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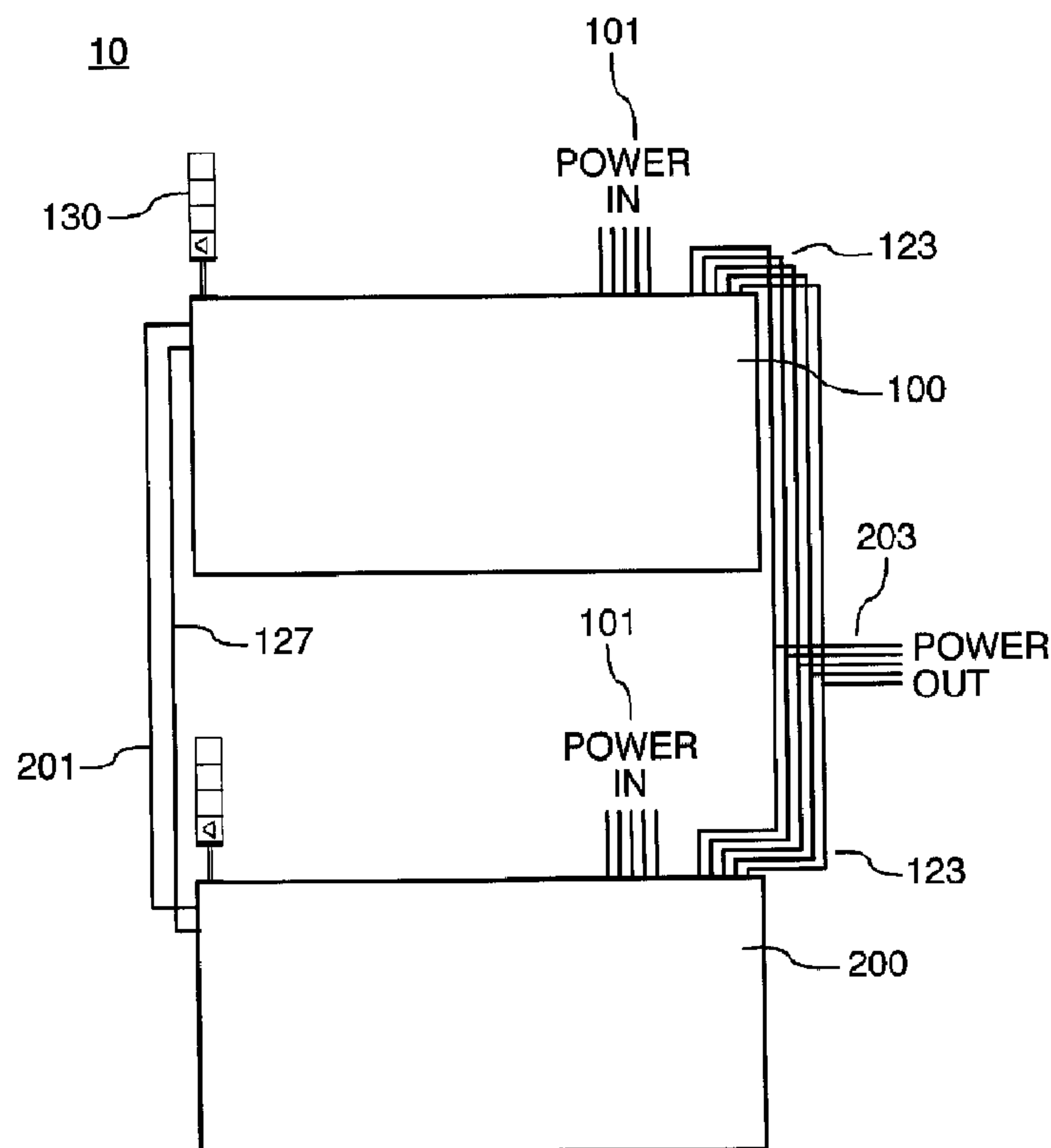
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(54) Title: PORTABLE MODULAR POWER SYSTEM



(57) Abrégé/Abstract:

A portable modular power system, comprising: a first module having a first generator set coupled to a first battery charger, a first output of the first battery charger coupled to a first battery bank, the first battery bank coupled to a connection point; a second module having a second generator set coupled to a second battery charger, a second output of the second battery charger coupled to a second battery bank, the second battery bank coupled to the connection point; a circuit coupling the first and second outputs of the first and second battery chargers; and, a first control system located in the first module and communicatively coupled to components of the first and second modules for controlling the components.

ABSTRACT

A portable modular power system, comprising: a first module having a first generator set coupled to a first battery charger, a first output of the first battery charger coupled
5 to a first battery bank, the first battery bank coupled to a connection point; a second module having a second generator set coupled to a second battery charger, a second output of the second battery charger coupled to a second battery bank, the second battery bank coupled to the connection point; a
10 circuit coupling the first and second outputs of the first and second battery chargers; and, a first control system located in the first module and communicatively coupled to components of the first and second modules for controlling the components.

PORTABLE MODULAR POWER SYSTEM

[0001] This application claims priority from United States Provisional Patent Application No. 61/757,957, filed January 5 29, 2013, and incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates to the field of portable power systems, and more specifically, to portable modular power systems.

10 **BACKGROUND**

[0003] The production of electric power in emergencies or in remote locations is a common problem. A portable electric generator may be used to produce electric power in emergencies or for delivering electric power to remote locations not 15 served by the local electric utility.

[0004] One problem with portable electric generators relates to their capacity. In particular, while a single portable generator may be used to supply a load having a given demand, providing loads of higher demand with multiple portable 20 generators can raise both technical and safety related problems.

[0005] A need therefore exists for an improved portable power system. Accordingly, a solution that addresses, at least in part, the above and other shortcomings is desired.

25 **SUMMARY OF THE INVENTION**

[0006] According to one aspect of the invention, there is provided a portable modular power system, comprising: a first

module having a first generator set coupled to a first battery charger, a first output of the first battery charger coupled to a first battery bank, the first battery bank coupled to a connection point; a second module having a second generator set coupled to a second battery charger, a second output of the second battery charger coupled to a second battery bank, the second battery bank coupled to the connection point; a circuit coupling the first and second outputs of the first and second battery chargers; and, a first control system located in the first module and communicatively coupled to components of the first and second modules for controlling the components.

[0007] According to another aspect of the invention, there is provided a portable modular power system, comprising: a first module having a first generator set coupled to a first battery charger for charging a first battery bank coupled to a connection point; a second module having a second generator set coupled to a second battery charger for charging a second battery bank coupled to the connection point; a first control system in the first module for controlling operation of both the first and second modules; and, a circuit coupling the first and second battery chargers for enabling battery charger sharing between the first and second modules.

[0008] In accordance with further aspects of the invention, there is provided an apparatus such as a control system, a method for adapting same, as well as articles of manufacture such as a computer readable medium or product and computer program product or software product (e.g., comprising a non-

transitory medium) having program instructions recorded thereon for practising the method of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0009] Features and advantages of the embodiments of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

10 [0010] FIG. 1 is a block diagram illustrating a hub portable power system module in accordance with an embodiment of the invention;

15 [0011] FIG. 2 is a block diagram illustrating the hub portable power system module of FIG. 1 coupled to a first spoke portable power system module to form a portable modular power system in accordance with an embodiment of the invention;

[0012] FIG. 3 is a schematic diagram illustrating the interconnection of the hub and spoke modules of the portable modular power system of FIG. 2 in accordance with an embodiment of the invention;

20 [0013] FIG. 4 is a block diagram illustrating a portable modular power system have a hub portable power system module coupled to first, second, and third spoke portable power system modules in accordance with an embodiment of the invention;

25 [0014] FIG. 5 is a block diagram illustrating a portable modular power system have a hub portable power system module coupled to first through seventh spoke portable power system modules in accordance with an embodiment of the invention;

[0015] FIG. 6 is a schematic diagram illustrating the interconnection of the hub and spoke modules of the portable modular power system of FIG. 5 in accordance with an embodiment of the invention;

5 **[0016]** FIG. 7 is a cut-away perspective view illustrating the hub portable power system module of FIG. 1 in accordance with an embodiment of the invention; and,

[0017] FIG. 8 is a block diagram illustrating a control system in accordance with an embodiment of the invention.

10 **[0018]** It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0019] In the following description, details are set forth to provide an understanding of the invention. In some instances, certain circuits, structures, software, techniques and methods have not been described or shown in detail in order not to obscure the invention. The term "control system" is used herein to refer to any machine for processing data, including the data processing systems, computer systems, and network arrangements described herein. Method related aspects of the present invention may be implemented in any computer programming language provided that the operating system of the control system provides the facilities that may support the requirements of the present invention. Any limitations presented would be a result of a particular type of operating system or computer programming language and would not be a limitation of the present invention. Method related aspects of

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the present invention may also be implemented in hardware or in a combination of hardware and software.

[0020] FIG. 8 is a block diagram illustrating a control system **129** in accordance with an embodiment of the invention. The control system **129** is suitable for controlling a portable modular power system **10** and for performing as a data processing system, programmable logic controller ("PLC"), or supervisory control and data acquisition ("SCADA") system. The control system **129** is also suitable for generating, displaying, and adjusting presentations in conjunction with a graphical user interface ("GUI") or Operator Interface Terminal ("OIT"), as described below. The control system **129** may be a client and/or server in a client/server system. For example, the control system **129** may be a server system or a personal computer ("PC") system. The control system **129** may also be a wireless device or other mobile, portable, or handheld device. The control system **129** may include an input device **310**, a central processing unit ("CPU") **320**, memory **330**, a display **340**, and an interface device **350**. The input device **310** may include a keyboard, a mouse, a trackball, a touch sensitive surface or screen, a position tracking device, an eye tracking device, or a similar device. The display **340** may include a computer screen, television screen, display screen, terminal device, a touch sensitive display surface or screen, or a hardcopy producing output device such as a printer or plotter. The memory **330** may include a variety of storage devices including internal memory and external mass storage typically arranged in a hierarchy of storage as understood by those skilled in the art. For example, the memory **330** may

include databases, random access memory ("RAM"), read-only memory ("ROM"), flash memory, and/or disk devices. The interface device **350** may include one or more network connections. The control system **129** may be adapted for communicating with other data processing systems (e.g., similar to the control system **129**) over a network **351** via the interface device **350**. For example, the interface device **350** may include an interface to a network **351** such as the Internet and/or another wired (e.g., **125**, **127**) or wireless network (e.g., a wireless local area network ("WLAN"), a cellular telephone network, etc.). As such, the interface **350** may include suitable transmitters, receivers, antennae, etc. In addition, the control system **129** may include a Global Positioning System ("GPS") receiver. Thus, the control system **129** may be linked to other data processing systems (e.g., **129**) by the network **351**. The CPU **320** may include or be operatively coupled to dedicated coprocessors, memory devices, or other hardware modules **321**. The CPU **320** is operatively coupled to the memory **330** which stores an operating system (e.g., **331**) for general management of the system **129**. The CPU **320** may be operatively coupled to the input device **310** for receiving user commands or queries and for displaying the results of these commands or queries to the user on the display **340**. Commands and queries may also be received via the interface device **350** and results may be transmitted via the interface device **350**. The control system **129** may include a data store or database system **332** for storing data and programming information. The database system **332** may include a database management system (e.g., **332**) and a database (e.g., **332**) and may be stored in the memory **330** of the control system **129**. In general, the

control system **129** has stored therein data representing sequences of instructions which when executed cause the method described herein to be performed. Of course, the control system **129** may contain additional software and hardware a
5 description of which is not necessary for understanding the invention.

[0021] Thus, the control system **129** includes computer executable programmed instructions for directing the system **129** to implement the embodiments of the present invention. The
10 programmed instructions may be embodied in one or more hardware modules **321** or software modules **331** resident in the memory **330** of the control system **129** or elsewhere (e.g., **320**). Alternatively, the programmed instructions may be embodied on a computer readable medium or product (e.g., a memory stick,
15 a compact disk ("CD"), etc.) which may be used for transporting the programmed instructions to the memory **330** of the control system **129**. Alternatively, the programmed instructions may be embedded in a computer-readable signal or signal-bearing medium or product that is uploaded to a network
20 **351** by a vendor or supplier of the programmed instructions, and this signal or signal-bearing medium may be downloaded through an interface (e.g., **350**) to the control system **129** from the network **351** by end users or potential buyers.

[0022] A user may interact with the control system **129** and its
25 hardware and software modules **321**, **331** using a user interface such as a graphical user interface ("GUI") or Operator Interface Terminal ("OIT") **380** (and related modules **321**, **331**). The OIT **380** may be used for monitoring, managing, and

accessing the control system **129**. OITs are supported by common operating systems and provide a display format which enables a user to choose commands, execute application programs, manage computer files, and perform other functions by selecting
5 pictorial representations known as icons, or items from a menu through use of an input device **310** such as a mouse. In general, an OIT is used to convey information to and receive commands from users and generally includes a variety of OIT objects or controls, including icons, toolbars, drop-down
10 menus, text, dialog boxes, buttons, and the like. A user typically interacts with an OIT **380** presented on a display **340** by using an input device (e.g., a mouse) **310** to position a pointer or cursor **390** over an object (e.g., an icon) **391** and by "clicking" on the object **391**. Typically, an OIT based
15 system presents application, system status, and other information to the user in one or more "windows" appearing on the display **340**. A window **392** is a more or less rectangular area within the display **340** in which a user may view an application or a document. Such a window **392** may be open,
20 closed, displayed full screen, reduced to an icon, increased or reduced in size, or moved to different areas of the display **340**. Multiple windows may be displayed simultaneously, such as: windows included within other windows, windows overlapping other windows, or windows tiled within the display area.

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[0023] FIG. 1 is a block diagram illustrating a portable modular power system **10** having a hub portable power system module **100** in accordance with an embodiment of the invention. FIG. 2 is a block diagram illustrating a portable modular power system **10**

having a hub portable power system module **100** coupled to a first spoke portable power system module **200** in accordance with an embodiment of the invention. FIG. 3 is a schematic diagram illustrating the interconnection of the hub and spoke
5 modules **100, 200** of the portable modular power system **10** of FIG. 2 in accordance with an embodiment of the invention. And, FIG. 7 is a cut-away perspective view illustrating the hub portable power system module **100** of FIG. 1 in accordance with an embodiment of the invention.

10 **[0024]** According to one embodiment, the invention provides a portable modular power system **10** having a master or "hub" portable power system module **100** coupled to one or more slave or "spoke" portable power system modules **200**. The portable modular power system **10** may consist of a single portable power
15 system module **100** as shown in FIG. 1 or it may consist of multiple portable power system modules **100, 200** as shown in FIG. 2. If the portable modular power system **10** includes multiple portable power system modules, one of the modules is configured as the hub module **100** and the remaining modules are
20 configured as spoke modules **200**. According to one embodiment, each module **100, 200** may have a power output rating of 500 kW.

[0025] Referring to FIG. 3, each hub and spoke module **100, 200** includes: a generator set (or "gen-set") **105** for generating alternating current ("AC") power, a transfer switch **107**
25 coupled to a battery power isolating circuit breaker ("CB") **111** for switching between an output of the gen-set **105** and an alternating current ("AC") utility (or line) power input **101** (which may optionally be supplied from a renewable energy source **103**), one or more battery chargers **115** coupled to the

output of the battery power isolating CB **111** for charging one or more batteries or battery banks **117** coupled thereto, an inverter **119** coupled to the battery banks **117** for generating AC power from direct current ("DC") power output from the battery banks **117**, power factor correction equipment **121** coupled to the output of the inverter **119** for adjusting the power factor of the AC power output therefrom, and a connection point **123** coupled to the output of the power factor correction equipment **121** for providing output AC power from the module **100, 200**.

[0026] A gen-set power isolating CB **113** is provided between an output of the gen-set **105** and the connection point **123** for connecting the output of the gen-set **105** directly to the connection point **123**. Similarly, a utility power isolating CB **109** is provided between the utility power input **101** and the connection point **123** for connecting the utility power directly to the connection point **123**.

[0027] The control system **129** is provided to control operation of the system **10** and to control and monitor the status of the components (e.g., **100, 200, 105, 107, 109, 111, 113, 115, 117, 119, 121, 125, 127, 130, 201**, etc.) of the system **10** as described below. The control system **129** may include feedback communications circuits **125** between the one or more battery chargers **115**, the utility power input **101**, and the gen-set **105**. In addition, the control system **129** may include inter-module communications circuits **127** between the hub and spoke modules **100, 200** and their components.

[0028] The control circuitry of the gen-set **105** of each module **100, 200** may be linked by the inter-module communications circuits **127** to the control system **129** for synchronizing the phase and frequency of the output of each gen-set **105** to facilitate their interconnection. The control system **129** may be housed with the gen-set **105** or it may be housed separately.

[0029] As shown in FIG. 2, a battery charger inter-connection circuit **201** is provided between the battery chargers **115** of each module **100, 200** to enable charge sharing between the modules **100, 200**. The connection points **123** of each module **100, 200** are coupled to provide a combined output **203** for the system **10**. In FIG. 2, according to one embodiment, the total power output of the system **10** is 1 MW being the sum of the 500 kW power outputs of each module **100, 200**.

[0030] FIG. 4 is a block diagram illustrating a portable modular power system **10** have a hub portable power system module **100** coupled to first, second, and third spoke portable power system modules **200, 300, 400** in accordance with an embodiment of the invention. FIG. 5 is a block diagram illustrating a portable modular power system **10** have a hub portable power system module **100** coupled to first through seventh spoke portable power system modules **200, 300, 400, 500, 600, 700, 800** in accordance with an embodiment of the invention. And, FIG. 6 is a schematic diagram illustrating the interconnection of the hub and spoke modules **100, 200, 300, 400, 500, 600, 700, 800** of the portable modular power system **10** of FIG. 5 in accordance with an embodiment of the invention. According to one embodiment, the system **10** may include a maximum of eight modules **100, 200, 300, 400, 500, 600, 700, 800**.

[0031] As shown in FIGS. 4 and 5, for a system **10** including more than two modules, the modules **100, 200, 300, 400, 500, 600, 700, 800** of the system **10** are connected in pairs **410, 420, 430, 440**. For example, for the 2 MW system **10** shown in FIG. 4, two pairs **410, 420** of modules are used. The first pair **410** includes two modules **100, 200** and the second pair includes an additional two modules **300, 400**. However, only one hub module **100** is included in the 2 MW system **10**. The other modules **200, 300, 400** are configured as spoke modules. Similarly, for the 4 MW system **10** shown in FIG. 5, four pairs **410, 420, 430, 440** of modules are used. The first pair **410** includes two modules **100, 200**, the second pair **420** includes an additional two modules **300, 400**, the third pair **430** includes an additional two modules **500, 600**, and the fourth pair **440** includes a final two modules **700, 800**. Again, only one hub module **100** is included in the 4 MW system **10**. The other modules **200, 300, 400, 500, 600, 700, 800** are configured as spoke modules.

[0032] As shown in FIGS. 4 and 5, according to one embodiment, a battery charger inter-connection circuit **201** is only provided between the battery chargers **115** of each module **100, 200** in a module pair **410**. A battery charger inter-connection circuit **201** is not provided between module pairs **410, 420, 430, 440**. However, note that inter-module communications circuits **127** are provided to couple each module **100, 200, 300, 400, 500, 600, 700, 800** in the system **10**.

[0033] As shown in FIGS. 5 and 6, the outputs **203** of each module pair **410, 420, 430, 440** are coupled to provide a combined output **610** for the system **10**. In FIG. 5, according to one embodiment, the total power output of the system **10** is 4 MW

being the sum of the 1 MW power outputs of each module pair
410, 420, 430, 440.

[0034] Referring again to FIGS. 2 and 3, power is received at the utility power input **101** from the local utility and is
5 generally connected to each module **100** via four individual phase connectors rated at the appropriate voltage and current (e.g., 480 VAC, etc.). With utility power present, the battery chargers **115** will charge battery banks **117** from this source and, according to one embodiment, the charging function will
10 be controlled by the battery chargers **115**. During times of low output demand, the battery chargers **115** in the hub module **100** may trickle charge (i.e., from utility power) both the battery banks **117** in the hub module **100** and the battery banks **117** in the spoke module **200** (i.e., if the output demand of the spoke
15 module **200** is also sufficiently low).

[0035] The gen-set **105** of the hub module **100** is primarily used to generate electric power for the battery chargers **115** and is only run when battery capacity/reserve is sufficiently low that a "re-charge request" is issued to the battery chargers
20 **115** from the control system **129**. The gen-set **105** of the hub module **100** is electrically linked (via external cabling or circuits) to the gen-set **105** of one spoke module **200** with the following connections: i) utility power; ii) battery charger inter-connection circuit **201** cabling; iii) communications
25 cabling **127**; and, iv) control cabling **127** (dependent upon communication capacity and specific design control requirements).

[0036] The battery charger inter-connection circuit **201** cabling or circuit allows the gen-set **105** in the hub module **100** to divert charging power between itself and the spoke module **200** and vice-versa therefore reducing or eliminating the need for both the hub and spoke modules **100, 200** to operate together in times of low power demand. The hub module **100** may charge the battery banks **117** in the spoke module **200** and the spoke module **200** may be controlled to charge the battery banks **117** in the hub module **100**.

[0037] An optional internal intelligence control panel ("ICP") (e.g., **129**) on the gen-set **105** of the hub module **100** may communicate with up to seven gen-sets **105** of connected spoke modules **200, 300, 400, 500, 600, 700, 800**. As mentioned above, the hub-plus-spoke module pair **410** and three spoke-plus-spoke module pairs **420, 430, 440** may provide a maximum capacity for up to 4 MW of electrical power (see FIG. 6). The hub module **100** may also command a spoke module (e.g., **300**) to divert power to its partner (e.g., **400**) in a module pair (e.g., **420**) to allow for similar "charge-sharing" between a spoke-plus-spoke module pair **420** as between a hub-plus-spoke module pair **410**.

[0038] The gen-set **105** of the spoke module **200** is also used primarily to generate electrical power for the battery charger **115** and only runs when battery capacity/reserve is sufficiently low that a "re-charge request" is issued by the control system **129** to the battery charger **115** and when the hub module **100** is not diverting charging current to the spoke module **200**. In the event of maintenance of the battery chargers **115**, battery banks **117**, or other equipment in the

system **10**, an electrical power outlet (socket) rated at 480 VAC, 3-phase, 20A, for example, may be provided directly from the gen-set **105**. This is for the purpose of powering equipment needed to service the module **200** or its internal components.

- 5 **[0039]** The battery chargers **115** are connected together via a battery bank monitor ("BBM") (e.g., **129**) coupled to the control system **129** and which controls charge to individual batteries **117** and battery banks **117**. Both trickle charging and fast charging may be accommodated.
- 10 **[0040]** Electrical power received from the utility power input **101** (or generated from the gen-set **105** of the hub module **100** and/or the gen-set **105** of the spoke module **200**) at 480 VAC is presented (via optional additional internal module equipment) to the battery chargers **115**. The output of the battery banks
- 15 **117** is DC power which is generally unsuitable for electrical distribution and requires conversion to AC power. The inverter **119** performs this task (with some electrical losses in conversion) ensuring that a controlled AC supply is provided to the power factor correction ("PFC") equipment or unit **121**.
- 20 **[0041]** With respect to power factor correction (PFC), first note that there are primarily three types of electrical demand as follows: resistive, capacitive, and inductive. Resistive power is generally accepted as being not highly affected by PFC with exceptions only for high demand equipment/processes.
- 25 Capacitive power may be disregarded as a concern due to the inherent nature of the majority of electrical equipment as not being designed to have a high capacitive load. Inductive loads however are highly susceptible to capacitance increase in

electrical circuits and this effect may be used to reduce current draw for certain types of circuits and systems. Typical systems that are inherently inductive include copper coiled equipment such as motors, welders, transformers, etc.

5 The PFC equipment **121** is capable of determining when inductance within a load is excessive and of balancing or compensating for this by automatically adding and/or removing PFC capacitor banks to the load.

[0042] With respect to electrical distribution, a 1 MW capacity
10 bus-bar system (e.g., at connection point **123**) is provided in each module **100, 200**. Electrically coupling the hub module **100** and the spoke module **200** together combines the two 500 kW systems to provide a 1 MW output.

[0043] In operation, when utility power is active and stable it
15 is directed from the utility power input **101** to the battery chargers **115** under control of the control system **29**. The battery chargers **115** regulate the current charge to the battery banks **117** depending on discharge rate and electrical charge remaining within the battery banks **117**. When the
20 battery banks **117** are optimally charged (e.g., 95+ %), the battery chargers **115** are isolated from the battery banks **117**. This allows the batteries **117** to discharge as per their battery design and prevents continual charging. Output demand from a module **100, 200** is met by the stored and available
25 power within the battery banks **117**. When demand is such that the reserves of the battery banks **117** are below 60%, for example, utility power is redirected to the respective battery banks **117** via the battery chargers **115**.

[0044] If there is no utility power available or utility power fails and when the reserves of the battery banks **117** are below 50%, for example, the gen-set **105** of the hub module **100** will engage and begin to re-charge the battery banks **117** via the
5 battery chargers **115** under control of the control system **29**. The gen-set **105** of the hub module **100** and the associated gen-set **105** of the spoke module **200** will alternate in battery charging under the conditions outlined above.

[0045] DC power output (e.g., up to 500 kW) from the battery
10 banks **117** is delivered to the inverter **119** which converts it to AC power, continuously. The input voltage to the inverter **119** should remain constant with only available current capacity reducing with respect to demand. After inversion, AC
15 power is presented to the power factor correction (PFC) equipment **121** and, dependent upon loading and demand, the PCF equipment **121** will internally and automatically engage banks of capacitors to limit output current draw/demand. Output
power may be delivered from the connection point **123**, for
example, by way of a bank of five liquid-tight style
20 connectors or protected terminal lugs (i.e., L1, L2, L3, N, and E).

[0046] The system **10** provides several levels of power redundancy. At a first level, the charge of the battery banks **117** relies on the availability of line or utility power for
25 re-charging purposes. At a second level, when line or utility power fails, the charging of the battery banks **117** relies on power from the gen-set **105** of the hub module **100** for recharging purposes. At a third level, in the event of both line or utility power failure and inoperability of the gen-set

105 of the hub module **100**, the battery banks **117** are charged from the gen-set **105** of the associated spoke module **200**. At a fourth level, in the event of no available line or utility power at either module **100**, **200** and with the gen-sets **105** of both modules **100**, **200** in-operable, the capacity of battery banks **117** may be shared **201** between modules **100**, **200** to offer prolonged power at either of the hub or spoke modules **100**, **200**. At a fifth level, if the spoke module **200** is powered from a different line or utility power source, the third level of redundancy allows for the battery banks **117** of the hub module **100** to be trickle charged from the battery banks **117** of the spoke module **200**.

[0047] As shown in FIGS. 1, 2, and 7, the components (e.g., gen-set **105**, battery banks **117**, etc.) of each module **100**, **200** may be mounted in a housing or container **110** for transport. The housing or container **110** may be sized for transport via truck or rail. A tower light warning system **130** may be mounted on the container **110**. The warning system **130** may include a red lamp **131**, an amber lamp **132**, a green lamp **133**, and an audible siren **134**. Solid lighting of the green lamp **133** may indicate that line or utility power is available to the module **100**, **200**. Blinking of the green lamp **133** may indicate that there is a fault or failure with respect to the line or utility power. Solid lighting of the red lamp **131** may indicate that the gen-set **105** is running and/or charging the battery banks **117**. Blinking of the red lamp **131** may indicate that there is a fault with the gen-set **105** or that attention is required. And, solid lighting of the amber light **132** may indicate that

operator attention is required (e.g., low fuel, minor fault, etc.).

[0048] Thus, according to one embodiment, there is provided a portable modular power system **10**, comprising: a first module **100** having a first generator set **105** coupled to a first battery charger **115**, a first output of the first battery charger **115** coupled to a first battery bank **117**, the first battery bank **117** coupled to a connection point **123**; a second module **200** having a second generator set **105** coupled to a second battery charger **115**, a second output of the second battery charger **115** coupled to a second battery bank **117**, the second battery bank **117** coupled to the connection point **123**; a circuit **201** coupling the first and second outputs of the first and second battery chargers **115**; and, a first control system **29** located in the first module **100** and communicatively coupled to components (e.g., **100**, **200**, **105**, **107**, **109**, **111**, **113**, **115**, **117**, **119**, **121**, **125**, **127**, **130**, **201**, etc.) of the first and second modules **100**, **200** for controlling the components.

[0049] In the above portable modular power system **10**, the control system **29** may control one of the first battery charger **115** and the second battery charger **115** to charge both of the first battery bank **117** and the second battery bank **117** via the circuit **201**. The portable modular power system **10** may further include first and second selector switches **107** in the first and second modules **100**, **200** selectively coupling one of first and second utility power inputs **101** and the first and second generator sets **105** to the first and second battery chargers **115**, respectively. The control system **29** may control the first and second selector switches **107** to couple the first and

second utility power inputs **101** to the first and second battery chargers **115**, respectively. The control system **29** may control the first and second selector switches **107** to couple the first and second generator sets **105** to the first and second battery chargers **115**, respectively. The first and second utility power inputs **101** may be coupled to the first and second battery chargers **115**, respectively, when utility power is available. The first and second generator sets **105** may be coupled to the first and second battery chargers **115**, respectively, when utility power is not available. The portable modular power system **10** may further include a second control system **29** located in the second module **200** and communicatively coupled to components of the second module **200**, and the second control system **29** may operate under the control of the first control system **29** located in the first module **100**. The portable modular power system **10** may further include a communication circuit **127** coupling the first and second modules **100**, **200**, the communication circuit **127** carrying control signals between the first and second modules **100**, **200**. The communication circuit **127** may communicatively couple the first and second control systems **29**. The portable modular power system **10** may further include first and second inverters **119** coupled between the connection point **123** and the first and second battery banks **117** in the first and second modules **100**, **200**, respectively. The portable modular power system **10** may further include first and second power factor correction equipment **121** coupled between the connection point **123** and the first and second inverters **119** in the first and second modules **100**, **200**, respectively. The portable modular power system **10** may further include first and second

containers **110** housing the first and second modules **100**, **200**, respectively. The first and second containers **110** may be transportable via at least one of truck, rail, and ship. The portable modular power system **10** may further include first and
5 second warning systems **130** mounted on the first and second containers **110**, respectively, the first and second warning systems **130** respectively indicating at least one of a fault and an operation of a component of one of the first and second modules **100**, **200**. And, the circuit **201** may allow at least one
10 of the first and second battery chargers **115** to charge at least one of the first and second battery banks **117**.

[0050] According to another embodiment, there is provided a portable modular power system **10**, comprising: a first module **100** having a first generator set **105** coupled to a first
15 battery charger **115** for charging a first battery bank **117** coupled to a connection point **123**; a second module **200** having a second generator set **105** coupled to a second battery charger **115** for charging a second battery bank **117** coupled to the connection point **123**; a first control system **129** in the first
20 module **100** for controlling operation of both the first and second modules **100**, **200**; and, a circuit **201** coupling the first and second battery chargers **115** for enabling battery charger sharing between the first and second modules **100**, **200**.

25 **[0051]** The above portable modular power system **10** may further include first and second inverters **119** for producing alternating current power coupled between the connection point **123** and the first and second battery banks **117** in the first and second modules **100**, **200**, respectively. The portable

modular power system **10** may further include first and second selector switches **107** in the first and second modules **100**, **200** for selectively coupling one of first and second utility power inputs **101** and the first and second generator sets **105** to the first and second battery chargers **115**, respectively. The portable modular power system **10** may further include a second control system **129** in the second module **200** for controlling operation of the second module **200**, the second control system **129** operating under the control of the first control system **129** in the first module **100**. And, the portable modular power system **10** may further include first and second containers **110** for housing the first and second modules **100**, **200**, respectively.

[0052] The above embodiments may contribute to an improved portable modular power system **10** and may provide one or more advantages. First, multiple modules **100**, **200** may be used to provide scalable output. Second, the system **10** may be transported easily.

[0053] While aspects of this invention may be primarily discussed as a method, a person of ordinary skill in the art will understand that the apparatus discussed above with reference to a control system **129** may be programmed to enable the practice of the method of the invention. Moreover, an article of manufacture for use with a control system **129**, such as a pre-recorded storage device or other similar computer readable medium or computer program product including program instructions recorded thereon, may direct the control system **129** to facilitate the practice of the method of the invention.

It is understood that such apparatus, products, and articles of manufacture also come within the scope of the invention.

[0054] In particular, the sequences of instructions which when executed cause the method described herein to be performed by the control system **129** may be contained in a data carrier product according to one embodiment of the invention. This data carrier product may be loaded into and run by the control system **129**. In addition, the sequences of instructions which when executed cause the method described herein to be performed by the control system **129** may be contained in a computer software product or computer program product (e.g., comprising a non-transitory medium) according to one embodiment of the invention. This computer software product or computer program product may be loaded into and run by the control system **129**. Moreover, the sequences of instructions which when executed cause the method described herein to be performed by the control system **129** may be contained in an integrated circuit product (e.g., a hardware module or modules **321**) which may include a coprocessor or memory according to one embodiment of the invention. This integrated circuit product may be installed in the control system **129**.

[0055] The embodiments of the invention described above are intended to be exemplary only. Those skilled in this art will understand that various modifications of detail may be made to these embodiments, all of which come within the scope of the invention.

WHAT IS CLAIMED IS:

1. A portable modular power system, comprising:

a first module having a first generator set coupled to a
5 first battery charger, a first output of the first
battery charger coupled to a first battery bank, the
first battery bank coupled to a connection point;

a second module having a second generator set coupled to
a second battery charger, a second output of the second
10 battery charger coupled to a second battery bank, the
second battery bank coupled to the connection point;

a circuit coupling the first and second outputs of the
first and second battery chargers; and,

a first control system located in the first module and
15 communicatively coupled to components of the first and
second modules for controlling the components.
2. The portable modular power system of claim 1 wherein the
control system controls one of the first battery charger and
the second battery charger to charge both of the first battery
20 bank and the second battery bank via the circuit.
3. The portable modular power system of claim 1 and further
comprising first and second selector switches in the first and
second modules selectively coupling one of first and second
utility power inputs and the first and second generator sets
25 to the first and second battery chargers, respectively.

4. The portable modular power system of claim 3 wherein the control system controls the first and second selector switches to couple the first and second utility power inputs to the first and second battery chargers, respectively.
- 5 5. The portable modular power system of claim 3 wherein the control system controls the first and second selector switches to couple the first and second generator sets to the first and second battery chargers, respectively.
6. The portable modular power system of claim 4 wherein the
10 first and second utility power inputs are coupled to the first and second battery chargers, respectively, when utility power is available.
7. The portable modular power system of claim 5 wherein the first and second generator sets are coupled to the first and
15 second battery chargers, respectively, when utility power is not available.
8. The portable modular power system of claim 1 and further comprising a second control system located in the second module and communicatively coupled to components of the second
20 module, wherein the second control system operates under the control of the first control system located in the first module.
9. The portable modular power system of claim 8 and further comprising a communication circuit coupling the first and
25 second modules, the communication circuit carrying control signals between the first and second modules.

10. The portable modular power system of claim 9 wherein the communication circuit communicatively couples the first and second control systems.

11. The portable modular power system of claim 1 and further comprising first and second inverters coupled between the connection point and the first and second battery banks in the first and second modules, respectively.

12. The portable modular power system of claim 11 and further comprising first and second power factor correction equipment coupled between the connection point and the first and second inverters in the first and second modules, respectively.

13. The portable modular power system of claim 1 and further comprising first and second containers housing the first and second modules, respectively.

14. The portable modular power system of claim 13 wherein the first and second containers are transportable via at least one of truck, rail, and ship.

15. The portable modular power system of claim 13 and further comprising first and second warning systems mounted on the first and second containers, respectively, the first and second warning systems respectively indicating at least one of a fault and an operation of a component of one of the first and second modules.

16. The portable modular power system of claim 1 wherein the circuit allows at least one of the first and second battery

chargers to charge at least one of the first and second battery banks.

17. A method for providing electric power, comprising:

5 coupling a first generator set to a first battery charger in a first module, a first output of the first battery charger coupled to a first battery bank, the first battery bank coupled to a connection point;

10 coupling a second generator set to a second battery charger in a second module, a second output of the second battery charger coupled to a second battery bank, the second battery bank coupled to the connection point;

coupling the first and second outputs of the first and second battery chargers with a circuit; and,

15 controlling components of the first and second modules with a first control system located in the first module and communicatively coupled to the components to thereby output electric power from the connection point.

18. The method of claim 17 wherein the control system controls one of the first battery charger and the second battery charger to charge both of the first battery bank and the second battery bank via the circuit.

19. The method of claim 17 and further comprising selectively coupling one of first and second utility power inputs and the first and second generator sets to the first and second battery chargers, respectively, using first and second

25

selector switches in the first and second modules, respectively.

20. The method of claim 19 wherein the control system controls the first and second selector switches to couple the
5 first and second utility power inputs to the first and second battery chargers, respectively.

21. The method of claim 19 wherein the control system controls the first and second selector switches to couple the first and second generator sets to the first and second
10 battery chargers, respectively.

22. The method of claim 20 wherein the first and second utility power inputs are coupled to the first and second battery chargers, respectively, when utility power is available.

15 23. The method of claim 21 wherein the first and second generator sets are coupled to the first and second battery chargers, respectively, when utility power is not available.

24. The method of claim 17 wherein a second control system is located in the second module and is communicatively coupled to
20 components of the second module and wherein the second control system operates under the control of the first control system located in the first module.

25 25. The method of claim 24 wherein a communication circuit couples the first and second modules, the communication circuit carrying control signals between the first and second modules.

26. The method of claim 25 wherein the communication circuit communicatively couples the first and second control systems.

27. The method of claim 17 wherein first and second inverters are coupled between the connection point and the first and
5 second battery banks in the first and second modules, respectively.

28. The method of claim 27 wherein first and second power factor correction equipment are coupled between the connection point and the first and second inverters in the first and
10 second modules, respectively.

29. The method of claim 17 wherein first and second containers house the first and second modules, respectively.

30. The method of claim 29 wherein the first and second containers are transportable via at least one of truck, rail,
15 and ship.

31. The method of claim 29 wherein first and second warning systems are mounted on the first and second containers, respectively, the first and second warning systems respectively indicating at least one of a fault and an
20 operation of a component of one of the first and second modules.

32. The method of claim 17 wherein the circuit allows at least one of the first and second battery chargers to charge at least one of the first and second battery banks.

33. A portable modular power system, comprising:
- a first module having a first generator set coupled to a first battery charger for charging a first battery bank coupled to a connection point;
 - 5 a second module having a second generator set coupled to a second battery charger for charging a second battery bank coupled to the connection point;
 - a first control system in the first module for controlling operation of both the first and second
10 modules; and,
 - a circuit coupling the first and second battery chargers for enabling battery charger sharing between the first and second modules.
34. The portable modular power system of claim 33 and further
15 comprising first and second inverters for producing alternating current power coupled between the connection point and the first and second battery banks in the first and second modules, respectively.
35. The portable modular power system of claim 33 and further
20 comprising first and second selector switches in the first and second modules for selectively coupling one of first and second utility power inputs and the first and second generator sets to the first and second battery chargers, respectively.
36. The portable modular power system of claim 33 and further
25 comprising a second control system in the second module for controlling operation of the second module, the second control

system operating under the control of the first control system in the first module.

37. The portable modular power system of claim 33 and further comprising first and second containers for housing the first
5 and second modules, respectively.

1/8

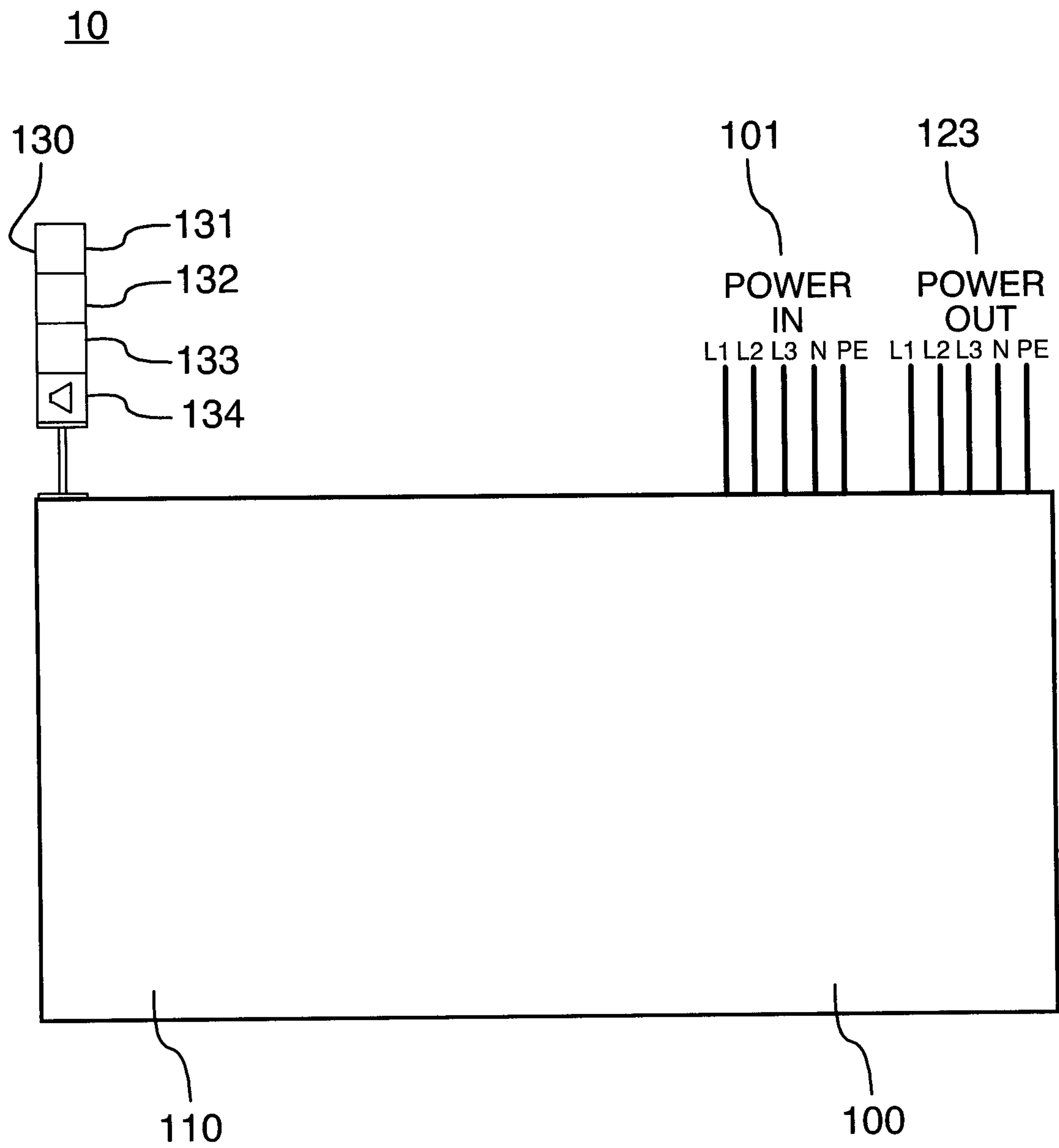


FIG.1

2/8

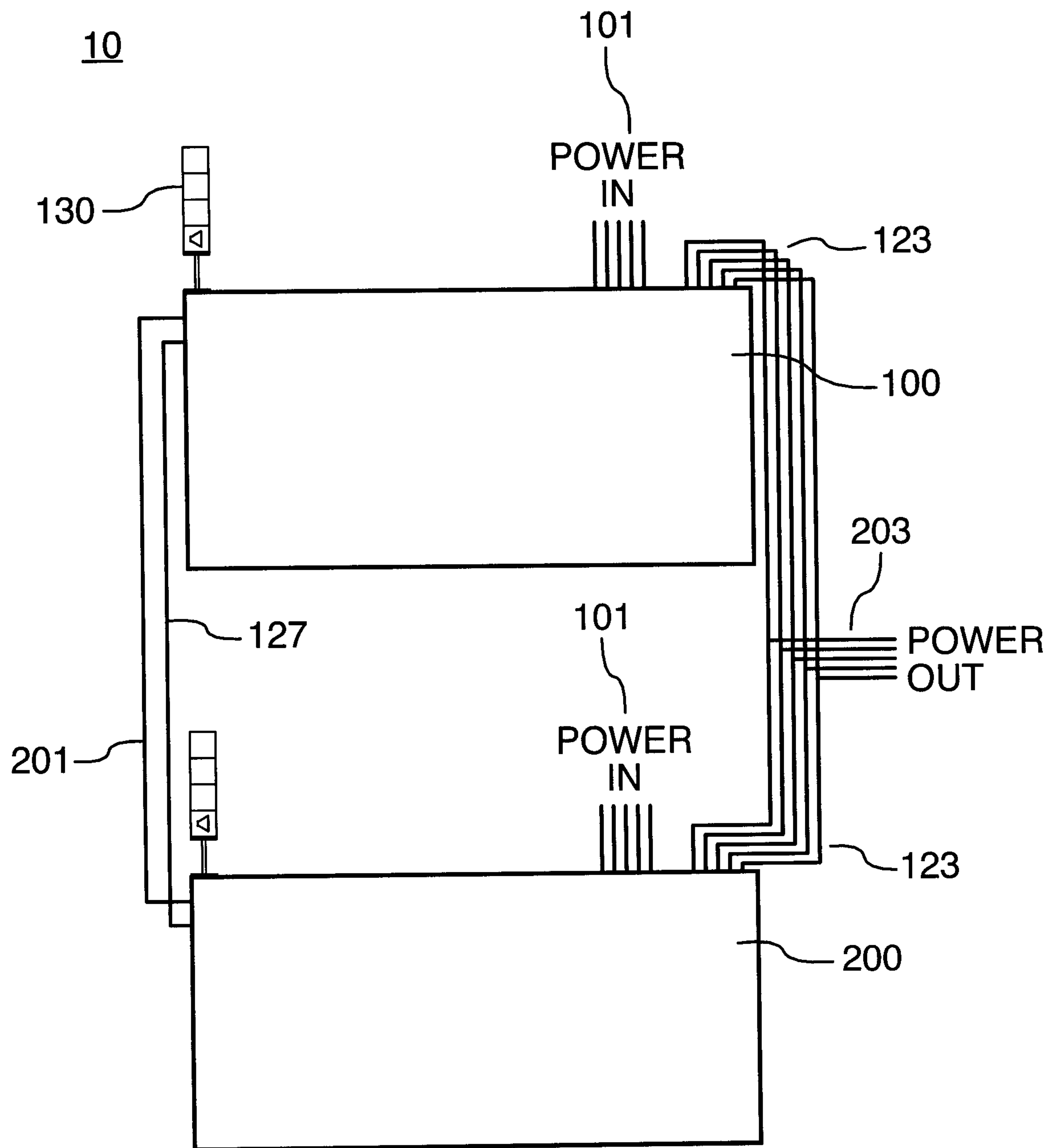


FIG.2

3/8

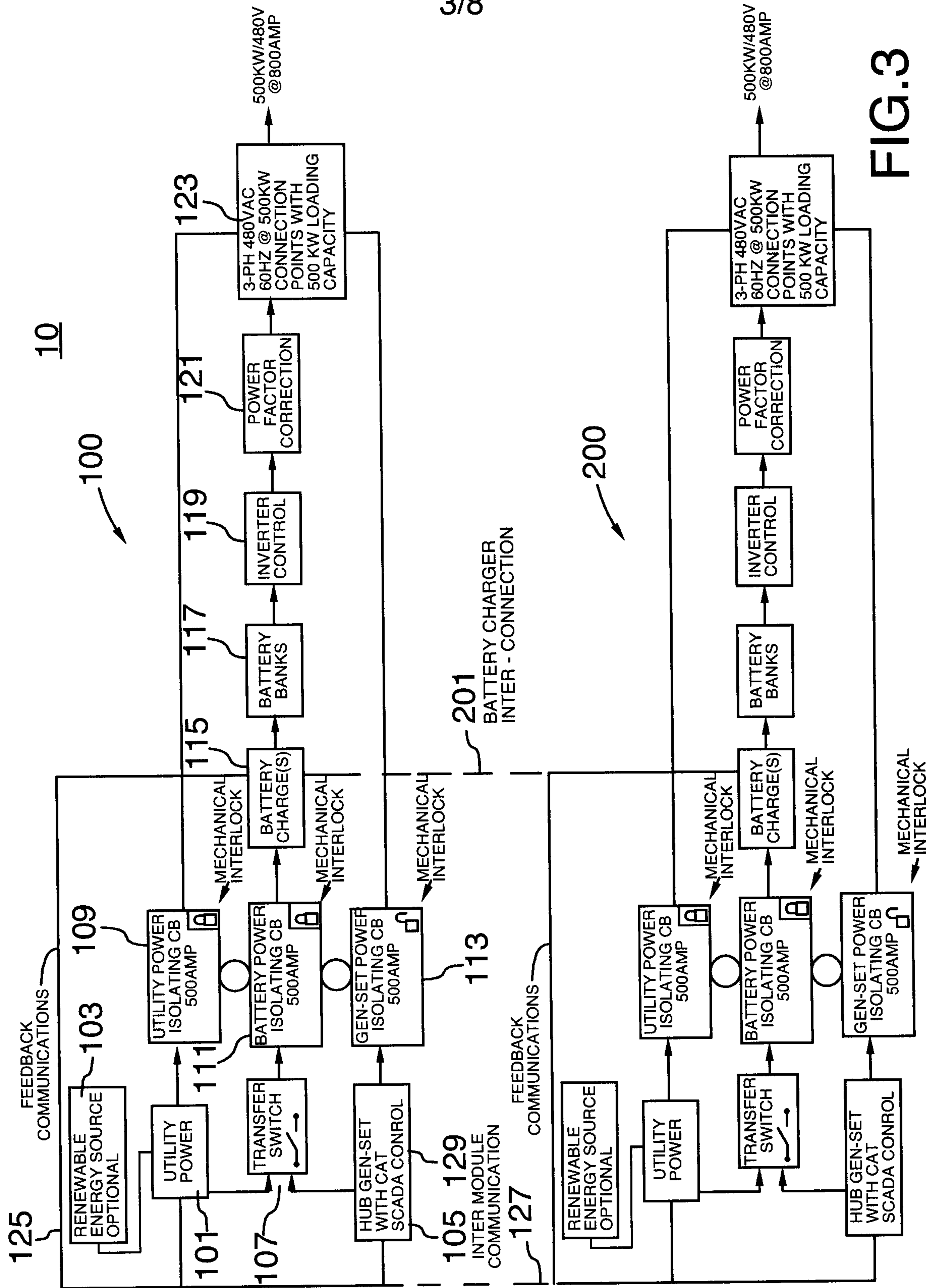


FIG. 3

4/8

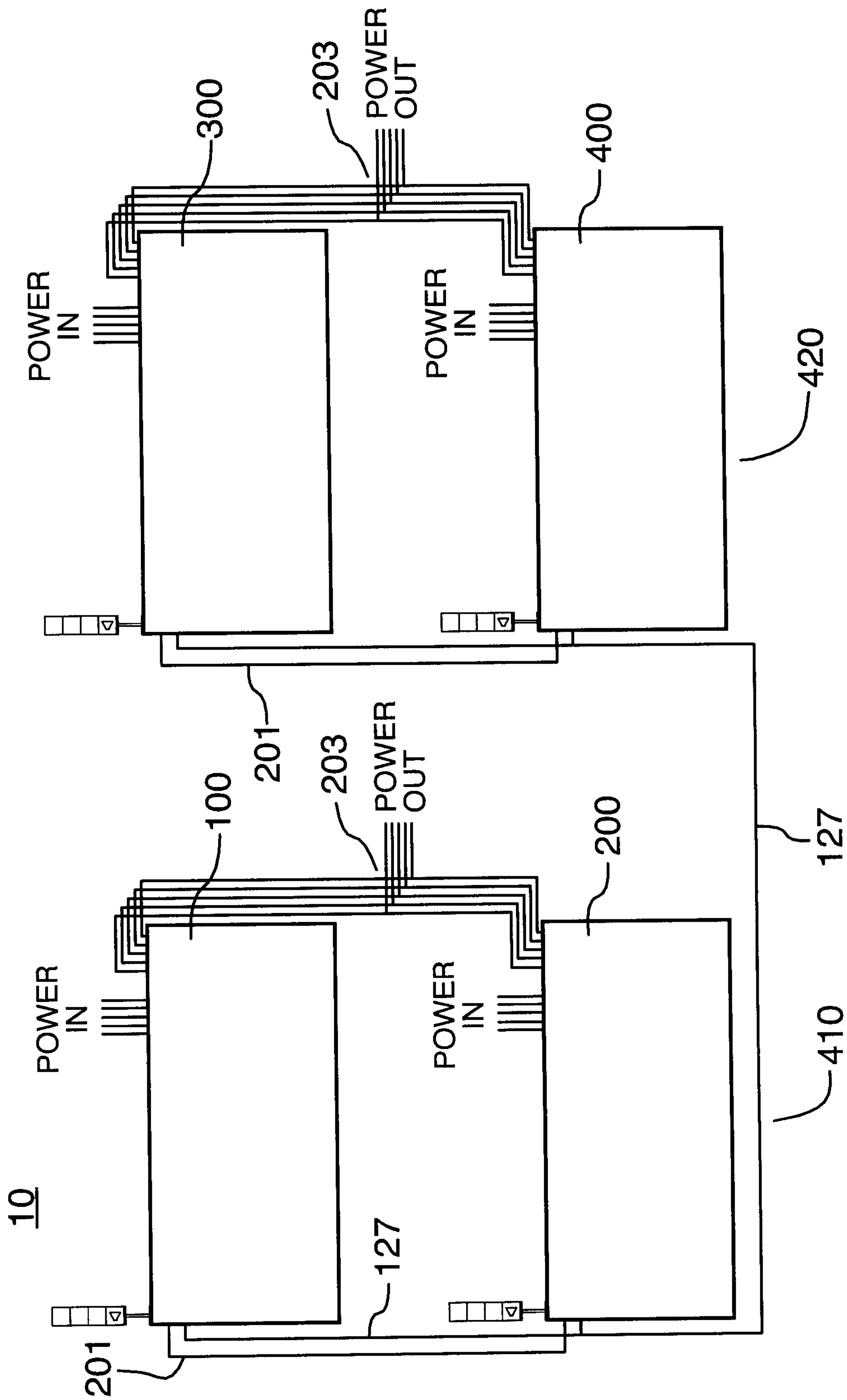


FIG.4

5/8

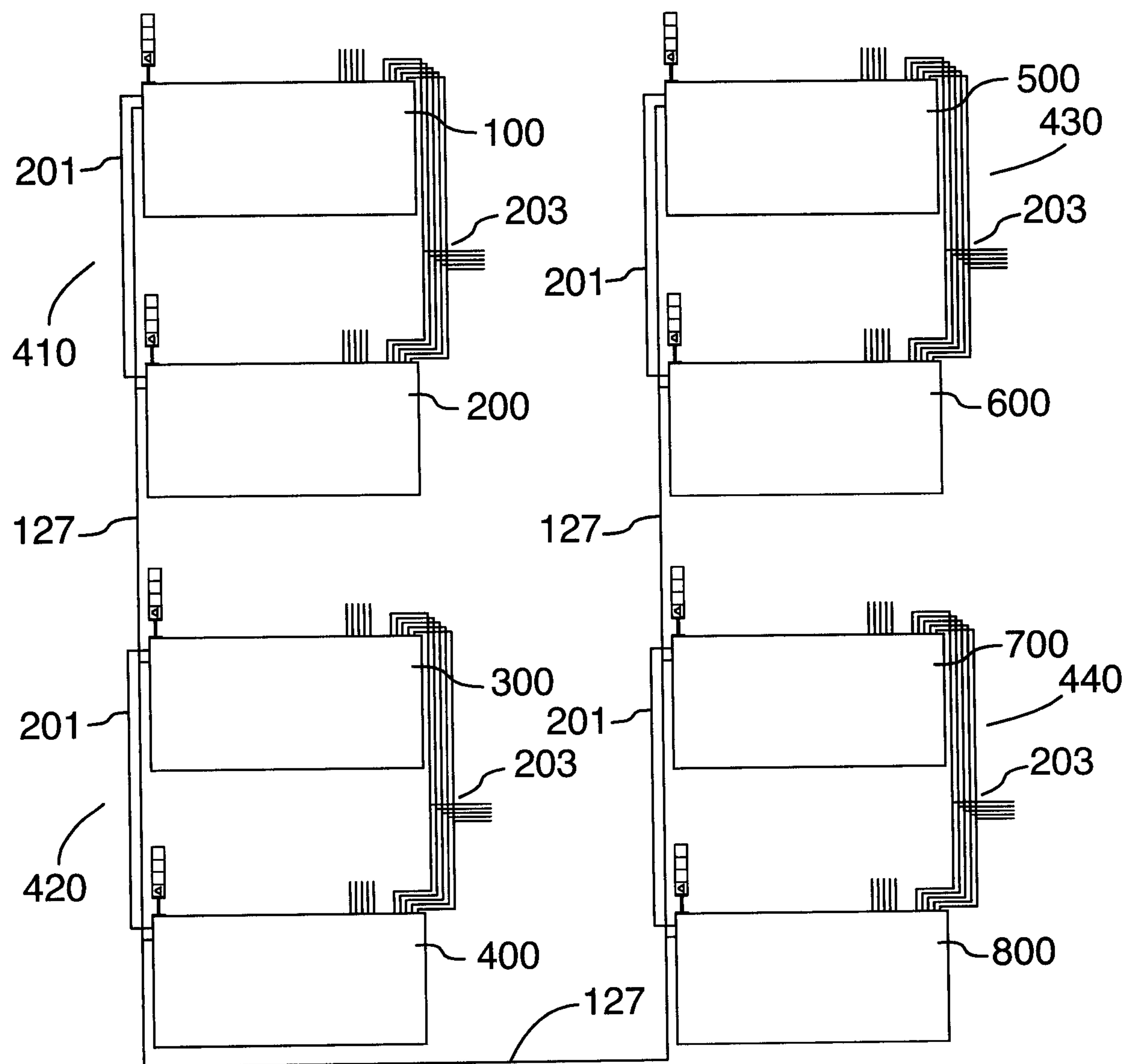
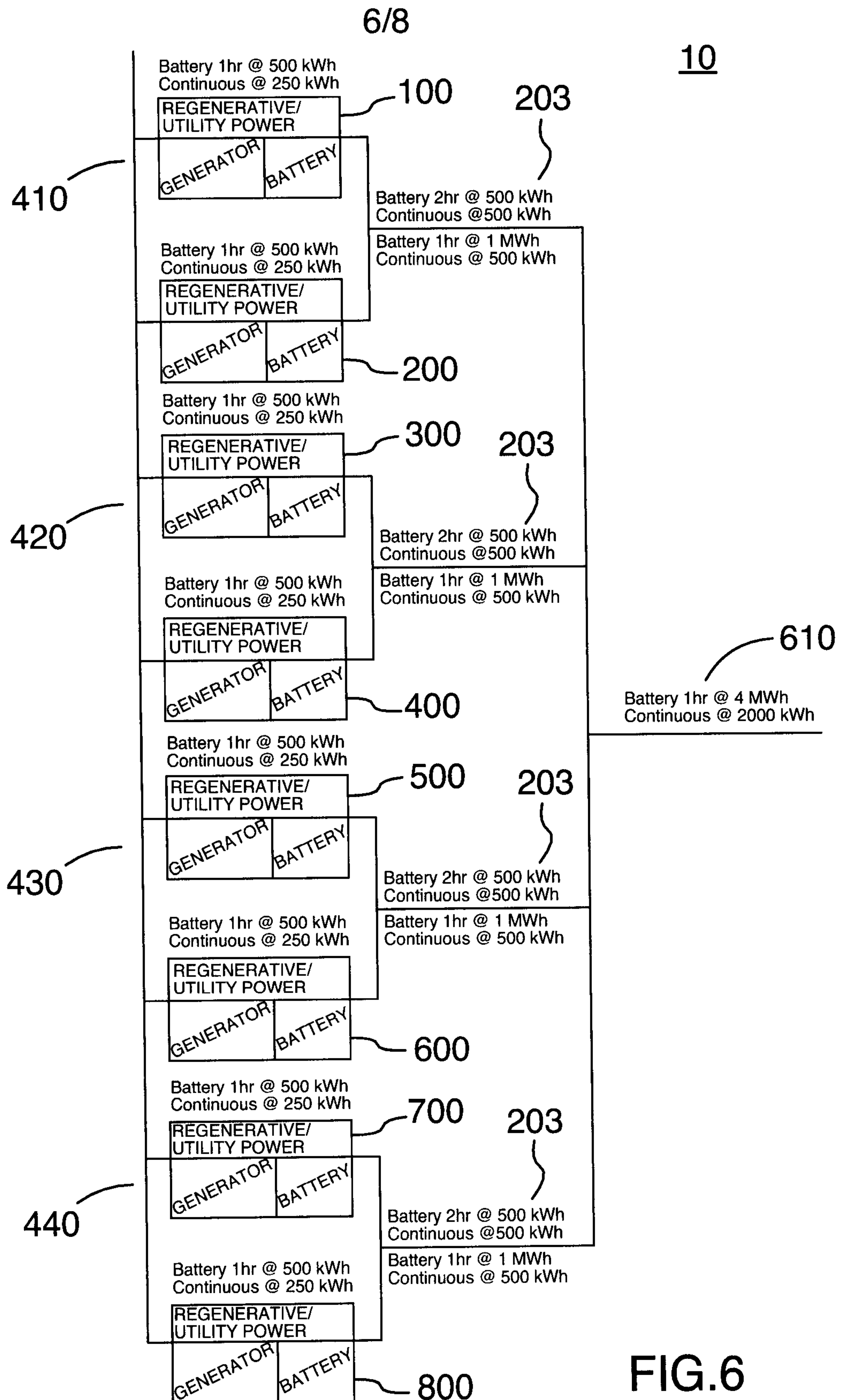
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FIG.5



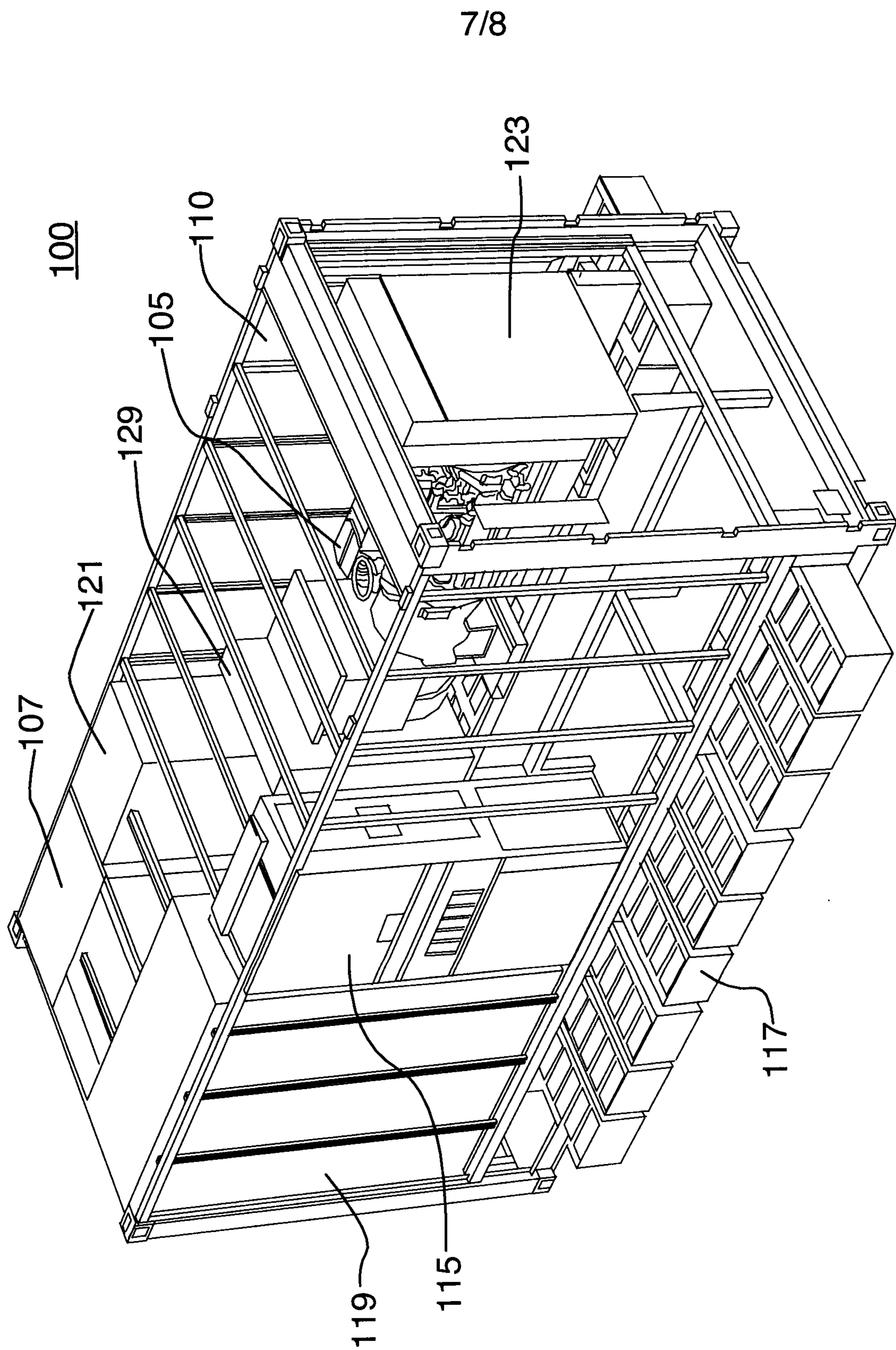


FIG.7

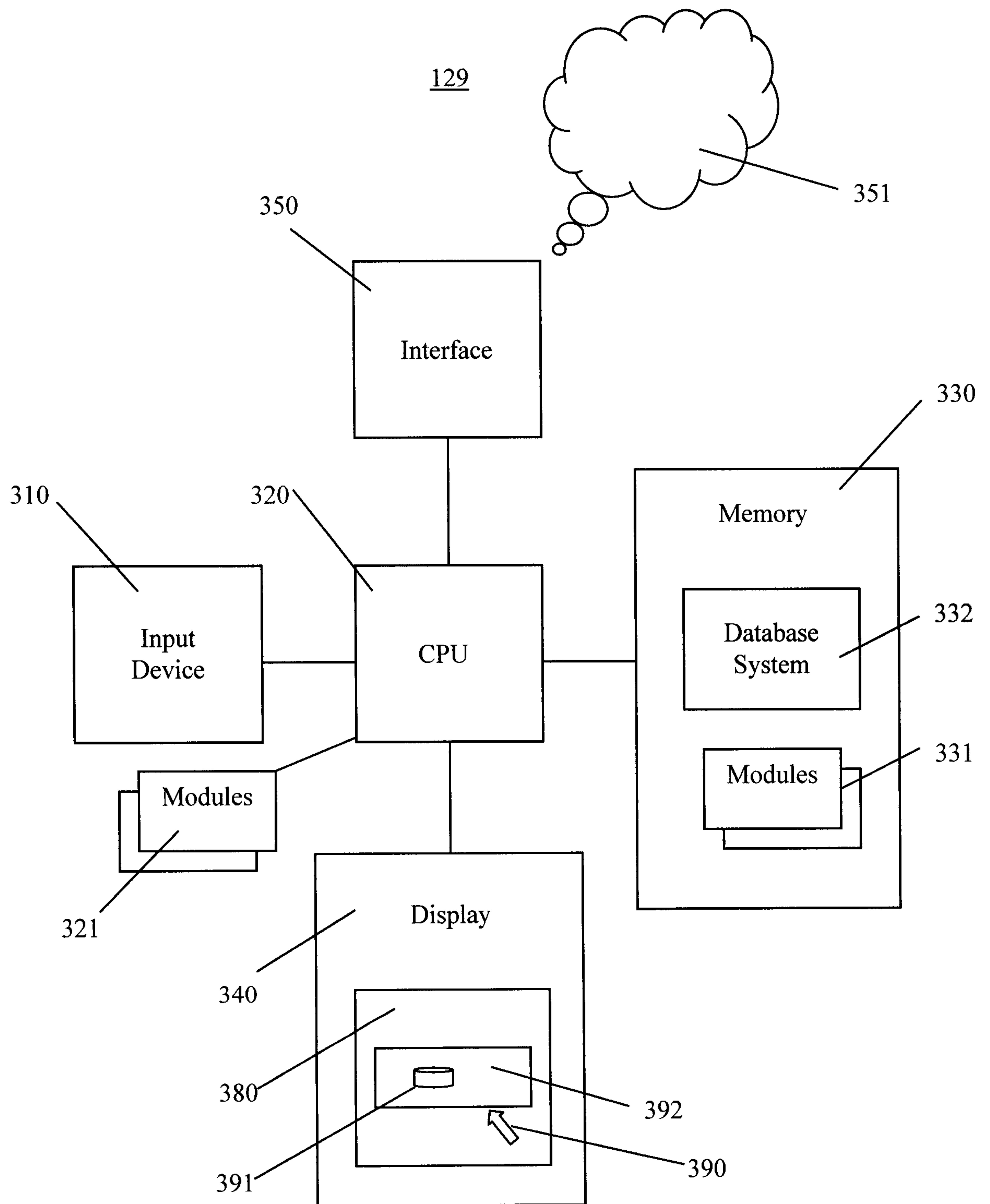


FIG. 8

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