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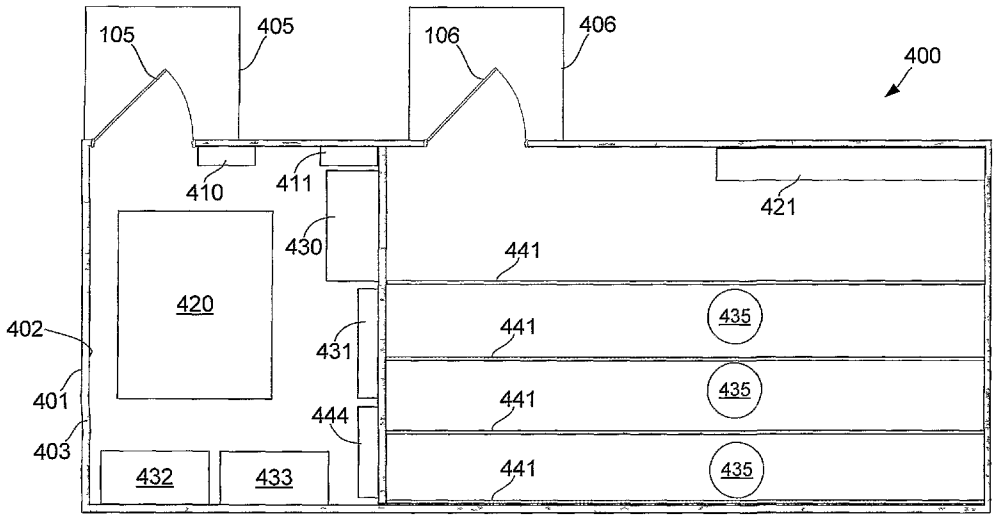
(54) Title: DATA PROCESSING APPARATUS



(57) Abstract: Apparatus for providing data processing capabilities. The apparatus includes a container defining a first portion for housing a number of data processing units and a second portion including a power management system for supplying power to the data processing units, a climate control system for at least partially controlling the climate in the first portion and a control system for at least partially controlling the power management system.

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DATAPROCESSING APPARATUS

Background of the Invention

The present invention relates to apparatus for providing data processing capabilities, and in particular to transportable apparatus for providing portable or fixed data processing capabilities.

Description of the Prior Art

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that the prior art forms part of the common general knowledge.

In a number of situations it is necessary to provide data processing capabilities in environments where service infrastructure, space or deployment-time is limited or otherwise compromised. This can occur, for example, in emergency relief situations where it is necessary to provide a data processing capabilities to coordinate rescue or aid teams, as well as to identify and process individuals affected by the emergency, such as refugees, disaster victims or the like. Other situational examples include rapid-deployment, for reasons of business or military logistics. Non-situational examples include regions which are chronically underdeveloped or have development compromised by long-term environmental changes or conflict.

In such situations there is often no, or only limited, power available and it is therefore typical to use a low power battery operated device such as a laptop, PDA, or the like. However, this suffers from a number of disadvantages. For example, power sources are still required in order to recharge the batteries, and the data processing capabilities of such portable devices are typically limited thereby restricting the amount of processing that can be performed.

Consequently, in many cases it is necessary to arrange for data to be transferred to another location to allow suitable processing. However, this may require complex communications technology, such as a satellite link, which can inturn require significant power. Additionally, this suffers from time lag caused in transferring data for processing.

Accordingly, there is a need to provide a system that can be used for implementing data processing capabilities in remote or otherwise restricted environments.

Summary **of the Present Invention**

In a first broad form the present invention provides apparatus for providing data processing capabilities, the apparatus including a container defining:

a) a first portion for housing a number of data processing units; and,

b) a second portion including:

i) a power management system for supplying power to the data processing units;

ii) a climate control system for at least partially controlling the climate in the first portion; and,

iii) a control system for at least partially controlling the power management system.

Typically the first and second portions are physically separated by a dividing wall.

Typically the dividing wall is fireproof.

Typically the container includes first and second sealed doors for providing access to the first and second portions respectively.

Typically the container includes:

a) an inner wall;

b) an outer wall; and,

c) an insulating layer provided between the inner and outer walls.

Typically the processing units are provided on moveable racks.

Typically the power management system includes at least one of:

a) a generator;

b) at least one battery;

c) solar panel; and,

d) a connector for coupling to an external power source.

Typically the climate control system includes at least one of:

a) an air filtration unit;

b) an absorption chiller; and,

c) a phase change air conditioning unit.

Typically the climate control system includes:

a) a primary cooling mechanism;

b) a secondary cooling mechanism; and,

c) a thermostatic control for selectively activating the primary and secondary cooling systems.

Typically the climate control system is for controlling at least one of:

a) the temperature; and,

b) the humidity.

Typically the power management system includes a generator and wherein the climate control system includes an absorption chiller operable using waste heat from exhaust gases generated by the generator.

Typically the control system includes at least one processing system.

Typically the control system is for:

a) monitoring power usage requirements; and,

b) selectively activating one or more power supply mechanisms in accordance with the monitored usage requirements.

Typically the control system is for:

a) monitoring data processing requirements; and,

b) selectively activating data processing units in accordance with the data processing requirements.

Brief Description of the Drawings

An example of the present invention will now be described with reference to the accompanying drawings, in which: -

Figure 1 is a schematic diagram of an example of data processing apparatus;

Figure 2 is a schematic diagram of an example of a processing system for use in the apparatus of Figure 1;

Figure 3 is a flow chart of an example of the control process performed by the processing system of Figure 2;

Figure 4A is a schematic plan view of a second example of a data processing apparatus;

Figure 4B is a schematic cross sectional view of the data processing apparatus of Figure 4A;

Figure 5A is a schematic plan view of a first example of a rack arrangement;

Figure 5B is a schematic plan view of a second example of a rack arrangement;

Figure 6 is a schematic diagram of an absorption chiller; and,

Figures 7A and 7B are schematic diagrams of an example of a tent arrangement.

Detailed Description of the Preferred Embodiments

An example of apparatus for providing data processing capabilities will now be described with reference to Figure 1.

In this example the apparatus is formed from a container 100, such as a shipping container or the like, having an outer wall 101 and a dividing wall 102, which operates to define a plant compartment 103 and a data processing compartment 104. Access to each of the plant compartment 103 and the data processing compartment 104 can be provided via respective doors 105, 106.

The plant compartment 103 typically includes a control system 110, a power management system 120 and a climate control system 130. The data processing compartment 104 includes data processing units shown generally at 140, as well as an access space 141 to allow physical access to the data processing units.

The data processing units 140 may be formed from a combination of one or more data processing devices, but typically include a number of servers or other processing systems, configured to provide required data processing capabilities.

In use, the power is supplied to the processing units 140 using the power management system 120. The power management system 120 may utilise one or more of a number of different power supply mechanisms depending on the circumstances in which the system is to be used, and the resources available. Thus, for example, power can be obtained via an external power

supply, such as mains electricity, if this is available. Additionally, or alternatively, the power management system 120 can utilise a generator, batteries, solar panels, or the like, to provide electricity when external supplies are unavailable, or provide insufficient power. This allows the data processing systems to be used in a variety of remote environments.

Typically the processing units 140 will generate a significantly amount of heat and it is therefore important to ensure the data compartment 104 is adequately cooled. Similarly, in some environments, humidity and airborne contaminants, such as dust, can represent a major problem. Accordingly the climate control system 130 is adapted to maintain the data compartment 104 within a predetermined climate range.

To achieve this, the climate control system 130 typically includes air conditioning equipment of one form or another, as well as air filtration and/or air scrubbing systems, to ensure the air is not overly contaminated with dust or the like. In general, the climate control system 130 operates to monitor the climate within the data compartment 104 and supply appropriately conditioned air via a suitable ducting system. This control can be a simple thermostatic control system, or may utilise more complex control mechanisms depending on the implementation.

It will be appreciated that the configuration of the power management and climate control systems 120, 130 can be customised depending on the circumstances in which the apparatus is to be used. This can be achieved for example by providing specific component configurations based on the intended use, and/or by providing appropriate control of the power management and climate control systems 120, 130, using the control system 110.

The control system 110 is also typically capable of monitoring operation of the apparatus and controlling the operation of the power management and climate control systems 120, 130, as well as the processing units 140, as required. This can be performed by any suitable form of control system, but is typically achieved using one or more processing systems implementing appropriate control algorithms.

An example processing system is shown in Figure 2. In this example the processing system 200 is formed from a processor 210, a memory 211, an input/output I/O device 212 such as a

keyboard, mouse, display or the like, and an external interface 213, interconnected via a bus 214.

In this example, the control system 110 is coupled to the power management system 120 and the climate control system 130, as well as any additional sensors 215, via the external interface 213. The sensors 215 may include a range of different types of sensors, to allow the control system to monitor various operating parameters, such as the current processing unit utilisation, available power supplies, and the like.

This allows the processing system 200 to receive data regarding the current operation of the power management and climate control systems 120, 130, and provide any appropriate control signals required. This may be achieved using suitable control algorithms stored in the memory 211.

From this, it would be appreciated that the processing system 200 may be any suitable form of control system such as a computer system, laptop, desktop, standard rack-mountable server or data/voice/video communications equipment, custom hardware, PLC (programmable logic controller), or the like.

An example control process implemented by the control system 110 will now be described with reference to Figure 3. For the purpose of this example, the climate control system 130 operates based on a simple thermostatic control system, using a primary phase change cooling system and a back-up secondary system in case additional cooling is required.

In this example, at step 300 the control system 110 determines data processing power requirements, which will depend, for example, on the number of processing units 140 that are required to operate. In one example, this can be controlled using server virtualisation techniques, as will be described in more detail below.

Simultaneously, at step 310, the control system 110 monitors the climate control system to determine its current power usage requirements, based on the current load on the climate system, allowing total power management requirements to be calculated.

At step 330, the control system 110 determines power supply availability from the power management system 120, and uses this information to determine if sufficient power can be

provided to satisfy total power requirements at step 340. If so the process can proceed to step 350, to control the power management system 120 if required, for example, by selectively activating/deactivating one or more additional power supplies, such as back-up supplies, if required.

If sufficient power cannot be provided, the control system 110 proceeds to step 360 to allow rescheduling of the data processing. Alternatively, or additionally, the control system 110 can operate to adjust the operation of the climate control system 130, for example, to reduce the power supply requirements by altering the climate control mechanism used.

It will be appreciated that the control system 110 can therefore control the various systems to balance the power supply requirements of both the climate control system 130 and the data processing units 140. This allows the control system 110 to maximise the ability of the system to provide required data processing capabilities, whilst maintaining the required climate in the data compartment 104, and using the available power supplies.

It will be appreciated that operation of the climate control system 130 and the data processing units 140 will be interdependent. For example, if there is an increase in data processing requirements, this typically leads to an increase in the power required by the processing units 140, as well as a consequent increase in temperature in the data compartment 104. In turn, this increases cooling requirements, which can further increase power supply requirements.

Additionally, the cooling mechanisms available may be dependent on the current power supply used. For example, if cooling is to be provided by way of an absorption chiller, as will be described in more detail below, this may require that the generator is operational or that a supplemental boiler is utilised.

To take these issues into account, the control system 110 may include information, algorithms or other functions defining different operating scenarios. This information can specify for certain operating parameters, the cooling mechanism and power supply mechanisms that should be used. This information can be stored, for example, as a look-up table (LUT) in the memory 211, so that the control system 110 can access the LUT and allow appropriate control to be provided, or as a traditional control system, a fuzzy logic control system, or a neural network control system.

The use of controlling mechanisms described above can be implemented using similar arrangements to the "enterprise systems management platforms" such as the IBM Tivoli Framework, albeit extended to allow control of computing resources, power consumption, cooling and the like.

A second specific example of a portable data processing apparatus will now be described with reference to Figures 4A and 4B. In this example, similar reference numerals are used to denote similar features to the earlier examples.

The container 400 includes an outer wall 401 and an inner wall 402, having insulation 403 provided therebetween. This operates to insulate the internal environment, to thereby reduce the climate control requirements. The doors 105, 106 may also be provided in tents 405, 406 as shown. The tents act as airlocks, thereby helping to provide an additional level of environmental insulation.

The control system 110 is formed from a master controller (MC) 410 and a container management system (CMS) 411. In general each of the MC 410 and the CMS 411, may be implemented by a respective processing system 200, although other suitable control hardware may be used.

The power management system 120 includes a generator 420, a set of batteries 421 and optionally a roof mounted solar panels shown generally at 422. The power management system is connected to the processing units via appropriate cables 423, 424 as will be described in more detail below. Connection (not shown) to an external power supply may also be provided.

The climate control system 130 includes an evaporator 430, an air filter system 431, an absorber 432 and a compressor 433. In use, the evaporator and the absorber 430, 432 can be used as an absorption chiller, whilst the compressor 433 can provide phase change air conditioning, and air filtering, as will be described in more detail below.

Ducting 434, having movable outlet vents 435, is provided to allow conditioned air to be supplied from the climate control system 130. Any number of ducts and vents can be provided and adjusted for various rack placement schemes such as hot/cold isles, and three

vents 435 are shown for the purpose of example only. Similarly, whilst the duct 434 shown in Figure 4B is coupled to the air filtration system 431 this is for the purpose of clarity only and the ducting 434 may be coupled to any one or more of the climate control system components as required.

The data compartment 104 includes a ceiling framework apparatus 408 for supporting the cabling 423 and the ducting 434. Racks 440, having shelves 443, are provided for housing the processing units 140. The racks are movably mounted on floor mounted between rack tracks 441, and corresponding ceiling mounted rack guides 442, thereby allowing the racks 440 to be moved as shown by rack in dotted lines. This allows access to be provided to the processing units 140, whilst maximising the volume of plant compartment that can be used for containing processing units 140.

In use, power is provided to the processing units 140 via the cabling 423, 424, which in this example is shown coupled to the generator 420 for the purpose of clarity only. As shown in this example the cable 424 forms a flexible umbilical cable bundle that is capable of ensuring coupling between the power management system 120 and the racks 440 even when the racks are moved as shown by dotted lines.

Each of the above described components and a specific example of their interoperation will now be described in more detail.

Container 400

The container 400 can have exterior physical properties (i.e. dimensions, corner fittings, structural integrity, etc.) that are fully compliant with ISO specifications for 20', 30' and 40' shipping containers. This allows for easy transport of the container 400 using existing transportation systems, thereby allowing the system to be readily shipped to remote areas as required.

Thus, for example, when used in an emergency relief situation, the container 400 can be shipped together with other emergency supplies, allowing it to be provided onsite for controlling emergency supply distribution.

Whereas a typical ISO shipping container is constructed with corrugated single sheet steel and unsealed doors, in one example, the container 400 is constructed with exterior structural material, such as steel or aluminium, to form the outer wall 401. The inner wall 402 is used to retain the insulation 403 in place, and can therefore be formed from a lining or the like, or can alternatively also be formed from structural material, such as steel, although in general, the inner wall is not required to provide structural strength. It will be appreciated that this arrangement is particularly suited for extreme environments, such as high or low temperature environments.

Further insulation can be provided using sealed doors 105, 106, and external airlock tents 405, 406. This arrangement also the benefit that access to the plant compartment 103 will not greatly affect the temperature in the data compartment 104, and vice versa, thereby minimising internal environmental fluctuations.

The exterior wall 401 may also be treated for protection against the elements before a final finish is applied. This can include, for example, the use of camouflage paint or armour, in the event that the system is used in a military context.

The dividing wall 102 is typically formed from a fire-rated wall, to thereby separate the data compartment 104 and plant compartment 103. This ensures that should a fire occur in the plant compartment 103, this will not effect data or equipment housed in the data compartment 104.

While remaining in compliance with ISO specifications for external features (i.e. dimensions, corner fittings, structural integrity, etc.), multiple vents, access doors, panels and ports can be provided, including, but not limited to:

- plant and data compartment service doors;
- plant compartment exhaust and air intake vents;
- an external MC access panel;
- an external mains power connection port (for example, with internally housed receptacles, eg. 3-phase 440V 30A receptacles, 10 ct); and,
- a data connection port (for example, with internal jacks, eg. RJ45 for copper Cat-5e or Cat6, SC connectors for multi-mode fibre, etc.).

A number of additional optional features may also be implemented depending on the intended use of the system, such as:

- external airlock tent;
- side-telescoping or fold-out service corridor/annex tent for data compartment access;
- water proofing (extra seals, etc.) to a particular height, for operation in standing water (from flooding, for example);
- field-installable snorkels over vents and access panels for further water proofing;
- external security monitoring systems (eg. sensors, cameras, etc.);
- field-deployable satellite, microwave or other wireless communication system;
- exterior final treatment with specialised solar-reflective coating;
- exterior final treatment with camouflage paint or netting; and,
- exterior amour.

The tent arrangement can also be extended to provide additional space, for example, to allow users work space, or the like. An example tent arrangement is shown in more detail in Figures 7A and 7B. In this example, the tent 706 extends along the length of the data compartment 104, as shown, to thereby provide the additional working space.

As shown in Figure 6B, the tent is formed from a fold-out roof section 701, and a fold-out floor section 702, having feet 703. During transport the fold-out roof and floor sections 701, 702 can be folded against the side of the container 400, being folded out, as shown in dotted lines at 704, 705, when the system is being used. In this instance, the roof will typically clip into place using an appropriate locking mechanism (not shown), to retain the roof in place, whilst the feet 703 extend downwards as shown in Figure 7A to support the floor 702. Suitable material 707 can then be attached to the floor and roof as required to form the tent 706, as shown.

Data Compartment 104

The data compartment 104 can be sealed to allow it to be pressurised with a positive air pressure to help reduce environmental contamination, for example, from dust and the like. Additionally, air quality can be further maintained by having the air cooled and filtered by the climate control system 130.

The container walls 401, 402, provide acoustic and thermal insulation, whilst an internal static electricity control system can be provided through the use of anti-static floor tiles.

One or more additional optional features may be implemented, such as:

- static electricity discharge stations with tethers at each service door;
- data compartment personnel and/or storage space (may reduce rack space; eg. work bench, desk, storage cabinet, etc.); and,
- internal security monitoring systems (eg. sensors, cameras, etc.).

It will be appreciated that the processing units 140 may provide any form of data processing capabilities, depending on the desired use. Example configurations include:

- mid density (standard): balanced storage, CPU and network throughput;
- low density: reduced power use or increased service space (eg. to allow inclusion of a workbench or desk);
- high density: CPU optimised; and,
- high density: storage optimised.

Racks 440

In one example, the racks are in the form of standard width "19-inch" racks for rack-mountable equipment, in vertical increments of standard rack units (RU), with approximately 40 RU spaces per rack. Individual rows of racks may vary in depth (eg. 600mm, 700mm, etc.), to be specified at build-time. All racks can include an integrated cable management system.

The rack configuration is typically designed to maximise the use of space with complimentary ceiling-hanging flexible power and data cabling umbilicals and ventilation ducts and vents with adjustable placement to maximise cooling efficacy and efficiency.

The use of a rack based compression system can provide multiple configurations for three modes of operation:

- normal position (periodically spaced rack rows) for most efficient cooling;
- service positions (at least one for each rack row) for rack front and back access; and,

- transportation positions with lock-down and space for re-packaged equipment or supplemental cargo.

A number of different rack configurations may be used, as will now be described with respect to Figures 5A and 5B.

The example of Figure 5A includes five rows of three racks 440 each. The rack rows are placed adjacent to the wall opposite the door 106 and move in the direction of the arrows 500, along the length of the data compartment 104, using rack-mounted steel roller bearings, or the like, running over the floor tracks 441 and the guide rails 442. Racks rows are positioned with pins and secured with bolts, both running through the roller bearing rail and into the steel track secured on the floor.

However, alternative configurations can be used, such as row configurations with, for example, two long rows running along the length of the data compartment, with the racks moveable in the direction of the arrows 501, as shown in Figure 5B.

It will be appreciated that the number of rows may be varied depending on the size of the container 400 and the data compartment 104, or by altering the depth of the racks in each row (eg. six rows and a mixed configuration may be achieved with four 400mm depth racks and two 600mm depth racks). Similarly alternative compression system mechanisms, or no compression mechanism with racks fixed in place, can be used, and the rack depth may be adjustable by use of a telescoping system. Furthermore, whilst the above description focuses on the use of standard size racks, any suitable rack configuration can be used.

Cabling

In one example, cabling management is used to provide specified power and data cabling to each rack through per-rack flexible umbilical cable bundles, and per-rack cable management. The cabling will typically be adapted to provide, for each rack unit 444:

- a single 120/240V 250W/500W (mean/peak) power lead with standard 3-prong plug; and,
- two Cat5e data leads with RJ45 connectors terminating (also with RJ45 connectors) at a top 4RU space designed for a network switching and/or routing equipment.

Typically, this will include, for each rack 440:

- single flexible power bundle containing cabling for 4-6 single phase 120/240V circuits; and,
- single flexible data bundle containing four multi-mode fibre leads terminated with SC connectors at the top 4RU network space.

However, any suitable connections and cabling may be used.

Plant Compartment 103

Typically equipment housed in the plant compartment 103 is placed to maximise the use of space and allow for adequate serviceability. The plant compartment is also typically acoustically baffled and actively fan-ventilated with outdoor air.

Power Management System 120

The integrated power management system is designed with several operating and backup modes, facility for multiple input power sources, facility for several power storage systems, and provides conditioned power with maximum efficiency during normal operation.

Power sources can include but are not limited to an external mains supply, solar panels 422 and the generator 420, while temporary backup can be provided by batteries 421 or by batteries distributed throughout racks 440. Power is typically conditioned to ensure proper operation of data compartment equipment; with operation being coordinated and monitored with the MC 410.

A number of alternative configurations can be used however, depending on the intended utilisation of the system, including for example:

- an Uninterruptible Power Supply (UPS) system;
- a configuration without UPS or battery backup;
- a configuration without local power generation;
- ultra low power (solar power, for extreme remote or economy operation);
- a diesel generator for backup or main operation;
- a gas turbine power generator with mains natural gas, CNG, LPG or Hydrogen gas;

- fuel cell power generator with natural gas, Hydrogen gas, ethanol, methanol, CNG, LPG or other hydrogen or hydrocarbon source;
- local hydrogen or hydrocarbon fuel generation (electrical or heat catalytic) and storage for use with fuel cell system (including rainwater collection and storage system); and,
- solar supplemental power generation to augment other power supplies;

The system may also implement a power-up sequence to meet total power use specifications which is to be implemented by an appropriate network management system, the MC, or UPS control system, as required. This may be provided together with a per-rack power distribution controller for sequenced power-up and individual remote RU power up or down.

Climate Control System 130

The integrated cooling system can include a range of cooling mechanisms, including passive solar, ventilation, air-to-air heat exchange, absorption cooling, and traditional phase change cooling.

Typically the system uses a primary and back-up system using redundant independent thermostatic control with the primary system typically set to a range of 20-21 ^{0}C and the backup system set to a range of 22-23 ^{0}C. Return air ducting is strategically placed on the ceiling to provide optimal air flow and cooling. A HEPA air filtration system is integrated into the ducting system. A bypass for outdoor air is used to create a small positive pressure.

The primary cooling system of data compartment is a phase change cooling system, backup for which is provided by an absorption cooling system. An example of an absorption cooling system will now be described with reference to Figure 6.

In particular, the system uses the evaporator 430, which has an inlet 632 and an outlet 633. The evaporator 430 is coupled to the absorber 432, via a pipe 635, which is in turn connected to a heating system 636 via pipes 637A, 637B as shown. A pipe 641, having an inlet 642, and an outlet 643 receives heat in the form of waste gases from the generator 420, as shown at 640, and transfers this to a heat exchanger 636. The heat exchanger 636 is connected to a condenser 638 via a pipe 639. The condenser 638 typically generates waste heat as shown at 644 and is also coupled to the evaporator 430 via a pipe 645.

The system utilises a solution formed form a combination of a refrigerant and an absorber in order to provide heat transfer mechanisms, as will now be described. Typically the solution is either a water/lithium bromide or an ammonia/water combination as will be appreciated by a person skilled in the art.

In use, the evaporator 430 operates to receive liquid refrigerant from the condenser 638, via the pipe 645. The refrigerant is provided into a low-pressure environment within the evaporator 430, and evaporates, thereby extracting heat from air supplied to the inlet 632, via an appropriate heat exchanger. The chilled air is then output via the outlet 633, to the duct 434, whilst the evaporated refrigerant is transferred via the pipe 635 to the absorber 432, where it is absorbed by a refrigerant-depleted solution.

The solution is transferred via the pipe 637A to the heat exchanger 636, which operates to heat the solution using fluid in the pipe 641, thereby causing the refrigerant to be evaporated. The remaining refrigerant-depleted solution returns to the absorber 432 via the pipe 637B, whilst the vaporised refrigerant is transferred via the pipe 639 to the condenser 638. The vaporised refrigerant is allowed to condense with waste heat being output at 644 before being transferred via the pipe 645 to the evaporator 430, thereby allowing the cycle to be repeated.

In addition to the features outlined above, a number of additional optional climate control features can be implemented, such as:

- an air-to-air heat exchanger;
- roof-mounted fold-out side shade flaps;
- natural or artificial shade barriers (trees, screens, etc.);
- active supplemental solar cooling; and,
- supplemental purpose-use boiler for absorption cooling only.

Additionally, in-floor ducting and vents can be provided together with a shutter system to restrict airflow to special narrow vents for temporary operation in service configuration. In this example, the racks can be designed to enhance airflow from underneath each rack to the front and back of each rack. The absorption cooling component can also be adapted to provide 100% primary or backup to electrically powered phase change cooling in the data compartment.

Plant Compartment Cooling

The plant compartment 103 is designed to be cooled with outdoor air ventilation when the generator is not in use and with absorption cooling when the generator is in use or if the compartment overheats.

The energy required for basic absorption cooling is provided by surplus heat from the generator and is used to cool the generator, plus provide supplemental cooling to the data compartment, thereby reducing power requirements of the data compartment cooling system.

Container Management System 411

In the above-described example, the CMS 411 can be used to monitor key plant components and vital statistics, and report faults via a customer-provided gateway such as IMPI, SNMP, or simpler SMTP. In one example, the CMS includes a Linux-based controller which interfaces via serial or Ethernet connections to management/monitor modules on individual components such as the generator, AC systems, etc. An external data port can be provided adjacent to the CMS 411 for allowing external connectivity.

However, any suitable arrangement may be used, including, for example, system integration with existing network management systems.

In one example, the container 400 can include independent fire suppression systems for the plant compartment and the data compartment, such as gas based suppression systems. Such systems would typically be controlled by the CMS 411. The CMS 411 can also monitor and schedule servicing and maintenance for all included equipment and other moving parts.

Power management and service schedule management of the processing units 140 can be enhanced through the use of server virtualisation technologies traditionally used primarily for server consolidation (eg. virtual machines, hypervisors, clustering systems, message passing systems, etc.).

In one example, the use of virtualisation to manage power includes switching off processing units during periods of underutilisation. This is possible because virtualisation allows the "processing unit" which is visible to applications and users to be a collection of individual

units from a pool, where units can enter or leave the active pool without applications or users taking notice.

An example of the use of virtualisation to manage service schedule management includes remote recovery from component failures and replacement of failed parts deferred to regularly scheduled times by removing affected units from the active pool.

Service and maintenance schedules for, including service for unscheduled failures, may be also be synchronised with plant compartment service schedules.

Shipping and Deployment

In one example, the container is shipped independently of the processing units 140, with the deployment and final systems integration for non-hardened customer-provided equipment occurring on site. During this process, the tents 405, 406 can be used to provide an airlock between the container 400 and the delivery container/trailer, to help provide protection from the elements, including dust, rain and heat.

However, alternatively, hardened equipment may be installed in the container 400 prior to shipping.

Interior space permitting, field-installable external apparatus (such as optional solar array or wireless communications equipment) may be stowed internally for shipping.

It will be appreciated that wheels, axles, lights and other fixtures may be permanently attached to the apparatus in consideration of continued transportability and/or local government classifications, requirements and regulations.

Use

Accordingly, the above described system provides a configurable and self-contained "data processing system" packaged in a purpose-built container for field deployment which can be ISO standard size (10ft, 20ft, 30ft or 40ft), pallet size, or any other suitable size.

The container design and integrated systems management provides high reliability with a long service life, maximised power efficiency, and field serviceability balanced with optimised component density. The container is designed to allow for rapid-deploy (and rapid-

redeploy) permanent or semi-permanent installations (fixed, for example via bolts through corner castings or guy wires), while remaining cost-competitive with fixed data centre infrastructure and operations.

The system can be used in applications spanning multiple industries, including any corporation, organisation, project, government body or defence with data processing, media, or communications needs. This provides an ideal solution for capacity planning (eg. carpark overflow of fixed data centres, data warehousing, etc.), continuity planning (eg. backup & disaster recovery), remote deployment (eg. branch offices, conventions and special events, etc.), military field deployment, and emergency deployment. However, it will be appreciated that the system can be used in any circumstances in which there is a need for data processing capabilities.

Accordingly, the above described apparatus can provide an integrated self-contained transportable and modular (dual-mode, temporary or fixed) data processing centre that is capable of providing many or all of the features normally provided by a full-scale data centre, whilst maximising the use of energy and space.

Persons skilled in the art will appreciate that numerous variations and modifications will become apparent. All such variations and modifications which become apparent to persons skilled in the art, should be considered to fall within the spirit and scope that the invention broadly appearing before described.

THE CLAIMS:

1) Apparatus for providing data processing capabilities, the apparatus including a container defining:
   a) a first portion for housing a number of data processing units; and,
   b) a second portion including:
      i) a power management system for supplying power to the data processing units;
      ii) a climate control system for at least partially controlling the climate in the first portion; and,
      iii) a control system for at least partially controlling the power management system.
2) Apparatus according to claim 1, wherein the first and second portions are physically separated by a dividing wall.
3) Apparatus according to claim 2, wherein the dividing wall is fireproof.
4) Apparatus according to any one of the claims 1 to 3, wherein the container includes first and second sealed doors for providing access to the first and second portions respectively.
5) Apparatus according to any one of the claims 1 to 4, wherein the container includes:
   a) an inner wall;
   b) an outer wall; and,
   c) an insulating layer provided between the inner and outer walls.
6) Apparatus according to any one of the claims 1 to 5, wherein the processing units are provided on moveable racks.
7) Apparatus according to any one of the claims 1 to 6, wherein the power management system includes at least one of:
   a) a generator;
   b) at least one battery;
   c) solar panel; and,
   d) a connector for coupling to an external power source.
8) Apparatus according to any one of the claims 1 to 7, wherein the climate control system includes at least one of:
   a) an air filtration unit;
   b) an absorption chiller; and,
   c) a phase change air conditioning unit.

9) Apparatus according to any one of the claims 1 to 8, wherein the climate control system includes:

a) a primary cooling mechanism;

b) a secondary cooling mechanism; and,

c) a thermostatic control for selectively activating the primary and secondary cooling systems.

10) Apparatus according to any one of the claims 1 to 9, wherein the climate control system is for controlling at least one of:

a) the temperature; and,

b) the humidity.

11) Apparatus according to any one of the claims 1 to 10, wherein the power management system includes a generator and wherein the climate control system includes an absorption chiller operable using waste heat from exhaust gases generated by the generator.

12) Apparatus according to any one of the claims 1 to 11, wherein the control system includes at least one processing system.

13) Apparatus according to any one of the claims 1 to 12, wherein the control system is for:

a) monitoring power usage requirements; and,

b) selectively activating one or more power supply mechanisms in accordance with the monitored usage requirements.

14) Apparatus according to any one of the claims 1 to 13, wherein the control system is for:

a) monitoring data processing requirements; and,

b) selectively activating data processing units in accordance with the data processing requirements.

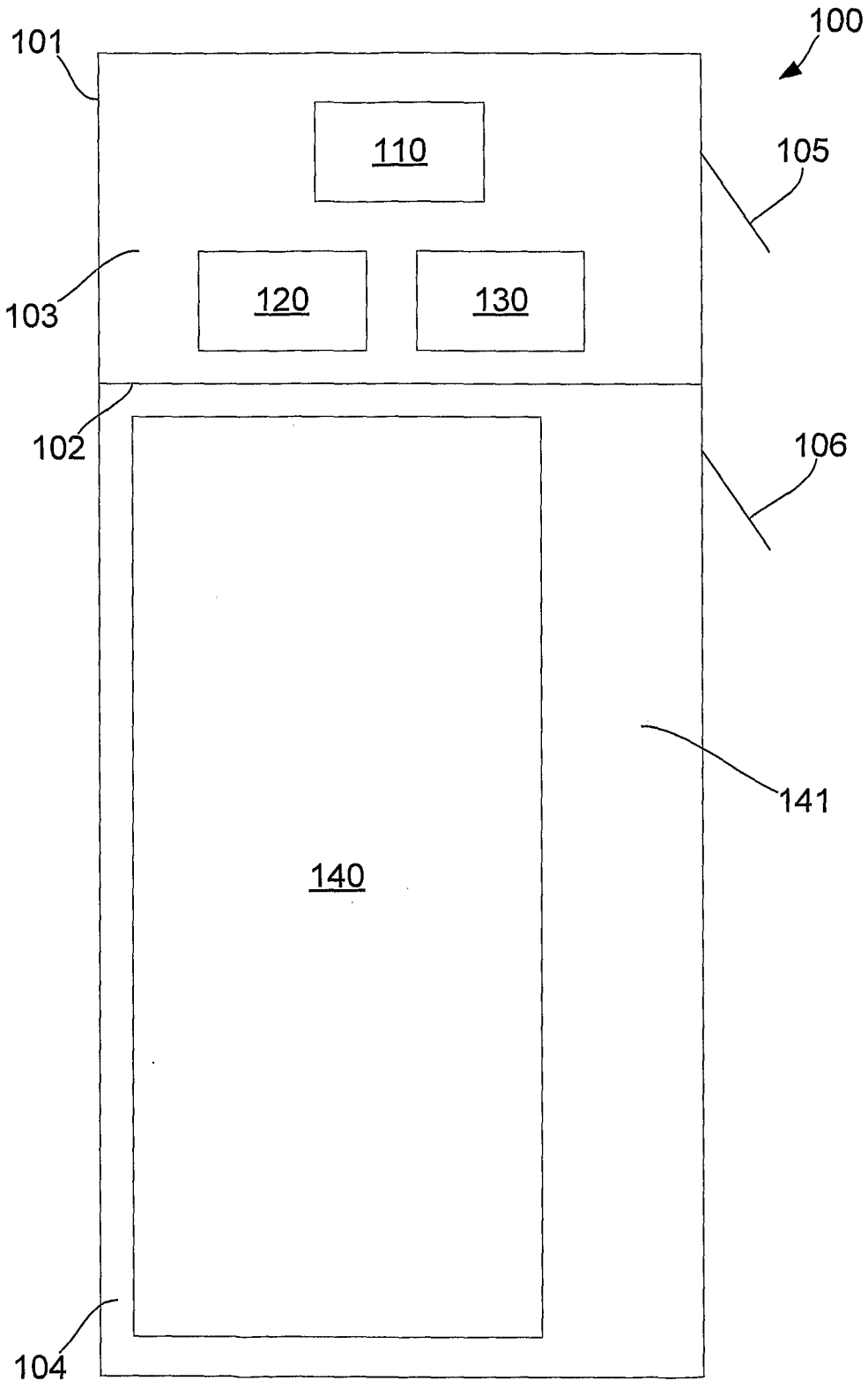

Fig. 1

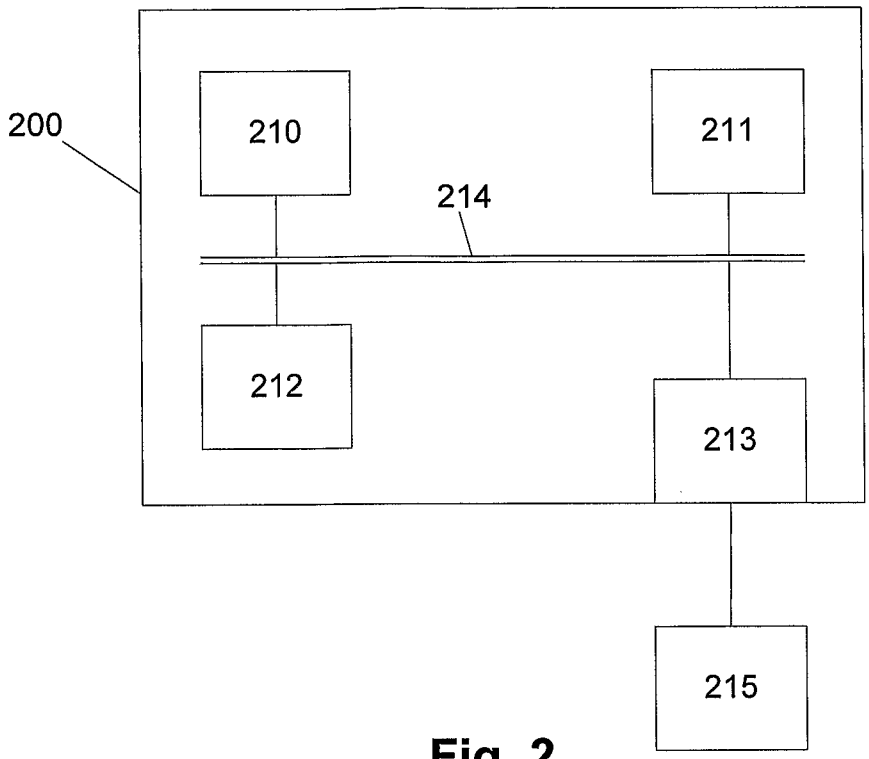
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Fig. 2

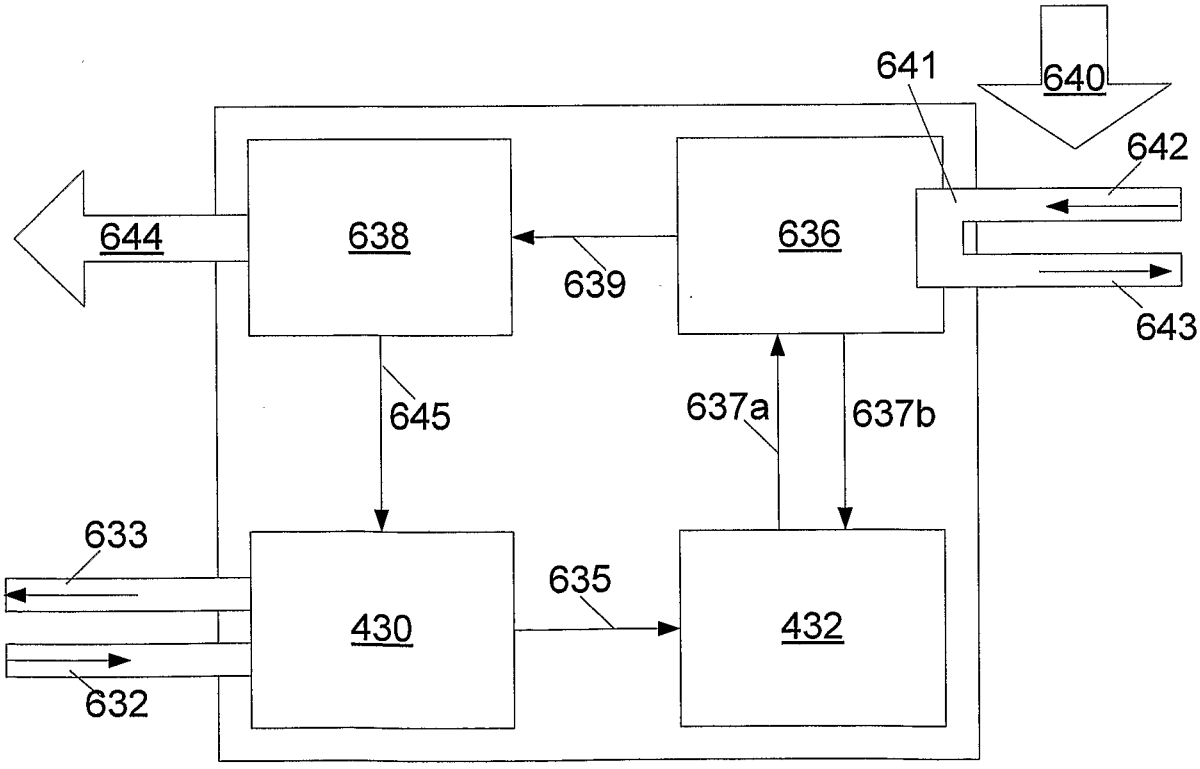
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Fig. 6

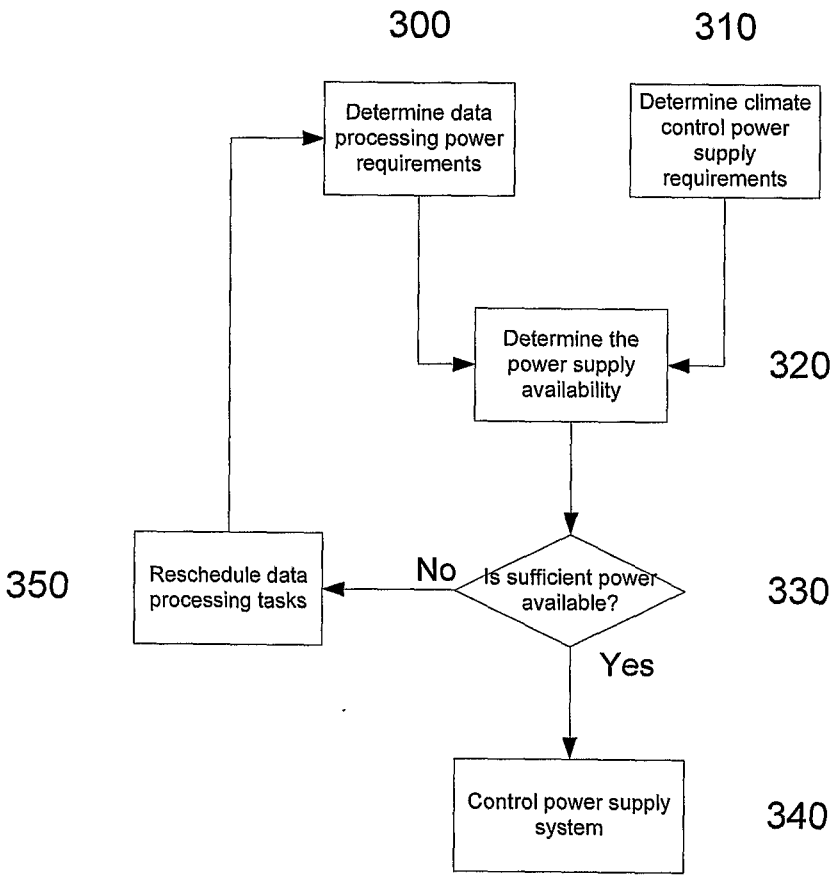
300
310
Determine data processing power requirements
Determine climate control power supply requirements
Determine the power supply availability
320
Reschedule data processing tasks
No
Is sufficient power available?
330
350
Yes
Control power supply system
340

Fig. 3

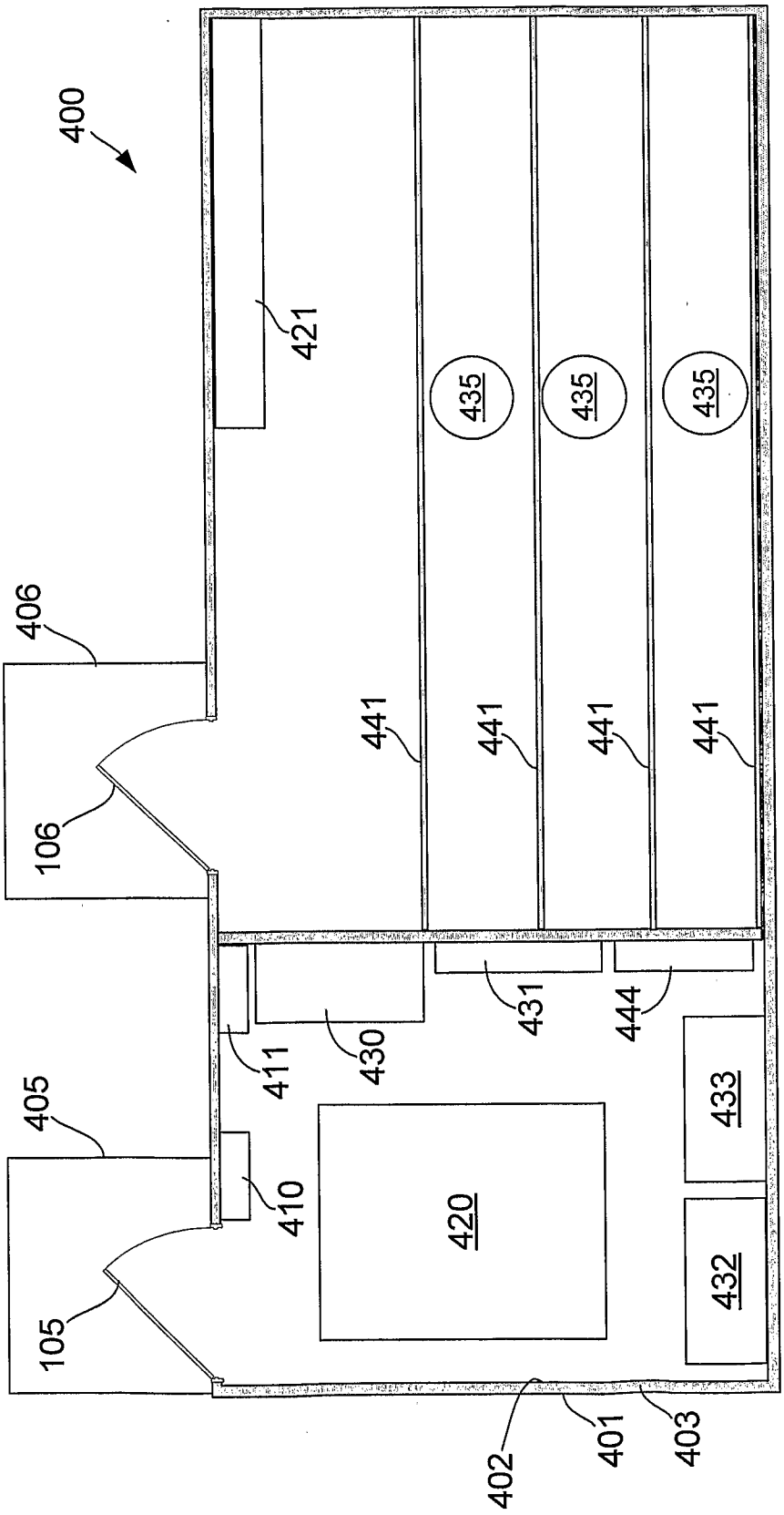
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Fig. 4A

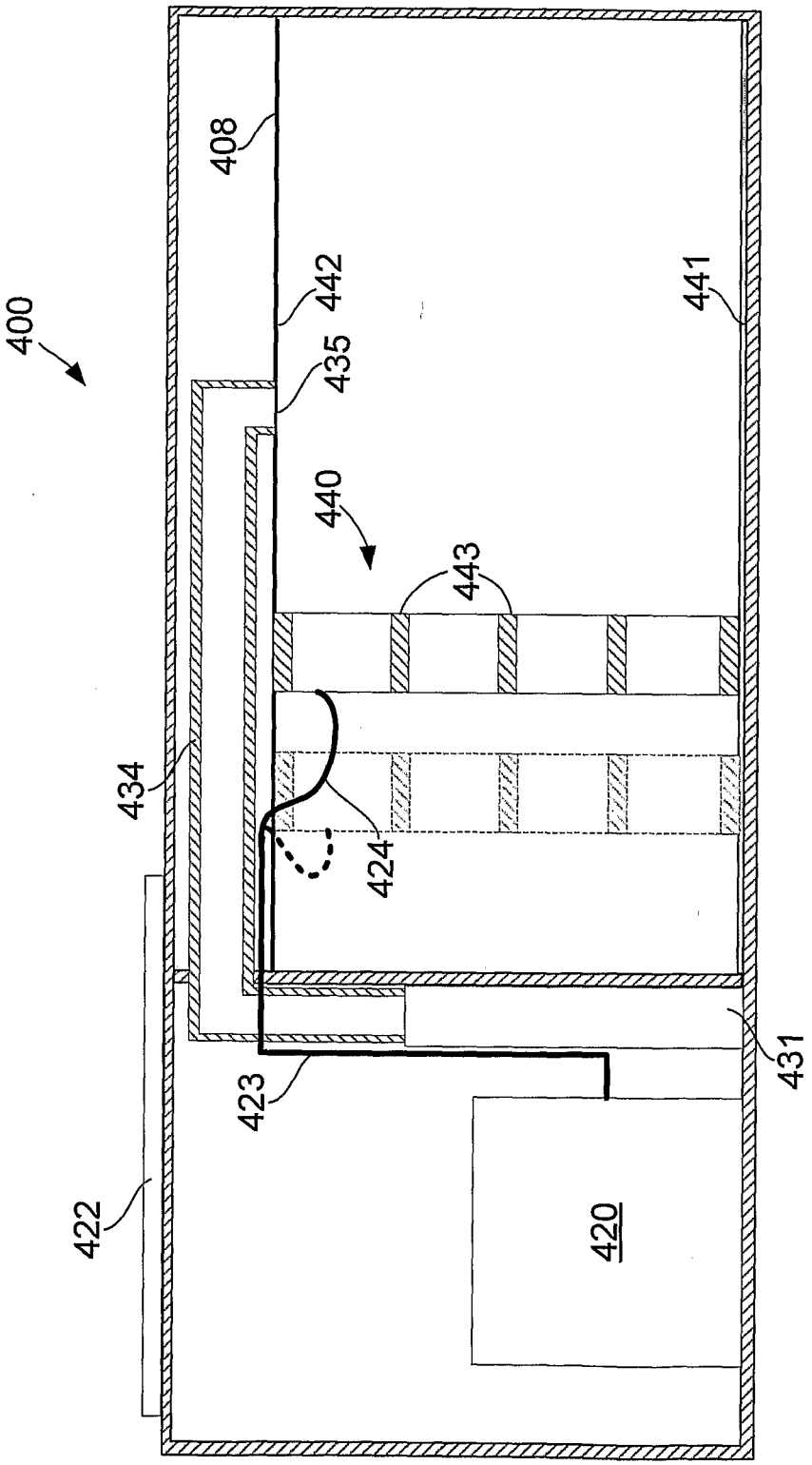

Fig. 4B

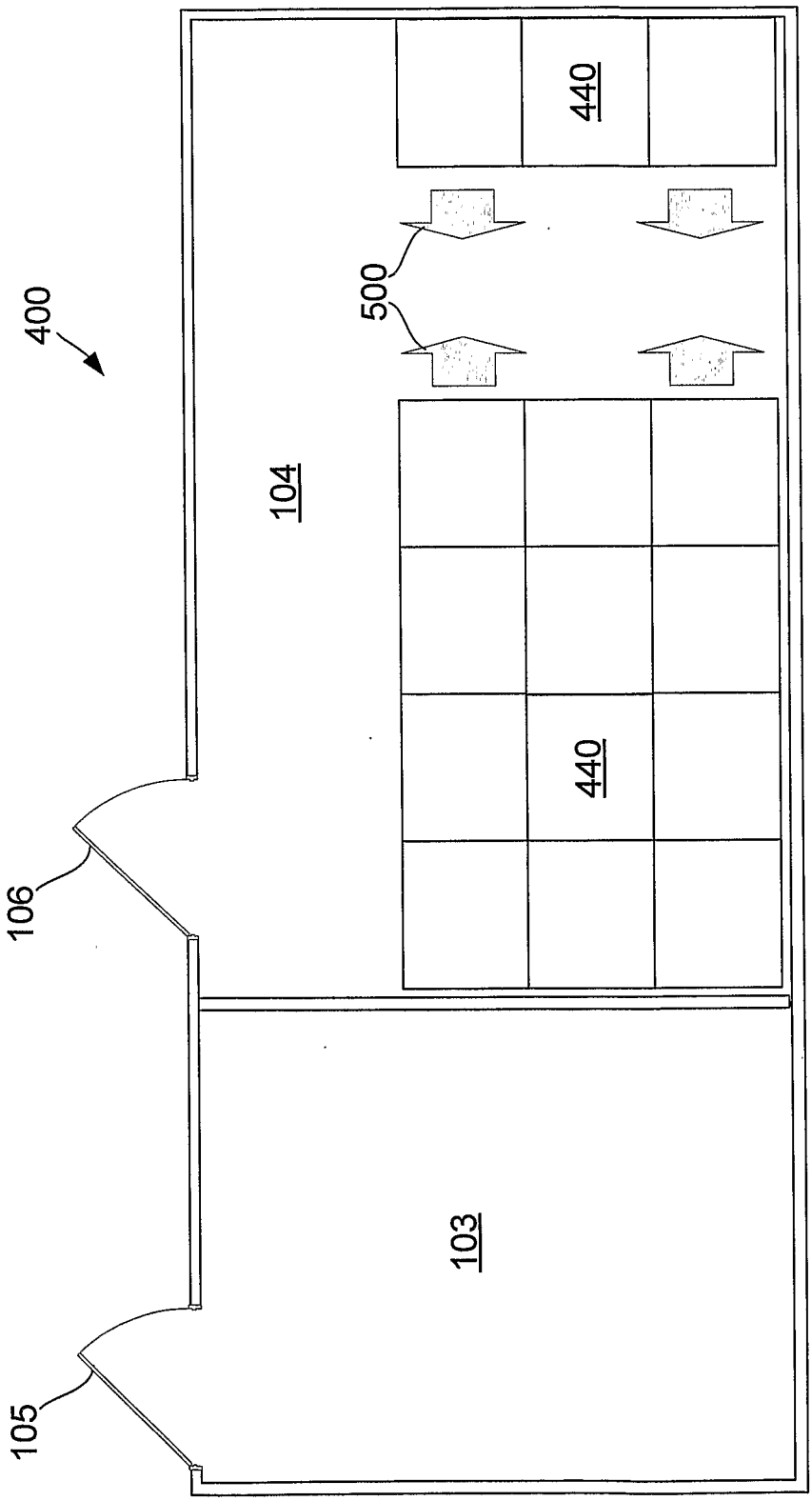

Fig. 5A

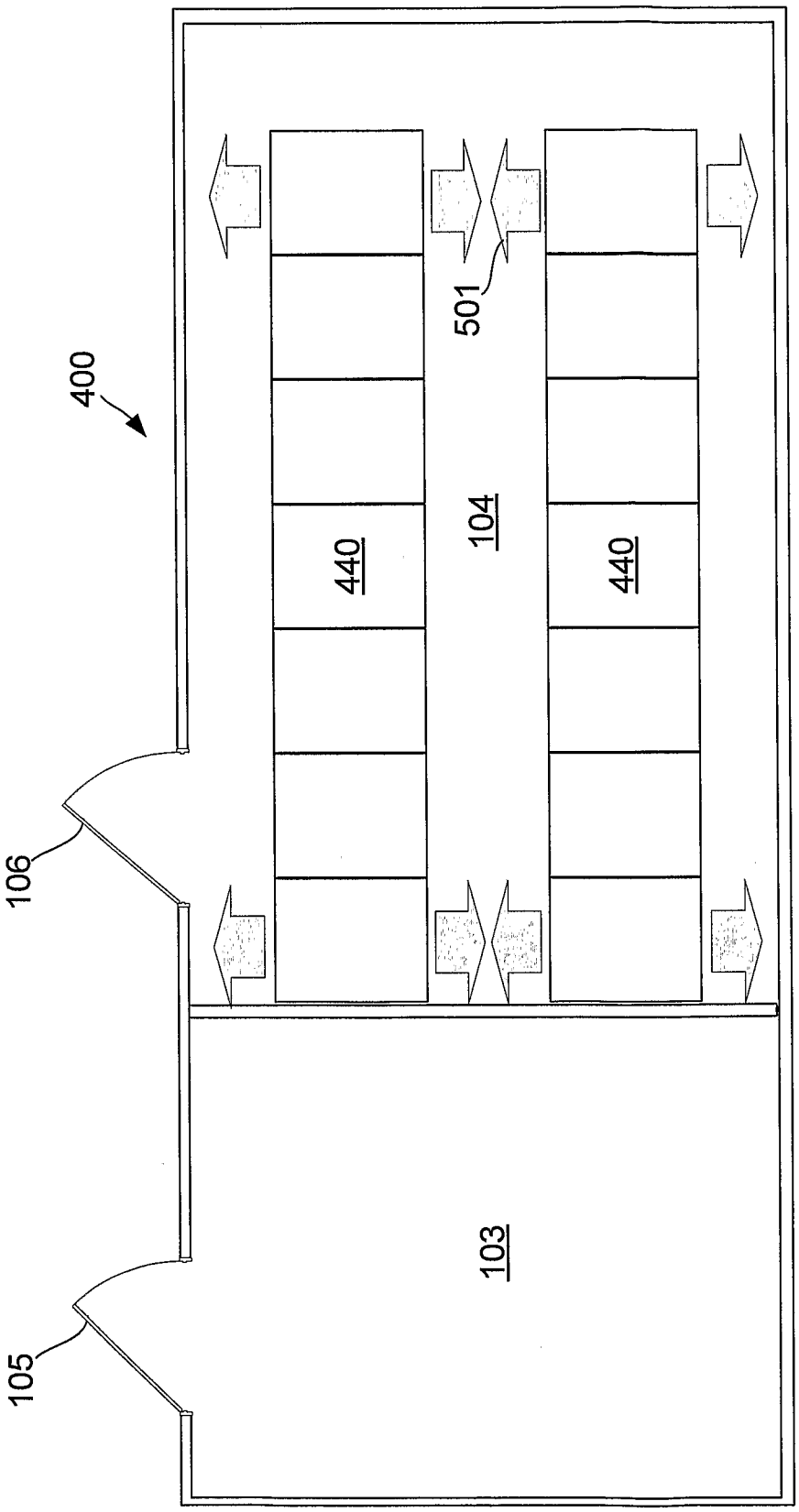

Fig. 5B

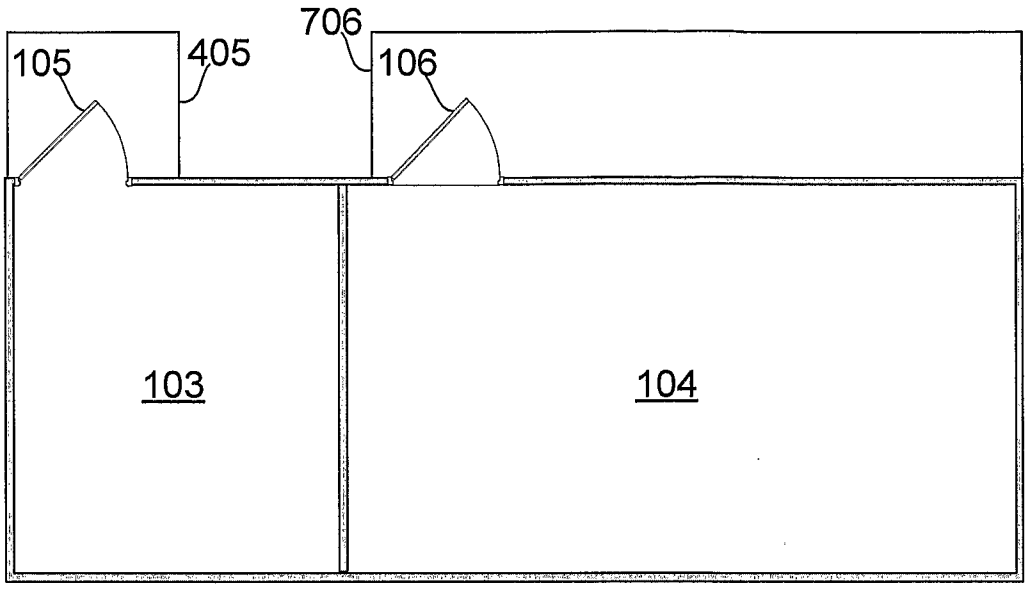

Fig. 7A

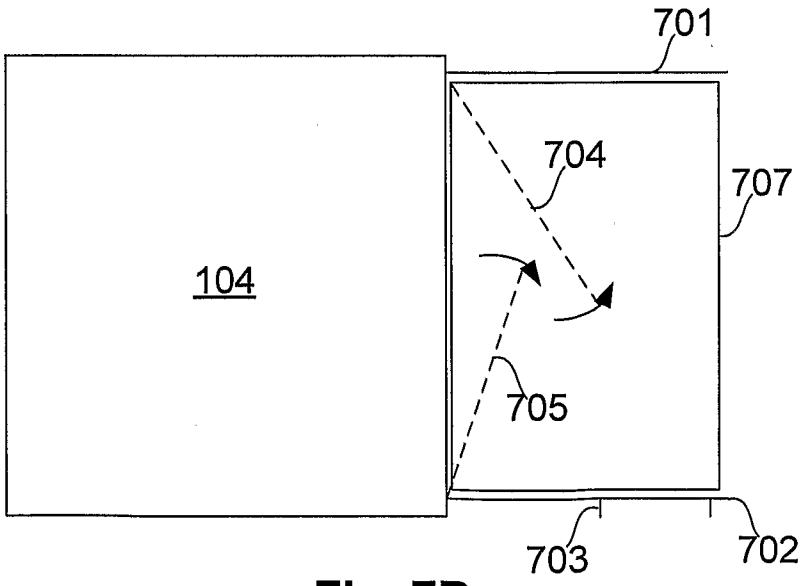

Fig. 7B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000053

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G06F 1/16 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Google and DWPI with keywords: PORTABLE , MOBILE , CONTAINER , SHIP+ , HOUSING, BOX, an OMPARTMENT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0132398 A1 (SHARP et al) 8 July 2004 See whole document	1- 14
X	US 6722474 B2 (HATZOR) 20 April 2004 See whole document	1- 14
P, X	US 2006/0082263 A1 (RIMLER et al) 20 April 2006 See whole document	1- 14

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 March 2007	2 3 MAR 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **MICHAEL HARDY** Telephone No : (02) 6283 2547

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000053

C (Continuation), DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0160897 A1 (FOWLER et al) 19 August 2004 See whole document	1 - 14
X	US 6141213 A (ANTONUCCIO et al) 31 October 2000 See whole document	1 - 14
Y	US 4909557 A (DE WECK et al) 20 March) 1990 See whole document In combination of US 2004/0132398 or US 6141213	1 - 14
O, T	Project Blackbox (17 October 2006) <URL: http://www.sun.com/emrkt/blackbox/index.jsp>	1 - 14

"fhis Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	2004132398	AU	2003286620	WO	2004040724		
US	6722474	AU	2002249496	EP	1495199	US	2003183456
		WO	03080964				
us	2006082263						
us	2004160897	AU	12395/01	AU	2002235472	CA	2395450
		EP	1096724	EP	1360796	US	6714977
		US	7159022	US	2002124081	**us**	2002161885
		us	2002174223	**us**	2004163102	WO	0131849
		WO	02060124	WO	02093403	WO	02099683
us	6141213	EP	0887725	JP	11095874		
us	4909557	EP	02581.64	FR	2599315	JP	63057347

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX