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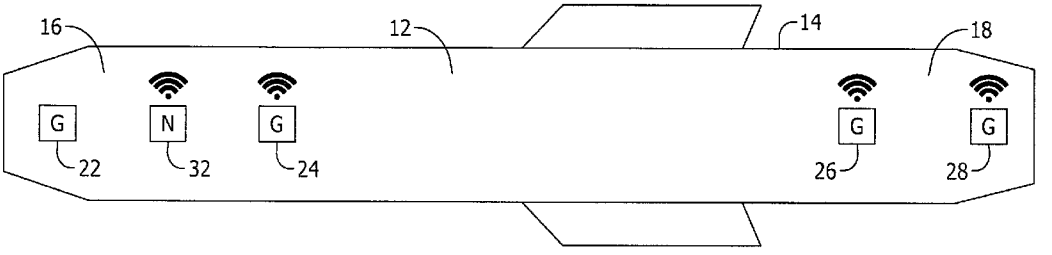
(54) Title: REAL TIME GALLEY POWER MANAGEMENT AND FAULT MONITORING SYSTEM



(57) Abrégé/Abstract:
A real-time galley power management and fault monitoring system for an aircraft comprises a network server in an interior of the aircraft, a plurality of separate galley complexes in the interior of the aircraft, and a wireless galley control unit inside each galley complex. The network server is separate from each galley complex. Each wireless galley control unit is configured for wireless communication with the network server. Each galley complex may also contain a plurality of galley inserts, each galley insert configured for wireless communication with the wireless galley control unit of the galley complex. The system may thus manage a status of power consumption of the plurality of galley inserts inside each galley complex and monitor fault status of each galley insert of the plurality of galley inserts.

ABSTRACT

A real-time galley power management and fault monitoring system for an aircraft comprises a network server in an interior of the aircraft, a plurality of separate galley complexes in the interior of the aircraft, and a wireless galley control unit inside each galley complex. The network server is separate from each galley complex. Each wireless galley control unit is configured for wireless communication with the network server. Each galley complex may also contain a plurality of galley inserts, each galley insert configured for wireless communication with the wireless galley control unit of the galley complex. The system may thus manage a status of power consumption of the plurality of galley inserts inside each galley complex and monitor fault status of each galley insert of the plurality of galley inserts.

REAL TIME GALLEY POWER MANAGEMENT AND FAULT MONITORING SYSTEM

FIELD

[0001] This disclosure pertains to a power management and fault monitoring system for galley complexes in an aircraft.

BACKGROUND

[0002] In an aircraft having several galley complexes, the several galley complexes are allocated a predetermined amount of power generated by the aircraft. This predetermined amount of power is shared by the several galley complexes.

[0003] Because there is a set amount of power to be shared by the several galley complexes, this set amount of power must be managed so that the inserts (microwave ovens, coffee makers or water heaters, galley cart chillers, etc.) of each galley complex are provided with power in an orderly sequence when needed.

[0004] The orderly sequence in which electric power is allocated to a particular insert of a particular galley complex is typically determined by a flight attendant working in each galley complex of the several galley complexes. A flight attendant is needed at each galley complex to turn on the inserts (i.e., microwave ovens, coffee makers or water heaters, galley cart chillers, etc.) to attend to the passengers being served by each of the galley complexes.

[0005] The current system of managing power between several galley complexes of an aircraft is disadvantaged in that it requires extra wiring to implement the wired

galley network system. The weight and the space requirements of the wired communication bus that communicates all of the galley complexes adds weight to the aircraft and detracts from the volume of the aircraft cabin occupied by the passengers, which detracts from the efficient operation of the aircraft and detracts from the comfort of the passengers in the aircraft cabin.

SUMMARY

[0006] The real time galley power management and fault monitoring system of this disclosure overcomes the disadvantages associated with multiple galley complexes in an aircraft that communicate with each other and with the airplane through a wired communication bus. The system also overcomes the disadvantages associated with the need for flight attendants to be in each of the galley complexes of the aircraft to communicate requests for electric power and allocate electric power allowances to each of the galley complexes in a prioritized sequence determined by the flight attendants. A wireless system would also permit a flight attendant to set the priorities from a centralized on board computerized interface. The flight attendant would allocate priorities, the airplane and the power management logic would then translate those priorities into electric power allowances.

[0007] The real time galley power management and fault monitoring system of this disclosure includes a network server on a wireless infrastructure that is provided inside the aircraft. The network server is programmed with a power management algorithm. The algorithm consists of a priority based logic that allows and denies inserts of the galley complexes to come online.

[0008] The system also includes several wireless galley control units acting as nodes on the wireless infrastructure. A wireless galley control unit (wGCU) is provided in each one of several galley complexes of the aircraft. Each wireless galley control unit is provided in one of several galley complexes of the aircraft. Each wGCU communicates with the inserts (i.e., microwave ovens, coffee makers or water heaters, galley cart chillers, etc.) of its associated galley complex and monitors the status and controls the operation of the inserts. The wireless galley unit would communicate with the inserts via a wired connection or potentially a wireless connection as well. Additionally, the wireless galley control unit communicating with the inserts of its associated galley complex monitors the operational health of each insert of the galley complex and also monitors for faults in each insert of the galley complex.

[0009] Each galley complex is also provided with a cabin attendant control panel display that are used to display a graphical user interface configuration screen to the flight attendants of the galley complexes. The panel displays enable the flight attendants to select a desired galley insert priority for the particular galley complex. The panels also enable the flight attendants to view faults and operational statuses of the inserts of the galley complex.

[0010] The wireless galley control unit at each galley complex also communicates with the wireless network server of the aircraft. The wireless galley control unit receives power data available to the galley complex from the network server. The wireless galley control unit also transmits back to the network server periodic status and fault messages of the inserts of the galley complex. The wireless transmitter

coupled with the control unit eliminates the need for a hard wire communication bus from the network server to the control units of the galley complexes.

[0010a] In one embodiment, there is provided a real-time galley power management and fault monitoring system for an aircraft. The system includes: a network server in an interior of the aircraft; a plurality of separate galley complexes in the interior of the aircraft, the network server being separate from each galley complex of the plurality of galley complexes; and a wireless galley control unit inside each galley complex in the interior of the aircraft, each wireless galley control unit inside each galley complex being configured for wireless communication with the network server.

[0010b] Each wireless galley control unit inside its respective galley complex may be configured for communication with a plurality of galley inserts inside said respective galley complex and configured not to communicate with galley inserts inside other galley complexes that are not said respective galley complex.

[0010c] The galley inserts may be compatible with a predefined configuration inside each galley complex.

[0010d] Each wireless galley control unit inside each galley complex may be configured for wireless communication with the galley inserts in the each galley complex.

[0010e] Each wireless galley control unit inside each galley complex may be configured to control operation of the plurality of galley inserts inside the each galley complex.

[0010f] The network server may be configured to allocate electric power to each wireless galley control unit and to the plurality of galley inserts under the control of the each wireless galley control unit.

[0010g] Each wireless galley control unit may be configured to communicate status information and fault information of the plurality of galley inserts under the control of the each wireless galley control unit to the network server.

[0010h] The network server may be configured to store status information and fault information communicated to the network server by the each wireless galley control unit.

[0010i] The each wireless galley control unit may have a display screen that is configured to display on the display screen status information and fault information for each galley insert of the plurality of galley inserts under the control of the each wireless galley control unit.

[0010j] In another embodiment, there is provided a real-time galley power management and fault monitoring system for an aircraft. The system includes: a network server in an interior of the aircraft; and a plurality of wireless galley control units, each wireless galley control unit of the plurality of wireless galley control units being inside a respective separate galley complex in the interior of the aircraft, each wireless galley control unit of the plurality of wireless galley control units being configured for wireless communication with the network server.

[0010k] Each wireless galley control unit may be configured for communication with a plurality of galley inserts inside the galley complex.

[0010l] The galley inserts may be compatible with a predefined configuration inside each galley complex.

[0010m] The wireless galley control unit may be configured for one of wireless communication with the inserts in the galley complex and wired communication with the inserts in the galley complex.

[0010n] The wireless galley control unit may be configured to control operation of the plurality of galley inserts.

[0010o] The network server may be configured to allocate electric power to each wireless galley control unit of the plurality of wireless galley control units.

[0010p] Each wireless galley control unit of the plurality of wireless galley control units may be configured to communicate status information and fault information of the plurality of galley inserts with the network server either upon request by an application hosted on the network server or whenever the wireless galley control unit detects exceedance in observed parameters related to the wireless galley control unit within a local network.

[0010q] The network server may be configured to record status information and fault information communicated to the network server by the plurality of wireless galley control units.

[0010r] Each wireless galley control unit may have a display screen configured to display on the display screen status information and fault information for each galley insert of the plurality of galley inserts.

[0010s] In another embodiment, there is provided a method of real-time galley power management and fault monitoring for an aircraft. The method involves:

causing a plurality of wireless galley control units inside a plurality of separate galley complexes in an interior of the aircraft to communicate with a network server in the interior of the aircraft, the network server being separate from the plurality of separate galley complexes and not in any of the galley complexes; and causing the network server to manage requests for power received from each wireless galley control unit and to allocate electric power to the wireless galley control unit and to accept power management requests from other systems of the aircraft.

[0010t] The method may further involve causing the network server to manage requests for power received from the plurality of galley complexes and to allocate electric power to each of the galley complexes and to record statuses of the galley complexes and record statuses of galley inserts within the galley complexes.

[0011] The features, functions, and advantages that have been discussed can be achieved independently and in various embodiments or may be combined in yet other embodiments, further details of which can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure **1** is a representation of an aircraft and the positioning of a network server and several wireless galley control units in the several galley complexes of the aircraft.

[0013] Figure **2** is a representation of a galley complex and a wireless galley control unit communicating with the inserts of the galley complex.

DESCRIPTION

[0014] Figure **1** is a representation of an aircraft cabin interior **12** inside the fuselage **14** of an aircraft. As represented in Figure **1**, the forward area **16** of the aircraft interior **12** is to the left in the drawing figure and the rearward area **18** of the aircraft interior **12** is to the right in the figure. Although no seating is represented, the aircraft interior **12** represented in Figure **1** is the interior of a passenger aircraft. As is typical, passengers traveling in the aircraft interior **12** are serviced by flight attendants.

[0015] The aircraft interior **12** is provided with several galley complexes **22**, **24**, **26**, **28**. In Figure **1**, four galley complexes **22**, **24**, **26**, **28** are represented. The galley

complexes **22**, **24**, **26**, **28** are used by the flight attendants in providing services to the passengers traveling in the aircraft interior **12**. Although there are four galley complexes **22**, **24**, **26**, **28** represented in Figure **1**, the aircraft interior **12** could be provided with more galley complexes, or could be provided with fewer galley complexes.

[0016] A wireless network server **32** is programmed with a custom algorithm. The algorithm manages requests for power received from the galley complexes **22**, **24**, **26**, **28** and allocates electric power allowances to each of the galley complexes. The programmed algorithm of the network server **32** also prioritizes requests for power based on logic to allow inserts (microwave ovens, coffee makers or water heaters, galley cart chillers, etc.) to come online or deny the galley inserts online.

[0017] The wireless network server **32** also has a memory. The memory records statuses of inserts in the galley complexes **22**, **24**, **26**, **28** and records fault messages received from inserts.

[0018] Figure **2** is a representation of each of the galley complexes, **22**, **24**, **26**, **28**. The galley complex **22** represented in Figure **2** includes the typical galley inserts (i.e., microwave ovens **42**, coffee makers or water heaters **44**, galley cart chillers **46**, etc.). Each of the inserts **42**, **44**, **46** is an ARINC-**812** insert. ARINC-**812** inserts are designed for easy configurability by airlines, high interoperability between different aircraft types, and with high requirements on power management.

[0019] Each of the galley complexes **22**, **24**, **26**, **28** as represented by the galley complex **22** in Figure **2** is also provided with a wireless galley control unit **52**. As represented in Figure **2**, the wireless galley control until **52** communicates with the

galley inserts **42**, **44**, **46**, etc. The control unit **52** wirelessly communicates with the inserts **42**, **44**, **46**, etc.. Additionally, the control unit **52** communicates only with the inserts **42**, **44**, **46**, etc. of its galley complex **22**. Although it is preferred that the control unit **52** communicates wirelessly with the galley inserts **42**, **44**, **46**, etc. of its galley complex **22**, the control unit **52** could also communicate with the inserts **42**, **44**, **46**, etc. through a wiring bus.

[0020] The communication of the control unit **52** with its associated inserts **42**, **44**, **46**, etc. controls selective operation of the inserts by providing power to a selected insert. Additionally, the communication of the control unit **52** with its associated inserts **42**, **44**, **46**, etc. receives status information from the inserts and fault messages from the inserts.

[0021] The wireless galley control unit **52** in each of the galley complexes, **22**, **24**, **26**, **28** is provided with a control panel **54** that is useable by a cabin attendant to control operation of the wireless galley control unit **52**. The control panel **54** has a display screen that displays to the attendant graphical status information on each of the galley inserts **42**, **44**, **46**, etc. such as an "on" or "off" condition of the insert, the rate of power usage of the insert, any faults associated with the insert, etc. The control panel **54** also enables control of the wireless galley control unit **52** to prioritize which of the galley inserts **42**, **44**, **46**, etc. is to come online and when that insert is to come online.

[0022] In addition to controlling the operation of the galley inserts **42**, **44**, **46**, the wireless galley control unit **52** also communicates with the network server **32**. The wireless galley control unit communicates wirelessly with the network server **32**. The control unit **52** receives electric power data from the network server **32**. The control

unit **52** also transmits information to the network server **32**. The control unit **52** transmits galley insert status information to the network server **32**, such as whether a particular galley insert **42**, **44**, **46**, etc. is in its "on" or "off" condition, power usage by any of the particular galley inserts, etc. The control unit **52** also transmits inventory information to the network server **32**, such as the number and type of beverages and other goods needing replenishment. The information transmitted by the wireless galley control unit **52** to the network server **32** can be transmitted periodically, or in real time. The wireless galley control unit **52** also transmits any fault information received from any of the inserts **42**, **44**, **46**, etc. to the wireless network server **32**. The memory of the wireless network server **32** records the status information and fault information on any of the galley inserts **42**, **44**, **46**, etc. transmitted by the galley control unit **52**. This recorded information can then be later used when the aircraft is being serviced to identify which, if any of the galley inserts **42**, **44**, **46**, etc. requires servicing or replacement. The recorded information can also be used to restock the galley complex **22**.

[0023] The galley power management and fault monitoring system comprised of the wireless network server **32** and the wireless galley control units **52** in each of the galley complexes **22**, **24**, **26**, **28** combine to improve galley operation and fault monitoring. The power management serves to mitigate disruptive load shedding events in the galley complexes **22**, **24**, **26**, **28** initiated by the electrical power system of the aircraft that can lead to loss of electric power to the galley complexes and a disruption to flight attendants and passenger services. The wireless network server **32** combined with the wireless galley control units **52** in each of the galley complexes

22, **24**, **26**, **28** eliminate the need for hard wiring from the aircraft equipment centers to the galley complexes. The wireless implementation eliminates wiring the infrastructure on the aircraft fuselage.

[0024] As various modifications could be made in the construction of the apparatus and its method of operation herein described and illustrated, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative rather than limiting. Thus, the breadth and scope of the present disclosure should not be limited by any of the above described exemplary embodiments, but should be defined only in accordance with the following claims appended hereto and their equivalents.

EMBODIMENTS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A real-time galley power management and fault monitoring system for an aircraft, the system comprising:

    a network server in an interior of the aircraft;

    a plurality of separate galley complexes in the interior of the aircraft, the network server being separate from each galley complex of the plurality of galley complexes; and

    a wireless galley control unit inside each galley complex in the interior of the aircraft, each wireless galley control unit inside each galley complex being configured for wireless communication with the network server.

2. The system of claim **1**, wherein each wireless galley control unit inside its respective galley complex, each galley complex is configured for communication with a plurality of galley inserts inside said respective galley complex and configured not to communicate with galley inserts inside other galley complexes that are not said respective galley complex.

3. The system of claim **2**, wherein the galley inserts are compatible with a predefined configuration inside each galley complex.

4. The system of claim **2** or **3**, wherein each wireless galley control unit inside each galley complex is configured for wireless communication with the galley inserts in said each galley complex.

5. The system of any one of claims **2** to **4**, wherein each wireless galley control unit inside each galley complex is configured to control operation of the plurality of galley inserts inside said each galley complex.

6. The system of claim **5**, wherein the network server is configured to allocate electric power to each wireless galley control unit and to the plurality of galley inserts under the control of said each wireless galley control unit.

7. The system of any one of claims **2** to **6**, wherein each wireless galley control unit is configured to communicate status information and fault information of the plurality of galley inserts under the control of said each wireless galley control unit to the network server.

8. The system of claim **7**, wherein the network server is configured to store status information and fault information communicated to the network server by said each wireless galley control unit.

9. The system of any one of claims **2** to **8**, wherein each wireless galley control unit has a display screen that is configured to display on the display screen status information and fault information for each galley insert of the plurality of galley inserts under the control of said each wireless galley control unit.

10. A real-time galley power management and fault monitoring system for an aircraft, the system comprising:

a network server in an interior of the aircraft; and

a plurality of wireless galley control units, each wireless galley control unit of the plurality of wireless galley control units being inside a respective separate galley complex in the interior of the aircraft, each wireless galley

control unit of the plurality of wireless galley control units being configured for wireless communication with the network server.

11. The system of claim **10**, wherein each wireless galley control unit is configured for communication with a plurality of galley inserts inside the galley complex.

12. The system of claim **11**, wherein the galley inserts are compatible with a predefined configuration inside each galley complex.

13. The system of claim **11** or **12**, wherein the wireless galley control unit is configured for one of wireless communication with the inserts in the galley complex and wired communication with the inserts in the galley complex.

14. The system of any one of claims **11** to **13**, wherein the wireless galley control unit is configured to control operation of the plurality of galley inserts.

15. The system of any one of claims **10** to **14**, wherein the network server is configured to allocate electric power to each wireless galley control unit of the plurality of wireless galley control units.

16. The system of any one of claims **11** to **14**, wherein each wireless galley control unit of the plurality of wireless galley control units is configured to communicate status information and fault information of the plurality of galley inserts with the network server either upon request by an application hosted on the network server or whenever the wireless galley control unit detects exceedance in observed parameters related to the wireless galley control unit within a local network.

17. The system of claim **16**, wherein the network server is configured to record status information and fault information communicated to the network server by the plurality of wireless galley control units.

18. The system of any one of claims **11** to **14**, **16**, or **17**, wherein each wireless galley control unit has a display screen configured to display on the display screen status information and fault information for each galley insert of the plurality of galley inserts.

19. A method of real-time galley power management and fault monitoring for an aircraft, the method comprising:

causing a plurality of wireless galley control units inside a plurality of separate galley complexes in an interior of the aircraft to communicate with a network server in the interior of the aircraft, the network server being separate from the plurality of separate galley complexes and not in any of the galley complexes; and

causing the network server to manage requests for power received from each wireless galley control unit and to allocate electric power to the wireless galley control unit and to accept power management requests from other systems of the aircraft.

20. The method of claim **19**, further comprising:

causing the network server to manage requests for power received from the plurality of galley complexes and to allocate electric power to each of the galley complexes and to record statuses of the galley complexes and record statuses of galley inserts within the galley complexes.

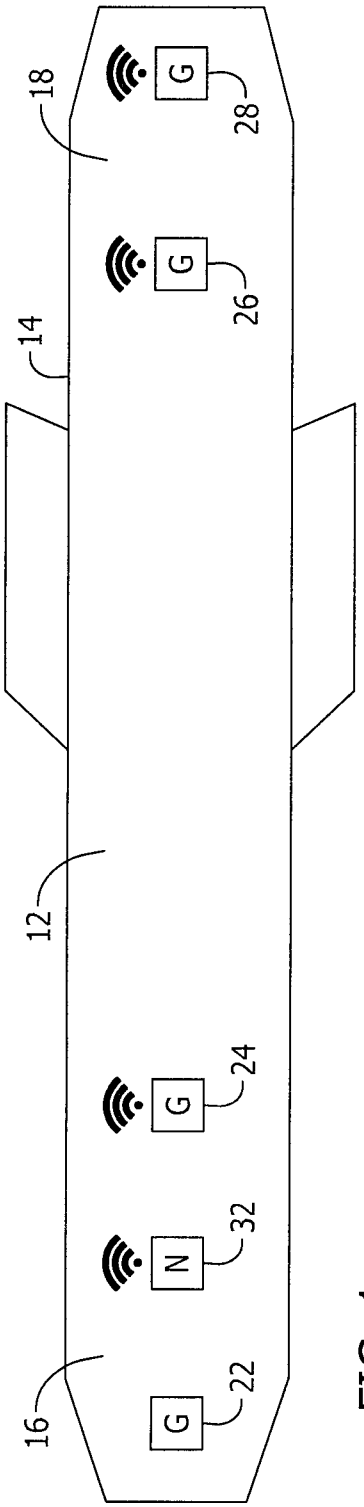


FIG. 1

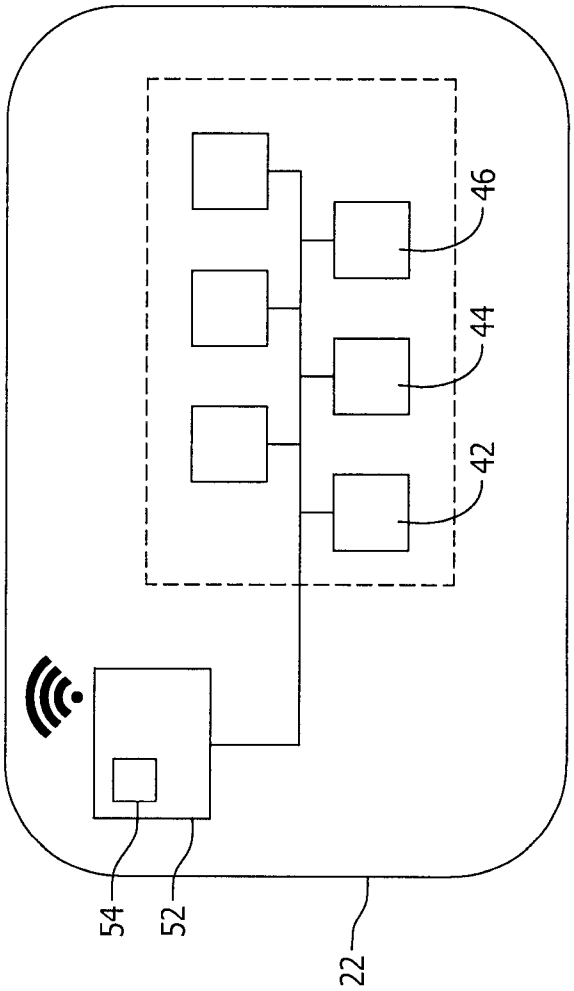
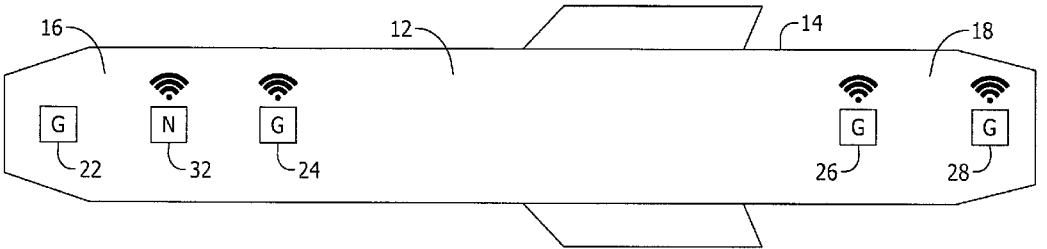


FIG. 2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