Title: HOSPITAL BED SENSOR SYSTEM

Fig. 3

Fig. 10

Abstract: A first embodiment provides a manually operable castor assembly (4) for a hospital bed, including a wheel unit (4) fittable to a bed frame (6) and provided with a lock actuator (5). A sensor unit (11, 12) is provided with a trigger element (12) and a sensor element (11), the trigger element being located on the manually operable brake actuator (5) and the sensor element (11) being located on the wheel unit (4). Another embodiment provides a manually operable safety side panel assembly (1, 2) including a hinge assembly (3) coupled to the panel element and attachable to a bed frame, and a sensor unit including a trigger element (18) and a sensor element (25), the trigger element (11) being located on the manually operable actuator and the sensor element being located on a part of the side panel or hinge assembly. Monitoring apparatus monitors the manually operable bed safety device and including a control unit coupled to the sensor unit and an indicator unit controllable by the control unit and operable to give an indication of the state of the device.
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HOSPITAL BED SENSOR SYSTEM

The present invention relates to a manually operable bed safety features and to monitoring apparatus for monitoring the state of one or more bed safety features.

Hospital beds are provided with a number of convenience and safety features including, for example, side barriers for retaining a patient safely in the bed and castors for allowing care staff to move the patient while in the bed. There are typically provided one or more brakes for locking the castors and thus the bed in position. It is generally convenient to have the side barriers and brakes manually operable, for instance for patient and care worker convenience as well as to avoid the need to have a power supply available for operation of these particular features. Manual operation can, however, lead to operator error and uncertainty as to whether these safety devices have been properly set in their safe configurations.

The present invention seeks to provide a system for monitoring such features of a hospital bed.

According to an aspect of the present invention, there is provided a manually operable bed safety device for a hospital bed including a lock arranged to lock the device in a safety position, a manually operable actuator for releasing the lock and thereby releasing the safety device, a sensor unit fitted at least in part to the actuator and operable to detect whether the actuator is in a locking or a releasing condition.

This structure provides a manually operable bed safety device with means to sense the condition of the device, which in practice can avoid errors in configuration of the bed, particularly when the patient is left unattended.

In an embodiment, the device is a castor assembly including a wheel unit fittable to a bed frame and provided with a castor, the lock being a brake mounted on the castor assembly and movable between a release position allowing rotation of the castor and a locking position preventing rotation of the castor; the manually operable actuator being coupled to the brake and operable to move the brake between the release and locking positions; the sensor unit being provided with a trigger element and a sensor element, the trigger element being located on the
manually operable brake actuator and the sensor device being located on the wheel unit.

The trigger device, which need not be electrically wired, is located on the movable part of the device, whereas the sensor element, which may be wired, is located on a part of the device which does not move relative to the bed frame. Thus, the sensor unit is able to be coupled readily to a control unit fitted to the bed frame without impinging upon the movement of the various elements of the bed, including the manually operable device.

In another embodiment, the device is a safety side panel assembly for a hospital bed including a panel element, a hinge assembly coupled to the panel element and attachable to a bed frame, the hinge assembly permitting movement of the panel element between a safety position and an access position; the lock being coupled to the hinge assembly for locking the hinge assembly and thereby the panel element in the safety position, the manually operable actuator being located on the side panel and connected to the lock, the sensor unit including a trigger element and a sensor element, the trigger element being located on the manually operable actuator and the sensor element being located on a part of the side panel or hinge assembly.

More generally, the sensor unit may include a trigger element and a sensor element, the trigger element being coupled to the manually operated actuator.

By locating the trigger element on and in practice integrally with, the manually movable actuator of the safety device, the trigger will reliably be moved and thus trigger the sensor unit. Advantageously, the sensor element includes no separately movable parts which depend upon cooperation with the actuator, such as a switch lever. This provides a most reliable sensor arrangement that devices which include moving sensor parts able to fail.

In the preferred embodiment, the trigger element is a magnet and the sensor element is a Hall sensor.

According to another aspect of the present invention, there is provided monitoring apparatus for monitoring a manually operable bed safety device as taught herein, including a control unit coupled to the sensor unit and an indicator
unit controllable by the control unit and operable to give an indication of the state of the device.

Preferably, the control unit includes a memory and a clock and is configured to store data relating to the state of the device over a period of time. There may also be provided a report generating unit operable to provide a report of the data stored in memory. These features enable a history of the state of operation of the device to be obtained, useful in determining correct operation of the safety features of the bed and can be used both for manually operable safety devices as well as actuator operated devices.

In an embodiment, the control unit is configured to receive data from a plurality of sensor units of a plurality of associated manually operable bed safety devices and to give an indication of the state of all of the plurality of devices.

Embodiments of the present invention are described below, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a general arrangement of a hospital fitted with safety-sides and braking system for the castors;

Figure 2 is an exploded view showing a complete brake sensor, brake pedal, activating magnet, and magnet holder of a preferred embodiment of bed safety device;

Figure 3 is an exploded view showing the brake sensor with cover removed, brake pedal, activating magnet, and magnet holder of the embodiment of Figure 2;

Figure 4 is an exploded view showing the brake sensor located inside a base cross-member, brake pedal, activating magnet, and magnet holder of the embodiment of Figure 2;

Figure 5 is an exploded view showing the magnet holder, located inside the brake pedal of the embodiment of Figure 2;

Figure 6 shows the relative positions of the activating magnet and Hall-effect switch in un-braked and braked positions;

Figure 7 shows a general arrangement of a bed safety-side according to another embodiment of the present invention;

Figure 8 is a view of internal components of the safety-side arm with locking plungers in the locked position, of the embodiment of Figure 7;
Figure 9 is a view of the internal components of the safety-side arm with locking plungers in the un-locked position, of the embodiment of Figure 7;

Figure 10 is a view of the internal components of the safety-side arm with sensor case and plunger actuator removed to show relative positions of activating magnet and Hall-effect switch when in locked position, of the embodiment of Figure 7;

Figure 11 is a view of the internal components of the safety-side arm with sensor case and plunger actuator removed to show relative positions of activating magnet and Hall-effect switch when in un-locked position; and

Figure 12 shows back and front views of the sensor of the embodiment of Figure 7.

Referring to Figure 1, there is shown an example of hospital bed to which the teachings herein can be applied. The bed includes a number of movable safety devices and a raisable and lowerable platform. The principal components of relevance to the teachings herein include side panels 1 and 2, of which there are pairs on both sides of the bed, coupled to the bed platform by manually actuatble hinge assemblies 3. Castor assemblies 5 are located at either corner of bed frame 6 and are provided with manually operable brake actuators 4. The skilled person will understand that reference to manual operation includes operation by a person’s foot and is intended to refer to a mechanical device rather than a powered device.

The advantage of having at least the side panels 1, 2 and the castor assemblies 5 manually operable is that they do not need any power supply and can therefore be adjusted wherever the bed is positioned in a hospital or other care environment. It may be desirable or necessary, for example, to park the bed in a waiting zone in which a power supply may not be immediately available. Similarly, it may be desired or necessary to get a patient onto or off the bed in any of a multitude of circumstances and again where a power supply may not be available. Whilst an on-board power supply, typically a battery, may be feasible in some cases, this does not provide a guarantee of reliable operation of the safety devices, particularly given the power such devices can consume.
Referring now to Figures 2 to 6, there is shown a preferred embodiment of castor and brake assembly 4, 5 for the bed of Figure 1, which incorporates a sensor unit for determining the state of operation of the brake actuator 4 and thus of whether the castor 5 is locked or free to rotate.

The assembly includes a moulded clam shell housing 7 containing a printed circuit board (PCB) 10 on which is mounted a Hall-effect switch 11 and other associated electronic components. An electrical cable 8 is fitted to the sensor to provide power and communicate with a bed monitoring or control system (not shown). An over-moulded grommet 15 is attached to the cable which creates a seal for the cable entry into the housing and provides a degree of flex-protection. The grommet also locates into a slot 14 in the base cross-member 9, thereby fixing the sensor radially. Splines 16 are moulded onto the side-wall of the housing 7 to provide a snug fit with the bore of the base cross-member 9.

A magnet 12 is fitted to a magnet holder 13 which in turn is fitted to brake pedal or actuator 4. In another embodiment, the magnet could be fitted directly to the pedal by provision of a suitable recess.

Operation of the sensor is a simple process. When the brake pedal 4 is in the "un-braked" or released position (see Figure 6), the magnet is positioned sufficiently far enough away from the Hall-effect switch to not activate it. When the pedal is in the "braked" or locking position the magnet is in line with the Hall-effect switch which is thus activated.

In the preferred embodiment of bed, all four brake pedals are linked by means of bars 17 and links 6, such that operation of any brake pedal will effect the same change to the other brake pedals and will be monitored by the same sensor 11 and thus requiring only a single sensor unit for all four castor assemblies. Other embodiments may have additional sensor units on other castor assemblies, for example as verification sensors and in which the monitoring or control unit will only determine correct actuation of the brakes when every sensor detects brake activation. Similarly, in cases where the castor assemblies are not mechanically linked to one another or linked in smaller sets, for example pairs, there is preferably provided a sensor unit per castor assembly or per set.
As the Hall effect switch is a non-mechanical electronic device the sensor is inherently reliable.

Referring now to Figures 7 to 12, there is shown the preferred embodiment of hinge assembly for the side panels 1 and 2. As the side panels 1 and 2 are typically independently movable, a sensor system is advantageously provided in each hinge assembly.

The preferred embodiment of safety side sensor unit includes an over-moulded casing 22 disposed over a printed circuit board (PCB) 26 on which is mounted a Hall-effect switch 25 and other associated electronic components. An electrical cable 20 is fitted to the PCB to provide power and communicate with the bed monitoring or control system. The sensor is fitted into the safety-side panel assembly 3 and locates by means of a groove 29 in the casing which fits over as rib in the arm casting 21. A local thinning of the casing 30 is located over the Hall-effect switch 25 so as not to decrease its sensitivity unnecessarily. An activating magnet 18 is fitted into a hole in the plunger actuator 17.

In order to lower the safety-side 2, the release lever 24 is manually pulled outwards, causing the link 23 to slide the plunger actuator 17 upwards, which in turn disengages the plungers 19 from the holes 27 in the mounting bracket 28. This also positions the activating magnet 18 in line with the Hall-effect switch 25, thereby indicating to the bed-monitoring system that the safety-side is unlocked.

Once the plungers are disengaged and the safety-side 2 is free to move, the operator can let go of the release lever 24 and the side 2 lowered.

When the safety-side 2 is raised again, the plungers 19 automatically engage into the holes 27 in the mounting bracket 28. This allows the plunger actuator 17 to move downwardly and so re-position the activating magnet 18 away from the Hall-effect switch 25, thereby so indicating to the bed-monitoring system that the safety-side is locked.

The plunger actuator 17 is always held in the up position unless both the plungers are fully engaged. This means that a partial engagement of the plunger/plungers 19 would indicate to the bed-monitoring system that the safety-side is in an unsafe condition.
As with the castor brake sensor, the Hall effect switch is a non-mechanical electronic device so the sensor is inherently reliable.

The monitoring or control system could be based on commonplace components, including a processor and a memory. In the preferred embodiment, the system also includes a recording capability, a clock and an output unit for outputting historical data relating to the operation of the safety device or devices. It is envisaged that the output unit could be a printer or an output port for coupling to a computer or printer, so as to provide the care facility with the stored record. The record can thus give data as to when the safety features were active and not active, which can be correlated with a patient's movement on the bed over that period. This will enable verification of the state of the bed in case of dispute as to whether the bed had been properly set during a patient's stay thereon.

It is to be appreciated that specific embodiments are described above which include specific details not essential to the performance of the inventive features taught herein and which could therefore be modified, replaced or omitted without detriment to the advantageous characteristics of the inventive features.

It will also be appreciate that although the castor and side panel assemblies taught herein are the preferred implementations of the invention taught herein, the teachings herein could be applied to other manually operable safety devices.

The sensor units disclosed herein could be arranged to trigger either when the safety feature is in a locked condition or in an unlocked condition, depending on design choice. The result is the same, with the monitoring or control unit monitoring either for a trigger signal indicative of a locked condition or a trigger signal indicative of an unlocked condition.

A Hall-effect sensor system is preferred for its simplicity and reliability. However, other sensor systems could be used, including for example an optical system. It is preferred that the sensor includes no moving parts for reliability, in which any moving trigger element, magnet or mirror for example, is integral with the manual actuator used to lock or unlock the safety device.

Other embodiments will be apparent to the skilled person having regard for the teachings herein and the claims which follow.
1. A manually operable bed safety device for a hospital bed including a lock arranged to lock the device in a safety position, a manually operable actuator for releasing the lock and thereby releasing the safety device, a sensor unit fitted at least in part to the actuator and operable to detect whether the actuator is in a locking or a releasing condition.

2. A device according to claim 1, wherein the device is a castor assembly including a wheel unit fittable to a bed frame and provided with a castor, the lock being a brake mounted on the castor assembly and movable between a release position allowing rotation of the castor and a locking position preventing rotation of the castor; the manually operable actuator being coupled to the brake and operable to move the brake between the release and locking positions; the sensor unit being provided with a trigger element and a sensor element, the trigger element being located on the manually operable brake actuator and the sensor device being located on the wheel unit.

3. A device according to claim 1, wherein the device is a safety side panel assembly for a hospital bed including a panel element, a hinge assembly coupled to the panel element and attachable to a bed frame, the hinge assembly permitting movement of the panel element between a safety position and an access position; the lock being coupled to the hinge assembly for locking the hinge assembly and thereby the panel element in the safety position, the manually operable actuator being located on the side panel and connected to the lock, the sensor unit including a trigger element and a sensor element, the trigger element being located on the manually operable actuator and the sensor element being located on a part of the side panel or hinge assembly.

4. A device according to claim 1, wherein the sensor unit includes a trigger element and a sensor element, the trigger element being coupled to the manually operated actuator.
5. A device according to claim 2, 3 or 4, wherein the sensor element includes no movable parts.

6. A device according to any one of claims 2 to 5, wherein the trigger element is a magnet and the sensor element is a Hall-type sensor.

7. Monitoring apparatus for monitoring a manually operable bed safety device according to any preceding claim, including a control unit coupled to the sensor unit and an indicator unit controllable by the control unit and operable to give an indication of the state of the device.

8. Apparatus according to claim 7, wherein the control unit includes a memory and a clock and is configured to store data relating to the state of the device over a period of time.

9. Apparatus according to claim 8, including a report generating unit operable to provide a report of the data stored in memory.

10. Apparatus according to claim 9, wherein the report generating unit includes an output device for outputting said data.

11. Apparatus according to any one of claims 7 to 10, wherein the control unit is configured to receive data from a plurality of sensor units of a plurality of associated manually operable bed safety devices and to give an indication of the state of all of the plurality of devices.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

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ADJ.

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)
A61G

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

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<td>X</td>
<td>US 2010/077548 Al (GENSKE DAVID [US] ET AL) 1 April 2010 (2010-04-01) paragraph [0033] - paragraph [0034] ; figures 7, 8 paragraph [0047] ; figures 16, 17</td>
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[X] Further documents are listed in the continuation of Box C. | [X] See patent family annex.

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<td>EP 2 030 602 A2 (HI LL ROM SERVICES INC [US]) 4 March 2009 (2009-03-04) paragraph [0026] - paragraph [0027] ; figures 1-3 paragraph [0040] - paragraph [0041] ; figures 6A-6E</td>
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