United States Patent [19]

Harrison et al.

[11] **3,781,843**

[45] **Dec. 25, 1973**

[54] **BED GUARD SYSTEM**

[75] Inventors: **William L. Harrison**, Hollis; **Ronald G. Purington**, Hudson; **Donald L. Anderson**, Nashua, all of N.H.

[73] Assignee: **Sanders Associates**, Nashua, N.H.

[22] Filed: **Apr. 15, 1971**

[21] Appl. No.: **134,247**

[52] **U.S. Cl.**..... **340/279**, 340/272, 200/81 H, 200/83 Z

[51] **Int. Cl.**... **G08b 7/04**, H01h 35/32, H01h 35/34

[58] **Field of Search**..... 340/279, 240, 272; 200/81 H, 83 Z, 82 A, 85

[56] **References Cited**

UNITED STATES PATENTS

2,436,518	2/1948	Lieffers et al.	340/279 VN X
299,649	6/1884	Keep et al.	340/272
2,795,668	6/1957	Puckett	200/81 H X
3,104,293	9/1963	Rendler	200/81 H X
3,436,503	4/1969	Moody	200/83 Z
3,122,731	2/1964	Hutchison	200/81 H
2,226,325	12/1940	Sandford	200/83 Z
2,838,629	6/1958	Panzenhagen	200/81 H

FOREIGN PATENTS OR APPLICATIONS

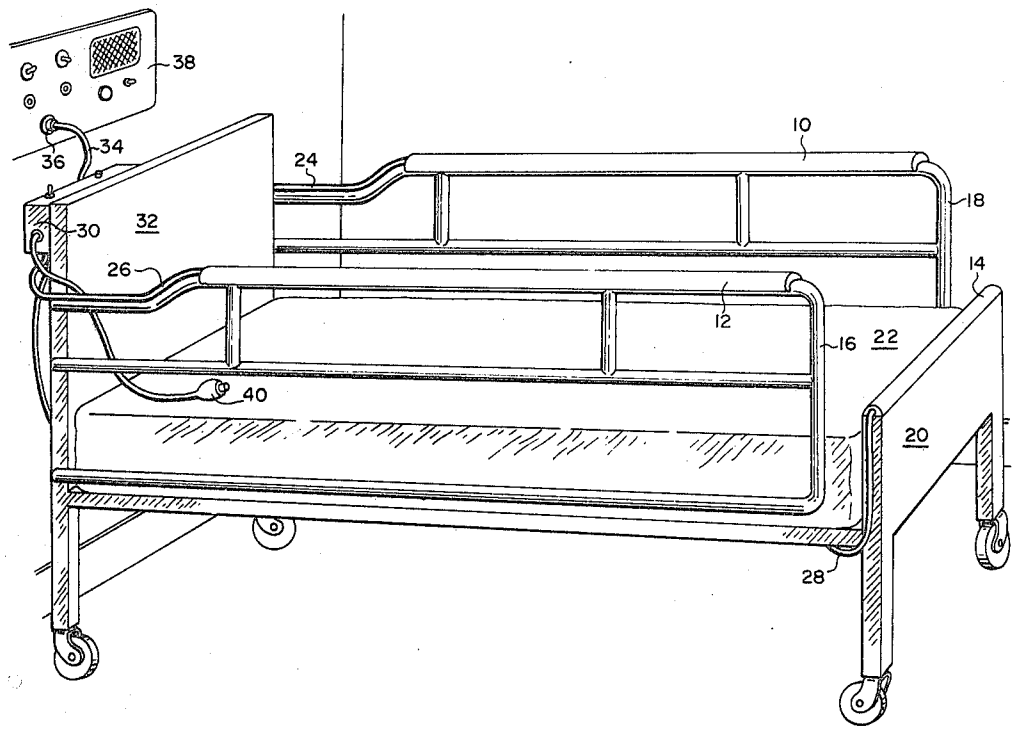
262,429	9/1967	Germany	200/83 Z

Primary Examiner—John W. Caldwell
Assistant Examiner—Scott F. Partridge
Attorney—Louis Etlinger

[57] **ABSTRACT**

Apparatus is provided for alerting nurses that a patient is attempting to leave his bed, comprising members having a fluid filled passageway therein which can be attached to the top of the side rails and footboard of a bed. The members are coupled via lines to transducers which activate an alarm when a predetermined volume of fluid is displaced.

13 Claims, 7 Drawing Figures



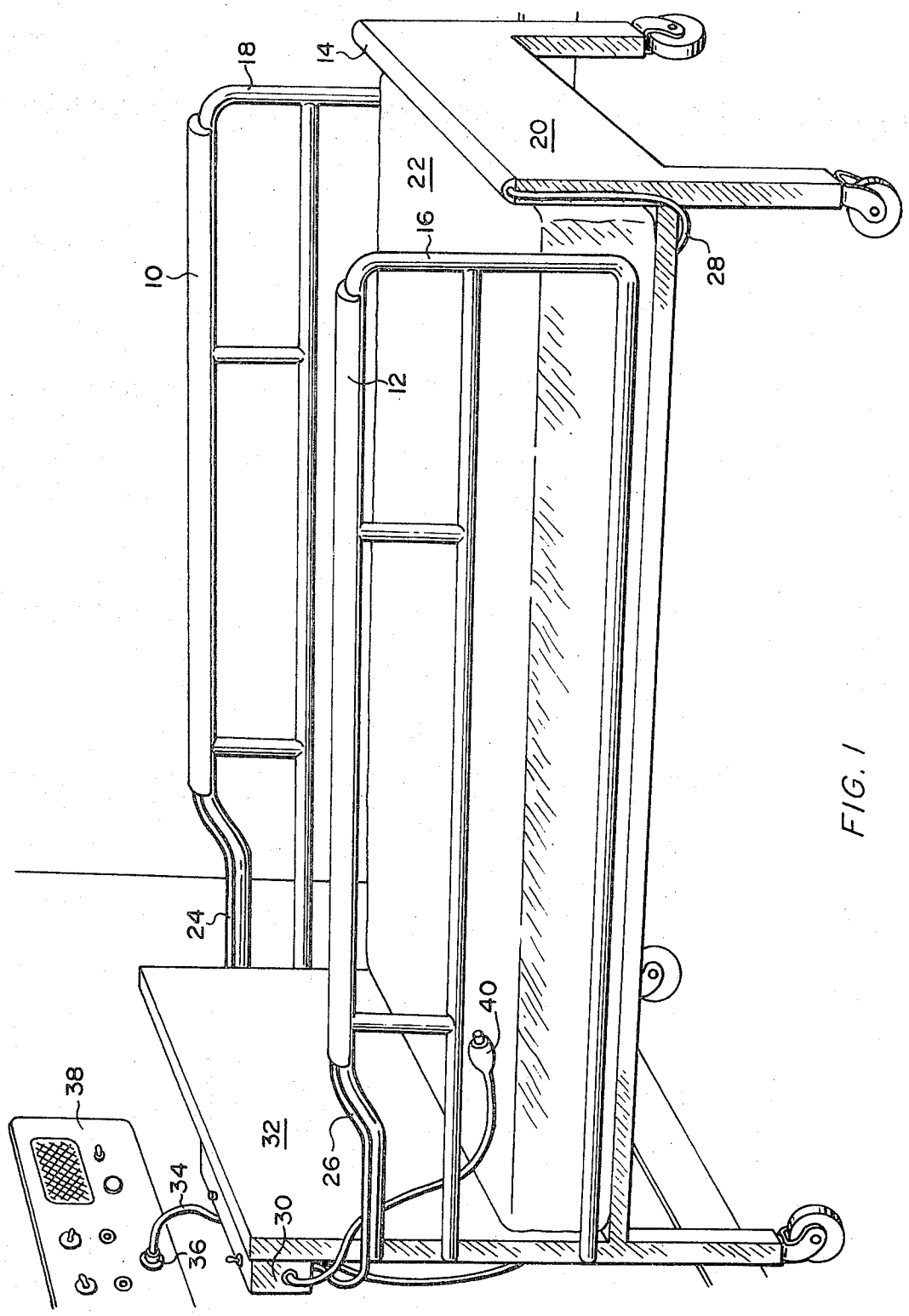


FIG. 1

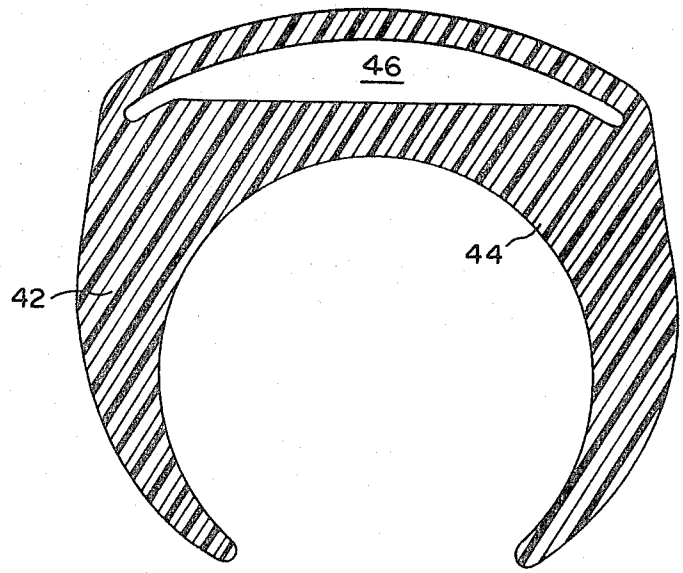


FIG. 2

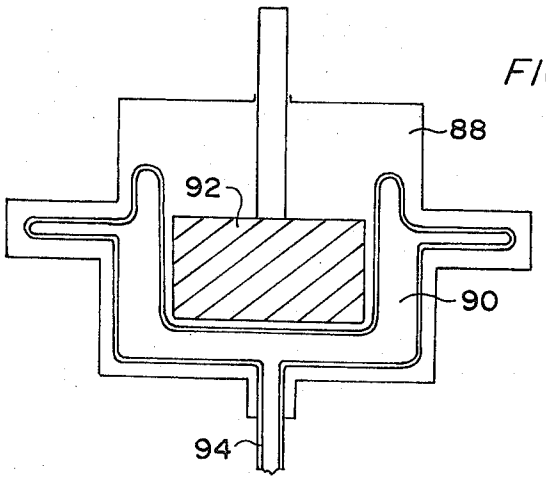


FIG. 4A

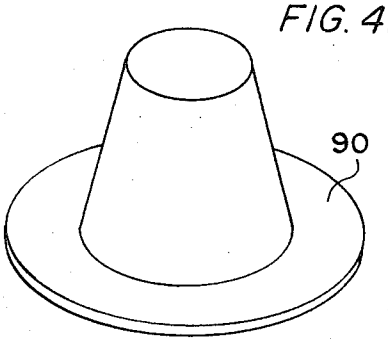


FIG. 4B

INVENTORS
WILLIAM L. HARRISON
RONALD G. PURINGTON
DONALD L. ANDERSON
BY Richard A. Seligman
ATTORNEY

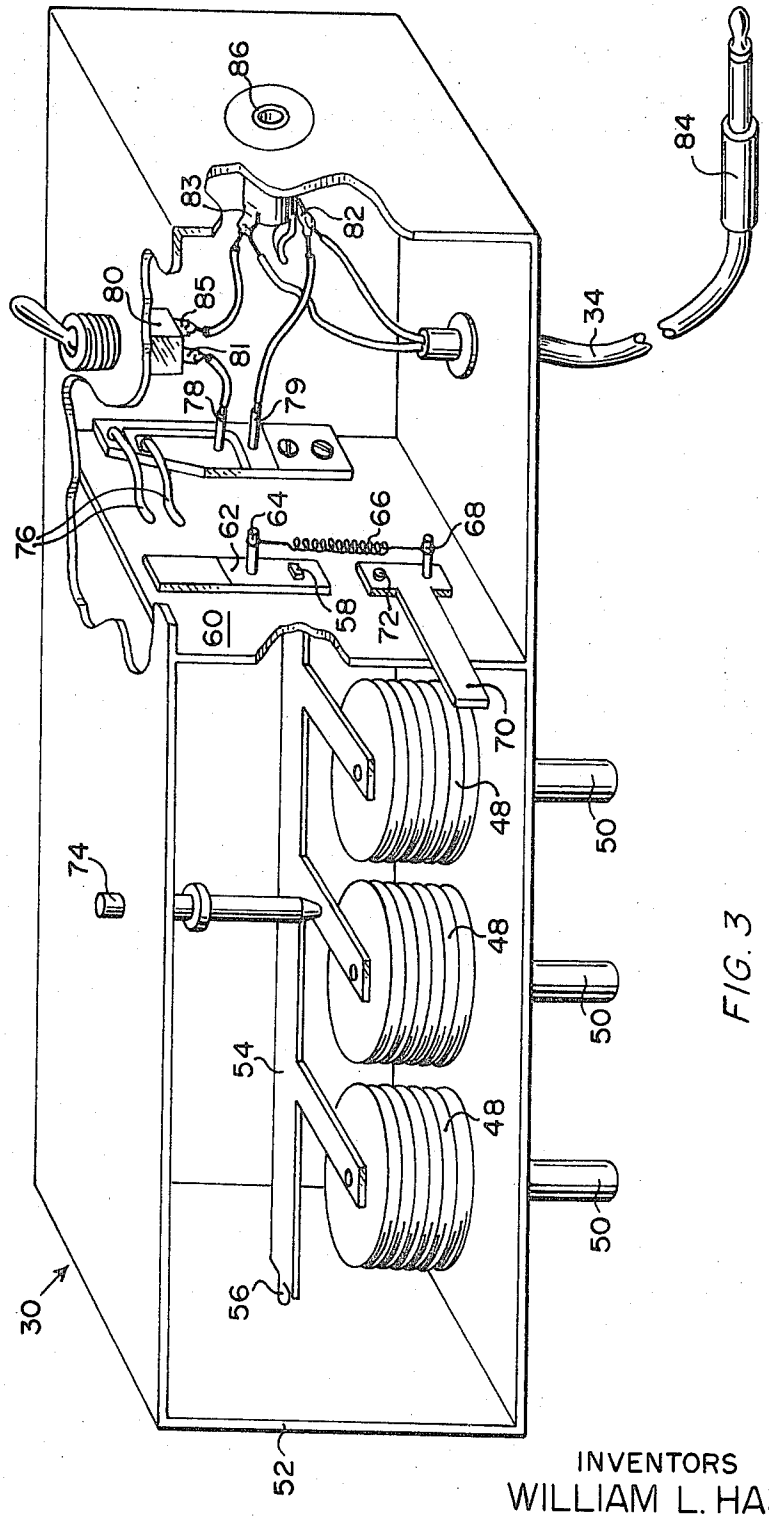


FIG. 3

INVENTORS
WILLIAM L. HARRISON
RONALD G. PURINGTON
DONALD L. ANDERSON
BY Richard L. Seligman
ATTORNEY

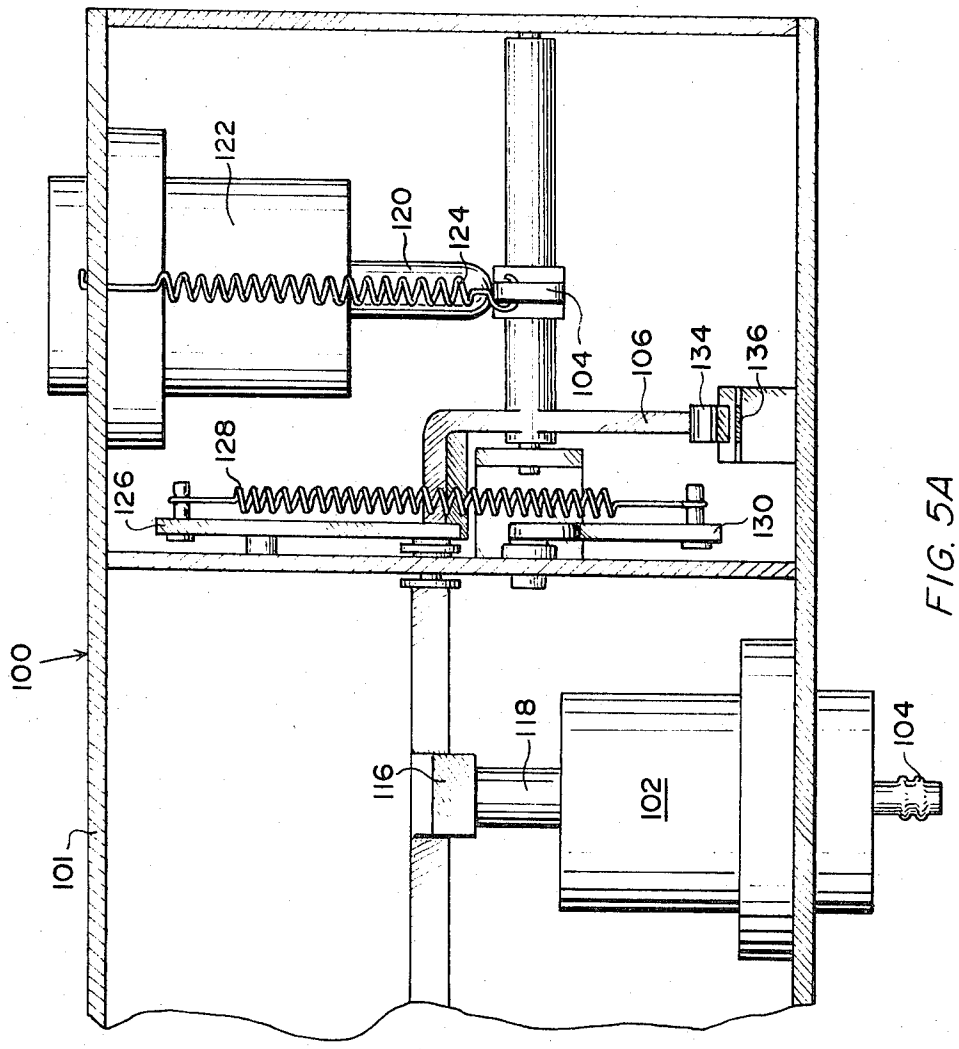


FIG. 5A

INVENTORS
WILLIAM L. HARRISON
RONALD G. PURINGTON
DONALD L. ANDERSON
BY Richard L. Seligman
ATTORNEY

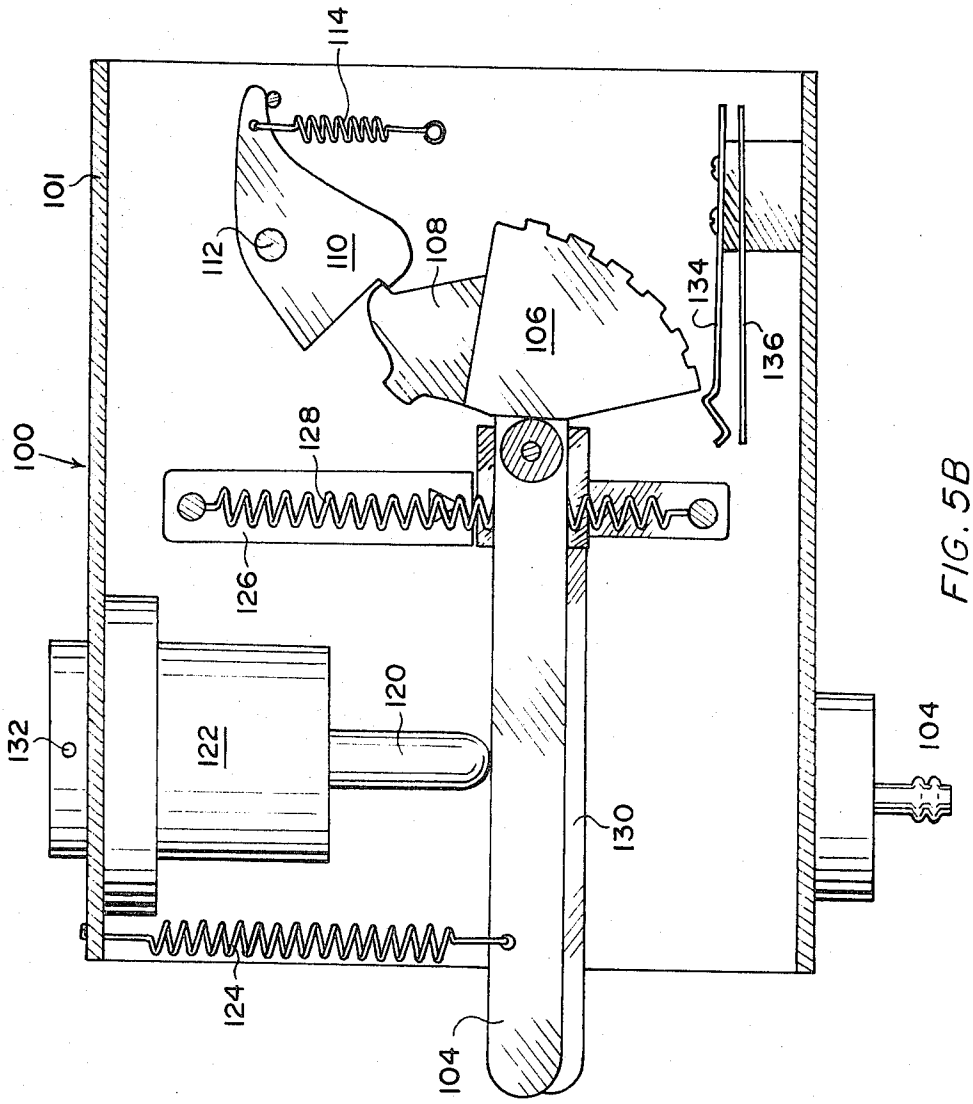


FIG. 5B

INVENTORS
WILLIAM L. HARRISON
RONALD G. PURINGTON
DONALD L. ANDERSON
BY Richard J. Seligman
ATTORNEY

BED GUARD SYSTEM

BACKGROUND OF THE INVENTION

Patients in hospitals often sustain injuries while attempting to leave their beds. This is especially true of patients who are either heavily sedated, as, for example, after an operation, or whose mental faculties are impaired. Presently hospital beds have side rails thereon to prevent a patient from falling out or easily leaving his bed. However, it is not that difficult to climb over the side rails and get out of bed or alternatively climb over the footboard. Restraining straps which are uncomfortable and psychologically depressive and nets which are cumbersome and awkward to both patient and nurses are currently in use to restrain a patient.

The prior art has suggested the use of switches coupled to the side rails wherein pressure on the side rails will cause a contact to close, sounding an alarm and signifying that a person is applying pressure to the side rails. This type of arrangement is problemsome from a safety viewpoint in that if fingers get near the contact, they could be pinched and, furthermore, this system requires electrical potentials to be brought within reach of the person, which is undesirable. Also, no notice is given that the person is going over the footboard. Further, this system requires major alterations to be made to the modern hospital bed. Another analogous system is an inflatable pad with alarm wherein the pad is placed under the user and connected to a pressure switch to activate an alarm. In this type of system, the lack of pressure is detected and activates the alarm. The disadvantage to this system for bedridden patients is that detection may not occur until the patient has left the bed, which may be too late to prevent injuries.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide apparatus which will alert others that a person in a bed is attempting to leave same.

It is another object of this invention to provide apparatus for sounding an alarm when a patient leaves his bed wherein the apparatus does not require the patient to come in contact with any electricity carrying elements.

It is a further object of this invention to provide apparatus having a fluid therein which fluid will be displaced when a patient attempts to leave his bed and will cause the actuation of an alarm.

It is yet another object of this invention to provide a bed guard system with sensitivity adjustment.

It is a still further object of this invention to provide a bed guard system which can be connected into present nurse call systems.

In accordance with one embodiment of the invention, a fluid carrying member is attached to the top of each side rail and footboard of a bed and connected to transducers by tubing. Each transducer employs a bellows which expands when fluid is forced into it, and the bellows expansion makes contact with and moves a trip arm to actuate an alarm. The alarm is actuated only when a predetermined amount of fluid is displaced by, for example, a patient applying sufficient force on one of the fluid carrying members.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sketch showing the relationship between a hospital bed, the bed guard rail detectors, the bed guard system control unit, and a conventional patient call-box;

FIG. 2 illustrates a cross-section of one embodiment of a bed guard rail detector;

FIG. 3 is a sketch of a control unit for a bed guard system employing bellows;

FIG. 4A is a sketch of a rolling diaphragm pressure responsive device which can be used in place of the bellows of FIG. 3;

FIG. 4B is a sketch of a rolling diaphragm employed in the pressure responsive device of FIG. 4A; and

FIGS. 5A and 5B are sketches of a second embodiment of a control unit for a bed guard system.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is illustrated thereby a bed guard system for use in a hospital environment. Although this embodiment is shown for hospital applications, the invention is certainly not limited thereto. The invention also has utilization in a home wherein someone would wish to know when either a baby or young child was leaving his crib or an invalid was attempting to get out of bed.

In the embodiment of FIG. 1, three bed guard rail detectors 10, 12 and 14 are shown attached to the bed side rails 16 and 18, and to the footboard 20 of a hospital bed 22. Lengths of small diameter tubing 24, 26 and 28 are attached to one end of the bed guard rail detectors 10–14. The other ends of the bed guard rail detectors are closed. The lengths of tubing 24–28 are connected to a bed guard system control unit 30 which may be attached to the outside end of a headboard 32 of bed 22. Alternatively, control unit 30 may be attached to the wall adjacent bed 22. An output from control unit 30 is coupled via a cord 34 to a patient call button jack 36 on a patient call-box 38. The patient call button 40 is plugged into a jack on the control unit 30. Normally, it would be plugged into jack 36 of the call-box 38.

One embodiment for bed guard rail detectors 10-14 is illustrated by the cross-section sketch of FIG. 2 and comprises a rubber, plastic or other suitable fluid carrying material 42. Member 42 can be formed by, for example, extrusion or molding. A surface 44 is formed in the shape of the bed rails and footboards so as to fit over same. If desired, a strap or other suitable holding means can be used to more securely hold the detectors in place. In the upper portion of the member 42 a passageway 46 is formed, and passageway 46 is filled with a fluid and operates at zero static pressure. It is preferred that a force of approximately two pounds per square inch over a linear length of approximately three inches displace eighty percent of the fluid under that area. When the applied force is removed, member 42 returns to its natural shape.

Referring now to FIG. 3, there is illustrated thereby one typical bed guard system control unit 30. Bed guard system control unit 30 comprises a plurality of bellows 48, one bellows for each bed guard rail detector. The tubings 24–28 couple the bed guard rail detectors 10–14 to the bellows 48 by way of a number of corresponding hollow tubes 50. A fluid transfer rate damper (a metal tube with a small orifice) can be in-

serted in the fluid coupling line to filter out transient type contacts to the bed rail detectors that might cause a false alarm. The bellows are contained within a box **52.** Arranged above the bellows **48** is a trip arm **54** which is pivotably mounted in box **52** at point **56.** Trip arm **54** is also pivotably mounted at point **58** in a plate **60** which divides box **52** into two compartments. Trip arm **54** is connected to a toggle arm **62.**

Toggle arm **62** has a pin **64** connected thereto. A spring **66** is connected between pin **64** and a pin **68** on a sensitivity adjust arm **70.** Sensitivity adjust arm **70** is pivotally mounted via a pin **72** to plate **60.** The closest portion of sensitivity adjust arm **70** is mounted in a detent (not shown) on the front plate of box **52.** Preferably, there are a number of detends on the front plate, and, thus, to alter the sensitivity required to trip the toggle arm **62** the user merely changes in which detent arm **70** is placed. This feature is desired since different size people will displace different amounts of fluid in the lines and it is not desirable that a false alarm be given when a person merely rests his hand on a detector or grips one of the detectors with one hand.

Trip arm **54** is reset by a reset button **74** which presses the trip arm **54** against the top portions of bellows **48.** Reset button **74** can be spring loaded, if desired, to return it to its set position. As fluid is displaced from any of the bed guard rail detectors **10—14,** one or more of the bellows **48** is caused to expand pushing up the trip arm **54** until it reaches the trip point of toggle arm **62** whereupon toggle arm **62** makes contact with contact pins **76** on a contact board **77.**

Contact pins **76** are electrically connected to a pair of standoffs **78** and **79.** One contact **81** of a toggle switch **80** is connected to standoff **78.** Standoff **79** is connected to a contact **82** of a jack **86.** A second contact **83** of jack **86** is connected to a second contact **85** of switch **80.** The cord **34** is also connected to contacts **82** and **83.** Cord **34** has a plug **84** at the other end thereof. Plug **84,** which is at the end of the bed guard system output cord, is inserted in the normal patient call button jack in the wall patient call-box **38.** The normal patient call button **40** is applied to jack **86** in the box **52** so that the bed guard system can be used in the bed guard mode and patient call mode, simultaneously. Switch **80** permits the bed guard system to be disabled and yet permit the patient call button to be still used. In other applications where there is no patient call box, the contacts can be used to actuate an alarm (not shown).

Operation of the system occurs when switch **80** is switched to the "enable" position and reset button **74** is depressed. The system is thus armed. As a patient tries to get over a side rail or footboard, he exerts enough pressure on the detector to force sufficient fluid into one of the bellows **48.** As the bellows extends, trip arm **54** turns up and toggle arm moves toward contact board **77.** At a certain position determined by sensitivity adjust arm **70,** toggle action due to spring force from spring **66** takes over and snaps toggle arm **62** against contact pins **76** which sets off an alarm. Simultaneously, as toggle action occurs, the trip arm's upward movement forces the reset button to the uncocked position.

FIGS. **4A** and **4B** illustrate an alternate transducer which may be used in place of the bellows **48** in the bed guard control unit and comprises a housing **88** containing a rolling diaphragm **90.** A rolling diaphragm is illustrated in FIG. **4B** and it is inserted in the inverted position of the housing **88.** A piston **92** sits in the rolling diaphragm **90.** Fluid from a bed guard rail detector is applied to an inlet **94.** The reason for using a rolling diaphragm rather than a conventional diaphragm is to get large displacement. On conventional diaphragms only minimal displacement can be obtained, wherein with a rolling type diaphragm displacement on the order of four tenths of an inch can be obtained. Applying fluid to the diaphragm **90** will cause piston **92** to move upward and cause trip arm **54** (FIG. **3**), to be rotated as described hereinbefore. Piston **92** can be spring loaded, if desired.

In an alternate embodiment rather than merely making contact when sufficient displacement is achieved, a rotating cam can be used to provide a coded alarm which would be different from a mere patient's call and, therefore, promote a much quicker response from the listener. A control unit **100** of this type is illustrated in FIGS. **5A** and **5B.**

Control unit **100** comprises a number of transducers **102** arranged in a housing **101.** In this embodiment rolling diaphragm pressure responsive transducers as previously described in FIG. **4** are used. Bed guard rail detectors are coupled to the inputs **104** of transducers **102.** The system is set by providing counterclockwise rotation to a reset arm **104;** that is, reset arm **104** is pressed down to reset the system. Reset arm **104** has a contact cam **106** and a reset arm extension **108** thereon. When reset arm **104** reaches the reset position (the position shown in the drawing), reset arm extension **108** engages a toggle arm **110,** as shown. Toggle arm **110** pivots about a point **112** and is further coupled to housing **101** by way of a latch spring **114.** When the reset arm **104** is pushed down, it is carried past center and pushes a trip arm **116** to its set position against the piston rods **118** of transducers **102.** When the reset arm **104** is released after being reset, it will return to its center position, as shown in the drawing, being stopped thereby by latch spring **114.** Also, when the reset arm is pushed down, a piston rod **120** of a timer **122** will fall down onto the reset arm setting timer **122,** which is a pneumatic timer filled with air. Reset arm **104** also pulls down a power spring **124.**

The control unit also contains a toggle arm **126,** a toggle spring **128,** and a sensitivity adjust arm **130,** as in the embodiment of FIG. **3.** Also as in the embodiment of FIG. **3,** sensitivity adjust arm has a number of positions and is mounted in detents in the front plate of the control unit (not shown).

As fluid is displaced from any of the bed guard rail detectors **10–14,** one or more of the transducers **102** is actuated causing piston rod **118** to move upwards rotating the trip arm **116** and thereby the toggle arm **126** attached thereto until the trip point of toggle arm **126** is reached whereupon toggle arm **126** is tripped, thereby releasing the latch by rotating the toggle arm latch **110** in a counterclockwise rotation. The trip arm **126** is shown in phantom lines in its tripped position. This will cause the reset arm **104** and its cam assembly **106** to rotate slowly in a clockwise direction at a rate determined by the air discharged from a timer orifice **132** of timer **122,** and the spring-timer diaphragm-orifice combination. This slow rotation will provide a series of contact closures with contacts **134** and **136** with a rhythm determined by the cam shape of **106.**

The contacts are connected in the same manner shown in the unit of FIG. 3. With this arrangement the alarm given to, for example, a nurse, will be distinctive from the patient call alarm. Furthermore, if desired, the cam surface 106 can be made to give a coded alarm.

In certain hospital systems the patient call system alarm latches after a single switch closure, and in these instances the patient call system would require minor modification to install the distinctive alarm feature.

While we have described the principles of our invention in accordance with specific apparatus, it is to be clearly understood that the description is made only by way of example and not as a limitation of the scope of our invention as set forth in the accompanying claims.

We claim:

1. Apparatus for indicating that a person is attempting to leave his bed, comprising:
at least one bed guard rail detector having a fluid therein;
a transducer coupled to said bed guard rail detector and responsive to fluid displaced from said bed guard rail detector; and
means coupled to said transducer for providing an indication when a predetermined amount of fluid is displaced from said bed guard rail detector.

2. Apparatus as defined in claim 1, wherein said bed guard rail detector includes a length of resilient tubing closed at one end and means associated therewith for attaching said tubing to a bed.

3. Apparatus as defined in claim 1, wherein said bed guard rail detector includes a resilient member closed at one end and having a hollow portion filled with a fluid, said hollow portion being a predetermined size to displace a predetermined amount of fluid when a predetermined force is applied to said detector.

4. Apparatus as defined in claim 1, wherein said transducer is a bellows.

5. Apparatus as defined in claim 1, wherein said transducer includes a housing having a rolling diaphragm therein and a piston arranged in said rolling diaphragm whereby fluid entering said diaphragm will cause movement of said piston.

6. Apparatus as defined in claim 1, wherein said indicator means includes a trip arm arranged adjacent said transducer for movement therewith and a toggle device coupled to said trip arm whereby a predetermined movement of said trip arm will cause said toggle device to trip.

7. Apparatus as defined in claim 6, further including means for adjusting the sensitivity of said toggle device.

8. Apparatus as defined in claim 6, wherein said indicator means further includes contact means arranged proximate said toggle device to make electrical contact therewith when said toggle device is tripped.

9. Apparatus as defined in claim 6, wherein said indicator means further includes means for providing a distinctive alarm.

10. Apparatus as defined in claim 8, further including means coupling said contact means to an alarm.

11. Apparatus for providing a signal to a patient call-box signifying that a patient is attempting to leave his bed, comprising:
at least one bed guard rail detector arranged on said bed said bed guard rail detector including a resilient member having a fluid therein;
a bed guard control unit;
first means for coupling said bed guard rail detector to said bed guard control unit; and
second means coupling said bed guard control unit to said patient call-box.

12. Apparatus as defined in claim 11, wherein said bed guard control unit includes:
at least one transducer coupled to said first coupling means;
a toggle device;
means coupling the motion of said transducer to said toggle device, whereby said toggle device will be tripped when a predetermined amount of fluid is displaced from said bed guard rail detector; and
means closing an electrical contact upon tripping of said toggle device, said contact closure coupled to said second coupling means.

13. Apparatus as defined in claim 12, further including means for adjusting the sensitivity of said toggle device.

* * * * *