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(54) **Title**: APPARATUS AND METHOD FOR COOLING A DOCKING STATION

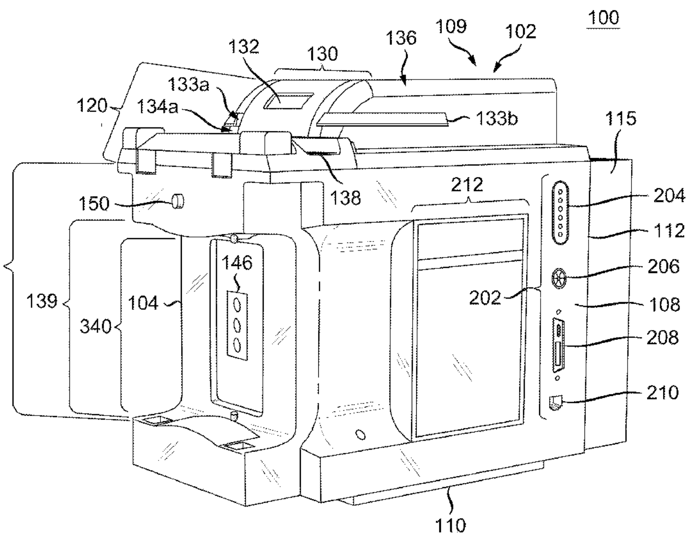

Fig. 2

(57) **Abstract**: A docking station that enables the simultaneous connection of two patient monitoring devices is provided. A housing selectively supports two patient monitoring devices thereon. A first port positioned on the housing receives a first patient monitoring device therein and a second port positioned on the housing receives a second patient monitoring device therein. At least one vent extends through the housing and is positioned between the first port and the second port. A plurality of electrical components positioned in the housing that connects each of the first and second patient monitoring device to the docking station and controls the operation of the docking station and heat generated by the plurality of electrical components flows out of the housing via the at least one vent.

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Apparatus and Method for Cooling A Docking Station

Field of the Invention

The present invention relates to a docking station able to receive at least two patient monitoring devices, and more specifically, to a docking station that enables data transfer between two patient monitoring devices received thereby.

Background of the Invention

During the course of providing healthcare to patients, practitioners typically connect at least one type of sensor to a patient to sense, derive and otherwise monitor at least one type of patient medical parameter. These patient connected sensors are further connected to a monitoring device that includes all relevant electronic components that enable conversion, manipulation and processing of the data sensed by the at least one type of sensor in order to generate the patient medical parameter. These patient medical parameters are usable by healthcare practitioners (e.g. nurses, doctors, physician assistants, or any other person charged with providing a healthcare service to a patient) in monitoring a patient and determining a course of healthcare to be provided to the patient.

Patient monitoring devices may be selectively connected to the patients at any point during which a healthcare professional comes into contact with the patient and thus may remain connected with the patient as the patient moves through various locations within a particular healthcare enterprise (e.g. hospital) or between different healthcare enterprises (e.g. different medical facilities). Once it is determined that a patient is to remain in a fixed location, the patient monitoring devices are selectively connected (docked) to a docking station that may serve as a gateway for connecting the patient monitoring device to a hospital information system (HIS) and/or central monitoring station and allowing data representing the at least one patient medical parameter to be communicated to other systems within the healthcare enterprise. This data may then be used by different systems in further patient care.

However, during the course of providing treatment, the patient may be connected to a plurality of different types of patient monitoring devices that are charged with monitoring the same (or different) patient parameter data. For example, a patient who is travelling between different units in a hospital may be selectively connected to a small portable monitoring device that may be easily transported around the hospital. But, when the patient returns to their hospital room, the patient may then be connected to a bedside patient monitoring device. However, a drawback associated with this scenario is that each patient monitoring device needs to be connected to its own cradle or docking station which is connected to a central station or HIS enabling transfer of patient data from the respective patient monitoring device, through the central station or HIS, to a repository of patient data associated with the respective patient. This is the case because many conventional portable patient monitoring devices do not have the ability to record and store patient data on a removable storage medium (e.g. memory card). A further drawback with the current state of monitoring devices is, when connecting the patient to a different patient monitoring device, the newly connected patient monitoring device must query the repository to acquire the patient parameter data that was recently uploaded by the original patient monitoring device. The delays associated with the conventional patient parameter data transfer process, not only are time consuming and increase the chances of human error associated with manual reconfiguration of patient monitoring devices, but also may result in an interruption in monitoring of the patient. Therefore, a need exists to provide an apparatus and system for improving the ability to transfer data between patient monitoring devices. An apparatus and method of operating the apparatus according to invention principles addresses deficiencies of transferring data between portable patient monitoring devices.

Summary of the Invention

In one embodiment, a docking station for at least two patient monitoring devices is provided. The docking station includes a housing that selectively supports a first patient monitoring device and second patient monitoring device thereon. A first port is positioned on the housing for receiving the first patient monitoring device therein and a second port positioned on the housing for receiving the second patient monitoring device therein. A controller selectively connects the first patient monitoring device and the second patient monitoring device to the docking station and controls a transfer of a set of data between the first and second patient monitoring devices via the docking station.

In another embodiment, a method of connecting at least two patient monitoring devices to a docking station is provided. The method of connecting includes selectively supports a first patient monitoring device and second patient monitoring device on a housing and receiving the first patient monitoring device in a first port positioned on the housing and receiving the second patient monitoring device in a second port positioned on the housing. A controller selectively connects the first patient monitoring device and the second patient monitoring device to the docking station and controls a transfer of a set of data between the first and second patient monitoring devices via the docking station.

In a further embodiment, a docking station that enables the simultaneous connection of two patient monitoring devices is provided. A housing selectively supports two patient monitoring devices thereon. A first port positioned on the housing receives a first patient monitoring device therein and a second port positioned on the housing receives a second patient monitoring device therein. At least one vent extends through the housing and is positioned between the first port and the second port. A plurality of electrical components positioned in the housing that connects each of the first and second patient monitoring device to the docking station and controls the operation of the docking station and heat generated by the plurality of electrical components flows out of the housing via the at least one vent.

In yet another embodiment, a method of cooling a docking station that enables the simultaneous connection of two patient monitoring devices is provided. The method includes receiving a first patient monitoring device at a first port positioned on a housing of the docking station and receiving a second patient monitoring device at a second port positioned on the housing. The heat generated by a plurality of electrical components positioned in the housing that connects each of the first and second patient monitoring device to the docking station and controls the operation of the docking station is enabled to flow out of the housing via at least one vent extending through the housing being positioned between the first port and second port.

In a further embodiment, a docking station for at least two patient monitoring devices is provided. The docking station includes a housing that selectively supports a first patient monitoring device and second patient monitoring device thereon. A connection is port positioned on the housing for receiving one of the first patient monitoring device and second patient monitoring device therein. The docking station further includes a memory and a controller that acquires a set of data from a first patient monitoring device and stores the acquired set of data in a memory and, upon connection of the second patient monitoring device with the connection port, transfers the set of data stored in the memory to the second patient monitoring device.

In another embodiment, a method of connecting at least two patient monitoring devices to a docking station is provided. The method includes receiving a first type of patient monitoring device at a connection port and acquiring a set of data from the first type of patient monitoring device. The acquired set of data is stored in a memory and, upon connecting a second type of patient monitoring device to the connection port, the set of data stored in the memory is transferred to the second patient monitoring device.

Brief Description of the Drawing Figures

FIGURE 1 is a front view of an exemplary docking station according to invention principles;

FIGURE 2 is a right perspective view of an exemplary docking station according to invention principles;

FIGURE 3 is a top view of an exemplary docking station according to invention principles;

FIGURE 4 is a left perspective view of an exemplary docking station according to invention principles;

FIGURE 5 is a rear view of an exemplary docking station according to invention principles;

FIGURE 6 is a block diagram of the components of the docking station according to invention principles;

FIGURES 7A & 7B are block diagrams detailing the transfer operation performed by the docking station according to invention principles;

FIGURES 8A – 8D are flow diagrams detailing exemplary algorithms for controlling the operation of the docking station according to invention principles;

FIGURE 9 is a downward right side perspective view of the docking station according to invention principles;

FIGURE 10 is an upward front side perspective view of the docking station according to invention principles;

FIGURE 11 is a rear view of a first type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 12 is a bottom view of a first type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 13 is a top view of a first type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 14 is a front view of a first type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 15 is a front perspective view of a second type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 16 is a rear view of a second type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 17 is a top view of a second type of patient monitoring device able to be connected to the docking station according to invention principles;

FIGURE 18 is a front view of a second type of patient monitoring device able to be connected to the docking station according to invention principles; and

FIGURE 19 is an illustrative view of the docking station according to invention principles having two patient monitoring devices connected thereto.

Detailed Description of the Invention

In accordance with invention principles, a docking station is provided for receiving at least two patient monitoring devices and enabling data to be communicated directly between the at least two patient monitoring devices. In particular, the docking station advantageously facilitates the communication of patient parameter data directly from a first patient monitoring device to a second different patient monitoring device. While the transfer of data is described as being from the first patient monitoring device to the second patient monitoring device, it should be understood that data can also be transferred from the second patient monitoring device to the first patient monitoring device. Thus, the notation of first and second patient monitoring devices is described to facilitate the understanding of the principle of the invention. The direct transfer of data from the first patient monitoring device to a second patient monitoring device facilities the quick transfer of patient related information enabling the healthcare practitioner to switch devices being used to monitor at least one patient parameter.

The docking station may also advantageously communicate configuration data including information associated with configuration settings for one of the first and second patient monitoring devices used to configure the operation of a respective patient monitoring device. Configuration data may include at least one of (a) monitor settings representing information directing the operation of the monitoring device and (b) monitoring settings representing information controlling the manner in which the patient is monitored. The direct transfer of configuration data from the first patient monitor directly to the second patient monitor results in automatically configuring the second patient monitoring device with at least one of (a) the same monitoring settings or (b) a subset of monitoring settings. As will be used herein, when referring to transferring patient parameter data and configuration, the description may collectively refer to these types of data as a set of data. The direct transfer of the set of data minimizes any interruption in monitoring the patient by advantageously automatically translating patient parameter and/or configuration data from a first data format associated with the first patient monitoring device into a second data format associated with the second patient monitoring device. In one embodiment, the automatic translation between data formats occurs in real-time and is performed by a controller within the docking station once it is determined that a data transfer between patient monitoring devices should take place. The direct transfer of the set of data between patient monitoring devices is done without the need to connect to a central monitoring station or other healthcare information system. Thus, by connecting the first and second patient monitoring devices to the docking station, a sub-local area network including the docking station and any patient monitoring device locally connected thereto is created. The controller of the docking station advantageously and automatically receives, interprets and translates the set of data based on the format and/or protocol of the patient monitoring device from which the set of data is received and the format and/or protocol of the patient monitoring device to which the set of data is being transferred. The rules and/or templates used in the automatic translation of the set of data may be determined by the controller in response to the controller detecting the type of patient monitoring device connected to the docking station. No connection to an outside network or database is required to facilitate the transfer of the set of data between the devices.

Each of the first and second patient monitoring devices include at least one sensor connection port for connecting sensors that may monitor at least one type of physiological signal of a patient which is used, by the respective patient monitoring device, to generate the patient parameter data. These patient connected sensors may be coupled, via cables, to the at least one sensor connection port. To continue monitoring patient parameter data after transferring the set of data from the first patient monitoring device to the second patient monitoring device, the cables which connect the sensor to the patient monitoring device need to be disconnected from the first patient monitoring device and connected to the second patient monitoring device. However, when patient connected sensors are disconnected from a monitoring device, the monitoring device typically issues an alarm or notification informing a healthcare professional (e.g. doctor, nurse, orderly etc.) of such a condition. The docking station advantageously minimizes erroneous alarm notifications during the transfer process by automatically identifying the presence of two patient monitoring devices connected to the docking station and suppresses any alarm notifications on either of the patient monitoring devices until the transfer of the set of data is completed. In one embodiment, the controller may suppress any alarms/notifications for a predetermined amount of time. In another embodiment, the controller may suppress and re-engage alarms/notifications in response to user command. In a further embodiment, the controller may suppress alarms/notifications until the controller determines a continuity metric indicating that the set of data has been transferred and that the monitor to which the set of data has been transferred is actively monitoring patient physiological signals and determining, from those monitored signals, at least one patient parameter. The continuity metric advantageously indicates that the transfer of the set of data and subsequent patient monitoring has been successfully completed.

Once the set of data and the patient connected sensors have been transferred from the first patient monitoring device to the second patient monitoring device, the docking station automatically determines that the second patient monitoring device is charged with monitoring the at least one patient parameter and automatically re-enables the previously programmed alarms and/or notifications that were included within the transferred set of data to be effective for the second patient monitoring device. The docking station may also cause the first patient monitoring device (the device from which the set of data was transferred) to be one of discharged or re-purposed. Once the set of data and monitoring capabilities have been transferred, the docking station may automatically discharge and erase any and all patient specific data from the first patient monitoring device allowing the first patient monitoring device to be used for a subsequent patient thereby maintaining the required patient confidentiality. Alternatively, the docking station may, in response to a reconfiguration message, enable the first patient monitoring device to be reconfigured to monitor different patient parameter data for the particular patient. For example, additional patient connected sensors may be coupled to the re-purposed patient monitoring device enabling sensing of other physiological signals from the patient and determining patient parameter data from the sensed other physiological signals.

The docking station further advantageously facilitates the simultaneous connection and operation of the first and second patient monitoring devices by utilizing an inventive heat dissipation scheme. The simultaneous connection and operation of two patient monitoring devices results in additional heat being generated by the electrical components of each patient monitor as well as by the electrical components in the docking station itself. The docking station includes at least two connection ports that each receives a respective type of patient monitoring device therein. A first connection port is positioned on a first side of the docking station for receiving a first type of patient monitoring device therein and a second connection port is positioned on a second face of the docking station for receiving the second type of patient monitoring device therein. The first and second sides of the docking station may be connected to one another at a substantially ninety degree angle. In one embodiment, the first side of the docking station is a top side and the second side of the docking station is a front face of the docking station.

The docking station advantageously includes at least one vent positioned on an underside of the docking station that serves as an inlet for ambient air. The air flowing into the docking station via the at least one underside vent on the docking station is preferably cooler than any air within the docking station. Additionally, the docking station further advantageously includes at least one vent positioned between the first connection port and second connection port such that the second connection port is positioned on one side of the vent and the first connection port is positioned on the opposite side of the vent. Heat generated by the electrical components within the docking station further heats the air flowing into the docking station by the at least one underside vent and flows outward from an inner cavity thereof and through the at least one vent positioned between the first connection port and second connection port. The heat flowing through the at least one vent is drawn into the first patient monitoring device via a first patient monitoring device vent positioned adjacent to and substantially aligned with the at least one vent on the docking station. The heat further flows through an internal cavity of the first patient monitoring device towards a second patient monitoring device vent positioned on a side of the first patient monitoring device other than the side having the first patient monitoring device vent. In one embodiment, the at least one vent position between the connection ports, the at least one underside vent, and the first and second patient monitoring device vents may be substantially aligned with one another. Thus, by heating of air entering the cavity via the at least one underside vent increases and be aligned with the first and second vents on the first patient monitoring device, increases the temperature of the air creating an even more powerful chimney effect to dissipate the heat. Thus, the orientation of the first and second patient monitoring devices on the docking station, in conjunction with the vents on the docking station and on the first patient monitoring device produces a chimney effect thereby enabling the heat to flow upwards and out of both the docking station and the first patient monitoring device. To further dissipate the heat generated by the operation of two patient monitoring devices and the docking station itself, a main heatsink is provided on the housing of the docking station. In one embodiment, heat may be generated by at least one of (a) electrical components enabling connection of the first patient monitoring device with the docking station; (b) electrical components enabling the connection of the second patient monitoring device with the docking station; (c) electrical components used in transferring and translating the set of data from the first patient monitoring device to the second patient monitoring device; (d) electrical components used in connecting the docking station to one of a central monitoring or a healthcare information system; (e) operation of other docking station components; and (f) providing regulated power for both monitoring devices.

An exemplary embodiment of a docking station 100 for connecting two different patient monitoring devices and facilitating direct transfer of at least one type of data therebetween is provided in Figures 1 - 8. As discussed above, the docking station enables direct transfer of at least one of (a) patient parameter data and (b) configuration data (collectively referred to as a set of data) from one patient monitoring device to a second patient monitoring device. Figures 1 – 8 depict various views of an exemplary docking station that is able to selectively receive two types of patient monitoring devices and establish a connection enabling data communication therebetween.

Turning to Figure 1, a front view of the docking station 100 that facilitates direct communication of a set of data between two patient monitoring devices is depicted. The docking station 100 includes a housing 102 having a front face 104, a left face 106, right face 108, a top face 109, a bottom face 110 and back face (112 in Fig. 2). The housing 102 includes a first section 120 positioned on substantially the top face 109 of the housing 102. The first section 120 may selectively receive a first type of patient monitoring device thereon. The housing 102 further includes a second section 122 which is positioned adjacent the first section 120. The second section 122 includes the front face 104, left face 106, right face 108, back face (112 in Fig. 2) and bottom face 110. The second section 122 is adapted to selectively receive a second type of patient monitoring device, different from the first type of patient monitoring device therein. By simultaneously enabling the connection of two different patient monitoring devices, the docking station 100 advantageously enables direct data transfer from one patient monitoring device to a second different patient monitoring device.

The first section 120 forms the top face 109 of the docking station 100. The first section includes a first port 130 that selectively receives a first type of patient monitoring device. The first port 130 includes an access door 132 that is pivotally connected to the housing 102. The access door 132 provides selective access to an inner portion of the first section 120. Behind the access door 132 is a first connector that electrically couples the docking station 100 with the first type of patient monitoring device enabling one of data to be communicated and power to be provided to the first patient monitoring device from the docking station. The first connector may be, for example, a pin connector having a plurality of electrical pins that can be selectively assigned in a desired manner to effect operation thereof. For example, pins may be configured to one of transmit and receive data. Additionally, the pins in the connector may also be configured to provide power from the docking station 100 to the first patient monitoring device connected at the first port 130. However, this is described for purposes of example only and the first connector may be any type of connector that enables a signal transfer to occur between the first patient monitoring device and the docking station 100. The first section 120 further includes openings 133a and 133b. The first section 120 also includes a set of arms 134a and 134b that extend at least partially through respective openings 133a and 133b. The arms 134a and 134b comprise a part of a locking mechanism that selectively locks the first type of patient monitoring device received by the first port 130.

For example, an exemplary locking mechanism may include a bias force being applied to the arms 134a and 134b resulting in the arms 134a and 134b extending in a direction away from a vertical midpoint of the docking station 100. The bias force applied to the arms 134a and 134b may be selectively overcome by applying a predetermined amount of opposing force thereto. The arms 134a and 134b may be received within a track positioned on a housing of the first type of patient monitoring device. In exemplary operation, when the first type of patient monitoring device is positioned atop the housing 102, the first type of patient monitoring device applies the opposing bias force on the arms 134a and 134b causing the arms 134a and 134b to move inward towards the vertical midpoint of the housing 102. By causing the arms 134a and 134b to move inward, the patient monitoring device may be seated on the first port 130. While being seated on the first port 130, the housing of the patient monitoring device causes the access door 132 to pivot thereby enabling a connector on the first type of patient monitoring device to be received within the first section 120 of the housing 102.

The second section 122 of the housing 102 is adapted to selectively receive a second different type of patient monitoring device having a different shape associated therewith. The second section 122 includes a second port 139 for receiving the second type of patient monitoring device. The port 139 includes a channel 140 extending horizontally across the front face 104 of the housing 102. The channel 140 includes a first protrusion 142 extending from a top side 141 of the channel 140. The first protrusion 142 is positioned at substantially a center point of the top side 141 of the channel 140. The channel 140 includes a second protrusion 144 extending from a bottom side 143 of the channel 140. The second protrusion 144 is positioned at substantially a center point of the bottom side 143 of the channel 140. The first protrusion 142 and the second protrusion 144 are in substantial vertical alignment with each other. The first protrusion 142 and second protrusion 144 are selectively received within a track on the second type of patient monitoring device and partially secure the second type of patient monitoring device within the channel 140.

The second section 122 may also includes a plurality of tabs 148a – 148d, collectively referred to using reference numeral 148, that extend into the channel 140 and form a second type of locking mechanism which secures the second type of patient monitoring device within the channel 140 and to the docking station 100. Each tab has a respective bias force applied thereto and remain extended into the channel 140. This bias force may be selectively overcome by exerting an opposing force thereon. The opposing force results from the insertion of the second patient monitoring device into the channel 140. The bias force applied to the tabs 148 is overcome causing the tabs 148 to move within the second section 122 of the housing 102 until the second patient monitoring device is fully received within the channel 140. The second patient monitoring device may include a plurality of indents at positions aligned with each of the tabs 148a – 148d. When in proper position, the tabs 148 are caused to extend into corresponding indents on the housing of the second type of patient monitoring device. The second patient monitoring device is seated within the channel 140 when a rear face of the second patient monitoring device contacts the front face 104 of the housing 102. The bias force is reapplied to the tabs 148 which are secured in the indents of the second patient monitoring device thereby locking the patient monitoring device to the docking station.

The front face 104 of the docking station further includes a second connector 146 that, when aligned with a corresponding connector on a back face of the second patient monitoring device enables connection therebetween allowing power to be provided from the docking station to the second patient monitoring device and enabling data transfer to occur between the second patient monitoring device and the docking station 100. The second connector 146 also enables bidirectional communication of a set of data between the second patient monitoring device and the first patient monitoring device connected to the first port 130. As shown herein, the second connector 146 is an electro-optical connector enabling electrical and optical connection between the second patient monitoring device and the docking station. Power may be provided via electrical contacts whereas data may be communicated via the optical connection between the second patient monitoring device and the docking station. However, this is described for purposes of example only and the second connector 146 may be any type of connector that enables a signal transfer to occur between the second patient monitoring device and the docking station. The electro-optical connection shown herein enables data transfer between the second patient monitoring device and the docking station and also allows for providing power to the second patient monitoring device.

The front face 104 further includes at least one action button 150. The action button 150 allows a user to initiate an operational activity. In one embodiment, the operational activity causes the docking station 100 to initiate a transfer and translation of a set of data from one patient monitoring device (e.g. a second patient monitoring device) to another patient monitoring device (e.g. a first patient monitoring device). This type of transfer and translation is described for purposes of example only and the direct transfer and translation of the set of data may be from the first patient monitoring device to the second patient monitoring device.

In one embodiment, the second patient monitoring device is a small, handheld patient monitoring device that is easily transportable from one location to another whereas the first type of patient monitoring device is typically a bedside patient monitoring device that is engaged when the patient is primarily located in a single location (e.g. hospital room). The portability of the second type of patient monitoring device enables accurate and complete monitoring of patient parameters as the patient is moved between locations such as different units in a hospital or from a medical transport (e.g. ambulance) into a particular care unit in a healthcare enterprise. Thus, it is desirable to offload patient-specific data from the portable second patient monitoring device to the first patient monitoring device located at the patient's bedside. Once the patient specific data has been transferred to the bedside patient monitoring device (e.g. first patient monitoring device), the portable patient monitoring device (e.g. the second patient monitoring device) may be discharged and all patient specific data deleted thereby ensuring confidentiality and compliance with all privacy regulations so that the portable patient monitoring device may be used to monitor a second different patient.

The algorithms controlling the transfer and translation operation of the docking station will be described hereinafter with respect to Figures 7 and 8. As there may be multiple types of transfer procedures executed by the docking station 100, the docking station 100 may include a plurality of action buttons 150 each corresponding to a unique data transfer and translation operation.

Figure 2 is a right perspective view of the docking station 100 according to invention principles. This view of the docking station 100 includes many of the same elements described above with respect to Figure 1, the discussion of which will not be repeated. The right perspective view of the docking station 100 shows the first section 120 and the second section 122. Additionally, Figure 2 shows a partial side view of the back face 112 of the housing 102. The back face 112 of the housing includes a heatsink 115 positioned thereon to enable effective dissipation of heat from the electronic components housed within the housing 102. In one embodiment, the entire back face 112 of the housing 102 may be formed as a heatsink 115. In another embodiment, only a portion of the back face 112 of the housing 102 may be formed as the heatsink 115.

The first section 120 includes the top side 109 having a tray 138 that extends along the width thereof. The tray 138 is positioned proximate to the front face 104 of the housing 102. The tray 138 selectively receives a mating lip of a patient monitoring device when the first patient monitoring device is connected to the docking station 100 via the port 130. The top side 109 of the housing 102 further includes the first type of sensor 136. The first type of sensor 136 selectively senses a presence of the first patient monitoring device on the first port 130. In one embodiment, the first type of sensor is a pressure sensor that senses an amount of force exerted on the top side 109 of the housing 102 which advantageously enables the docking station 100 to know when a patient monitoring device is connected to the port 130.

Additionally, on the front face 104 of the docking station, the second section 122 includes the second port 139 having the channel 140 for receiving the second patient monitoring device therein. The second connector 146 is also positioned within the second section and on the front face 104 of the housing 102. The second patient monitoring device may be received within the channel 140 such that a connector on the rear face of the second patient monitoring device mates with the second connector 146 on the front face 104 of the docking station. In one embodiment, the docking station may automatically detect the presence of the second patient monitoring device within the channel 140 by sensing at least one of an electrical connection and optical connection between the second connector 146 and the mating connector on the rear face of the second patient monitoring device. In another embodiment, the docking station 100 may also include a presence sensor positioned within the channel 140 that detects when the second patient monitoring device has been received therein.

Figure 2 further illustrates additional features of the docking station 100 positioned on the right side 108 of the housing 102. The right side of the housing 102 includes a plurality of connection ports, collectively referred to with reference numeral 202. The connection ports 202 include a first connection port 204, a second connection port 206, a third connection port 208 and a fourth connection port 210.

The first connection port 204 may be an MIB/UART port enabling communication of certain parameters associated with docking station configuration and/or operation to other devices plugged into a wall outlet including, but not limited to, ventilators, infusion devices, etc. Thus, the first connection port 204 allows additional parameters to be connected to one of the monitoring devices connected to the docking station 100. The additional parameters may be for display and processing on any patient monitor connected to the docking station 100. Furthermore, the first connection port 204 also allows data from the patient monitoring devices connected to the docking station 100 to be sent to external devices. The first connection port 204 may also have a receiver connected thereto enabling remote control of any patient monitoring devices connected to the docking station 100 as well as connection to one of a user interface device and/or a paging system. The second connection port 206 may be a COMM port enabling connection with other parameter monitoring devices such as an EEG, NMT, Flow, BisX. The second connection port 206 is able to provide power to a device connected thereto as well as communicating data. The third connection port 208 may be a video connection port for connecting a video monitor to the docking station 100. The fourth connection port 210 may be a network connection port that enables the docking station to connect to one of a local area network and wide area network enabling communication of data from one of the first patient monitoring device, the second patient monitoring device and the docking station to a remote computing system such as a central monitoring station or a hospital information system. Data from any of the first patient monitoring device, the second patient monitoring device and/or the docking station may be communicated to any peripheral device connected via any of the connection ports 202. The docking station 100 may also include a recorder 212 that selectively generates a paper record of data from any patient monitoring device connected thereto. The inclusion of a recorder 212 is common in docking station 100, thus the operation thereof need not be further discussed.

Figure 3 is a top view of the docking station 100. The top side 109 of the housing includes the first port 130 having the access door 132 that, pivots in a direction towards the bottom face (110 in Fig. 1) of the housing and enables access to an inner cavity of the docking station 100 for connecting the patient monitoring device to the docking station. Further illustrated are the arms 134a and 134b extending at least partially through respective openings 133a and 133b and are able to at least partially secure the first patient monitoring device to the top side 109 of the housing 102. The sensor 136 may also be positioned on the top side for sensing a presence of any first patient monitoring device connected to the first port 130. The top view of Figure 3 illustrates the top side 109 of the housing 102 which provides a more clear view of the tray 138 which receives a portion of the bottom side of the first patient monitoring device. The tray 138 may include at least one recess forming a vent 137 extending through the housing and along the width thereof which provides access into the inner cavity of the docking station 100. The vent enables heat from within the docking station to flow out therefrom. As shown herein, the vent 137 of the tray 138 includes a plurality of recesses along the length of the tray 138. The position, shape and size of the at least one recess of the vent 137 is shown for purposes of example only and the at least one recess may be any shape or size in the tray 138 so long as heat from within the docking station may flow out therefrom. In one embodiment, the heat flows out from the inner cavity of the docking station into the ambient air via the at least one recess of the vent 137. In another embodiment, which will be discussed in greater detail with respect to Figures 9 – 19, when the first patient monitoring device is positioned on the top side 109 of the housing 102, the heat may flow from the inner cavity of the docking station 100 through the at least one recess of the vent 137 and into an inner cavity of the first patient monitoring device which operates as a chimney facilitating further flow of heat in a direction away from the docking station and out to the ambient air.

Additionally, Figure 3 illustrates an exemplary heatsink 115 positioned on a back face 112 of the housing 102. As shown herein, the heatsink 115 includes a plurality of fins or peaks and valleys which encourage air flow. This enables heat to flow from an area within the housing 102 having a higher temperature into the ambient air and away from the housing 102 which has a lower temperature thus effectively dissipating the heat generated by the electrical components. In one embodiment, the heatsink 115 is able to dissipate between substantially 10 watts and substantially 40 watts. The heatsink 115 may include a plurality of fins that extend outward from a single plate such that a right angle is formed between each fin and the plate. This advantageously enables heat to spread evenly over the entire surface of the plate to allow for more uniform dissipation via the fins. Moreover, the heatsink 115 allows for high dissipation hot components within the docking station 100 to be mounted to the plate.

Figure 4 is a left perspective view of the housing 102 of the docking station 100 according to invention principles. This view of the docking station 100 includes many of the same elements described above with respect to Figures 1 - 3, the discussion of which will not be repeated. The left perspective view of the docking station 100 shows the first section 120 and the second section 122. Additionally, Figure 4 shows a partial side view of the back face 112 of the housing 102. The back face 112 of the housing includes a heatsink 115 positioned thereon to enable effective dissipation of heat from the electronic components housed within the housing 102. The left perspective view of Figure 4 differs from the right perspective view of Figure 2 in that Figure 4 depicts the left face 106 of the housing 102. While no connection ports or recorder are shown on the left face 106 of the housing, it should be noted that the left face of the housing 102 may include similar connection ports and/or recorder shown in Figure 2 as being disposed on the right side 108 of the housing. Alternatively, the left face 106 of the housing may include additional connection ports for connecting other peripheral devices to the docking station 100.

Figure 5 is a rear view of the housing 102 of the docking station 100 is shown. The rear view depicts the first section 120 and the second section 122. In the second section 122, the rear side 112 of the housing 102 includes the heatsink 115. As shown herein, the entire rear side 112 of the housing 102 is covered by the heatsink 115 which effectively dissipates heat from within the housing 102 via passive cooling.

In operation a first patient monitoring device may be connected to the first section 120. A connection portion on the first type of patient monitoring device conforms to the shape and size of the port 130 of the top side 109. Upon connection to the first port 130, a bottom side of the patient monitoring device is positioned against the top side 109 of the housing and is received within the tray 138. Connection of the first type of patient monitoring device to the port 130 causes the access door 132 to pivot downwards towards the bottom face 110 of the docking station 100. The patient monitoring device being seated on the top side 109 of the housing 102 exerts a force against the arms 134a and 134b and overcomes the bias force applied to the arms 134a and 134b. The arms 134a and 134b are caused to move inside of their respective openings 133a and 133b enabling the bottom side of the first type of patient monitoring device to be positioned adjacent to the top face 109 of the housing 102. Once adjacent to the top face 109, the bias force is reapplied to the arms 134a and 134b causing them to re-extend through their respective openings 133a and 133b and into a corresponding track of the patient monitoring device. Once secured to the top side 109 of the housing 102, the first connector positioned within the housing 102 may be engaged with a mating connector on a rear side of the first patient monitoring device thereby establishing an electrical connection between the docking station 100 and the first patient monitoring device. The electrical connection between the first patient monitoring device and the docking station enables power to be provided from the docking station to the first patient monitoring device and bidirectional communication of data between the docking station and the first patient monitoring device. In one embodiment, the first connector 102 is automatically engaged upon sensing that the first patient monitoring device is positioned within the first port 130. In another embodiment, the first connector may be manually connected to the mating connector of the first patient monitoring device. The manner in which the first patient monitoring device is at least partially secured to the top side of the docking station 100 is described for purposes of example only and the docking station 100 may include any type of mechanism that secures the first patient monitoring device to the housing 102. The second type of patient monitoring device may be received within the channel 140 of the second port 139 causing the connector on a rear face of the second patient monitoring device to mate with the second connector 146 establishing an optical-electrical connection with the docking station 100. The optical-electrical connection between the docking station 100 and the second patient monitoring device also enables power to be provided from the docking station 100 to the second patient monitoring device as well as bidirectional communication between the second patient monitoring device and the docking station.

Once both the first and second patient monitoring devices are connected to the docking station 100, a user may initiate a transfer and translation action by activating the action button 150. The following description of the user initiated transfer and translation includes transferring a set of data (patient parameter data and configuration data) from the second patient monitoring device to the first patient monitoring device. However, this description is for purposes of example only and merely illustrates the principles of the transfer and translation operation executed by the docking station. One skilled in the art will appreciate that a transfer and translation of data from the first patient monitoring device to the second patient monitoring device is also possible.

In response activation of the action button 150, the docking station enables the direct transfer of the set of data from one of the first and second patient monitoring devices to the other of the first and second patient monitoring devices. A controller 602 (shown in Figures 6 and 7) of the docking station 100 requests the set of data from the one of the first and second patient monitoring devices (in this example, the second patient monitoring device 704). The requested set of data is communicated from the second patient monitoring device 704 via the connection unit 610 where it is received by the controller 602. The controller automatically and, in real time, translates the requested data and transfers the translated data to the other of the first and second patient monitoring devices (in this example, the first patient monitoring device 702) via the first connector which enables configuration and setup of the first patient monitoring device with the settings of the second patient monitoring device 704. This also enables the first patient monitoring device to have all the previously determined patient parameter data for all patient parameters being monitored. At the completion of the transfer, the controller enables the second patient monitoring device from which the original data was transferred, to be discharged and used on a different patient.

Turning now to Figure 6, an illustrative view of the components of the docking station 100 according to invention principles is provided. Figure 6 is a top cross sectional view of the housing 102 of the docking station and illustrates at least a portion of the components contained in an inner cavity 601 of the housing. The components contained in the inner cavity 601 of the housing 102 enable connection of two patient monitoring devices to the docking station as well as the direct transfer and translation of a set of data from one of the patient monitoring devices to the other. Additionally, Figure 6 represents an exemplary layout of the components within the inner cavity 601 of the housing 102. However, for simplicity, the individual connections between each of the components described herein are not shown as they are conventionally known and understood mechanisms for coupling computer components to one another. Thus, unless otherwise stated, certain components may be indicated as connected to one another and the connection therebetween is accomplished using the conventional manner for connecting the specified components.

The docking station 100 includes a controller 602 coupled to a motherboard 604. The controller 602 executes a plurality of algorithms that, when executed, control the various operational features of the docking station. While the controller 602 may execute any number of different types of algorithms that control various features of the docking station, only the algorithms that are pertinent to the present invention will be discussed. Thus, discussion of any algorithm in the following description should not be viewed as limiting as the controller 602 may execute a number of well known algorithms associated with the operation of a docking station to which at least one type of patient monitoring device may be connected. In one embodiment, the controller 602 and motherboard 604 maybe positioned at substantially a horizontal center point within the inner cavity 601 of the housing 102.

A first connector 603 is coupled to the controller 602 for releasably connecting the first patient monitoring device to the docking station. The first connector 603 is shown in dashed lines to indicate its relative position within the housing 102 of the docking station 100 as being positioned over the recorder 634. It should be understood that the first connector 603 and recorder 634 are separate components. The first connector 603 is coupled to the motherboard 604 via a cable 605 (e.g. a flex circuit cable). The cable 605 is able to provide power to the first connector 603 as well as enable bidirectional communication of data between the motherboard 604 and the first connector 603.

A connection unit 610 is provided for coupling the second patient monitoring device to the docking station. The connection unit 610 establishes an optical-electrical connection between the second patient monitoring device and the controller 602 of the docking station. The connection unit 610 is positioned within the inner cavity 601 and adjacent to the front face 104 of the housing 102. Thus, the connection unit 610 is substantially aligned with the second connector 146 (in Figure 1) such that one of an optical and electrical signal provided from the second patient monitoring device may be received and processed by the connection unit 610. The signal transmission between the connection unit 610 and the second patient monitoring device is provided by an optical communication board 611 which is further connected and provides signals to the controller 602 for further processing thereof. The connection unit 610 further includes at least one cooler 613a and 613b (collectively referred to using reference numeral 613) for selectively cooling the second patient monitoring device when it is connected to the front face 104 of the docking station 100. The at least one cooler 613 is positioned closest to the front face 104 of the housing 102. In one embodiment, the at least one cooler 613 is a thermal electric cooling device that passively cools the second patient monitoring device by pulling heat away from an internal heatsink mounted to a surface connected to plate of the second connector 146 (Fig. 1). The connection unit 610 further includes at least one internal heatsink 615a and 615b (collectively referred to using reference numeral 615). The at least one internal heatsink 615 is positioned on a side of the at least one cooler 613 opposite the front face 104 of the housing. Thus, in operation, the at least one cooler 613 passively cools the second patient monitoring device connected to the housing and the heat is transferred to and dissipated by the at least one internal heatsink 615. As will be discussed later with respect to Figures 9 – 20, the heat dissipated by the internal heatsink 615 may flow from the inner cavity out through the at least one vent in the tray (138 in Figure 3).

A power board 606 provides power to each of the components contained in the inner cavity 601 of the docking station 100. Additionally, the power board 606 maybe coupled to the first connector which couples the first patient monitoring device to the docking station 100 and the connection unit 610 which couples the second patient monitoring device to the docking station 100. Thus, the power board 606 may provide power which is delivered to respective patient monitoring devices connected to the docking station 100 in the manner discussed above with respect to Figures 1 – 5. The power board 606 is positioned within the inner cavity 601 and adjacent to the back face 112 of the housing 102. Positioned on an opposite side of the back face 112 and externally on the housing 102 is the heatsink 115. The heat sink 115 effectively dissipates a predetermined amount of heat from within the inner cavity 601 that is generated by the power board 606 as well as all other components of the docking station 100. The power board 606 includes magnetics and active switching components 607 coupled thereto for dissipating heat during power regulation.

The docking station 100 further includes other ports and features that are common to a docking station that enables them to function in a healthcare environment. These features and connectors will be described briefly to complete the description of the internal arrangement of all components. However, these are not directly related to the present invention and need not be further explained. The docking station includes at least one video port 620 enabling connection of at least one display device to the docking station 100. The at least one video port 620 is coupled to the controller 602 via the motherboard 604 by a video connector 622. In one embodiment, the video port and video connector may be a DVI connector. The docking station 100 also includes a network port 624 for connecting the docking station 100 to one of a local area network and wide area network. A network connector 626 couples the network port 624 to the controller 602 via the motherboard 604. In the embodiment shown in Figure 6, the at least one video port 620 and video connector 622 is positioned adjacent the left face 106 of the housing 102 and between the motherboard 604 and power board 606. The network port 624 and network connector 626 is positioned adjacent the right side 108 of the housing between the motherboard 604 and power board 606.

A system connector 628 may be an interface that connects the docking station 100 to the healthcare enterprise infrastructure. For example, the system connector may provide a single point of connection for connecting the docking station 100 to a source of power. Additionally, the system connector 628 may further facilitate connection of the docking station to the healthcare information system such that data acquired from one of the first and second patient monitoring devices may be communicated to a central station for monitoring. Alternatively, the system connector 628 enables data acquired from one of the first and second patient monitoring devices to be communicated to a repository that stores patient specific data such as medical records.

The docking station 100 also includes a peripheral communication board 630 positioned adjacent the left face 106 of the housing 102 on a side of the motherboard 604 opposite the video port 620 and video connector 622. At least one peripheral port 632 is coupled to the peripheral communication board 630 and enables at least one peripheral device to be coupled to the docking station 100. In one embodiment, the at least one peripheral port 632 may be a connector facilitating connection with a peripheral device able to monitor additional patient parameters which may be a pulse oximetry monitoring device that selectively monitors the oxygen level in the blood of a patient. Other devices that may be selectively connected to the docking station 100 may include, but are not limited to, at least one of (a) an infusion pump; (b) a ventilator; (c) a gas monitoring device; and (d) remote control unit.

The docking station 100 also includes a recorder 634 which is connected to the motherboard 604 via a ribbon connector 636. The recorder 634 selectively enables a healthcare professional to print a copy of patient parameter data that has been monitored by one of the patient monitoring devices connected to the docking station. The recorder 634 is positioned between the connection unit 610 which connects the second patient monitoring device to the docking station and the motherboard 604. The recorder 634 advantageously enables a healthcare professional (e.g. nurse, doctor, etc) to generate a hard copy of particular patient parameter data for inclusion into a patient chart.

The arrangement of the components shown in Figure 6 and described above are laid out in such a manner to include all features of a typical docking station 100 that is positioned at the bedside of a patient. However, this layout advantageously includes the electronic components that enable the simultaneous connection of two different patient monitoring devices using two different connection interfaces to do so. Furthermore, the layout advantageously considers the amount of heat generated by the operation of these components and orients them in such a manner that the generated heat can be effectively dissipated using a plurality of heat dissipation mechanisms without negatively impacting the operation of either or both patient monitoring devices connected to the docking station 100.

Figure 7A is a block diagram of an embodiment of the docking station 100 according to invention principles. The docking station 100 includes the housing 102 that houses all components that enable the direct transfer and translation of a set of data between two patient monitoring devices connected to the docking station 100. The housing 102 includes connection ports (130 and 139 in Figure 1) for connecting a first patient monitoring device 702 and a second patient monitoring device 704 to the docking station 100. When the first patient monitoring device 702 and second patient monitoring device 704 are simultaneously connected to the docking station 100, the docking station 100 advantageously directly transfers a set of data (including patient parameter data and configuration data for configuring a patient monitoring device) from the first patient monitoring device 702 to the second patient monitoring device 704 (or vice versa). The direct transfer of the set of data occurs directly in the docking station 100 without needing to connect either patient monitoring device (702 and/or 704) to a remote system (e.g. HIS or central monitoring station). The following describes the manner and process for accomplishing the direct transfer and translation of a set of data between two patient monitoring devices 702, 704 by the docking station 100.

As discussed above, the controller 602 is the processing device that controls the operation of the docking station 100. A translator 703 is coupled to the controller 602 provides the electrical translation between the various components of the docking station 100 to enable communication between the different components thereof. A first connector 705 connects the first patient monitoring device 702 to the controller 602 via the translator 703. The connection unit 610, including the second connector (146 in Figure 1), connects the second patient monitoring device 704 to the controller 602 via the translator 703. A memory 708 is coupled to the controller 602 for storing data related to the transfer and translation between the first and second patient monitoring devices 702 and 704, respectively. In another embodiment, the first connector 705 and second connector 146 may be the same type of connector (e.g. both pin connectors or both optical-electrical connectors or any other type of connection mechanism able to transfer data from the respective patient monitoring device to the docking station). This advantageously enables two different patient monitoring devices employing the same mechanism for connecting to a docking station to have data transferred therebetween in accordance with any of the exemplary operations discussed below.

In a first exemplary operation, a set of data from a first patient monitoring device 702 may be translated and directly transferred to the second patient monitoring device 704 based on the sequential connection of the first patient monitoring device 702 and second patient monitoring device 704 to the docking station 100. Thus, in this embodiment, the first and second patient monitoring devices 702, 704 need not be simultaneously connected to the docking station 100. In this embodiment, the first patient monitoring device 702 may be coupled to the first connector 705 and, in response to user command, the set of data may be acquired from the first patient monitoring device 702 and stored in memory 708. The transfer may be completed upon connection of the second patient monitoring device 704 to the connection unit 610 whereupon the set of data stored in memory 708 is automatically retrieved by the controller 602 and provided to translator 703 for translation thereof. Once the translation has been completed, the translated set of data may be provided to the second patient monitoring device 704. Alternatively, the translation of the set of data received from the first patient monitoring device 702 may occur prior to storage in memory 708 and the stored translated set of data may be communicated to the second patient monitoring device 704 upon connection to the docking station 100. In a further alternative operation, there need not be any translation of data prior to providing the set of data to the patient monitoring device. This may occur if the set of data is being provided to a different one of the same type of patient monitoring device from which it has been acquired (e.g. first patient monitoring device to first patient monitoring device or second patient monitoring device to second patient monitoring device).

In another exemplary operation, the direct transfer and translation of a set of data from the second patient monitoring device 704 to the first patient monitoring device 702 will now be discussed. It should be noted that this is one exemplary directional transfer of the set of data and the operational principles described below apply to the opposite directional transfer from the first patient monitoring device 702 to the second patient monitoring device 704. The controller 602 selectively detects the presence of the first patient monitoring device 702 and/or the second patient monitoring device 704. To determine which of the devices 702 and 704 is currently configured to actively monitor at least one patient parameter, the controller 602 may poll the status of each the first patient monitoring device 702 and second patient monitoring device 704 requesting information about the respective devices activities. The status poll (and all other messages pass through the translator 703) which translates the format and protocol from a device specific format and protocol into a common format and protocol used by the controller 602. For simplicity and ease of understanding, unless otherwise stated, all communication between the controller 602 and the first patient monitor 702 is translated by the translator and communicated through the first connector 705. Similarly, for simplicity and ease of understanding, unless otherwise stated, all communication between the controller 602 and the second patient monitoring device 704 is translated by the translator 703 and communicated through the connection unit 610.

In this embodiment, the second patient monitoring device 704 is configured to actively monitor at least one patient parameter and, upon receiving the status poll from the controller 602, transmits an active status message indicating that it is currently actively monitoring the patient. The first patient monitoring device 702 similarly transmits an inactive status message indicating that it is currently not configured to monitor patient parameter data. The inactive status message may also include information indicating that the inactive monitoring device, although currently inactive, is able to receive and monitor patient parameter data.

The controller 602 may generate a transfer request message to determine if a transfer of the set of data (patient parameter and/or configuration data) is desired. The transfer request message is provided to the second patient monitoring device 704 for display on a monitoring device display screen to a user. Should a user desire to transfer the set of data from the second patient monitoring device 704 to the first patient monitoring device, the transfer may be initiated by activating an action button 150. In one embodiment, the action button 150 may be a hard button position on the housing 102 of the docking station 100. In another embodiment, the action button may be a hard button positioned on the housing of the patient monitoring device. In a further embodiment, the action button may be a user selectable image element displayed on a touch screen display of the respective patient monitoring device. In response to activating the action button, a transfer initiation message is generated by the active (second) patient monitoring device and provided to the controller 602 which determines that a transfer of the set of data is imminent and prepares the inactive (first) patient monitoring device to receive the set of data from the currently active (second) patient monitoring device. The controller 602 generates a data transfer request to receive the set of data from the currently active (second) patient monitoring device. The set of data received includes at least one of (a) patient identification data; (b) patient parameter data; and (c) configuration data.

Patient identification data includes a unique patient identifier used to identify the patient and all healthcare-related activities associated with the patient. Patient identification information may also include patient demographic information. Patient parameter data may include data representing at least one patient parameter that is currently being monitoring by the active patient monitoring device. In one embodiment, the patient parameter data may include electrocardiograph data. In another embodiment, the patient parameter data may include at least one of (a) blood pressure data; (b) respiration data; (c) temperature data; (d) trend data associated with a particular parameter or set of parameters; and (e) ECG morphology data. Configuration data may include data used to configure the type of data being monitoring by the patient monitoring data as well. Configuration data may also include data identifying a manner or method for monitoring a particular type of patient parameter. Configuration data may also include data representing at least one threshold associated with the type of data being monitored that would trigger an alarm notifying a healthcare professional of a potentially dangerous condition that needs to be addressed. Configuration data may further include data for configuring a display of parameters being monitored (e.g. color and position of waveforms, position of various parameters on a display screen, scaling, etc).

The data transfer request generated by the controller 602 also includes an alarm suppression message which selectively suppresses at least one alarm generated by the currently active (second) patient monitoring device. The alarm suppression message advantageously disables certain, non-essential alarms generated by the patient monitoring device that would be triggered by, for example, disconnecting cables therefrom. The alarm suppression message also prevents any alarm data from being transferred to the docking station which would typically further transfer the occurrence of the alarm to a central monitoring station.

In response to receiving the data transfer request message, the currently active (second) patient monitoring device transfers the set of data to the controller 602. The controller 602 automatically translates the set of data from the format and protocol associated with the second patient monitoring device into a different format and protocol that is associated with the first patient monitoring device. The controller 602 may use, for example, a mapping table that maps data in a first format and/or protocol associated with a first patient monitoring device into a second different format and/or protocol associated with a second different type of patient monitoring device. The controller 602, in real time, translates the set of data and communicates the translated set of data to the inactive (first) patient monitoring device thereby automatically changing the state of the device from inactive to a ready state indicating that the first patient monitoring device is being prepared to take over active monitoring of a patient. The translated set of data (which includes configuration data) enables the first patient monitoring device to configure itself to continue monitoring the patient in the same manner as was done by the second patient monitoring device. In another embodiment, the controller 602 may use the configuration data from the set of data received from the second patient monitoring device to automatically configure the monitor settings of the first patient monitoring device.

When the translated set of data has been communicated from the controller 602 to the first patient monitoring device in the “ready” state, the controller 602 generates a cable transfer message for display to a user that indicates that the cables connecting sensors to the patient should be disconnected from the second monitoring device and re-connected to the first patient monitoring device. The controller 602 detects the disconnection from the second patient monitoring device, generates a discharge message and communicates the discharge message to the second patient monitoring device. The discharge message automatically discharges the second patient monitoring device by deleting any and all patient specific data previously stored thereon and changes the status of the device from “active” to “inactive”. Simultaneously, the controller 602 detects that the cables have been connected to the first patient monitoring device and the status of the first patient monitoring device is changed from “ready” to “active” indicating that the first patient monitoring device is now actively responsible for monitoring patient parameter data.

In another embodiment, in response to detecting that the cables have been disconnected from the second patient monitoring device, the controller 602 may generate a reconfigure message which requests if a user would like to reconfigure the second patient monitoring device to monitor at least one other type of patient parameter thereby allowing simultaneous monitoring of the patient using both the first patient monitoring device and the second patient monitoring device. The reconfiguration message may be displayed to the user and, if the reconfiguration operation is activated, a user may selectively reconfigure the second patient monitoring device to monitor the at least one other patient parameter and also connect cables and/or sensors to the second patient monitoring device to facilitate the monitoring of the at least one other patient parameter.

In a further embodiment, the controller 602 may directly transfer data from an active (second) patient monitoring device to an inactive (first patient monitoring device upon detection of a characteristic associated with one of the first and second patient monitoring devices. The characteristic associated with the one of the first and second patient monitoring devices includes at least one of (a) a monitoring device identifier identifying a type of patient monitoring device; and (b) an ownership identifier that identifies an entity that owns the one of the first and second patient monitoring device. If the characteristic detected by the controller 602 match a pre-stored characteristic of the docking station, the controller 602 may directly transfer the data between monitoring devices.

In addition to the direct transfer and translation of data between patient monitoring devices, the docking station 100 facilitates other interaction with different peripheral devices and systems that are commonly associated with providing patient care in a healthcare enterprise such as a hospital. The controller 602 is connected to a hospital network, including its power grid, via the system connector 628. The system cable provides a single point of connection for the docking station 100 to connect to the hospital network. The system connector 628 provides power to the docking station (which is also provided to the respective patient monitoring devices) as well as enabling bidirectional communication between the docking station (and any monitoring device connected thereto) and a central monitoring station or other hospital information system. Thus, the set of data from a respective patient monitoring device may be communicated via network communication to the central monitoring station and/or hospital information system. Additionally, the recorder 634 is connected to the controller 602 enabling a user to selectively create a printed record of at least a subset of patient parameter data. The recorder engine 634 may be engaged using the operational keys (either fixed or soft keys) on a respective patient monitoring device. Further, the docking station includes a peripheral connection board 630 coupled to the controller that enables the connection of various peripheral devices to the docking station. The peripheral connection board 630 includes connection ports similar to those discussed above in Figure 6. Peripheral connection board 630 also may include a USB port enabling connection of any peripheral device to the docking station 100. In some instances, the peripheral connection board includes an isolator 631 coupled to certain peripheral connection ports thereby electrically isolating the devices connected to the docking station 100 via the ports.

Figure 7B is another embodiment of the docking station 100 according to invention principles. The embodiment of Figure 7B includes many similar components as those described above with respect to Figure 7A and those components having common reference numerals operate in a like manner. In this embodiment, the docking station includes a universal connector 720 that provides a single point of connection for a plurality of different types of docking stations, wherein each type of docking station has a unique type of connector. In this embodiment, a first type of patient monitoring device 702 having a first type of connector (e.g. a pin connector) may be connected to the universal connector 720. The universal connector 720 is able to align with all conductive elements of the first type of connecter and facilitate bidirectional communication between the first type of patient monitoring device 702 and the controller 602 of the docking station 100. A second type of patient monitoring device having a second type of connector (e.g. an optical-electrical connector) may also be connected to the universal connector 720. The universal connector 720 may also include mating optics and electrical contacts to mate with the second different type of connector on the second patient monitoring device 704.

In this embodiment, the first patient monitoring device 702 may be coupled to the universal connector 720 and, in response to user command, the set of data may be acquired from the first patient monitoring device 702 and stored in memory 708. The transfer may be completed upon disconnection of the first patient monitoring device 702 from the docking station and connection of the second patient monitoring device 704 to the universal connector 720 whereupon the set of data stored in memory 708 is automatically retrieved by the controller 602 and provided to translator 703 for translation thereof. Once the translation has been completed, the translated set of data may be provided to the second patient monitoring device 704. Alternatively, the translation of the set of data received from the first patient monitoring device 702 may occur prior to storage in memory 708 and the stored translated set of data may be communicated to the second patient monitoring device 704 upon connection to the docking station 100. In a further alternative operation, there need not be any translation of data prior to providing the set of data to the patient monitoring device. This may occur if the set of data is being provided to a different one of the same type of patient monitoring device from which it has been acquired (e.g. first patient monitoring device to first patient monitoring device or second patient monitoring device to second patient monitoring device).

In a further embodiment, an adapter may be used when connecting each respective type of patient monitoring device 702 and 704 to the universal connector 720. In this embodiment, in view of the different types of connectors associated with various monitoring devices, an adapter for each type of connector may be provided and coupled between the respective patient monitoring device 702, 704 and the universal connector 720. For example, if the first type of connector is a pin connector wherein signals are communicated via various conductors coupled to various pins, the adapter, at one end, includes a mating pin connector (e.g. similar to the connector shown and described in Fig. 11). At an opposite end, the adapter may include any type of connector that mates with the universal connector 720. This advantageously enables the configured path for communicating signals to remain the same despite the different types of connectors.

Figures 8A – 8D represent exemplary algorithms used in the direct transfer and translation of a set of data from one patient monitoring device to a second different patient monitoring device when both are connected to a single docking station such as shown in Figures 1 – 7. These algorithms are described as individual processes, however, it should be understood that any of the algorithms in Figures 8A – 8D may be combined into a single data transfer algorithm.

Figure 8A represents an exemplary transfer and translation algorithm. In step 802, the controller detects the presence of two patient monitoring devices connected thereto. In step 804, the controller determines which of the patient monitoring devices is currently actively monitoring patient parameter data. In step 806, a query to the user requesting whether a transfer and translation of data should occur. If the result of the query in 806 is negative, then controller instructs the active patient monitoring device to continue monitoring the patient in step 807. If the result of the query in 806 is positive, the controller 602 initiates the transfer and translation of data from the active patient monitoring device to the inactive patient monitoring device in step 808. The controller 602 also suppresses at least one alarm associated with one patient parameter being monitored by the active patient monitoring device. In one embodiment, the suppression of the at least one alarm may last for a predetermined amount of time (e.g. 5 minutes). For example, if the patient monitoring device was an ECG monitoring device, the controller may suppress alarms relating to a “lead off” condition and asystole. In this embodiment, certain other alarms such as for vfib and/or vtach would not be suppressed. This advantageously would aid in preventing a caregiver from having to silence nuisance alarms as well as preventing these alarms from propagating to the central station. In step 812, the controller receives and translates the set of data from the active patient monitoring device and provides the translated data to the inactive patient monitoring device in step 813. The inactive monitoring device is configured (either by itself in response to receiving the translated set of data or by the controller) to be the active patient monitoring device in step 814. Step 814 may also include transferring the cables that connect sensors to the patient from the previously active patient monitoring device to the newly configured active patient monitoring device. Thereafter, the controller 602 discharges, in step 816, the formerly active patient monitoring device resulting in all patient specific data being deleted therefrom thereby enabling the monitoring device to be connected to an used by another patient.

Figure 8B is another algorithm detailing a further aspect of the transfer and translation algorithm of Figure 8A. In step 820, the controller selects a subset of data from the set of data being transferred from an active patient monitoring device to an inactive patient monitoring device. In one embodiment, the subset of data selected in step 820 includes patient parameter data associated with at least one patient parameter being monitored. Moreover, the subset of data may be selected from a predetermined period of time (e.g. the most recent 1 minute of data). The controller identifies the selected subset of data as consistency metric in step 822. In step 824, once the newly configured active patient monitor begins to monitor patient data, the controller detects the newly monitored patient parameter data and compares the newly monitored patient parameter data to the consistency metric. In step 826, the controller determines if the newly monitored data is substantially similar to the data included in the consistency metric. If the determination in step 826 is negative, a determination is made in step 827 as to whether or not this is a first or second time that a match was not detected. If the determination in step 827 indicates that this is the first time, the process returns to step 824. If the determination in step 827 is that this the second time, then a notification is provided to a caregiver to address the inconsistency in step 829. If the determination in step 826 is positive, the controller, in step 828, generates a consistency message which is provided to the user and indicates that the transfer of the data is complete and the transfer, translation and subsequent monitoring of the patient was successful.

By implementing the algorithm of Figure 8B the controller looks for patient parameter values to be the same on all parameters which would indicate that the transfer is complete and all parameters are consistent. This advantageously enables the caregiver to feel confident that the transfer was done properly and the trending information could be marked with dotted lines showing that parameters were most likely stable during that period when the patient was disconnected from the monitoring devices. On the other hand, if the parameter values are not all the same before and after the transfer, the controller may provide an indication to the caregiver that the transfer is complete but that certain parameters have changed and the caregiver could look into reasons why the certain parameters have changed.

Figure 8C provides an algorithm further describing an aspect of receiving, translating and transferring the set of data in Figure 8A. In step 840, patient parameter data is provided for display to a user on a secondary display device. In one embodiment, the secondary display is directly connected to the docking station. In another embodiment, the secondary display is located remotely from the docking station, for example, over a network. In step 842, the controller identifies a number and type of patient parameter being monitored and identifies a source of each patient parameter being monitored. At this time, since the patient parameter data is being monitored by a first patient monitoring device, the source of the patient parameter data is the first patient monitoring device. In step 844, a determination as to whether or not a transfer from the first patient monitoring device to a second patient monitoring device has been initiated. If the determination in step 844 is negative, the algorithm continues to display the patient parameter data on a secondary display. If the determination in step 844 is positive, the controller initiates the transfer and translation process in step 846. In step 848, the controller identifies respective patient parameters being monitored and sequentially transfers each identified respective patient parameter from the first patient monitoring device to the second patient monitoring device. In step 850, the controller modifies the source data associated with each patient parameter as they are being transferred. The controller uses the modified source data in providing the patient parameters to the secondary display in step 852. Thus, the docking station could fill in data representing respective patient parameters (e.g. waveforms) from a combination of monitors until the transfer is complete. In other words, as the transfer was being performed all of the waveforms would originally be sourced from a first monitor. Then, as the first parameter was translated and transferred to the second monitor the secondary display would have one waveform from the destination patient monitor and other waveforms from the original patient monitoring device from which the data is being transferred. Eventually all of the waveforms would be sourced from the second patient monitoring device to which the data has been transferred. This advantageously prevents the loss of waveforms and/or trend indicative data while all of the parameters are switched. Instead, only the particular parameter is lost for a limited time as the data is transferred between monitors.

Figure 8D is an exemplary algorithm of an aspect of the transfer and translation process implemented by the docking station according to invention principles. In step 860, the controller initiates a transfer and translation process for transferring the set of data from the first patient monitoring device to a second patient monitoring device. In step 862, the controller maintains a connection between the docking station and a remote system such as a central monitoring station or HIS. Step 862 advantageously enables bed labeling and central station discovery in docking station because the docking station remains connected to the remote system (e.g. central station) without interruption during transfer. This is particularly advantageous because in previous systems where the different monitoring devices had two different docking stations, the central station first loses the patient as it is discharged from one monitor and regains the patient when the patient is reconnected to the second monitoring device docked in the second docking station. In the present system, any remote system or central station is unaware that the monitor monitoring the patient has been switched. In step 864, once the transfer has been completed, the patient parameter data being monitored on the second patient monitoring device is provided to the remote system/central station enabling continuous monitoring of the patient parameter data.

The process of simultaneously connecting two patient monitoring devices and directly transferring data therebetween as discussed above in Figure 1 – 8 results in an increased amount of heat being generated within the housing of the docking station. It is therefore desirable to improve the dissipation of heat from the inner cavity of the docking station in order to minimize wear and tear on the components of the docking station as well as the patient monitoring devices. Figures 9 – 19 illustrate an inventive mechanism for improving the heat dissipation from within the inner cavity of the docking station when one or more patient monitoring devices are connected thereto.

Figure 9 is a perspective view of the docking station 100 according to invention principles. As Figure 9 represents a different view of the same docking station discussed above with respect to Figures 1 – 8, the description of such will not be repeated and it should be understood that the same elements described in Figures 1 – 7 are present in the following figures. Instead, the following description will relate to elements that improve the dissipation of heat from within the inner cavity of the docking station 100.

Figure 9 shows the first section 120 and second section 122 of the housing 102. The top side 109 of the housing 102 includes the tray 138 adjacent to the front face 104. The tray 138 includes the plurality of recesses/openings that represent the vent 137. The openings of the vent 137 provide access into the inner cavity of the housing 102. These vent openings advantageously enable heat generated by components within the housing 102 to flow out therefrom. The direction of heat flow is illustrated by the arrow labeled with reference numeral 902. Thus, any heat generated by the operation of any components within the docking station (e.g. components shown in Figures 6 & 7) flows out from an inner cavity of the housing 102 in direction 902. For example, heat may be generated when the set of data is being translated and transferred between patient monitoring devices. Heat may also be generated by an internal cooling unit used to cool the second patient monitoring device connected at the second port 139 such that the heat dissipated from the second patient monitoring device is dissipated into the inner cavity of the docking station 100 and is caused to flow in direction 902 outward therefrom via the recesses of the vents 137. Heat will continue to flow in direction 902 and into the first patient monitoring device connected to the docking station 100 at the first port 130. This flow of heat will be further illustrated in Figure 11. Additional heat dissipation is achieved by the heatsink 115 coupled to the back face 112 of the housing 102.

In one exemplary operation, a patient monitoring device may be connected within the second port 139. The connection with the second port enables power to be provided to the patient monitoring device from the docking station as well as the bidirectional communication between the patient monitoring device and the docking station. In this embodiment, the patient monitoring device is coupled by optical-electrical connection to the docking station via the connection unit (610 in Figure 6). The connection unit may include passive cooling such as thermal electric cooling and a heatsink for dissipating heat. Thus, the heat dissipated from the connection unit 610 may concentrate within the inner cavity of the housing adjacent the front face 104. However, the tray 138 is positioned in substantial alignment with the connection unit enabling heat generated by the connection unit (and other components of the docking station) to flow through the recesses 137 forming the vents. Thus, when only a single patient monitor device is connected via the second port 139, the vent 137 in the tray 138 enables the heat to escape the inner cavity of the housing 102.

Figure 10 is another perspective view of an embodiment of the docking station 100 according to invention principles. The docking station 100 includes a mounting plate 156 that is connected to the bottom face 110 of the housing 102. The mounting plate 156 may be formed in any manner that enables the docking station 100 to be mounted to a surface of any kind. The mounting plate 156 may be secured to the housing 102 by a plurality of spaced connectors 158 thereby creating a predetermined distance between the bottom face 110 of the housing 102 and the mounting plate 156 which allows air to flow between the mounting plate 156 and the bottom face 110 of the housing. In this view, the housing 102 includes at least one underside vent 152 that allow for ambient air to flow into the housing 102. The directional flow of air into the housing and through the at least one underside vent is illustrated by arrow 154.

Preferably, the air flowing into the housing is cooler than the air within the housing 102. Moreover, the heat generated by the electrical components in the housing 102 further heats the air and creates a more powerful chimney effect in view of the vents described above in Figure 9 and those in the first patient monitoring device described below in Figures 11 – 14. Also shown in Figure 10, is the second port 139 including the channel 140. The first protrusion 142 extends at least partially into the channel 140. The first protrusion 142 mates with a corresponding indent on the patient monitoring device received within the channel 140 and partially securing the patient monitoring device within the channel 140. The second connector 146 mates with a corresponding connector on a rear side of the patient monitoring device establishing an optical-electrical connection between the patient monitoring device and the docking station 100 via plate 146. In an optional embodiment, to further facilitate heat dissipation, the first protrusion 142 may include a series of openings 145 representing another vent that allows heat generated within the patient monitoring device to flow through the inner cavity of the housing 102 and out from the vent 137 in the tray 138 as shown in Figure 9. Thus, the vent 137 in the tray 138 acts as a chimney allowing the greater concentration of heat from within the inner cavity to flow in a direction 902 (Fig. 9) out through the vent 137 where the ambient air is cooler. Furthermore, as the amount of heat in the inner cavity increases, the amount of heat dissipation and transfer is increased. In one optional embodiment, the openings 145 extending through the first protrusion 142 mate with corresponding vent openings (see Figures 16 – 19) on the patient monitoring device positioned within the channel 140. The mating of these vents further facilitate the chimney effect generated by the positioning of the vents 145 and 137 in the housing 102.

A further problem arises because the docking station 100 not only enables the connection of a patient monitoring device within the second port 139, but also enables connection of a first patient monitoring device to the first port 130 on the top side 109 of the housing as shown in Figure 9 (and elsewhere). Thus, when the first patient monitoring device is connected via the first port 130, the first patient monitoring device rests within the tray 138 and atop the vent 137. However, the docking station makes use of an inventive housing design for the first patient monitoring device which enables the chimney effect heat dissipation to still occur despite the first patient monitoring sitting in the tray 138 and on top of the vent 137.

An exemplary embodiment of the first patient monitoring device 702 is shown in Figure 11. The first patient monitoring device 702 includes a housing 1101 having a rear face 1102. The rear face 1102 includes a plurality of openings extending through the housing 1101 providing pathways for air and heat to circulate into and out of the first patient monitoring device. The housing 1101 includes a bottom face 1108. The bottom face 1108 of the first patient monitoring device 702, when connected to the docking station, is positioned adjacent to the top side 109 of the first section 120 of the docking station 100 as shown in Figure 9. The bottom face 1108 includes a track 1114 having a connector 1116 positioned therein. The track 1114 is substantially the same shape and size of the first port 130 on the top side 109 of the docking station 100. The manner in which the first patient monitoring device 702 engages the locking mechanism of the first port 130 is discussed above and need not be repeated. When connected to the first port 130 of the docking station, the connector 1116 extends through the opening created by the downward pivot of the door 132 (Fig. 1) to mate with the first connector in the docking station 100.

The rear face 1102 and bottom face 1108 of the first patient monitoring device 702 include a plurality of vents 1122. The vents 1122 extends through the bottom face 1108 and are substantially aligned with the vents 137 in the tray 138 of the docking station 100. Thus, the heat from the inner cavity of the docking station represented by the directional arrow labeled 902 in Figure 9 may flow through the vents 137 in the tray 138 and into an inner cavity of the first patient monitoring device 702 illustrated by directional arrow 902a via the vents 1122 on the bottom face 1108 thereof. Moreover, as the first patient monitoring device 702 includes electronic components for use in monitoring at least one patient parameter, additional heat is generated further increasing the concentration of heat present in the inner cavity of the first patient monitoring device 702. The chimney effect continues to operate because the heat is able to flow in a direction away from the docking station illustrated by directional arrow labeled 902b where the air temperature is cooler by flowing out of the vents 1122 on the rear face 1102 and top side 1110 (as shown in Figure 13). Thus, the positioning of the vents 137 on the docking station 100 in conjunction with the position of the vents 1122 on the respective patient monitoring devices leverages the chimney effect and further improves the dissipation of heat that is generate when two patient monitoring devices are connected to the docking station.

Figure 12 is a view of the bottom face 1108 of the first patient monitoring device 702. As can be seen herein, the bottom face 1108 includes a plurality of vents extending therethrough. A first set of vents 1122a is positioned adjacent the front face 1103 of the first patient monitoring device 702. The first set of vents 1122a may be substantially aligned with the vents 137 in the tray 138 when the first patient monitoring device 702 is connected to the docking station 100 via the first port 130. The substantial alignment of these vents 137 and 1122a provides a direct path for heat to flow causing the chimney effect to occur thereby removing heat from within the inner cavity of the docking station and the inner cavity of the first patient monitoring device 702. A second set of vents 1122b extends through the bottom face 1108 and is positioned between the first set of vents 1122a and the rear face 1102 of the first patient monitoring device 702. These vents 1122a and 1122b are intake ports allowing air to flow into the first patient monitoring device 702. The air flowing through vents 1122a include air escaping the inner cavity of the docking station where as air flowing through vents 1122b allows cooler ambient air to flow into the first patient monitoring device 702 due to the width of the first patient monitoring device 702 being greater than a width of the docking station. Additionally, the second set of vents open into the ambient air and direct the heat away from the top side of the docking station.

Figure 13 is a top view of the first patient monitoring device 702. The top view illustrates the top face 1110 of the first patient monitoring device 702. The top face 1110 includes a third set of vents 1122c extending though the housing 1101. The third set of vents 1122c may be substantially aligned with the first set of vents 1122a on the bottom face 1108 (Fig. 12) of the first patient monitoring device. The heat from within the inner cavity of the first patient monitoring device 702 that was one of generated by components of the first patient monitoring device and originated from within the inner cavity of the docking station may selectively flow out through the third set of vents 1122c on the top face 1110 into the ambient air which has a temperature lower than a temperature of the air within the first patient monitoring device 702.

Figure 14 represents a front view of the first patient monitoring device 702. As shown herein, the first patient monitoring device 702 includes a display screen 1121 positioned on the front face 1103 of the housing. Also shown are a plurality of buttons 1120 for controlling various functions of associated with monitoring at least one patient parameter. The display screen 1121 selectively displays data representing at least one patient parameter being monitored by the first patient monitoring device 702. Additionally, during the transfer operation, the display screen 1121 may selectively display messages generated by the controller (602 in Fig. 6) associated with transferring a set of data from a second different patient monitoring device to the first patient monitoring device. In one embodiment, the first patient monitoring device is a bedside patient monitoring device that is coupled directly to the hospital systems and which can monitor a plurality of different patient parameters via various patient connected sensors.

Figures 15 – 18 represent different view of the second patient monitoring device 704 that may be connected to the docking station via the second port 139 (Fig. 1). In one embodiment, the second patient monitoring device 704 is a battery powered patient monitoring device that is easily transportable around a healthcare enterprise such as a hospital as well as between different healthcare enterprises. In this embodiment, the second patient monitoring device 704 is sealed from the external environment and is able be submerged in water (e.g. IPX7 compliant) and include a thermal electric cooling mechanism such as the one described above with respect to Figure 6. As shown in Figure 15, the second patient monitoring device 704 includes a housing 1501 having a front face 1502, a right face 1504, a left face 1506, a top face 1507, a bottom face 1508 and a rear face 1503. The front face 1502 includes a display screen 1510 for display data representing at least one patient parameter being monitored. The display screen 1510 may include a plurality of soft keys 1512a and 1512b disposed on each side thereof. These soft keys may be selectively programmed to operate a particular function associated with monitoring patient parameters. Additionally, these soft keys may maintain their initially programmed function despite the orientation of the second patient monitoring device. Positioned on a right face 1504 of the second patient monitoring device 704 is at least one cable connector 1514 enabling connection of at least one type of patient connected sensor for sensing physiological signals from a patient and deriving patient parameter information therefrom.

The top face 1507 and bottom face 1508 includes respective indents 1520a and 1520b. The indents 1520a and 1520b are substantially aligned with one another and mate with the first protrusions 142 and second protrusion 144 within the channel 140 on the front face 104 of the docking station 100 (see Fig. 1). In one optional embodiment, positioned within the indents 1520a and 1520b, are first vents 1522a and

1522b. These vents may enable heat generated by the components within the second patient monitoring device to flow out therethrough. Moreover, when the second patient monitoring device 704 is positioned within the channel 140, a respective one of the vents 1522a or 1522b, align with the optional vents 145 on the first protrusion 142 of the docking station (Fig. 10). In this optional embodiment, heat is able to flow out from the vents 1522a or 1522b of the second patient monitoring device 704 and into the docking station 100 via the vents 145 in the first protrusion. This further concentrates the heat in the inner cavity of the docking station and improves the chimney effect created by the venting system described herein. It is important to note that the second patient monitoring device 704 may be inserted into the channel 140 with either the top side 1507 or the bottom side 1508 contacting the first protrusion 142 in the channel.

Figure 16 is a rear view of the second patient monitoring device 704. The rear face 1503 of the housing 1501 includes the connector 1530 for creating an optical-electrical connection between the second patient monitoring device and the docking station. The connector 1530 includes optical ports 1531 and electrical contacts 1533. These optical ports mate with the optical ports in the second connector 146 on the front face of the docking station (in Figure 1). Figure 17 and 18 represent top and bottom views of the second patient monitoring device 704, respectively. The top face 1507 of the housing 1501 is shown in Figure 17 including the optional vents 1522a within the indent 1520a. The bottom face 1508 of the housing 1501 is shown in Figure 18 and includes the optional vents 1522b within the indent 1520b.

Turning now to Figure 19, an illustration showing the orientation and interconnection between the first and second patient monitoring devices and the docking station is provided. The first patient monitor 702 is oriented such that its bottom face 1108 is positioned adjacent the top side 109 of the docking station 100. The first patient monitoring device 702 is connected to the docking station via the first port 130 such that it at least partially rests within the tray 138 enabling respective vents on the docking station and first patient monitoring device to be in substantial alignment with one another. The second patient monitoring device 704 is connected to the docking station 100 via the second port 139. The second patient monitoring device 704 is received within the channel 140 and oriented such that a rear face 1503 of the second patient monitoring device 704 contacts a front face 104 of the docking station 100. In the embodiment where both the second patient monitor device 704 and the channel 140 include vents, the connection of the second patient monitoring device 704 to the docking station results in the substantial alignment of these vents. Once connected in this manner, the docking station 100 is able to provide power to both the monitoring devices as well as engage in bidirectional communication with both monitoring devices. The docking station 100 is also connected to a remote system via a system connector 2002. The system connector 2002 provides power to the docking station as well as network connectivity for the docking station 100. Further as shown herein, the docking station 100 may be mounted to a surface (not shown) via a mount 2004. This is described for purposes of example only and the docking station 100 may be positioned near a bedside of a patient using any securing means including, but not limited to a stand, cart or other stand alone mounting mechanism.

Once connected as shown in Figure 19, the docking station 100 may facilitate the direct transfer of data from one patient monitoring device to another without notifying a central station or HIS of the transfer. This advantageously saves time associated with transferring patients to different monitors because the patient identification and location in the healthcare enterprise is not affected. Furthermore, the docking station can transfer the data in real time and allows for the monitor from which the data is being transferred to be one of discharged for use by another patient or reconfigured to monitor additional patient parameter data not able to be monitored by the other patient monitoring device.

Furthermore, this interconnection of the two patient monitoring devices with the docking station 100 results in the generation of heat within the inner cavity of the docking station. One exemplary operation that generates heat within the docking station 100 is the cooling of the second patient monitoring device connected at the second port 139. The heat dissipation mechanism is positioned within the inner cavity of the housing resulting in the dissipation of heat from the second patient monitoring device 704 into the docking station. Another exemplary operation that may generate heat within the docking station may result from the direct transfer and translation of data between the first and second patient monitoring devices. Additionally, heat may be generated by any operation of the docking station including but not limited to at least one of (a) monitoring of at least one patient parameter by either or both the first patient monitoring devices 702 and second patient monitoring device 704; and (b) communication with a remote computing system. Thus the heat generated is represented by the arrow labeled 1900 which originates within the docking station 100 and flow in the direction of arrow 1900 through the vents 137 in the tray 138 and into the first patient monitoring device an outward therefrom providing a chimney effect for dissipating heat from within the docking station.

It will be understood that each of the elements described above, or two or more together may also find a useful application in other types of devices differing from the type described above.

While certain novel features have been shown and described and are pointed out in the annexed claims, it is not intended to be limited to the details above, since it will be understood that various omissions, modifications, substitutions and changes in the forms and details of the device illustrated and in its operation can be made by those skilled in the art without departing in any way from the spirit and scope of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

CLAIMS

We claim,

1. A docking station that enables the simultaneous connection of two patient monitoring devices comprising

a housing that selectively supports two patient monitoring devices thereon;

a first port positioned on the housing for receiving a first patient monitoring device therein;

a second port positioned on the housing for receiving a second patient monitoring device therein;

at least one vent extending through the housing and positioned between the first patient monitoring device and second patient monitoring device; and

a plurality of electrical components positioned in the housing that connects each of the first and second patient monitoring device to the docking station and controls the operation of the docking station, wherein heat generated by the plurality of electrical components flows out of the housing via the at least one vent.

2. The docking station according to claim 1, wherein

the at least one vent is positioned between the first port and second port.

3. The docking station according to claim 1, wherein

the plurality of electrical components include:

a controller that enables direct transfer of data between the two patient monitoring device and,

a connection unit including a cooling device that selectively connects one of the two patient monitoring devices to the controller and passively cools the one of the two patient monitoring devices.

4. The docking station according to claim 2, wherein

the connection unit is positioned in the housing substantially vertically aligned with the at least one vent thereby enabling the heat dissipated by the passive cooling of the one of the two patient monitoring devices to flow out of the housing through the at least one vent.

5. The docking station according to claim 1, wherein

a first patient monitoring device connected to the first port includes a housing having at least two vents, one of the at least two vents being aligned with the at least one vent extending through the housing, wherein the heat generated by the plurality of electrical components in the housing flows out of the housing from the at least one vent into the first patient monitoring device via the one of the at least two vents.

6. The docking station according to claim 2, wherein

a first patient monitoring device connected to the first port includes a housing having at least two vents, one of the at least two vents being aligned with the at least one vent extending through the housing, wherein the heat generated by the plurality of electrical components including the connection unit and controller in the housing flows out of the housing from the at least one vent into the first patient monitoring device via the one of the at least two vents.

7. The docking station according to claim 1, further comprising

a heat sink positioned on an external surface of the housing for further dissipating the heat generated by the plurality of electrical components.

8. A method of cooling a docking station that enables the simultaneous connection of two patient monitoring devices comprising the activities of

receiving a first patient monitoring device at a first port positioned on a housing of the docking station;

receiving a second patient monitoring device at a second port positioned on the housing;

enabling heat generated by a plurality of electrical components positioned in the housing that connects each of the first and second patient monitoring device to the docking station and controls the operation of the docking station to flow out of the housing via at least one vent extending through the housing and being positioned between the first patient monitoring device and second patient monitoring device.

9. The method according to claim 8, wherein

the plurality electrical components include:

a controller that enables direct transfer of data between the two patient monitoring device and,

a connection unit including a cooling device that selectively connects of the two patient monitoring devices to the controller and passively cools the one of the two patient monitoring devices.

10. The method according to claim 7, further comprising

aligning the connection unit in the housing substantially vertically with the at least one vent; and

enabling the heat dissipated by the passive cooling of the one of the two patient monitoring devices to flow out of the housing through the at least one vent.

11. The method according to claim 7, wherein

the first patient monitoring device connected to the first port includes a housing having at least two vents, and further comprising

aligning one of the at least two vents with the at least one vent extending through the housing when the first patient monitoring device is connected to the first port; and

enabling the heat generated by the plurality of electrical components in the housing to flows out of the housing from the at least one vent into the first patient monitoring device via the one of the at least two vents.

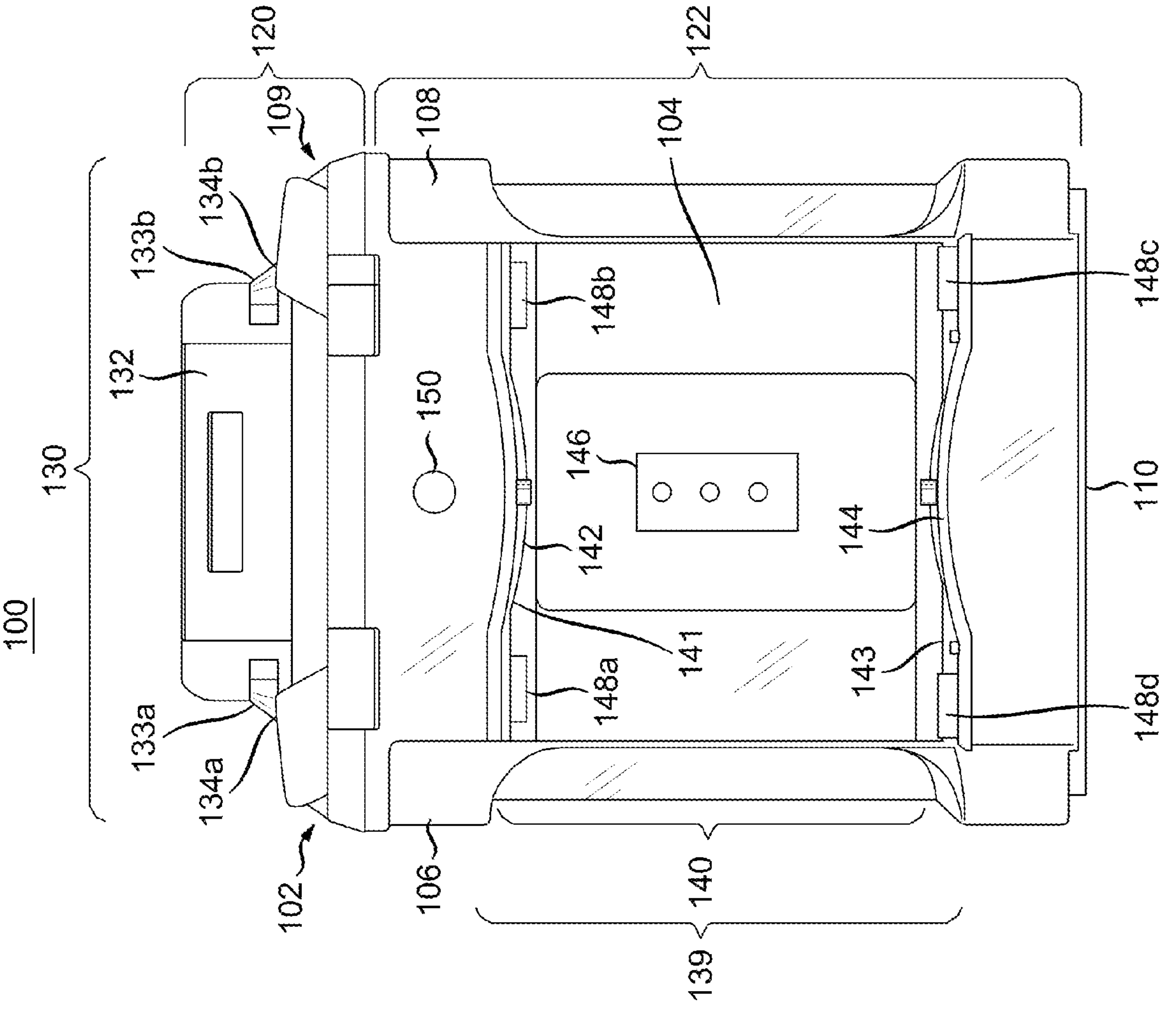
12. The method according to claim 9, wherein

the first patient monitoring device connected to the first port includes a housing having at least two vents, and further comprising

aligning one of the at least two vents with the at least one vent extending through the housing when the first patient monitoring device is connected to the first port; and enabling the heat generated by the plurality of electrical components including the connection unit and controller in the housing flows out of the housing from the at least one vent into the first patient monitoring device via the one of the at least two vents.

13. The method according to claim 7, further comprising

dissipating the heat generated by the plurality of electrical components via a heat sink positioned on an external surface of the housing.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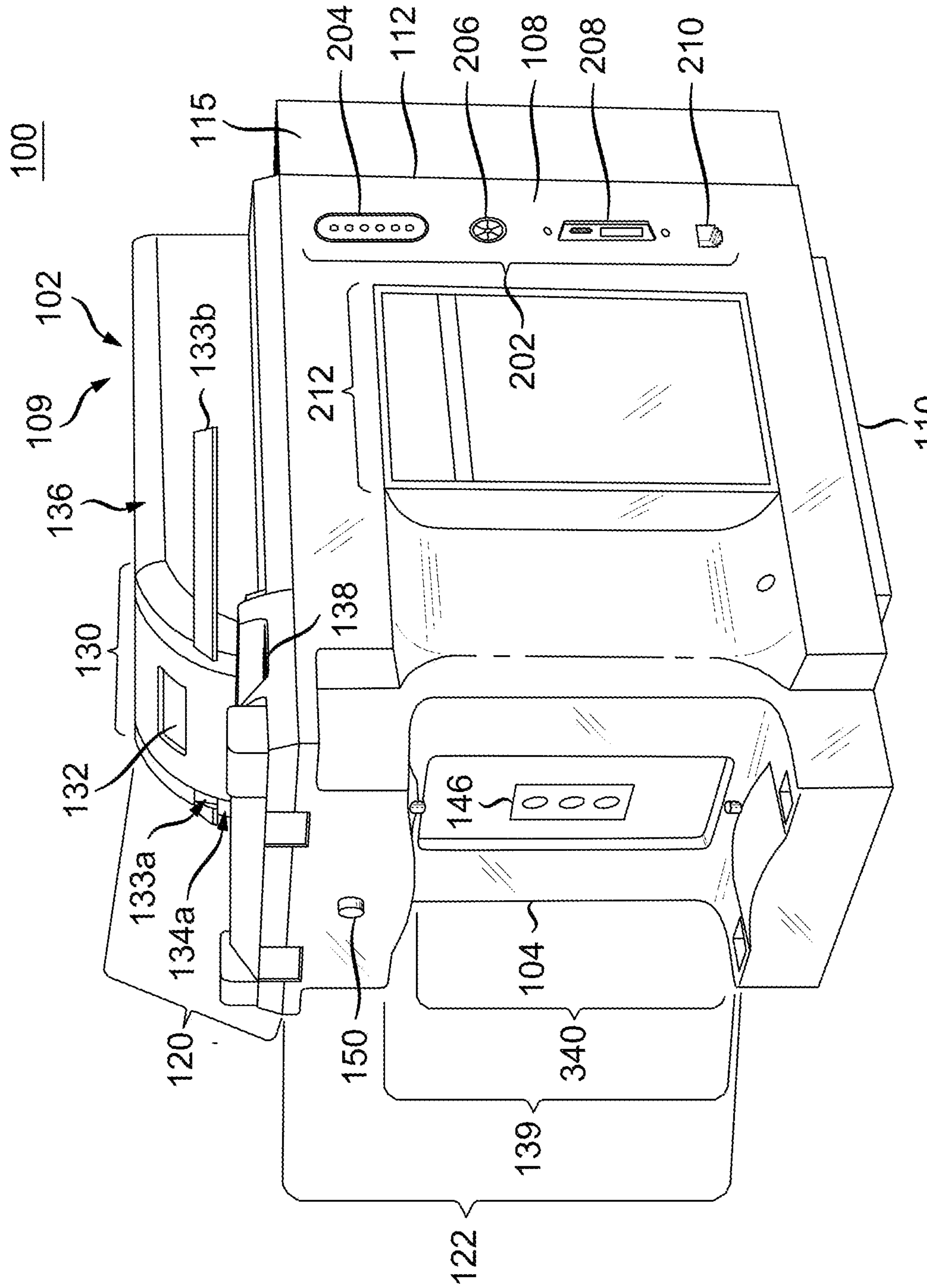
120
122
109
108
104
134b
133b
132
150
146
148b
148c
142
144
141
143
148a
148d
133a
134a
102
106
140
139
110

Fig. 1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109
136
130
132
133a
134a
133b
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112
115
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110
146
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104
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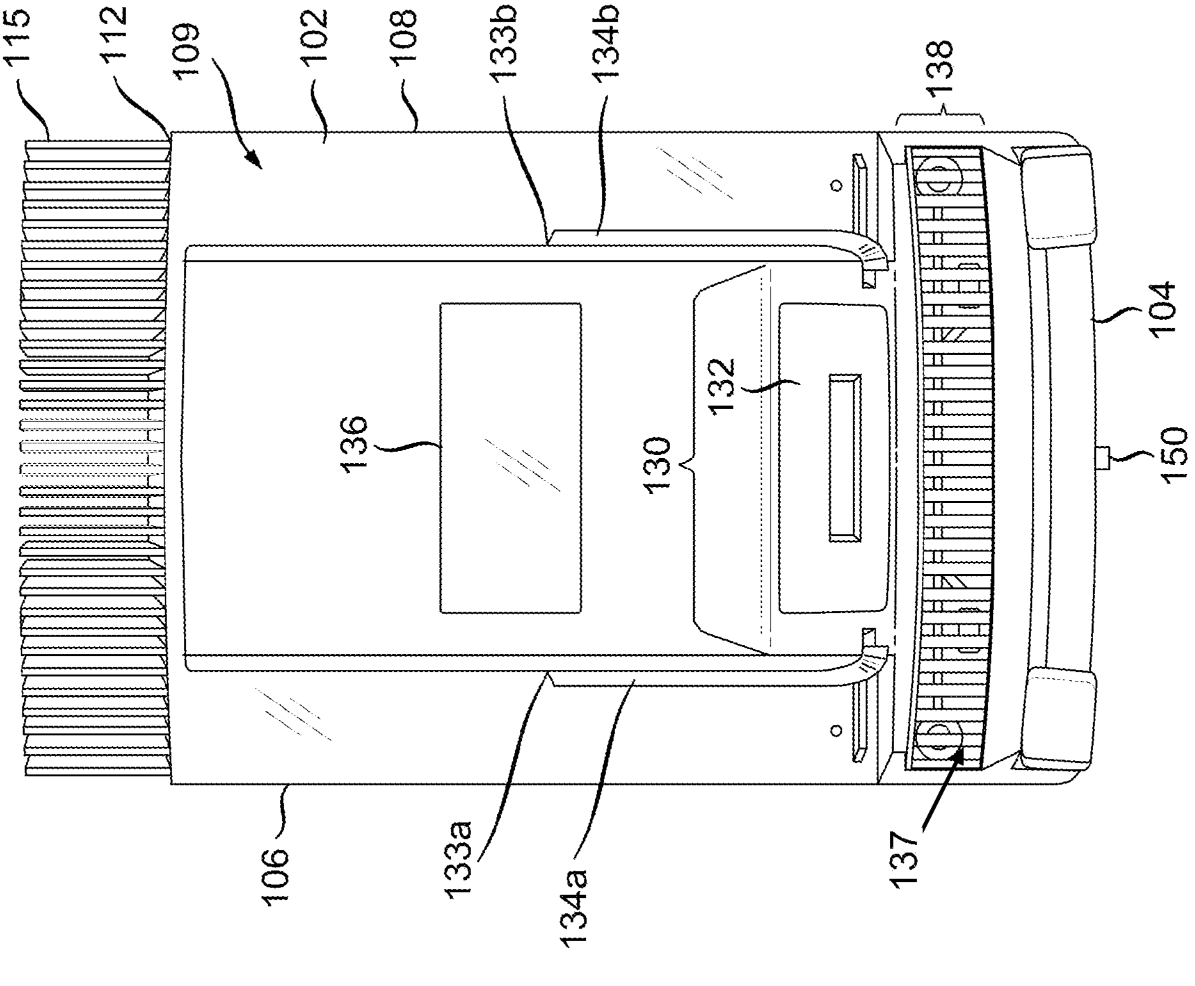
139
122

Fig. 2


115
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108
133b
134b
138
104
150
132
130
136
106
133a
134a
137

Fig. 3

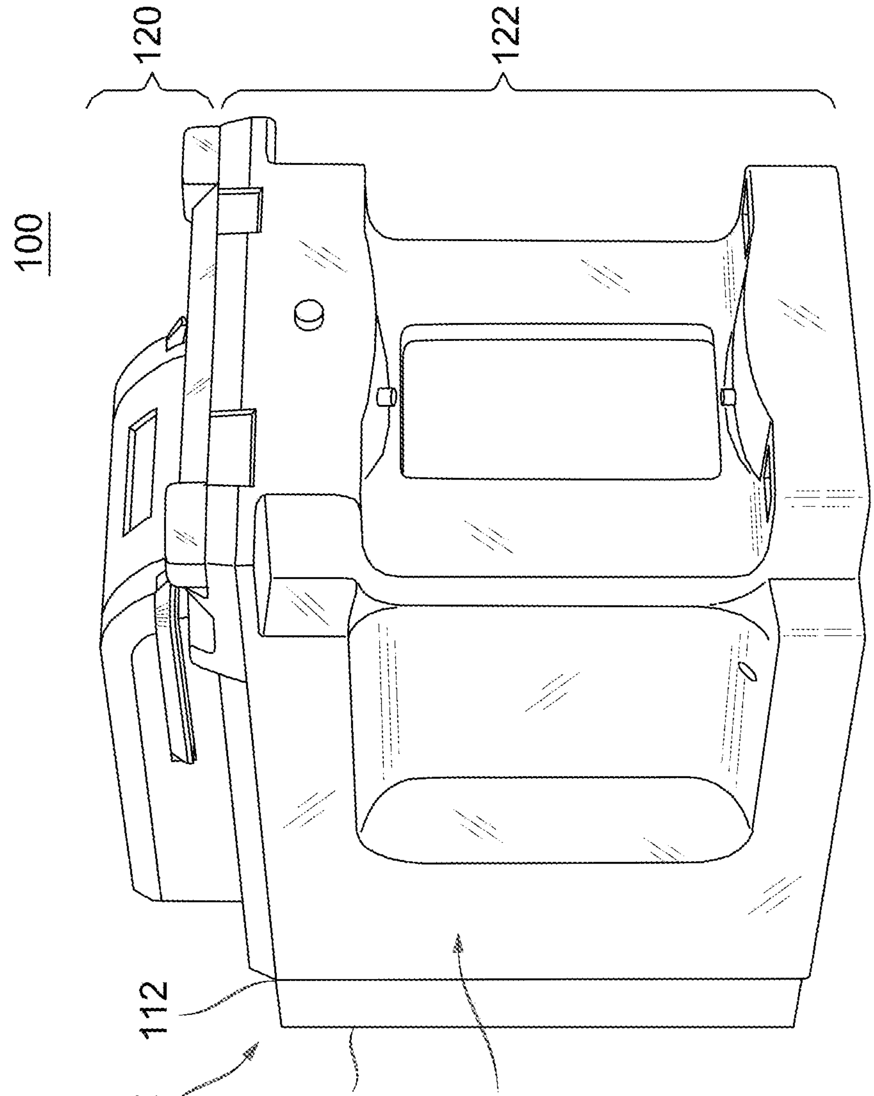

Fig. 4

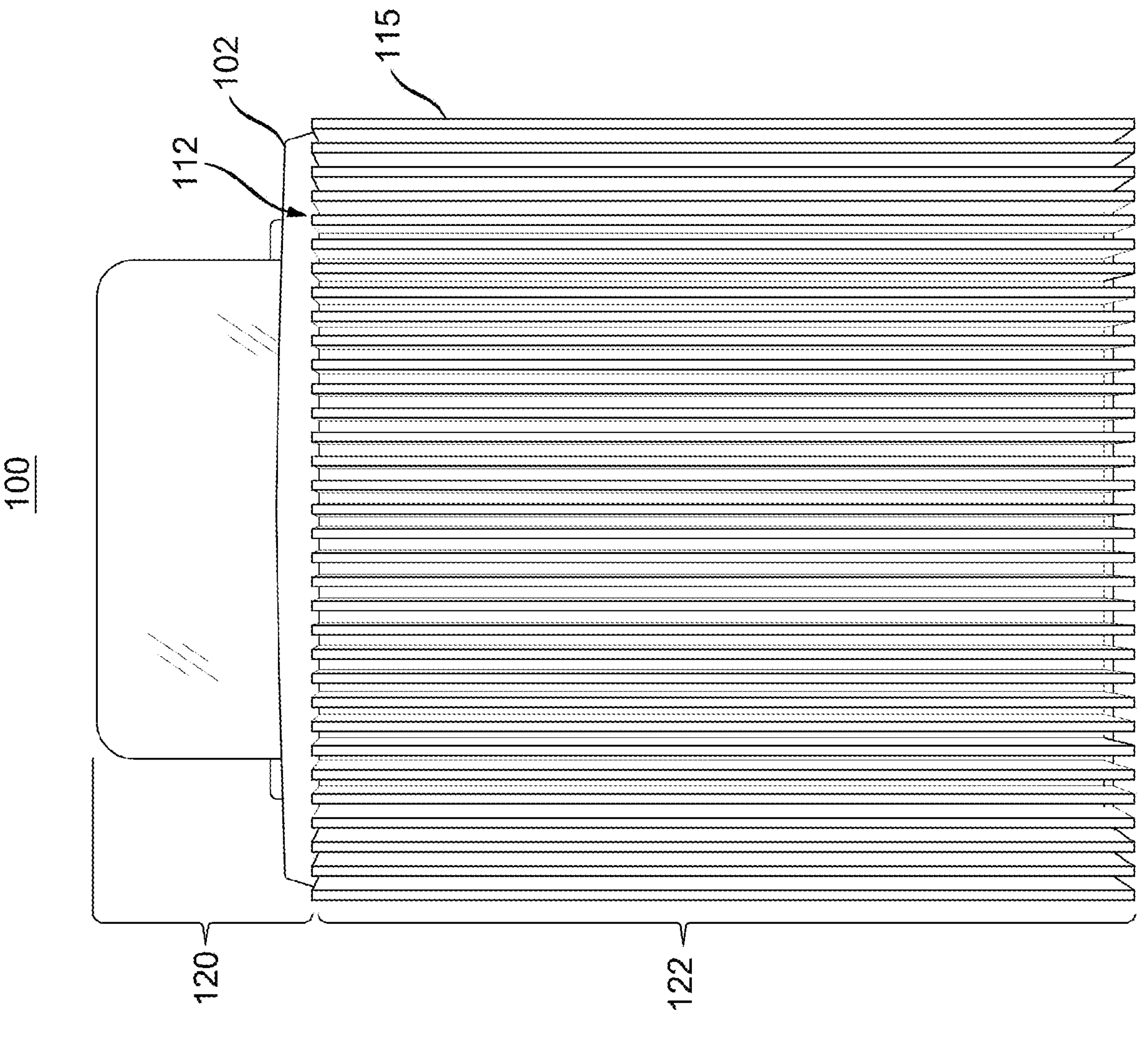

Fig. 5

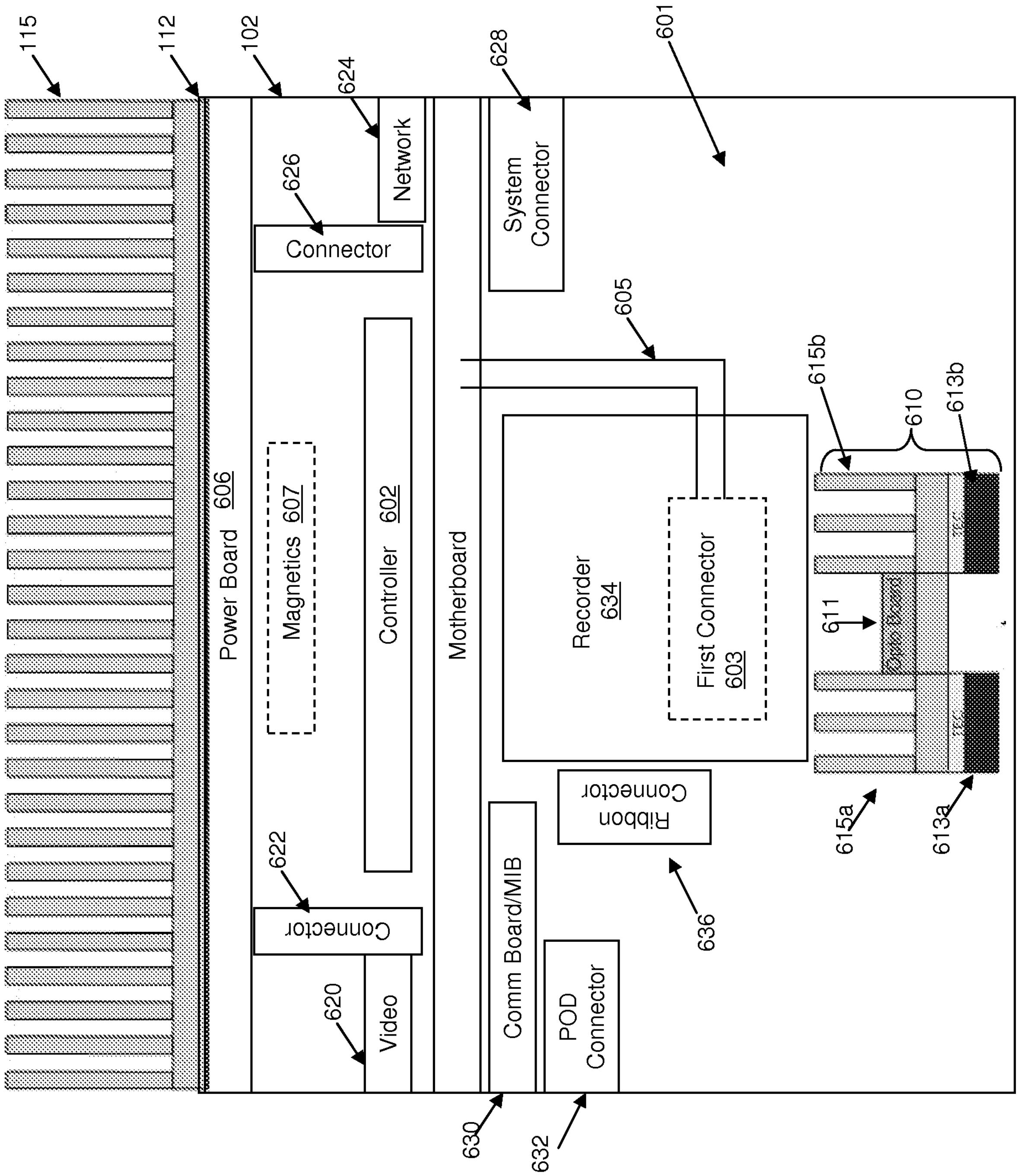
115
112
102
624
Network
626
Connector
628
System Connector
601
Power Board 606
Magnetics 607
Controller 602
Motherboard
605
Recorder 634
First Connector 603
615b
610
613b
611
622
Connector
620
Video
Comm Board/MIB
POD Connector
Ribbon Connector
636
615a
613a
630
632

Fig. 6

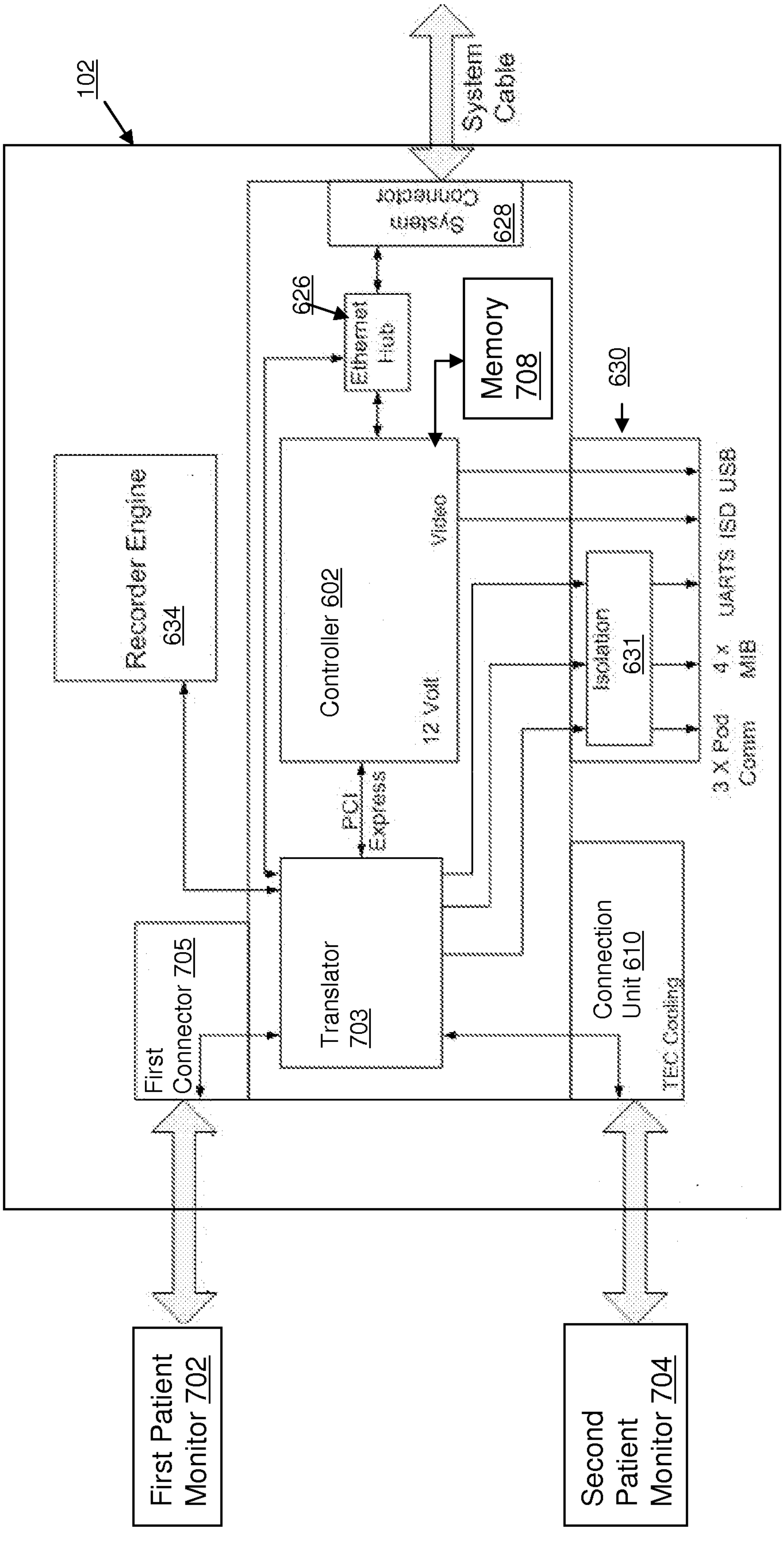
102
System Cable
System Connector 628
626
Ethernet Hub
Memory 708
630
Recorder Engine 634
Controller 602
Video
12 Volt
Isolation 631
USB
ISD
UARTS
4 x MIB
3 X Pod Comm
PCI Express
First Connector 705
Translator 703
Connection Unit 610
TEC Cooling
First Patient Monitor 702
Second Patient Monitor 704

Fig. 7A

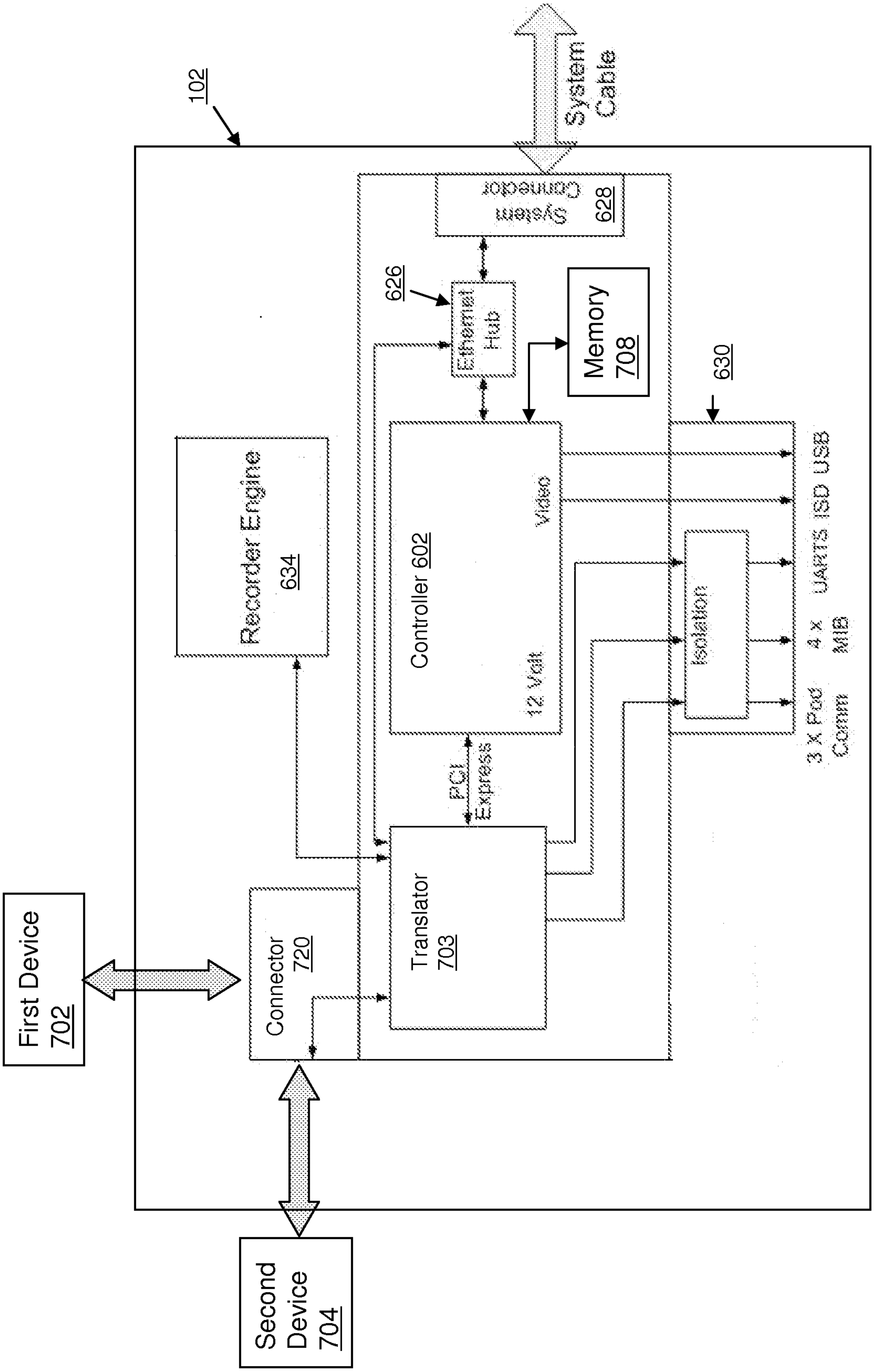
102
System Cable
System Connector 628
626
Ethernet Hub
Memory 708
630
Recorder Engine 634
Controller 602
Video
12 Volt
USB
ISD
UARTS
4 x MIB
3 X Pod Comm
Isolation
PCI Express
Translator 703
Connector 720
First Device 702
Second Device 704

Fig. 7B

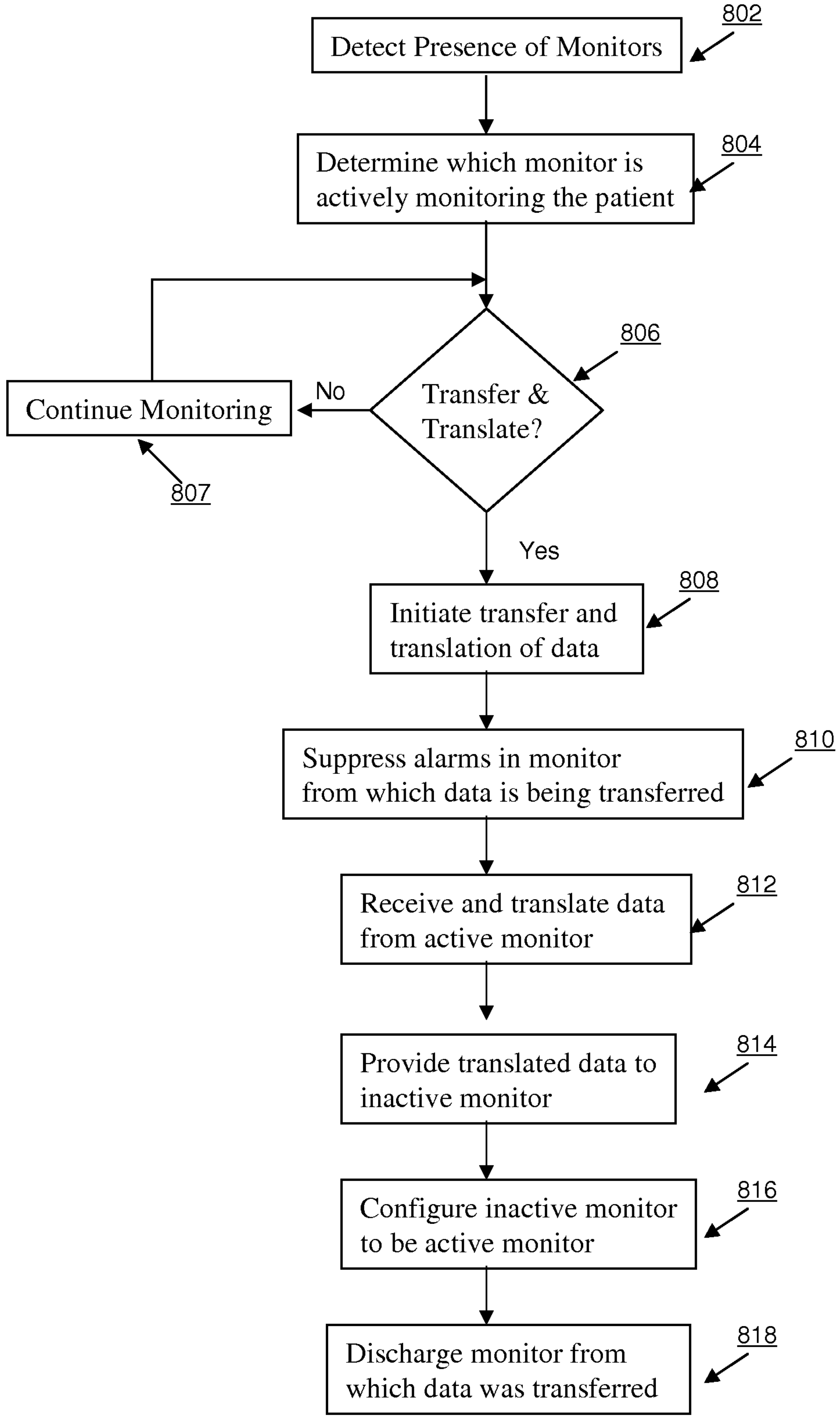
Detect Presence of Monitors
802
Determine which monitor is actively monitoring the patient
804
806
Transfer & Translate?
No
Continue Monitoring
807
Yes
Initiate transfer and translation of data
808
Suppress alarms in monitor from which data is being transferred
810
Receive and translate data from active monitor
812
Provide translated data to inactive monitor
814
Configure inactive monitor to be active monitor
816
Discharge monitor from which data was transferred
818

Fig. 8A

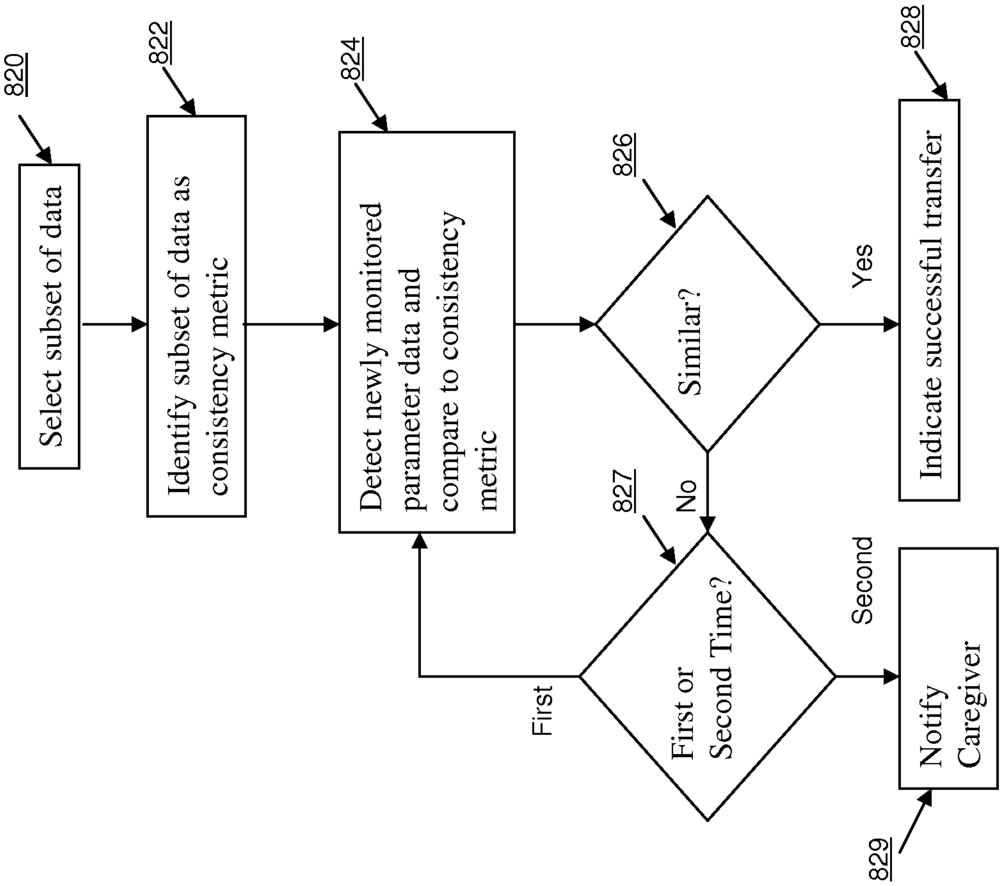
820
Select subset of data
822
Identify subset of data as consistency metric
824
Detect newly monitored parameter data and compare to consistency metric
826
Similar?
Yes
828
Indicate successful transfer
No
827
First or Second Time?
First
Second
Notify Caregiver
829

Fig. 8B

11/21

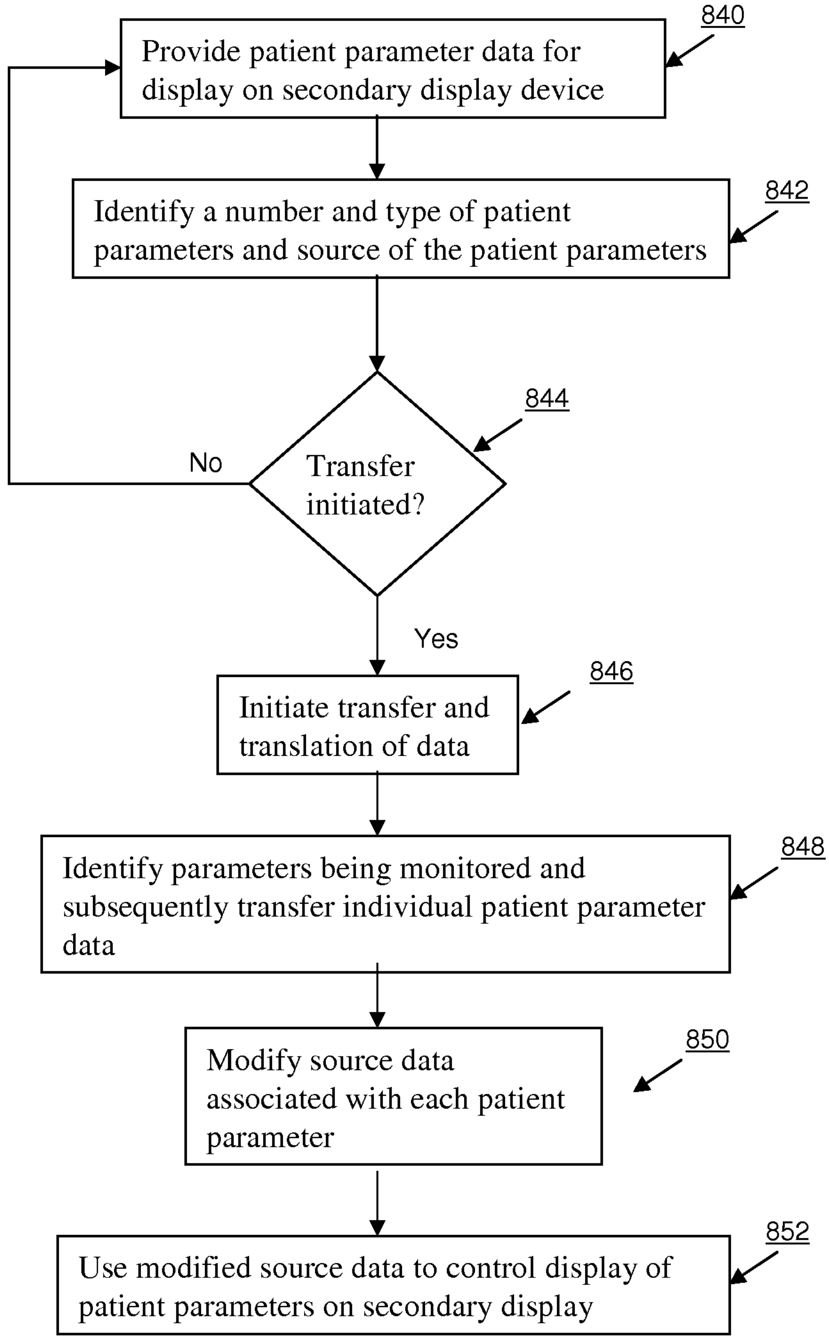
840
Provide patient parameter data for display on secondary display device
842
Identify a number and type of patient parameters and source of the patient parameters
844
Transfer initiated?
No
Yes
846
Initiate transfer and translation of data
848
Identify parameters being monitored and subsequently transfer individual patient parameter data
850
Modify source data associated with each patient parameter
852
Use modified source data to control display of patient parameters on secondary display

Fig. 8C

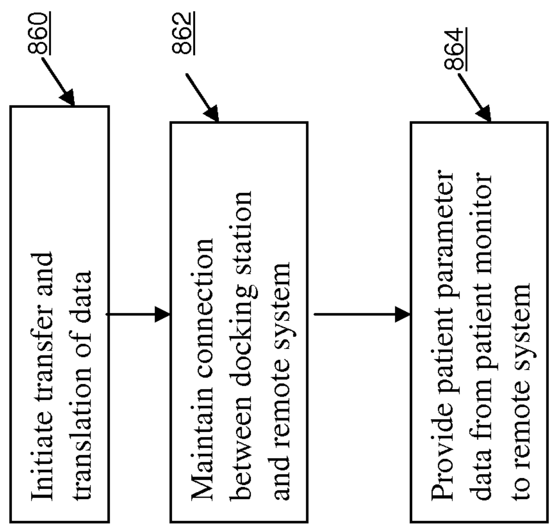
860
Initiate transfer and translation of data
862
Maintain connection between docking station and remote system
864
Provide patient parameter data from patient monitor to remote system

Fig. 8D

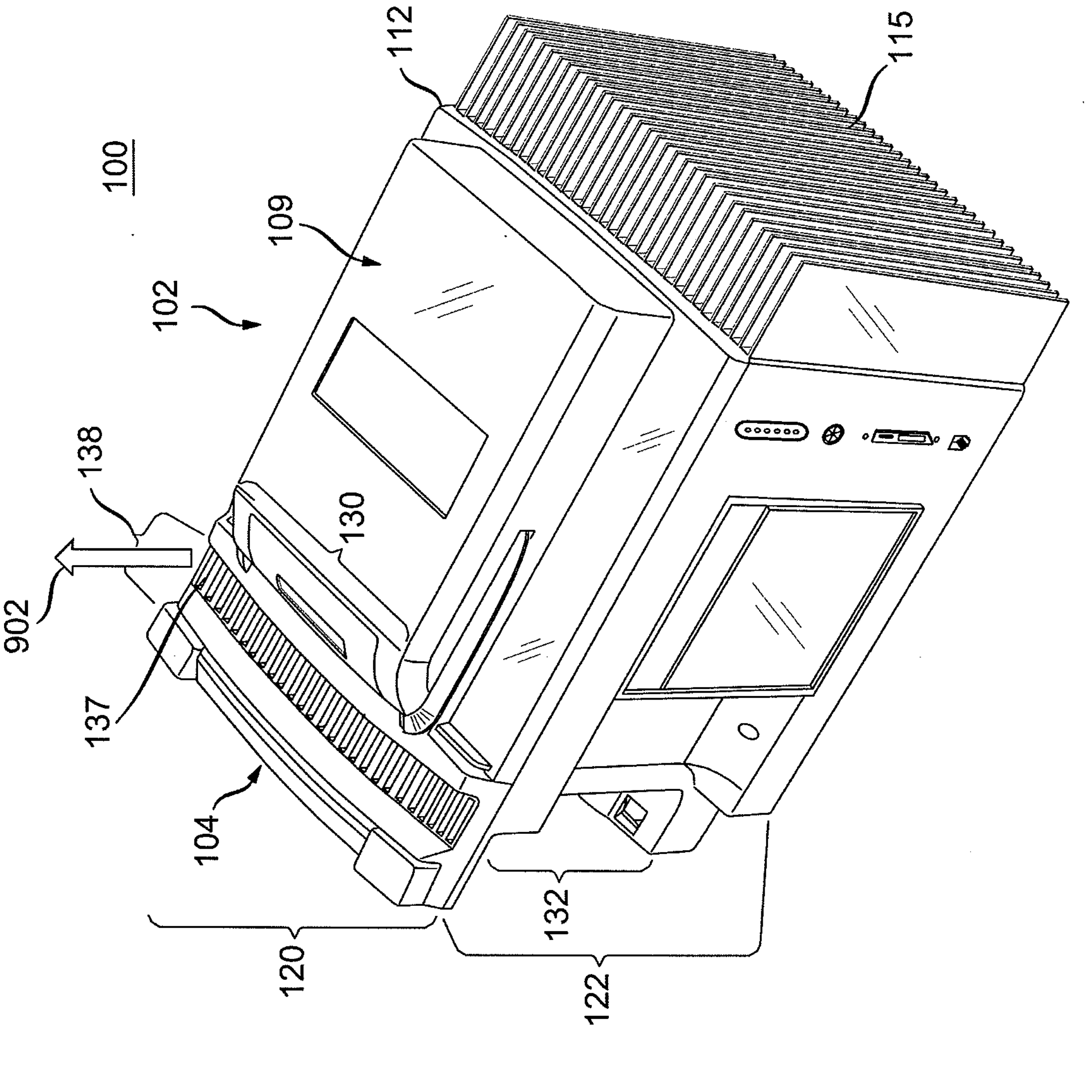

Fig. 9

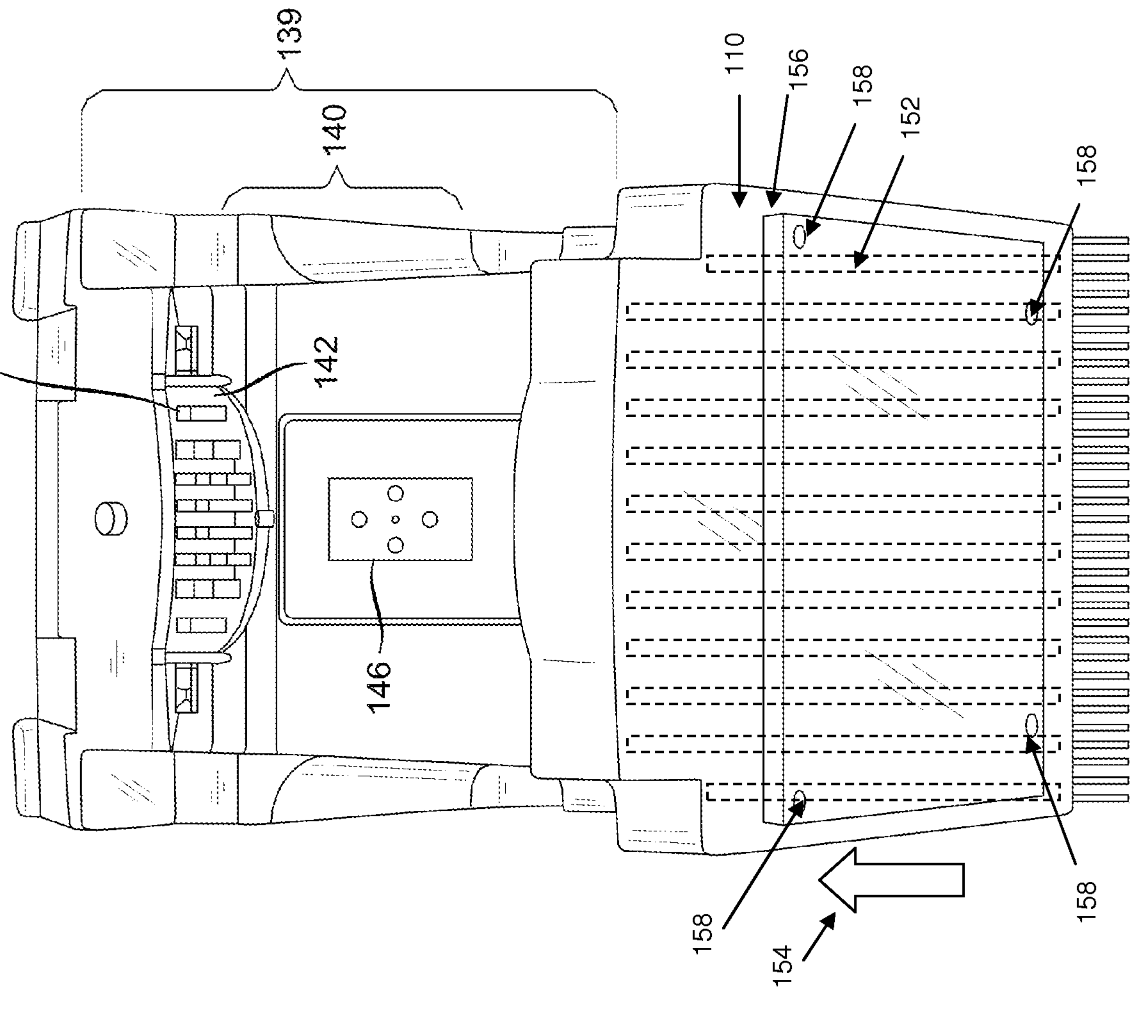

Fig. 10

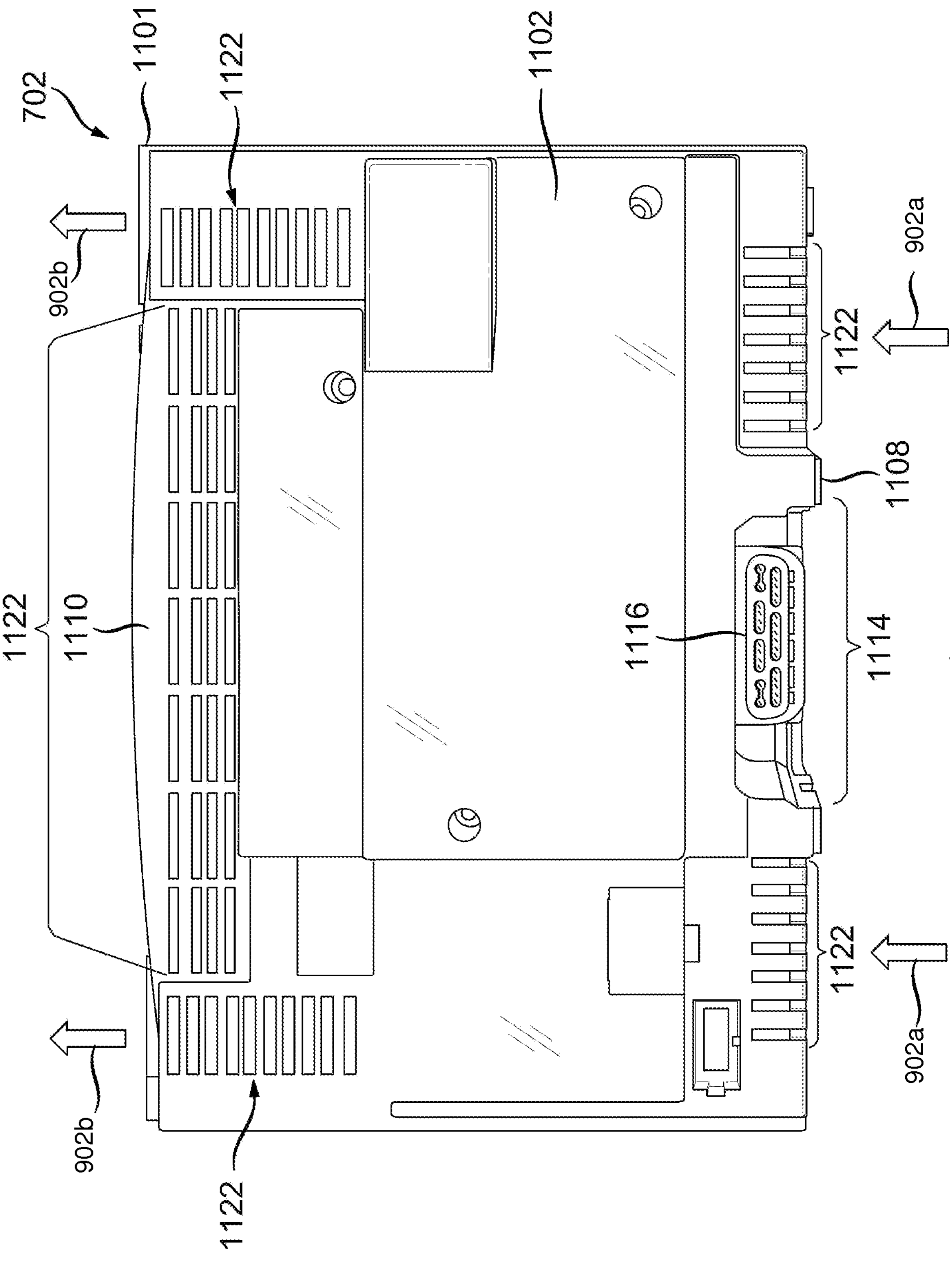
702
1101
1122
1102
902b
902a
1122
1108
1122
1110
1116
1114
1122
902a
902b
1122

Fig. 11

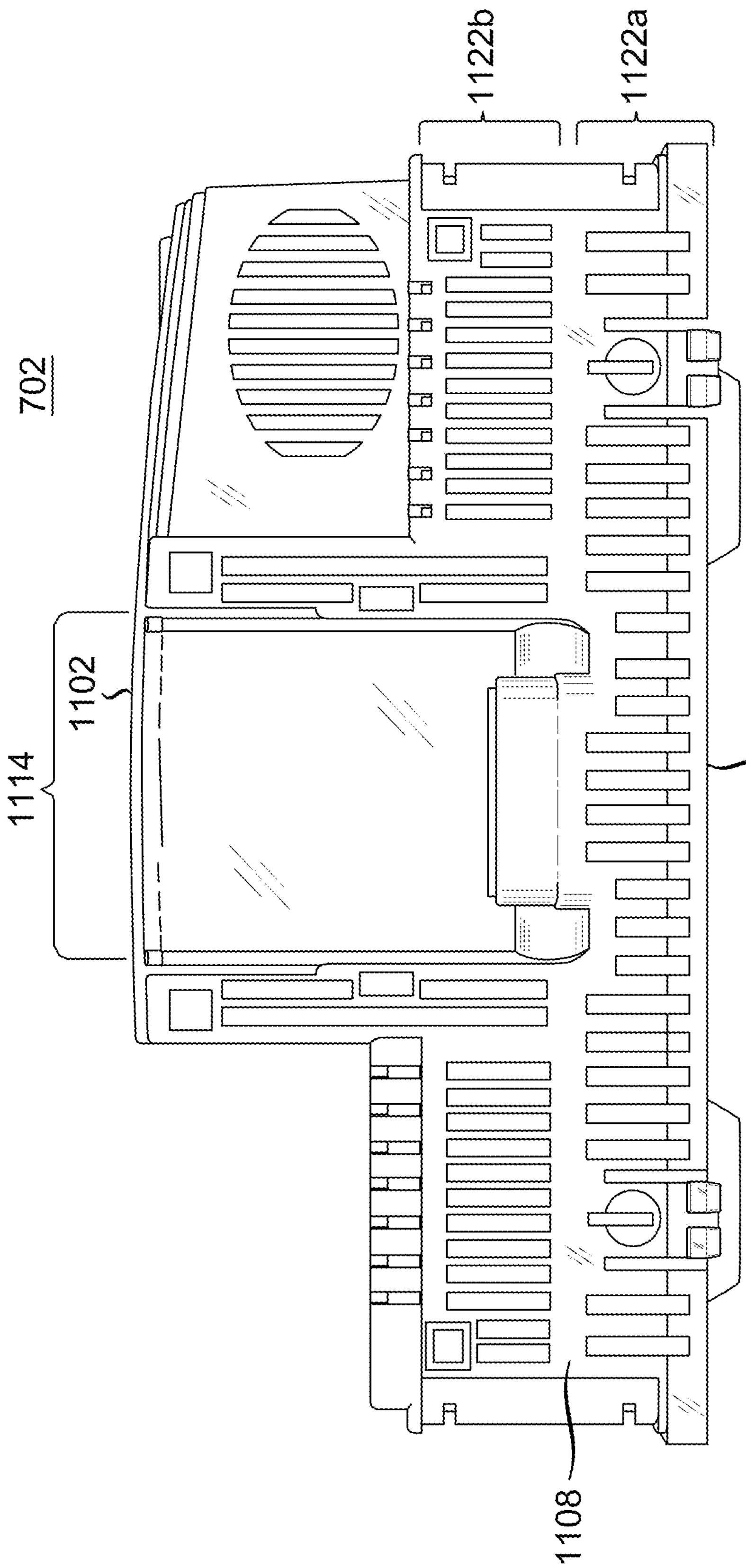

Fig. 12

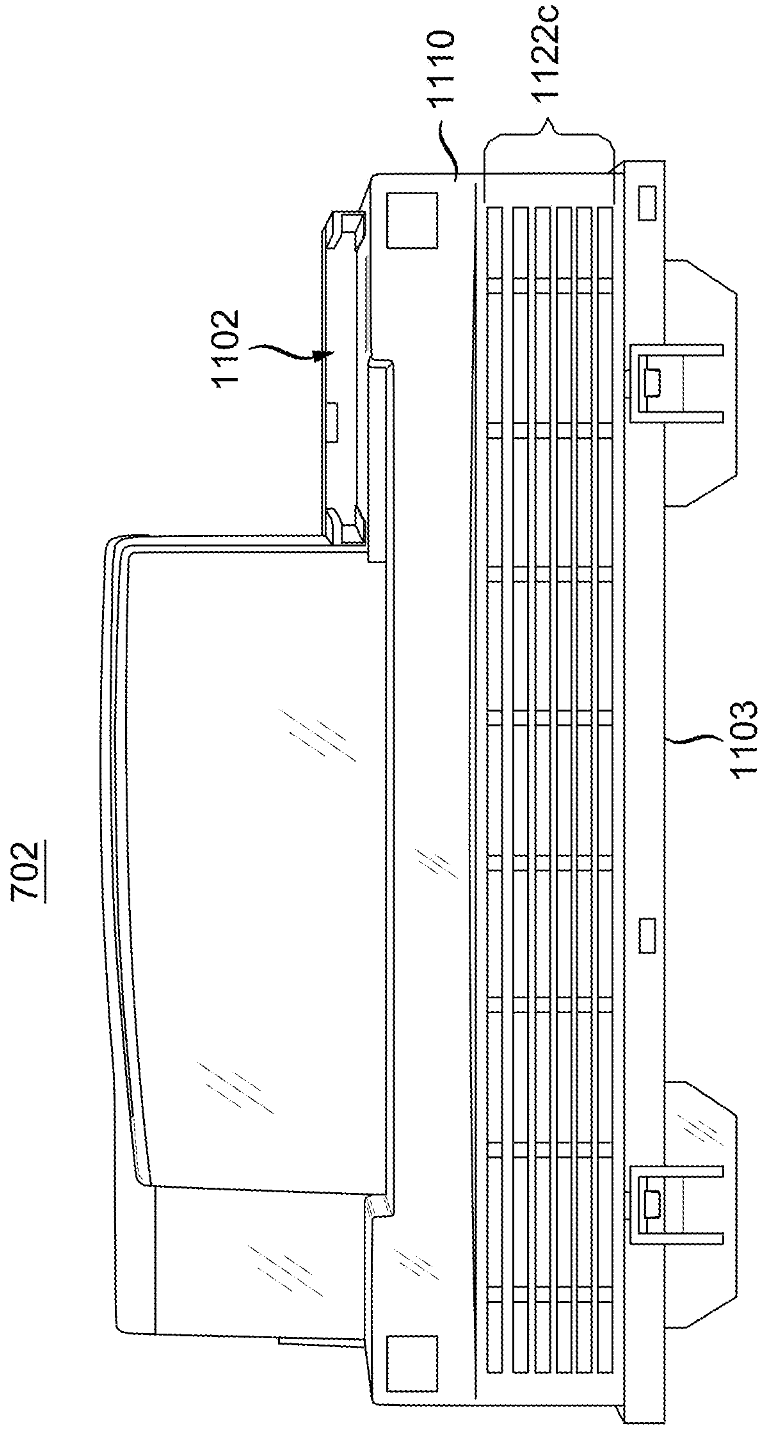

Fig. 13

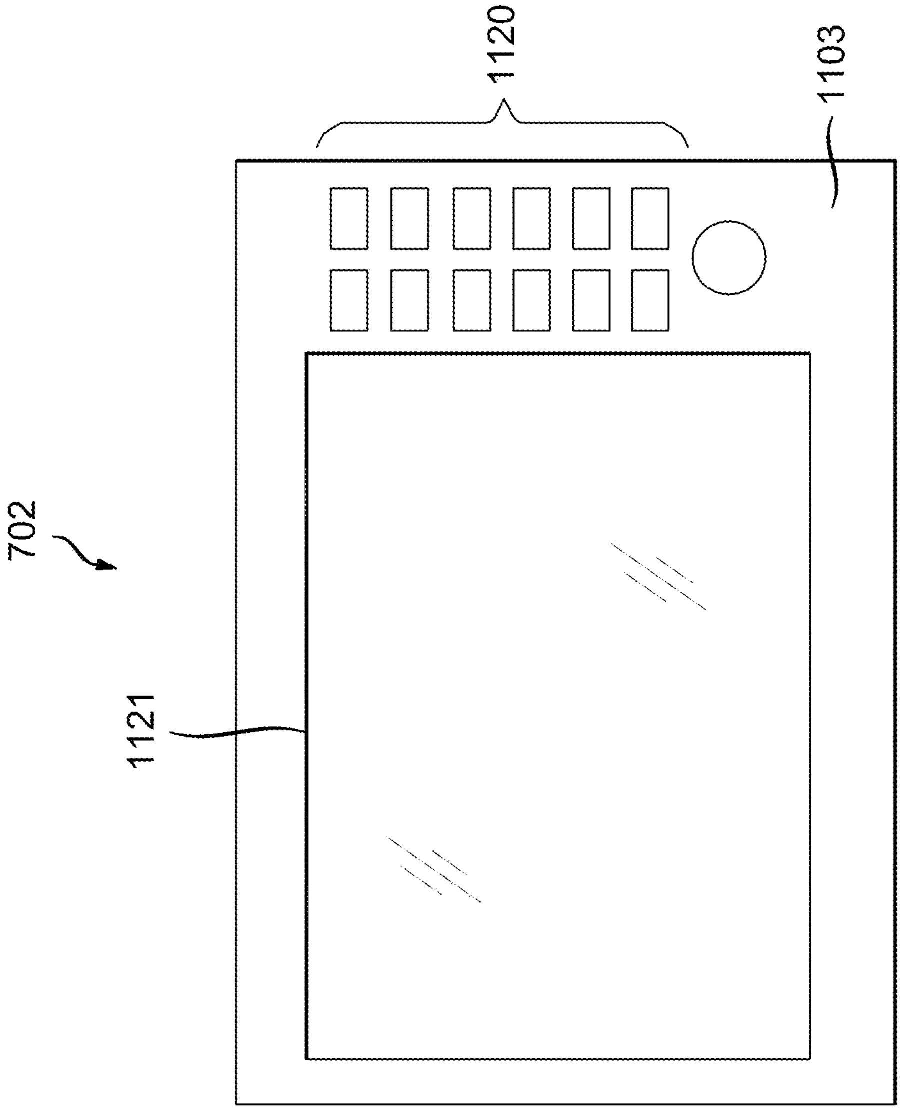

Fig. 14

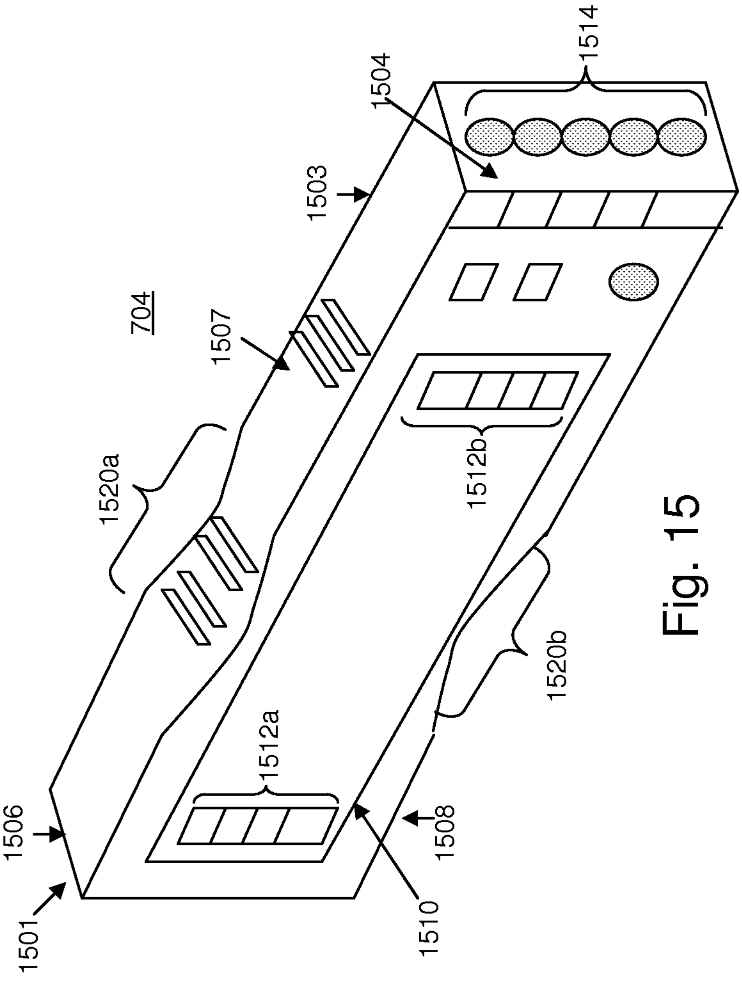
704
1501
1503
1504
1506
1507
1508
1510
1512a
1512b
1514
1520a
1520b

Fig. 15

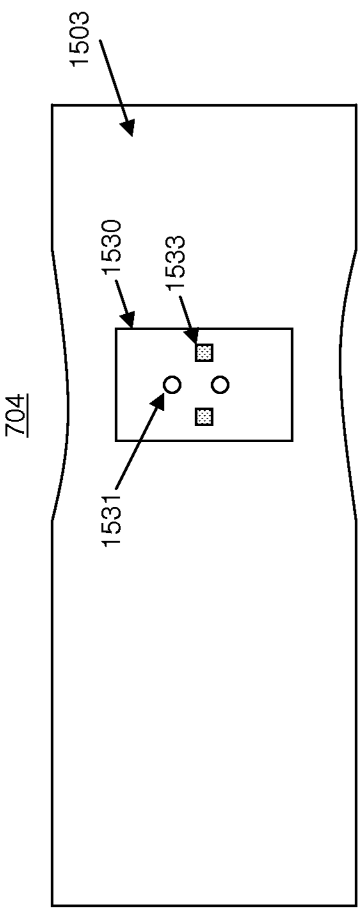
1503
704
1530
1531
1533

Fig. 16

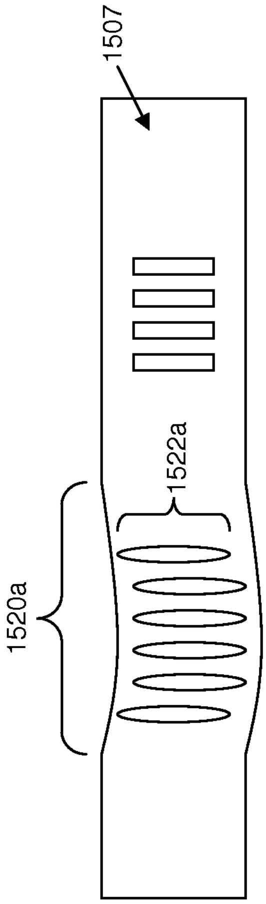

Fig. 17

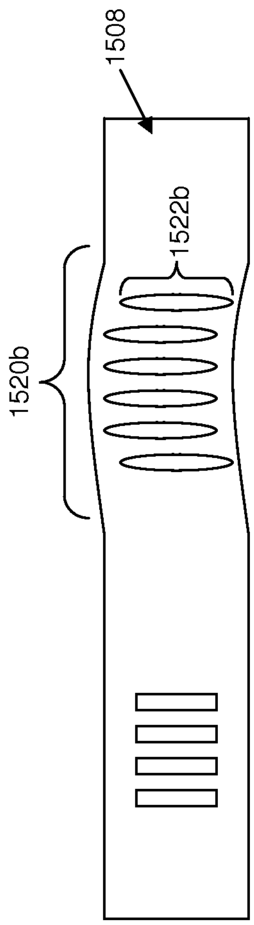

Fig. 18

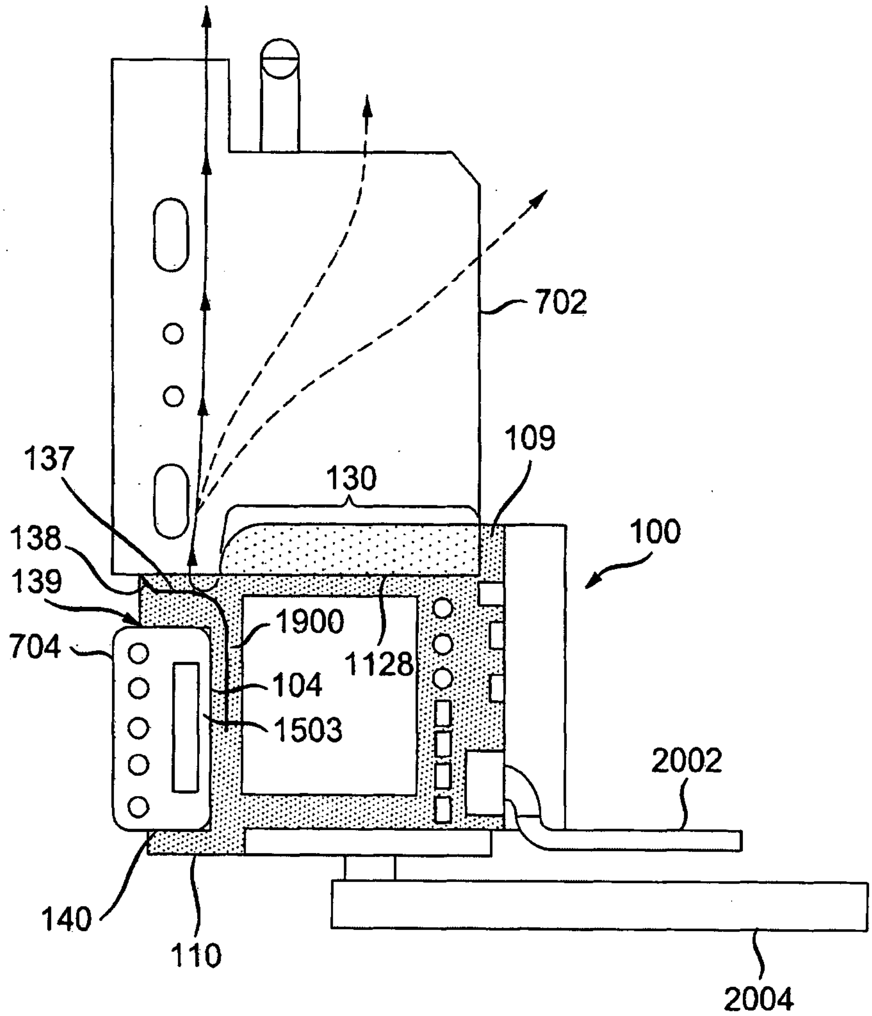
702
137
130
109
100
138
139
1900
704
1128
104
1503
2002
140
110
2004

Fig. 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/072632

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/0205 G06Q50/24 G06F1/16
ADD.

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)
A61B G06Q

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/261979 A1 (KIANI MASSI JOE E [US]) 14 October 2010 (2010-10-14) paragraphs [0028], [0049]; figures 10A-C	1-13
Y	EP 2 278 433 A2 (GEN ELECTRIC [US]) 26 January 2011 (2011-01-26) paragraphs [0003], [0018]; figures 1,2	1-13
A	US 7 974 090 B2 (RISHER-KELLY CLIFFORD [US]) 5 July 2011 (2011-07-05) figure 1	7,13
A	US 2011/054268 A1 (FIDACARO JAMES [US] ET AL) 3 March 2011 (2011-03-03) paragraphs [0057], [0058], [0063]	1-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"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
7 May 2014	16/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Koprinarov, Ivaylo

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/072632

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 2080257 A2	22-07-2009
		US 2010008036 A1	14-01-2010
		WO 2008058266 A2	15-05-2008
US 2011054268 A1	03-03-2011	CN 102160819 A	24-08-2011
		US 2011054268 A1	03-03-2011