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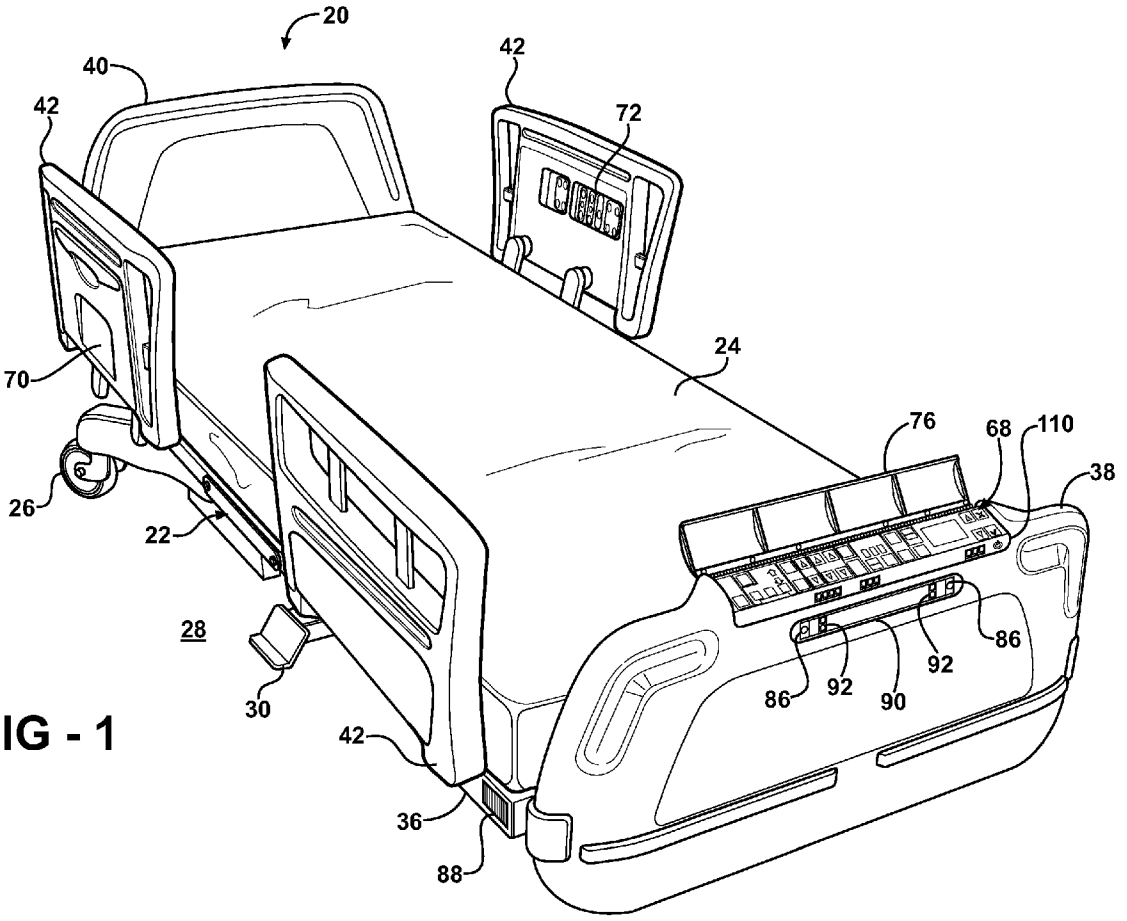


FIG - 1

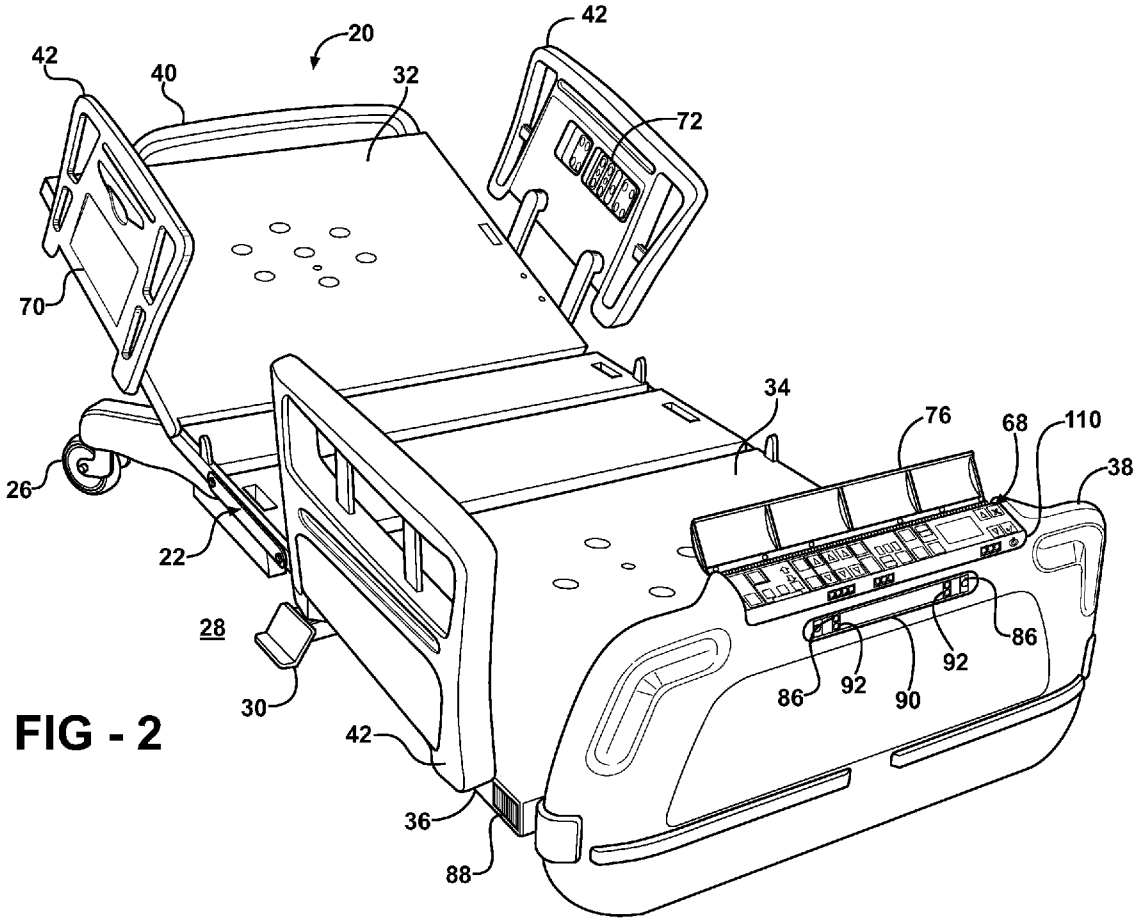


FIG - 2

FIG - 3

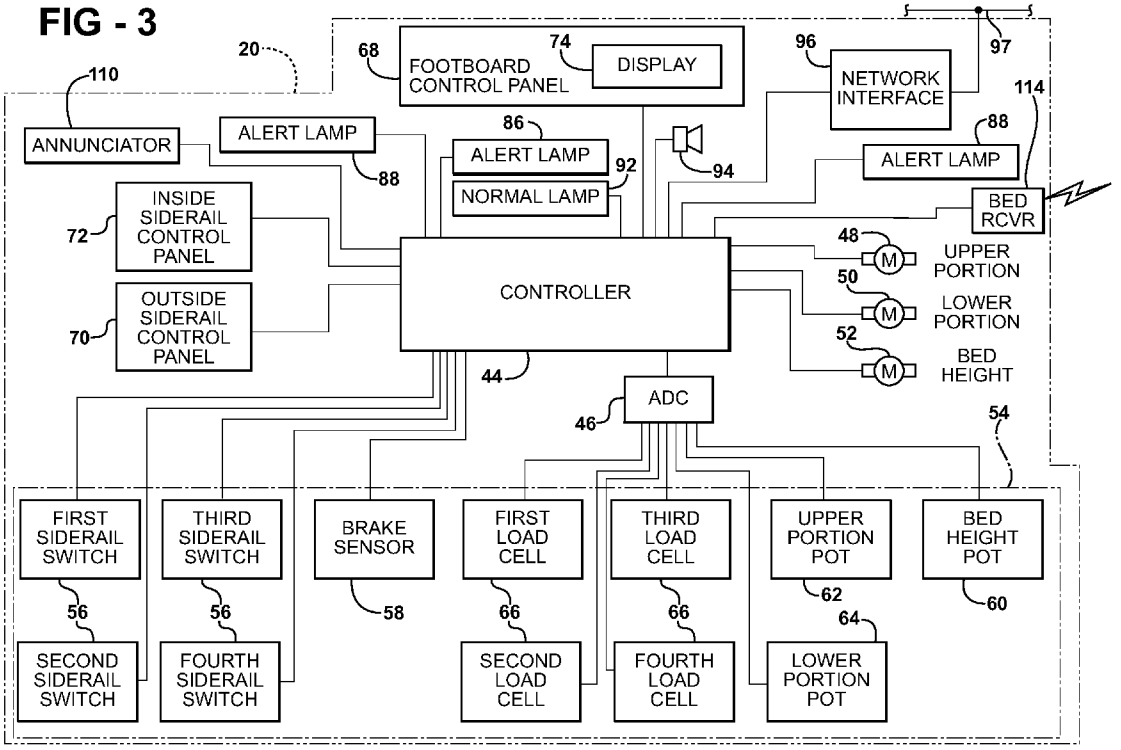

20
110
ANNUNCIATOR
ALERT LAMP
88
68
FOOTBOARD CONTROL PANEL
74
DISPLAY
86
ALERT LAMP
92
NORMAL LAMP
94
96
NETWORK INTERFACE
97
114
88
ALERT LAMP
BED RCVR
72
INSIDE SIDERAIL CONTROL PANEL
70
OUTSIDE SIDERAIL CONTROL PANEL
CONTROLLER
48
UPPER PORTION
50
LOWER PORTION
52
BED HEIGHT
44
46
ADC
54
FIRST SIDERAIL SWITCH
THIRD SIDERAIL SWITCH
BRAKE SENSOR
FIRST LOAD CELL
THIRD LOAD CELL
UPPER PORTION POT
BED HEIGHT POT
56
56
58
66
66
62
64
60
SECOND SIDERAIL SWITCH
FOURTH SIDERAIL SWITCH
SECOND LOAD CELL
FOURTH LOAD CELL
LOWER PORTION POT

FIG - 4

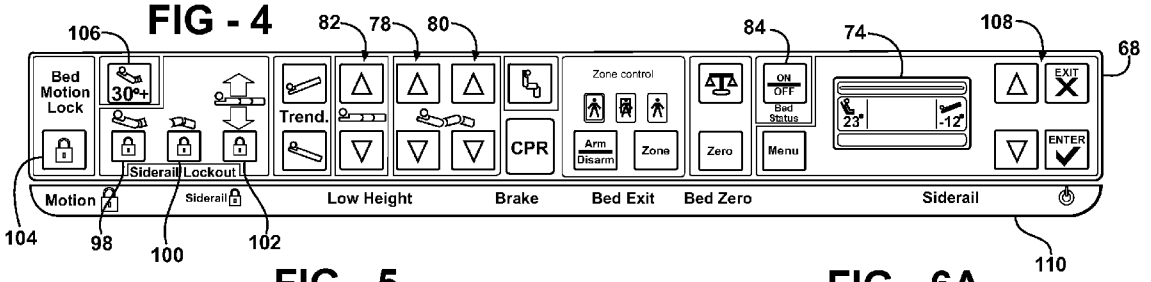


FIG - 5

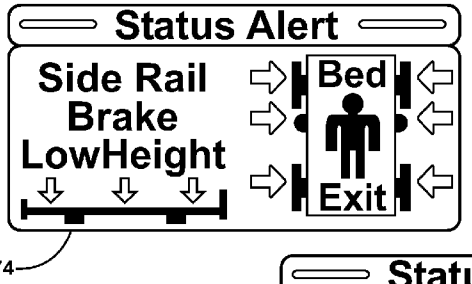
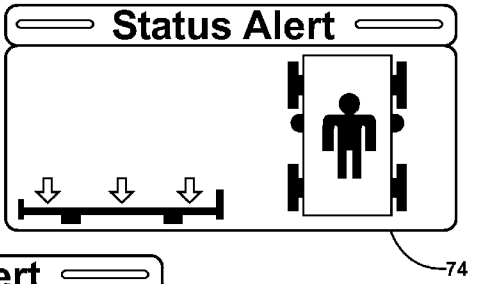


FIG - 6A



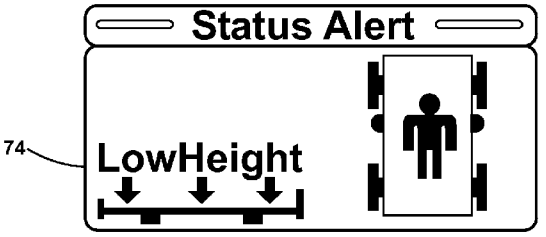


FIG - 6B

FIG - 7A

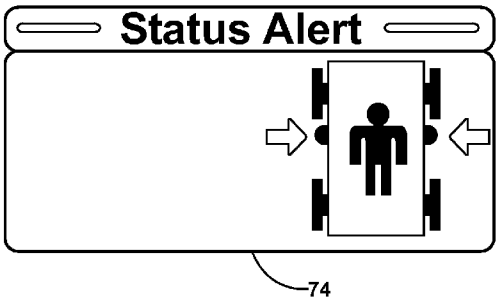


FIG - 7B

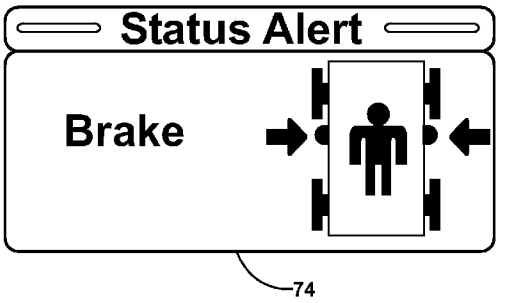


FIG - 8A

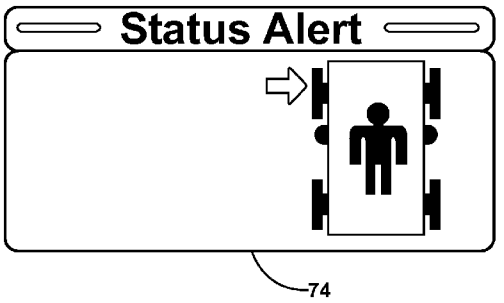


FIG - 8B

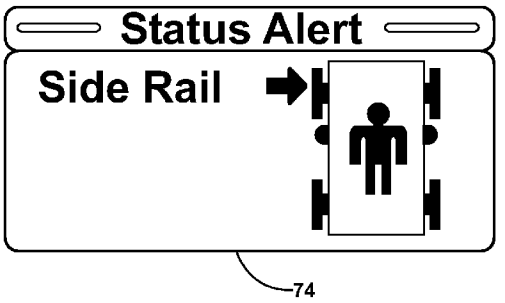


FIG - 9A

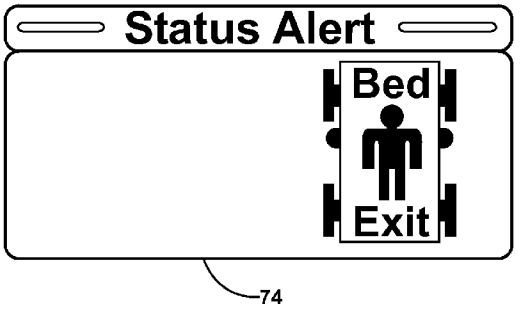
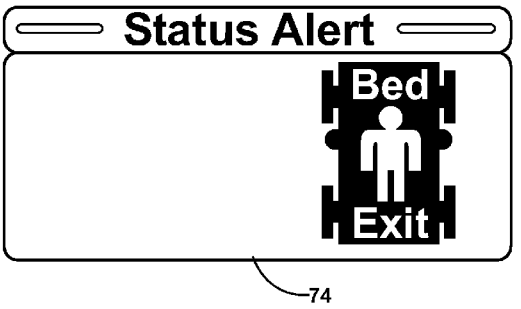


FIG - 9B



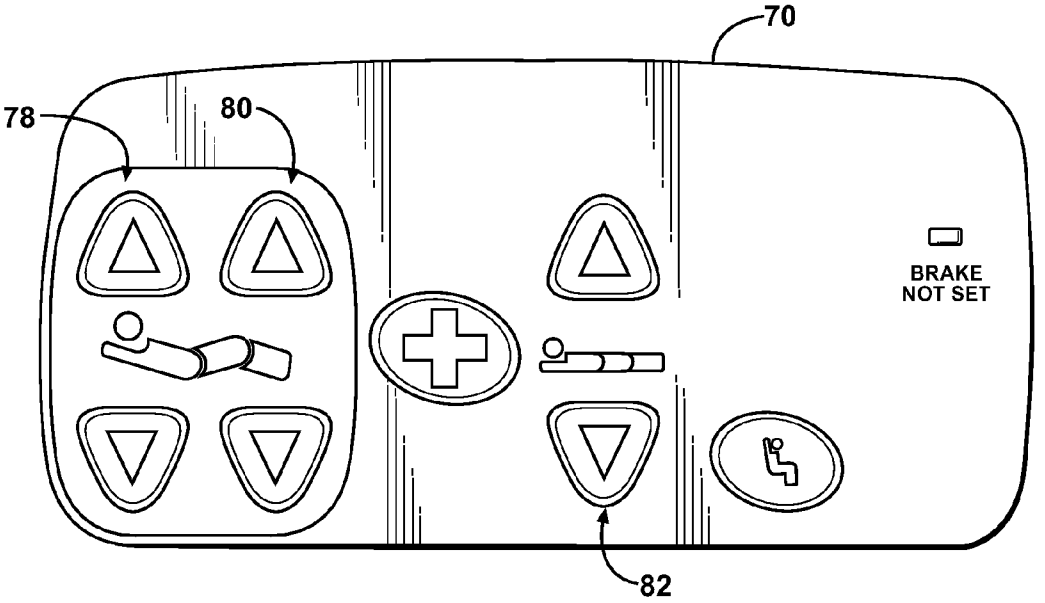


FIG - 10

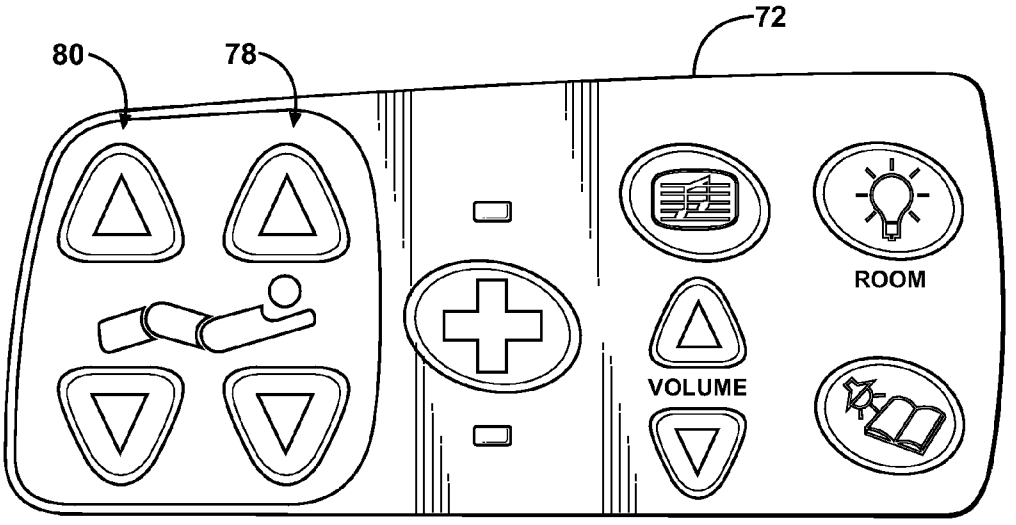


FIG - 11

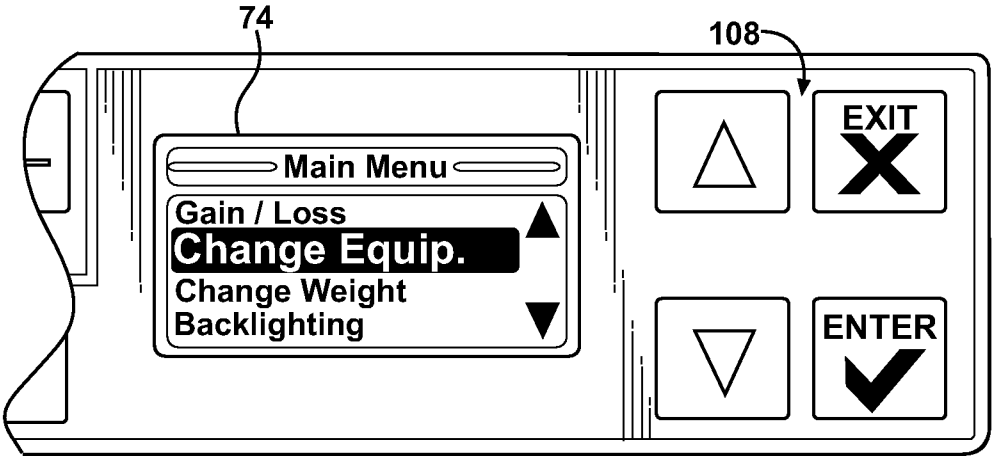

74
108
Main Menu
Gain / Loss
Change Equip.
Change Weight
Backlighting
EXIT
ENTER

FIG - 12

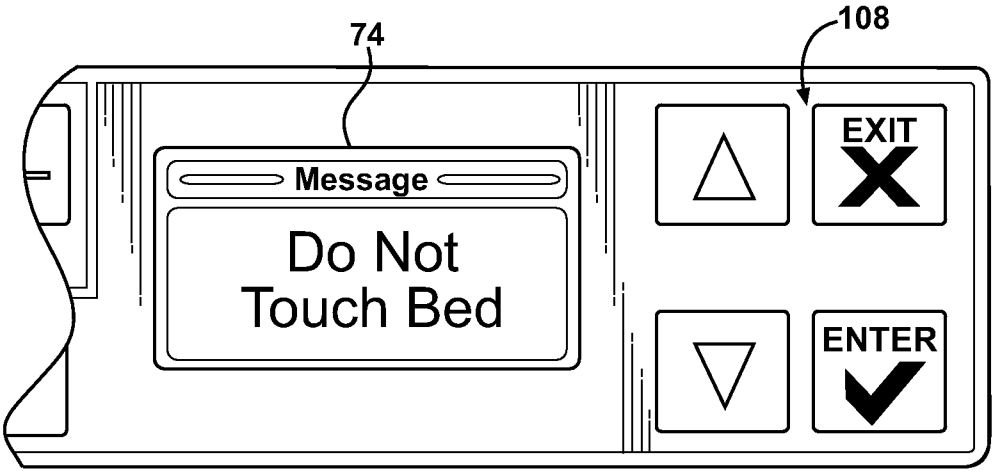

74
108
Message
Do Not
Touch Bed
EXIT
ENTER

FIG - 13

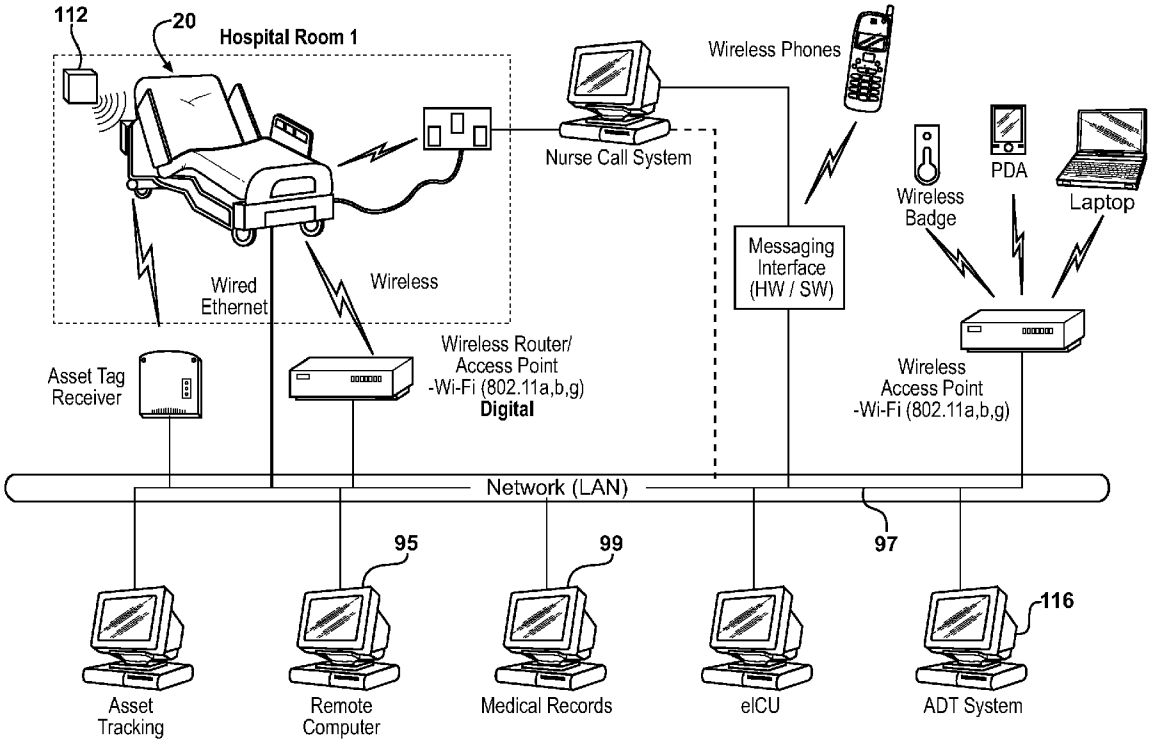
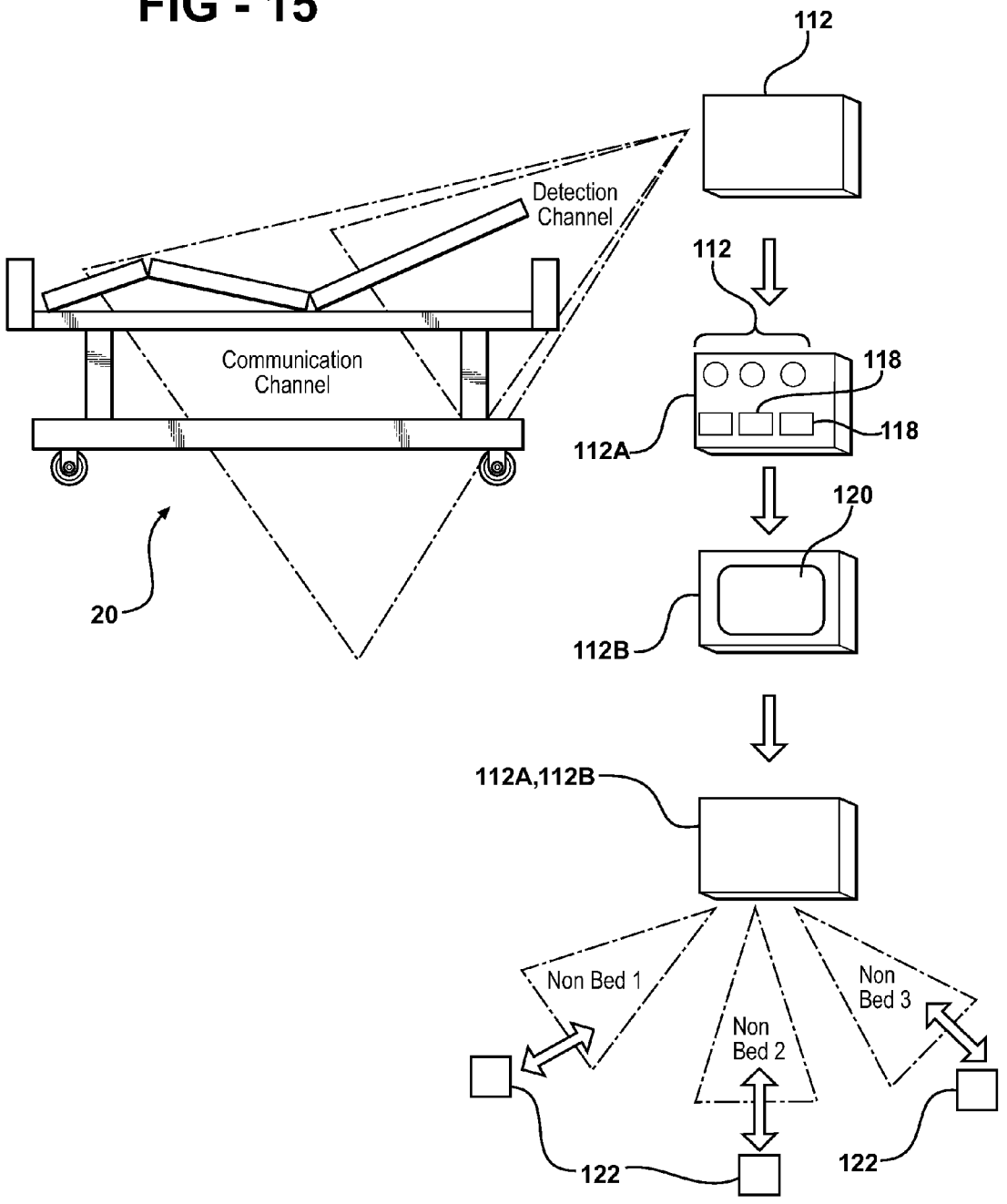

112
20
Hospital Room 1
Wireless Phones
Nurse Call System
Wireless Badge
PDA
Laptop
Messaging Interface (HW / SW)
Wired Ethernet
Wireless
Asset Tag Receiver
Wireless Router/ Access Point -Wi-Fi (802.11a,b,g) Digital
Wireless Access Point -Wi-Fi (802.11a,b,g)
Network (LAN)
95
99
97
116
Asset Tracking
Remote Computer
Medical Records
eICU
ADT System

FIG - 14

FIG - 15


112
Detection Channel
112
Communication Channel
118
118
112A
120
112B
20
112A,112B
Non Bed 1
Non Bed 2
Non Bed 3
122
122

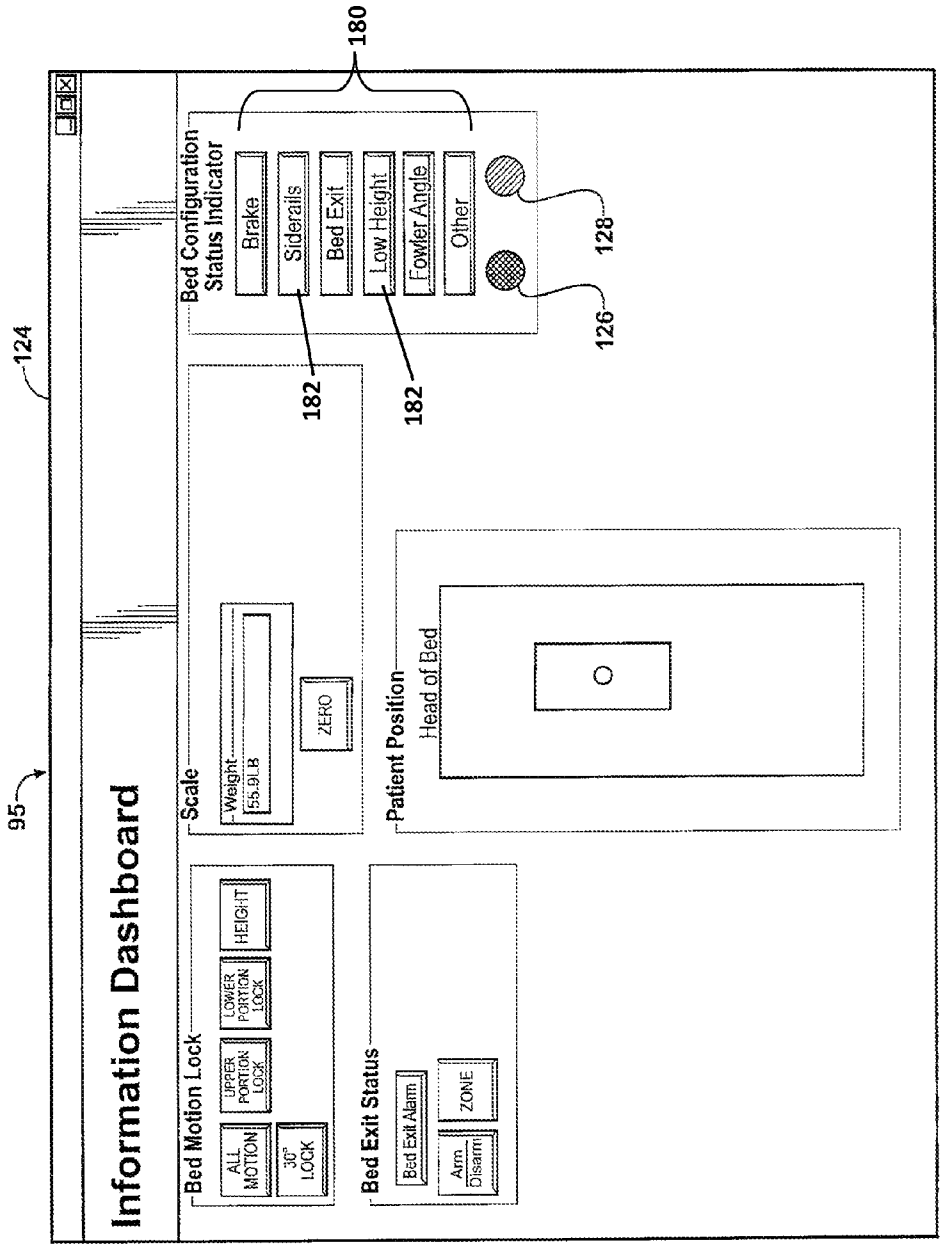

95
124
Information Dashboard
Bed Motion Lock
ALL MOTION
30° LOCK
UPPER PORTION LOCK
LOWER PORTION LOCK
HEIGHT
Bed Exit Status
Bed Exit Alarm
Arm Disarm
ZONE
Scale
Weight
55.9LB
ZERO
182
182
Bed Configuration Status Indicator
Brake
Siderails
Bed Exit
Low Height
Fowler Angle
Other
180
126
128
Patient Position
Head of Bed

FIG - 16

PATIENT HANDLING DEVICE INCLUDING LOCAL STATUS INDICATION, ONE-TOUCH FOWLER ANGLE ADJUSTMENT, AND POWER-ON ALARM CONFIGURATION

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/734,083 filed Nov. 7, 2005, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject invention relates to a patient handling device such as a hospital bed and associated methods of operation.

2. Description of the Related Art

Modern patient handling devices are becoming increasingly integrated with advanced electronic devices, such as a microprocessors, communication busses, network interfaces, wireless networks, high-tech displays, and advanced sensors. These electronic devices have the potential to greatly enhance patient care. But too often, these electronic devices are complex and do not adequately address ease of use, which can be essential for patient care by accounting for the stresses of a hospital/medical environment. As a result, modern patient handling device controls and user interfaces may be difficult to operate.

One difficulty is the complexity involved in setting the desired state of the components of the patient handling device in order to produce an alarm should the components be in a non-desired state. Another difficulty is the ability to even notice when the patient handling device is alarming due to one or more components in a non-desired state. Yet another difficulty is the ability to prevent a patient from lowering a fowler of the patient handling device past prescribed angular position, yet maintaining the ability for the patient to still selectively adjust the fowler between a plurality of angular positions above the prescribed angular position. Therefore, there is a need in the art for a patient handling device that can address the difficulties described above.

SUMMARY OF THE INVENTION AND ADVANTAGES

A first aspect of the present invention provides a method of monitoring a patient handling device. The patient handling device includes a plurality of sensors sensing a plurality of features of the patient handling device and a controller in communication with the sensors. The method includes the step of receiving a control signal at the controller to initiate monitoring of the patient handling device. Sensor signals are acquired at the controller from the sensors in response to receiving the control signal. Initial sensor data is generated from the sensor signals based on the initial state of the sensors to establish a desired state of the patient handling device. The method continues with the steps of periodically acquiring the sensor signals from the sensors after generating the initial sensor data and generating current sensor data from the sensor signals based on the current state of the sensors. The current sensor data is compared to the initial sensor data and an alarm is generated in response to a substantial variation between the current sensor data and the initial sensor data.

A second aspect of the invention provides a patient handling device having a plurality of features for patient care. The patient handling device includes a frame for supporting a patient and a plurality of sensors supported by the frame for generating a plurality of sensor signals, wherein each sensor signal corresponds to one of the features of the device. A user-selectable control produces a control signal to initiate monitoring of the patient handling device. A controller is in communication with the sensors and the user-selectable control for receiving the control signal, acquiring the sensor signals from the sensors in response to receiving the control signal, and generating initial sensor data from the sensor signals based on the initial state of the sensors. The controller also periodically acquires the sensor signals from the sensors and generates current sensor data from the sensor signals based on the current state of the sensors. The controller then compares the current sensor data to the initial sensor data and alarms in response to a substantial variation between the current sensor data and the initial sensor data.

A third aspect of the invention provides a patient handling device having a plurality of features for patient care and a frame for supporting a patient. A plurality of sensors are supported by the frame, wherein each sensor senses a feature of the patient handling device and generates a sensor signal corresponding to one of the features of the patient handling device. The patient handling device further includes a controller in communication with the plurality of sensors for periodically acquiring the sensor signals from the plurality of sensors to generate current sensor data. The controller also compares the current sensor data to predetermined data. An alert lamp in communication with the controller produces light in response to a substantial variation between the current sensor data and the predetermined data. The light produced by the alert lamp is viewable outward from the frame along at least 180 degrees of a circle defined around the frame.

A fourth aspect of the invention provides a patient handling device including a frame for supporting a patient above a surface. The frame includes an upper portion which is angularly adjustable with respect to the surface. An actuator is operatively connected to the upper portion for adjusting the upper portion between a plurality of angular positions relative to the surface. An actuator control generates an actuator control signal and an angular position sensor is coupled to the frame for sensing the angular position of the upper portion with respect to the surface. The patient handling device further includes a position lock control for generating a position lock signal. A controller is in communication with the actuator control and the actuator for controlling the actuator to selectively adjust the upper portion between the plurality of angular positions. The controller is also in communication with the position lock control and the angular position sensor for preventing operation of the actuator and thereby preventing adjustment of the upper portion to at least one restricted angular position in response to the position lock signal

In a fifth aspect of the invention, a method of operating a patient handling device is provided. The patient handling device includes a frame for supporting a patient above a surface. The frame includes an upper portion which is angularly adjustable with respect to the surface and an actuator for adjusting the upper portion. The method includes the step of receiving an actuator control signal to adjust the upper portion between a plurality of angular positions relative to the surface. The method also includes the step of sensing an angular position of the upper portion with respect to the surface. When a position lock signal is received, operation of the actuator is prevented, which thereby prevents adjustment of the upper portion to at least on restricted angular position.

The first and second aspects of the invention allow a user of the patient handling device to easily configure the desired state of the patient handling device. This is accomplished by

simply setting the patient handling device to the desired configuration (e.g., setting angles, heights, and siderail positions) and turning the patient handling device on. The initial state of the patient handling device is recorded and the patient handling device produces an alarm when the patient handling device is no longer in this initial state.

The third aspect of the invention provides at least one alert lamp which is viewable to alert the user when any of a number of sensors indicates an alarm condition. The light produced by the alert lamp is viewable at numerous locations around the bed.

The fourth and fifth aspects of the invention provide a simple, one-touch lockout that allows a patient to adjust a fowler of the patient handling device, but prevents the patient from lowering the fowler past a certain point.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. **1** is a perspective view of a patient handling device with a mattress;

FIG. **2** is a perspective view of the patient handling device with the mattress removed to illustrate the upper portion in an inclined position;

FIG. **3** is a schematic block diagram of the various electrical and electronic components of the patient handling device;

FIG. **4** is a detailed view of a footboard control panel and annunciator;

FIG. **5** is a detailed view of a display of the footboard control panel showing an example of several alarms;

FIGS. **6**A and **6**B are detailed views of the display of the footboard control panel showing a low height alarm;

FIGS. **7**A and **7**B are detailed views of the display of the footboard control panel showing a brake alarm;

FIGS. **8**A and **8**B are detailed views of the display of the footboard control panel showing a siderail alarm;

FIGS. **9**A and **9**B are detailed views of the display of the footboard control panel showing a bed exit alarm;

FIG. **10** is a detailed view of an outside siderail control panel;

FIG. **11** is a detailed view of an inside siderail control panel;

FIG. **12** is a detailed view of the display of the footboard control panel showing a menu;

FIG. **13** is a detailed view of the display of the footboard control panel showing an instructional message;

FIG. **14** is a schematic view of a healthcare facility with a network and a patient handling device bay ID system;

FIG. **15** is a schematic view of alternative room modules in the patient handling device bay ID system illustrating their communication with the patient handling device and non-patient handling device devices; and

FIG. **16** is a display representation at a remote computer illustrating a user interface of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a patient handling device **20** is shown in FIG. **1**. Those skilled in the art realize that the patient handling device **20** of the present invention may be implemented as a gurney, stretcher, surgical table, examination table, wheel chair, ambulance cot, or other suitable device as is known to the art. Furthermore, the patient handling device **20** need not be utilized solely in a hospital, but in any suitable environment.

The patient handling device **20** includes a frame **22** for supporting a patient (not shown). A mattress **24** is preferably disposed on the frame **22** for comfortably supporting the patient. However, those skilled in the art realize that the patient handling device **20** may be implemented without the mattress **24** or with numerous alternatives for the mattress **24**, such as cushions. The mattress **24** could be a therapy mattress such as that disclosed in U.S. patent application Ser. No. 11/260,452, filed Oct. 27, 2005, which is hereby incorporated by reference.

The patient handling device **20** also preferably includes a plurality of wheels **26** supporting the frame **22**. The wheels **26** allow the patient handling device **20** to be easily moved along a surface **28** (i.e., the floor). Of course, the patient handling device **20** may be implemented without the wheels **26**, such that the patient handling device **20** is relatively stationary. When implemented with the wheels **26**, the patient handling device **20** preferably includes a brake for immobilizing at least one of the wheels **26** and more preferably immobilizing all of the wheels **26**. The brake is applied via a brake pedal **30**. In alternative embodiments, the brake may be applied utilize a handle, button, or other suitable activation technique. Braking systems employed on patient handling devices are well known in the art and any suitable system may be employed here, thus the braking system is not described in detail.

Referring to FIG. **2**, the frame **22** includes an upper portion **32** and a lower portion **34**. The upper portion **32** is often referred to as a "fowler portion" or simply a "fowler". The upper and lower portions **32**, **34** are angularly adjustable with respect to the surface **28** between a plurality of angular positions. Said another way, the upper and lower portions **32**, **34** may be adjusted such that they are non-parallel with the surface **28**. This allows the patient to be positioned in a variety of configurations as are well known to those skilled in the art. The angular position of the upper portion **32** with respect to the surface **28** is commonly referred to as a "fowler angle" or "fowler position".

The frame **22** defines two sides **36** running lengthwise with the arms and legs of a patient lying in the patient handling device **20** and two ends (not labeled) transverse to the sides **36**. A footboard **38** is disposed transverse to the sides **36** and adjacent to one of the ends. Likewise, a headboard **40** may be disposed transverse to the sides **36** and adjacent to the other end of the frame **22**. Obviously, the footboard **38** is typically disposed near the feet of a patient lying on the patient handling device **20** while the headboard **40** is disposed near the head of the patient.

The patient handling device **20** also includes at least one siderail **42** disposed adjacent one of the sides **36** of the frame **22**. The siderail **42** is moveable between an up position and a down position. In the up position, the siderail **42** prevents the patient from accidentally rolling off the patient handling device **20** or easily exiting the patient handling device **20**. It is preferred that the siderail **42** include a locking mechanism (not shown) to lock the siderail **42** in the up position, such that it may not be easily lowered by the patient. In the preferred embodiment, the at least one siderail is implemented as a plurality of siderails, and more preferably as four siderails: two adjacent the upper portion **32** with one on each side **36** of the frame **22** and two adjacent the lower portion **34** with one on each side **36** of the frame **22**. In FIGS. **1** and **2**, three of the siderails **42** are shown in the up position and one (not shown) is in the down position.

Referring now to FIG. **3**, the patient handling device **20** includes a controller **44** for controlling operation of the

patient handling device **20** and monitoring various features of the patient handling device **20**. The controller **44** is preferably a microprocessor-based device, such as a microcontroller. However, those skilled in the art realize that other suitable implementations may be employed for the controller **44**. The patient handling device **20** also includes a variety of electrical and electronic components (not shown) interfaced with or integrated into the controller **44** for enabling operation of the controller **44** and communication with the controller **44**. These components may include, but are not limited to, power supplies, communication interface circuits, networking circuits, amplifiers, multiplexers, logic gates, resistors, capacitors, inductors, and diodes. At least one analog-to-digital converter **46** (ADC) is electrically connected to the controller **44** to convert analog signals from variable voltage/current devices to digital signals which are usable by the controller **44**. The at least one ADC **46** may be separate (i.e., stand-alone) from the controller **44** and/or integrated within the controller **44**. Furthermore, the patient handling device **20** may also include a plurality of distributed nodes (not shown) electrically connected to the controller **44** and various electrical/electronic devices as described herein. The distributed nodes facilitate communication between the devices and the controller **44** while reducing overall wiring costs and complexity.

The patient handling device **20** includes an upper portion actuator **48** operatively connected to the upper portion **32**. The upper portion actuator **48** moves the upper portion **32** to adjust the upper portion **32** between a plurality of angular positions. The upper portion actuator **48** is in communication with the controller **44** to receive control signals from the controller **44**. The upper portion actuator **48** is preferably a bi-directional motor such that the upper portion actuator **48** can increase and decrease the angular position of the upper portion **32** with respect to a horizontal surface **28** such as the floor upon which the patient handling device **20** is supported. The patient handling device **20** also includes a lower portion actuator **50** operatively connected to the lower portion **34** for moving the lower portion **34** to adjust the lower portion **34** between a plurality of angular positions. The lower portion actuator **50** is electrically connected to the controller **44** and is preferably a bi-directional motor and operates similarly to the upper portion actuator **48** described above. The patient handling device **20** also includes a lifting mechanism **52** operatively connected to the frame **22** for lifting and lowering the frame **22** with respect to the surface **28**. The lifting mechanism **52** is electrically connected to the controller **44** and preferably includes a bi-directional motor. Of course, those skilled in the art realize that the patient handling device **20** may include other actuators for operating features of the patient handling device **20**. The actuators **48**, **50** and lifting mechanism **52** are well known to those skilled in the art and any suitable actuator **48**, **50** or lifting mechanism **52** may be implemented; therefore, the actuators **48**, **50** and lifting mechanism **52** are not described in further detail.

A plurality of sensors **54** are supported by the patient handling device **20** with each sensor **54** being associated with the various features of the patient handling device **20**. Each sensor **54** senses at least one feature of the patient handling device **20** and generates a sensor signal corresponding to that feature of the patient handling device **20**. These sensors **54** include, but are not limited to:

- at least one siderail switch **56** for sensing the position of each siderail **42**, specifically, whether each siderail **42** is in the up position;
- a brake sensor **58** for sensing the activation of the brake;
- a height sensor **60** for sensing the height of the frame **22** with respect to the surface **28**.
- an upper portion potentiometer **62** for sensing an angular position of the upper portion **32** with respect to the surface **28**;
- a lower portion potentiometer **64** for sensing an angular position of the lower portion **34** with respect to the surface **28**;
- at least one load cell **66**, and preferably four load cells **66**, for sensing the weight, presence, and/or position of the patient on the patient handling device **20**; and
- an arm/disarm signal from a bed exit system.

Those skilled in the art will realize numerous techniques for implementing the sensors **54** with the patient handling device **20**. For example, in the preferred embodiment, the siderail switches **56** are implemented as mechanical rocker-type switches. However, the siderail switches **56** may alternatively be implemented as inductive or capacitive sensing proximity switches, photosensitive detectors, etc. Furthermore, those skilled in the art will realize that additional sensors that may be utilized to monitor a feature of the patient handling device **20**.

The bed exit system detects patient exit from the patient handling device **20** and/or detects a position of the patient on the patient handling device **20**. Such a bed exit system is described in U.S. Pat. No. 5,276,432, which is hereby incorporated by reference. The bed exit system is preferably incorporated as one or more software routines in the controller **44** and utilizes the preferred four load cells **66** as described above. The load cells **66**, via the bed exit system, may be used to track the patient's center of gravity. By knowing the patient's center of gravity, pressure ulcer management can be performed by knowing that the patient hasn't moved or turned. Furthermore, the load cells **66**, via the bed exit system, may be utilized to predict a bed exit before it occurs.

Referring again to FIG. **1**, the patient handling device **20** also preferably includes several control panels **68**, **70**, **72** in communication with the controller **44**. In the preferred embodiment, the patient handling device **20** includes a footboard control panel **68** disposed in the footboard **38** of the patient handling device **20**. The footboard control panel **68**, as shown in detail in FIG. **4**, includes a plurality of membrane-style pushbuttons for controlling various features of the patient handling device **20**. Of course, the footboard control panel **68** may use different styles of pushbuttons, switches, or knobs as is well known to those skilled in the art. The footboard control panel **68** also includes a display **74** for displaying information regarding the patient handling device **20** to a user (e.g., nurse, doctor, technician, etc.). The display **74** in the preferred embodiment is a back-lit liquid crystal-type device, however, other types of displays **74**, including touch-screen displays **74** for accepting user input, are known to those skilled in the art. A cover **76** is pivotally hinged to the footboard **38** adjacent to the footboard control panel **68** for concealing and protecting the footboard control panel **68** when closed. The cover **76** may include a window (not shown) to allow viewing of the display **74** when the cover **76** is closed.

The patient handling device **20** also preferably includes at least one outside siderail control panel **70**, shown in detail in FIG. **10**, and at least one inside siderail control panel **72**, shown in detail in FIG. **11**. The inside siderail control panel **72** is disposed on the inside (i.e., close to the patient) of at least one of the siderails **42** to allow convenient control of the patient handling device **20** and an interface to other off-bed features (e.g., television control, nurse call, etc.). The outside siderail control panel **70** is disposed on the outside (i.e., away

from the patient) of at least one of the siderails to allow convenient control of the patient handling device **20** by users other than the patient. The siderail control panels **70**, **72** preferably include membrane-style pushbuttons, but other alternatives are known to those skilled in the art.

The patient handling device **20** includes an upper portion control **78**, a lower portion control **80**, and a height control **82**, each control electrically connected to the controller **44**. Each of these controls **78**, **80**, **82** is preferably implemented as a pair of membrane-style pushbuttons (one for up and one for down). In the preferred embodiment, the upper and lower portion controls **78**, **80** are disposed on each of the control panels **68**, **70**, **72** while the height control **82** is disposed on the outside siderail control panel **70** and the footboard control panel **68**, i.e., not on the inside siderail control panel **72**. The upper portion control **78** generates an upper portion control signal, the lower portion control **80** generates a lower portion control signal, and the height control **82** generates a height control signal. Each of these control signals is communicated to the controller **44**. The controller **44** typically responds to each control signal by controlling the actuator corresponding to the control signal in the appropriate direction. A patient or user of the patient handling device **20** can then use the controls **78**, **80**, **82** to selectively adjust the height, upper portion angular position, and/or lower portion angular position of the patient handling device **20**.

The patient handling device **20** includes a user-selectable control for producing a control signal. In the preferred embodiment, the user-selectable control is a power button **84**, preferably as part of the footboard control panel **68**, as shown in FIG. **4**. However, other controls for producing the control signal and other locations for the power button **84** are also acceptable. The power button **84** produces the control signal, which is sent to the controller **44** to initiate monitoring of the patient handling device **20**. In the preferred embodiment, the power button **84** also controls the flow of power to the patient handling device **20**. Furthermore, the power button **84** cannot be activated (i.e., power will not flow to the patient handling device **20**) unless the brake has been set to immobilize the patient handling device **20**.

The controller **44** receives the control signal and begins to initiate the monitoring of the patient handling device **20**. Specifically, in response to receiving the control signal, the controller **44** acquires the sensor signal from each of the sensors **54** that is to be monitored. The controller **44** generates initial sensor data based on the initially acquired sensor signals. This initial sensor data then becomes the "setpoint" and is stored in a memory of the controller **44**, thus establishing a desired state of the patient handling device. For example, if the sensors **54** to be monitored are the four siderail switches **56**, the brake sensor **58**, and the load cells **66**, then the position of each siderail **42** and the brake and the weight measured by the load cells **66** are stored in the memory. If the sensors **54** to be monitored are the four siderail switches **56**, the brake sensor **58**, and the arm/disarm signal from the bed exit system, then the position of each siderail **42** and the brake and the current configuration of the arm/disarm signal (e.g., armed or disarmed) are stored in the memory. Thus, the initial sensor data is based on the position of the components being monitored when the power button **84** is depressed.

After generating the initial sensor data, the controller **44** then will periodically acquire the sensor signal from each of the monitored sensors **54** to generate current sensor data. This current sensor data is then compared to the initial sensor data. An alarm may be then issued in response to a substantial variation between the current sensor **54** data and the initial sensor data. This variation indicates a change from the desired state to an undesired state. Of course, the amount of variation between the current and initial sensor data that results in triggering the alarm may be adjusted, depending on the nature of the data. For example, a variation of a few pounds in the weight of the patient (between initial and current sensor data) need not trigger the alarm, but a variation of fifty pounds could. Furthermore, the step of periodically acquiring the sensor signals may be described as the controller **44** routinely examining the sensor signals to determine the current state of the sensors **54**. Alternatively, the step of periodically acquiring the sensor signals may be described as being immediately triggered by a state change, such as, but not limited to, the presence of an interrupt signal at the controller **44**.

Alternative methods to issuing the alarm are contemplated within the scope of the invention. In one method, the current sensor data is compared to predetermined data. This predetermined data may be set by the manufacturer of the patient handling device **20** or may be set by the user. In an embodiment in which the predetermined data is set by the user, configuration controls are provided as part of the footboard control panel **68**. Those skilled in the art realize that the initial sensor data may be considered to be the predetermined data since the initial sensor data is set (i.e., predetermined) by the user's act of turning the patient handling device **20** on via the power button **84**.

The alarm may be conveyed in several forms. In one instance, the alarm may be conveyed by activating an alert lamp which produces light. Referring to FIGS. **1** and **2**, in the preferred embodiment, the patient handling device **20** includes a plurality of alert lamps: at least one footboard alert lamp **86** and a pair of side alert lamps **88**. The footboard alert lamp **86** is coupled to the footboard **38** and disposed in a footboard lamp housing **90** located below the footboard control panel **68**.

One side alert lamp **88** is disposed on one side **36** of the patient handling device **20** while the other side alert lamp **88** is disposed on the other side **36** of the patient handling device **20**. The alert lamps **86**, **88** are positioned such that the light produced by the alert lamp is viewable outward from the patient handling device **20** along at least 180 degrees of a circle defined around the patient handling device **20** and more preferably viewable at least 270 degrees of the circle defined by the patient handling device **20**. Since the headboard **40** of the patient handling device **20** is traditionally positioned against a wall, the light produced by the alert lamps **86**, **88** is viewable no matter where a user is around the patient handling device **20**. Furthermore, alert lamps may be positioned such that light is viewable at any point (i.e., 360 degrees) around the patient handling device **20**.

Preferably, the alert lamps **86**, **88** are light emitting diodes (LEDs) such that replacement of the alert lamps **86**, **88** is a rarity. It is also preferred that the alert lamps **86**, **88** produce an amber (or yellow) colored light. Light having an amber color typically has a wavelength in the range of 577 to 597 nanometers. Furthermore, it is preferred that the alert lamp flash on and off, to emphasize the alarm condition. Those skilled in the art will realize other locations, configurations, colors, and wavelengths for the alert lamps **86**, **88**. The alert lamps **86**, **88** are deactivated, i.e., turned off, when there is no substantial variation between the current sensor data and the predetermined data (or initial sensor data).

To deactivate the alarm and the alert lamps **86**, **88**, a user may simply correct the problem (e.g., raise a siderail that was lowered). Alternatively, deactivating the alert lamps **86**, **88** may be accomplished by simply turning off power to the patient handling device **20** by pressing the power button **84** and then turning power back on, by again pressing the power

button **84**. When the patient handling device **20** is restarted, the initial sensor data will be set to the current (and desired) state.

The patient handling device **20** may also include a normal lamp **92** which is activated (i.e., illuminated) when there is no substantial variation between the current sensor data and the predetermined data (or initial sensor data). Said another way, the normal lamp **92** is illuminated when there is no alarm. The normal lamp **92** is also preferably disposed within the footboard lamp housing **90**. The normal lamp **92** produces a light having a wavelength different from the wavelength of the light produced by the alert lamp. Preferably, the normal lamp **92** is at least one LED that produces a green colored light. Those skilled in the art realize that green color light has a wavelength in the range of 492 to 577 nanometers. The normal lamp **92** is deactivated, i.e., turned off, when there is a substantial variation between the current sensor data and the predetermined data (or initial sensor data), i.e., when the patient handling device **20** is in the undesired state.

Thus, in the preferred embodiment, it is easy for a user (e.g., nurse, doctor, orderly, etc.) to quickly determine if there is a problem with the patient handling device **20** that needs to be addressed. The user need simply notice whether the patient handling device **20** is producing a green light or a flashing amber light.

In another instance, the alarm may be conveyed to a user by sounding an audible signal. The patient handling device **20** may include a speaker **94** in communication with the controller **44** for sounding this audible signal.

In yet another instance, the alarm may be conveyed by transmitting alarm data to a remote computer **95**, external from the patient handling device **20**. The controller **44** of the patient handling device **20** is in communication with a network interface **96**. The network interface **96** may then communicate the alarm data (as well as other data) to the remote computer **95** over a network **97**. Those skilled in the art realize that the network **97** may be a hardwired network (e.g., Ethernet) or a wireless network (e.g., WiFi., cellular telephone, GSM, Bluetooth, etc.).

The alarm my also be conveyed by transmitting a nurse call signal to a nurse call system. Nurse call systems are well known to those skilled in the art, but typically lack functionality for detailed data handling. Rather, nurse call systems typically provide a simple on/off signal to alert the user (e.g., a nurse) to a problem.

The patient handling device **20** of the present invention also provides functionality for limiting (or locking out) operation of the patient handling device **20**. The footboard control panel **68** includes an upper portion lockout control **98**, a lower portion lockout control **100**, a height lockout control **102**, and a motion lockout control **104**. Each of these lockout controls **98**, **100**, **102**, **104** is electrically connected to the controller **44** and sends a corresponding lockout control signal to the controller **44** when activated. For example, when the lower portion lockout control **98** is activated, the lower portion actuator **50** will not function when the lower portion controls **80** on the siderails **42** and/or the footboard control panel **68** are depressed. The same reasoning extends to the upper portion lockout control **100**, the height lockout control **102**, and the motion lockout control **104**.

The patient handling device **20** of the present invention also provides a position lock control **106**. The position lock control **106** is preferably a membrane-style pushbutton located in the footboard control panel **68** and electrically connected to the controller **44**. The position lock control **106** generates a position lock signal which is received by the controller **44**. The activation of the position lock control **106** in the preferred embodiment provides several results. First, the lower portion actuator **48** is actuated to position the lower portion to a horizontal position (i.e., parallel with the surface **28**). Next, the upper portion actuator **48** is actuated to position the upper portion **32** outside of a restricted range of angular positions of the upper portion **32** In the preferred embodiment, this restricted range is between 0 and 30 degrees with respect to the surface **28**. However, different ranges of angular positions may also be utilized. For example, in one alternative embodiment, the restricted range may be between 0 and 45 degrees. In another alternative embodiment, the restricted range may be any angular position greater than 45 degrees. If the upper portion **32** is already positioned outside the restricted range of angular positions, then no actuation takes place. The controller **44** receives feedback (i.e., the current position of the upper portion **32**) from the upper position sensor **54**.

Finally, activation of the position lock control **106** results in preventing the operation of the upper portion actuator **48** utilizing the upper portion control **78** into the restricted range of angular positions. Thus, in the preferred embodiment, the patient (or other user) is not able to lower the upper portion **32** under 30 degrees utilizing the pushbuttons of the upper portion control **78**. This allows a simple and convenient technique for a user to place the patient in an inclined position and keep the patient in that position. In some embodiments, however, even when the position lock control **106** is actuated, the upper portion **32** can be adjusted through a plurality of permitted angular positions that fall outside the restricted range of angular positions, such as those positions above 30 degrees with respect to the surface **28**. Those skilled in the art realize that certain medical conditions necessitate positioning patients in these permitted positions for extended periods of time. Those skilled in the art realize other restricted range of angular positions that have clinical or operational significance. Two examples of restricted ranges of angular positions are related to the commonly known Trendelenberg position (where the patient's feet are disposed higher than their head) and the knee gatch position. Of course, if CPR is to be initiated, a CPR button allows immediate movement of the upper and lower portions of the bed to a fully horizontal position.

In the preferred embodiment described above, the position lock control **106** restricted the range of angular positions of the upper portion **32**. In other embodiments, however, the position lock control **106** may alternatively restrict the range of angular positions of other portions of the patient handling device **20**, such as, but not limited to, the lower portion **34**.

The patient handling device **20** also includes an annunciator **110** for quickly alerting the user to status conditions of the patient handling device **20**. The annunciator **110** is preferably located adjacent to and below the footboard control panel **68**, however other locations may also be acceptable. The annunciator **110** includes annunciator lamps (not shown) electrically connected to the controller **44**. A cover plate is affixed over the annunciator lamps, such that messages are illuminated when appropriate. These messages may include, but are not limited to:

Motion Lockout Set
Siderail Lockout Set
Low Height
Brake Set
Bed Exit Alarm
Zero Weight Alarm
Siderail Alarm
Power On

One advantageous feature of the annunciator **110** is that it remains visible to the user, even when the cover **76** of the footboard control panel **68** is closed.

The display **74** of the footboard control panel **68** is used as an interface between a user of the patient handling device **20** and the controller **44**. As shown in FIG. **4**, the display may provide information to the user, such as the upper portion angular position and the lower portion angular position. Referring to FIG. **5**, the display **74** may provide a graphical representation and/or a schematic map of the patient handling device **20** to indicate which component is triggering an alarm. The triggering component may be blinking or otherwise indicated as is known to those skilled in the art. For example, FIGS. **6**A and **6**B will alternate on the display **74**, creating a blinking effect to inform the user that the height of the patient handling device **20** is low (i.e., lower than the desired state). FIGS. **7**A and **7**B will alternate on the display **74** to show the user that the brake is no longer set. Likewise, FIGS. **8**A and **8**B show that one of the siderails **42** is out of position and FIGS. **9**A and **9**B indicate that a bed exit alarm is tripped.

As shown in FIG. **12**, the display may provide a menu from which the user can configure features of the patient handling device, by utilizing user interface controls **108** located on the footboard control panel **68**. The display **74** can also convey non-alarm messages to the user, such as in FIG. **13**, instructing the user not to touch the bed (e.g., while the patient is weighed).

Referring now to FIG. **14**, the patient handling device **20** of the present invention may be a part of a location detection system (not labeled). The location detection system locates patient handling devices **20** in a facility such as a hospital. Such a location detection system is described in U.S. patent application Ser. No. 11/277,838, filed on Mar. 29, 2006, which is hereby incorporated by reference.

The location detection system includes a locator **112** mounted at each bay location in each room of the hospital. The locator **112** is programmed with a location ID to transmit to the patient handling device **20** once the patient handling device **20** has "docked" with the locator **112**. The locator **112** could be mounted on the ceiling, wall, floor, or any location that permits the locator **112** to carry out its intended function.

Referring to FIG. **15**, the locator **112** could also include additional features to provide an intelligent room module **112**A. For instance, the intelligent room module **112**A may include interface buttons **118** for operator selection that correspond to the patient handling device **20** or room being clean, dirty, empty, occupied, ready for occupancy, etc. An alternative intelligent room module **112**B may also include a graphic display **120** such as a touch-screen display with multiple nested user screens to access or transmit patient data, patient handling device data, or room data. The intelligent room module **112**A, **112**B may transmit this information, e.g., clean/dirty, etc., directly or indirectly to the hospital network **97** using wired and/or wireless communication paths. Communication can occur from the intelligent room modules **112**A, **112**B directly to the hospital network **97**, from the intelligent room modules **112**A, **112**B to other patient handling devices and then to the hospital network **97** or to more than one available hospital network, or directly from the intelligent room modules **112**A, **112**B to the computer **95** or to more than one computer **95**. The intelligent room modules **112**A, **112**B may also be configured as access points between the patient handling devices **20** and multiple non-bed devices **122** such as patient monitoring devices, patient treatment devices, diagnostic devices, and the like, or the intelligent room modules **112**A, **112**B may be configured as access points between the hospital network **12** and the non-bed devices **122**.

As stated above, data may be transmitted to the remote computer **95** from the patient handling device **20** via the network **97**. This data may include, but is not limited to, any data collected by the controller **44** of the patient handling device **20**, alarm data, location ID data, and non-bed device data from non-bed devices **122** in communication with the patient handling device **20**. This data may also be utilized by other systems present on the network **97**. For instance, the data may be automatically transmitted to an electronic medical record system **99**. Furthermore, the controller **44** of the patient handling device **20** may receive commands initiated at the remote computer **95**.

Referring to FIG. **16**, one possible configuration of a display **124** at the remote computer **95** is shown. As shown, the remote computer **95** includes a touch-sensitive user interface (not labeled) that allows hospital personnel such as a nurse to not only view the patient handling device data transmitted to the network **97** from the patient handling device **20**, but also remotely activate features of the patient handling device **20** such as a scale, the bed exit system, brakes, articulation locks, and the like. The user interface may also include configuration controls to allow the users to set the desired state of the patient handling device **20**.

As shown in FIG. **16**, the user interface also includes a bed configuration interface **180**. This interface **180** includes multiple buttons **182** that allow a user such as a nurse to establish the "desired" configuration of the bed or patient handling device **20** by setting the conditions to be monitored. As each of the buttons **182** are selected, various options are provided to the user to establish the "desired" bed configuration. For example, when the brakes button is selected, the user may have the option to add or delete brake monitoring as a monitored bed condition, or the user may elect "brakes on" as a "desired" state. When the side rails button is selected, the user may be able to select which, if any, side rails are included as monitored bed conditions and whether the "desired" state is up, down, or an intermediate position. When the bed exit button is selected, the user may define whether bed exit is to be monitored, and whether bed exit armed is a "desired" state. When the bed height button is selected, the user may be able to define a range of bed heights as being within a "desired" state, or the user may elect not to monitor bed height. The fowler angle can also be similarly monitored using the fowler angle button. Other bed conditions may be monitored based on the specific needs of the user or facility in which the bed is located. Lastly, predefined "desired" bed configurations may also be stored on the hospital network **97** or in the bed network. These predefined "desired" bed configurations may be selectable at the bed configuration interface **180** and may be based on events such as surgery, or clinical conditions of the patient such as when a ventilator is in use to prevent ventilator induced pneumonia (VIP), as described further below.

The bed status monitored can also be armed with an activation button on the footboard. This embodiment allows for the nurse or other clinician to configure the bed physically, as they normally would, and then identify this as the desired state by activating the monitoring system.

The display **124** may also include amber **126** and green **128** indicators activated in the same manner as the alert and normal lamps **86**, **92** on the patient handling device **20**. Audible alarms may also be provided at the remote computer **95** or other locations to indicate whether the patient handling device **20** is in a desired or undesirable state or configuration.

The remote computer **95** may be in communication with a portable device (e.g., cellular phones, PDAs, pagers, etc.) to deliver information about one or more patient handling devices **20** to a user. This information may include not only that an alarm has occurred, but the exact nature of the alarm.

For instance, the portable device may display data similar to that displayed on the display **74** of the footboard control panel **68**.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims.

What is claimed is:

1. A bed comprising:

a frame for supporting a patient;

a plurality of side rails movable between raised and lowered positions;

a plurality of wheels adapted to support said frame;

a brake for immobilizing at least one of said plurality of wheels;

a lifting mechanism adapted to raise and lower said frame;

a bed exit system adapted to detect when a patient has exited the bed; and

a controller with a monitoring system in communication with said brake, said bed exit system, and said plurality of side rails, said monitoring system monitoring said brake, said side rails, and said bed exit system, and said controller determining whether each of said brake, said side rails, and said bed exit system is in a desired state so that the bed is in a desired configuration or whether any of said brake, said side rails, and said bed exit system deviates from their desired state so that the bed is in an undesired configuration, and said controller generating a unified indication when said bed is in said desired configuration and generating another indication when said bed is in said undesired configuration.

2. The bed of claim **1** wherein said controller is further adapted to allow a user to select if said bed exit system is to be monitored, wherein if said bed exit system is monitored said controller will generate said other indication or a third indication when said bed exit system is disarmed.

3. The bed of claim **1** wherein said unified indication comprises a lamp, wherein said controller causes a change in illumination state of said lamp when at least one of said brake, said lifting mechanism, and said side rails are changed to an undesired state.

4. The bed of claim **1** wherein said unified indication comprises a lamp, wherein said frame further includes an upper portion and a lower portion, said upper portion adapted to be angularly adjustable; and wherein said controller is further adapted to allow a user to select if an angle of said upper portion is to be monitored, said controller causing a change in illumination state of said if said angle is monitored and if said angle changes to an undesired state.

5. The bed of claim **3** wherein said lamp is positioned beneath a foot end of said bed and spaced from said control panel, said bed including no indicia adjacent said lamp indicating a condition associated with said lamp.

6. The bed of claim **3** said lamp comprising a first lamp, further including a second lamp in communication with said controller, said controller adapted to cause a change in an illumination state of said second lamp when said controller causes a change in the illumination state of said first lamp.

7. The bed of claim **6** wherein said first lamp and said second lamp are both positioned at a foot end of said bed.

8. A bed comprising:

a patient support for supporting a patient;

a plurality of sensors for generating a plurality of sensor signals, said sensors associated with a set of conditions associated with said bed for being monitored; and

a controller in communication with said sensors for monitoring whether said set of conditions is in a desired state and providing a unified indication that said bed is in a desired configuration when each of said conditions is in their desired state or providing an indication that said bed is in an undesired configuration when at least one of said conditions deviates from its desired state.

9. The bed of claim **8**, wherein said unified indication comprises a lamp in communication with said controller, said controller illuminating said lamp to provide said unified indication that said bed is in a desired configuration.

10. The bed of claim **9**, further including another lamp in communication with said controller, said controller adapted to cause a change in an illumination state of said other lamp when said controller provides said indication that that said bed is in said undesired desired configuration.

11. The bed of claim **9**, wherein said lamp produces a green colored light when illuminated to provide said unified indication that said bed is in a desired configuration.

12. The bed of claim **8**, wherein said unified indicator comprises a lamp, said controller illuminating said lamp to provide an indication that that said bed is in an undesired desired configuration.

13. The bed of claim **12**, further including another lamp in communication with said controller, said controller adapted to cause a change in an illumination state of said other lamp when said controller provides said indication that that said bed is in said undesired desired configuration.

14. The bed of claim **12**, wherein said lamp produces a yellow or amber colored light when illuminated to provide said indication that said bed is in an undesired configuration.

15. The bed of claim **8**, further comprising a bed exit system, wherein one of said conditions comprises a bed occupancy condition detected by said bed exit system.

16. The bed of claim **15**, further comprising a user input device to allow a user to select if said bed exit system is to be monitored.

17. The bed of claim **15**, wherein said user input actuates said bed exit system, when said bed exit system is activated said controller monitors said bed exit system and when said bed exit system is not activated said controller does not monitor said bed exit system.

18. The bed of claim **9**, wherein said lamp is positioned at a foot end of said bed and is viewable by a caregiver spaced from the foot end of the bed.

19. The bed of claim **8**, further comprising a side rail movable between raised and lowered positions, wherein one of said conditions comprises whether said rail is moved.

20. The bed of claim **8**, further comprising a plurality of wheels adapted to support said patient support and a brake for immobilizing at least one of said plurality of wheels, wherein one of said conditions comprises whether brake is actuated.

21. The bed of claim **8**, further comprising a deck with a first portion and a second portion, said first portion adapted to be angularly adjustable; and

wherein one of said conditions comprises said angle of said first portion.

22. The bed of claim **8**, wherein said controller is adapted to acquire the sensor signal from each of the sensors that is to be monitored and generate initial sensor data based on the initially acquired sensor signals.

23. The bed of claim **22**, wherein said initial sensor data is stored as a setpoint in a memory device.

24. The bed of claim **23**, wherein said memory device comprises a memory device of controller or a network.

25. The bed of claim **22**, wherein said conditions comprise conditions of components of said bed, and said initial sensor data is based on the position of the components being monitored when a user actuates a user input device.

26. The bed of claim **22**, wherein said controller periodically acquires the sensor signal from each of the monitored sensors to generate current sensor data and compares the current sensor data to the initial sensor data and generates said indication that said bed is in an undesired desired configuration in response to a substantial variation between the current sensor data and the initial sensor data.

27. The bed of claim **26**, wherein the amount of variation between the current and initial sensor data that results in said indication that that said bed is in an undesired desired configuration may be adjusted.

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(54) **PATIENT HANDLING DEVICE INCLUDING LOCAL STATUS INDICATION, ONE-TOUCH FOWLER ANGLE ADJUSTMENT, AND POWER-ON ALARM CONFIGURATION**

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(57) **ABSTRACT**

A patient handling device includes a controller, with a plurality of sensors, control panels, and lamps electrically connected to the controller. The patient handling device records the normal/desired state of the various components when power is applied. When one of the components goes outside the normal/desired state, the controller issues an alarm. This alarm includes illuminating a plurality of amber alert lamps which can normally be viewed by a user at any position around the outside of the patient handling device. The patient handling device also includes a position control. This control restricts movement of an upper (fowler) portion of the patient handling device in a certain range of angular positions, while permitting movement of the upper portion outside the certain range.

27 Claims, 11 Drawing Sheets