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Riley et al.

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(54) **HOSPITAL BED EQUIPMENT SUPPORT APPARATUS**

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(73) Assignee: **Hill-Rom Services, Inc.**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/224,201**

(22) Filed: **Aug. 20, 2002**

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Related U.S. Application Data

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(51) **Int. Cl.**[7] **A61G 7/05**
(52) **U.S. Cl.** **5/600**; 5/658; 5/503.1
(58) **Field of Search** 5/658, 503.1, 600, 5/607, 620

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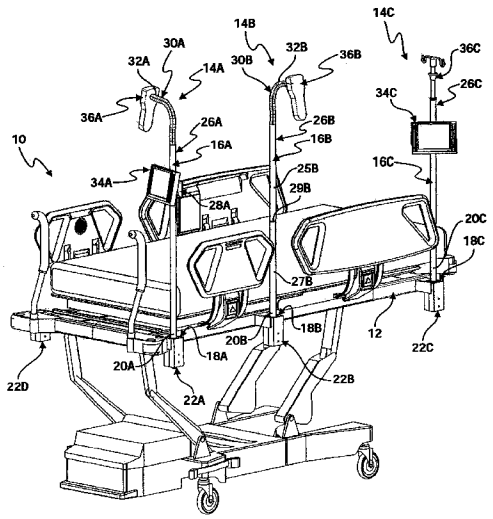
(57) **ABSTRACT**

An equipment support for use with a patient assist apparatus having a signal source includes a receptacle adapted to mount to the patient assist apparatus having a plurality of contacts adapted to receive signals from the signal source and a cavity, and a support body or pole having an equipment mount on one end and a plug on the other end for being removably inserted into the cavity. The plug includes a plurality of contacts that are connected to conductors that extend through the support body to the equipment mount to provide the signals from the signal source to equipment mounted on the equipment mount. The plug contacts and receptacle contacts are arranged such that all of the plug contacts contact their corresponding receptacle contacts as the plug is inserted into the receptacle.

49 Claims, 15 Drawing Sheets



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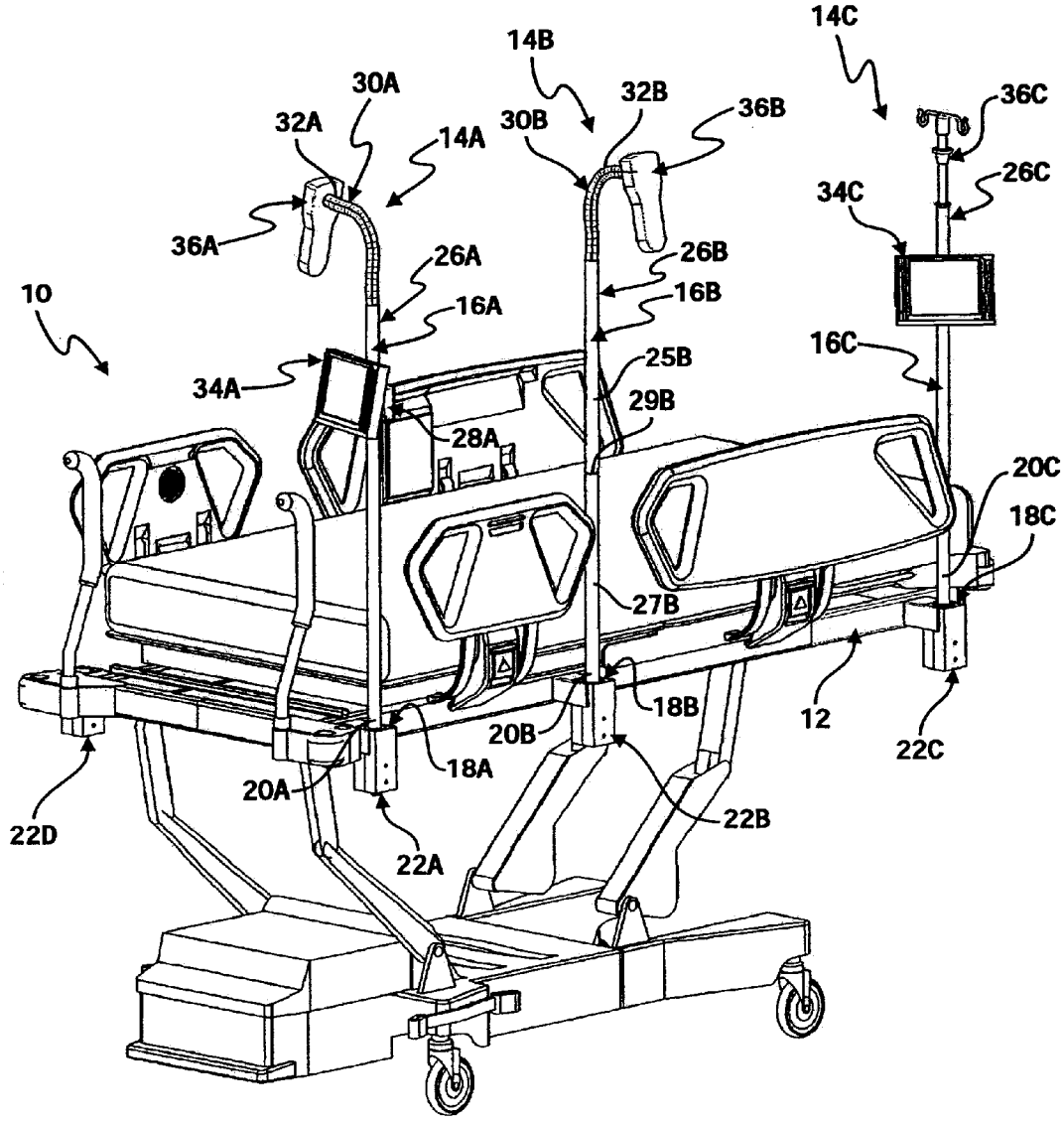
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14B
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32B
36C
32A
30B
36B
14A
34C
26C
36A
26A
26B
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16A
16B
16C
34A
25B
29B
28A
20C
18C
27B
18B
12
20B
22C
18A
20A
22B
22D
22A

FIG. 1

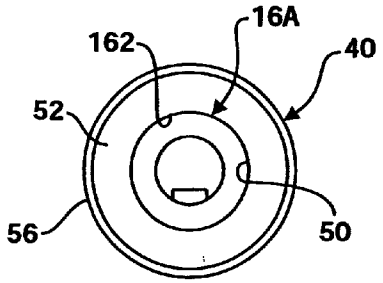
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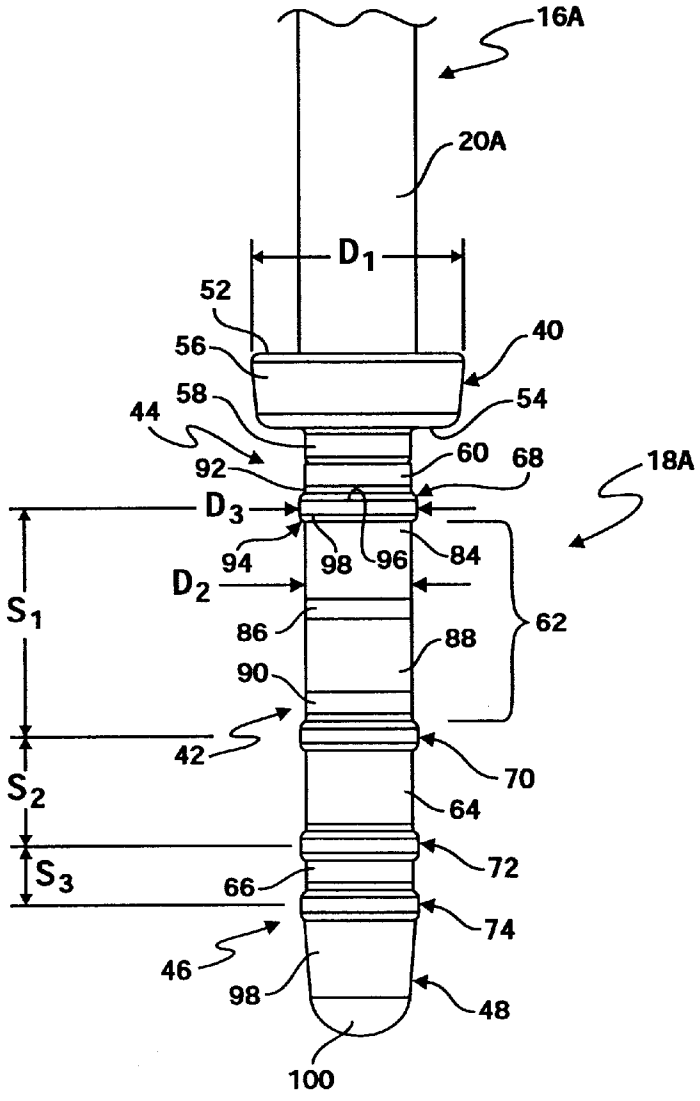
FIG. 2B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20A
D_1
52
40
56
58
54
44
60
68
18A
92
D_3
94
98
96
84
D_2
S_1
86
88
62
90
42
70
S_2
64
S_3
72
66
74
46
98
48
100

FIG. 2A

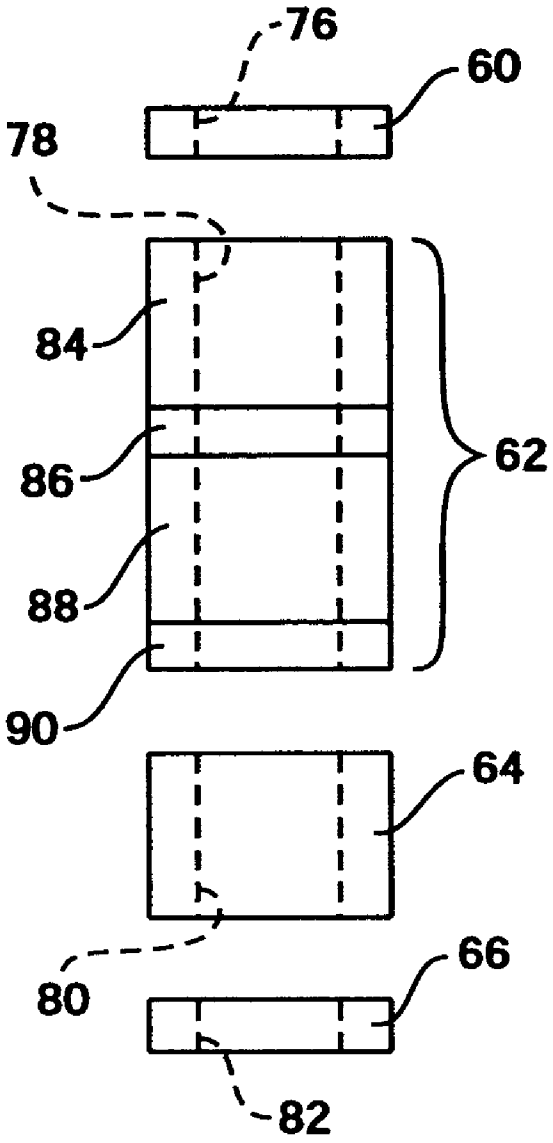
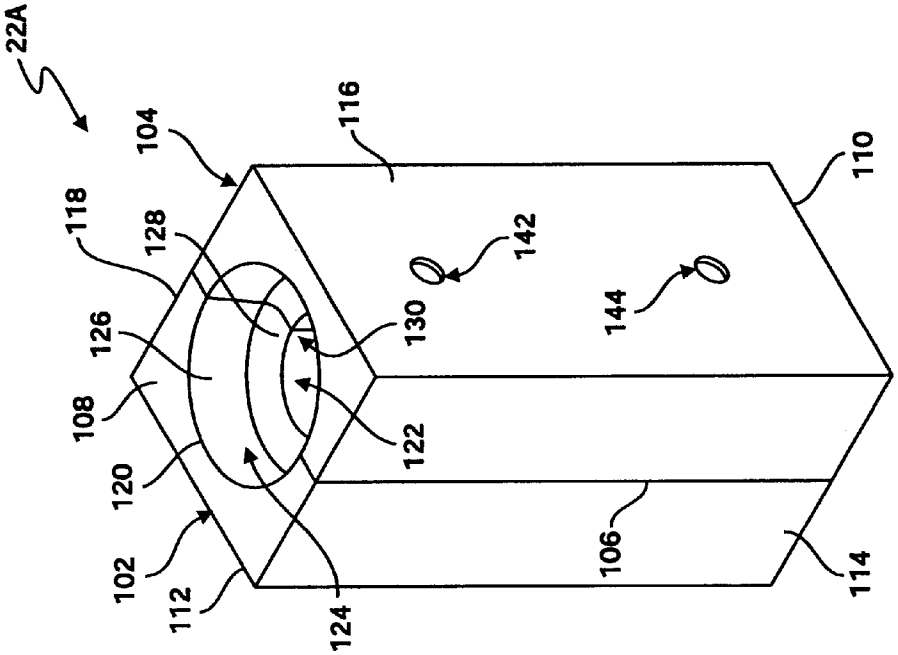


FIG. 3


22A
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118
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120
106
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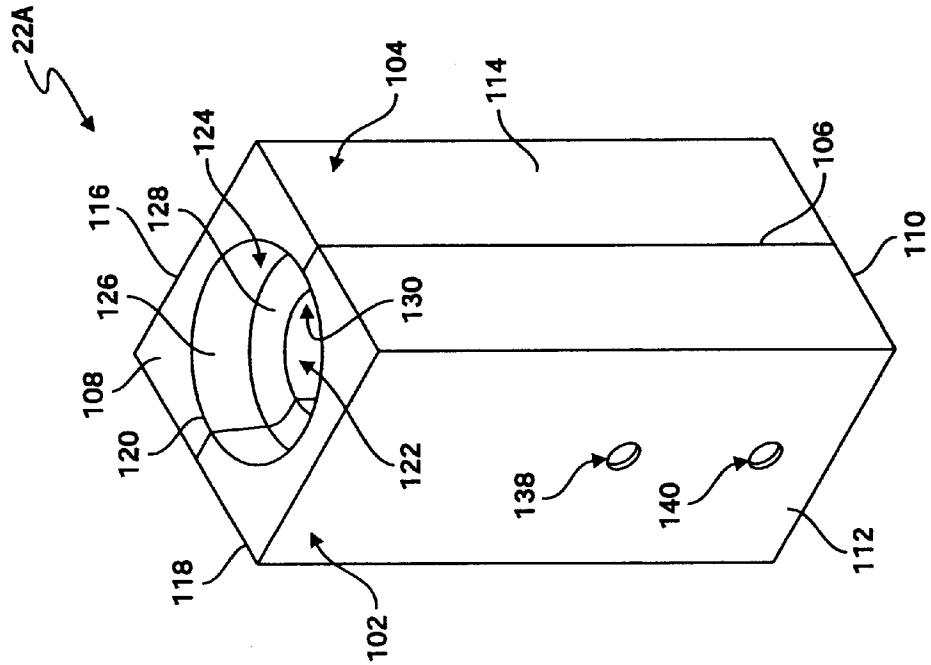
114
112
124

FIG. 4B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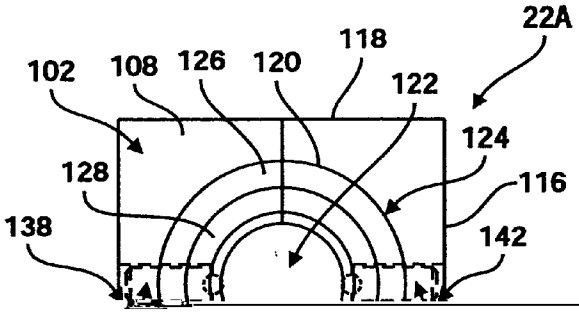
102

FIG. 4A



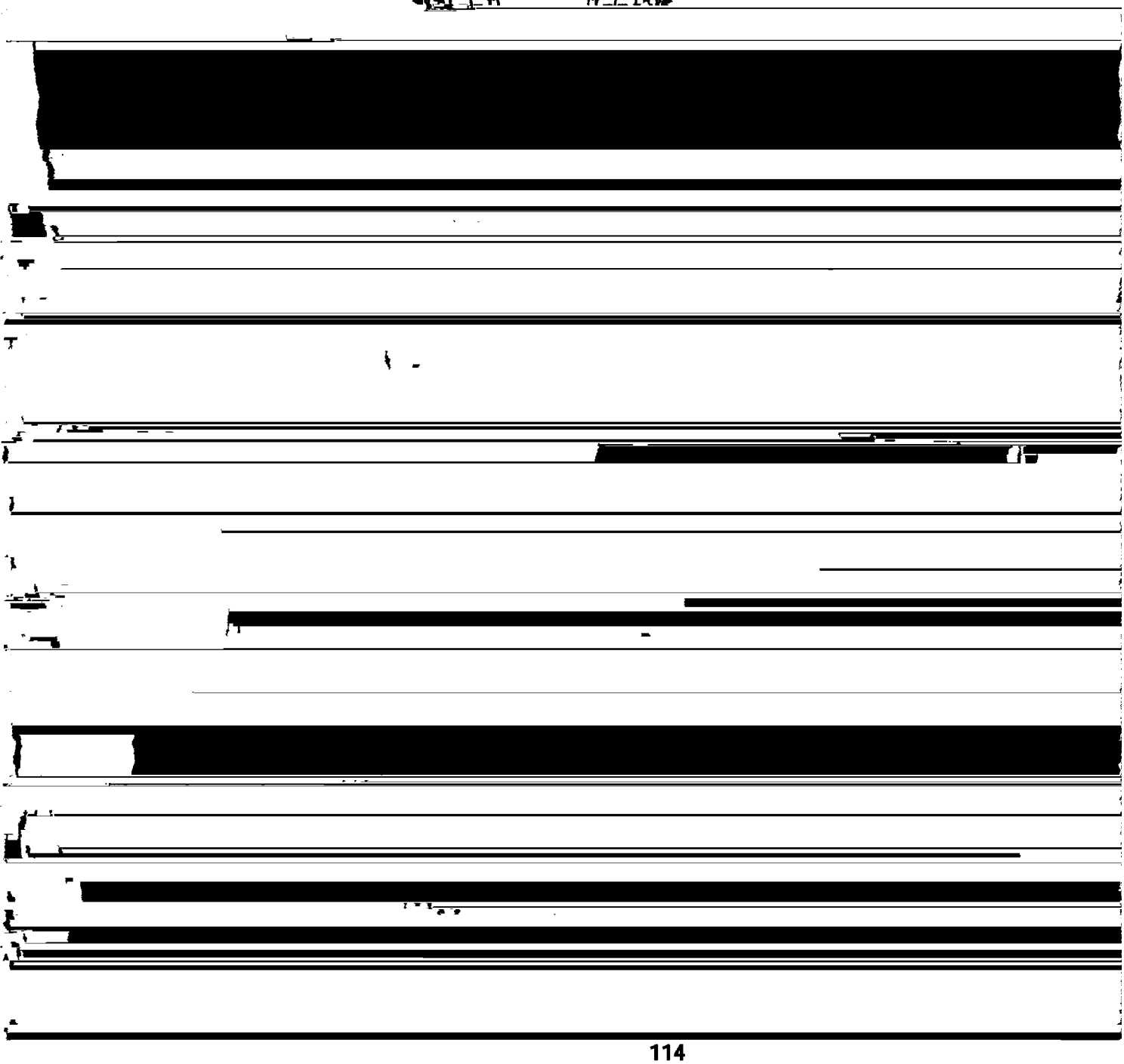
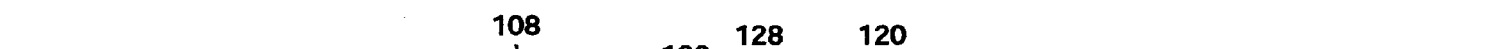
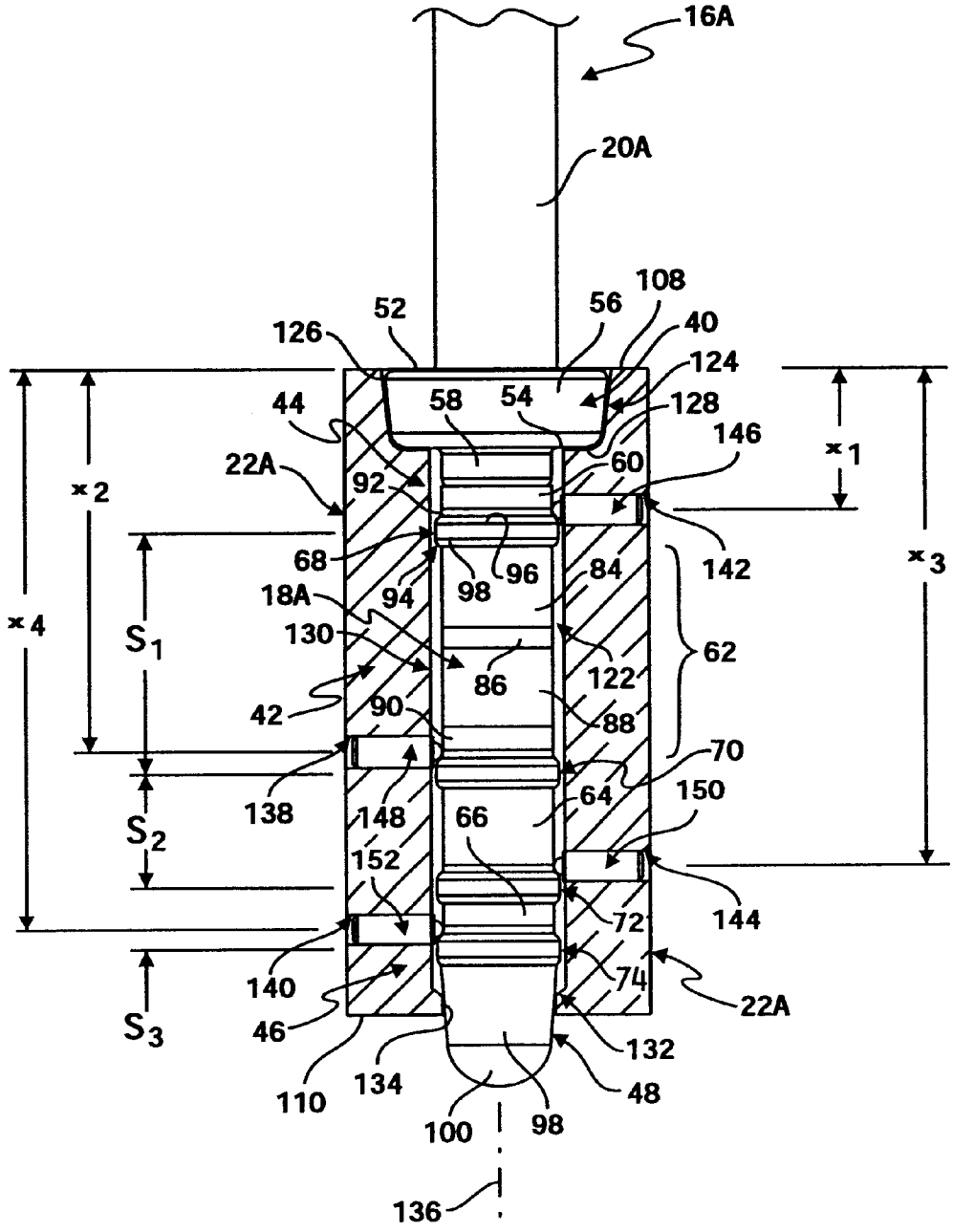


FIG. 4D

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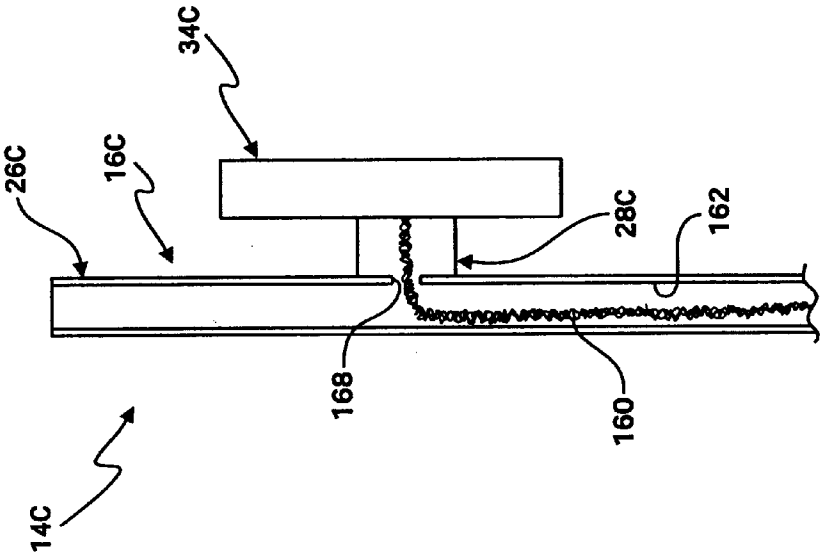
124
58
54
128
44
146
22A
60
92
x1
x2
142
68
96
84
x3
98
94
18A
x4
130
62
S1
86
122
42
90
88
70
64
150
138
148
66
S2
152
144
72
74
22A
140
S3
46
132
110
134
48
100
98
136

FIG. 5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28C
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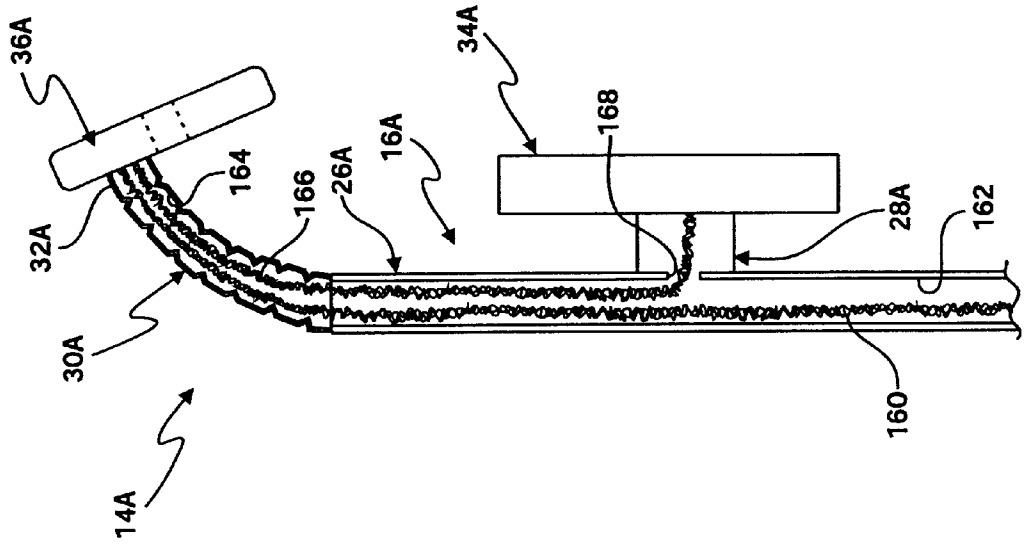
168
160
14C

FIG. 6B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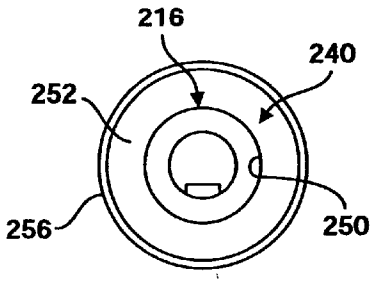
164
166
26A
16A
28A
162
32A
30A
160
14A

FIG. 6A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250

FIG. 7B

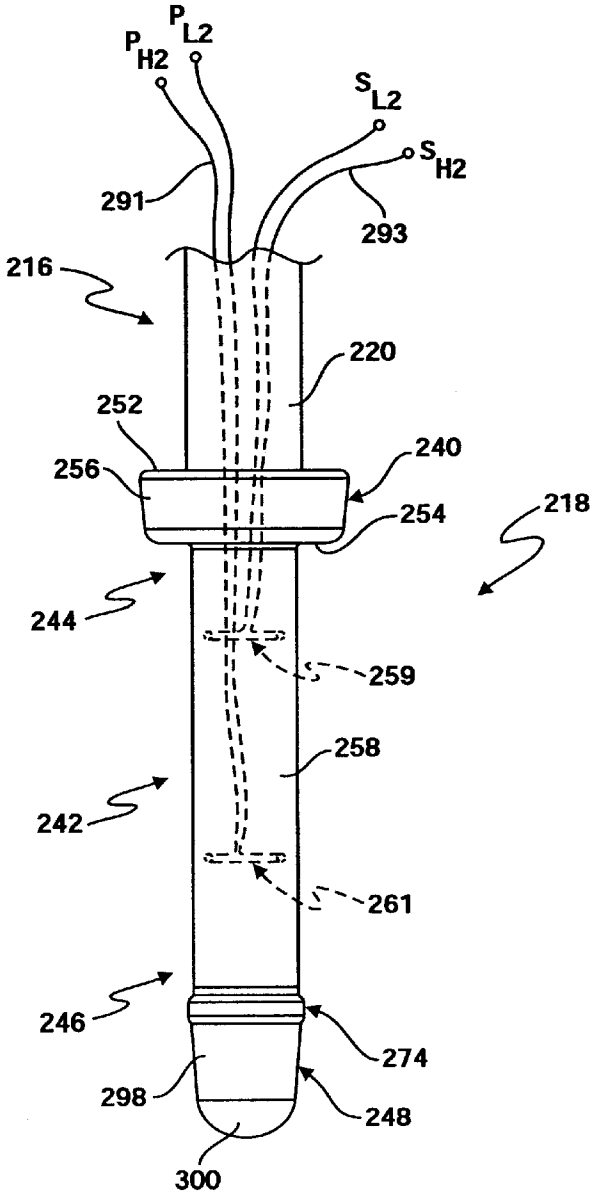
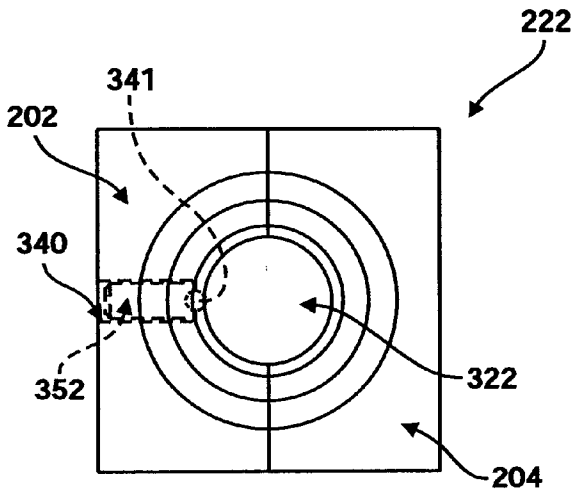

P L2
P H2
S L2
S H2
291
293
216
220
252
240
256
254
218
244
259
258
242
261
246
274
298
248
300

FIG. 7A


222
19
40


222
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322
204

FIG. 8D

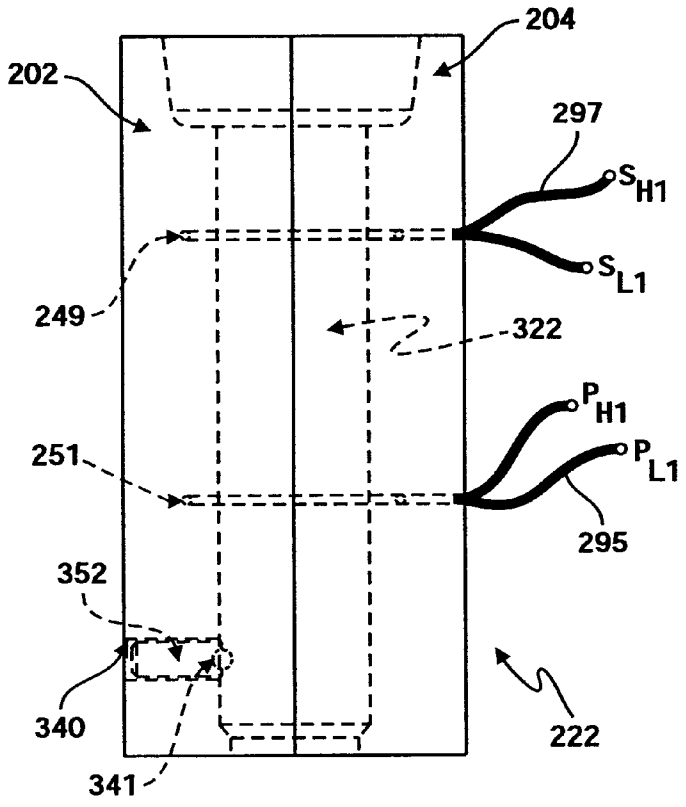
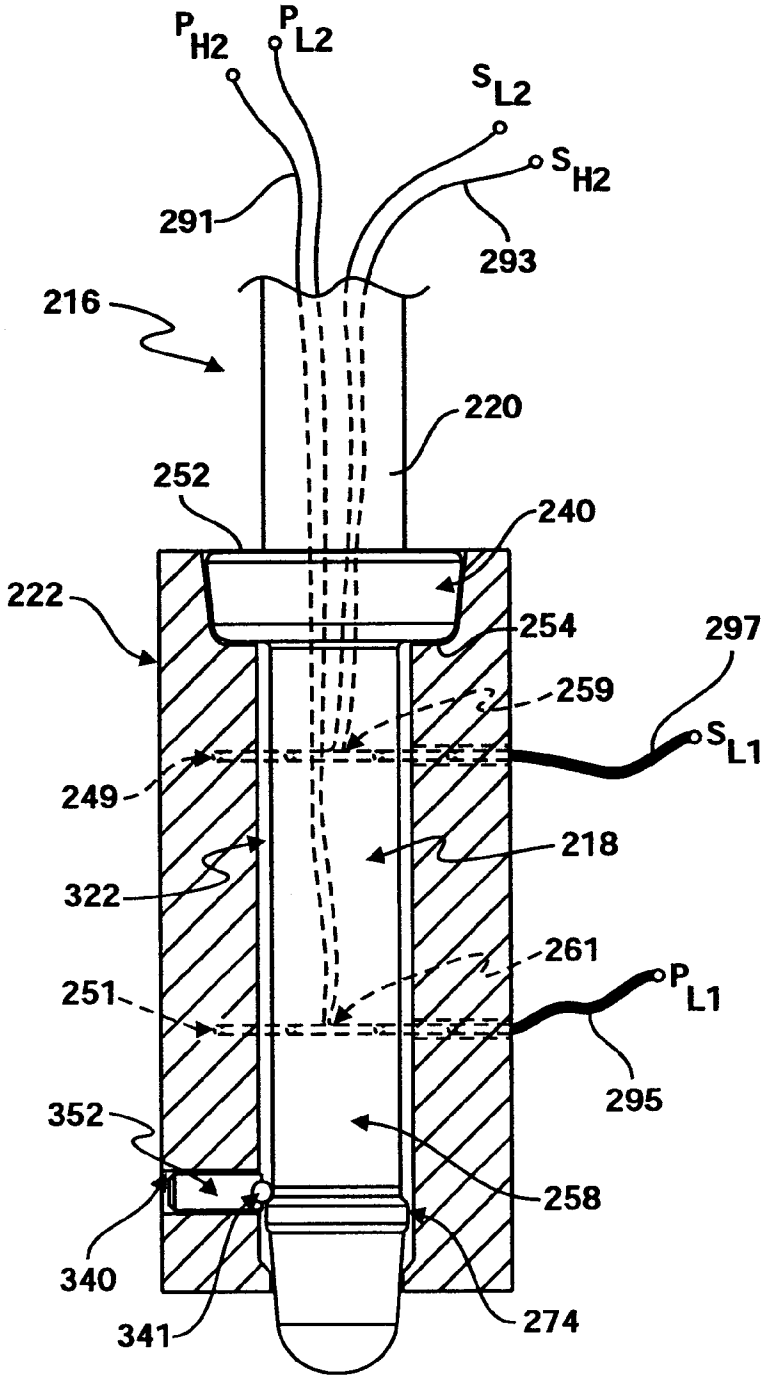

204
202
297
S_{H1}
S_{L1}
249
322
P_{H1}
P_{L1}
251
295
352
340
222
341

FIG. 8C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P_{L2}
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S_{H2}
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216
220
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240
222
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S_{L1}
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322
261
P_{L1}
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295
352
258
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341
274

FIG. 9

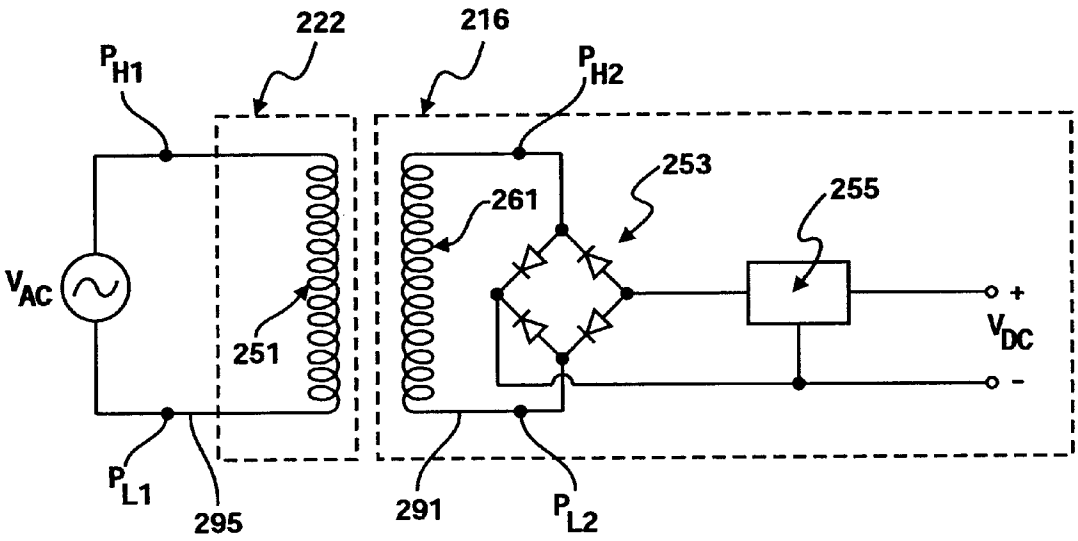


FIG. 10A

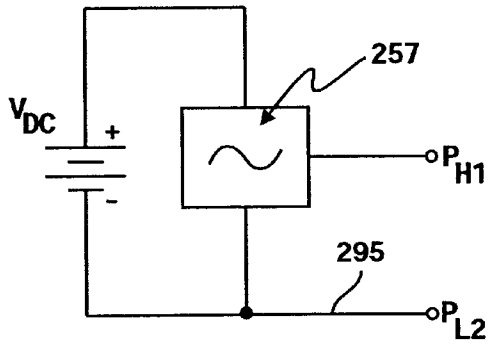
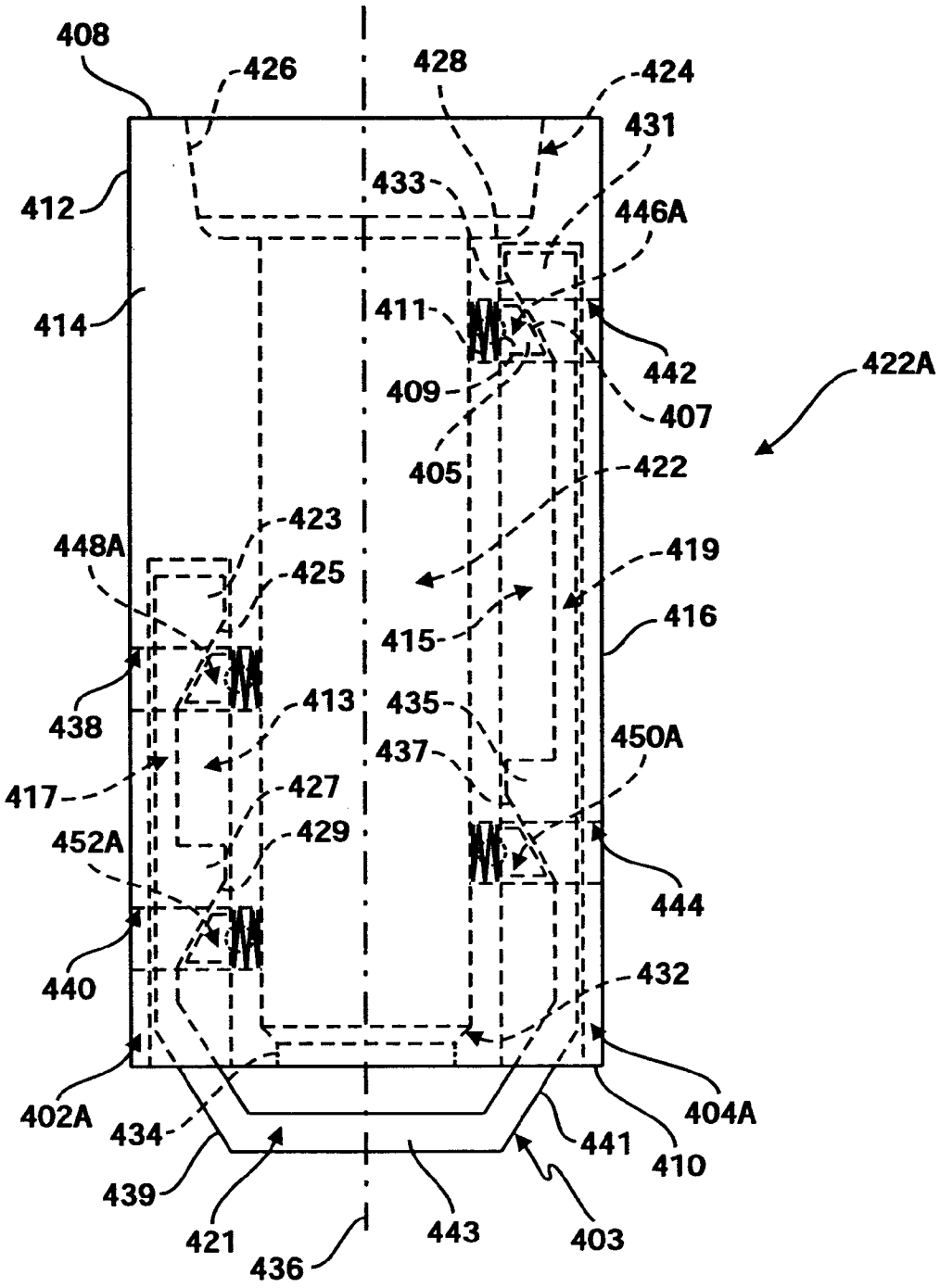


FIG. 10B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450A
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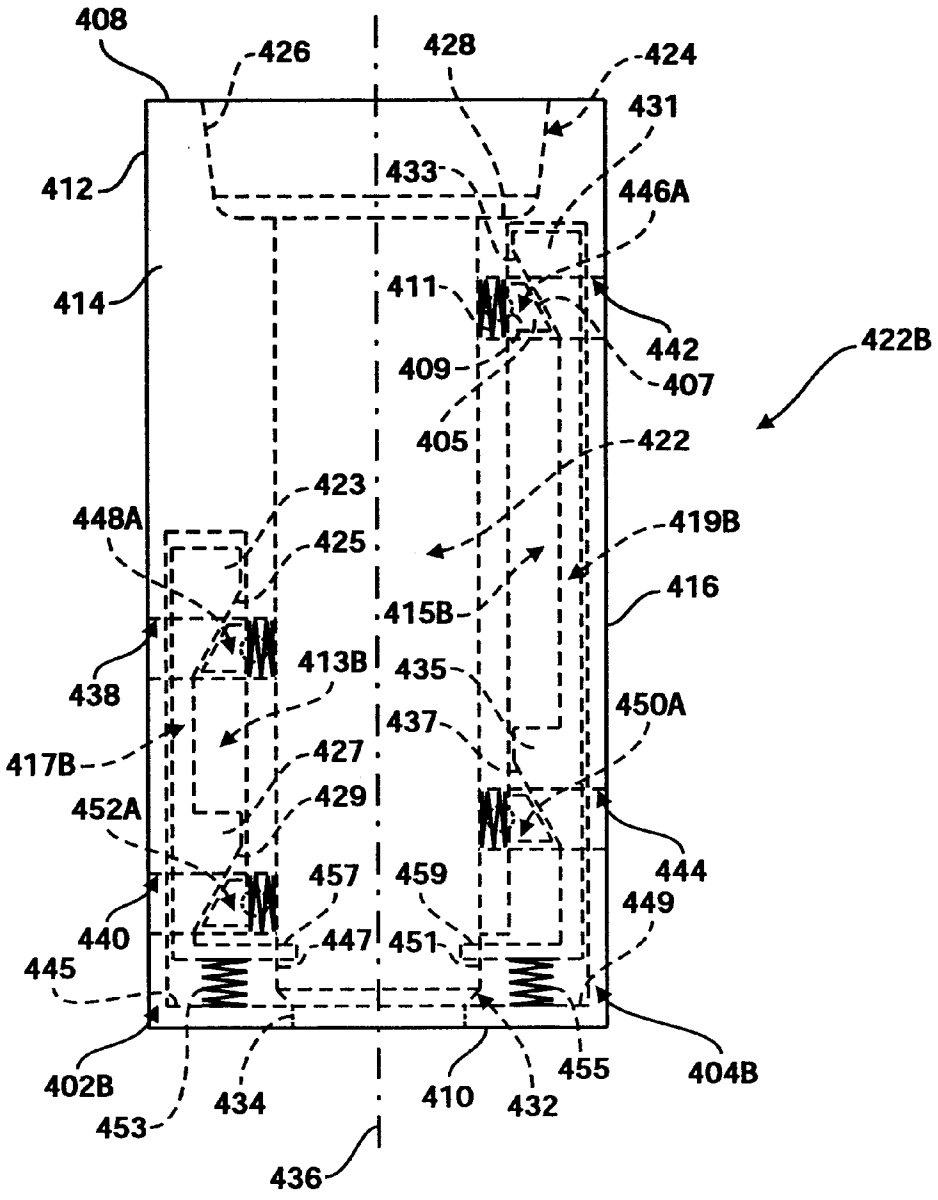
FIG. 11A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415B
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413B
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450A
417B
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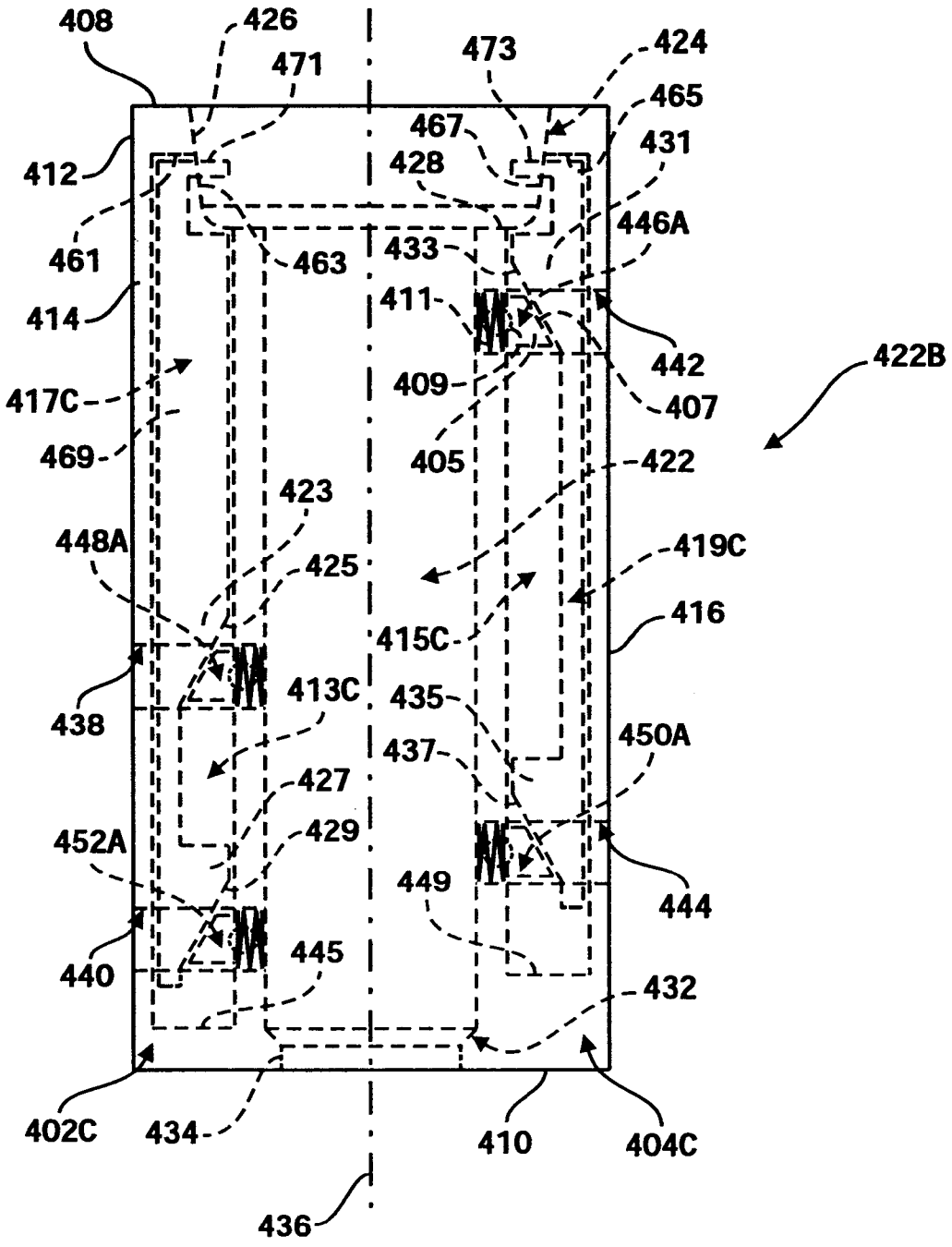
FIG. 11B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417C
407
469
405
422
423
448A
425
419C
416
415C
438
413C
435
450A
437
427
452A
429
449
444
440
445
432
402C
434
410
404C
436

FIG. 11C

HOSPITAL BED EQUIPMENT SUPPORT APPARATUS

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/314,483, filed Aug. 23, 2001, and U.S. Provisional Patent Application Ser. No. 60/333,387, filed Nov. 26, 2001, the disclosures of which are hereby expressly incorporated herein by reference.

FIELD OF THE INVENTION

The present invention generally relates to devices for supporting equipment used with patient assist apparatuses, and more particularly to a device for supporting patient care equipment and providing electrical connections thereto from a receptacle attached to the patient assist apparatus which removably receives the support.

BACKGROUND OF THE INVENTION

Patient assist apparatuses, such as hospital beds, are typically provided with or connected to medical equipment, such as control pendants, monitors/interface devices, etc. Conventional pendants are generally electrically connected to the control circuitry of the bed by a cable which permits placement of the pendant at various locations on the bed. Interface devices are generally mounted to the side rails or the head or foot board of the bed, and electrically hardwired to the bed electronics.

It is desireable to have maximum flexibility in terms of locating and relocating such medical equipment to accommodate access to the patient by medical personnel, placement of other monitoring and treatment equipment, and re-positioning of the patient. While conventional pendants are easily moved between various locations, the cable may become tangled, or otherwise impede access to the patient, placement of other equipment, and movement of the patient.

Additionally, interface devices may be difficult to use or inconviently located when provided at a fixed location on the bed. For example, if an interface device is mounted to a bed side rail which must be folded down, the interface may be rendered essentially useless. If the interface is mounted to the foot board, medical personnel positioned at the head of the bed must relocate to use the interface.

SUMMARY OF THE INVENTION

The present invention provides an equipment support device for use with a patient assist apparatus which may include a plurality of receptacles mounted at various locations on the apparatus for removably receiving a support body to which is mounted equipment, such as a control pendant and/or an interface device. The receptacles may include a cavity and a plurality of contacts extending into the cavity and being connected to the control circuitry of the apparatus. The support body may include a plug at one end having a plurality of contacts configured to mate with the receptacle contacts when the plug is seated in the receptacle cavity. Conductors extend from the plug contacts to the equipment mounted to the support body. Accordingly, medical personnel may locate the equipment support device at any of the receptacle locations around the patient assist apparatus by inserting the support body plug into the desired receptacle, thereby electrically connecting the equipment mounted to the equipment support device to the apparatus control circuitry and mechanically supporting the equipment in a desired location.

In an alternate embodiment, the receptacles may include power and signal windings that loop around the central cavity of the receptacle. These windings form one side of a pair of transformers, one for supplying power to the support body, and one for supplying other signals to the support body. The support body plug includes corresponding secondary windings that complete the pair of transformer circuits, and are connected to conductors that supply power and other signals to the equipment mounted to the support body. In this embodiment, the receptacle contacts and the plug contacts are eliminated. Power and other signals are provided to the equipment with electrical isolation. Additionally, a spring-loaded detent is provided in each of the receptacles for cooperating with a lock ring on the support body plug to mechanically retain the plug in the receptacle when the plug is in a seated position.

The features of the present invention described above, as well as additional features, will be readily apparent to those skilled in the art upon reference to the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a patient assist apparatus having a plurality of equipment support apparatuses attached thereto.

FIG. **2**A is a partially fragmented, side elevational view of a portion of an equipment support apparatus according to the present invention.

FIG. **2**B is a top plan view of the equipment support apparatus shown in FIG. **2**A.

FIG. **3** is a side elevational view of components of an equipment support apparatus according to the present invention.

FIGS. **4**A and **4**B are perspective views of a receptacle of an equipment support apparatus according to the present invention.

FIG. **4**C is a side elevational view of the receptacle shown in FIGS. **4**A and **4**B.

FIG. **4**D is a top plan view of the receptacle shown in FIGS. **4**A–C.

FIG. **5** is a partially fragmented, side elevational view, partly in section, of a portion of an equipment support apparatus according to the present invention.

FIGS. **6**A and **6**B are partially fragmented, side elevational views, partly in section, depicting the electrical connections of embodiments of an equipment support apparatus according to the present invention.

FIG. **7**A is a partially fragmented, side elevational view of a portion of another embodiment of an equipment support apparatus according to the present invention.

FIG. **7**B is a top plan view of the equipment support apparatus shown in FIG. **7**A.

FIGS. **8**A and **8**B are perspective views of another embodiment of a receptacle of an equipment support apparatus according to the present invention.

FIG. **8**C is a side elevational view of the receptacle shown in FIGS. **8**A and **8**B.

FIG. **8**D is a top plan view of the receptacle shown in FIGS. **8**A–C.

FIG. **9** is a partially fragmented, side elevational view, partly in section, of a portion of another embodiment of an equipment support apparatus according to the present invention.

FIG. **10**A is an electrical schematic diagram of a portion of the circuit of the equipment support apparatus shown in FIGS. **7**–**9**.

FIG. **10**B is an electrical schematic diagram of an alternate power input circuit to replace a portion of the circuit of FIG. **10**A.

FIGS. **11**A–C are side elevational views of alternate embodiments of a receptacle of an equipment support apparatus according to the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The exemplary embodiments selected for description below are not intended to limit the invention to the precise forms disclosed. Instead, the embodiments have been selected for description to enable one of ordinary skill in the art to practice the invention.

FIG. **1** shows a hospital bed **10** that has a variety of conventional components including a frame **12**. Three embodiments of an equipment support apparatus according to the present invention **14**A–C are shown attached to frame **12**. Equipment supports **14**A, **14**B, and **14**C differ in various ways which will be described in detail below. In general, however, each equipment support **14**A, **14**B, and **14**C includes a support body **16**A–C, a plug **18**A–C at one end **20**A–C of support body **16**A–C, and a receptacle **22**A–C attached to frame **12**.

Support body **16**A of equipment support **14**A may be formed from a generally rigid hollow pole, and includes an equipment end **26**A opposite end **20**A. Equipment support **14**A also includes an equipment mount **28**A connected to equipment end **26**A of support body **16**A. A goose neck or flexible portion **30**A having a free end **32**A is also connected to equipment end **26**A of support body **16**A. An interface **34**A is physically and electrically connected to equipment mount **28**A as is further described below. Interface **34**A (and interface **34**C) may be a display, a control panel, or any other type of interface or monitor. Similarly, a pendant **36**A is physically and electrically connected to free end **32**A of flexible portion **30**A as is further described below. The position of pendant **36**A may be adjusted by moving the pendant within the range of positions provided by the flexibility of flexible portion **30**A. It should be understood that equipment mount **28**A may be movably or adjustably mounted on support body **16**A such that interface **34**A may be moved upwardly and downwardly on support body **16**A, rotated about support body **16**A, and tilted relative to support body **16**A. If such adjustability is provided, then the electrical conductors or wires connecting equipment mount **28**A (and interface **34**A) to plug **18**A, further described below, may extend through an opening or slot in support body **16**A and have sufficient slack and/or flexibility to accommodate the full range of adjustment of equipment mount **28**A.

Equipment support **14**B similarly includes a support body **16**B with an equipment end **26**B, a flexible portion **30**B having a free end **32**B, and a pendant **36**B mechanically and electrically connected to free end **32**B of flexible portion **30**B. Unlike support body **16**A, support body **16**B does not include an equipment mount or interface. Also, support body **16**B includes a first section **25**B and a second section **27**B. First section **25**B is connected to second section **27**B at a telescopic joint **29**B. Telescopic joint **29**B permits adjustment of the height of pendant **36**B above bed **10**. In other words, as one of first section **25**B or second **27**B is telescopically received within the other section, the overall height of support body **16**B is reduced. As will be further described below, conductors (not shown) extend between pendant **36**B and plug **18**B (through flexible portion **30**B and support body **16**B) to permit communication between electronics on pendant **36**B and other portions of bed **10**. Obviously, the conductors (not shown) connecting pendant **36**B to plug **18**B must have sufficient slack and/or flexibility to accommodate the full range of adjustment of support body **16**B. Additionally, the position of pendant **36**B may be adjusted within the range of positions provided by flexible portion **30**B.

Equipment support **14**C also includes a support body **16**C with an equipment mount (not shown) for mounting an interface **34**C at equipment end **26**C of support body **16**C. A standard, telescopically extendable IV bag hook **36**C is received by equipment end **26**C of support body **16**C. Like support bodies **16**A and **16**B, support body **16**C includes conductors (not shown) which extend between the equipment mount (not shown) and plug **18**C.

Also shown in FIG. **1** is a fourth receptacle **22**D mounted to the perimeter of frame **12**. Additional receptacles may be mounted at other locations on frame **12** to permit relocation of any of equipment supports **14**A–C. As is further described below, electrical contacts in receptacles **22**A–D provide power and other signals to interfaces **34**A, **34**C, and pendants **36**A, **36**B. When receptacles **22**A–D are mounted to frame **12**, these electrical contacts may be hard-wired to the control circuitry of bed **10**.

FIGS. **2**A and **2**B show a plug according to the present invention. Since plugs **18**A–C of equipment supports **14**A–C are identical, only one plug is described below. Plug **18**A generally includes a stop **40** which is connected to end **20**A of support body **16**A, and a substantially cylindrical, elongated body **42** including an end **44** connected to stop **40** and an end **46** connected to a tip **48**. Tip **48** is formed of a non-conductive material and includes a slightly tapered outer surface **98** which terminates in a rounded dome **100**. As shown in FIG. **2**A, support body **16**A, stop **40**, plug body **42**, and tip **48** are substantially coaxial.

Stop **40** is an annular, ring-shaped member having a central opening **50** (FIG. **2**B) that receives support body **16**A, an upper surface **52**, a lower surface **54**, and an outer surface **56** which tapers slightly from upper surface **52** to lower surface **54**. A cylindrical extension **58** protrudes from lower surface **54** of stop **40** and is connected to end **44** of plug body **42**.

Plug body **42** includes insulators **60**, **62**, **64**, **66**, and contacts **68**, **70**, **72**, **74**. As best shown in FIG. **3**, insulators **60**, **62**, **64**, **66** are substantially cylindrical with central openings **76**, **78**, **80**, **82**, respectively. As should be apparent from the figures, spacers **60**, **62**, **64**, **66** include annular members having one of two lengths. Specifically, spacers **60** and **66** are identical in length and shorter than spacer **64**. Spacer **62** is an assembly of four spacer sections **84**, **86**, **88**, **90**. Spacer sections **86** and **90** are identical to spacers **60** and **66**. Spacer sections **84** and **88** are identical to spacer **64**. Accordingly, spacers having any of a variety of different lengths may be assembled using two standard length spacer sections. It should be understood that stop **40**, tip **48**, and all of the components of plug body **42** may be assembled in any of a variety of ways. For example, each piece could include appropriately threaded male and female portions (not shown), or simply be formed as slip rings to be received over a common inner sleeve (not shown).

Referring again to FIG. **2**A, spacers **60**, **62**, **64**, **66** have substantially the same outer diameter D_2, which is smaller than the outer diameter D_1 of stop **40**. First contact **68** is located between spacer **60** and spacer **62**. Second contact **70** is located between spacer **62** and spacer **64**. Third contact **72**

is located between spacer **64** and spacer **66**. Finally, fourth contact **74** is located between spacer **66** and tip **48**.

Contacts **68**, **70**, **72**, and **74** are substantially identical. Therefore, only one is labeled in FIG. **2**A. Each of contacts **68**, **70**, **72**, and **74** include an annular portion **92** and a retention ring **94** having a diameter D_3 which is larger than diameter D_2 and smaller than diameter D_1. Retention rings **94** have a chamfered upper edge **96** and a chamfered lower edge **98**. Retention rings **94** may be either conductive or non-conductive. Likewise, portions **92** may be either conductive or non-conductive. In the embodiment described, portions **92** are non-conductive and retention rings **94** are conductive. As shown in FIG. **2**A, the spacings S_1, S_2, S_3 between retention rings **94** of contacts **68**, **70**, **72**, and **74** are all different as a result of the different lengths of spacers **62**, **64** and **66**. This prevents shorting and erroneous connec-

surface **108**, bore **144** and detent contact **150** are spaced a distance X_3 from upper surface **108**, and bore **140** and detent contact **152** are spaced a distance X_4 from upper surface **108**. The difference between distances X_2 and X_1 corresponds to spacing S_1. Likewise, the difference between distances X_3 and X_2 corresponds to spacing S_2. Finally, the difference between distances X_4 and X_3 corresponds to spacing S_3. Since detent contacts **146**, **148**, **150**, **152** are spaced to correspond with the spacings S_1, S_2, S_3 between plug contacts **68**, **70**, **72**, **74**, when plug **18**A is in the seated position shown in FIG. **5**, electrical connections are made between detent contact **146** and contact **68**, detent contact **148** and contact **70**, detent contact **150** and contact **72**, and detent contact **152** and contact **74**. Because spacings S_1, S_2, S_3 are different from one another, as plug **18**A is inserted downwardly into cavity **122** of receptacle **22**A, all of detent

through central opening **162** in support body **16**A, through equipment end **26**A and a hollow interior **164** of flexible portion **30**A to pendant **36**A. Conductors **160** may provide power and other signals to pendant **36**A from receptacle **18**A, and pendant **36**A may provide signals through conductors **160** to receptacle **18**A. For example, a patient may press a call button on pendant **36**A which sends a signal through conductors **160** to receptacle **18**A and equipment associated with bed **10** according to principles well known in the art. Conductors **166** extend from pendant **36**A through hollow interior **164** of flexible portion **30**A, central opening **162** of support body **16**A, and an opening **168** formed in support body **16**A to equipment mount **28**A. Conductors **166** are connected to interface **34**A at equipment mount **28**A using appropriate connectors. Accordingly, power and other signals may be routed between receptacle **18**A and interface **34**A through equipment mount **28**A and pendant **36**A.

FIG. **6**B reflects the basic conductor routing of equipment support **14**C (FIG. **1**) which does not include a pendant. IV bag hook **36**C of equipment support **14**C, shown in FIG. **1**, is not shown in FIG. **6**B. FIG. **6**B shows conductors **160** from plug contacts **68**, **70**, **72**, **74** routed directly to interface **34**C through central opening **162** of support body **16**C, opening **168**, and equipment mount **28**C. It should be understood from the foregoing that the conductor routing of equipment support **14**B (which includes only a pendant and no interface) is the same as that shown in FIG. **6**A except that conductors **166** are unnecessary.

FIGS. **7**–**10** depict an alternate embodiment of an equipment support apparatus according to the present invention. Various components of the alternate embodiment described below are similar to the components described with reference to the previous figures. Accordingly, the reference designations of like components have been retained, but increased by **200**. FIGS. **7**A and **7**B show an alternate embodiment of a plug **218** according to the present invention. Plug **218** generally includes a stop **240** that is connected to an end **220** of support body **216**, and a substantially cylindrical, elongated body **242** including an end **244** connected to stop **240** and an end **246** connected to a tip **248**. Body **242**, stop **240**, and tip **248** are formed of a non-conductive material. Tip **248** includes a slightly tapered outer surface **298** which terminates in a rounded dome **300**. As shown, support body **216**, stop **240**, plug body **242**, and tip **248** are substantially coaxial.

Stop **240** is an annular, ring-shaped member having a central opening **250** (FIG. **7**B), an upper surface **252**, a lower surface **254**, and an outer surface **256** which tapers slightly from upper surface **252** to lower surface **254**. A cylindrical extension **258** extends from lower surface **254** to tip **248**, and carries an increased diameter retention ring **274**. In FIG. **7**A, retention ring **274** is shown positioned adjacent tip **248**. It should be understood, however, that retention ring **274** may be located anywhere along the length of extension **258**.

A first conductor **291** extends from end P_{H2}, through support body **216** and central opening **250** of plug **218** to a location within extension **258** of plug body **242**. Conductor **291** forms a loop **261** embedded within the non-conductive material of extension **258** adjacent the outer surface of extension **258**. The other end of conductor **291** extends back through central opening **250** and support body **216** to end P_{L2}. Similarly, a second conductor **293** extends from end S_{H2}, through support body **216** and central opening **250** to form a loop **259** within extension **258** adjacent the outer surface of extension **258**. Conductor **293** also extends back through opening **250** to end S_{L2}. As will be further described below, loops **259**, **261** each form one side of a transformer circuit.

FIGS. **8**A–**8**D show an alternate embodiment of a receptacle **222** according to the present invention for receiving plug **218** described above. Receptacle **222** differs from receptacle **22**A of FIGS. **4**A–D in that it does not include a plurality of electrically conductive detent contacts **146**, **148**, **150**, **152**, but instead includes conductive loops **249**, **251** as described below. Receptacle **222** includes halves **202**, **204** which are substantially the same as halves **102**, **104** of receptacle **22**A (except for bores **142**, **144**, **146**, **148**) and therefore not described in detail with reference to FIGS. **8**A–**8**D. Halves **202**, **204** form a central cavity **322** that extends substantially the entire length of receptacle **222** as best shown in FIG. **8**C. Again, since cavity **322** is substantially the same as cavity **122** of receptacle **22**A, the various surfaces and portions of cavity **322** are not repeated in the description of receptacle **222**. Receptacle **222** further includes a bore **340** that extends through half **204** from an outer surface of receptacle **222** to central cavity **322**. A spring loaded detent **352** is mounted within bore **340** such that a ball **341** of detent **352** (FIGS. **8**C and **8**D) is biased partially into cavity **322**.

A conductor **295** extends from end P_{H1} through an opening in receptacle **222** to form a loop **251** about central cavity **322**. The other end of conductor **295** extends through another opening in receptacle **222** to end P_{L1}. Similarly, at another location within receptacle **222**, a second conductor **297** extends from end S_{H1} through an opening in receptacle **222** to form a loop **249** about central cavity **322**. The other end of conductor **297** extends through another opening in receptacle **222** to end S_{L1}. Loops **249**, **251** are embedded within the material of receptacle **222** just below the surface of cavity **322**. In other words, loops **249**, **251** are embedded into the inner, cylindrical wall of cavity **322** such that loops **249**, **251** do not contact plug **218** when plug **218** is inserted into receptacle **222**.

Referring now to FIG. **9**, plug **218** is shown in a seated position within receptacle **222**. As shown, loop **259** of plug **218** lies substantially within the same plane as loop **249** of receptacle **222** such that the signal provided on conductor **297** is inductively coupled from loop **249** to loop **259** and conductor **293** having ends S_{L2} and S_{H2}. Similarly, loop **261** lies substantially within the plane as loop **251** such that the signal provided on conductor **295** is inductively coupled from loop **251** to loop **261** and conductor **291** having ends P_{H2} and P_{L2}. In this manner, power and control signals are provided from receptacle **222** to equipment support **216** even if dirt or other foreign material is built up in cavity **322** or on plug **218**. Additionally, electricity is provided from receptacle **222** to equipment support **216** without requiring exposed, electrically conductive contacts.

As shown in FIG. **9**, when plug **218** is in the seated position, ball **341** of detent **352** is urged outwardly toward extension **258** of plug **218** above retention ring **274**. The outward biasing force of the spring (not shown) on ball **341** resists upward movement of plug **218** through interference with retention ring **274**. Accordingly, the possibility of accidental removal of equipment support **216** from receptacle **222** is reduced.

FIG. **10**A shows a basic schematic diagram of one possible circuit for supplying power from receptacle **222** to equipment support **216**. An AC source (V_{AC}) is provided externally to the equipment support apparatus of the present invention. One side of supply V_{AC} is connected to end P_{H1} of conductor **295**, and the other side is connected to end P_{L1}. Loop **251** is formed between ends P_{H1} and P_{L1} to form one side of the transformer shown in FIG. **10**A. As shown, loop **251** is formed within receptacle **222** as described above.

Loop **261** (the other side of the transformer) is formed within equipment support **216** as described above. Conductor **291** from loop **261** extends to ends P_{H2}, P_{L2} which are connected to a full-wave rectifier circuit **253** and a voltage regulator **255** to provide a DC output in a manner that is well-known to those skilled in the art. It should be understood that the signals provided on conductor **297** extending between ends S_{H1} and S_{L1} may be implemented using the same circuit as that described above.

FIG. **10**B shows an alternate embodiment of the circuit of FIG. **10**A. Specifically, instead of an AC power supply (V_{AC}), the circuit of FIG. **10**B includes a DC power supply (V_{DC}) or a battery that is connected in a conventional manner to an oscillator circuit **257**. The output of oscillator circuit **257** to nodes P_{H1} and P_{L1} is an AC signal similar to that provided from the AC power supply (V_{AC}). This signal may be passed through a transformer as described with reference to FIG. **10**A, rectified by full wave rectifier **253**, and regulated to form a DC signal at the output of regulator **255**.

Referring now to FIGS. **11**A–C, alternate embodiments of a receptacle of an equipment support apparatus according to the present invention are shown. Unlike receptacle **22**A shown in FIGS. **4**A–C, the receptacles of these embodiments do not include detent contacts that normally extend into the central cavity of the receptacle. Instead, as further described below, the detent contacts of these embodiments are actuated or moved to contacting positions within the cavity as a result of movement of plug **18**A to the seated position within the cavity. Otherwise, several of the items shown in FIGS. **11**A–C are similar to items depicted in FIGS. **4**A–C, and are referred to using reference designations that have been

is inserted farther downwardly, tip **48** moves actuator **403** downwardly such that first portion **417** and second portion **419** are moved downwardly in channels **413**, **415**, respectively. As first portion **417** and second portion **419** move downwardly, cam surfaces **425**, **429**, **433**, and **437** of cams **423**, **427**, **431**, and **435** respectively engage cam surfaces **407** of detent contacts **448**A, **452**A, **446**A, **450**A. As a result, detent contacts **446**A, **448**A, **450**A, **452**A are urged inwardly toward plug **18**A against the biasing force of springs **411**. Accordingly, when plug **18**A is in the seated position, balls **409** of detent contacts **446**A, **448**A, **450**A, **452**A are in electrical connection with rings **94** of plug contacts **68**, **70**, **72**, and **74**, respectively. As should be apparent from the foregoing, actuator **403** may include a return mechanism such as a spring (not shown) to return actuator **403** to the position shown in FIG. **11**A when plug **18**A is removed from receptacle **422**A. Alternatively, springs **411** of detent contacts **446**A, **448**A, **450**A, and **452**A may provide a sufficiently large biasing force to cause cam surfaces **407** of detent contacts **446**A, **448**A, **450**A, and **452**A to move along cam surfaces **433**, **425**, **437**, **429** of cams **431**, **423**, **435**, and **427**, respectively, thereby urging actuator **403** upwardly into the position shown in FIG. **11**A.

Referring now to FIG. **11**B, another embodiment of a receptacle is shown. Receptacle **422**B is generally similar to receptacle **422**A, but includes a two-piece actuator that does not extend out of the assembly. More specifically, first half **402**B includes a modified channel **413**B that terminates at a lower end **445** rather than extending through bottom surface **410**. Additionally, channel **413**B includes an opening **447** that extends between channel **413**B and cavity **422**. Second half **404**B similarly includes a modified channel **415**B that

position shown in FIG. **11**B. It should be understood that springs **453**, **455** may be optional, since the biasing force of springs **411** may, without any other return mechanism, cam first actuator **417**B and second actuator **419**B into the upward positions.

FIG. **11**C shows yet another receptacle **422**C according to the present invention. Receptacle **422**C is similar to receptacle **422**B in that it includes a two-piece actuator that does not extend out of the assembly. Unlike receptacle **422**B, receptacle **422**C includes a two-piece actuator that is engaged by stop **40** of plug **18**A. More specifically, first half **402**C includes a modified channel **413**C that terminates at a lower end **445** and at an upper end **461**. An opening **463** is formed adjacent upper end **461** between channel **413**C and enlarged diameter portion **424** of cavity **422**. Second half **404**C similarly includes a modified channel **415**C that terminates at an upper end **465** and includes an opening **467**.

First actuator **417**C of receptacle **422**C is situated within channel **413**C, and includes cams **423**, **427** as described above with reference to FIG. **11**A. First actuator **417**C further includes an elongated body portion **469** that extends from cam **423** and terminates at an engagement portion **471** that extends through opening **463** into enlarged diameter portion **424** of cavity **422**. Second actuator **419**C is similarly situated within channel **415**C, and includes cams **431**, **435** as described above. Second actuator **419**C also includes an engagement portion **473** that extends from above cam **431**, through opening **467**, and into enlarged diameter portion **424**.

When plug **18**A is inserted into cavity **422** of receptacle **422**C, no electrical connections are made between plug **18**A and receptacle **422**C until plug **18**A approaches the seated position. More specifically, as plug **18**A reaches the lower portion of cavity **422**, a pair of openings or grooves (not shown) formed in stop **40** of plug **18**A receive engagement portions **471**, **473**. When engagement portions **471**, **473** reach a stop surface (not shown) formed in the grooves, further downward movement of plug **18**A into cavity **422** moves first actuator **417**C and second actuator **419**C downwardly. This downward movement of first actuator **417**C and second actuator **419**C causes cams **423**, **427**, **431**, and **435** to respectively move detent contacts **448**A, **452**A, **446**A, and **450**A into electrical connection with plug **18**A as described above. When plug **18**A is withdrawn from cavity **422**, springs **411** urge detent contacts **448**A, **452**A, **446**A, and **450**A, first actuator **417**C, and second actuator **419**C back into the upward position shown in FIG. **11**C.

The foregoing description of the invention is illustrative only, and is not intended to limit the scope of the invention to the precise forms set forth. Although the invention has been described in detail with reference to certain illustrative embodiments, variations and modifications exist within the scope and spirit of the invention as described and defined in the following claims. For example, one skilled in the art could readily adapt interfaces, pendants, and other equipment with conventional connectors so that the various pieces of equipment are modular and easily replaceable. Moreover, the entire support body of an equipment support device according to the present invention could be formed from flexible, gooseneck material to provide additional flexibility. It should be further understood, that the basic concept of the present invention may be adapted to other uses such as with headwall units, power columns, overbed tables, and wheelchairs.

What is claimed is:

1. An equipment support for use with a patient assist apparatus having a signal source providing a first and a second signal, the support including:

a receptacle adapted to mount to the patient assist apparatus, the receptacle including a first contact adapted to receive the first signal, a second contact adapted to receive the second signal, and a cavity; and

a support body having an equipment end and a plug for being removably inserted into the cavity, the plug having a body including a first contact connected to a first conductor and a second contact connected to a second conductor, the first and second conductors extending to the equipment end of the support body and being adapted for connection to a first piece of equipment mounted to the equipment end of the support body;

wherein the first plug contact contacts the first receptacle contact and the second plug contact contacts the second receptacle contact only when substantially the entire plug body is inserted into the cavity.

2. The support of claim **1**, wherein the receptacle cavity is substantially cylindrical.

3. The support of claim **1**, wherein the receptacle contacts are detents.

4. The support of claim **1**, wherein the support body is substantially cylindrical.

5. The support of claim **4**, wherein each of the plug contacts includes a ring portion having a diameter that is greater than a diameter of the body, the ring portions cooperating with the receptacle contacts to resist removal of the plug from the receptacle when substantially the entire plug body is inserted into the cavity.

6. The support of claim **1**, wherein the support body further includes a first section that is telescopically connected to a second section.

7. The support of claim **1**, further including a flexible portion extending from the equipment end of the support body.

8. The support of claim **7**, wherein the first and second conductors are adapted for connection to a second piece of equipment mounted to a free end of the flexible portion.

9. The support of claim **1**, wherein the plug body is substantially cylindrical.

10. The support of claim **9**, wherein the plug further includes an annular stop having a diameter that is greater than a diameter of the plug body, the stop being seated within an enlarged diameter portion of the cavity when substantially the entire plug body is inserted into the cavity.

11. The support of claim **1**, wherein the plug contacts are annular.

12. The support of claim **1**, wherein the cavity has a central axis, the first receptacle contact extending into the cavity at a first location along the central axis, and the second receptacle contact extending into the cavity at a second location along the central axis.

13. The support of claim **12**, wherein the receptacle further includes a third contact extending into the cavity at a third location along the central axis, and a fourth contact extending into the cavity at a fourth location along the central axis, the plug body further including third and fourth contacts that contact the third and fourth receptacle contacts, respectively, only when substantially the entire plug body is inserted into the cavity.

14. The support of claim **13**, wherein the plug body is cylindrical and the plug contacts are annular, the plug further including annular insulators separating the plug contacts.

15. The support of claim **13**, wherein the second location is a first distance from the first location, the third location is a second distance from the second location, and the fourth location is a third distance from the third location, each of

the first, second and third distances being different from the other distances.

16.The apparatus of claim **1**, wherein the plug is included in a plug end of the support body.

17. The apparatus of claim **1**, wherein the plug is integral with an end of the second body.

18. The apparatus of claim **1**, wherein the plug fails to extend beyond the end of the support body.

19. The apparatus of claim **1**, wherein the cavity is sized and shaped to receive an end of the support body therein.

20. The apparatus of claim **1**, wherein distance between the first plug contact and the equipment end is always less than the distance between second plug contact and the equipment end.

21. The apparatus of claim **1**, wherein the support body is at least partially received in the cavity.

22. A hospital bed, including

a frame for supporting a patient, the frame including a

32. The bed of claim **22**, wherein the plug further includes a stop that engages the receptacle to prevent further insertion of the plug into the cavity when the plug is fully inserted into the cavity.

33. The bed of claim **22**, wherein the plug includes a body having an outer surface, the plug contacts being annular and protruding from the outer surface.

34. The bed of claim **22**, wherein the receptacle further includes a third contact and a fourth contact, and the plug further includes a third contact and a fourth contact that contact the third and fourth receptacle contacts, respectively, as the plug is inserted into the cavity.

35. The bed of claim **34**, wherein the plug contacts are separated by insulators.

36. The bed of claim **34**, wherein the plug contacts are unequally spaced apart from one another along a length of the plug to prevent simultaneous contact between the plug contacts and their respective receptacle contacts when the

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

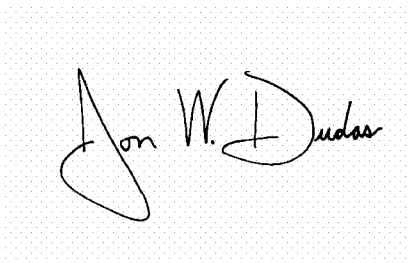
PATENT NO. : 6,704,956 B2
DATED : March 16, 2004
INVENTOR(S) : Riley et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [75], Inventors, second inventor should read -- **Troy D. Acton** --.

Signed and Sealed this

Eleventh Day of April, 2006



JON W. DUDAS
Director of the United States Patent and Trademark Office