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(71) Applicant: **AMAZON TECHNOLOGIES INC** [US/US]; PO Box 8102, Reno, NV 89507 (US).

(72) Inventors: **TOWNER, Richard, Chadwick**; 410 Terry Avenue North, Seattle, WA 98109-5210 (US). **CZAMARA, Michael, Phillip**; 410 Terry Avenue North, Seattle, WA 98109-5210 (US). **MORALES, Osvaldo, P.**; 410 Terry Avenue North, Seattle, WA 98109-5210 (US). **KNIGHT, Kraig**; 410 Terry Aveue North, Seattel, WA 98109-5210 (US). **RAMIREZ, Antonio, William Vasquez**; 410 Terry Avenue North, Seattle, WA 98109-5210 (US).

(74) Agents: **HAYES, Daniel, L.** et al.; Lee & Hayes, PLLC, 601 W. Riverside Ave, Suite 1400, Spokane, WA 99201 (US).

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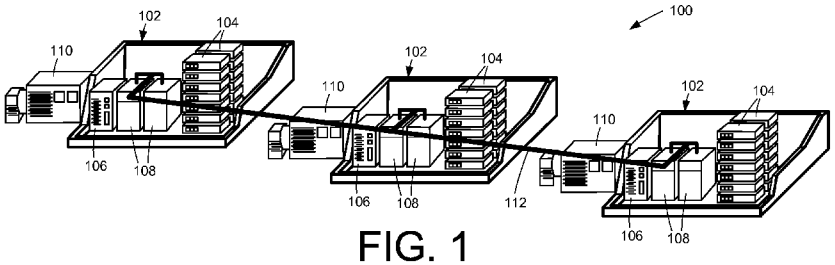

FIG. 1

(57) Abstract: In a data center having multiple resource zones, each of the zones has an uninterruptable power supply (UPS) and associated power storage elements such as batteries. A power bus may be provided between the resource zones to connect the outputs of the power storage elements of the resource zones. The power storage elements may thereby be shared between the UPS's so that an individual resource zone may be operated for a longer duration under anomalous conditions.

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SHARED BACKUP POWER FOR DATA CENTERS

RELATED APPLICATIONS

[0001] The present application claims priority to US Patent Application No. 14/010,781 filed on August 27, 2013, entitled "Shared Backup Power For Data Centers", which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] Data centers are facilities used to house and operate computing resources such as computers, processors, servers, telecommunications equipment, data storage systems, and so forth. Data centers may be used to provide services such as large-scale internet applications. Data centers may also be used to provide infrastructure services to customers who may implement their own applications using the resources provided by data centers. Data centers are increasingly critical to various types of computing activities, services, and applications.

[0003] The reliability and continuous availability of data center equipment are critically important. Various equipment redundancies are typically implemented within data centers to ensure continuous availability. In particular, redundant power sources are provided to ensure continuous operation during power failures or outages.

[0004] Many data centers may include multiple resource zones, each having its own infrastructure and support system. Electrical power for the equipment within a resource zone is provided by an uninterruptable power supply (UPS).

The UPS conditions alternating current (AC) power and includes an inverter for generating AC power from associated direct current (DC) batteries.

[0005] Normally, the UPS is powered from AC electric mains provided by a power utility. Upon a failure or outage of the AC electric mains, the UPS may temporarily draw DC power from its associated batteries for a short period of time to generate AC power while backup generators are started.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different figures indicates similar or identical components or features.

[0007] FIG. 1 is a figurative drawing of a data center having multiple resource zones, where each resource zone has a dedicated UPS and associated batteries that are potentially shared between the UPS's.

[0008] FIG. 2 is a figurative drawing of a data center having multiple resource zones. Each resource zone has a dedicated UPS and associated batteries. In addition, the data center has an additional set of batteries that are potentially shared between the UPS's of the different resource zones.

[0009] FIGS. 3, 4, and 5 are block diagrams illustrating example configurations that may be used within data centers to provide backup power to resource zones of the data centers.

[0010] FIG. 6 is a flow diagram illustrating an example method of operating a data center using shared UPS power storage elements.

DETAILED DESCRIPTION

[0011] This disclosure describes systems and techniques for providing backup power to computing resources and other equipment within a data center. The data center has multiple resource zones supported by infrastructures that are generally independent of each other, so that failures relating to one resource zone do not affect the ongoing operations of other resource zones.

[0012] Various types of computing resources are located within each of the resource zones. With regard to power distribution, each resource zone has an uninterruptable power supply (UPS) that provides power to the computing resources within the zone. A set of batteries or other energy storage elements are located in the resource zone along with the UPS. Each resource zone may also have a backup generator for providing power during power outages.

[0013] The UPS within a particular resource zone normally receives alternating current (AC) power from an electric mains of a power utility. Upon failure of the electric mains, the UPS receives AC power from a backup generator that is dedicated to the resource zone. In the time between failure of the AC mains and startup of the backup generator, the UPS draws direct current (DC) power from its associated batteries and uses an electrical inverter to generate AC power for the equipment of the resource zone.

[0014] A power bus may be provided to allow sharing of DC power between the UPS's of different resource zones. The power bus may extend between and/or pass through each of the resource zones, and may be configured to provide a common connection between the DC outputs of the UPS batteries of the different resource zones. The UPS batteries of the different zones may therefore be operated in parallel, to increase the length of time that a particular UPS may operate from DC power. This may be useful in various situations, and may allow battery capacities to be reduced overall and/or within individual resource zones.

[0015] In certain embodiments, the power bus may be switched, and control logic may be provided to selectively direct DC power from one resource zone to another based on need. For example, DC power may be directed from a first resource zone to a second resource zone in response to a detected depletion of the batteries of the second resource zone.

[0016] FIG. 1 shows an example of a data center 100 in which the described techniques may be implemented. The data center 100 has a plurality of resource zones 102 in different areas or locations of the data center 100. Each resource zone 102 may, for example, comprise a room of the data center. As another example, each resource zone 102 may comprise a specific area of the data center. In general, each resource zone is supported by an independent local infrastructure, so that a failure relating to one of the resource zones does not affect other resource zones.

[0017] Each resource zone 102 has or contains multiple computing resources 104. The resources 104 may include computers, processors, servers, storage devices, networking equipment, telecommunications equipment, control equipment, support equipment, and so forth. The computing resources 104 are typically housed in racks, which are arranged in rows within the data center 100.

[0018] Each resource zone 102 has an uninterruptable power supply (UPS) 106 and associated UPS power storage elements 108. The power storage elements 108 may comprise sets of batteries or other power storage mechanisms, including chemical and kinetic power storage devices. For example, each UPS storage element 108 may comprise one or more batteries connected to provide direct current (DC) power to the associated UPS 106. The UPS 106 charges the batteries during normal mains-powered operation, and may draw upon the batteries when conditioning alternating current (AC) mains power or generator-provided AC power. Alternatively, each UPS power storage element or set 108 may comprise a flywheel energy storage unit.

[0019] Each resource zone 102 may have its own UPS 106 and corresponding set of storage elements 108, which may be physically located within the resource zone 102.

[0020] Each resource zone 102 may also have its own dedicated backup generator 110 or set of backup generators 110 for use during power outages or interruptions. During normal operation, the UPS 106 operates from AC mains provided by an electric power utility. In the case of an AC mains failure, AC

power may be provided by the backup generator 110. In the interim between AC mains failure and startup of the backup generator 110, the UPS 106 may generate AC power based on DC power drawn from the storage elements 108 associated with the UPS 106. The UPS 106 may have one or more inverters (not shown) that are used to generate AC power from DC power.

[0021] In the described embodiment, a common power bus 112 extends between and into each of the resource zones 102 to provide a common connection between the UPS storage elements 108 of the multiple resource zones 102. The common power bus allows for DC power sharing between the UPS's of the resource zones.

[0022] Generally, each of the UPS power storage elements 108 has a power output comprising multiple power terminals, lines, or connections. For example, each set of the storage elements 108 may have a positive terminal, a negative terminal, and a ground terminal. The power bus 112 may have conductors corresponding to each of the multiple terminals, and may be connected in such a way that corresponding terminals of the multiple storage elements 108 are connected in common. Multi-conductor DC power bus bars may be used for this purpose.

[0023] The interconnection of the UPS storage elements shown in FIG. 1 may be useful in various situations. As an example, it may happen at the beginning of a power outage that most of the generators start up within an expected startup time, while one of the generators does not start as expected. In a situation like this, the UPS storage elements associated with the resource

zones that are receiving backup power from their backup generators may be used to supplement the power of the storage element within the resource zone of the malfunctioning generator. This may allow more time for technicians to troubleshoot and/or manually start the malfunctioning generator.

[0024] As another example, it may happen that a bank of UPS storage elements associated with a particular resource zone fails or becomes depleted in an unusually or abnormally short time. In this situation, the UPS storage elements of the other resource zones may be drawn from to supplement or replace the power that would otherwise have been provided by the malfunctioning or depleted storage elements.

[0025] As yet another example, it may happen that a UPS associated with a particular resource zone fails. In this situation, the power storage elements of that zone may be used to extend DC power availability to the UPS's of other zones.

[0026] Furthermore, it may be possible because of the shared arrangement of UPS power storage elements to reduce the number of storage elements that are located within each of the resource zones. Normally, UPS batteries within a particular zone are sized to accommodate anomalous conditions that are unlikely to occur simultaneously in multiple resource zones. With the arrangement described above, the batteries of different resource zones may be used in combination to supplement an individual zone that is experiencing an unusual or unique condition.

[0027] FIG. 2 shows an alternative implementation of the data center 100. In addition to the UPS storage elements 108 that are dedicated to corresponding UPS's 106 and located within the same resource zones 102 as the associated UPS's 106, additional or supplemental power storage elements 202 may be located within the data center 100. The supplemental power storage elements 202 may comprise one or more chemical power storage devices such as battery banks or kinetic energy storage devices such as flywheels that are not collocated with or directly associated with corresponding UPS devices. The supplemental power storage elements 202 may be located within one of the resource zones 102 or at a separate or central location with the data center 100, possibly apart from any UPS units of the data center 100. The common power bus 112 connects the supplemental power storage elements 202 in common with each of the dedicated power storage elements 108.

[0028] The supplemental power storage elements 202 may be useful in the scenarios described above, to supplement the power provided by the dedicated power storage elements 108. In certain implementations, the availability of the supplemental storage elements 202 may make it possible to reduce the number or capacity of the dedicated power storage elements 108 that are located in each of the resource zones 102. For example, the dedicated power storage elements 108 may be sized to accommodate normal or expected failure sequences, such as might be based on an assumption that the backup generators 110 will be started within an expected time after the beginning of an AC mains power failure. In the case that one or more of the backup generators 110 does

not start as expected, the supplemental storage elements 202 may be used to provide additional DC power for the UPS 106 of the resource zone 102 where the backup generator 110 has failed to start.

[0029] FIG. 3 shows further details regarding an implementation of a data center backup power system 300. The system 300 includes a plurality of UPS's 106 as described above. Each UPS 106 is associated with and dedicated to a particular resource zone, and may be located at or within the resource zone. Each UPS 106 provides conditioned power and backup power to the computing resources within the associated resource zone.

[0030] Each UPS 106 normally receives AC power from a power utility mains. In addition, a backup generator 110 is associated with and/or dedicated to each of the resource zones and the UPS's 106 of the resource zones. Upon failure or outage of the AC power mains, the generator 110 automatically starts within a period of time such as 45-120 seconds. During the interim between AC power mains failure and startup of the generator 110, each UPS 106 draws power from one or more associated or dedicated power storage elements 108, which in this example are illustrated as battery sets, groups, or banks. Each battery set may comprise one or more batteries or battery elements. Although FIG. 3 is illustrated as being implemented with chemical-based battery sets, other implementations may use other types of storage elements in place of the battery sets. For example, kinetic energy storage devices may be used in place of the battery sets in certain embodiments.

[0031] In the embodiment of FIG. 3, each UPS 106 has a set 302 of power storage elements, which may comprise a number n of individual storage elements 108. Each set 302 of power storage elements is located at or within its associated resource zone. Each set 302 of storage elements 108 is connected through power switches 304 with the common power bus 112. The common power bus 112 extends into each of the resource zones to connect between the storage elements 108 of the different resource zones.

[0032] Control logic 306 may be provided to selectively direct and/or connect DC power from the storage element set 302 of one or more of the resource zones to the storage elements and/or UPS's 106 of one or more others of the resource zones. In some cases, the control logic 306 may monitor the power levels of the storage element sets 302. In response to detecting depletion of power in one of the storage element sets 302, the control logic 306 may direct or connect power to the depleted storage element set 302 and its associated UPS 106 from another of the storage element sets 302. This may happen, for example, when the backup generator 110 associated with a particular UPS 106 fails to start as expected, and additional DC power is needed to sustain the UPS 106 while the backup generator 110 is started manually.

[0033] FIG. 4 shows details regarding another implementation of a data center backup power system 400. The system 400 includes a plurality of UPS's 106 as described above. Each UPS 106 is associated with and dedicated to a particular resource zone, and may be located at or within the resource zone.

Each UPS 106 provides conditioned power and backup power to the computing resources within the associated resource zone.

[0034] Each UPS 106 normally receives AC power from a power utility mains. In addition, a generator 110 is associated with and/or dedicated to each of the resource zones and the UPS's 106 of the resource zones. Upon failure or outage of the AC power mains, the generator 110 automatically starts within a period of time such as 45-120 seconds. During the interim between AC power mains failure and startup of the generator 110, each UPS 106 draws power from one or more associated and dedicated power storage elements 402. Each storage element may comprise one or more batteries, one or more kinetic energy storage devices, other types of energy storage devices, or sets of energy storage devices. For example, a single flywheel-based energy storage device may be associated with each of the UPS's 106, in each of the resource zones. Each dedicated storage element 402 is located at or within its associated resource zone.

[0035] Each of the dedicated storage elements 402 is connected through power switches 404 with the common power bus 112. The common power bus 112 extends into each of the resource zones to connect between the storage elements 402 of the different resource zones.

[0036] In addition to the dedicated storage elements 402, which are collocated and associated directly with respective UPS units, the system 400 may include one or more shared or supplemental storage elements 406, which may comprise one or more batteries, one or more kinetic energy storage

devices, other types of energy storage devices, or sets of energy storage devices.

[0037] Control logic 408 may be provided to selectively direct and/or connect DC power from the supplemental storage elements 406 to one or more of the dedicated storage elements 402 and/or UPS's 106. In some cases, the control logic 408 may monitor the power levels of the storage elements 402. In response to detecting depletion of power in one of the dedicated storage elements 402, the control logic 408 may direct power to the depleted storage element 402 and its associated UPS 106 from the supplemental storage elements 406. This may happen, for example, when the backup generator 110 associated with a particular UPS 106 fails to start as expected, and additional DC power is needed to sustain the UPS 106 while the backup generator 110 is started manually.

[0038] FIG. 5 shows details regarding another implementation of a data center backup power system 500. The system 500 includes a plurality of UPS's 106 as described above. Each UPS 106 is associated with and dedicated to a particular resource zone, and may be located at or within the resource zone. Each UPS 106 provides conditioned power and backup power to the computing resources within the associated resource zone.

[0039] Each UPS 106 normally receives AC power from a power utility mains. In addition, a generator 110 is associated with and/or dedicated to each of the resource zones and the UPS's 106 of the resource zones. Upon failure or outage of the AC power mains, the generator 110 automatically starts within a

period of time such as 45-120 seconds. During the interim between AC power mains failure and startup of the generator 110, each UPS 106 draws power from one or more power storage elements.

[0040] In the example of FIG. 5, the power storage elements may include one or more dedicated power storage elements 502 and one or more shared power storage elements 504. Each dedicated power storage element 502 is associated with and located at or within a corresponding resource zone to provide temporary operating power to the UPS 106 associated with that zone. The shared power storage element 504 may be commonly located, such as at a central location within the data center or at any other location. The power bus 112 extends from the shared power storage element 504 to each of the resource zones.

[0041] Some of the resource zones and their UPS's 106 may not be associated with dedicated power storage elements. In this example, two of the UPS's 106 do not have dedicated or directly associated power storage elements 502. Rather, these UPS's 106 are connected by the power bus 112 to receive temporary power directly from the shared power storage element 504.

[0042] Each of the storage element 502 and 504 may comprise one or more batteries, one or more kinetic energy storage devices, other types of energy storage devices, or sets of energy storage devices.

[0043] The dedicated storage element 502 may be connected through a power switch 506 with the common power bus 112. Control logic 508 may be provided to selectively direct and/or connect DC power from the shared power

storage element 504 to the dedicated storage element 502 and/or UPS's 106. In some cases, the control logic 508 may monitor the power levels of the dedicated storage element 502. In response to detecting depletion of power in the dedicated storage element 502, the control logic 508 may direct power to the depleted storage element 502 and its associated UPS 106 from the shared storage element 504.

[0044] FIG. 6 illustrates an example method 600 of operating a data center in accordance with the techniques described above. An action 602 comprises operating a plurality of computing resources within different resource zones of a data center. The resource zones may in some cases comprise physically different areas or rooms of the data center, and may be locally supported by independent infrastructures.

[0045] An action 604 comprises supplying operating power to the computing resources from UPS's located respectively in the different resource zones. The UPS's may be configured to receive AC power from an AC power mains and/or from an AC generator. The generator may be used to supply AC power upon failure of the AC power mains.

[0046] An action 606 comprises providing temporary power to the UPSs from a plurality of power storage elements, including one or more power storage elements located in each of the different resource zones. This may be performed during initial stages of a power outage, before backup generators have been started.

[0047] An action 608 comprises sharing the temporary power from the power storage elements located in the different resource zones among the UPS's located in the different resource zones. In some embodiments, this may be accomplished by use a power bus that extends between the power storage elements. In some cases, the action 608 may comprise selectively directing the temporary power provided by a first of the power storage elements to the uninterruptable power supply associated with a second of the power storage elements in response to power depletion of the second of the power storage elements.

[0048] Embodiments of the disclosure can be described in view of the following clauses:

1. A data center, comprising:

a plurality of resource zones;

computing resources located within each of the resource zones;

a plurality of uninterruptable power supplies, wherein each resource zone is associated with a respective uninterruptable power supply, and wherein the respective uninterruptable power supply provides operating power to the computing resources located within the resource zone associated with the respective uninterruptable power supply;

a plurality of battery sets, wherein each resource zone is associated with at least one of the battery sets, and wherein a battery set provides temporary power to the uninterruptable power supply of the resource zone associated with the battery set; and

a power bus that extends to each of the resource zones, the power bus connecting the plurality of battery sets to share the temporary power provided by the plurality of battery sets among the uninterruptable power supplies.

2. The data center of clause 1, further comprising control logic that selectively directs the temporary power provided by the battery sets among the interruptible power supplies in response to power depletion the battery sets.

3. The data center of clause 1, further comprising control logic that selectively directs the temporary power provided by a first of the battery sets to the uninterruptable power supply associated with a second of the battery sets in response to power depletion of said second of the battery sets.

4. The data center of any preceding clause, wherein:

each uninterruptable power supply is located at its associated resource zone; and

each battery set is located at its associated resource zone.

5. The data center of any preceding clause, further comprising a plurality of backup generators, wherein the battery sets are configured to provide the temporary power during startup of the backup generators.

6. The data center of any preceding clause, further comprising a supplemental battery set that provides supplemental power, wherein the power

bus extends from the supplemental battery set to each of the resource zones, the power bus connecting the supplemental battery set to the battery sets associated with the resource zones to supplement the temporary power of the battery sets associated with the resource zones.

7. A data center, comprising:

a plurality of resource zones;

computing resources located within each of the resource zones;

a plurality of uninterruptable power supplies, wherein each uninterruptable power supply is associated with an individual one of the resource zones, and wherein each uninterruptable power supply provides operating power to the computing resources located within the associated resource zone;

one or more power storage elements that provide temporary power; and

a power bus that extends to each of the resource zones to share the temporary power provided by the one or more power storage elements among the uninterruptable power supplies.

8. The data center of clause 7, further comprising control logic that selectively directs the temporary power among the uninterruptible power supplies in response to power depletion of the one or more power storage elements.

9. The data center of clause 7, wherein:

the one or more power storage elements comprise a plurality of power storage elements that are commonly located; and

the power bus extends from the plurality of uninterruptable power supplies to each of the resource zones.

10. The data center of clause 7, wherein:

a particular one of the uninterruptable power supplies is associated with a first of the one or more power storage elements; and

further comprising control logic that selectively directs the temporary power provided by a second of the one or more power storage elements to said particular one of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

11. The data center of clause 7, wherein:

a first of the uninterruptable power supplies is associated with a first of the one or more power storage elements;

a second of the uninterruptable power supplies is associated with a second of the one or more power storage elements; and

further comprising control logic that selectively directs the temporary power provided by the second of the one or more power storage elements to the first of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

12. The data center of clause 7, wherein:

each uninterruptable power supply is located at its associated resource zone;

each power storage element is located at a corresponding one of the resource zones; and

the power storage element located at a particular resource zone provides temporary power to the uninterruptable power supply located at said particular resource zone.

13. The data center of clause 7, further comprising a plurality of backup generators, wherein the one or more power storage elements are configured to provide the temporary power during startup of the backup generators.

14. The data center of clause 7, wherein the one or more power storage elements comprise:

a plurality of dedicated power storage elements associated respectively with individual uninterruptable power supplies, wherein each dedicated power storage element provides temporary power to the associated uninterruptable power supply;

a supplemental power storage element that provides supplemental power; and

wherein the power bus connects the supplemental power storage element to the dedicated power storage elements to supplement the temporary power of the dedicated power storage elements.

15. The data center of clause 14, further comprising control logic that selectively directs the temporary power provided by the supplemental power storage element to the uninterruptable power supply associated with one of the dedicated power storage elements in response to power depletion of said one of the dedicated power storage elements.

16. The data center of clause 7, wherein the one or more power storage elements comprise:

a plurality of dedicated battery sets associated respectively with individual uninterruptable power supplies, wherein each dedicated battery set provides temporary power to the associated uninterruptable power supply;

a supplemental battery set that provides supplemental power; and

wherein the power bus connects the supplemental battery set to the dedicated battery sets to supplement the temporary power of the dedicated battery sets.

17. The data center of clause 7, wherein the one or more power storage elements comprise:

a plurality of kinetic energy storage devices associated respectively with individual uninterruptable power supplies, wherein each kinetic energy storage device provides temporary power to the associated uninterruptable power supply;

one or more batteries that provide supplemental power; and

wherein the power bus connects the one or more batteries to the uninterruptible power supplies associated with the kinetic energy storage devices to supplement the temporary power of the one or more kinetic energy storage devices.

18. A method, comprising:

operating computing resources within resource zones of a data center;

supplying operating power to the computing resources from uninterruptable power supplies associated respectively with the resource zones;

providing temporary power to the uninterruptable power supplies from one or more power storage elements; and

sharing the temporary power from the one or more power storage elements among the uninterruptable power supplies associated with the resource zones.

19. The method of clause 18, wherein the one or more power storage elements include at least one power storage element that is located at a corresponding one of the resource zones.

20. The method of clause 18, wherein the one or more power storage elements include at least one power storage element located at each of the resource zones.

21. The method of clause 18, wherein the one or more power storage elements include at least one kinetic energy storage device that is associated with each of the resource zones and at least one chemical power storage device that is associated with a plurality of the resource zones.

22. The method of clause 18, wherein:

a particular one of the uninterruptable power supplies is associated with a first of the one or more power storage elements; and

sharing the temporary power comprises selectively directing the temporary power provided by a second of the one or more power storage elements to said particular one of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

23. The method of clause 18, wherein:

a first of the uninterruptable power supplies is associated with a first of the one or more power storage elements;

a second of the uninterruptable power supplies is associated with a second of the one or more power storage elements; and

sharing the temporary power comprises selectively directing the temporary power provided by the second of the one or more power storage elements to the first of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

[0049] Although the subject matter has been described in language specific to structural features, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features described. Rather, the specific features are disclosed as illustrative forms of implementing the claims.

CLAIMS

WHAT IS CLAIMED IS:

1. A data center, comprising:

a plurality of resource zones;

computing resources located within each of the resource zones;

a plurality of uninterruptable power supplies, wherein each uninterruptable power supply is associated with an individual one of the resource zones, and wherein each uninterruptable power supply provides operating power to the computing resources located within the associated resource zone;

one or more power storage elements that provide temporary power; and

a power bus that extends to each of the resource zones to share the temporary power provided by the one or more power storage elements among the uninterruptable power supplies.

2. The data center of claim 1, further comprising control logic that selectively directs the temporary power among the uninterruptible power supplies in response to power depletion of the one or more power storage elements.

3. The data center of any preceding claim, wherein:

the one or more power storage elements comprise a plurality of power storage elements that are commonly located; and

the power bus extends from the plurality of uninterruptable power supplies to each of the resource zones.

4. The data center of any preceding claim, wherein:

a particular one of the uninterruptable power supplies is associated with a first of the one or more power storage elements; and

further comprising control logic that selectively directs the temporary power provided by a second of the one or more power storage elements to said particular one of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

5. The data center of any of claims 1-3, wherein:

a first of the uninterruptable power supplies is associated with a first of the one or more power storage elements;

a second of the uninterruptable power supplies is associated with a second of the one or more power storage elements; and

further comprising control logic that selectively directs the temporary power provided by the second of the one or more power storage elements to the first of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

6. The data center of any preceding claim, wherein:

each uninterruptable power supply is located at its associated resource zone;

each power storage element is located at a corresponding one of the resource zones; and

the power storage element located at a particular resource zone provides temporary power to the uninterruptable power supply located at said particular resource zone.

7. The data center of any preceding claim, further comprising a plurality of backup generators, wherein the one or more power storage elements are configured to provide the temporary power during startup of the backup generators.

8. The data center of any preceding claim, wherein the one or more power storage elements comprise:

a plurality of dedicated power storage elements associated respectively with individual uninterruptable power supplies, wherein each dedicated power storage element provides temporary power to the associated uninterruptable power supply;

a supplemental power storage element that provides supplemental power; and

wherein the power bus connects the supplemental power storage element to the dedicated power storage elements to supplement the temporary power of the dedicated power storage elements.

9. The data center of claim 8, further comprising control logic that selectively directs the temporary power provided by the supplemental power storage element to the uninterruptable power supply associated with one of the dedicated power storage elements in response to power depletion of said one of the dedicated power storage elements.

10. The data center of any preceding claim, wherein the one or more power storage elements comprise:

a plurality of dedicated battery sets associated respectively with individual uninterruptable power supplies, wherein each dedicated battery set provides temporary power to the associated uninterruptable power supply;

a supplemental battery set that provides supplemental power; and

wherein the power bus connects the supplemental battery set to the dedicated battery sets to supplement the temporary power of the dedicated battery sets.

11. The data center of any preceding claim, wherein the one or more power storage elements comprise:

a plurality of kinetic energy storage devices associated respectively with individual uninterruptable power supplies, wherein each kinetic energy storage device provides temporary power to the associated uninterruptable power supply;

one or more batteries that provide supplemental power; and

wherein the power bus connects the one or more batteries to the uninterruptible power supplies associated with the kinetic energy storage devices to supplement the temporary power of the one or more kinetic energy storage devices.

12. A method, comprising:

operating computing resources within resource zones of a data center;

supplying operating power to the computing resources from uninterruptable power supplies associated respectively with the resource zones;

providing temporary power to the uninterruptable power supplies from one or more power storage elements; and

sharing the temporary power from the one or more power storage elements among the uninterruptable power supplies associated with the resource zones.

13. The method of claim 12, wherein the one or more power storage elements include at least one power storage element that is located at a corresponding one of the resource zones, or wherein the one or more power storage elements include at least one power storage element located at each of the resource zones, or wherein the one or more power storage elements include at least one kinetic energy storage device that is associated with each of the resource zones and at least one chemical power storage device that is associated with a plurality of the resource zones.

14. The method of claim 12 or 13, wherein:

a particular one of the uninterruptable power supplies is associated with a first of the one or more power storage elements; and

sharing the temporary power comprises selectively directing the temporary power provided by a second of the one or more power storage elements to said particular one of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

15. The method of any of claims 12-14, wherein:

a first of the uninterruptable power supplies is associated with a first of the one or more power storage elements;

a second of the uninterruptable power supplies is associated with a second of the one or more power storage elements; and

sharing the temporary power comprises selectively directing the temporary power provided by the second of the one or more power storage elements to the first of the uninterruptable power supplies in response to power depletion of said first of the one or more power storage elements.

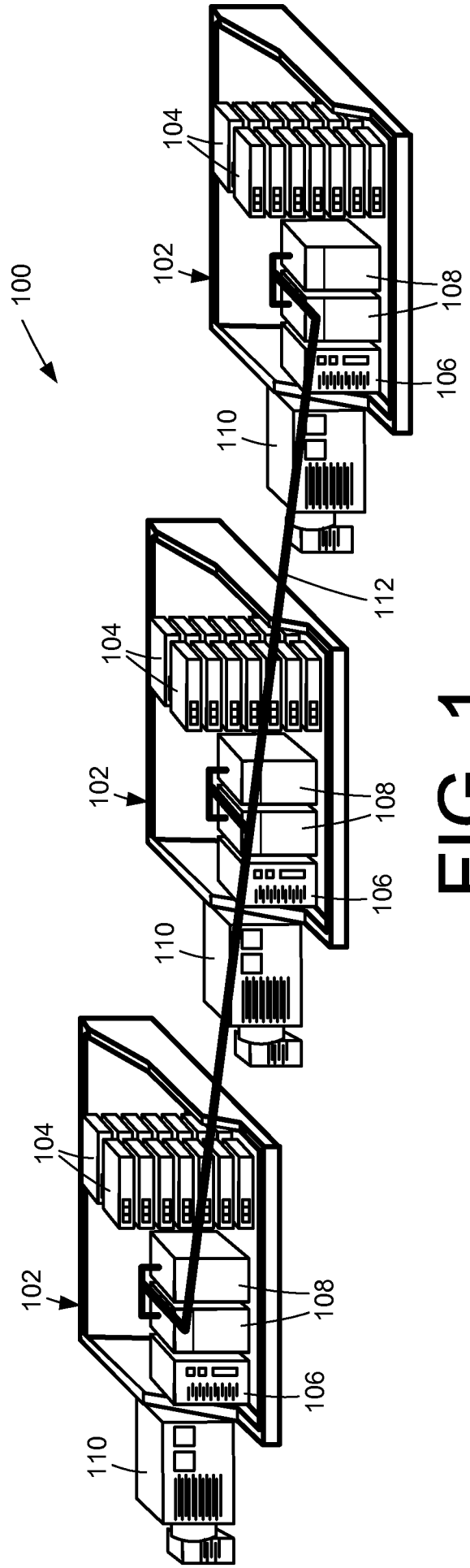


FIG. 1

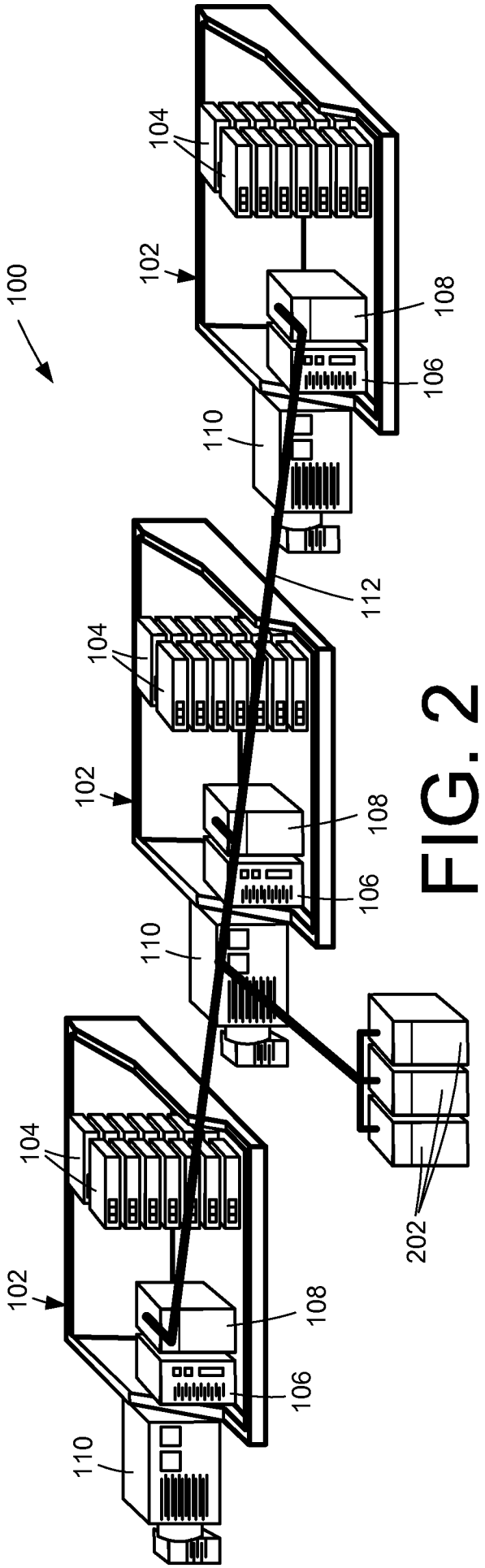


FIG. 2

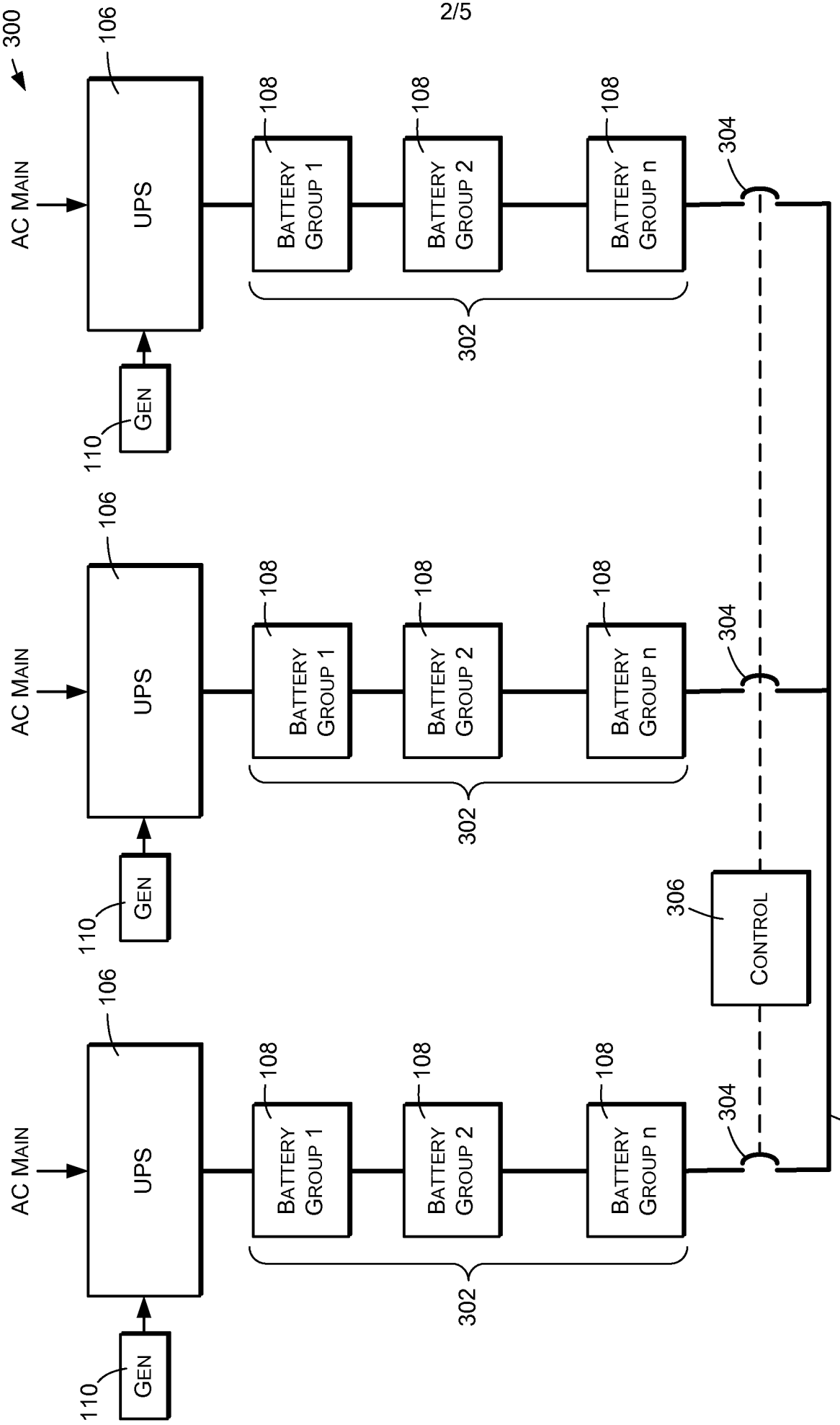
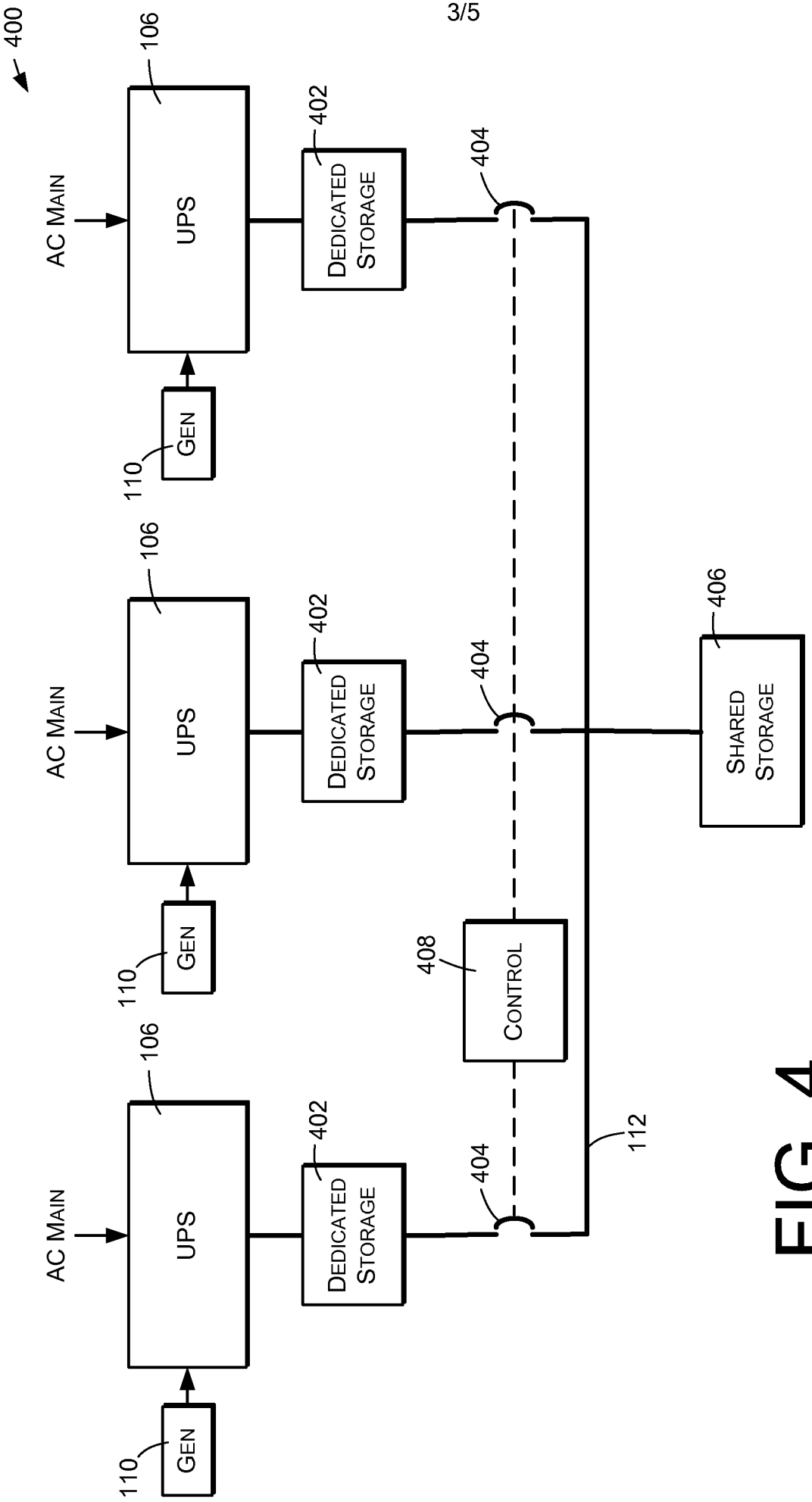

300
AC MAIN
UPS
106
GEN
110
BATTERY GROUP 1
BATTERY GROUP 2
BATTERY GROUP n
108
302
304
CONTROL
306
112

FIG. 3


400
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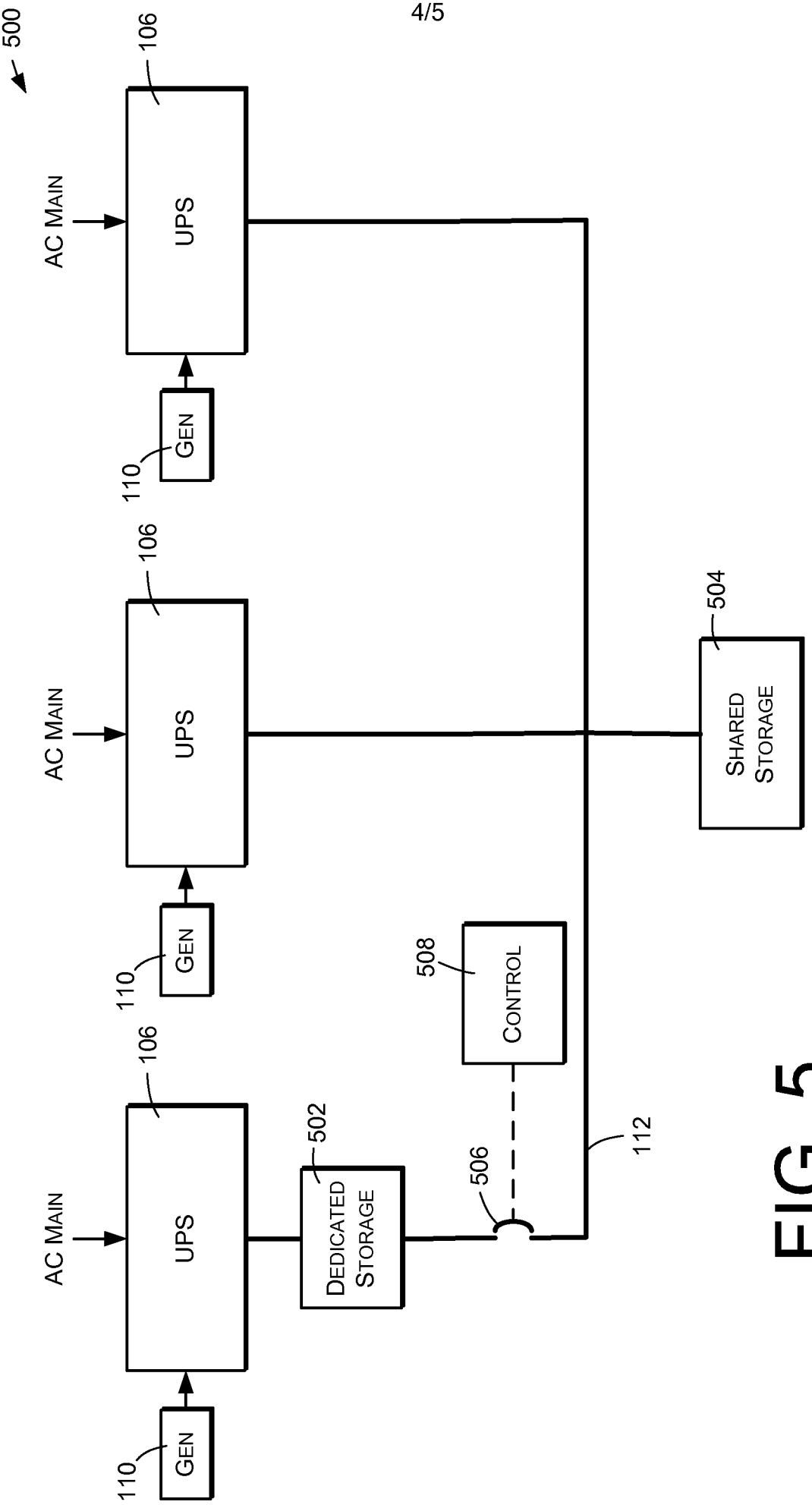
AC MAIN
UPS
402
DEDICATED STORAGE
404
110
GEN
406
SHARED STORAGE
408
CONTROL
112

FIG. 4


500
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AC MAIN
UPS
110
GEN
106
AC MAIN
UPS
110
GEN
504
SHARED STORAGE
508
CONTROL
106
AC MAIN
UPS
502
DEDICATED STORAGE
506
112
110
GEN

FIG. 5

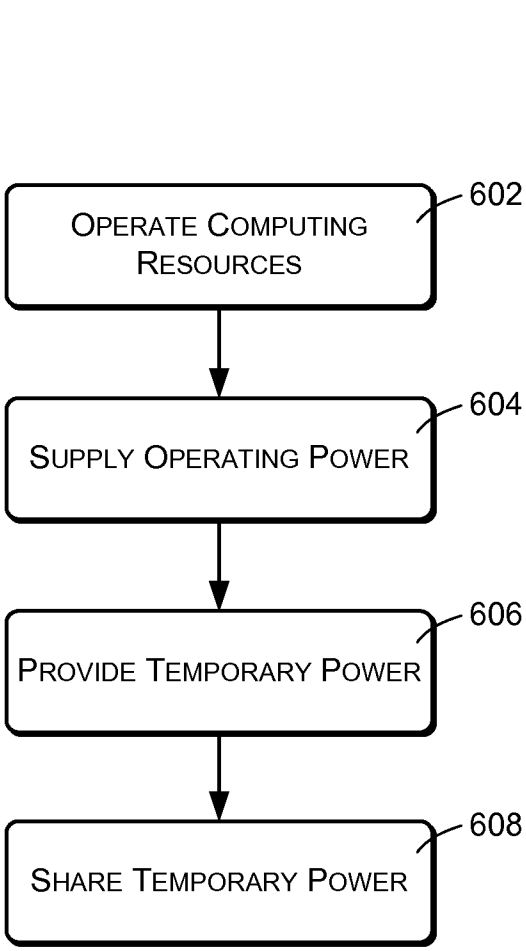
600
OPERATE COMPUTING RESOURCES
602
SUPPLY OPERATING POWER
604
PROVIDE TEMPORARY POWER
606
SHARE TEMPORARY POWER
608

FIG. 6