls for compressor **110**, 24 VAC is applied to the Y_{out} terminal which turns on the compressor **110**. Additional components may be used to provide short circuit, static electricity, and surge protection, which one of skill in the art would recog-

nize as being part of system **200** and electronics **204** without departing from the scope of the instant disclosure.

[0026] Accordingly, as discussed herein, the disclosed systems provide the novel ability, via a novel/modified configuration, for power to be provided to inherent system circuitry and components when there is no power input, which can be according to system needs, requirements, requests and/or other real-world events that cause such climate system to operate.

[0027] Examples of hardware elements may include processors, microprocessors, circuits, circuit elements (e.g., transistors, resistors, capacitors, inductors, and so forth), integrated circuits, application specific integrated circuits (ASIC), programmable logic devices (PLD), digital signal processors (DSP), field programmable gate array (FPGA), logic gates, registers, semiconductor device, chips, microchips, chip sets, and so forth. In some embodiments, the one or more processors may be implemented as a Complex Instruction Set Computer (CISC) or Reduced Instruction Set Computer (RISC) processors; x86 instruction set compatible processors, multi-core, or any other microprocessor or central processing unit (CPU). In various implementations, the one or more processors may be dual-core processor(s), dual-core mobile processor(s), and so forth.

[0028] Computer-related systems, computer systems, and systems, as used herein, include any combination of hardware and software. Examples of software may include software components, programs, applications, operating system software, middleware, firmware, software modules, routines, subroutines, functions, methods, procedures, software interfaces, application program interfaces (API), instruction sets, computer code, computer code segments, words, values, symbols, or any combination thereof. Determining whether an embodiment is implemented using hardware elements and/or software elements may vary in accordance with any number of factors, such as desired computational rate, power levels, heat tolerances, processing cycle budget, input data rates, output data rates, memory resources, data bus speeds and other design or performance constraints.

[0029] For the purposes of this disclosure a module is a software, hardware, or firmware (or combinations thereof) system, process or functionality, or component thereof, that performs or facilitates the processes, features, and/or functions described herein (with or without human interaction or augmentation). A module can include sub-modules. Software components of a module may be stored on a computer readable medium for execution by a processor. Modules may be integral to one or more servers, or be loaded and executed by one or more servers. One or more modules may be grouped into an engine or an application.

[0030] One or more aspects of at least one embodiment may be implemented by representative instructions stored on a machine-readable medium which represents various logic within the processor, which when read by a machine causes the machine to fabricate logic to perform the techniques described herein. Such representations, known as "IP cores," may be stored on a tangible, machine readable medium and supplied to various customers or manufacturing facilities to load into the fabrication machines that make the logic or processor. Of note, various embodiments described herein may, of course, be implemented using any appropriate hardware and/or computing software languages (e.g., C++, Objective-C, Swift, Java, JavaScript, Python, Perl, QT, and the like).

[0031] For example, exemplary software specifically programmed in accordance with one or more principles of the present disclosure may be downloadable from a network, for example, a website, as a stand-alone product or as an add-in package for installation in an existing software application. For example, exemplary software specifically programmed in accordance with one or more principles of the present disclosure may also be available as a client-server software application, or as a web-enabled software application. For example, exemplary software specifically programmed in accordance with one or more principles of the present disclosure may also be embodied as a software package installed on a hardware device.

[0032] For the purposes of this disclosure the term "user", "subscriber" "consumer" or "customer" should be understood to refer to a user of an application or applications as described herein and/or a consumer of data supplied by a data provider. By way of example, and not limitation, the term "user" or "subscriber" can refer to a person who receives data provided by the data or service provider over the Internet in a browser session, or can refer to an automated software application which receives the data and stores or processes the data. Those skilled in the art will recognize that the methods and systems of the present disclosure may be implemented in many manners and as such are not to be limited by the foregoing exemplary embodiments and examples. In other words, functional elements being performed by single or multiple components, in various combinations of hardware and software or firmware, and individual functions, may be distributed among software applications at either the client level or server level or both. In this regard, any number of the features of the different embodiments described herein may be combined into single or multiple embodiments, and alternate embodiments having fewer than, or more than, all of the features described herein are possible.

[0033] Functionality may also be, in whole or in part, distributed among multiple components, in manners now known or to become known. Thus, myriad software/hardware/firmware combinations are possible in achieving the functions, features, interfaces and preferences described herein. Moreover, the scope of the present disclosure covers conventionally known manners for carrying out the described features and functions and interfaces, as well as those variations and modifications that may be made to the hardware or software or firmware components described herein as would be understood by those skilled in the art now and hereafter.

[0034] Furthermore, the embodiments of methods presented and described as flowcharts in this disclosure are provided by way of example in order to provide a more complete understanding of the technology. The disclosed methods are not limited to the operations and logical flow presented herein. Alternative embodiments are contemplated in which the order of the various operations is altered and in which sub-operations described as being part of a larger operation are performed independently.

[0035] While various embodiments have been described for purposes of this disclosure, such embodiments should not be deemed to limit the teaching of this disclosure to those embodiments. Various changes and modifications may

be made to the elements and operations described above to obtain a result that remains within the scope of the systems and processes described in this disclosure.

What is claimed is:

1. A system comprising:
a compressor;
a controller;
a transformer;
wherein the transformer is configured to receive a first signal from the controller to enable the compressor, and
wherein in response to receiving the first signal, the transformer is configured to output a full wave alternating current power signal;
an electronic device in electrical communication with the compressor and the transformer; and
a diode connected in electrical communication with the controller and the transformer;
wherein the diode is configured to provide a half wave power signal to the electronic device when the first signal is not present.

2. The system of claim **1**, wherein the electronic device is configured to monitor for an input voltage that is less than a specified negative voltage, and wherein, in response to the input voltage being less than the specified negative voltage, the electronic device is configured to output a power signal to the compressor.

3. The system of claim **1**, wherein the diode is configured between R and Y terminals associated with the controller.

4. The system of claim **3**, wherein the controller and transformer correspond to indoor components of the system.

5. The system of claim **1**, wherein the transformer is a 24 VAC transformer.

6. The system of claim **1**, wherein the electronic device comprises:
a diode;
a capacitor; and
circuitry.

7. The system of claim **6**, wherein the diode and compressor create a half wave direct current (DC) supply voltage.

8. The system of claim **7**, wherein the electronic device has a negative voltage.

9. The system of claim **8**, wherein the electronic device turns on a relay to connect input and output of the electronic device for a period of time.

10. The system of claim **7**, wherein the electronic device oscillates between a positive and negative voltage at a predetermined line frequency.

11. The system of claim **1**, wherein the system is a climate system associated with a location.

12. The system of claim **11**, wherein the climate system is a heating, ventilation and air conditioning (HVAC) system.

13. The system of claim **1**, wherein the controller is a thermostat.

14. A heating, ventilation and air conditioning system (HVAC) system comprising:
a compressor;
a thermostat;
a transformer;
wherein the transformer is configured to receive a first signal from the thermostat to enable the compressor,
wherein the transformer is a 24 VAC transformer, and
wherein in response to receiving the first signal, the transformer is configured to output a full wave alternating current power signal;
an electronic device in electrical communication with the compressor and the transformer; and
a diode connected in electrical communication with the thermostat and the transformer,
wherein the diode is configured between R and Y terminals associated with the thermostat, and
wherein the diode is configured to provide a half wave power signal to the electronic device when the first signal is not present.

15. The HVAC system of claim **14**, wherein the electronic device is configured to monitor for an input voltage that is less than a specified negative voltage, and wherein, in response to the input voltage being less than the specified negative voltage, the electronic device is configured to output a power signal to the compressor.

16. The HVAC system of claim **14**, wherein the thermostat and transformer correspond to indoor components of the system.

17. The HVAC system of claim **14**, wherein the electronic device comprises:
a diode;
a capacitor, wherein the diode and compressor create a half wave direct current (DC) supply voltage; and
circuitry.

18. The HVAC system of claim **17**, wherein the electronic device has a negative voltage.

19. The HVAC system of claim **18**, wherein the electronic device turns on a relay to connect input and output of the electronic device for a period of time.

20. The HVAC system of claim **17**, wherein the electronic device oscillates between a positive and negative voltage at a predetermined line frequency.

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