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Benoit et al.

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[54] **FLUIDIC SWITCHING SYSTEM**

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[52] **U.S. Cl.** ..... **5/66**, 5/68, 200/83 R

[51] **Int. Cl.** **A61g 7/10**, A61g 7/00

[58] **Field of Search** ..... 297/330; 5/63–69; 200/83 R, 83 C

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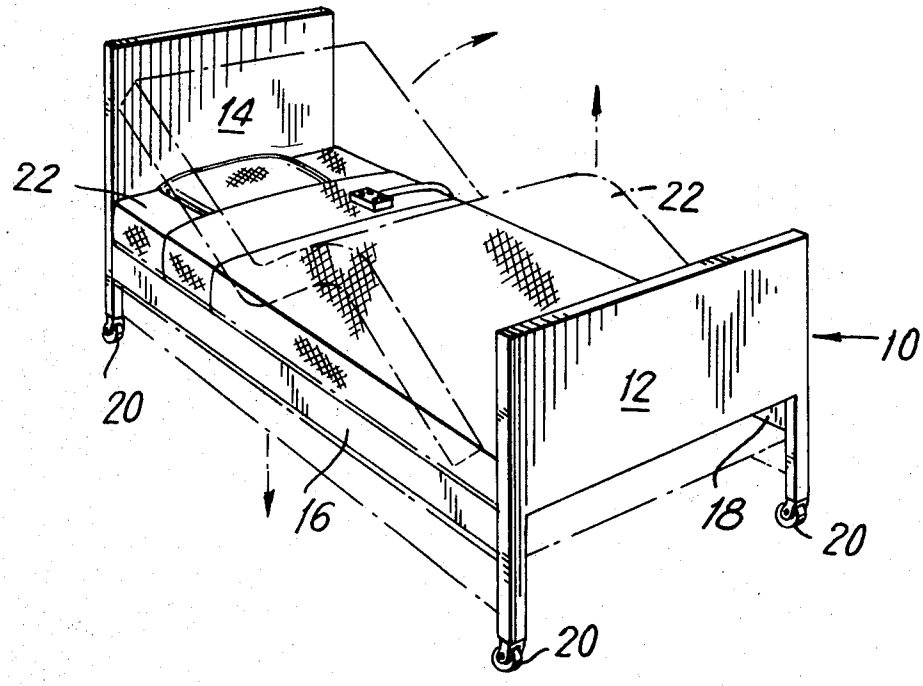
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Primary Examiner—Casmir A. Nunberg

[57] **ABSTRACT**

A non-electrical fluidic control system is provided for actuating means for adjusting the position of a hospital bed. The fluidic control cystem includes a hand-held pendant having a plurality of plungers which communicate with respective cylinders to force air pressure through respective air tubes or conduits. A bellows, connected to the distal end of the tubes, cooperates with a snap-action switch for energizing a respective motor means for adjusting the position of the bed. Additionally, an assembly retriever means is provided for supporting and maintaining an air tube sleeve off the floor lever as an improved safety feature.

8 Claims, 10 Drawing Figures



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SHEET 1 OF 4

FIG. 1

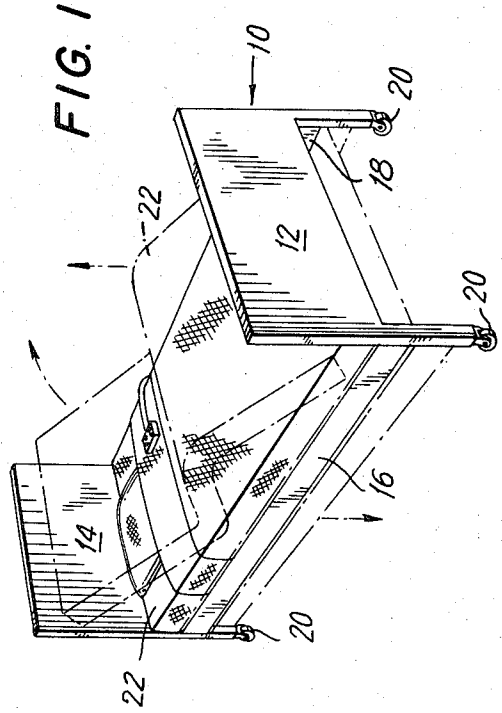
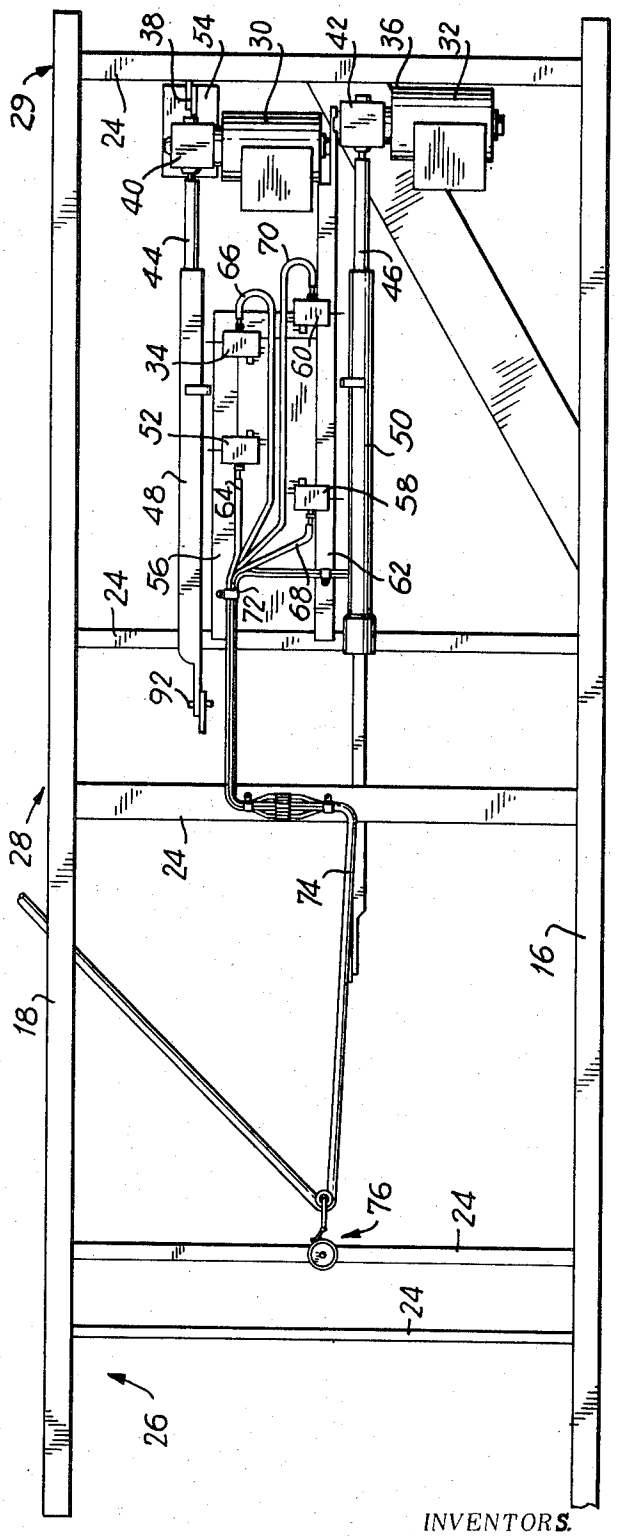


FIG. 2



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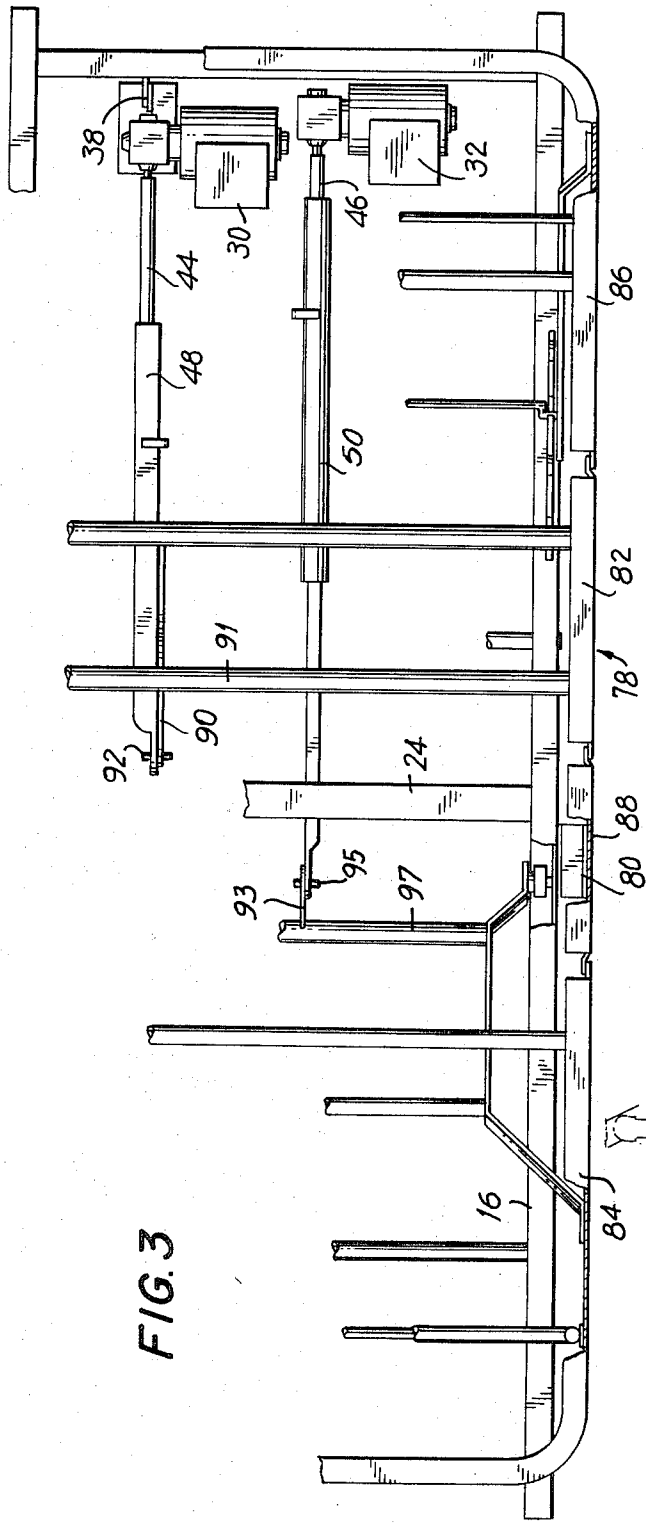


FIG. 3

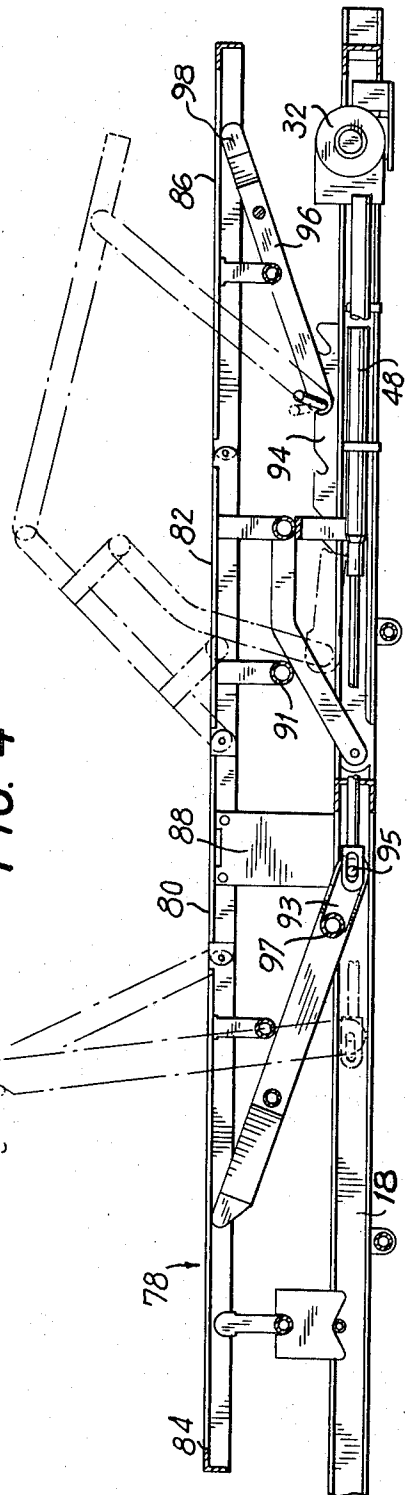
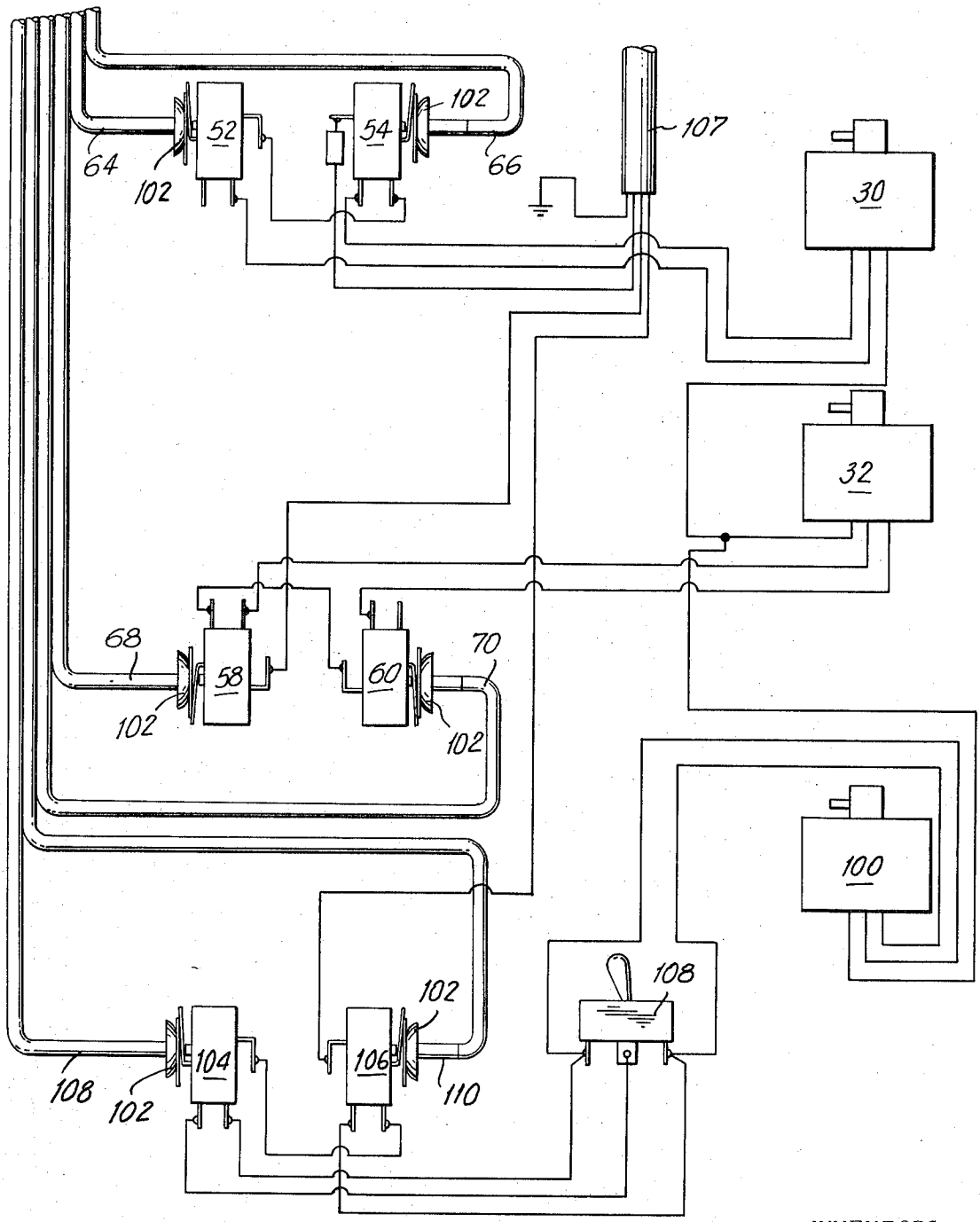


FIG. 4

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FIG. 5



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FIG. 6

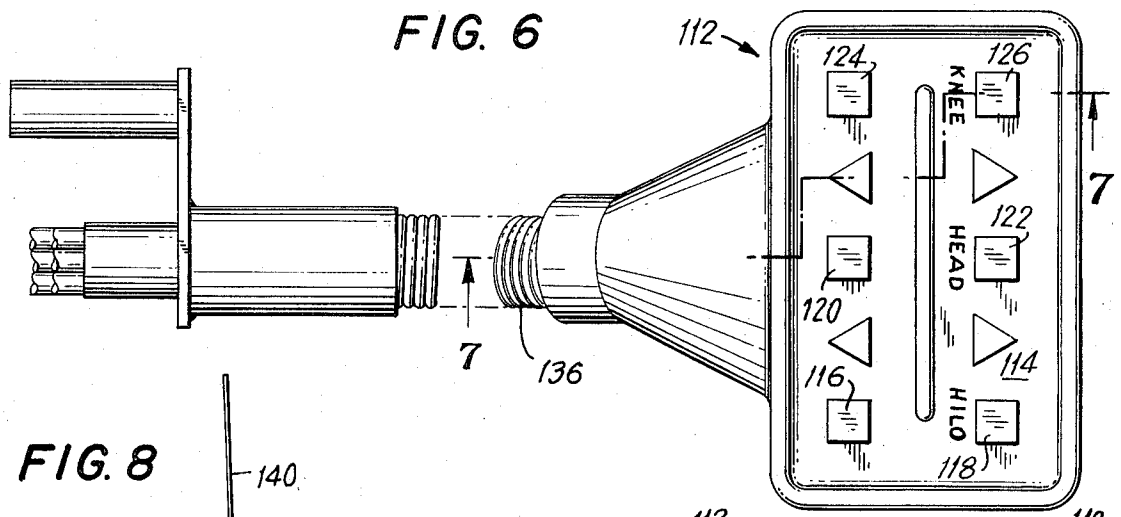


FIG. 8

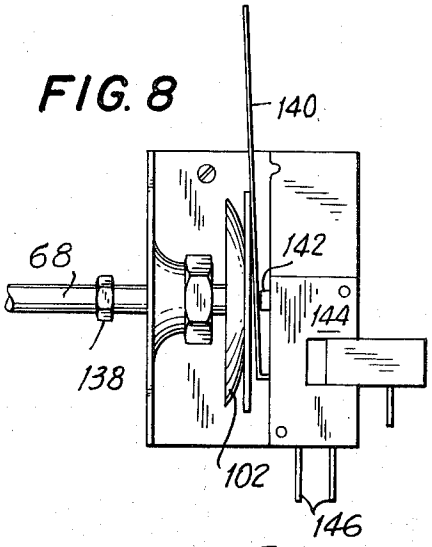


FIG. 7

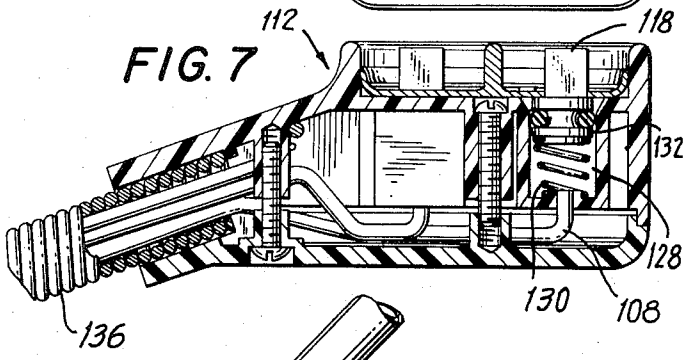


FIG. 9

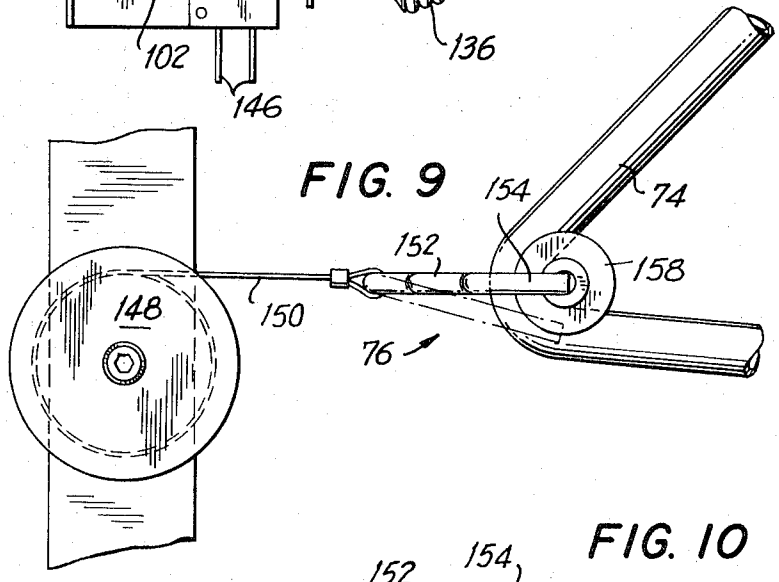
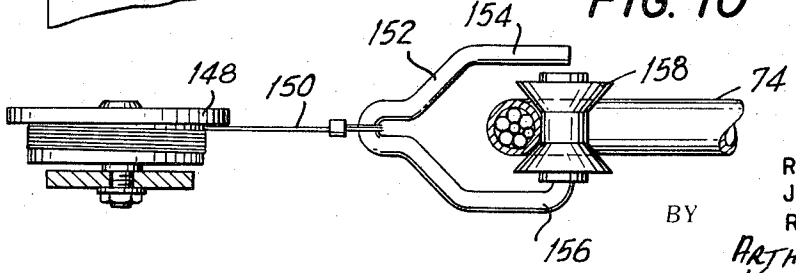


FIG. 10



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FLUIDIC SWITCHING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to an actuating mechanism for hospital beds, and more particularly, to an improved actuating mechanism capable of being operated by a patient or attendant.

Hospital beds as presently constructed are capable of being adjusted to a variety of positions, such as the Fowler and the contour positions. In the Fowler position, the head end of the bed is elevated so that the head and shoulders of the occupant or patient are similarly elevated, while in the contour position, the knees of the patient are elevated by elevating the foot assembly in an inverted V configuration. Additionally, hospital beds may be equipped with means for raising and lowering the entire mattress assembly, or by elevating the head end (Trendelenberg position) or the foot end (reverse Trendelenberg position) etc.

These prior art beds are normally controlled by the occupant with a hand-operated set of electrical switches which actuate respective electric motors to control associated mechanical means serving to adjust the positions of the bed. The electric motors are conventional and are controlled by switches which are hand-held by the occupant.

The possibility of an explosion resulting from an electrical spark in an oxygen atmosphere always exists when an electrical circuit is present within the oxygen tent in which the patient is being treated. The hand operated electrically operated control mechanisms of the prior art thus presents a hazard and has been banned least in many jurisdictions for use in such circumstances.

Recently a great deal of attention is being drawn to hospital equipment which is electrically operated because of the discovery that extremely small amounts of current, known as leakage current, has been found to present a high degree of hazard to patients. The term "micro-shock" describes a condition which may be brought about by direct contact with only milliamperes of electricity. It has been demonstrated, for example, that when the current path-way is directly heart to ground, as little as 0.00002 of one ampere of current can fibrillate the heart. Current in this range is not perceptible to the touch and can only be detected with sensitive instruments. Thus even small amounts of electricity can be extremely hazardous to some patients.

With prior art hospital beds, a large number of electrical cables are required to control the various electrical motors included within the hospital bed frame. These wires frequently drag on the floor and also present dangerous conditions. Further, prior art devices which are capable of adjusting the position of the bed frequently comprise separate switches, each of which is operated by the patient. This multiplicity of separate switches is frequently complex, and it is often difficult for the occupant to properly select the desired switch for operating the respective control function.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an improved actuating mechanism to assume the various positions of a hospital bed without electrically operated control mechanisms.

Another object of the invention is to provide a control system which exhibits greater safety features than those found in the prior art.

Still another object of the invention is to provide a control system which is relatively simple to understand and easy to operate.

Yet another object of the invention is to provide a mechanism whereby cables and wires associated with the control functions of the bed positions are permanently maintained off the floor thereby eliminating the above-mentioned dangerous condition.

It is a further object of the invention to provide an improved hospital bed which enables the occupant to select a desired position with a simple manually operated selector mechanism which does not rely on electricity in its operation.

Another object of the invention is to provide a hospital bed wherein all electrical components are double insulated from the bed parts to prevent any current leakage thereto.

Other objects, advantages and features of the invention will become more apparent from the following description.

In accordance with the principles of the invention, the above objects are accomplished by providing a hospital bed including a plurality of motors and interconnected mechanical means capable, under control of the motors, to adjust the bed to various positions, wherein the motors are controlled by a switch which, in turn, is controlled by a fluid pressure developed by a hand-held pendant which includes a plurality of depressable plungers. When a selected plunger is depressed, a fluid is forced through a fluidic carrying tube to cause a bellows to expand, closing a switch and actuating a respective motor. The pendant includes a plurality of similar plungers which are associated with respective cylinders so that when a plunger is depressed, a cylinder head is also compressed, causing the fluid within the fluidic system to expand the bellows. A respective motor is provided for each of the adjustments of the bed position, and each motor is controlled by a separate bellows actuated switch. The preferred fluid is air, however other fluids may be used in the fluidic system of this invention.

In accordance with a feature of the invention, a plurality of tubes connect from the cylinders to respective ones of the bellows, and the air tubes are joined together in a common sleeve which is maintained off the floor by a retriever assembly under tension.

Additionally all of the electrical components of the beds are doubly insulated from the metallic portions so as to prevent any current leakage through the bed to its occupant.

The pendant containing the fluidic control system is clearly marked so as to be easily recognized by the occupant or attendant and thus, the pendant is capable of being simply manually operated to adjust the bed configuration quickly and efficiently.

IN THE DRAWINGS

FIG. 1 is a perspective view of a conventional hospital bed for use with the present invention.

FIG. 2 is a top plan view of the bed frame adapted with the manually operated non-electrical selector mechanism of the invention.

FIG. 3 is an enlarged top plan view of the bed frame of FIG. 2, shown thus for purposes of clarity.

FIG. 4 is a side view of the embodiment of FIGS. 1 and 2 taken along line 4—4 of FIG. 2

FIG. 5 is an enlarged view showing the interconnection between the fluidic system, the snap-action switches and the operating means of the inventive concept.

FIG. 6 is a front view of a pendant and air tube and cable assembly used with the present invention.

FIG. 7 is a sectional view of the pendant taken along line 7—7 of FIG. 6.

FIG. 8 is a top view of a bellows operated switch mechanism used with our invention.

FIG. 9 is a top plan view of the assembly retriever mechanism used for maintaining the cables off the floor.

FIG. 10 is a side view of the assembly retriever mechanism shown in FIG. 9.

DETAILED DESCRIPTION

Referring now to the drawings, and particularly to FIG. 1, there is shown a conventional hospital bed for use in hospitals and nursing homes, the bed being capable of assuming several configurations. As illustrated in FIG. 1, the bed 10 is provided with a foot board 12 and head board 14 connected together by side rails 16 and 18. The bed is easily moved from position to position by means of casters 20 inserted in the bottom of the foot and head boards 12 and 14 respectively.

The bed further includes a mattress 22 supported on the bed frame, the mattress and frame being capable of assuming several different configurations. The contour position is illustrated by the dotted lines and is attained by raising the middle portion of the foot assembly in the normal inverted V. Additionally, the Fowler position is capable of being achieved with the head portion elevated to elevate the head and shoulders of the occupant.

FIGS. 2 through 4, which show the actuating mechanism or mechanical adjustment means for adjusting the position of the bed, will now be described.

In FIG. 2 a fragmentary view of a main frame assembly is shown. Side rails 16 and 18 are rigidly attached to transverse bars 24 which conventionally are angle-iron bars. Two such transverse bars are located at the head section 26, another two transverse bars in an intermediate section 28, and another transverse bar 24 is located at the foot portion 29 of the main frame of the bed.

To control the position of the bed, at least two electrical motor means 30 and 32 are provided for controllingthe movemetn of the knee and head sections, respectively. Other motors may be provided for raising and lowering the bed, andfor providing other types of positions, as desired.

Motors 30 and 32 are secured through insulators on respective motor mounts 34 and 36 which, as illustrated with respect to motor mount 34, is rigidly secured to one of the transverse bars 24 through a conventional attachment means 38. Motors 30 and 32 are coupled to gearboxes 40 and 42, respectively, which transmit the rotational movement of the motors to drive screws 44 and 46, respectively. These screws are conventional Acme screws which, upon rotation, operate to adjust the position of the hospital bed and communicate with respective elevating arms 48 and 50.

Motor 30 is actuated by doubly insulated switch means 52 and 54 which are supported on support member 56, integrally attached to one of the transverse bars 24 and motor 32 is operated by a double insulated switch means 58 and 60 supported on support member 62 rigidly attached to another transverse bar 24. Each of the switches is operated by a respective fluidic control means which includes a fluidic conduit or tube 64, 66, 68 and 70. These tubes are integrally carried in a collar 72 attached to support member 56 and a sleeve 74 in which the fluidic tubes are housed. The sleeve 74 is maintained off the floor level by an assembly retriever 76 (to be described in more detail hereinafter) and terminates in a fluidic pendant control for use by the patient.

Referring now to FIGS. 3 and 4 there is shown an enlarged view illustrating the operation of the adjustment mechanism used with this invention. The adjustment mechanism is conventional and as described above utilizes a rotating Acme screw which cooperates with an elevating arm to achieve the desired movement. With particular reference to FIG. 4, there is shown the lower side rail 18 fixed in position to the main frame of the bed and an upper assembly 78 parallel to the side rail. The upper assembly 78 is formed by a plurality of independent sections, such as a hip section 80, a thigh section 82, a head section 84, and a foot section 86. A side plate 88 is rigidly fastened between upper assembly 78 and side rail 18 to secure the hip section firmly in place. Elevating arm 48, which is utilized for raising or lowering the thigh section, is attached to transverse rod member 91 by means of a clevis 90 and clevis pin 92, and as the motor rotates the Acme screw 44, elevating arm 48 moves transversely imparting an elevating and depressing motion through clevis 90 and rod 91 to thigh and foot sections 82 and 86, respectively, as shown in the dotted lines. (FIG. 4) Additionally a foot ratchet 94 is utilized with a foot pawl arm 96 to set the position of the foot section 86. Foot pawl arm 96 is rotatable through the action of a pivot pin fixedly secured to the foot section 86.

Similarly for adjusting the head section 84, Acme screw 46 and elevating arm 50 cooperate with a clevis 93, clevis pin 95 and transverse rod 97 to impart an elevating or depressing motion to the head section thereby raising or lowering the head portion with respect to the remainder of the bed.

FIG. 5 is an electrical wiring diagram for motors 30 and 32 and for an additional motor 100, such as a hi-lo position motor, for example. For purposes of simplification the adjustment mechanism controlled by motor 100 has not been shown in FIGS. 2–4 since such mechanism is similar to that described for the other adjustments and is known to the art.

Fluidic carrier tubes 64 and 66 and 68 and 70 are associated with switches 52 and 54 and 58 and 60, respectively. These switches are electrically connected to motors 30 and 32, respectively. The fluidic carrier tubes terminate in a bellows or a pressure responsive means, such as 102 and a pressure increase of the fluid in the tubes causes the bellows to expand. When the bellows expand, a spring arm is urged against a projecting member which is coupled to an electrical contact within the switch. Upon movement of the projecting member, the electrical path is closed allowing power to be supplied to a respective motor. Hi-lo motor 100 is connected to switches 104 and 106 which are controlled by tubes 108 and 110, respectively, which expand and contract the associated bellows. A source of

power is connected to each motor through a master switch (not shown) and cable **107** which carries the power to respective terminals of the switches **52, 54, 58, 60, 104** and **106.** An override switch **108** is connected between switches **104** and **106** and motor **100** which may be mounted to the bed frame or in a suitable remote central control station manned by hospital personnel and is used to remotely control the horizontal position of the bed.

As was stated above, all components of the electrical system are insulated from the frame members through insulators to prevent any current leakage from being conducted to the bed occupant.

Thus, the closing of a selected switch will energize a respective motor to rotate in one direction actuating the adjustment mechanism for moving the bed to a selected configuration. The motors are of the reversible type capable of being rotated in either direction, thus one motor furnishing power for both the elevation and depression, for example.

It is the main feature of this invention that the motors are controlled not by electrical switches in the hands of the occupant, as is usual in the prior art, but by a fluidic system. This system comprises a set of fluidic tubes which at one end are connected to operate respective switches through the bellows as indicated in FIG. **5** and at the other end terminate in a hand-held pendant **112** as illustrated in FIGS. **6** and **7.**

The pendant **112** is preferably made of a plastic type material and is provided with a face plate **114** through which are mounted plungers **116** and **118** for controlling the hi-lo position of the bed, plungers **120** and **122** for controlling the head position, and plungers **124** and **126** for controlling the knee position of the bed. These plungers may be suitably colored so as to be distinguishable from the face plate and with the proper labelling as indicated in FIG. **6,** are capable of being easily recognized by the patient. Each of the six fluidic tubes, such as **108,** terminates in a respective cylinder **128** (as illustrated in FIG. **7**) which communicates with a respective plunger. Each plunger is biased in an upward position by a spring member **130** housed in the respective cylinders. Upon depression of the plunger **118,** for example, the air pressure in the cylinder **128** is increases and carried through the respective tube extending a bellows causing a respective switch to close.

A spring member **130** abuts the shoulder **132** provided on the upper end of each of the plungers **116** and **118.** The spring **130** tends to return the plunger to its outward position. When the plunger is depressed, against the action of the spring, air in a chamber near the base of the plunger is evacuated and enters the bellows to expand the same. Fluidic tubes are carried in the sleeve **136** which may be of a relatively rigid coiled construction.

FIG. **8** illustrates in more detail the bellows operated switch means. A fluidic tube, such as **68,** is connected through a fitting **138** to bellows **102** which abuts against the spring arm member **140.** When the bellows expands, arm member **140** is pushed against projecting member **142** which closes a pair of associated contacts housed within the switch **144** to control the operation of a respective motor through a pair of electrical terminals **146** for connecting the switch to the motor and source of power.

FIGS. **9** and **10** illustrate yet another feature of the present invention in which the assembly retriever **76** is shown in greater detail.

The assembly retriever is provided with a spring biased retriever reel **148** upon which is wound a cable **150** which is connected to a bracket yoke **152** having oppositely disposed legs **154** and **156** between which is mounted a roller **158.** The tube sleeve **74** is wound onto roller **158** and is maintained in a generally horizontal position through the action of biased reel **148,** cable **150,** bracket yoke **152** and roller **158,** keeping the slack out of the sleeve **74** and off the floor. As the sleeve is moved the retriever moves outwardly from its normally retracted position against the leasing action reel **148.** The spring biased retriever reel **148** is fixedly attached to a transverse bar member **24** (FIG. **3**) providing a fixed support point for the assembly retriever.

To summarize briefly, the present invention provides an improved control mechanism for adjusting the positions of a hospital bed which does not utilize electrical components. The control system of the invention utilizes a fluidic system utilizing fluid pressure to control respective motors for selective position adjustment. The prior art electrical switches and the hazards attendant thereto have been removed and replaced by the improved pressure system of the invention. In addition, an assembly retriever is provided for maintaining the sleeve housing the requisite cables, wiring and tubing off the floor, thereby eliminating and minimizing accidents.

As another feature of the inventive concept all components carrying electric current are carefully doubly insulated from the metal of the frame to insure absence of current leakage found to be prevalent in prior art beds.

It will thus be seen that the objects set forth above, amont those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above apparatus without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanyng drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An adjustable multi-section hospital bed capable of assuming a variety of positions of the sections relative to each other comprising:

mechanical adjustment means for selectively moving the position of the different sections of said bed relative to one another,

motor means coupled to said mechanical adjustment means for establishing a calculated movement thereof under the influence of remote control,

fluid operative switch means connected to said motor means for providing actuation thereof to control the positional change of the bed section under control derived from the remote control,

a pendant control means at the remote control location for controlling the motor switch connected means,

a plurality of fluid carrier tubes connected between the remote control and the switch connected means,

a plurality of pressure responsive means connected at one end with the remotely located pendant control means and at the other end with expansible bellows means for controlling the switch operation, and

means provided through the pressure responsive means for controlling the operation of the switching means to control thereby motor activation and deactivation.

2. The Hospital Bed structure claimed in claim **1** wherein the said control means comprises

a plurality of plungers,

a fluid carrier tube connected between said plungers and the motor control switch means to force fluid through the tube associated with the activated control so that with the depression of the associated plunger therewith the associated switch may be moved between two limiting positions.

3. The adjustable multi-section hospital bed, as claimed in claim **1**, comprising

separate motor means for achieving each control where said motor means consists of a reversible motor.

4. The adjustable hospital bed as set forth by claim **2**, comprising, in addition:

a spring member located within each of the cylinders to bias the plunger supported therein in one direction so that a normal condition to the plunger is independent of any movement of a bed component.

5. The adjustable hospital bed, as claimed in claim **2**, comprising, in addition:

a bellows member connected at one end of each fluid carrier tube and adapted to be expanded with the movement of fluid through the tube as controlled from the remotely positioned pendant control.

6. An adjustable hospital bed as set forth in claim **2**, including spring biased retriever means for supporting said sleeve.

7. An adjustable hospital bed as set forth in claim **5**, wherein said retriever means comprises a spring biased retriever reel rigidly mounted to said hospital bed, a cable wound on said retriever reel, a bracket attached to the end of said cable, and a roller mounted to said bracket, said sleeve being carried by said roller.

8. A bed as set forth in claim **1**, wherein said switch means comprises a spring arm member abutting against said bellows, a movable projecting member abutting against said spring arm member, a pair of contacts controlled by the position of said projecting member, wherein when said bellows expands said projecting member is moved closing said contacts and energizing a respective motor means.

* * * * *

Disclaimer and Dedication

3,798,684.—*Roland A. Benoit*, Danielson, *John H. Curran*, Norwich and *Richard L. Bennice*, Danielson, Conn. FLUIDIC SWITCHING SYSTEM. Patent dated Mar. 26, 1974. Disclaimer and Dedication filed June 12, 1980, by the assignee, *Interroyal Corporation.*

Hereby disclaims and dedicates to the Public the remaining term of said patent.

[*Official Gazette August 26, 1980.*]

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