Description

FIELD

[0001] A portable battery connector device, for example, a battery connector arrangement or assembly for a battery jump starting device, in particular a portable vehicle jump starting apparatus, configured for enhancing the conductivity between the battery of the jump starting apparatus and a battery being charged.

BACKGROUND

[0002] The exists a portable vehicle battery jump start apparatus as disclosed in U.S. Patent No. 9,007,015 to Nook et al. The apparatus utilizes a lithium ion battery pack. In this type of apparatus, there exists a need to maximize conductivity from the battery pack to the vehicle battery of the vehicle being jump started.

[0003] For successful car jump-starts, there are two main factors dictating the results. The first factor is the amount of power provided by the lithium ion battery pack, and the second factor is the maximum conductivity. You need both factors to have the best chance to jump-start big engines. One factor without the other factor is not enough.

SUMMARY

[0004] The presently described subject matter is directed to a battery device, for example, a battery connector, battery connector arrangement, or battery conductor assembly for use in a device for jump starting a vehicle, and a device for jump starting a vehicle comprising the battery connector device.

[0005] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having at least one battery conductor connected to a terminal of the battery.

[0006] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having at least one battery conductor or cable connected to a battery tab of the battery.

[0007] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor and a negative conductor connected to the battery.

[0008] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor plate and/or a negative conductor plate connected to the battery.

[0009] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor plate and/or a negative conductor plate connected to the battery, and a positive cable connected to the positive conductor plate and/or a negative cable connected to the negative conductor plate.

[0010] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal of the battery and/or a negative battery conductor connected to a negative terminal of the battery.

[0011] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, the battery conductors being soldered to the respective terminals of the battery.

[0012] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to one of the battery conductors of the battery.

[0013] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

[0014] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

[0015] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and multiple relays connected to the negative battery conductor.

[0016] The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative

battery conductor connected to a negative terminal contact of the battery, and a positive cable connected to the positive battery conductor.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

FIG. 1 is a front view of the battery jump starting device with the clamps un-deployed.
FIG. 2 is a rear perspective view of the battery jump starting device shown in FIG. 1.
FIG. 3 is an end perspective view of the battery jump starting device shown in FIGS. 1 and 2.
FIG. 4 is a front perspective view of the battery jump starting device shown in FIG. 1, however, with the clamps deployed.
FIG. 5 is a front perspective view of a battery connector device contained within the battery jump starting device shown in FIG. 1, however, with the negative cable not yet installed.
FIG. 6 is a top planer view of the battery connector device shown in FIG. 5.
FIG. 7 is a side elevational view of the battery connector device shown in FIG. 5.
FIG. 8 is an end elevational view of the battery connector device shown in FIG. 5.
FIG. 9 is a perspective view of the battery connector device shown in FIG. 5, however, with the negative cable connected to the battery connector device.
FIG. 10 is a view perspective view of the battery connector device shown in FIG. 5, however, with a diode connector installed on the positive cable.
FIG. 11 is a perspective view of the battery connector device connected to other components or parts of the battery jump starting device.
FIG. 12 is a perspective view of the battery assembly of the battery connector device shown in FIG. 5.
FIG. 13 is a front perspective view of another battery connector device for the battery jump starting device.
FIG. 14 is a detailed view of the positive cable connection with the relay printed circuit board prior to being soldered thereto.
FIG. 15 is a detailed view of the positive cable connection with the relay printed circuit board after being soldered thereto.
FIG. 16 is a front perspective view of the battery assembly of the battery connector device shown in FIG. 13.
FIG. 17 is a partial top planar view of the battery assembly shown in FIG. 16, however, with the positive terminal conductor sheet in an unwound condition.
FIG. 18 is a partial top planer view of the positive terminal conductor of the battery assembly shown in FIG. 16.
FIG. 19 is an end perspective view of the positive terminal conductor partially wound around the end of the positive cable.
FIG. 20 is an end perspective view of the positive terminal conductor fully wound around the end of the positive cable.
FIG. 21 is a side perspective view of the positive terminal conductor fully wound around and soldered to the end of the positive cable.
FIG. 22 is an opposite end perspective view of the positive terminal conductor fully wound around and soldered to the end of the positive cable.
FIG. 23 is a perspective view of the diode connector between sections of the positive cable.
FIG. 24 is a perspective view of a Schottky Diode used in the diode connector.
FIG. 25 is a perspective view of the diode connector insulated with a shrink wrap sleeve.
FIG. 27 is a graphical illustration showing a load test of the battery connection shown in FIGS. 5-10.
FIG. 28 is a graphical illustration showing a load test of the battery connection shown in FIGS. 13-25.
FIG. 29 is a front view of a further battery connector device for the battery jump starting device.
FIG. 30 is a front view of the battery connector device comprising a plurality of battery cells, separate tab, and conductors (e.g. plate conductors) prior to assembly.
FIG. 31 is a front view of the battery connector device comprising battery cells being prepared with separate tabs for lengthening the tabs.
FIG. 32 is a front view of the battery connector device comprising the plurality of battery cells, separate tab, and conductors shown in FIG. 30, after assembly.
FIG. 33 is a perspective view showing the battery connector device comprising the battery cell assembly shown in FIG. 32, after folding the battery cells.
FIG. 34 is an end perspective view of the battery connector device showing the separate tab being wrapped or wound around an exposed end of the positive cable, and soldered together.
FIG. 35 is an opposite end perspective view of the battery connector device showing a negative battery tab wrapped around the negative terminal conductor plate and welded and/or soldered together.

WINPLUS Ex. 1003, p. 977

FIG. 36 is a perspective view of the battery connector device showing the flat separate tab connected to the battery and extending outwardly prior to connection to the positive cable.

FIG. 37 is a side view of the temperature sensor assembly with wires and connector.

FIG. 38 is a perspective view of the diode circuit board assembled connected inline or spliced into the positive cable.

DETAILED DESCRIPTION

[0018] A battery jump starter device 10 is shown in FIGS. 1 and 2. The battery jump starting device 10 comprises a casing 12 having a display 14 provided with an arrangement of light emitting diodes (LEDs) 16.

[0019] The battery jump starting device 10 further comprises a positive cable 18 having a positive clamp 20 and a negative cable 22 having a negative clamp 24. The positive cable 18 and negative cable 22 pass through openings 12a, 12b, respectively, in the casing 12.

[0020] The clamps 20, 24 are stowed away or docked in an un-deployed mode by clamping each to a respective side posts 26 extending outwardly on opposite sides of the casing 12, as shown in FIG. 1. The side posts 26 are shown in FIG. 2. The clamps 20, 24 are docked when the battery jump starter device 10 is in non-use, and then unclamped from the side post 26 during use.

[0021] The battery jump starting device 10 is configured to jump start a vehicle battery. For example, the battery jump starting device 10 can be the PORTABLE VEHICLE JUMP START APPARATUS WITH SAFETY PROTECTION disclosed in U.S. Patent No. 9,007,015, which is fully incorporated herein by reference, or a device or apparatus similar thereto.

[0022] The battery jump starting device 10 comprises electrical components or parts located inside the casing 12. For example, the battery jump starting device 10 comprises a battery connector device 100 shown in FIGS. 3 - 9.

[0023] The battery connector device 100 comprises a battery assembly 110 having a battery 112. For example, the battery 112 is a lithium ion rechargeable type battery. The battery connector device 100 is configured to maximize conductivity from the battery 112 to the cables 18, 22 and clamps 20, 24 of the battery jump starter device 10. The battery 112 comprises a battery casing 112a, for example, a rectangular-shaped battery casing 112a.

[0024] The battery 112 comprises a positive tab at one end (e.g. width) of the battery 112, and a negative terminal tab at an opposite end (e.g. width) of the battery 112. For example, the battery 112 comprises one or more battery cells each having a positive and negative tab. For example, the positive tab from one battery cell is located at the one end of the battery 112 and the negative tab from one battery cell is located at the opposite end of the battery 112. A positive terminal conductor plate 114 is connected (e.g. soldered, welded, or sonically welded) at the one end of the battery 112 to the positive tab (i.e. contact) of the battery 112. The positive terminal conductor plate 114 extends along the one end (e.g. width) of the battery 112.

[0025] The positive cable 18 can be connected (e.g. directly connected by soldering) to the positive terminal conductor plate 114 and/or the positive tab of the battery 112. For example, the positive terminal conductor bar 114 can be provided with a conductive loop 116 wrapping around (e.g. entirely wrapping around) and connected (e.g. crimped and/or soldered) to an exposed end 18a of the positive cable 18. For example, the positive terminal conductor plate 114 is made from heavy gauge copper sheet (e.g. machined, cut, or stamped therefrom).

[0026] As shown in FIGS. 5 and 6, the positive terminal conductor sheet 114 can be configured (e.g. bent) to wrap around one of the square-shaped corners of the rectangular-shaped casing 112a of the battery 112 (e.g. L-shaped). The L-shaped positive terminal conductor sheet 114 can extend along an end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIG. 5.

[0027] The positive terminal conductor plate 114 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional support and stability thereof (e.g. assembled to survive mechanical shock when drop testing the battery jump starter device 10). For example, the positive terminal conductor bar 114 can be mechanically connected to the battery casing 112 by adhesive (e.g. silicon adhesive), double sided tape, double sided foam tape, insulated plastic or ceramic connector with snap fit connection and/or adhesive connection, and/or the battery casing 112 can be formed (e.g. molded) to mechanically connect (e.g. snap fit or interference connection) with the positive terminal conductor plate 114.

[0028] The positive cable 18 can be a single piece of wire or a cable (e.g. twisted or braided wires) extending from the battery 110 to the positive clamp 20. Specifically, one end of the positive cable 18 is connected to the positive terminal conductor plate 114 connected to the battery 18, and the opposite end of the positive cable 18 is connected to the positive clamp 20.

[0029] More specifically, the positive cable 18 can comprise a flexible or bent cable portion 118 for changing the direction of the positive cable 18 within the casing 12. The positive cable 18 can be fitted with a flexible outer sleeve portion 120 transitioning into a flexible inner sleeve portion 122 to flexibly accommodate the positive cable 18 passing through the casing 12. The flexible outer sleeve portion 120 is externally located relative to the casing 12 of the battery jump starter device 10, and the flexible inner sleeve portion 122 is internally located relative to the casing 12 of the

WINPLUS Ex. 1003, p. 978

battery jump starter device 10.

[0030] The flexible outer sleeve portion 120 is configured to reinforce the connection between the positive cable 18 and the casing 12 of the battery jump starter device while remaining flexible. For example, the flexible outer sleeve portion 120 is provided with one or more grooves 124 (e.g. three (3) shown in FIG. 5) exposing portions of the positive cable 18. The one or more grooves 124 act as hinges to ease bending of the positive cable 18 within the flexible outer sleeve portion 120.

[0031] The flexible sleeve 120 comprises an outer flange 124 spaced apart (e.g. a small distance equal to about a wall thickness of the casing 12 of the battery jump starter device 10) from an in inner flange 126. The flanges 124, 126 further anchor the positive cable 18 to the casing 12 of the battery jump starter device 10.

[0032] The flexible sleeve 120 comprises a sleeve portion 128 (FIG. 6) connecting together the outer flange 124 and inner flange 126. For example, the flexible outer sleeve portion 120 is molded or applied onto and around the positive cable 18 as a single unit (e.g. the flexible sleeve 120 is molded onto a portion of the positive cable 18 inserted within the mold during the molding process). Alternatively, the flexible sleeve 120 is made (e.g. molded) separately, and then installed or assembled onto a portion of the positive cable 18.

[0033] The positive cable 18 comprises an inner conductor 18b (e.g. single wire conductor, twisted wires, or braided wires) disposed within an outer insulating sheath 18c (e.g. extruded plastic sheath). The inner conductor 18b, for example, can be a solid wire conductor or a multi strand metal wire conductor comprising bundle of wires 18d. The inner wire can be made of copper or aluminum. The flexible sleeve 120 can be applied (e.g. molded or installed or assembled) onto and surrounding the outer insulating sheath 18c of the positive cable 18.

[0034] The battery connector device 100 further comprises a negative terminal conductor plate 130 connected (e.g. soldered, welded, or sonically welded) at an opposite end of the battery 112 to the negative tab (i.e. contact) of the battery 112. The negative terminal conductor plate 130 can extend along the opposite end of the battery 112.

[0035] The other end of the negative terminal conductor plate 130 is provided with a negative terminal conductor plate connector portion 132, as shown in FIGS. 5 and 6.

[0036] The negative terminal conductor plate 130 can be configured to wrap around one of the corners of the rectangular-shaped battery 112 (e.g. L-shaped). The L-shaped negative terminal conductor plate 130 can extend along an end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIGS. 5 and 6.

[0037] The negative terminal conductor bar 130 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional support and stability thereof (e.g. to survive mechanical shock when drop testing the battery jump starter device 10). For example, the negative terminal conductor bar 114 can be mechanically connected to the battery casing 112a by adhesive (e.g. silicon adhesive), double sided tape, double sided foam tape, insulating plastic or ceramic connector with snap fit connection and/or adhesive connection, and/or the battery casing 112 can be formed (e.g. molded) to mechanically connect (e.g. snap fit or interference connection) with the positive terminal conductor plate 114.

[0038] The battery connector device 100 further comprises a smart switch battery interface 134. The smart switch battery interface 134 comprises a relay printed circuit board (PCB) 136 having a first circuit board conductor bar 138 spaced apart from a second circuit board conductor bar 140 located on one side of the circuit board 136, as shown in FIGS. 5 and 6.

[0039] A pair of relays 142 are mounted on an opposite side of the circuit board 136. The relays 142 include relay anchoring pins 142a located in through holes 136a in the relay printed circuit board 136 (FIGS. 5 and 7). The relays 142 further comprise relay connector pins 142b extending through the through holes 136b provided in the circuit board 136 and slots 138a provided in the first conductor bar 138. The relays 142 even further comprise relay connector pins 142c located in the through holes 136c provided in the circuit board 136 and through holes 140a provided in the second conductor bar 140. The relay anchoring pins 136a are soldered in place to mechanically connect the relays 142 to the circuit board 136. The relay connecting pins 142b and 142c are soldered in place to mechanically and electrically connect the relays 142, respectively, to the circuit board conductor plates 138, 140.

[0040] The through holes 136a in the circuit board 136 are rectangular-shaped (FIGS. 5 and 7) and accommodate the relay anchoring pins 142a. Specifically, a base portion of the relay anchoring pins 142a are rectangular-shaped with square-shaped ends. The square-shaped ends are dimensionally less wide verses the base portions creating transverse edges oriented flush with the outer surface of the circuit board 136. When solder is applied to the exposed ends of the relay anchoring pins 142a, the solder connects to the sides of the square-shaped ends and transverse edges to anchor and lock the relay anchoring pins to the circuit board 136.

[0041] The slots 132a provided in negative terminal conductor bar connector portion 132 are rectangular-shaped and the through holes138a in the first circuit board conductor bar 138 (FIG. 3) are T-shaped to accommodate the three (3) horizontally oriented relay connector pins 142b, as shown in FIG. 3. The ends of the relay connector pins 142b are shown flush with the outer surface of the negative terminal conductor bar connector portion 132. When solder is applied to the exposed ends of the relay connector pins 142b, the solder fills in the slots 132a in the negative terminal conductor bar connector portion 132 and the through holes 138a of the first circuit board conductor bar 138, and connects the

WINPLUS Ex. 1003, p. 979

sides of the connector pins 142b with inner edges of the slots 132a and through holes 138a to anchoring the relays 142 to the circuit board 136 and negative terminal conductor bar connector portion 132. This applied solder also electrically connects the negative terminal conductor bar connector portion 132 to the first circuit board conductor bar 138.

[0042] The through holes 140a provided in the second circuit board conductor bar 140 are T-shaped to accommodate the three (3) vertically oriented relay connecting pins 142c, as shown in FIG. 3. The relay connector prongs 140a extend outwardly from the outer surface of the circuit board 136 to connect with the exposed conductor end 144a of the negative cable 144, and shown in FIG. 7. When solder is applied to the exposed conductor end 144a and the ends of the relay connector prongs 140a, the solder fills in the T-shaped slot and electrically connects the relay connector prongs 140a, second circuit board conductor 140, and exposed conductor end 144a of the negative cable 144.

[0043] The negative terminal conductor bar connector portion 132 of the negative terminal conductor bar 130 is connected (e.g. by soldering) to the first circuit board conductor bar 138 of the circuit board 136. The exposed conductor end 22a (i.e. with the insulating sheath removed) of the negative cable 22 is connected (e.g. by soldering) to the second circuit board conductor bar 140, as shown in FIG. 9.

[0044] The battery connector device 100 can be modified by providing the positive cable 18 with a diode connection 150, as shown in FIG. 10. For example, a diode connection is installed (e.g. spliced) into the positive cable 18. The diode connection 150 comprises a diode printed circuit board (PCB) 152 provided with a set of back-charge diodes 154 (e.g. Schottky Diodes) located on one side thereof, and a conductor bar 156 provided on an opposite side of the circuit board 152.

ASSEMBLY

[0045] The battery jump starting device 10 comprises the casing 12 having an upper casing portion 12a and a lower casing portion 12b, as shown in FIG. 11. The upper casing portion 12a and the lower casing portion 12b are configured to be connected together when assembling the battery jump starting device 10.

[0046] The battery jump starting device 10 further comprises the battery connection device 100 and controller assembly 210 both disposed within the casing 12. The controller assembly 210 comprises a circuit board 212 located adjacent to another circuit board 214.

[0047] The positive terminal of the battery assembly 110 (FIG. 12) is connected to the circuit board 212 via a positive power wire 216. For example, the positive power wire 216 is soldered to the positive conductor bar 114 (FIG. 5). The negative terminal of the battery assembly 110 is connected to the circuit board 214 via a negative power wire 218.

[0048] The relay circuit board 136 is provided with a wire set 220 having a connector 222. The connector 222 is configured to connect with the relay board connector 224 located on the circuit board 212 of the controller assembly 210 during assembly of the battery jump starting device 10.

[0049] The battery assembly 110 further comprises a wire set 226 having a connector 228. The connector 228 is configured to connect with the battery cell charging/monitoring connector 230 located on the circuit board 212 of the controller assembly 220.

[0050] The battery assembly 110 also comprises a battery temperature sensor having a wire set 232 having a connector 234. The connector 234 is configured to connect with the temperature sensor connector 236 located on the circuit board 212 of the controller assembly 220.

[0051] The circuit board 212 is provided with in charge power resistors 240 and an out relay 242, as shown in FIG. 11. Further, the lower casing portion 12a is provided with a main user out connector 244 having a wire set 246 connected to the circuit board 214, and a main user in connector 248 having a wire set 250 connected to the circuit board 214.

[0052] The battery assembly 110 is connected to battery jump starting device 10, as shown in FIG. 11. The battery connector device 110 is installed within the casing 12 of the battery jump starting device 10 when assembled.

ENHANCED CONDUCTIVITY

[0053] An enhanced conductivity battery connector device 400 is shown in FIGS. 13 - 25. The enhanced conductivity battery connector device 400 provides a significantly increased conductivity compared to the battery connector device 100, as shown in FIGS. 5 - 10.

[0054] The amount of power to be conducted from the battery 412 to the clamps can be enhanced as follows:

1) Increase Wire Gauge

[0055] e.g. change 4AWG (American Wire Gage) positive cable 18 and negative cable 22 (FIG. 9) to a 2AWG positive cable 318 and negative cable 322 (FIGS. 13 and 15).

WINPLUS Ex. 1003, p. 980

2) Increase Conductivity of Negative Cable Connection

[0056] e.g. negative cable end 322a (FIG. 15) connection to the relays will extend all the way across the connector pins 422c of the relays 422.

3) Increase Conductivity of Positive Cable Connection

[0057] e.g. the positive battery tab 414 is lengthened so that the positive cable 318 can be rolled up (FIGS. 17-22) in the positive battery tab 414 and soldered together thoroughly;

4) Increase Conductivity of Diode Connection

[0058] e.g. replace the diode connection 150 (FIG. 5) with the diode connection 450 (FIG. 23).

5) Redesign Resistor/Diode Printed Circuit Board (PCB)

[0059] e.g. replace the diode printed circuit board (PCB) 152 (FIG. 10) with the diode printed circuit board (PCB) 452 (FIG. 23).

6) Reconnect Resistors

[0060] e.g. reconnect resistors R134A&B, R135A&B located on the diode printed circuit board (PCB) 152 (FIG. 10) to be connected again.

[0061] A detailed description of each of these enhanced conductivity features or arrangement is set forth below.

1) Increase Wire Gauge

[0062] The gauge of the positive cable 18 and negative cable 22 (FIG. 9), for example, can be increased from 4AWG (American Wire Gage) cable to a 2AWG cable for positive cable 318 and negative cable 322 (FIGS. 13 and 15). The comparative specifications of the 4AWG cable and 2AWG cable are as follows:

	2AWG	4AWG
Diameter	0.2576 in (6.544 mm)	0.2294 in (5.189 mm)
Turns of wire	3.88/in (1.53/cm)	4.89/in (1.93/cm)
Area	66.4 kcmil (33.6 mm^2)	41.7 kcmil (21.2 mm^2)
Resistance/length	0.5127 mΩ/m (0.1563 mΩ/ft)	0.8152 mΩ/m (0.2485 mΩ/m)
Ampacity	95 (60° C)	70 (60° C)
	115 (75° C)	85 (75° C)
	130 (90° C)	95 (90° C)
Fusing current	1.3 kA (10 s)	946 A (10 s)
	10.2 kA (1s)	6.4 kA (1 s)
	57kA (32 ms)	36 kA (32 ms)

[0063] The 2AWG cable provides a significant increase of conductivity (i.e. ampacity) compared to the 4AWG cable (i.e. approximately 36%).

2) Increase Conductivity of Negative Cable Connection

[0064] The negative cable 322 (FIG. 15) can be connected to the battery 412 (FIG. 13) in a manner to increase the conductivity (i.e. ampacity) between the battery 412 and negative cable 322. For example, the negative cable end 322a can be directly connected (e.g. soldered) to the connector prongs 442c (FIG. 15) of the relays 442. Specifically, the negative cable end 322a can extend across and directly connect to all relays 342 of the smart switch battery interface 434, as shown in FIGS. 14 and 15. Further, the negative cable end 322a can be connected to a conductor loop 441 of the circuit board conductor bar 440.

[0065] The negative cable 322, for example, can be stranded wire comprising an inner electrical wire conductor 322b composed of an untwisted or twisted bundle of wires 322d disposed within an outer electrical insulating sheath 322c.

The electrical insulating sheath 322c of the negative cable 322 can be removed from the negative cable end 322a exposing the inner electrical conductor 322b at the negative cable end 322a.

[0066] The exposed bundle of wires 322d of the electrical conductor 322b can be forced over the ends of the exposed connector pins 442c of the relays 442 so that strands of wires 322d are captured between the adjacent connector pins 442c. The exposed bundles of wires 332d can be further forced into contact with the conductor bar 440 (e.g. made of copper). Solder 423 is applied to this assembly so that the solder flows between the exposed bundles of wires 422d to the connector pins 442c and the conductor bar 440 to complete the electrical connection between the negative cable 322 and the smart switch battery interface 434 connected to the battery 412.

[0067] The length of the exposed bundle of wires 322d is selected so that exposed bundle of wires 322d directly connects with each set of connector pins 442c of each and every relay 442 to provide the maximum electrical conductivity (i.e. maximum ampacity) between the negative cable 322 and the battery 412.

3) Increase Conductivity of Positive Cable Connection

[0068] The positive cable 318 can be connected to the battery 412 in a manner to increase the conductivity (i.e. ampacity) between the battery 412 and positive cable 318. For example, the positive cable 318 can be rolled up in the positive battery tab 414 and soldered together thoroughly. The connection between the positive cable 318 and battery 412 is shown in FIGS. 16-22.

[0069] The positive cable 318, for example, can be stranded wire comprising an inner electrical wire conductor 318b composed of an untwisted or twisted bundle of wires 318d disposed within an outer electrical insulating sheath 318c. The electrical insulating sheath 318c of the positive cable 318 can be removed from the positive cable end 318a exposing the inner electrical conductor 318b at the positive cable end 318a.

[0070] The battery 412 is provided with a positive battery tab 414. The positive battery tab 414 is a metal sheet (e.g. copper sheet) connected to the positive terminal tab 414 of the battery 412.

[0071] The exposed bundle of wires 318d of the inner electrical conductor 318b can be soldered with tin, and then rolled up within the positive battery tab 312a. Solder 415 (FIG. 21) is applied to the exposed bundle of wires 318d and the positive battery tab 312a.

[0072] The length of the exposed bundle of wires 318d is selected so that exposed bundle of wires 318d directly connects with the full width of the positive battery tab 414 to provide the maximum electrical conductivity (i.e. maximum ampacity) between the battery 312 and the positive cable 318.

4) Increase Conductivity of Diode Connection

[0073] The positive cable 318 can be provided with a diode connection 450 configured to increase the conductivity along the positive cable 318, as shown in FIGS. 23 - 25.

[0074] The diode connection 450 comprises a plurality of diodes 454 connected between positive cable sections 318e and 318f (FIG. 25). For example, the diode connection 450 comprises six (6) back-charge type diodes (e.g. Schottky barrier diodes).

[0075] The diodes 454 are soldered between the positive cable sections 318e and 318f. Specifically, the diode conductor tabs 454a are soldered to the positive cable section 318e and the diode conductor prongs 454b are soldered to the positive cable section 318f. More specifically, the diode conductor prongs 454b of the diodes 354 extend through the diode circuit board 452, extend into the bundle of wires 318b, and then are soldered in place completing assembly of the diode connection 450.

[0076] The diode connection 450 is then insulated, for example, using a shrink wrap insulator 455 (FIG. 25), which is applied around the diode connection 450, and then shrunk by applying heat (e.g. using heat gun).

5) Redesign Resistor/Diode Printed Circuit Board (PCB)

[0077] e.g. redesign of resistor/diode PCB to eliminate the diodes extending therefrom;

6) Reconnect Resistors

[0078] e.g. reconnect resistors R134A&B, R135A&B that are on the Resistor/Diode PCB to be connected again.

TEST #1

[0079] The battery connection device 100 shown in FIG. 5 was subjected to a 1250A Load Test. The results are shown in FIG. 27, and as follows:

WINPLUS Ex. 1003, p. 982

Pulse #1 Average Power of 4799.01W
Pulse #2 Average Power of 5528.99W
Pulse #3 Average Power of 6101.63W

TEST #2

[0080] The battery connection device 400 shown in FIG. 13 was subjected to a 1250A Load Test. The results are shown in FIG. 28, and as follows:

Pulse #1 Average Power of 6584.61W
Pulse #2 Average Power of 7149.60W
Pulse #3 Average Power of 7325.91W

[0081] This results in a significant increase of approximately twenty percent (20%) for peak power compared to the results of TEST #1.

[0082] Another enhanced conductivity battery conductor device 500 is shown in FIGS. 29 - 37. The enhanced conductivity battery connector device 500 provides a significantly increased conductivity compared to the battery connector device 100, as shown in FIGS. 5 - 10.

[0083] The battery conductor device 500 comprises the battery assembly 410, including the battery 512 connected to the positive cable 518 and the negative terminal conductor plate 530. A positive wire 519 is connected directly or indirectly to the positive tab or positive cable 518 of the battery 530, and a negative wire 523 is connected directly or indirectly to the negative tab or negative terminal conductor plate 530. The battery conductor device 500 can further include a bundle of wires 570 connected to or associated with the operation of the battery 512 (e.g. battery temperature sensor, power supply, etc.).

[0084] The battery 512 can comprise a single battery cell 512c (FIG. 30), or multiple battery cells 512C connected end-to-end in series. Three (3) separate battery cells 512c are shown in FIG. 30.

[0085] The battery cells 512c each have positive and negative tabs 512d located at opposite ends of each battery cell 512c. The battery cells 512c are connected together in series by welding (e.g. sonically and/or thermally welding) and/or soldering respective positive and negative tabs 512d together. For example, the tabs 512d are positioned so as to overlap each other (e.g. edges overlapping opposite tab 512d, or edge-to-edge).

[0086] The tabs 512d are metal plates (e.g. relative thin metal foils) extending outwardly from the body and opposite edges of each battery cell 512c. As shown in FIG. 30, the tabs 512d extend along opposite edges at the width of each battery cell 512c. The tabs 512d are each centered and extend most of the width of each opposite edge of each battery cell 512c.

[0087] As shown in FIGS. 30 and 31, a separate tab 512e is added or connected to the right side of the battery cell 512c to extend the length of the tab 512d. The separate tab 512e is shown as having the same width as the tab 512d; however, this width can be different. To assemble the separate tab 512e to the tab 512d, for example, the separate tab 512e is positioned to overlap over the tab 512d, and then welded (e.g. sonically and/or thermally welded) and/or soldered together. The exposed end of the positive cable 518 is then wound up inside the separate tab, as shown in FIGS. 32 and 34. For example, the initially flat separate tab 512e is wrapped around the exposed end of the positive cable 518, and then connected to the exposed end by welding (e.g. sonically and/or thermally welding) and/or soldering. For example, a layer of solder is applied to one or both sides of the separate tab 512e, and then after wrapping the separate tab 512e around the exposed end of the positive wire 518, the assembly is heated to melt the layered solder and solder the assembly together.

[0088] The three (3) battery cells 512c once connected together, as shown in FIG. 32, are then folded over each other into the layered battery cell arrangement shown in FIG. 33. The layered battery cell arrangement can be packaged (e.g. the three (3) battery cells can be taped or shrink wrapped together), or placed within a battery cover or casing, as shown in FIG. 34.

[0089] As shown in FIG. 35, the negative tab 512d can be attached to the negative terminal conductor plate 530. For example, the negative tab 512d can be wrapped partially or fully, as shown, around the negative terminal conductor plate 530. The negative tab 512d can be provided with a plurality of through holes 512f to facilitate welding and/or soldering the negative tab 512d to the negative terminal conductor plate 530. For example, the through holes 512f can be square-shaped through holes arranged into a matrix, as shown in FIG. 35. The negative wire 523 is shown connected (e.g. soldered) to the negative tab 512d.

[0090] A separate tab 512e (see FIG. 30) can be connected to the negative tab 512d to lengthen same, so that the

WINPLUS Ex. 1003, p. 983

lengthened negative tab can be wrapped or wound around the negative terminal conductor plate 530 more than one time (e.g. 2, 3, 4, or more times). In this manner, the electrical connection between the negative tab 512d and the negative terminal conductor plate 530 can be enhanced. The separate tab 512e can be provided with a layer of solder on one or both sides, so that after the separate tab 512e is wrapped or wound around the negative terminal conductor plate 530, this assembly can be heated up to solder the separate tab 512e onto the negative terminal conductor plate 530.

[0091] The completed assembly of the battery conductor device 500 with the connected separate positive tab 512d ready to be wrapped or wound an exposed end of the positive cable 518 (FIG. 29) can be seen in FIG. 36. The bundle of wires 570 shown in FIG. 36, includes wires 572 for a temperature sensor embedded within the battery 512 (e.g. temperature sensor located near battery tab or between battery cells. The temperature sensor 574 having two (2) wires 572a, 572b is shown in FIG. 37.

[0092] The battery conductor device 500 can comprise a diode connector 550 connected inline or splice into the positive cable 518, as shown in FIG. 38.

[0093] The battery conductor device 500 comprises a diode circuit board 552 having a plurality of diodes 454 assembled thereon. The diodes 454 each have a diode conductor tab 454a connected (e.g. soldered) to an exposed end of the positive cable 518. The prongs of the diodes 454 extend through holes in the diode circuit board 552, and are soldered to both the conductive traces and exposed end of the positive cable 518 along with a resistor 576 to complete the assembly.

Claims

1. A rechargeable battery assembly for use in a rechargeable jump starting device having a positive cable with a positive battery clamp and a negative cable with a negative battery clamp, the rechargeable battery assembly comprising:

   a rechargeable battery comprising one or more battery cells having a positive terminal and a negative terminal;
   a positive terminal conductor bar connected to the positive terminal of the one or more battery cells, the positive terminal conductor bar being connected to the positive cable of the rechargeable jump starting device providing an electrically highly conductive conduit between the rechargeable battery and the positive battery clamp; and
   a negative terminal conductor bar connected to the negative terminal of the one or more battery cells, the negative terminal conductor bar being electrically connected to the negative cable of the rechargeable jump starting device during operation of the rechargeable battery jump starting device providing an electrically highly conductive conduit between the rechargeable battery and the negative battery clamp;
   wherein the rechargeable battery assembly is configured to maximize electrical conductivity from the rechargeable battery to a battery being jump started.

2. The battery assembly according to claim 1, wherein the rechargeable battery is a rechargeable Li-ion battery.

3. The battery assembly according to any preceding claim, wherein the rechargeable Li-ion battery comprises multiple Li-ion cells connected together in series by connecting a negative tab of one rechargeable Li-ion cell to the positive tab of the next successive Li-ion cell in a series arrangement.

4. The battery assembly according to any preceding claim, wherein the positive terminal of the one or more battery cells is defined by a positive tab of the one or more battery cells, the positive tab being directly electrically connected to the positive terminal conductor bar.

5. The battery assembly according to any preceding claim, wherein the negative terminal of the one or more battery cells is defined by a negative tab of the one or more battery cells, the negative tab being directly electrically connected to the negative terminal conductor bar.

6. The battery assembly according to any of claims 3-5, wherein the positive tab of the one or more battery cells is soldered to the positive terminal conductor bar.

7. The battery assembly according to any of claims 3-6, wherein the negative tab of the one or more battery cells is at least partially wrapped around at least a portion of the negative terminal conductor bar.

8. The battery assembly according to any of claims 3-7, wherein the negative tab is wrapped around the at least a portion of the negative terminal conductor bar more than one time.

WINPLUS Ex. 1003, p. 984

9. The battery assembly according to any of claims 3-8, wherein the negative tab of the one or more battery cells wrapped around the at least a portion of the negative conductor bar is soldered to the negative terminal conductor bar.

10. The battery assembly according to any preceding claim, wherein one end of the positive terminal conductor bar is electrically connected to the positive terminal of the one or more battery cells and an opposite end of the positive terminal conductor bar is connected to the positive cable.

11. The battery assembly according to any preceding claim, wherein the positive terminal conductor bar is an L-shaped positive terminal conductor bar bent around a corner of the rechargeable battery.

12. The battery assembly according to any preceding claim, wherein the negative terminal conductor bar is an L-shaped negative terminal conductor bar bent around a corner of the rechargeable battery.

13. The battery assembly according to any preceding claim, wherein the positive terminal of the one or more battery cells is defined by a positive tab of the one or more battery cells, the positive tab being directly electrically connected to the positive terminal conductor bar, wherein the negative terminal of the one or more battery cells is defined by a negative tab of the one or more battery cells, the negative tab being directly electrically connected to the negative terminal conductor bar, and wherein the positive tab is provided with a tab extension and the negative tab is provided with a tab extension to lengthen the positive tab and negative tab.

14. A rechargeable jump starting device comprising:

a rechargeable battery assembly device according to any preceding claim;
a smart switch interface comprising a circuit board having a first circuit board conductor bar connected to the negative terminal conductor bar of the rechargeable battery and a second circuit board conductor bar spaced apart from the first circuit board conductor bar on the circuit board, the smart switch interface further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal of the rechargeable battery and a battery being jump started by the battery jump starting device;
wherein one end of the positive cable is connected to the positive terminal conductor bar,
wherein an opposite end of the positive cable is connected to the positive clamp; and
wherein the negative cable is connected to the second circuit board conductor bar.

WINPLUS Ex. 1003, p. 985

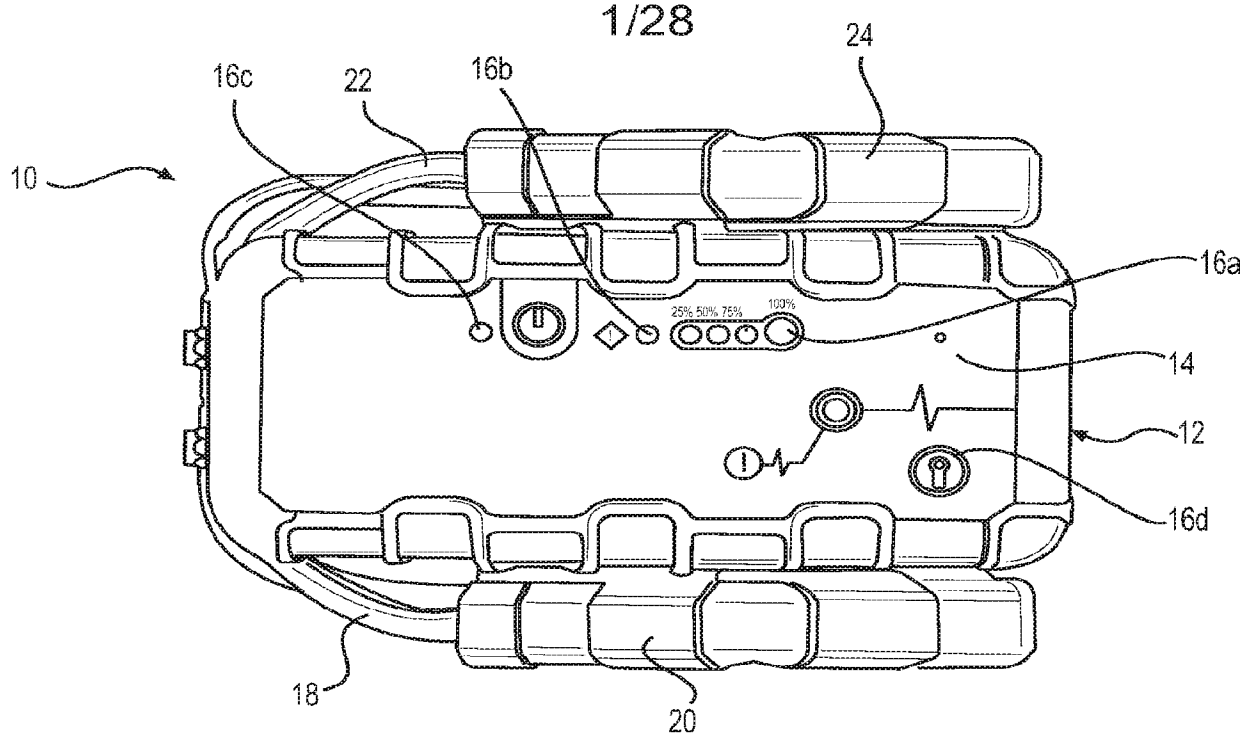


FIG. 1

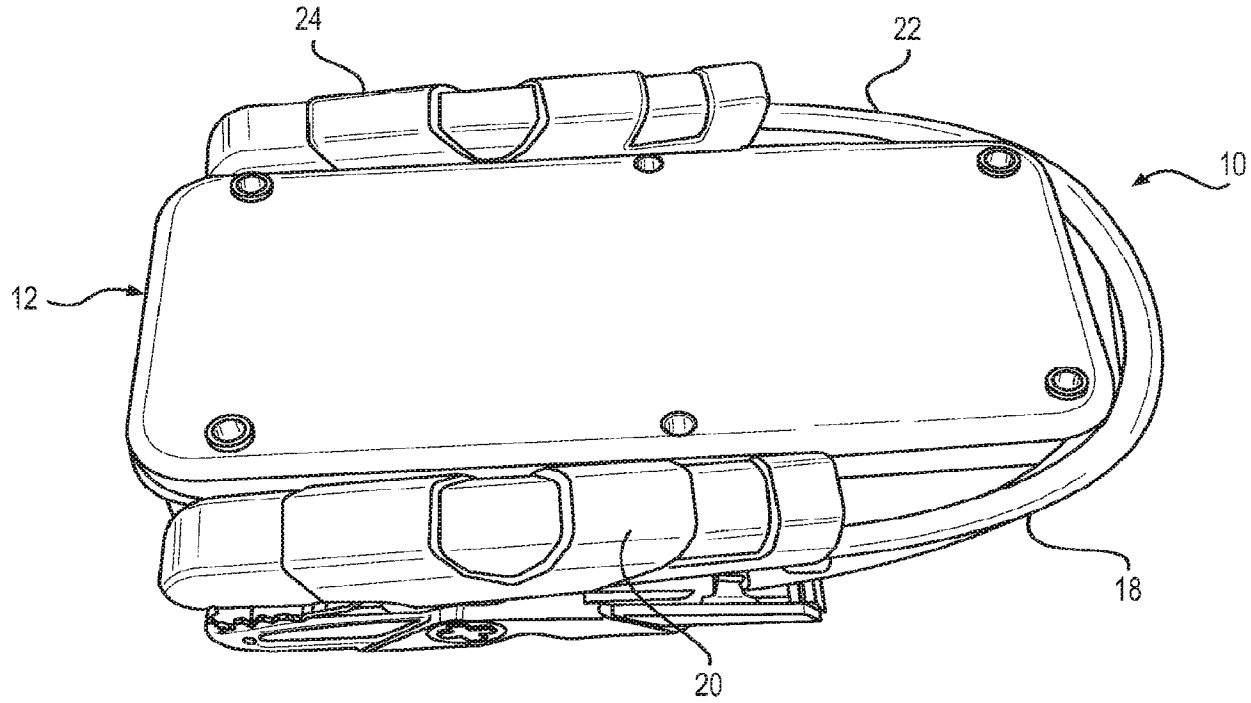


FIG. 2

WINPLUS Ex. 1003, p. 986

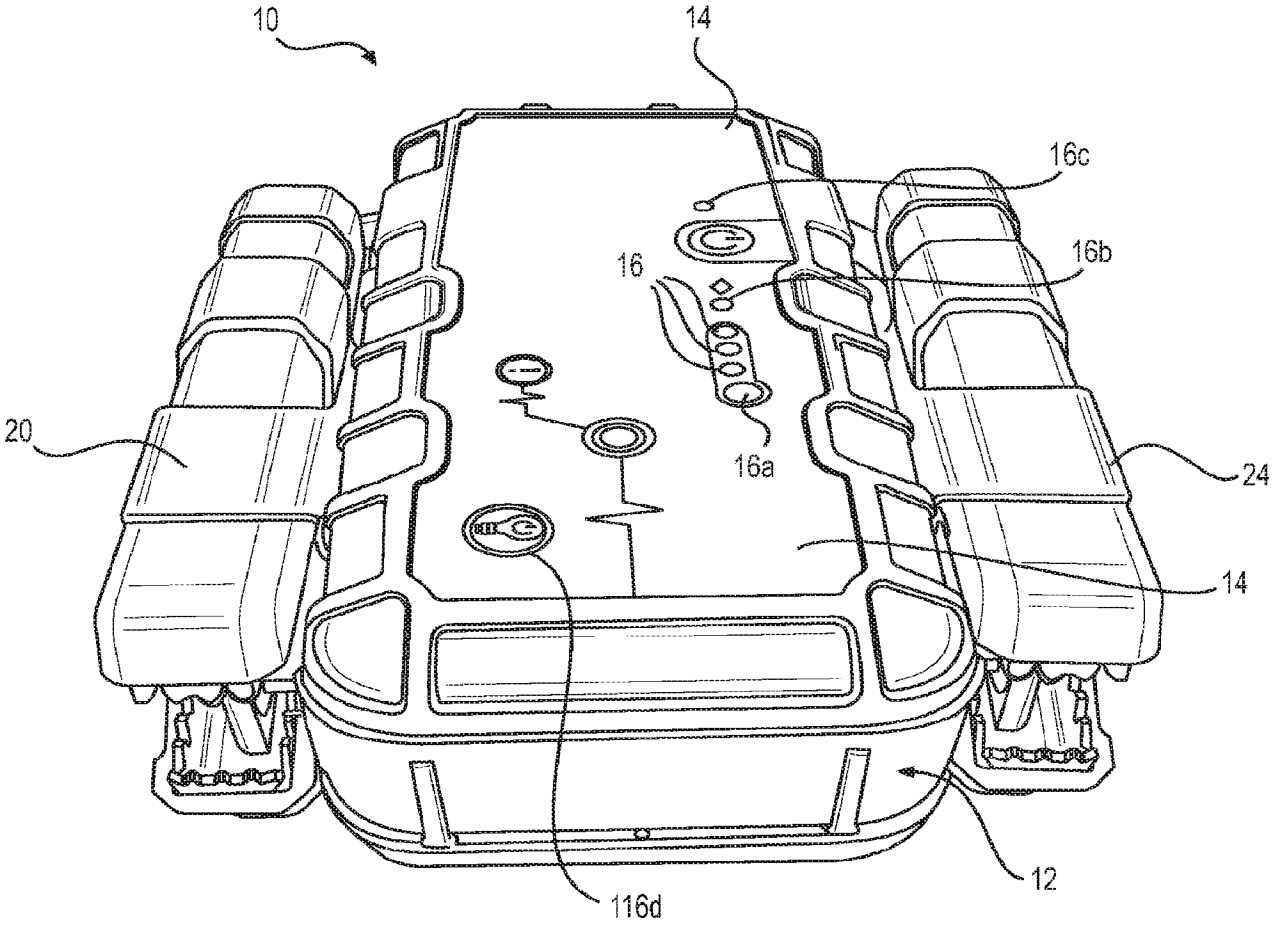


FIG. 3

WINPLUS Ex. 1003, p. 987

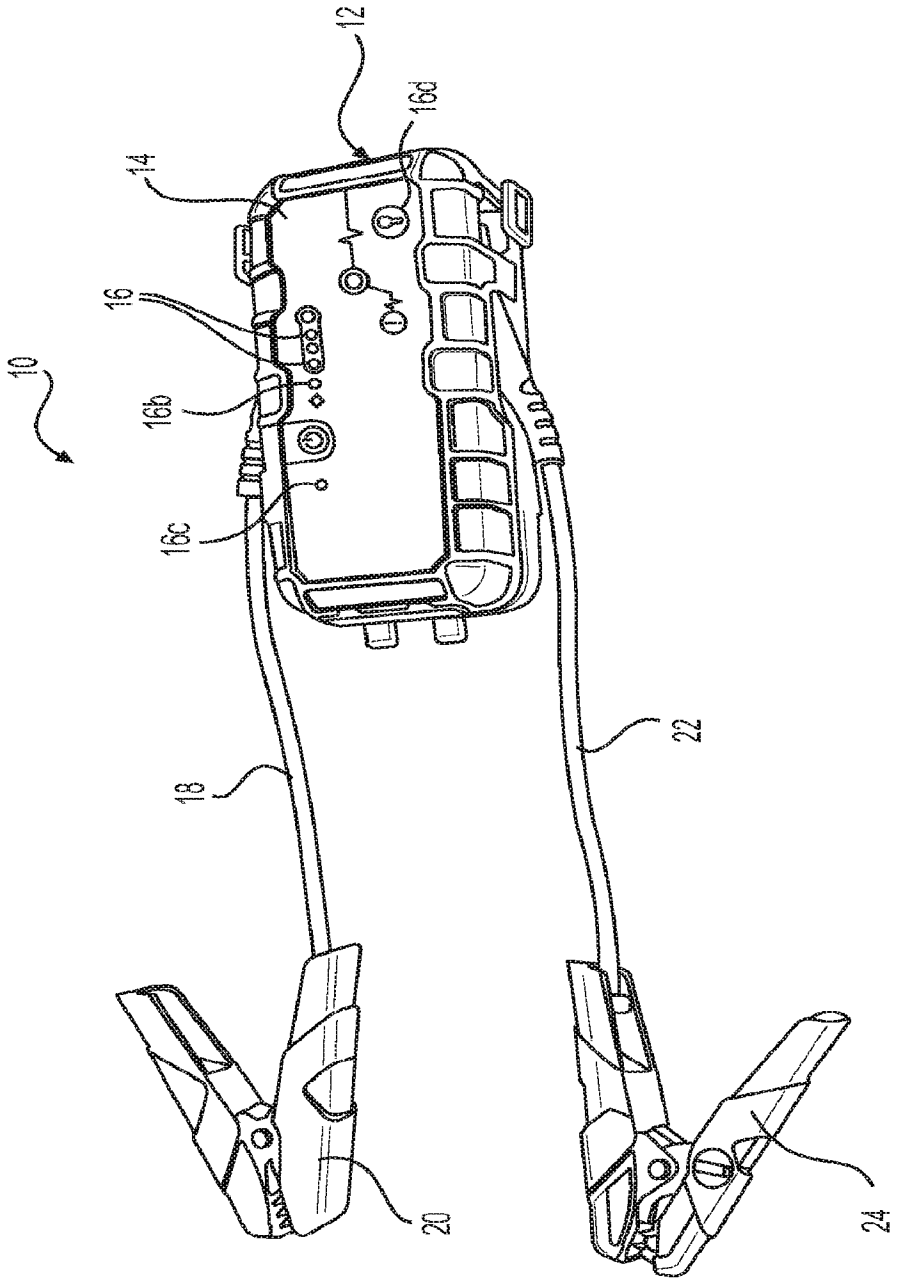


FIG. 4

WINPLUS Ex. 1003, p. 988

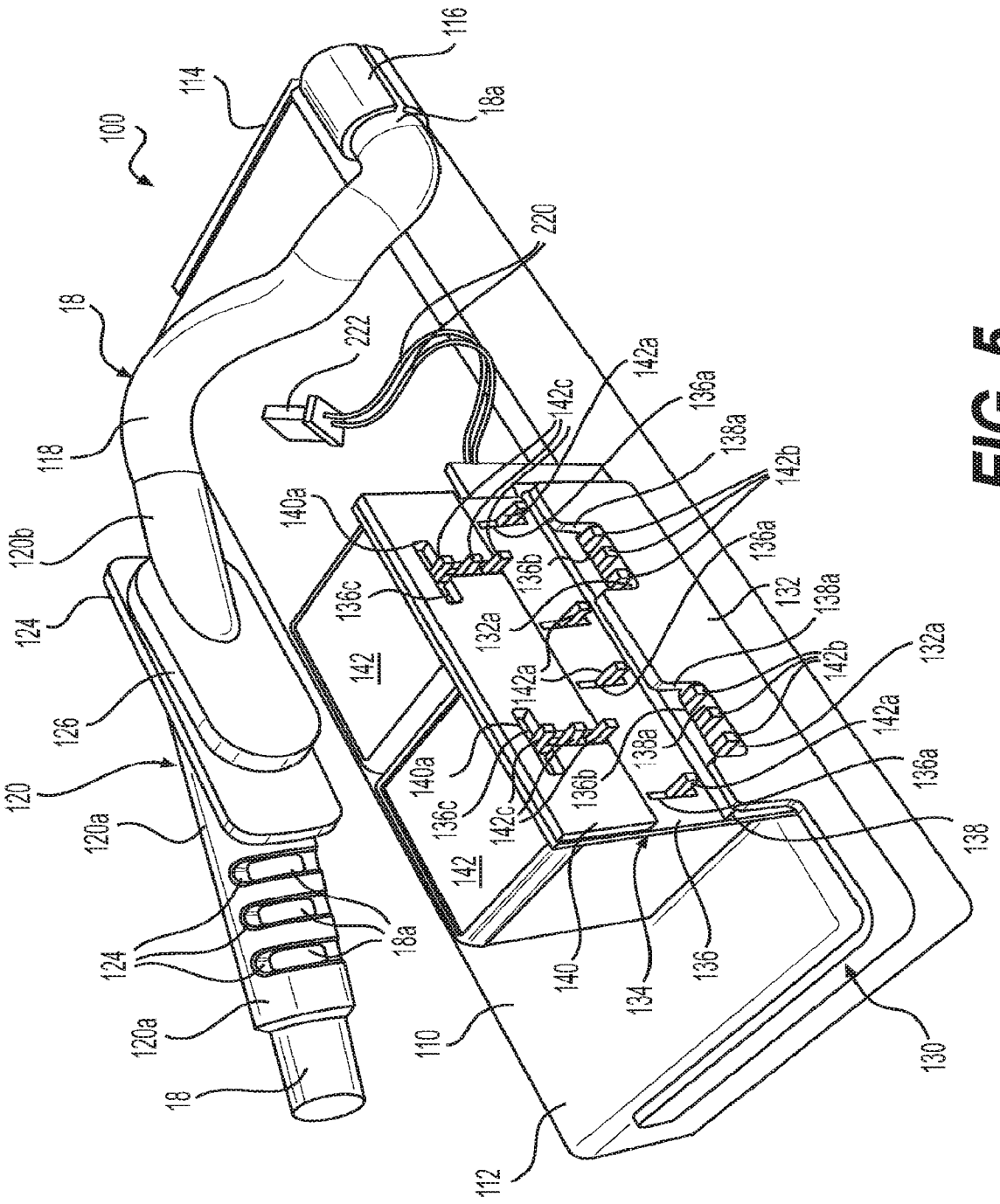


FIG. 5

WINPLUS Ex. 1003, p. 989

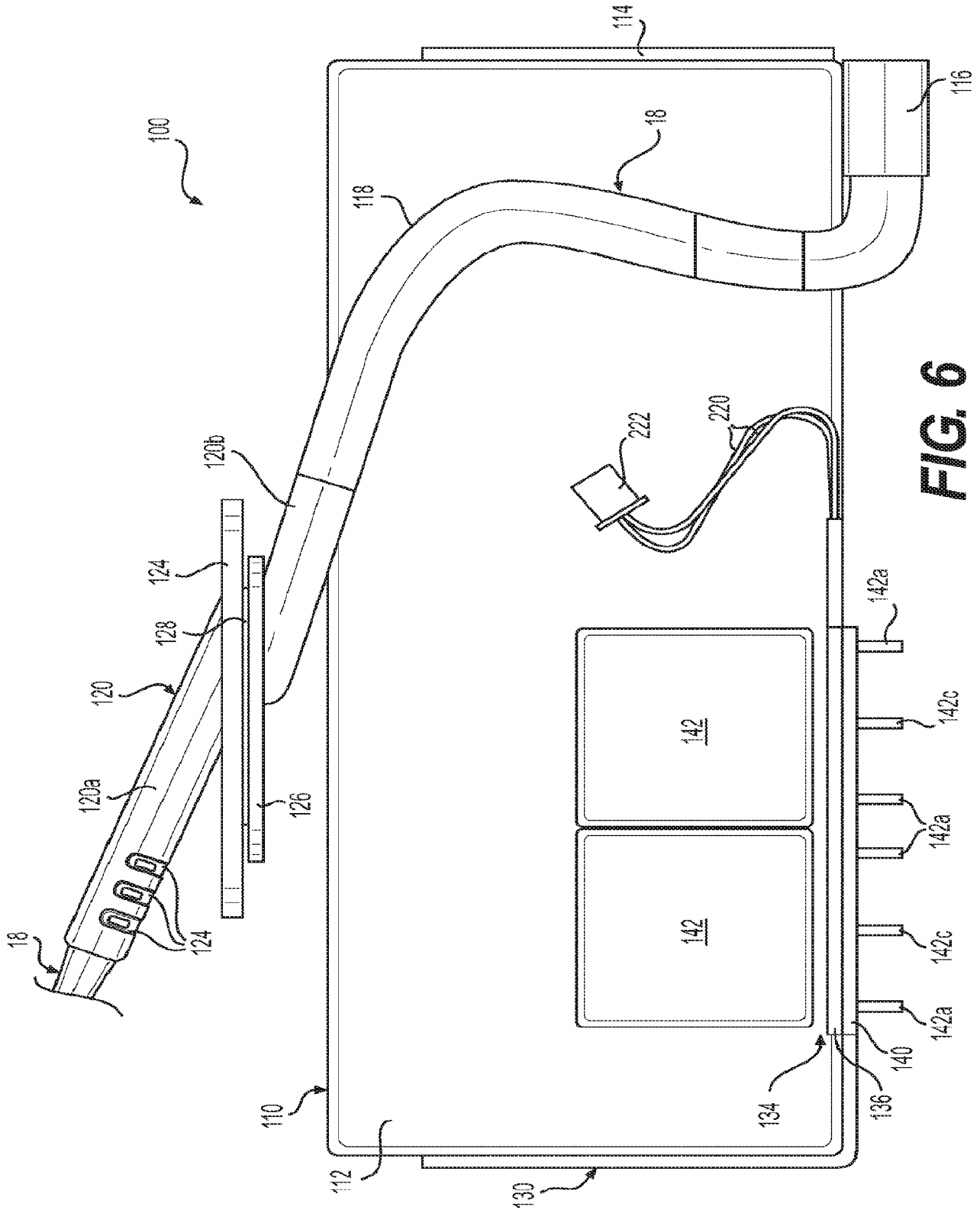


FIG. 6

WINPLUS Ex. 1003, p. 990

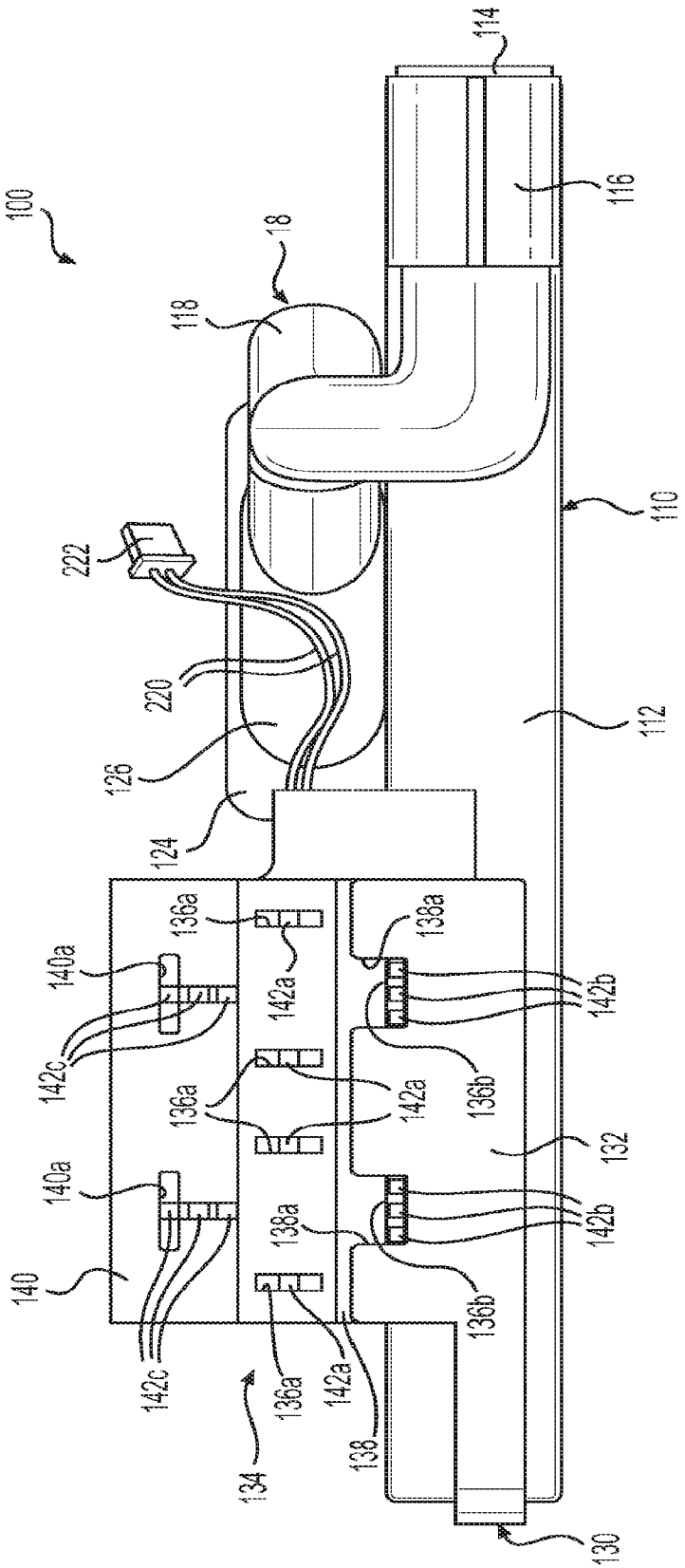


FIG. 7

WINPLUS Ex. 1003, p. 991

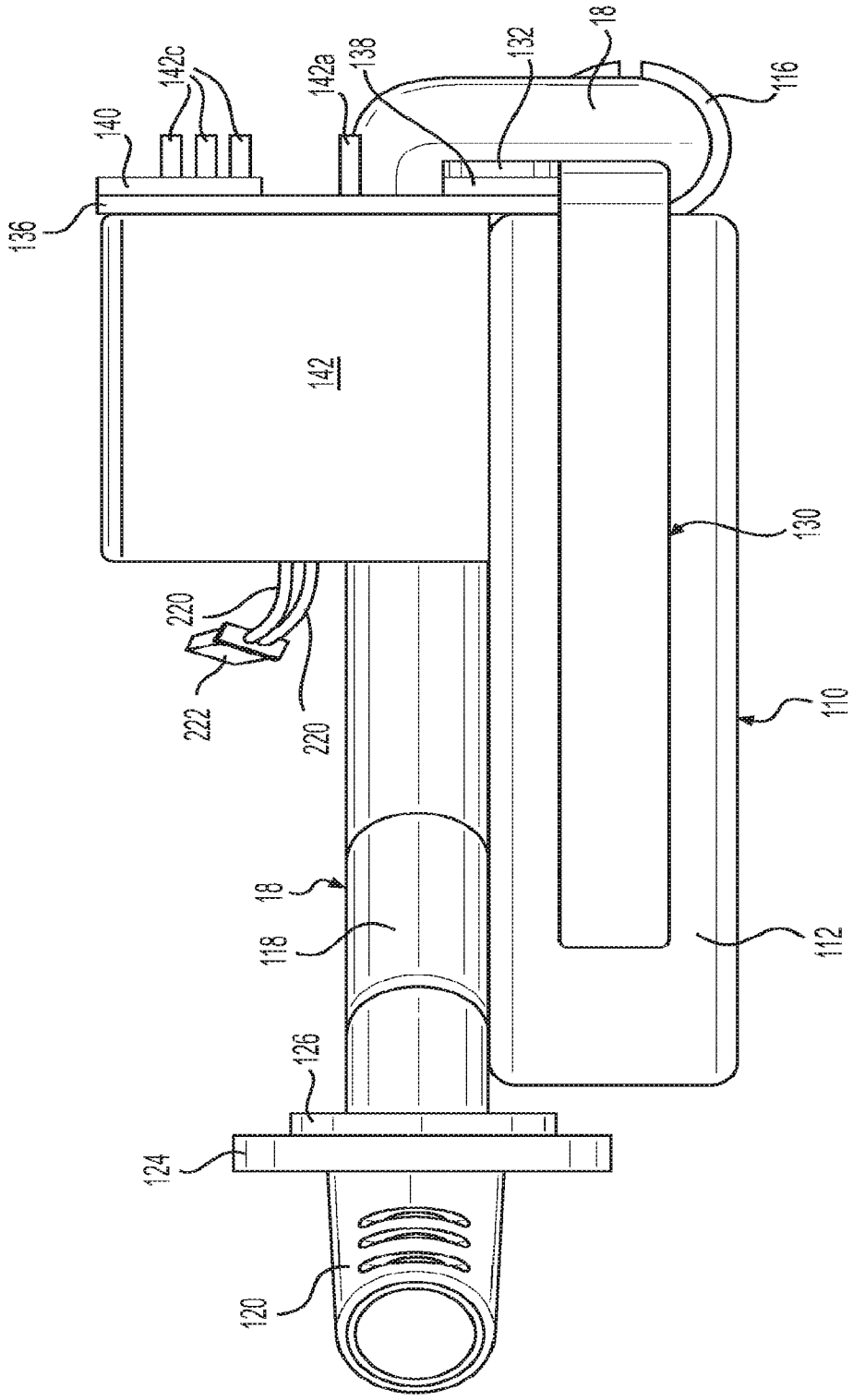


FIG. 8

WINPLUS Ex. 1003, p. 992

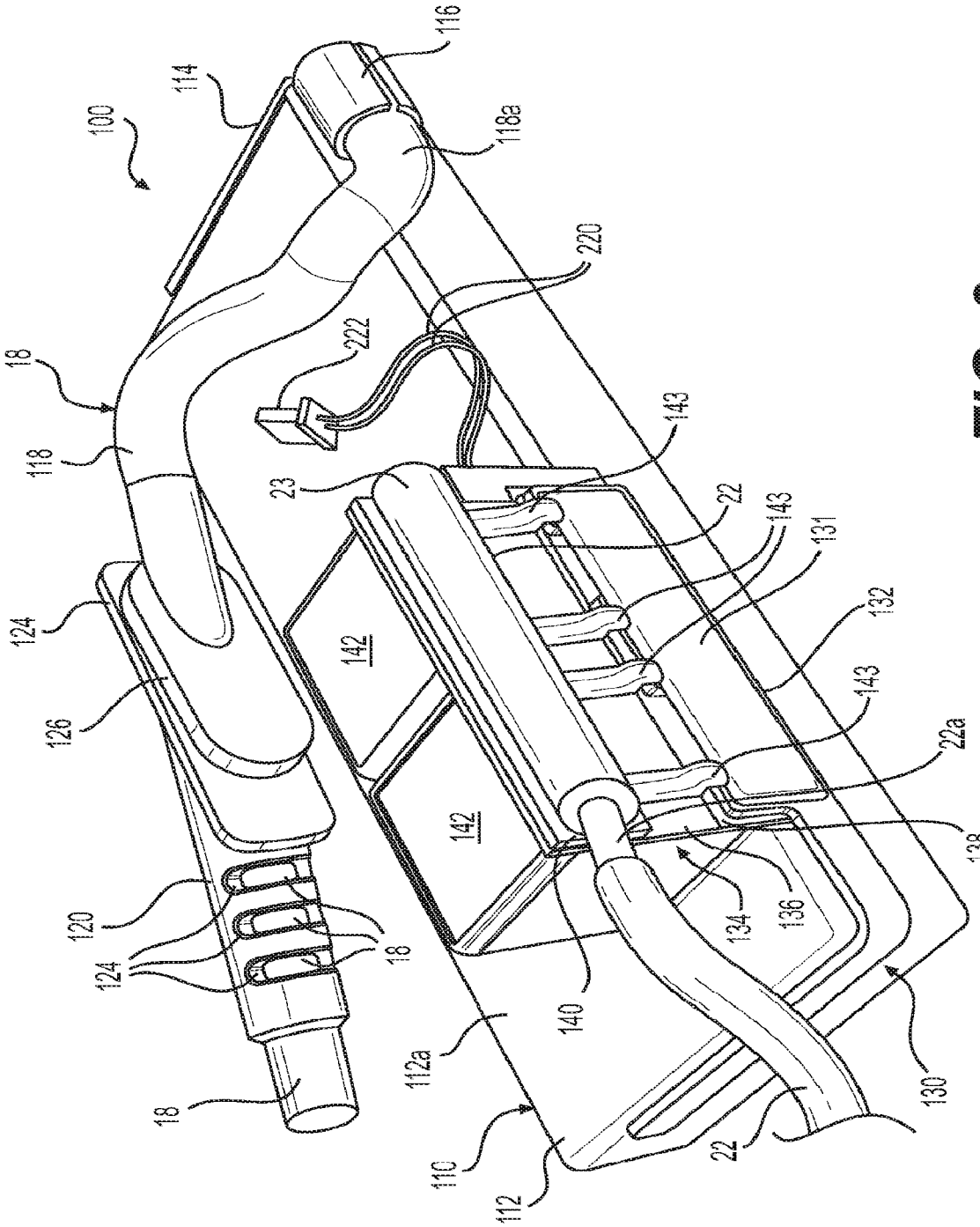


FIG. 9

WINPLUS Ex. 1003, p. 993

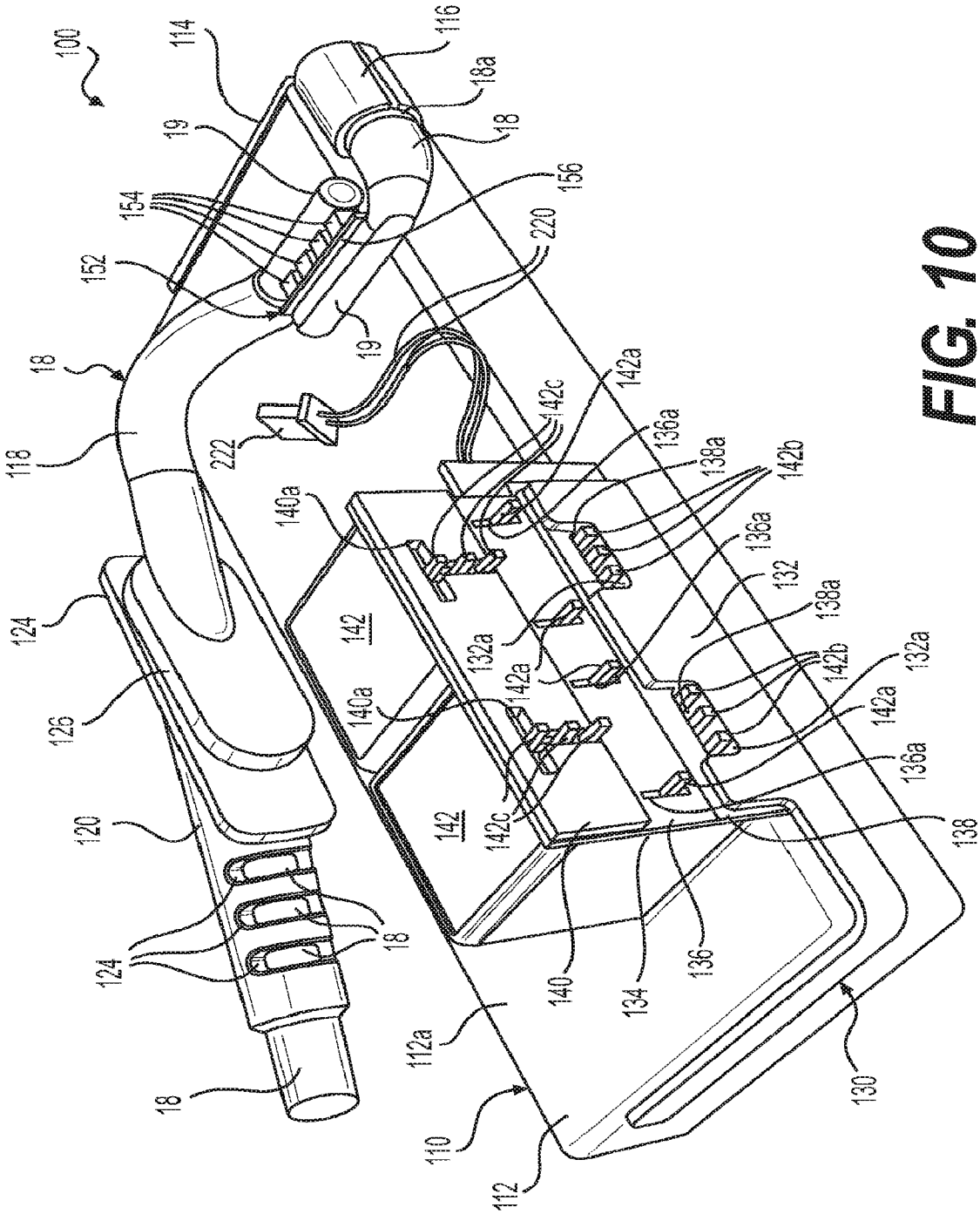


FIG. 10

WINPLUS Ex. 1003, p. 994

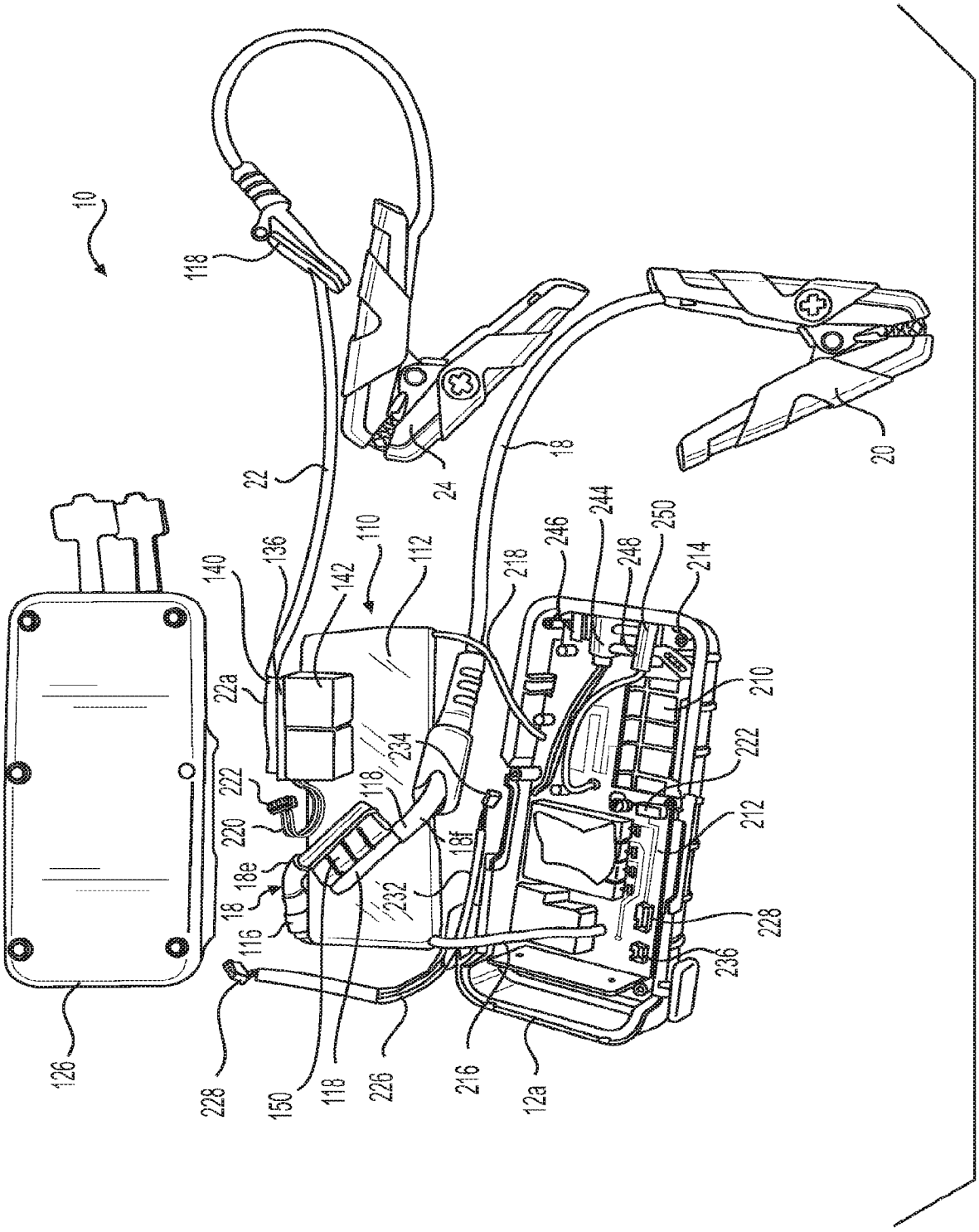

10
118
22
24
18
20
140
136
142
110
112
218
246
244
248
250
214
210
222
212
228
236
22a
234
118
18f
232
220
18e
18
116
126
228
150
118
226
216
12a

FIG. 11

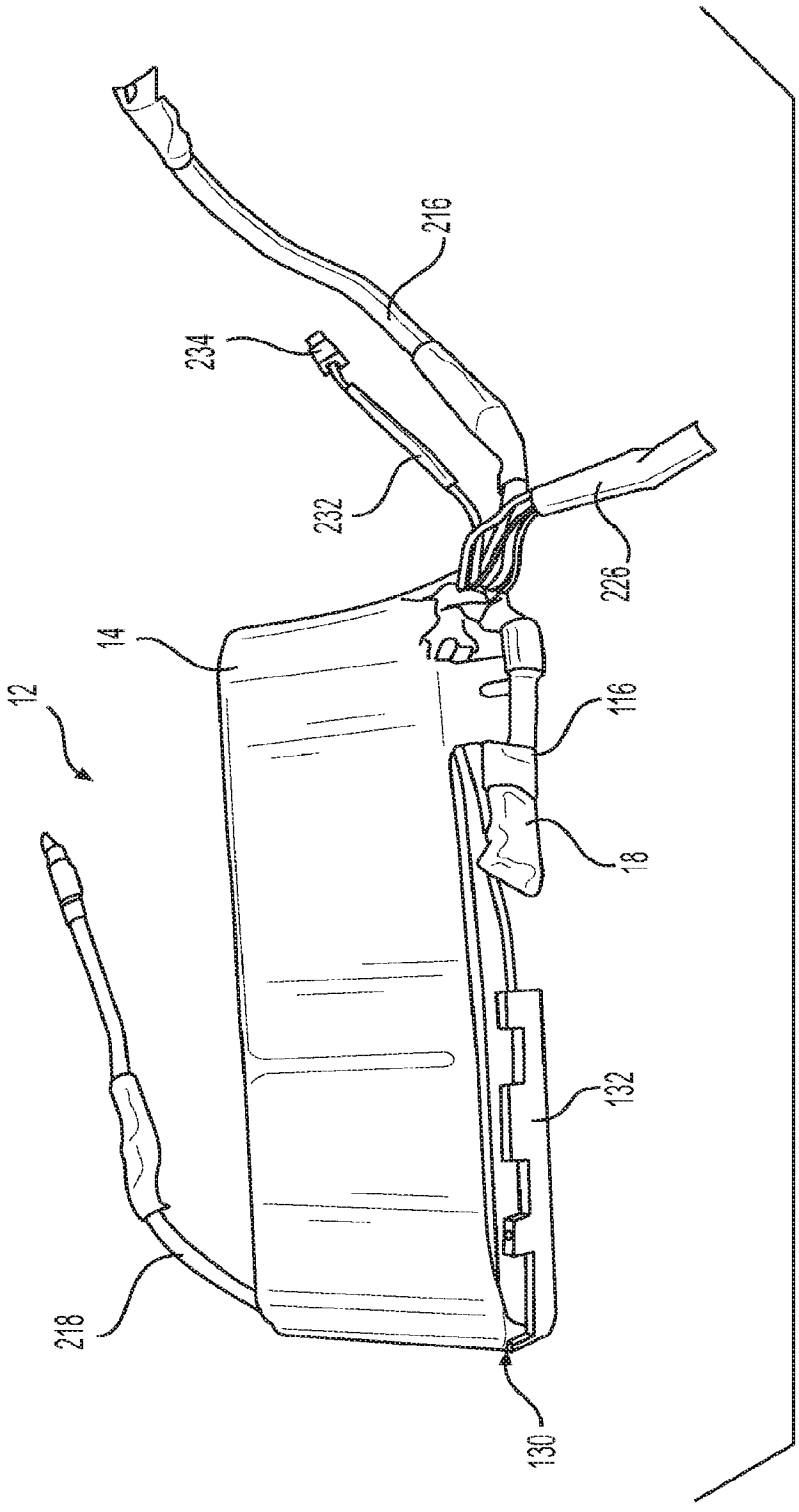


FIG. 12

WINPLUS Ex. 1003, p. 996

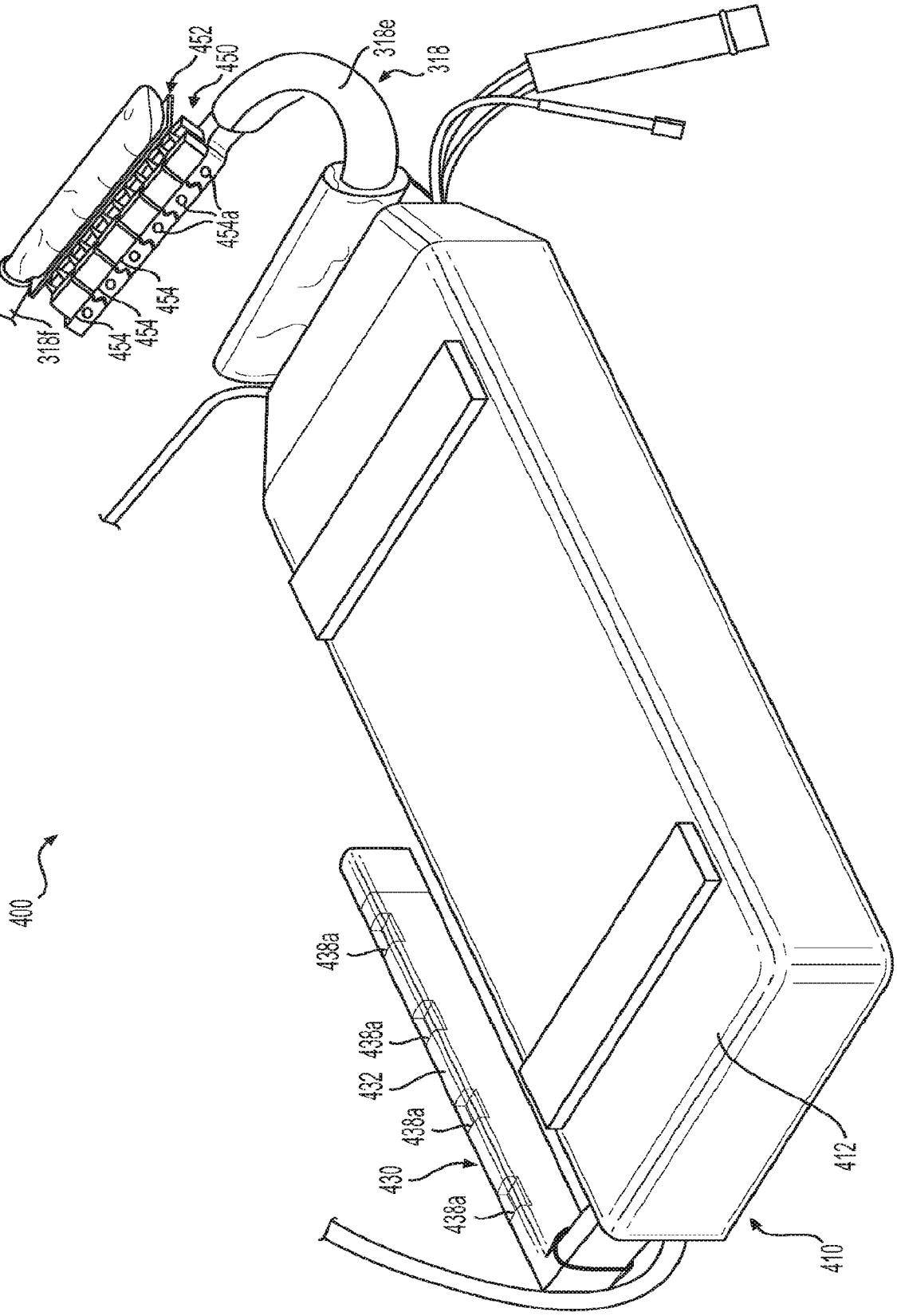

452
450
318e
318
318
454a
454
454
454
318f
400
438a
438a
432
438a
430
438a
412
410

FIG. 13

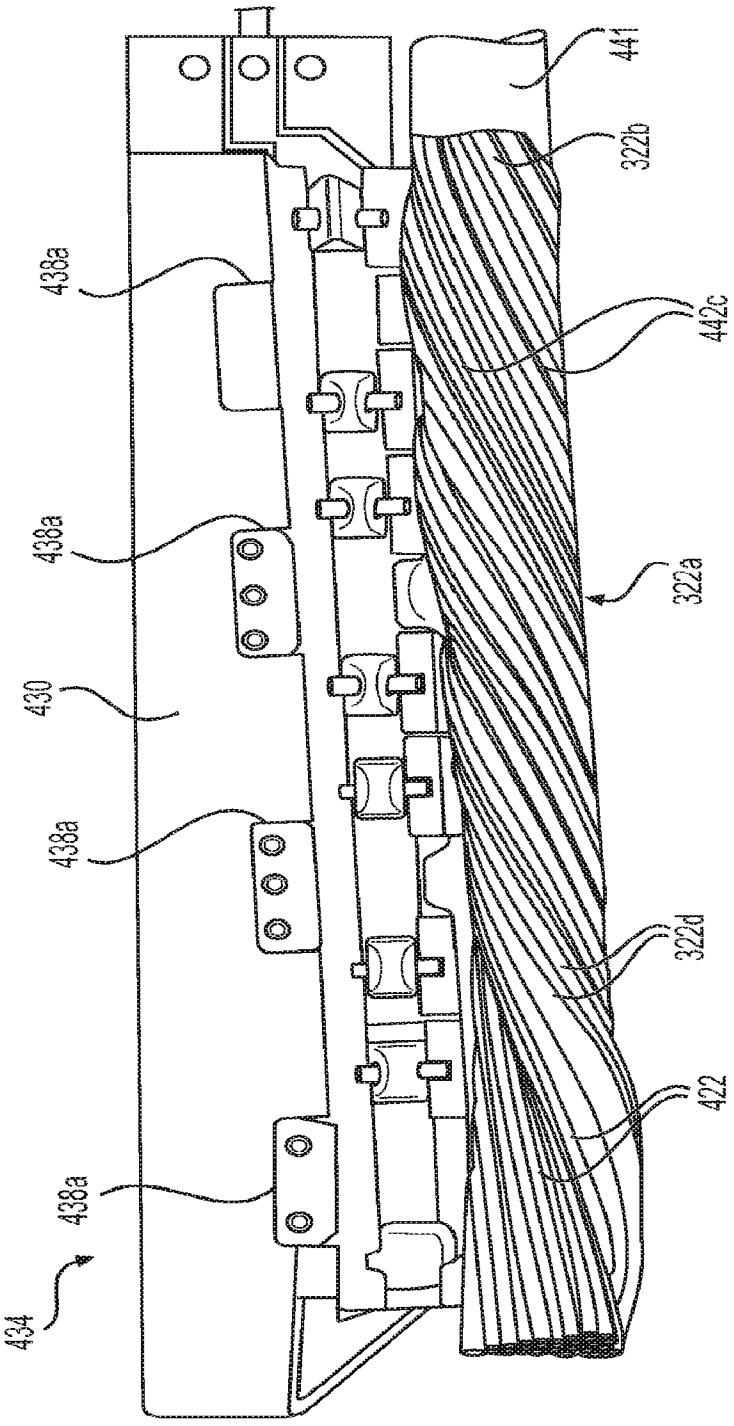


FIG. 14

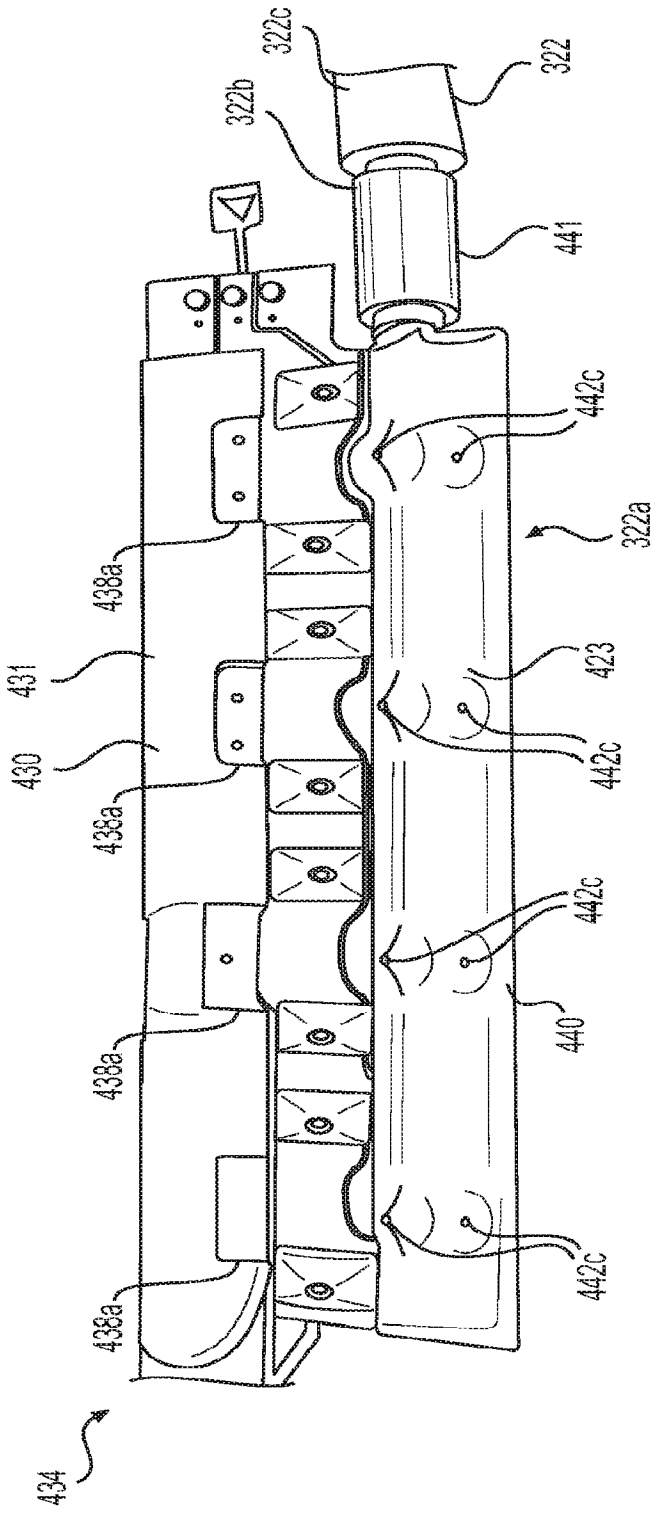


FIG. 15

WINPLUS Ex. 1003, p. 999

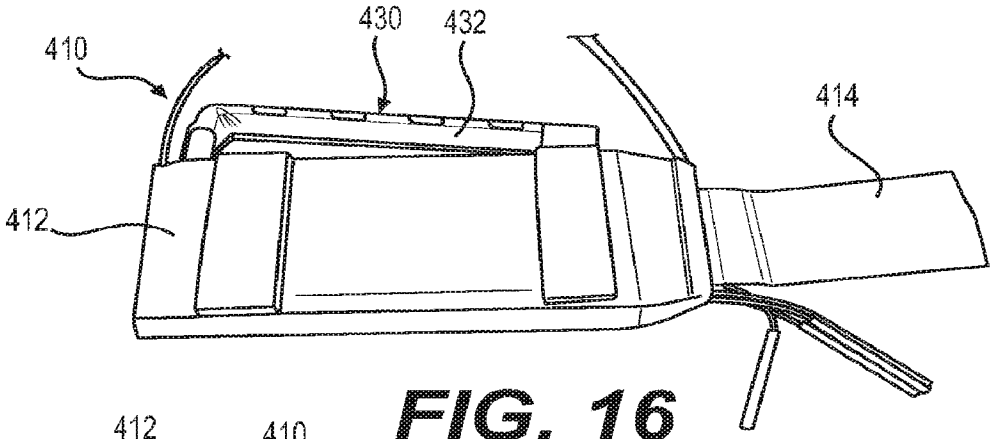


FIG. 16

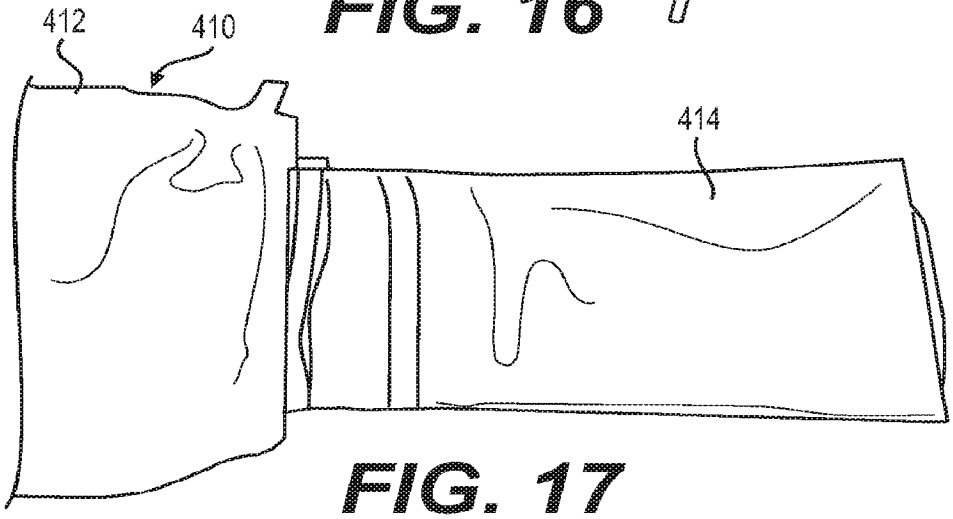


FIG. 17

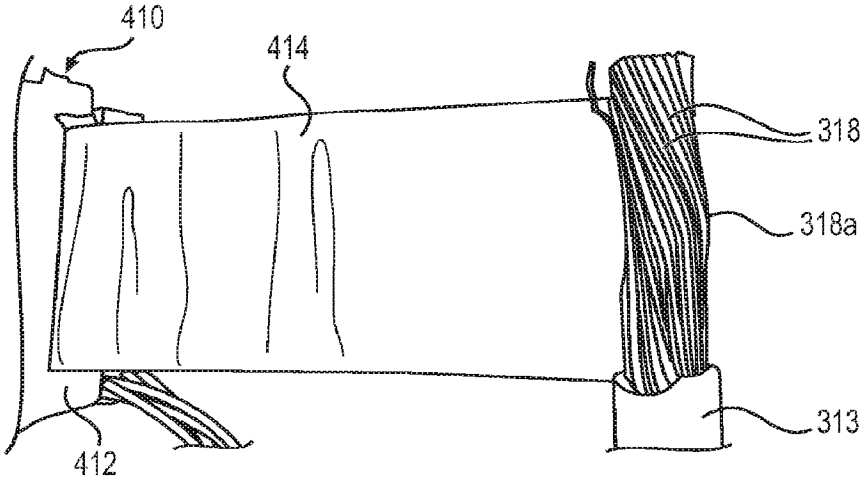


FIG. 18

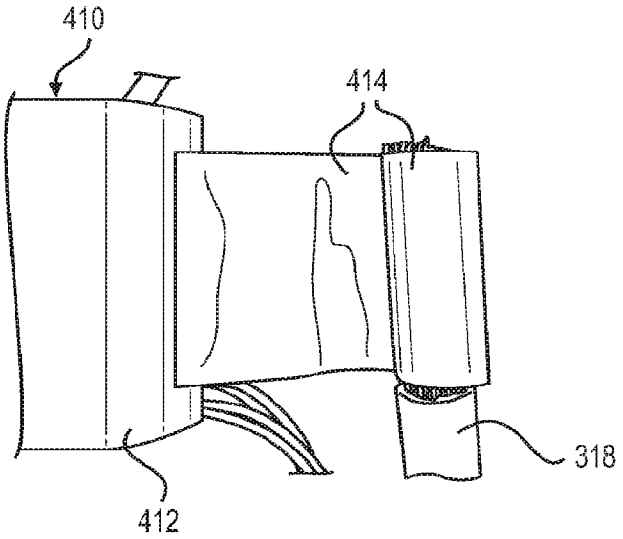


FIG. 19

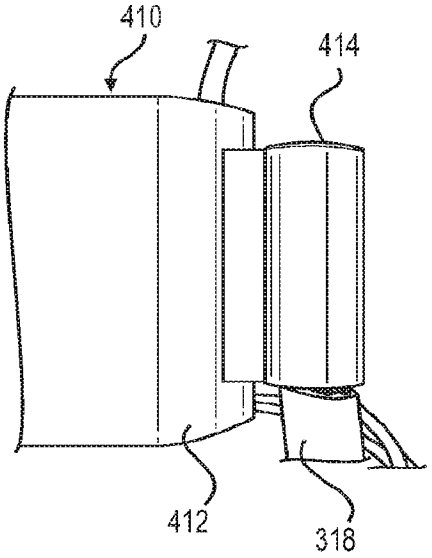


FIG. 20

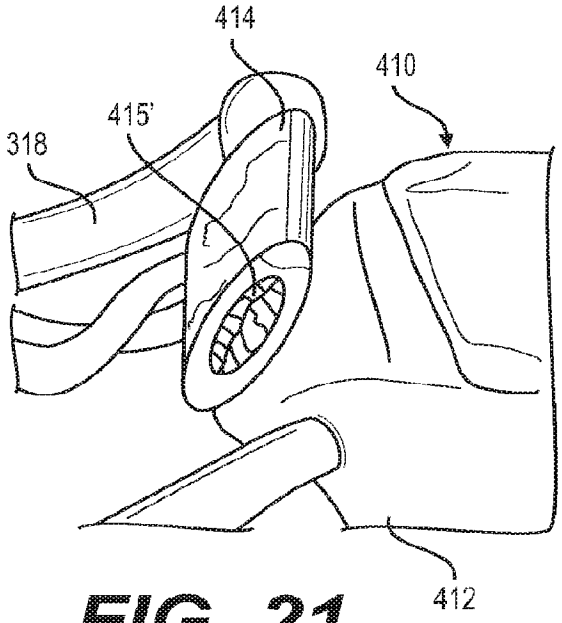


FIG. 21

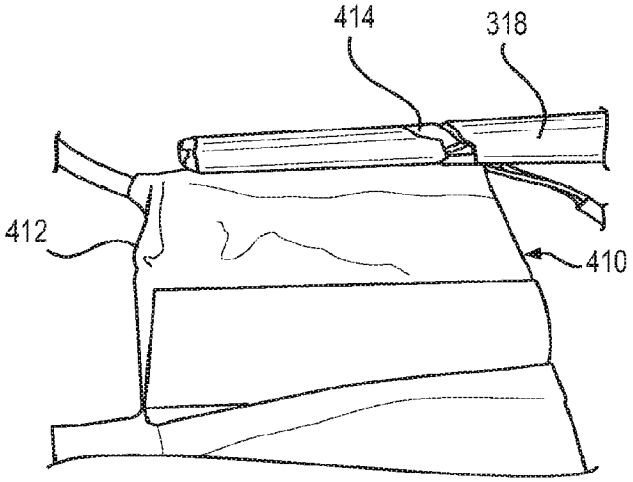


FIG. 22

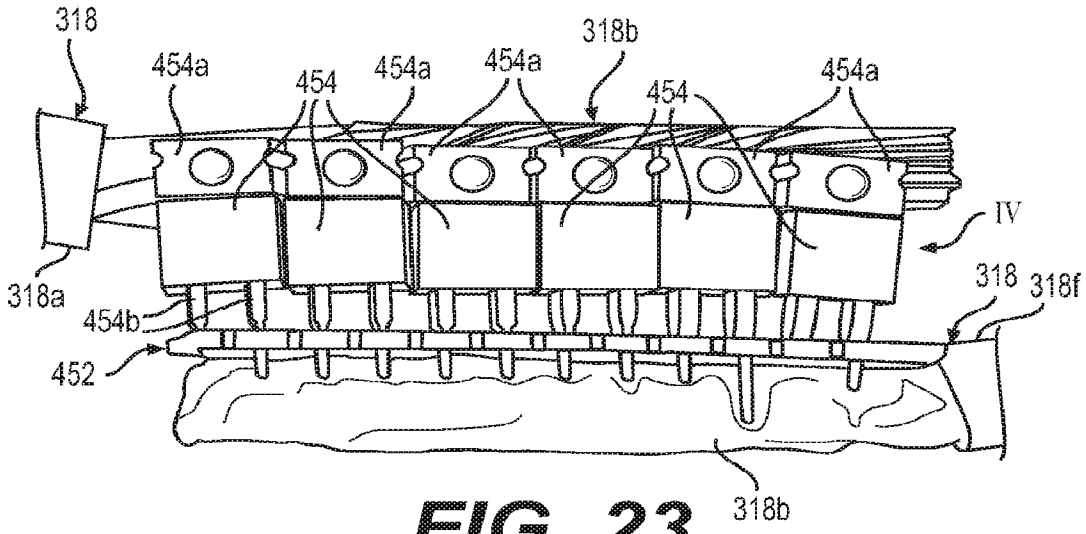


FIG. 23

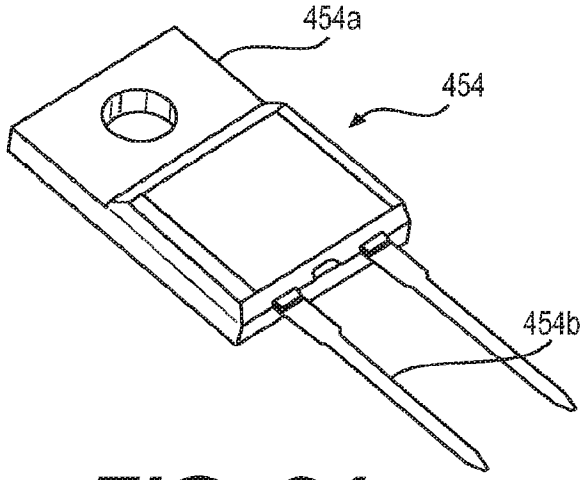


FIG. 24

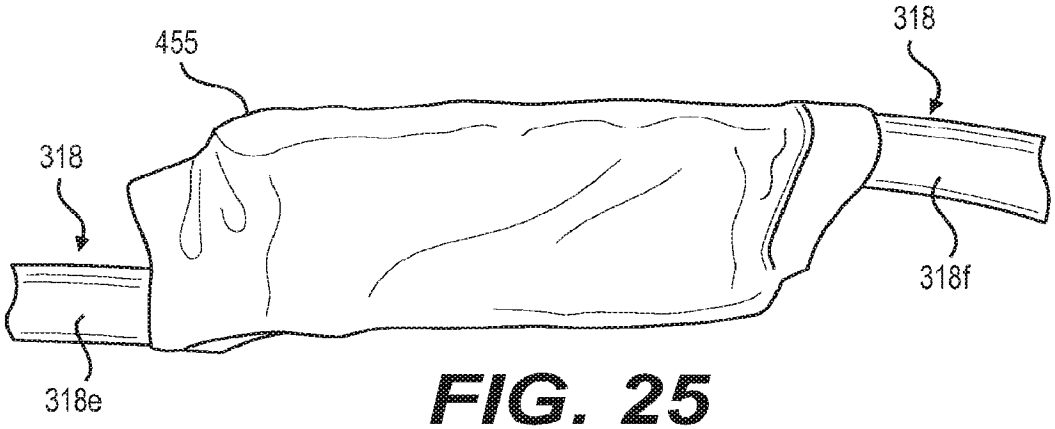


FIG. 25

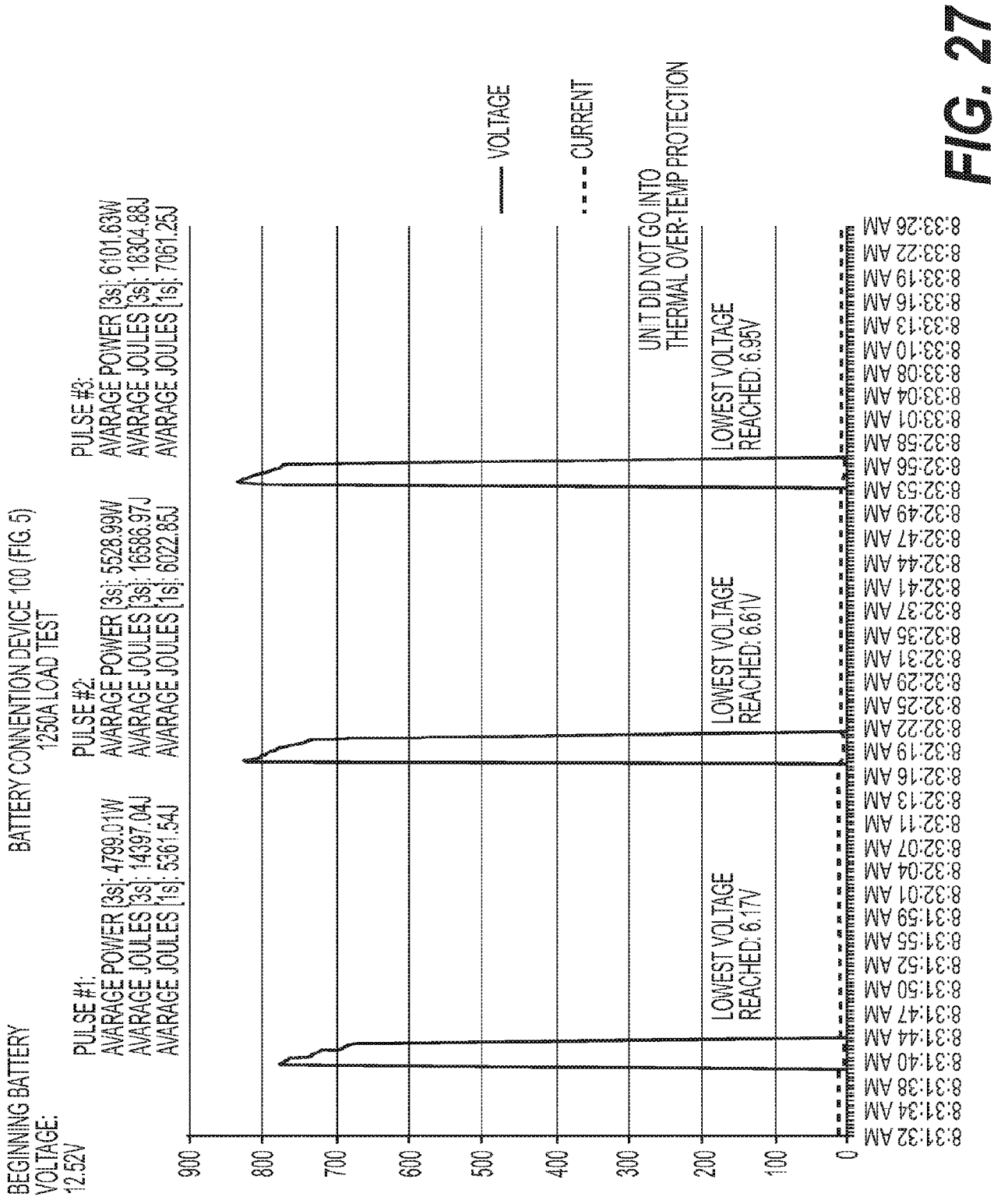


FIG. 27

WINPLUS Ex. 1003, p. 1003

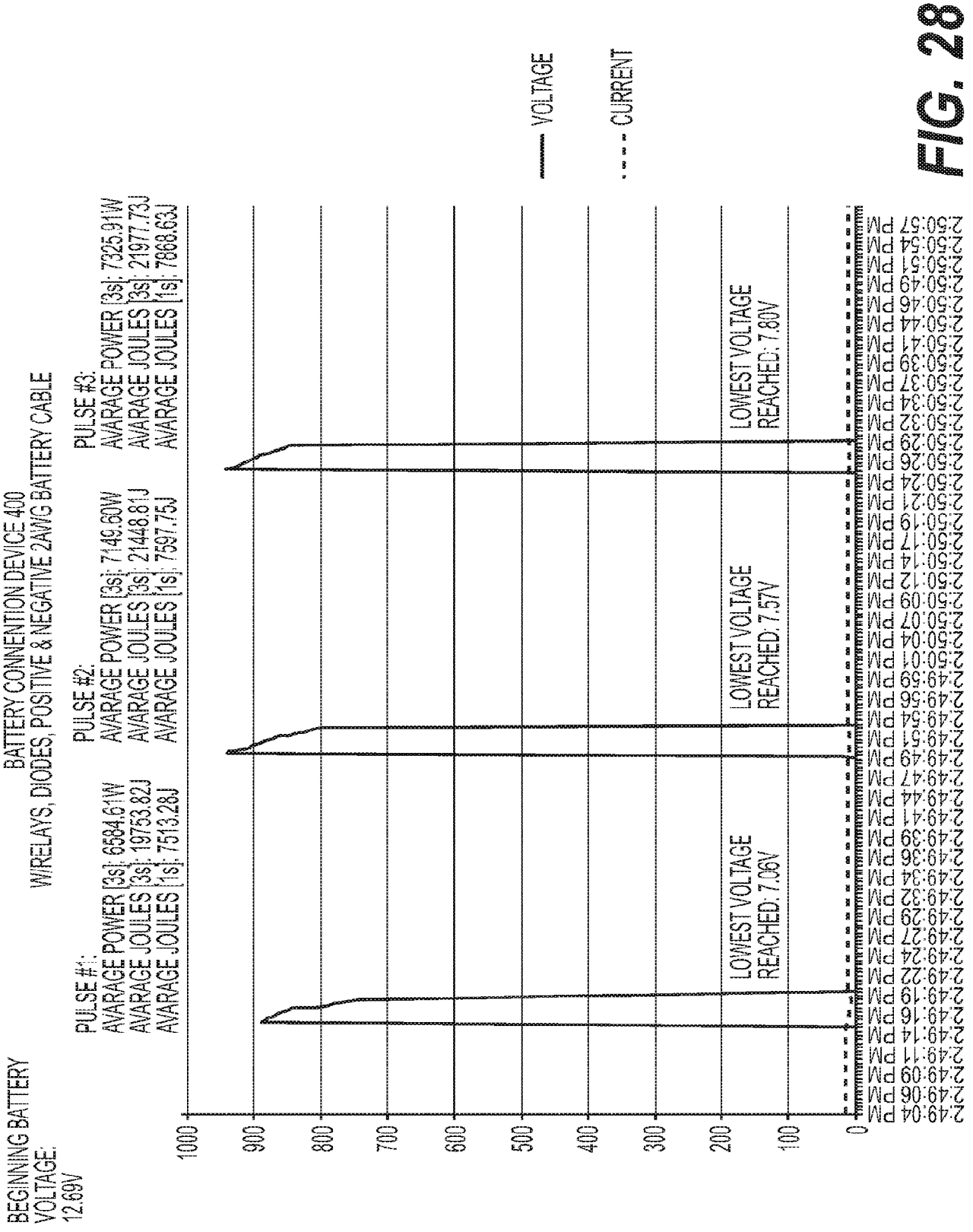

BEGINNING BATTERY VOLTAGE: 12.69V
BATTERY CONNENTION DEVICE 400
W/RELAYS, DIODES, POSITIVE & NEGATIVE 2AWG BATTERY CABLE
PULSE #1:
AVARAGE POWER [3s]: 6584.61W
AVARAGE JOULES [3s]: 19753.82J
AVARAGE JOULES [1s]: 7513.28J
PULSE #2:
AVARAGE POWER [3s]: 7149.60W
AVARAGE JOULES [3s]: 21448.81J
AVARAGE JOULES [1s]: 7597.75J
PULSE #3:
AVARAGE POWER [3s]: 7325.91W
AVARAGE JOULES [3s]: 21977.73J
AVARAGE JOULES [1s]: 7868.63J
VOLTAGE
CURRENT
LOWEST VOLTAGE REACHED: 7.06V
LOWEST VOLTAGE REACHED: 7.57V
LOWEST VOLTAGE REACHED: 7.80V
1000
900
800
700
600
500
400
300
200
100
0

FIG. 28

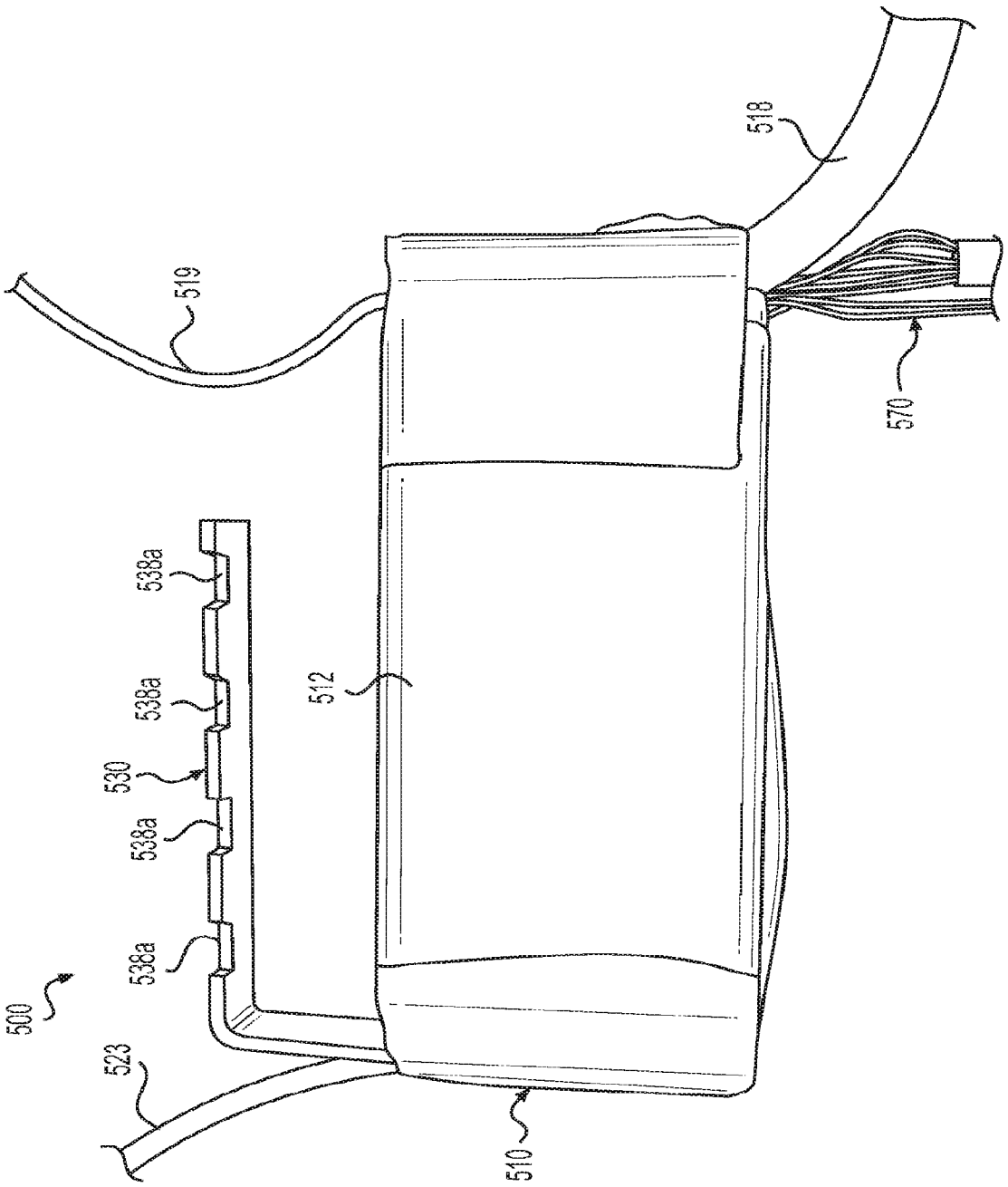


FIG. 29

WINPLUS Ex. 1003, p. 1005

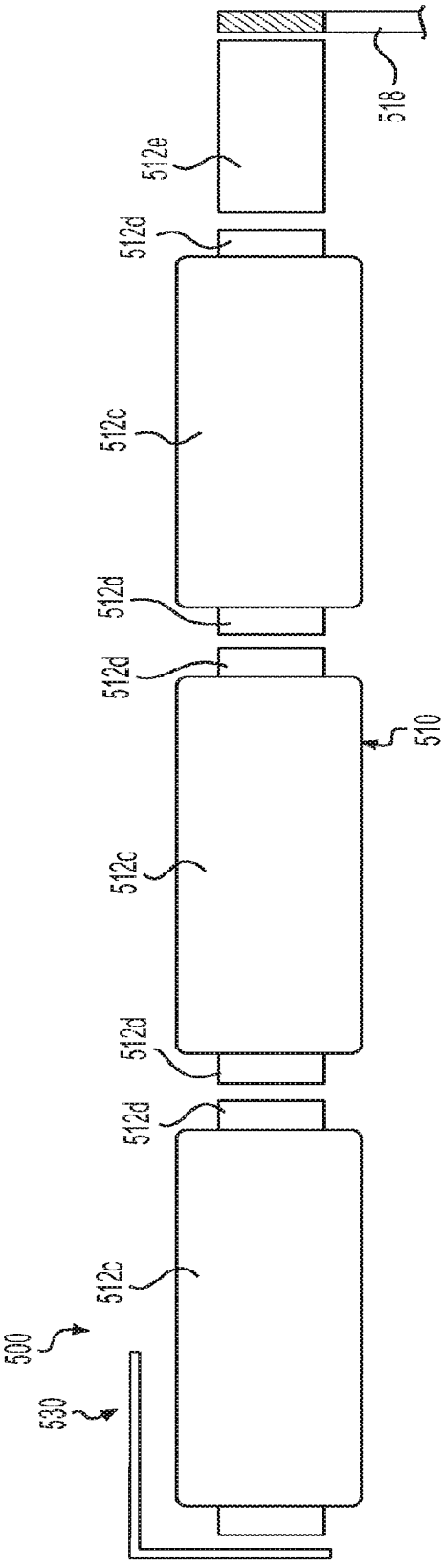

518
512e
512d
512c
512d
512d
510
512c
512d
512d
512c
500
530

FIG. 30

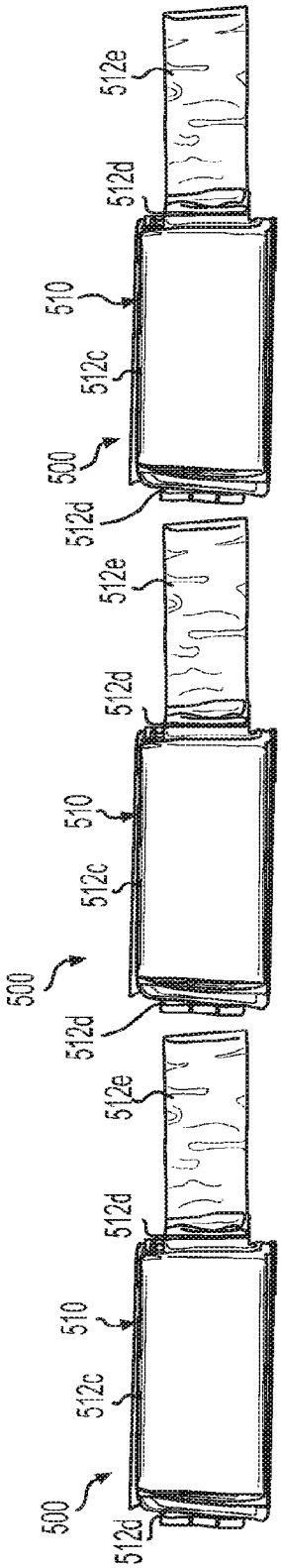

512e
512d
510
512c
500
512d
512e
512d
510
512c
500
512d
512e
512d
510
512c
500
512d

FIG. 31

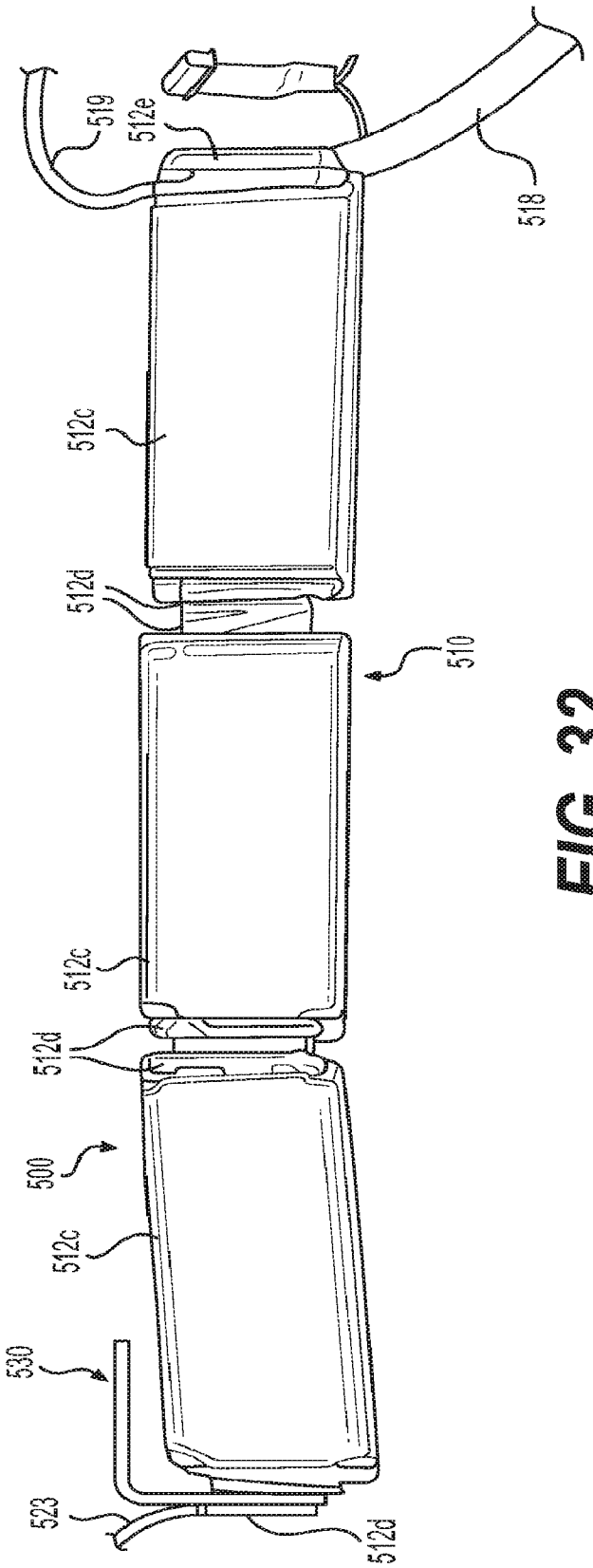


FIG. 32

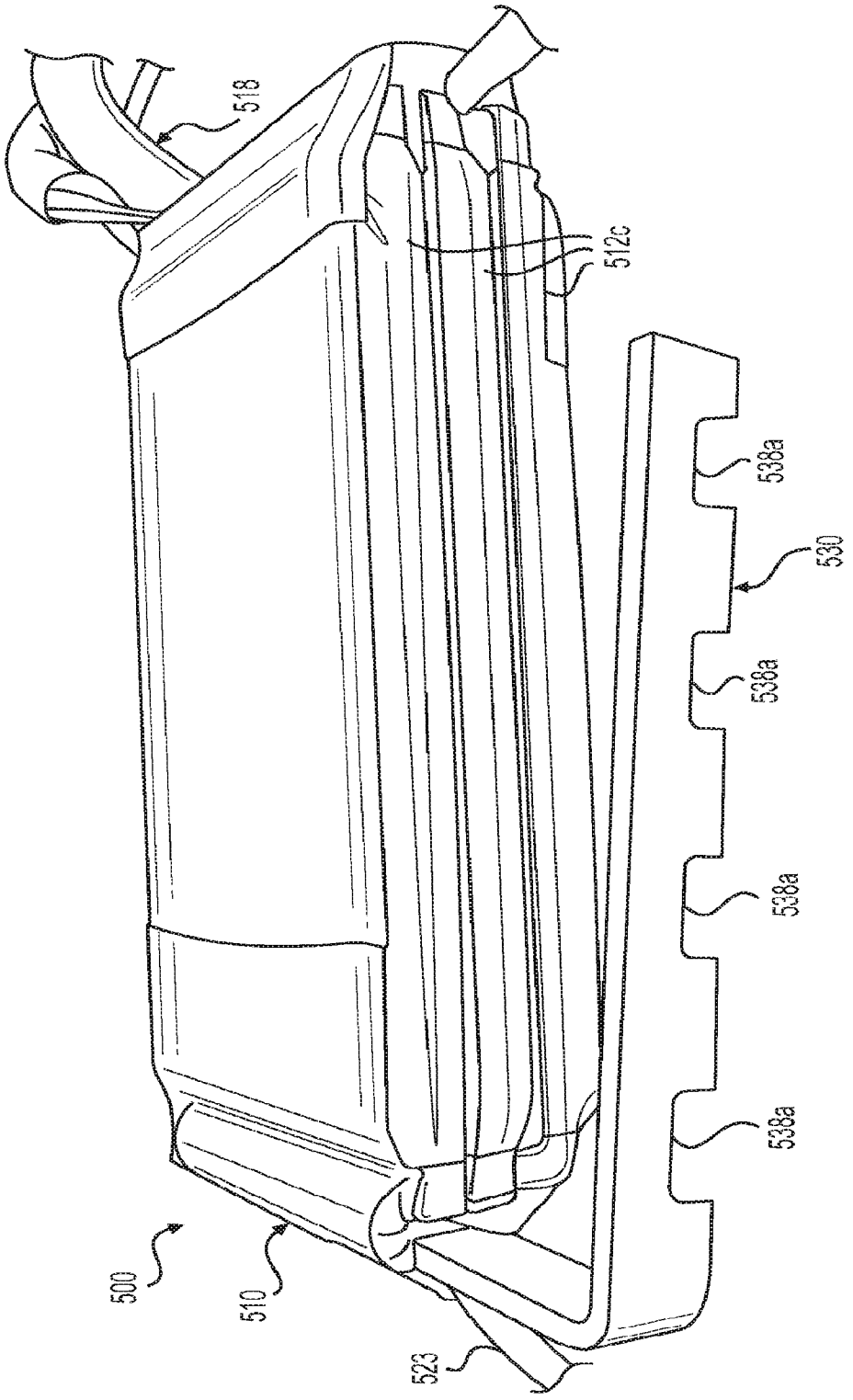


FIG. 33

WINPLUS Ex. 1003, p. 1008

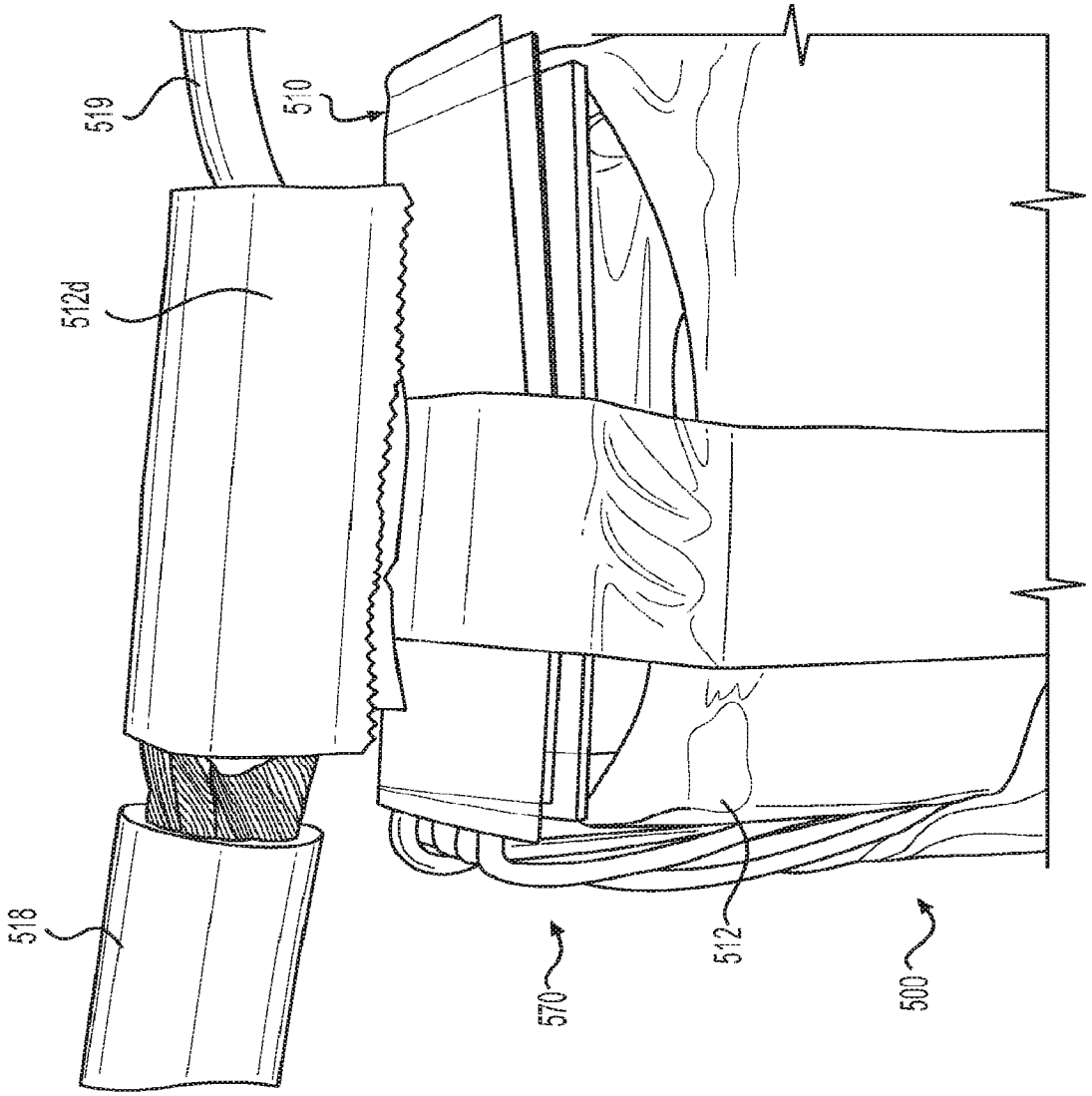


FIG. 34

WINPLUS Ex. 1003, p. 1009

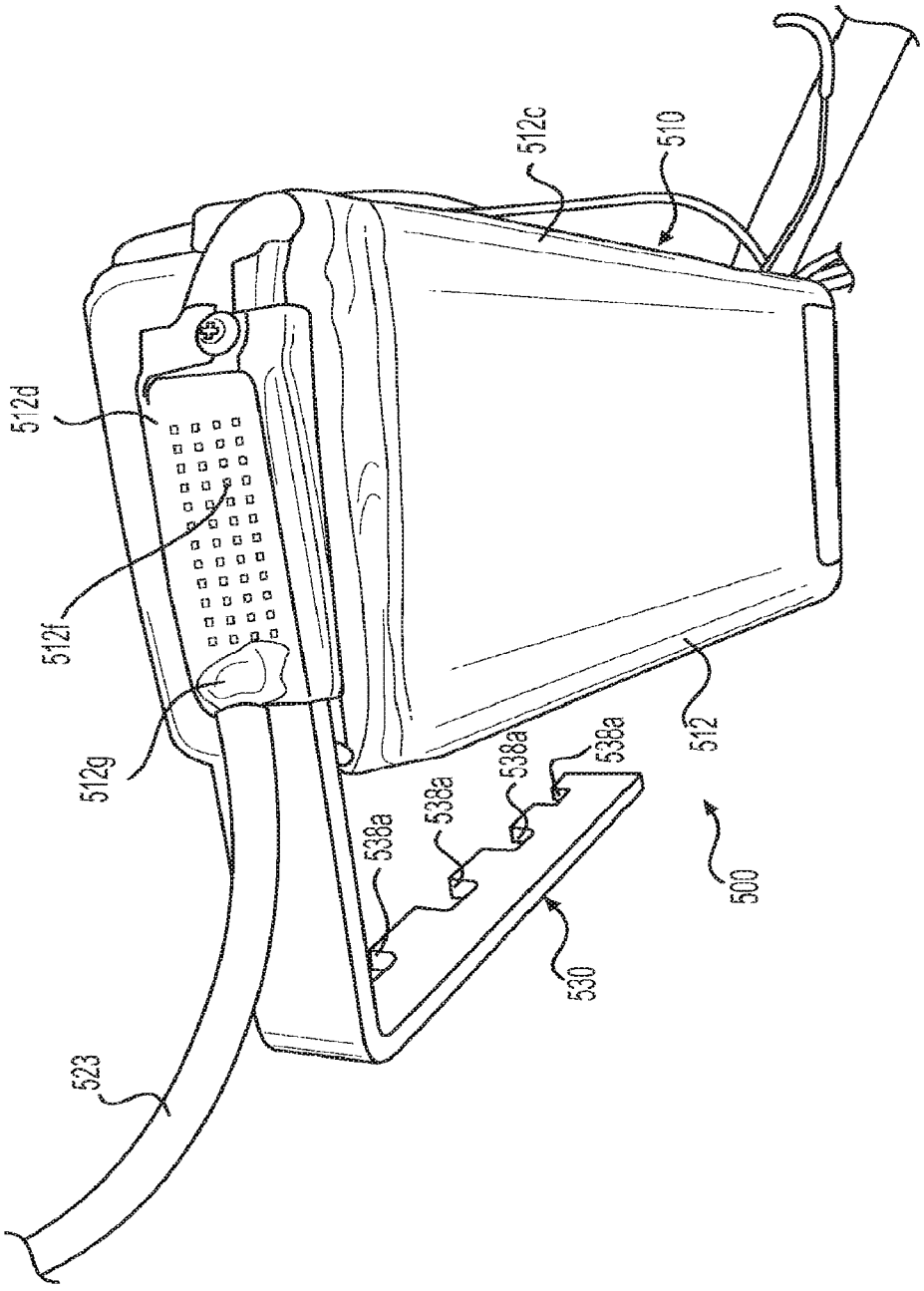


FIG. 35

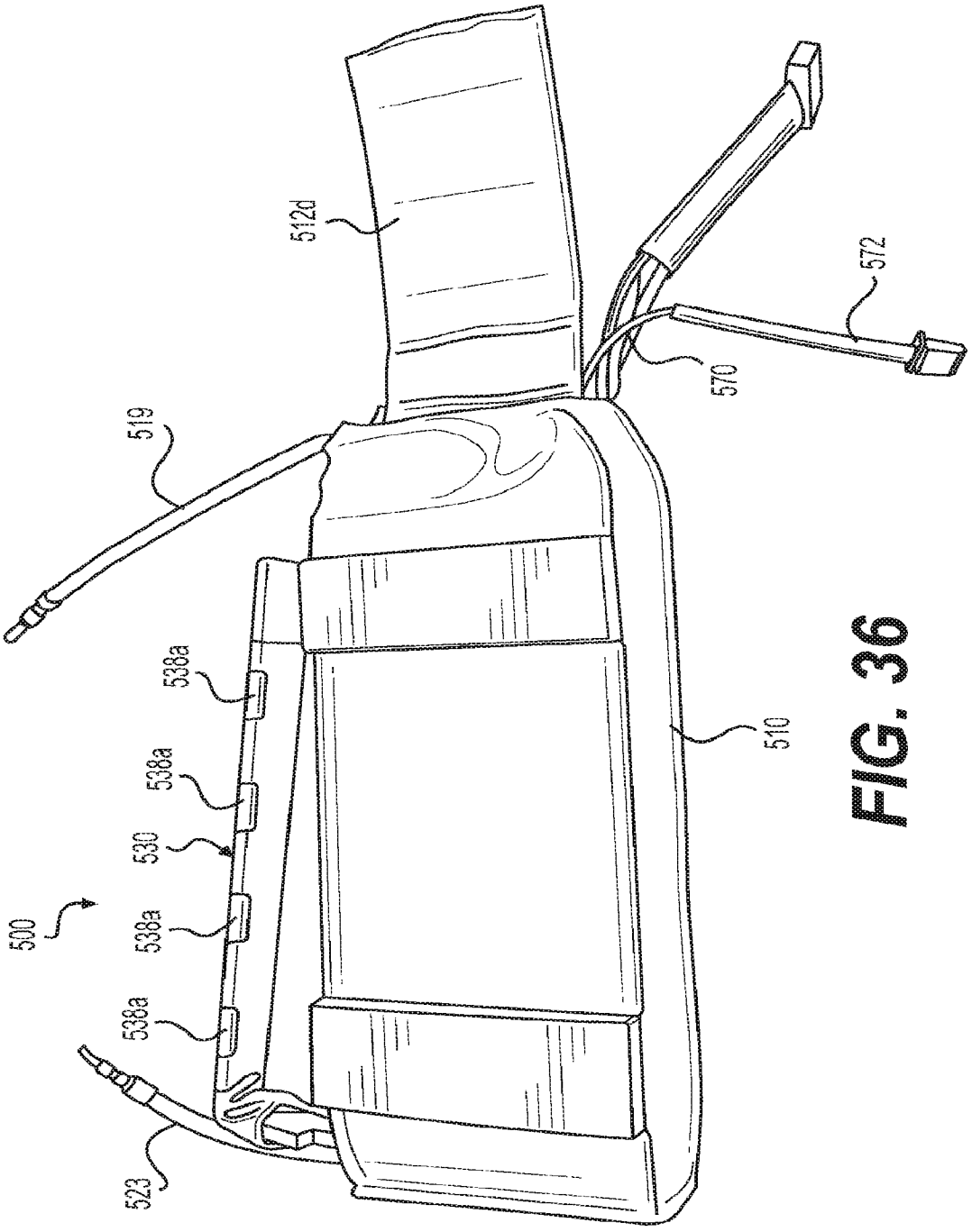


FIG. 36

WINPLUS Ex. 1003, p. 1011

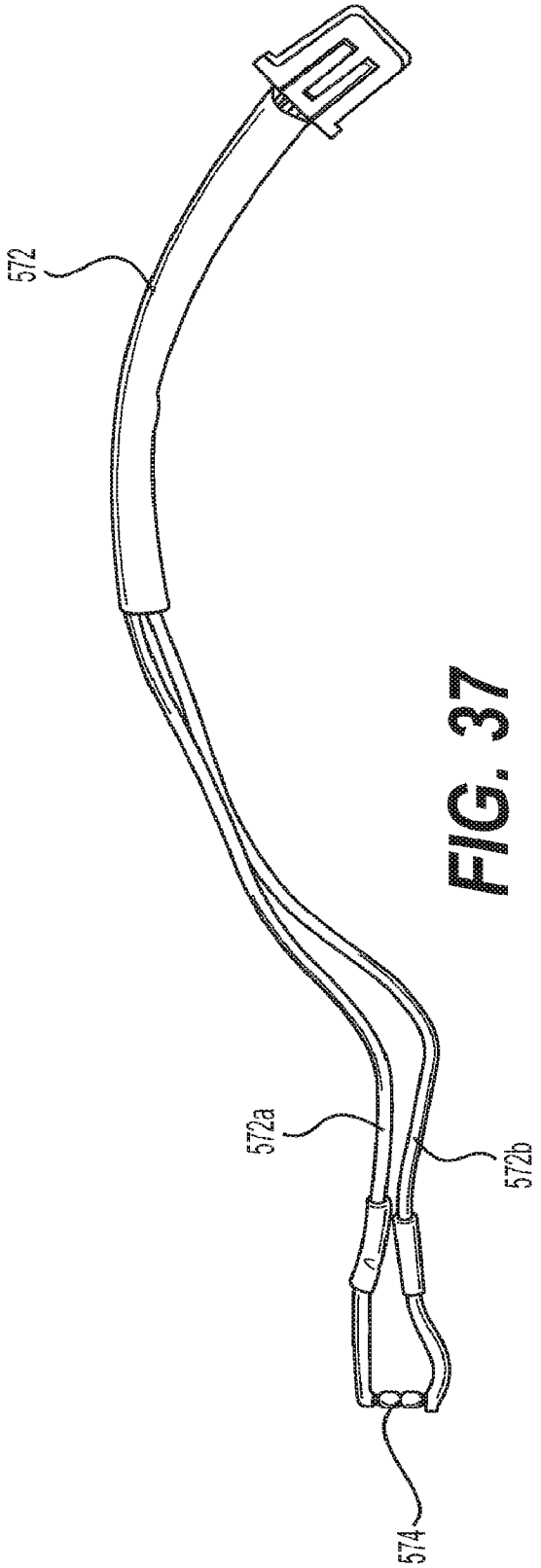


FIG. 37

WINPLUS Ex. 1003, p. 1012

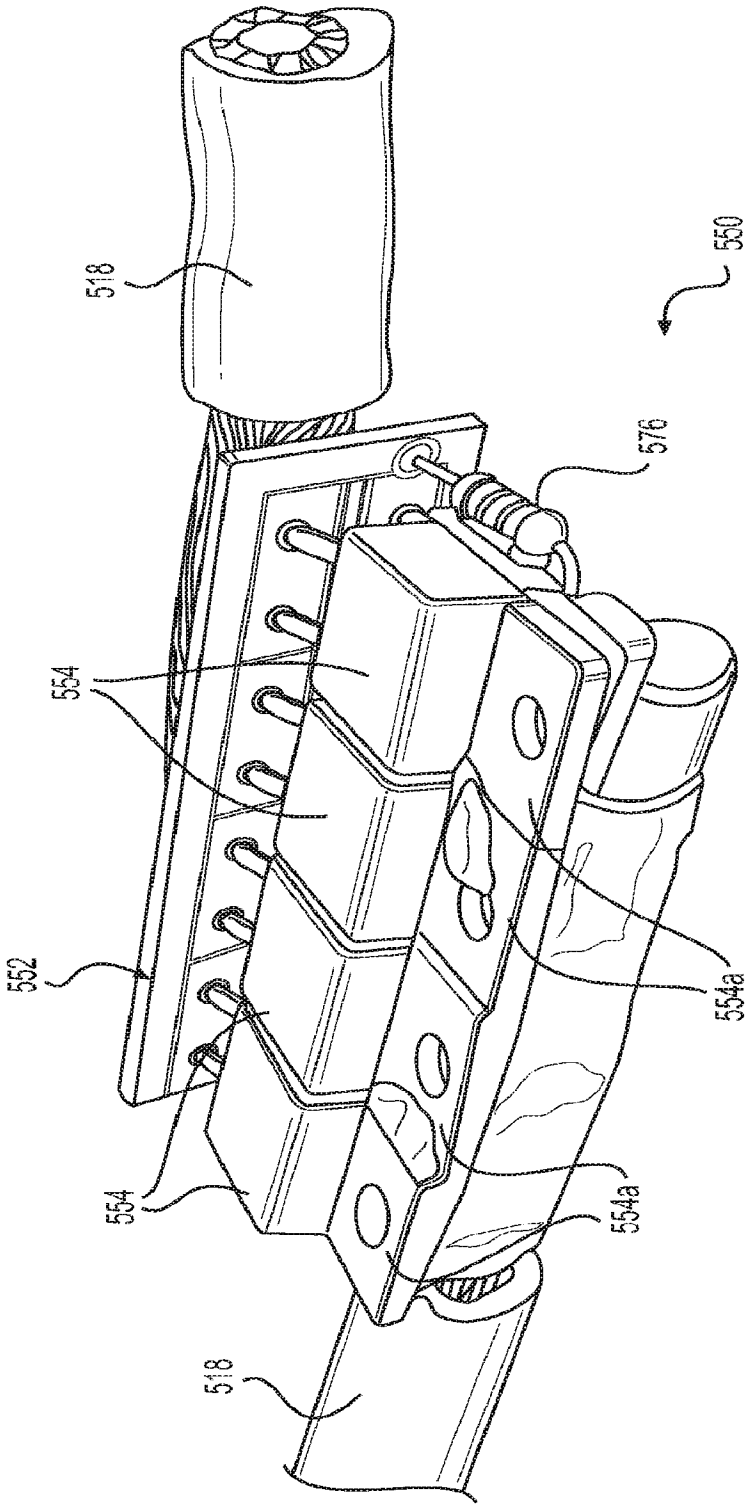


FIG. 38

WINPLUS Ex. 1003, p. 1013

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 18 1486

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2011/140651 A1 (DAI ALEX [TW]) 16 June 2011 (2011-06-16) * paragraphs [0024] - [0025]; figures *	1-14	INV. H01M2/30 F02N11/12
X	WO 2012/074548 A1 (KOEBLER MARTIN [US]) 7 June 2012 (2012-06-07)	1-14	ADD. F02N11/08
Y	* page 10, line 22 - line 27; figures 1-3,13 * * page 12, line 14 - line 31; figures 7-8 *	1-14	H02J1/00 H01H59/00 F02N11/14
X	US 4 972 135 A (BATES BOBBY L [US] ET AL) 20 November 1990 (1990-11-20) * column 4, line 32 - line 37; figures 1,2,6,7 *	1-14	
Y,D	US 9 007 015 B1 (NOOK JONATHAN LEWIS [US] ET AL) 14 April 2015 (2015-04-14) * column 7, line 54 - column 8, line 8 *	1-14	
Y	US 2004/130298 A1 (KRIEGER MICHAEL [US] ET AL) 8 July 2004 (2004-07-08) * paragraph [0029]; figures *	1-14	TECHNICAL FIELDS SEARCHED (IPC) H01M F02N H02J H01R
Y	US 2010/244766 A1 (OLSBERG ALAN [US]) 30 September 2010 (2010-09-30) * paragraphs [0023] - [0024], [0030]; figures 1,3 *	1-14	
Y	US 2006/244412 A1 (BONZER ROBERT [US] ET AL) 2 November 2006 (2006-11-02) * paragraph [0027]; figures 2,3 *	1-14	
Y	US 2004/150373 A1 (CHAN SING [US]) 5 August 2004 (2004-08-05) * figures *	1-14	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 October 2018	Ulivieri, Enrico

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 18 1486

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
T	The Noco Company: "NOCO Genius Boost GB40 Jump Starter", , 1 August 2016 (2016-08-01), pages 1-2, XP055517270, Glenwillow, USA Retrieved from the Internet: URL:https://images-eu.ssl-images-amazon.com/images/I/A1q9gUpcSfL.pdf [retrieved on 2018-10-19] * the whole document *	1-14	
T	The Noco Company: "NOCO Genius Boost HD GB70 Jump Starter", , 1 August 2016 (2016-08-01), pages 1-2, XP055517268, Glenwillow,USA Retrieved from the Internet: URL:https://www.batterystuff.com/files/934-genius-boost-car-battery-jump-starter-sell-sheet-gb70.pdf [retrieved on 2018-10-19]	1-14	TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 October 2018	Ulivieri, Enrico

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 18 1486

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-10-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011140651 A1	16-06-2011	NONE	
WO 2012074548 A1	07-06-2012	CN 103477528 A	25-12-2013
		CN 105244549 A	13-01-2016
		CN 105244961 A	13-01-2016
		CN 105390757 A	09-03-2016
		CN 105391115 A	09-03-2016
		CN 107946536 A	20-04-2018
		EP 2647102 A1	09-10-2013
		US 2013241498 A1	19-09-2013
		WO 2012074548 A1	07-06-2012
US 4972135 A	20-11-1990	NONE	
US 9007015 B1	14-04-2015	US 9007015 B1	14-04-2015
		US 2016001666 A1	07-01-2016
		US 2018111491 A1	26-04-2018
		US 2018215274 A1	02-08-2018
US 2004130298 A1	08-07-2004	US 2004130298 A1	08-07-2004
		US 2008203967 A1	28-08-2008
US 2010244766 A1	30-09-2010	CA 2790505 A1	01-09-2011
		US 2010244766 A1	30-09-2010
		WO 2011106343 A1	01-09-2011
US 2006244412 A1	02-11-2006	NONE	
US 2004150373 A1	05-08-2004	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 9007015 B, Nook **[0002] [0021]**

WINPLUS Ex. 1003, p. 1017

Espacenet

Bibliographic data: EP3308446 (A1) — 2018-04-18

BATTERY ASSEMBLY DEVICE

Inventor(s): NOOK JONATHAN LEWIS [US]; NOOK WILLIAM KNIGHT [US]; STANFIELD JAMES RICHARD [US]; UNDERHILL DEREK MICHAEL [US] ± (NOOK, Jonathan, Lewis, ; NOOK, William, Knight, ; STANFIELD, James, Richard, ; UNDERHILL, Derek, Michael)

Applicant(s): NOCO CO [US] ± (The Noco Company)

Classification: **- international:** ***H02J7/00; H02J7/14***
- cooperative: **H01M2/30 (US)**; **H01R11/24 (US)**; **H02J1/122 (EP)**; **H02J7/14 (EP, GB, US)**; **H02J7/342 (GB)**; F02N11/12 (EP); F02N11/14 (EP); H02J1/122 (US)

Application number: EP20160831887 20160329 Global Dossier

Priority number(s): US201662294067P 20160211 ; WO2016US24680 20160329

Also published as: EP3308446 (A4) AU2016392707 (A1) AU2016392707 (B2) AU2020200268 (A1) CA2957431 (A1) more

Abstract not available for EP3308446 (A1)
Abstract of corresponding document: WO2017138963 (A1)

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

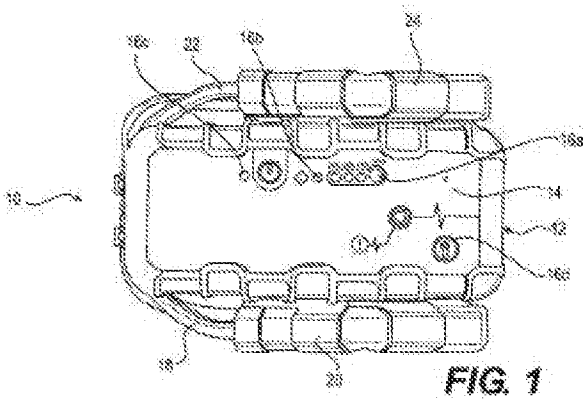


FIG. 1

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Veröffentlichungsnummer:
(11) Publication number: **EP 3 308 446 A0**
(11) Numéro de publication:

Internationale Anmeldung veröffentlicht durch die Weltorganisation für geistiges Eigentum unter der Nummer:

WO 2017/138963 (Art. 153(3) EPÜ).

International application published by the World Intellectual Property Organization under number:

WO 2017/138963 (Art. 153(3) EPC).

Demande internationale publiée par l'Organisation Mondiale de la Propriété Intellectuelle sous le numéro:

WO 2017/138963 (art. 153(3) CBE).

Espacenet

Bibliographic data: EP2472698 (A2) — 2012-07-04

On-board power supply system and protection method

Inventor(s): GRAF ALFONS [DE] ± (GRAF, ALFONS, ; Graf, Alfons)

Applicant(s): INFINEON TECHNOLOGIES AG [DE] ± (INFINEON TECHNOLOGIES AG, ; Infineon Technologies AG)

Classification: - international: ***H02J7/00***
- cooperative: **B60R16/03 (EP, US); H02J7/0034 (EP, US)**

Application number: EP20110192468 20111207 Global Dossier

Priority number (s): US20100982613 20101230

Also published as: EP2472698 (A3) CN102545199 (A) CN102545199 (B) US2012169116 (A1) US9041244 (B2)

Abstract of EP2472698 (A2)

Disclosed is an on-board power supply system and a protection method for protecting an on-board power supply system. The system comprises: a first power supply terminal (1) and a second power supply terminal (2) configured to have a battery (11) and/or a generator (13) connected thereto; a first external terminal (31) coupled to the first power supply terminal (1) and a second external terminal (32) coupled to the second power supply terminal (2); and a protection unit (40) connected between the first external terminal (31) and the first power supply terminal (1), wherein the protection unit (40) comprises: a semiconductor switching unit (41) having a load path and a control terminal, the load path connected between the first external terminal (31) and the first power supply terminal (1); and a control circuit (42) coupled to the control terminal of the semiconductor switching unit (41) and configured to switch the semiconductor switching unit (41) on and off dependent on at least one electrical parameter in the on-board power supply system.

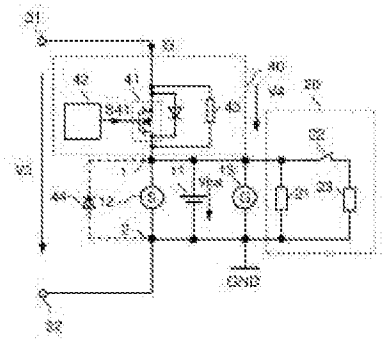


Fig 1

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 472 698 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.07.2012 Bulletin 2012/27

(51) Int Cl.:
H02J 7/00 *(2006.01)*

(21) Application number: **11192468.4**

(22) Date of filing: **07.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **30.12.2010 US 982613**

(71) Applicant: **Infineon Technologies AG**
85579 Neubiberg (DE)

(72) Inventor: **Graf, Alfons**
86916 Kaufering (DE)

(74) Representative: **Patentanwälte**
Westphal, Mussgnug & Partner
Herzog-Wilhelm-Strasse 26
80331 München (DE)

(54) On-board power supply system and protection method

(57) Disclosed is an on-board power supply system and a protection method for protecting an on-board power supply system. The system comprises:
a first power supply terminal (1) and a second power supply terminal (2) configured to have a battery (11) and/or a generator (13) connected thereto;
a first external terminal (31) coupled to the first power supply terminal (1) and a second external terminal (32) coupled to the second power supply terminal (2); and
a protection unit (40) connected between the first external terminal (31) and the first power supply terminal (1), wherein the protection unit (40) comprises:
a semiconductor switching unit (41) having a load path and a control terminal, the load path connected between the first external terminal (31) and the first power supply terminal (1); and
a control circuit (42) coupled to the control terminal of the semiconductor switching unit (41) and configured to switch the semiconductor switching unit (41) on and off dependent on at least one electrical parameter in the on-board power supply system.

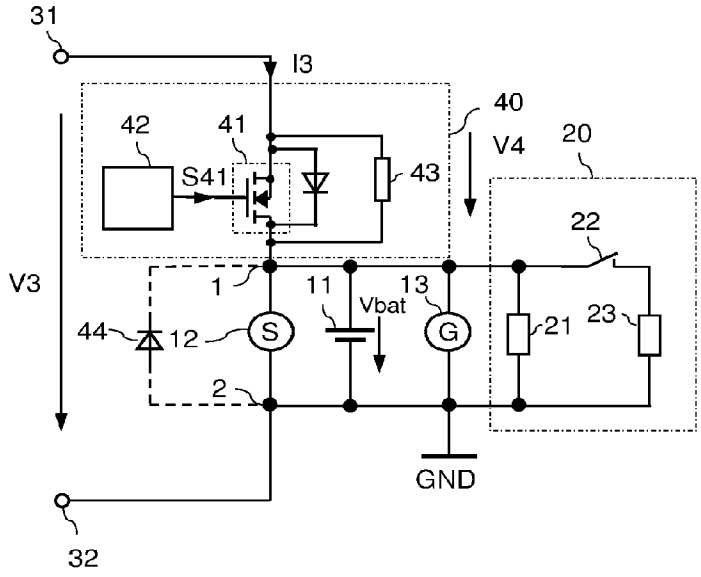


FIG 1

EP 2 472 698 A2

Description

[0001] Embodiments of the present invention relate to an on-board power supply system, and in particular to the reverse polarity protection of an on-board power supply system.

[0002] Automotive on-board power supply systems usually include a battery and a generator. A plurality of electrical loads may be coupled to the on-board power supply system. These loads can include a starter, electrical motors, and lights, as well as control and driver units for driving the individual loads. Most of the electrical loads connected to an on-board power supply system require a supply voltage with a given polarity and must not have the polarity of their supply voltage reversed. Each of these loads may include a reverse polarity protection circuit or element, like a diode. This, however, increases the costs of the overall system.

[0003] While in modern cars it is almost impossible to connect the car battery with a reverse polarity in the on-board power supply system, a reverse polarity error may occur when the on-board system is connected to an external power source, like a battery charger or the battery of another car. Connecting the battery to an external source can be required for charging the battery or for jump-start purposes. In modern cars, terminals for connecting an external power source are located remote from the battery and are connected to the on-board systems through electrically connecting wires. These terminals are also known as jump-start terminals or assist start terminals.

[0004] Although these terminals are labeled in a manner which should prevent a reverse polarization, errors may occur. Thus, the problem underlying the present invention is to provide an on-board power supply system that is robust against reverse polarization and to provide a method for protecting an on-board power supply system in case of reverse polarization.

[0005] This problem is solved by an on-board power supply system according to claim 1 and by a method according to claim 22.

[0006] A first aspect relates to an on-board power supply system. The system includes a first and a second power supply terminal configured to have at least one of a battery and a generator connected thereto, a first external terminal coupled to the first power supply terminal, and a second external terminal coupled to the second power supply terminal, and a protection unit connected between the first external terminal and the first power supply terminal. The protection unit includes a semiconductor switching unit having a load path and a control terminal, the load path connected between the first external terminal and the first power supply terminal, and a control circuit coupled to the control terminal of the semiconductor switching unit and configured to switch the switching unit on and off dependent on at least one electrical parameter in the on-board power supply system.

[0007] A second aspect relates to a method for protecting an on-board power supply system. The power supply system includes a first and a second power supply terminal configured to have at least one of a battery and a generator connected thereto, and a first external terminal coupled to the first power supply terminal, and a second external terminal coupled to the second power supply terminal. The method includes connecting a protection unit with a semiconductor switching unit between the first external terminal and the first power supply terminal, and switching the switching unit on and off dependent on at least one electrical parameter in the on-board power supply system.

[0008] Examples will now be explained with reference to the drawings. The drawings serve to illustrate the basic principle, so that only aspects necessary for understanding the basic principle are illustrated. The drawings are not to scale. In the drawings the same reference characters denote like features.

Figure 1 schematically illustrates a first embodiment of an on-board power supply system including a reverse polarity protection unit;

Figure 2 illustrates an embodiment of a semiconductor switching unit of the protection unit;

Figure 3 illustrates a second embodiment of an on-board power supply system;

Figure 4 illustrates the operating principle of a reverse polarity protection unit according to a first embodiment;

Figure 5 illustrates a first embodiment of a control circuit of the protection unit;

Figure 6 illustrates a first operating scenario in which an external power source is correctly connected to the on-board power supply system;

Figure 7 illustrates a second operating scenario in which an external power source is connected to the on-board power supply system with a reverse polarity;

Figure 8 illustrates a third operating scenario in which an external load is connected to the on-board power supply system;

Figure 9 illustrates a further embodiment of a semiconductor switching unit of the protection unit;

Figure 10 illustrates an embodiment of a control circuit of the reverse polarity protection unit;

Figure 11 illustrates the operating principle of the pro-

tection unit according to a further embodiment; and

Figure 12 schematically illustrates an arrangement in which two on-board power supply systems each having a reverse polarity protection unit have their external terminals connected with each other.

[0009] Figure 1 schematically illustrates a first embodiment of an on-board power supply system, like an automotive on-board power supply system. The power supply system includes first and second power supply terminals 1, 2 configured to have at least one of a battery 11 and a generator 13 connected thereto. In the embodiment illustrated in Figure 1, both a battery 11 and a generator 13 are connected to the power supply terminals 1, 2. However, this is only an example. There may be on-board power supply systems or there may be operating scenarios of on-board power supply systems in which one of the battery 11 and the generator 13 is not available or is missing, respectively. The battery 11 can be a conventional automotive battery providing a supply voltage Vbat of 12V or, in modern cars, of 24V, 42V or 48V. The generator 13 can be a conventional generator driven by the internal combustion machine (not shown) and providing a supply voltage when driven by the internal combustion machine. The generator 13 can be a stand-alone generator or can be combined with a starter (starter-generator).

[0010] A plurality of loads can be connected to the power supply terminals 1, 2. These loads include a starter 12 connected between the power supply terminals 1, 2 and a load arrangement 20 with a plurality of further electrical loads. These loads may include: electric window lifts; electric seat adjustments; a media device, like a radio, a CD or DVD player; internal and external lighting; a car navigation system; and safety devices, like ABS, airbags or seat-belt tensioners. The load arrangement 20 may include loads which are permanently connected to the power supply terminals 1, 2. These loads are commonly represented by load 21 illustrated in Figure 1. The load arrangement 20 may further include loads which are only connected to the power supply terminals 1, 2 when the ignition key of the car has been turned on, which means when the ignition lock has been activated. In Figure 1, these loads are represented by load 23. The ignition lock is represented by a switching element 22 connected between the load 23 and the power supply terminals 1, 2.

[0011] The on-board power supply system further includes first and second external terminals 31, 32, wherein a first external terminal 31 is coupled to the first power supply terminal 1, and a second external terminal 32 is coupled to the second power supply terminal 2. Power supply terminals 1, 2 are, for example, formed by battery terminals (posts) of the battery 11. In modern cars the battery can be mounted at a location which is not or which is only difficult to access, like, for example, under the rear seat. The external terminals 31, 32 are located remote from the battery and are connected to the power supply terminals 1, 2 or the battery terminals, respectively, through electrically connecting lines. These external terminals 31, 32 allow to connect an external power source to the on-board power supply system or allow to connect an external electrical load to the on-board power supply system.

[0012] An external power supply to be connected to the external terminals 31, 32 is, for example, a battery charger for charging the car battery 11 or is, for example, a battery of another car. The battery of another car is, for example, connected to the on-board power supply system when the car's own battery 11 is empty so that jump start or assist start is required. An external load connected to the externals 31, 32 can be the on-board power supply system of another car to which jump start is to be provided, or can be one of a plurality of different loads that can be powered by automotive on-board power supply systems, like a winch, a compressor, a lamp, etc.

[0013] While it is almost impossible to connect the car battery 11 with a reverse polarity to the power supply terminals 1, 2 of the on-board power supply system, there is the risk that a user connects an external voltage source, like a battery charger or a battery of another car, with a reverse polarity to the external terminals 1, 2. Most of the electrical loads connected to an on-board power supply system require a supply voltage with a given polarity. In order to protect these loads from being damaged these loads must not have the polarity of their supply voltages reversed. Further, a generator, like generator 13 of Figure 1, usually includes an internal rectifier arrangement (not shown) which is capable of blocking a supply voltage between the power supply terminals 1, 2 with a first polarity, but which would allow a current to flow when a supply voltage with a second polarity - a reverse polarity relative to the first polarity - would be applied between the power supply terminals 1, 2.

[0014] Since the application of an external supply voltage with a reverse polarity between the external terminals 31, 32 cannot be prevented, it should be prevented that this supply voltage is applied to the power supply terminals 1, 2 of the on-board power supply system. For this purpose, the on-board power supply system of Figure 1 includes a reverse polarity protection unit 40 connected between the first external terminal 31 and the first power supply terminal 1. It should be noted, that the protection unit 40 could also be connected between the second power supply terminal 2 and the second external terminal 32, or that two protection units could be provided: a first one between the first external terminal 31 and the first power supply terminal 1, and a second one between the second power supply terminal 2 and the second external terminal 32.

[0015] The protection unit 40 includes a semiconductor switching unit 41 having a load path and a control terminal, wherein the load path of the semiconductor switching unit 41 is connected between the first external terminal 31 and the first power supply terminal 1. The

protection unit 40 further includes a control circuit 42 coupled to the control terminal of the semiconductor switching unit 41. The control circuit is configured to switch the semiconductor switching unit 41 on and off dependent on at least one electrical parameter of the on-board power supply system. This will be explained in further detail hereinbelow.

[0016] The semiconductor switching unit 41 can be implemented with at least one transistor. In Figure 1, this transistor is implemented as an n-type MOSFET having its source terminal connected to the first external terminal 31 and having its drain terminal connected to the first power supply terminal 1. However, implementing the semiconductor switching unit 41 with an n-type MOSFET is only an example. Any other type of semiconductor switching element, like a p-type MOSFET, an IGBT (Insulated Gate Bipolar Transistor), or a BJT (Bipolar Junction Transistor) can be used as well. A p-type MOSFET in the semiconductor switching unit 41 would have its drain terminal connected to the first external terminal 31, and would have its source terminal connected to the first power supply terminal 1.

[0017] The semiconductor switching unit 41 can be implemented with one transistor. However, referring to Figure 2, it is also possible to implement the semiconductor switching unit 41 with a plurality of two or more transistors 41_1, 41_n having their load paths connected in parallel. In Figure 2, these transistors are implemented as n-type transistors. However, any other type of transistor can be used as well.

[0018] The semiconductor switching unit 41 can be switched on and off by the control circuit 42 via a control or drive signal S41. When the semiconductor switching unit 41 is switched on, the power supply terminals 1, 2 of the on-board power supply system are electrically connected to the external terminals 31, 32. In this case, a current I3 can be supplied to the on-board power supply system via the external terminals 31, 32, or a current can be supplied by the on-board power supply system to the external terminals 31, 32. In the first case, the current 13 flows in the direction as illustrated in Figure 1, while in the second case the current flows in the opposite direction.

[0019] The control circuit 42 is configured to switch the semiconductor switching unit 41 off when an external voltage V3 is supplied between the external terminals 31, 32 which has a reverse polarity compared with the required polarity of the supply voltage of the on-board power supply system. In the embodiment of Figure 1, the supply voltage of the on-board power supply system is the voltage Vbat provided by the battery and/or the generator. In Figure 1, the first power supply terminal 1 of the on-board power supply system is a positive supply terminal, while the second supply terminal 2 is a negative supply terminal or reference terminal. In Figure 1, the second power supply terminal 2 is connected to ground of the automobile in which the on-board power supply system is implemented. The external voltage V3 has a reverse polarity when the external voltage V3 is a negative voltage between the first and second external terminals 31, 32.

[0020] The control circuit 42 is configured to evaluate at least one electrical parameter in the on-board power supply system in order to detect a reverse polarity of an external voltage V3, wherein the semiconductor switching unit 41 is switched off in order to protect the on-board power supply system when a reverse polarity is detected.

[0021] According to one embodiment, the control circuit 42 is configured to only evaluate a first voltage V3 which is the external voltage between the first and second external terminals 31, 32, and to switch the semiconductor switching unit off when this voltage is a negative voltage.

[0022] According to another embodiment illustrated in Figure 3, the control circuit 42 is configured to evaluate a first voltage V3 which is the external voltage between the first and second external terminals 31, 32, and to evaluate a second voltage V4 which is the voltage between the first external terminal 31 and the first power supply terminal 1. The second voltage V4 corresponds to the voltage across the load path of the semiconductor switching unit 41. Referring to Figure 3, the protection unit 40 includes a first voltage measurement unit 44 configured to measure the first voltage V3 and to provide a first voltage measurement signal S3 to the control circuit 42. The first voltage measurement signal S3 is representative of the first voltage V3. According to one embodiment, the first voltage measurement signal S3 is proportional to the first voltage V3. The protection unit 40 further includes a second voltage measurement unit 45 which is configured to measure the second voltage V4 and to provide a second voltage measurement signal S4 to the control circuit 42. The second voltage measurement signal S4 is representative of the second voltage V4. According to one embodiment, the second voltage measurement signal S4 is proportional to the second voltage V4. The first and second voltage measurement units 44, 45 can be implemented as conventional voltage measurement units. Such voltage measurement units are commonly known, so that no further explanations are required in this regard.

[0023] The operating principle of a first embodiment of the control circuit 42 of Figure 3 will now be explained with reference to Figure 4. In this embodiment, the control circuit 42 is configured to switch the semiconductor switching unit 41 on when the first voltage V3 is higher than a first threshold value $V3_{TH}$ and when the second voltage V4 is outside a given first voltage range which ranges from a first voltage value $V4_{TH1}$ to a second voltage value $V4_{TH2}$. The first threshold value $V3_{TH}$ is, for example, below zero. According to one embodiment, the first threshold value $V3_{TH}$ is selected from a voltage range ranging from about -5 V to about -0.05 V, in particular ranging from about -2 V to about -0.5 V. The external voltage V3 may approach zero value when a low-ohmic external load, such as a lamp, is connected to the external

terminals 31, 32 and when the protection unit 40 is switched off. When the protection unit 40 then switches on, the load will be supplied by the battery 11.

[0024] The first voltage value $V4_{TH1}$ is, for example, selected from a voltage of between about -5 V and about -0.05 V, and the second voltage value $V4_{TH2}$, which together with the first voltage value defines the first voltage range, is, for example, selected from a voltage of between about 0.05 V and about 1 V. According to one embodiment, the first voltage range is symmetrically relative to zero (0V), but the first voltage range could also be asymmetrical.

[0025] An embodiment of a control circuit 42 having a functionality as illustrated in Figure 4, is schematically illustrated in Figure 5. This control circuit 42 includes three comparators: a first comparator 421 for comparing the first voltage measurement signal S3 with a first threshold signal $S3_{TH}$ representing the first threshold value $V3_{TH}$; a second comparator 422 for comparing the second voltage measurement signal S4 with a first signal value $S4_{TH1}$ representing the first voltage value $V4_{TH1}$; and a third comparator 423 for comparing the second voltage measurement signal S4 with a second signal value $S4_{TH2}$ representing the second voltage value $V4_{TH2}$. In the control circuit 42 of Figure 5, the drive signal S41 is available at an output of a first logic gate 425, which is an AND-gate in this case. Optionally, the output signal S41 of the logic gate 425 is amplified using an amplifier or driver stage 426 in order to provide the drive signal for the semiconductor switching unit 41. The drive signal S41 may assume one of two different signal levels: an on-level at which the semiconductor switching unit 41 is switched on; and an off-level at which the semiconductor switching unit 41 is switched off. For explanation purposes it may be assumed that in the control circuit 42 in Figure 5 an on-level is a high signal level and that an off-level is a low signal level. In this control circuit 42 the drive signal S41 assumes an on-level, when a comparator signal S421 of the first comparator 421 and when one of the comparator signals S422, S423 of the second and third comparators 422, 423 have an on-level. In this case, the first voltage V3 is above the threshold value $V3_{TH}$, and the second voltage V4 is outside the voltage range defined by the first and second voltage values $V4_{TH1}$, $V4_{TH2}$. The AND-gate 425 receives the first comparator signal S421 at a first input terminal. The second and third comparator signals S422, S423 are OR-connected by an OR-gate 424 wherein an output signal of the OR-gate 424 is received at a second input terminal of the AND-gate 425.

[0026] It should be noted that the control circuit 42 illustrated in Figure 5 represents only one of a plurality of different ways in which a control circuit having a functionality as illustrated in Figure 4 can be implemented. To evaluate the first and second voltages V3, V4 in order to decide whether or not the semiconductor switching unit 41 is switched on has the following effects: the on-board power supply system is protected from having an external voltage V3 with a reverse polarity connected thereto, because the semiconductor switching unit 41 is switched off when the external voltage V3 is below the threshold voltage $V3_{TH}$; the switching unit 41 is also switched off when the voltage between the external terminals 31, 32 is only slightly different from the internal supply voltage Vbat between the power supply terminals 1, 2. In this case, the second voltage V4 would be within the first voltage range defined by the first and second voltage values $V4_{TH1}$, $V4_{TH2}$. When the second voltage is within the first voltage range it can be assumed that the first and second external terminals are floating, which means that there is no external device connected to the external terminals.

[0027] The operating principle of the protection unit 40 explained with reference to Figures 2 to 5 will be better understood with reference to Figures 6 to 8 in which different operating scenarios are illustrated. In these Figures, the protection unit 40 is only illustrated as a circuit block.

[0028] Figure 6 illustrates a first operating scenario in which an external voltage source 50 is connected between the first and second external terminals 31, 32. In this scenario the external voltage source has the correct polarity, so that the voltage V3 between the external terminals 31, 32 is a positive voltage. The external voltage source 50 can be a battery charger, or can be a battery of another car. In this operating scenario the protection unit 40 turns on, i.e., switches the semiconductor switching unit 41 (see Figures 1 and 3) on, when the external voltage V3 exceeds the internal power supply voltage Vbat for more than the second voltage value $V4_{TH2}$.

[0029] Figure 7 illustrates a further operating scenario in which an external voltage source 50 is connected to the external terminals 31, 32. In this scenario the external voltage source 50 is connected to the external terminals 31, 32 with a reverse polarity, so that the external voltage V3 equals the negative value -V50 of the supply voltage V50 provided by the external source 50. Assume that the absolute value of the supply voltage V50 of the external source 50 is higher than the absolute value of the first threshold value $V3_{TH}$, so that in this scenario the protection unit 40 is off, i.e., has its semiconductor switching unit 41 switched off.

[0030] Figure 8 illustrates an operating scenario in which an external load 60 is connected to the external terminals 31, 32. The load 60 is represented as an impedance in Figure 8. However, the load could also include a voltage source. The load 60 is, for example, an on-board power supply system of another car to which jump start is to be provided, but could also be any other kind of load which could be connected to the on-board power supply system of a car. When the external load 60 is connected to the external terminals 31, 32, the electrical potential of the first external terminal 31 is either drawn to ground GND or to the electrical potential of an internal voltage source (not shown) in the load 60. This causes a negative second voltage V4 across the protection unit

40, while the first voltage V3 is zero or positive. The protection unit 40 turns on when the absolute value of the voltage drop V4 across the protection unit 40 is higher than the first voltage value $V4_{TH1}$. Thus, the protection unit 40 does not only protect the on-board power supply system from having a supply voltage with a reverse polarity connected thereto, but also allows to provide jump start to another car or to supply some external load connected to the external terminals 31, 32.

[0031] According to one embodiment, the semiconductor switching unit 41 of the protection unit 40 is configured to have a high current-carrying capacity in order to protect the semiconductor switching unit 41 from being damaged when a short-circuit in the external load 60 (see Figure 8) occurs. The current-carrying capacity is, for example, selected such that it allows to discharge the car's own battery 11 without damaging or destroying the protection unit 40. According to one embodiment the current-carrying capacity of the semiconductor switching unit 41 is 1000 A for 10 seconds or 500 A for 1 minute.

[0032] When the semiconductor switching unit 41 (see Figures 1 and 3) is implemented with at least one n-type MOSFET or at least one p-type MOSFET there is a diode present between the first external terminal 31 and the first power supply terminal 1, with the anode of the diode coupled to the first external terminal 31 and the cathode of the diode coupled to the first power supply terminal 1. This diode is the internal body diode of a MOSFET, in particular a power MOSFET. This body diode is also illustrated in the protection unit 40 of Figures 1 and 3. The body diode conducts when an external voltage V3 is applied between the first and second external terminals 31, 32, and when this external voltage V3 is higher than the internal voltage Vbat for more than the forward voltage of the body diode. By virtue of the presence of this body diode it would not be necessary to switch the semiconductor switching unit 41 on when an external voltage source is correctly connected to the external terminals 31, 32, like in the operating scenario illustrated in Figure 6. However, electric losses that occur in a MOSFET which is in its on-state are lower than losses which occur in the forward-biased body diode, so that it is advantageous in terms of reducing power losses to switch the semiconductor switching unit on also when a positive supply voltage is supplied to the external terminals 31, 32.

[0033] According to a further embodiment which is illustrated in Figure 9, the semiconductor switching unit 41 is implemented with two MOSFETs 41_1, 41_2 connected in series. In the embodiment of Figure 9, these MOSFETs are n-type MOSFETs which have their drain terminals connected together. However, it would also be possible to connect these MOSFETs 41_1, 41_2 such that they have their source terminals connected together. Further, p-type MOSFETs instead of n-type MOSFETs could be used. The arrangement with the two MOSFETs 41_1, 41_2 can block positive and negative voltages across the protection unit 40. The two MOSFETs 41_1, 41_2 are switched on and off by the control circuit (not shown in Figure 9) simultaneously. For this, a common control or drive signal S41 may be provided to the two MOSFETs 41_1, 41_2. Alternatively, separate drive signals are generated by the control circuit 42 and provided to the individual MOSFETs 41_1, 41_2.

[0034] Figure 10 schematically illustrates a further embodiment of the control circuit 42. In this embodiment, the control circuit 42 includes a logic unit 46 and a drive unit 47. In this control circuit 42 logic unit 46 generates the drive signal S41 - which is amplified by the driver stage 47 - dependent on the first and second voltage measurement signals S3, S4. The logic unit 46 may include a logic circuit which corresponds to the logic circuit illustrated in Figure 5. Further, the driver stage 47 can be activated and deactivated by the logic unit 46. The logic unit 46 is configured to deactivate the driver stage 47 when or after the drive signal S41 assumes an off-level, and activates the driver stage 47 when or before the drive signal S41 assumes an on-level. The semiconductor switching unit 41 includes at least one transistor which is a normally-off transistor, so that the switched off semiconductor switching unit 41 remains in its off-state when the driver stage 47 is deactivated. By deactivating the driver stage 47, the power consumption of the protection unit 40 can be reduced. A low power consumption is in particular relevant when the car is parked and the battery is not charged.

[0035] According to a further embodiment the logic unit 46 is not only configured to activate or deactivate the driver stage 47 dependent on the first and second voltage measurement signals S3, S4, but also dependent on an ignition signal S22. The ignition signal S22 represents a switching state of the ignition lock which is represented by switch 22 in the figures explained hereinbefore.

[0036] The operating principle of the control circuit 42 of Figure 10 will be explained with reference to Figure 11 in which a state diagram is illustrated. The state diagram illustrates different operating states the protection unit 40 can assume. In a first state 101 the protection unit 40 is turned off, which means that the semiconductor switching unit 41 is switched off and that the driver stage is deactivated. The protection unit 40 enters a second state 102 when the first and second voltage measurement signals S3, S4 indicate that the first voltage V3 is higher than the threshold value $V3_{TH}$ and that the second voltage V4 is outside the voltage range defined by the first and second voltage values $V4_{TH1}$, $V4_{TH2}$. This is indicated by S3=T and S4=T in Figure 11. In this second state 102 the ignition signal S22 is evaluated. When the ignition signal S22 indicates that the ignition lock has been activated (the ignition key has been turned on) the protection unit 40 is turned on in a third state 103. The protection unit 40 is kept in this on-state 103 until either the first voltage V3 falls below the threshold value $V3_{TH}$, which is indicated by S3=F in Figure 11, or until the ignition lock is deactivated, which is indicated by 22=OFF. The sequence 101-102-103-101 of states is a typical sequence which may occur when jump start is received by the car, jump

start is provided to another car or when an external load is supplied when the car is in operation, i.e., when the ignition key has been turned on.

[0037] When it is determined in step 102 that the ignition lock is deactivated then the protection unit 40 is activated in state 104. The protection unit 40 leaves the on-state 104 to the off-state 101 when either the first voltage V3 falls below the threshold value $V3_{TH}$ or when an internal timer which is activated when the protection unit 40 is turned on in state 104 has elapsed. The timer is, for example, set to a time period of several minutes up to several hours. The sequence 101-102-104-101 is a typical sequence when the on-board power supply system is connected to an external voltage source, like a battery charger, or to an external load, when the car is not in operation. In this case, the timer prevents that the protection unit is kept in its on-state - in which it consumes power - for a very long time during car parking. When there is still an operating condition which requires the protection unit to be turned on after it has been turned off induced by the timer, it is again turned on until the timer again elapses.

[0038] In most cars there is a battery sensor (not shown in the drawings) coupled to the battery 11. This battery sensor provides information on the state of charge (SOC) of the battery 11 and/or on the current flowing into or out of the battery and/or the state of health (SOH) and/or the state of function (SOF) of the battery. According to one embodiment, additionally or alternatively to turning off the protection unit 40 dependent on a timer, the protection unit is turned off (transitions from state 104 to state 101) dependent on battery parameters.

[0039] The protection unit 40 is, for example, switched off when a state of charge (SOC) of the battery falls below a given threshold, such as 50% of its capacity. This prevents the battery 11 from being unduly discharged by an external load. In this case, the protection unit 40 can only be switched on again for further supplying the load, when this is be confirmed by a user, for example, by turning on the ignition key. Thus, the transition from state 101 to 104 has to be locked until ignition key is turned to ON.

[0040] According to another embodiment, the protection unit 40 is switched off, when the state of charge (SOC) of the battery exceeds a given threshold, such as 90% of its capacity, and/or when a charging current falls below a given value, such as 10mA, for a given time, such as some minutes up to several hours, or even days. In this case, the protection unit 40 is switched off when the battery is sufficiently charged.

[0041] Figure 12 illustrates an embodiment in which two on-board power supply systems, namely the on-board power supply system explained herein before and a further on-board power supply system had their external terminals connected together. In Figure 12 like features of the second on-board power supply system have the same reference characters as the first on-board power supply system, wherein the features of the second on-board power supply system have a reference character with index "1".

[0042] Referring to Figures 1 and 3 an optional resistor 43 can be connected in parallel with the load path of the semiconductor switching unit 41 in the protection unit 40. This resistor 43 may help to set the potential at the first external terminal to a defined value. This is, in particular, useful when two on-board power supply systems with protection units are connected together. According to one embodiment, the resistor 43 is implemented as PTC (positive thermal coefficient) resistor. Instead of a resistor, a switching element, such as a transistor, or a transistor in series with a resistor, could be connected in parallel with the load path of the switching unit 41.

[0043] Alternatively, or additionally, to resistor 43 another resistor (not shown) can be connected between the first external terminal 31 and ground.

[0044] Further, a diode 44 can be connected in parallel with the power supply terminals 1, 12. This diode 44 may clamp reverse voltage spikes.

[0045] The semiconductor switching unit 41 and the control circuit 42 can be implemented in a common semiconductor chip or can be implemented in different semiconductor chips.

[0046] According to a further embodiment, the control circuit is configured to prevent the semiconductor switching unit 41 from being switched on when an external load (60 in Figure 8) is connected to the external terminals. This may protect the car battery. According to one embodiment supplying an external load is prevented when the charging state of the battery 11 is low. In this case, the protection unit 40 also receives an information on the charging state of the battery from a sensor unit in order to evaluate this information.

[0047] A supply voltage of the protection unit 40, in particular of the control circuit 42 of the protection unit 40, can be provided by the car battery 11 and/or by the voltage available at the external terminals 31, 32. If both of these voltages are voltages with a reverse polarity, the protection unit 40 would not be supplied, causing the protection unit 40 to be (stay) switched off. According to one embodiment, the semiconductor switching unit includes a normally-off transistor which is switched off when the protection unit 40 is not supplied with a suitable supply voltage.

[0048] In the embodiments explained hereinbefore, the external voltage (first voltage) V3 and the voltage (second voltage) V4 across the protection unit 40 are evaluated in order to decide whether or not the protection unit is to be activated (switched on) or deactivated (switched off). According to a further embodiment, the current 13 through the protection unit 40 is evaluated instead of the second voltage. In this case, the protection unit 40 is activated when this current 13 is outside a given current range and when the first voltage is higher than the first threshold value $V3_{TH}$ (see Figure 4). In Figure 3, the dependency of the activation of the protection unit 40 on the current 13 is also schematically illustrated. Referring to Figure 3, the protection unit is deactivated or

switched off, when the first voltage is below the threshold and/or when the current 13 is within a given range which includes zero. This current range ranges from a first threshold current $I3_{TH1}$ to a second threshold current $I3_{TH2}$. The first threshold current $I3_{TH1}$ is, for example, between about -1A and about -100μA, in particular ranging from about -1 00mA to about -1 mA, and the second threshold current $I3_{TH2}$ is, for example, between about 100μA and about 1A, in particular ranging from about 1 mA to about 100mA. This current range can be symmetrically or asymmetrically relative to zero.

[0049] Everything which has been explained concerning an evaluation of the second voltage V4 in order to activate or deactivate the protection unit 40, applies to the evaluation of the current 13 instead of the second voltage V4 accordingly. In this connection it should be mentioned that, when the protection unit 40 is deactivated, the resistor 43 connected in parallel with the load path of the semiconductor switching unit 41 allows the current 13 to flow in the first direction illustrated in Figure 1, and in the opposite second direction until the protection unit 40 activated. When a semiconductor switching unit 41 with at least one MOSFET is used, the body diode of the MOSFET allows the current 13 to flow in the first direction when the protection unit 40 is deactivated.

[0050] Although various exemplary embodiments of the invention have been disclosed, it will be apparent to those skilled in the art that various changes and modifications can be made which will achieve some of the advantages of the invention without departing from the spirit and scope of the invention. It will be obvious to those reasonably skilled in the art that other components performing the same functions may be suitably substituted. It should be mentioned that features explained with reference to a specific figure may be combined with features of other figures, even in those cases in which this has not explicitly been mentioned. Further, the methods of the invention may be achieved in either all software implementations, using the appropriate processor instructions, or in hybrid implementations that utilize a combination of hardware logic and software logic to achieve the same results. Such modifications to the inventive concept are intended to be covered by the appended claims.

Claims

1. An on-board power supply system, the system comprising:

   a first power supply terminal (1) and a second power supply terminal (2) configured to have a battery (11) and/or a generator (13) connected thereto;
   a first external terminal (31) coupled to the first power supply terminal (1) and a second external terminal (32) coupled to the second power supply terminal (2); and
   a protection unit (40) connected between the first external terminal (31) and the first power supply terminal (1),
   wherein the protection unit (40) comprises:

   a semiconductor switching unit (41) having a load path and a control terminal, the load path connected between the first external terminal (31) and the first power supply terminal (1); and
   a control circuit (42) coupled to the control terminal of the semiconductor switching unit (41) and configured to switch the semiconductor switching unit (41) on and off dependent on at least one electrical parameter in the on-board power supply system.

2. The on-board power supply system of claim 1, wherein the at least one electrical parameter comprises one of a first voltage (V3) between the first and second external terminals (31, 32), a second voltage (V4) across the protection unit (40),
   a current (13) through the protection unit (40).

3. The on-board power supply system of claim 1, wherein the control circuit (42) is configured to switch the semiconductor switching unit (41) on and off dependent on a first voltage (V1) between the first and second external terminals (31, 32) and dependent on a second voltage (V4) across the protection unit (40).

4. The on-board power supply system of claim 3, wherein the control circuit (42) is configured to switch the semiconductor switching unit (41) on when the first voltage (V1) is higher than a first threshold value and when the second voltage (V4) is outside a given first voltage range.

5. The on-board power supply system of claim 4, wherein the first threshold value is a voltage between -5V and -0.05V

6. The on-board power supply system of one of claims 4 and 5, wherein the first voltage range includes zero.

7. The on-board power supply system of one of claims 4 to 6, wherein the first voltage range ranges from between about -5V and about -0.05V to between about 0.05V and about 1.0V.

8. The on-board power supply system of one of claims 4 to 7, wherein the first voltage range is symmetrical relative to zero or is asymmetrical relative to zero.

9. The on-board power supply system of one of the preceding claims, further comprising:

a switch (22) operated by an ignition key, wherein the control circuit (42) is further configured to switch the semiconductor switching unit (41) on and off dependent on a switching state of the switch (22).

10. The on-board power supply system of one of the preceding claims, wherein the semiconductor switching unit (41) comprises at least one semiconductor switching element.

11. The on-board power supply system of claim 10, wherein the semiconductor switching unit comprises one of an n-type MOSFET, a p-type MOSFET, an IGBT or a BJT.

12. The on-board power supply system of one of the preceding claims, wherein the protection unit (40) further comprises a resistive element (43) connected between the first external terminal (31) and the first power supply terminal (1).

13. The on-board power supply system of claim 12, wherein the resistive element comprises an ohmic resistor, a PTC resistor, a switching element, or a constant current source.

14. The on-board power supply system of claim 1, wherein the control circuit is configured to switch the semiconductor switching unit (41) on and off dependent on a first voltage between the external terminals (V3) and dependent on a current (13) through the protection unit (40).

15. The on-board power supply system of claim 14, wherein the control circuit (42) is configured to switch the semiconductor switching unit (41) on when the first voltage (V1) is higher than a first threshold value and when the current (13) through the protection unit (40) is outside a given current range ranging from a first threshold current to a second threshold current.

16. The on-board power supply system of claim 15, wherein the first threshold current is selected from a current between about -1A and about -100μA.

17. The on-board power supply system of claim 15, wherein the second threshold current is selected from a current between about 100μA and about 1A.

18. The on-board power supply system of claim 17, wherein the current range includes zero.

19. The on-board power supply system of claim 17, wherein the current range is symmetrical relative to zero or is asymmetrical relative to zero.

20. The on-board power supply unit of one of the preceding claims, wherein the protection (40) unit further comprises a diode connected between the first external terminal (1) and the first power supply terminal (31).

21. A method for protecting an on-board power supply system that comprises a first power supply terminal (1) and a second power supply terminal (2) configured to have a battery (11) and/or a generator (13) connected thereto, and a first external terminal (31) coupled to the first power supply terminal (1), and a second external terminal (32) coupled to the second power supply terminal (2), the method comprising:

connecting a protection unit (41) with a semiconductor switching unit between the first external terminal (31) and the first power supply terminal (1); and
switching the semiconductor switching unit (41) on and off dependent on at least one electrical parameter in the on-board power supply system.

22. The method of claim 21, wherein the at least one electrical parameter is selected from one of a first voltage (V1) between the external terminals (31, 32) a second voltage (V4) across the protection unit (40), a current (13) through the protection unit (40).

23. The method of claim 21, wherein switching comprises switching the semiconductor switching unit on and off dependent on a first voltage between the external terminals and dependent on a second voltage across a load path of the semiconductor switching unit.

24. The method of claim 21, wherein switching comprises switching the semiconductor switching unit on when the first voltage is higher than a first threshold value and when the second voltage is outside a given first voltage range.

25. The method of claim 21, wherein switching comprises switching the semiconductor switching unit on and off dependent on a first voltage between the external terminals and dependent on a current through the protection unit.

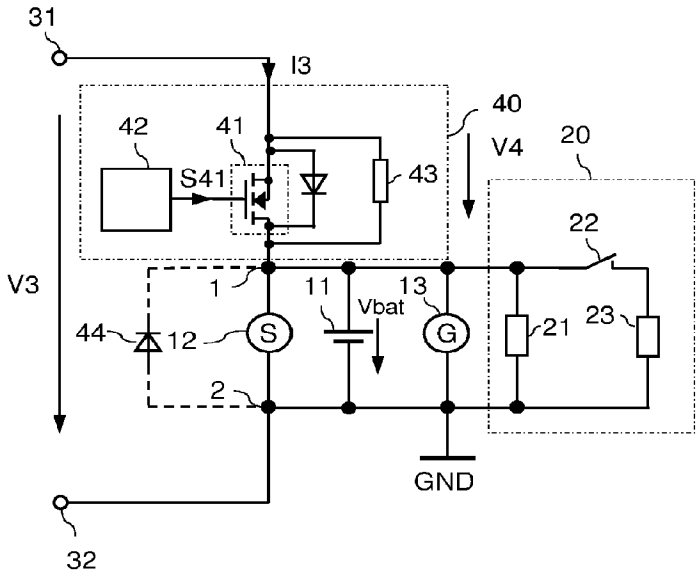


FIG 1

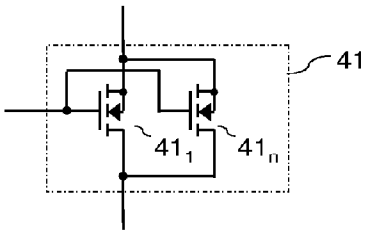


FIG 2

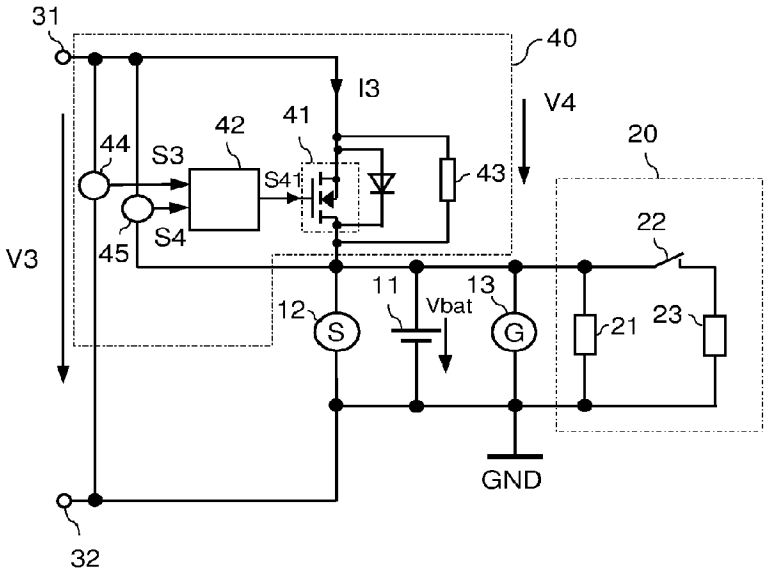


FIG 3

WINPLUS Ex. 1003, p. 1031

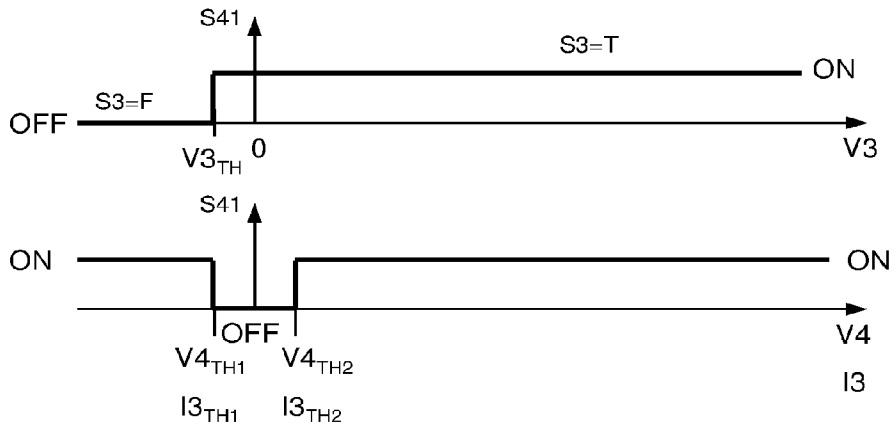

S41
S3=T
ON
S3=F
OFF
V3TH
0
V3
S41
ON
ON
OFF
V4
V4TH1
V4TH2
I3
I3TH1
I3TH2

FIG 4

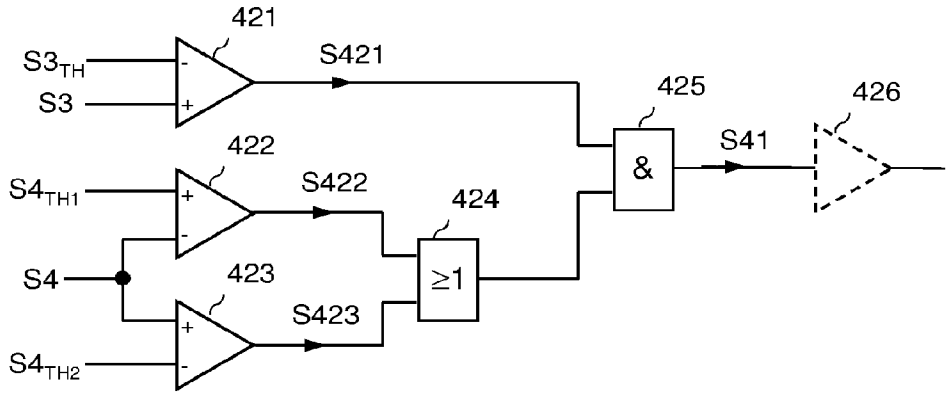

421
S3TH
S3
S421
425
426
S41
422
S4TH1
S422
424
S4
423
≥1
S423
S4TH2
&

FIG 5

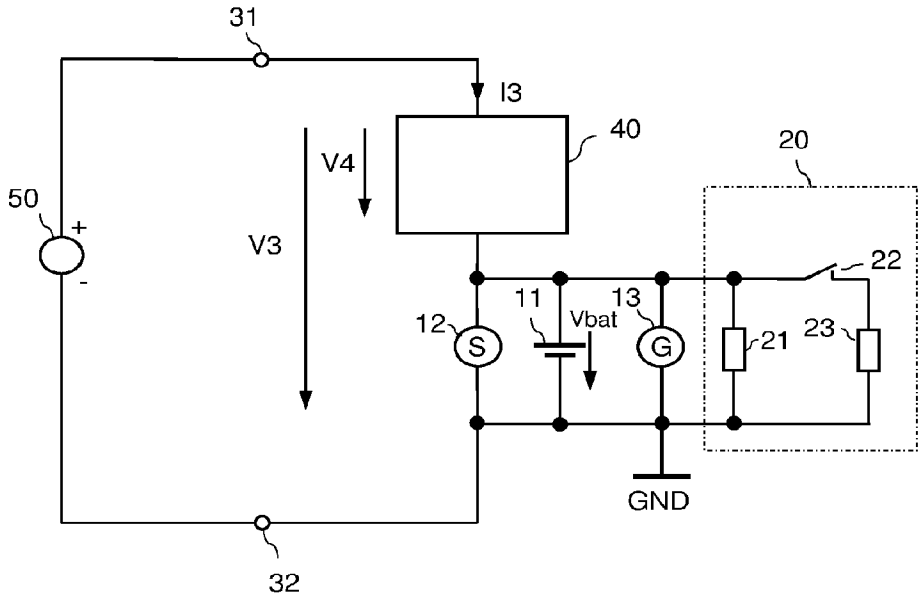

31
I3
40
20
V4
50
+
V3
-
22
11
13
12
Vbat
S
G
21
23
GND
32

FIG 6

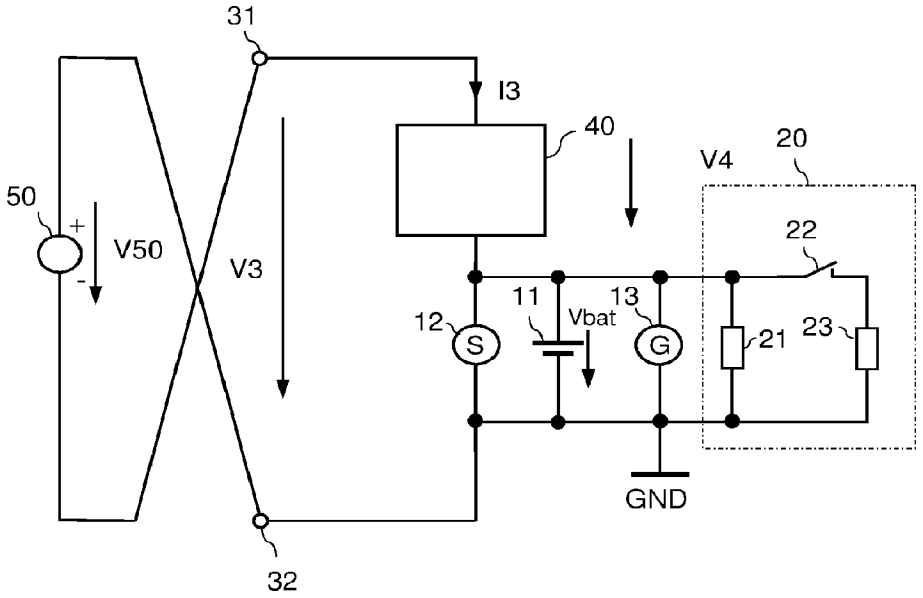

31
I3
40
20
V4
50
+
V50
-
V3
22
11
13
12
Vbat
S
G
21
23
GND
32

FIG 7

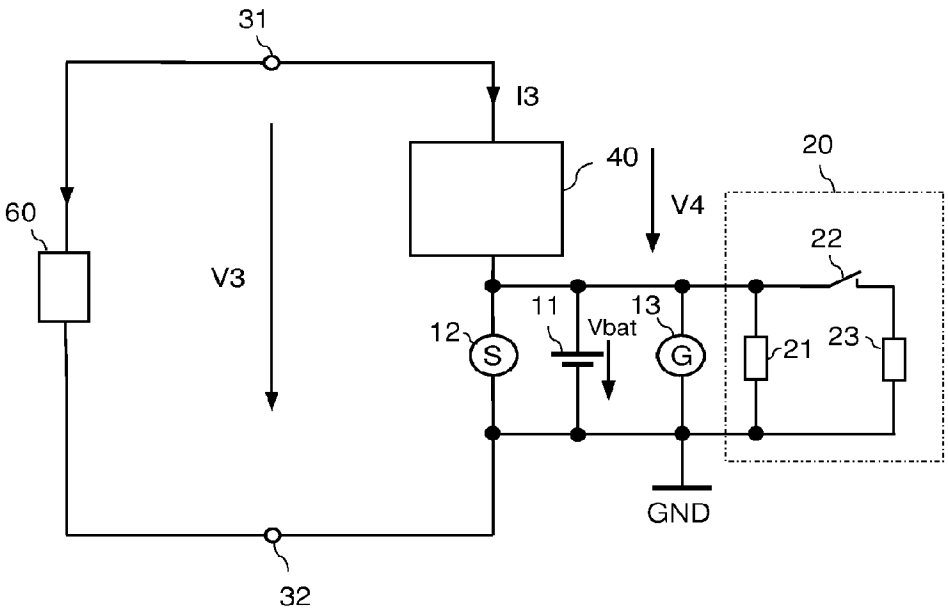


FIG 8

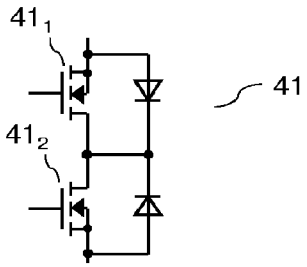


FIG 9

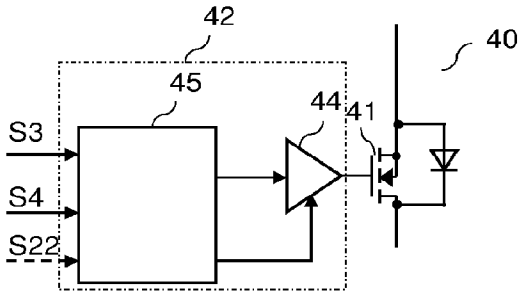


FIG 10

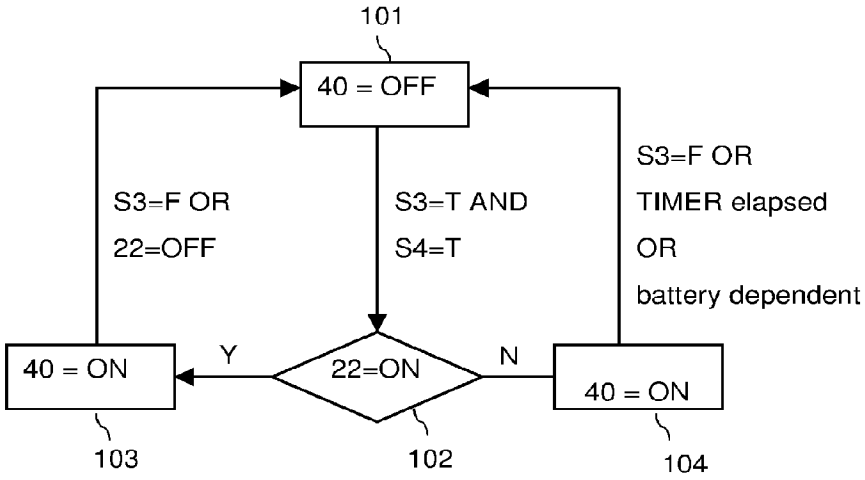

101
40 = OFF
S3=F OR
22=OFF
S3=T AND
S4=T
S3=F OR
TIMER elapsed
OR
battery dependent
40 = ON
Y
22=ON
N
40 = ON
103
102
104

FIG 11

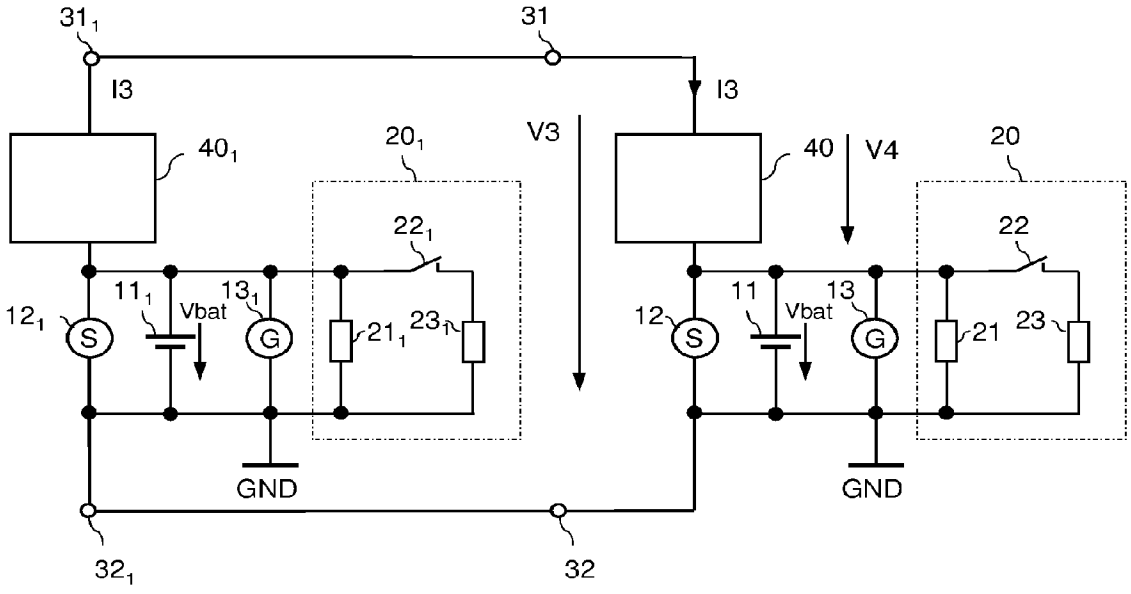

31₁
31
I3
I3
40₁
20₁
V3
40
V4
20
22₁
22
11₁
13₁
Vbat
12₁
S
G
21₁
23₁
11
13
12
Vbat
S
G
21
23
GND
GND
32₁
32

FIG 12

M417714

(19)中華民國智慧財產局

(12)新型說明書公告本 **(11)證書號數：TW M417714U1**

(45)公告日： 中華民國 100 (2011) 年 12 月 01 日

(21)申請案號：100207272 (22)申請日： 中華民國 100 (2011) 年 04 月 25 日

(51)Int. Cl.： ***H02J7/32 (2006.01)***

(71)申請人：海鉅能源股份有限公司(中華民國) (TW)

桃園縣楊梅市民富路 1 段 796 巷 22 弄 19 號 4 樓

(72)創作人：羅仲和 (TW)

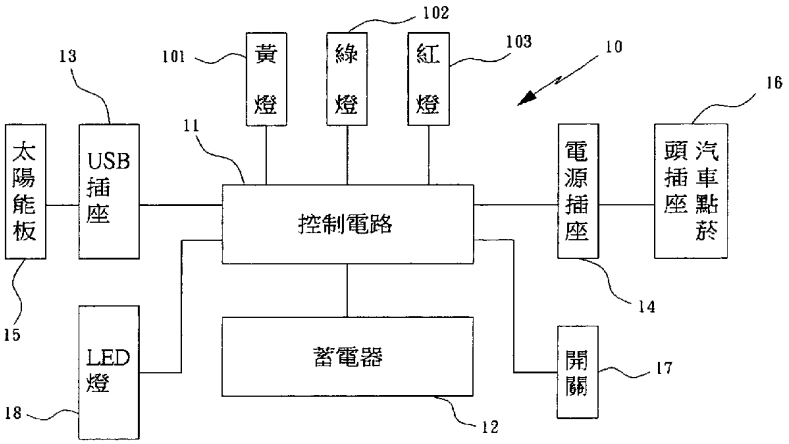
申請專利範圍項數：6 項 圖式數：4 共 14 頁

(54)名稱

多功能隨身電源裝置

(57)摘要

一種多功能隨身電源裝置，包括：一控制電路、一蓄電器、一 USB 插座及一電源插座；其中，該控制電路設於本體內；該蓄電器設於本體內，與控制電路相接；該 USB 插座設於本體上，與控制電路相接，可藉由一 USB 傳輸線一端連接於該 USB 插座，另一端連接於一太陽能板，使太陽能板發電產生之電力，經由控制電路之操控，而對蓄電器充電與蓄電；該電源插座設於本體上，與控制電路相接，可藉由一電源線一端連接於該電源插座，另一端連接於一汽車之點菸頭插座上，使控制電路啟動蓄電器供電予汽車，藉以作為輔助啟動汽車電源之救援。



第3圖

10・・・本體

101・・・黃燈

102・・・綠燈

103・・・紅燈

11・・・控制電路

12・・・蓄電器

13・・・USB 插座

14・・・電源插座

15・・・太陽能板

16・・・汽車之點菸頭插座

17・・・開關

18・・・LED 燈

五、新型說明：

【新型所屬之技術領域】

本創作係一種多功能隨身電源裝置，尤指一種結合蓄電器及控制電路之創新構造，藉以作為輔助啟動汽車電源救援及戶外電源使用之裝置者。

【先前技術】

按，汽車駕駛人在用車過程當中，難免會遇到汽車無法發動的情形，而這其中的原因，往往和電瓶之電力不足有關，而導致的原因也有幾種可能，例如：忘記關掉車燈、周遭溫度過低、電瓶本身過於老舊而失去效能等因素；而當此一問題發生時，若是汽車停在汽車過往頻繁的地點，或許駕駛人能夠藉由它車的電瓶連結來輔助發動引擎讓問題獲得解決；又或者，汽車恰好停在修護場附近，也能夠交由修護人員加以修復。

然而，駕駛人有時也可能遇到求助困難的時候（如深夜時、偏僻地區），最終，可能就因為電瓶電力不足的問題而無法開車，因而耽誤了原本的計劃、行程，造成駕駛人莫大的損失。

WINPLUS Ex. 1003, p. 1037

【新型內容】

創作人有鑑於前述先前技術之缺點，乃依其從事各種電源裝置之製造經驗和技術累積，針對上述缺失悉心研究各種解決的方法，在經過不斷的研究、實驗與改良後，終於開發設計出本創作之一種全新多功能隨身電源裝置之創作，以期能摒除先前技術所產生之缺失。

本創作之一目的，係提供一種多功能隨身電源裝置，係結合蓄電器及控制電路之創新構造，藉以作為輔助啟動汽車電源之救援。

本創作之另一目的，係提供一種多功能隨身電源裝置，係結合蓄電器及控制電路之創新構造，藉以作為戶外電源之使用。

根據上述之目的，本創作之隨身電源裝置，其係設有一本體，該本體包括有：一控制電路、一蓄電器、一USB插座及一電源插座；其中，該控制電路設於本體內；該蓄電器設於本體內，與控制電路相連接；該USB插座設於本體上，與控制電路相連接，可藉由一USB傳輸線一端連接於該USB插座，另一端連接於一太陽能板，使太陽能板發電產生之電力，經由控制電路之操控，而對蓄電器充電與蓄電；該電源插座設於本體上，與控制電路相連接，可藉由一電源線一端連接於該電源插座，另一端連接於一汽車之點菸頭插座上，使控制電路啟動蓄電器供電予汽車，作為輔助啟動汽車電源之救援；如此，當汽車駕駛人遇到汽車電

WINPLUS Ex. 1003, p. 1038

瓶電力不足無法發動的情形時，即可藉助蓄電器之供電來發動汽車，達到自力救濟之目的。

為便 貴審查委員能對本創作之目的、形狀、構造裝置特徵及其功效，做更進一步之認識與瞭解，茲舉實施例配合圖式，詳細說明如下：

【實施方式】

本創作乃有關一種「多功能隨身電源裝置」，請參閱第1、2、3圖所示，本創作之隨身電源裝置，其係設有一本體10，該本體10包括有：一控制電路11、一蓄電器12、一USB插座13及一電源插座14。

其中，該控制電路11設於本體10內。

該蓄電器12設於本體10內，其與控制電路11相連接。

該USB插座13設於本體10上，其與控制電路11相連接，可藉由一USB傳輸線131一端連接於該USB插座13，另一端連接於一太陽能板15，使太陽能板15發電產生之電力，經由控制電路11之操控，而對蓄電器12充電與蓄電。

該電源插座14設於本體10一端上，與控制電路11相連接，可藉由一電源線141一端連接於該電源插座14，另一端連接於一汽車之點菸頭插座16上，使控制電路11啟動蓄電器12供電予汽車，作為輔助啟動汽車電源之救援。

藉此，當汽車駕駛人遇到汽車電瓶電力不足無法

WINPLUS Ex. 1003, p. 1039

發動的情形時，即可藉助本創作之隨身電源裝置的蓄電器12之供電來發動汽車，達到自力救濟之目的。

另，該本體10上設有一黃燈101、一綠燈102及一紅燈103，其中該黃燈101、綠燈102、紅燈103分別與控制電路11相連接，當控制電路11偵測出該蓄電器12過度充電時，係啟動該黃燈101發出黃色之警示亮光，當控制電路11偵測出該蓄電器12正常時，係啟動該綠燈102發出綠色之正常亮光，當控制電路11偵測出該蓄電器12需充電時，係啟動該紅燈103發出紅色之提示需充電亮光。

該本體10上設有一開關17，該開關17與該控制電路11相連接，可藉由操控該開關17為開啟（ON）/關閉（OFF），來啟動（ON）及關閉（OFF）該本體10之運作。

該本體10一端上設有一LED燈18，該LED燈18與該控制電路11相連接，當該本體10被啟動（ON）運作時，該控制電路11可啟動蓄電器12供電予該LED燈18，使該LED燈18發亮作為照明使用，當該本體10被關閉（OFF）運作時，同時該LED燈18被關閉（OFF）。

請參閱第4圖所示，該本體10底部設有一安裝孔104，該安裝孔104供安裝一腳架19，使本體10藉由該腳架19之支撐，而站立於一平面上。

該本體10在該USB插座13一側邊設有一防塵開關20，該防塵開關20具有一防塵蓋21，藉由推動該防塵開關20可使防塵蓋21蓋覆/離開該USB插座13上，藉以

WINPLUS Ex. 1003, p. 1040

防止細塵微粒落入該USB插座13中。

當藉由電源線141一端連接於該電源插座14，另一端連接於汽車之點菸頭插座16上時，該控制電路11可對汽車之電源設備作穩壓及穩流之作動。

當藉由電源線141一端連接於該電源插座14，另一端連接於汽車之點菸頭插座16上時，亦可利用汽車之電源設備產生之電力，對蓄電器12充電與蓄電。

又，亦可藉由一USB傳輸線131一端連接於該USB插座13，另一端連接於一攜帶型電子裝置（圖中未示）（例如：平板電腦、手機、筆記型電腦…等），使控制電路11啟動蓄電器12供電予該攜帶型電子裝置。

綜合上所述，本創作之多功能隨身電源裝置，確實具有前所未有之創新構造，其既未見於任何刊物，且市面上亦未見有任何類似的產品，是以，其具有新穎性應無疑慮。另外，本創作所具有之獨特特徵以及功能遠非習用所可比擬，所以其確實比習用更具有其進步性，而符合我國專利法有關新型專利之申請要件之規定，乃依法提起專利申請。

以上所述，僅為本創作最佳具體實施例，惟本創作之構造特徵並不侷限於此，任何熟悉該項技藝者在本創作領域內，可輕易思及之變化或修飾，皆可涵蓋在以下本案之專利範圍。

【圖式簡單說明】

第 1、2 圖為本創作多功能隨身電源裝置之二

WINPLUS Ex. 1003, p. 1041

種立體外觀圖。

第 3 圖為本創作多功能隨身電源裝置之電路方塊圖。

第 4 圖為本創作多功能隨身電源裝置之腳架示意圖。

【主要元件符號說明】

本體10
黃燈101
綠燈102
紅燈103
安裝孔104
控制電路11
蓄電器12
USB插座13
USB傳輸線131
電源插座14
電源線141
太陽能板15
汽車之點菸頭插座16
開關17
LED燈18
腳架19
防塵開關20
防塵蓋21

WINPLUS Ex. 1003, p. 1042

公告本

新型專利說明書

（本說明書格式、順序，請勿任意更動，※記號部分請勿填寫）

※申請案號：100207272

※申請日：　　※IPC 分類：H02J 7/32 (2006.01)

一、新型名稱：(中文/英文)

多功能隨身電源裝置

二、中文新型摘要：

一種多功能隨身電源裝置，包括：一控制電路、一蓄電器、一 USB 插座及一電源插座；其中，該控制電路設於本體內；該蓄電器設於本體內，與控制電路相接；該 USB 插座設於本體上，與控制電路相接，可藉由一 USB 傳輸線一端連接於該 USB 插座，另一端連接於一太陽能板，使太陽能板發電產生之電力，經由控制電路之操控，而對蓄電器充電與蓄電；該電源插座設於本體上，與控制電路相接，可藉由一電源線一端連接於該電源插座，另一端連接於一汽車之點菸頭插座上，使控制電路啟動蓄電器供電予汽車，藉以作為輔助啟動汽車電源之救援。

三、英文新型摘要：

WINPLUS Ex. 1003, p. 1043

六、申請專利範圍：

1、一種多功能隨身電源裝置，其係設有一本體，該本體包括有：

一控制電路，設於本體內；

一蓄電器，設於本體內，其與控制電路相接；

一USB插座，設於本體上，其與控制電路相接，藉由一USB傳輸線一端連接於該USB插座，另一端連接於一太陽能板，使太陽能板發電產生之電力，經由控制電路之操控，而對蓄電器充電及蓄電；

一電源插座，設於本體一端上，與控制電路相接，藉由一電源線一端連接於該電源插座，另一端連接於一汽車之點菸頭插座上，使控制電路啟動蓄電器供電予汽車，作為輔助啟動汽車電源之救援。

2、如申請專利範圍第 1 項所述之多功能隨身電源裝置，其中該本體上設有一黃燈、一綠燈及一紅燈，該黃燈、綠燈、紅燈分別與控制電路相接，當控制電路偵測出該蓄電器過度充電時，係啟動該黃燈發出黃色之警示亮光，當控制電路偵測出該蓄電器正常時，係啟動該綠燈發出綠色之正常亮光，當控制電路偵測出該蓄電器需充電時，係啟動該紅燈發出紅色之提示需充電亮光。

3、如申請專利範圍第 1 項所述之多功能隨身電源裝置，其中該本體上設有一開關，該開關與該控制電路相連接，藉由操控該開關為開啟（ON）/關閉（OFF），來啟動（ON）及關閉（OFF）該本體之運作。

WINPLUS Ex. 1003, p. 1044

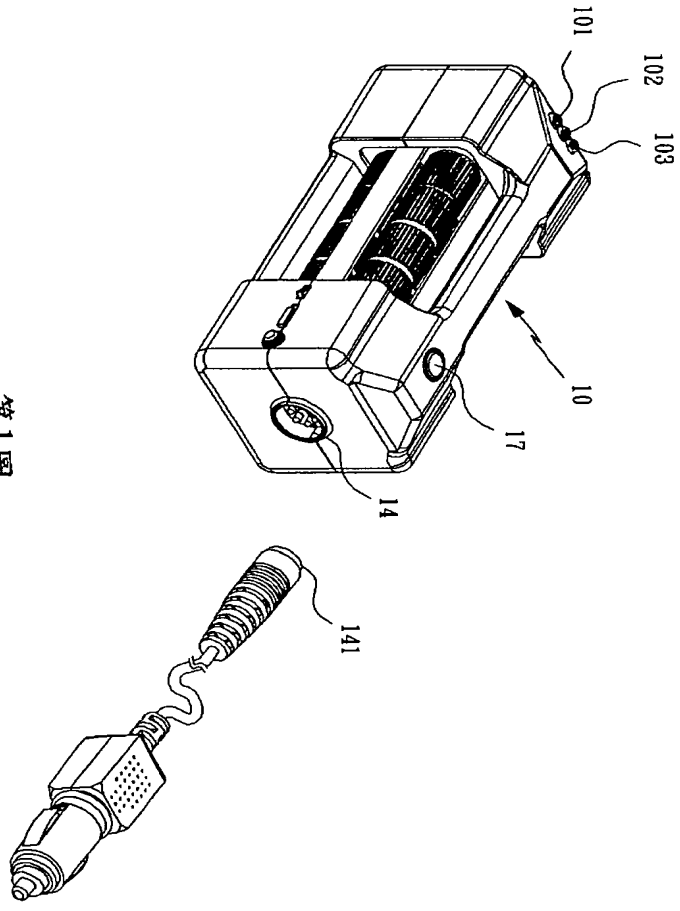
4、如申請專利範圍第 1 項所述之多功能隨身電源裝置，其中該本體一端上設有一LED燈，該LED燈與該控制電路相接，當該本體被啟動（ON）運作時，該控制電路啟動蓄電器供電予該LED燈，使該LED燈發亮作為照明使用。

5、如申請專利範圍第 1 項所述之多功能隨身電源裝置，其中該本體底部設有一安裝孔，該安裝孔供安裝一腳架。

6、如申請專利範圍第 1 項所述之多功能隨身電源裝置，其中該本體在該USB插座一側邊設有一防塵開關，該防塵開關具有一防塵蓋，藉由推動該防塵開關可使防塵蓋蓋覆/離開該USB插座上。

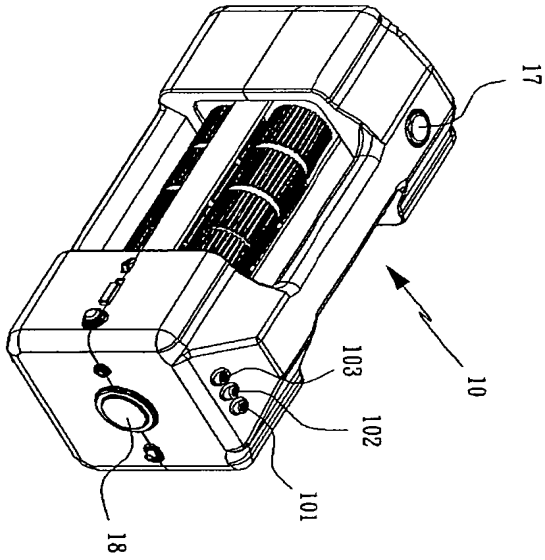
WINPLUS Ex. 1003, p. 1045

七、圖式：



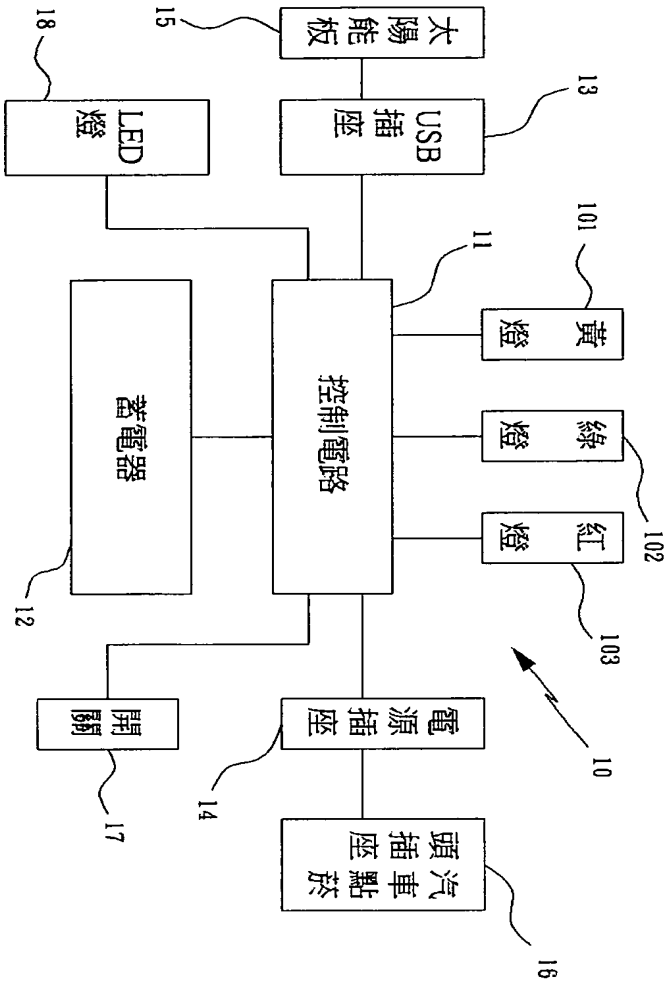
第1圖

WINPLUS Ex. 1003, p. 1046



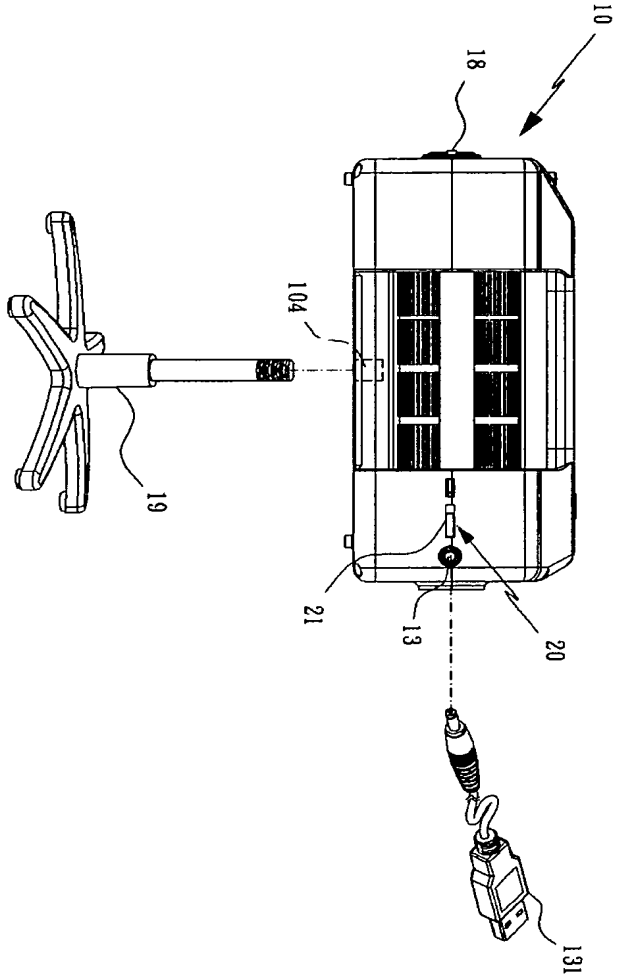
第2圖

WINPLUS Ex. 1003, p. 1047



第3圖

WINPLUS Ex. 1003, p. 1048



第4圖

WINPLUS Ex. 1003, p. 1049

四、指定代表圖：

(一)本案指定代表圖為：第（ 3 ）圖。

(二)本代表圖之元件符號簡單說明：

本體10

黃燈101

綠燈102

紅燈103

控制電路11

蓄電器12

USB插座13

電源插座14

太陽能板15

汽車之點菸頭插座16

開關17

LED燈18

WINPLUS Ex. 1003, p. 1050

TWM417714U – Machine Translation

Title

Multifunctional portable power supply device

Abstract:

A multifunctional portable power supply device, comprising: a control circuit, an accumulator, a USB socket and a power socket; wherein the control circuit is arranged in the body; the accumulator is arranged in the body and connected to the control circuit; the USB socket is set on the main body and is connected to the control circuit. One end of a USB transmission line can be connected to the USB socket and the other end is connected to a solar panel, so that the power generated by the solar panel can be controlled by the control circuit to charge the battery. The power socket is set on the main body and connected to the control circuit. One end of a power cord can be connected to the power socket and the other end is connected to the cigarette lighter socket of a car, so that the control circuit activates the battery to supply power to the car, in order to assist the rescue of starting the car's power supply.

Description:

[Technical field to which the invention belongs]

[0001] This invention is a multi-functional portable power device, especially an innovative structure that combines a storage device and a control circuit, which can be used as a device to assist in starting car power rescue and outdoor power supply.

[Prior Art]

[0002] During the process of using the car, car drivers will inevitably encounter situations where the car cannot be started. The reason for this is often related to insufficient battery power, and there are several possible reasons, such as forgetting to turn off the car. Lights, the surrounding temperature is too low, the battery itself is too old and ineffective; and when this problem occurs, if the car is parked in a place where the car passes frequently, perhaps the driver can use the battery connection of another car to assist in starting The engine solves the problem; or, if the car happens to be parked near the maintenance yard, it can be repaired by maintenance personnel.

[0003] However, sometimes drivers may encounter difficulties in seeking help (such as late at night, remote areas), and eventually, they may not be able to drive due to insufficient battery power, which delays the original plan and itinerary, causing great driver Loss.

[Content of the invention]

[0004] In view of the aforementioned shortcomings of the prior art, the inventors, based on their experience in manufacturing various power supply devices and accumulated technologies, carefully studied various solutions to the above-mentioned shortcomings. After continuous research, experimentation and improvement, they finally developed and designed the present invention. The invention of a brand-new multi-functional portable power supply device, intending to eliminate the deficiencies caused by the prior art technology.

[0005] One of the purposes of the present invention is to provide a multifunctional portable power supply device that combines an innovative structure with a storage device and a control circuit, which can be used as a rescue to assist in starting the car's power supply.

[0006] Another purpose of the present invention is to provide a multifunctional portable power supply device, which combines an innovative structure of a storage device and a control circuit to be used as an outdoor power source.

[0007] According to the above-mentioned purpose, the portable power supply device of this invention is provided with a main body, the main body includes: a control circuit, an accumulator, a USB socket and a power socket; wherein the control circuit is arranged in the main body; the accumulator Set in the main body and connected to the control circuit; the USB socket is set on the main body and connected to the control circuit. One end of a USB transmission line can be connected to the USB socket and the other end is connected to a solar panel to make the solar panel generate electricity. The generated electricity is controlled by the control circuit to charge the battery; the power socket is located on the main body and is connected to the control circuit. One end of the power cord can be connected to the power socket and the other end to a car. On the cigarette lighter socket, the control circuit activates the accumulator to supply power to the car as an aid to start the car's power supply; in this way, when the car driver encounters a situation where the car's battery is insufficient to start the car, he can start the car with the power of the accumulator to achieve the purpose of self-relief.

[0008] In order to facilitate your reviewer to have a further understanding and understanding of the purpose, shape, features and effects of the structure and device of this invention, the examples and diagrams are described in detail as follows:

[Implementation mode]

[0009] This invention is about a "multifunctional portable power device". Please refer to Figures 1, 2 and 3. The portable power device of

this invention is provided with a body 10, which includes: a control circuit 11, a battery 12, a USB socket 13, and a power socket 14.

[0010] Wherein, the control circuit 11 is provided in the main body 10.

[0011] The accumulator 12 is arranged in the main body 10 and is connected to the control circuit 11.

[0012] The USB socket 13 is arranged on the main body 10 and is connected to the control circuit 11. One end of a USB transmission line 131 can be connected to the USB socket 13 and the other end is connected to a solar panel 15, so that the solar panel 15 generates electricity. Through the control of the control circuit 11, the accumulator 12 is charged and stored.

[0013] The power socket 14 is arranged on one end of the main body 10 and is connected to the control circuit 11. One end of a power cord 141 is connected to the power socket 14 and the other end is connected to a cigarette lighter socket 16 of a car and the control circuit 11. The starting accumulator 12 supplies power to the car as a rescue to assist in starting the car's power supply.

[0014] In this way, when the car driver encounters a situation where the car battery is insufficient to start, he can start the car with the power of the accumulator 12 of the portable power device of this invention to achieve the purpose of self-relief.

[0015] In addition, the main body 10 is provided with a yellow light 101, a green light 102, and a red light 103. The yellow light 101, the green light 102, and the red light 103 are respectively connected to the control circuit 11. When the control circuit 11 detects the storage device 12 when overcharged, the yellow light 101 is activated to emit a yellow warning light. When the control circuit 11 detects that the storage device 12 is normal, the green light 102 is activated to emit a green normal light. When the control circuit 11 detects the storage device 12 12 when charging is required, the red light 103 is activated to give a red reminder that charging is required.

[0016] The main body 10 is provided with a switch 17 which is connected to the control circuit 11, and the main body can be turned on (ON) and closed (OFF) by manipulating the switch 17 to turn on (ON)/close (OFF) 10 of the operation.

[0017] An LED lamp 18 is provided on one end of the main body 10, and the LED lamp 18 is connected to the control circuit 11. When the main body 10 is turned on (ON), the control circuit 11 can activate the storage device 12 to supply power to the LED lamp 18. The LED lamp 18 is turned on for illumination. When the main body 10 is turned off (OFF), the LED lamp 18 is turned off (OFF).

[0018] Please refer to FIG. 4, where the bottom of the main body 10 is provided with a mounting hole 104 for mounting a stand 19, so that the main body 10 stands on a flat surface by the support of the stand 19.

[0019] The body 10 is provided with a dustproof switch 20 on one side of the USB socket 13. The dustproof switch 20 has a dustproof cover 21. By pushing the dustproof switch 20, the dustproof cover 21 can cover/leave the USB socket 13, thereby Prevent fine dust particles from falling into the USB socket 13.

[0020] When one end of the power cord 141 is connected to the power socket 14 and the other end is connected to the cigarette lighter socket 16 of the car, the control circuit 11 can stabilize and stabilize the power supply of the car.

[0021] When one end of the power cord 141 is connected to the power socket 14 and the other end is connected to the cigarette lighter socket 16 of the car, the electric power generated by the power supply equipment of the car can also be used to charge and store the battery 12.

[0022] In addition, one end of a USB transmission line 131 can be connected to the USB socket 13 and the other end can be connected to a portable electronic device (not shown in the figure) (for example: tablet computer, mobile phone, notebook computer... etc.) to control The circuit 11 activates the storage device 12 to supply power to the portable electronic device.

[0023] In summary, the multifunctional portable power supply device created by this invention does have an unprecedented innovative structure. It has not been seen in any publications, and there is no similar product on the market. Therefore, its novelty should be considered. In addition, the unique features and functions of this invention are far from comparable to those of conventional ones, so it is indeed more progressive than conventional ones, and it complies with the requirements of my country's patent law on the requirements for new patent applications. Patent applications are filed in accordance with the law.

[0024] The above are only the best specific embodiments of this invention, but the structural features of this invention are not limited to this. Any change or modification that can be easily thought of by anyone familiar with the art in this invention field can be covered. In the following patent scope of this case.

[Schematic description]

[0043] Figures 1 and 2 are two three-dimensional appearance diagrams of the created multifunctional portable power device.

[0044] Figure 3 is the circuit block diagram of the creative multifunctional portable power supply device.

[0045] Figure 4 is a schematic diagram of the tripod of the creative multifunctional portable power device.

[Description of main component symbols]

[0025] 10 body

[0026] 101 yellow light

[0027] 102 green light

[0028] 103 red light

[0029] 104 mounting holes

[0030] 11 control circuit

[0031] 12 accumulator

[0032] 13 USB socket

[0033] 131 USB cable

[0034] 14 power outlet

[0035] 141 power cable

[0036] 15 solar panels

[0037] 16 car cigarette socket

[0038] 17 switch

[0039] 18 LED lights

[0040] 19 tripod

[0041] 20 dust switch

[0042] 21 dust cover

Claims:

1. A multifunctional portable power supply device, which is provided with a body, the body includes: a control circuit arranged in the body; an accumulator arranged in the body and connected to the control circuit; and a USB socket arranged in the body it is connected to the control circuit; one end of a USB transmission line is connected to the USB socket and the other end is connected to a solar panel, so that the power generated by the solar panel is controlled by the control circuit to charge and store electricity; a power socket is set on one end of the main body and is connected to the control circuit; one end of a power cord is connected to the power socket and the other end is connected to a cigarette lighter socket of a car, so that the control circuit activates the battery to supply power to the car, as a rescue aid to start the car power supply.

2. The multifunctional portable power supply device described in item 1 of the scope of patent application, wherein the main body is provided with a yellow light, a green light and a red light, and the yellow light, green light and red light are respectively connected to the control circuit, when the control circuit detects that the storage device is overcharged, it activates the yellow light to emit a yellow warning light, when the control circuit detects that the storage device is normal, it activates the green light to emit a green normal light, when the control circuit detects the When the accumulator needs to be charged, the red light is activated to indicate that it needs to be charged.

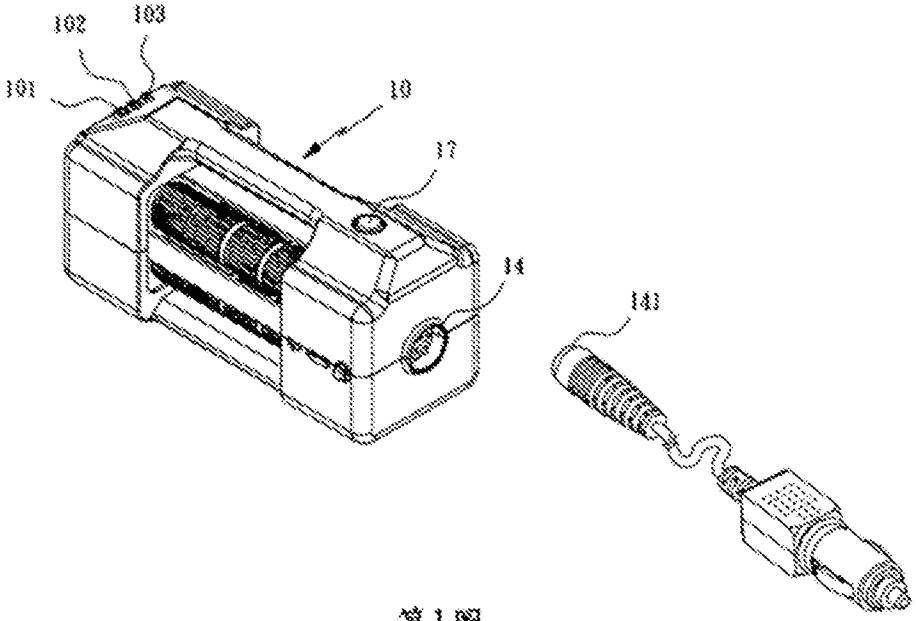
3. The multifunctional portable power supply device described in item 1 of the scope of patent application, wherein a switch is provided on the main body, and the switch is connected with the control circuit, and the switch is turned on (ON)/closed (OFF) by manipulating the switch , to start (ON) and close (OFF) the operation of the main body.

4. The multifunctional portable power supply device described in the first item of the scope of patent application, wherein an LED lamp is provided on one end of the main body, and the LED lamp is connected with the control circuit. When the main body is turned on (ON), the control circuit activates the accumulator to supply power to the LED lamp, so that the LED lamp is lit for illumination.

5. The multifunctional portable power supply device described in item 1 of the scope of patent application, wherein a mounting hole is provided at the bottom of the main body, and the mounting hole is for mounting a tripod.

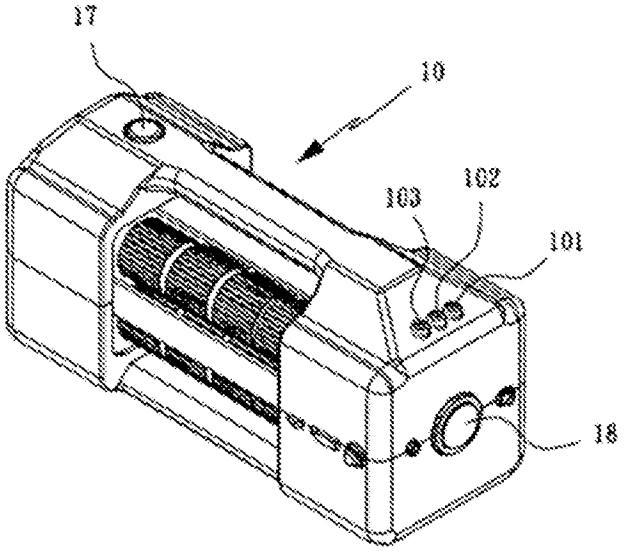
6. The multifunctional portable power supply device described in item 1 of the scope of patent application, wherein the main body is provided with a dust-proof switch on one side of the USB socket, and the dust-proof switch has a dust-proof cover and a cover for the USB socket.

Figures:



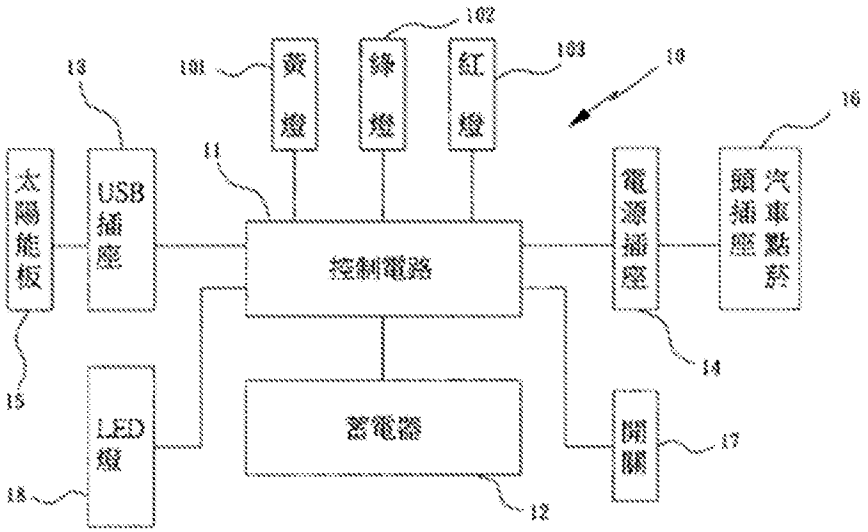
第1圖

FIG. 1



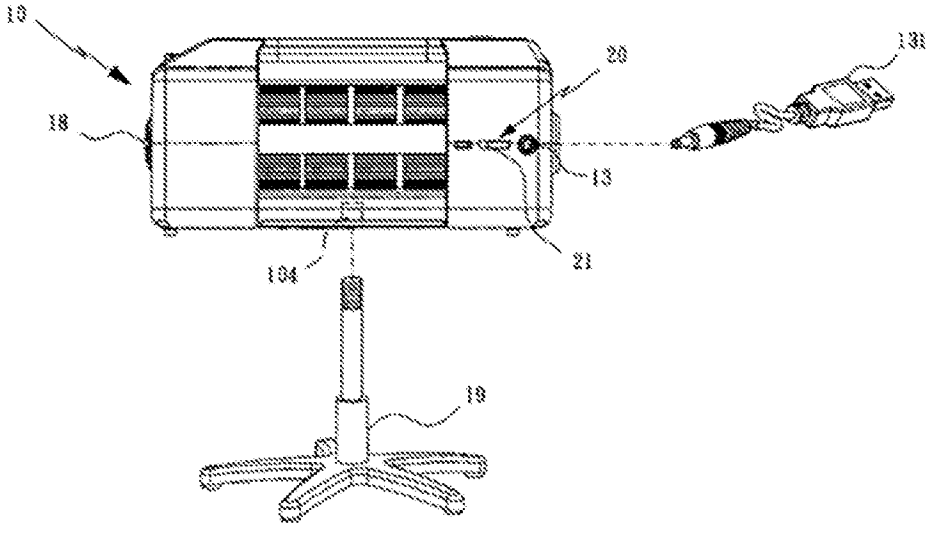
第2圖

FIG. 2



第3圖

FIG. 3



第4圖

FIG. 4

Espacenet

Bibliographic data: GB2557733 (A) — 2018-06-27

Battery assembly device

Inventor(s): JONATHAN LEWIS NOOK [US]; WILLIAM KNIGHT NOOK [US]; JAMES RICHARD STANFIELD [US]; DEREK MICHAEL UNDERHILL [US] ± (Jonathan Lewis Nook, ; William Knight Nook, ; James Richard Stanfield, ; Derek Michael Underhill)

Applicant(s): NOCO CO [US] ± (The NOCO Company)

Classification: - international: ***H02J7/00; H02J7/14***
- cooperative: **H01M2/30 (US); H01R11/24 (US); H02J1/122 (EP); H02J7/14 (EP, GB, US); H02J7/342 (GB);** F02N11/12 (EP); F02N11/14 (EP); H02J1/122 (US)

Application number: GB20170018653 20160329

Priority number(s): WO2016US24680 20160329 ; US201662294067P 20160211

Also published as: AU2016392707 (A1) AU2016392707 (B2) AU2020200268 (A1) CA2957431 (A1) CN107852004 (A) more

Abstract of GB2557733 (A)

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

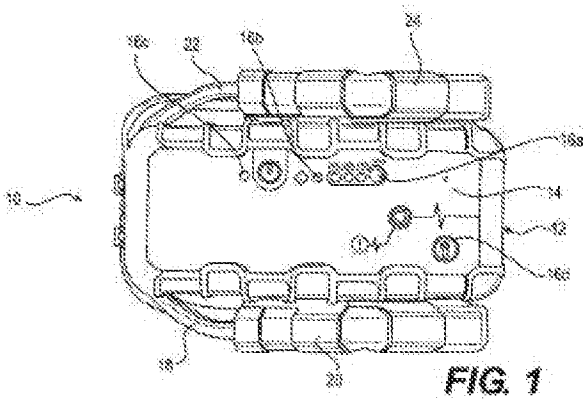


FIG. 1

(12) UK Patent Application (19) GB (11) 2557733 (13) A

(43) Date of Reproduction by UK Office 27.06.2018

(21) Application No: 1718653.7

(22) Date of Filing: 29.03.2016

Date Lodged: 10.11.2017

(30) Priority Data:
(31) 62294067 (32) 11.02.2016 (33) US

(86) International Application Data:
PCT/US2016/024680 En 29.03.2016

(87) International Publication Data:
WO2017/138963 En 17.08.2017

(71) Applicant(s):
The NOCO Company
30339 Diamond Parkway, #102, Glenwillow 44139,
Ohio, United States of America

(72) Inventor(s):
Jonathan Lewis Nook
William Knight Nook
James Richard Stanfield
Derek Michael Underhill

(74) Agent and/or Address for Service:
Slingsby Partners LLP
1 Kingsway, LONDON, WC2B 6AN, United Kingdom

(51) INT CL:
H02J 7/14 (2006.01) *H02J 7/00* (2006.01)

(56) Documents Cited:
US 9007015 B1
US 6002235 A
US 20150087182 A1
US 6679708 B1
US 4990723 A
US 20050213867 A1

(58) Field of Search:
INT CL H02J

(54) Title of the Invention: **Battery assembly device**
Abstract Title: **Battery assembly device**

(57) The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

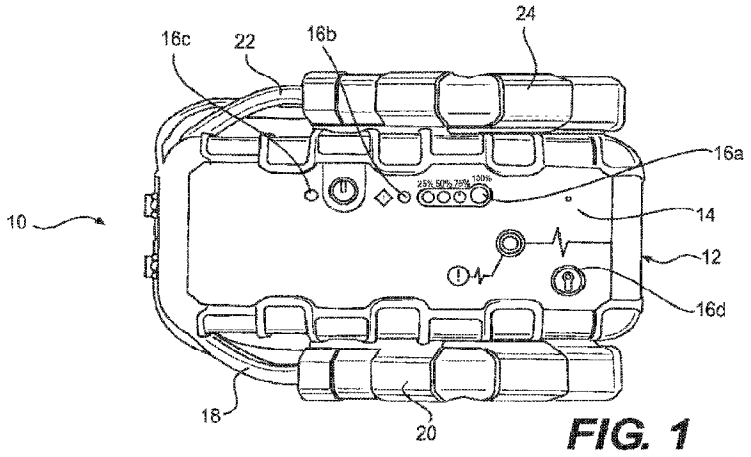


FIG. 1

GB 2557733 A

This international application has entered the national phase early.

Espacenet

Bibliographic data: GB2527858 (A) — 2016-01-06

Portable vehicle battery jump start apparatus with safety protection

Inventor(s): NOOK JONATHAN LEWIS [US]; NOOK WILLIAM KNIGHT [US]; STANFIELD JAMES RICHARD [US]; UNDERHILL DEREK MICHAEL [US] ± (JONATHAN LEWIS NOOK, ; WILLIAM KNIGHT NOOK, ; JAMES RICHARD STANFIELD, ; DEREK MICHAEL UNDERHILL, ; Jonathan Lewis Nook, ; William Knight Nook, ; James Richard Stanfield, ; Derek Michael Underhill)

Applicant(s): NOCO COMPANY [US] ± (THE NOCO COMPANY, ; The NOCO Company)

Classification: **- international:*H02J7/00***
- cooperative: H02J7/0034 (EP, GB); H02J7/0036 (EP, GB); H02J7/342 (EP, GB)

Application number: GB20140015291 20140829

Priority number(s): WO2014US45434 20140703

Also published as: GB2527858 (B) AU2015258229 (A1) AU2016269555 (A1) AU2016269555 (B2) AU2019201559 (A1) more

Abstract of GB2527858 (A)

A handheld device for jump starting a vehicle engine includes a rechargeable lithium ion battery pack 32 and a microcontroller 1. The lithium ion battery 32 is coupled to a power output port of the device through a FET smart switch 15 actuated by the microcontroller 1. A vehicle battery isolation sensor 12 detects the presence of a vehicle battery 72 connected between the positive and negative polarity outputs. A reverse polarity sensor 10 detects the polarity of a vehicle battery 72 connected between the positive and negative polarity outputs, such that the microcontroller 1 will enable power

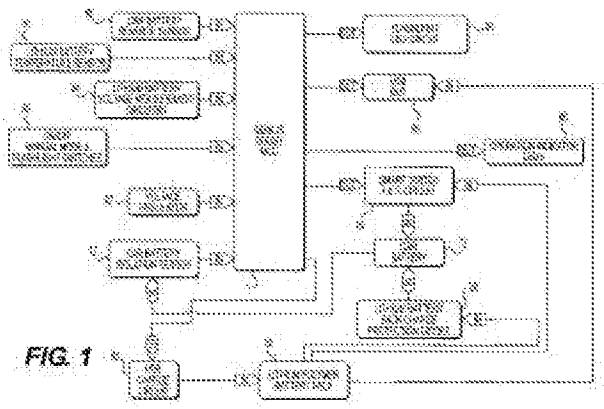


FIG. 1

to be delivered from the lithium ion power pack 32 to the output port only when a good battery is connected to the output port and only when the battery is connected with proper polarity of positive and negative terminals.

(12) UK Patent Application (19) GB (11) 2527858 (13) A

(43) Date of A Publication 06.01.2016

(21) Application No: 1415291.2

(22) Date of Filing: 29.08.2014

(30) Priority Data:
(31) US2014045434 (32) 03.07.2014 (33) WO

(71) Applicant(s):
The NOCO Company
30339 Diamond Parkway, #102, Glenwillow 44139, Ohio, United States of America

(72) Inventor(s):
Jonathan Lewis Nook
William Knight Nook
James Richard Stanfield
Derek Michael Underhill

(74) Agent and/or Address for Service:
Slingsby Partners LLP
5 Chancery Lane, LONDON, EC4A 1BL, United Kingdom

(51) INT CL:
H02J 7/00 (2006.01)

(56) Documents Cited:
WO 2004/036714 A1 **US 20140159509 A1**
US 20130154543 A1 **US 20100301800 A1**
US 20040130298 A1 **US 20020041174 A1**

(58) Field of Search:
INT CL **H02J**
Other: **WPI, EPODOC, TXTE**

(54) Title of the Invention: **Portable vehicle battery jump start apparatus with safety protection**
Abstract Title: **Vehicle jump starter with battery presence and polarity detection**

(57) A handheld device for jump starting a vehicle engine includes a rechargeable lithium ion battery pack 32 and a microcontroller 1. The lithium ion battery 32 is coupled to a power output port of the device through a FET smart switch 15 actuated by the microcontroller 1. A vehicle battery isolation sensor 12 detects the presence of a vehicle battery 72 connected between the positive and negative polarity outputs. A reverse polarity sensor 10 detects the polarity of a vehicle battery 72 connected between the positive and negative polarity outputs, such that the microcontroller 1 will enable power to be delivered from the lithium ion power pack 32 to the output port only when a good battery is connected to the output port and only when the battery is connected with proper polarity of positive and negative terminals.

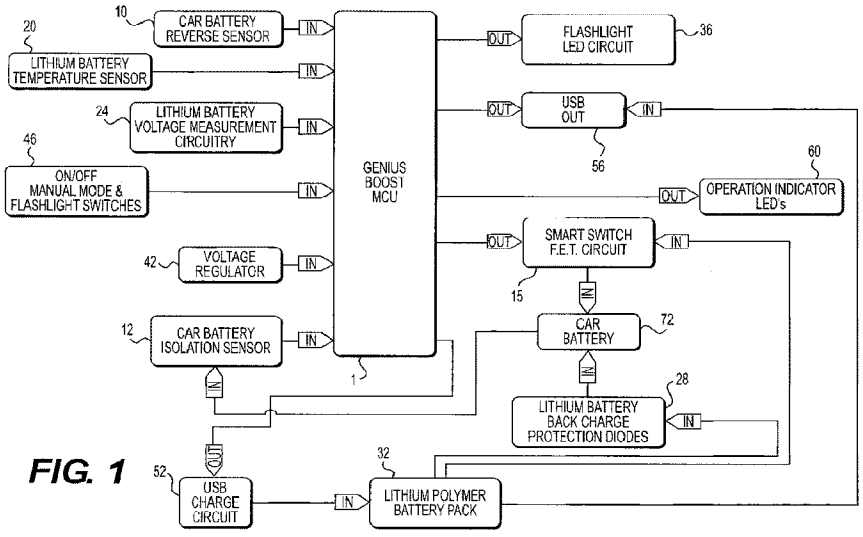


FIG. 1

GB 2527858 A

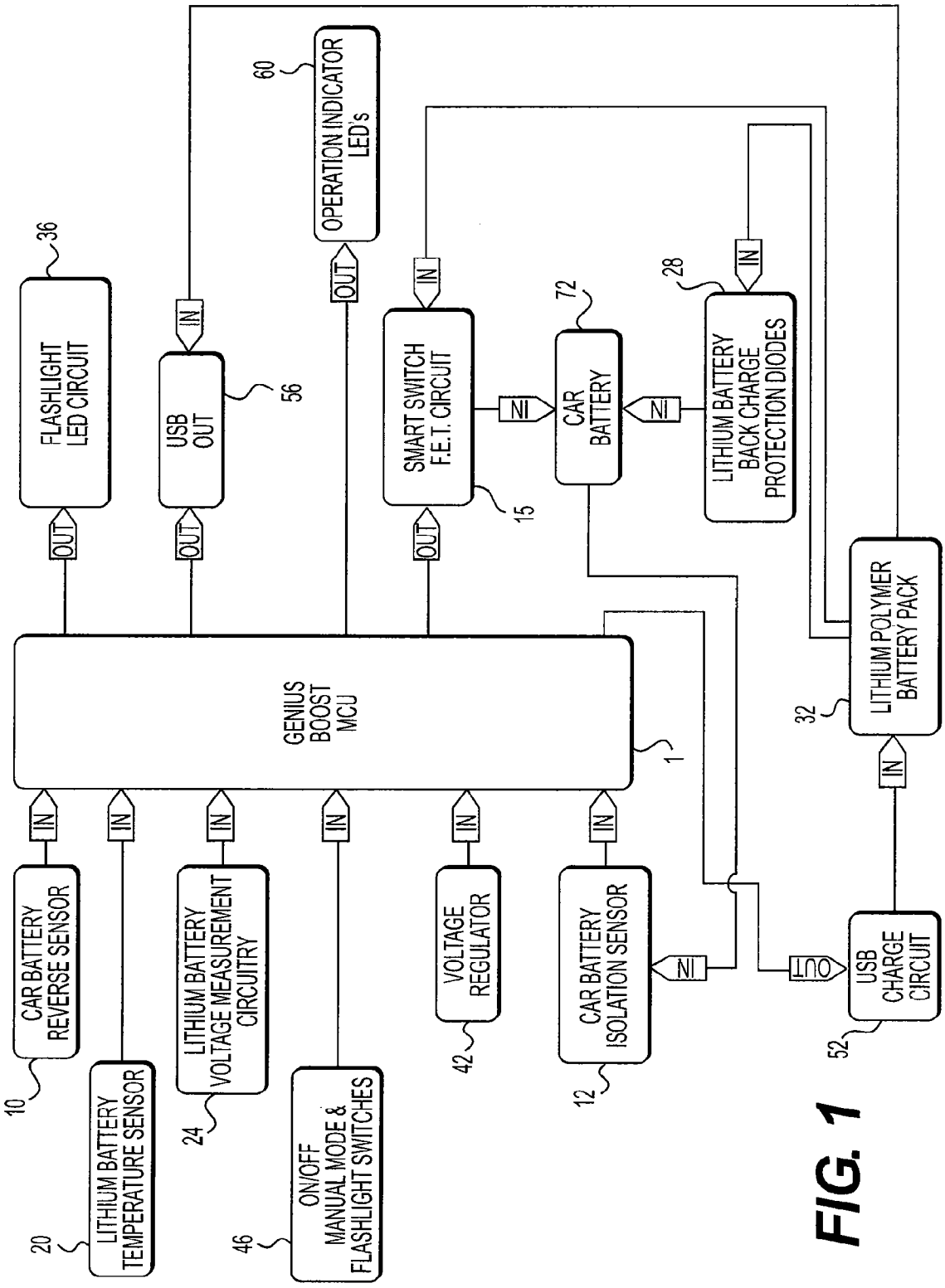

GENIUS BOOST MCU
1
LITHIUM POLYMER BATTERY PACK
32
FLASHLIGHT LED CIRCUIT
36
USB OUT
56
OPERATION INDICATOR LED's
60
SMART SWITCH F.E.T. CIRCUIT
15
CAR BATTERY
72
LITHIUM BATTERY BACK CHARGE PROTECTION DIODES
28
CAR BATTERY REVERSE SENSOR
10
LITHIUM BATTERY TEMPERATURE SENSOR
20
LITHIUM BATTERY VOLTAGE MEASUREMENT CIRCUITRY
24
ON/OFF MANUAL MODE & FLASHLIGHT SWITCHES
46
VOLTAGE REGULATOR
42
CAR BATTERY ISOLATION SENSOR
12
USB CHARGE CIRCUIT
52
IN
OUT

FIG. 1

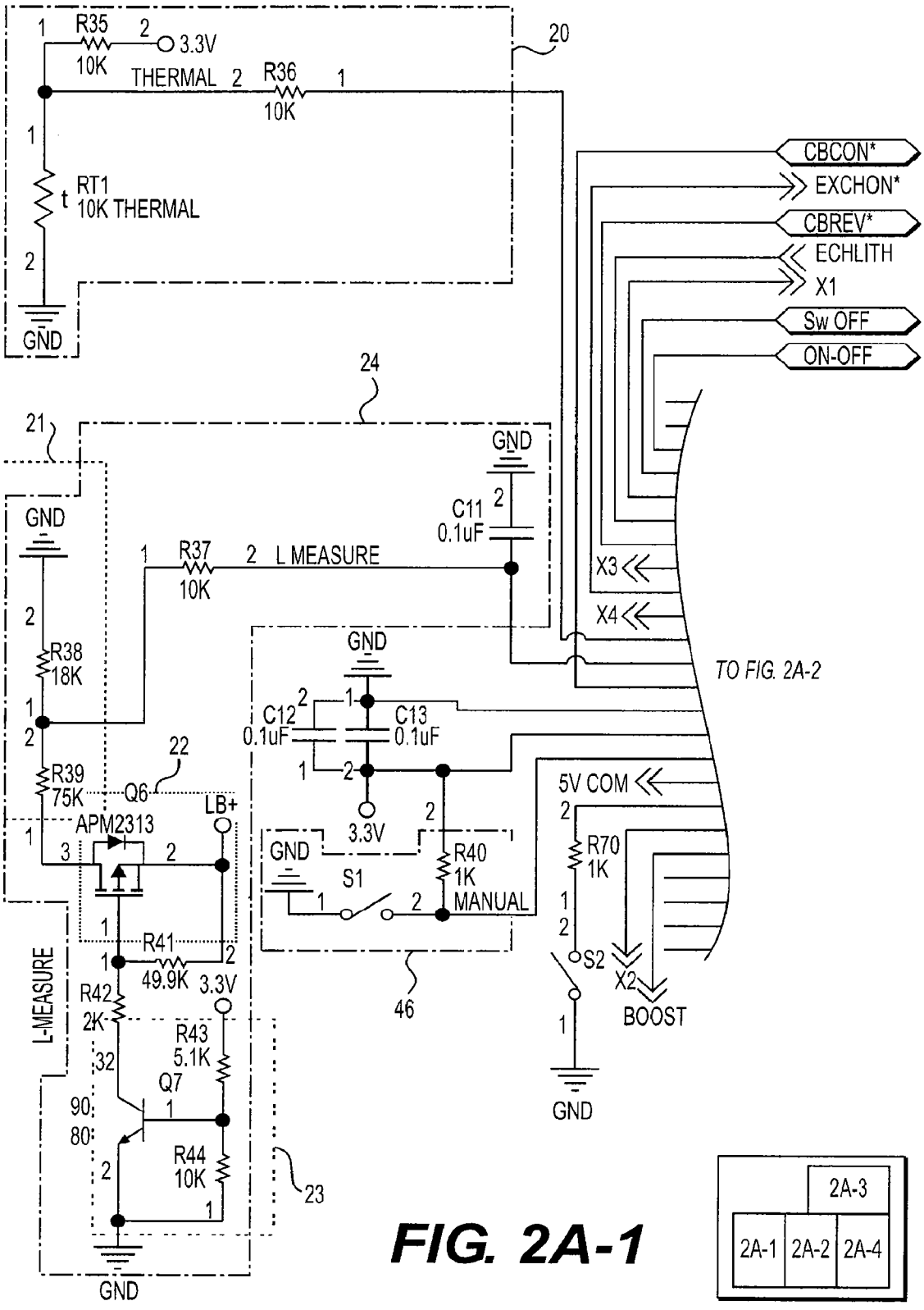
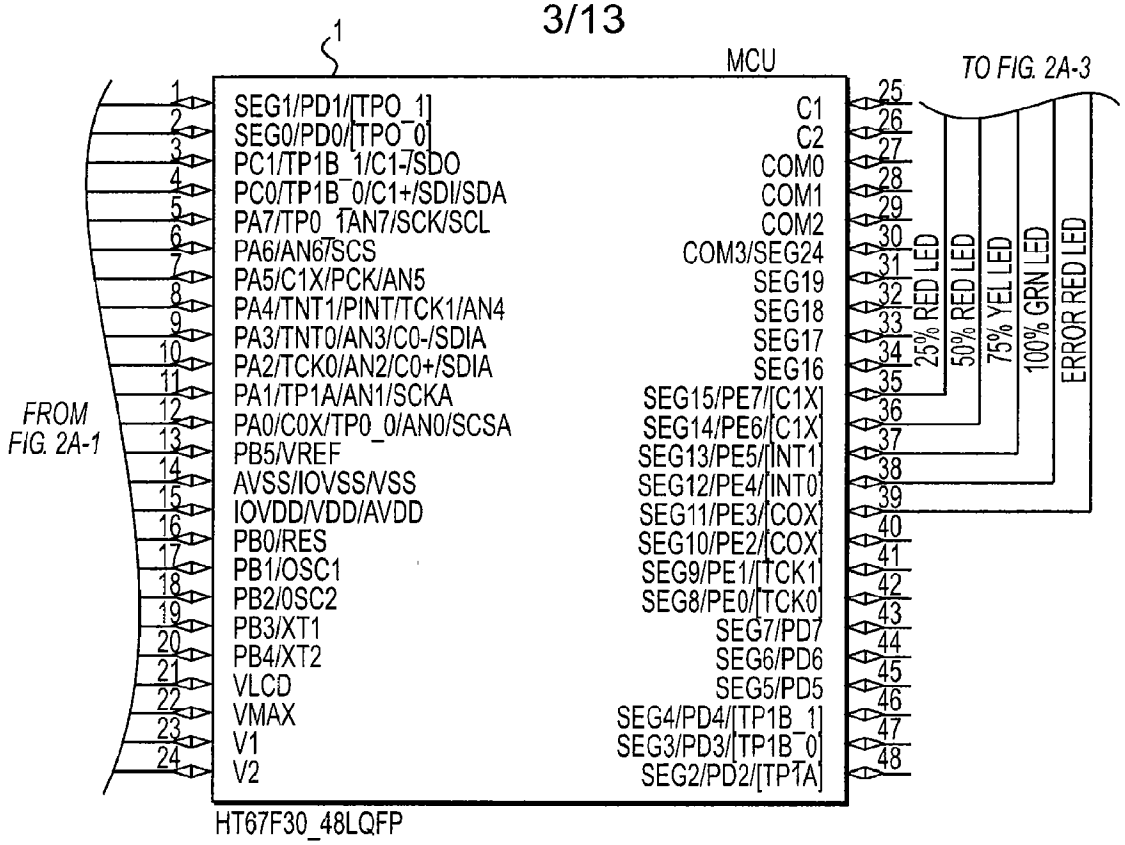

20
R35
10K
3.3V
THERMAL
R36
10K
RT1
10K THERMAL
GND
CBCON*
EXCHON*
CBREV*
ECHLITH
X1
Sw OFF
ON-OFF
24
21
GND
C11
0.1uF
R37
10K
L MEASURE
X3
X4
R38
18K
C12
0.1uF
C13
0.1uF
TO FIG. 2A-2
22
R39
75K
Q6
APM2313
LB+
3.3V
5V COM
R70
1K
R40
1K
S1
MANUAL
S2
X2
BOOST
46
R41
49.9K
R42
2K
R43
5.1K
Q7
R44
10K
L-MEASURE
23

FIG. 2A-1

2A-3
2A-1
2A-2
2A-4


1
MCU
TO FIG. 2A-3
FROM FIG. 2A-1
SEG1/PD1/[TPO_1]
SEG0/PD0/[TPO_0]
PC1/TP1B_1/C1-/SDO
PC0/TP1B_0/C1+/SDI/SDA
PA7/TP0_1AN7/SCK/SCL
PA6/AN67/SCS
PA5/C1X/PCK/AN5
PA4/TNT1/PINT/TCK1/AN4
PA3/TNT0/AN3/C0-/SDIA
PA2/TCK0/AN2/C0+/SDIA
PA1/TP1A/AN1/SCKA
PA0/C0X/TP0_0/AN0/SCSA
PB5/VREF
AVSS/IOVSS/VSS
IOVDD/VDD/AVDD
PB0/RES
PB1/OSC1
PB2/0SC2
PB3/XT1
PB4/XT2
VLCD
VMAX
V1
V2
C1
C2
COM0
COM1
COM2
COM3/SEG24
SEG19
SEG18
SEG17
SEG16
SEG15/PE7/[C1X]
SEG14/PE6/[C1X]
SEG13/PE5/[INT1]
SEG12/PE4/[INT0]
SEG11/PE3/[COX]
SEG10/PE2/[COX]
SEG9/PE1/[TCK1]
SEG8/PE0/[TCK0]
SEG7/PD7
SEG6/PD6
SEG5/PD5
SEG4/PD4/[TP1B_1]
SEG3/PD3/[TP1B_0]
SEG2/PD2/[TP1A]
25% RED LED
50% RED LED
75% YEL LED
100% GRN LED
ERROR RED LED
HT67F30_48LQFP

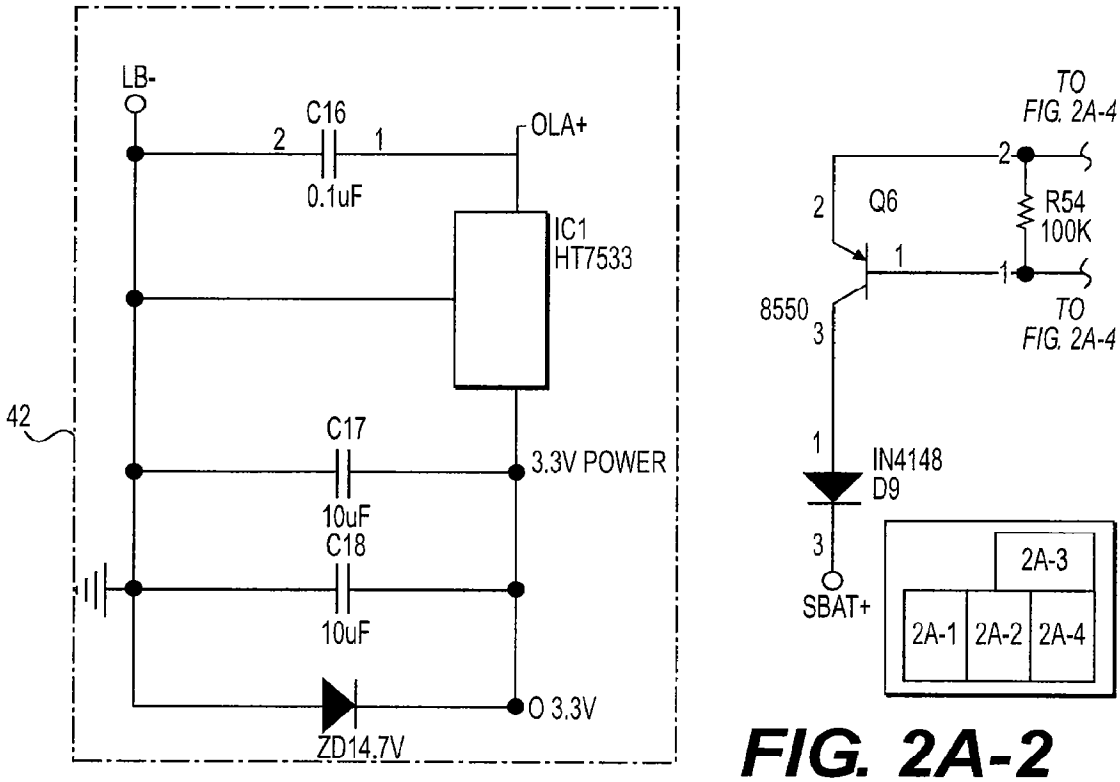

LB-
C16
0.1uF
OLA+
IC1
HT7533
42
C17
10uF
3.3V POWER
C18
10uF
O 3.3V
ZD14.7V
TO FIG. 2A-4
Q6
R54
100K
8550
TO FIG. 2A-4
IN4148
D9
SBAT+
2A-3
2A-1
2A-2
2A-4

FIG. 2A-2

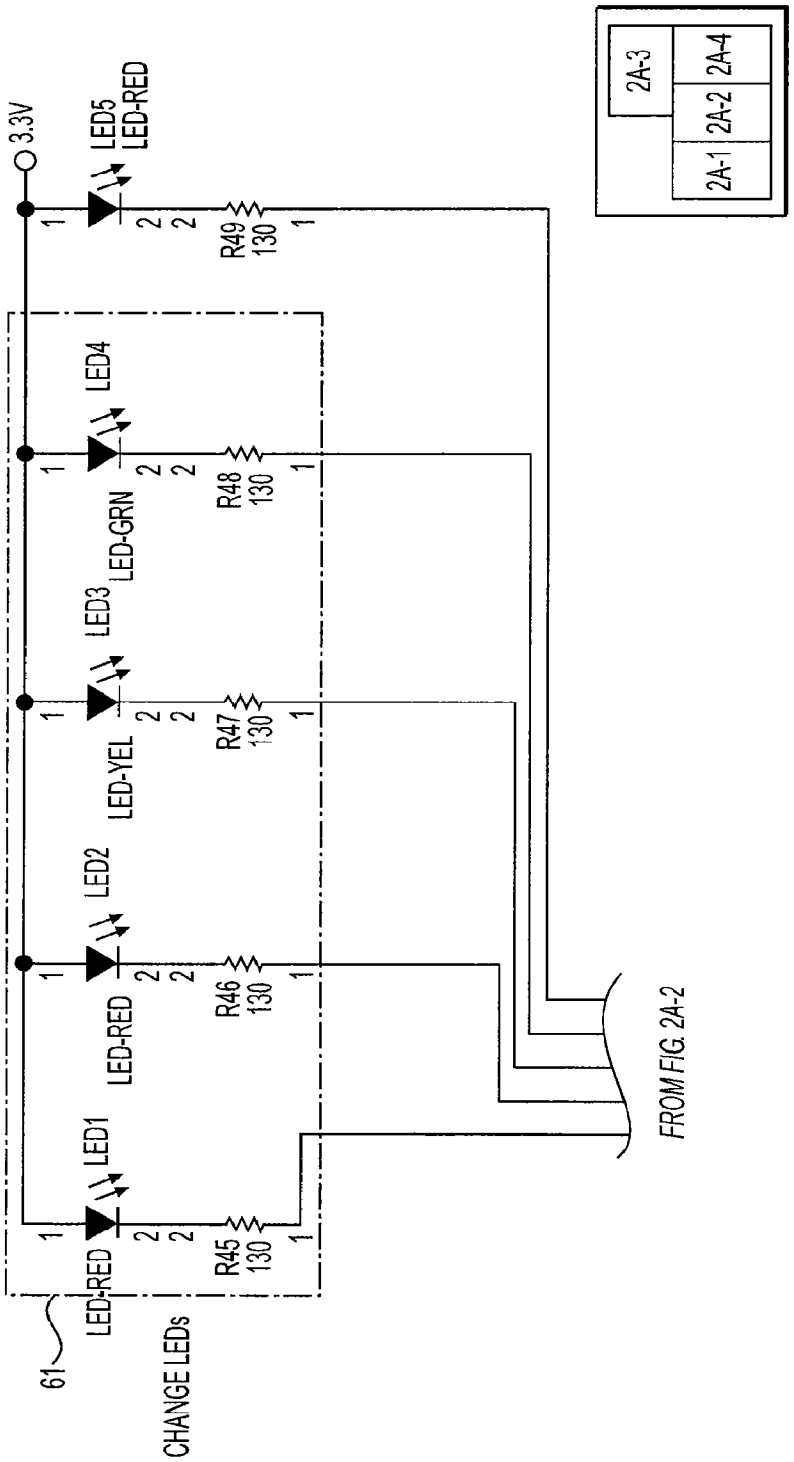

3.3V
LED5
LED-RED
R49
130
LED4
LED-GRN
R48
130
LED3
LED-YEL
R47
130
LED2
LED-RED
R46
130
LED1
LED-RED
R45
130
61
CHANGE LEDs
FROM FIG. 2A-2
2A-3
2A-1
2A-2
2A-4

FIG. 2A-3

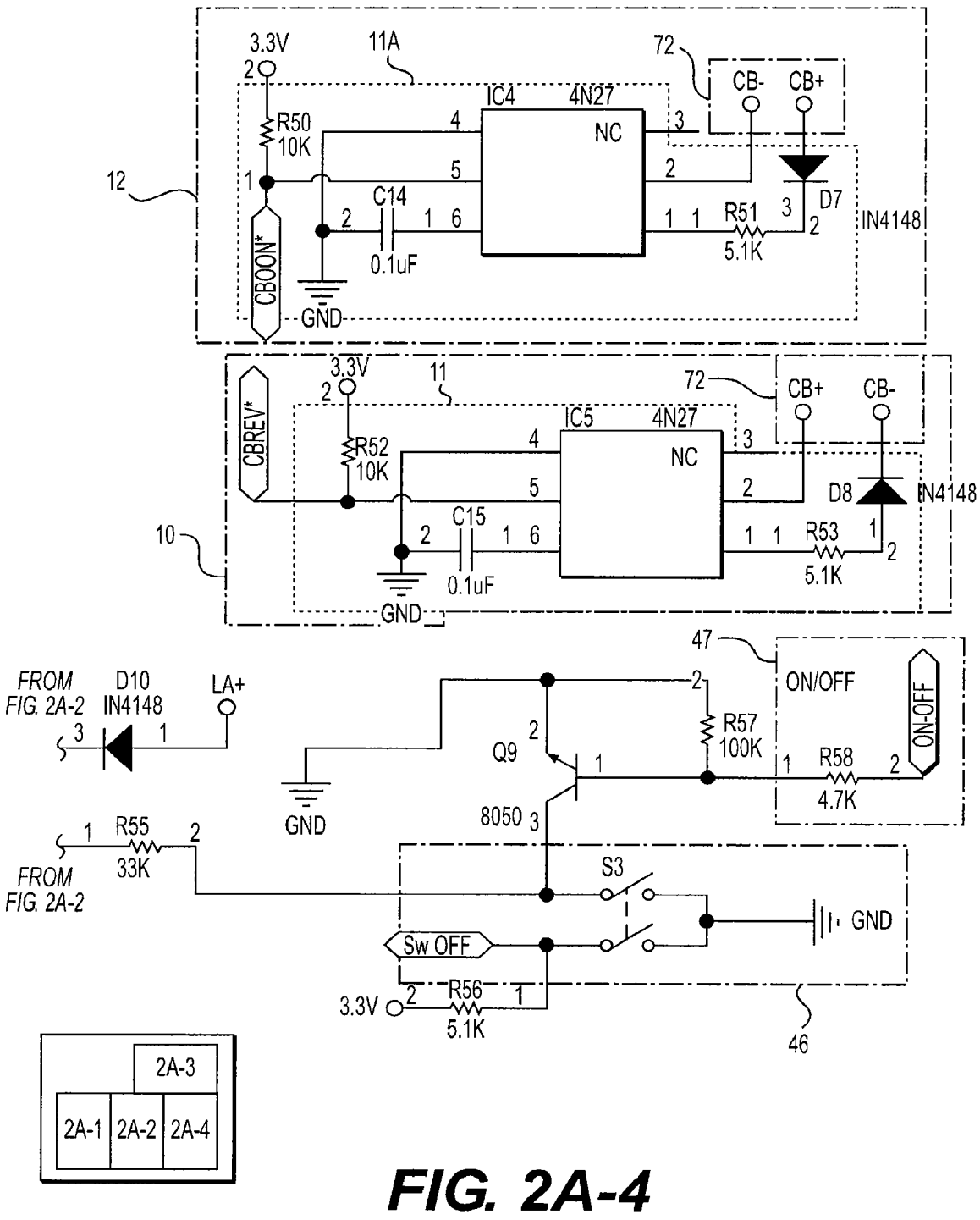

3.3V
11A
72
CB-
CB+
IC4
4N27
NC
R50
10K
12
C14
0.1uF
R51
5.1K
D7
IN4148
CBOON*
GND
3.3V
11
CBREV*
R52
10K
IC5
4N27
NC
D8
IN4148
C15
0.1uF
R53
5.1K
10
GND
47
ON/OFF
ON-OFF
FROM FIG. 2A-2
D10
IN4148
LA+
Q9
R57
100K
R58
4.7K
8050
R55
33K
FROM FIG. 2A-2
GND
S3
Sw OFF
GND
3.3V
R56
5.1K
46
2A-3
2A-1
2A-2
2A-4

FIG. 2A-4

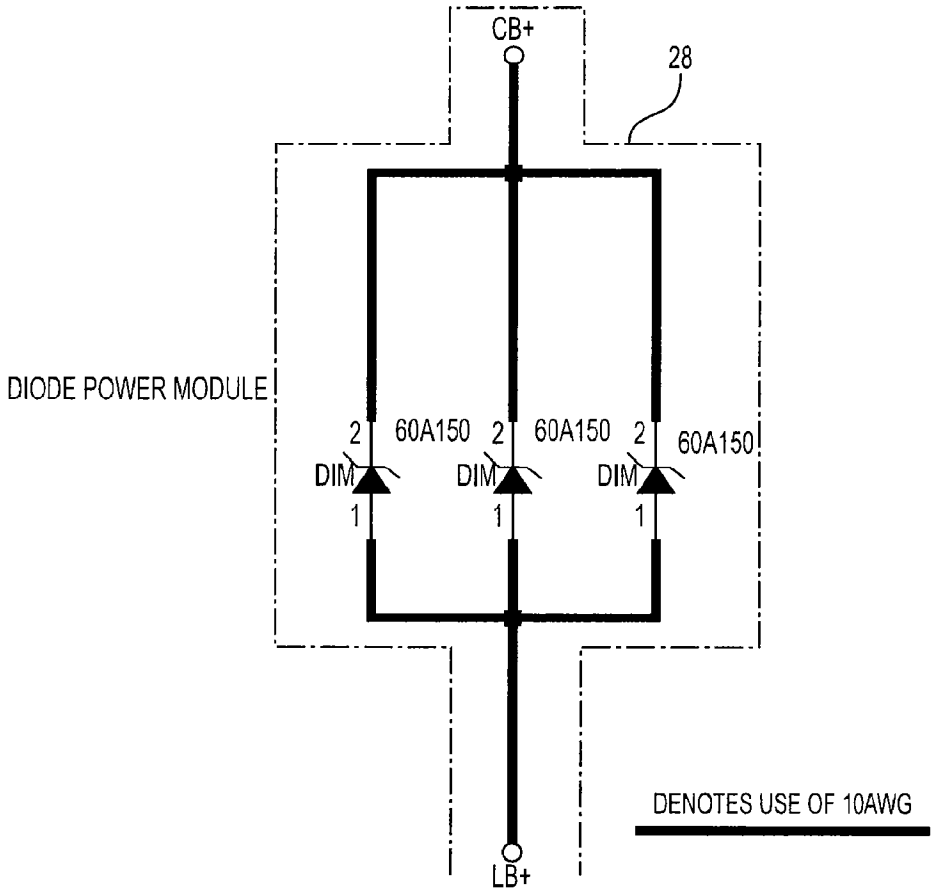
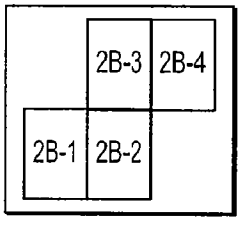

CB+
28
DIODE POWER MODULE
2
60A150
2
60A150
2
60A150
DIM
1
DIM
1
DIM
1
DENOTES USE OF 10AWG
LB+

FIG. 2B-1


2B-3
2B-4
2B-1
2B-2

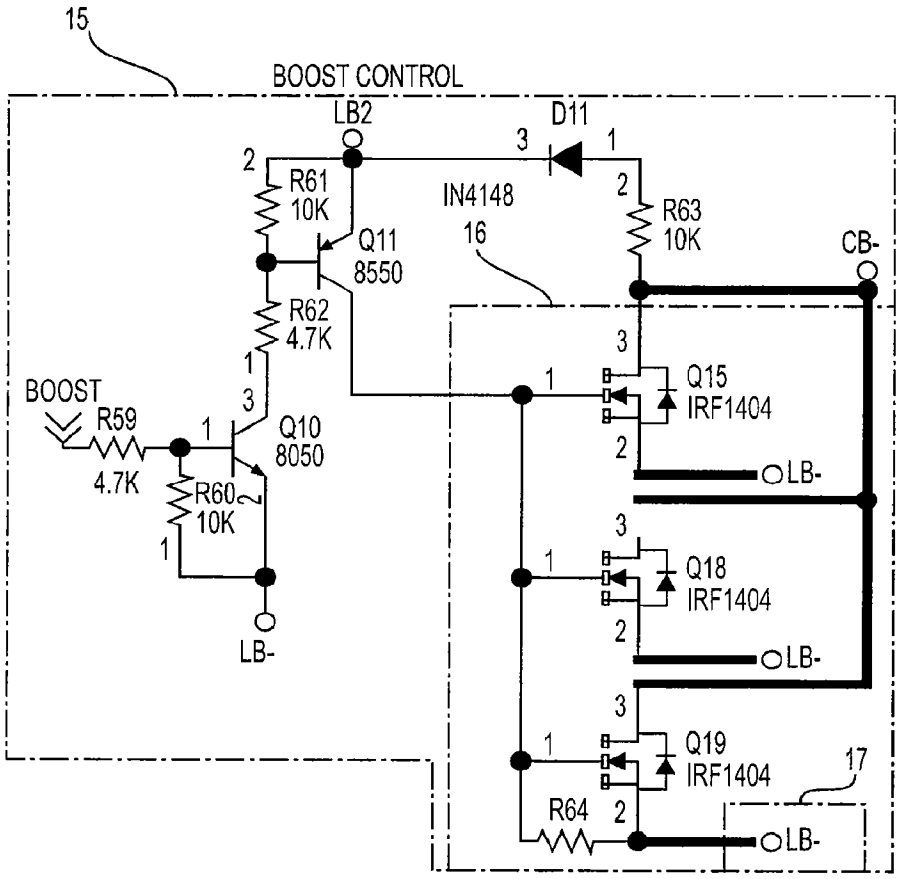
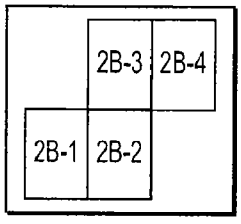

15
BOOST CONTROL
LB2
D11
R61
10K
IN4148
R63
10K
Q11
8550
16
CB-
R62
4.7K
BOOST
R59
4.7K
Q10
8050
R60
10K
LB-
Q15
IRF1404
LB-
Q18
IRF1404
LB-
Q19
IRF1404
17
R64
LB-

FIG. 2B-2


2B-3
2B-4
2B-1
2B-2

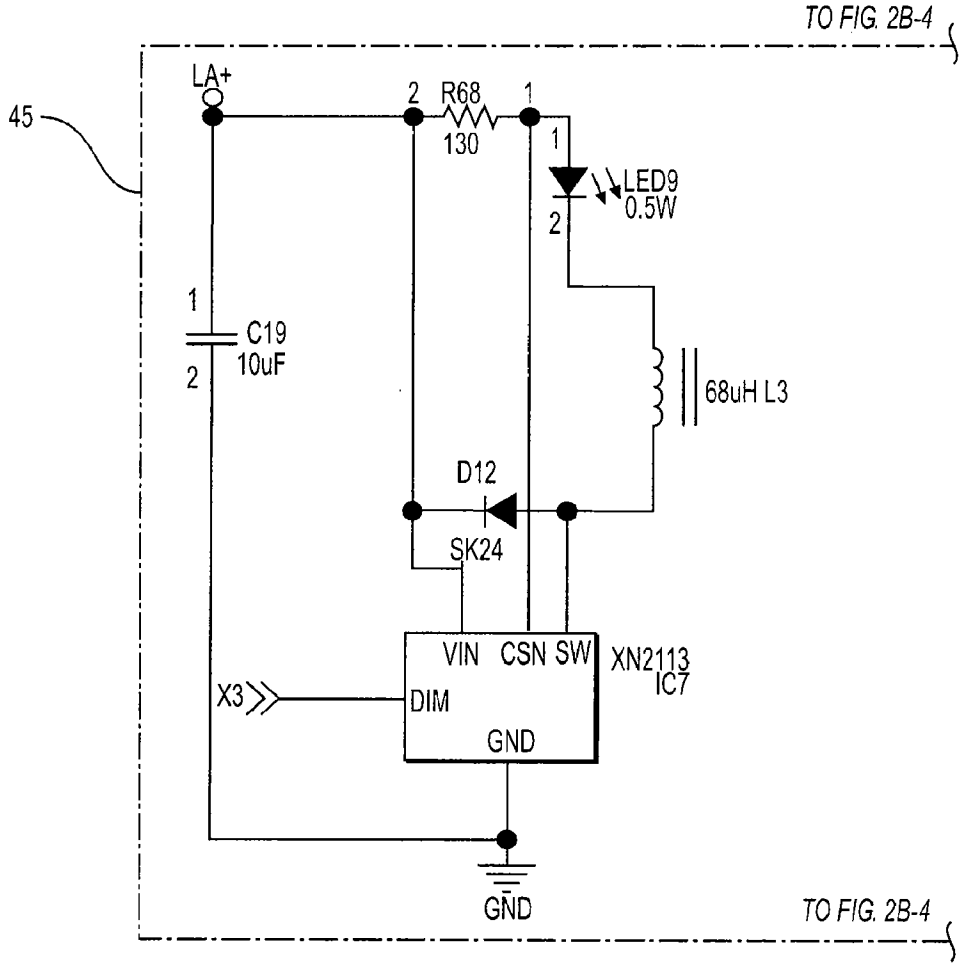
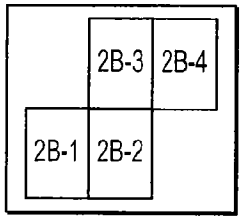

TO FIG. 2B-4
45
LA+
2
R68
130
1
1
LED9
0.5W
2
1
C19
10uF
2
68uH L3
D12
SK24
VIN
CSN
SW
XN2113
IC7
X3
DIM
GND
GND
TO FIG. 2B-4

FIG. 2B-3


2B-3
2B-4
2B-1
2B-2

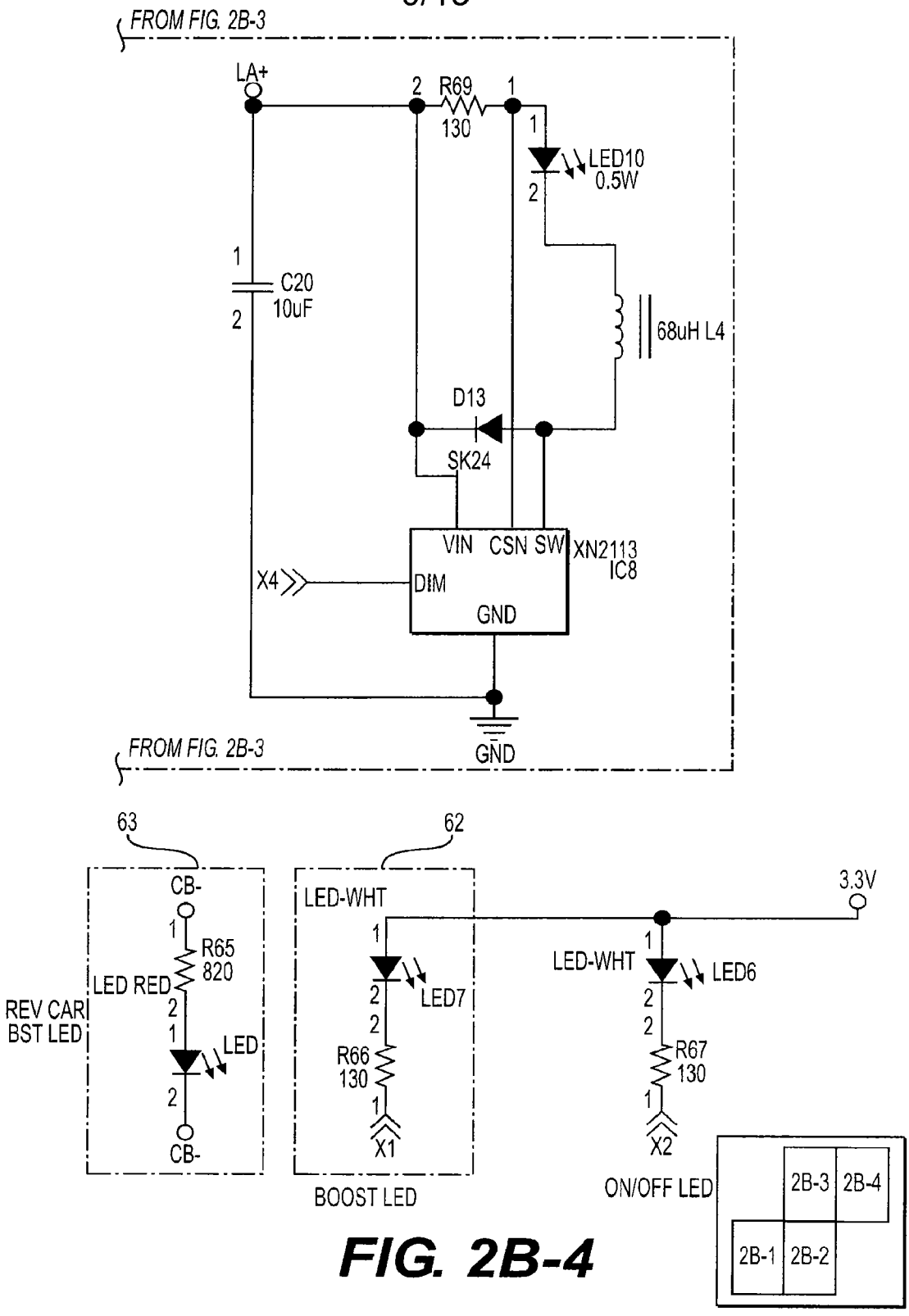

FROM FIG. 2B-3
LA+
2
R69
130
1
1
LED10
0.5W
2
1
C20
10uF
2
68uH L4
D13
SK24
VIN
CSN
SW
XN2113
IC8
X4
DIM
GND
GND
FROM FIG. 2B-3
63
62
CB-
1
R65
820
LED RED
2
REV CARI
BST LED
1
LED
2
CB-
LED-WHT
1
LED7
2
2
R66
130
1
X1
BOOST LED
3.3V
LED-WHT
1
LED6
2
2
R67
130
1
X2
ON/OFF LED
2B-3
2B-4
2B-1
2B-2

FIG. 2B-4

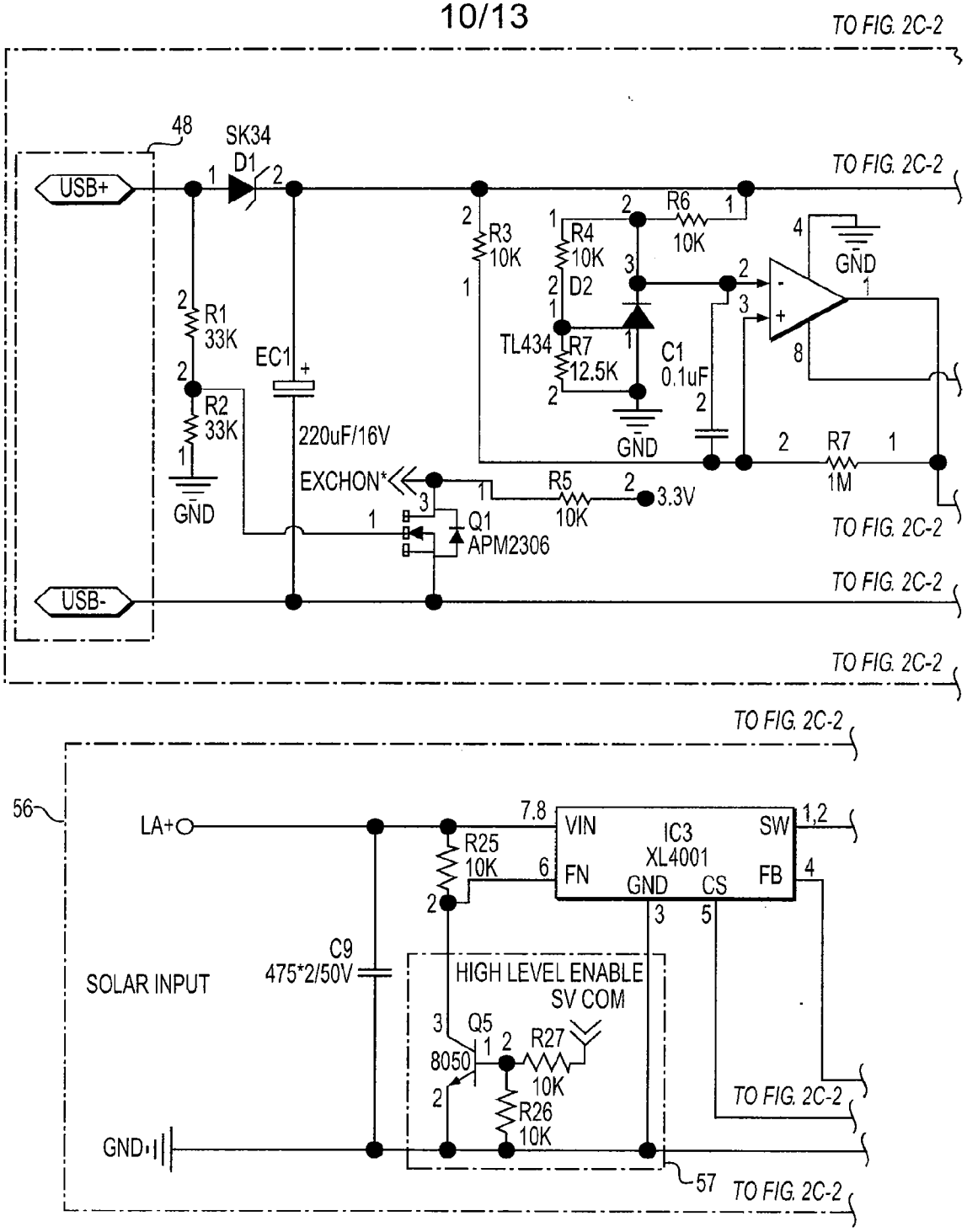
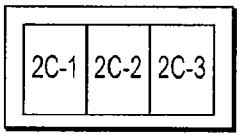

TO FIG. 2C-2
48
SK34
D1
USB+
USB-
R1
33K
R2
33K
GND
EC1
220uF/16V
EXCHON*
R3
10K
R4
10K
D2
TL434
R7
12.5K
R6
10K
C1
0.1uF
R5
10K
3.3V
Q1
APM2306
R7
1M
56
LA+
SOLAR INPUT
C9
475*2/50V
R25
10K
IC3
XL4001
VIN
SW
FN
GND
CS
FB
HIGH LEVEL ENABLE
5V COM
Q5
8050
R27
10K
R26
10K
57

FIG. 2C-1


2C-1
2C-2
2C-3

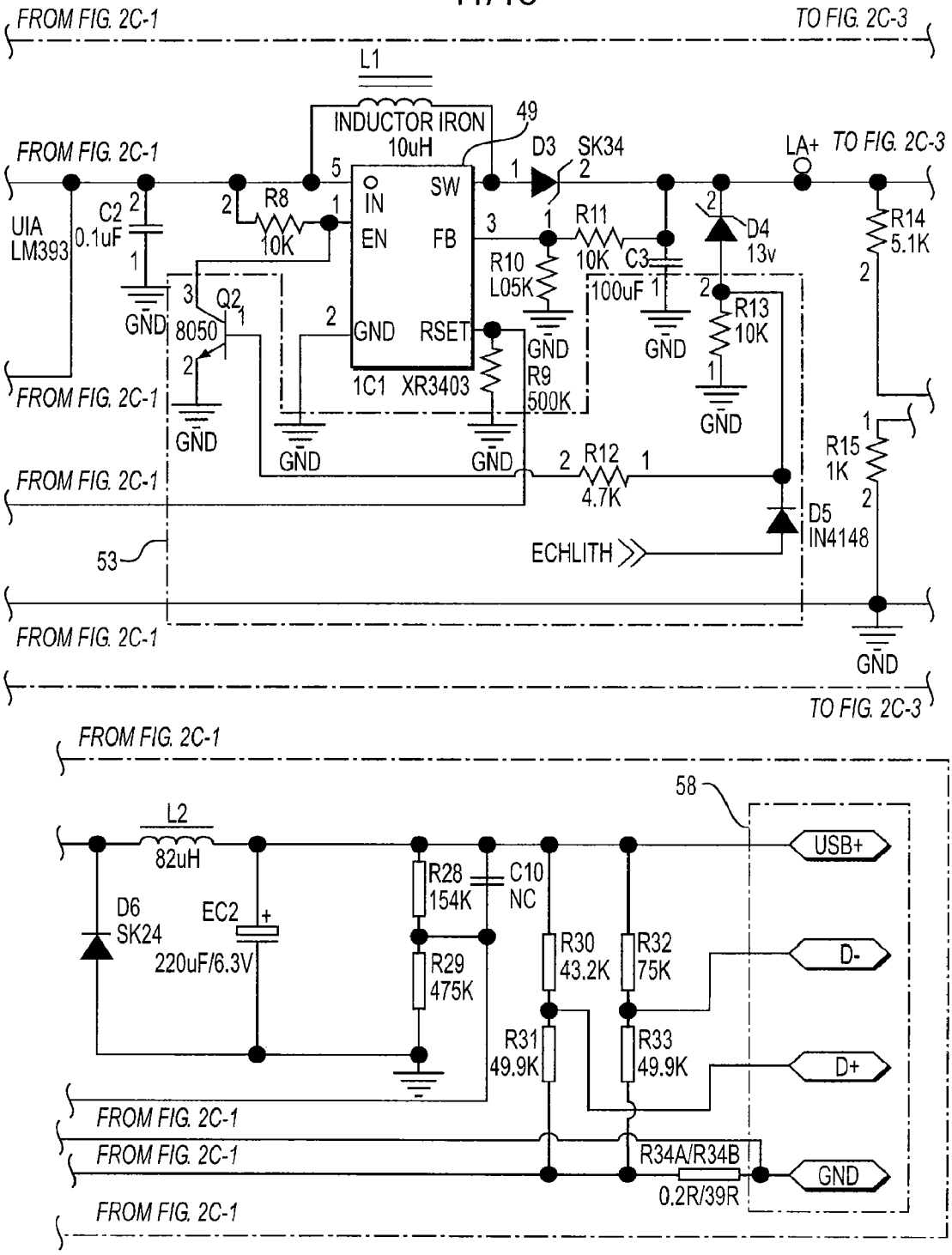

FROM FIG. 2C-1
TO FIG. 2C-3
L1
INDUCTOR IRON
10uH
49
D3
SK34
LA+
UIA
LM393
C2
0.1uF
R8
10K
IN
SW
EN
FB
GND
RSET
1C1 XR3403
R10
L05K
R11
10K
C3
100uF
D4
13v
R14
5.1K
R13
10K
Q2
8050
R9
500K
R12
4.7K
R15
1K
D5
IN4148
ECHLITH
53
GND
L2
82uH
D6
SK24
EC2
220uF/6.3V
R28
154K
C10
NC
R29
475K
R30
43.2K
R32
75K
R31
49.9K
R33
49.9K
58
USB+
D-
D+
R34A/R34B
0.2R/39R
2C-1
2C-2
2C-3

FIG. 2C-2

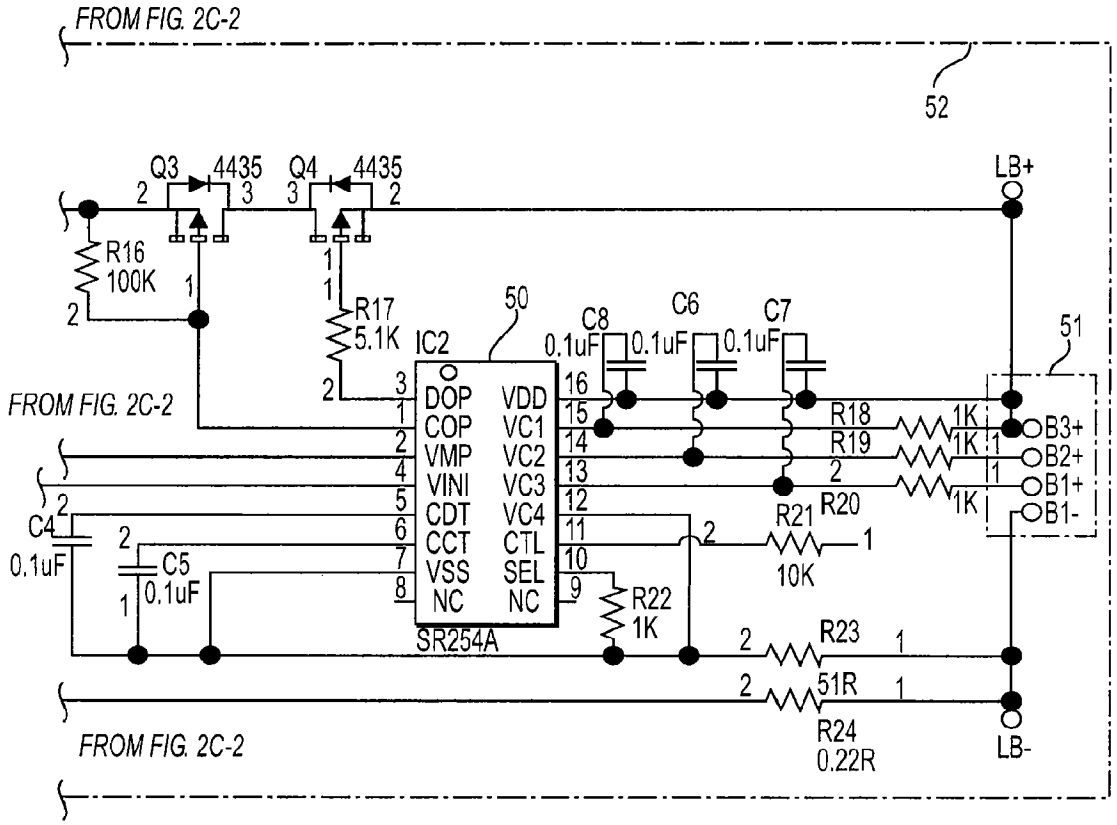

FROM FIG. 2C-2
52
Q3 4435
Q4 4435
LB+
R16
100K
R17
5.1K
IC2
50
C8
C6
C7
0.1uF
0.1uF
0.1uF
51
FROM FIG. 2C-2
DOP
COP
VMP
VINI
CDT
CCT
VSS
NC
VDD
VC1
VC2
VC3
VC4
CTL
SEL
NC
SR254A
R18
R19
R20
R21
1K
1K
1K
10K
B3+
B2+
B1+
B1-
C4
0.1uF
C5
0.1uF
R22
1K
R23
51R
R24
0.22R
FROM FIG. 2C-2
LB-
2C-1
2C-2
2C-3

FIG. 2C-3

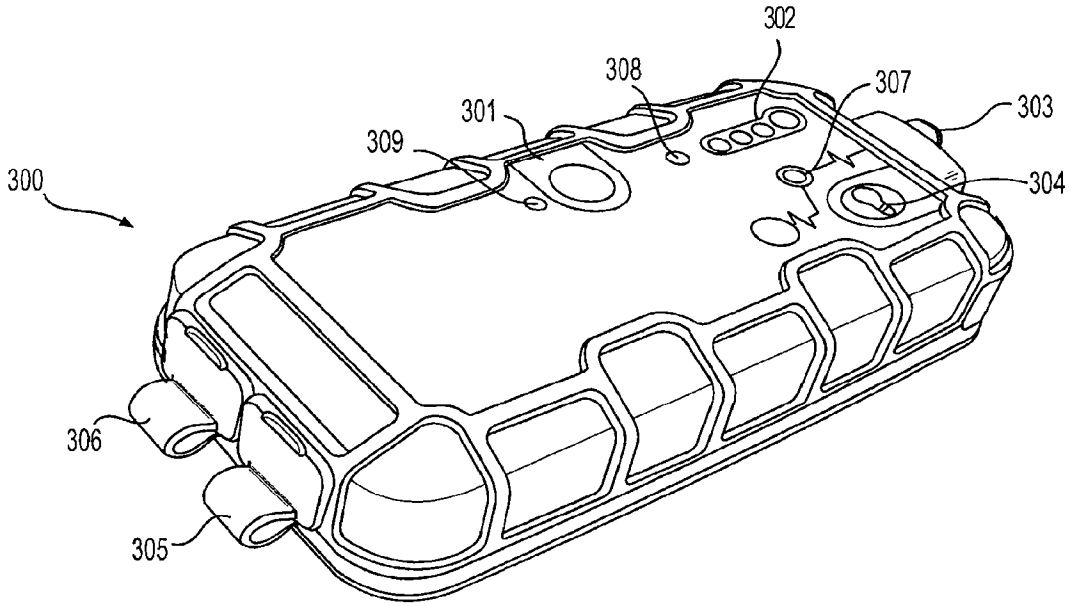

300
301
302
303
304
305
306
307
308
309

FIG. 3

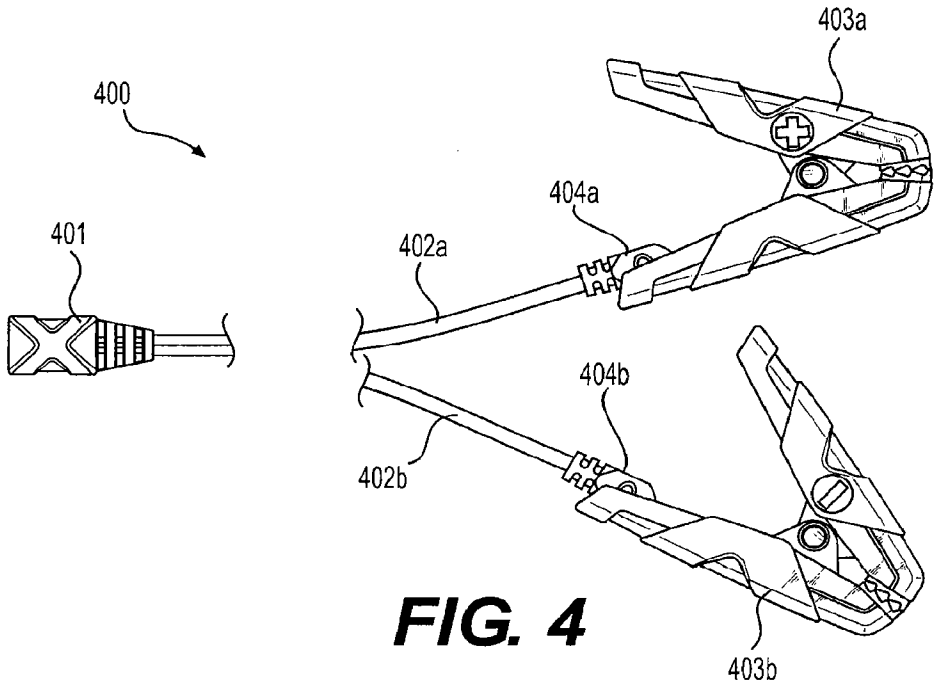

400
401
402a
402b
403a
403b
404a
404b

FIG. 4

PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

BACKGROUND OF THE INVENTION

The present invention relates generally to apparatus for jump-starting a vehicle having a depleted or discharged battery. Prior art devices are known, which provide either a pair of electrical connector cables that connect a fully-charged battery of another vehicle to the engine start circuit of the dead battery vehicle, or portable booster devices which include a fully-charged battery which can be connected in circuit with the vehicle's engine starter through a pair of cables.

Problems with the prior art arose when either the jumper terminals or clamps of the cables were inadvertently brought into contact with each other while the other ends were connected to a charged battery, or when the positive and negative terminals were connected to the opposite polarity terminals in the vehicle to be jumped, thereby causing a short circuit resulting in sparking and potential damage to batteries and/or bodily injury.

Various attempts to eliminate these problems have been made in the prior art. **U.S. Patent No. 6,212,054** issued April 3, 2001, discloses a battery booster pack that is polarity sensitive and can detect proper and improper connections before providing a path for electric current flow. The device uses a set of LEDs connected to optical couplers oriented by a control circuit. The control circuit controls a solenoid assembly controlling the path of power current. The control circuit causes power current to flow through the solenoid assembly only if the points of contact of booster cable clamp connections have been properly made.

U.S. Patent No. 6,632,103 issued October 14, 2003, discloses an adaptive booster cable connected with two pairs of clips, wherein the two pairs of clips are respectively attached to two batteries to transmit power from one battery to the other battery. The adaptive booster cable includes a polarity detecting unit connected to each clip, a switching unit and a current detecting unit both provided between the two pairs of clips. After the polarity of each clip is sensed by the polarity detecting unit, the switching unit generates a proper connection between the two

batteries. Therefore, the positive and negative terminals of the two batteries are correctly connected based on the detected result of the polarity detecting unit.

U.S. Patent No. 8,493,021 issued July 23, 2013, discloses apparatus that monitors the voltage of the battery of a vehicle to be jump started and the current delivered by the jump starter batteries to determine if a proper connection has been established and to provide fault monitoring. Only if the proper polarity is detected can the system operate. The voltage is monitored to determine open circuit, disconnected conductive clamps, shunt cable fault, and solenoid fault conditions. The current through the shunt cable is monitored to determine if there is a battery explosion risk, and for excessive current conditions presenting an overheating condition, which may result in fire. The system includes an internal battery to provide the power to the battery of the vehicle to be jump started. Once the vehicle is started, the unit automatically electrically disconnects from the vehicle's battery.

U.S. Patent No. 5,189,359 issued February 23, 1993, discloses a jumper cable device having two bridge rectifiers for developing a reference voltage, a four-input decoder for determining which terminals are to be connected based on a comparison of the voltage at each of the four terminals to the reference voltage, and a pair of relays for effecting the correct connection depending on the determination of the decoder. No connection will be made unless only one terminal of each battery has a higher voltage than the reference voltage, indicating "positive" terminals, and one has a lower voltage than the reference voltage, indicating "negative" terminals, and that, therefore, the two high voltage terminals may be connected and the two lower voltage terminals may be connected. Current flows once the appropriate relay device is closed. The relay device is preferably a MOSFET combined with a series array of photodiodes that develop MOSFET gate-closing potential when the decoder output causes an LED to light.

U.S. Patent No. 5,795,182 issued August 18, 1998, discloses a polarity independent set of battery jumper cables for jumping a first battery to a second battery. The apparatus includes a relative polarity detector for detecting whether two batteries are configured cross or parallel. A three-position high current capacity crossbar pivot switch is responsive to the relative polarity

detector for automatically connecting the plus terminals of the two batteries together and the minus terminals of the two batteries together regardless of whether the configuration detected is cross or parallel, and an undercurrent detector and a delay circuit for returning the device to its ready and unconnected state after the device has been disconnected from one of the batteries. The crossbar pivot switch includes two pairs of contacts, and a pivot arm that pivots about two separate points to ensure full electrical contact between the pairs of contacts. The invention can also be used to produce a battery charger that may be connected to a battery without regard to the polarity of the battery.

U.S. Patent No. 6,262,492 issued July 17, 2001, discloses a car battery jumper cable for accurately coupling an effective power source to a failed or not charged battery, which includes a relay switching circuit connected to the power source and the battery by two current conductor pairs. First and second voltage polarity recognition circuits are respectively connected to the power source and the battery by a respective voltage conductor pair to recognize the polarity of the power source and the battery. A logic recognition circuit produces a control signal subject to the polarity of the power source and the battery, and a driving circuit controlled by the control signal from the logic recognition circuit drives the relay switching circuit, enabling the two poles of the power source to be accurately coupled to the two poles of the battery.

U.S. Patent No. 5,635,817 issued June 3, 1997, discloses a vehicle battery charging device that includes a control housing having cables including a current limiting device to prevent exceeding of a predetermined maximum charging current of about 40 to 60 amps. The control housing includes a polarity detecting device to verify the correct polarity of the connection of the terminals of the two batteries and to electrically disconnect the two batteries if there is an incorrect polarity.

U.S. Patent No. 8,199,024 issued June 12, 2012, discloses a safety circuit in a low-voltage connecting system that leaves the two low-voltage systems disconnected until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and that it is safe to connect the two low-voltage systems, the safety circuit may connect the two systems by way of a "soft start" that provides a connection between the two

systems over a period of time that reduces or prevents inductive voltage spikes on one or more of the low-voltage systems. When one of the low-voltage systems has a completely-discharged battery incorporated into it, a method is used for detection of proper polarity of the connections between the low-voltage systems. The polarity of the discharged battery is determined by passing one or more test currents through it and determining whether a corresponding voltage rise is observed.

U.S. Patent No. 5,793,185 issued August 11, 1998, discloses a hand-held jump starter having control components and circuits to prevent overcharging and incorrect connection to batteries.

While the prior art attempted solutions to the abovementioned problems as discussed above, each of the prior art solutions suffers from other shortcomings, either in complexity, cost or potential for malfunction. Accordingly, there exists a need in the art for further improvements to vehicle jump start devices.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, apparatus is provided for jump starting a vehicle engine, including: an internal power supply; an output port having positive and negative polarity outputs; a vehicle battery isolation sensor connected in circuit with said positive and negative polarity outputs, configured to detect presence of a vehicle battery connected between said positive and negative polarity outputs; a reverse polarity sensor connected in circuit with said positive and negative polarity outputs, configured to detect polarity of a vehicle battery connected between said positive and negative polarity outputs; a power FET switch connected between said internal power supply and said output port; and a microcontroller configured to receive input signals from said vehicle isolation sensor and said reverse polarity sensor, and to provide an output signal to said power FET switch, such that said power FET switch is turned on to connect said internal power supply to said output port in response to signals from said sensors indicating the presence of a vehicle battery at said output port and proper polarity connection of

positive and negative terminals of said vehicle battery with said positive and negative polarity outputs.

The internal power supply may comprise a lithium ion battery. The lithium ion battery may comprise a battery pack of multiple lithium ion batteries.

The internal power supply may be a rechargeable lithium ion battery pack.

The power FET switch may comprise a plurality of FETs in parallel.

The vehicle isolation sensor and reverse polarity sensor may comprise optically coupled isolator phototransistors.

The apparatus may further comprise a plurality of power diodes coupled between said output port and said internal power supply to prevent back-charging of said internal power supply from an electrical system connected to said output port.

The apparatus may further comprise a temperature sensor configured to detect temperature of said internal power supply and to provide a temperature signal to said microcontroller.

The apparatus may further comprise a voltage measurement circuit configured to measure output voltage of said internal power supply and to provide a voltage measurement signal to said microcontroller.

The apparatus may further comprise a voltage regulator configured to convert output voltage of said internal power supply to a voltage level appropriate to provide operating power to internal components of the apparatus.

The apparatus may further comprise a USB output port configured to provide charging power from said internal power supply to a USB-chargeable device.

The apparatus may further comprise a USB charging port configured to provide charging power from an external power source to said internal power supply.

The apparatus may further comprise a flashlight circuit configured to provide a source of light to a user. The source of light may be at least one LED. The microcontroller may be configured to control said at least one LED to provide a visual alarm indicating an emergency situation.

The apparatus may further comprise a plurality of visual indicators configured to display remaining capacity status of said internal power supply. The plurality of visual indicators may comprise a plurality of LEDs providing output light of different colors.

The apparatus may further comprise a visual indicator configured to warn a user when a vehicle battery is connected with reverse polarity.

The apparatus may further comprise separate visual indicators configured to display the power on status of the apparatus, and the jump start boost power status of power supplied to said output port.

The apparatus may further comprise a manual override switch configured to activate a manual override mode to enable a user to connect jump start power to said output port when said vehicle battery isolation sensor is unable to detect presence of a vehicle battery. The microcontroller may be configured to detect actuation of said manual override switch for at least a predetermined period of time before activation of said manual override mode.

The apparatus may further comprise a jumper cable device including a plug configured to plug into said output port, a pair of cables integrated with the plug at one respective end thereof and being configured to be connected to terminals of a battery at another respective end thereof. The jumper cable device may further comprise a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp. The output port and said plug may be dimensioned so that the plug will fit into the output port only in one specific orientation.

In accordance with yet another aspect of the invention, a jumper cable device is provided, having a plug configured to plug into an output port of a handheld battery charger booster device having an internal power supply; a pair of cables integrated with the plug at one respective end thereof; said pair of cables being configured to be separately connected to terminals of a battery at another respective end thereof.

The jumper cable device may further comprise a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp.

The output port and said plug may be dimensioned so that the plug will fit into the output port only in one specific orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a functional block diagram of a handheld vehicle battery boost apparatus in accordance with one aspect of the present invention;

Figs. 2A – 2C are schematic circuit diagrams of an example embodiment of a handheld vehicle battery boost apparatus in accordance with an aspect of the invention;

Fig. 3 is a perspective view of a handheld jump starter booster device in accordance with one example embodiment of the invention; and

Fig. 4 is a plan view of a jumper cable usable with the handheld jump starter booster device in accordance with another aspect of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a functional block diagram of a handheld battery booster according to one aspect of the invention. At the heart of the handheld battery booster is a lithium polymer battery pack 32, which stores sufficient energy to jump start a vehicle engine served by a conventional

12 volt lead-acid or valve regulated lead-acid battery. In one example embodiment, a high-surge lithium polymer battery pack includes three 3.7V, 2666 mAh lithium polymer batteries in a 3S1P configuration. The resulting battery pack provides 11.1V, 2666Ah (8000Ah at 3.7V, 29.6Wh). Continuous discharge current is 25C (or 200 amps), and burst discharge current is 50C (or 400 amps). The maximum charging current of the battery pack is 8000mA (8 amps).

A programmable microcontroller unit (MCU) 1 receives various inputs and produces informational as well as control outputs. The programmable MCU 1 further provides flexibility to the system by allowing updates in functionality and system parameters, without requiring any change in hardware. According to one example embodiment, an 8 bit microcontroller with 2K x 15 bits of flash memory is used to control the system. One such microcontroller is the HT67F30, which is commercially available from Holtek Semiconductor Inc.

A car battery reverse sensor 10 monitors the polarity of the vehicle battery 72 when the handheld battery booster device is connected to the vehicle's electric system. As explained below, the booster device prevents the lithium battery pack from being connected to the vehicle battery 72 when the terminals of the battery 72 are connected to the wrong terminals of the booster device. A car battery isolation sensor 12 detects whether or not a vehicle battery 72 is connected to the booster device, and prevents the lithium battery pack from being connected to the output terminals of the booster device unless there is a good (e.g. chargeable) battery connected to the output terminals.

A smart switch FET circuit 15 electrically switches the handheld battery booster lithium battery to the vehicle's electric system only when the vehicle battery is determined by the MCU 1 to be present (in response to a detection signal provided by isolation sensor 12) and connected with the correct polarity (in response to a detection signal provided by reverse sensor 10). A lithium battery temperature sensor 20 monitors the temperature of the lithium battery pack 32 to detect overheating due to high ambient temperature conditions and overextended current draw during jump starting. A lithium battery voltage measurement circuit 24 monitors the voltage of the lithium battery pack 32 to prevent the voltage potential from rising too high during a charging operation and from dropping too low during a discharge operation.

Lithium battery back-charge protection diodes 28 prevent any charge current being delivered to the vehicle battery 72 from flowing back to the lithium battery pack 32 from the

vehicle's electrical system. Flashlight LED circuit 36 is provided to furnish a flashlight function for enhancing light under a vehicle's hood in dark conditions, as well as providing SOS and strobe lighting functions for safety purposes when a vehicle may be disabled in a potentially dangerous location. Voltage regulator 42 provides regulation of internal operating voltage for the microcontroller and sensors. On/Off manual mode and flashlight switches 46 allow the user to control power-on for the handheld battery booster device, to control manual override operation if the vehicle has no battery, and to control the flashlight function. The manual button functions only when the booster device is powered on. This button allows the user to jump-start vehicles that have either a missing battery, or the battery voltage is so low that automatic detection by the MCU is not possible. When the user presses and holds the manual override button for a predetermined period time (such as three seconds) to prevent inadvertent actuation of the manual mode, the internal lithium ion battery power is switched to the vehicle battery connect port. The only exception to the manual override is if the car battery is connected in reverse. If the car battery is connected in reverse, the internal lithium battery power shall never be switched to the vehicle battery connect port.

USB charge circuit 52 converts power from any USB charger power source, to charge voltage and current for charging the lithium battery pack 32. USB output 56 provides a USB portable charger for charging smartphones, tablets, and other rechargeable electronic devices. Operation indicator LEDs 60 provide visual indication of lithium battery capacity status as well as an indication of smart switch activation status (indicating that power is being provided to the vehicle's electrical system).

Detailed operation of the handheld booster device will now be described with reference to the schematic diagrams of Figs. 2A-2C. As shown in Fig. 2A, the microcontroller unit 1 is the center of all inputs and outputs. The reverse battery sensor 10 comprises an optically coupled isolator phototransistor (4N27) connected to the terminals of vehicle battery 72 at input pins 1 and 2 with a diode D8 in the lead conductor of pin 1 (associated with the negative terminal CB-), such that if the battery 72 is connected to the terminals of the booster device with the correct polarity, the optocoupler LED 11 will not conduct current, and is therefore turned off, providing a "1" or high output signal to the MCU 1. The car battery isolation sensor 12 comprises an optically coupled isolator phototransistor (4N27) connected to the terminals of vehicle battery 72

WINPLUS Ex. 1003, p. 1086

at input pins 1 and 2 with a diode D7 in the lead conductor of pin 1 (associated with the positive terminal CB+), such that if the battery 72 is connected to the terminals of the booster device with the correct polarity, the optocoupler LED 11A will conduct current, and is therefore turned on, providing a "0" or low output signal to the MCU, indicating the presence of a battery across the jumper output terminals of the handheld booster device.

If the car battery 72 is connected to the handheld booster device with reverse polarity, the optocoupler LED 11 of the reverse sensor 10 will conduct current, providing a "0" or low signal to microcontroller unit 1. Further, if no battery is connected to the handheld booster device, the optocoupler LED 11A of the isolation sensor 12 will not conduct current, and is therefore turned off, providing a "1" or high output signal to the MCU, indicating the absence of any battery connected to the handheld booster device. Using these specific inputs, the microcontroller software of MCU 1 can determine when it is safe to turn on the smart switch FET 15, thereby connecting the lithium battery pack to the jumper terminals of the booster device. Consequently, if the car battery 72 either is not connected to the booster device at all, or is connected with reverse polarity, the MCU 1 can keep the smart switch FET 15 from being turned on, thus prevent sparking/short circuiting of the lithium battery pack.

As shown in Fig. 2B, the FET smart switch 15 is driven by an output of the microcontroller 1. The FET smart switch 15 includes three FETs (Q15, Q18, and Q19) in parallel, which spreads the distribution of power from the lithium battery pack over the FETs. When that microcontroller output is driven to a logic low, FETs 16 are all in a high resistance state, therefore not allowing current to flow from the internal lithium battery negative contact 17 to the car battery 72 negative contact. When the micro controller output is driven to a logic high, the FETs 16 (Q15, Q18, and Q19) are in a low resistant state, allowing current to flow freely from the internal lithium battery pack negative contact 17 (LB-) to the car battery 72 negative contact (CB-). In this way, the microcontroller software controls the connection of the internal lithium battery pack 32 to the vehicle battery 72 for jumpstarting the car engine.

Referring back to Fig. 2A, the internal lithium battery pack voltage can be accurately measured using circuit 24 and one of the analog-to-digital inputs of the microcontroller 1. Circuit 24 is designed to sense when the main 3.3V regulator 42 voltage is on, and to turn on

WINPLUS Ex. 1003, p. 1087

transistor 23 when the voltage of regulator 42 is on. When transistor 23 is conducting, it turns on FET 22, thereby providing positive contact (LB+) of the internal lithium battery a conductive path to voltage divider 21 allowing a lower voltage range to be brought to the microcontroller to be read. Using this input, the microcontroller software can determine if the lithium battery voltage is too low during discharge operation or too high during charge operation, and take appropriate action to prevent damage to electronic components.

Still referring to Fig. 2A, the temperature of the internal lithium battery pack 32 can be accurately measured by two negative temperature coefficient (NTC) devices 20. These are devices that reduce their resistance when their temperature rises. The circuit is a voltage divider that brings the result to two analog-to-digital (A/D) inputs on the microcontroller 1. The microcontroller software can then determine when the internal lithium battery is too hot to allow jumpstarting, adding safety to the design.

The main voltage regulator circuit 42 is designed to convert internal lithium battery voltage to a regulated 3.3 volts that is utilized by the microcontroller 1 as well as by other components of the booster device for internal operating power. Three lithium battery back charge protection diodes 28 (see Fig. 2B) are in place to allow current to flow only from the internal lithium battery pack 32 to the car battery 72, and not from the car battery to the internal lithium battery. In this way, if the car electrical system is charging from its alternator, it cannot back-charge (and thereby damage) the internal lithium battery, providing another level of safety. The main power on switch 46 (Fig. 2A) is a combination that allows for double pole, double throw operation so that with one push, the product can be turned on if it is in the off state, or turned off if it is in the on state. This circuit also uses a microcontroller output 47 to "keep alive" the power when it is activated by the on switch. When the switch is pressed the microcontroller turns this output to a high logic level to keep power on when the switch is released. In this way, the microcontroller maintains control of when the power is turned off when the on/off switch is activated again or when the lithium battery voltage is getting too low. The microcontroller software also includes a timer that turns the power off after a predefined period of time, (such as, e.g. 8 hours) if not used.

The flashlight LED circuit 45 shown in Fig. 2B controls the operation of flashlight LEDs. Two outputs from the microcontroller 1 are dedicated to two separate LEDs. Thus, the LEDs

WINPLUS Ex. 1003, p. 1088

can be independently software-controlled for strobe and SOS patterns, providing yet another safety feature to the booster device. LED indicators provide the feedback the operator needs to understand what is happening with the product. Four separate LEDs 61 (Fig. 2A) are controlled by corresponding individual outputs of microcontroller 1 to provide indication of the remaining capacity of the internal lithium battery. These LEDs are controlled in a "fuel gauge" type format with 25%, 50%, 75% and 100% (red, red, yellow, green) capacity indications. An LED indicator 63 (Fig. 2B) provides a visual warning to the user when the vehicle battery 72 has been connected in reverse polarity. "Boost" and on/off LEDs 62 provide visual indications when the booster device is provide jump-start power, and when the booster device is turned on, respectively.

A USB output 56 circuit (Fig. 2C) is included to provide a USB output for charging portable electronic devices such as smartphones from the internal lithium battery pack 32. Control circuit 57 from the microcontroller 1 allows the USB Out 56 to be turned on and off by software control to prevent the internal lithium battery getting too low in capacity. The USB output is brought to the outside of the device on a standard USB connector 58, which includes the standard voltage divider required for enabling charge to certain smartphones that require it. The USB charge circuit 52 allows the internal lithium battery pack 32 to be charged using a standard USB charger. This charge input uses a standard micro-USB connector 48 allowing standard cables to be used. The 5V potential provided from standard USB chargers is up-converted to the 12.4VDC voltage required for charging the internal lithium battery pack using a DC-DC converter 49. The DC-DC converter 49 can be turned on and off via circuit 53 by an output from the microcontroller 1.

In this way, the microcontroller software can turn the charge off if the battery voltage is measured to be too high by the A/D input 22. Additional safety is provided for helping to eliminate overcharge to the internal lithium battery using a lithium battery charge controller 50 that provides charge balance to the internal lithium battery cells 51. This controller also provides safety redundancy for eliminating over discharge of the internal lithium battery.

Fig. 3 is a perspective view of a handheld device 300 in accordance with an exemplary embodiment of the invention. 301 is a power on switch. 302 shows the LED "fuel gauge" indicators 61. 303 shows a 12 volt output port connectable to a cable device 400, described

WINPLUS Ex. 1003, p. 1089

further below. 304 shows a flashlight control switch for activating flashlight LEDs 45. 305 is a USB input port for charging the internal lithium battery, and 306 is a USB output port for providing charge from the lithium battery to other portable devices such as smartphones, tablets, music players, etc. 307 is a "boost on" indicator showing that power is being provided to the 12V output port. 308 is a "reverse" indicator showing that the vehicle battery is improperly connected with respect to polarity. 309 is a "power on" indicator showing that the device is powered up for operation.

Fig. 4 shows a jumper cable device 400 specifically designed for use with the handheld device 300. Device 400 has a plug 401 configured to plug into 12 volt output port 303 of the handheld device 300. A pair of cables 402a and 402b are integrated with the plug 401, and are respectively connected to battery terminal clamps 403a and 403b via ring terminals 404a and 404b. The port 303 and plug 401 may be dimensioned so that the plug 401 will only fit into the port 303 in a specific orientation, thus ensuring that clamp 403a will correspond to positive polarity, and clamp 403b will correspond to negative polarity, as indicated thereon. Additionally, the ring terminals 404a and 404b may be disconnected from the clamps and connected directly to the terminals of a vehicle battery. This feature may be useful, for example, to permanently attach the cables 302a-302b to the battery of a vehicle. In the event that the battery voltage becomes depleted, the handheld booster device 300 could be properly connected to the battery very simply by plugging in the plug 401 to the port 303.

The invention having been thus described, it will be apparent to those skilled in the art that the same may be varied in many ways without departing from the spirit or scope of the invention. Any and all such variations are intended to be encompassed within the scope of the following claims.

WINPLUS Ex. 1003, p. 1090

WHAT IS CLAIMED IS:

1. Apparatus for jump starting a vehicle engine, comprising:

an internal power supply;

an output port having positive and negative polarity outputs;

a vehicle battery isolation sensor connected in circuit with said positive and negative polarity outputs, configured to detect presence of a vehicle battery connected between said positive and negative polarity outputs;

a reverse polarity sensor connected in circuit with said positive and negative polarity outputs, configured to detect polarity of a vehicle battery connected between said positive and negative polarity outputs;

a power FET switch connected between said internal power supply and said output port; and

a microcontroller configured to receive input signals from said vehicle isolation sensor and said reverse polarity sensor, and to provide an output signal to said power FET switch, such that said power FET switch is turned on to connect said internal power supply to said output port in response to signals from said sensors indicating the presence of a vehicle battery at said output port and proper polarity connection of positive and negative terminals of said vehicle battery with said positive and negative polarity outputs.

2. The apparatus of claim 1, wherein said internal power supply comprises a lithium ion battery.

3. The apparatus of claim 2, wherein said lithium ion battery comprises a battery pack of multiple lithium ion batteries.

4. The apparatus of claim 1, wherein said power FET switch comprises a plurality of FETs in parallel.

5, The apparatus of claim 1, wherein said vehicle isolation sensor and reverse polarity sensor comprise optically coupled isolator phototransistors.

WINPLUS Ex. 1003, p. 1091

6. The apparatus of claim 1, further comprising a plurality of power diodes coupled between said output port and said internal power supply to prevent back-charging of said internal power supply from an electrical system connected to said output port.

7. The apparatus of claim 1, further comprising a temperature sensor configured to detect temperature of said internal power supply and to provide a temperature signal to said microcontroller.

8. The apparatus of claim 1, further comprising a voltage measurement circuit configured to measure output voltage of said internal power supply and to provide a voltage measurement signal to said microcontroller.

9. The apparatus of claim 1, further comprising a voltage regulator configured to convert output voltage of said internal power supply to a voltage level appropriate to provide operating power to internal components of the apparatus.

10. The apparatus of claim 1, further comprising a USB output port configured to provide charging power from said internal power supply to a USB-chargeable device.

11. The apparatus of claim 1, further comprising a USB charging port configured to provide charging power from an external power source to said internal power supply.

12. The apparatus of claim 1, further comprising a flashlight circuit configured to provide a source of light to a user.

13. The apparatus of claim 12, wherein said source of light is at least one LED.

14. The apparatus of claim 13, wherein said microcontroller is configured to control said at least one LED to provide a visual alarm indicating an emergency situation.

WINPLUS Ex. 1003, p. 1092

15. The apparatus of claim 1, further comprising a plurality of visual indicators configured to display remaining capacity status of said internal power supply.

16. The apparatus of claim 15, wherein said plurality of visual indicators comprises a plurality of LEDs providing output light of different colors.

17. The apparatus of claim 1, further comprising a visual indicator configured to warn a user when a vehicle battery is connected with reverse polarity.

18. The apparatus of claim 1, further comprising separate visual indicators configured to display the power on status of the apparatus, and the jump start boost power status of power supplied to said output port.

19. The apparatus of claim 1, further comprising a manual override switch configured to activate a manual override mode to enable a user to connect jump start power to said output port when said vehicle battery isolation sensor is unable to detect presence of a vehicle battery.

20. The apparatus of claim 19, wherein said microcontroller is configured to detect actuation of said manual override switch for at least a predetermined period of time before activation of said manual override mode.

21. The apparatus of claim 1, further comprising a jumper cable device including a plug configured to plug into said output port, a pair of cables integrated with the plug at one respective end thereof and being configured to be connected to terminals of a battery at another respective end thereof.

22. The apparatus of claim 21, wherein said jumper cable device further comprises a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp.

23. The apparatus of claim 21, wherein said output port and said plug are dimensioned so that the plug will fit into the output port only in one specific orientation.

24. A jumper cable device, comprising:

a plug configured to plug into an output port of a handheld battery charger booster device having an internal power supply;

a pair of cables integrated with the plug at one respective end thereof;

said pair of cables being configured to be separately connected to terminals of a battery at another respective end thereof.

25. The jumper cable device of claim 24, further comprising a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp.

26. The jumper cable device of claim 24, wherein said output port and said plug are dimensioned so that the plug will fit into the output port only in one specific orientation.

WINPLUS Ex. 1003, p. 1094

Application No:	GB1415291.2	**Examiner:**	Peter Keefe
Claims searched:	1-23	**Date of search:**	1 October 2014

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3, 5, 7-18, 21-23	WO 2004/036714 A1 (VECTOR PRODUCTS) page 20 lines 13-28, page 22 line 1-page 23 line 33, page 25 line 22-page 26 line 11
X	1-3, 7-19, 21-23	US 2013/154543 A1 (RICHARDSON ET AL.) paragraphs 0006-0007, 0014-0021, 0027-0031
X	1-6, 8-18, 21-23	US 2004/130298 A1 (KRIEGER ET AL.) paragraphs 0010-0014, 0030, 0032, 0034-0035
X	1, 5, 19	US 2002/041174 A1 (PURKEY) paragraphs 0020-0023, 0055, 0059-0060
Y	10-14	US 2010/301800 A1 (INSKEEP) paragraphs 0007, 0032, 0034
Y	10-14	US 2014/159509 A1 (INSKEEP) paragraphs 0005, 0012-0013, 0015, 0018

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H02J

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, TXTE

Intellectual Property Office is an operating name of the Patent Office

www.ipo.gov.uk

International Classification:

Subclass	Subgroup	Valid From
H02J	0007/00	01/01/2006

Espacenet

Bibliographic data: GB2562950 (A) — 2018-11-28

Battery connector device for a battery jump starting device

Inventor(s): JONATHAN LEWIS NOOK [US]; WILLIAM KNIGHT NOOK [US]; JAMES RICHARD STANFIELD [US]; DEREK MICHAEL UNDERHILL [US] ± (Jonathan Lewis Nook, ; William Knight Nook, ; James Richard Stanfield, ; Derek Michael Underhill)

Applicant(s): NOCO CO [US] ± (The NOCO Company)

Classification: - international: ***F02N11/04; F02N11/12; F02N19/00; H02J7/00***
- cooperative: **F02N11/12 (EP, GB)**; **F02N11/14 (GB)**; **F02N19/00 (GB)**; **H01M2/30 (EP)**; **H02J1/122 (EP)**; **H02J7/00 (GB)**; **H02J7/0032 (GB)**; F02N11/087 (EP); F02N11/14 (EP)

Application number: GB20180013107 20170210

Priority number(s): WO2017US17289 20170210 ; US201662294067P 20160211 ; WO2016US24680 20160329 ; US201615137626 20160329 ; US201662424297P 20161118

Also published as: AU2017217661 (A1) AU2017217661 (B2) AU2019201081 (A1) CA3005971 (A1) CN108884801 (A) more

Abstract of GB2562950 (A)

An enhanced conductivity battery connector device for use in a battery jump starting device. The enhance conductivity battery connector providing enhanced conductivity from the battery to a battery being recharged by the battery jump starting device.

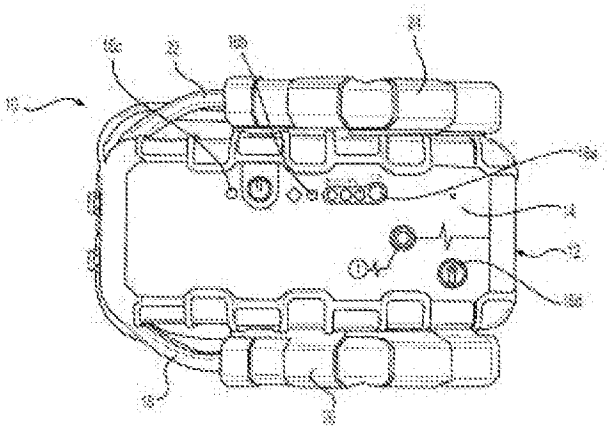


FIG. 1

(12) UK Patent Application (19) GB (11) 2562950 (13) A

(43) Date of Reproduction by UK Office 28.11.2018

(21) Application No: 1813107.8

(22) Date of Filing: 10.02.2017

Date Lodged: 10.08.2018

(30) Priority Data:

(31) 62294067	(32) 11.02.2016	(33) US
(31) 2016024680	(32) 29.03.2016	(33) US
(31) 15137626	(32) 25.04.2016	(33) US
(31) 62424297	(32) 18.11.2016	(33) US

(86) International Application Data:
PCT/US2017/017289 En 10.02.2017

(87) International Publication Data:
WO2017/139524 En 17.08.2017

(71) Applicant(s):
The NOCO Company
30339 Diamond Parkway, #102, Glenwillow 44139, Ohio, United States of America

(72) Inventor(s):
Jonathan Lewis Nook
William Knight Nook
James Richard Stanfield
Derek Michael Underhill

(74) Agent and/or Address for Service:
Slingsby Partners LLP
1 Kingsway, LONDON, WC2B 6AN, United Kingdom

(51) INT CL:
F02N 11/12 (2006.01) ***F02N 11/04*** (2006.01)
F02N 19/00 (2010.01) ***H02J 7/00*** (2006.01)

(56) Documents Cited:
US 6222342 B1 **US 6215273 B1**
US 20160181587 A1 **US 20160001666 A1**
US 20130241498 A1

(58) Field of Search:
INT CL **F02N, H02J**

(54) Title of the Invention: **Battery connector device for a battery jump starting device**
Abstract Title: **Battery connector device for a battery jump starting device**

(57) An enhanced conductivity battery connector device for use in a battery jump starting device. The enhance conductivity battery connector providing enhanced conductivity from the battery to a battery being recharged by the battery jump starting device.

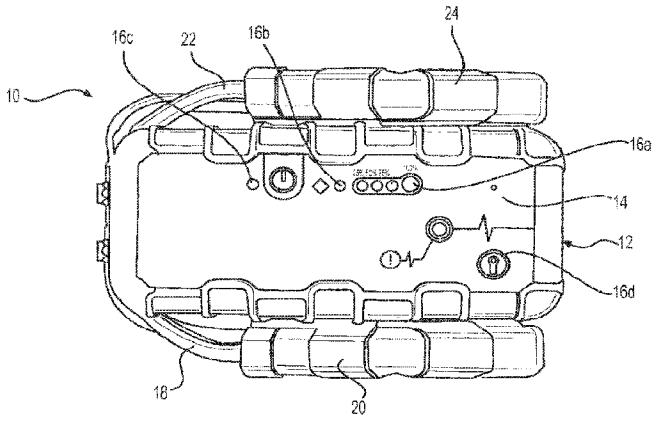


FIG. 1

GB 2562950 A

Espacenet

Bibliographic data: JP2018536789 (A) — 2018-12-13

バッテリジャンプスタート装置用バッテリコネクタ装置

Inventor(s): ジョナサン・ルイス・ヌック, ; ウィリアム・ナイト・ヌック, ; ジェイムズ・リチャード・スタンフィールド, ; デレク・マイケル・アンダーヒル

Applicant(s): ザ・ノコ・カンパニーＴｈｅ Ｎｏｃｏ Ｃｏｍｐａｎｙ

Classification: **- international:** ***F02N11/08; F02N11/12; H02J7/00***
- cooperative:

Application number: JP20170561919 20170210 Global Dossier

Priority number (s): US201662424297P 20161118 ; WO2016US24680 20160329 ; US201662294067P 20160211 ; WO2017US17289 20170210 ; US201615137626 20160329

Abstract of JP2018536789 (A)

バッテリジャンプスタート装置で使用するための改良導電率バッテリコネクタ装置。バッテリからバッテリジャンプスタート装置によって再充電されるバッテリへの高められた導電率を提供する改良導電率バッテリコネクタ。【選択図】図１

(19)日本国特許庁(JP)　(12)公表特許公報(A)　(11)特許出願公表番号
特表2018-536789
(P2018-536789A)
(43)公表日　平成30年12月13日(2018.12.13)

(51)Int.Cl.		F I			テーマコード（参考）
F02N 11/12	(2006.01)	F02N	11/12		5G503
F02N 11/08	(2006.01)	F02N	11/08	Z	
H02J 7/00	(2006.01)	F02N	11/08	L	
		H02J	7/00	301B	

審査請求 有　予備審査請求 未請求　（全 28 頁）

(21)出願番号　特願2017-561919 (P2017-561919)
(86)(22)出願日　平成29年2月10日 (2017.2.10)
(85)翻訳文提出日　平成30年3月14日 (2018.3.14)
(86)国際出願番号　PCT/US2017/017289
(87)国際公開番号　WO2017/139524
(87)国際公開日　平成29年8月17日 (2017.8.17)
(31)優先権主張番号　62/294,067
(32)優先日　平成28年2月11日 (2016.2.11)
(33)優先権主張国　米国 (US)
(31)優先権主張番号　PCT/US2016/024680
(32)優先日　平成28年3月29日 (2016.3.29)
(33)優先権主張国　米国 (US)
(31)優先権主張番号　15/137,626
(32)優先日　平成28年4月25日 (2016.4.25)
(33)優先権主張国　米国 (US)

(71)出願人　517284935
ザ・ノコ・カンパニー
Ｔｈｅ　Ｎｏｃｏ　Ｃｏｍｐａｎｙ
アメリカ合衆国４４１３９オハイオ州グレンウィロウ、ダイアモンド・パークウェイ３０３３９番、ナンバー１０２
(74)代理人　100100158
弁理士　鮫島　睦
(74)代理人　100111039
弁理士　前堀　義之
(72)発明者　ジョナサン・ルイス・ヌック
アメリカ合衆国４４１３９オハイオ州グレンウィロウ、ダイアモンド・パークウェイ３０３３９番、ナンバー１０２、ザ・ノコ・カンパニー内

最終頁に続く

(54)【発明の名称】バッテリジャンプスタート装置用バッテリコネクタ装置

(57)【要約】
バッテリジャンプスタート装置で使用するための改良導電率バッテリコネクタ装置。バッテリからバッテリジャンプスタート装置によって再充電されるバッテリへの高められた導電率を提供する改良導電率バッテリコネクタ。
【選択図】図1

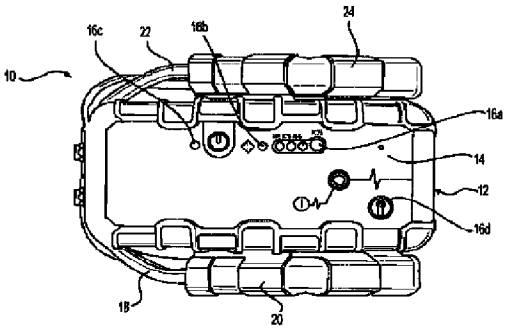


FIG. 1

【特許請求の範囲】
【請求項１】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリコネクタ装置であって、
正極端子タブと、負極端子タブとを有するバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体板と、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記バッテリの前記正極端子導体板に接続された正極ケーブルと、
第２回路基板導体バーから離間した第１回路基板導体バーを有する回路基板を有し、前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと、
前記第２回路基板導体バーに接続された負極ケーブルと
を備え、
前記第１回路基板導体バーは、前記バッテリの前記負極端子導体バーに電気的に接続され、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンプスタートされるバッテリとの間の隔離を提供するために第１回路基板導体バーと第２回路基板導体バーとの間に接続された１又は複数のリレーを更に備える、バッテリコネクタ装置。
【請求項２】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリコネクタ装置であって、
正極端子タブと、負極端子タブとを有する再充電可能なバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体板と、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記バッテリの前記正極端子導体板に接続された正極ケーブルと、
第２回路基板導体バーから離間した第１回路基板導体バーを有する回路基板を有し、前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと、
前記第２回路基板導体バーに接続された負極ケーブルと
を備え、
前記第１回路基板導体バーは、前記バッテリの前記負極端子導体バーに電気的に接続され、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンプスタートされるバッテリとの間の隔離を提供するために第１回路基板導体バーと第２回路基板導体バーとの間に接続された１又は複数のリレーを更に備え、
前記負極ケーブルは、前記複数のリレーのそれぞれに電気的に接続されている、バッテリコネクタ装置。
【請求項３】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリコネクタ装置であって、
正極端子タブと、負極端子タブとを有する再充電可能なバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体板と、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記バッテリの前記正極端子導体板に接続された正極ケーブルと、
第２回路基板導体バーから離間した第１回路基板導体バーを有する回路基板を有し、前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと、
前記第２回路基板導体バーに接続された負極ケーブルと、
前記正極ケーブルの第１部分と、前記正極ケーブルの第２部分との間に設けられたダイ

オード接続部と
を備え、
前記第１回路基板導体バーは、前記バッテリの前記負極端子導体バーに電気的に接続され、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンプスタートされるバッテリとの間の隔離を提供するために第１回路基板導体バーと第２回路基板導体バーとの間に接続された１又は複数のリレーを更に備え、
前記負極ケーブルは、前記複数のリレーのそれぞれに電気的に接続されている、バッテリコネクタ装置。
【請求項４】
前記１又は複数のリレーは、前記第１回路基板導体バーと前記第２回路基板導体バーとの間を並列に接続する複数のリレーである、請求項１に記載の装置。
【請求項５】
前記負極端子導体バーは、前記バッテリを前記スマートスイッチバッテリインターフェイスに機械的及び電気的に接続するように構成されている、請求項１に記載の装置。
【請求項６】
負極端子導体バーは、前記スマートスイッチバッテリインターフェイスを前記バッテリの上方に隣接して配置するように構成されている、請求項５に記載の装置。
【請求項７】
前記正極端子導体板は、前記正極ケーブルの一端に巻き付き、前記バッテリを前記正極ケーブルに電気的に接続する、請求項１に記載の装置。
【請求項８】
前記正極端子導体バーは、前記バッテリの前記正極端子タブに超音波溶着されており、前記負極端子導体バーは、前記バッテリの前記負極端子タブに超音波溶着されている、請求項１に記載の装置。
【請求項９】
前記バッテリは、矩形状であり、
前記バッテリの前記正極端子導体板の幅は、前記バッテリの幅と等しく、
前記負極端子導体バーは、Ｌ字状であり、前記バッテリのそれぞれの角に巻き付くように構成されている、請求項１に記載の装置。
【請求項１０】
前記バッテリタブは、前記バッテリのケーシングと同一平面に搭載されている、請求項９に記載の装置。
【請求項１１】
ダイオード接続部は、前記正極ケーブルの第１部分と、前記正極ケーブルの第２部分との間に設けられている、請求項１に記載の装置。
【請求項１２】
前記ダイオード接続部は、前記正極ケーブルの前記第１部分と前記正極ケーブルの前記第２部分との間に接続された１又は複数のダイオード接続部を備える、請求項１１に記載の装置。
【請求項１３】
前記ダイオード接続部は、前記正極ケーブルの前記第１部分と前記正極ケーブルの前記第２部分との間にそれぞれ接続された複数のダイオードを備える、請求項１２に記載の装置。
【請求項１４】
前記複数のダイオードの導体タブは、前記正極ケーブルの前記第１部分に接続されており、
前記複数のダイオードの前記導体突起は、前記正極ケーブルの前記第２部分に接続されている、請求項１３に記載の装置。
【請求項１５】

前記複数のダイオードは、プリント回路基板に接続されている、請求項１４に記載の装置。

【請求項１６】

前記複数のダイオードの前記導体突起は、前記プリント回路基板を通過して延在し、前記導体突起の前記第２部分と電気的に接続されている、請求項１５に記載の装置。

【請求項１７】

前記複数のダイオードは、単軸に沿って互いに隣接して配置されている、請求項１６に記載の装置。

【請求項１８】

前記ダイオード導体は、熱収縮絶縁体で絶縁されている、請求項１３に記載の装置。

【発明の詳細な説明】

【技術分野】

【０００１】

ジャンプスタート装置のバッテリと、充電されるバッテリとの間の導電率を高めるように構成された携帯用のバッテリコネクタ装置、例えば、バッテリジャンプスタート装置（特に携帯型車両ジャンプスタート装置）用のバッテリコネクタ配置ないしアセンブリ。

【背景技術】

【０００２】

ヌック（Nook）らの米国特許第９００７０１５号に開示されているような携帯型車両バッテリジャンプスタート装置が存在する。この装置は、リチウムイオンバッテリパックを使用する。このタイプの装置では、バッテリパックからジャンプスタートされる車両の車載バッテリへの導電率を最大化する必要がある。

【０００３】

自動車のジャンプスタートの成功のためには、結果を決定づける主な要素が２つある。第１の要素は、前記リチウムイオンバッテリパックから供給される電力量であり、第２の要素は、最大導電率である。大型のエンジンをジャンプスタートする最良の可能性を得るためには両方の要素が必要である。他方の要素がなく一方の要素だけでは、不十分である。

【発明の概要】

【課題を解決するための手段】

【０００４】

ここで説明する主題は、車両のジャンプスタート用の装置に使用されるバッテリ装置（例えば、バッテリコネクタ、バッテリコネクタ配置、又はバッテリ導体アセンブリ）、及びバッテリコネクタ装置を有する車両のジャンプスタート用の装置を対象にする。

【０００５】

ここで説明する主題は、バッテリの端子に接続された少なくとも１つのバッテリ導体を有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【０００６】

ここで説明する主題は、バッテリのバッテリタブに接続された少なくとも１つのバッテリ導体ないしケーブルを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【０００７】

ここで説明する主題は、バッテリに接続された正極導体及び負極導体を有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【０００８】

ここで説明する主題は、バッテリに接続された正極導体板及び／又は負極導体板を有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【０００９】

ここで説明する主題は、バッテリに接続された正極導体板及び／又は負極導体板と、正極導体板に接続された正極ケーブル及び／又は負極導体板に接続された負極ケーブルとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１０】

ここで説明する主題は、バッテリの正極端子に接続された正極バッテリ導体及び／又はバッテリの負極端子に接続された負極バッテリ導体を有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１１】

ここで説明する主題は、バッテリの正極端子接点に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体を有し、前記バッテリ導体は、前記バッテリのそれぞれの端子にはんだ付けされている前記バッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１２】

ここで説明する主題は、バッテリの正極端子に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体と、バッテリのバッテリ導体の1つに接続されたリレーとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置。

【００１３】

ここで説明する主題は、バッテリの正極端子接点に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体と、負極バッテリ導体に接続されたリレーとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１４】

ここで説明する主題は、バッテリの正極端子接点に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体と、負極バッテリ導体に接続されたリレーとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１５】

ここで説明する主題は、バッテリの正極端子接点に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体と、負極バッテリ導体に接続された複数のリレーとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【００１６】

ここで説明する主題は、バッテリの正極端子接点に接続された正極バッテリ導体及び／又はバッテリの負極端子接点に接続された負極バッテリ導体と、正極バッテリ導体に接続された正極ケーブルとを有するバッテリを備えるないしはかかるバッテリからなるバッテリコネクタ装置を対象とする。

【図面の簡単な説明】

【００１７】

【図１】クランプが展開されていないバッテリジャンプスタート装置の正面図。

【図２】図１に示したバッテリジャンプスタート装置の背面斜視図。

【図３】図１及び図２に示したバッテリジャンプスタート装置の端部斜視図。

【図４】図１に示したバッテリジャンプスタート装置（ただし、クランプが展開されている）の正面斜視図

【図５】図１に示したバッテリジャンプスタート装置内に格納されたバッテリコネクタ装置（ただし、負極ケーブルはまだ設置されていない）の正面斜視図。

【図６】図５に示したバッテリコネクタ装置の平面図。

【図７】図５に示したバッテリコネクタ装置の側面図。

【図８】図５に示したバッテリコネクタ装置の端面図。

【図９】図５に示したバッテリコネクタ装置（ただし、バッテリコネクタ装置に接続された負極ケーブルを有する）の斜視図。
【図１０】図５に示したバッテリコネクタ装置（ただし、正極ケーブルに設置されたダイオード導体を備える）の斜視図。
【図１１】バッテリジャンプスタート装置の他の構成要素ないし部品が接続されたバッテリコネクタ装置の斜視図。
【図１２】図５に示したバッテリコネクタ装置のバッテリアセンブリの斜視図。
【図１３】バッテリジャンプスタート装置用の他のバッテリコネクタ装置の正面斜視図。
【図１４】リレープリント回路基板にはんだ付けされる前のリレープリント回路基板との正極ケーブル接続の詳細図。
【図１５】リレープリント回路基板にはんだ付けされた後のリレープリント回路基板との正極ケーブル接続の詳細図。
【図１６】図１３に示したバッテリコネクタ装置のバッテリアセンブリの正面斜視図。
【図１７】図１６に示したバッテリアセンブリ（ただし、巻かれていない状態の正極端子導体を有する）の部分平面図。
【図１８】図１６に示したバッテリアセンブリの正極端子導体の部分平面図。
【図１９】正極ケーブルの端部を部分的に巻いた正極端子導体の端部斜視図。
【図２０】正極ケーブルの端部を完全に巻いた正極端子導体の端部斜視図。
【図２１】正極ケーブルの端部を完全に巻き、はんだ付けされた正極端子導体の側部斜視図。
【図２２】正極ケーブルの端部を完全にまきはんだ付けされた正極端子導体の反対端部斜視図。
【図２３】正極ケーブルのセクション間のダイオードコネクタの斜視図。
【図２４】ダイオードコネクタに使用されるショットキーダイオードの斜視図。
【図２５】収縮包装スリーブで絶縁されたダイオードコネクタの斜視図。
【図２７】図５から図１０に示したバッテリ接続の負荷試験を示すグラフィックイラスト。
【図２８】図１３から図２５に示したバッテリ接続の負荷試験を示したグラフィックイラスト。
【図２９】ジャンプスタート装置用のさらなるバッテリコネクタ装置の正面斜視図。
【図３０】組み立て前の複数のバッテリセル、セパレートタブ、及び導体（例えば、板状導体）を備えるバッテリコネクタ装置の正面図。
【図３１】タブを長くするためのセパレートタブを有するバッテリセルを備えるバッテリコネクタ装置の正面図。
【図３２】組み立て後の図３０に示した複数のバッテリセル、セパレートタブ、及び導体を備えるバッテリコネクタ装置の正面図。
【図３３】バッテリセルを折り畳んだ後の、図３２に示したバッテリセルアセンブリを備えるバッテリコネクタ装置を示す斜視図。
【図３４】正極ケーブルの露出端部を包むか巻き付いて、共にはんだ付けされたセパレートタブを示すバッテリコネクタ装置の端部斜視図。
【図３５】負極端子導体板を包んで、共に溶着及び／又ははんだ付けされた負極バッテリタブを示すバッテリコネクタ装置の反対端部斜視図。
【図３６】正極ケーブルに接続される前の、バッテリに接続されて外側に延在する平坦なセパレートタブを示すバッテリコネクタ装置の斜視図。
【図３７】ワイヤとコネクタとを有する温度センサアセンブリの側面図。
【図３８】正極ケーブルに一列に接続され接合されたダイオード回路基板の斜視図。
【発明を実施するための形態】
【００１８】
バッテリジャンプスタータ装置１０を図１及び２に示す。バッテリジャンプスタート装置１０は、複数の発光ダイオード（ＬＥＤｓ）１６が配列されたディスプレイ１４を有す

るケーシング１２を備える。
【００１９】
バッテリジャンプスタート装置１０は、正極クランプ２０を有する正極ケーブル１８と、負極クランプ２４を有する負極ケーブル２２とを更に備える。正極ケーブル１８及び負極ケーブル２２とは、ケーシング１２中の開口１２ａ，１２ｂをそれぞれ通過する。
【００２０】
クランプ２０，２４は、図１に示すようにクランプ２０，２４のそれぞれがケーシング１２の両端から外側に延びるそれぞれのサイドポスト２６をクランプすることによって、展開されていない状態で格納ないしは固定される。サイドポスト２６は、図２に示される。クランプ２０，２４は、バッテリジャンプスタータ装置１０が使用されないときに固定され、その後使用するときにサイドポスト２６からアンクランプされる。
【００２１】
バッテリジャンプスタート装置１０は、車載バッテリをジャンプスタートするように構成されている。例えば、バッテリジャンプスタート装置１０は、米国特許第９００７０１５号（参照することにより本明細書に全体を援用する）に開示されている安全保護付携帯型車両ジャンプスタート装置、又はこれに類似する装置であってもよい。
【００２２】
バッテリジャンプスタート装置１０は、ケーシング１２の内側に配置された電気部品ないしは部品を備える。例えば、バッテリジャンプスタート装置１０は、図３から図９に示すバッテリコネクタ装置１００を備える。
【００２３】
バッテリコネクタ装置１００は、バッテリ１１２を有するバッテリアセンブリ１１０を備える。例えば、バッテリ１１２は、充電式リチウムイオンバッテリである。バッテリコネクタ装置１００は、バッテリ１１２からバッテリジャンプスタータ装置１０のケーブル１８，２２及びクランプ２０，２４への電気導電率を最大化するように構成されている。バッテリ１１２は、バッテリケーシング１１２ａ、例えば、矩形状のバッテリケーシング１１２ａを備える。
【００２４】
バッテリ１１２は、バッテリ１１２の一方の端部（例えば幅端部）に正極タブを備え、バッテリ１１２の他方の端部（例えば幅端部）に負極タブを備える。例えば、バッテリ１１２は、正極タブ及び負極タブをそれぞれ有する１又は複数のバッテリセルを備える。例えば、バッテリセルの正極タブは、バッテリ１１２の前記一方の端部に配置され、バッテリセルの負極タブは、バッテリ１１２の前記他方の端部に配置される。正極端子導体板１１４は、バッテリ１１２の前記一方の端部で、バッテリ１１２の正極タブ（すなわち接点）に接続（例えば、はんだ付け、溶接、又は超音波接合）される。正極端子導体板１１４は、バッテリ１１２の前記一方の端部（例えば幅端部）に沿って延在している。
【００２５】
正極ケーブル１８は、正極端子導体板１１４及び／又はバッテリ１１２の正極タブに接続（例えば、はんだ付けによって直接接続）されてもよい。例えば、正極端子導体バー１１４は、導体環１１６を備えていてもよい。導体環１１６は、正極ケーブル１８の露出端部１８ａに巻き付いて（例えば、全体に巻き付いて）、接続（例えば、圧着及び／又ははんだ付け）されている。例えば、正極端子導体板１１４は、（例えば、機械加工された、切断された、又は厚肉銅板から打ち抜かれた）厚肉銅板から作られる。
【００２６】
図５及び図６に示すように、正極端子導体シート１１４は、（例えば、Ｌ字状の）バッテリ１１２の矩形状のケーシング１１２ａの正方形状の角部のうちの１つに巻き付くように構成（例えば、屈曲）されていてもよい。Ｌ字状正極端子導体シート１１４は、図５に示すように、バッテリ１１２の端部と、バッテリ１１２の側部の少なくとも一部に沿って延在してもよい。
【００２７】

また、正極端子導体板１１４は、（例えば、バッテリジャンプスタータ装置１０を落下試験したときに機械的な衝撃に耐えるように組み立てられる）付加的な支持及び安定性を提供するように、バッテリケーシング１１２ａの外表面に機械的に結合及び／又は接着されてもよい。例えば、正極端子導体バー１１４は、バッテリケーシング１１２に接着剤（例えば、シリコン接着剤）、両面テープ、両面フォームテープ、スナップフィット接続及び／又は接着接続を有する絶縁プラスチック若しくはセラミックのコネクタによって機械的に接続されてもよい。バッテリケーシング１１２は、正極端子導体板１１４と機械的に接続（例えば、スナップフィット接続又は干渉接続）するように形成（例えば、成形）されていてもよい。

【００２８】

正極ケーブル１８は、バッテリ１１０から正極クランプ２０へと延びる１本のワイヤないしはケーブル（例えば、撚線又は編組線）であってもよい。具体的には、正極ケーブル１８の一方の端部は、バッテリ１８に接続された正極端子導体板１１４に接続されており、正極ケーブル１８の他方の端部は、正極クランプ２０に接続されている。

【００２９】

より具体的には、正極ケーブル１８は、ケーシング１２内で正極ケーブル１８の向きを変更するために、可撓性ケーブル部ないしは屈曲ケーブル部１１８を備えていてもよい。正極ケーブル１８は、ケーシング１２を通過する正極ケーブル１８を柔軟に収容するために、可撓性内側スリーブ部１２２につながる可撓性外側スリーブ部１２０が装着されてもよい。可撓性外側スリーブ部１２０は、バッテリジャンプスタータ装置１０のケーシング１２に対して外側に位置しており、可撓性内側スリーブ部１２２は、バッテリジャンプスタータ装置１０のケーシング１２に対して内側に位置している。

【００３０】

可撓性外側スリーブ部１２０は、可撓性を維持しつつ、正極ケーブル１８とバッテリジャンプスタータ装置のケーシング１２との間の接続を補強するように構成されている。例えば、可撓性外側スリーブ部１２０は、正極ケーブル１８の複数の部分を露出させる１又は複数（例えば、図５では３つ）の溝１２４を備える。１又は複数の溝１２４は、ヒンジとして機能して、可撓性外側スリーブ部１２０内の正極ケーブル１８の屈曲を容易にする。

【００３１】

可撓性スリーブ１２０は、内側フランジ１２６から（例えば、バッテリジャンプスタータ装置１０のケーシング１２の壁厚とほぼ等しい短い距離で）離間した外側フランジ１２４を備える。フランジ１２４，１２６は、正極ケーブル１８をバッテリジャンプスタータ装置１０のケーシング１２にさらに固定する。

【００３２】

可撓性スリーブ１２０は、外側フランジ１２４と内側フランジ１２６とを接続するスリーブ部１２８(図６)を備える。例えば、可撓性外側スリーブ部１２０は、単一ユニットとして正極ケーブル１８上及びその周囲に、成形ないしは取り付けられる（例えば、可撓性スリーブ１２０は、成形工程の間に金型内に挿入されている正極ケーブル１８の一部に成形される）。あるいは、可撓性スリーブ１２０は、別個に製造（例えば成形）され、その後正極ケーブル１８の一部に設置されるか組み付けられる。

【００３３】

正極ケーブル１８は、外側絶縁シース１８ｃ（例えば、押出プラスチックシース）内に配置された内側導体１８ｂ（例えば、素線導体、撚線、又は編組線）を備える。

内側導体１８ｂは、例えば、単線導体又はワイヤ束１８ｄを有する多重撚線金属線導体を備えていてもよい。

【００３４】

内部電線は、銅ないしはアルミニウムから作られてもよい。可撓性スリーブ１２０は、正極ケーブル１８の外側絶縁シース１８ｃ上及びその周りに（例えば、成形されるか設置されるか組み付けられて）取り付けられてもよい。

【００３５】
バッテリコネクタ装置１００は、バッテリ１１２の負極タブ（すなわち接点）に、バッテリ１１２の他方の端部において接続（例えば、はんだ付け、溶接又は超音波溶着）された負極端子導体板１３０を更に備える。負極端子導体板１３０は、バッテリ１１２の他方の端部に沿って延在してもよい。
【００３６】
負極端子導体板１３０の他方の端部は、図５及び図６に示すように、負極端子導体板コネクタ部１３２を備える。
【００３７】
負極端子導体板１３０は、矩形状バッテリ１１２の複数の角部の１つに巻き付くように（例えばＬ字状に）構成されていてもよい。Ｌ字状負極端子導体板１３０は、図５及び図６に示すように、バッテリ１１２の端部に沿って及びバッテリ１１２の側部の少なくとも一部に沿って延在してもよい。
【００３８】
負極端子導体バー１３０は、また、（例えば、バッテリジャンプスタータ装置１０を落下試験したときに機械的な衝撃に耐えるために）付加的な支持及び安定性を提供するために、バッテリケーシング１１２ａの外表面に機械的に結合及び／又は接着されてもよい。例えば、負極端子導体バー１１４は、接着剤（例えばシリコン接着剤）、両面テープ、両面フォームテープ、スナップフィット接続及び／又は接着接続を有する絶縁プラスチックないしはセラミックのコネクタによって、バッテリケーシング１１２ａに機械的に接続されてもよい。バッテリケーシング１１２は、正極端子導体板１１４と機械的に接続（例えば、スナップフィット接続又は干渉接続）するように形成（例えば成形）されてもよい。
【００３９】
バッテリコネクタ装置１００は、スマートスイッチバッテリインターフェイス１３４をさらに備える。スマートスイッチバッテリインターフェイス１３４は、リレープリント回路基板（ＰＣＢ）１３６を備え、回路基板１３６は、図５及び図６に示すように、回路基板１３６の一方側に配置された第２回路基板導体バー１４０から離間した第１回路基板導体バー１３８を備える。
【００４０】
一対のリレー１４２は、回路基板１３６の反対側に搭載されている。リレー１４２は、リレープリント回路基板１３６の部品穴１３６ａに配置されているリレーアンカーピン１４２ａを含む。リレー１４２は、回路基板１３６に設けられた部品穴１３６ｂと第１導体バーに設けられたスロット１３８ａとを通過して延びるリレーコネクタピン１４２ｂを備える。さらに、リレー１４２は、回路基板１３６に設けられた部品穴１３６ｃと第２導体バー１４０に設けられた部品穴１４０ａとに配置されたリレーコネクタピン１４２ｃをさらに備える。リレーアンカーピン１３６ａは、適切な位置にはんだ付けされて、リレー１４２を回路基板１３６に機械的に接続している。リレーコネクタピン１４２ｂ，１４２ｃは、適切な位置にはんだ付けされて、それぞれリレー１４２を回路基板導体板１３８，１４０に機械的及び電気的に接続している。
【００４１】
回路基板１３６の部品穴１３６ａは、矩形状（図５及び図７）であり、リレーアンカーピン１４２ａを収容する。具体的には、リレーアンカーピン１４２ａの基部は、正方形の端部を有する矩形状である。前記正方形の端部は、回路基板１３６の外表面と同一平面に配置された横方向の縁部を形成する基部と比較して、寸法的に幅が狭い。リレーアンカーピン１４２ａの露出端部にはんだが塗布されたとき、はんだは、前記正方形の端部の側部と横方向の縁部とを接続し、リレーアンカーピンを回路基板１３６に固定及び固着する。
【００４２】
負極端子導体板コネクタ部１３２に設けられたスロット１３２ａは、矩形状であり、第１回路基板導体バー１３８に設けられた部品穴１３８ａ（図３）は、Ｔ字状であり、図３に示すように３つの水平を向いたリレーコネクタピン１４２ｃを収容する。リレーコネク

タピン１４２ｂの端部は、負極端子導体バーコネクタ部１３２の外表面と同一平面に示されている。はんだがリレーコネクタピン１４２ｂの露出端部に塗布されたとき、はんだは負極端子導体バーコネクタ部１３２のスロット１３２ａと、第１回路基板導体バー１３８の部品穴１３８ａとを満たし、コネクタピン１４２ｂの側部とスロット１３２ａ及び部品穴１３８ａの内縁とを接続し、リレー１４２を回路基板１３６と負極端子導体バーコネクタ部１３２とに接続する。また、塗布されたはんだは、負極端子導体バーコネクタ部１３２を第１回路基板導体バー１３８に電気的に接続する。

［００４３］

第２回路基板導体バー１４０に設けられた部品穴１４０ａは、図３に示すように、Ｔ字状であり、３つの垂直に向いたリレーコネクタピン１４２ｃを収容する。リレーコネクタ突起１４０ａは、図７に示すように、回路基板１３６の外表面から外側に延びて、負極ケーブル１４４の露出導体端部１４４ａと接続している。露出導体端部１４４ａとリレーコネクタ突起１４０ａの端部とにはんだが塗布されたとき、はんだは、Ｔ字状のスロットを満たし、リレーコネクタ突起１４０ａと、第２回路基板導体１４０と、負極ケーブル１４４の露出導体端部１４４ａとを接続する。

［００４４］

負極端子導体バー１３０の負極端子導体バーコネクタ部１３２は、回路基板１３６の第１回路基板導体バー１３８に（例えば、はんだ付けにより）接続されている。負極ケーブル２２の露出導体端部２２ａ（すなわち、絶縁シースが取り除かれている）は、図９に示すように第２回路基板導体バー１４０に（例えば、はんだ付けにより）接続されている。

［００４５］

バッテリコネクタ装置１００は、図１０に示すように、正極ケーブル１８にダイオード接続部１５０を提供することで改良されてもよい。例えば、ダイオード接続部は、正極ケーブル１８に設置される（例えば、接合される）。ダイオード接続部１５０は、ダイオードプリント回路基板（ＰＣＢ）１５２を備える。

ダイオードプリント回路基板１５２は、回路基板１５２の一方側に配置された一組のバックチャージダイオード１５４（例えば、ショットキーダイオード）と、回路基板１５２の他方側に設けられた導体バー１５６とを備える。

［００４６］

（組み立て）

バッテリジャンプスタート装置１０は、図１１に示すように、上側ケーシング部１２ａと下側ケーシング部１２ｂとを有するケーシング１２を備える。上側ケーシング部１２ａと下側ケーシング部１２ｂとは、バッテリジャンプスタート装置１０を組み立てるときに、互いに接続されるように構成されている。

［００４７］

バッテリジャンプスタート装置１０は、バッテリコネクタ装置１００とコントローラアセンブリ２１０とをさらに備え、バッテリコネクタ装置１００とコントローラアセンブリ２１０との両方が、ケーシング１２内に配置されている。コントローラアセンブリ２１０は、回路基板２１２を備え、回路基板２１２は、他の回路基板２１４に隣接して配置されている。

［００４８］

バッテリアセンブリ１１０（図１２）の正極端子は、正極電源線２１６を介して回路基板２１２に接続されている。例えば、正極電源線２１６は、正極導体バー１１４（図５）に接続されている。バッテリアセンブリ１１０の負極端子は、負極電源線２１８を介して回路基板２１４に接続されている。

［００４９］

リレー回路基板１３６は、コネクタ２２２を有するワイヤセット２２０を備える。コネクタ２２２は、バッテリジャンプスタート装置１０の組み立てのときに、コントローラアセンブリ２１０の回路基板２１２上に配置されるリレー基板コネクタ２２４と接続するように構成されている。

［００５０］
バッテリアセンブリ１１０は、コネクタ２２８を有するワイヤセット２２６をさらに備える。コネクタ２２８は、コントローラアセンブリ２２０の回路基板２１２上に配置されたバッテリセル充電／監視コネクタ２３０と接続するように構成されている。
［００５１］
バッテリアセンブリ１１０は、ワイヤセット２３２を有するバッテリ温度センサを備え、ワイヤセット２３２はコネクタ２３４を有する。コネクタ２３４は、コントローラアセンブリ２２０の回路基板２１２上に配置された温度センサコネクタ２３６と接続するように構成されている。
［００５２］
回路基板２１２は、図１１に示すように、充電電力抵抗器２４０と、出力リレー２４２とを備える。
さらに、下側ケーシング部１２ａは、回路基板２１４に接続されたワイヤセット２４６を有するメインユーザ出力コネクタ２４４と、回路基板２１４に接続されたワイヤセット２５０を有するメインユーザ入力コネクタ２４８とを備える。
［００５３］
バッテリアセンブリ１１０は、図１１に示すように、バッテリジャンプスタート装置１０と接続されている。バッテリコネクタ装置１１０は、組み立てられたとき、バッテリジャンプスタート装置１０のケーシング１２内に設置されている。
［００５４］
（導電率の改良）
改良導電率バッテリコネクタ装置４００は、図１３から図２５に示されている。改良導電率バッテリコネクタ装置４００は、図５から図１０に示されたバッテリコネクタ装置１００と比較して大幅に増加した導電率を提供する。
［００５５］
バッテリ４１２からクランプへと伝導される電力量は、以下のように改良され得る。
［００５６］
１）ワイヤゲージを大きくする
例えば、４ＡＷＧ（米国ワイヤゲージ規格）の正極ケーブル１８及び負極ケーブル２２（図９）を、２ＡＷＧ正極ケーブル３１８及び負極ケーブル３２２（図１３及び図１５）に変更する。
［００５７］
２）負極ケーブル接続部の導電率を高める
例えば、リレーへの負極ケーブル端部３２２ａ（図１５）が、リレー４２２のコネクタピン４２２ｃに幅広くまたがって延びる。
［００５８］
３）正極ケーブル接続部の導電率を高める
例えば、正極ケーブル３１８が正極バッテリタブ４１４に巻かれ、互いに完全にはんだ付けされるように正極バッテリタブ４１４を伸ばす。
［００５９］
４）ダイオード接続部の導電率を高める
例えば、ダイオード接続部１５０（図５）をダイオード接続部４５０（図２３）に置き換える。
［００６０］
５）抵抗器／ダイオードプリント回路基板（ＰＣＢ）を再設計する
例えば、ダイオードプリント回路基板（ＰＣＢ）１５２をダイオードプリント回路基板（ＰＣＢ）４５２（図２３）に置き換える。
［００６１］
６）抵抗器を再接続する
例えば、再び接続されるダイオードプリント回路基板（ＰＣＢ）１５２（図１０）上に

配置された抵抗器Ｒ１３４Ａ及びＢ、１３５Ａ及びＢを再接続する。

【００６２】

これらの導電率を増加する特徴ないし配置のそれぞれの詳細な説明を以下に述べる。

【００６３】

１）ワイヤゲージを大きくする

正極ケーブル１８及び負極ケーブル２２（図９）のゲージは、例えば、４ＡＷＧ（米国ワイヤゲージ規格）ケーブルから、正極ケーブル３１８及び負極ケーブル３２２（図１３及び図１５）の２ＡＷＧケーブルへと増加されてもよい。４ＡＷＧケーブルと２ＡＷＧケーブルの比較仕様は、以下の通りである。

【００６４】

【表１】

	2AWG	4AWG
直径	0.2576 in	0.2294 in
	(6.544 mm)	(5.189 mm)
巻き数	3.88/in	4.89/in
	(1.53/cm)	(1.93/cm)
面積	66.4 kcmil	41.7 kcmil
	(33.6 mm²)	(21.2 mm²)
抵抗率	0.5127 mΩ/m	0.8152 mΩ/m
	(0.1563 mΩ/ft)	(0.2485 mΩ/ft)
許容電流	95 (60° C)	70 (60° C)
	115 (75° C)	85 (75° C)
	130 (90° C)	95 (90° C)
溶断電流	1.3 kA (10 s)	946 A (10 s)
	10.2 kA (1 s)	6.4 kA (1 s)
	57 kA (32 s)	36 kA (32 s)

【００６５】

２ＡＷＧケーブルは、４ＡＷＧケーブルと比較して、導電率（すなわち許容電流）の大幅な増加（すなわち約３６％）を提供する。

【００６６】

２）負極ケーブル接続部の導電率を増加する

負極ケーブル３２２（図１５）は、バッテリ４１２と負極ケーブル３２２との間の導電率（すなわち許容電流）を増加する方法で、バッテリ４１２（図１３）に接続されてもよい。例えば、負極ケーブル端部３２２ａは、リレー４２２のコネクタ突起４４２ｃ（図１５）に直接接続（例えば、はんだ付け）されてもよい。具体的には、負極ケーブル端部３２２ａは、図１４及び図１５に示すように、スマートスイッチバッテリインターフェイス４３４の全てのリレー３４２に渡って延在して、それらに直接接続されてもよい。

【００６７】

さらに、負極ケーブル端部３２２ａは、回路基板導体バー４４０の導体環４４１に接続されてもよい。

【００６８】

負極ケーブル３２２は、例えば、内側電線導体３２２ｂを有する撚線であってもよい。内側電線導休３２２ｂは、外側電気絶縁シース３２２ｃ内に配置された、撚られていない又は撚られたワイヤ束３２２ｄから構成される。負極ケーブル３２２の電気絶縁シース３２２ｃは、負極ケーブル端部３２２ａから取り除かれて、負極ケーブル端部３２２ａにおいて内側電導体３２２ｂを露出してもよい。

【００６９】

電導体３２２ｂの露出ワイヤ束３２２ｄは、リレー４２２の露出コネクタピン４４２ｃ

の端部に押し付けられ、ワイヤ３２２ｄの撚り糸が隣接するコネクタピン４４２ｃの間に捕捉される。露出ワイヤ束３３２ｄは、導体バー４４０（例えば、銅からなる）に接触されてもよい。はんだ４２３は、このアセンブリに塗布され、はんだが露出ワイヤ束４２２ｄとコネクタピン４４２ｃと導体バー４４０との間を流れ、負極ケーブル３２２と、バッテリ４１２に接続されたスマートスイッチバッテリインターフェイス４３４との間の電気的な接続が完成する

【００７０】

露出ワイヤ束３２２ｄの長さは、露出ワイヤ束３２２ｄがひとつひとつのリレー４２２のコネクタピン４２２ｃの各組と直接接続し、負極ケーブル３２２とバッテリ４１２との間の最大電気導電率（すなわち最大許容電流）を提供するように、選択される。

【００７１】

３）正極ケーブル接続の導電率を増加する

正極ケーブル３１８は、バッテリ４１２と正極ケーブル３１８との間の導電率（すなわち、許容電流）を増加する方法で、バッテリ４１２に接続されてもよい。例えば、正極ケーブル３１８は、正極バッテリタブ４１４に巻かれて、完全に互いにはんだ付けされてもよい。正極ケーブル３１８とバッテリ４１２との間の接続は、図１６から図２２に示される。

【００７２】

正極ケーブル３１８は、例えば、内側電線導体３１８ｂを有する撚線であってもよい。内側電線導体３１８ｂは、外側電気絶縁シース３１８ｃ内に配置された、撚られていないないしは撚られたワイヤ束３１８ｄから構成される。正極ケーブル３１８の電気絶縁シース３１８ｃは、正極ケーブル端部３１８ａから取り除かれて、正極ケーブル端部３１８ａにおいて内側電導体３１８ｂを露出してもよい。

【００７３】

バッテリ４１２は、正極バッテリタブ４１４を備える。正極バッテリタブ４１４は、バッテリ４１２の正極バッテリタブ４１４に接続された金属板（例えば銅板）である。

【００７４】

内側電導体３１８ｂの露出ワイヤ束３１８ｄは、スズを用いてはんだ付けされて、その後正極バッテリタブ３１２ａ内に巻かれてもよい。はんだ４１５（図２１）は、露出ワイヤ束３１８ｄと正極バッテリタブ３１２ａとに塗布されている。

【００７５】

露出ワイヤ束３１８ｄの長さは、露出ワイヤ束３１８ｄが正極バッテリタブ４１４の全幅と直接接続し、バッテリ３１２と正極ケーブル３１８との間の最大電気導電率（すなわち最大許容電流）を提供するように、選択される。

【００７６】

４）ダイオード接続部の導電率を高める

正極ケーブル３１８は、図２３から図２５に示すように、正極ケーブル３１８に沿った導電率を高めるように構成されたダイオード接続部４５０を備えてもよい。

【００７７】

ダイオード接続部４５０は、正極ケーブル部分３１８ｅ及び３１８ｆ（図２５）との間に接続された複数のダイオード４５４を備える。

例えば、ダイオード接続部４５０は、６つのバックチャージ型ダイオード（例えば、ショットキーバリアダイオード）を備える。

【００７８】

ダイオード４５４は、正極ケーブル部分３１８ｅ及び３１８ｆの間にはんだ付けされている。具体的には、ダイオード導体タブ４５４ａは、正極ケーブル部分３１８ｅにはんだ付けされ、ダイオード導体突起４５４ｂは、正極ケーブル部分３１８ｆにはんだ付けされる。より具体的には、ダイオード３５４のダイオード導体突起４５４ｂは、ダイオード回路基板４５２を通じて、ワイヤ束３１８ｄに及び、その後適切な位置ではんだ付けされて、ダイオード接続部４５０の組み立てを完了する。

［００７９］
ダイオード接続部４５０は、その後、例えば収縮包装絶縁体４５５（図２５）を用いて、絶縁される。収縮包装絶縁体４５５は、ダイオード接続部４５０の周囲に取り付けられ、その後、熱を加えることで（例えば、熱線銃を用いて）収縮する。
［００８０］
抵抗器／ダイオードプリント回路基板（ＰＣＢ）を再設計する
例えば、抵抗器／ダイオードＰＣＢを再設計して、抵抗器／ダイオードＰＣＢから延びるダイオードを排除する。
［００８１］
抵抗器を再接続する
例えば、再度接続される抵抗器／ダイオードＰＣＢ上の抵抗器Ｒ１３４Ａ及びＢ、１３５Ａ及びＢを再接続する。
［００８２］
（試験１）
図５に示されるバッテリコネクタ装置１００は、１２５０Ａの負荷試験に付された。結果を図２７に示す。また、以下の通りである。
［００８３］
［表２］

パルス１	**4779.01 Wの平均出力**
パルス２	**5528.99 Wの平均出力**
パルス３	**6101.63 Wの平均出力**

［００８４］
（試験２）
図１３に示されるバッテリコネクタ装置４００は、１２５０Ａの負荷試験に付された。結果を図２８に示す。また、以下の通りである。
［００８５］
［表３］

パルス１	**6584.61 Wの平均出力**
パルス２	**7149.60 Wの平均出力**
パルス３	**7325.91 Wの平均出力**

［００８６］
これは、試験１の結果と比較して、最大出力で約２０パーセント（２０％）の大幅な増加という結果になった。
［００８７］
他の改良伝導率バッテリ導体装置５００は、図２９から図３７に示される。
改良伝導率バッテリコネクタ装置５００は、図５から図１０に示されるバッテリコネクタ装置１００と比較して、大幅に増加した導電率を提供する。
［００８８］
バッテリ導体装置５００は、バッテリアセンブリ４１０を備え、バッテリアセンブリ４１０は、正極ケーブル５１８及び負極端子導体板５３０に接続されたバッテリ５１２を含む。正極ワイヤ５１９は、バッテリ５３０の正極タブないし正極ケーブル５１８と直接的又は間接的に接続され、負極ワイヤ５２３は、負極タブないし負極端子導体板５３０に直接的又は間接的に接続される。バッテリ導体装置５００は、バッテリ５１２に接続されるか、バッテリ５１２の動作に関連するワイヤ束５７０を更に含んでいてもよい（例えば、バッテリ温度センサ、電力供給など）。
［００８９］

バッテリ５１２は、単一のバッテリセル５１２ｃ（図３０）、又は端と端を直列に接続された複数のバッテリセル５１２Ｃを備えていてもよい。図３０では、３つの別々のバッテリセル５１２ｃが示されている。

【００９０】

バッテリセル５１２ｃは、各バッテリセル５１２ｃの対向する端部に配置された正極及び負極タブ５１２ｄをそれぞれ有する。バッテリセル５１２ｃは、正極及び負極タブ５１２ｄをそれぞれ直列に共に溶接（例えば、超音波溶着及び／又は熱溶着）及び／又ははんだ付けすることで、共に接続されている。

例えば、タブ５１２ｄは、互いに重なるように配置されている（例えば、縁部が対向するタブ５１２ｄに重なるか、又は縁部と縁部）

【００９１】

タブ５１２ｄは、各バッテリセル５１２ｃの本体及び両端から外側に延在する金属板（例えば、比較的薄い金属片）である。図３０に示すように、タブ５１２ｄは、各バッテリセル５１２ｃの幅の両端に沿って延在する。タブ５１２ｄは、それぞれ、中央に位置し、各バッテリセル５１２ｃの両端部のそれぞれの幅の大部分に延在する。

【００９２】

図３０及び図３１に示すように、セパレートタブ５１２ｅは、バッテリセル５１２ｃの右側に追加されるか接続されて、タブ５１２ｄの長さを伸ばす。セパレートタブ５１２ｅは、タブ５１２ｄと同一の幅を有するものとしてしめされているが、この幅は異なってもよい。セパレートタブ５１２ｅをタブ５１２ｄに組み付けるために、例えば、セパレートタブ５１２ｅは、タブ５１２ｄ上に重なるように配置され、その後溶着（例えば超音波溶着及び／又は熱溶着）及び／又ははんだ付けされる。正極ケーブル５１８の露出端部は、図３２及び図３４に示すように、その後、セパレートタブの内側に巻き上げられる。例えば、最初は平坦なセパレートタブ５１２ｅは、正極ケーブル５１８の露出端部に巻き付き、その後、溶着（例えば、超音波溶着及び／又は熱溶着）及び／又ははんだ付けによって、露出端部に接続される。例えば、はんだの層は、セパレートタブ５１２ｅの一方側又は両側に塗布され、そして、セパレートタブ５１２ｅを正極ワイヤ５１８の露出端部の周りに巻き付けた後、アセンブリは、加熱されて、層状のはんだは溶かされ、アセンブリは全体としてはんだ付けされる、

【００９３】

図３２に示すように、一度共に接続された３つのバッテリセル５１２ｃは、その後、図３３に示す層状のバッテリセル構成に互いに折り畳まれる。層状のバッテリセル構成は、包装されてもよいし（例えば、３つのバッテリセルは、ともにテープでくくられるか、収縮包装される）、又は、図３４に示すように、バッテリカバーないしケーシングの内部に配置される。

【００９４】

図３５に示すように、負極タブ５１２ｄは、負極端子導体板５３０に取り付けられてもよい。例えば、負極タブ５１２ｄは、部分的に又は全体的に（図視するように）負極端子導体板５３０の周りに巻き付けられてもよい。負極タブ５１２ｄは、負極タブ５１２ｄの負極端子導体板５３０への溶着及び／又ははんだ付けを容易にするために、複数の部品穴５１２ｆを備えてもよい。例えば、部品穴５１２ｆは、図３５に示すように、格子状に配置された複数の正方形状の部品穴であってもよい。負極ワイヤ５２３は、負極タブ５１２ｄに接続（例えば、はんだ付け）されて示されている。

【００９５】

セパレートタブ５１２ｅ（図３０参照）は、負極タブ５１２ｄに接続されて、負極タブ５１２ｄを伸ばしてもよく、伸ばされた負極タブは、１回以上（例えば、２、３、４又はそれ以上）負極端子導体板５３０を包み込むか巻き付く。この方法で、負極タブ５１２ｄと負極端子導体板５３０との間の電気的な接続は強化される。このセパレートタブ５１２ｅは、一方側ないし両側にはんだの層を備えていてよく、セパレートタブ５１２ｅが負極端子導体板５３０を包み込むか巻き付いた後に、アセンブリは、加熱されて、セパレート

タブ５１２ｅを負極端子導体板５３０上にはんだ付けする。

【００９６】

正極ケーブル５１８（図２９）の露出端部を包むか巻き付く準備ができている接続されたセパレート正極タブ５１２ｄを有するバッテリ導体装置５００の完成したアセンブリは、図３６に示されている。図３６に示されているワイヤ束５７０は、バッテリ５１２内に埋設された温度センサ（例えば、バッテリタブの近傍、又はバッテリセルの間に配置された温度センサ）用のワイヤ５７２を含む。ワイヤ５７２ａ，５７２ｂを有する温度センサ５７４は、図３７に示されている。

【００９７】

バッテリ導体装置５００は、図３８に示すように、一列に接続されたダイオードコネクタ５５０を備えてもよく、正極ケーブル５１８に接合されてもよい。

【００９８】

バッテリ導体装置５００は、ダイオード回路基板５５２を備え、ダイオード回路基板５５２は、ダイオード回路基板５５２上に組み付けられた複数のダイオード４５４を備える。ダイオード４５４は、正極ケーブル５１８の露出端部に接続（例えば、はんだ付け）されたダイオード導体タブ４５４ａをそれぞれ備える。ダイオード４５４の突起は、ダイオード回路基板５５２の部品穴に延在し、導電性トレースと正極ケーブル５１８の露出端部との両方に、抵抗器５７６と共にはんだ付けされ、アセンブリは完成する。

【図１】

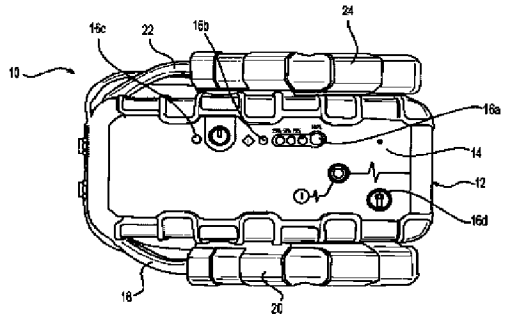


FIG. 1

【図２】

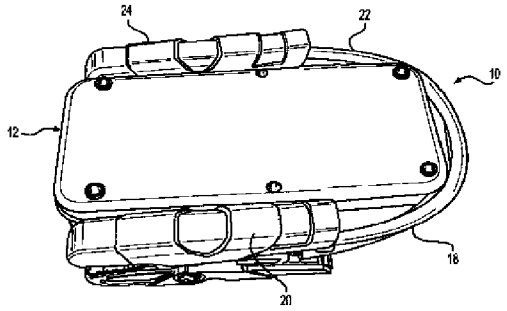


FIG. 2

【図３】

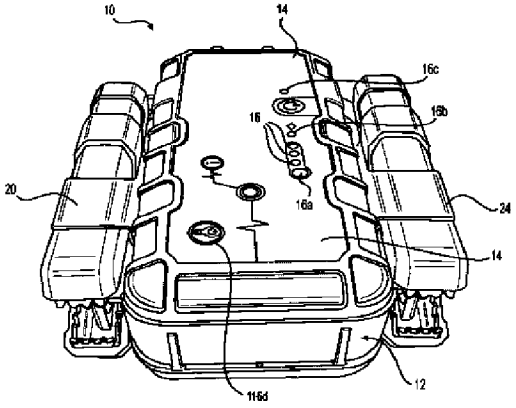


FIG. 3

【 図４ 】

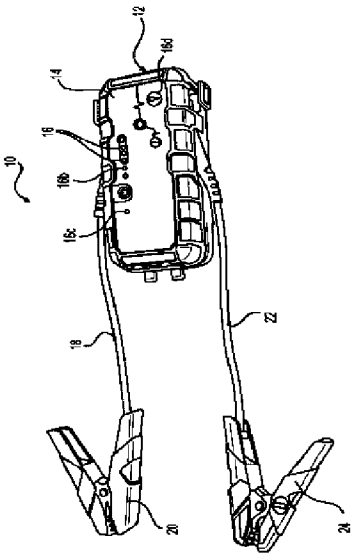


FIG. 4

【 図５ 】

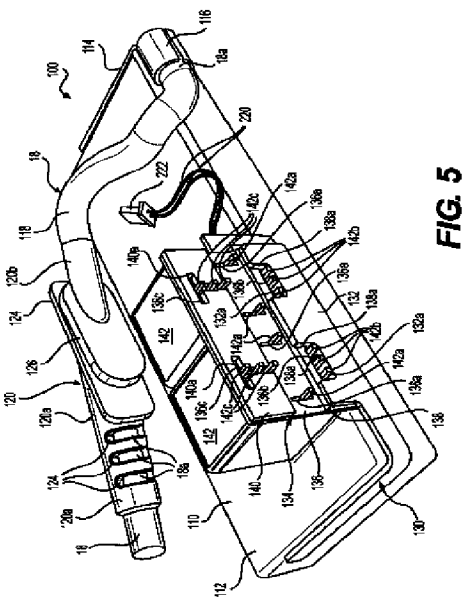


FIG. 5

【 図６ 】

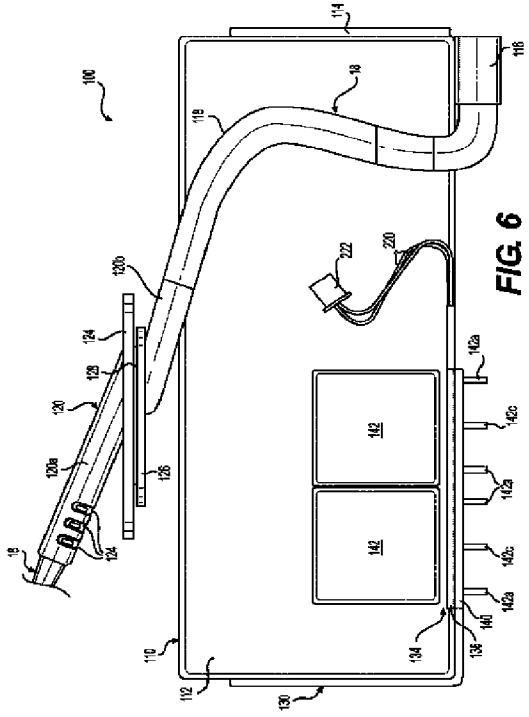


FIG. 6

【 図７ 】

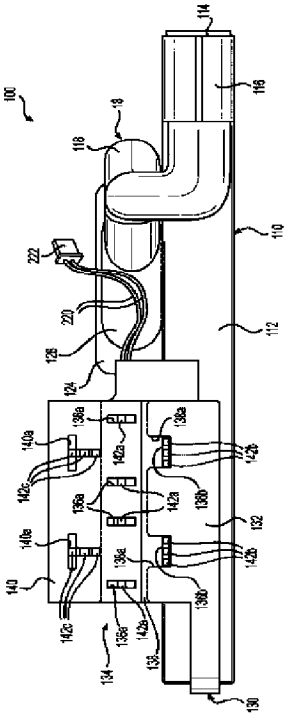


FIG. 7

【 図８ 】

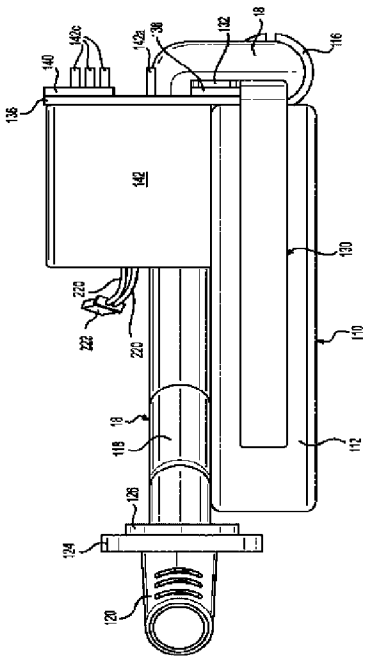


FIG. 8

【 図９ 】

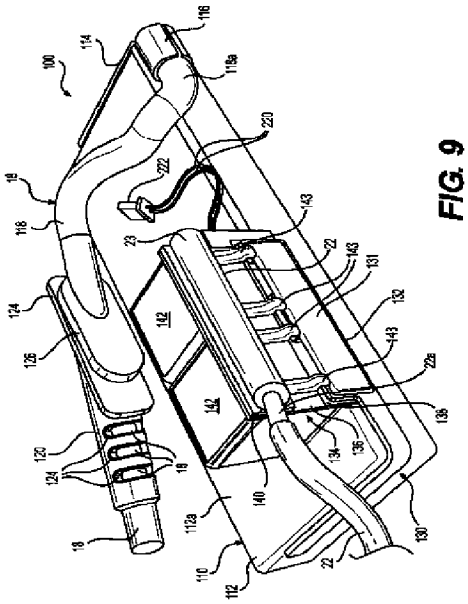


FIG. 9

【 図１０ 】

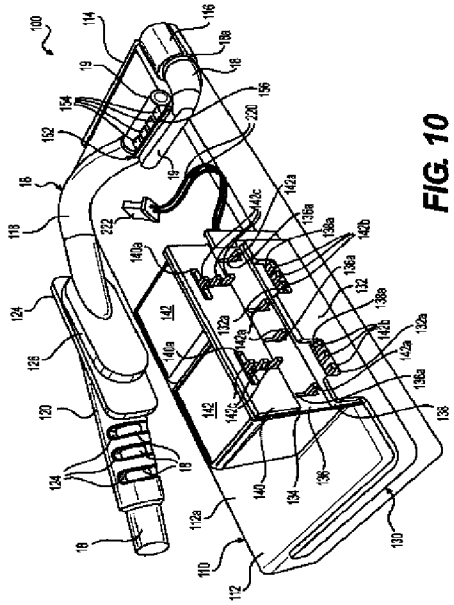


FIG. 10

【 図１１ 】

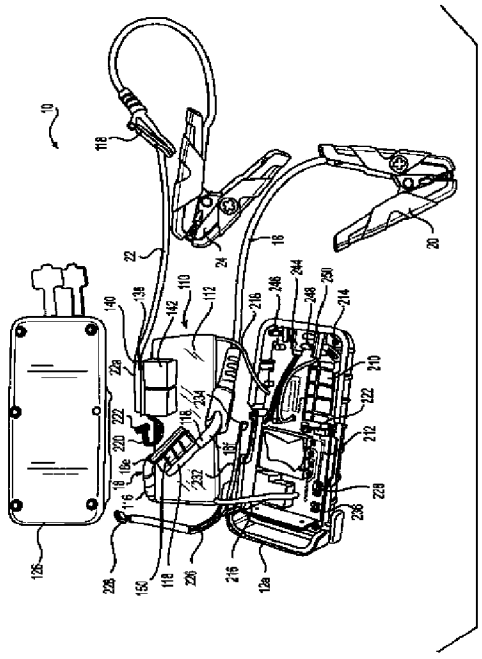


FIG. 11

【 図１ ２ 】

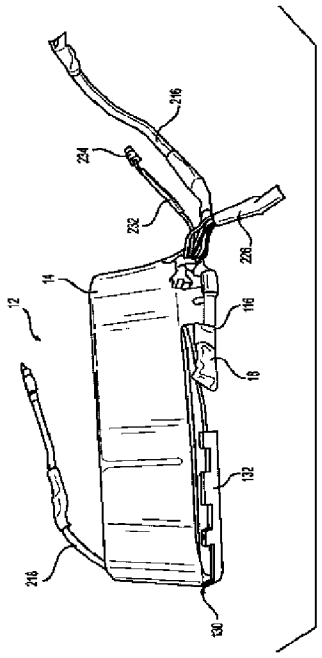


FIG. 12

【 図１ ３ 】

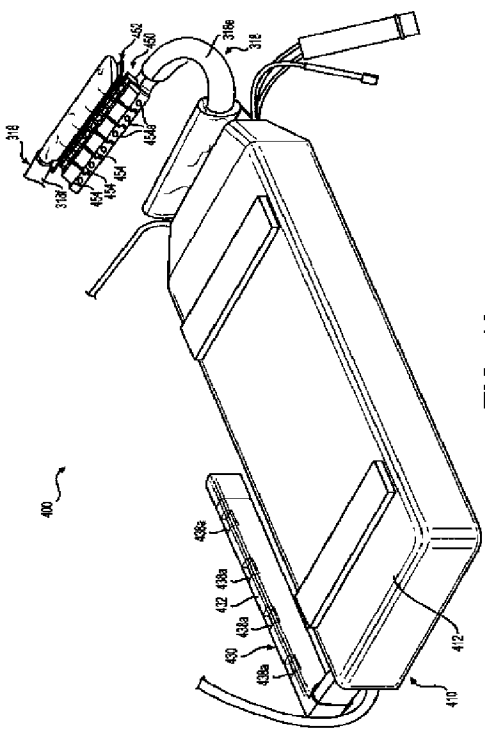


FIG. 13

【 図１ ４ 】

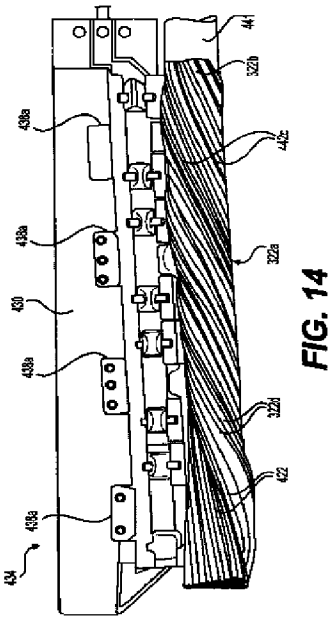


FIG. 14

【 図１ ５ 】

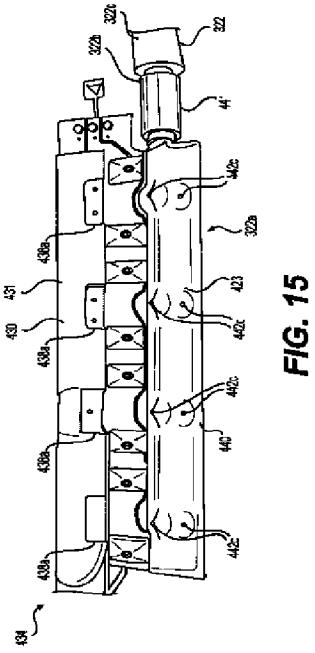


FIG. 15

【 図１６ 】

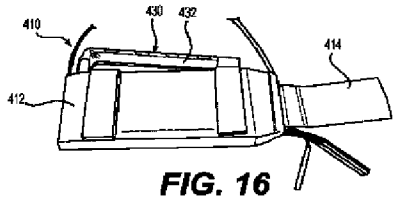


FIG. 16

【 図１７ 】

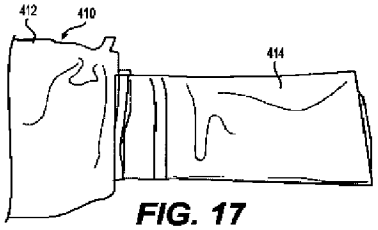


FIG. 17

【 図１８ 】

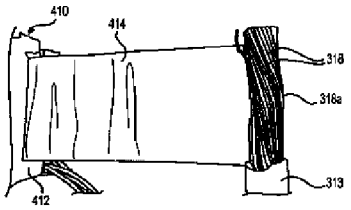


FIG. 18

【 図１９ 】

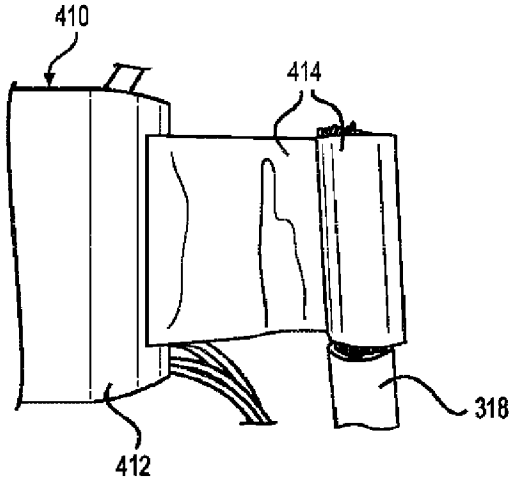


FIG. 19

【 図２０ 】

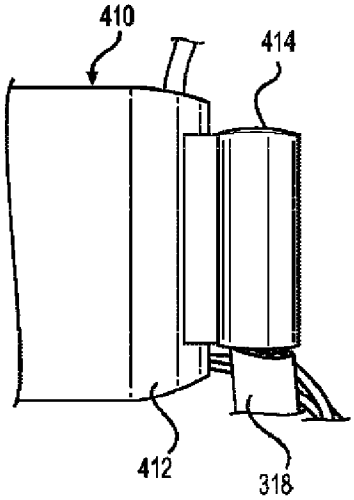


FIG. 20

【図２１】

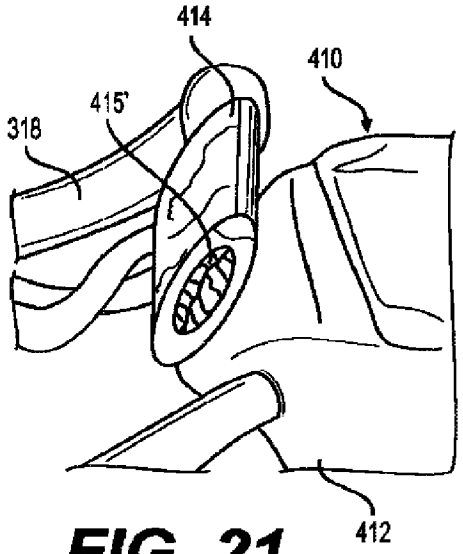


FIG. 21

【図２２】

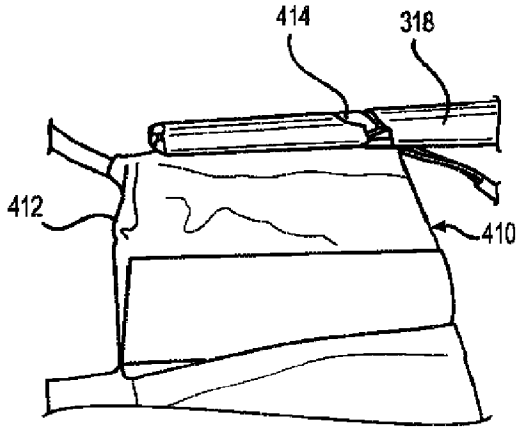


FIG. 22

【図２３】

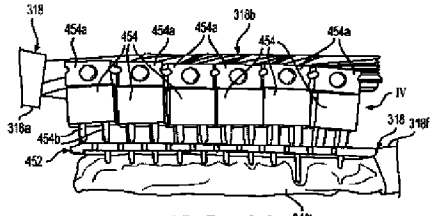


FIG. 23

【図２４】

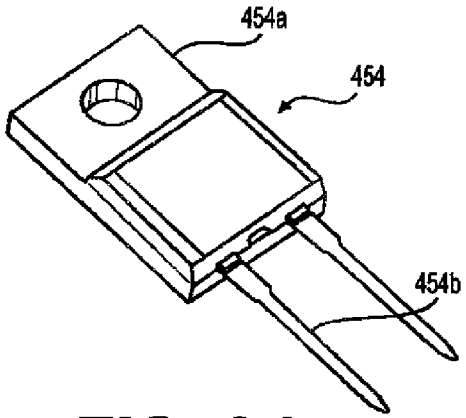


FIG. 24

【図２５】

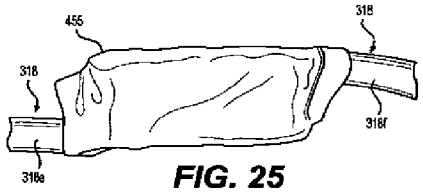
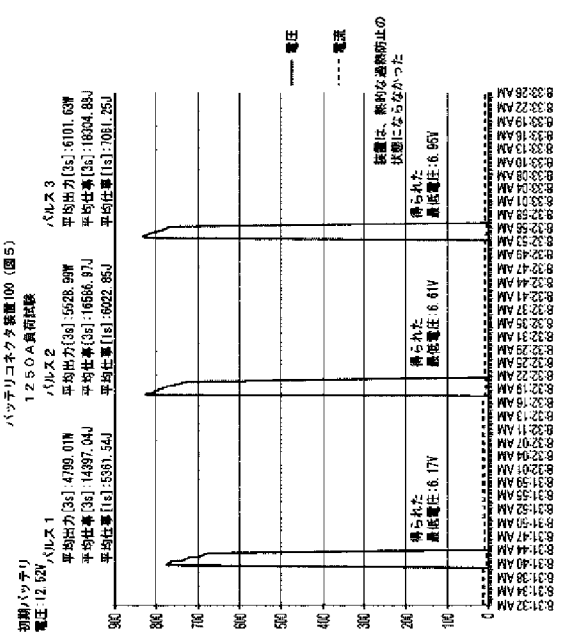
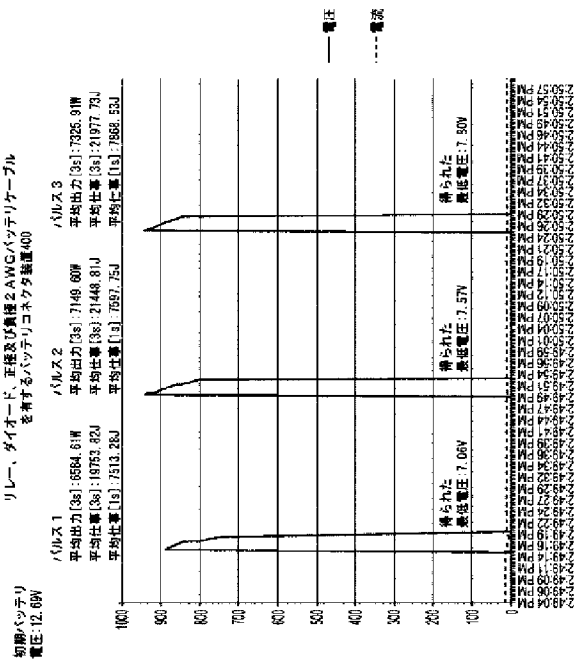


FIG. 25

【 図２７ 】



【 図２８ 】



【 図２９ 】

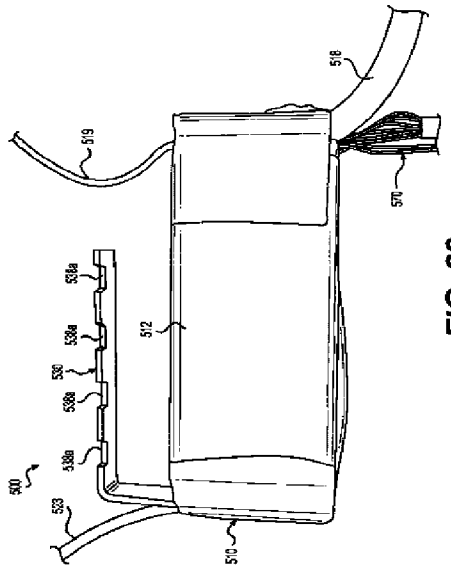


FIG. 29

【 図３０ 】

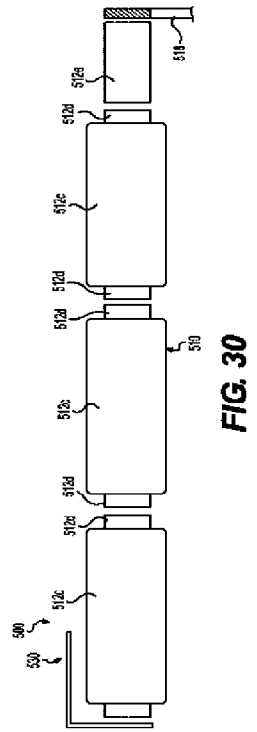


FIG. 30

【 図３１ 】

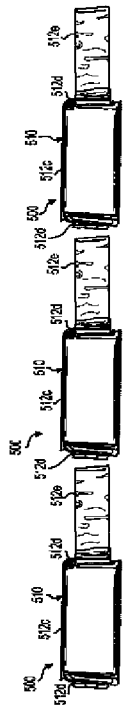


FIG. 31

【 図３２ 】

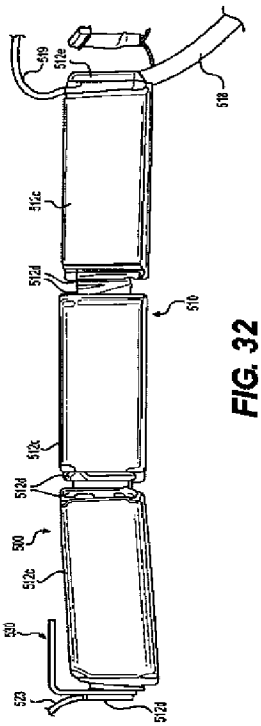


FIG. 32

【 図３３ 】

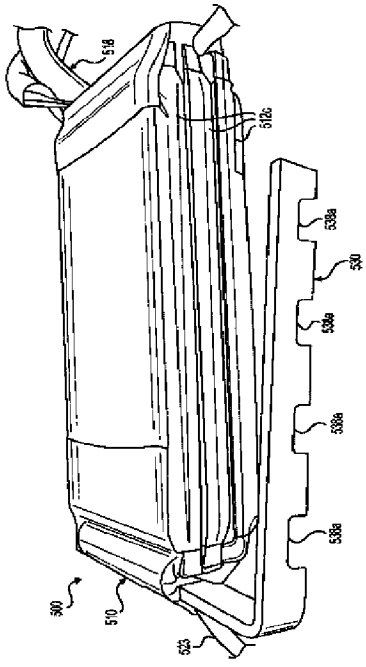


FIG. 33

【 図３４ 】

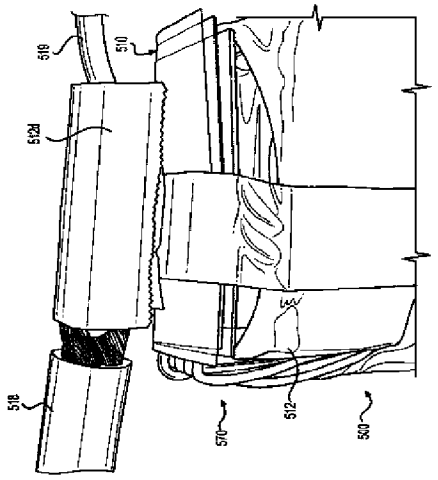


FIG. 34

【 図３５ 】

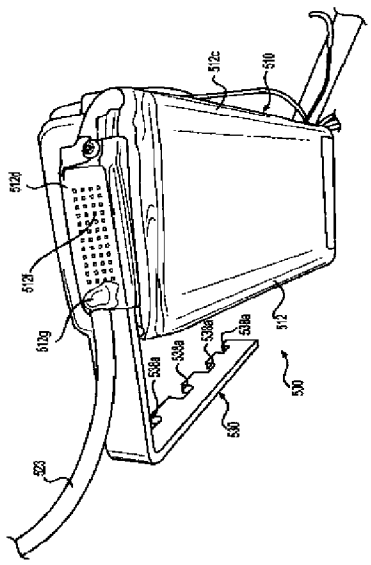


FIG. 35

【 図３６ 】

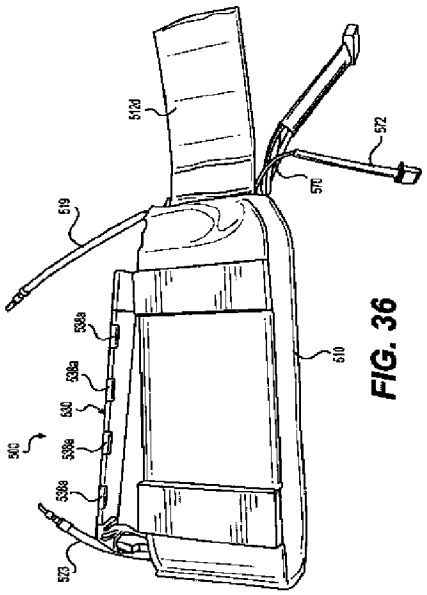


FIG. 36

【 図３７ 】

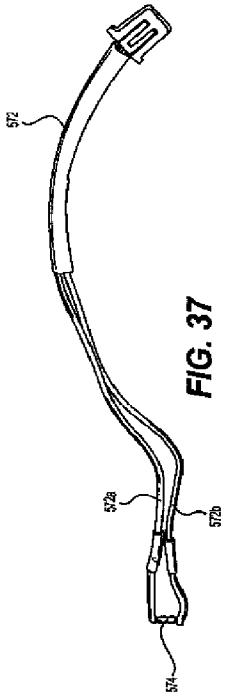


FIG. 37

【 図３８ 】

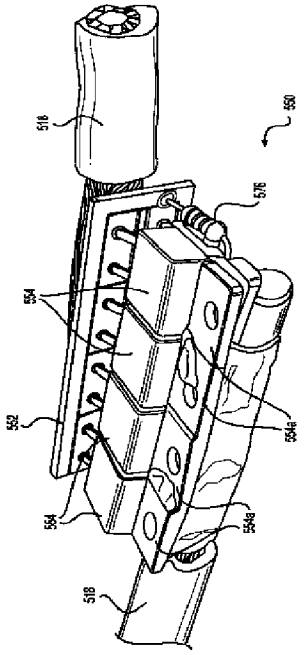


FIG. 38

【手続補正書】
【提出日】平成30年3月14日(2018. 3. 14)
【手続補正1】
【補正対象書類名】特許請求の範囲
【補正対象項目名】全文
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項1】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリコネクタ装置であって、
正極端子タブと、負極端子タブとを有するバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体板と、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記バッテリの前記正極端子導体板に接続された正極ケーブルと、
第2回路基板導体バーから離間した第1回路基板導体バーを有する回路基板を有し、前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと、
前記第2回路基板導体バーに接続された負極ケーブルと
を備え、
前記第1回路基板導体バーは、前記バッテリの前記負極端子導体バーに電気的に接続され、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンプスタートされるバッテリとの間の隔離を提供するために第1回路基板導体バーと第2回路基板導体バーとの間に接続された1又は複数のリレーを更に備える、バッテリコネクタ装置。
【請求項2】
前記1又は複数のリレーは、前記第1回路基板導体バーと前記第2回路基板導体バーとの間を並列に接続する複数のリレーである、請求項1に記載の装置。
【請求項3】
前記負極端子導体バーは、前記バッテリを前記スマートスイッチバッテリインターフェイスに機械的及び電気的に接続するように構成されている、請求項1に記載の装置。
【請求項4】
負極端子導体バーは、前記スマートスイッチバッテリインターフェイスを前記バッテリの上方に隣接して配置するように構成されている、請求項3に記載の装置。
【請求項5】
前記正極端子導体板は、前記正極ケーブルの一端に巻き付き、前記バッテリを前記正極ケーブルに電気的に接続する、請求項1に記載の装置。
【請求項6】
前記正極端子導体バーは、前記バッテリの前記正極端子タブに超音波溶着されており、前記負極端子導体バーは、前記バッテリの前記負極端子タブに超音波溶着されている、請求項1に記載の装置。
【請求項7】
前記バッテリは、矩形状であり、
前記バッテリの前記正極端子導体板の幅は、前記バッテリの幅と等しく、
前記負極端子導体バーは、L字状であり、前記バッテリのそれぞれの角に巻き付くように構成されている、請求項1に記載の装置。
【請求項8】
前記バッテリタブは、前記バッテリのケーシングと同一平面に搭載されている、請求項7に記載の装置。

【請求項９】
ダイオード接続部は、前記正極ケーブルの第１部分と、前記正極ケーブルの第２部分との間に設けられている、請求項１に記載の装置。
【請求項１０】
前記ダイオード接続部は、前記正極ケーブルの前記第１部分と前記正極ケーブルの前記第２部分との間に接続された１又は複数のダイオード接続部を備える、請求項９に記載の装置。
【請求項１１】
前記ダイオード接続部は、前記正極ケーブルの前記第１部分と前記正極ケーブルの前記第２部分との間にそれぞれ接続された複数のダイオードを備える、請求項１０に記載の装置。
【請求項１２】
前記複数のダイオードの導体タブは、前記正極ケーブルの前記第１部分に接続されており、
前記複数のダイオードの前記導体突起は、前記正極ケーブルの前記第２部分に接続されている、請求項１１に記載の装置。
【請求項１３】
前記複数のダイオードは、プリント回路基板に接続されている、請求項１２に記載の装置。
【請求項１４】
前記複数のダイオードの前記導体突起は、前記プリント回路基板を通過して延在し、前記導体突起の前記第２部分と電気的に接続されている、請求項１３に記載の装置。
【請求項１５】
前記複数のダイオードは、単軸に沿って互いに隣接して配置されている、請求項１４に記載の装置。
【請求項１６】
前記ダイオード導体は、熱収縮絶縁体で絶縁されている、請求項１１に記載の装置。

【 国際調査報告 】

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US17/17269

A. CLASSIFICATION OF SUBJECT MATTER
IPC - F02N 11/12, 11/14, 19/00; H02J 7/00, 7/32 (2017.01)
CPC - F02N 11/12, 11/14, 19/00; H02J 7/0029, 7/0031, 7/0044, 7/0054, 7/0057, 7/0075;

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,215,273 B1 (SHY, J) April 10, 2001; abstract; figures 1-3; column 2, lines 8-27 and 51-64	1-18
A	US 2016/0001666 A1 (THE NOCO COMPANY) January 7, 2016; abstract; figures 1-4; paragraphs [0020, 0028, 0031, 0036]	1-18
A	US 6,222,342 B1 (EGGERT, D et a.) April 24, 2001; abstract; figures 1-5; column 2, lines 20-32; column 3, lines 5-19; column 4, lines 32-50	1-18
A	US 2013/0241498 A1 (KOEBLER, M) September 19, 2013; entire document	1-18
P,Y	US 2016/0181587 A1 (KOEBLER, M et al.) June 23, 2016; entire document	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 April 2017 (11.04.2017)	04 MAY 2017
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

フロントページの続き

(31)優先権主張番号 62/424,297
(32)優先日 平成28年11月18日(2016.11.18)
(33)優先権主張国 米国(US)

(81)指定国 AP(BW,GH,GM,KE,LR,LS,MW,MZ,NA,RW,SD,SL,ST,SZ,TZ,UG,ZM,ZW),EA(AM,AZ,BY,KG,KZ,RU,TJ,TM),EP(AL,AT,BE,BG,CH,CY,CZ,DE,DK,EE,ES,FI,FR,GB,GR,HR,HU,IE,IS,IT,LT,LU,LV,MC,MK,MT,NL,NO,PL,PT,RO,RS,SE,SI,SK,SM,TR),OA(BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,KM,ML,MR,NE,SN,TD,TG),AE,AG,AL,AM,AO,AT,AU,AZ,BA,BB,BG,BH,BN,BR,BW,BY,BZ,CA,CH,CL,CN,CO,CR,CU,CZ,DE,DJ,DK,DM,DO,DZ,EC,EE,EG,ES,FI,GB,GD,GE,GH,GM,GT,HN,HR,HU,ID,IL,IN,IR,IS,JP,KE,KG,KH,KN,KP,KR,KW,KZ,LA,LC,LK,LR,LS,LU,LY,MA,MD,ME,MG,MK,MN,MW,MX,MY,MZ,NA,NG,NI,NO,NZ,OM,PA,PE,PG,PH,PL,PT,QA,RO,RS,RU,RW,SA,SC,SD,SE,SG,SK,SL,SM,ST,SV,SY,TH,TJ,TM,TN,TR,TT,TZ

(72)発明者 ウィリアム・ナイト・ヌック
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内
(72)発明者 ジェイムズ・リチャード・スタンフィールド
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内
(72)発明者 デレク・マイケル・アンダーヒル
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内

Fターム(参考) 5C503 BB02 FA03

Espacenet

Bibliographic data: JP2018536789 (A) — 2018-12-13

バッテリジャンプスタート装置用バッテリコネクタ装置

Inventor(s): ジョナサン・ルイス・ヌック, ; ウィリアム・ナイト・ヌック, ; ジェイムズ・リチャード・スタンフィールド, ; デレク・マイケル・アンダーヒル

Applicant(s): ザ・ノコ・カンパニーＴｈｅ Ｎｏｃｏ Ｃｏｍｐａｎｙ

Classification: **- international:** ***F02N11/08; F02N11/12; H02J7/00***
- cooperative:

Application number: JP20170561919 20170210 Global Dossier

Priority number (s): US201662424297P 20161118 ; WO2016US24680 20160329 ; US201662294067P 20160211 ; WO2017US17289 20170210 ; US201615137626 20160329

Abstract of JP2018536789 (A)

バッテリジャンプスタート装置で使用するための改良導電率バッテリコネクタ装置。バッテリからバッテリジャンプスタート装置によって再充電されるバッテリへの高められた導電率を提供する改良導電率バッテリコネクタ。【選択図】図１

Patent Translate
Powered by EPO and Google

Notice

This translation is machine-generated. It cannot be guaranteed that it is intelligible, accurate, complete, reliable or fit for specific purposes. Critical decisions, such as commercially relevant or financial decisions, should not be based on machine-translation output.

DESCRIPTION JP2018536789

Abstract An improved conductivity battery connector device for use in a battery jump start device. An improved conductivity battery connector that provides enhanced conductivity from the battery to the battery that is recharged by the battery jump start device. [Selection diagram] Figure 1

Battery connector device for battery jump start device

[0001]

A portable battery connector device configured to increase the conductivity between the battery of the jump start device and the battery to be charged, for example, a battery connector for a battery jump start device (particularly a portable vehicle jump start device). Placement or assembly.

[0002]

There is a portable vehicle battery jump start device such as that disclosed in US Pat. No. 9,0070,15 to Nook et al.

This device uses a lithium-ion battery pack. In this type of device, it is necessary to maximize the conductivity to the on-board battery of the vehicle that is jump-started from the battery pack.

[0003]

There are two main factors that determine the outcome of a successful car jump start. The first factor is the amount of electric power supplied from the lithium-ion battery pack, and the second factor is the maximum conductivity. Both factors are needed to get the best chance of jumpstarting a large engine. One element alone, without the other, is not enough.

[0004]

The subject matter described herein is a battery device (e.g., a battery connector, a battery connector arrangement, or a battery conductor assembly) used in a device for vehicle jump start, and a device for vehicle jump start having a battery connector device. Target.

[0005]

The subject matter described here is directed to a battery connector device comprising or consisting of a battery having at least one battery conductor connected to a terminal of the battery.

[0006]

The subject matter described herein is directed to a battery connector arrangement that comprises or consists of at least one battery conductor or cable connected to a battery tab of a battery.

[0007]

The subject matter described herein is directed to a battery connector device comprising or comprising a battery having a positive electrode conductor and a negative electrode conductor connected to a battery.

[0008]

The subject matter described here is directed to a battery connector device comprising or comprising a battery having a positive conductor plate and / or a negative conductor plate connected to a battery.

[0009]

The subject matter described herein comprises a battery having a positive electrode conductor plate and / or a negative electrode conductor plate connected to a battery and a positive electrode cable and / or a negative electrode cable connected to the negative electrode conductor plate. Or, a battery connector device including such a battery is targeted.

[0010]

The subject matter described herein is directed to a battery connector device comprising or comprising a battery having a positive battery conductor connected to the positive terminal of the battery and / or a negative battery conductor connected to the negative terminal of the battery.

[0011]

The subject matter described herein has a positive battery conductor connected to a positive terminal contact of a battery and / or a negative battery conductor connected to a negative terminal contact of a battery, the battery conductor at each terminal of the battery. The present invention is directed to a battery connector device that includes the battery that is soldered or that includes the battery.

[0012]

The subject matter described herein has a positive battery conductor connected to the positive terminal of the battery and / or a negative battery conductor connected to the negative terminal contact of the battery, and a relay connected to one of the battery conductors of the battery. A battery connector device comprising or including a battery.

[0013]

The subject matter described herein comprises a battery having a positive battery conductor connected to the positive terminal contact of the battery and / or a negative battery conductor connected to the negative terminal contact of the battery, and a relay connected to the negative battery conductor. Or, a battery connector device including such a battery is targeted.

[0014]

The subject matter described herein comprises a battery having a positive battery conductor connected to the positive terminal contact of the battery and / or a negative battery conductor connected to the negative terminal contact of the battery, and a relay connected to the negative battery conductor. Or, a battery connector device including such a battery is targeted.

[0015]

The subject matter described herein is a battery having a positive battery conductor connected to a positive terminal contact of a battery and / or a negative battery conductor connected to a negative terminal contact of a battery, and a plurality of relays connected to the negative battery conductor. The present invention is directed to a battery connector device including or including such a battery.

[0016]

The subject matter described herein is a battery having a positive battery conductor connected to the positive terminal contact of the battery and / or a negative battery conductor connected to the negative terminal contact of the battery, and a positive cable connected to the positive battery conductor. The present invention is directed to a battery connector device that is provided or that includes such a battery.

[0017]

The front view of the battery jump start device in which the clamp is not expanded.

FIG. 2 is a rear perspective view of the battery jump start device shown in FIG. 1.

FIG. 3 is an end perspective view of the battery jump start device shown in FIGS. 1 and 2.

1 is a front perspective view of the battery jump start device shown in FIG. 1 with the clamps unfolded. The battery connector device housed within the battery jump start device shown in FIG. 1 with the negative cable still installed. (Not shown) front perspective view.

FIG. 6 is a plan view of the battery connector device shown in FIG. 5.

The side view of the battery connector apparatus shown in FIG.

FIG. 6 is an end view of the battery connector device shown in FIG. 5.

FIG. 6 is a perspective view of the battery connector device shown in FIG. 5 (however, the negative electrode cable is connected to the battery connector device).

FIG. 6 is a perspective view of the battery connector device shown in FIG. 5 (provided that a diode conductor is provided on the positive electrode cable).

The perspective view of the battery connector device to which other components or parts of the battery jump start device were connected.

FIG. 6 is a perspective view of a battery assembly of the battery connector device shown in FIG. 5.

The front perspective view of the other battery connector device for battery jump start devices.

FIG. 4 is a detailed view of the positive electrode cable connection with the relay printed circuit board before being soldered to the relay printed circuit board.

Detailed view of the positive cable connection with the relay printed circuit board after being soldered to the relay printed circuit board. FIG. 14 is a front perspective view of the battery assembly of the battery connector device shown in FIG. 13. FIG. 17 is a partial plan view of the battery assembly shown in FIG. 16, but with the positive terminal conductor in an unwound state. FIG. 17 is a partial plan view of the positive electrode terminal conductor of the battery assembly shown in FIG. 16. FIG. 6 is a perspective view of an end portion of a positive electrode terminal conductor obtained by partially winding the end portion of the positive electrode cable. FIG. 6 is a perspective view of an end portion of a positive electrode terminal conductor in which the end portion of the positive electrode cable is completely wound. FIG. 4 is a side perspective view of the positive electrode terminal conductor in which the end portion of the positive electrode cable is completely wound and soldered. FIG. 6 is a perspective view of the opposite end portion of the positive electrode terminal conductor in which the end portion of the positive electrode cable is completely wound and soldered. FIG. 3 is a perspective view of a diode connector between sections of a positive cable. The perspective view of the Schottky diode used for a diode connector. FIG. 6 is a perspective view of a diode connector insulated with a shrink wrap sleeve. FIG. 11 is a graphic illustration showing a load test of the battery connection shown in FIGS. 5 to 10. FIG. 26 is a graphic illustration showing a load test of the battery connection shown in FIGS. 13 to 25. FIG. 7 is a front perspective view of a further battery connector device for a jump start device. FIG. 3 is a front view of a battery connector device including a plurality of battery cells before assembly, a separate tab, and a conductor (for example, a plate-shaped conductor). The front view of the battery connector device provided with the battery cell which has a separate tab for lengthening a tab. FIG. 31 is a front view of the battery connector device including the plurality of battery cells, the separate tabs, and the conductors shown in FIG. 30 after assembly. FIG. 33 is a perspective view showing a battery connector device including the battery cell assembly shown in FIG. 32 after folding the battery cells. FIG. 3 is an end perspective view of the battery connector device showing the separate tab wrapped or wrapped around the exposed end of the positive electrode cable and soldered together. FIG. 3 is a perspective view of the opposite end of a battery connector device showing a negative

electrode battery tab wrapped around a negative electrode terminal conductor plate and welded and / or soldered together. FIG. 3 is a perspective view of the battery connector device showing a flat, separate outwardly extending tab that is connected to the battery before being connected to the positive electrode cable. FIG. 5 is a side view of a temperature sensor assembly having wires and connectors. FIG. 4 is a perspective view of a diode circuit board connected to and joined to a positive electrode cable in a line.

[0018]

A battery jump starter device 10 is shown in FIGS. The battery jump start device 10 includes a casing 12 having a display 14 in which a plurality of light emitting diodes (LEDs) 16 are arranged.

[0019]

The battery jump start device 10 further includes a positive electrode cable 18 having a positive electrode clamp 20 and a negative electrode cable 22 having a negative electrode clamp 24. The positive electrode cable 18 and the negative electrode cable 22 pass through the openings 12a and 12b in the casing 12, respectively.

[0020]

The clamps 20 and 24 are stored or fixed in the undeployed state by clamping the respective side posts 26 extending outward from both ends of the casing 12 as shown in FIG. The side posts 26 are shown in FIG. The clamps 20 and 24 are fixed when the battery jump starter device 10 is not used, and are unclamped from the side posts 26 when used thereafter.

[0021]

The battery jump start device 10 is configured to jump start an in-vehicle battery. For example, the battery jump start device 10 is a safety protected portable vehicle jump start device disclosed in U.S. Pat. No. 9,0070,15 (incorporated herein by reference in its entirety), or a device similar thereto. It may be.

[0022]

The battery jump start device 10 includes electric parts or parts arranged inside the casing 12. For example, the battery jump start device 10 includes the battery connector device 100 shown in FIGS. 3 to 9.

[0023]

The battery connector device 100 includes a battery assembly 110 having a battery 112. For example, the battery 112 is a rechargeable lithium-ion battery. The battery connector device 100 is configured to maximize electrical conductivity from the battery 112 to the cables 18, 22 and clamps 20, 24 of the battery jump starter device 10. The battery 112 includes a battery casing 112a, for example, a rectangular battery casing 112a.

[0024]

The battery 112 includes a positive electrode tab at one end (for example, a width end) of the battery 112 and a negative electrode tab at the other end (for example, a width end) of the battery 112. For example, the battery 112 includes one or more battery cells each having a positive electrode tab and a negative electrode tab. For example, the positive electrode tab of the battery cell is arranged at the one end of the battery 112, and the negative electrode tab of the battery cell is arranged at the other end of the battery 112. The positive electrode terminal conductor plate 114 is connected (eg, soldered, welded, or ultrasonically bonded) to the positive electrode tab (ie, contact) of the battery 112 at the one end of the battery 112. The positive electrode terminal conductor plate 114 extends along the one end (for example, the width end) of the battery 112.

[0025]

The positive electrode cable 18 may be connected (eg, directly connected by soldering) to the positive electrode terminal conductor plate 114 and / or the positive electrode tab of the battery 112. For example, the positive electrode terminal conductor bar 114 may include a conductor ring 116. The conductor ring 116 is wound (for example, wound around the whole) on the

exposed end portion 18a of the positive electrode cable 18 and connected (for example, crimped and / or soldered). For example, the positive terminal conductor plate 114 is made from a thick copper plate (eg, machined, cut, or stamped from a thick copper plate).

[0026]

As shown in FIGS. 5 and 6, the positive electrode terminal conductor sheet 114 is configured to wrap around one of the square corners of the rectangular casing 112a of the (eg, L-shaped) battery 112. It may be bent (for example, bent). As shown in FIG. 5, the L-shaped positive electrode terminal conductor sheet 114 may extend along the end of the battery 112 and at least a part of the side of the battery 112.

[0027]

The positive terminal conductor plate 114 also provides battery support 112a to provide additional support and stability (eg, assembled to withstand mechanical shock when the battery jump starter device 10 is drop tested). May be mechanically bonded and / or glued to the outer surface of the. For example, the positive terminal conductor bar 114 is mechanically attached to the battery casing 112 by an adhesive (eg, silicon adhesive), double-sided tape, double-sided foam tape, an insulating plastic or ceramic connector with snap-fit connection and / or adhesive connection. May be connected. The battery casing 112 may be formed (eg, molded) so as to be mechanically connected (eg, snap-fit connection or interference connection) to the positive electrode terminal conductor plate 114.

[0028]

The positive cable 18 may be a single wire or cable (eg, stranded or braided wire) that extends from the battery 110 to the positive clamp 20. Specifically, one end of the positive electrode cable 18 is connected to the positive electrode terminal conductor plate 114 connected to the battery 18, and the other end of the positive electrode cable 18 is connected to the positive electrode clamp 20. ..

[0029]

More specifically, the positive electrode cable 18 may include a flexible cable portion or a bent cable portion 118 in order to change the direction of the positive electrode cable 18 inside the casing 12. The positive electrode cable 18 may be fitted with a flexible outer sleeve portion 120 that connects to the flexible inner sleeve portion 122 to flexibly accommodate the positive electrode cable 18 passing through the casing 12. The flexible outer sleeve portion 120 is located outside the casing 12 of the battery jump starter device 10, and the flexible inner sleeve portion 122 is located inside the casing 12 of the battery jump starter device 10. is doing.

[0030]

The flexible outer sleeve portion 120 is configured to reinforce the connection between the positive electrode cable 18 and the battery jump starter device casing 12 while maintaining flexibility. For example, the flexible outer sleeve portion 120 includes one or more (eg, three in FIG. 5) grooves 124 that expose multiple portions of the positive electrode cable 18. The one or more grooves 124 act as hinges to facilitate bending of the positive electrode cable 18 within the flexible outer sleeve portion 120.

[0031]

The flexible sleeve 120 includes an outer flange 124 spaced from an inner flange 126 (eg, a short distance approximately equal to the wall thickness of the casing 12 of the battery jump starter device 10). The flanges 124 and 126 further fix the positive electrode cable 18 to the casing 12 of the battery jump starter device 10.

[0032]

Flexible sleeve 120 includes a sleeve portion 128 (FIG. 6) that connects outer flange 124 and inner flange 126. For example, the flexible outer sleeve portion 120 may be molded or attached onto and around the positive electrode cable 18 as a single unit (eg, the flexible sleeve 120 may be inserted into a mold during the molding process). Is formed on a part of the positive

electrode cable 18). Alternatively, the flexible sleeve 120 may be separately manufactured (eg, molded) and then installed or assembled on a portion of the positive electrode cable 18.

[0033]

The positive cable 18 includes an inner conductor 18b (eg, wire conductor, stranded wire, or braided wire) disposed within an outer insulating sheath 18c (eg, extruded plastic sheath). The inner conductor 18b may comprise, for example, a single wire conductor or a multi-stranded metal wire conductor having a wire bundle 18d.

[0034]

The internal wire may be made of copper or aluminum. The flexible sleeve 120 may be mounted (eg, molded, installed or assembled) on and around the outer insulating sheath 18c of the positive electrode cable 18.

[0035]

The battery connector device 100 further includes a negative electrode terminal conductor plate 130 connected (eg, soldered, welded, or ultrasonically welded) to the negative electrode tab (ie, contact) of the battery 112 at the other end of the battery 112. The negative electrode terminal conductor plate 130 may extend along the other end of the battery 112.

[0036]

The other end of the negative electrode terminal conductor plate 130 is provided with a negative electrode terminal conductor plate connector portion 132, as shown in FIGS. 5 and 6.

[0037]

The negative electrode terminal conductor plate 130 may be configured so as to be wound around one of the plurality of corners of the rectangular battery 112 (for example, in an L shape).

The L-shaped negative electrode terminal conductor plate 130 may extend along the end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIGS. 5 and 6.

[0038]

The negative terminal conductor bar 130 is also external to the battery casing 112a to provide additional support and stability (eg, to withstand mechanical shock when the battery jump starter device 10 is drop tested). It may be mechanically bonded and / or glued to the surface. For example, the negative terminal conductor bar 114 may be mechanically attached to the battery casing 112a by an adhesive (eg, silicone adhesive), double-sided tape, double-sided foam tape, an insulating plastic or ceramic connector with snap-fit connection and / or adhesive connection. May be connected. The battery casing 112 may be formed (eg, molded) so as to be mechanically connected (eg, snap-fit connection or interference connection) to the positive electrode terminal conductor plate 114.

[0039]

The battery connector device 100 further includes a smart switch battery interface 134. The smart switch battery interface 134 includes a relay printed circuit board (PCB) 136, and the circuit board 136 is a second circuit board conductor bar 140 disposed on one side of the circuit board 136 as shown in FIGS. 5 and 6. A first circuit board conductor bar 138 spaced from.

[0040]

The pair of relays 142 is mounted on the opposite side of the circuit board 136. The relay 142 includes a relay anchor pin 142a arranged in the component hole 136a of the relay printed circuit board 136. The relay 142 includes a relay connector pin 142b extending through a component hole 136b provided in the circuit board 136 and a slot 138a provided in the first conductor bar. Further, the relay 142 further includes a relay connector pin 142c arranged in a component hole 136c provided in the circuit board 136 and a component hole 140a provided in the second conductor bar 140. The relay anchor pins 136a are soldered in

place to mechanically connect the relay 142 to the circuit board 136. The relay connector pins 142b, 142c are soldered in place to mechanically and electrically connect the relay 142 to the circuit board conductor plates 138, 140, respectively.

[0041]

The component hole 136a of the circuit board 136 has a rectangular shape (FIGS. 5 and 7) and accommodates the relay anchor pin 142a. Specifically, the base portion of the relay anchor pin 142a has a rectangular shape with square end portions. The ends of the square are dimensionally narrow compared to a base forming a lateral edge flush with the outer surface of the circuit board 136. When solder is applied to the exposed end of the relay anchor pin 142a, the solder connects the sides of the square end and the lateral edges to secure and secure the relay anchor pin to the circuit board 136. ..

[0042]

The slot 132a provided in the negative terminal conductor plate connector portion 132 has a rectangular shape, and the component hole 138a (FIG. 3) provided in the first circuit board conductor bar 138 has a T shape and is shown in FIG. Thus, the three horizontally oriented relay connector pins 142c are housed. The end portion of the relay connector pin 142b is shown flush with the outer surface of the negative electrode terminal conductor bar connector portion 132. When the solder is applied to the exposed end of the relay connector pin 142b, the solder fills the slot 132a of the negative terminal conductor bar connector part 132 and the component hole 138a of the first circuit board conductor bar 138, and the side of the connector pin 142b. The slot 142a and the inner edge of the component hole 138a are connected to each other, and the relay 142 is connected to the circuit board 136 and the negative terminal conductor bar connector portion 132. Further, the applied solder electrically connects the negative terminal conductor bar connector portion 132 to the first circuit board conductor bar 138.

[0043]

The component hole 140a provided in the second circuit board conductor bar 140 is T-shaped as shown in FIG. 3, and accommodates three vertically oriented relay connector pins 142c. As shown in FIG. 7, the relay connector protrusion 140 a extends outward from the outer surface of the circuit board 136 and is connected to the exposed conductor end portion 144 a of the negative electrode cable 144. When solder is applied to the exposed conductor end portion 144a and the end portion of the relay connector protrusion 140a, the solder fills the T-shaped slot, and the relay connector protrusion 140a, the second circuit board conductor 140, and the negative electrode cable 144. To the exposed conductor end portion 144a.

[0044]

The negative terminal conductor bar connector portion 132 of the negative terminal conductor bar 130 is connected (for example, by soldering) to the first circuit board conductor bar 138 of the circuit board 136. The exposed conductor end 22a of the negative cable 22 (ie, with the insulating sheath removed) is connected (eg, by soldering) to the second circuit board conductor bar 140, as shown in FIG.

[0045]

The battery connector device 100 may be improved by providing a diode connection 150 on the positive cable 18, as shown in FIG. For example, the diode connection is installed (eg, bonded) on the positive cable 18. The diode connection unit 150 includes a diode printed circuit board (PCB) 152. The diode printed circuit board 152 includes a set of back-charge diodes 154 (for example, Schottky diodes) arranged on one side of the circuit board 152, and a conductor bar 156 provided on the other side of the circuit board 152.

[0046]

(Assembly) As shown in FIG. 11, the battery jump start device 10 includes a casing 12 having an upper casing portion 12a and a lower casing portion 12b. The upper casing portion 12a and the lower casing portion 12b are configured to be connected to each other when the battery jump start device 10 is assembled.

[0047]

The battery jump start device 10 further includes a battery connector device 100 and a controller assembly 210, and both the battery connector device 100 and the controller assembly 210 are arranged inside the casing 12. The controller assembly 210 includes a circuit board 212, and the circuit board 212 is disposed adjacent to another circuit board 214.

[0048]

The positive terminal of the battery assembly 110 (FIG. 12) is connected to the circuit board 212 via the positive power line 216. For example, the positive power line 216 is connected to the positive conductor bar 114 (FIG. 5). The negative terminal of the battery assembly 110 is connected to the circuit board 214 via the negative power line 218.

[0049]

The relay circuit board 136 includes a wire set 220 having a connector 222. The connector 222 is configured to be connected to the relay board connector 224 disposed on the circuit board 212 of the controller assembly 210 when the battery jump start device 10 is assembled.

[0050]

Battery assembly 110 further comprises a wire set 226 having a connector 228. The connector 228 is configured to connect to a battery cell charging / monitoring connector 230 located on the circuit board 212 of the controller assembly 220.

[0051]

The battery assembly 110 comprises a battery temperature sensor having a wire set 232. The wire set 232 has a connector 234. The connector 234 is configured to connect to a temperature sensor connector 236 disposed on the circuit board 212 of the controller assembly 220.

[0052]

As shown in FIG. 11, the circuit board 212 includes a charging power resistor 240 and an output relay 242. Further, the lower casing portion 12 a includes a main user output connector 244 having a wire set 246 connected to the circuit board 214 and a main user input connector 248 having a wire set 250 connected to the circuit board 214.

[0053]

The battery assembly 110 is connected to the battery jump start device 10, as shown in FIG. When assembled, the battery connector device 110 is installed in the casing 12 of the battery jump start device 10.

[0054]

Improved Conductivity An improved conductivity battery connector device 400 is shown in FIGS. 13-25. The improved conductivity battery connector device 400 provides a significantly increased conductivity as compared to the battery connector device 100 shown in FIGS.

[0055]

The amount of power transferred from the battery 412 to the clamp can be improved as follows.

[0056]

1) Increasing the wire gauge For example, the positive electrode cable 18 and the negative electrode cable 22 (FIG. 9) of 4AWG (American wire gauge standard) are changed to the 2AWG positive electrode cable 318 and the negative electrode cable 322 (FIGS. 13 and 15).

[0057]

2) Increase the conductivity of the negative cable connection. For example, the negative cable end 322a to the relay (FIG. 15) extends widely across the connector pin 422c of the relay 422.

[0058]

3) Increase the conductivity of the positive electrode cable connection. For example, the positive electrode cable 318 is wound around the positive electrode battery tab 414, and the positive electrode battery tab 414 is extended so as to be completely soldered to each other.

[0059]

4) Increase the conductivity of the diode connection part For example, the diode connection part 150 (FIG. 5) is replaced with the diode connection part 450 (FIG. 23).

[0060]

5) Redesign the resistor / diode printed circuit board (PCB) For example, replace the diode printed circuit board (PCB) 152 with a diode printed circuit board (PCB) 452 (FIG. 23).

[0061]

6) Reconnect the resistors For example, reconnect resistors R134A and B, 135A and B located on the reconnected diode printed circuit board (PCB) 152 (FIG. 10).

[0062]

A detailed description of each of these conductivity enhancing features or arrangements is provided below.

[0063]

1) Increase the wire gauge The gauges of the positive electrode cable 18 and the negative electrode cable 22 (FIG. 9) are, for example, 4 AWG (American wire gauge standard) cable, 2 AWG of the positive electrode cable 318 and the negative electrode cable 322 (FIGS. 13 and 15) May be increased to cables.

The comparative specifications of the 4AWG cable and the 2AWG cable are as follows.

[0064]

[0065]

The 2 AWG cable provides a significant increase (ie, about 36%) in conductivity (ie, amperage) compared to the 4 AWG cable.

[0066]

2) Increasing the conductivity of the negative electrode cable connection portion The negative electrode cable 322 (FIG. 15) is a method of increasing the conductivity (that is, allowable current) between the battery 412 and the negative electrode cable 322, and the battery 412 (FIG. 13). May be connected to.

For example, the negative cable end 322a may be directly connected (eg, soldered) to the connector protrusion 442c (FIG. 15) of the relay 422.

Specifically, the negative cable end 322a may extend across and be directly connected to all the relays 342 of the smart switch battery interface 434, as shown in FIGS. 14 and 15.

[0067]

Further, the negative cable end 322a may be connected to the conductor ring 441 of the circuit board conductor bar 440.

[0068]

The negative electrode cable 322 may be, for example, a stranded wire having an inner electric wire conductor 322b.

The inner wire conductor 322b comprises an untwisted or twisted wire bundle 322d disposed within an outer electrically insulating sheath 322c.

The electrically insulating sheath 322c of the negative cable 322 may be removed from the negative cable end 322a to expose the inner conductor 322b at the negative cable end 322a.

[0069]

The exposed wire bundle 322d of the conductor 322b is pressed against the end of the exposed connector pin 442c of the relay 422, and the strand of the wire 322d is captured between adjacent connector pins 442c.

The exposed wire bundle 332d may contact a conductor bar 440 (eg, made of copper).

Solder 423 is applied to this assembly such that solder flows between exposed wire bundle 422d, connector pins 442c and conductor bar 440, between negative cable 322 and smart switch battery interface 434 connected to battery 412. Electrical connection is completed

[0070]

The length of the exposed wire bundle 322d is such that the exposed wire bundle 322d is directly connected to each set of the connector pins 422c of each relay 422, and the maximum electric conductivity (that is, the maximum allowable current) between the negative electrode cable 322 and the battery 412. Are selected to provide.

[0071]

3) Increasing the conductivity of the positive cable connection The positive cable 318 may be connected to the battery 412 in a manner that increases the conductivity (ie, the permissible current) between the battery 412 and the positive cable 318.

For example, the positive cable 318 may be wrapped around the positive battery tab 414 and completely soldered together.

The connection between the positive electrode cable 318 and the battery 412 is shown in FIGS.

[0072]

The positive electrode cable 318 may be, for example, a stranded wire having an inner electric wire conductor 318b.

The inner wire conductor 318b comprises an untwisted or twisted wire bundle 318d disposed within an outer electrically insulating sheath 318c.

The electrically insulating sheath 318c of the positive cable 318 may be removed from the positive cable end 318a to expose the inner conductor 318b at the positive cable end 318a.

[0073]

The battery 412 includes a positive battery tab 414.

The positive electrode battery tab 414 is a metal plate (for example, a copper plate) connected to the positive electrode battery tab 414 of the battery 412.

[0074]

The exposed wire bundle 318d of the inner conductor 318b may be soldered with tin and then wound into the positive battery tab 312a. Solder 415 (FIG. 21) is applied to exposed wire bundle 318d and positive battery tab 312a.

[0075]

The length of the exposed wire bundle 318d is such that the exposed wire bundle 318d connects directly to the full width of the positive battery tab 414 and provides maximum electrical conductivity (ie, maximum allowable current) between the battery 312 and the positive electrode cable 318. , Selected.

[0076]

4) Increase the conductivity of the diode connection part The positive electrode cable 318 may include a diode connection part 450 configured to increase the conductivity along the positive electrode cable 318, as shown in FIGS. 23 to 25.

[0077]

The diode connection portion 450 includes a plurality of diodes 454 connected between the positive electrode cable portions 318e and 318f (FIG. 25).

For example, the diode connection unit 450 includes six back-charge type diodes (for example, Schottky barrier diodes).

[0078]

The diode 454 is soldered between the positive cable portions 318e and 318f.

Specifically, the diode conductor tab 454a is soldered to the positive electrode cable portion 318e, and the diode conductor protrusion 454b is soldered to the positive electrode cable portion 318f. More specifically, the diode conductor protrusion 454b of the diode 354 extends through the diode circuit board 452 to the wire bundle 318d and is then soldered in place to complete the assembly of the diode connection 450.

[0079]

The diode connection 450 is then insulated using, for example, shrink wrap insulator 455 (FIG. 25). A shrink wrap insulator 455 is attached around the diode connection 450 and then shrinks by the application of heat (eg, using a heat gun).

[0080]

Redesigning the resistor / diode printed circuit board (PCB) For example, redesigning the resistor / diode PCB to eliminate the diode extending from the resistor / diode PCB.

[0081]

Reconnect the resistors For example, reconnect resistors R134A and B, 135A and B on the reconnected resistor / diode PCB.

[0082]

(Test 1) The battery connector device 100 shown in FIG. 5 was subjected to a load test of 1250A.

The results are shown in Fig. 27.

Moreover, it is as follows.

[0083]

[0084]

(Test 2) The battery connector device 400 shown in FIG. 13 was subjected to a load test of 1250A.

The results are shown in Fig. 28. Moreover, it is as follows.

[0085]

[0086]

This resulted in a significant increase of about 20 percent (20%) at maximum power as compared to the test 1 results.

[0087]

Another improved conductivity battery conductor device 500 is shown in FIGS. 29-37.

The improved conductivity battery connector device 500 provides a significantly increased conductivity as compared to the battery connector device 100 shown in FIGS.

[0088]

The battery conductor device 500 includes a battery assembly 410, which includes a battery 512 connected to a positive electrode cable 518 and a negative electrode terminal conductor plate 530.

The positive electrode wire 519 is directly or indirectly connected to the positive electrode tab or the positive electrode cable 518 of the battery 530, and the negative electrode wire 523 is directly or indirectly connected to the negative electrode tab or the negative electrode terminal conductor plate 530. The battery conductor device 500 may further include a wire bundle 570 connected to the battery 512 or associated with operation of the battery 512 (eg, battery temperature sensor, power supply, etc.).

[0089]

The battery 512 may include a single battery cell 512c (FIG. 30) or a plurality of battery cells 512C connected end to end in series. In FIG. 30, three separate battery cells 512c are shown.

[0090]

The battery cells 512c each include a positive electrode tab 512d and a negative electrode tab 512d arranged at opposite ends of each battery cell 512c. The battery cells 512c are connected together by welding (eg, ultrasonic welding and / or heat welding) and / or soldering the positive and negative tabs 512d in series, respectively. For example, the tabs 512d are arranged to overlap one another (eg, edges overlap the opposing tabs 512d, or edges to edges).

[0091]

The tab 512d is a metal plate (for example, a relatively thin metal piece) extending outward from the main body and both ends of each battery cell 512c. As shown in FIG. 30, the tabs 512d extend along both ends of the width of each battery cell 512c. Each of the tabs 512d is located in the center and extends over most of the width of each end of each battery cell 512c.

[0092]

As shown in FIGS. 30 and 31, a separate tab 512e is added or connected to the right side of the battery cell 512c to extend the length of the tab 512d. Although the separate tab 512e is shown as having the same width as the tab 512d, this width may be different. To assemble the separate tabs 512e to the tabs 512d, for example, the separate tabs 512e are placed over the tabs 512d and then welded (eg, ultrasonically welded and / or thermally welded) and / or soldered. The exposed end of the positive electrode cable 518 is then rolled up inside the separate tab, as shown in FIGS. 32 and 34. For example, the initially flat separate tab 512e is wrapped around the exposed end of the positive electrode cable 518 and then connected to the exposed end by welding (eg, ultrasonic welding and / or heat welding) and / or soldering. .. For example, a layer of solder is applied to one or both sides of the separate tab 512e, and after wrapping the separate tab 512e around the exposed end of the positive wire 518, the assembly is heated to remove the layered solder. Melted, the assembly is soldered as a whole,

[0093]

As shown in FIG. 32, three battery cells 512c once connected together are then folded together into the layered battery cell configuration shown in FIG. The layered battery cell configuration may be packaged (eg, three battery cells taped together or shrink wrapped) or, as shown in FIG. 34, inside a battery cover or casing. Is located in.

[0094]

As shown in FIG. 35, the negative electrode tab 512 d may be attached to the negative electrode terminal conductor plate 530. For example, the negative electrode tab 512d may be partially or wholly (as shown) wrapped around the negative electrode terminal conductor plate 530. The negative electrode tab 512d may include a plurality of component holes 512f to facilitate welding and / or soldering of the negative electrode tab 512d to the negative electrode terminal conductor plate 530. For example, the component hole 512f may be a plurality of square-shaped component holes arranged in a lattice as shown in FIG. The negative electrode wire 523 is shown connected (eg, soldered) to the negative electrode tab 512d.

[0095]

The separate tab 512e (see FIG. 30) may be connected to the negative electrode tab 512d to extend the negative electrode tab 512d, and the extended negative electrode tab may be extended more than once (eg, 2, 3, 4 or more) negative electrodes. The terminal conductor plate 530 is wrapped or wrapped. In this way, the electrical connection between the negative electrode tab 512d and the negative electrode terminal conductor plate 530 is strengthened. The separate tab 512e may include a layer of solder on one or both sides, and after the separate tab 512e has wrapped or wrapped around the negative terminal conductor plate 530, the assembly is heated to separate the separate tab 512e from the negative terminal conductor. Solder on plate 530.

[0096]

The completed assembly of the battery conductor device 500 with the attached separate positive tabs 512d ready to wrap or wrap the exposed end of the positive cable 518 (FIG. 29) is shown in FIG. The wire bundle 570 shown in FIG. 36 includes wires 572 for a temperature sensor embedded within the battery 512 (eg, a temperature sensor located near a battery tab or between battery cells). A temperature sensor 574 having wires 572a, 572b is shown in FIG.

[0097]

As shown in FIG. 38, the battery conductor device 500 may include diode connectors 550 connected in a line, and may be joined to the positive electrode cable 518.

[0098]

The battery conductor device 500 includes a diode circuit board 552, and the diode circuit board 552 includes a plurality of diodes 454 assembled on the diode circuit board 552.

The diodes 454 each include a diode conductor tab 454a connected (eg, soldered) to the exposed end of the positive cable 518. The protrusions of diode 454 extend into the component holes in diode circuit board 552 and are soldered with resistor 576 to both the conductive traces and the exposed end of positive cable 518 to complete the assembly.

Patent Translate
Powered by EPO and Google

Notice

This translation is machine-generated. It cannot be guaranteed that it is intelligible, accurate, complete, reliable or fit for specific purposes. Critical decisions, such as commercially relevant or financial decisions, should not be based on machine-translation output.

CLAIMS JP2018536789

1.

A battery connector device for a battery jump start device having a smart switch, comprising: a battery having a positive electrode terminal tab and a negative electrode terminal tab; a positive electrode terminal conductor plate connected to the positive electrode terminal tab of the battery; A circuit board having a negative electrode terminal conductor bar connected to the negative electrode terminal tab, a positive electrode cable connected to the positive electrode terminal conductor plate of the battery, and a first circuit board conductor bar separated from a second circuit board conductor bar. A smart switch interface connectable to the smart switch of the jump start device and a negative electrode cable connected to the second circuit board conductor bar, wherein the first circuit board conductor bar is Electrically connected to the negative terminal conductor bar, the smart switch interface includes a first circuit board conductor bar and a second circuit board conductor bar to provide isolation between the negative terminal tab of the battery and a jump-started battery. The battery connector device further comprising one or more relays connected to the circuit board conductor bar.

2.

A battery connector device for a battery jump start device having a smart switch, the rechargeable battery having a positive electrode terminal tab and a negative electrode terminal tab, and a positive electrode terminal conductor plate connected to the positive electrode terminal tab of the battery. A negative electrode terminal conductor bar connected to the negative electrode terminal tab of the battery; a positive electrode cable connected to the positive electrode terminal conductor plate of the battery; and a first circuit board conductor bar separated from a second circuit board conductor bar. A smart switch interface connectable to the smart switch of the jump start device; and a negative electrode cable connected to the second circuit board conductor bar, wherein the first circuit board conductor bar is Electrically connected to the negative terminal conductor bar of the battery, the smart switch interface providing a first circuit board conductor to provide isolation between the negative terminal tab of the battery and a jump-started battery. The battery connector device, further comprising one or a plurality of relays connected between the bar and the second circuit board conductor bar, wherein the negative electrode cable is electrically connected to each of the plurality of relays.

3.

A battery connector device for a battery jump start device having a smart switch, the rechargeable battery having a positive electrode terminal tab and a negative electrode terminal tab, and a positive electrode terminal conductor plate connected to the positive electrode terminal tab of the battery. A negative electrode terminal conductor bar connected to the negative electrode terminal tab of the battery; a positive electrode cable connected to the positive electrode terminal conductor plate of the battery; and a first circuit board conductor bar separated from a second circuit board conductor bar. A smart switch interface connectable to the smart switch of the jump start device; a negative electrode cable connected to the second circuit board conductor bar; a first portion of the positive electrode cable; A diode connection portion provided between the positive electrode cable and a second portion, the first circuit board conductor bar is electrically connected to the negative electrode terminal

conductor bar of the battery, and the smart switch interface is Further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar to provide isolation between the negative terminal tab of the battery and the jump-started battery. A battery connector device, wherein the negative electrode cable is electrically connected to each of the plurality of relays.

4.

The device according to claim 1, wherein the one or more relays are a plurality of relays that connect the first circuit board conductor bar and the second circuit board conductor bar in parallel.

5.

The apparatus of claim 1, wherein the negative terminal conductor bar is configured to mechanically and electrically connect the battery to the smart switch battery interface.

6.

The apparatus of claim 5, wherein the negative terminal conductor bar is configured to position the smart switch battery interface adjacently above the battery.

7.

The device according to claim 1, wherein the positive electrode terminal conductor plate is wrapped around one end of the positive electrode cable to electrically connect the battery to the positive electrode cable.

8.

The positive electrode terminal conductor bar is ultrasonically welded to the positive electrode terminal tab of the battery, and the negative electrode terminal conductor bar is ultrasonically welded to the negative electrode terminal tab of the battery. apparatus.

9.

The battery has a rectangular shape, the width of the positive electrode terminal conductor plate of the battery is equal to the width of the battery, and the negative electrode terminal conductor bar is L-shaped and wound around each corner of the battery. The apparatus of claim 1, configured as:

10.

10. The device of claim 9, wherein the battery tab is mounted flush with a casing of the battery.

11.

The device according to claim 1, wherein a diode connection portion is provided between a first portion of the positive electrode cable and a second portion of the positive electrode cable.

12.

12. The device of claim 11, wherein the diode connection comprises one or more diode connections connected between the first portion of the positive cable and the second portion of the positive cable.

13.

13. The device of claim 12, wherein the diode connection comprises a plurality of diodes each connected between the first portion of the positive cable and the second portion of the positive cable.

14.

14. The conductor tabs of the plurality of diodes are connected to the first portion of the positive cable, and the conductor protrusions of the plurality of diodes are connected to the second portion of the positive cable. The device according to.

15.

15. The device of claim 14, wherein the plurality of diodes are connected to a printed circuit board.

16.

16. The apparatus of claim 15, wherein the conductor protrusions of the plurality of diodes extend through the printed circuit board and are electrically connected to the second portion of the conductor protrusions.

17.

17. The device of claim 16, wherein the plurality of diodes are arranged adjacent to each other along a single axis.

18.

14. The device of claim 13, wherein the diode conductor is insulated with a heat shrink insulator.

Espacenet

Bibliographic data: JP2018534892 (A) — 2018-11-22

BATTERY ASSEMBLY DEVICE

Inventor(s): ジョナサン・ルイス・ヌック, ; ウィリアム・ナイト・ヌック, ; ジェイムズ・リチャード・スタンフィールド, ; デレク・マイケル・アンダーヒル

Applicant(s): ザ・ノコ・カンパニーＴｈｅ Ｎｏｃｏ Ｃｏｍｐａｎｙ

Classification: - international: ***B60R16/04; H01M2/10; H01M2/20; H02J7/00; H02J7/10***
- cooperative: **H01M2/30 (US); H01R11/24 (US); H02J1/122 (EP); H02J7/14 (EP, GB, US); H02J7/342 (GB);** F02N11/12 (EP); F02N11/14 (EP); H02J1/122 (US)

Application number: JP20170558697 20160329 Global Dossier

Priority number (s): US201662294067P 20160211 ; WO2016US24680 20160329

Also published as: AU2016392707 (A1) AU2016392707 (B2) AU2020200268 (A1) CA2957431 (A1) CN107852004 (A) more

Abstract not available for JP2018534892 (A)
Abstract of corresponding document: WO2017138963 (A1)

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

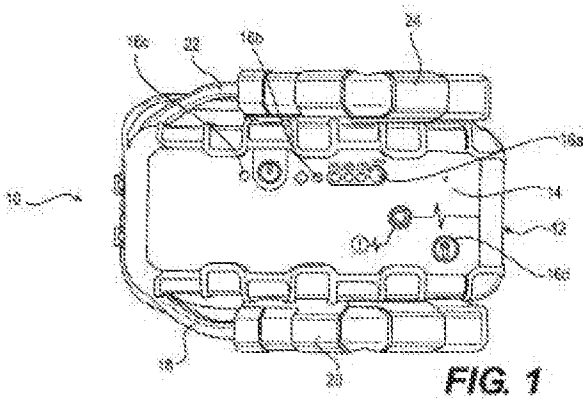


FIG. 1

(19)日本国特許庁(JP)　(12)公表特許公報(A)　(11)特許出願公表番号
特表2018-534892
(P2018-534892A)
(43)公表日　平成30年11月22日(2018.11.22)

(51)Int.Cl.			F I			テーマコード（参考）
H02J	7/00	(2006.01)	H02J	7/00	301B	5G503
H01M	2/10	(2006.01)	H02J	7/00	301C	5H040
H01M	2/20	(2006.01)	H01M	2/10	S	5H043
B60R	16/04	(2006.01)	H01M	2/20	A	
H02J	7/10	(2006.01)	H01M	2/10	M	

審査請求 有　予備審査請求 未請求　（全 16 頁）　最終頁に続く

(21)出願番号　特願2017-558697 (P2017-558697)
(86)(22)出願日　平成28年3月29日 (2016.3.29)
(85)翻訳文提出日　平成30年1月25日 (2018.1.25)
(86)国際出願番号　PCT/US2016/024680
(87)国際公開番号　WO2017/138963
(87)国際公開日　平成29年8月17日 (2017.8.17)
(31)優先権主張番号　62/294,067
(32)優先日　平成28年2月11日 (2016.2.11)
(33)優先権主張国　米国 (US)

(71)出願人　517284935
ザ・ノコ・カンパニー
The Noco Company
アメリカ合衆国４４１３９オハイオ州グレンウィロウ、ダイアモンド・パークウェイ３０３３９番、ナンバー１０２
(74)代理人　100100158
弁理士　鮫島　睦
(74)代理人　100111039
弁理士　前堀　義之
(72)発明者　ジョナサン・ルイス・ヌック
アメリカ合衆国４４１３９オハイオ州グレンウィロウ、ダイアモンド・パークウェイ３０３３９番、ナンバー１０２、ザ・ノコ・カンパニー内

最終頁に続く

(54)【発明の名称】バッテリアセンブリ装置

(57)【要約】
主題は、車両のジャンプスタート用の装置と共に用いるバッテリアセンブリ装置、及び前記バッテリアセンブリ装置を備える車両のジャンプスタート用の装置に関する。バッテリジャンプスタート装置用のバッテリアセンブリ装置。前記バッテリアセンブリ装置は、前記バッテリジャンプスタート装置のバッテリパックから充電されるバッテリへの導電率を最大化するように構成されている。

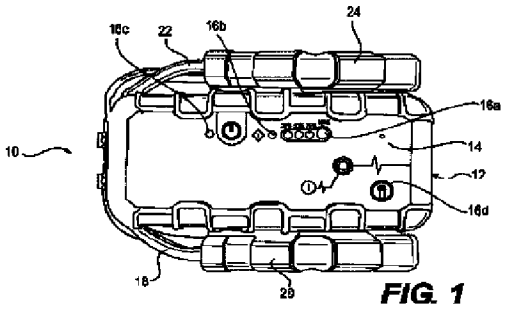


FIG. 1

【特許請求の範囲】
【請求項１】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリアセンブリ装置であって、
正極端子タブと、負極端子タブとを有するバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体バーと、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記正極端子導体バーに接続された正極ケーブルと、
前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと
を備え、
前記スマートスイッチインターフェイスは、回路基板を備え、
前記回路基板は、前記回路基板上で互いに離間した第１回路基板導体バーと第２回路基板導体バーとを備え、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンプスタートされるバッテリとの間の絶縁を提供するために、前記第１回路基板導体バーと前記第２回路基板導体バーとの間を接続する１又は複数のリレーを更に備える、バッテリアセンブリ装置。
【請求項２】
スマートスイッチを有するバッテリジャンプスタート装置用のバッテリアセンブリ装置であって、
正極端子タブと、負極端子タブとを備える矩形のバッテリと
前記バッテリの前記正極タブに接続された正極端子導体バーと、
前記バッテリの前記負極タブに接続された負極端子導体バーと、
前記正極導体バーに可撓性ケーブルコネクタによって接続された正極ケーブルと、
前記ジャンプスタート装置のスマートスイッチに接続可能なスマートスイッチインターフェイスと
を備え、
前記スマートスイッチバッテリインターフェイスは、回路基板を備え、
前記回路基板は、前記回路基板上で互いに離間した第１回路基板導体バーと第２回路基板導体バーとを備え、
前記スマートスイッチバッテリインターフェイスは、ジャンプスタートされる前記バッテリの前記負極タブの間の絶縁を提供するために、前記第１回路基板導体バーと前記第２回路基板導体バーとの間に接続された１又は複数のリレーを更に備える、バッテリアセンブリ装置。
【請求項３】
スマートスイッチを有するバッテリジャンプ装置用のバッテリアセンブリ装置であって、
バッテリの両端部にそれぞれ位置する正極端子タブと負極端子タブとを備える矩形状バッテリと、
前記バッテリの前記負極端子タブに接続されたＬ型正極端子導体バーと、前記Ｌ形正極端子は前記バッテリの角の周りに屈曲しており、前記バッテリの側部の少なくとも一部に沿って延在している
前記正極端子導体バーに接続された正極タブと、
前記ジャンプスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと
を備え、
前記スマートスイッチインターフェイスは、回路基板を備え、
前記回路基板は、前記回路基板上で互いに離間して配置された第１回路基板導体バーと第２回路基板導体バーとを備え、

前記スマートスイッチインターフェイスは、前記バッテリジャンプスタート装置の前記負極タブの間の絶縁を提供するために、前記第１回路基板導体バーと前記第２回路基板導体バーとの間を接続する１又は複数のリレーを備える、バッテリアセンブリ装置。
【請求項４】
前記リレーは、前記第１回路基板導体バーと前記第２回路基板導体バーとの間を平行に接続する複数のリレーである、請求項１に記載の装置。
【請求項５】
前記負極端子導体バーは、前記バッテリを前記スマートスイッチバッテリインターフェイスに機械的及び電気的に接続する、請求項１に記載の装置。
【請求項６】
前記スマートスイッチバッテリインターフェイスは、前記負極端子導体バーによって前記バッテリの上方に隣接して配置されている、請求項５に記載の装置。
【請求項７】
前記正極ケーブルの一端は、前記正極ケーブルの露出ケーブル導体端部を少なくとも部分的に巻回するように構成されている、請求項１に記載の装置。
【請求項８】
前記正極端子導体バーは、前記バッテリの前記正極端子タブに超音波溶着されており、
前記負極端子導体バーは、前記バッテリの前記負極端子タブに超音波溶着されている、請求項１に記載の装置。
【請求項９】
前記バッテリは、矩形であり、
前記正極端子導体バーと前記負極端子導体バーとは、Ｌ形であり、前記バッテリのそれぞれの角部を巻回している、請求項１に記載の装置。
【請求項１０】
複数の前記バッテリタブは、前記バッテリのケーシングと同一平面に搭載された、請求項９に記載の装置。
【請求項１１】
前記正極ケーブルは、可撓性ケーブルコネクタによって前記正極端子導体バーに接続されている、請求項１に記載の装置。
【請求項１２】
前記可撓性ケーブルコネクタは、可撓性外側スリーブ部と可撓性内側スリーブ部とを備える、請求項１１に記載の装置。
【請求項１３】
前記可撓性外側スリーブ部は、外側フランジを備え、
前記可撓性内側スリーブ部は、内側フランジを備え、
前記外側フランジと前記内側フランジとは、前記バッテリジャンプスタート装置のケーシング壁を挟み込んでいる、請求項１２に記載の装置。
【請求項１４】
前記可撓性ケーブルコネクタは、内側蛇行ケーブル部を備える、請求項１１に記載の装置。
【請求項１５】
前記可撓性ケーブルコネクタは、前記バッテリジャンプスタート装置のケーシング壁に対して斜めに向けられるように配置された正極ケーブルを収容するように構成されており、
前記内側蛇行ケーブル部は、前記ケーシング壁に対する角度と、前記内側蛇状ケーブル部の前記正極端子導体バーへの取付角度との間のずれを吸収するように構成されている、請求項１４に記載の装置。
【発明の詳細な説明】
【技術分野】
【０００１】

本発明は、例えば、バッテリジャンプスタート装置に用いられるバッテリアセンブリ装置に関する。

【背景技術】

【０００２】

ヌック（Nook）らの米国特許第９００７０１５号に開示されているような携帯型車両バッテリジャンプスタート装置が存在する。この装置は、リチウムイオンバッテリパックを使用する。このタイプの装置では、前記装置の前記バッテリパックからジャンプスタートされる車両の車載バッテリへの導電率を最大化する必要がある。

【０００３】

自動車のジャンプスタートの成功のためには、結果を決定づける主な要素が２つある。第１の要素は、前記リチウムイオンバッテリパックから供給される電力量であり、第２の要素は、最大導電率である。大型のエンジンをジャンプスタートする最良の可能性を得るためには両方の要素が必要である。他方の要素がなく一方の要素だけでは、不十分である。

【発明の概要】

【０００４】

主題は、車両をジャンプスタートするための装置とともに用いるバッテリアセンブリ装置、及び前記バッテリアセンブリ装置を備える車両をジャンプスタートするための装置に関する。

【０００５】

主題は、以下の対象に関する。

【０００６】

バッテリの端子に接続された少なくとも１つのバッテリ導体を有するバッテリを備えるないしはかかるバッテリからなるバッテリアセンブリ装置。

【０００７】

バッテリの端子タブに接続された少なくとも１つのバッテリ導体を有するバッテリを備えるないしはかかるバッテリからなるバッテリアセンブリ装置。

【０００８】

バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリを備えるないしはかかるバッテリからなるバッテリアセンブリ装置。

【０００９】

バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有し、前記バッテリ導体は、前記バッテリのそれぞれの端子接点にはんだ付けされている前記バッテリを備えるないしはかかるバッテリからなるバッテリアセンブリ装置。

【００１０】

バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリ、及び前記バッテリの前記バッテリ導体のうちの１つに接続されたリレーを備えるないしはかかるバッテリとかかるリレーとからなるバッテリアセンブリ装置。

【００１１】

バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリ、及び前記負極バッテリ導体に接続されたリレーを備えるないしはかかるバッテリとかかるリレーとからなるバッテリアセンブリ装置。

【００１２】

バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリ、及び前記負極バッテリ導体に接続されたリレーを備えるないしはかかるバッテリとかかるリレーとからなるバッテリアセ

ンブリ装置。
【００１３】
バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリ、及び前記負極バッテリ導体に接続された複数のリレーを備えるないしはかかるバッテリとかかる複数のリレーとからなるバッテリアセンブリ装置。
【００１４】
バッテリの正極端子接点に接続された正極バッテリ導体と前記バッテリの負極端子接点に接続された負極バッテリ導体とを有する前記バッテリ、及び前記正極バッテリ導体に接続された正極ケーブルを備えるないしはかかるバッテリとかかる正極ケーブルとからなるバッテリアセンブリ装置。
【図面の簡単な説明】
【００１５】
【図１】クランプが展開されていないバッテリジャンプスタート装置の正面斜視図。
【図２】図１に示したバッテリジャンプスタート装置の背面斜視図。
【図３】図１及び図２に示したバッテリジャンプスタート装置の端部斜視図。
【図４】図１に示したバッテリジャンプスタート装置（ただし、クランプが展開されている）の正面斜視図。
【図５】図１に示すバッテリジャンプスタート装置の内部に格納されたバッテリアセンブリ装置（バッテリジャンプスタート装置の中に設置されているが、負極ケーブルはまだ設置されていないとき）の斜視図。
【図６】図５に示すバッテリアセンブリ装置の平面図。
【図７】図５に示すバッテリアセンブリ装置の正面図。
【図８】前記正極ケーブルの屈曲ケーブルコネクタの側面図
【図９】負極ケーブルが接続されている図５に示すバッテリアセンブリ装置の斜視図。
【図１０】ダイオード装置が正極ケーブル上に設置されている図５に示すバッテリアセンブリ装置の斜視図。
【図１１】バッテリジャンプスタート装置の他の構成要素ないしは装置と接続されたバッテリアセンブリ装置の斜視図。
【図１２】図１に示すバッテリジャンプスタート装置の中に格納されたバッテリパック装置（バッテリジャンプスタート装置の中に設置されているとき）の斜視図。
【発明を実施するための形態】
【００１６】
バッテリジャンプスタータ装置１０を図１及び２に示す。バッテリジャンプスタート装置１０は、複数の発光ダイオード（ＬＥＤｓ）１６が配列されたディスプレイ１４を有するケーシング１２を備える。バッテリジャンプスタート装置１０は、正極クランプ２０を有する正極ケーブル１８と、負極クランプ２４を有する負極ケーブル２２とを更に備える。正極ケーブル１８及び負極ケーブル２２とは、ケーシング１２中の開口１２ａ，１２ｂを通り、以下に詳述する内部に位置する構成要素（すなわち、バッテリアセンブリ装置）に配線される。
【００１７】
クランプ２０，２４は、図１に示すようにクランプ２０，２４のそれぞれがケーシング１２の両端から外側に延びるそれぞれのサイドポスト２６にクランプされることによって、展開されていない状態で格納ないしは固定される。サイドポスト２６は、図２に示される。クランプ２０，２４は、バッテリジャンプスタータ装置１０が使用されないときに固定され、使用中はサイドポスト２６からアンクランプされる。
【００１８】
バッテリジャンプスタート装置１０は、車載バッテリをジャンプスタートするように構成されている。例えば、バッテリジャンプスタート装置１０は、米国特許第９００７０１５号（参照することにより本明細書に全体を援用する）に開示されている安全保護付携帯

型車両ジャンプスタート装置、又はこれに類似する装置であってもよい。

【００１９】

バッテリジャンプスタート装置１０は、ケーシング１２の内側に配置された様々な電気部品又は部品を備える。例えば、バッテリジャンプスタート装置１０は、図５から図１０に示すバッテリアセンブリ１１０と、図１１に示す内部電気部品とを備える。

【００２０】

図５から図１０に示すように、バッテリアセンブリ１１０は、バッテリ１１２を備える。バッテリ１１２は、例えば、充電式リチウムイオンバッテリである。バッテリアセンブリ１１０は、バッテリ１１２からバッテリジャンプスタータ装置１０のケーブル１８，２２及びクランプ２０、２４への電気伝導率を最大化するように構成されている。バッテリ１１２は、ケーシング、例えば、矩形のケーシング１１２ａを備える。

【００２１】

バッテリアセンブリ１１０は、正極端子導体バー１１４を更に備える。正極端子導体バー１１４は、一方の端部において、バッテリ１１２の正極タブ（すなわち接点）と接続（例えばはんだ付け）されている。正極端子導体バー１１４の他方の端部には、導体環１１６が設けられている。導体環１１６は、正極ケーブル１８のケーブル導体の露出した導体端部１８ａに巻き付いて接続（例えば、圧着及び／又ははんだ付け）されている。

【００２２】

図５及び図６に示すように、正極端子導体バー１１４は、（例えば、バッテリ１１２を平面視したとき）バッテリ１１２の矩形のケーシング１１２ａの四角形の角部に巻き付くように、例えば、Ｌ形であってもよい。

【００２３】

Ｌ形の正極端子導体バー１１４は、図６に示すように、バッテリ１１２の一端に沿って延在するとともに、バッテリ１１２の側部の少なくとも一部に沿って延在する。

【００２４】

正極端子導体バー１１４は、（例えば、バッテリジャンプスタータ装置１０が偶然に落下した場合に、機械的な衝撃に耐えるための）付加的な構造的支持及び安定性を提供するために、バッテリケーシング１１２ａの前記外表面に機械的に連結及び／又は接着されていてもよい。例えば、正極端子導体バー１１４は、バッテリケーシング１１２ａに対して接着剤（例えば、シリコン接着剤）、両面テープ、両面フォームテープ、スナップフィット接続を有する絶縁プラスチック若しくはセラミックのコネクタ、及び／又はメカニカルファスナーによって機械的に接続されていてもよい。

【００２５】

正極ケーブル１８は、正極ケーブル１８を正極端子導体バー１１４に接続する屈曲ケーブル部１１８を備える。屈曲ケーブル部１１８は、可撓性スリーブ１２０につながる外側スリーブ部１１８ａを備える。可撓性スリーブ１２０は、バッテリジャンプスタータ装置１０のケーシング１１２に対して外側に位置する外側スリーブ部１２０ａと、バッテリジャンプスタータ装置１０のケーシング１１２に対して内側に位置する可撓性内側スリーブ部１２０ｂとを備える。

【００２６】

可撓性スリーブ１２０は、可撓性を維持しつつ、バッテリジャンプスタータ装置１０の正極ケーブル１８とケーシング１２との間の接続を補強するように構成されている。例えば、可撓性スリーブ１２０は、正極ケーブル１８の外側スリーブ１８ａを露出する１又は複数の溝１２４（図３では３つ）を備える。１又は複数の溝１２４は、可撓性外側スリーブ部１２０の位置で正極ケーブル１８の折り曲げを容易にするために、ヒンジとして機能する。

【００２７】

可撓性スリーブ１２０は、内側フランジ１２６から離間した外側フランジ１２４を更に備え、内側フランジ１２６は、外側フランジ１２４との間で溝１２５を画定している。例えば、外側フランジ１２４は、ケーシング１２の壁厚と等しい距離で内側フランジ１２６

から離間している。フランジ１２４，１２６は、可撓性コネクタ１２０を正極ケーブル１８とともにバッテリジャンプスタート装置１０のケーシング１２に固定するように構成されている。可撓性コネクタ１２０のスリーブ部１２８（図６）は、外側フランジ１２４と内側フランジ１２８とに共に接続されている。例えば、可撓性スリーブ１２０は、別個に成形されて正極ケーブル１８上に組み付けられているか、正極ケーブル１８に成形されて単一ユニットを形成する。例えば、可撓性外側スリーブ部１２０は、成型工程の間に金型内に挿入されている正極ケーブル１８の一部にインサート射出成形される。あるいは、可撓性外側スリーブ部１２０は、別個に製造（例えば成形）され、その後正極ケーブル１８の一部に設置されるか組み付けられる。例えば、正極ケーブル１８は、内側導体（例えば、銅やアルミニウムからなる、例えば単線導体、又はマルチストランド金属ワイヤ導体）と外側絶縁スリーブ１８ａ（例えば、成形プラスチックスリーブ）とを備える。可撓性スリーブ１２０は、正極ケーブル１８の外側スリーブ１８ａの上及び周囲に取付（例えば、成形又は設置又は組立）されてもよい。

［００２８］

バッテリアセンブリ１１０は、負極端子導体バー１３０を更に備える。負極導体バー１３０は、一方の端部で、バッテリ１１２の負極端子タブ（すなわち接点）に接続（例えば、はんだ付け）されている。負極端子導体バー１３０の他方の端部は、図５に示すように、負極端子導体バー接続部１３２を備える。

［００２９］

負極端子導体バー１３０は、図６に示すように、矩形バッテリ１１２の角部に巻き付くようにＬ形であってもよい。Ｌ形負極端子導体バー１３０は、バッテリ１１２の端部に沿って延在するとともに、バッテリ１１２の側部の少なくとも一部に沿って延在する。

［００３０］

負極端子導体バー１３０もまた、（例えば、バッテリジャンプスタータ装置１０が偶然に落下した場合に機械的な衝撃に耐えるために）付加的な支持及びその安定性を提供するために、バッテリケーシング１１２ａの外表面に機械的連結及び／又は接着されていてもよい。例えば、負極端子導体バー１１４は、接着剤（例えば、シリコン接着剤）、両面テープ、両面フォームテープ、スナップフィット接続を有する絶縁プラスチック若しくはセラミックのコネクタ、及び／又はメカニカルファスナーによって、バッテリケーシング１１２ａに機械的に接続されていてもよい。

［００３１］

図５に示すように、バッテリアセンブリ１１０は、スマートスイッチバッテリインターフェイス１３４を更に備える。スマートスイッチバッテリインターフェイス１３４は、第１回路基板導体バー１３８を有する回路基板１３６を備える。第１回路基板導体バー１３８は、第２基板導体バー１４０から離間しており、第１回路基板導体バー１３８と第２回路基板導体バー１４０とは、図５に示すように、回路基板１３６の一方側に位置している。

［００３２］

一対のリレー１４２は、回路基板１３６の反対側に搭載されている。リレー１４２は、基板１３６（図５）のスロット１３６ａを通って延在する複数のリレーアンカーピン１４２ａを含む。リレー１４２は、第１リレーコネクタピン１４２ｂを更に含む。第１リレーコネクタピン１４２ｂは、回路基板１３６の両方に配置された複数のスロットを通って延在し、負極端子導体バー接続部１３２のスロット１３２ａを通って延在する。リレー１４２は、第２リレーコネクタピン１４２ｃを更に含む。第２リレーコネクタピン１４２ｃは、回路基板１３６と、第１回路基板導体バー１３８のウインドウ１３８ａとの両方に配置された複数のスロット、及び第１導体バー１３８設けられたスロット１３２ａを通過して延在している。複数のリレーアンカーピン１３６ａは、適切な位置にはんだ付けされて、リレー１４２を基板１３６に機械的に接続する。リレーコネクタピン１４２ｂ，１４２ｃは、適切な位置にはんだ付けされて、それぞれ、リレー１４２を、回路基板導体プレート１３８，１４０に機械的及び電気的に接続する。

【００３３】
回路基板１３６のスロット１３６ａは、例えば、矩形（図５）であり、矩形のリレーアンカーピン１４２ａを収容する。
【００３４】
具体的には、リレーアンカーピン１４２ａの基部は、矩形であり、正方形の端部へとつながっている。前記正方形の端部は、回路基板１３６の外表面と同一平面に配置された横方向の縁部を形成する基部と比較して、寸法的に幅が狭い。リレーアンカーピン１４２ａの露出した端部にはんだが塗布されたとき、はんだは、前記正方形の端部の両端部と前記横方向の縁部とを接続して、リレーアンカーピン１４２ａを回路基板１３６に固定し、係止する。
【００３５】
スロット１３２ａは、負極端子導体バーコネクタ部１３２に設けられており、第１回路基板導体バー１３８のスロット１３８ａは、矩形である。第２回路基板導体バー１４０（図５）中のスロット１４０ａは、Ｔ形であり、３つの水平を向いたリレーコネクタピン１４２ｂを収容する。リレーコネクタピン１４２ｂの端部は、負極端子導体バーコネクタ部１３２の外表面と同一平面に示されている。はんだがリレーコネクタピン１４２ｂの露出端部に塗布されたとき、はんだは、負極端子導体バーコネクタ部１３２中のスロット１３２ａと第１回路基板導体バー１３８のスロット１３８ａとを埋め、コネクタピン１４２ｂの端部をスロット１３２ａ及びスロット１３８ａの内側縁に接続し、リレー１４２を回路基板１３６及び負極端子導体バーコネクタ部１３２に固定する。また、この塗布されたはんだは、負極端子導体バーコネクタ部１３２を第１回路基板導体バー１３８に電気的に接続する。
【００３６】
第２回路基板導体バー１４０に設けられたスロット１４０ａは、Ｔ形であり、縦に３つ並んだ第２リレーコネクタピン１４２ｃを収容する。第２リレーコネクタ突起１４２ｃは、図９に示すように、回路基板１３６の外表面から外側に延在しており、負極ケーブル１４の露出ケーブル端部１４ａと接続している。はんだが第２リレーコネクタ突起１４２ｃの端部に塗布されたとき、はんだは、Ｔ形スロット１４０ａ（図５）を埋め、第２リレーコネクタ突起１４０ｃを第２回路基板導体バー１４０に電気的に接続する。図９に示すように、負極ケーブル２２の露出ケーブル端部２２ａは、第２リレーコネクタ突起１４２ｃ（図５）にはんだ付けされる。
【００３７】
負極端子導体バー１３０の負極端子導体バーコネクタ部１３２は、回路基板１３６の第１回路基板導体バー１３８に（例えば、はんだ付けによって）接続される。さらに、図９に示すように、負極ケーブル２２の露出ケーブル端部２２ａ（すなわち絶縁スリーブが取り外されている）は、第２回路基板導体バー１４０に（例えば、はんだ付けによって）接続される。図１１に示すように、負極ケーブル２２は、可撓性スリーブ１１８に取り付けられている。
【００３８】
屈曲ケーブルコネクタ１１８（図５）の構成の代替案として、図１０に示すように、ダイオード装置１５０は、可撓性ケーブルコネクタ１１８の上に設置される（すなわち、挿入される）。ダイオード装置１５０は、回路基板１５２の片面に配置されたバックチャージダイオード１５４のセットが設けられた回路基板１５２と、回路基板１５２の反対側に設けられた導体バー１５６とを備える。
【００３９】
（組立）
バッテリジャンプスタート装置１０は、図１１に示すように、上部ケーシング部１２ａと下部ケーシング部１２ｂとを有するケーシング１２を備える。
上部ケーシング部１２ａ及び下部ケーシング部１２ｂは、バッテリジャンプスタート装置１０を組み立てるときに、互いに接続されるように構成されている。

［００４０］
バッテリジャンプスタート装置１０は、バッテリアセンブリ１１０とコントローラアセンブリ２１０とを更に備え、バッテリアセンブリ１１０とコントローラアセンブリ２１０との両方が、図１１に示すように、バッテリジャンプスタート装置１０を組み立てるときに、ケーシング１２の内部に配置される。コントローラアセンブリ２１０は、回路基板２１２を備え、回路基板２１２は、他の回路基板２１４に隣接して配置される。
［００４１］
バッテリアセンブリ１１０の正極端子は、図１１に示すように、回路基板２１２に、正極電源線２１６を介して接続されている。例えば、正極電源線２１６は、正極導体バー１１４（図５）にはんだ付けされている。バッテリアセンブリ１１０の負極端子は、負極電源線２１８を介して回路基板２１４に接続されている。
［００４２］
リレー回路基板１３６は、図１１に示すように、コネクタ２２２を有するワイヤセット２２０を備える。コネクタ２２２は、図１１に示すように、バッテリジャンプスタート装置１０の組み立て中に、コントローラアセンブリ２１０の回路基板２１２上に配置されているリレー基板コネクタ２２４と接続するように構成されている。
［００４３］
バッテリアセンブリ１１０は、図１１に示すように、コネクタ２２８を有するワイヤセット２２６を更に備える。コネクタ２２８は、コントローラアセンブリ２２０の回路基板２１２上に配置されたバッテリセル充電／測定コネクタ２３０に接続するように構成されている。
［００４４］
バッテリアセンブリ１１０は、図１１に示すように、コネクタ２３４を有するワイヤセット２３２を有するバッテリ温度センサを更に備える。コネクタ２３４は、コントローラアセンブリ２２０の回路基板２１２上に配置された温度センサコネクタ２３６に接続されるように構成されている。
［００４５］
回路基板２１２は、図１１に示すように、充電電力抵抗器２４０と出力リレー２４２とを備える。さらに、下部ケーシング部１２ａは、回路基板２１４に接続されたワイヤセット２４６を有するメインユーザ出力コネクタ２４４と、回路基板２１４に接続されたワイヤセット２５０を有するメインユーザ入力コネクタ２４８とを備える。
［００４６］
バッテリアセンブリ１１０は、図１１に示すように、バッテリジャンプスタート装置１０と接続されている。バッテリコネクタ装置１１０は、組み立てられたとき、バッテリジャンプスタート装置１０のケーシング１２の内部に設置される。

【 図 1 】

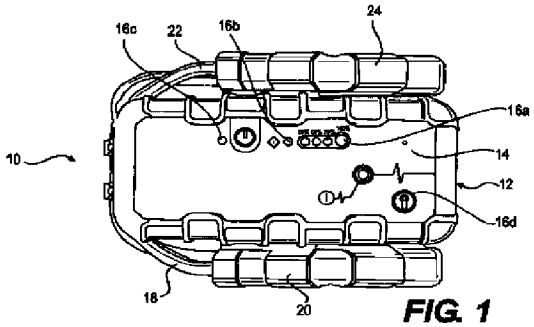


FIG. 1

【 図 2 】

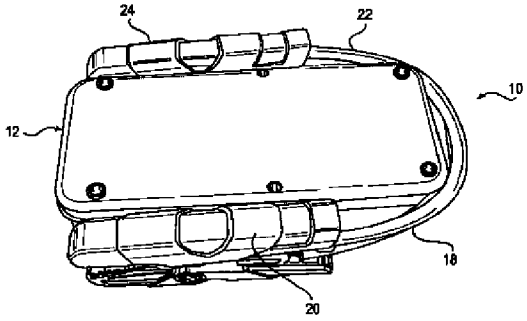


FIG. 2

【 図 3 】

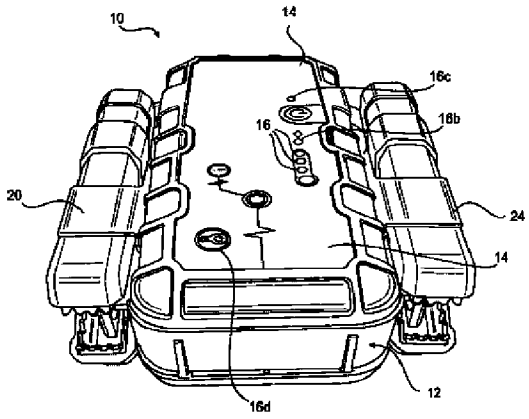


FIG. 3

【 図 4 】

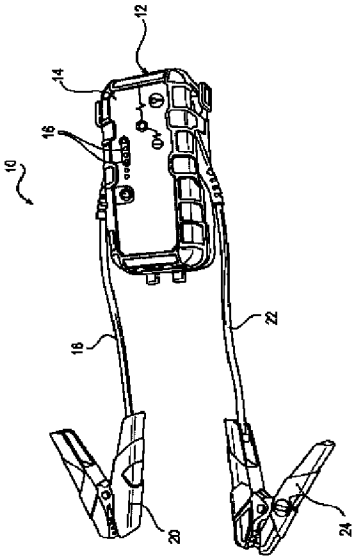


FIG. 4

【 図 5 】

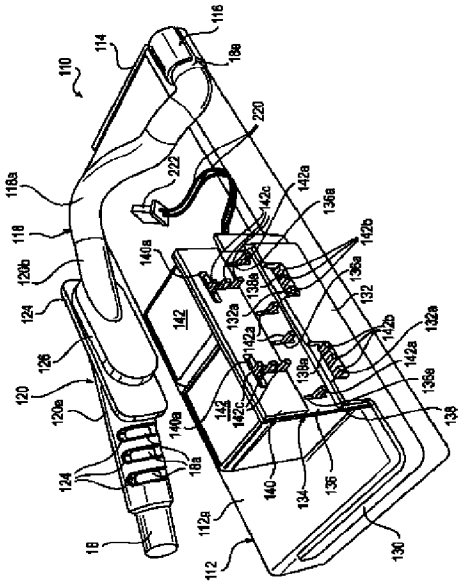


FIG. 5

【 図 6 】

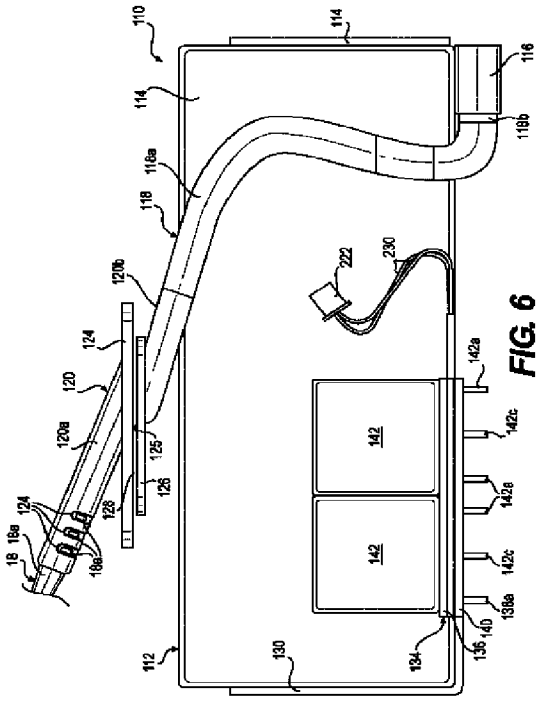


FIG. 6

【 図 7 】

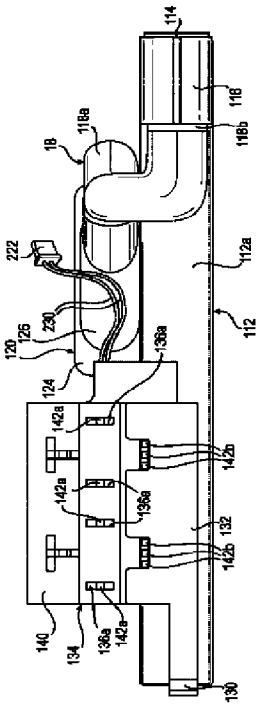


FIG. 7

【 図 8 】

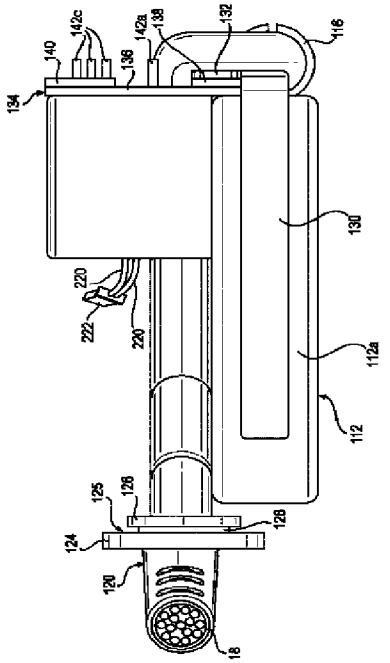


FIG. 8

【 図 9 】

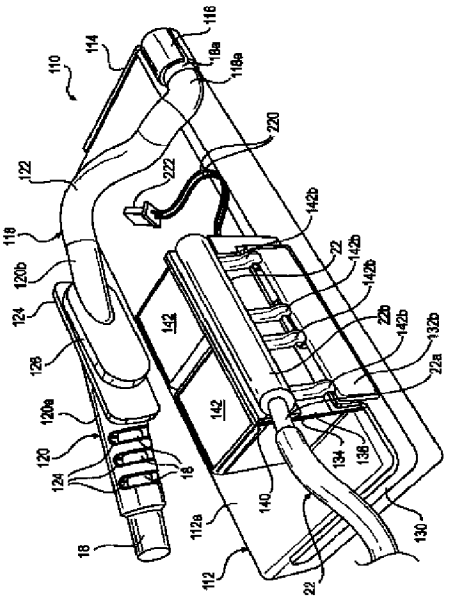


FIG. 9

【 図１０ 】

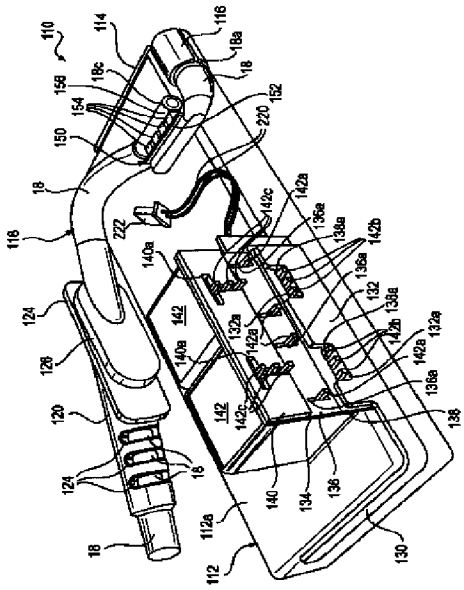


FIG. 10

【 図１１ 】

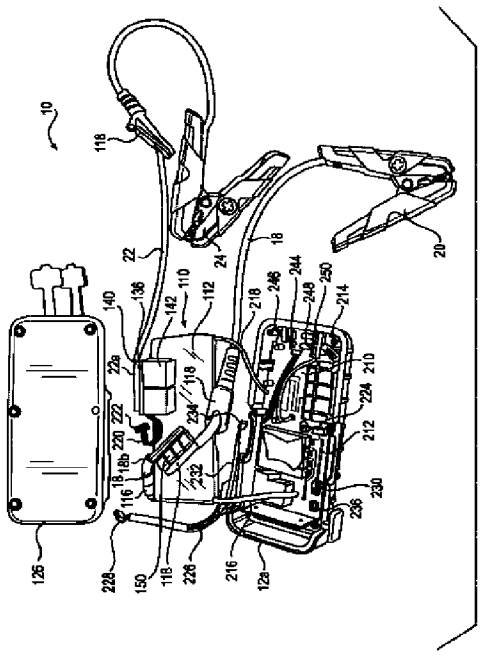


FIG. 11

【 図１２ 】

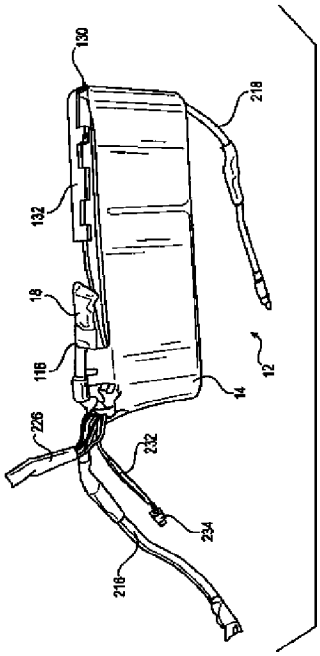


FIG. 12

【手続補正書】
【提出日】平成30年1月25日(2018. 1. 25)
【手続補正1】
【補正対象書類名】特許請求の範囲
【補正対象項目名】全文
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項1】
スマートスイッチを有するバッテリジャンピングスタート装置用のバッテリコネクタ装置であって、
正極端子タブと負極端子タブとを有するバッテリと、
前記バッテリの前記正極端子タブに接続された正極端子導体バーと、
前記バッテリの前記負極端子タブに接続された負極端子導体バーと、
前記正極端子導体バーに接続された正極ケーブルと、
前記ジャンピングスタート装置の前記スマートスイッチに接続可能なスマートスイッチインターフェイスと
を備え、
前記スマートスイッチインターフェイスは、回路基板を備え、
前記回路基板は、前記回路基板上に互いに離間して配置された第1回路基板導体バーと第2回路基板導体バーとを備え、
前記スマートスイッチインターフェイスは、前記バッテリの前記負極端子タブとジャンピングスタートされるバッテリとの間の分離を提供するために、前記第1回路基板導体バーと前記第2回路基板導体バーとの間を接続する1又は複数のリレーを備える、バッテリコネクタ装置。
【請求項2】
前記リレーは、前記第1回路基板導体バーと前記第2回路基板導体バーとを並列に接続する複数のリレーである、請求項1に記載の装置。
【請求項3】
前記負極端子導体バーは、前記バッテリを前記スマートスイッチバッテリインターフェイスに機械的及び電気的に接続する、請求項1に記載の装置。
【請求項4】
前記スマートスイッチバッテリインターフェイスは、前記負極端子導体バーによって前記バッテリの上方に隣接して配置されている、請求項1に記載の装置。
【請求項5】
前記正極端子導体バーの一端は、前記正極ケーブルの露出ケーブル導体端部に少なくとも部分的に巻き付くように構成されている、請求項1に記載の装置。
【請求項6】
前記正極端子導体バーは、前記バッテリの前記正極端子タブに超音波溶着されており、
前記負極端子導体バーは、前記バッテリの前記負極端子タブに超音波溶着されている、請求項1に記載の装置。
【請求項7】
前記バッテリは、矩形であり、
前記正極端子導体バーと前記負極端子導体バーとは、L形であり、前記バッテリのそれぞれの角部に巻き付いている、請求項1に記載の装置。
【請求項8】
複数の前記バッテリタブは、前記バッテリのケーシングと同一平面に搭載された、請求項7に記載の装置。
【請求項9】
前記正極ケーブルは、可撓性ケーブルコネクタによって前記正極端子導体バーに接続さ

れている、請求項１に記載の装置。
【請求項１０】
前記可撓性ケーブルコネクタは、可撓性外側スリーブ部と可撓性内側スリーブ部とを備える、請求項９に記載の装置。
【請求項１１】
前記可撓性外側スリーブ部は、外側フランジを備え、
前記可撓性内側スリーブ部は、内側フランジを備え、
前記外側フランジと前記内側フランジとは、前記バッテリジャンピングスタート装置のケーシング壁を挟み込んでいる、請求項１０に記載の装置。
【請求項１２】
前記可撓性ケーブルコネクタは、内側蛇行ケーブル部を備える、請求項９に記載の装置。
【請求項１３】
前記可撓性ケーブルコネクタは、前記正極ケーブルを前記バッテリジャンピングスタート装置のケーシング壁に対して斜めに向けられるように収容するように構成されており、
前記内側蛇行ケーブル部は、前記ケーシング壁に対する角度と、前記内側蛇状ケーブル部の前記正極端子導体バーへの取付角度との間のずれを吸収するように構成されている、請求項１２に記載の装置。
【請求項１４】
前記正極端子導体バーは、Ｌ形正極端子導体バーであり、
前記負極端子導体バーは、Ｌ形負極導体バーである、請求項１に記載の装置。
【請求項１５】
前記Ｌ形正極導体バーは、前記バッテリの角部を巻回するように方向づけられてり、
前記Ｌ形負極導体バーは、前記バッテリの他の角部を巻回するように方向づけられている、請求項１４に記載の装置。

【 国際調査報告 】

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/024680

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/00, H02J 7/14 (2016.01)
CPC - H02J 7/0054, H02J 7/0034, H02J 7/0042, H02J 7/0047, H02J 7/0052, H02J 2007/0095 (2016.02)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H02J 7/00, H02J 7/14 (2016.01)
CPC - H02J 7/0054, H02J 7/0034, H02J 7/0042, H02J 7/0047, H02J 7/0052, H02J 2007/0095 (2016.02)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 320/103, 104, 105, 107 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Orbit, Google Patents, Google Scholar
Search terms used: battery, jump start, portable, relay, L-shaped, conductor, bus, bar, isolation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,002,235 A (CLORE) 14 December 1999 (14.12.1999) entire document	1-15
Y	US 9,007,015 B1 (THE NOCO COMPANY) 14 April 2015 (14.04.2015) entire document	1-15
Y	US 6,679,708 B1 (DEPP et al.) 20 January 2004 (20.01.2004) entire document	1-15
Y	US 2015/0087182 A1 (TYCO ELECTRONICS CORPORATION) 26 March 2015 (26.03.2015) entire document	2, 3, 6-15
Y	US 4,990,723 A (ZIBERNA et al.) 05 February 1991 (05.02.1991) entire document	13
Y	US 2005/0213887 A1 (RAJENDRAN et al.) 29 September 2005 (29.09.2005) entire document	14, 15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2016	24 JUN 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

フロントページの続き

(51) Int. Cl.	FI		テーマコード (参考)
	B 6 0 R	16/04	S
	H 0 2 J	7/00	P
	H 0 2 J	7/10	H
	H 0 2 J	7/00	3 0 3 C

(81) 指定国 AP(BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), EA(AM, AZ, BY, KG, KZ, RU, TJ, TM), EP(AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OA(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG), AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US

(72) 発明者 ウィリアム・ナイト・ヌック
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内
(72) 発明者 ジェイムズ・リチャード・スタンフィールド
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内
(72) 発明者 デレク・マイケル・アンダーヒル
アメリカ合衆国44139オハイオ州グレンウィロウ、ダイアモンド・パークウェイ30339番、ナンバー102、ザ・ノコ・カンパニー内

Fターム(参考) 5C503 AA04 BB02 CA01 DA04 FA02 FA03 FA06
5H040 AA01 AS07 AT06 AY05 CC15 CC28 CC38 DD06 DD09 DD10
DD13 DD24 DD26 JJ08 NN03
5H043 AA14 BA11 CA05 CA22 CA28 DA06 FA06 FA23 FA26 FA37
HA17F JA07F JA09F JA11F JA17F JA21F JA28F KA44F LA21F LA22F

Espacenet

Bibliographic data: JP2018534892 (A) — 2018-11-22

BATTERY ASSEMBLY DEVICE

Inventor(s): ジョナサン・ルイス・ヌック, ; ウィリアム・ナイト・ヌック, ; ジェイムズ・リチャード・スタンフィールド, ; デレク・マイケル・アンダーヒル

Applicant(s): ザ・ノコ・カンパニーＴｈｅ Ｎｏｃｏ Ｃｏｍｐａｎｙ

Classification: - international: ***B60R16/04; H01M2/10; H01M2/20; H02J7/00; H02J7/10***
- cooperative: **H01M2/30 (US); H01R11/24 (US); H02J1/122 (EP); H02J7/14 (EP, GB, US); H02J7/342 (GB);** F02N11/12 (EP); F02N11/14 (EP); H02J1/122 (US)

Application number: JP20170558697 20160329 Global Dossier

Priority number (s): US201662294067P 20160211 ; WO2016US24680 20160329

Also published as: AU2016392707 (A1) AU2016392707 (B2) AU2020200268 (A1) CA2957431 (A1) CN107852004 (A) more

Abstract not available for JP2018534892 (A)
Abstract of corresponding document: WO2017138963 (A1)

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

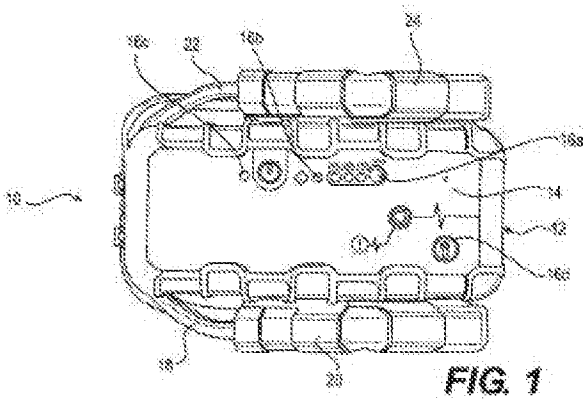


FIG. 1

Patent Translate
Powered by EPO and Google

Notice

This translation is machine-generated. It cannot be guaranteed that it is intelligible, accurate, complete, reliable or fit for specific purposes. Critical decisions, such as commercially relevant or financial decisions, should not be based on machine-translation output.

DESCRIPTION JP2018534892

Abstract: The subject matter relates to a battery assembly device for use with a vehicle jump start device, and a vehicle jump start device comprising said battery assembly device. Battery assembly device for battery jump start device. The battery assembly device is configured to maximize conductivity from a battery pack of the battery jump start device to a battery to be charged.

Battery assembly equipment

[0001]

The present invention relates to a battery assembly device used in, for example, a battery jump start device.

[0002]

There is a portable vehicle battery jump start device such as that disclosed in US Pat. No. 9,0070,15 to Nook et al.

This device uses a lithium-ion battery pack. In this type of device, it is necessary to maximize the conductivity of the device from the battery pack to the onboard battery of the vehicle that is jumpstarted.

[0003]

There are two main factors that determine the outcome of a successful car jump start. The first factor is the amount of electric power supplied from the lithium-ion battery pack, and the second factor is the maximum conductivity. Both factors are needed to get the best chance of jumpstarting a large engine. One element alone, without the other, is not enough.

[0004]

The subject matter relates to a battery assembly device for use with a device for jump starting a vehicle, and a device for jump starting a vehicle comprising said battery assembly device.

[0005]

The subject relates to the following subjects:

[0006]

A battery assembly device comprising or comprising a battery having at least one battery conductor connected to a terminal of the battery.

[0007]

A battery assembly device comprising or comprising a battery having at least one battery conductor connected to a terminal tab of the battery.

[0008]

A battery assembly device comprising or comprising the battery having a positive battery conductor connected to a positive terminal contact of a battery and a negative battery conductor connected to a negative terminal contact of the battery.

[0009]

A positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery, the battery conductor being soldered to each terminal contact of the battery; A battery assembly device comprising or comprising a battery.

[0010]

A battery having a positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery; and a relay connected to one of the battery conductors of the battery. A battery assembly device comprising or including such a battery and such a relay.

[0011]

A battery having a positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery, and a relay connected to the negative electrode battery conductor, or such a battery and such a relay And a battery assembly device.

[0012]

A battery having a positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery, and a relay connected to the negative electrode battery conductor, or such a battery and such a relay And a battery assembly device.

[0013]

A battery having a positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery; and a battery including a plurality of relays connected to the negative electrode battery conductor, or such a battery. A battery assembly device comprising such a plurality of relays.

[0014]

A battery having a positive electrode battery conductor connected to a positive electrode terminal contact of a battery and a negative electrode battery conductor connected to a negative electrode terminal contact of the battery, and a positive electrode cable connected to the positive electrode battery conductor, or such a battery. A battery assembly device comprising a positive electrode cable.

[0015]

The front perspective view of the battery jump start device in which the clamp is not expanded.

FIG. 2 is a rear perspective view of the battery jump start device shown in FIG. 1.

FIG. 3 is an end perspective view of the battery jump start device shown in FIGS. 1 and 2.

The front perspective view of the battery jump start device (however, the clamp is expanded) shown in FIG.

FIG. 2 is a perspective view of a battery assembly device (when installed in the battery jump start device but the negative electrode cable is not installed yet) housed inside the battery jump start device shown in FIG. 1.

The top view of the battery assembly apparatus shown in FIG.

The front view of the battery assembly apparatus shown in FIG.

The side view of the bending cable connector of the said positive electrode cable The perspective view of the battery assembly apparatus shown in FIG. 5 to which the negative electrode cable is connected.

FIG. 6 is a perspective view of the battery assembly device shown in FIG. 5 in which the diode device is installed on the positive electrode cable.

FIG. 3 is a perspective view of a battery assembly device connected to other components or devices of the battery jump start device.

FIG. 2 is a perspective view of a battery pack device (when installed in a battery jump start device) housed in the battery jump start device shown in FIG. 1.

[0016]

A battery jump starter device 10 is shown in FIGS.

The battery jump start device 10 includes a casing 12 having a display 14 in which a plurality of light emitting diodes (LEDs) 16 are arranged. The battery jump start device 10 further includes a positive electrode cable 18 having a positive electrode clamp 20 and a negative electrode cable 22 having a negative electrode clamp 24. The positive electrode cable 18 and the negative electrode cable 22 pass through the openings 12a and 12b in the casing 12 and are wired to the components (that is, the battery assembly device) located inside as described in detail below.

[0017]

As shown in FIG. 1, the clamps 20 and 24 are stored or fixed in the undeployed state by the clamps 20 and 24 being clamped to the respective side posts 26 extending outward from both ends of the casing 12. .. The side posts 26 are shown in FIG. The clamps 20 and 24 are fixed when the battery jump starter device 10 is not used and are unclamped from the side posts 26 during use.

[0018]

The battery jump start device 10 is configured to jump start an in-vehicle battery. For example, the battery jump start device 10 is a safety protected portable vehicle jump start device disclosed in U.S. Pat. No. 9,0070,15 (incorporated herein by reference in its entirety), or a device similar thereto. It may be.

[0019]

The battery jump start device 10 includes various electric components or parts arranged inside the casing 12. For example, the battery jump start device 10 includes the battery assembly 110 shown in FIGS. 5 to 10 and the internal electric components shown in FIG. 11.

[0020]

As shown in FIGS. 5 to 10, the battery assembly 110 includes a battery 112. The battery 112 is, for example, a rechargeable lithium-ion battery. The battery assembly 110 is configured to maximize electrical conductivity from the battery 112 to the cables 18, 22 and clamps 20, 24 of the battery jump starter device 10. The battery 112 includes a casing, for example, a rectangular casing 112a.

[0021]

The battery assembly 110 further comprises a positive terminal conductor bar 114. The positive electrode terminal conductor bar 114 is connected (for example, soldered) to a positive electrode tab (that is, a contact) of the battery 112 at one end. A

conductor ring 116 is provided at the other end of the positive electrode terminal conductor bar 114. The conductor ring 116 is wound around and connected (for example, crimping and / or soldering) around the exposed conductor end portion 18a of the cable conductor of the positive electrode cable 18.

[0022]

As shown in FIGS. 5 and 6, the positive electrode terminal conductor bar 114 is, for example, L-shaped so as to be wound around the square corner portion of the rectangular casing 112a of the battery 112 (for example, when the battery 112 is viewed in plan). May be

[0023]

As shown in FIG. 6, the L-shaped positive electrode terminal conductor bar 114 extends along one end of the battery 112 and also extends along at least a part of a side portion of the battery 112.

[0024]

The positive terminal conductor bar 114 provides the battery casing 112a with additional structural support and stability (eg, to withstand mechanical shock if the battery jump starter device 10 is accidentally dropped). May be mechanically connected and / or glued to the outer surface of.

For example, the positive terminal conductor bar 114 may be attached to the battery casing 112a by an adhesive (eg, a silicone adhesive), a double-sided tape, a double-sided foam tape, an insulating plastic or ceramic connector with a snap-fit connection, and / or a mechanical fastener. It may be mechanically connected.

[0025]

The positive electrode cable 18 includes a bent cable portion 118 that connects the positive electrode cable 18 to the positive electrode terminal conductor bar 114.

The flex cable portion 118 includes an outer sleeve portion 118 a that connects to the flexible sleeve 120. The flexible sleeve 120 includes an outer sleeve portion 120a located outside the casing 112 of the battery jump starter device 10 and a flexible inner sleeve portion 120b located inside the casing 112 of the battery jump starter device 10. With.

[0026]

The flexible sleeve 120 is configured to reinforce the connection between the positive electrode cable 18 of the battery jump starter device 10 and the casing 12 while maintaining flexibility. For example, the flexible sleeve 120 includes one or more grooves 124 (three in FIG. 3) exposing the outer sleeve 18a of the positive electrode cable 18. The one or more grooves 124 function as hinges to facilitate bending of the positive electrode cable 18 at the location of the flexible outer sleeve portion 120.

[0027]

Flexible sleeve 120 further includes an outer flange 124 spaced from an inner flange 126, which defines a groove 125 with outer flange 124. For example, the outer flange 124 is spaced from the inner flange 126 by a distance equal to the wall thickness of the casing 12. The flanges 124 and 126 are configured to fix the flexible connector 120 together with the positive electrode cable 18 to the casing 12 of the battery jump start device 10. The sleeve portion 128 (FIG. 6) of the flexible connector 120 is connected to both the outer flange 124 and the inner flange 128. For example, the flexible sleeve 120 may be molded separately and assembled onto the positive cable 18, or may be molded to the positive cable 18 to form a single unit. For example, the flexible outer sleeve portion 120 is insert injection molded into a portion of the positive electrode cable 18 that is inserted into the mold during the molding process. Alternatively, the flexible outer sleeve portion 120 is manufactured (eg, molded) separately and then placed or assembled on a portion of the positive electrode cable 18. For example, the positive electrode cable 18 includes an inner conductor (eg, a single-wire conductor made of copper or aluminum, or a multi-strand metal wire conductor) and an outer insulating sleeve 18a (eg, a molded plastic sleeve). Flexible sleeve 120 may be mounted (eg, molded or installed or assembled) on and around outer sleeve 18a of positive electrode cable 18.

[0028]

The battery assembly 110 further includes a negative terminal conductor bar 130. The negative conductor bar 130 is connected (eg, soldered) at one end to a negative terminal tab (or contact) of the battery 112. The other end of the negative electrode terminal conductor bar 130 is provided with a negative electrode terminal conductor bar connecting portion 132, as shown in FIG.

[0029]

The negative terminal conductor bar 130 may be L-shaped so as to be wound around a corner of the rectangular battery 112, as shown in FIG. 6. The L-shaped negative electrode terminal conductor bar 130 extends along the end portion of the battery 112 and also extends along at least a part of the side portion of the battery 112.

[0030]

The negative terminal conductor bar 130 also includes a battery casing 112a to provide additional support and stability (eg, to withstand mechanical shock if the battery jump starter device 10 is accidentally dropped). It may be mechanically connected and / or glued to the outer surface. For example, the negative terminal conductor bar 114 may be mechanically attached to the battery casing 112a by adhesive (eg, silicone adhesive), double-sided tape, double-sided foam tape, insulating plastic or ceramic connector with snap-fit connection, and / or mechanical fasteners. May be connected physically.

[0031]

As shown in FIG. 5, the battery assembly 110 further comprises a smart switch battery interface 134. The smart switch battery interface 134 comprises a circuit board 136 having a first circuit board conductor bar 138. The first circuit board conductor bar 138 is separated from the second board conductor bar 140, and the first circuit board conductor bar 138 and the second circuit board conductor bar 140 are arranged on the circuit board 136 as shown in FIG. Located on one side.

[0032]

The pair of relays 142 is mounted on the opposite side of the circuit board 136. Relay 142 includes a plurality of relay anchor pins 142a that extend through slots 136a in substrate 136 (FIG. 5). The relay 142 further includes a first relay connector pin 142b. The first relay connector pin 142b extends through a plurality of slots arranged on both of the circuit boards 136, and extends through a slot 132a of the negative terminal conductor bar connecting portion 132. The relay 142 further includes a second relay connector pin 142c. The second relay connector pin 142c extends through a plurality of slots arranged in both the circuit board 136 and the window 138a of the first circuit board conductor bar 138, and a slot 132a provided in the first conductor bar 138. Existence A plurality of relay anchor pins 136a are soldered in place to mechanically connect the relay 142 to the substrate 136. The relay connector pins 142b, 142c are soldered in place to mechanically and electrically connect the relay 142 to the circuit board conductor plates 138, 140, respectively.

[0033]

The slot 136a of the circuit board 136 is, for example, rectangular (FIG. 5) and accommodates the rectangular relay anchor pin 142a.

[0034]

Specifically, the base of the relay anchor pin 142a is rectangular and is connected to the end of the square.

The ends of the square are dimensionally narrow compared to a base forming a lateral edge flush with the outer surface of the circuit board 136. When solder is applied to the exposed end of the relay anchor pin 142a, the solder connects both ends of the square end and the lateral edge to attach the relay anchor pin 142a to the circuit board 136. Fix and lock.

[0035]

The slot 132a is provided in the negative terminal conductor bar connector portion 132, and the slot 138a of the first circuit board conductor bar 138 is rectangular. The slot 140a in the second circuit board conductor bar 140 (FIG. 5) is T-shaped and

accommodates three horizontally oriented relay connector pins 142b. The end portion of the relay connector pin 142b is shown flush with the outer surface of the negative electrode terminal conductor bar connector portion 132. When the solder is applied to the exposed end of the relay connector pin 142b, the solder fills the slot 132a in the negative terminal conductor bar connector portion 132 and the slot 138a of the first circuit board conductor bar 138, and the end of the connector pin 142b. Portions are connected to the inner edges of the slots 132a and 138a, and the relay 142 is fixed to the circuit board 136 and the negative terminal conductor bar connector portion 132. Further, the applied solder electrically connects the negative electrode terminal conductor bar connector portion 132 to the first circuit board conductor bar 138.

[0036]

The slot 140a provided in the second circuit board conductor bar 140 is T-shaped, and accommodates three vertically arranged second relay connector pins 142c. As shown in FIG. 9, the second relay connector protrusion 142c extends outward from the outer surface of the circuit board 136 and is connected to the exposed cable end portion 14a of the negative electrode cable 14. When the solder is applied to the end of the second relay connector protrusion 142c, the solder fills the T-shaped slot 140a (FIG. 5) and electrically connects the second relay connector protrusion 140c to the second circuit board conductor bar 140. To do. As shown in FIG. 9, the exposed cable end portion 22a of the negative electrode cable 22 is soldered to the second relay connector protrusion 142c (FIG. 5).

[0037]

The negative electrode terminal conductor bar connector portion 132 of the negative electrode terminal conductor bar 130 is connected (for example, by soldering) to the first circuit board conductor bar 138 of the circuit board 136. Further, as shown in FIG. 9, the exposed cable end 22a of the negative cable 22 (ie, with the insulation sleeve removed) is connected (eg, by soldering) to the second circuit board conductor bar 140. As shown in FIG. 11, the negative electrode cable 22 is attached to the flexible sleeve 118.

[0038]

As an alternative to the configuration of flex cable connector 118 (FIG. 5), diode device 150 is installed (ie, inserted) over flexible cable connector 118, as shown in FIG. The diode device 150 includes a circuit board 152 provided with a set of back-charge diodes 154 arranged on one side of the circuit board 152, and a conductor bar 156 provided on the opposite side of the circuit board 152.

[0039]

(Assembly) As shown in FIG. 11, the battery jump start device 10 includes a casing 12 having an upper casing portion 12a and a lower casing portion 12b. The upper casing portion 12a and the lower casing portion 12b are configured to be connected to each other when the battery jump start device 10 is assembled.

[0040]

The battery jump start device 10 further includes a battery assembly 110 and a controller assembly 210, both of which include the casing 12 when the battery jump start device 10 is assembled, as shown in FIG. Placed inside. The controller assembly 210 comprises a circuit board 212, which is arranged adjacent to another circuit board 214.

[0041]

As shown in FIG. 11, the positive electrode terminal of the battery assembly 110 is connected to the circuit board 212 via the positive electrode power supply line 216. For example, the positive power line 216 is soldered to the positive conductor bar 114 (FIG. 5). The negative terminal of the battery assembly 110 is connected to the circuit board 214 via the negative power line 218.

[0042]

The relay circuit board 136 includes a wire set 220 having a connector 222, as shown in FIG. 11. As shown in FIG. 11, the connector 222 is configured to connect with the relay board connector 224 disposed on the circuit board 212 of the controller assembly 210 during the assembly of the battery jump start device 10.

[0043]

The battery assembly 110 further comprises a wire set 226 having a connector 228, as shown in FIG. The connector 228 is configured to connect to a battery cell charge / measurement connector 230 located on the circuit board 212 of the controller assembly 220.

[0044]

Battery assembly 110 further comprises a battery temperature sensor having a wire set 232 having a connector 234, as shown in FIG. The connector 234 is configured to be connected to a temperature sensor connector 236 arranged on the circuit board 212 of the controller assembly 220.

[0045]

The circuit board 212 includes a charging power resistor 240 and an output relay 242, as shown in FIG. 11. Further, the lower casing part 12 a includes a main user output connector 244 having a wire set 246 connected to the circuit board 214 and a main user input connector 248 having a wire set 250 connected to the circuit board 214.

[0046]

The battery assembly 110 is connected to the battery jump start device 10, as shown in FIG. When assembled, the battery connector device 110 is installed inside the casing 12 of the battery jump start device 10.

Patent Translate
Powered by EPO and Google

Notice

This translation is machine-generated. It cannot be guaranteed that it is intelligible, accurate, complete, reliable or fit for specific purposes. Critical decisions, such as commercially relevant or financial decisions, should not be based on machine-translation output.

CLAIMS JP2018534892

1.

A battery assembly device for a battery jump start device having a smart switch, comprising: a battery having a positive electrode terminal tab and a negative electrode terminal tab; a positive electrode terminal conductor bar connected to the positive electrode terminal tab of the battery; A negative electrode terminal conductor bar connected to the negative electrode terminal tab, a positive electrode cable connected to the positive electrode terminal conductor bar, and a smart switch interface connectable to the smart switch of the jump start device. The interface includes a circuit board, the circuit board includes a first circuit board conductor bar and a second circuit board conductor bar spaced apart from each other on the circuit board, and the smart switch interface includes the negative terminal of the battery. A battery assembly further comprising one or more relays connecting between the first circuit board conductor bar and the second circuit board conductor bar to provide insulation between the tab and the jump-started battery. apparatus.

2.

A battery assembly device for a battery jump start device having a smart switch, comprising: a rectangular battery having a positive electrode terminal tab and a negative electrode terminal tab; a positive electrode terminal conductor bar connected to the positive electrode tab of the battery; A negative electrode terminal conductor bar connected to the negative electrode tab, a positive electrode cable connected to the positive electrode conductor bar by a flexible cable connector, and a smart switch interface connectable to a smart switch of the jump start device, The smart switch battery interface includes a circuit board, the circuit board includes a first circuit board conductor bar and a second circuit board conductor bar spaced apart from each other on the circuit board, and the smart switch battery interface includes a jump. Further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar to provide insulation between the negative tabs of the battery to be started, Battery assembly equipment.

3.

A battery assembly device for a battery jump device having a smart switch, comprising: a rectangular battery having positive electrode terminal tabs and negative electrode terminal tabs respectively located at both ends of the battery; and a battery connected to the negative electrode terminal tab of the battery. The L-shaped positive electrode terminal conductor bar and the L-shaped positive electrode terminal are bent around a corner of the battery and connected to the positive electrode terminal conductor bar extending along at least a part of a side portion of the battery. And a smart switch interface connectable to the smart switch of the jump start device, the smart switch interface includes a circuit board, and the circuit board is spaced apart from each other on the circuit board. A first circuit board conductor bar and a second circuit board conductor bar disposed, wherein the smart switch interface provides the first circuit board to provide insulation between the negative electrode tabs of the battery jump start device. A battery assembly device comprising one or more relays connecting between a conductor bar and the second circuit board conductor bar.

4.

The device according to claim 1, wherein the relays are a plurality of relays that connect the first circuit board conductor bar and the second circuit board conductor bar in parallel.

5.

The apparatus of claim 1, wherein the negative terminal conductor bar mechanically and electrically connects the battery to the smart switch battery interface.

6.

6. The device of claim 5, wherein the smart switch battery interface is located adjacent and above the battery by the negative terminal conductor bar.

7.

The apparatus of claim 1, wherein one end of the positive cable is configured to at least partially wind around an exposed cable conductor end of the positive cable.

8.

The positive electrode terminal conductor bar is ultrasonically welded to the positive electrode terminal tab of the battery, and the negative electrode terminal conductor bar is ultrasonically welded to the negative electrode terminal tab of the battery. apparatus.

9.

The device according to claim 1, wherein the battery is rectangular, the positive electrode terminal conductor bar and the negative electrode terminal conductor bar are L-shaped, and each corner of the battery is wound.

10.

The apparatus of claim 9, wherein a plurality of the battery tabs are mounted flush with a casing of the battery.

11.

The apparatus of claim 1, wherein the positive cable is connected to the positive terminal conductor bar by a flexible cable connector.

12.

The device of claim 11, wherein the flexible cable connector comprises a flexible outer sleeve portion and a flexible inner sleeve portion.

13.

The flexible outer sleeve portion includes an outer flange, the flexible inner sleeve portion includes an inner flange, and the outer flange and the inner flange sandwich a casing wall of the battery jump start device. An apparatus according to claim 12.

14.

12. The device of claim 11, wherein the flexible cable connector comprises an inner serpentine cable section.

15.

The flexible cable connector is configured to accommodate a positive electrode cable arranged so as to be obliquely oriented with respect to a casing wall of the battery jump start device, and the inner meandering cable portion is the casing wall. 15. The device of claim 14, configured to absorb a deviation between an angle relative to the and the attachment angle of the inner serpentine cable portion to the positive terminal conductor bar.

Espacenet

Bibliographic data: WO2016003471 (A1) — 2016-01-07

PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

Inventor(s): NOOK JONATHAN LEWIS [US]; NOOK WILLIAM KNIGHT [US]; STANFIELD JAMES RICHARD [US]; UNDERHILL DEREK MICHAEL [US] ± (NOOK, JONATHAN, LEWIS, ; NOOK, WILLIAM, KNIGHT, ; STANFIELD, JAMES, RICHARD, ; UNDERHILL, DEREK, MICHAEL)

Applicant(s): NOCO COMPANY [US] ± (THE NOCO COMPANY)

Classification: **- international:** ***H02J7/00***
- cooperative: **H02J7/0034 (EP, GB)**; **H02J7/0036 (EP, GB)**; **H02J7/342 (EP, GB)**

Application number: WO2014US45434 20140703 Global Dossier

Priority number(s): WO2014US45434 20140703

Also published as: AU2015258229 (A1) AU2016269555 (A1) AU2016269555 (B2) AU2019201559 (A1) AU2019201559 (B2) more

Abstract of WO2016003471 (A1)

A handheld device for jump starting a vehicle engine includes a rechargeable lithium ion battery pack and a microcontroller. The lithium ion battery is coupled to a power output port of the device through a FET smart switch actuated by the microcontroller. A vehicle battery isolation sensor connected in circuit with positive and negative polarity outputs detects the presence of a vehicle battery connected between the positive and negative polarity outputs. A reverse polarity sensor connected in circuit with the positive and negative polarity outputs detects the polarity of a vehicle battery connected between the positive and negative polarity outputs, such that the microcontroller will

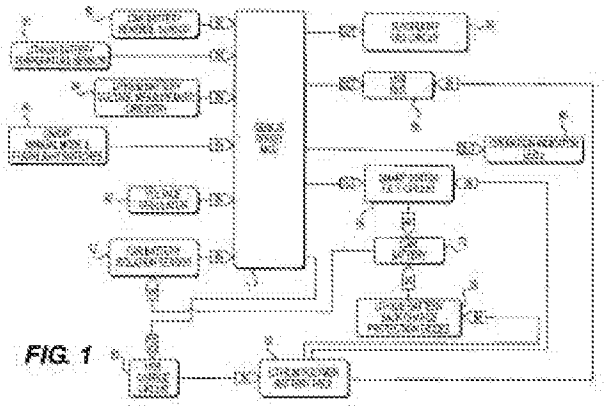


FIG. 1

enable power to be delivered from the lithium ion power pack to the output port only when a good battery is connected to the output port and only when the battery is connected with proper polarity of positive and negative terminals.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 January 2016 (07.01.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/003471 A1

(51) International Patent Classification:
H02J 7/00 (2006.01)

(21) International Application Number:
PCT/US2014/045434

(22) International Filing Date:
3 July 2014 (03.07.2014)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **THE NOCO COMPANY** [US/US]; 30339 Diamond Parkway #102, Glenwillow, OH 44139 (US).

(72) Inventors: **NOOK, Jonathan, Lewis**; 1659 Berkshire Road, Gates Mills, OH 44040 (US). **NOOK, William, Knight**; 2726 Dryden Road, Shaker Heights, OH 44122 (US). **STANFIELD, James, Richard**; 6802 West Banff Lane, Peoria, AZ 85381 (US). **UNDERHILL, Derek, Michael**; 6094 West Trovita Place, Chandler, AZ 85226 (US).

(74) Agent: **DELUCA, Vincent, M.**; Vorys, Sater, Seymour And Pease Llp, 1909 K St., Nw, Ninth Floor, Washington, DC 20006 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

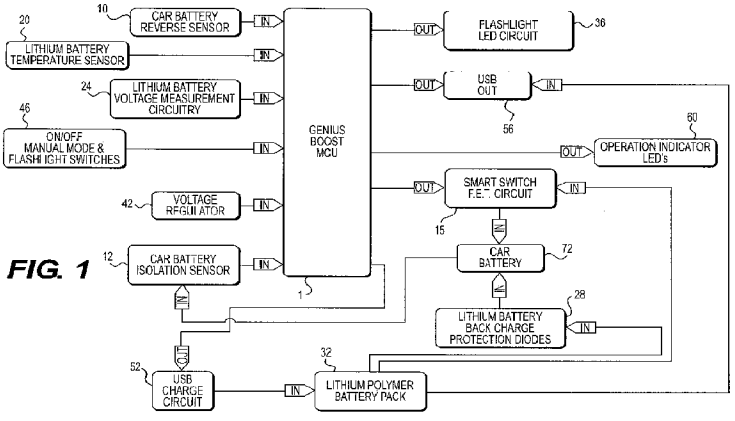


FIG. 1

(57) **Abstract**: A handheld device for jump starting a vehicle engine includes a rechargeable lithium ion battery pack and a microcontroller. The lithium ion battery is coupled to a power output port of the device through a FET smart switch actuated by the microcontroller. A vehicle battery isolation sensor connected in circuit with positive and negative polarity outputs detects the presence of a vehicle battery connected between the positive and negative polarity outputs. A reverse polarity sensor connected in circuit with the positive and negative polarity outputs detects the polarity of a vehicle battery connected between the positive and negative polarity outputs, such that the microcontroller will enable power to be delivered from the lithium ion power pack to the output port only when a good battery is connected to the output port and only when the battery is connected with proper polarity of positive and negative terminals.

WO 2016/003471 A1

PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

BACKGROUND OF THE INVENTION

The present invention relates generally to apparatus for jump-starting a vehicle having a depleted or discharged battery. Prior art devices are known, which provide either a pair of electrical connector cables that connect a fully-charged battery of another vehicle to the engine start circuit of the dead battery vehicle, or portable booster devices which include a fully-charged battery which can be connected in circuit with the vehicle's engine starter through a pair of cables.

Problems with the prior art arose when either the jumper terminals or clamps of the cables were inadvertently brought into contact with each other while the other ends were connected to a charged battery, or when the positive and negative terminals were connected to the opposite polarity terminals in the vehicle to be jumped, thereby causing a short circuit resulting in sparking and potential damage to batteries and/or bodily injury.

Various attempts to eliminate these problems have been made in the prior art. **U.S. Patent No. 6,212,054** issued April 3, 2001, discloses a battery booster pack that is polarity sensitive and can detect proper and improper connections before providing a path for electric current flow. The device uses a set of LEDs connected to optical couplers oriented by a control circuit. The control circuit controls a solenoid assembly controlling the path of power current. The control circuit causes power current to flow through the solenoid assembly only if the points of contact of booster cable clamp connections have been properly made.

U.S. Patent No. 6,632,103 issued October 14, 2003, discloses an adaptive booster cable connected with two pairs of clips, wherein the two pairs of clips are respectively attached to two batteries to transmit power from one battery to the other battery. The adaptive booster cable includes a polarity detecting unit connected to each clip, a switching unit and a current detecting unit both provided between the two pairs of clips. After the polarity of each clip is sensed by the polarity detecting unit, the switching unit generates a proper connection between the two

batteries. Therefore, the positive and negative terminals of the two batteries are correctly connected based on the detected result of the polarity detecting unit.

U.S. Patent No. 8,493,021 issued July 23, 2013, discloses apparatus that monitors the voltage of the battery of a vehicle to be jump started and the current delivered by the jump starter batteries to determine if a proper connection has been established and to provide fault monitoring. Only if the proper polarity is detected can the system operate. The voltage is monitored to determine open circuit, disconnected conductive clamps, shunt cable fault, and solenoid fault conditions. The current through the shunt cable is monitored to determine if there is a battery explosion risk, and for excessive current conditions presenting an overheating condition, which may result in fire. The system includes an internal battery to provide the power to the battery of the vehicle to be jump started. Once the vehicle is started, the unit automatically electrically disconnects from the vehicle's battery.

U.S. Patent No. 5,189,359 issued February 23, 1993, discloses a jumper cable device having two bridge rectifiers for developing a reference voltage, a four-input decoder for determining which terminals are to be connected based on a comparison of the voltage at each of the four terminals to the reference voltage, and a pair of relays for effecting the correct connection depending on the determination of the decoder. No connection will be made unless only one terminal of each battery has a higher voltage than the reference voltage, indicating "positive" terminals, and one has a lower voltage than the reference voltage, indicating "negative" terminals, and that, therefore, the two high voltage terminals may be connected and the two lower voltage terminals may be connected. Current flows once the appropriate relay device is closed. The relay device is preferably a MOSFET combined with a series array of photodiodes that develop MOSFET gate-closing potential when the decoder output causes an LED to light.

U.S. Patent No. 5,795,182 issued August 18, 1998, discloses a polarity independent set of battery jumper cables for jumping a first battery to a second battery. The apparatus includes a relative polarity detector for detecting whether two batteries are configured cross or parallel. A three-position high current capacity crossbar pivot switch is responsive to the relative polarity

detector for automatically connecting the plus terminals of the two batteries together and the minus terminals of the two batteries together regardless of whether the configuration detected is cross or parallel, and an undercurrent detector and a delay circuit for returning the device to its ready and unconnected state after the device has been disconnected from one of the batteries. The crossbar pivot switch includes two pairs of contacts, and a pivot arm that pivots about two separate points to ensure full electrical contact between the pairs of contacts. The invention can also be used to produce a battery charger that may be connected to a battery without regard to the polarity of the battery.

U.S. Patent No. 6,262,492 issued July 17, 2001, discloses a car battery jumper cable for accurately coupling an effective power source to a failed or not charged battery, which includes a relay switching circuit connected to the power source and the battery by two current conductor pairs. First and second voltage polarity recognition circuits are respectively connected to the power source and the battery by a respective voltage conductor pair to recognize the polarity of the power source and the battery. A logic recognition circuit produces a control signal subject to the polarity of the power source and the battery, and a driving circuit controlled by the control signal from the logic recognition circuit drives the relay switching circuit, enabling the two poles of the power source to be accurately coupled to the two poles of the battery.

U.S. Patent No. 5,635,817 issued June 3, 1997, discloses a vehicle battery charging device that includes a control housing having cables including a current limiting device to prevent exceeding of a predetermined maximum charging current of about 40 to 60 amps. The control housing includes a polarity detecting device to verify the correct polarity of the connection of the terminals of the two batteries and to electrically disconnect the two batteries if there is an incorrect polarity.

U.S. Patent No. 8,199,024 issued June 12, 2012, discloses a safety circuit in a low-voltage connecting system that leaves the two low-voltage systems disconnected until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and that it is safe to connect the two low-voltage systems, the safety circuit may connect the two systems by way of a "soft start" that provides a connection between the two

systems over a period of time that reduces or prevents inductive voltage spikes on one or more of the low-voltage systems. When one of the low-voltage systems has a completely-discharged battery incorporated into it, a method is used for detection of proper polarity of the connections between the low-voltage systems. The polarity of the discharged battery is determined by passing one or more test currents through it and determining whether a corresponding voltage rise is observed.

U.S. Patent No. 5,793,185 issued August 11, 1998, discloses a hand-held jump starter having control components and circuits to prevent overcharging and incorrect connection to batteries.

While the prior art attempted solutions to the abovementioned problems as discussed above, each of the prior art solutions suffers from other shortcomings, either in complexity, cost or potential for malfunction. Accordingly, there exists a need in the art for further improvements to vehicle jump start devices.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, apparatus is provided for jump starting a vehicle engine, including: an internal power supply; an output port having positive and negative polarity outputs; a vehicle battery isolation sensor connected in circuit with said positive and negative polarity outputs, configured to detect presence of a vehicle battery connected between said positive and negative polarity outputs; a reverse polarity sensor connected in circuit with said positive and negative polarity outputs, configured to detect polarity of a vehicle battery connected between said positive and negative polarity outputs; a power FET switch connected between said internal power supply and said output port; and a microcontroller configured to receive input signals from said vehicle isolation sensor and said reverse polarity sensor, and to provide an output signal to said power FET switch, such that said power FET switch is turned on to connect said internal power supply to said output port in response to signals from said sensors indicating the presence of a vehicle battery at said output port and proper polarity connection of

positive and negative terminals of said vehicle battery with said positive and negative polarity outputs.

In accordance with another aspect of the invention, the internal power supply is a rechargeable lithium ion battery pack.

In accordance with yet another aspect of the invention, a jumper cable device is provided, having a plug configured to plug into an output port of a handheld battery charger booster device having an internal power supply; a pair of cables integrated with the plug at one respective end thereof; said pair of cables being configured to be separately connected to terminals of a battery at another respective end thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a functional block diagram of a handheld vehicle battery boost apparatus in accordance with one aspect of the present invention;

Figs. 2A – 2C are schematic circuit diagrams of an example embodiment of a handheld vehicle battery boost apparatus in accordance with an aspect of the invention;

Fig. 3 is a perspective view of a handheld jump starter booster device in accordance with one example embodiment of the invention; and

Fig. 4 is a plan view of a jumper cable usable with the handheld jump starter booster device in accordance with another aspect of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a functional block diagram of a handheld battery booster according to one aspect of the invention. At the heart of the handheld battery booster is a lithium polymer battery pack 32, which stores sufficient energy to jump start a vehicle engine served by a conventional 12 volt lead-acid or valve regulated lead-acid battery. In one example embodiment, a high-surge lithium polymer battery pack includes three 3.7V, 2666 mAh lithium polymer batteries in a 3S1P configuration. The resulting battery pack provides 11.1V, 2666Ah (8000Ah at 3.7V, 29.6Wh). Continuous discharge current is 25C (or 200 amps), and burst discharge current is 50C (or 400 amps). The maximum charging current of the battery pack is 8000mA (8 amps).

A programmable microcontroller unit (MCU) 1 receives various inputs and produces informational as well as control outputs. The programmable MCU 1 further provides flexibility to the system by allowing updates in functionality and system parameters, without requiring any change in hardware. According to one example embodiment, an 8 bit microcontroller with 2K x 15 bits of flash memory is used to control the system. One such microcontroller is the HT67F30, which is commercially available from Holtek Semiconductor Inc.

A car battery reverse sensor 10 monitors the polarity of the vehicle battery 72 when the handheld battery booster device is connected to the vehicle's electric system. As explained below, the booster device prevents the lithium battery pack from being connected to the vehicle battery 72 when the terminals of the battery 72 are connected to the wrong terminals of the booster device. A car battery isolation sensor 12 detects whether or not a vehicle battery 72 is connected to the booster device, and prevents the lithium battery pack from being connected to the output terminals of the booster device unless there is a good (e.g. chargeable) battery connected to the output terminals.

A smart switch FET circuit 15 electrically switches the handheld battery booster lithium battery to the vehicle's electric system only when the vehicle battery is determined by the MCU 1 to be present (in response to a detection signal provided by isolation sensor 12) and connected with the correct polarity (in response to a detection signal provided by reverse sensor 10). A lithium battery temperature sensor 20 monitors the temperature of the lithium battery pack 32 to

detect overheating due to high ambient temperature conditions and overextended current draw during jump starting. A lithium battery voltage measurement circuit 24 monitors the voltage of the lithium battery pack 32 to prevent the voltage potential from rising too high during a charging operation and from dropping too low during a discharge operation.

Lithium battery back-charge protection diodes 28 prevent any charge current being delivered to the vehicle battery 72 from flowing back to the lithium battery pack 32 from the vehicle's electrical system. Flashlight LED circuit 36 is provided to furnish a flashlight function for enhancing light under a vehicle's hood in dark conditions, as well as providing SOS and strobe lighting functions for safety purposes when a vehicle may be disabled in a potentially dangerous location. Voltage regulator 42 provides regulation of internal operating voltage for the microcontroller and sensors. On/Off manual mode and flashlight switches 46 allow the user to control power-on for the handheld battery booster device, to control manual override operation if the vehicle has no battery, and to control the flashlight function. The manual button functions only when the booster device is powered on. This button allows the user to jump-start vehicles that have either a missing battery, or the battery voltage is so low that automatic detection by the MCU is not possible. When the user presses and holds the manual override button for a predetermined period time (such as three seconds) to prevent inadvertent actuation of the manual mode, the internal lithium ion battery power is switched to the vehicle battery connect port. The only exception to the manual override is if the car battery is connected in reverse. If the car battery is connected in reverse, the internal lithium battery power shall never be switched to the vehicle battery connect port.

USB charge circuit 52 converts power from any USB charger power source, to charge voltage and current for charging the lithium battery pack 32. USB output 56 provides a USB portable charger for charging smartphones, tablets, and other rechargeable electronic devices. Operation indicator LEDs 60 provide visual indication of lithium battery capacity status as well as an indication of smart switch activation status (indicating that power is being provided to the vehicle's electrical system).

Detailed operation of the handheld booster device will now be described with reference to the schematic diagrams of Figs. 2A-2C. As shown in Fig. 2A, the microcontroller unit 1 is the center of all inputs and outputs. The reverse battery sensor 10 comprises an optically coupled

isolator phototransistor (4N27) connected to the terminals of vehicle battery 72 at input pins 1 and 2 with a diode D8 in the lead conductor of pin 1 (associated with the negative terminal CB-), such that if the battery 72 is connected to the terminals of the booster device with the correct polarity, the optocoupler LED 11 will not conduct current, and is therefore turned off, providing a "1" or high output signal to the MCU 1. The car battery isolation sensor 12 comprises an optically coupled isolator phototransistor (4N27) connected to the terminals of vehicle battery 72 at input pins 1 and 2 with a diode D7 in the lead conductor of pin 1 (associated with the positive terminal CB+), such that if the battery 72 is connected to the terminals of the booster device with the correct polarity, the optocoupler LED 11A will conduct current, and is therefore turned on, providing a "0" or low output signal to the MCU, indicating the presence of a battery across the jumper output terminals of the handheld booster device.

If the car battery 72 is connected to the handheld booster device with reverse polarity, the optocoupler LED 11 of the reverse sensor 10 will conduct current, providing a "0" or low signal to microcontroller unit 1. Further, if no battery is connected to the handheld booster device, the optocoupler LED 11A of the isolation sensor 12 will not conduct current, and is therefore turned off, providing a "1" or high output signal to the MCU, indicating the absence of any battery connected to the handheld booster device. Using these specific inputs, the microcontroller software of MCU 1 can determine when it is safe to turn on the smart switch FET 15, thereby connecting the lithium battery pack to the jumper terminals of the booster device. Consequently, if the car battery 72 either is not connected to the booster device at all, or is connected with reverse polarity, the MCU 1 can keep the smart switch FET 15 from being turned on, thus prevent sparking/short circuiting of the lithium battery pack.

As shown in Fig. 2B, the FET smart switch 15 is driven by an output of the microcontroller 1. The FET smart switch 15 includes three FETs (Q15, Q18, and Q19) in parallel, which spreads the distribution of power from the lithium battery pack over the FETs. When that microcontroller output is driven to a logic low, FETs 16 are all in a high resistance state, therefore not allowing current to flow from the internal lithium battery negative contact 17 to the car battery 72 negative contact. When the micro controller output is driven to a logic high, the FETs 16 (Q15, Q18, and Q19) are in a low resistant state, allowing current to flow freely from the internal lithium battery pack negative

contact 17 (LB-) to the car battery 72 negative contact (CB-). In this way, the microcontroller software controls the connection of the internal lithium battery pack 32 to the vehicle battery 72 for jumpstarting the car engine.

Referring back to Fig. 2A, the internal lithium battery pack voltage can be accurately measured using circuit 24 and one of the analog-to-digital inputs of the microcontroller 1. Circuit 24 is designed to sense when the main 3.3V regulator 42 voltage is on, and to turn on transistor 23 when the voltage of regulator 42 is on. When transistor 23 is conducting, it turns on FET 22, thereby providing positive contact (LB+) of the internal lithium battery a conductive path to voltage divider 21 allowing a lower voltage range to be brought to the microcontroller to be read. Using this input, the microcontroller software can determine if the lithium battery voltage is too low during discharge operation or too high during charge operation, and take appropriate action to prevent damage to electronic components.

Still referring to Fig. 2A, the temperature of the internal lithium battery pack 32 can be accurately measured by two negative temperature coefficient (NTC) devices 20. These are devices that reduce their resistance when their temperature rises. The circuit is a voltage divider that brings the result to two analog-to-digital (A/D) inputs on the microcontroller 1. The microcontroller software can then determine when the internal lithium battery is too hot to allow jumpstarting, adding safety to the design.

The main voltage regulator circuit 42 is designed to convert internal lithium battery voltage to a regulated 3.3 volts that is utilized by the microcontroller 1 as well as by other components of the booster device for internal operating power. Three lithium battery back charge protection diodes 28 (see Fig. 2B) are in place to allow current to flow only from the internal lithium battery pack 32 to the car battery 72, and not from the car battery to the internal lithium battery. In this way, if the car electrical system is charging from its alternator, it cannot back-charge (and thereby damage) the internal lithium battery, providing another level of safety. The main power on switch 46 (Fig. 2A) is a combination that allows for double pole, double throw operation so that with one push, the product can be turned on if it is in the off state, or turned off if it is in the on state. This circuit also uses a microcontroller output 47 to "keep alive" the power when it is activated by the on switch. When the switch is pressed the microcontroller turns this output to a high logic level to keep power on when the switch is

released. In this way, the microcontroller maintains control of when the power is turned off when the on/off switch is activated again or when the lithium battery voltage is getting too low. The microcontroller software also includes a timer that turns the power off after a predefined period of time, (such as, e.g. 8 hours) if not used.

The flashlight LED circuit 45 shown in Fig. 2B controls the operation of flashlight LEDs. Two outputs from the microcontroller 1 are dedicated to two separate LEDs. Thus, the LEDs can be independently software-controlled for strobe and SOS patterns, providing yet another safety feature to the booster device. LED indicators provide the feedback the operator needs to understand what is happening with the product. Four separate LEDs 61 (Fig. 2A) are controlled by corresponding individual outputs of microcontroller 1 to provide indication of the remaining capacity of the internal lithium battery. These LEDs are controlled in a "fuel gauge" type format with 25%, 50%, 75% and 100% (red, red, yellow, green) capacity indications. An LED indicator 63 (Fig. 2B) provides a visual warning to the user when the vehicle battery 72 has been connected in reverse polarity. "Boost" and on/off LEDs 62 provide visual indications when the booster device is provide jump-start power, and when the booster device is turned on, respectively.

A USB output 56 circuit (Fig. 2C) is included to provide a USB output for charging portable electronic devices such as smartphones from the internal lithium battery pack 32. Control circuit 57 from the microcontroller 1 allows the USB Out 56 to be turned on and off by software control to prevent the internal lithium battery getting too low in capacity. The USB output is brought to the outside of the device on a standard USB connector 58, which includes the standard voltage divider required for enabling charge to certain smartphones that require it. The USB charge circuit 52 allows the internal lithium battery pack 32 to be charged using a standard USB charger. This charge input uses a standard micro-USB connector 48 allowing standard cables to be used. The 5V potential provided from standard USB chargers is up-converted to the 12.4VDC voltage required for charging the internal lithium battery pack using a DC-DC converter 49. The DC-DC converter 49 can be turned on and off via circuit 53 by an output from the microcontroller 1.

In this way, the microcontroller software can turn the charge off if the battery voltage is measured to be too high by the A/D input 22. Additional safety is provided for helping to

eliminate overcharge to the internal lithium battery using a lithium battery charge controller 50 that provides charge balance to the internal lithium battery cells 51. This controller also provides safety redundancy for eliminating over discharge of the internal lithium battery.

Fig. 3 is a perspective view of a handheld device 300 in accordance with an exemplary embodiment of the invention. 301 is a power on switch. 302 shows the LED "fuel gauge" indicators 61. 303 shows a 12 volt output port connectable to a cable device 400, described further below. 304 shows a flashlight control switch for activating flashlight LEDs 45. 305 is a USB input port for charging the internal lithium battery, and 306 is a USB output port for providing charge from the lithium battery to other portable devices such as smartphones, tablets, music players, etc. 307 is a "boost on" indicator showing that power is being provided to the 12V output port. 308 is a "reverse" indicator showing that the vehicle battery is improperly connected with respect to polarity. 309 is a "power on" indicator showing that the device is powered up for operation.

Fig. 4 shows a jumper cable device 400 specifically designed for use with the handheld device 300. Device 400 has a plug 401 configured to plug into 12 volt output port 303 of the handheld device 300. A pair of cables 402a and 402b are integrated with the plug 401, and are respectively connected to battery terminal clamps 403a and 403b via ring terminals 404a and 404b. The port 303 and plug 401 may be dimensioned so that the plug 401 will only fit into the port 303 in a specific orientation, thus ensuring that clamp 403a will correspond to positive polarity, and clamp 403b will correspond to negative polarity, as indicated thereon. Additionally, the ring terminals 404a and 404b may be disconnected from the clamps and connected directly to the terminals of a vehicle battery. This feature may be useful, for example, to permanently attach the cables 302a-302b to the battery of a vehicle. In the event that the battery voltage becomes depleted, the handheld booster device 300 could be properly connected to the battery very simply by plugging in the plug 401 to the port 303.

The invention having been thus described, it will be apparent to those skilled in the art that the same may be varied in many ways without departing from the spirit or scope of the invention. Any and all such variations are intended to be encompassed within the scope of the following claims.

WHAT IS CLAIMED IS:

1. Apparatus for jump starting a vehicle engine, comprising:

an internal power supply;

an output port having positive and negative polarity outputs;

a vehicle battery isolation sensor connected in circuit with said positive and negative polarity outputs, configured to detect presence of a vehicle battery connected between said positive and negative polarity outputs;

a reverse polarity sensor connected in circuit with said positive and negative polarity outputs, configured to detect polarity of a vehicle battery connected between said positive and negative polarity outputs;

a power FET switch connected between said internal power supply and said output port; and

a microcontroller configured to receive input signals from said vehicle isolation sensor and said reverse polarity sensor, and to provide an output signal to said power FET switch, such that said power FET switch is turned on to connect said internal power supply to said output port in response to signals from said sensors indicating the presence of a vehicle battery at said output port and proper polarity connection of positive and negative terminals of said vehicle battery with said positive and negative polarity outputs.

2. The apparatus of claim 1, wherein said internal power supply comprises a lithium ion battery.

3. The apparatus of claim 2, wherein said lithium ion battery comprises a battery pack of multiple lithium ion batteries.

4. The apparatus of claim 1, wherein said power FET switch comprises a plurality of FETs in parallel.

5, The apparatus of claim 1, wherein said vehicle isolation sensor and reverse polarity sensor comprise optically coupled isolator phototransistors.

6. The apparatus of claim 1, further comprising a plurality of power diodes coupled between said output port and said internal power supply to prevent back-charging of said internal power supply from an electrical system connected to said output port.

7. The apparatus of claim 1, further comprising a temperature sensor configured to detect temperature of said internal power supply and to provide a temperature signal to said microcontroller.

8. The apparatus of claim 1, further comprising a voltage measurement circuit configured to measure output voltage of said internal power supply and to provide a voltage measurement signal to said microcontroller.

9. The apparatus of claim 1, further comprising a voltage regulator configured to convert output voltage of said internal power supply to a voltage level appropriate to provide operating power to internal components of the apparatus.

10. The apparatus of claim 1, further comprising a USB output port configured to provide charging power from said internal power supply to a USB-chargeable device.

11. The apparatus of claim 1, further comprising a USB charging port configured to provide charging power from an external power source to said internal power supply.

12. The apparatus of claim 1, further comprising a flashlight circuit configured to provide a source of light to a user.

13. The apparatus of claim 12, wherein said source of light is at least one LED.

14. The apparatus of claim 13, wherein said microcontroller is configured to control said at least one LED to provide a visual alarm indicating an emergency situation.

15. The apparatus of claim 1, further comprising a plurality of visual indicators configured to display remaining capacity status of said internal power supply.

16. The apparatus of claim 15, wherein said plurality of visual indicators comprises a plurality of LEDs providing output light of different colors.

17. The apparatus of claim 1, further comprising a visual indicator configured to warn a user when a vehicle battery is connected with reverse polarity.

18. The apparatus of claim 1, further comprising separate visual indicators configured to display the power on status of the apparatus, and the jump start boost power status of power supplied to said output port.

19. The apparatus of claim 1, further comprising a manual override switch configured to activate a manual override mode to enable a user to connect jump start power to said output port when said vehicle battery isolation sensor is unable to detect presence of a vehicle battery.

20. The apparatus of claim 19, wherein said microcontroller is configured to detect actuation of said manual override switch for at least a predetermined period of time before activation of said manual override mode.

21. The apparatus of claim 1, further comprising a jumper cable device including a plug configured to plug into said output port, a pair of cables integrated with the plug at one respective end thereof and being configured to be connected to terminals of a battery at another respective end thereof.

22. The apparatus of claim 21, wherein said jumper cable device further comprises a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp.

23. The apparatus of claim 21, wherein said output port and said plug are dimensioned so that the plug will fit into the output port only in one specific orientation.

24. A jumper cable device, comprising:

a plug configured to plug into an output port of a handheld battery charger booster device having an internal power supply;

a pair of cables integrated with the plug at one respective end thereof;

said pair of cables being configured to be separately connected to terminals of a battery at another respective end thereof.

25. The jumper cable device of claim 24, further comprising a pair of ring terminals configured to respectively connect said pair of cables at said another end thereof with one of a battery terminal, or a battery terminal clamp.

26. The jumper cable device of claim 24, wherein said output port and said plug are dimensioned so that the plug will fit into the output port only in one specific orientation.

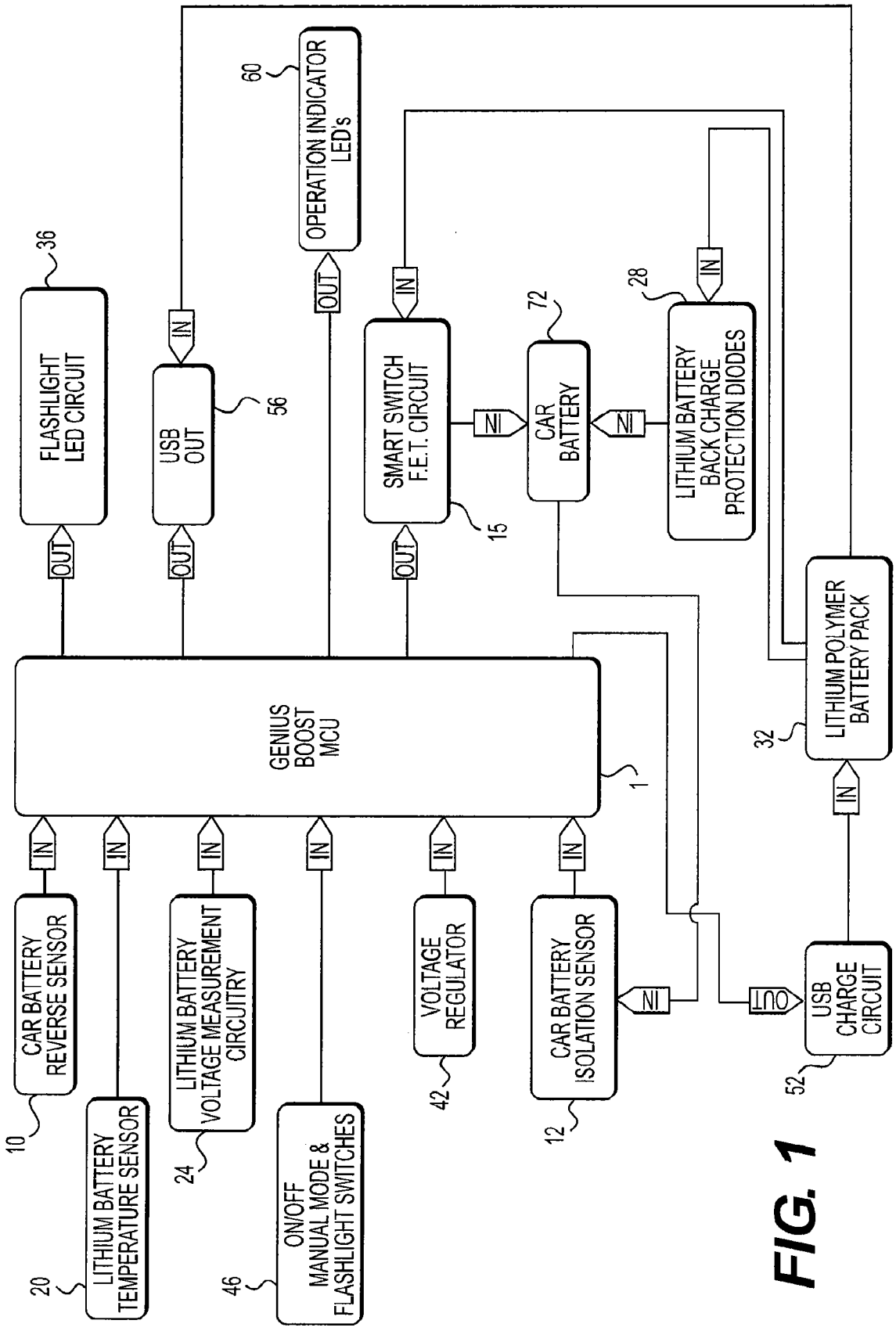

GENIUS BOOST MCU
1
FLASHLIGHT LED CIRCUIT
36
USB OUT
56
OPERATION INDICATOR LED's
60
SMART SWITCH F.E.T. CIRCUIT
15
CAR BATTERY
72
LITHIUM BATTERY BACK CHARGE PROTECTION DIODES
28
LITHIUM POLYMER BATTERY PACK
32
USB CHARGE CIRCUIT
52
CAR BATTERY ISOLATION SENSOR
12
VOLTAGE REGULATOR
42
LITHIUM BATTERY VOLTAGE MEASUREMENT CIRCUITRY
24
CAR BATTERY REVERSE SENSOR
10
LITHIUM BATTERY TEMPERATURE SENSOR
20
ON/OFF MANUAL MODE & FLASHLIGHT SWITCHES
46
IN
OUT
NI
NO

FIG. 1

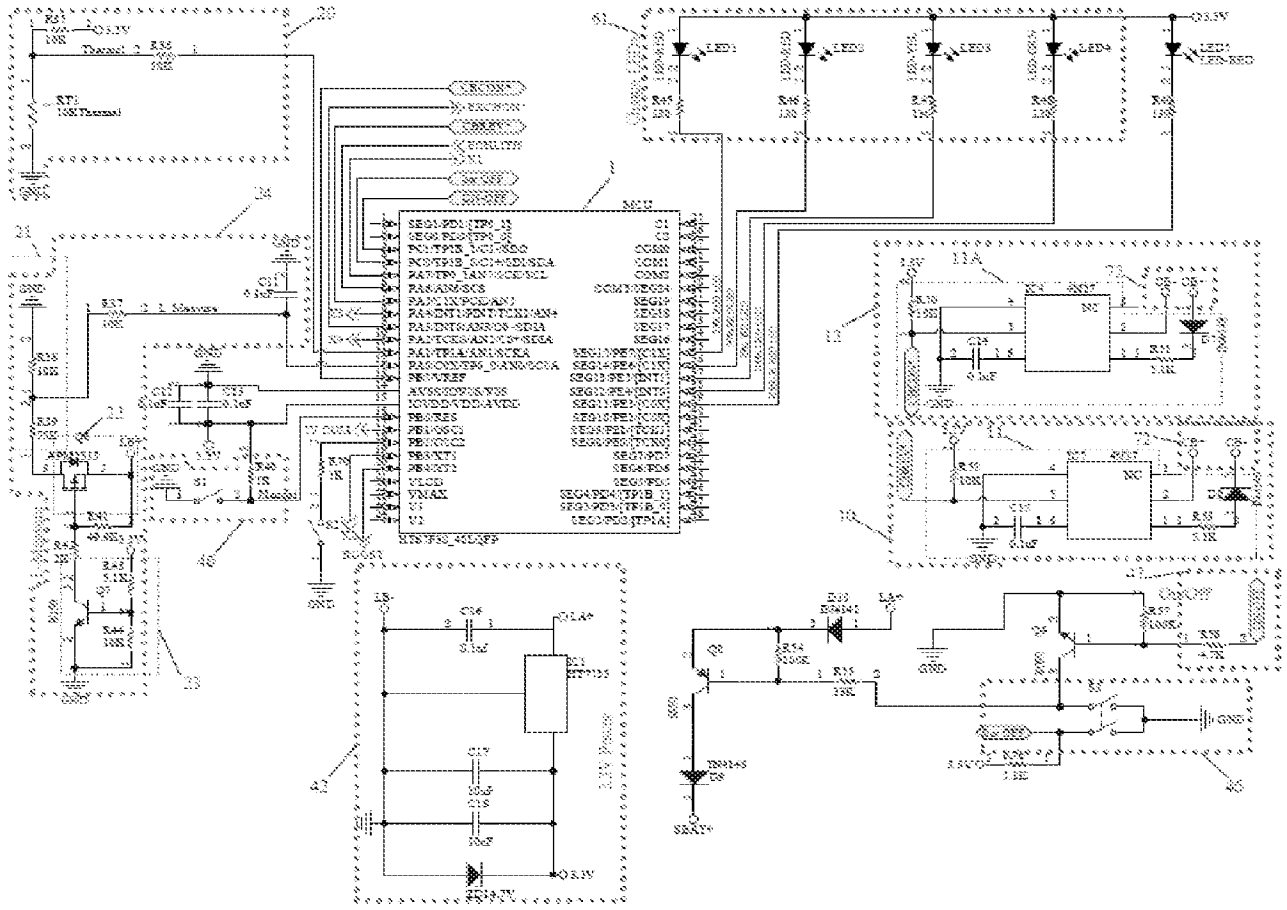


FIG. 2A

WINPLUS Ex. 1003, p. 1192

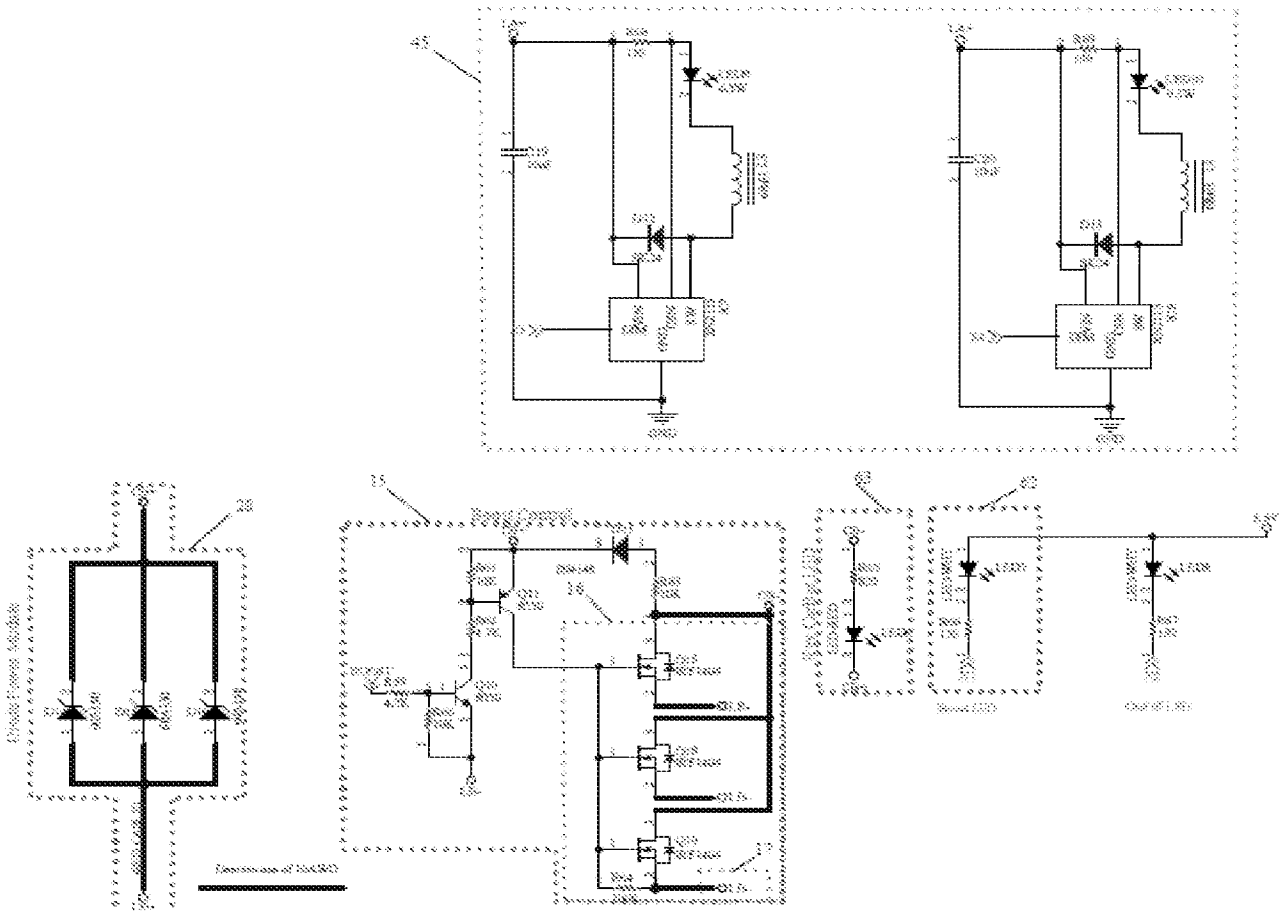


FIG. 2B

WINPLUS Ex. 1003, p. 1193

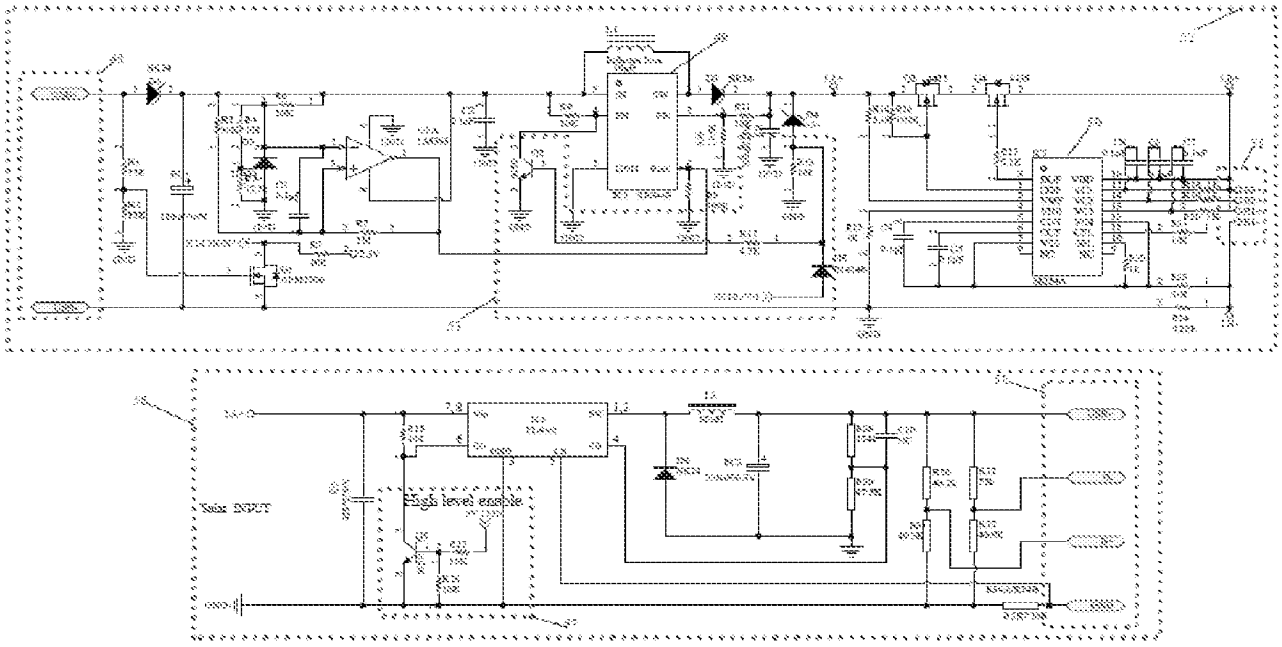


FIG. 2C

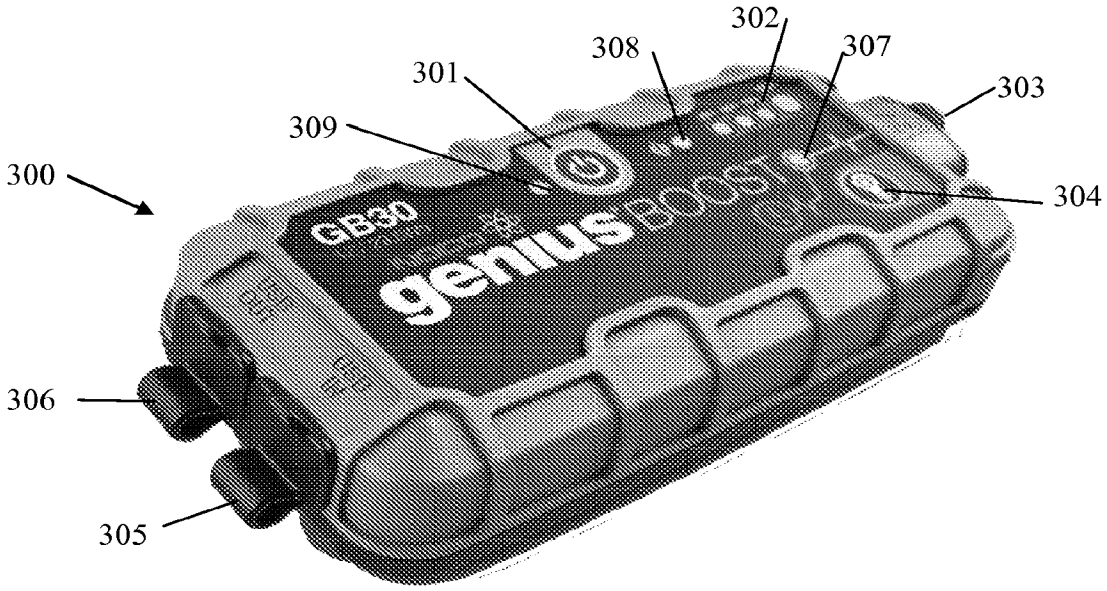


FIG. 3

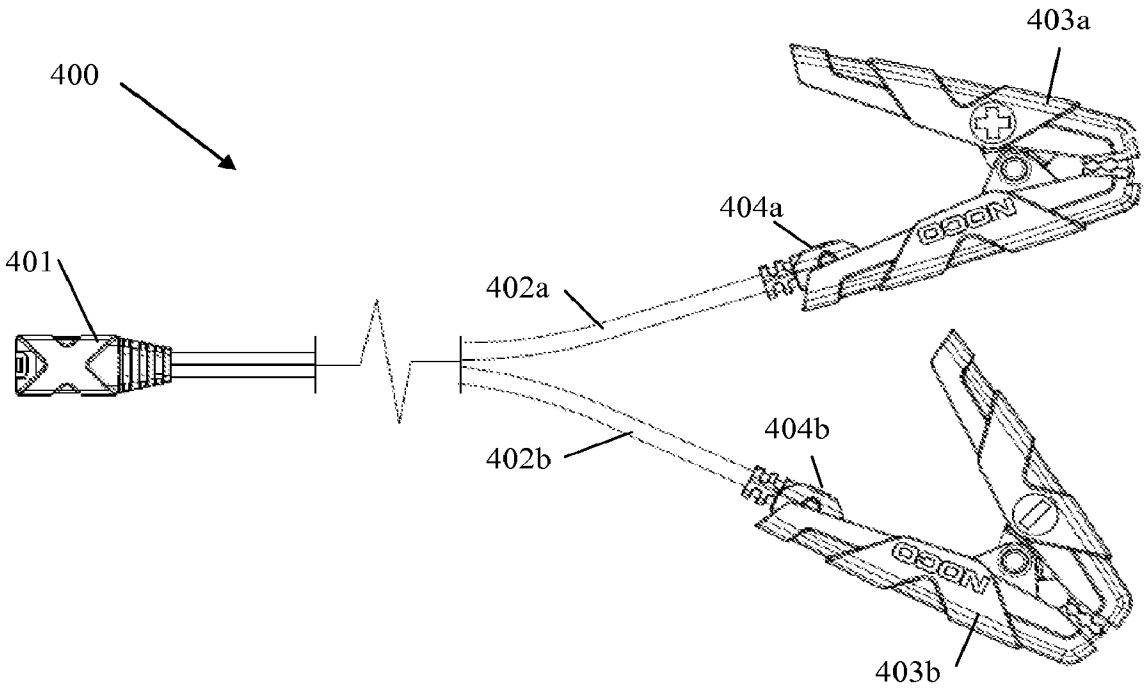


FIG. 4

WINPLUS Ex. 1003, p. 1195

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/045434

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/00 (2014.01)
CPC - H02J7/0034 (2014.09)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - B60R-016/03, B60R-016/04, F02N-11/08, H02J 7/00 (2014.01)
USPC -307/150, 320/105, 307/127, 340/636.1, 340/636.150, 361/82, 320/103

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - H02J7/0063, H02J7/0034, H02J 2001/006 (2014.09)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2005/0110467 A1 (THOMASON) 26 May 2005 (26.05.2005) entire document	1, 4-6,8-9, 12-18, 22, 25 --------- 2, 3, 7, 10, 11, 19, 20, 21, 23, 24, 26
Y	WO 2013/137873 A1 (DAO) 19 September 2013 (19.09.2013) entire document	2-3, 10-11
Y	US 6362599 B1 (TURNER et al.) 26 March 2002 (26.03.2002) entire document	7, 19-20
Y	US 7148580 B2 (SODEMANN et al.) 12 December 2006 (12.12.2006) entire document	21,23,24,26
A	US 6803743 B2 (GEORGE et al.) 12 October 2004 (12.10.2004) entire document	1-26

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 October 2014	03 NOV 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

Espacenet

Bibliographic data: WO2017139524 (A1) — 2017-08-17

BATTERY CONNECTOR DEVICE FOR A BATTERY JUMP STARTING DEVICE

Inventor(s): NOOK JONATHAN LEWIS [US]; NOOK WILLIAM KNIGHT [US]; STANFIELD JAMES RICHARD [US]; UNDERHILL DEREK MICHAEL [US] ± (NOOK, Jonathan Lewis, ; NOOK, William Knight, ; STANFIELD, James Richard, ; UNDERHILL, Derek Michael)

Applicant(s): NOCO CO [US] ± (THE NOCO COMPANY)

Classification: - international: ***F02N11/12; F02N11/14; F02N19/00; H02J7/00; H02J7/32***
- cooperative: **F02N11/12 (EP, GB); F02N11/14 (GB); F02N19/00 (GB); H01M2/30 (EP); H02J1/122 (EP); H02J7/00 (GB); H02J7/0032 (GB);** F02N11/087 (EP); F02N11/14 (EP)

Application number: WO2017US17289 20170210 Global Dossier

Priority number(s): US201662294067P 20160211 ; WO2016US24680 20160329 ; US201615137626 20160329 ; US201662424297P 20161118

Also published as: AU2017217661 (A1) AU2017217661 (B2) AU2019201081 (A1) CA3005971 (A1) CN108884801 (A) more

Abstract of WO2017139524 (A1)

An enhanced conductivity battery connector device for use in a battery jump starting device. The enhance conductivity battery connector providing enhanced conductivity from the battery to a battery being recharged by the battery jump starting device.

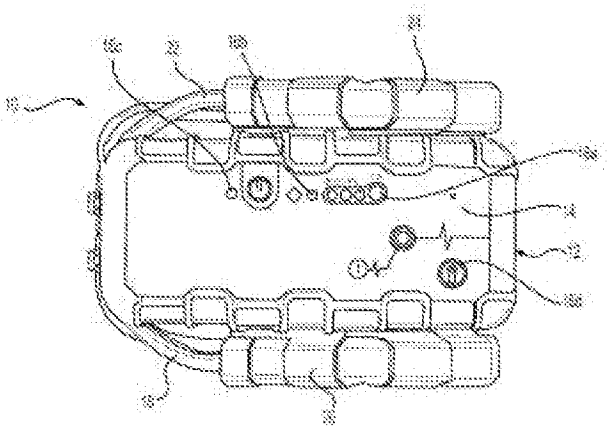


FIG. 1

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 August 2017 (17.08.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/139524 A1

(51) International Patent Classification:
F02N 11/12 (2006.01) *H02J 7/00* (2006.01)
F02N 11/14 (2006.01) *H02J 7/32* (2006.01)
F02N 19/00 (2010.01)

(21) International Application Number:
PCT/US2017/017289

(22) International Filing Date:
10 February 2017 (10.02.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/294,067 11 February 2016 (11.02.2016) US
PCT/US2016/024680 29 March 2016 (29.03.2016) US
15/137,626 25 April 2016 (25.04.2016) US
62/424,297 18 November 2016 (18.11.2016) US

(71) Applicant: **THE NOCO COMPANY** [US/US]; 30339 Diamond Parkway, #102, Glenwillow, OH 44139 (US).

(72) Inventors: **NOOK, Jonathan Lewis**; c/o The Noco Company, 30339 Diamond Parkway, #102, Glenwillow, Ohio 44139 (US). **NOOK, William Knight**; c/o The Noco Company, 30339 Diamond Parkway, #102, Glenwillow, Ohio 44139 (US). **STANFIELD, James Richard**; c/o The Noco Company, 30339 Diamond Parkway, #102, Glenwillow, Ohio 44139 (US). **UNDERHILL, Derek Michael**; c/o The Noco Company, 30339 Diamond Parkway, #102, Glenwillow, Ohio 44139 (US).

(74) Agents: **KLIMA, William L.** et al.; Vorys, Sater, Seymour and Pease LLP, 1909 K Street, N.W., 9th Floor, Washington, District of Columbia 20006 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

[Continued on next page]

(54) Title: BATTERY CONNECTOR DEVICE FOR A BATTERY JUMP STARTING DEVICE

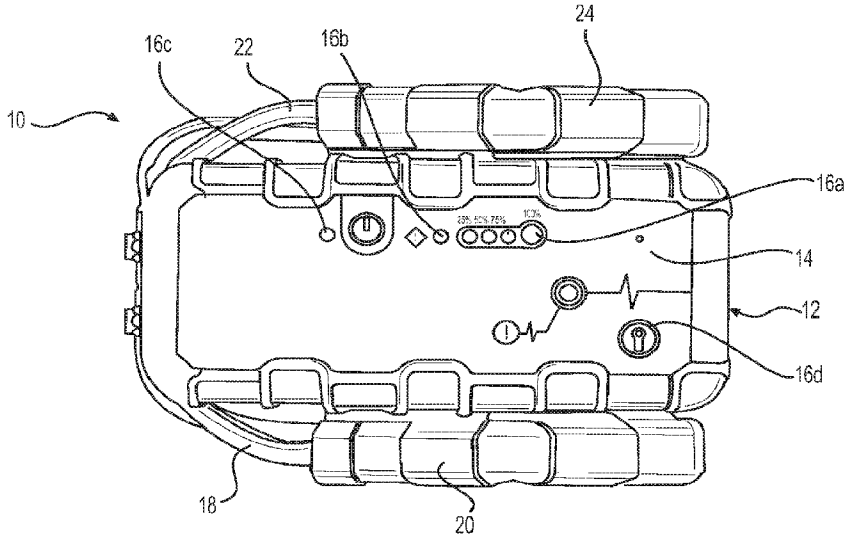


FIG. 1

(57) Abstract: An enhanced conductivity battery connector device for use in a battery jump starting device. The enhance conductivity battery connector providing enhanced conductivity from the battery to a battery being recharged by the battery jump starting device.

WO 2017/139524 A1

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

TITLE

BATTERY CONNECTOR DEVICE FOR A BATTERY JUMP STARTING DEVICE

FIELD

A portable battery connector device, for example, a battery connector arrangement or assembly for a battery jump starting device, in particular a portable vehicle jump starting apparatus, configured for enhancing the conductivity between the battery of the jump starting apparatus and a battery being charged.

BACKGROUND

The exists a portable vehicle battery jump start apparatus as disclosed in U.S. Patent No. 9,007,015 to Nook et al. The apparatus utilizes a lithium ion battery pack. In this type of apparatus, there exists a need to maximize conductivity from the battery pack to the vehicle battery of the vehicle being jump started.

For successful car jump-starts, there are two main factors dictating the results. The first factor is the amount of power provided by the lithium ion battery pack, and the second factor is the maximum conductivity. You need both factors to have the best chance to jump-start big engines. One factor without the other factor is not enough.

SUMMARY

The presently described subject matter is directed to a battery device, for example, a battery connector, battery connector arrangement, or battery conductor assembly for use in a device for jump starting a vehicle, and a device for jump starting a vehicle comprising the battery connector device.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having at least one battery conductor connected to a terminal of the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having at least one battery conductor or cable connected to a battery tab of the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor and a negative conductor connected to the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor plate and/or a negative conductor plate connected to the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive conductor plate and/or a negative conductor plate connected to the battery, and a positive cable connected to the positive conductor plate and/or a negative cable connected to the negative conductor plate.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal of the battery and/or a negative battery conductor connected to a negative terminal of the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, the battery conductors being soldered to the respective terminals of the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to one of the battery conductors of the battery.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to

a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and multiple relays connected to the negative battery conductor.

The presently described subject matter is directed to a battery connector device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and/or a negative battery conductor connected to a negative terminal contact of the battery, and a positive cable connected to the positive battery conductor.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front view of the battery jump starting device with the clamps un-deployed.

FIG. 2 is a rear perspective view of the battery jump starting device shown in FIG. 1.

FIG. 3 is an end perspective view of the battery jump starting device shown in FIGS. 1 and 2.

FIG. 4 is a front perspective view of the battery jump starting device shown in FIG. 1, however, with the clamps deployed.

WINPLUS Ex. 1003, p. 1203

FIG. 5 is a front perspective view of a battery connector device contained within the battery jump starting device shown in FIG. 1, however, with the negative cable not yet installed.

FIG. 6 is a top planer view of the battery connector device shown in FIG. 5.

FIG. 7 is a side elevational view of the battery connector device shown in FIG. 5.

FIG. 8 is an end elevational view of the battery connector device shown in FIG. 5.

FIG. 9 is a perspective view of the battery connector device shown in FIG. 5, however, with the negative cable connected to the battery connector device.

FIG. 10 is a view perspective view of the battery connector device shown in FIG. 5, however, with a diode connector installed on the positive cable.

FIG. 11 is a perspective view of the battery connector device connected to other components or parts of the battery jump starting device.

FIG. 12 is a perspective view of the battery assembly of the battery connector device shown in FIG. 5.

FIG. 13 is a front perspective view of another battery connector device for the battery jump starting device.

FIG. 14 is a detailed view of the positive cable connection with the relay printed circuit board prior to being soldered thereto.

FIG. 15 is a detailed view of the positive cable connection with the relay printed circuit board after being soldered thereto.

FIG. 16 is a front perspective view of the battery assembly of the battery connector device shown in FIG. 13.

FIG. 17 is a partial top planar view of the battery assembly shown in FIG. 16, however, with the positive terminal conductor sheet in an unwound condition.

FIG. 18 is a partial top planer view of the positive terminal conductor of the battery assembly shown in FIG. 16.

FIG. 19 is an end perspective view of the positive terminal conductor partially wound around the end of the positive cable.

FIG. 20 is an end perspective view of the positive terminal conductor fully wound around the end of the positive cable.

FIG. 21 is a side perspective view of the positive terminal conductor fully wound around and soldered to the end of the positive cable.

FIG. 22 is an opposite end perspective view of the positive terminal conductor fully wound around and soldered to the end of the positive cable.

FIG. 23 is a perspective view of the diode connector between sections of the positive cable.

FIG. 24 is a perspective view of a Schottky Diode used in the diode connector.

FIG. 25 is a perspective view of the diode connector insulated with a shrink wrap sleeve.

FIG. 27 is a graphical illustration showing a load test of the battery connection shown in FIGS. 5-10.

FIG. 28 is a graphical illustration showing a load test of the battery connection shown in FIGS. 13-25.

FIG. 29 is a front view of a further battery connector device for the battery jump starting device.

FIG. 30 is a front view of the battery connector device comprising a plurality of battery cells, separate tab, and conductors (e.g. plate conductors) prior to assembly.

FIG. 31 is a front view of the battery connector device comprising battery cells being prepared with separate tabs for lengthening the tabs.

FIG. 32 is a front view of the battery connector device comprising the plurality of battery cells, separate tab, and conductors shown in FIG. 30, after assembly.

FIG. 33 is a perspective view showing the battery connector device comprising the battery cell assembly shown in FIG. 32, after folding the battery cells.

FIG. 34 is an end perspective view of the battery connector device showing the separate tab being wrapped or wound around an exposed end of the positive cable, and soldered together.

FIG. 35 is an opposite end perspective view of the battery connector device showing a negative battery tab wrapped around the negative terminal conductor plate and welded and/or soldered together.

FIG. 36 is a perspective view of the battery connector device showing the flat separate tab connected to the battery and extending outwardly prior to connection to the positive cable.

FIG. 37 is a side view of the temperature sensor assembly with wires and connector.

FIG. 38 is a perspective view of the diode circuit board assembled connected inline or spliced into the positive cable.

DETAILED DESCRIPTION

A battery jump starter device 10 is shown in FIGS. 1 and 2. The battery jump starting device 10 comprises a casing 12 having a display 14 provided with an arrangement of light emitting diodes (LEDs) 16.

The battery jump starting device 10 further comprises a positive cable 18 having a positive clamp 20 and a negative cable 22 having a negative clamp 24. The positive cable 18 and negative cable 22 pass through openings 12a, 12b, respectively, in the casing 12.

The clamps 20, 24 are stowed away or docked in an un-deployed mode by clamping each to a respective side posts 26 extending outwardly on opposite sides of the casing 12, as shown in FIG. 1. The side posts 26 are shown in FIG. 2. The clamps 20, 24 are docked when the battery jump starter device 10 is in non-use, and then unclamped from the side post 26 during use.

The battery jump starting device 10 is configured to jump start a vehicle battery. For example, the battery jump starting device 10 can be the PORTABLE VEHICLE JUMP START APPARATUS WITH SAFETY PROTECTION disclosed in U.S. Patent No. 9,007,015, which is fully incorporated herein by reference, or a device or apparatus similar thereto.

The battery jump starting device 10 comprises electrical components or parts located inside the casing 12. For example, the battery jump starting device 10 comprises a battery connector device 100 shown in FIGS. 3 - 9.

The battery connector device 100 comprises a battery assembly 110 having a battery 112. For example, the battery 112 is a lithium ion rechargeable type battery. The

battery connector device 100 is configured to maximize conductivity from the battery 112 to the cables 18, 22 and clamps 20, 24 of the battery jump starter device 10. The battery 112 comprises a battery casing 112a, for example, a rectangular-shaped battery casing 112a.

The battery 112 comprises a positive tab at one end (e.g. width) of the battery 112, and a negative terminal tab at an opposite end (e.g. width) of the battery 112. For example, the battery 112 comprises one or more battery cells each having a positive and negative tab. For example, the positive tab from one battery cell is located at the one end of the battery 112 and the negative tab from one battery cell is located at the opposite end of the battery 112. A positive terminal conductor plate 114 is connected (e.g. soldered, welded, or sonically welded) at the one end of the battery 112 to the positive tab (i.e. contact) of the battery 112. The positive terminal conductor plate 114 extends along the one end (e.g. width) of the battery 112.

The positive cable 18 can be connected (e.g. directly connected by soldering) to the positive terminal conductor plate 114 and/or the positive tab of the battery 112. For example, the positive terminal conductor bar 114 can be provided with a conductive loop 116 wrapping around (e.g. entirely wrapping around) and connected (e.g. crimped and/or soldered) to an exposed end 18a of the positive cable 18. For example, the positive terminal conductor plate 114 is made from heavy gauge copper sheet (e.g. machined, cut, or stamped therefrom).

As shown in FIGS. 5 and 6, the positive terminal conductor sheet 114 can be configured (e.g. bent) to wrap around one of the square-shaped corners of the rectangular-shaped casing 112a of the battery 112 (e.g. L-shaped). The L-shaped

positive terminal conductor sheet 114 can extend along an end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIG. 5.

The positive terminal conductor plate 114 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional support and stability thereof (e.g. assembled to survive mechanical shock when drop testing the battery jump starter device 10). For example, the positive terminal conductor bar 114 can be mechanically connected to the battery casing 112 by adhesive (e.g. silicon adhesive), double sided tape, double sided foam tape, insulated plastic or ceramic connector with snap fit connection and/or adhesive connection, and/or the battery casing 112 can be formed (e.g. molded) to mechanically connect (e.g. snap fit or interference connection) with the positive terminal conductor plate 114.

The positive cable 18 can be a single piece of wire or a cable (e.g. twisted or braided wires) extending from the battery 110 to the positive clamp 20. Specifically, one end of the positive cable 18 is connected to the positive terminal conductor plate 114 connected to the battery 18, and the opposite end of the positive cable 18 is connected to the positive clamp 20.

More specifically, the positive cable 18 can comprise a flexible or bent cable portion 118 for changing the direction of the positive cable 18 within the casing 12. The positive cable 18 can be fitted with a flexible outer sleeve portion 120 transitioning into a flexible inner sleeve portion 122 to flexibly accommodate the positive cable 18 passing through the casing 12. The flexible outer sleeve portion 120 is externally located relative to the casing 12 of the battery jump starter device 10, and the flexible inner sleeve

portion 122 is internally located relative to the casing 12 of the battery jump starter device 10.

The flexible outer sleeve portion 120 is configured to reinforce the connection between the positive cable 18 and the casing 12 of the battery jump starter device while remaining flexible. For example, the flexible outer sleeve portion 120 is provided with one or more grooves 124 (e.g. three (3) shown in FIG. 5) exposing portions of the positive cable 18. The one or more grooves 124 act as hinges to ease bending of the positive cable 18 within the flexible outer sleeve portion 120.

The flexible sleeve 120 comprises an outer flange 124 spaced apart (e.g. a small distance equal to about a wall thickness of the casing 12 of the battery jump starter device 10) from an in inner flange 126. The flanges 124, 126 further anchor the positive cable 18 to the casing 12 of the battery jump starter device 10.

The flexible sleeve 120 comprises a sleeve portion 128 (FIG. 6) connecting together the outer flange 124 and inner flange 126. For example, the flexible outer sleeve portion 120 is molded or applied onto and around the positive cable 18 as a single unit (e.g. the flexible sleeve 120 is molded onto a portion of the positive cable 18 inserted within the mold during the molding process). Alternatively, the flexible sleeve 120 is made (e.g. molded) separately, and then installed or assembled onto a portion of the positive cable 18.

The positive cable 18 comprises an inner conductor 18b (e.g. single wire conductor, twisted wires, or braided wires) disposed within an outer insulating sheath 18c (e.g. extruded plastic sheath). The inner conductor 18b, for example, can be a solid wire conductor or a multi strand metal wire conductor comprising bundle of wires 18d.

The inner wire can be made of copper or aluminum. The flexible sleeve 120 can be applied (e.g. molded or installed or assembled) onto and surrounding the outer insulating sheath 18c of the positive cable 18.

The battery connector device 100 further comprises a negative terminal conductor plate 130 connected (e.g. soldered, welded, or sonically welded) at an opposite end of the battery 112 to the negative tab (i.e. contact) of the battery 112. The negative terminal conductor plate 130 can extend along the opposite end of the battery 112.

The other end of the negative terminal conductor plate 130 is provided with a negative terminal conductor plate connector portion 132, as shown in FIGS. 5 and 6.

The negative terminal conductor plate 130 can be configured to wrap around one of the corners of the rectangular-shaped battery 112 (e.g. L-shaped). The L-shaped negative terminal conductor plate 130 can extend along an end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIGS. 5 and 6.

The negative terminal conductor bar 130 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional support and stability thereof (e.g. to survive mechanical shock when drop testing the battery jump starter device 10). For example, the negative terminal conductor bar 114 can be mechanically connected to the battery casing 112a by adhesive (e.g. silicon adhesive), double sided tape, double sided foam tape, insulating plastic or ceramic connector with snap fit connection and/or adhesive connection, and/or the battery casing 112 can be formed (e.g. molded) to mechanically connect (e.g. snap fit or interference connection) with the positive terminal conductor plate 114.

The battery connector device 100 further comprises a smart switch battery interface 134. The smart switch battery interface 134 comprises a relay printed circuit board (PCB) 136 having a first circuit board conductor bar 138 spaced apart from a second circuit board conductor bar 140 located on one side of the circuit board 136, as shown in FIGS. 5 and 6.

A pair of relays 142 are mounted on an opposite side of the circuit board 136. The relays 142 include relay anchoring pins 142a located in through holes 136a in the relay printed circuit board 136 (FIGS. 5 and 7). The relays 142 further comprise relay connector pins 142b extending through the through holes 136b provided in the circuit board 136 and slots 138a provided in the first conductor bar 138. The relays 142 even further comprise relay connector pins 142c located in the through holes 136c provided in the circuit board 136 and through holes 140a provided in the second conductor bar 140. The relay anchoring pins 136a are soldered in place to mechanically connect the relays 142 to the circuit board 136. The relay connecting pins 142b and 142c are soldered in place to mechanically and electrically connect the relays 142, respectively, to the circuit board conductor plates 138, 140.

The through holes 136a in the circuit board 136 are rectangular-shaped (FIGS. 5 and 7) and accommodate the relay anchoring pins 142a. Specifically, a base portion of the relay anchoring pins 142a are rectangular-shaped with square-shaped ends. The square-shaped ends are dimensionally less wide verses the base portions creating transverse edges oriented flush with the outer surface of the circuit board 136. When solder is applied to the exposed ends of the relay anchoring pins 142a, the solder

connects to the sides of the square-shaped ends and transverse edges to anchor and lock the relay anchoring pins to the circuit board 136.

The slots 132a provided in negative terminal conductor bar connector portion 132 are rectangular-shaped and the through holes138a in the first circuit board conductor bar 138 (FIG. 3) are T-shaped to accommodate the three (3) horizontally oriented relay connector pins 142b, as shown in FIG. 3. The ends of the relay connector pins 142b are shown flush with the outer surface of the negative terminal conductor bar connector portion 132. When solder is applied to the exposed ends of the relay connector pins 142b, the solder fills in the slots 132a in the negative terminal conductor bar connector portion 132 and the through holes 138a of the first circuit board conductor bar 138, and connects the sides of the connector pins 142b with inner edges of the slots 132a and through holes 138a to anchoring the relays 142 to the circuit board 136 and negative terminal conductor bar connector portion 132. This applied solder also electrically connects the negative terminal conductor bar connector portion 132 to the first circuit board conductor bar 138.

The through holes 140a provided in the second circuit board conductor bar 140 are T-shaped to accommodate the three (3) vertically oriented relay connecting pins 142c, as shown in FIG. 3. The relay connector prongs 140a extend outwardly from the outer surface of the circuit board 136 to connect with the exposed conductor end 144a of the negative cable 144, and shown in FIG. 7. When solder is applied to the exposed conductor end 144a and the ends of the relay connector prongs 140a, the solder fills in the T-shaped slot and electrically connects the relay connector prongs 140a, second

circuit board conductor 140, and exposed conductor end 144a of the negative cable 144.

The negative terminal conductor bar connector portion 132 of the negative terminal conductor bar 130 is connected (e.g. by soldering) to the first circuit board conductor bar 138 of the circuit board 136. The exposed conductor end 22a (i.e. with the insulating sheath removed) of the negative cable 22 is connected (e.g. by soldering) to the second circuit board conductor bar 140, as shown in FIG. 9.

The battery connector device 100 can be modified by providing the positive cable 18 with a diode connection 150, as shown in FIG. 10. For example, a diode connection is installed (e.g. spliced) into the positive cable 18. The diode connection 150 comprises a diode printed circuit board (PCB) 152 provided with a set of back-charge diodes 154 (e.g. Schottky Diodes) located on one side thereof, and a conductor bar 156 provided on an opposite side of the circuit board 152.

ASSEMBLY

The battery jump starting device 10 comprises the casing 12 having an upper casing portion 12a and a lower casing portion 12b, as shown in FIG. 11. The upper casing portion 12a and the lower casing portion 12b are configured to be connected together when assembling the battery jump starting device 10.

The battery jump starting device 10 further comprises the battery connection device 100 and controller assembly 210 both disposed within the casing 12. The

controller assembly 210 comprises a circuit board 212 located adjacent to another circuit board 214.

The positive terminal of the battery assembly 110 (FIG. 12) is connected to the circuit board 212 via a positive power wire 216. For example, the positive power wire 216 is soldered to the positive conductor bar 114 (FIG. 5). The negative terminal of the battery assembly 110 is connected to the circuit board 214 via a negative power wire 218.

The relay circuit board 136 is provided with a wire set 220 having a connector 222. The connector 222 is configured to connect with the relay board connector 224 located on the circuit board 212 of the controller assembly 210 during assembly of the battery jump starting device 10.

The battery assembly 110 further comprises a wire set 226 having a connector 228. The connector 228 is configured to connect with the battery cell charging/monitoring connector 230 located on the circuit board 212 of the controller assembly 220.

The battery assembly 110 also comprises a battery temperature sensor having a wire set 232 having a connector 234. The connector 234 is configured to connect with the temperature sensor connector 236 located on the circuit board 212 of the controller assembly 220.

The circuit board 212 is provided with in charge power resistors 240 and an out relay 242, as shown in FIG. 11. Further, the lower casing portion 12a is provided with a main user out connector 244 having a wire set 246 connected to the circuit board 214,

and a main user in connector 248 having a wire set 250 connected to the circuit board 214.

The battery assembly 110 is connected to battery jump starting device 10, as shown in FIG. 11. The battery connector device 110 is installed within the casing 12 of the battery jump starting device 10 when assembled.

ENHANCED CONDUCTIVITY

An enhanced conductivity battery connector device 400 is shown in FIGS. 13 – 25. The enhanced conductivity battery connector device 400 provides a significantly increased conductivity compared to the battery connector device 100, as shown in FIGS. 5 – 10.

The amount of power to be conducted from the battery 412 to the clamps can be enhanced as follows:

1) Increase Wire Gauge

e.g. change 4AWG (American Wire Gage) positive cable 18 and negative cable 22 (FIG. 9) to a 2AWG positive cable 318 and negative cable 322 (FIGS. 13 and 15).

2) Increase Conductivity of Negative Cable Connection

e.g. negative cable end 322a (FIG. 15) connection to the relays will extend all the way across the connector pins 422c of the relays 422.

3) Increase Conductivity of Positive Cable Connection

e.g. the positive battery tab 414 is lengthened so that the positive cable 318 can be rolled up (FIGS. 17-22) in the positive battery tab 414 and soldered together thoroughly;

4) Increase Conductivity of Diode Connection

e.g. replace the diode connection 150 (FIG. 5) with the diode connection 450 (FIG. 23).

5) Redesign Resistor/Diode Printed Circuit Board (PCB)

e.g. replace the diode printed circuit board (PCB) 152 (FIG. 10) with the diode printed circuit board (PCB) 452 (FIG. 23).

6) Reconnect Resistors

e.g. reconnect resistors R134A&B, R135A&B located on the diode printed circuit board (PCB) 152 (FIG. 10) to be connected again.

A detailed description of each of these enhanced conductivity features or arrangement is set forth below.

1) Increase Wire Gauge

The gauge of the positive cable 18 and negative cable 22 (FIG. 9), for example, can be increased from 4AWG (American Wire Gage) cable to a 2AWG cable for positive cable 318 and negative cable 322 (FIGS. 13 and 15). The comparative specifications of the 4AWG cable and 2AWG cable are as follows:

	2AWG	4AWG
Diameter	0.2576 in	0.2294 in
	(6.544 mm)	(5.189 mm)
Turns of wire	3.88/in	4.89/in
	(1.53/cm)	(1.93/cm)
Area	66.4 kcmil	41.7 kcmil
	(33.6 mm^2)	(21.2 mm^2)
Resistance/length	0.5127 mΩ/m	0.8152 mΩ/m
	(0.1563 mΩ/ft)	(0.2485 mΩ/m)
Ampacity	95 (60° C)	70 (60° C)
	115 (75° C)	85 (75° C)
	130 (90° C)	95 (90° C)
Fusing current	1.3 kA (10 s)	946 A (10 s)
	10.2 kA (1s)	6.4 kA (1 s)
	57kA (32 ms)	36 kA (32 ms)

The 2AWG cable provides a significant increase of conductivity (i.e. ampacity) compared to the 4AWG cable (i.e. approximately 36%).

2) Increase Conductivity of Negative Cable Connection

The negative cable 322 (FIG. 15) can be connected to the battery 412 (FIG. 13) in a manner to increase the conductivity (i.e. ampacity) between the battery 412 and negative cable 322. For example, the negative cable end 322a can be directly connected (e.g. soldered) to the connector prongs 442c (FIG. 15) of the relays 442. Specifically, the negative cable end 322a can extend across and directly connect to all relays 342 of the smart switch battery interface 434, as shown in FIGS. 14 and 15. Further, the negative cable end 322a can be connected to a conductor loop 441 of the circuit board conductor bar 440.

The negative cable 322, for example, can be stranded wire comprising an inner electrical wire conductor 322b composed of an untwisted or twisted bundle of wires 322d disposed within an outer electrical insulating sheath 322c. The electrical insulating sheath 322c of the negative cable 322 can be removed from the negative cable end 322a exposing the inner electrical conductor 322b at the negative cable end 322a.

The exposed bundle of wires 322d of the electrical conductor 322b can be forced over the ends of the exposed connector pins 442c of the relays 442 so that strands of wires 322d are captured between the adjacent connector pins 442c. The exposed bundles of wires 332d can be further forced into contact with the conductor bar 440 (e.g. made of copper). Solder 423 is applied to this assembly so that the solder flows between the exposed bundles of wires 422d to the connector pins 442c and the conductor bar 440 to complete the electrical connection between the negative cable 322 and the smart switch battery interface 434 connected to the battery 412.

The length of the exposed bundle of wires 322d is selected so that exposed bundle of wires 322d directly connects with each set of connector pins 442c of each and every relay 442 to provide the maximum electrical conductivity (i.e. maximum ampacity) between the negative cable 322 and the battery 412.

3) Increase Conductivity of Positive Cable Connection

The positive cable 318 can be connected to the battery 412 in a manner to increase the conductivity (i.e. ampacity) between the battery 412 and positive cable 318. For example, the positive cable 318 can be rolled up in the positive battery tab 414 and soldered together thoroughly. The connection between the positive cable 318 and battery 412 is shown in FIGS. 16-22.

The positive cable 318, for example, can be stranded wire comprising an inner electrical wire conductor 318b composed of an untwisted or twisted bundle of wires 318d disposed within an outer electrical insulating sheath 318c. The electrical insulating sheath 318c of the positive cable 318 can be removed from the positive cable end 318a exposing the inner electrical conductor 318b at the positive cable end 318a.

The battery 412 is provided with a positive battery tab 414. The positive battery tab 414 is a metal sheet (e.g. copper sheet) connected to the positive terminal tab 414 of the battery 412.

The exposed bundle of wires 318d of the inner electrical conductor 318b can be soldered with tin, and then rolled up within the positive battery tab 312a. Solder 415 (FIG. 21) is applied to the exposed bundle of wires 318d and the positive battery tab 312a.

The length of the exposed bundle of wires 318d is selected so that exposed bundle of wires 318d directly connects with the full width of the positive battery tab 414 to provide the maximum electrical conductivity (i.e. maximum ampacity) between the battery 312 and the positive cable 318.

4) Increase Conductivity of Diode Connection

The positive cable 318 can be provided with a diode connection 450 configured to increase the conductivity along the positive cable 318, as shown in FIGS. 23 – 25.

The diode connection 450 comprises a plurality of diodes 454 connected between positive cable sections 318e and 318f (FIG. 25). For example, the diode connection 450 comprises six (6) back-charge type diodes (e.g. Schottky barrier diodes).

The diodes 454 are soldered between the positive cable sections 318e and 318f. Specifically, the diode conductor tabs 454a are soldered to the positive cable section 318e and the diode conductor prongs 454b are soldered to the positive cable section 318f. More specifically, the diode conductor prongs 454b of the diodes 354 extend through the diode circuit board 452, extend into the bundle of wires 318b, and then are soldered in place completing assembly of the diode connection 450.

The diode connection 450 is then insulated, for example, using a shrink wrap insulator 455 (FIG. 25), which is applied around the diode connection 450, and then shrunk by applying heat (e.g. using heat gun).

5) Redesign Resistor/Diode Printed Circuit Board (PCB)

e.g. redesign of resistor/diode PCB to eliminate the diodes extending therefrom;

6) Reconnect Resistors

e.g. reconnect resistors R134A&B, R135A&B that are on the Resistor/Diode PCB to be connected again.

TEST #1

The battery connection device 100 shown in FIG. 5 was subjected to a 1250A Load Test. The results are shown in FIG. 27, and as follows:

Pulse #1 Average Power of 4799.01W

Pulse #2 Average Power of 5528.99W

Pulse #3 Average Power of 6101.63W

TEST #2

The battery connection device 400 shown in FIG. 13 was subjected to a 1250A Load Test. The results are shown in FIG. 28, and as follows:

Pulse #1 Average Power of 6584.61W

Pulse #2 Average Power of 7149.60W

Pulse #3 Average Power of 7325.91W

This results in a significant increase of approximately twenty percent (20%) for peak power compared to the results of TEST #1.

Another enhanced conductivity battery conductor device 500 is shown in FIGS. 29 - 37. The enhanced conductivity battery connector device 500 provides a significantly increased conductivity compared to the battery connector device 100, as shown in FIGS. 5 – 10.

The battery conductor device 500 comprises the battery assembly 410, including the battery 512 connected to the positive cable 518 and the negative terminal conductor plate 530. A positive wire 519 is connected directly or indirectly to the positive tab or positive cable 518 of the battery 530, and a negative wire 523 is connected directly or indirectly to the negative tab or negative terminal conductor plate 530. The battery conductor device 500 can further include a bundle of wires 570 connected to or associated with the operation of the battery 512 (e.g. battery temperature sensor, power supply, etc.).

The battery 512 can comprise a single battery cell 512c (FIG. 30), or multiple battery cells 512C connected end-to-end in series. Three (3) separate battery cells 512c are shown in FIG. 30.

The battery cells 512c each have positive and negative tabs 512d located at opposite ends of each battery cell 512c. The battery cells 512c are connected together in series by welding (e.g. sonically and/or thermally welding) and/or soldering respective positive and negative tabs 512d together. For example, the tabs 512d are positioned so as to overlap each other (e.g. edges overlapping opposite tab 512d, or edge-to-edge).

The tabs 512d are metal plates (e.g. relative thin metal foils) extending outwardly from the body and opposite edges of each battery cell 512c. As shown in FIG. 30, the tabs 512d extend along opposite edges at the width of each battery cell 512c. The tabs

512d are each centered and extend most of the width of each opposite edge of each battery cell 512c.

As shown in FIGS. 30 and 31, a separate tab 512e is added or connected to the right side of the battery cell 512c to extend the length of the tab 512d. The separate tab 512e is shown as having the same width as the tab 512d; however, this width can be different. To assemble the separate tab 512e to the tab 512d, for example, the separate tab 512e is positioned to overlap over the tab 512d, and then welded (e.g. sonically and/or thermally welded) and/or soldered together. The exposed end of the positive cable 518 is then wound up inside the separate tab, as shown in FIGS. 32 and 34. For example, the initially flat separate tab 512e is wrapped around the exposed end of the positive cable 518, and then connected to the exposed end by welding (e.g. sonically and/or thermally welding) and/or soldering. For example, a layer of solder is applied to one or both sides of the separate tab 512e, and then after wrapping the separate tab 512e around the exposed end of the positive wire 518, the assembly is heated to melt the layered solder and solder the assembly together.

The three (3) battery cells 512c once connected together, as shown in FIG. 32, are then folded over each other into the layered battery cell arrangement shown in FIG. 33. The layered battery cell arrangement can be packaged (e.g. the three (3) battery cells can be taped or shrink wrapped together), or placed within a battery cover or casing, as shown in FIG. 34.

As shown in FIG. 35, the negative tab 512d can be attached to the negative terminal conductor plate 530. For example, the negative tab 512d can be wrapped partially or fully, as shown, around the negative terminal conductor plate 530. The

negative tab 512d can be provided with a plurality of through holes 512f to facilitate welding and/or soldering the negative tab 512d to the negative terminal conductor plate 530. For example, the through holes 512f can be square-shaped through holes arranged into a matrix, as shown in FIG. 35. The negative wire 523 is shown connected (e.g. soldered) to the negative tab 512d.

A separate tab 512e (see FIG. 30) can be connected to the negative tab 512d to lengthen same, so that the lengthened negative tab can be wrapped or wound around the negative terminal conductor plate 530 more than one time (e.g. 2, 3, 4, or more times). In this manner, the electrical connection between the negative tab 512d and the negative terminal conductor plate 530 can be enhanced. The separate tab 512e can be provided with a layer of solder on one or both sides, so that after the separate tab 512e is wrapped or wound around the negative terminal conductor plate 530, this assembly can be heated up to solder the separate tab 512e onto the negative terminal conductor plate 530.

The completed assembly of the battery conductor device 500 with the connected separate positive tab 512d ready to be wrapped or wound an exposed end of the positive cable 518 (FIG. 29) can be seen in FIG. 36. The bundle of wires 570 shown in FIG. 36, includes wires 572 for a temperature sensor embedded within the battery 512 (e.g. temperature sensor located near battery tab or between battery cells. The temperature sensor 574 having two (2) wires 572a, 572b is shown in FIG. 37.

The battery conductor device 500 can comprise a diode connector 550 connected inline or splice into the positive cable 518, as shown in FIG. 38.

The battery conductor device 500 comprises a diode circuit board 552 having a plurality of diodes 454 assembled thereon. The diodes 454 each have a diode conductor tab 454a connected (e.g. soldered) to an exposed end of the positive cable 518. The prongs of the diodes 454 extend through holes in the diode circuit board 552, and are soldered to both the conductive traces and exposed end of the positive cable 518 along with a resistor 576 to complete the assembly.

CLAIMS

1. A battery connector device for a battery jump starting device having a smart switch, the device comprising:

a battery comprising a positive terminal tab and a negative terminal tab;

a positive terminal conductor sheet connected to the positive terminal tab of the battery;

a negative terminal conductor bar connected to the negative terminal tab of the battery;

a positive cable connected to the positive terminal conductor sheet of the battery;

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar spaced apart from a second circuit board conductor bar, the first circuit board conductor bar electrically connected to the negative terminal conductor bar of the battery, the smart switch interface further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery and a battery being jump started; and

a negative cable connected to the second circuit board conductor bar.

WINPLUS Ex. 1003, p. 1227

2. A battery connector device for a battery jump starting device having a smart switch, the device comprising:

a rechargeable battery comprising a positive terminal tab and a negative terminal tab;

a positive terminal conductor sheet connected to the positive terminal tab of the battery;

a negative terminal conductor bar connected to the negative terminal tab of the battery;

a positive cable connected to the positive terminal conductor sheet of the battery;

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar spaced apart from a second circuit board conductor bar, the first circuit board conductor bar electrically connected to the negative terminal conductor bar of the battery, the smart switch interface further comprising a plurality of relays each connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery and a battery being jump started; and

a negative cable connected to the second circuit board conductor bar, the negative cable directly electrically connecting to each of the plurality of relays.

3. A battery connector device for a battery jump starting device having a smart switch, the device comprising:

a rechargeable battery comprising a positive terminal tab and a negative terminal tab;

a positive terminal conductor sheet connected to the positive terminal tab of the battery;

a negative terminal conductor bar connected to the negative terminal tab of the battery;

a positive cable connected to the positive terminal conductor sheet of the battery;

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar spaced apart from a second circuit board conductor bar, the first circuit board conductor bar electrically connected to the negative terminal conductor bar of the battery, the smart switch interface further comprising multiple relays each connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery and a battery being jump started;

a negative cable connected to the second circuit board conductor bar, the negative cable directly electrically connecting to each of the plurality of relays; and

a diode connection provided between a first section of the positive cable and a second section of the positive cable.

4. The device according to claim 1, wherein the one or more relays is multiple relays connected in parallel between the first circuit board conductor bar and the second circuit board conductor bar.

5. The device according to claim 1, wherein the negative terminal conductor bar is configured to mechanically and electrically connect the battery to the smart switch battery interface.

6. The device according to claim 5, wherein the negative terminal conductor bar is configured to position the smart switch battery above and adjacent to the battery.

7. The device according to claim 1, wherein the positive terminal conductor sheet wraps around one end of the positive cable to electrically connect the battery to the positive cable.

8. The device according to claim 1, wherein the positive terminal conductor bar is ultrasonically welded to the positive terminal tab of the battery and the negative terminal conductor bar is ultrasonically welded to the negative terminal tab of the battery.

9. The device according to claim 1, wherein the battery is rectangular-shaped and a width of the positive terminal conductor sheet of the battery is equal to the width of the battery, and the negative terminal conductor bar is L-shaped and configured to wrap around a respective corner of the battery.

10. The device according to claim 9, wherein the battery tabs are mounted flush with a casing of the battery.

11. The device according to claim 1, wherein a diode connection is provided between a first section of the positive cable and a second section of the positive cable.

12. The device according to claim 11, wherein the diode connection comprises one or more diodes connected between the first section of the positive cable and the second section of the positive cable.

13. The device according to claim 12, wherein the diode connection comprises multiple diodes each connected between the first section of the positive cable and the second section of the positive cable.

14. The device according to claim 13, wherein conductor tabs of the multiple diodes are connected to the first section of the positive cable and the conductor prongs of the multiple diodes are connected to the second section of the positive cable.

15. The device according to claim 14, wherein the multiple diodes are connected to a printed circuit board.

16. The device according to claim 15, wherein the conductor prongs of the multiple diodes extend through the printed circuit board and electrically connect with the second section of the conductor prongs.

17. The device according to claim 16, wherein the multiple diodes are arranged abutting each other along a single axis.

18. The device according to claim 13, wherein the diode connector is insulated with a heat shrink insulator.

WINPLUS Ex. 1003, p. 1232

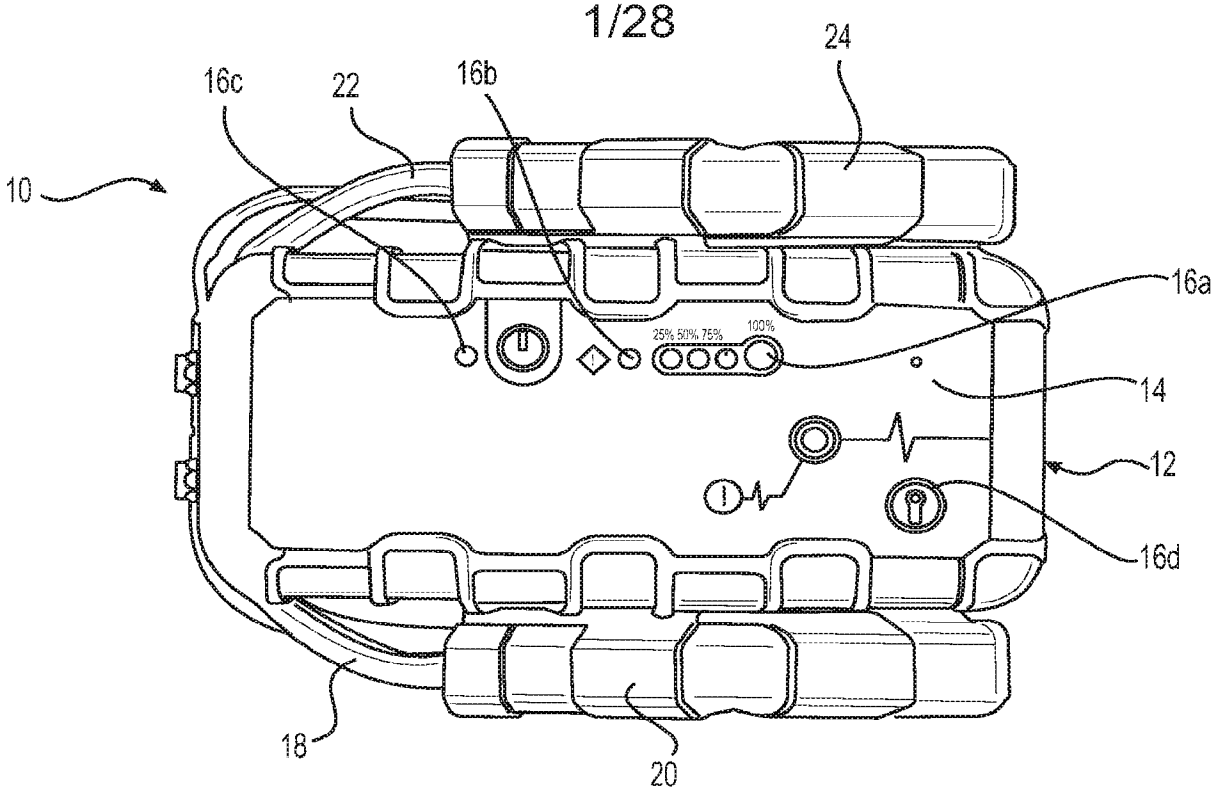


FIG. 1

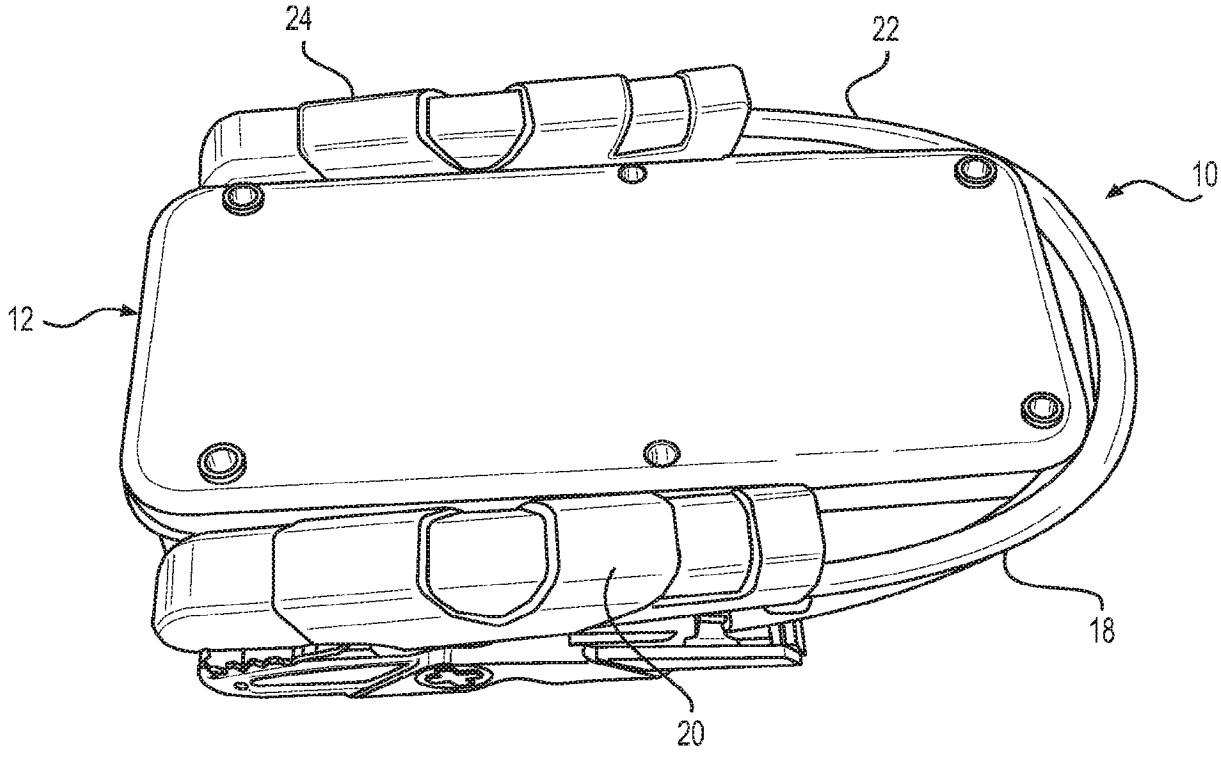


FIG. 2

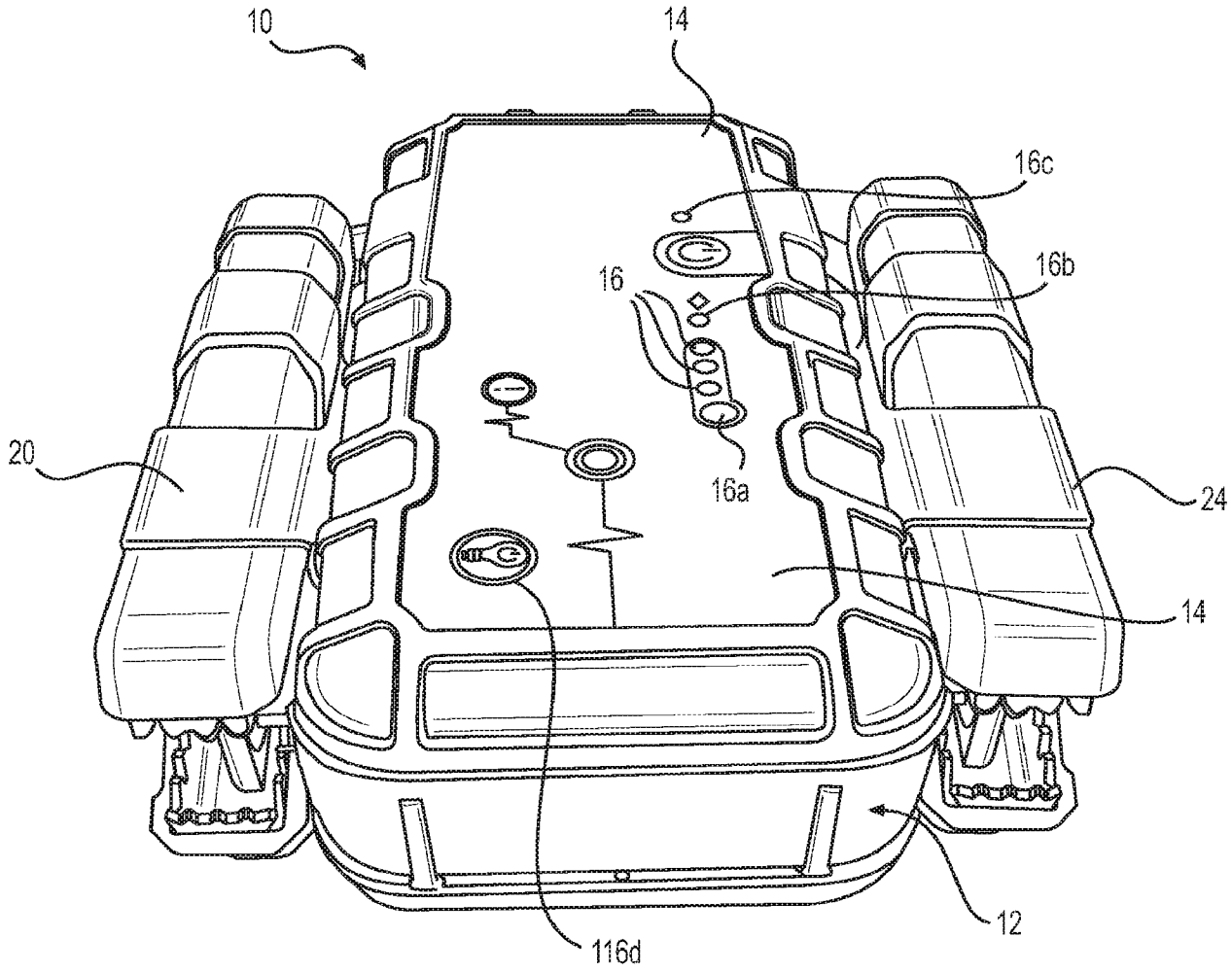


FIG. 3

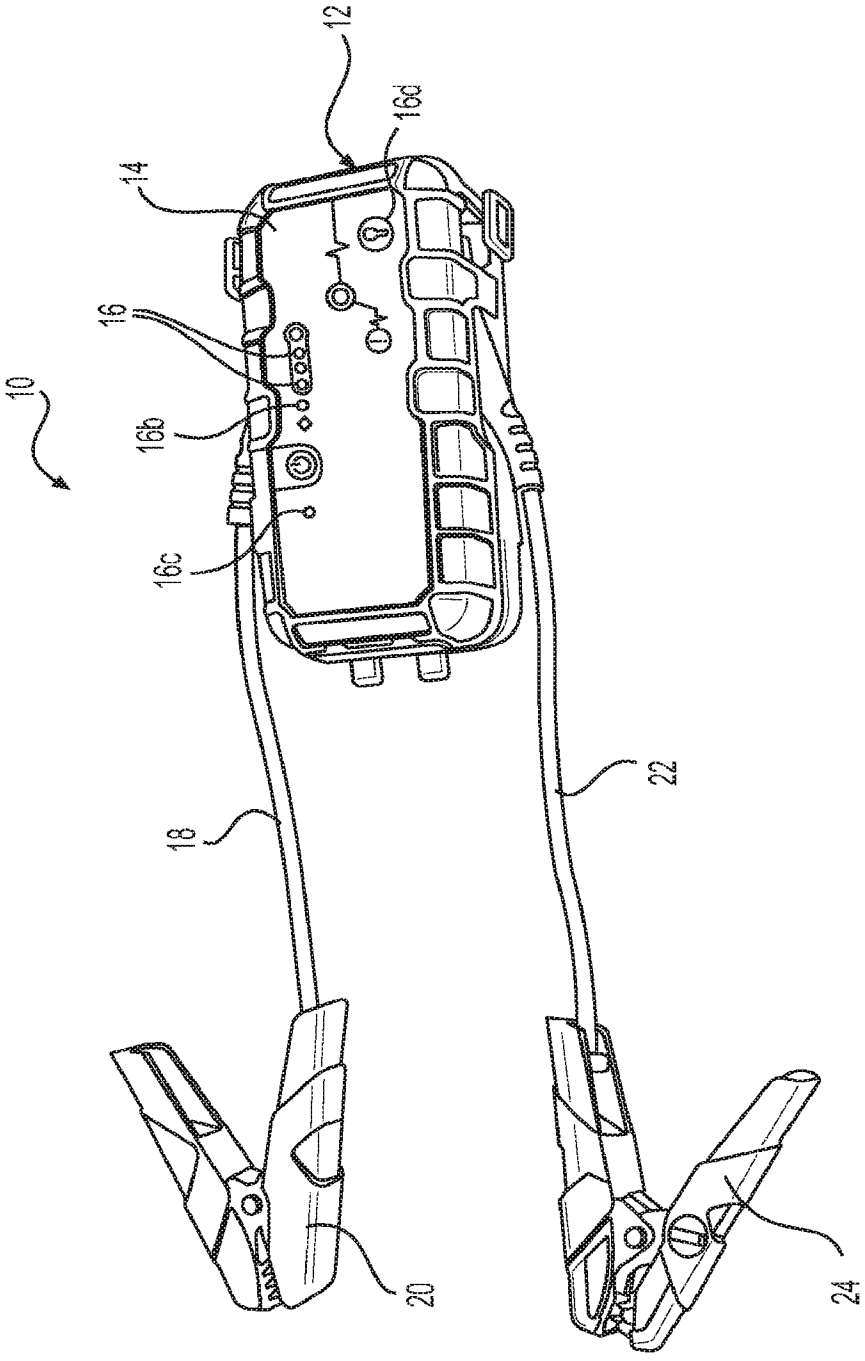


FIG. 4

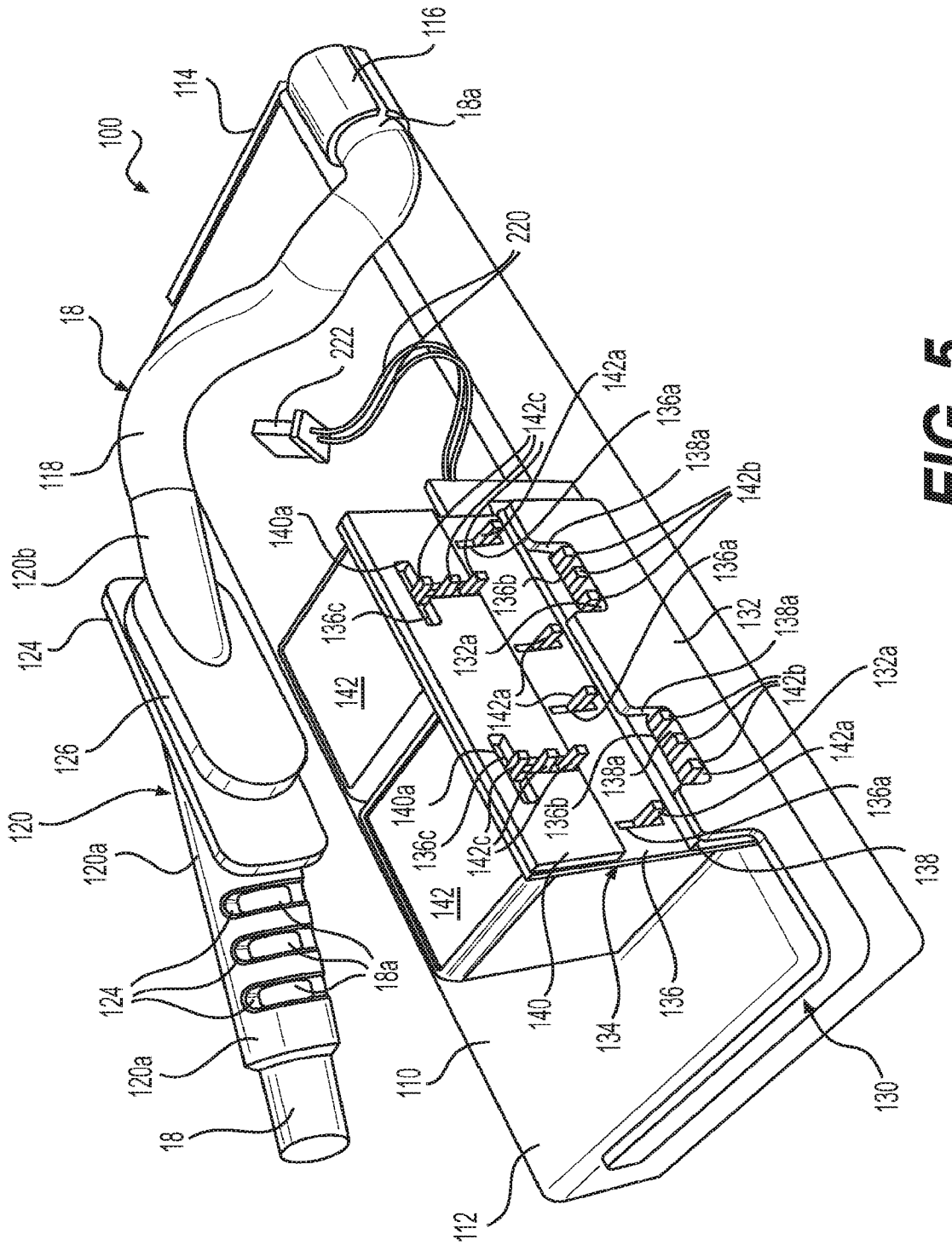

100
114
116
18a
18
220
222
118
142a
136a
138a
142b
142c
140a
120b
124
126
120
120a
132
132a
142
136b
136c
138
140
134
136
110
112
130

FIG. 5

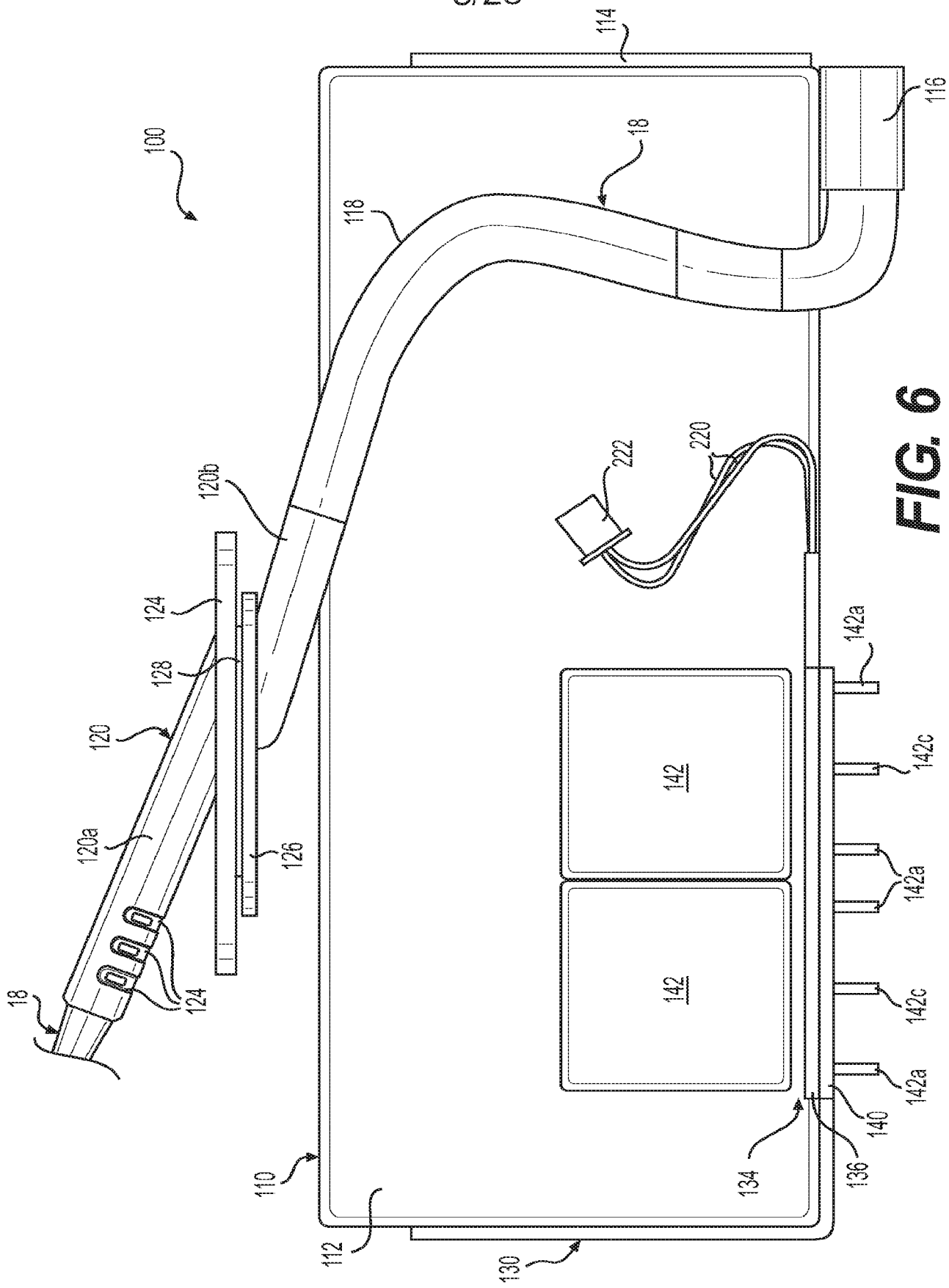

100
114
116
18
118
120b
222
220
124
128
120
142a
142c
142
120a
126
142
142a
142c
142a
18
124
140
110
134
136
112
130

FIG. 6

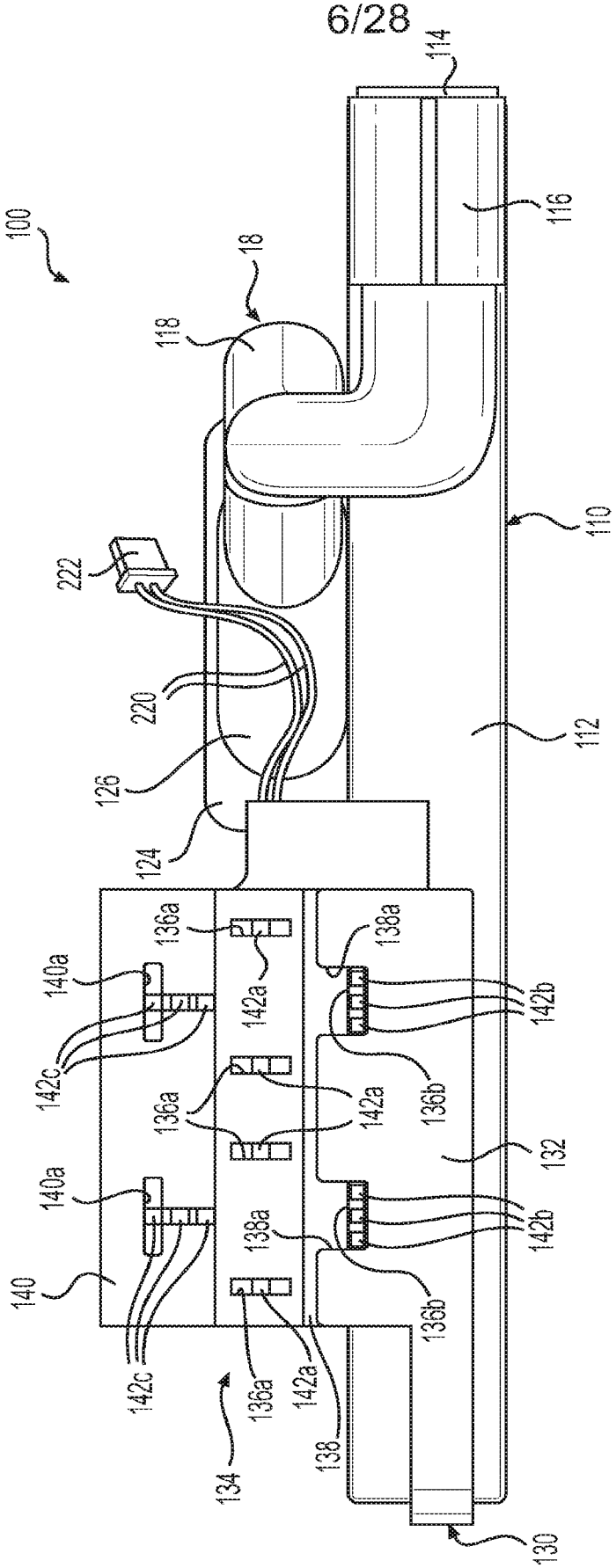

100
18
114
116
118
110
222
220
112
126
124
136a
138a
140a
142a
142b
142c
136b
132
140
138
134
130

FIG. 7

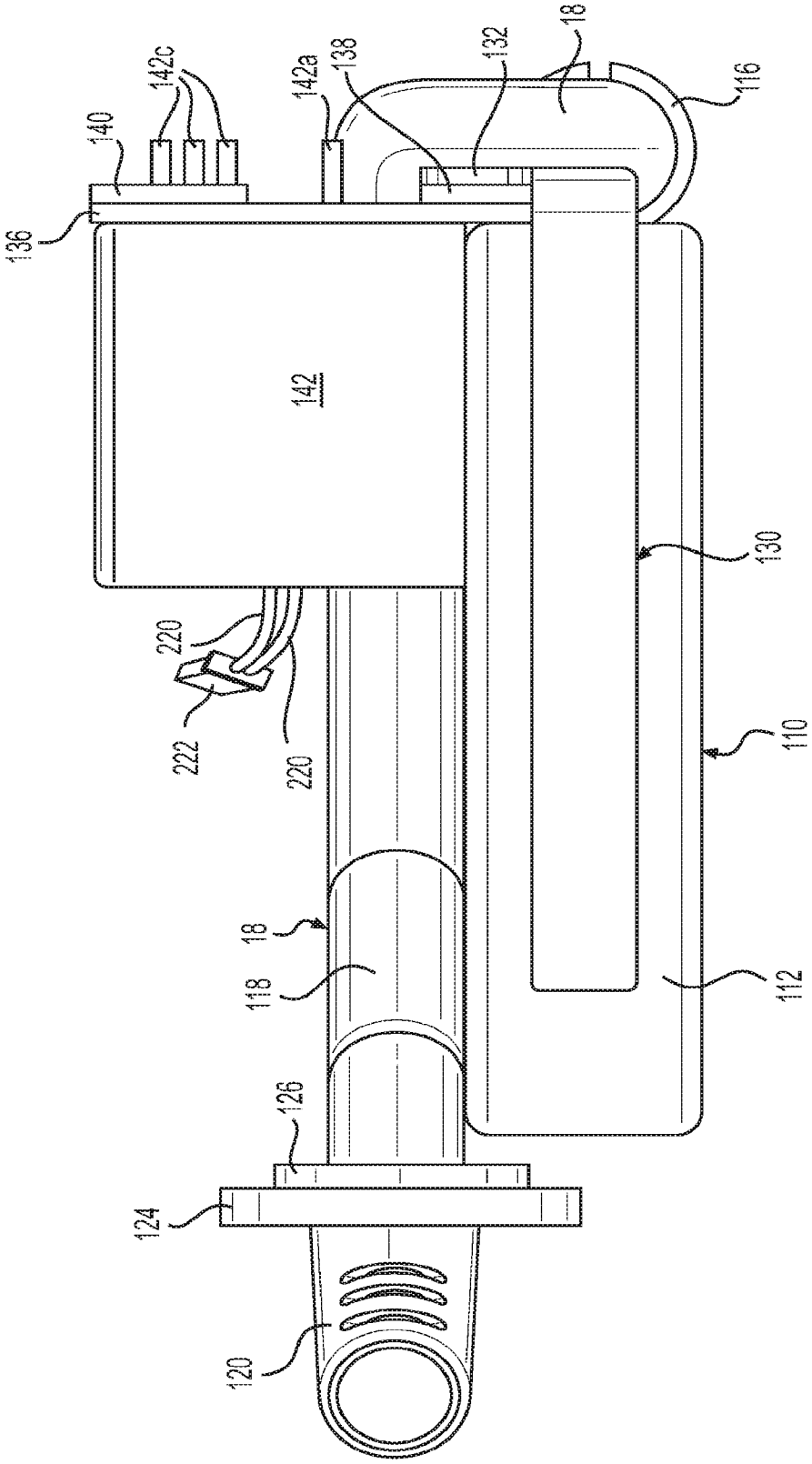

18
132
142c
142a
138
116
140
136
142
130
220
222
220
110
18
118
112
126
124
120

FIG. 8

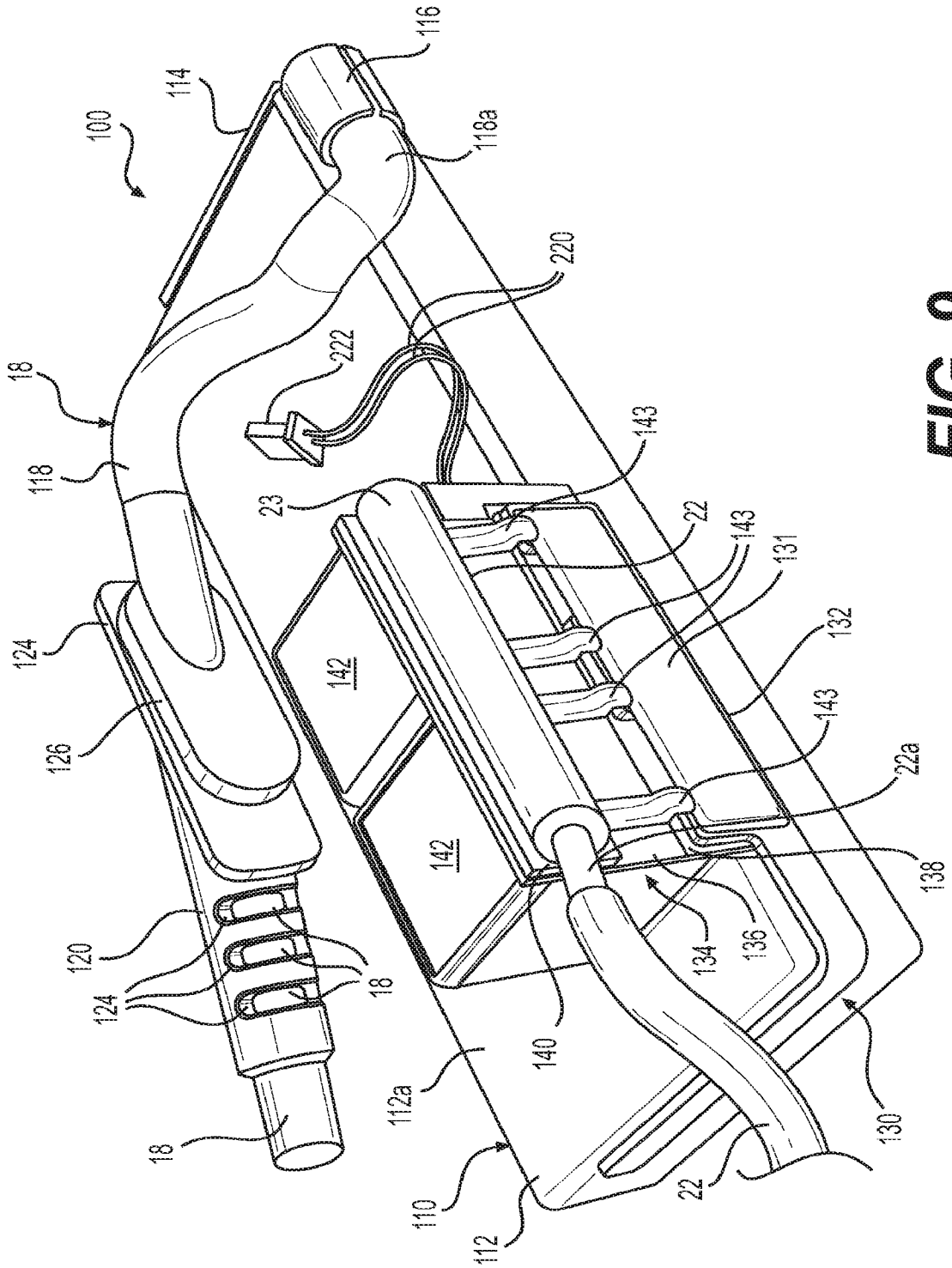

100
114
116
118a
220
222
18
118
23
143
22
131
132
124
126
142
120
18
112a
140
134
136
138
22a
110
112
130

FIG. 9

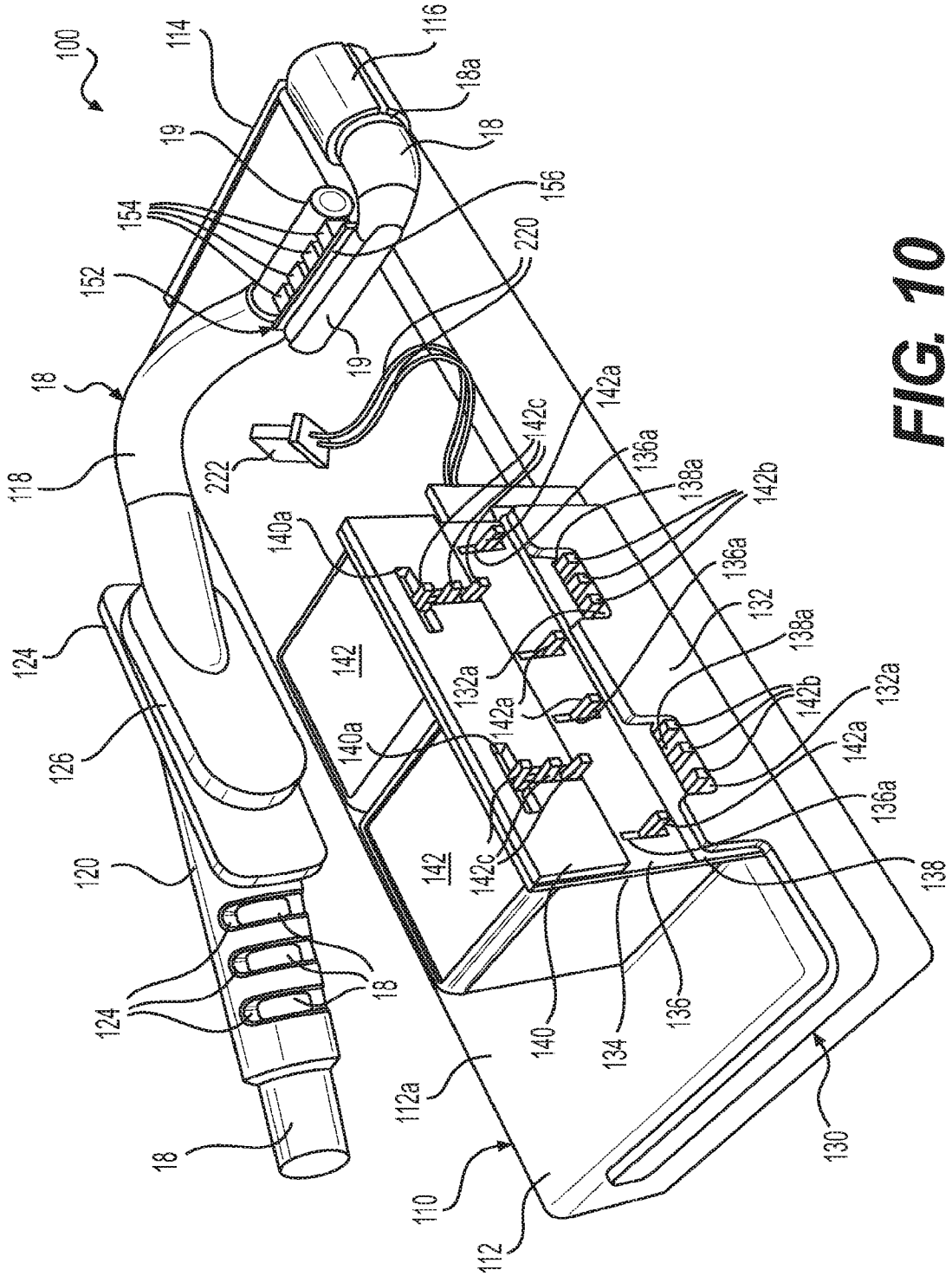

100
114
116
18a
18
19
154
156
152
220
19
18
222
142a
142c
118
136a
138a
142b
140a
136a
132
142
138a
124
132a
142b
126
140a
142a
132a
142a
136a
120
142
142c
138
124
18
18
140
134
136
112a
130
110
112

FIG. 10

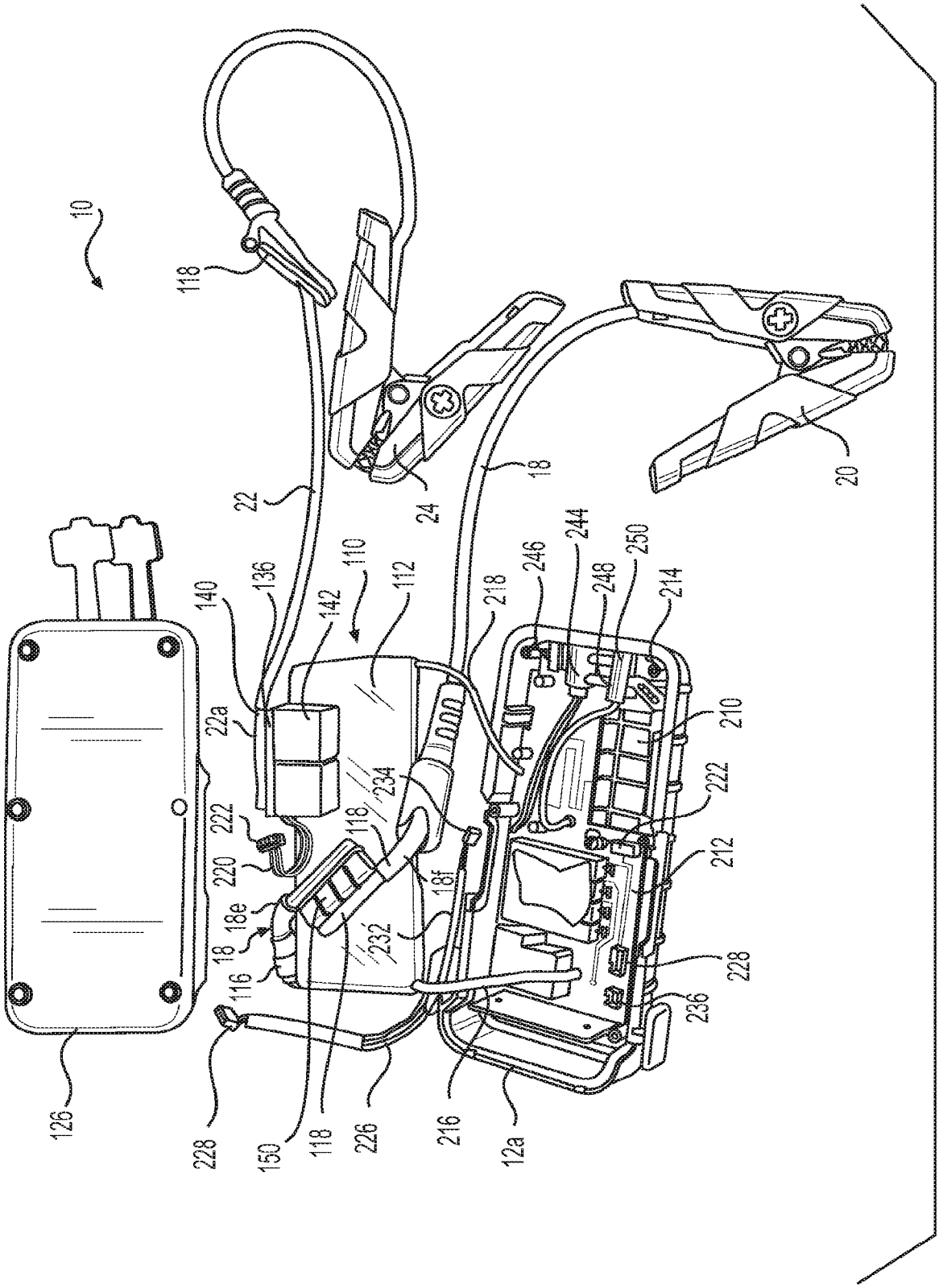

10
118
22
24
18
20
140
136
110
142
112
218
246
244
248
250
214
210
222
212
228
236
22a
234
220
18e
18
116
18f
232
126
228
150
118
226
216
12a

FIG. 11

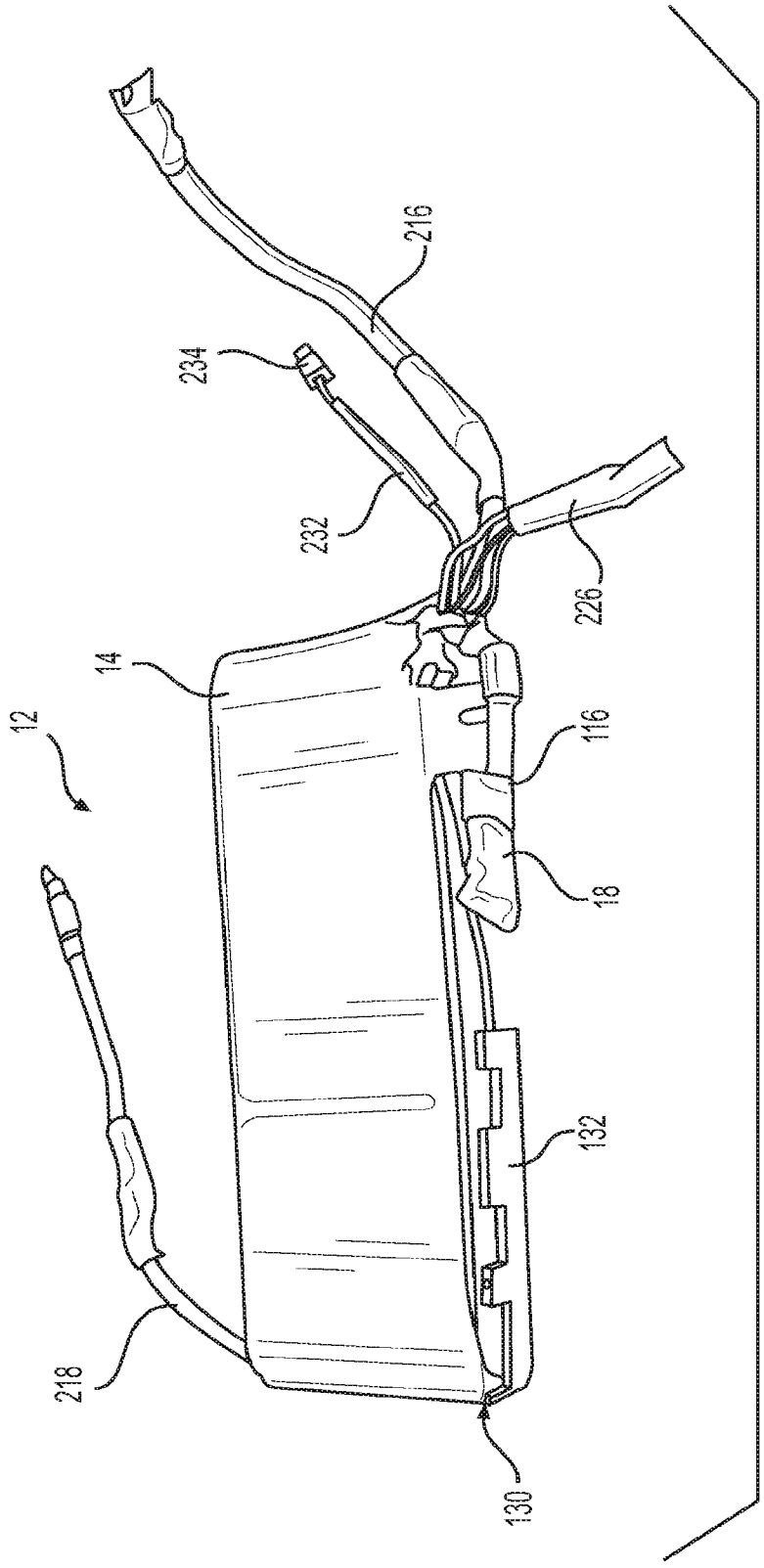


FIG. 12

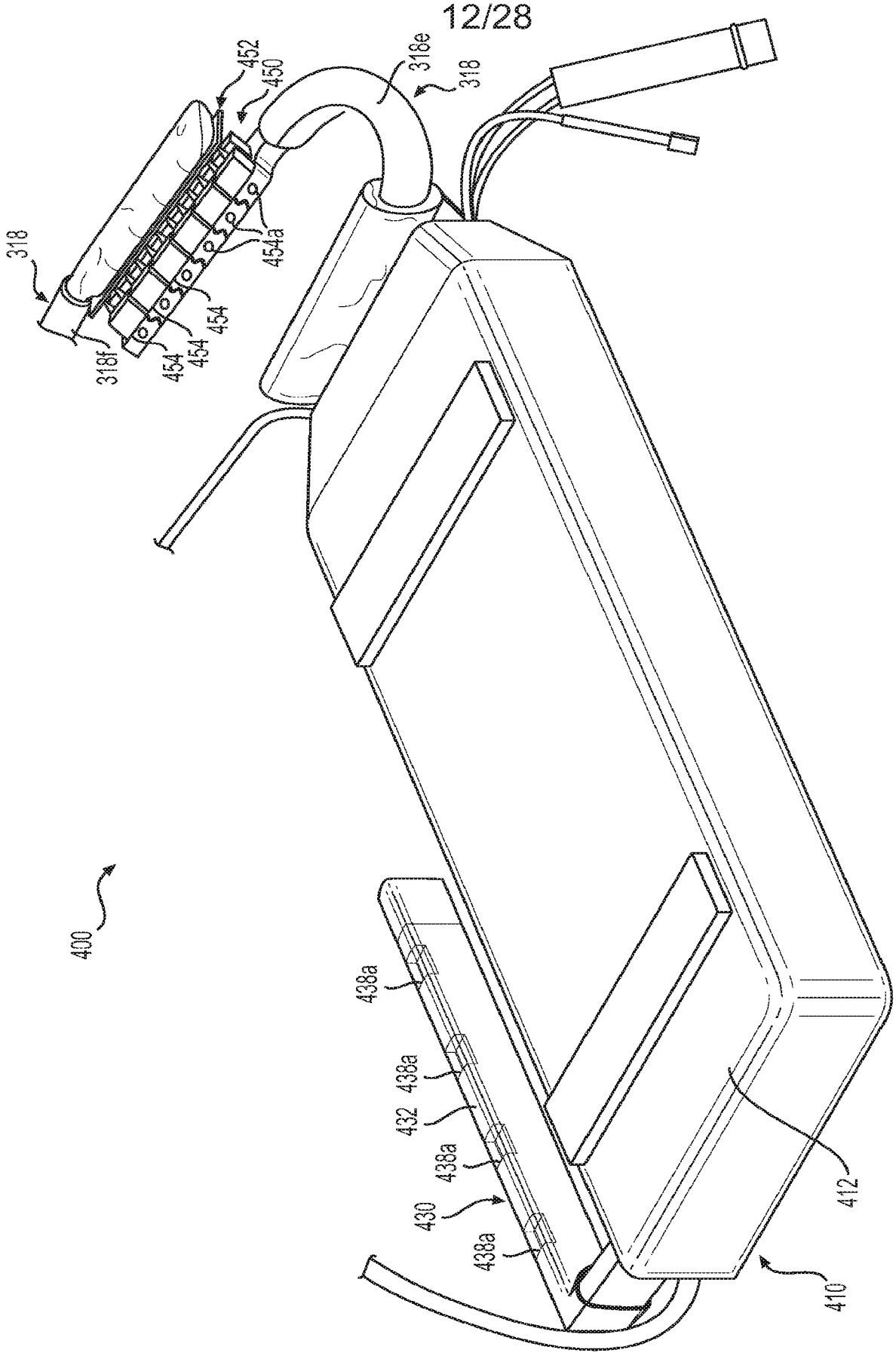

400
318
318f
454
454
454
454a
452
450
318e
318
438a
438a
432
438a
430
438a
412
410

FIG. 13

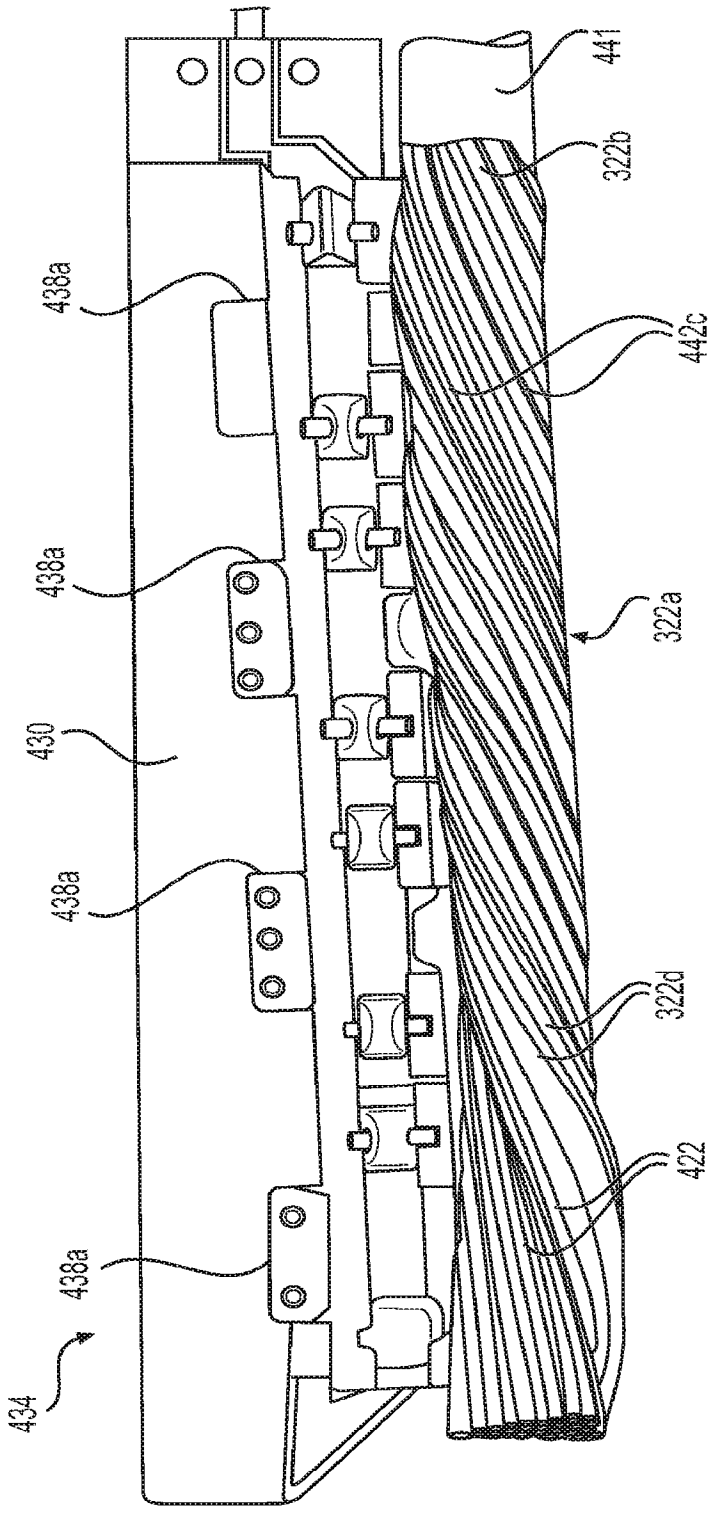


FIG. 14

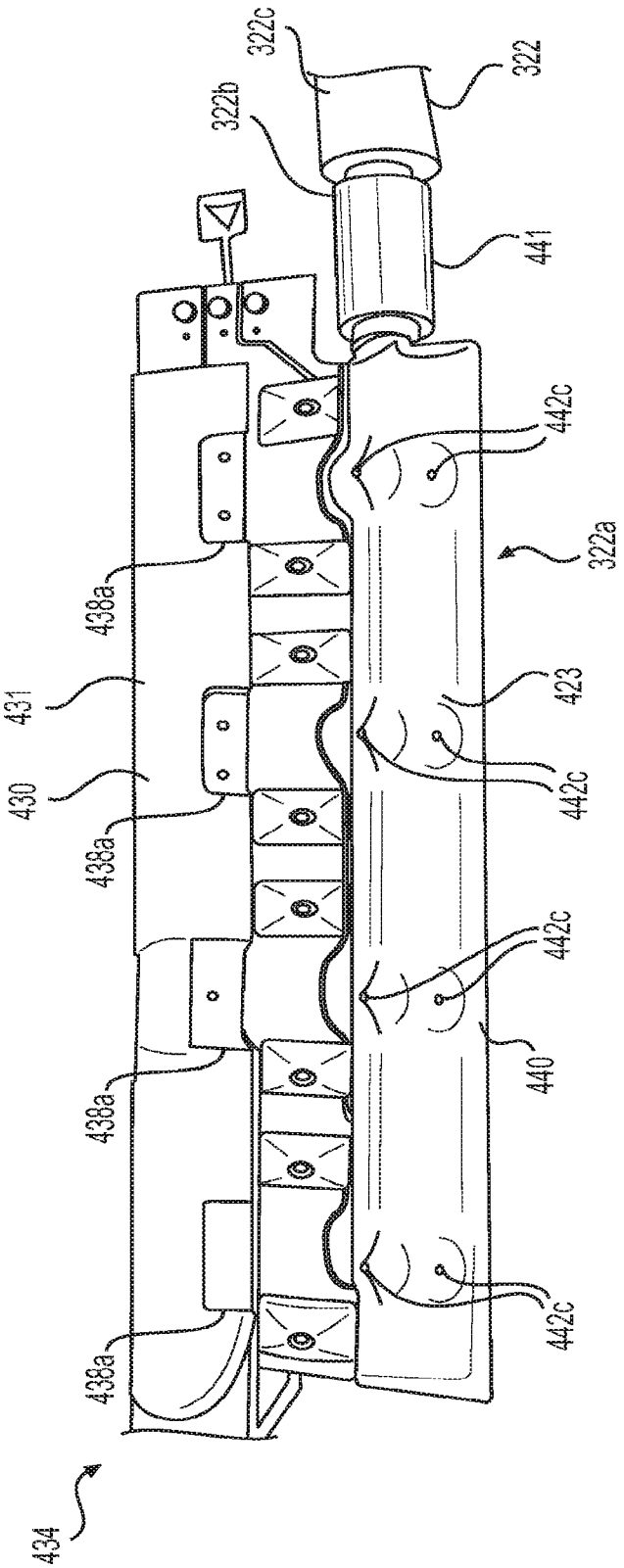

322c
322
322b
441
442c
322a
438a
431
423
430
442c
438a
442c
440
438a
442c
438a
434

FIG. 15

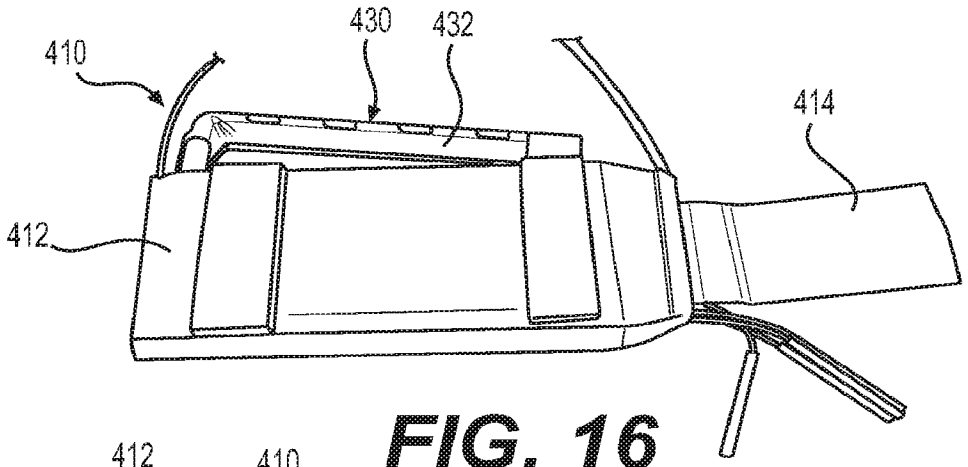


FIG. 16

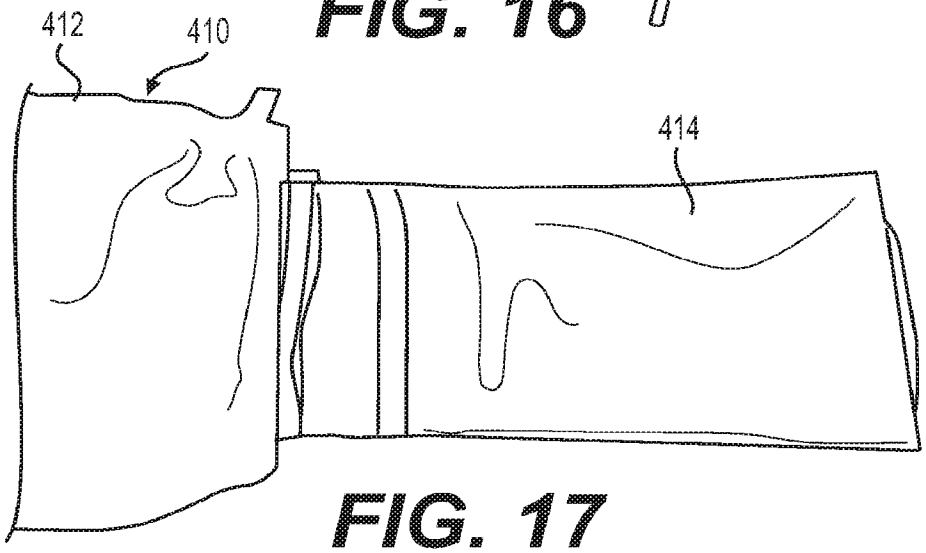


FIG. 17

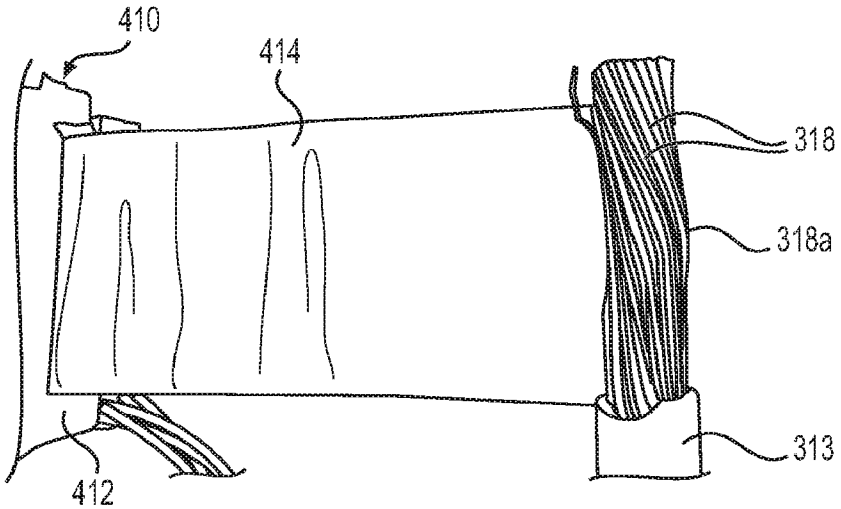


FIG. 18

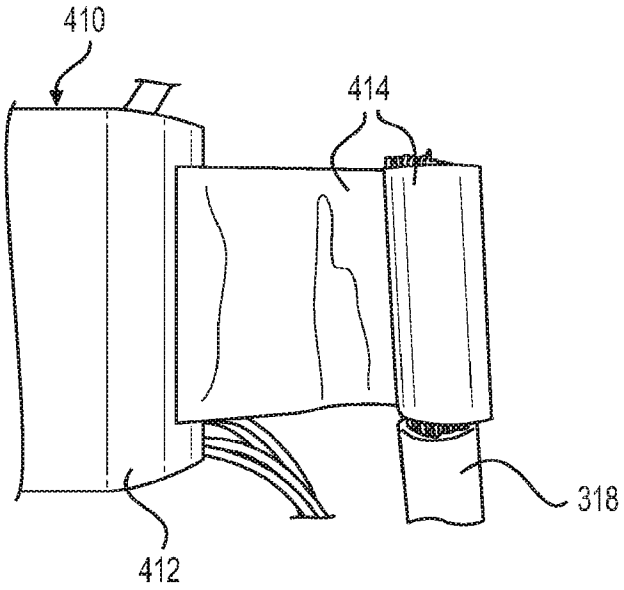


FIG. 19

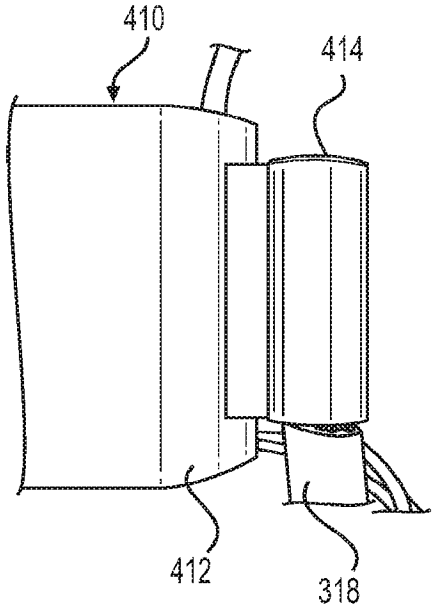


FIG. 20

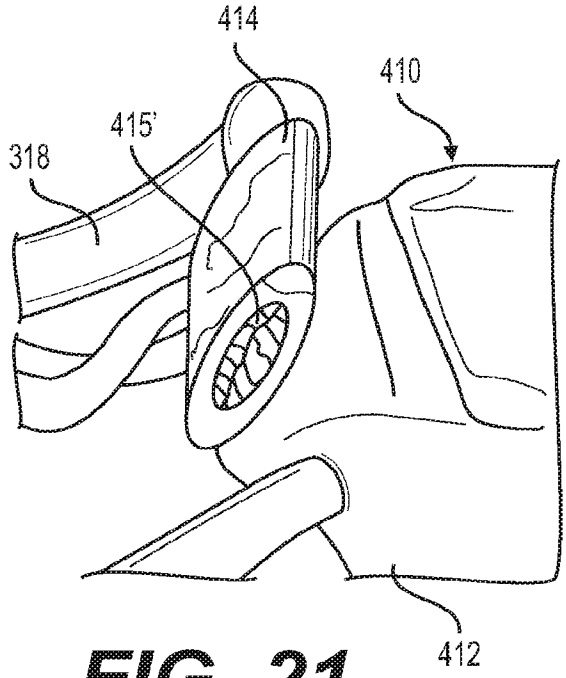


FIG. 21

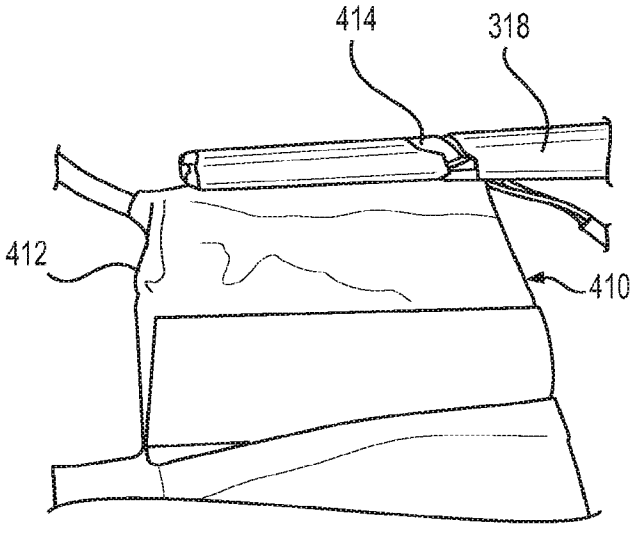


FIG. 22

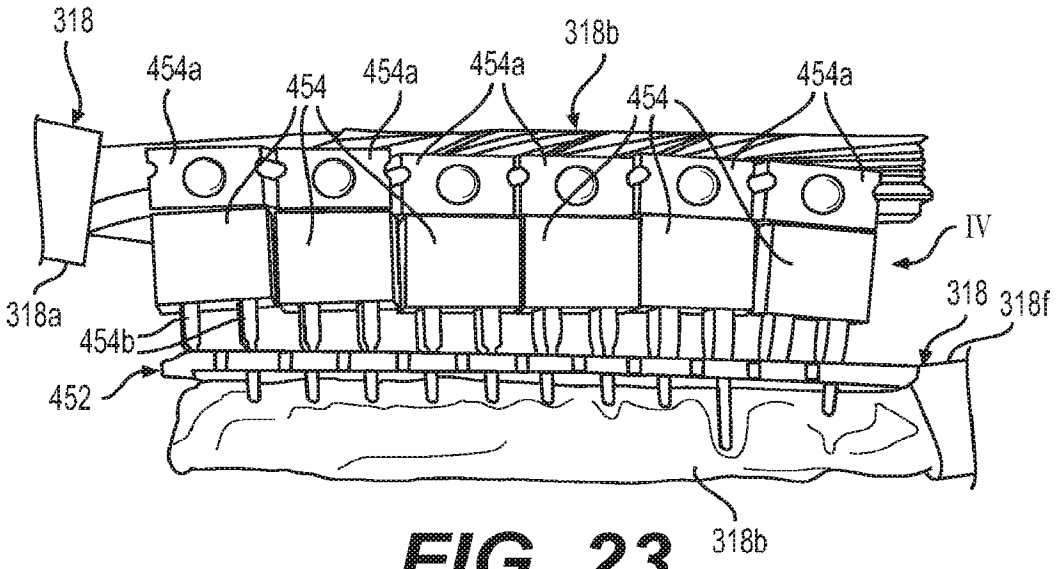


FIG. 23

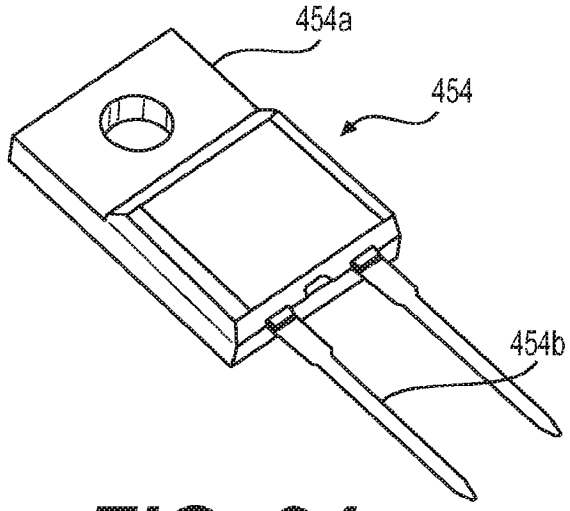


FIG. 24

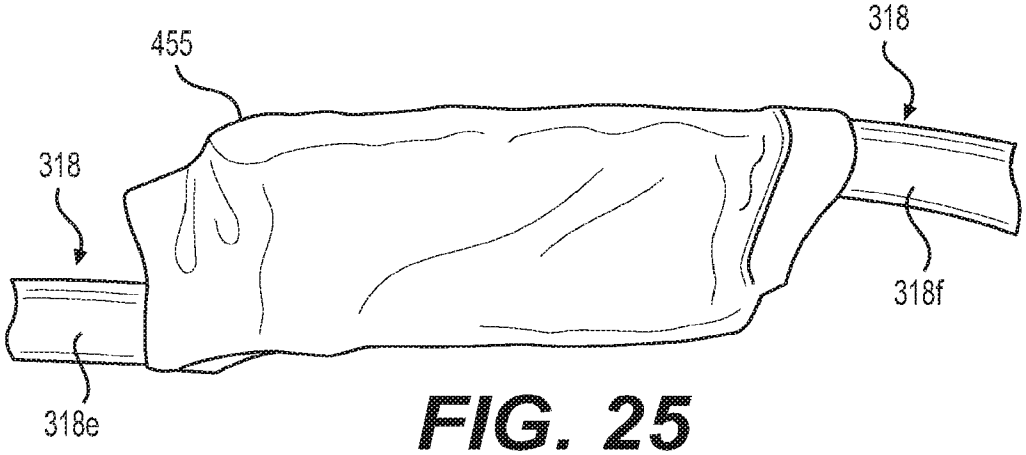


FIG. 25

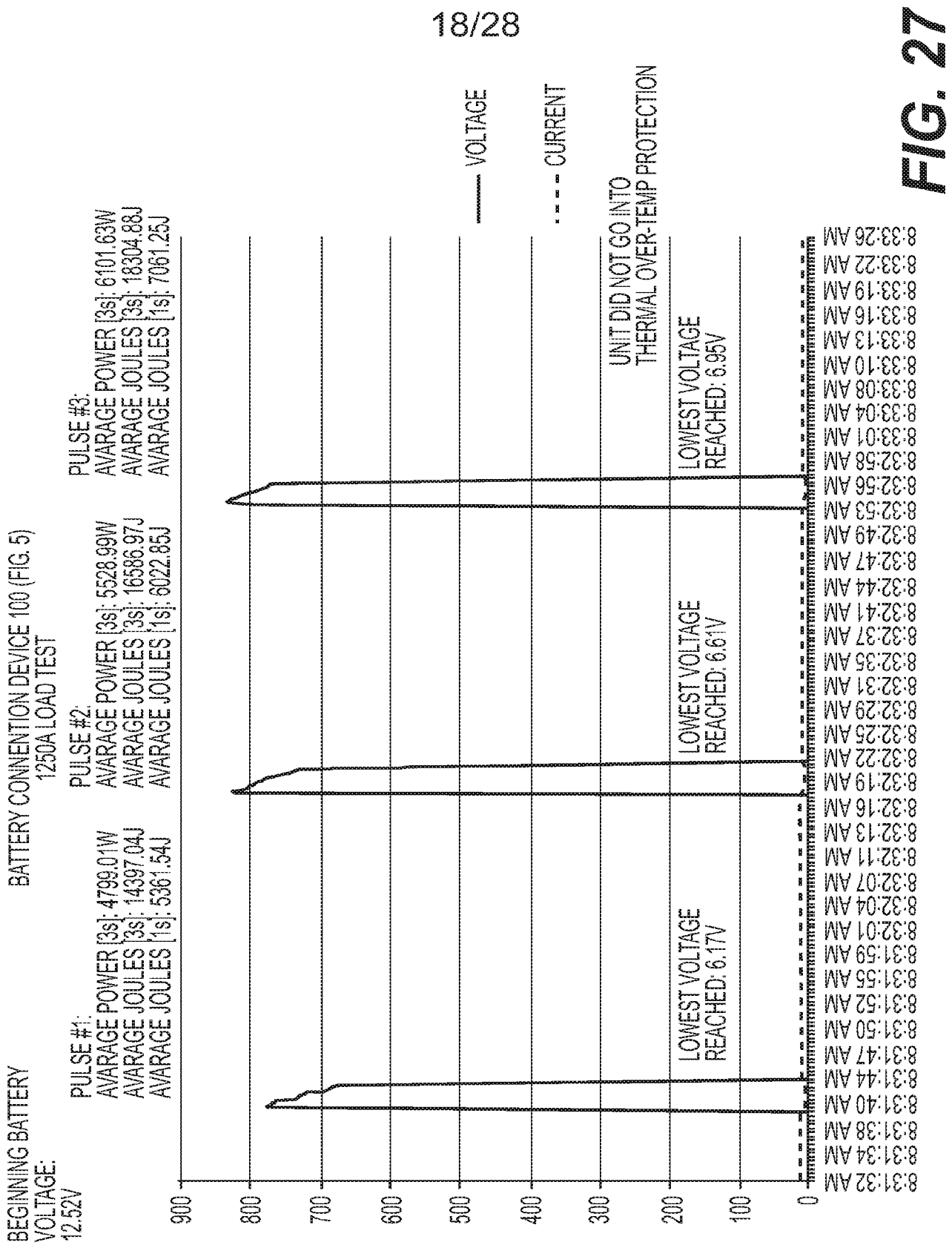

BEGINNING BATTERY VOLTAGE: 12.52V
BATTERY CONNENTION DEVICE 100 (FIG. 5)
1250A LOAD TEST
PULSE #1:
AVARAGE POWER [3s]: 4799.01W
AVARAGE JOULES [3s]: 14397.04J
AVARAGE JOULES [1s]: 5361.54J
PULSE #2:
AVARAGE POWER [3s]: 5528.99W
AVARAGE JOULES [3s]: 16586.97J
AVARAGE JOULES [1s]: 6022.85J
PULSE #3:
AVARAGE POWER [3s]: 6101.63W
AVARAGE JOULES [3s]: 18304.88J
AVARAGE JOULES [1s]: 7061.25J
VOLTAGE
CURRENT
UNIT DID NOT GO INTO THERMAL OVER-TEMP PROTECTION
LOWEST VOLTAGE REACHED: 6.17V
LOWEST VOLTAGE REACHED: 6.61V
LOWEST VOLTAGE REACHED: 6.95V
900
800
700
600
500
400
300
200
100
0
8:31:32 AM
8:31:34 AM
8:31:38 AM
8:31:40 AM
8:31:44 AM
8:31:47 AM
8:31:50 AM
8:31:52 AM
8:31:55 AM
8:31:59 AM
8:32:01 AM
8:32:04 AM
8:32:07 AM
8:32:11 AM
8:32:13 AM
8:32:16 AM
8:32:19 AM
8:32:22 AM
8:32:25 AM
8:32:29 AM
8:32:31 AM
8:32:35 AM
8:32:37 AM
8:32:41 AM
8:32:44 AM
8:32:47 AM
8:32:49 AM
8:32:53 AM
8:32:56 AM
8:32:58 AM
8:33:01 AM
8:33:04 AM
8:33:08 AM
8:33:10 AM
8:33:13 AM
8:33:16 AM
8:33:19 AM
8:33:22 AM
8:33:26 AM

FIG. 27

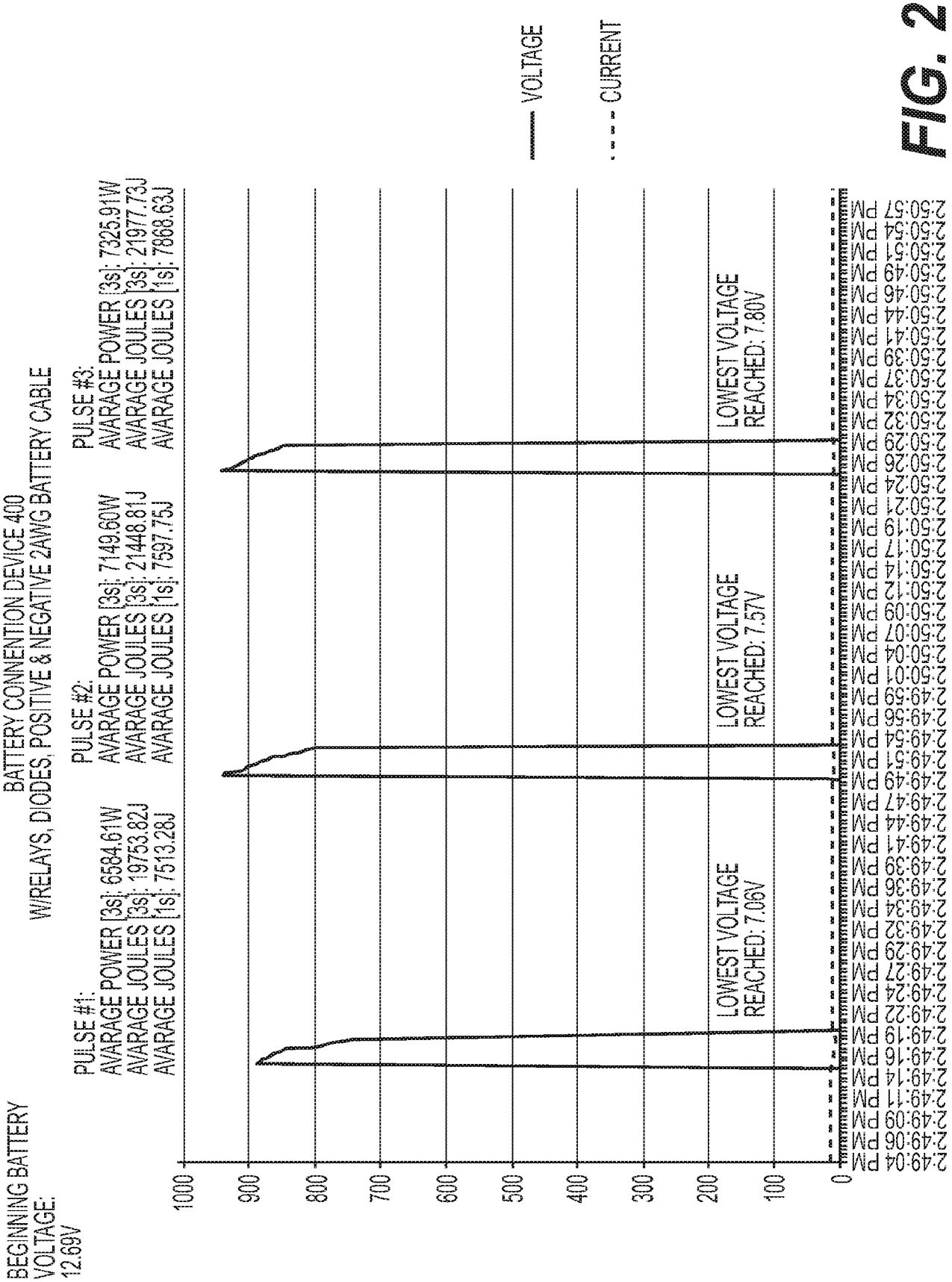

BEGINNING BATTERY VOLTAGE: 12.69V
BATTERY CONNENTION DEVICE 400
W/RELAYS, DIODES, POSITIVE & NEGATIVE 2AWG BATTERY CABLE
PULSE #1:
AVARAGE POWER [3s]: 6584.61W
AVARAGE JOULES [3s]: 19753.82J
AVARAGE JOULES [1s]: 7513.28J
PULSE #2:
AVARAGE POWER [3s]: 7149.60W
AVARAGE JOULES [3s]: 21448.81J
AVARAGE JOULES [1s]: 7597.75J
PULSE #3:
AVARAGE POWER [3s]: 7325.91W
AVARAGE JOULES [3s]: 21977.73J
AVARAGE JOULES [1s]: 7868.63J
VOLTAGE
CURRENT
LOWEST VOLTAGE REACHED: 7.06V
LOWEST VOLTAGE REACHED: 7.57V
LOWEST VOLTAGE REACHED: 7.80V
1000
900
800
700
600
500
400
300
200
100
0
2:49:04 PM
2:49:06 PM
2:49:09 PM
2:49:11 PM
2:49:14 PM
2:49:16 PM
2:49:19 PM
2:49:22 PM
2:49:24 PM
2:49:27 PM
2:49:29 PM
2:49:32 PM
2:49:34 PM
2:49:36 PM
2:49:39 PM
2:49:41 PM
2:49:44 PM
2:49:47 PM
2:49:49 PM
2:49:51 PM
2:49:54 PM
2:49:56 PM
2:49:59 PM
2:50:01 PM
2:50:04 PM
2:50:07 PM
2:50:09 PM
2:50:12 PM
2:50:14 PM
2:50:17 PM
2:50:19 PM
2:50:21 PM
2:50:24 PM
2:50:26 PM
2:50:29 PM
2:50:32 PM
2:50:34 PM
2:50:37 PM
2:50:39 PM
2:50:41 PM
2:50:44 PM
2:50:46 PM
2:50:49 PM
2:50:51 PM
2:50:54 PM
2:50:57 PM

FIG. 28

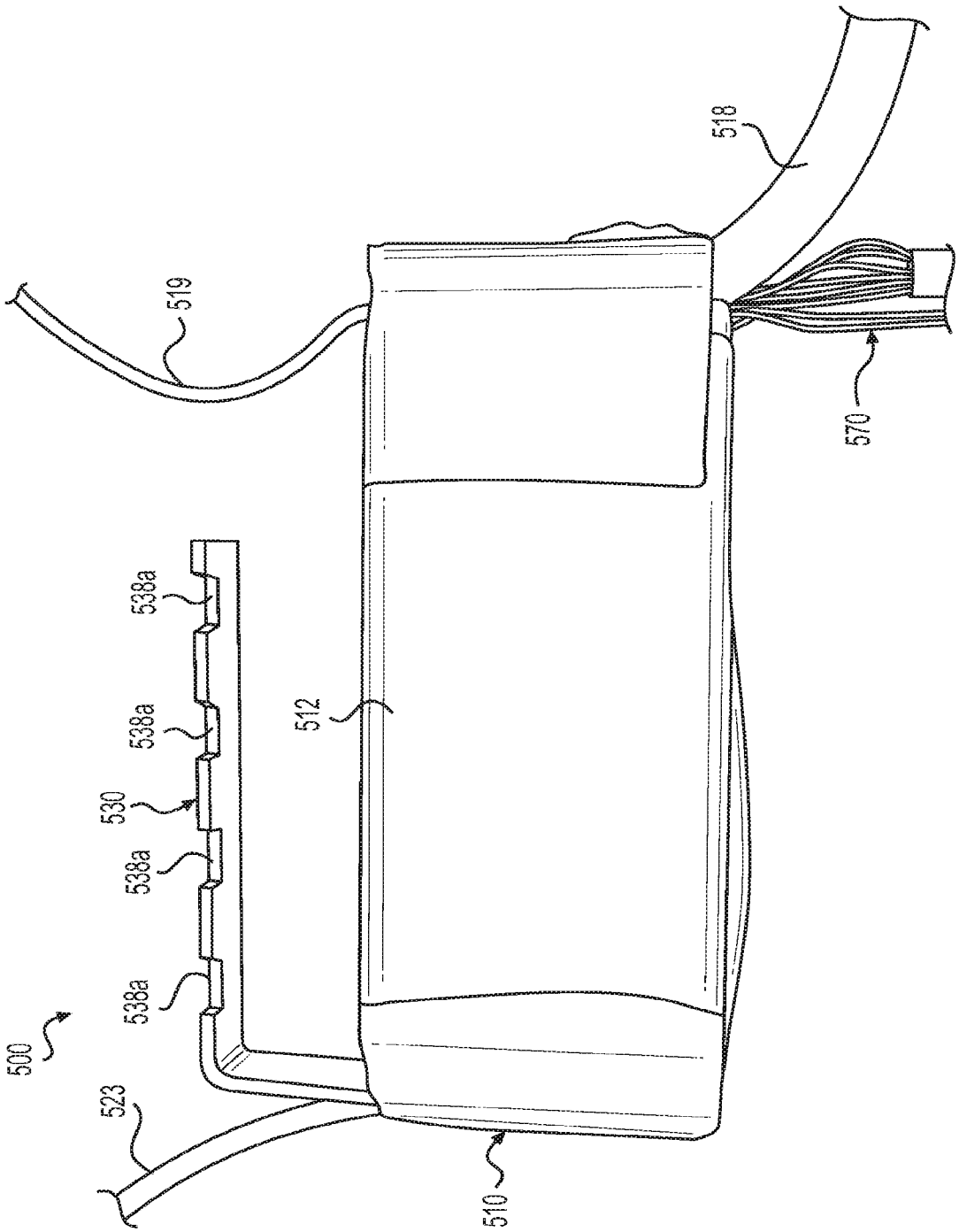


FIG. 29

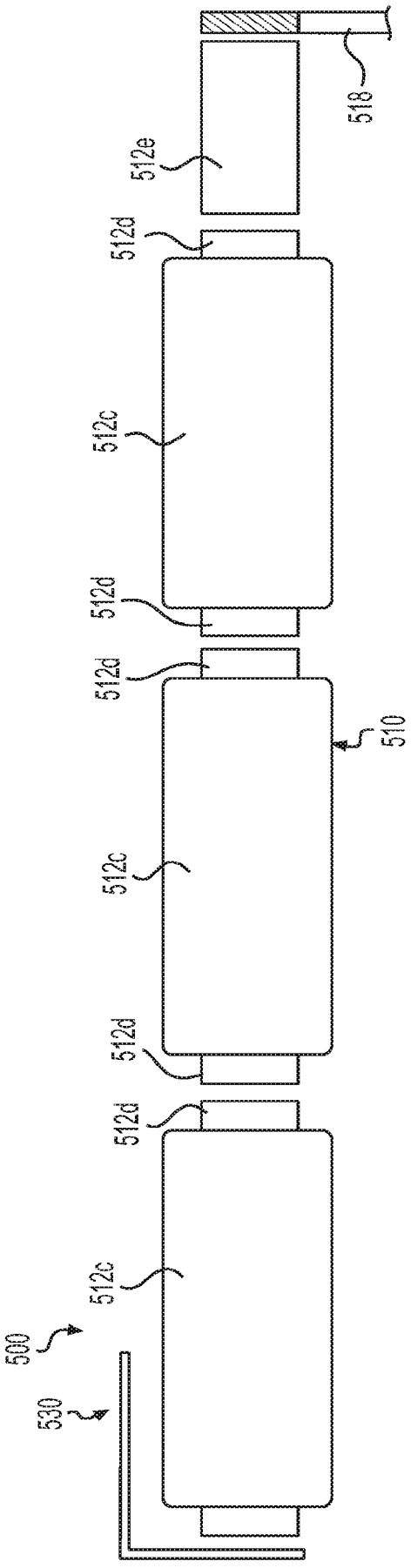

518
512e
512d
512c
512d
512d
510
512c
512d
512d
512c
500
530

FIG. 30

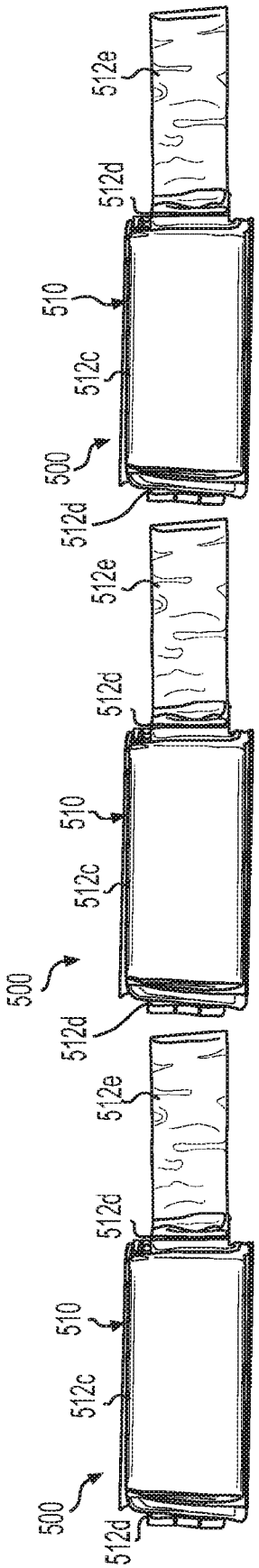

512e
512d
510
512c
500
512d
512e
512d
510
512c
500
512d
512e
512d
510
512c
500
512d

FIG. 31

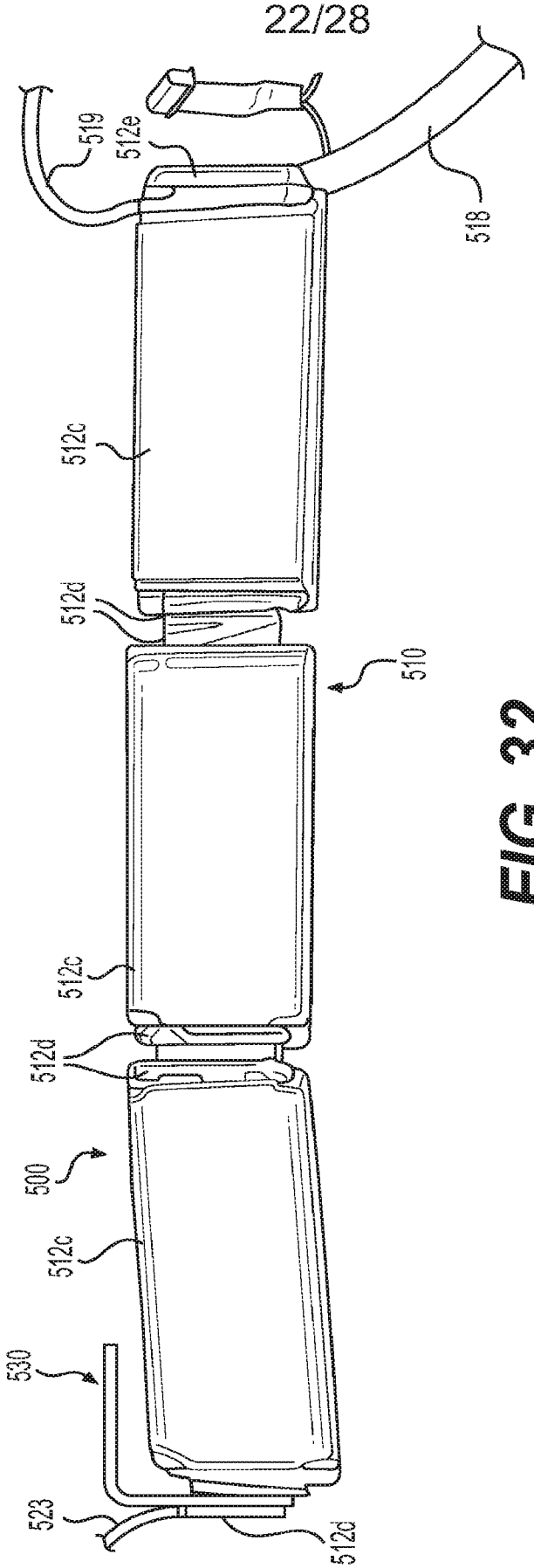


FIG. 32

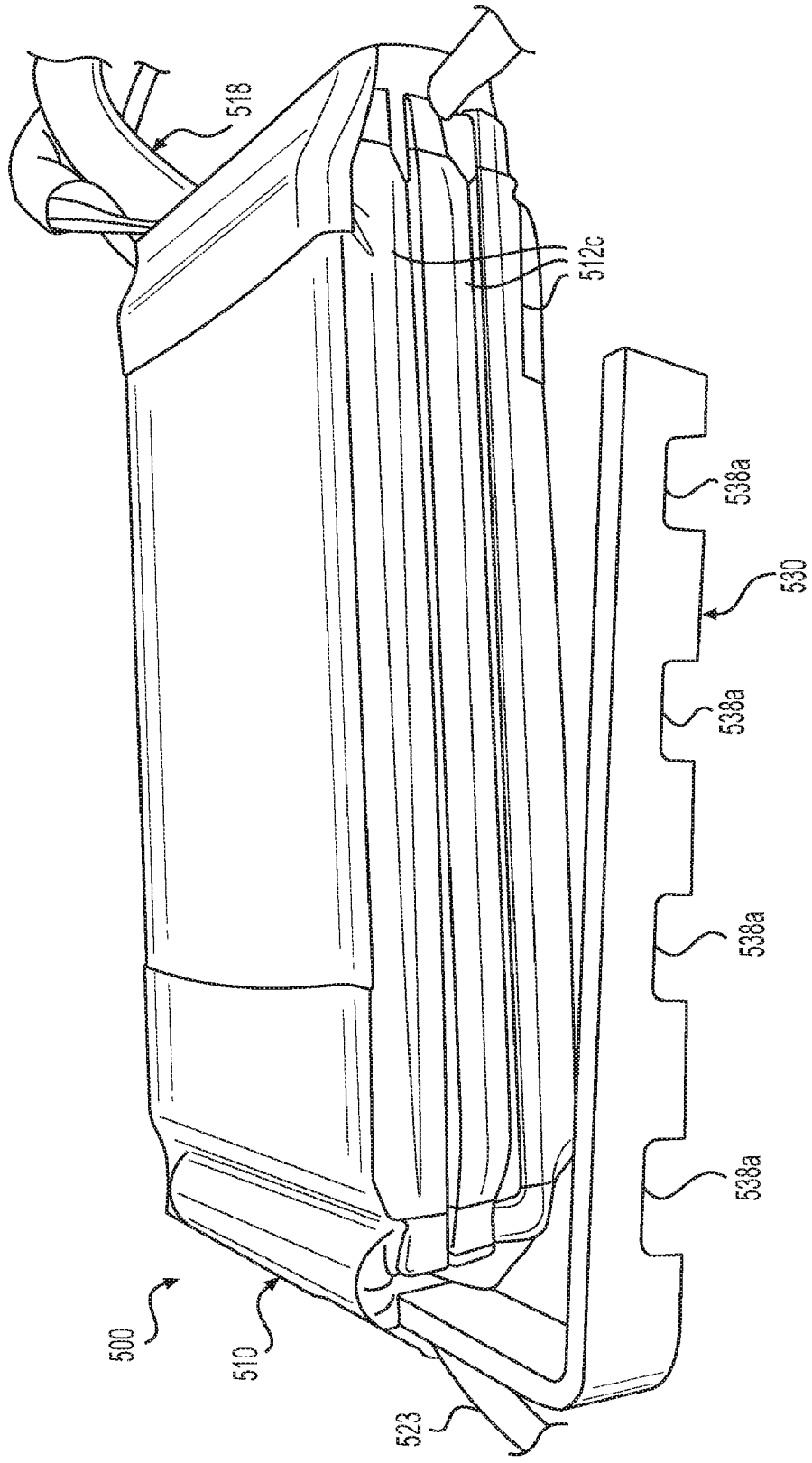


FIG. 33

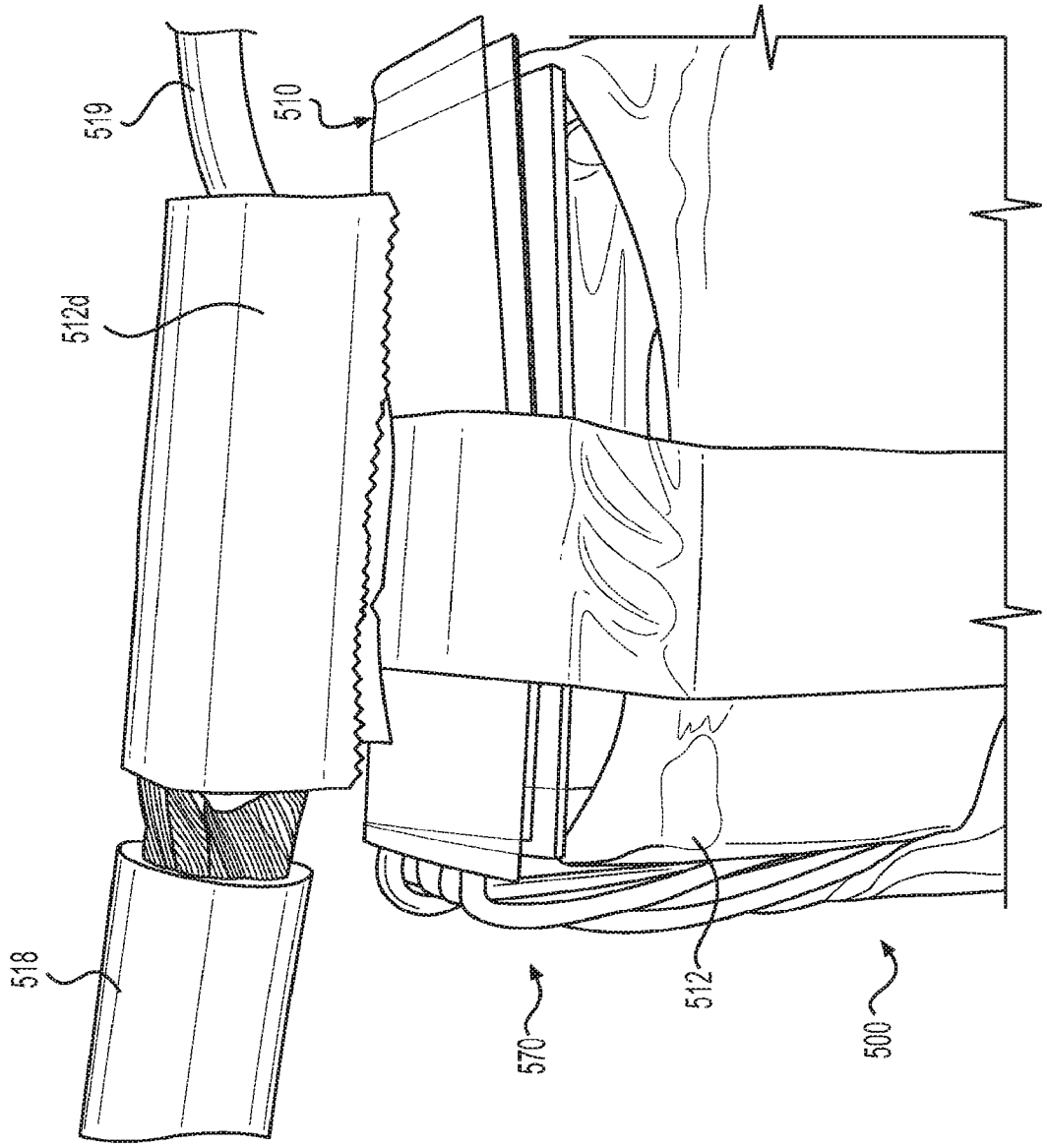


FIG. 34

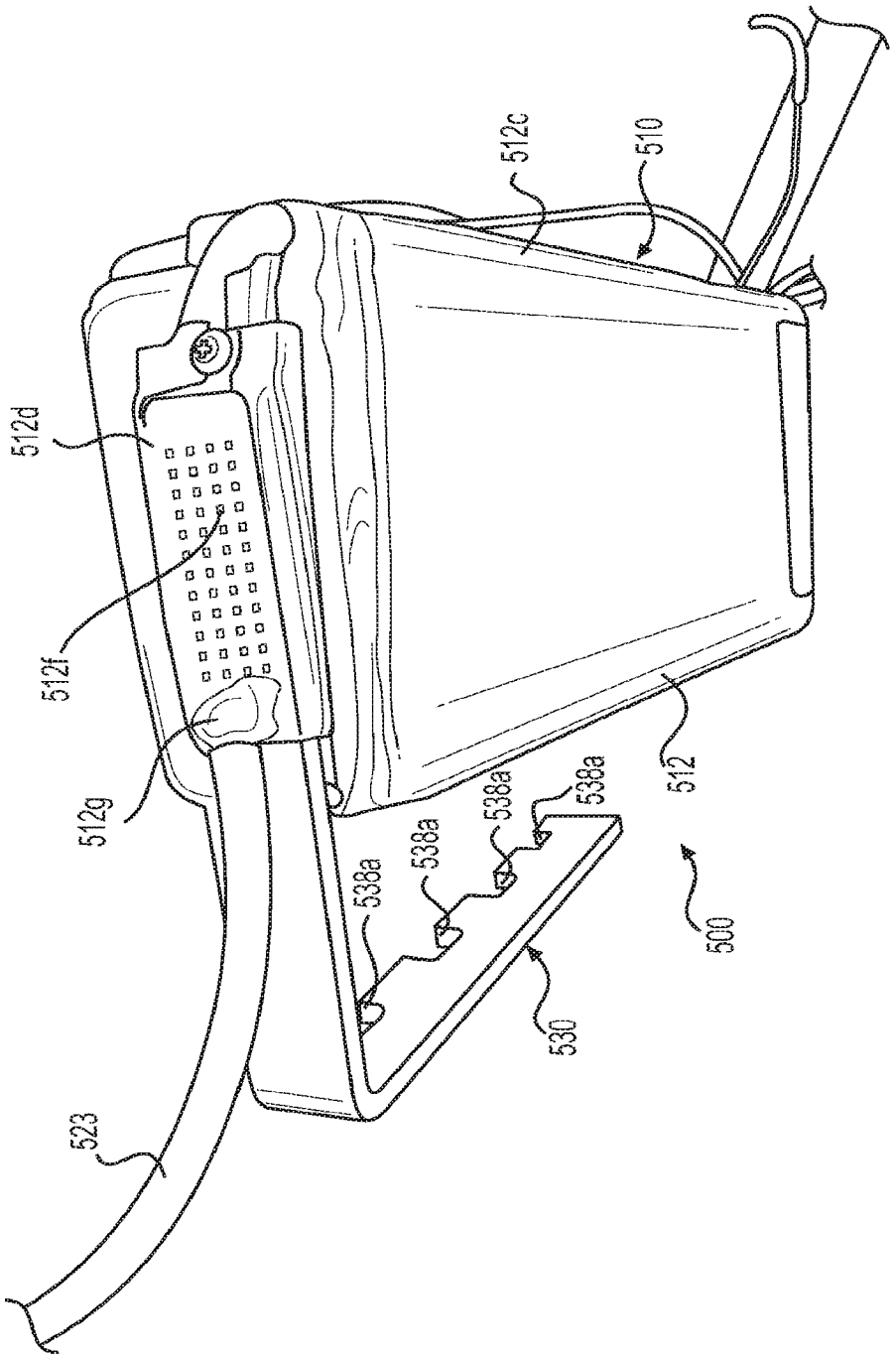


FIG. 35

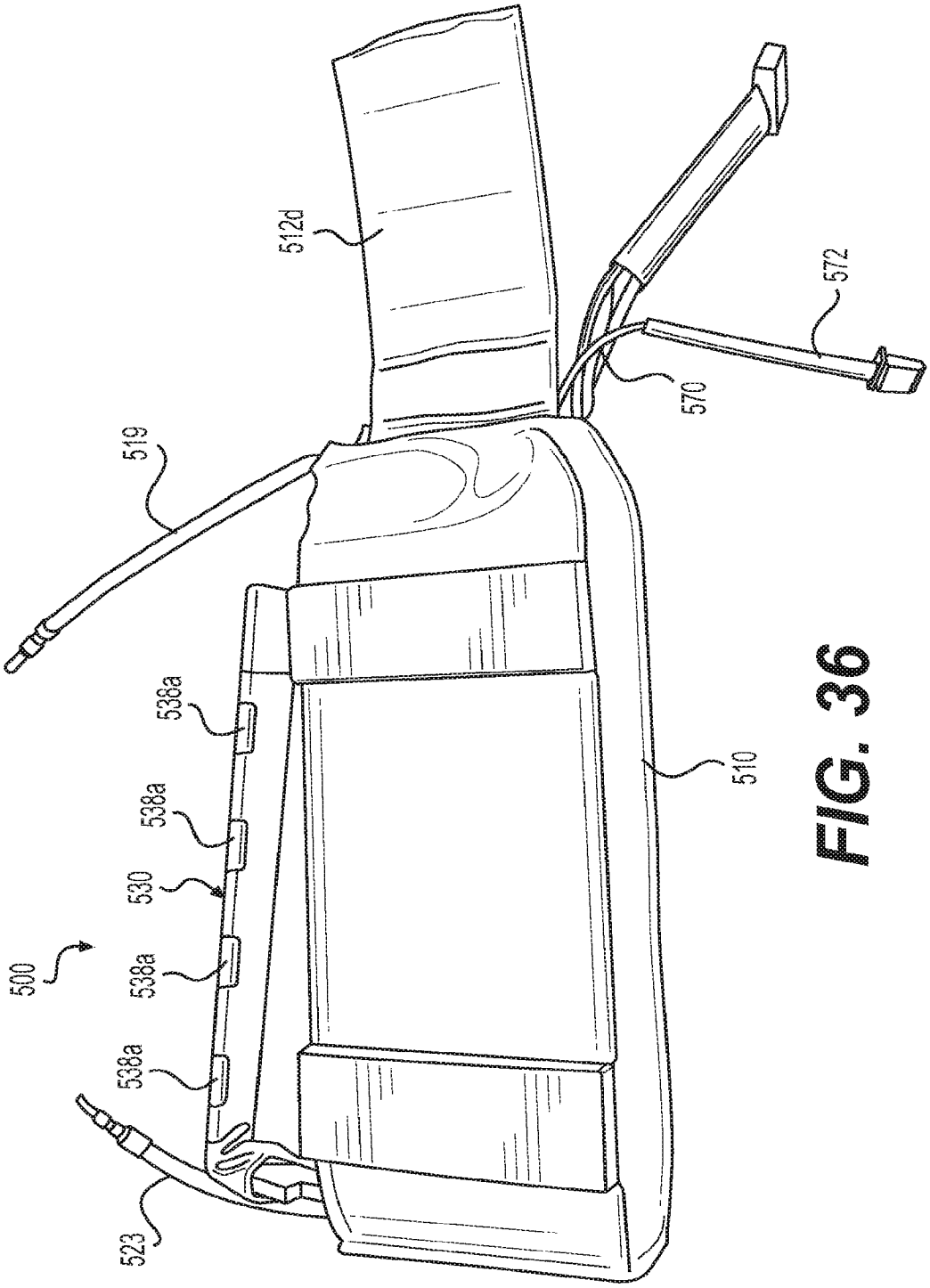


FIG. 36

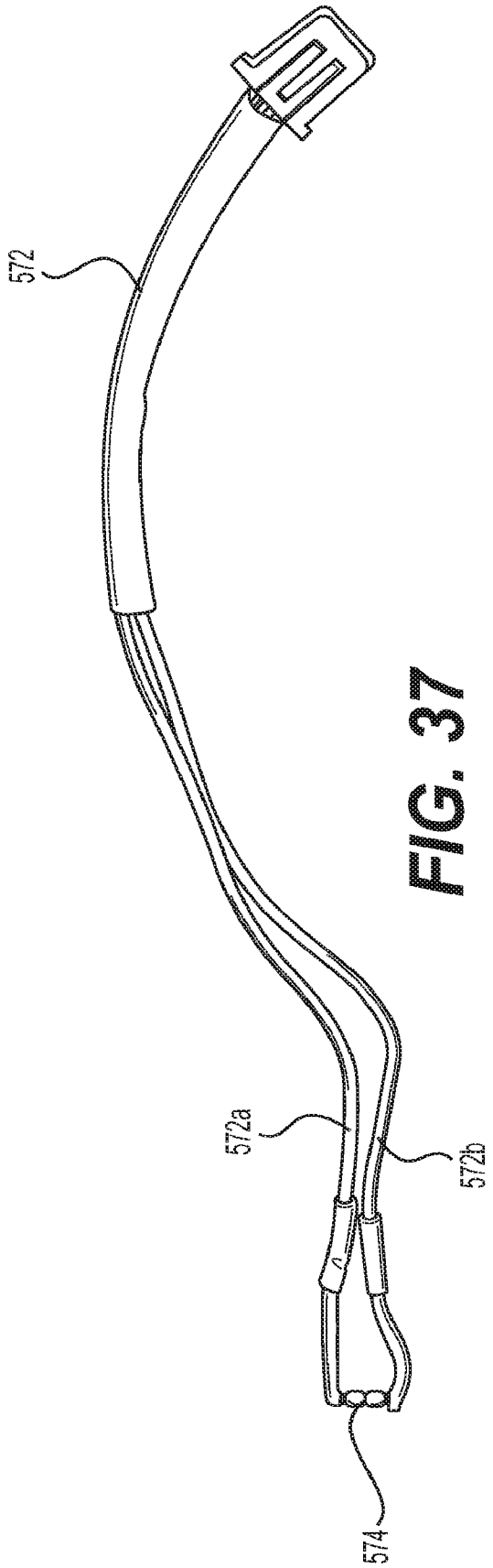


FIG. 37

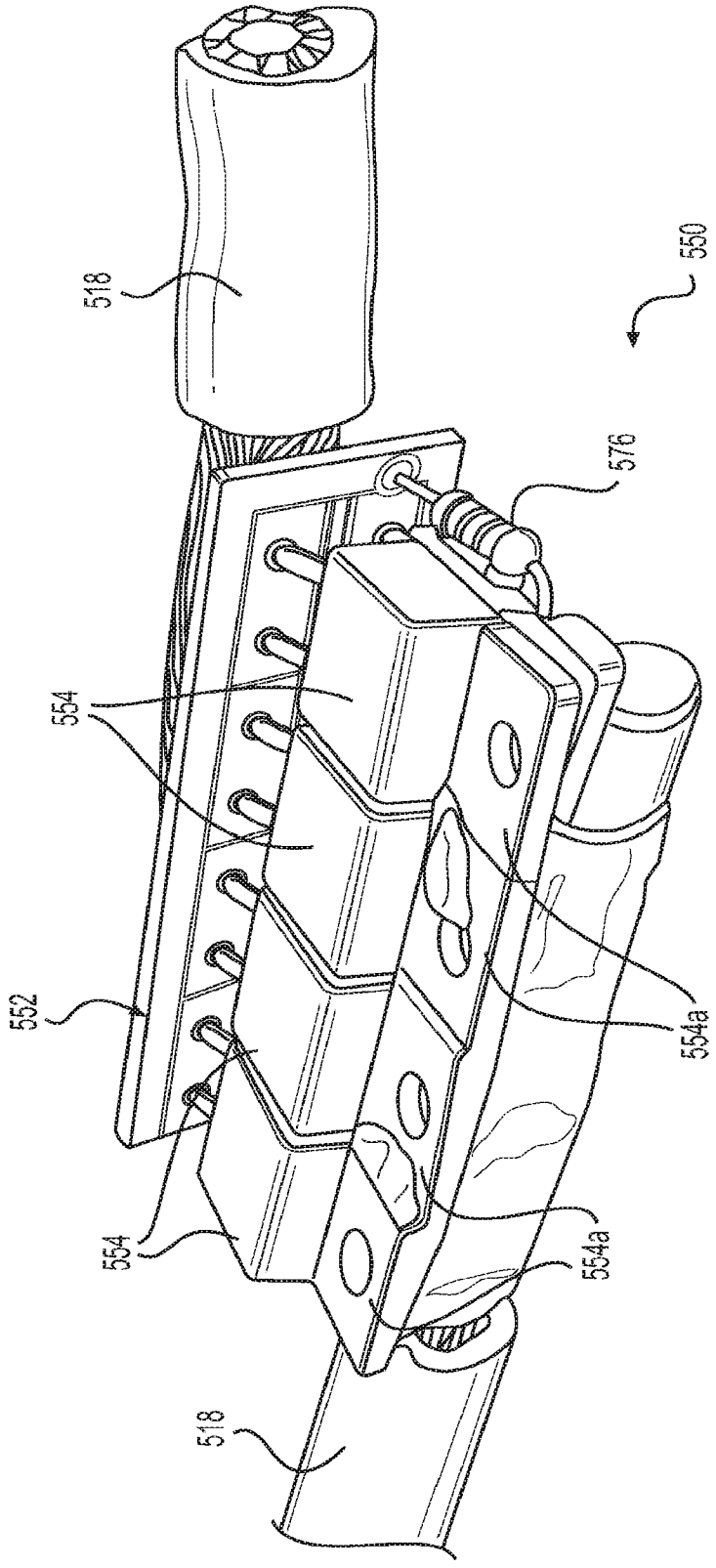


FIG. 38

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US17/17289

A. CLASSIFICATION OF SUBJECT MATTER
IPC - F02N 11/12, 11/14, 19/00; H02J 7/00, 7/32 (2017.01)
CPC - F02N 11/12, 11/14, 19/00; H02J 7/0029, 7/0031, 7/0044, 7/0054, 7/0057, 7/0075;

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,215,273 B1 (SHY, J) April 10, 2001; abstract; figures 1-3; column 2, lines 8-27 and 51-64	1-18
A	US 2016/0001666 A1 (THE NOCO COMPANY) January 7, 2016; abstract; figures 1-4; paragraphs [0020, 0028, 0031, 0036]	1-18
A	US 6,222,342 B1 (EGGERT, D et a.) April 24, 2001; abstract; figures 1-5; column 2, lines 20-32; column 3, lines 5-19; column 4, lines 32-50	1-18
A	US 2013/0241498 A1 (KOEBLER, M) September 19, 2013; entire document	1-18
P,Y	US 2016/0181587 A1 (KOEBLER, M et al.) June 23, 2016; entire document	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 April 2017 (11.04.2017)	04 MAY 2017
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 June 2012 (07.06.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/074548 A1

(51) International Patent Classification:
H02J 7/00 (2006.01)

(21) International Application Number:
PCT/US2011/001937

(22) International Filing Date:
28 November 2011 (28.11.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/458,657 29 November 2010 (29.11.2010) US
61/463,736 22 February 2011 (22.02.2011) US

(72) Inventor; and
(71) Applicant : **KOEBLER, Martin** [DE/US]; 630 Portside Drive, Davidson, NC 28036 (US).

(74) Agent: **DOUGHERTY, Ralph, H.**; RALPH H. DOUGHERTY, P.A., 4219 Kronos Place, Charlotte, NC 28209 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: LITHIUM STARTER BATTERY AND SOLID STATE SWITCH THEREFOR

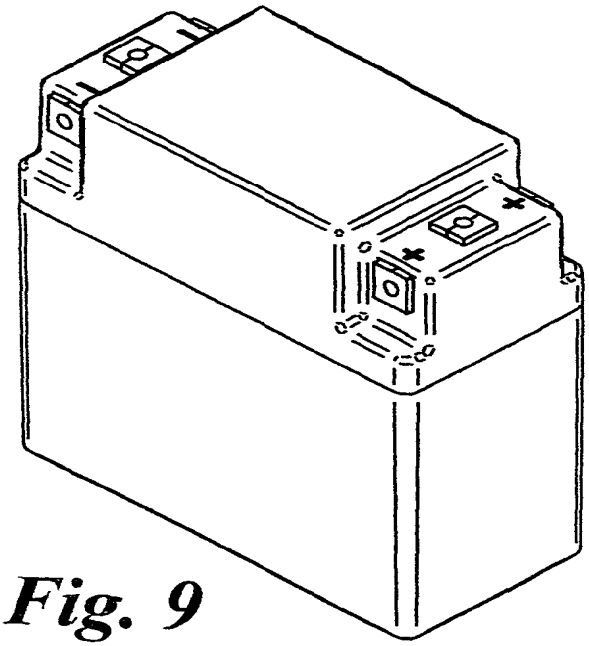


Fig. 9

(57) **Abstract**: Apparatus for increasing the efficiency of a starter battery for a starter motor of an internal combustion engine in a battery pack arrangement with one or more lithium based cells. The invention includes a solid state switching configuration for high powered battery systems for protecting against over-charging, over- discharging and short circuiting of batteries, especially starter batteries for internal combustion engines.

WO 2012/074548 A1

LITHIUM STARTER BATTERY AND SOLID STATE SWITCH THEREFOR

FIELD OF THE INVENTION

The present invention relates to a method and apparatus for starting an internal combustion (IC) engine. More particularly, the invention is a lithium-based cell for starting such engines. The invention includes a solid state switching configuration for high powered battery systems for protecting against over-charging, over- discharging and short circuiting of batteries, especially starter batteries for internal combustion engines (ICE).

BACKGROUND OF THE INVENTION

Presently, internal combustion engines use a starter battery comprised of lead-acid to turn over an electric motor to start an IC engine. Lead-acid batteries are heavy, bulky, and have short cycle life, short calendar life, and low turn around efficiency. Lead-acid batteries also have a high internal impedance (resistance) that is greater in cold weather making it more difficult to start an IC engine in cold weather with less current available. To overcome these variables, lead-acid starter batteries are provided with oversized battery capacity in order to produce the necessary current needed for an electric starter to start an IC engine. The oversized lead-acid battery increases the weight, space requirement, and cost needed to start an IC engine.

In order to turn off power terminals in presently known starter batteries, expensive electronic/electrical components are required to handle the high current loads that a starter motor needs to turn over an IC engine. These embody electronic protection circuitry for upper voltage cut-off (overcharging), lower level voltage cut-off (over discharging) and temperature measurements. These circuits also induce heat losses and electrical losses that can be large, as well as taking up additional space. (Noise) spikes can trigger false voltage, temperature or current readings that can terminate the battery system's operation, when in fact all the cells are working within safe specifications. Some of these protection circuits are temperamental and difficult to reactivate once they have been triggered. For example, if an under-voltage condition happens and the cells are still in under-voltage condition with a relay approach, current can not be provided to the cells since a path has been broken thus another button needs to be pressed to activate the system for a short duration in order to allow the cells to charge. Also, in some cases such as a military application or racing application, every last bit of

energy needs to be extracted, even if it damages the battery.

With any type of rechargeable (secondary) battery used, the battery does not operate well in a low state of charge (SOC), which in most cases is a low battery voltage. Whenever a battery is at a low voltage level, the battery can suffer internal damage permanently or the battery life can be drastically reduced. With battery chemistries such as lithium, over-charging a battery can be even more dangerous, potentially leading to an exothermal runaway reaction, which can create a fire. With a solid state switch placed in-line with the battery output power terminals, the solid state switch can be electronically controlled to open or close the current pathway leaving or entering the battery. This can prevent battery damage from happening if the battery voltage is brought too low or too high. This can be applied to any type of battery chemistry at any voltage. An example is to apply the solid state switch to a 12V car battery that starts a vehicle. A vehicle might have a voltage drain source left on, in which case the solid state switch would automatically turn off the current flow from the battery before the battery is damaged.

A relay or contactor could be used as well, but has the following disadvantages:

1) A relay or contactor continuously needs current to keep the contactor open or closed. That requires energy to do so.

2) A relay or contactor having a closed pathway allows current to flow in both directions and can not be controlled for a single direction.

3) A relay or contactor can only be ON or OFF. During a switching process for large currents large arcing can occur inside the relay or contactor, and that can cause the relay or contactor to "weld" shut. Once a relay or contactor is welded shut, no switching can occur at that point, which can be a safety issue, i.e., by not allowing switching to occur when needed.

4) Relays and contactors are large and bulky for larger current applications.

A better approach is to use a solid state switch either a FET, a MOSFET (metal–oxide–semiconductor field-effect transistor), or IGBT (insulated gate bipolar transistor) format, but not limited to these, in a unique configuration. The unique configuration involves connecting two solid state devices such as MOSFET or IGBT with the "Sources" or "Drains" tied together electrically. These solid state devices can be either N or P type. A doped semiconductor containing excess holes is called "p-type", and when it contains excess free electrons it is known as "n-type", where p (positive for holes) or n (negative for electrons) is the sign of the charge of the majority mobile charge carriers. This arrangement simplifies the control electronics needed and also allows current to flow in one direction but not the other with the internal diode. An FET (field-effect transistor) is a

majority-charge-carrier device having an active channel through which majority charge carriers, electrons or holes, flow from the source to the drain. Source and drain terminal conductors are connected to semiconductor through ohmic contacts. The majority charge carriers enter the channel through the source and leave the channel through the drain. Figure 15 shows the "Drain" of each terminal being connected, and Figure 16 shows the "Source" of each terminal being connected.

The advantages of a solid state switch are:

1) A solid state switch needs very little energy to activate an allowed pathway to be open or close.

2) A solid state device can gradually increase current, controlling inrush current that might occur switching ON large power applications or providing instant short circuit protection if the current is too high.

3) A solid state switch can be very compact and light for higher power applications.

DESCRIPTION OF THE PRIOR ART

Applicant is aware of the following U. S. Patent concerning battery packs for starting engines:

US Patent No.	Issue Date	Inventor	Title
7,525,287	April 28, 2009	Miyashi	BATTERY PACK FOR DRIVING ELECTRIC MOTOR OF COMPACT ENGINE STARTING DEVICE, ENGINE STARTING DEVICE DRIVEN BY THE BATTERY PACK, AND MANUAL WORKING MACHINE HAVING THE ENGINE STARTING DEVICE

SUMMARY OF THE INVENTION

The invention provides means for increasing the efficiency of a starter battery for a starter motor of an internal combustion engine. By replacing a lead-acid starter battery with a lithium base or lithium-iron-phosphate ($LiFePO_4$ or LiFePO) or $LiFeMgPO_4$ or $LiFeYPO_4$ cell, the needed capacity, weight and size is drastically reduced while increasing the cycle life, calendar life and turn around efficiency for a starter battery. The lithium iron phosphate ($LiFePO_4$) cell is a type of rechargeable cell, specifically a lithium ion cell, which uses $LiFePO_4$ as a cathode material. It may also include magnesium or yttrium in the lithium iron compound. Connecting four cylindrical cells in series, each of which has a standard industry

cell format size of both 18650 (less than 3Ah) or 26650 (less than 4Ah), or prismatic flat or other type cells, enough current is available to penetrate to a starter motor rated for 12V system to start large IC engines that use 1, 2, 3, 4, 5, 6, 8, or 12 cylinders. Larger cells may be utilized in the invention, from 1 Ah to 5000 Ah, common sizes being 5Ah, 10Ah, 20 Ah, 50Ah, 100Ah, 400Ah, and 500 Ah.

With a configuration of 4 cells in series, no protection circuit board is needed to protect the individual cells from over-voltage or undervoltage, unlike larger system using more cells which require a protection circuit board in them for safety protection. Individual cell balancing is also not needed for such a small starter battery but may be included to increase the product life. A smaller and lighter starter battery increases the performance of mobile systems that use starter batteries. The resulting increase of cycle life and calendar life reduces user costs.

No separate nor special charging system is needed with the invented system

The invention also comprises a housing for the lithium-based cells, with upper and lower mating casings, a contoured pad within the lower casing for receiving at least one lithium-based cell, and electrical connections from the at least one lithium-based batter to the exterior of the housing. Optionally, an upper battery pad may be placed in the upper casing, and, if desired, a protection circuit board, such as a balancing board or a cut-off circuit, may be placed within the upper casing for safety protection.

The invented solid state switch apparatus allows current to flow in one direction and not the other. A minimum of two solid state switches are arranged in a unique configuration, which allows current to flow in a controlled manner bidirectionally when needed. This is particularly useful for preventing overcharging or over- discharging an entire battery pack. A separate cell balancing circuit is used to balance out the individual cells. The solid state switch can be used on each individual cell, if desired, to prevent overcharging or over-discharging of the individual cell. It can be used with any battery application in which charging and discharging is required, and is particularly useful with lithium-based batteries. It can also be used with lead-acid batteries, nickel-cadmium (NiCd) batteries, and low self-discharge nickel metal hydride (NiMH) batteries. More sophisticated items of equipment to which a battery may be attached have programmable shut-off settings, but less sophisticated equipment does not have shut-off parameters in place. Using a battery in a starter applications (for instance, to start an IC engine) will prevent the battery from overcharging, as well as prevent the battery from being discharged to too low a level if a current drain (leakage) is present in the system, even though everything is turned off.

WINPLUS Ex. 1003, p. 1266

By connecting the "Sources" or the "Drains" together using a minimum of two solid state devices allows for automation and simplification to fully and partially switch the batteries power terminals ON and OFF. The two solid state devices can either be N or P type and connected either on the Positive or Negative side of the battery terminal and controlled by simple electronic circuit to control the drivers of the solid state devices.

This invented switch configuration also allows for short circuit protection across the battery power terminals, along with allowing the maximum current control when charging.

OBJECTS OF THE INVENTION

The principal object of the present invention is to provide means for increasing the performance of a starter battery for a starter motor of an internal combustion engine.

Another object of the invention is to provide a starter battery for an internal combustion engine that is lighter, more reliable, has less bulk, longer cycle life, longer calendar life, and higher turn around efficiency than lead-acid batteries.

A further object of this invention is to provide a starter battery system for an internal combustion engine that is easy to assemble, waterproof, and maintenance free.

Another object of the invention is to provide a starter battery for an internal combustion engine that can be used in existing vehicles.

Another object of the invention is to provide a starter battery for an internal combustion engine that has a wide operating temperature range with exceptional cold-weather cranking performance.

Another object of the invention is to provide an improved apparatus for protecting a single cell or battery from being overcharged or over-discharged.

Another object of the invention is to provide apparatus for charging a cell having a very low charge.

Another object of the invention is to provide apparatus for short circuit protection for one or more cells or batteries.

Another object of the invention is to provide apparatus for discharging a cell having too high a charge.

A further object of the invention is to provide an apparatus for short circuit protection in case a metal object causes a short circuit across the terminals.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects will become more readily apparent by referring to the

following detailed description and the appended drawings in which:

Figure 1 is an exploded isometric view of one embodiment of the invention, in which 4 cells are arranged into a starter battery pack.

Figure 2 is an exploded isometric view of another embodiment of the invention, in which 8 cells are arranged into a starter battery pack.

Figure 3 is an exploded isometric view of another embodiment of the invention, in which a prismatic cell is arranged into a starter battery pack.

Figure 4 is a front view of the assembled battery pack of Figure 3, the rear view being identical.

Figure 5 is a top view of the assembled battery pack of Figure 3.

Figure 6 is a right end view of the assembled battery pack of Figure 3, the left end view being a mirror image thereof.

Figure 7 is a schematic diagram of a block of 4 lithium prismatic cells in series connected to a balancing circuit board.

Figure 8 is a schematic diagram of a block of 4 lithium prismatic cells in series connected to a balancing and cutoff circuit board

Figure 9 is an isometric view of an alternative embodiment of a housing showing contacts for switches.

Figure 10 is a top view of the housing of Figure 9 showing the contact locations.

Figure 11 is a front view of the housing of Figure 9, the rear view being identical.

Figure 12 is an end view of the housing of Figure 9, the opposite end being identical.

Figure 13 is an exploded isometric view of an alternative embodiment of the invention of Figure 3, in which 2 blocks of prismatic cells and a control board of cutoff switch are arranged into the housing of Figure 9.

Figure 14 is a schematic diagram of a Solid State Switch with "Drain" connection.

Figure 15 is a schematic diagram of a Solid State Switch with "Source" connection.

Figure 16 is a schematic diagram showing a preferred embodiment of the invention in which the "Drain" of each gate is connected together using N type MOSFET or IGBT with the cells being above the solid state switches.

Figure 17 is a schematic diagram example of connecting the "Drain" of each gate together using N type FET, MOSFET, or IGBT with the cells being below the solid state switches.

Figure 18 is a schematic diagram illustrating connecting the "Source" of each gate together using N type FET, MOSFET or IGBT with the cells being above the solid state

WINPLUS Ex. 1003, p. 1268

switches.

Figure 19 is a schematic diagram illustrating connecting the "Source" of each gate together using N type FET, MOSFET or IGBT with the cells being below the solid state switches.

Figure 20 is a schematic diagram illustrating connecting the "Drain" of each gate together using P type FET, MOSFET or IGBT with the cells being above the solid state switches.

Figure 21 is a schematic diagram illustrating connecting the "Drain" together using P type FET, MOSFET or IGBT with the cells being below the solid state switches.

Figure 22 is a schematic diagram illustrating connecting the "Source" together using P type FET, MOSFET or IGBT with the cells being above the solid state switches.

Figure 23 is a schematic diagram illustrating connecting the "Source" together using P type FET, MOSFET or IGBT with the cells being below the solid state switches.

Figure 24 is a schematic diagram illustrating the invention utilized in engine restarting.

Figure 25 is a schematic diagram illustrating short circuit protection of a battery.

DETAILED DESCRIPTION

Lithium containing LiFePO, $LiFePO_4$, $LiFeMgPO_4$, and $LiFeYPO_4$ cells have a low nominal cell voltage (3.2V-3.3V) that match directly with existing 12V lead-acid equivalent systems. Four LiFePO cells in series have a nominal voltage of 13.2V. Thus they can directly replace existing 12V lead-acid equivalent systems without requiring any electrical modification.

Other lithium chemistries have a higher nominal voltage, such as: lithium-cobalt (3.6V), lithium-manganese (3.7V-3.8V), lithium-nickel-cobalt-manganese (3.7V). Each of these thus have a higher system voltage when 4 cells are used in series. With the higher cell voltages, most existing 12V direct replacement systems will not be able to charge other lithium cell chemistries above 60% of their capacity. Other lithium-based cells that can be utilized in this invention are lithium-cobalt-oxide ($LiCoO_2$), lithium-manganese-oxide ($LiMn_2O_4$), lithium-nickel-cobalt-manganese-oxide ($LiNiCoAlO_2$), lithium-nickel-manganese-cobalt-oxide ($LiNiMnCoO_2$), and lithium-titanate ($Li_4Ti_5O_{12}$).

LiFePO, $LiFePO_4$, $LiFeMgPO_4$, and $LiFeYPO_4$ cells also have a higher thermal runaway condition than lead-acid cells. For a thermal runaway to occur, the cell temperature must be extremely hot (over 200°C). When a cell reaches a certain temperature, mostly caused by overcharging, then the cell will start producing more heat by an internal reaction

that fuels itself in most cases with a fire, which phenomenon is known as "thermal runaway". All other Lithium cell chemistries have a lower thermal runaway temperature making those cells more prone to catch on fire.

A thermal venting cap is usually placed inside each individual cylindrical cell casing to minimize the chances of explosion. The venting cap allows the electrolyte of a cell to leak out before an internal fire can occur.

Although it is advantageous to use protective circuitry, it is possible to operate the present invention without protective circuitry, which simplifies the system to allow charging or discharging. Omitting all of the electronic protection circuitry for upper voltage cut-off (overcharging), lower level voltage cut-off (over discharging) and temperature measurements reduces the overall manufacturing cost of the starter battery. This also simplifies the system to allow charging or discharging in all conditions and not be restricted by any suggested or specified operating range.

By using lithium cells, a battery housing structure is both smaller and lighter than with lead-acid cells. Any time less internal mass is involved the housing structure size can be reduced, which also results in reducing cost.

The housing structure of the embodiment of Figures 1 and 2 may vary in depth to accommodate varying numbers of cells which provides for different capacity. The lid structure of the housing (or casing) for cylindrical cells is the same for most battery packs, as shown. Such cells can be stacked in parallel to allow for larger capacity for different battery packs to be assembled. The lid of the housing also incorporates a threaded bushing made from aluminum to minimize weight, but that has similar electrical properties to aluminum, copper or brass, or an internally threaded hole to receive an electrical connector screw.

Referring now to the drawings, and particularly to Figure 1, the invented battery pack 10 comprises a housing12, having a lower receptacle 14 and a mating top 16, at least one lithium-based rechargeable battery 18, or cell, within the housing, with appropriate electrical connections. The total discharging amount of each lithium-based cell in the battery pack is one (1) to 5000 Ah, and charging voltage per one cell is 3.0 to 4.2 V.

The lower portion of the housing 16 can be provided with bottom padding 20 which fits therein, receives the cell or cells, and mates with the lower receptacle 14. A top pad 22 can be provided in the top 16 of the housing, as desired.

Electrical connections 24 are provided between the cells, as shown, positive to negative, with screws 26 connecting the cells through holes 28 the bottom of the housing to electrical leads, not shown, but which leads connect to bottom screws 30. Alternatively, a

welded connection can be used instead of screws.

Optionally, a protection circuit board 32 may be placed within the upper casing or top 14 for safety protection. Such a protection circuit board may be a cutoff board or a cell-balancing circuit board. A cell-balancing circuit board may include a cutoff function. A lithium iron battery having two or more cells in series has a battery voltage equal to the sum of the individual cell voltages. Over the life of the battery, it may be charged and discharged for hundreds or thousands of cycles. The individual cells may age differently. Some cells may become mismatched with respect to the others. This phenomenon is corrected, by balancing. Balancing is the process of forcing all of the cells to have identical voltages. This is accomplished by a balancing circuit.

Starter battery systems can utilize a greater number of lithium cells as desired for greater capacity.

Lithium cells have substantially less weight than a lead-acid cell, and are 80% smaller. A lithium cell will last about 3 times as long as a lead-acid cell with 100% full discharge cycles. Lithium cells are maintenance free, whereas lead-acid cells need to be refilled with distilled water to maintain the acid level above the plates. Lithium cells do not freeze. They have a discharge power 8 times that of lead-acid. Their charging time is less than 2 hours.

Lithium cell self discharge rate is less than 2% monthly, whereas the self discharge rate for a lead-acid cell is 10% monthly.

Lithium cells can operate at very high temperature, up to 70°C without major degradation. They can also operate at very low temperature, down to -30°C with slight capacity degrade at that temperature, but power is available.

Lithium cells are 98% energy efficient (energy going in and out of the cell), whereas lead-acid cells are only 90% energy efficient.

For each 12 volt increment, four $LiFePO_4$ cells are required in series, and some cases fewer cells with other lithium chemistries. The following Table I compares lead-acid battery voltages to the $LiFePO_4$ cell requirements and for other lithium-based battery cells:

TABLE I

Nominal Lead-Acid Voltage	$LiFePO_4$ (3.3V nominal)	($LiCoO_2$), ($LiMn_2O_4$), ($LiNiCoAlO_2$), ($LiNiMnCoO_2$), or ($Li_4Ti_5O_{12}$) (3.7V nominal)
12V	3 to 4 cells in series	2 to 4 cells in series
24V	5 to 9 cells in series	5 to 8 cells in series
36V	8 to 13 cells in series	7 to 12 cells in series
48V	11 to 17 cells in series	10 to 16 cells in series
60V	14 to 22 cells in series	12 to 19 cells in series
72V	16 to 26 cells in series	15 to 23 cells in series
84V	19 to 31 cells in series	17 to 27 cells in series
96V	22 to 35 cells in series	19 to 31 cells in series
108V	25 to 39 cells in series	22 to 35 cells in series
120V	27 to 44 cells in series	24 to 39 cells in series

As shown in Figures 3 through 6, a block 40 formed of one or more flat prismatic cells connected in series is fitted into a housing 12, each block of cells having a common set of electrical connections 42A and 42B. A protection circuit board 30 is provided within the housing, and is electrically connected to the block. Figures 4 through 6 show the assembled housing with the electrical connections 24A and 24B in the top thereof.

Figure 7 shows a block of 4 flat lithium based prismatic cells connected to a balancing circuit board 46, which has a balancing controller or microprocessor 60. Figure 8 shows a block of 4 flat prismatic cells connected to a balancing and cutoff circuit board 48, which includes a controller 60 and a solid state cutoff switch 62, such as an FET. Figures 9 through 12 show the housing 12 for the battery pack 10 with positive terminal 34 and negative terminal 36.

Figure 13 shows multiple blocks 40 of flat cells along with bottom padding, packing, or spacers 50, flat packing 52, and large packing blocks 54, all of which packing is optional. The upper portion or top section 56 of the housing is advantageously provided with three contacts on each end thereof, as shown.

An auto-detect restart feature is especially useful for a motorcycle: "IQ Restart technology" protects the battery from a deep cycle discharge by monitoring battery voltage level and shutting the battery power off prior to a full discharge, such as in the case of leaving

WINPLUS Ex. 1003, p. 1272

a headlight or electrical component on for an extended period of time while the engine is off. Enough reserve power is left in the battery, to automatically detect (by measuring a change in resistivity) a starting effort and allow the user to start the engine again. This avoids the cyclist being stranded or the headache of replacing a battery. The auto-detect apparatus has at least one lithium-based cell, a voltage detector, an associated switch such as a cutoff board, or a micro-controller in a balancing circuit connected to a solid state switch, such as an FET. One function turns off an FET in the circuit when the voltage drops to a preselected level, leaving sufficient reserve capacity for starting the engine. A second function detects a "keying cycle" or the resistance change upon attempting to start the engine, which turns on the FET. This resistance change is a reaction to a key turn, push button, or remote activator.

To control the solid state switches, electronic controls are needed for the different voltages, currents and/or temperature with specified parameters in which cells work to prevent damage. The control electronics used in battery systems are often referred to a Battery Management System (BMS) or Battery Management Unit (BMU). The BMS or BMU can individual monitor all the cell or battery voltages, and/or temperatures. To protect a single cell or battery from being over charged, that might lead to an exothermal runaway reaction creating a fire and/or to prevent the cell from damaging when discharging them too low, the solid state switch would close or open the current pathway to prevent cell damage from occurring.

The arrangement of devices shown in Figures 15 and 16 are examples of how solid state switches can be configured to connect the "Drains" or "Sources" together which is an unconventional approach. The solid state switches in parallel are examples to increase the current capabilities.

Referring particularly to Figure 17, under normal operations both T1 and T2 are ON allowing power pathway to go in both directions: discharge and charge. Should a cell be outside of its specified working specification (cell voltage), both D1 and D2 can be turned off but current can still flow through the internal diode to allow for added functionality.

In the event that the cell voltage drops too low, below the set voltage configuration, from a drain on the battery, T1 will turn off, preventing further discharge from occurring. However, with the internal diode in place of T1, and T2 still on, the circuit will allow charging to occur.

If the cell voltage goes too high, above the set voltage configuration, T2 will turn off, preventing further over charging from occurring. However, with the internal diode in place of T2, and T1 still on, the circuit will allow discharging to occur.

WINPLUS Ex. 1003, p. 1273

Using solid state switching in the configuration shown in Figure 17 allows for user friendly reactivation of the circuit without any pushbuttons or reset buttons. Both Charge and Discharge current can go through the internal MOSFET or IGBT diode to bring the cell back to the specified operating voltage.

Alternative switch and gate arrangements are set forth in Figures 18 through 23. Each such arrangement works in a similar manner as that describing the Figure 17 operation.

The invention's restart function is illustrated by Figure 24. Controller 60 is connected to a battery pack having a block of cells 64 and to MOSFETs Q1 and Q2. After a low voltage cutoff, the controller periodically tests the load to detect a change in the load impedance. When an abrupt change in the load impedance is detected, for example connecting or disconnecting a load such as the headlight(s), the ignition switch, or the starter switch, the controller 60 turns on power MOSFETs Q1 and Q2, which reconnects the battery to the vehicle and allows the vehicle to be restarted.

When the controller drives the base of Q3 high through R1, Q3 and Q4 turn on. When Q4 turns on, it connects the battery to the load through R4 and D1. R4 and the load impedance form a voltage divider, and the resulting voltage at node A will depend on the load impedance. D2 steers the node A voltage to the R5/R6 voltage divider which scales down the voltage at node B to a level that the controller can read using an analog-to-digital converter (ADC). The ADC may be of the type commonly included as a built-in peripheral in a micro-controller or a digital signal processor; alternatively the ADC may be a standalone device. After turning on Q4, the controller may make one or more ADC readings after one or more fixed or variable delay periods. By reading the ADC at different times after turn-on, the controller can infer not only the resistive, but also the inductive and/or capacitive components of the load impedance. By tracking the periodic ADC readings and applying the appropriate digital filtering, abrupt changes in the load impedance can be determined. Gradual changes in the ADC readings, which may be caused for example by temperature changes or battery charge depletion, are disregarded (i.e., filtered out). Immediately after making the required ADC reading(s) the Controller turns off Q3 and Q4 to minimize battery drain. It should be noted that while Q3 and Q4 are shown here as bipolar junction transistors, a number of other types of electronic devices could be used to accomplish the switching function of Q4, including but not limited to one or more MOSFETs or a relay.

In order to conserve battery charge as long as possible in low voltage cutoff mode, the controller tests the load impedance only as often as necessary. The testing period is determined by the application, and is approximately 1 to 5 seconds. In a vehicle application,

this period represents the maximum time that a user would have to hold a starter switch in the start position in order to effect a restart after a low voltage cutoff. To further reduce drain on the battery, the testing period may be extended if the battery remains in low voltage shutdown mode for a long time, or if the battery voltage (in one or more cells) continues to drop.

The invention is useful for short circuit protection as shown in Figure 25. Cross-coupled NAND gates E and F form a set-reset (SR) latch that controls the gate drive of power MOSFET Q2. The latch is set when the controller 60 drives Q2 ENABLE low. When Q2 ENABLE is driven high again, the output of NAND gate G is low and NAND gate H turns on Q3, which turns on Q4, which supplies the boosted gate drive voltage to turn on Q2. C3 and C4 help ensure fast turn-on of Q2 even with the relatively high value resistors for R4, R5, and R8 required to satisfy the application's low power requirements.

Current monitor A monitors the voltage drop across the drain-source ON resistance ($R_{DS(on)}$) of power MOSFET Q1 and sources a current into node B that is proportional to the MOSFET current. R1 converts this current to a voltage that is compared to VREF at comparator D. When a short circuit occurs, the voltage at node B will exceed VREF (at least momentarily) and cause the output of D to go low, resetting the S-R latch. When the S-R latch is reset the output of G will go high, and C2 will differentiate a positive going pulse into the base of Q5, causing Q5 to turn on for a few microseconds and rapidly discharge the gate of Q2. Rapid turn-off of Q2 is essential to limiting the energy associated with a short circuit event. By monitoring the status of the S-R latch, the controller 60 can determine when a short circuit cut-off event has occurred. C1 low pass filters the signal at node B so that extremely short duration overcurrent conditions can be tolerated if desired. The controller 60 may adjust VREF to compensate for Q2's $R_{DS(on)}$ variation with temperature if desired, or to adjust the over current trip threshold.

The solid state switches can be transistors, FET (field-effect transistors), JFET or JUGFET (junction gate field-effect transistors), BJT bipolar junction transistors, CMOS (complementary metal–oxide–semiconductors), VMOS (Vertical Metal Oxide Silicon), TMOS transistors, vertical DMOS (Double-Diffused MOS), or HEXFET.(hexagonal shape MOSFET).

It should be noted that the invented solid state switch apparatus can also be used in any battery system that requires charging and discharging in order to extend the battery life, and for safety. This is extremely useful and is a first for starter batteries.

The solid state devices all must be the same (N) or (P) type used in the same circuit, as illustrated.

SUMMARY OF THE ACHIEVEMENT OF THE OBJECTS OF THE INVENTION

From the foregoing, it is readily apparent that I have invented an improved means for increasing the performance of a starter battery for a starter motor of an internal combustion engine, and a starter battery for an internal combustion engine that is lighter, more reliable, has less bulk, longer cycle life, longer calendar life, and higher turn around efficiency than lead-acid batteries. The starter battery system for an internal combustion engine is easy to assemble, waterproof, and maintenance free, can be used in existing vehicles, and has a wide operating temperature range with exceptional cold-weather cranking performance. The invention also apparatus for protecting a single cell or battery from being over charged, as well as providing apparatus for charging a cell having a very low charge, more effectively, and more economically than heretofore has been possible.

It is to be understood that the foregoing description and specific embodiments are merely illustrative of the best mode of the invention and the principles thereof, and that various modifications and additions may be made to the apparatus by those skilled in the art, without departing from the spirit and scope of this invention, which is therefore understood to be limited only by the scope of the appended claims.

WINPLUS Ex. 1003, p. 1276

What is claimed is:

1. A battery pack for driving an electrical device, said battery pack comprising:

a housing; and

at least one lithium-based rechargeable cell within said housing;

wherein a total discharging amount of each lithium-based cell in the battery pack is from one (1) Ah to 5000 Ah, and charging voltage per one cell is 3.0 to 4.2 V.

2. A battery pack according to claim 1 wherein the lithium-based cell is a lithium iron phosphate cell.

3. A battery pack according to claim 2, wherein the lithium iron phosphate cell is selected from the group consisting of LiFePO, $LiFePO_4$, $LiFeMgPO_4$, and $LiFeYPO_4$ cells.

4. A battery pack according to claim 1 wherein the lithium-based cell is selected from the group consisting of $LiCoO_2$, $LiMn_2O_4$, $LiNiCoAlO_2$, $LiNiMnCoO_2$, and $Li_4Ti_5O_{12}$ cells.

5. A battery pack according to claim 1, wherein said battery pack comprises four lithium-based rechargeable cells in series in said housing.

6. A battery pack according to claim 1, wherein said battery pack comprises an even number of lithium-based rechargeable cells in said housing.

7. A battery pack according to claim 1 wherein said electrical device is an internal combustion engine starting device connected to an internal combustion engine.

8. A battery pack according to claim 1, further comprising a protection circuit board within said housing.

9. A battery pack according to claim 8, wherein said protection circuit board is a cut-off board or a cell balancing circuit board.

WINPLUS Ex. 1003, p. 1277

10. A battery pack according to claim 9, wherein said protection circuit board is a cut-off board comprising a controller, said controller having associated means for periodically measuring a load to detect a change in load impedance, further comprising a switch between said battery pack and said device, and means for turning on said switch to provide power to the electrical device to restart the device.

11. A battery pack according to claim 9 wherein said protection circuit board is a cut-off board comprising a controller, said battery pack being connected to a current monitor, said current monitor being connected to a current comparator and a set-reset latch,

whereby upon the occurrence of a short circuit, the set-reset latch will turn off an associated switch.

12. Solid state switching apparatus for one or more cells in a battery pack having a positive terminal and a negative terminal, each of said cells having a positive pole and a negative pole, said apparatus comprising:

at least a pair of solid state switches, each switch having a source and a drain, with drains connected;

said solid state switches being connected to the positive pole of said one or more cells in series, and to said positive terminal, the negative pole of said one or more cells being connected to said negative terminal.

13. Apparatus according to claim 12, wherein the solid state switches are MOSFETs or IGBTs.

14. Apparatus according to claim 13, wherein the solid state switches are transistors, FET, JFET, BJT, CMOS, VMOS, TMOS, vertical DMOS or HEXFET.

15. Apparatus according to claim 12, wherein the solid state switches are either n-type or p-type.

16. Apparatus according to claim 12, wherein said one or more cells are selected from the group consisting of LiFePO, $LiFePO_4$, $LiFeMgPO_4$, $LiFeYPO_4$, $LiCoO_2$, $LiMn_2O_4$, $LiNiCoAlO_2$, $LiNiMnCoO_2$, $Li_4Ti_5O_{12}$, lead-acid, NiCd, and nickel metal hydride (NiMH) batteries.

17. Apparatus according to claim 12, further comprising a housing for said one or more cells, batteries, wherein said solid state switches are within said housing.

18. Solid state switching apparatus for one or more cells in a battery pack having a positive terminal and a negative terminal, each of said cells having a positive pole and a negative pole, said apparatus comprising:

at least a pair of solid state switches, each switch having a source and a drain, with sources connected;

said solid state switches being connected to the negative pole of said one or more cells in series, and to said negative terminal, the positive pole of said one or more cells being connected to said positive terminal.

19. Apparatus according to claim 18, wherein the solid state switches are transistors, FET, MOSFET, IGBT, JFET, BJT, CMOS, VMOS, TMOS, vertical DMOS or HEXFET.

20. Apparatus according to claim 18, wherein said one or more cells are selected from the group consisting of LiFePO, $LiFePO_4$, $LiFeMgPO_4$, $LiFeYPO_4$, $LiCoO_2$, $LiMn_2O_4$, $LiNiCoAlO_2$, $LiNiMnCoO_2$, $Li_4Ti_5O_{12}$, lead-acid, NiCd, and nickel metal hydride (NiMH) batteries.

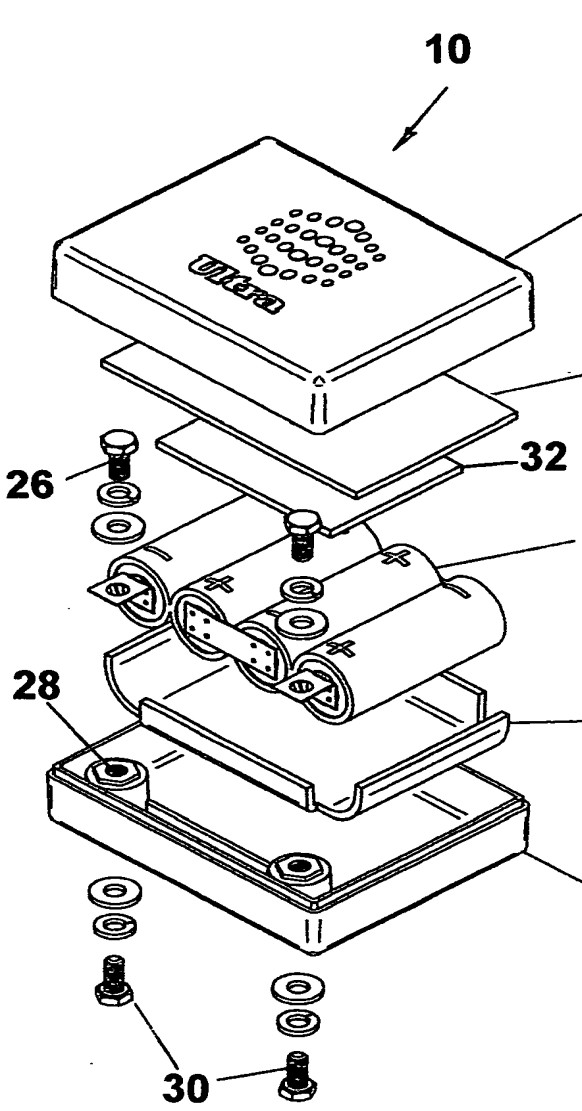


Fig. 1

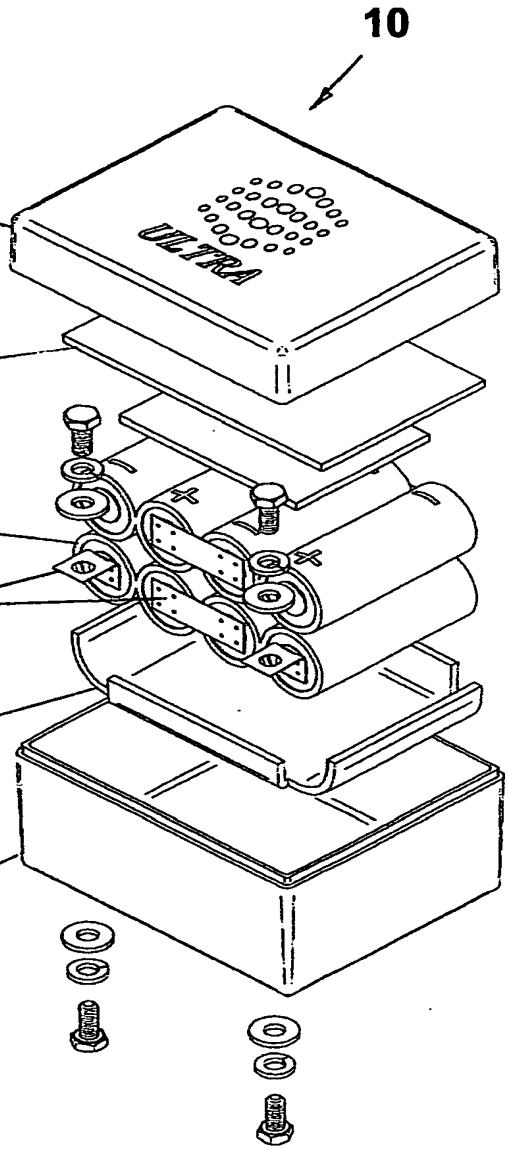


Fig. 2

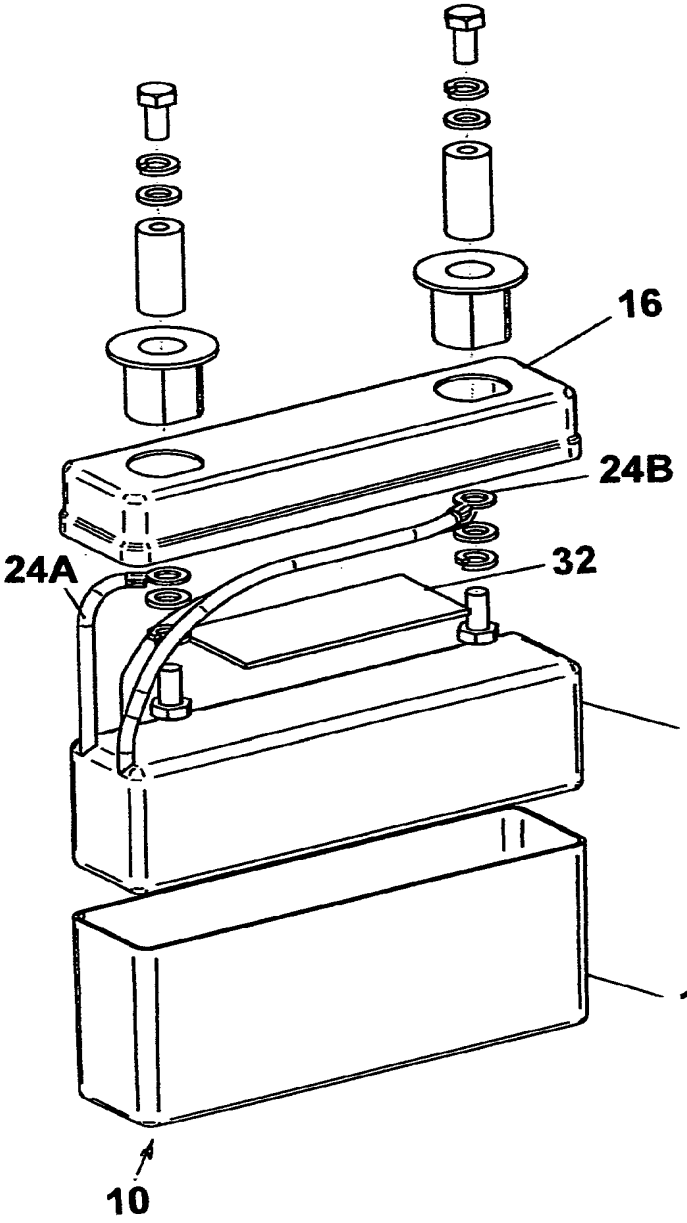


Fig. 3

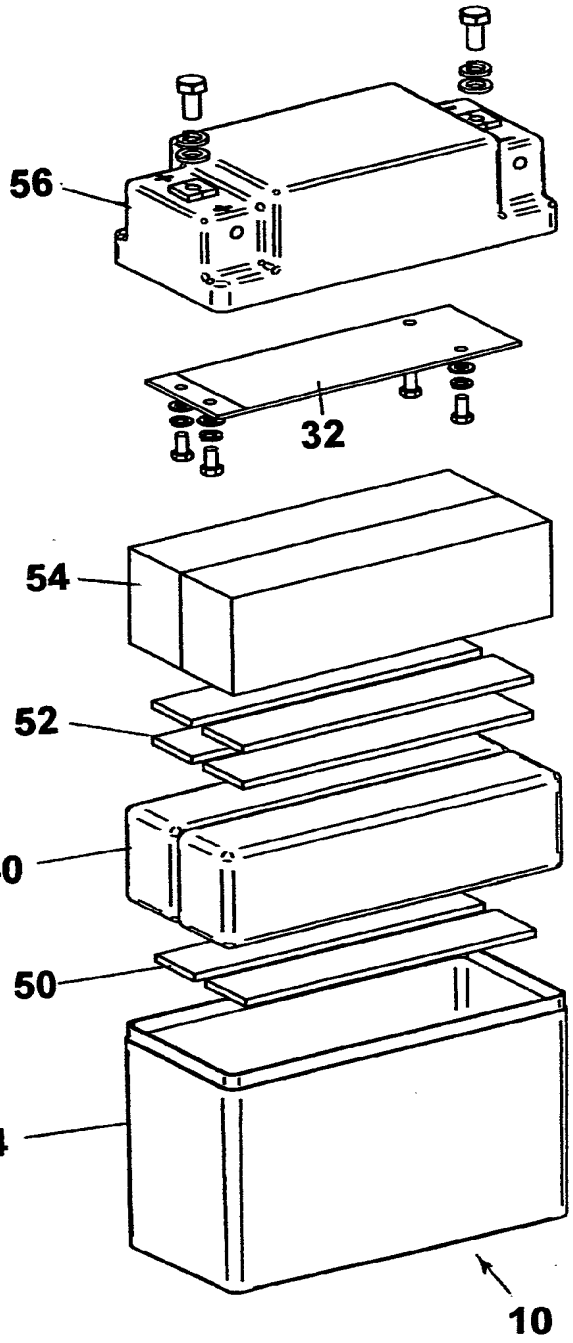


Fig. 13

Fig. 5

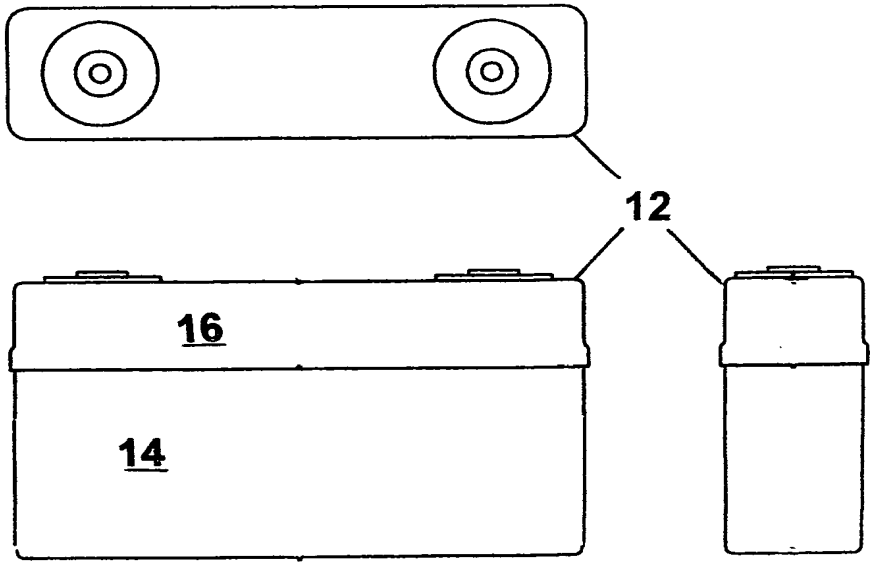


Fig. 4

Fig. 6

Fig. 7

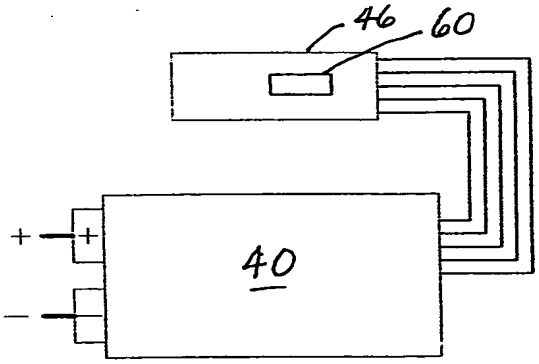
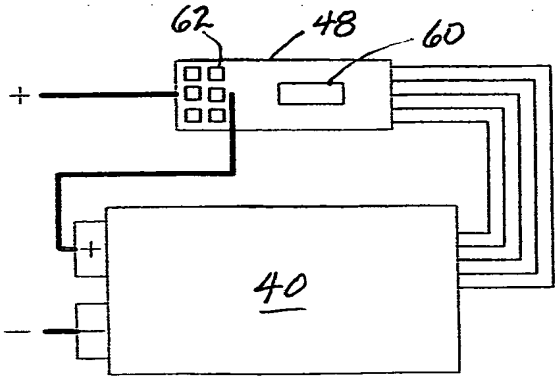


Fig. 8



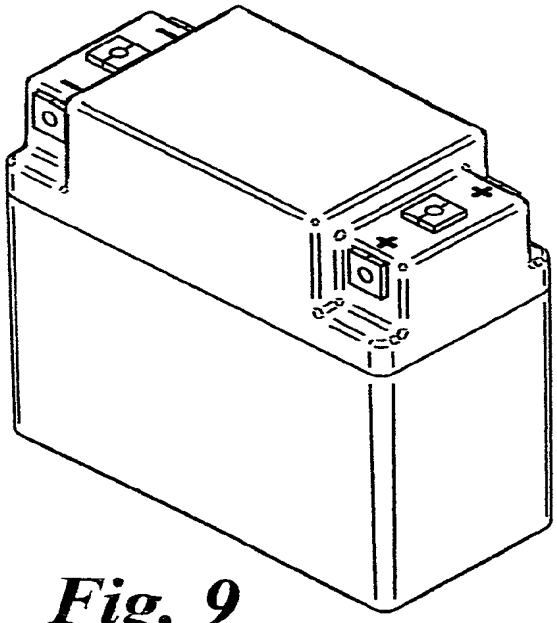


Fig. 9

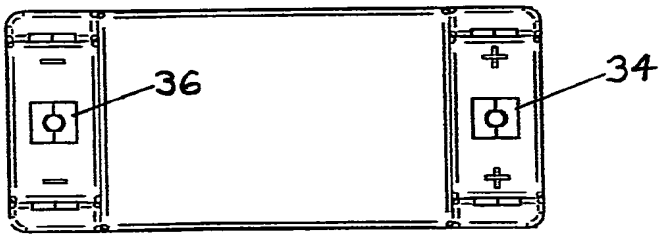


Fig. 10

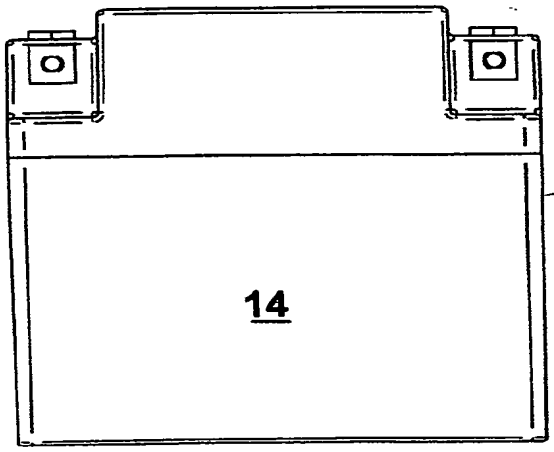


Fig. 11

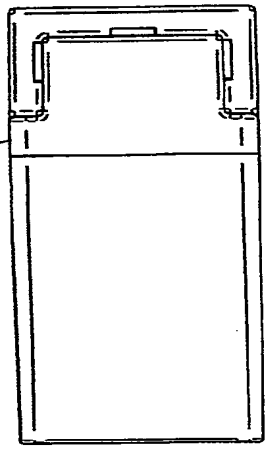


Fig. 12

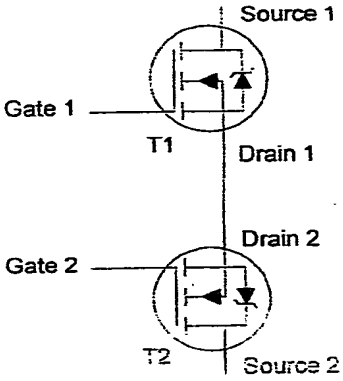


Fig. 14

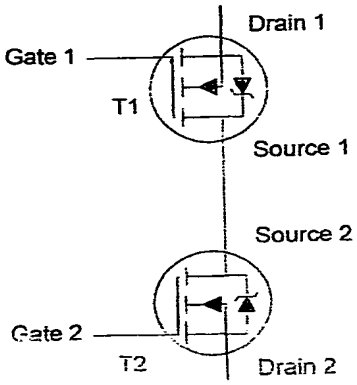


Fig. 15

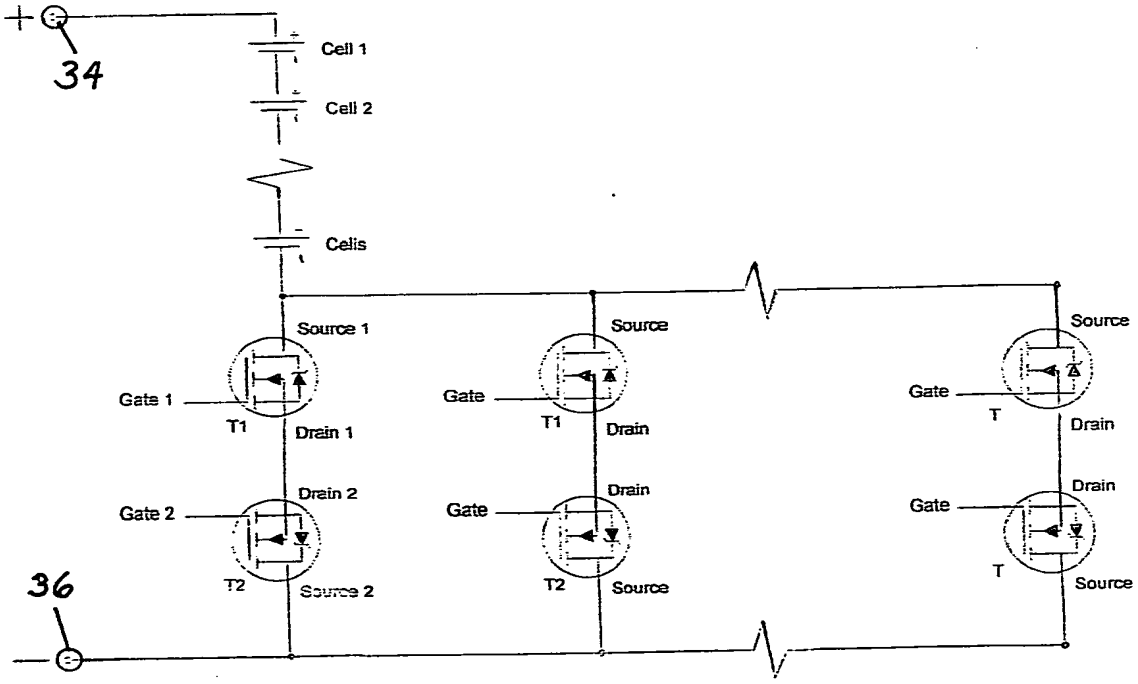


Fig. 16

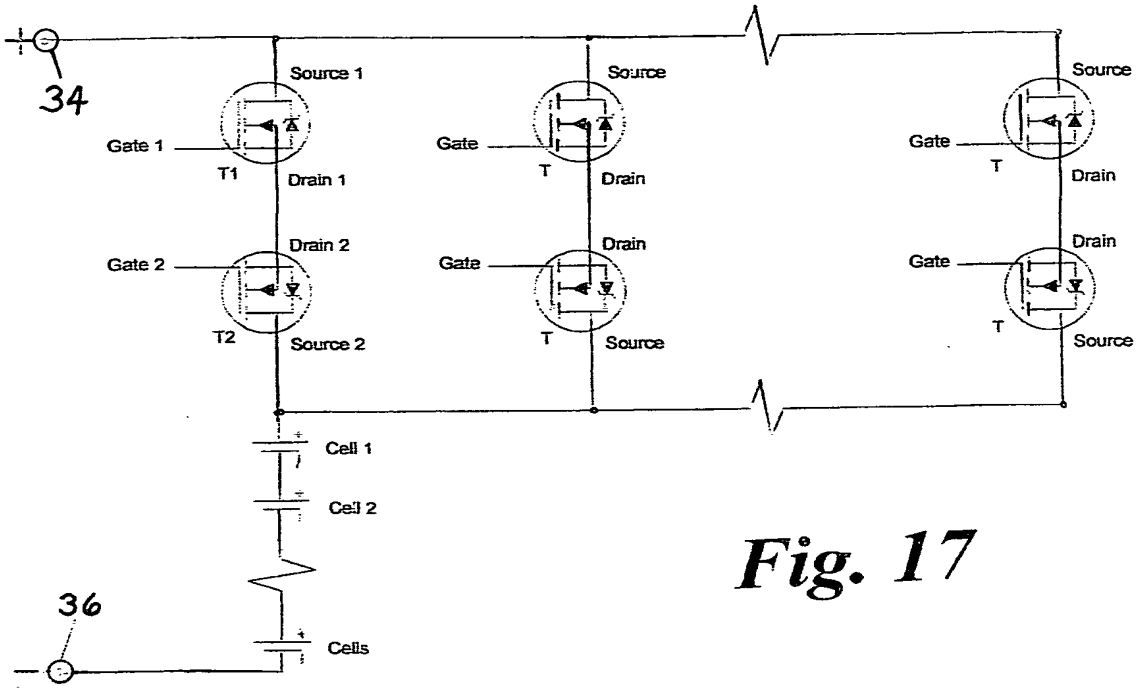

34
Source 1
Gate 1
T1
Drain 1
Drain 2
Gate 2
T2
Source 2
Source
Gate
T
Drain
Drain
Gate
T
Source
Source
Gate
T
Drain
Drain
Gate
T
Source
Cell 1
Cell 2
Cells
36

Fig. 17

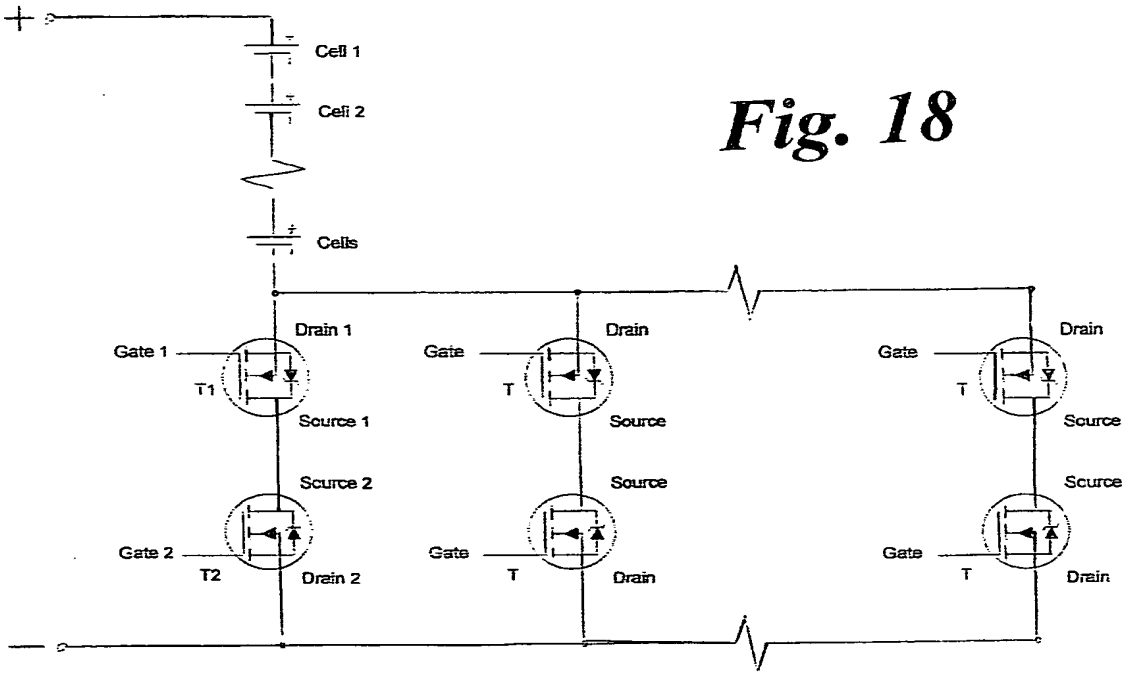

Cell 1
Cell 2
Cells
Drain 1
Gate 1
T1
Source 1
Source 2
Gate 2
T2
Drain 2
Drain
Gate
T
Source
Source
Gate
T
Drain
Drain
Gate
T
Source

Fig. 18

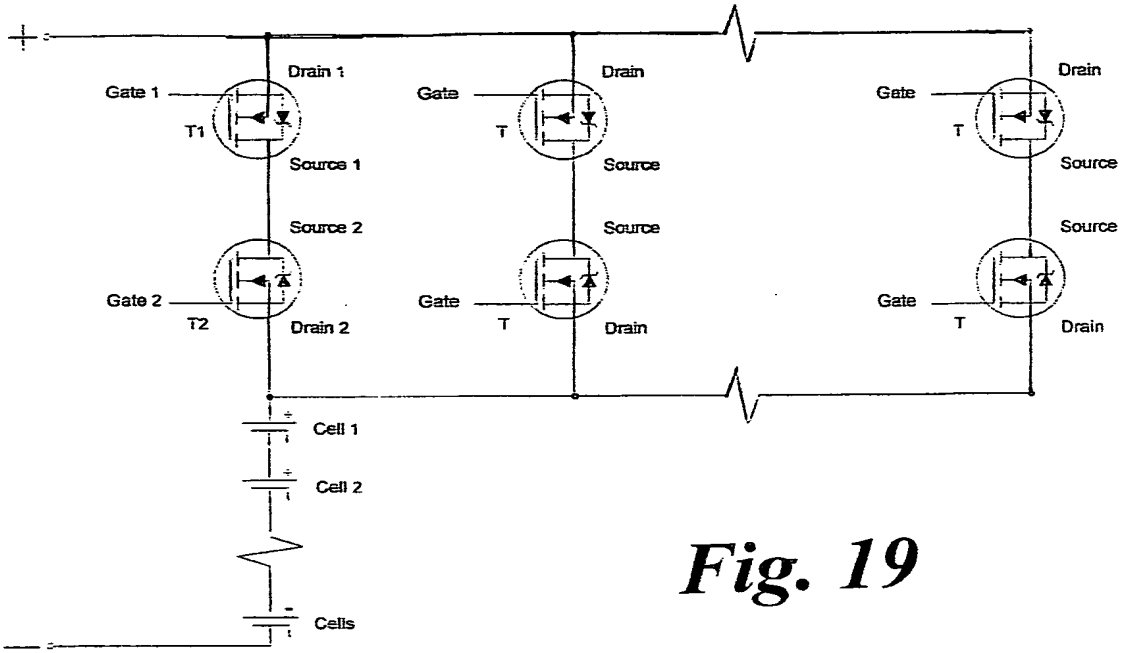

Drain 1
Gate 1
T1
Source 1
Source 2
Gate 2
T2
Drain 2
Gate
T
Drain
Source
Source
Gate
T
Drain
Gate
T
Source
Source
Gate
T
Drain
Cell 1
Cell 2
Cells

Fig. 19

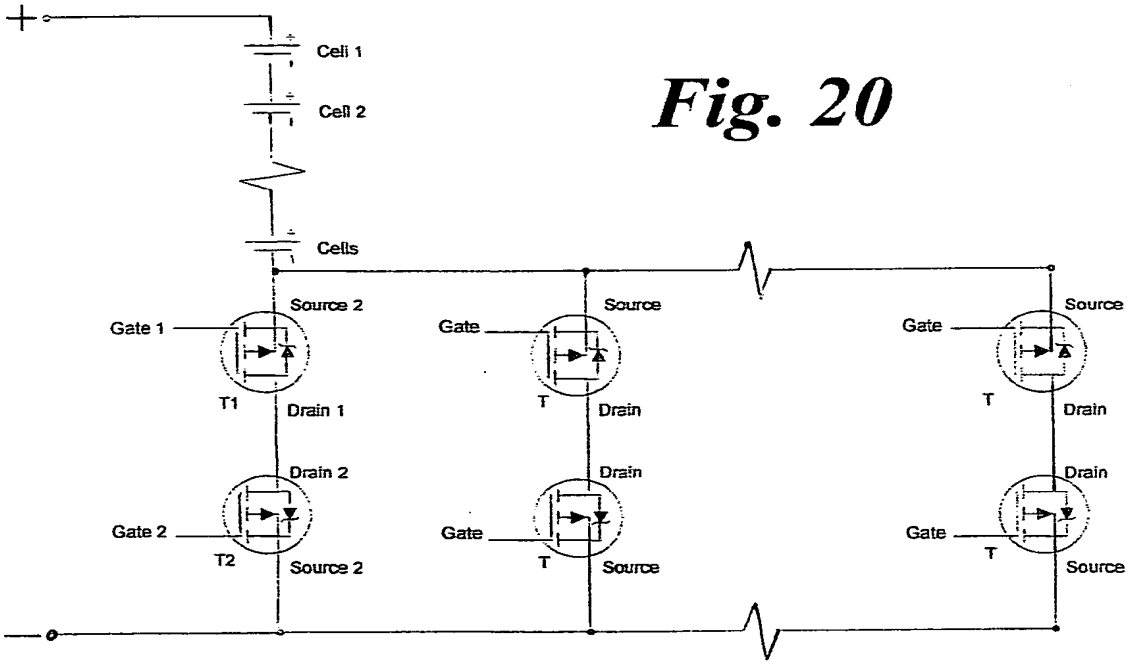

Cell 1
Cell 2
Cells
Source 2
Gate 1
T1
Drain 1
Drain 2
Gate 2
T2
Source 2
Gate
T
Source
Drain
Gate
T
Source
Drain
Gate
T
Source
Drain
Gate
T
Drain
Source

Fig. 20

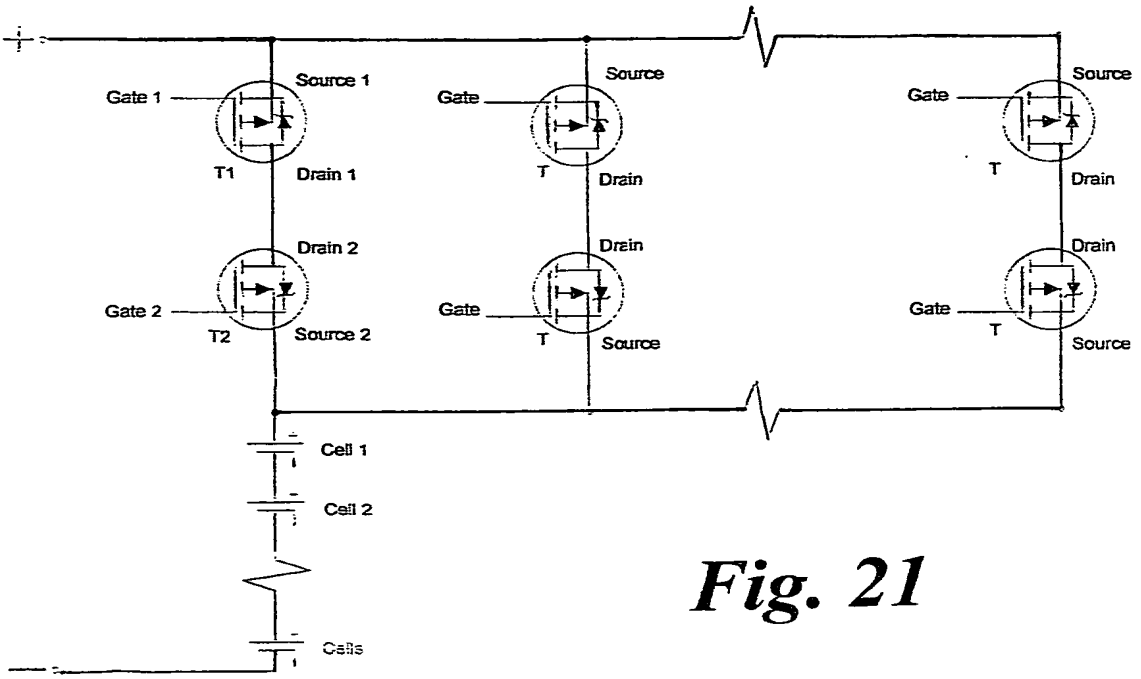

Gate 1
Source 1
T1
Drain 1
Drain 2
Gate 2
T2
Source 2
Gate
Source
T
Drain
Drain
Gate
T
Source
Gate
Source
T
Drain
Drain
Gate
T
Source
Cell 1
Cell 2
Cells

Fig. 21

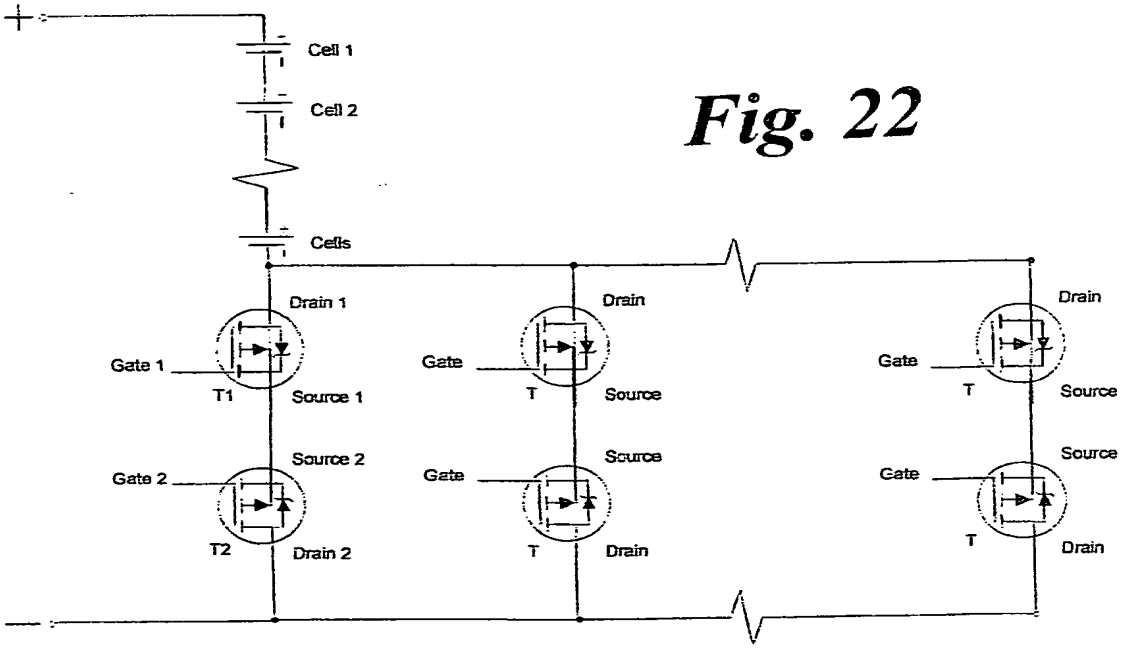

Cell 1
Cell 2
Cells
Drain 1
Gate 1
T1
Source 1
Source 2
Gate 2
T2
Drain 2
Gate
Drain
T
Source
Source
Gate
T
Drain
Drain
Gate
T
Source
Source
Gate
T
Drain

Fig. 22

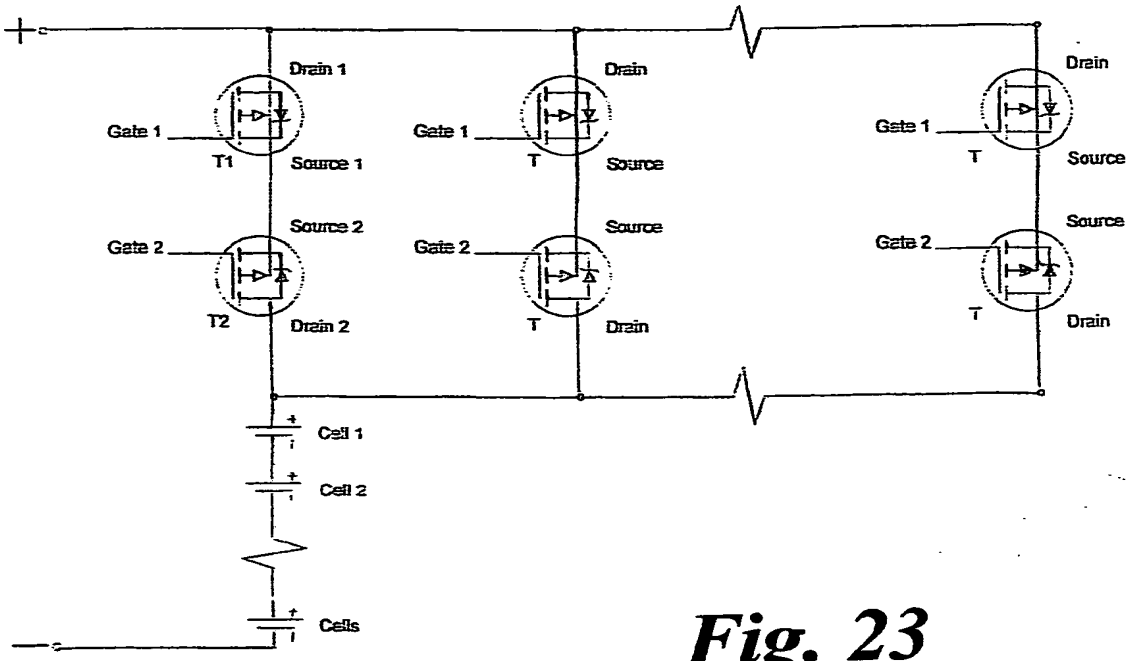

Drain 1
Gate 1
T1
Source 1
Source 2
Gate 2
T2
Drain 2
Drain
Gate 1
T
Source
Source
Gate 2
T
Drain
Drain
Gate 1
T
Source
Source
Gate 2
T
Drain
Cell 1
Cell 2
Cells

Fig. 23

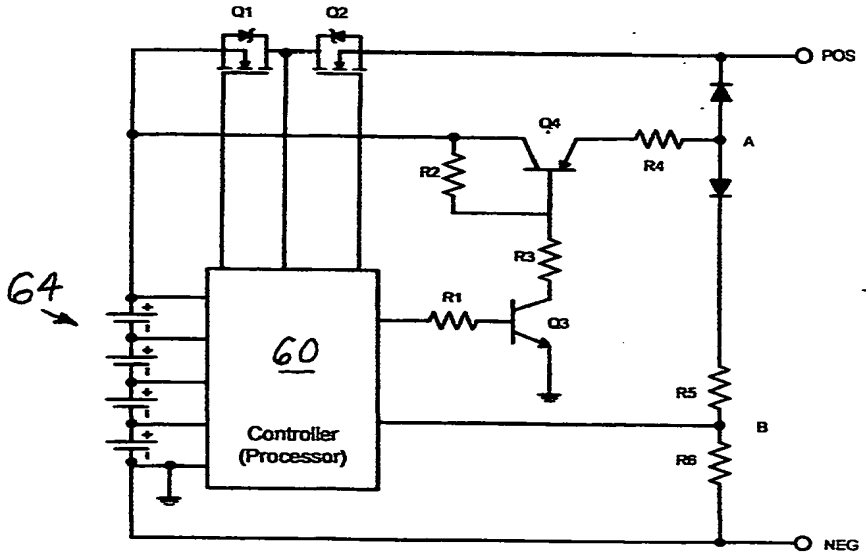

Q1
Q2
POS
Q4
R2
R4
A
R3
R1
Q3
64
60
Controller
(Processor)
R5
B
R6
NEG

Fig. 24

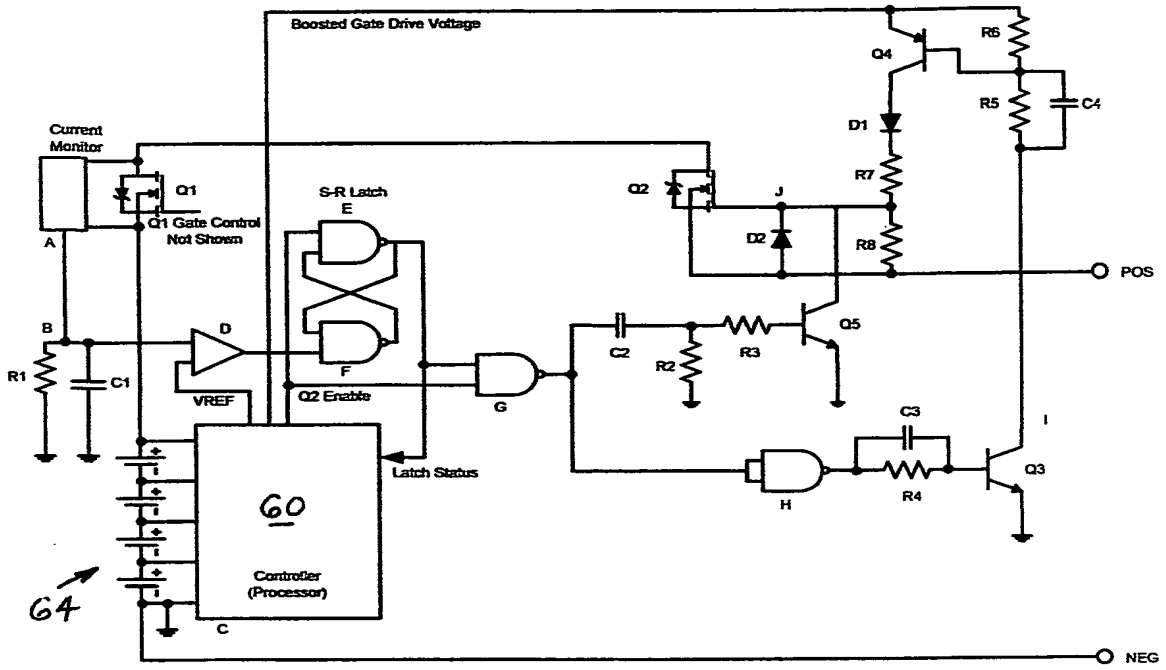

Boosted Gate Drive Voltage
Current Monitor
Q1
Q1 Gate Control Not Shown
A
B
R1
C1
D
VREF
S-R Latch
E
F
Q2 Enable
G
Latch Status
60
Controller (Processor)
C
64
Q2
J
D2
R6
Q4
R5
C4
D1
R7
R8
POS
C2
R2
R3
Q5
C3
I
H
R4
Q3
NEG

Fig. 25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/001937

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/00 (2012.01)
USPC - 320/121
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H01M 10/42, 10/44; H02J 7/00 (2012.01)
USPC - 320/104, 110, 112, 116, 118, 121; 429/50, 122, 149, 150, 153, 322

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/0087280 A1 (MIYASHITA et al) 27 April 2006 (27.04.2006) entire document	1, 6-9
---		---
Y		2-5, 10-20
Y	US 2009/0123813 A1 (CHIANG et al) 14 May 2009 (14.05.2009) entire document	2-4, 16, 20
Y	US 5,635,821 A (SMITH) 03 June 1997 (03.06.1997) entire document	5, 11-20
Y	US 2007/0080662 A1 (WU) 12 April 2007 (12.04.2007) entire document	10

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 2012	26 MAR 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

Espacenet

Bibliographic data: WO2004036714 (A2) — 2004-04-29

HIGH FREQUENCY BATTERY CHARGER AND METHOD OF OPERATING SAME

Inventor(s): KRIEGER MICHAEL [US]; RANDOLPH BRUCE [US] ± (KRIEGER, MICHAEL, ; RANDOLPH, BRUCE)

Applicant(s): VECTOR PROD INC [US]; KRIEGER MICHAEL [US]; RANDOLPH BRUCE [US] ± (VECTOR PRODUCTS, INC, ; KRIEGER, MICHAEL, ; RANDOLPH, BRUCE)

Classification: **- international:** (IPC1-7): H02J
- cooperative: **H02J7/0069 (EP)**; **H02J7/022 (EP, EP)**

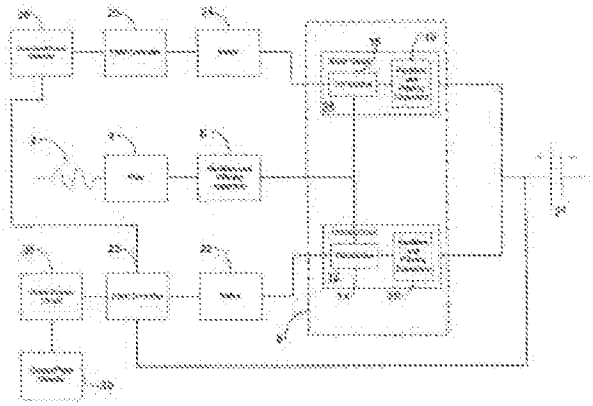
Application number: WO2003US18746 20030616 Global Dossier

Priority number (s): US20020270391 20021015 ; WO2003US02147 20030124

Also published as: WO2004036714 (A3) AU2003236519 (A1) AU2003236519 (A8) CA2502556 (A1) CA2502556 (C) more

Abstract of WO2004036714 (A2)

A high frequency charger includes a charge circuit for charging a depleted battery and a boost circuit for jump-starting a vehicle. Two separate high frequency transformers are provided for the charge and boost circuits. A selector switch selectively activates at least one of the charging circuit and the boost circuit.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 April 2004 (29.04.2004)

PCT

(10) International Publication Number
WO 2004/036714 A2

(51) International Patent Classification[7]: H02J

(21) International Application Number:
PCT/US2003/018746

(22) International Filing Date: 16 June 2003 (16.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/270,391 15 October 2002 (15.10.2002) US
PCT/US03/02147 24 January 2003 (24.01.2003) US

(71) Applicant *(for all designated States except US)*: **VECTOR PRODUCTS, INC.** [US/US]; 4140 S.W. 28th Way, Fort Lauderdale, FL 33312 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **KRIEGER, Michael** [US/US]; 34 West Dilido Drive, Miami Beach, FL 33139 (US). **RANDOLPH, Bruce** [US/US]; c/o Vector Products, Inc., 4140 S.W. 28th Way, Ft. Lauderdale, FL 33312 (US).

(74) Agent: **GLUCK, Jeffrey, W.**; VENABLE, BAETJER, HOWARD & CIVILETTI, LLP, P.O. Box 34385, 1201 New York Avenue, NW, Suite 1000, Washington, DC 20043-9998 (US).

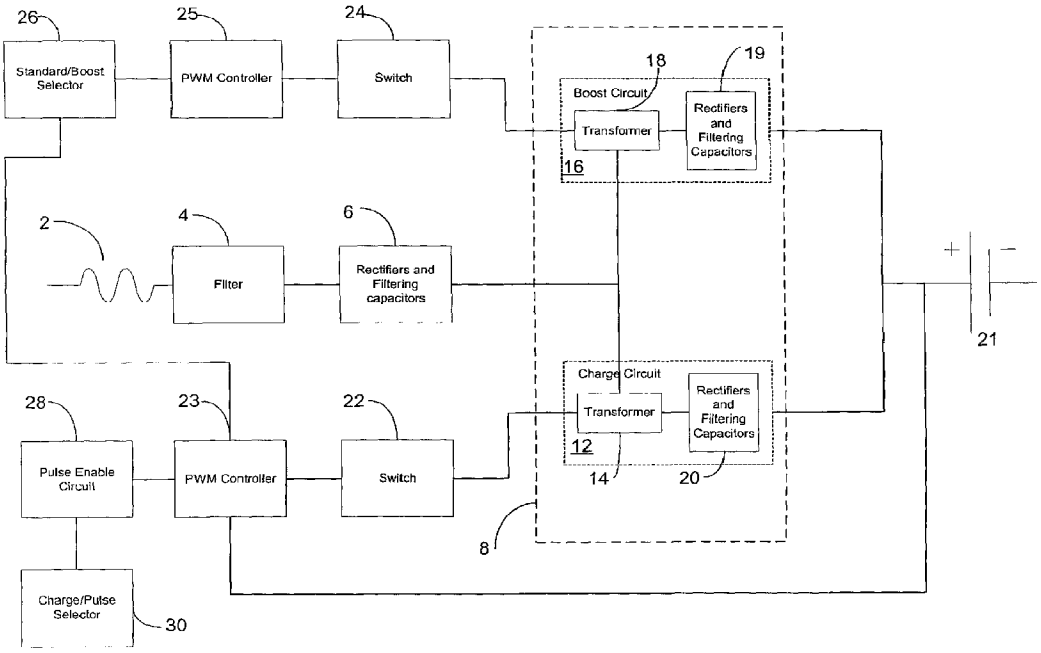
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

[Continued on next page]

(54) Title: HIGH FREQUENCY BATTERY CHARGER AND METHOD OF OPERATING SAME



(57) Abstract: A high frequency charger includes a charge circuit for charging a depleted battery and a boost circuit for jump-starting a vehicle. Two separate high frequency transformers are provided for the charge and boost circuits. A selector switch selectively activates at least one of the charging circuit and the boost circuit.

WO 2004/036714 A2

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

HIGH FREQUENCY BATTERY CHARGER AND METHOD OF OPERATING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

Priority is claimed with respect to PCT/US03/02147, filed January 24, 2003 which claims priority of U.S. Application Serial No. 10/270,391 filed October 15, 2002 and U.S. Provisional Application Nos. 60/363,202 filed March 11, 2002 and 60/350,897 filed January 25, 2002.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a battery charger or booster and in particular to a high frequency charger.

Technical Background

Dual-mode battery chargers currently exist. When operated in a first mode, the battery charger delivers a high current output for a short duration of time. This short duration, high current can be used to jump-start a vehicle with a dead battery. In a second mode, the battery charger provides a low current output that is used to charge the battery back to its full charge. Known dual-mode battery chargers typically use a single large transformer to achieve the dual-mode capability. The single transformer is usually a linear type transformer. A tap of a primary winding of the transformer is changed in order to achieve the dual capability with the linear-type transformer. As the tap of the transformer is changed, the output voltage, and hence, according to Ohm's Law, the output current of the transformer is changed, resulting in the dual-mode capability. Use of a single transformer for both modes of operation has the advantage of being very cost-efficient and very effective.

WINPLUS Ex. 1003, p. 1294

However, this approach also has several disadvantages. One of the disadvantages is that known single transformer battery chargers are very large and cumbersome. Standard linear transformers require iron for their cores, adding to the weight of the battery charger. They also require orders of magnitude more wire to form their windings than do high frequency chargers, again adding to the weight of the battery charger.

Additionally, although the linear transformer can provide a high current output, the high current output can only be provided for a very short period of time. As the transformer operates in high current mode, it generates an excessive amount of heat. In fact, so much heat may be generated that the transformer actually melts down. If a meltdown occurs, the transformer will not operate in either the high current mode or the low current mode. Linear transformers are also very lossy in terms of magnetic losses and eddy current losses, resulting in inefficiency.

Further, to charge an automobile battery that is of insufficient electric power by providing power from another power source, like a battery charger, the power source and the battery must be connected through a pair of electric wires, typically having clamps at their ends for connection to the battery. Making this connection can be very dangerous if there is a problem with the connection. For example, it is well known that sparking or arcing often occurs when a connection is being attempted between a battery charger and a battery. Additionally, sparking or arcing may occur when the clamps are connected to the battery with a reverse polarity. Sparking or arcing can also occur even after an apparently good connection is made. The sparking or arcing may occur due to corroded or poor terminal connections.

WINPLUS Ex. 1003, p. 1295

In the past, the use of a delay circuit or "soft start" was used to prevent sparking. A delay circuit prevents power flow to the battery from occurring until a connection is made between the battery and the battery charger. This method helps to prevent sparking upon the initial connection of the battery and battery charger. However, it does not prevent any sparking that occurs as a result of poor or corroded connections, the existence of which can only be determined after current flow begins. Sparking or arcing may result in damage to the battery, and under certain circumstances, an explosion, fire and damage to the vehicle or to a person may result.

Additionally, a characteristic of liquid electrolyte type batteries, particularly lead acid batteries used in vehicles, is that chemical compound deposits slowly build up on the plates to partially or entirely cover and displace the normal plate surfaces. Low current recharging is inadequate in that it can not, as such, sufficiently remove such deposits that with the passage of time crystallize and choke the battery plates by interfering with electrolyte movement. When this occurs a battery may still appear to have taken a charge and even the electrolyte may check as being correct, but the battery does not hold the charge because the plates are effectively shorted. Batteries using other electrolytes also face reclaiming, maintenance and charging problems that need to be successfully addressed.

Thus, there is a need for a method to release the deposits that are built up on the plate surfaces, where the deposits may either go back into the solution or be broken up. There is also a need for a simple and lightweight dual-mode battery charger. The battery charger should be able to provide a high current output that is sufficient to start an automobile or other vehicle with a dead battery, yet be easy to construct and safe to operate.

WINPLUS Ex. 1003, p. 1296

According to a variation on the preceding embodiment of the invention, there is provided a high frequency charger that_includes a charge circuit and a boost circuit. In this embodiment, the charge circuit and the boost circuit are constructed using a single high frequency transformer having two windings on its primary side, a charge winding and a boost winding. The charge winding and the boost winding effectively form (along with the single secondary winding) the first and_second high frequency transformers of the preceding embodiment of the invention (and may thus be thought of as the two separate transformers in other embodiments of the invention). The boost winding is adapted to provide a high current that can be used to jump-start a vehicle with a depleted battery.

DEFINITIONS:

In describing the invention, the following definitions are applicable throughout this application.

A "computer" refers to any apparatus that is capable of accepting a structured input, processing the structured input according to prescribed rules, and producing results of the processing as output. Examples of a computer include a computer; a general-purpose computer; a supercomputer; a mainframe; a super mini-computer; a mini-computer; a workstation; a microcomputer; a processor; a server; an interactive television; a hybrid combination of a computer and an interactive television; and application-specific hardware to emulate a computer and/or software. A computer can have a single processor or multiple processors, which can operate in parallel and/or not in parallel. A computer also refers to two or more computers connected together via a network for transmitting or receiving information between the computers. An example of such a computer includes a distributed computer system for processing information via computers linked by a network.

WINPLUS Ex. 1003, p. 1297

A "computer-readable medium" refers to any storage device used for storing data accessible by a computer. Examples of a computer-readable medium include a magnetic hard disk; a floppy disk; an optical disk, like a CD-ROM or a DVD; a magnetic tape; a memory chip (e.g., ROM or RAM); and a carrier wave used to carry computer-readable electronic data, such as those used in transmitting and receiving e-mail or in accessing a network.

"Software" refers to prescribed rules to operate a computer. Examples of software include software; code segments; instructions; computer programs; and programmed logic.

A "computer system" refers to a system having a computer, where the computer comprises a computer-readable medium embodying software to operate the computer.

SUMMARY OF THE INVENTION

According to an embodiment of the invention, a high frequency charger for charging a battery is provided. The charger comprises a charge circuit including a first high frequency transformer. A first switch switches the first high frequency transformer at a first frequency. The charger also includes means for measuring a charge rate of the battery; means for determining an amount of time the battery has been charging; means for measuring a voltage of the battery; and means for detecting an overtime fault if the charge rate is greater than a predetermined current, the battery has been charging longer than a predetermined amount of time, and the voltage of the battery is greater than or equal to a predetermined voltage.

In another embodiment, the high frequency charger comprises: a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; means for measuring a charge rate of the battery; means for

determining an amount of time the battery has been charging; means for measuring a voltage of the battery; and means for detecting a shorted cell battery fault if the charge rate is greater than a predetermined current, the battery has been charging more a predetermined amount of time, and the voltage of the battery is less than or equal to a predetermined voltage.

In another embodiment, the high frequency charger for charging a battery comprises a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; clamps for connecting the charger to the battery; means for measuring a voltage at the clamps; means for indicated a bad battery fault if no voltage is detected at the clamps.

In another embodiment, the high frequency charger comprises a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; means for measuring a charge current of the battery; means for determining an amount of time the battery has been charging; means for measuring a voltage of the battery; and means for detecting an open cell battery fault if the charge current is less than a predetermined current, the battery has been charging more a predetermined amount of time, and the voltage of the battery is greater than or equal to a predetermined voltage.

According to an embodiment of the invention, there is provided a high frequency charger that includes a charge circuit and a boost circuit. In a preferred embodiment, the charge circuit includes a first high frequency transformer. A switch switches this first high frequency transformer at a predetermined frequency. The boost circuit includes a second high frequency transformer that is separate from the first high frequency transformer in the charge circuit. The

WINPLUS Ex. 1003, p. 1299

first and second high frequency transformers are operated in a similar manner. However, the boost circuit is adapted provide a high current that can be used to jump-start a vehicle with a depleted battery.

According to a variation on the preceding embodiment of the invention, there is provided a high frequency charger that includes a charge circuit and a boost circuit. In this embodiment, the charge circuit and the boost circuit are constructed using a single high frequency transformer having two windings on its primary side, a charge winding and a boost winding. The charge winding and the boost winding effectively_form (along with the single secondary winding) the first and second high frequency transformers of the preceding embodiment of the invention (and may thus be thought of as the two separate transformers in other embodiments of the invention). The boost winding is adapted to provide a high current that can be used to jump-start a vehicle with a depleted battery.

In a preferred embodiment, a PWM controller provides a driving signal to the switch such that the transformer of the charge circuit is switched to output a pulse. The pulse output of the charge circuit can be used to condition the battery.

As noted, the transformer in the charge circuit and the transformer in the boost circuit are preferably separate from each other, that is, there are two transformers and associated circuits. Thus, the battery charger is not dependent on the same transformer for both standard charging and boosting. For example, if the transformer in a conventional charger burns out while performing a boost function, all the functionality of the charger may be lost, as one transformer is used for both functions. However, in the present embodiment, either of the transformers still

WINPLUS Ex. 1003, p. 1300

operates even if the other transformer is disabled for some reason.

A control circuit for a high frequency charger is also provided. In an exemplary embodiment, the control circuit includes a pulse width modulation (PWM) controller having a reference voltage input, a control input, and an output for a control signal. A switch receives the control signal and is switched on and off in response to the control signal. A voltage divider network divides the voltage applied to the reference voltage input and the control input. A duty cycle of the control signal output from the PWM controller varies based on the percentage of the reference voltage that is applied to the control.

In a further embodiment, the voltage divider network comprises a first resistor having a first terminal connected to the reference voltage input and a second terminal connected to the control input. A plurality of second resistors each has a first terminal connected to the second terminal of the first resistor and a second terminal. A plurality of transistors are also provided, each having a first electrode connected to the second terminal of one of the second resistors, a second electrode that is grounded, and a third electrode receiving an enable signal. The enable signal turns the transistors on and off, selectively connecting one of the second resistors to ground.

In another embodiment, a method for reducing arcing in a battery charger comprises: providing a test current that is lower than a charging current from the battery charger to a battery; detecting if the test current is present at the battery; if the test current is not detected at the battery, indicating a fault; and if the test current is detected at the battery, increasing the test current a predetermined amount and returning to the detecting step.

WINPLUS Ex. 1003, p. 1301

According to another aspect of the invention there is provided a computer-readable storage medium for use with a computer for controlling a high frequency charger including a charge circuit having a first high frequency transformer; a first switch switching the first high frequency transformer at a predetermined frequency for producing a charge signal in a first mode of operation; the charge circuit operating in at least one of a pulse mode and a charge mode; and a selector for selecting one of the charge mode and the pulse mode, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of: detecting a selected mode of operation for the charger; and when a pulse mode is selected, a) generating a driving signal for the first switch for a first period of time; b) disabling the first switch for a second period of time; and c) returning to step a).

According to yet a further aspect of the invention, there is provided a computer-readable information storage medium for use with a computer controlling a high frequency charger comprising a charge circuit including a high frequency transformer; and a switch switching the high frequency transformer at a predetermined frequency, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of: checking a flag indicating the battery is in a bulk charge state or an absorption charge state; if the battery is in the bulk charge state, increasing a duty cycle of a driving signal for the first switch if a current provided by the battery charger is less than a desired current; decreasing the duty cycle of the driving signal for the first switch if a current provided by the battery charger is greater than the desired current; setting the flag indicating the battery is in the absorption charge

WINPLUS Ex. 1003, p. 1302

stage when a voltage of the battery is greater than or equal a predetermined voltage and has been charging for a predetermined period of time, otherwise ending the charging process; if the battery is in the absorption charge stage, decreasing the duty cycle of the driving signal for the first switch if the voltage of the battery is greater than or equal to a predetermined voltage; increasing the duty cycle of the driving signal for the first switch if the voltage of the battery is less than the predetermined voltage; and stopping the charging process when the battery has been charging for more than a predetermined time.

According to yet another embodiment of the invention, computer-readable information storage medium for use with a computer controlling a high frequency charger comprising a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; a boost circuit including a second high frequency transformer; a second switch switching the second high frequency transformer at a second frequency, and a selector for selecting one of a charge mode for charging a depleted battery and a boost mode for supplying a boosting current to start a vehicle with the depleted battery, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of: detecting a selected mode of operation; if the boost mode is selected, controlling the boost circuit to supplying a boosting current to the depleted battery; checking for a rapid rise in voltage after the vehicle has been started; if the rapid rise in voltage is present, indicating the alternator is working properly; and if the rapid rise in voltage is not present, indicating the alternator is not working properly.

According to yet another embodiment of the invention, a high frequency charger for charging a battery, comprises a

WINPLUS Ex. 1003, p. 1303

charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; a filter coupled to the first and second high frequency transformers for passing a DC voltage signal; means for coupling a resistance in parallel with the battery; means for measuring a voltage of the battery while the battery is coupled to the resistance; and means for correlating the measured voltage to a CCA value.

The above and other features of the invention, along with attendant benefits and advantages will become apparent from the following detailed description when considered with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a block diagram showing a dual high frequency charger according to an embodiment of the present invention.

Figure 2 is a diagram of waveforms generated by control circuits according to an embodiment of the present invention.

Figure 3 is a circuit schematic in partial block diagram form showing an embodiment of the pulse enable circuit and the pulse width modulation controller shown in Figure 1.

Figure 4 is a block diagram of a battery charger according to a further embodiment of the invention.

Figure 5 is a block diagram of a battery charger according to a further embodiment of the invention.

Figures 6 and 7 are flow diagrams of a method according to an embodiment of the invention.

Figure 8 is a flow diagram of a method according to another embodiment of the invention.

WINPLUS Ex. 1003, p. 1304

Figure 9 is a partial block diagram showing an alternative implementation of the dual high frequency charger embodiments of Figures 1 and 4.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to Figure 1, there is shown a high frequency charger, according one embodiment of the invention, which includes a high frequency transformer portion 8. The high frequency transformer portion 8 typically receives a DC signal as its input. The DC signal can be provided from a battery or from an AC input. In the embodiment illustrated, an AC input 2, which may be provided by a typical wall-socket, is coupled to a filter 4, for example, a pi filter or an LC filter. The filter 4 is used to smooth and clean the AC input. An AC signal output from the filter 4 is provided to conventional rectifiers and filtering capacitors 6 for rectifying the AC signal. The rectifier is preferably a full-wave rectifier of a type known to one skilled in the art and provides a DC output of, for example, approximately 150 volts DC.

The full-wave rectified and filtered DC output from rectifier 6 is provided to the high frequency transformer portion 8 of the battery charger. The high frequency transformer portion 8 includes a charge circuit 12 and a boost circuit 16. The boost circuit 16 is used to provide a high current boost that can be used to jump-start a vehicle with a dead battery. The charge circuit 12 is used for normal charging of the battery. The operation of the boost circuit 16 and the charge circuit 12 may take place sequentially, in any order, or simultaneously. The charge circuit 12 and the boost circuit 16 each include a high frequency transformer 14, 18, respectively. A DC output from the rectifiers and filtering capacitors 6 is provided to each of the high frequency transformers 14, 18.

WINPLUS Ex. 1003, p. 1305

Transformers typically receive an AC input and provide an AC output. For example, a transformer plugged into an ordinary wall-socket is provided with a 120-Volt AC input and outputs an AC signal that is dependent on the secondary winding of the transformer. Thus, high frequency transformers 14, 18 need to be manipulated to behave so that the DC signal from rectifiers 6 looks like an AC input. This manipulation is accomplished by switching the DC output from rectifier 6 through the high frequency transformers. The transformers are turned on and off at a high frequency, for example, about 20kHz and above. This switching causes the transformers to behave as though their input is AC.

This switching can be accomplished using essentially any type of switch, for example, a field effect transistor (FET) or other electronic switch. The high frequency transformers 14, 18 of the illustrated embodiment are switched by switches 22, 24, respectively, coupled thereto. The switches 22, 24 are, in turn, controlled by PWM controllers 23, 25. The PWM controller may be, for example, a TL 494 Motorola type controller or a discrete controller. The PWM controller generates a PWM driving signal for turning the switches on and off.

The charge circuit 12 is capable of operation in two modes, a charge mode and a pulse mode. In the charge mode, the charge circuit 12 operates to charge a battery. In the pulse mode, the charge circuit 12 operates to condition or desulfate a battery. A user may select between one of these two modes via selector 30. The selector 30 provides the user's selection to a pulse enable circuit 28. The pulse enable circuit 28 controls the PWM controller 23 in accordance with whether the charge mode or the pulse mode of operation is selected for the charge circuit 12.

When the pulse mode is selected, the pulse enable circuit 28 controls the PWM controller 23 to alternately be

active and output a driving signal to the switch 22 and be inactive and not drive the switch 22. A cycle of enabling/disabling the switching of the switch 22 is repeated under the control of the PWM controller 23. Figure 2 illustrates exemplary output waveforms for the pulse enable circuit 28 and the PWM controller 23. In the pulse mode, the pulse enable circuit 28 is activated such that its output signal W_1 varies between low and high states as shown in Figure 2. The PWM controller 23 is activated depending upon the output signal W_1 of the pulse enable circuit 28. During a first time period t1, the output W_1 of the pulse enable circuit 28 is high and the PWM controller 23 is activated to generate a PWM driving signal W_2, as shown in Figure 2. The driving signal W_2 of the PWM controller 23 is provided to the switch 22, e.g., to the gate of a FET comprising switch 22, to turn it on and off. For example, the driving signal from the PWM controller 23 may have a duty cycle of less than 15% so that the FET is turned on for a very short period of time, outputs current to the battery, and is then disabled. The driving signal modulates the FET. During a second time period t2, the output W_1 of the pulse enable circuit 28 is low and the PWM controller is deactivated. No driving signal is provided to the FET, and the FET remains off. Pulsing of the high frequency transformer in this manner chops its output to condition the battery.

During the pulse mode, a series of output current pulses are generated by the battery charger and are provided to the discharged battery 21. The current pulses may have a frequency of about one pulse per second and a rise time of about 100 volts/microsecond or less.

When the charge mode is selected via selector 30, the PWM controller 23 is preferably always activated. Operation of the PWM controller 23 may be controlled in part via

feedback from the battery 21 being charged. The duty cycle of the driving signal generated by PWM controller 23 is varied based on the charging state of the battery. A feedback signal from the battery being charged 21 to the PWN controller 23 provides the information on the charging state of the battery. The more power the battery needs, the higher the duty cycle; and the less power the battery needs, the lower the duty cycle. Switch 22 switches transformer 14 in accordance with the driving signal to charge the battery.

Referring again to Figure 1, boost circuit 16 is now described. Boost circuit 16 provides a high current pulse that can be used to jump-start a dead battery. The boost circuit 16 is enabled via a standard/boost selector 26, which a user can actuate. When actuated, selector 26 enables PWM controller 25 to generate a signal that drives switch 24, which, in an exemplary embodiment, comprises a FET. The frequency of the driving signal for FET 24 in the high power boost circuit can be the same as or different from the frequency of the driving signal for switch 22 in the charge circuit, for example, about 20kHz, or even higher. When the same frequency is used, the clock frequency for the PWM controller 23 associated with the charge circuit 12 to be shared by the PWM controller 25 for the high power boost circuit 16.

The high power boost circuit 16 receives a DC input from the rectifier 6. The DC input is provided to high frequency transformer 18 in the high power boost circuit 16. Preferably, the high frequency transformer 18 in the high power boost circuit 16 is separate from the high frequency transformer 14 in the charge circuit 12. The high frequency transformer 18 in the high power boost circuit 16 outputs a relatively high current with respect to the output of the charge circuit 12. For example, the current output from the boost circuit 16 may range from about 30 amps to about 500

WINPLUS Ex. 1003, p. 1308

amps, compared to about 2-25 amps for the charge circuit 12. Additionally, the output from the boost circuit 16 is typically only generated for a short period of time, for example, about 3-40 seconds. Accordingly, the high frequency transformer 18 in the high power boost circuit 16 is preferably slightly larger than the high frequency transformer 14 in the charge circuit 12.

The high frequency transformer 18 has a duty cycle such that it may be on half the time and off the half the time, even though there may always be an output from the transformer that is rectified, filtered and used to recharge the battery. The PWM controller 25 is typically turned off for about 60-90% of the time and is turned on for about 10-40%, and then it is turned back off again to achieve the duty cycle for the high frequency charger. During the 10-40% of the time the PWM controller 25 is on, switch 24 switches the high frequency transformer. This provides a high current pulse out of the high frequency transformer through rectifier 19 to the battery to be charged.

Both the transformer 14 in the charge circuit 12 and the transformer 18 in the boost circuit 16 output an AC signal that needs to be converted to DC in order to be used by the battery. Therefore, the output of the high frequency charger in the charge circuit passes through standard rectifiers and filtering capacitors 19, 20 to provide a DC output. The high frequency transformer 14 in the charge circuit 12 is preferably a relatively small transformer capable of delivering a relatively low current, preferably between about between 2 and about 30 amperes, and a voltage corresponding to whatever the battery needs, for example, about 14.2 volts. The switching operation for the high frequency transformer 18 in the high power boost circuit 16 by switch 24 is preferably performed in a manner similar to that described above with regard to the charge circuit 12

WINPLUS Ex. 1003, p. 1309

but, due to its different construction, results in a current output from the boost circuit from about 30 amps to about 500 amps.

Turning now to Figure 3, an example of circuitry that may comprise the pulse enable circuit 28 is described. In the illustrated embodiment, the pulse enable circuit 28 incorporates manual control of the PWM controller 23. A user can thus control the charging of the battery. The PWM controller 23 has an input 31 to which a reference voltage is applied, and a dead time control input 32. The dead time control input 32 controls the duty cycle of the driving signal from output 34 of the PWM controller 23 based on a percentage of the reference voltage that is applied to the dead time control input 32. For example, when the full reference voltage is applied to the dead time control input 32, the duty cycle of the output signal of PWM controller 23 is set to zero, the switch 22 (Fig. 1) is off, and no voltage is applied to the battery being charged. When no voltage is applied to the dead time control input 32, the duty cycle of the output signal of the PWM controller 23 is set to its maximum, and a maximum current is applied to the battery. The duty cycle of the driving signal from output 34 of the PWM controller 23 varies between these two extremes in dependence on the percentages of the reference voltage applied to dead time control input 32.

In the embodiment shown in Figure 3, a combination of a counter circuit 36 and a number of transistors 38-41 is used to control the percentage of the reference voltage that is applied to the dead time control input 32. The counter 36 is preferably either a low active device with diodes or a high output active decade counter, for example a 4017B CMOS IC. Of course other arrangements are possible within the scope of the invention. Outputs of the counter 36 are each connected to transistors. Four transistors 38-41 for four

WINPLUS Ex. 1003, p. 1310

outputs of counter 36 are shown in Figure 3. The number of outputs and corresponding transistors may vary depending upon the type of counter used. Each transistor may be of a BJT or of a FET type. A control electrode of each transistor 38-41 is connected through a corresponding resistor 42-45 to a separate output of the counter 36. A first electrode in the main current path of each transistor 38-41 is coupled to ground. A second electrode in the main current path of each transistor 38-41 is coupled to a resistor 46-49, respectively. Each of the resistors 46-49 is coupled to the dead time control input 32 of the PWM controller 23. Each of the resistors 46-49 is also coupled to resistor 51, which is, in turn coupled to the reference voltage input 30 of the PWM controller 23.

The resistors 46-49, the associated transistors 38-41, and the resistor 51 form a voltage divider. The voltage difference between the reference voltage input 30 and the dead time control input 32 is controlled by the values of the resistors 46-49. For example, each of the resistors 46-49 can be selected to have a different resistance. The voltage drops across the resistors 46-49 will vary accordingly. Thus, the percentage of the reference voltage applied to the dead time control input 32 varies depending on which transistor 38-41 is turned on and the value of its associated resistor 46-49.

For example, as the counter 36 is clocked, one of the outputs of the counter 36 becomes active and turns on the respective transistor 38-41 connected to that output. Only one of the transistors 38-41 may be turned on at any one time. The turned on transistor 38-41 provides a current path from the dead time control input 32, through its respective resistor 46-49, to ground, thereby altering the voltage at the dead time control input 32 with respect to

WINPLUS Ex. 1003, p. 1311

the voltage at the reference voltage input 30. Alternately, more than one of the transistors 38-41 is turned on.

A switch 53, such as a push button switch, may be coupled to a clock input 37 and used to clock the counter 36. For example, actuating the switch once clocks the counter 36 from the zero output to the first output, actuating the switch a second time clocks the counter 36 to the second output, and so on. As each output of the counter 36 becomes active, the transistor associated with that output turns on, altering the voltage at the dead time control input 32. Thus, the duty cycle of the driving signal from PWM controller 23 can be manually stepped through various levels.

Figure 4 is a block diagram of a battery charger according to another embodiment of the present invention. The embodiment shown in Figure 4 includes a microprocessor that controls many of the functions of the battery charger. The general operating principles of the battery charger are the same as for the previous embodiment and are not discussed in detail here.

In this embodiment, a microprocessor 50 is coupled to switches 22, 24, which may, for example, comprise FETs, and to the high frequency transformer portion 8. A display 52 is also coupled to the microprocessor 50. The display 52 is used to display various diagnostic and output information regarding the battery charger. User controls for turning the battery charger on and off, as well as the selectors 26, 30 (see Fig. 1) and the push-button switch 53 (Fig. 3) for controlling the operation of the battery charger in the step mode may also be coupled to the microprocessor 50.

The microprocessor 50 can be programmed to perform essentially all of the control functions needed for operation of the battery charger. For example, the microprocessor 50 can be programmed to control the charging

WINPLUS Ex. 1003, p. 1312

process. When the charge/pulse selector 30 is actuated to select the charge mode, the microprocessor 50 receives this selection and controls the charging operation of the battery. This can be accomplished using the well-known negative delta V or other charge technique known to those of skill in the art. When the charge/pulse switch 30 is actuated to select the pulse mode, the microprocessor 50 receives this selection and controls the battery charger to perform the desulfation process. The microprocessor 50 may also include a timer such that the battery charger automatically shuts down after a predetermined period of time.

The microprocessor 50 can also monitor the charging operation. By way of a feedback circuit described below or other means, the microprocessor 50 can monitor the voltage and/or current being supplied to the battery from the battery charger and the voltage and/or current of the battery and can detect short circuits or other faults, as described in more detail below. A resistive divider may be used to provide the voltage and current measurements to the microprocessor's A/D input. A visual or audio indication of the faults is given, for example on display 52. A scrolling message describing the fault, a representative code, or other message may be displayed. The microprocessor 50 can also be programmed to control the actual pulse width modulation function. In this case, PWM controllers 23 and 25 (Fig. 1) can be eliminated and their functionality incorporated into the microprocessor 50.

In a further embodiment, the circuit shown in Figure 4 may include a logic setting that allows the high frequency charger to provide a power supply 56. The power supply 56 may be accessed via a typical cigarette plug adapter provided on the battery charger.

WINPLUS Ex. 1003, p. 1313

The embodiments shown in Figures 1 and 4 may be alternatively implemented by incorporating the apparatus of Figure 9 to implement high frequency transformer portion 8. Figure 9 shows the use of a single high frequency transformer 18′ to implement the two high frequency transformers 14 and 18. Switching circuits 22 and 24 are tied to different taps (18c′ and 18b′, respectively) of the primary side of transformer 18′. Lead 18a′ of transformer 18′ is coupled to the DC current source formed by components 2, 4, and 6 of Figures 1 and 4. As shown, switching circuit 24 controls a tap 18c′ corresponding to a winding that implements the transformer 14 of the charge circuit 12, while switching circuit 22 controls a tap 18b′ corresponding to a winding that implements the transformer 18 of the boost circuit 16. The latter winding necessarily produces the high current output needed to provide the boost function. The rectifiers and filtering capacitors 19′ replace components 19 and 20 of Figure 1 and 4. Other components of the apparatus are as shown in Figures 1 and 4.

Figure 4 also illustrates a feedback circuit that may be provided to prevent the battery from being overcharged. The feedback circuit ensures that the proper amount of current is supplied to the battery. An opto-isolator 58 is coupled between the microprocessor 50 and the battery 21 being charged and provides information regarding the battery charging process to the microprocessor.

Additional polarity and short-circuit protection circuitry can also be provided, as shown in the embodiment of Figure 5. Figure 5 is a partial schematic diagram of a battery charger showing only the short circuit and polarity protection elements to simplify the understanding of this embodiment. The other elements of the battery charger can be included as shown in Figures 1, 3, and 4.

WINPLUS Ex. 1003, p. 1314

In this embodiment, the battery charger is provided with a polarity detection circuit. Only when the polarity detection circuit detects that the battery has been connected to the battery charger with correct polarity is power supplied to the battery. Typically, the battery charger includes a pair of clamps 60, 61 for connection to the positive terminal and the negative terminal, respectively, of the battery to be charged 21. A polarity detection circuit detects the polarity of the connection of clamps 60, 61 and provides a signal to the microprocessor 50. In response to the signal from polarity detection circuit, the microprocessor controls the operation of the battery charger to supply power to the battery 21 or indicate an incorrect polarity accordingly.

In the embodiment illustrated in Figure 5, the polarity detection circuit includes an opto-isolator 62 connected to clamps 60, 61 and to microprocessor 50. The opto-isolator includes a light-emitting diode (LED) 63 and a phototransistor 65. When the battery 21 is connected with correct polarity, clamp 60 is connected to the positive terminal and clamp 61 is connected to the negative terminal of the battery 21. LED 63 is then forward biased and turns on phototransistor 65. When the phototransistor 65 is turned on, it provides a logic high signal to a pin a4 of the microprocessor 50. The logic high signal indicates to the microprocessor 50 that a correct polarity connection has been made. Connecting clamp 60 to the negative terminal of battery 21 reverse biases the LED 63, and no signal is provided to the microprocessor 50.

In response to the logic high signal, the microprocessor 50 outputs a control signal to a control circuit for completing the connection between the battery charger and the battery 21. Here, the control circuit includes a transistor 72 coupled between one of the clamps

WINPLUS Ex. 1003, p. 1315

60, 61 and the charger circuit. Transistor 72 acts as a switch to connect battery 21 to the charger circuit. Only when switch 72 is closed will transistor 69 complete the connection between the battery charger and the battery 21. The opening and closing of transistor 72 is controlled via transistors 69 and 70. A control electrode of transistor 69 receives the control signal from the microprocessor. When the control signal is received, transistor 69 turns on, which, in turn, turns on transistor 70. Current flow through transistor 70 activates a control electrode for transistor 72 and turns transistor 72 on, completing the circuit between the charger circuit and battery 21. Only when the control signal is provided to transistor 69 is it possible for transistor 72 to be turned on.

Once a correct polarity connection has been established, the transistor 72 may remain on even after clamps 60, 61 are disconnected from the battery 21. The disconnected clamps are thus still powered-up. Therefore, a means for detecting the presence of a battery at the clamps may be provided. The microprocessor 50 can be programmed to detect when the clamps 60, 61 have been disconnected and, in response, turn transistor 72 off. A voltage divider comprised of resistors 74 and 76 is provided for this purpose. The voltage divider divides the voltage across the clamps 60, 61 and provides a portion of this voltage to the microprocessor 50. When the clamps are disconnected from the battery 21, the voltage across the clamps 60, 61 will greatly increase. The voltage provided by the voltage divider will also increase in a corresponding manner. When the voltage provided to the microprocessor 50 exceeds a selected amount, for example, 18 volts, the microprocessor 50 detects that the clamps 60, 61 have been disconnected and immediately turns off transistors 69 and 70, which turns off

WINPLUS Ex. 1003, p. 1316

transistor 72. Various resistors, such as resistor 78, may also be included in the circuit.

According to another embodiment of the invention, the means for detecting the presence of a battery at the clamps may detect the presence of a current flowing through the clamps 60, 61, instead of, or in addition to the voltage across the clamps. The presence of a current flowing through the clamps 60, 61 may indicate whether the clamps 60, 61 are connected to a battery. A current flows through the clamps when they are connected to a battery and no current should flow through the clamps when they are not connected to a battery. The microprocessor 50 is adapted to detect the current flowing through the clamps 60, 61. When no current is detected, the microprocessor 50 detects that the clamps 60, 61 have been disconnected and immediately turns off transistors 69 and 70, which turns off transistor 72.

The means for detecting the presence of a battery at the clamps may also be used to detect a bad battery or a battery whose voltage is too low to be charged. Normally, even a dead battery has some voltage, usually about 3-5 volts. Occasionally, however, a battery does not have any voltage as it is so deeply discharged that the battery is totally dead. This type of battery cannot be immediately charged, if it can be charged at all. When the clamps of the battery charger are connected to this type of battery, it is as if the battery charger is not connected to anything. As the voltage of such a battery is extremely low, the microprocessor 50 does not detect any voltage across the clamps. A fault is displayed if an attempt is made to charge the battery. This type of fault will also occur if no connection or a poor connection is made to the battery 21 and the charger is activated. When the fault occurs, the microprocessor 50 can be programmed to display a suggestion

WINPLUS Ex. 1003, p. 1317

to a user that the battery be reconditioned before charging is attempted or to check if the clamps are connected to a battery.

In another embodiment of the invention, the microprocessor 50 is programmed to determine the cold-cranking amps (CCA) available from the battery 21. CCA is the amount of power exerted by a battery when starting a vehicle on a cold day. The definition by Battery Council International (BCI) is the discharge load in amperes which a new fully charged battery at 0 degrees Farenheit can deliver for 30 seconds and maintain a voltage of 1.2 volts per cell or higher.

CCA is determined in the described embodiment by connecting a resistance in parallel with the battery 21. The resistance should be connected for a short period of time so not to drain the battery. The voltage of the battery is determined when under the load of the resistance. The lower the voltage of the battery under the load, the lower the CCA of the battery. The microprocessor is programmed to correlate the measured voltage to a CCA value. The CCA value may then be displayed to the user.

Turning now to Figures 6 and 7, here are illustrated flow diagrams of a software program that can be used to control the operation of the microprocessor according to an exemplary embodiment of the present invention. At the start of the program, the battery charger is initialized, steps 100-108. The microprocessor checks the state of the various user controls that may be provided on the battery charger. These controls may include, for example, the charge/pulse selector 30, the boost selector 26, and any other user controls. The state of the input controls is checked after a predetermined period of time has passed, for example, 200 microseconds, in order to allow the control signals to reach the microprocessor. During this initialization process and

WINPLUS Ex. 1003, p. 1318

throughout the charging process, the microprocessor can detect various faults with the battery charger. For example, the battery charger may be provided with a temperature sensor that can detect the temperature of the battery. If the temperature of the battery is above a prescribed temperature, the microprocessor determines that the battery is overheated and shuts down the battery charger. A fault message may also be shown on display 52 indicating the overheated condition. If the sensed temperature is below the prescribed limit, the charging process proceeds.

Next, the microprocessor determines which of the operating modes (charging, pulsing, boosting, etc.) has been selected, steps 110-112. In the embodiment shown in figures 6 and 7, the processes for the charging mode and the battery-conditioning mode are illustrated. If none of the available operating modes has been selected, the process returns to the initialization step and checks the state of the input controls again.

Once an operating mode is selected, that selection may be shown to the user via display 52. For example, if the battery-conditioning mode has been selected, this selection is shown to the user via display 52, step 114. The battery conditioning mode is then begun. A timer is checked to determine if the battery charger has previously been operating in the battery-conditioning mode for a predetermined period of time. In this embodiment, it is checked if the battery charger has been operating in the battery-conditioning mode for 24 hours. If the charger has been operating in the battery-conditioning mode for greater than 24 hours, the battery conditioning process is complete and the process returns to the initialization step 102. If the battery conditioning process has been ongoing for less than 24 hours, the battery conditioning process continues.

WINPLUS Ex. 1003, p. 1319

The battery charger pulses the battery to perform the conditioning. The switching of the FET switch 22 is controlled to generate the conditioning pulses, steps 118-124. For example, the microprocessor may enable the PWM controller 23 to switch the FET on and off for a period of time, about 50 microseconds. The PWM controller 23 is then turned off, disabling the FET switch 22. The FET is not switched when the PWN controller 23 is off. The PWM controller 23 may remain off for about 1 second. The process then returns to the step 114 and repeats until the battery conditioning operation has been performed for 24 hours, at which time the battery conditioning process is completed.

When the microprocessor detects that the charge mode has been selected, the process proceeds to step 126. Here, the charging current being supplied to the battery 21 is shown to the user via display 52. The microprocessor detects if the charging process is complete. This may be done by checking if a flag indicating that the charging process is complete is set. If the charge complete flag is set, the charger is turned off and a charge complete indicator, for example, an LED, is activated to indicate to a user that charging is complete. The process then returns to the initialization stage and awaits further instructions via the user input, steps 128-132.

If the charge complete flag is not set, the process proceeds to step 134 (in Figure 7) and detects if a battery is connected to the charger. This check can prevent current from being supplied from the battery charger unless a battery is connected to the battery charger, preventing a potentially hazardous situation. The means for detecting the presence of a battery at the clamps discussed above in connection with figure 5 can be perform this check. Additionally, the process for detecting a bad battery or a

WINPLUS Ex. 1003, p. 1320

battery that has a voltage too low to be charged as described above may also be performed at this time. If a bad battery, a low voltage battery or no battery is detected, a fault is displayed; the charger may then be disabled in step 136, and the process returns to the initialization stage.

When a connection to a battery is detected, the microprocessor enables PWM controller 23 to generate a driving signal for FET switch 22, steps 138-142. If the charging process has already been initiated, these steps may be skipped. Next, it is determined if the battery charger is operating in a bulk charging mode or an absorption charging mode. This determination is made by examining an absorption stage flag. If the absorption stage flag is set, the battery is in the absorption charging mode, and the process proceeds according to step 168. If the absorption stage flag is not set, the battery is still in the bulk charging mode. The process then proceeds with step 146 to continue the bulk charging mode and to determine when the bulk charging mode has been completed.

Additional fault checks may be performed at this time to ensure the charging operation is proceeding correctly, steps 146-154. The fault checks may also be performed at other times during the process. The microprocessor can detect various faults, including a shorted cell battery, an open cell battery, and an overtime allowed for the charging process, among others. Various measurement means are provided to measure the required parameters and to supply this information to the microprocessor.

If a battery has a shorted cell, it is unlikely that the battery voltage will increase as it is attempted to charge the battery. However, charging must be attempted for some period of time before it can be determined if the battery has a shorted cell. The microprocessor can be

WINPLUS Ex. 1003, p. 1321

programmed to monitor the voltage, current, and time of charging to detect a shorted cell. If a charge rate is greater than a predetermined current, the battery has been charging more a predetermined amount of time, and the voltage of the battery is less than or equal to a predetermined voltage, a shorted cell is detected. For example, if the charge rate of the battery is greater than 2 amps, the battery has been charging for more than 1 hour, and the voltage of the battery is less than or equal to about 11 volts, the charger is turned off, and a shorted cell fault is indicated to the user.

The process for detecting an open cell battery is similar to the process for detecting a shorted cell battery. An open cell battery has some voltage due to leakage between the open cell and its connectors. However, the open cell battery does not have the ability to either accept or deliver current. When the battery charger is connected to an open cell battery, the microprocessor detects a voltage at the clamps of the battery charger, but when the charging process begins, no appreciable current is detected. If no current is detected after a predetermined period of time, for example five minutes, an open cell battery is detected and the appropriate fault displayed. If an open cell or shorted cell fault is not detected, the process may proceed to step 156.

Step 156 determines if the battery has been charging for an extended period of time, yet the charging process is not complete, an overtime fault. There may be situations when the voltage of a battery increases during charging, in contrast to a shorted cell battery, but the battery is not fully charged within a predetermined period of time. This can happen, for example, on a very large battery which is being charged at a very low current rate. A 100 amp hour battery cannot be charged with a change rate of 2 amps in a

WINPLUS Ex. 1003, p. 1322

reasonable amount of time. Therefore, the charge rate is too low to finish charging in a reasonable period of time and a fault is indicated. Additionally, another type of failure mode in a battery can cause this same circumstance, that is, a battery with a severe internal leakage.

An overtime fault occurs if a predetermined voltage is not reached within a predetermined time period, yet the called for current is still flowing. When these conditions are met, an overtime fault is indicated on the display For example, referring to steps 150-156 of figure 6, it is determined if the battery has been charging for over 18 hours. If so, the battery has been charging a substantial period of time, and yet the battery voltage is not over 12 volts, per step 150. Thus, a fault is detected and the process proceeds to step 152, where the charger is turned off, and then to step 154, where a fault is indicated.

If the battery has not been charging for 18 hours, the process continues with step 158. Step 158 utilizes feedback from the battery to adjust the duty cycle of the signal driving the FET 22. If the actual current being provided from the battery charger is greater than or equal to the desired current, the duty cycle of the driving signal is decreased, step 160. If the actual current is less than the desired current, then the duty cycle of the driving signal is increased, step 162.

Next, it is determined if the voltage of the battery is greater than or equal to a predetermined voltage, for example, 14 volts, for at least a predetermined period of time, for example, 2 seconds, step 164. If the voltage of the battery has not been greater than or equal to 14 volts for at least 2 seconds, the process returns to the initialization stage. On the other hand, if the voltage of the battery has been greater than or equal to 14 volts for more than 2 seconds and the battery has not been charging

WINPLUS Ex. 1003, p. 1323

for a predetermined time, for example 15 hours (step 166), a fault is indicated, and the process proceeds to steps 152 and 154. Otherwise, the process proceeds to step 200 and the flag for the absorption stage is set. The process then returns to the initialization stage and begins again.

If a flag for the absorption stage has been set, the process proceeds from step 144 to step 168. If the battery voltage is greater than or equal to the predetermined voltage, for example, 14 volts, the duty cycle of the driving signal is decreased. If the voltage is less than 14 volts, the duty cycle of the driving signal is increased, steps 168-172. Next, it is determined if the current of the battery is greater than or equal to the bulk charging current. If the current is greater than or equal to the bulk charging current, the duty cycle of the driving signal is decreased, otherwise no change to the duty cycle is made, steps 174-176. A check is then performed to determine if the absorption charge mode is complete. If the voltage of the battery is greater than or equal to a predetermined voltage, for example 14 volts, and the battery has been charging for a predetermined time, for example 2 hours, the absorption charge mode is complete and the flag for a complete charge is set, steps 178-200. The charging process is complete, and the process then returns to the initialization stage and awaits further instructions.

The microprocessor 50 may also be used to conduct a test of an alternator of a vehicle with a depleted battery. When the alternator of a vehicle is working properly, the voltage level of the discharged battery 21 rises rapidly immediately after the battery is jump-started. The rapid rise in voltage can be detected by the microprocessor 50 based on the signals the microprocessor receives from opto-isolator circuit 62. If a rapid rise in voltage is detected, a message that the alternator is working properly

WINPLUS Ex. 1003, p. 1324

may be shown on display 52. If no rapid rise in voltage is detected, then a message that the alternator is malfunctioning may be shown on display 52. The rapid rise in voltage may vary depending on how depleted the discharged battery is. The microprocessor should be programmed to account for this variance.

Another fault that may be detected by the microprocessor is an overheated charger. The charger may become overheated due to restricted airflow or an internal failure. A temperature sensor that measures the internal temperature of the charger can be coupled to the microprocessor. When the microprocessor detects that the temperature of the internal electronics of the battery charger is too high, a fault is detected and shown on display 52.

In a further embodiment of the invention, a method of electrically testing a connection between the battery charger and the battery to be charged is provided. The method enables this connection to be tested before high current levels that may result in a spark or arcing are available. According to this embodiment, an amount of current less than the total available charging current is initially provided from the battery charger. It is then determined if this smaller amount of current is present at the battery being charged. If so, the current level provided from the battery charger is gradually increased, for example, in a step wise manner or according to a ramp function. The current provided from the battery charger is checked at various increments to determine if the current provided from the battery charger is present at the battery being charged. If the current from the battery charger is present at the battery being charged, the increase of the current continues until the desired charging current is reached. If, at any point during the increase of current,

WINPLUS Ex. 1003, p. 1325

the current from the battery charger is not present at the battery being charged, a fault may be detected. When a fault is detected, the current from the battery charger can be reduced to a lower, safer level that does not produce a spark or arcing.

A flow chart relating to this embodiment of the invention is illustrated in Figure 8. First, the battery charger is coupled to the battery being charged, per step 202. The battery charger may have an available output current of about 6 amps, for example. Initially, a far lower current, for example, 0.5 amp, is provided from the battery charger as a test current, step 204. In step 206, a test is performed to detect the presence of the 0.5 amp test current at the battery being charged. If the test current is not detected, a fault is indicated, and the charging process may stop, per step 208. In step 210, it is determined if the test current is equal to the desired charging current. If so, the charging continues at the desired charging current, step 212. Otherwise the process proceeds to step 214. In this case, the 0.5 amp test current is present at the battery being charged, and the current provided from the battery charger is increased to the next level, for example, 0.75 amps. The process then returns to step 206 to detect the increased current. Stepping or ramping up the current in this manner detects a faulty connection between the battery charger and the battery being charged prior to high currents that can produce sparks being provided to the battery. The microprocessor may be programmed to operate the battery charger in this manner.

Accordingly, a high frequency charger and method of operating a high frequency charger are provided. The use of high frequency transformers provides several advantages. For example, as long as the switching frequency is high

WINPLUS Ex. 1003, p. 1326

enough, iron is not needed for the core of the transformers. A very light substance, for example, ferrite, can be used, greatly reducing the weight and unwieldiness of known devices. Additionally, the secondary winding of the transformers may have a small number of windings, for example, as few as four turns of wire. In comparison, a conventional transformer can require over 100 turns of wire. The higher the frequency, the less wire is needed, further reducing the cost required to manufacture the device.

The embodiments illustrated and discussed in this specification are intended only to teach those skilled in the art the best way known to the inventors to make and use the invention. Nothing in this specification should be considered as limiting the scope of the present invention. The above-described embodiments of the invention may be modified or varied, and elements added or omitted, without departing from the invention, as appreciated by those skilled in the art in light of the above teachings. It is therefore to be understood that, within the scope of the claims and their equivalents, the invention may be practiced otherwise than as specifically described. For example, the processes described above may be performed in an order different from that described above.

WINPLUS Ex. 1003, p. 1327

WE CLAIM:

1. A high frequency charger, comprising:

high frequency transformer means;

a first switch switching the high frequency transformer means at a first frequency and producing a charging current for charging a battery;

a second switch switching the high frequency transformer means at a second frequency and producing a relatively high boost current compared to the charging current for jump-starting a vehicle; and

a selector switch for selectively activating at least one of the first switch and the second switch.

2. The charger of claim 1, wherein the high frequency transformer means comprises a single high frequency transformer having two separate taps on its primary side, one tap being switched by the first switch and causing the charging current to be produced, and other tap being switched by the second switch and causing the boost current to be produced.

3. The charge of claim 1, wherein the high frequency transformer means comprises:

a first high frequency transformer for providing the charging current; and

a second high frequency transformer, separate from the first high frequency transformer, for providing the boost current.

4. The charger of claim 3, wherein the first switch switches the first high frequency transformer and the second switch switches the second high frequency transformer.

WINPLUS Ex. 1003, p. 1328

5. The charger of claim 1, further comprising:

a filter coupled to the high frequency transformer means for passing a DC voltage signal to the high frequency transformer means.

6. The charger of claim 1, further comprising:

at least one filter coupled to the output of the high frequency transformer means for passing a DC voltage signal to a charger output.

7. The charger of claim 1, wherein at least a portion of the high frequency transformer means and the first switch form a charging circuit, wherein the charging circuit has a charge mode and a pulse mode, and further comprising means for selectively activating one of the charge mode and the pulse mode.

8. The charger of claim 7, further comprising means coupled to the first switch for alternatingly enabling the first switch to switch the high frequency transformer means at the first frequency and disabling the first switch from switching the high frequency transformer means.

9. The charger of claim 1, further comprising:

a first controller providing a driving signal to the first switch; and

a second controller providing a driving signal to the second switch.

10. The charger of claim 9, wherein the selector switch is coupled to the first and second controllers for selectively activating at least one of the first and second controllers.

WINPLUS Ex. 1003, p. 1329

11. The charger of claim 10, wherein at least a portion of the high frequency transformer means and the first switch form a charging circuit, wherein the charging circuit has a charge mode and a pulse mode and further comprising a selector coupled to the first controller for selecting between the charge mode and the pulse mode.

12. The charger of claim 11, further comprising an enable circuit coupled to the selector that selectively enables and disables the first controller at a predetermined rate when the pulse mode is selected.

13. The charger of claim 9, further comprising a feedback circuit connected between the battery and the first controller for adjusting a duty cycle of the driving signal based on charging parameters of the battery.

14. The charger of claim 1, wherein a DC signal output from the high frequency transformer means has a current of about 25-300 amps.

15. The charger of claim 1, wherein a DC signal output from the high frequency transformer means has a duration of about 3-35 seconds.

16. The charger of claim 7, wherein, in the pulse mode, the DC output signal of the charging circuit is a series of pulses.

17. The charger of claim 16, wherein the series of pulses has a rise time of less than 100 volts per microsecond.

18. The charger of claim 16, wherein the series of pulses has a frequency of about one pulse per second.

WINPLUS Ex. 1003, p. 1330

19. The charger of claim 6, further comprising:

a pair of connectors coupled to the at least one filter and adapted for connection to a battery;

at least one switch coupled in between one of the connectors and the at least one filter;

a polarity detection circuit coupled to the connectors for determining a polarity between the connectors and providing a polarity signal representing the polarity; and

a microprocessor receiving the polarity signal and generating a signal for opening or closing the at least one switch in dependence on the polarity signal.

20. The charger of claim 19, wherein the polarity detection circuit includes an opto-isolator.

21. The charger of claim 19, wherein the at least one switch includes a transistor.

22. The charger of claim 19, further comprising means for detecting disconnection of the connectors from the battery and opening the at least one switch when disconnection is detected.

23. The charger of claim 9, further comprising a control circuit coupled to the first controller for setting a duty cycle of an output signal of the first controller.

WINPLUS Ex. 1003, p. 1331

24. The charger of claim 23, wherein the control circuit setting a duty cycle comprises:

an integrated circuit; and

at least two reference voltage circuits developing a reference voltage and coupled between the integrated circuit and the first controller, wherein the integrated circuit selectively enables at least one of the reference voltage circuits.

25. The charger of claim 24, wherein the integrated circuit comprises a counter.

26. The charger of claim 24, wherein each of the reference voltage circuits includes a switch that can be opened and closed in dependence on an output from the counter.

27. The charger of claim 24, wherein the control circuit setting a duty cycle comprises a voltage divider network dividing a voltage applied to a reference voltage input of the first controller and a control input of the first controller, wherein the duty cycle varies based on a percentage of the reference voltage applied to the control input.

28. The charger of claim 1, further comprising a computer for controlling the operation of the first and second switches.

29. The charger of claim 28, further comprising:

a display coupled to the computer for displaying output from the computer; and

input means coupled to the computer for permitting a user to select a mode of operation.

WINPLUS Ex. 1003, p. 1332

30. The charger of claim 28, further comprising:

means for detecting at least one of a voltage and a current at an interface of the charger with a battery; and

a feedback circuit for providing the detected voltage or current to the computer.

31. The charger of claim 30, wherein the means for detecting comprises an opto-isolator for producing a voltage representing the voltage of the battery while it is being charged by the charging current.

32. The charger of claim 1, further comprising:

means for testing for at least one fault; and

a display for displaying an alphanumeric fault code.

33. A control circuit for a high frequency charger, comprising:

a pulse width modulation controller having a reference voltage input, a control input and an output for outputting a control signal;

a switch receiving the control signal and being switched on and off in response to the control signal, the switch adapted for connection to a transformer for switching the transformer; and

a voltage divider network dividing a voltage applied to the reference voltage input and the control input, whereby a duty cycle of the control signal output from the pulse width modulation controller varies based on the percentage of the reference voltage applied to the control input.

34. The control circuit of claim 33, further comprising:

a transformer connected to the switch and being switched on and off via the switch.

WINPLUS Ex. 1003, p. 1333

35. The control circuit of claim 33, wherein the voltage divider network comprises:

a first resistor having a first terminal connected to the reference voltage input and a second terminal connected to the control input; and

a second resistor having a first terminal connected to second terminal of the first resistor and a second terminal that is grounded.

36. The control circuit of claim 33, wherein the voltage divider network comprises:

a first resistor having a first terminal connected to the reference voltage input and a second terminal connected to the control input; and

a plurality of second resistors each having a first terminal connected to the second terminal of the first resistor and a second terminal that is selectively grounded, wherein only one of the second resistors is selectively grounded at any time.

37. The control circuit of claim 36, further comprising a switch for selectively connecting the second resistors to ground.

38. The control circuit of claim 37, wherein the switch comprises a separate transistor for each of the second resistors providing a current path to ground when the transistor is turned on.

39. The control circuit of claim 33, wherein the voltage divider network comprises:

a first resistor having a first terminal connected to the reference voltage input and a second terminal connected to the control input; and

WINPLUS Ex. 1003, p. 1334

a plurality of second resistors each having a first terminal connected to the second terminal of the first resistor and a second terminal;

and further comprising a plurality of transistors, each having a first electrode connected to the second terminal of one the second resistors, a second electrode that is grounded, and a third electrode receiving an enable signal.

40. The control circuit of claim 39, further comprising:

an integrated circuit having outputs, each output being connected to one of the third electrodes and providing the enable signal thereto, only one of the outputs being active at any time.

41. The control circuit of claim 40, wherein the integrated circuit comprises a counter.

42. The charger of claim 28, wherein at least a portion of the high frequency transformer means and the first switch form a charging circuit, wherein the charging circuit has a charge mode and a pulse mode, and further comprising means for selectively activating one of the charge mode and the pulse mode; and a computer-readable information storage medium, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of:

detecting a selected of mode of operation; and

when a pulse mode is selected:

a) generating a driving signal for the first switch for a first period of time;

b) disabling the first switch for a second period of time; and

c) returning to step a).

WINPLUS Ex. 1003, p. 1335

43. A high frequency charger for charging a battery, comprising:

a charge circuit including a high frequency transformer;

a switch switching the high frequency transformer at a first frequency;

a filter coupled to the high frequency transformer for passing a DC voltage signal;

means for measuring a charge rate of the battery;

means for determining an amount of time the battery has been charging;

means for measuring a voltage of the battery; and

means for detecting at least one of an overtime fault, a shorted cell fault, a bad battery fault, and an open cell fault based on at least one of the charge rate, the charging time, and the battery voltage.

44. The charger of claim 43, wherein the means for detecting detects at least the overtime fault, and wherein the overtime fault is detected when the charge rate is greater than a predetermined current, the battery has been charging longer than a predetermined amount of time, and the voltage of the battery is greater than or equal to a predetermined voltage.

45. The charger of claim 43, further comprising a display that visually indicates at least one of the faults.

46. The charger of claim 44, wherein the predetermined current is 2 amps, the predetermined time is 18 hours, and the predetermined voltage is 12 volts.

WINPLUS Ex. 1003, p. 1336

47. The charger of claim 43, wherein the means for detecting detects at least the shorted cell battery fault, and wherein the shorted cell battery fault is detected when the charge rate is greater than a predetermined current, the battery has been charging more a predetermined amount of time, and the battery voltage is less than or equal to a predetermined voltage.

48. The charger claim 47, wherein the predetermined time is 1 hour, and the predetermined voltage is 11 volts.

49. The charger of claim 43, wherein the means for detecting detects at least the bad battery fault, and wherein the bad battery fault is detected when no battery voltage is measured by the means for measuring.

50. The charger of claim 43, wherein the means for detecting detects the open cell battery fault, and wherein the open cell battery fault is detected when the charge current is less than a predetermined current, the battery has been charging more a predetermined amount of time, and the battery voltage is greater than or equal to a predetermined voltage.

51. A computer-readable information storage medium for use with a computer controlling a high frequency charger comprising a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; a boost circuit including a second high frequency transformer; a second switch switching the second high frequency transformer at a second frequency, and a selector for selecting one of a charge mode for charging a depleted battery and a boost mode for supplying a boosting current to start a vehicle with the

WINPLUS Ex. 1003, p. 1337

depleted battery, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of:

detecting a selected mode of operation;

if the boost mode is selected, controlling the boost circuit to supplying a boosting current to the depleted battery;

checking for a rapid rise in voltage after the vehicle has been started;

indicating the alternator is working properly if the rapid rise in voltage is present; and

indicating the alternator is not working properly if the rapid rise in voltage is not present.

52. A computer-readable information storage medium for use with a computer controlling a high frequency charger comprising a charge circuit including a high frequency transformer; a switch switching the high frequency transformer at a predetermined frequency, the computer-readable information storage medium storing containing software implementing a method of reducing arcing in a battery charger, the method comprising the steps of:

providing a test current that is lower than a charging current from the battery charger to a battery;

detecting if the test current is present at the battery;

indicating a fault if the test current is not detected at the battery; and

increasing the test current a predetermined amount and returning to the detecting step if the test current is detected at the battery.

WINPLUS Ex. 1003, p. 1338

53. A computer-readable information storage medium for use with a computer controlling a high frequency charger for charging a battery, comprising a charge circuit including a first high frequency transformer; a first switch switching the first high frequency transformer at a first frequency; a filter coupled to the first high frequency transformer for passing a DC voltage signal, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of:

measuring a charge rate of the battery;

determining an amount of time the battery has been charging;

measuring a battery voltage; and

detecting at least one of an overtime fault, a shorted cell fault, a bad battery fault, and an open cell fault based on at least one of the charge rate, the amount of time, and the battery voltage.

54. The computer-readable information storage medium of claim 53, further comprising code for causing the computer to perform the step of visually indicating at least one of the faults on a display.

55. The computer-readable information storage medium of claim 53, further comprising code for causing the computer to perform the step of detecting at least the overtime fault, and wherein the overtime fault is detected when the charge rate is greater than a predetermined current, the battery has been charging longer than a predetermined amount of time, and the battery voltage is greater than or equal to a predetermined voltage.

WINPLUS Ex. 1003, p. 1339

56. The computer-readable information storage medium of claim 55, wherein the predetermined current is 2 amps, the predetermined time is 18 hours, and the predetermined voltage is 12 volts.

57. The computer-readable information storage medium of claim 53, further comprising code for causing the computer to perform the step of detecting at least the shorted cell battery fault, and wherein the shorted cell battery fault is detected when the charge rate is greater than a predetermined current, the battery has been charging more a predetermined amount of time, and the battery voltage is less than or equal to a predetermined voltage.

58. The computer-readable information storage medium of claim 57, wherein the predetermined time is 1 hour, and the predetermined voltage is 11 volts.

59. The computer-readable information storage medium of claim 53, further comprising code for causing the computer to perform the steps of:

detecting at least the bad battery fault;

indicating the bad battery fault if no battery voltage is detected; and

proceeding with a charging operation if the battery voltage is detected.

60. The computer-readable information storage medium of claim 53, further comprising code for causing the computer to perform the step of detecting at least the open cell battery fault, and wherein the open cell battery fault is detected when the charge current is less than a predetermined current, the battery has been charging more a

WINPLUS Ex. 1003, p. 1340

predetermined amount of time, and the battery voltage is greater than or equal to a predetermined voltage.

61. The computer-readable information storage medium of claim 53, further comprising computer-readable program code for causing a computer to perform the step of turning the battery charger off if a battery to be charged is not connected to the battery charger.

62. A method of reducing arcing in a battery charger, comprising:

providing a test current that is lower than a charging current from the battery charger to a battery;

detecting if the test current is present at the battery;

indicating a fault if the test current is not detected at the battery; and

increasing the test current a predetermined amount and returning to the detecting step if the test current is detected at the battery.

63. The method of claim 62, further comprising providing a current lower than the test current to the battery and returning to the detecting step if the test current is not detected at the battery.

64. The method of claim 62, wherein the test current is increased according to a ramp function.

65. The method of claim 62, wherein the test current is increased according to a step function.

WINPLUS Ex. 1003, p. 1341

66. The method of claim 62, further comprising the step of using pulse width modulation to control the current provided from the battery charger.

67. The method of claim 62, further comprising the step of determining if the test current equals a selected current and, if so, continuing charging at the selected current, otherwise returning to the detecting step.

68. A high frequency charger for charging a battery, comprising:

a charge circuit including a high frequency transformer;

a switch switching the high frequency transformer at a first frequency;

a filter coupled to the high frequency transformer for passing a DC voltage signal;

means for coupling a resistance in parallel with the battery;

means for measuring a voltage of the battery while the battery is coupled to the resistance; and

means for correlating the measured voltage to a CCA value.

69. The charger claim 68, further comprising a display and wherein the CCA is visually indicated on the display.

70. A computer-readable information storage medium for use with a computer controlling a high frequency charger for charging a battery, comprising a charge circuit including a high frequency transformer; a switch switching the high frequency transformer at a first frequency; a filter coupled to the high frequency transformer for passing a DC voltage signal, wherein a resistance is coupled in parallel with the

WINPLUS Ex. 1003, p. 1342

battery, the computer-readable information storage medium storing computer-readable program code for causing the computer to perform the steps of:

measuring a voltage of the battery while the battery is coupled to the resistance; and

correlating the measured voltage to a CCA value.

71. A high frequency booster circuit for boosting a vehicle, comprising:

a high frequency transformer means;

a switch switching the high frequency transformer at a given frequency; and

a filter for passing a DC signal derived from an output of the high frequency transformer.

72. The high frequency booster circuit of claim 71, further comprising:

means for performing fault detection; and

an alphanumeric display for displaying fault codes.

73. The high frequency booster circuit of claim 71, further comprising:

means for checking for a rapid rise in voltage after the vehicle has been started; and

means for providing an indication that the vehicle's alternator is working properly if such a rapid rise in voltage is detected and for providing an indication that the vehicle's alternator is not working properly if the rapid rise in voltage is not detected.

74. The high frequency booster circuit of claim 73, further comprising:

a computer for controlling the high frequency booster circuit; and

WINPLUS Ex. 1003, p. 1343

a computer-readable medium having software, the computer-readable medium being coupled for reading by the computer, wherein:

a first portion of the software implements at least a portion of the means for checking; and

a second portion of the software implements at least a portion of the means for providing an indication.

75. The high frequency booster circuit of claim 71, further comprising:

a pulse-width modulation controller for controlling the switch.

WINPLUS Ex. 1003, p. 1344

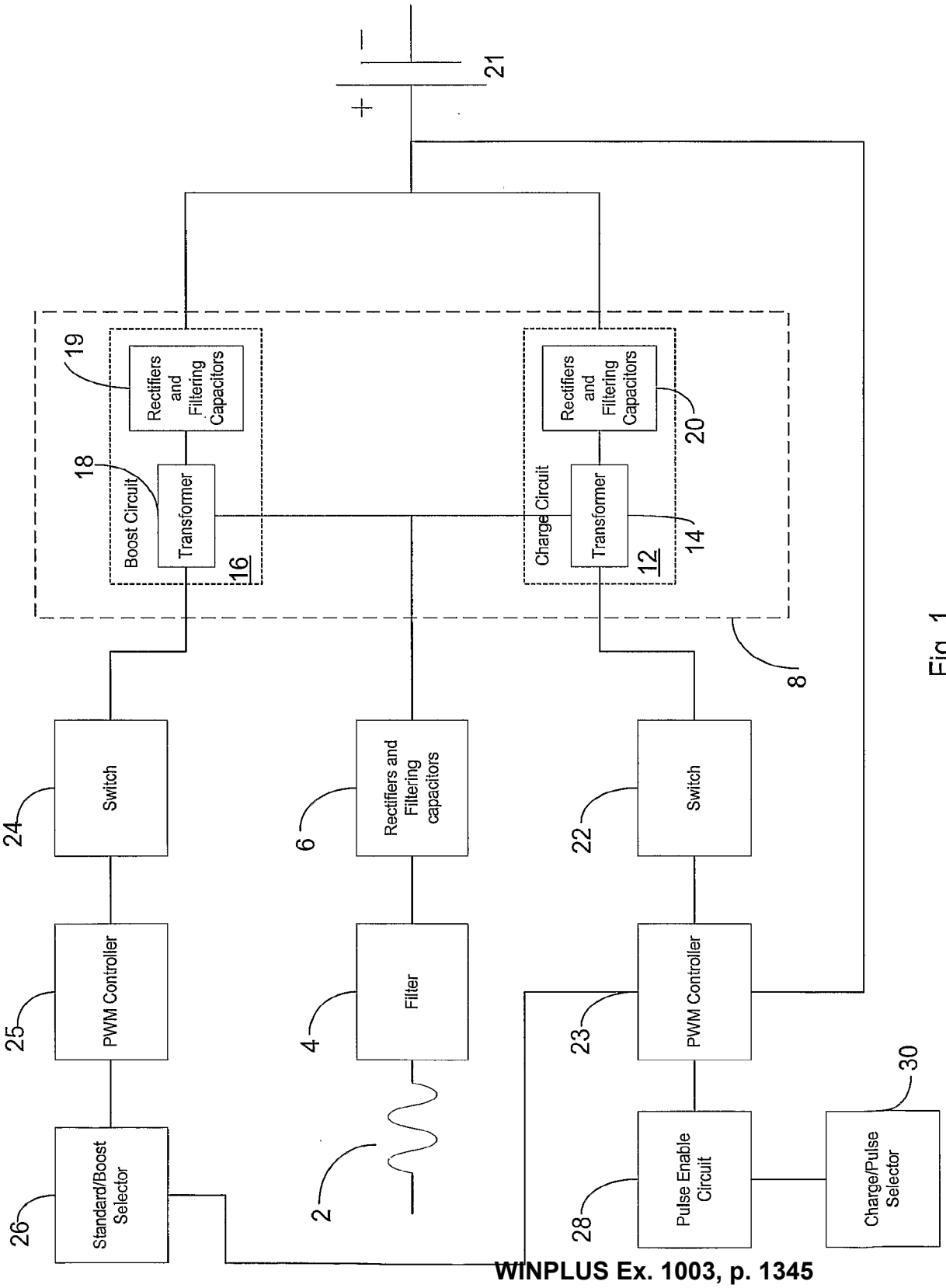

21
+
−
19
Rectifiers and Filtering Capacitors
18
Transformer
Boost Circuit
16
Rectifiers and Filtering Capacitors
20
Transformer
Charge Circuit
12
14
8
24
Switch
25
PWM Controller
26
Standard/Boost Selector
6
Rectifiers and Filtering capacitors
4
Filter
2
22
Switch
23
PWM Controller
28
Pulse Enable Circuit
30
Charge/Pulse Selector

Fig. 1

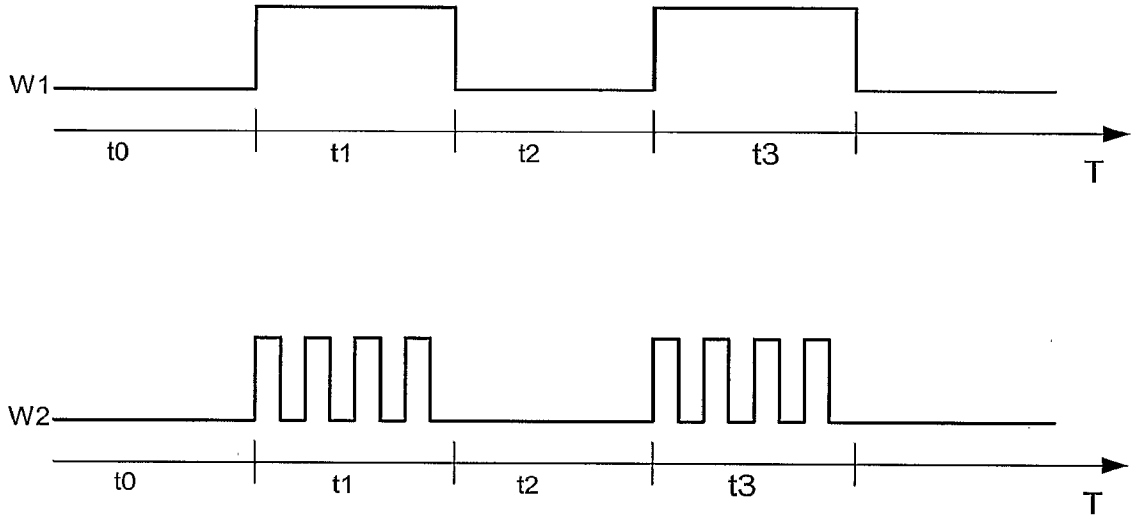


FIG. 2

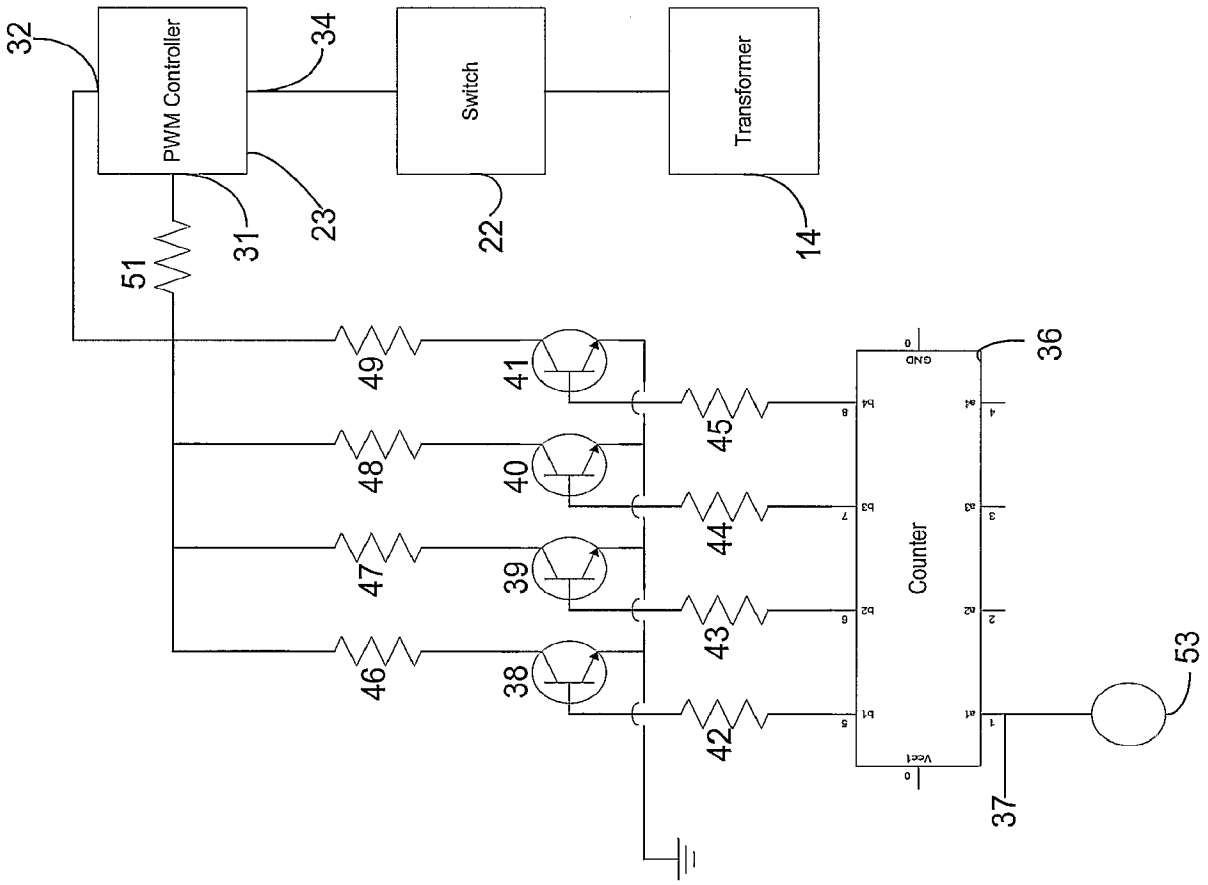

32
PWM Controller
34
Switch
Transformer
23
31
22
14
51
49
41
45
48
40
44
47
39
43
46
38
42
Counter
GND
Vcc1
36
37
53

Fig. 3

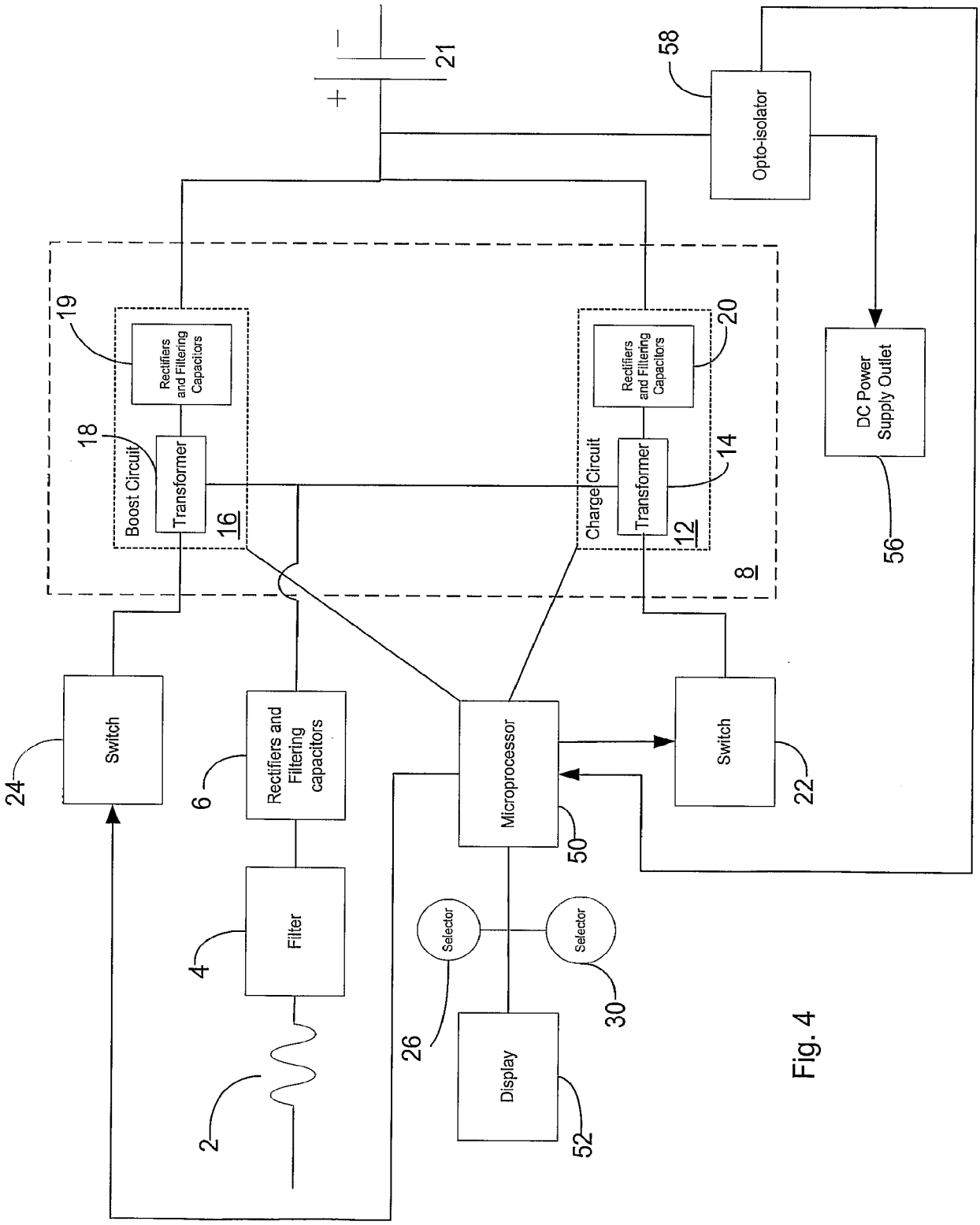

21
58
Opto-isolator
DC Power Supply Outlet
56
19
Rectifiers and Filtering Capacitors
18
Boost Circuit
Transformer
16
20
Rectifiers and Filtering Capacitors
Charge Circuit
Transformer
14
12
8
Switch
24
Rectifiers and Filtering capacitors
6
Filter
4
2
Microprocessor
50
Switch
22
Selector
Selector
26
30
Display
52

Fig. 4

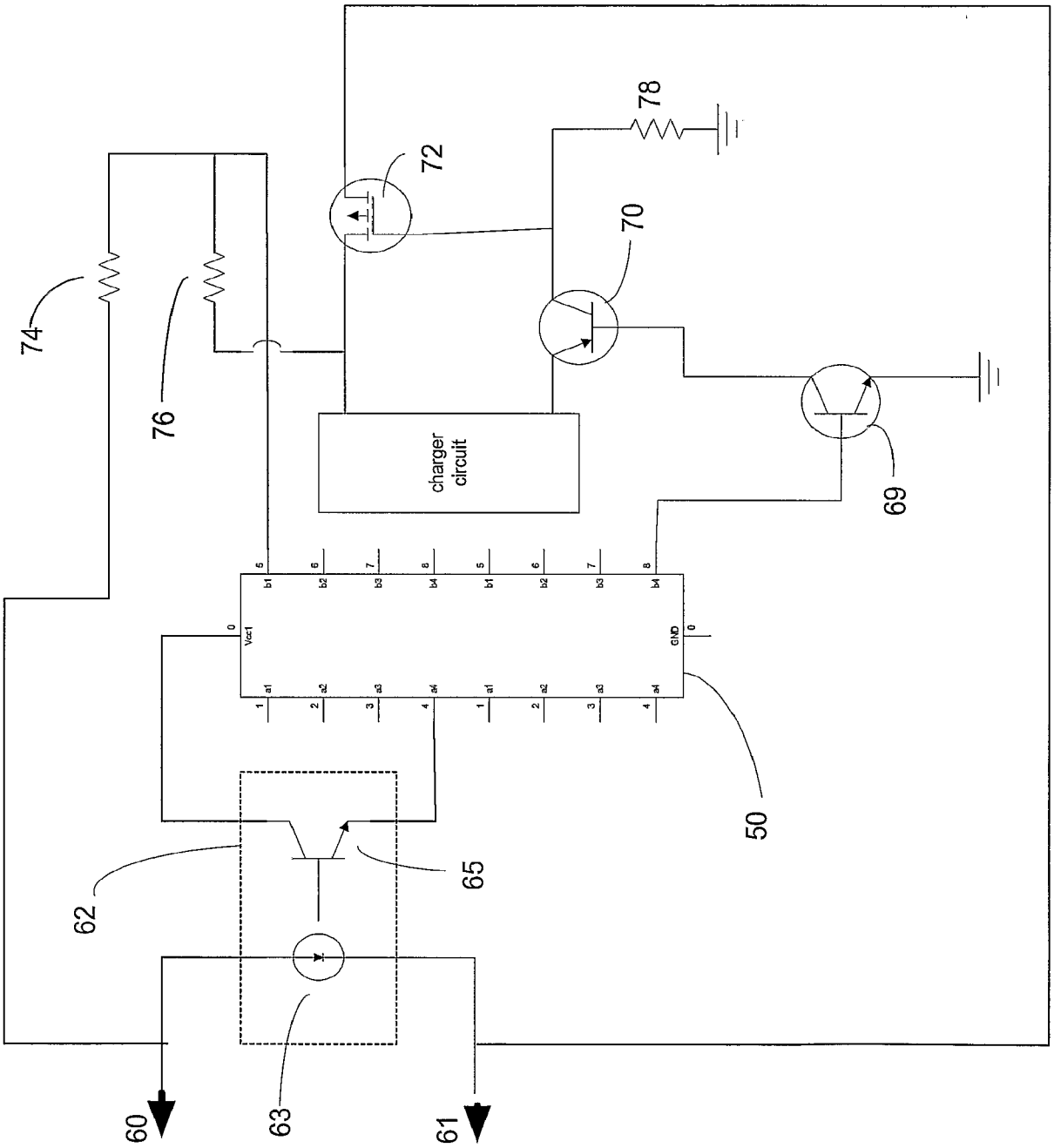


Fig. 5

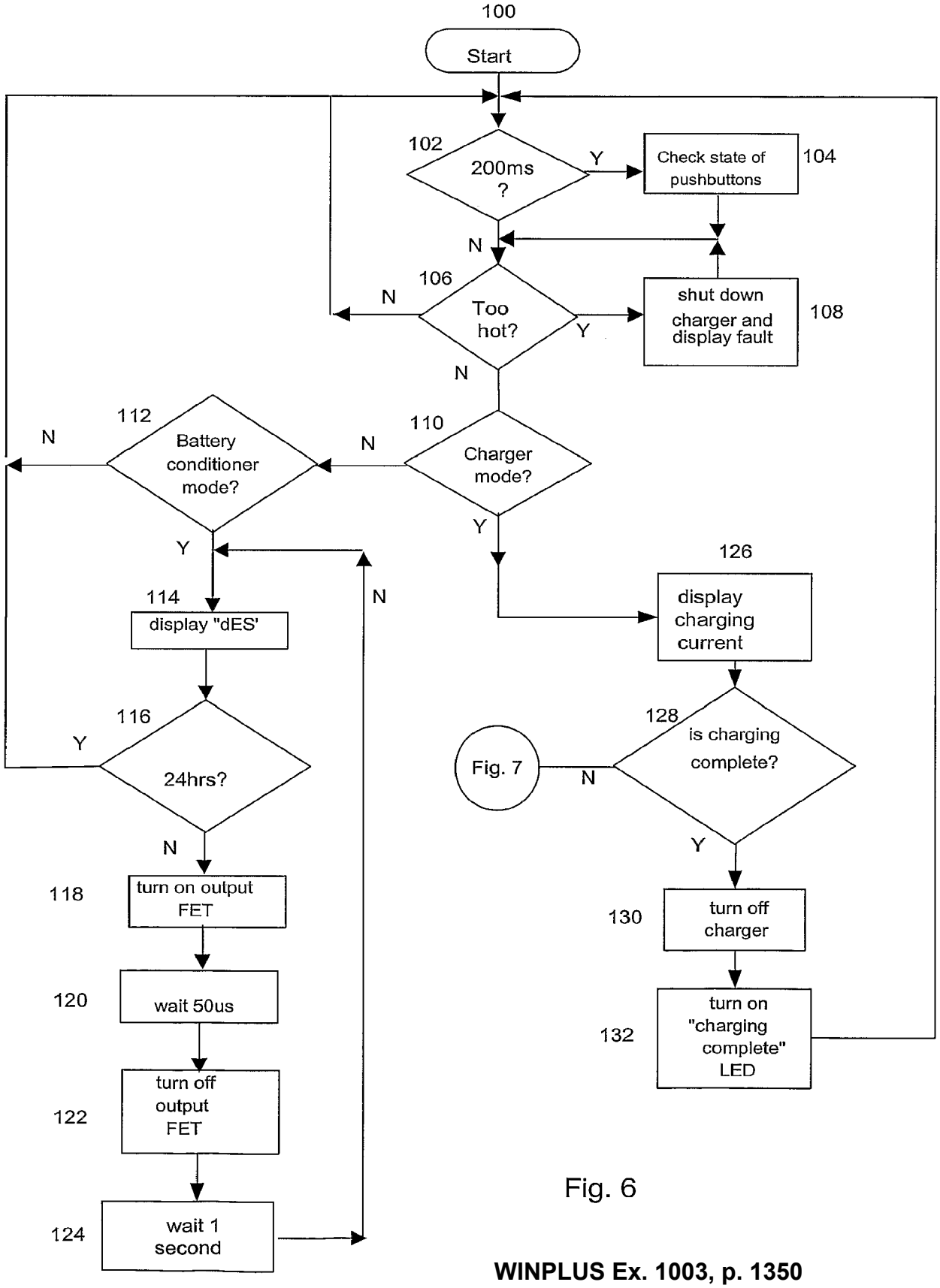

100
Start
102
200ms ?
Y
Check state of pushbuttons
104
N
106
Too hot?
N
Y
shut down charger and display fault
108
N
110
Charger mode?
N
112
Battery conditioner mode?
N
Y
126
display charging current
114
display "dES'
N
116
24hrs?
Y
N
128
is charging complete?
Fig. 7
N
Y
118
turn on output FET
130
turn off charger
120
wait 50us
132
turn on "charging complete" LED
122
turn off output FET
124
wait 1 second

Fig. 6

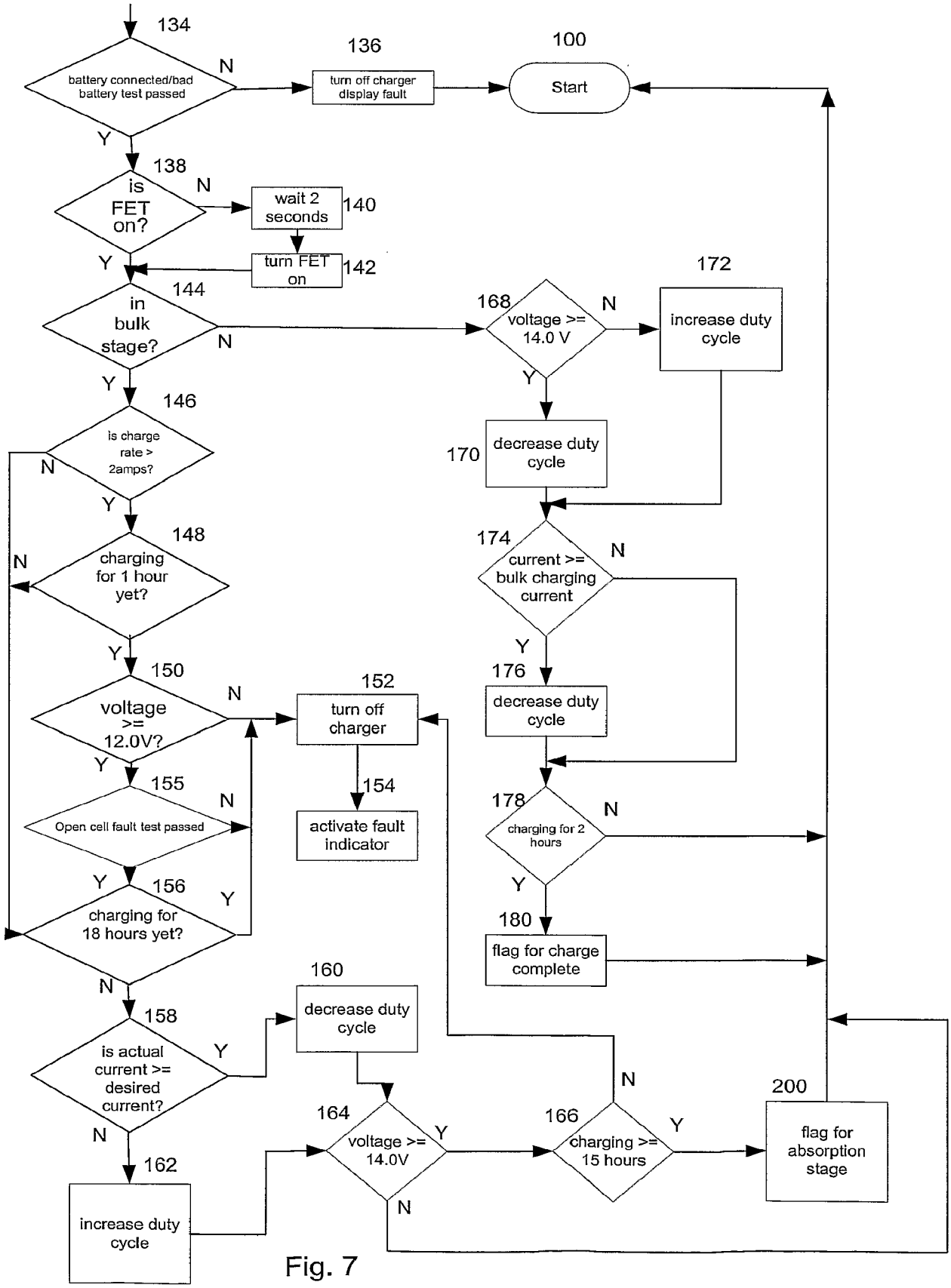

134
battery connected/bad battery test passed
N
136
turn off charger display fault
100
Start
Y
138
is FET on?
N
wait 2 seconds
140
Y
turn FET on
142
144
in bulk stage?
N
168
voltage >= 14.0 V
N
172
increase duty cycle
Y
Y
146
is charge rate > 2amps?
170
decrease duty cycle
N
Y
148
charging for 1 hour yet?
174
current >= bulk charging current
N
N
Y
Y
150
voltage >= 12.0V?
N
152
turn off charger
176
decrease duty cycle
Y
154
activate fault indicator
155
Open cell fault test passed
N
178
charging for 2 hours
N
Y
Y
156
charging for 18 hours yet?
Y
180
flag for charge complete
N
160
decrease duty cycle
158
is actual current >= desired current?
Y
N
200
N
164
voltage >= 14.0V
Y
166
charging >= 15 hours
Y
flag for absorption stage
N
162
increase duty cycle

Fig. 7

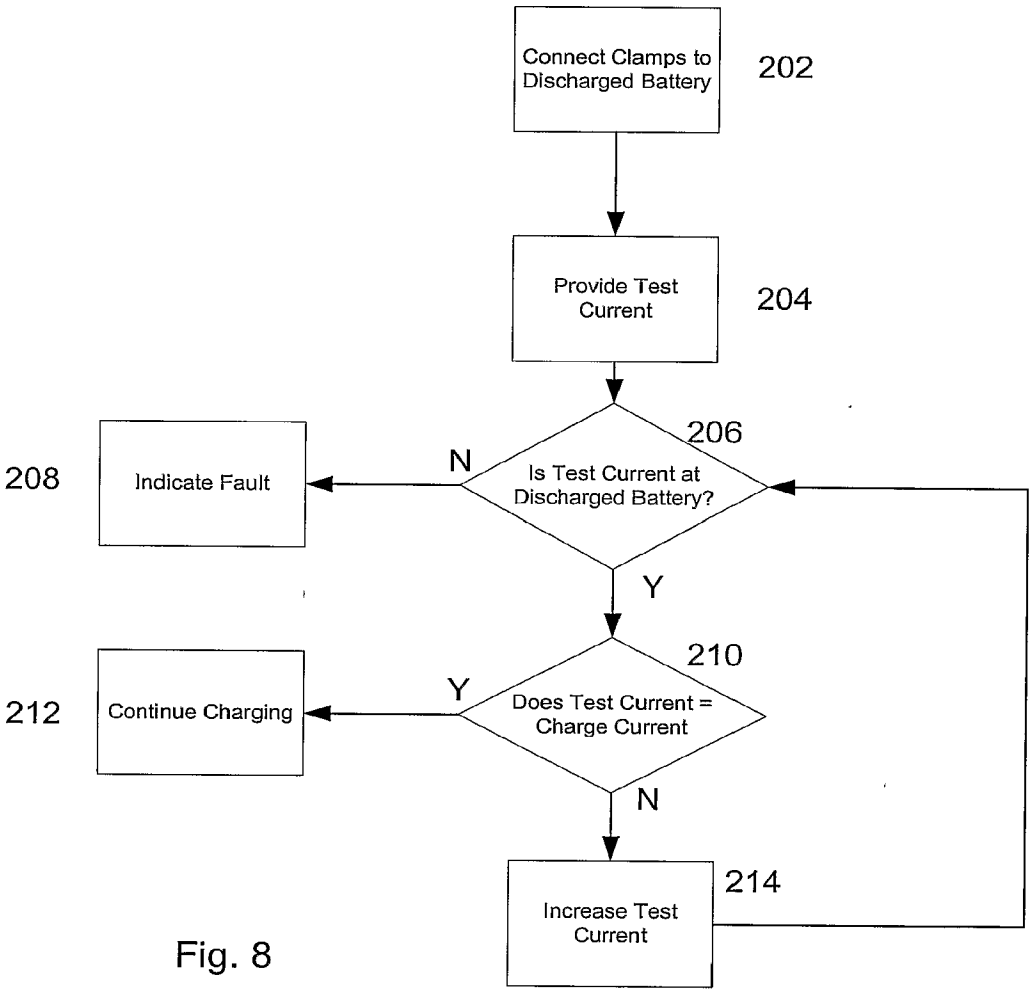

Connect Clamps to Discharged Battery
202
Provide Test Current
204
206
Is Test Current at Discharged Battery?
N
208
Indicate Fault
Y
210
Does Test Current = Charge Current
Y
212
Continue Charging
N
214
Increase Test Current

Fig. 8

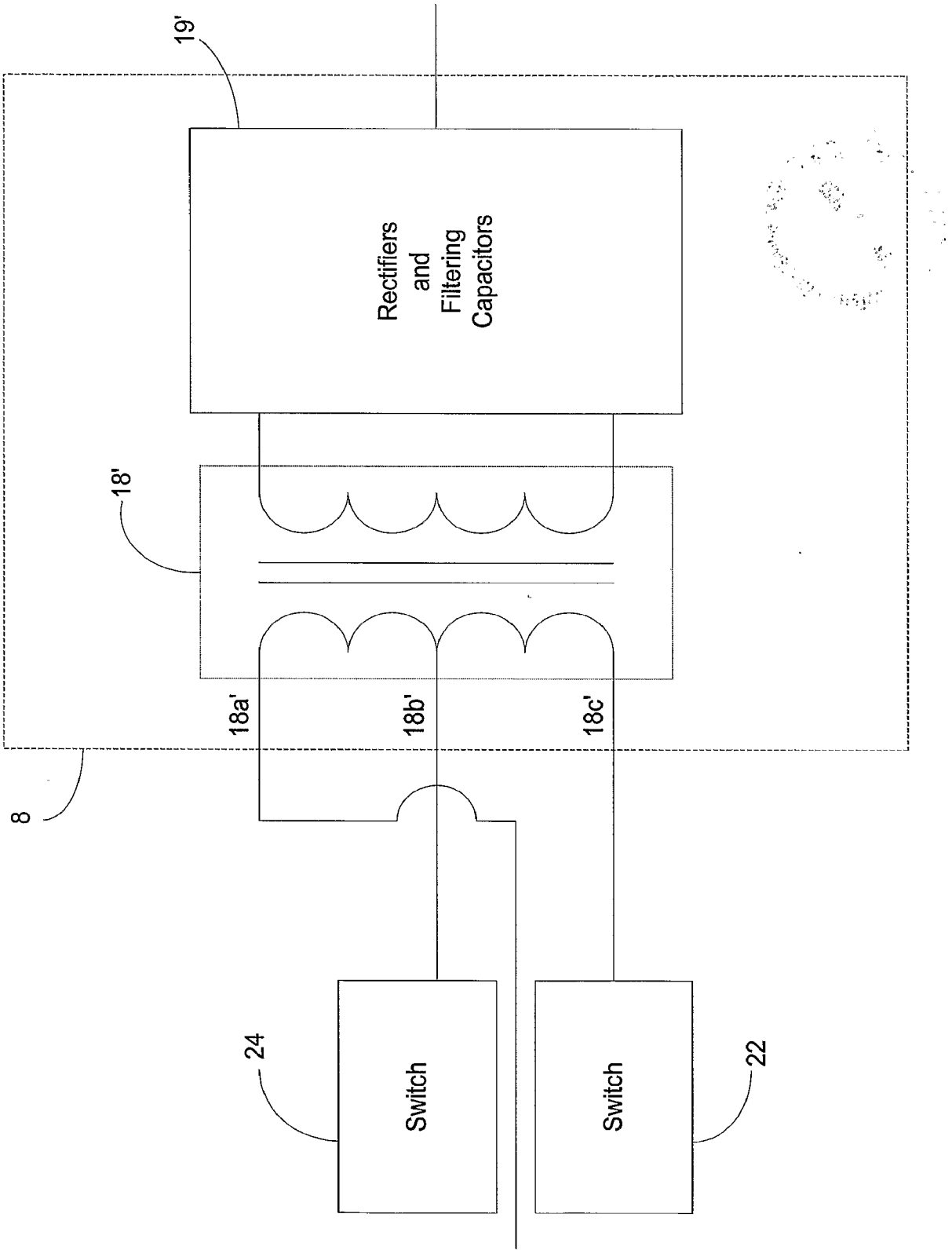

19'
Rectifiers and Filtering Capacitors
18'
18a'
18b'
18c'
8
24
Switch
Switch
22

Figure 9

Espacenet

Bibliographic data: WO2010129723 (A2) — 2010-11-11

LOW-VOLTAGE CONNECTION WITH SAFETY CIRCUIT AND METHOD FOR DETERMINING PROPER CONNECTION POLARITY

Inventor(s): BAXTER MICHAEL [US]; BAXTER JEFFREY [US]; BAXTER BRENT [US]; WALKER MARK [US]; HOLBROOK TED [US] ± (BAXTER, MICHAEL, ; BAXTER, JEFFREY, ; BAXTER, BRENT, ; WALKER, MARK, ; HOLBROOK, TED)

Applicant(s): ENERGY SAFE TECHNOLOGIES INC [US]; BAXTER MICHAEL [US]; BAXTER JEFFREY [US]; BAXTER BRENT [US]; WALKER MARK [US]; HOLBROOK TED [US] ± (ENERGY SAFE TECHNOLOGIES, INC, ; BAXTER, MICHAEL, ; BAXTER, JEFFREY, ; BAXTER, BRENT, ; WALKER, MARK, ; HOLBROOK, TED)

Classification: **- international:** ***B60R16/02; H02H7/20***
- cooperative: **H01M10/42 (EP, US); H01M10/4257 (EP, US); H01M10/488 (EP, US); H02J1/122 (EP); H02J7/0034 (EP, US);** H01M2200/00 (EP, US); H02J1/122 (US)

Application number: WO2010US33799 20100505 Global Dossier

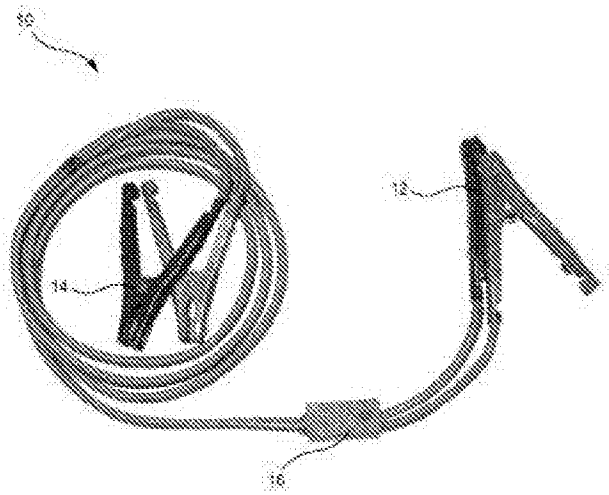
Priority number(s): US20090175696P 20090505 ; US20090559357 20090914 ; US20100731041 20100324

Also published as: WO2010129723 (A3) US2010173182 (A1)

Abstract of WO2010129723 (A2)

A safety circuit for use in low-voltage systems improves safety of and additional features to low-voltage connections. When incorporated into a battery, the circuit leaves the battery disconnected from the low-voltage system until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and 5 that it is safe to connect the battery or low-voltage systems, the safety circuit may make the connection by way of a soft start that provides a connection over a period of time that reduces or prevents inductive voltage spikes. A method is used for detection of proper polarity of the connections between the battery and the low-voltage system. When incorporated into a jumper cable, the 10 safety circuit provides communication abilities, can provide test abilities, and improves connection

safety and functionality, such as allowing transfer of power between low-voltage systems having different voltages.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 November 2010 (11.11.2010)

PCT

(10) International Publication Number
WO 2010/129723 A2

(51) International Patent Classification:
B60R 16/02 (2006.01) *H02H 7/20* (2006.01)

(21) International Application Number:
PCT/US2010/033799

(22) International Filing Date:
5 May 2010 (05.05.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

61/175,696	5 May 2009 (05.05.2009)	US
12/559,357	14 September 2009 (14.09.2009)	US
12/731,041	24 March 2010 (24.03.2010)	US

(71) Applicant *(for all designated States except US)*: **ENERGY SAFE TECHNOLOGIES, INC.** [US/US]; 98 Cuttermill Road, Suite 3705, Great Neck, New York 11021 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BAXTER, Michael** [US/US]; 27700 NW Meek Road, Hillsboro, Oregon 97124 (US). **BAXTER, Jeffrey** [US/US]; 27700 NW Meek Road, Hillsboro, Oregon 97124 (US). **BAXTER, Brent** [US/US]; 27700 NW Meek Road, Hillsboro, Oregon 97124 (US). **WALKER, Mark** [US/US]; 4075 SE Beaumead Street, Hillsboro, Oregon 97124 (US). **HOLBROOK, Ted** [US/US]; 27700 NW Meek Road, Hillsboro, Oregon 97124 (US).

(74) Agent: **KRIEGER, Michael, F.**; KIRTON & McCONKIE, 1800 Eagle Gate Tower, 60 East South Temple, Salt Lake City, Utah 84111 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

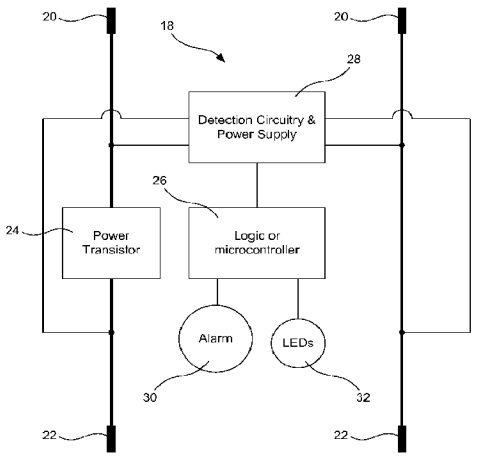
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: LOW-VOLTAGE CONNECTION WITH SAFETY CIRCUIT AND METHOD FOR DETERMINING PROPER CONNECTION POLARITY

FIG. 2



(57) Abstract: A safety circuit for use in low-voltage systems improves safety of and additional features to low-voltage connections. When incorporated into a battery, the circuit leaves the battery disconnected from the low-voltage system until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and 5 that it is safe to connect the battery or low-voltage systems, the safety circuit may make the connection by way of a soft start that provides a connection over a period of time that reduces or prevents inductive voltage spikes. A method is used for detection of proper polarity of the connections between the battery and the low-voltage system. When incorporated into a jumper cable, the 10 safety circuit provides communication abilities, can provide test abilities, and improves connection safety and functionality, such as allowing transfer of power between low-voltage systems having different voltages.

WO 2010/129723 A2

LOW-VOLTAGE CONNECTION WITH SAFETY CIRCUIT AND METHOD FOR DETERMINING PROPER CONNECTION POLARITY

TECHNICAL FIELD

The present invention relates to batteries and jumper cables and, more particularly, to batteries and jumper cables providing certain safety features.

BACKGROUND ART

Cables such as jumper cables are commonly used to connect two low-voltage (e.g. battery-powered) systems temporarily. However, the use of such cables can result in personal injury and equipment damage. For example, one instance where equipment damage or personal injury occurs is in the case of jump starting a car with a "dead" (i.e. partially- or totally-discharged) battery using a car with a good battery. During connection of jumper cables to jump start the car with the discharged battery, a spark may be created, and if the spark is in the vicinity of hydrogen gas commonly generated by car batteries, the spark can ignite the hydrogen gas to explosive effect. Additionally, as the connection is made between vehicles, inductive voltage spikes may be formed, and the voltage spikes can damage sensitive automotive electronics, including expensive computer-controlled engine control components and the like. Additionally, connecting a jumper cable set backward (i.e. with polarity of one of the battery connections reversed) can also cause injury or damage.

Similar problems can be encountered when replacing a battery in a battery-containing low-voltage system. For example, a battery that is improperly connected (e.g. a battery connected with reverse polarity, a battery connected to a system having an intermittent or long-term short circuit, etc.) can cause equipment damage or injury.

SUMMARY OF THE INVENTION

Implementation of the invention provides a connecting cable between two low-voltage systems (such as batteries) that includes a safety circuit. The safety circuit leaves the two low-voltage systems disconnected until it determines that it is safe to make a connection. If the safety circuit detects an unsafe condition, it responds to the unsafe condition in one or more of several fashions. In some instances, the safety circuit can internally reverse connection polarity to correct for incorrect connections between low-voltage systems of a reversed-polarity type. In some instances, the safety circuit provides an audible and/or visible alarm identifying a potential problem. In some instances, the safety circuit refuses to make a connection between the two low-voltage systems while an unsafe condition exists.

As it may be desirable to connect two low-voltage systems in an instance where one of the low-voltage systems has a completely-discharged battery incorporated into it, implementations of the invention may utilize a method for detection of proper polarity of the connections between the low-voltage systems. This method is particularly useful when a voltage of one of the low-voltage systems is below a reliable detection threshold and relies on nonlinear behavior of any discharged batteries in the low-voltage system. The polarity of the discharged battery (and thus whether the connected cable is connected correctly) is determined by passing a small amount of current through it and determining whether a corresponding voltage rise is observed (indicating a correct polarity connection) or not (indicating an incorrect polarity connection). In some implementations, test currents can be applied in opposite polarities and the resulting measured voltages compared to more reliably detect incorrect polarity connection and additional potential problem causes.

Further implementation of the invention provides a safety circuit for use in low-voltage systems that improves safety of and provides additional features to low-voltage connections. When incorporated into a battery, the circuit leaves the battery disconnected from the low-voltage system until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and that it is safe to connect the battery, the safety circuit may connect the battery by way of a "soft start" that provides a connection over a period of time that reduces or prevents inductive voltage spikes on the low-voltage system. A method is used for detection of proper polarity of the connections between the battery and the low-voltage system. When incorporated into a jumper cable, the safety circuit provides communication abilities, can provide test abilities, and improves connection safety and functionality, such as allowing transfer of power between low-voltage systems having different voltages.

Implementation of the invention provides a battery-integrated connection between a battery and a low-voltage system that includes a safety circuit. The safety circuit leaves the low-voltage system disconnected until it determines that it is safe to make a connection. If the safety circuit detects an unsafe condition, it responds to the unsafe condition in one or more of several fashions. In some instances, the safety circuit can internally reverse connection polarity to correct for incorrect connections to the low-voltage system of a reversed-polarity type. In some instances, the safety circuit provides an audible and/or visible alarm identifying a potential problem. In some instances, the safety circuit refuses to make a connection to the low-voltage system while an unsafe condition exists.

When the safety circuit determines that no unsafe conditions exist and that it is safe to connect or power the low-voltage system, the safety circuit may connect the system by way of a "soft start." The soft start provides a connection between the two systems that is not instantaneous, but is instead provided over a period of time, such as approximately a millisecond to tens of milliseconds, that reduces or prevents inductive voltage spikes on the low-voltage system. The soft start procedure reduces and/or prevents damage to sensitive low-voltage electronics forming a part of the low-voltage system.

Some implementations of the invention utilize one or more high-current transistors as a switch to connect the two low-voltage systems. The one or more transistors are controlled by the safety circuit or control circuit that detects the condition at each end of the connection cable or cables. In other implementations providing automatic correction of attempted reversed-polarity connections, additional components are used to provide additional convenience. While such implementations provide no additional safety benefit over implementations not providing automatic polarity reversal as the connection is not completed when a reversed polarity is detected, the added convenience of not requiring manual polarity correction may justify the added component cost in some instances.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only typical embodiments of the invention and are, therefore, not to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 shows a perspective view of a jumper cable embodiment;

Figure 2 shows a schematic illustrating concepts in accordance with embodiments of the invention;

Figure 3 shows a perspective view of a representative circuit board in accordance with embodiments of the invention;

Figure 4 shows a generalized circuit schematic representative of a discharged car battery in a car;

Figure 5 shows a representative schematic showing one method for testing a battery for proper polarity;

Figure 6 shows a representative schematic showing another method for testing a battery for proper polarity;

Figure 7 shows a representative circuit diagram for use in embodiments of the invention;

Figures 8-12 show expanded views of portions of the circuit diagram shown in Figure 7;

Figures 9-17 show flow charts illustrating processes that may be implemented in the circuit of Figures 7-12;

Figure 18 shows one example of a battery incorporating protection circuitry;

Figures 19-20 show overview views of a representative circuit diagram for use in embodiments of the invention; and

Figures 21-27 show expanded views of portions of the representative circuit of Figures 19-20 with representative component values added for clarity.

DETAILED DESCRIPTION OF THE INVENTION

A description of embodiments of the present invention will now be given with reference to the Figures. It is expected that the present invention may take many other forms and shapes, hence the following disclosure is intended to be illustrative and not limiting, and the scope of the invention should be determined by reference to the appended claims.

Embodiments of the invention provide a connecting cable or cables (such as jumper cables) between two low-voltage systems (such as batteries, battery-powered systems, or low-voltage systems incorporating one or more batteries) that includes a safety circuit. The safety circuit leaves the two low-voltage systems disconnected until it determines that it is safe to make a connection. If the safety circuit detects an unsafe condition, it responds to the unsafe condition in one or more of several fashions. In some instances, the safety circuit can internally reverse connection polarity to correct for incorrect connections between low-voltage systems of a reversed-polarity type. In some instances, the safety circuit provides an audible and/or visible alarm identifying a potential problem. In some instances, the safety circuit refuses to make a connection between the two low-voltage systems while an unsafe condition exists.

Embodiments of the invention provide a safety circuit for use in low-voltage systems that improves safety of and provides additional features to low-voltage connections. When incorporated into a battery, the circuit leaves the battery disconnected from the low-voltage system until it determines that it is safe to make a connection. When the safety circuit determines that no unsafe conditions exist and that it is safe to connect the battery, the safety circuit may connect the battery by way of a "soft start" that provides a connection over a period

of time that reduces or prevents inductive voltage spikes on the low-voltage system. A method is used for detection of proper polarity of the connections between the battery and the low-voltage system. When incorporated into a jumper cable, the safety circuit provides communication abilities, can provide test abilities, and improves connection safety and functionality, such as allowing transfer of power between low-voltage systems having different voltages.

Further embodiments of the invention provide a battery-integrated connection between a battery and a low-voltage system that includes a safety circuit. The safety circuit leaves the low-voltage system disconnected until it determines that it is safe to make a connection. If the safety circuit detects an unsafe condition, it responds to the unsafe condition in one or more of several fashions. In some instances, the safety circuit can internally reverse connection polarity to correct for incorrect connections to the low-voltage system of a reversed-polarity type. In some instances, the safety circuit provides an audible and/or visible alarm identifying a potential problem. In some instances, the safety circuit refuses to make a connection to the low-voltage system while an unsafe condition exists.

When the safety circuit determines that no unsafe conditions exist and that it is safe to connect or power the low-voltage system, the safety circuit may connect the system by way of a "soft start." The soft start provides a connection between the two systems that is not instantaneous, but is instead provided over a period of time, such as approximately a millisecond to tens of milliseconds, that reduces or prevents inductive voltage spikes on the low-voltage system. The soft start procedure reduces and/or prevents damage to sensitive low-voltage electronics forming a part of the low-voltage system.

Some embodiments of the invention utilize one or more high-current transistors as a switch to connect the two low-voltage systems. The one or more transistors are controlled by the safety circuit or control circuit that detects the condition at each end of the connection cable or cables. In other embodiments providing automatic correction of attempted reversed-polarity connections, additional components are used to provide additional convenience. While such embodiments provide no additional safety benefit over embodiments not providing automatic polarity reversal as the connection is not completed when a reversed polarity is detected, the added convenience of not requiring manual polarity correction may justify the added component cost in some instances.

An embodiment of the invention includes a battery-integrated safety circuit for use in establishing that a low-voltage system is safely and properly connected to a battery. The safety

circuit includes a pair of output terminals, a detection circuit operatively connected to the output terminals and configured to detect whether the output terminals are properly connected to a low-voltage system with a correct polarity, and a power-controlling circuit configured to provide electrical power to the output terminals only when a proper connection of correct polarity has been detected.

In some embodiments, the power-controlling circuit provides electrical power to the output terminals using a soft start procedure that reduces inductive voltage spikes. As one example, the power-controlling circuit may control one or more power transistors that are used to provide electrical power to the output terminals using the soft start procedure. The soft start procedure provides electrical power to the output terminal over a period of approximately a millisecond to tens of milliseconds.

A battery-integrated safety circuit may also include a polarity test circuit configured to supply a test current to the output terminals and measure a resulting voltage to determine a proper polarity of a low-voltage system connected to the output terminals. The polarity test circuit may be configured to supply test currents of different directions and to compare the voltages caused by the test currents.

Another embodiment of the invention provides a battery containing a battery-integrated safety circuit, the battery having a positive terminal, a negative terminal, and a safety circuit operatively connected to the positive terminal and the negative terminal and configured to supply power through the positive and negative terminals only when a connection between the terminals and a low-voltage system has been properly made with a correct polarity. The battery may prevent the supply of power to the positive and negative terminals when a short circuit exists between the positive and negative terminals. The safety circuit may include a polarity test circuit configured to supply a test current to the terminals and measure a resulting voltage to determine a proper polarity of a low-voltage system connected to the battery. The safety circuit may also include a detection circuit operatively connected to the terminals and configured to detect whether the terminals are connected to the low-voltage system with the correct polarity, and a power-controlling circuit configured to provide electrical power to the terminals.

Another embodiment encompasses a battery having an energy storage cell, a pair of output terminals, and a safety circuit electrically connected to the energy storage cell. The safety circuit includes a detection circuit operatively connected to the output terminals for detecting whether the output terminals are properly connected to a low-voltage system with a correct polarity of connection, and a power-controlling circuit configured to supply power from

the energy storage cell to the output terminals only when a proper connection of correct polarity has been detected.

Other embodiments of the invention illustrating features of the battery-incorporated safety circuits provide a connecting cable or cables (such as jumper cables) between two low-voltage systems (such as batteries, battery-powered systems, or low-voltage systems incorporating one or more batteries) that includes a safety circuit. The safety circuit leaves the two low-voltage systems disconnected until it determines that it is safe to make a connection. If the safety circuit detects an unsafe condition, it responds to the unsafe condition in one or more of several fashions. In some instances, the safety circuit can internally reverse connection polarity to correct for incorrect connections between low-voltage systems of a reversed-polarity type. In some instances, the safety circuit provides an audible and/or visible alarm identifying a potential problem. In some instances, the safety circuit refuses to make a connection between the two low-voltage systems while an unsafe condition exists.

When the safety circuit determines that no unsafe conditions exist and that it is safe to connect the two low-voltage systems, the safety circuit may connect the two systems by way of a "soft start." The soft start provides a connection between the two systems that is not instantaneous, but is instead provided over a period of time, such as approximately a millisecond to tens of milliseconds, that reduces or prevents inductive voltage spikes on one or more of the low-voltage systems. The soft start procedure reduces and/or prevents damage to sensitive low-voltage electronics forming a part of one or more of the low-voltage systems.

Some embodiments of the invention utilize two high-current transistors as a switch to connect the two low-voltage systems. The transistors are controlled by the safety circuit or control circuit that detects the condition at each end of the connection cable or cables. In other embodiments providing automatic correction of attempted reversed-polarity connections, additional components are used to provide additional convenience. While such embodiments provide no additional safety benefit over embodiments not providing automatic polarity reversal as the connection is not completed when a reversed polarity is detected, the added convenience of not requiring manual polarity correction may justify the added component cost in some instances.

In some embodiments, inexpensive transistors may be used, and the safety circuit or control circuit incorporates features to protect the transistors from potential damage. For example, the safety or control circuit may maintain a thermal model of the transistors and may turn the transistors off and on to protect the transistors against failure. Additionally, the safety

or control circuit may monitor for over-current conditions that could destroy the transistors in short periods of time, and could turn off the transistors when such conditions are detected. Such types of protection/detection also may serve to protect components of one or more of the connected low-voltage systems, such as by preventing a starter motor from overheating due to excessive cranking. The safety or control circuit may also monitor for under-voltage conditions on the transistor supply side, to prevent the transistors from entering a non-fully-on state that would cause increased heating and damage to the transistors.

As it may be desirable to connect two low-voltage systems in an instance where one of the low-voltage systems has a completely-discharged battery incorporated into it, embodiments of the invention may utilize a method for detection of proper polarity of the connections between the low-voltage systems. Such a method is particularly useful when a voltage of one of the low-voltage systems is below a reliable detection threshold. The method may rely on nonlinear behavior of any discharged batteries in the low-voltage system. The polarity of the discharged battery (and thus whether the connected cable is connected correctly) is determined by passing a small amount of current through it and determining whether a corresponding voltage rise is observed (indicating a correct polarity connection) or not (indicating an incorrect polarity connection). In some embodiments, test currents can be applied in opposite polarities and the resulting measured voltages compared to more reliably detect incorrect polarity connection and additional potential problem causes.

Similar methods may be used to discriminate between a short circuit condition (e.g. clamps touching) and a completely-discharged battery, and at least some embodiments may incorporate such features. Embodiments may also be able to detect whether there are batteries connected to both ends of the circuit by biasing the voltage at each connection to a voltage unlikely to occur in the low-voltage systems, such as 6.5 volts for a typical car battery system. If the voltage then varies from this value by a small amount in either direction, a battery is determined to be connected.

Figure 1 provides a perspective view of a jumper cable set 10 incorporating features in accordance with embodiments of the invention. The jumper cable set 10 includes a first pair of contact clamps 12 and a second pair of contact clamps 14. When two low-voltage systems (e.g. systems commonly including one or more batteries) are to be connected, the first pair of contact clamps 12 and the second pair of contact clamps 14 are used to connect to high and low (e.g. high and ground) terminals of the two low-voltage systems, similar to the manner in which such connections are commonly made with existing jumper cables. In automotive systems and other

vehicles (boats, motorcycles, all-terrain vehicles (ATVs), etc.), the final connection is commonly made to a ground location away from any battery to minimize the risk of any spark igniting hydrogen gas off-gassed by the battery. While this final connection is used or recommended with embodiments of the invention for maximum safety, such sparking is greatly reduced using embodiments of the invention, as no electrical connection is provided between the first pair of contact clamps 12 and the second pair of contact clamps 14 until it has been determined that it is safe to do so.

The jumper cable set 10 includes a control box 16 that provides one or more features including the features of testing the connections and of preventing any electrical connection until it has been determined that it is safe to provide the electrical connection. Although the control box 16 is illustrated as being physically close to the first pair of contact clamps 12 in Figure 1, it should be understood that the control box 16 can be located at any physical position along the jumper cable set 10 where it can control the electrical connection between the two pairs of contact clamps 12, 14. Placing the control box 16 near one of the ends of the jumper cable set 10 may provide some benefits to a user of the jumper cable set 10, such as making it more intuitive to know which end of the jumper cable set 10 has a problem by lighting an indicator on one side of the control box 16. It may also make it easier to see when the unit is powered (such as by a power-on LED). It also keeps the control box 16 in a location less likely to be stepped on, tripped over, etc. Such a location makes it less likely for one of the two pairs of contact clamps 12, 14 to be disturbed from their attachments to the battery by a user seeking to view the control box 16, and may assist in keeping the control box 16 out of water that may be on an underlying surface.

The control box 16 includes a safety circuit that leaves the two low-voltage systems disconnected until the safety circuit determines that it is safe to make the connection. If the safety circuit determines that it is unsafe to proceed, it may sound an audible alarm or illuminate one or more warning lights on the control box 16 to identify any detected potential problem before the problem can cause damage or injury. In some embodiments, the selection of lights illuminated or a physical and/or timed pattern of lights illuminated may indicate the type of problem detected. In other embodiments, no alarm (visual or auditory) is provided; instead, the connection is simply not made.

When the safety circuit determines that it is safe to proceed, the safety circuit completes the connection between the two low-voltage systems smoothly in a soft start. The soft start prevents or minimizes inductive voltage spikes that could damage sensitive electronics of the

low-voltage systems (such as an automobile computer component). In some embodiments, as a connection is made, and audible and/or visual notification may be provided so the user becomes aware that the connection has been made. In the case of a vehicle having a discharged battery, the user can thus be notified that the vehicle can then be started.

Figure 2 provides a diagram illustrating the concepts incorporated into one embodiment of a safety circuit 18 such as housed within the control box 16. The safety circuit 18 includes input terminals 20 and output terminals 22 that are electrically connected to the first and second pairs of contact clamps 12, 14. The input terminals 20 and the output terminals 22 are connected in this embodiment by way of one or more power transistors 24. The power transistor 24 (or transistors) are controlled by a logic circuit or microcontroller 26 that is operatively connected to a detection circuit and power supply 28. The detection circuit and power supply 28 and the logic circuit or microcontroller 26 may be powered by power received from the input terminals 20 (or alternatively the output terminals 22, depending on how the jumper cables are connected to active/inactive low-voltage systems), and therefore, no internal battery/power supply need be provided in at least some embodiments. The detection circuitry detects connection conditions on the input terminals 20 and the output terminals 22. The detection circuitry determines whether it is safe to connect the input terminals 20 and the output terminals 22. In embodiments where the safety circuit 18 is configured to correct for incorrect connection conditions (not shown in Figure 2) such as a reversed-polarity connection, the detection circuitry also detects such conditions and signals that a correction is necessary.

Control or detection information is passed from the detection circuitry to the logic circuit or microcontroller 26. The logic circuit or microcontroller 26 uses this information to activate a connected alarm 30 and one or more optical signals 32 based on the conditions detected by the detection circuitry. For example, if proper connection conditions are detected and it is determined that it is safe to make a connection, the logic circuit or microcontroller 26 can activate a green LED as a signal of proper connection prior to or concurrent with making an electrical connection between the two low-voltage circuits connected to the input terminals 20 and the output terminals 22. Alternatively, a red LED might be activated if an improper connection is detected, along with activation of the alarm 30. Different signals (via the alarm 30 and/or the optical signal 32 or optical signals 32) may be used to indicate different detected conditions (e.g. reversed polarity, no connection, short circuit, etc.).

When the safety circuit 18 determines that it is safe to proceed, the one or more power transistors 24 is used to make the electrical connection between the input terminals 20 and the

output terminals 22, thereby connecting the two low-voltage systems. The one or more power transistors 24 may be controlled so as to make the electrical connection in a "soft start" to eliminate inductive voltage spikes that could cause damage to sensitive electronic components that are part of one or both low-voltage systems. The soft start is implemented in the illustrated embodiment by way of the one or more power transistors 24, which allow the electrical connection (e.g. the flow of electrical current between the input terminals 20 and the output terminals 22) to be made slowly, such as over a period of approximately one or a few milliseconds to tens of milliseconds. The one or more power transistors 24 are controlled by small voltages provided by the logic or microcontroller 26.

Although the soft start procedure has been illustrated in Figure 2 using one or more power transistors 24 (which may include one or more power transistor 24 on each of the positive and negative cables, if desired), other embodiments are envisioned, including mechanical embodiments. For example, the soft start concept can be approximated using mechanical relays fitted with suitable filtering components such as inductors and diodes and other spark-suppression components or devices. For example, one system using relays to provide a soft start approximation utilizes a pair of inductors, one on each side of the relay, with back-to-back zener diode pairs between the inductor and the relay and the other line on each side of the relay.

It is anticipated that such an embodiment might be larger and bulkier than an embodiment using semiconductor-based switches. Those of skill in the art will appreciate configurations of such devices that can be used in such embodiments. Similarly, although the embodiment of Figure 2 provides one or more power transistors 24 acting as switches to connect the two low-voltage systems, other more-complicated configurations can be provided that provide for additional features, such as automatic polarity reversal. In such an embodiment, if the polarity of the connected input terminals 20 or output terminals 22 has been reversed, the safety circuit 18 uses the extra components to correct the polarity as the input terminals 20 are electrically connected to the output terminals 22. Thus, in such an embodiment, the safety circuit 18 includes components for selectively connecting either of the input terminals 20 to either of the output terminals 22. Although such an embodiment does not improve safety over the embodiment of Figure 2, it does increase convenience, as a user need not remove and re-connect the previously-made connections between low-voltage systems.

Embodiments of the invention can be used in a wide variety of systems for connecting to low-voltage systems and/or for connecting between low-voltage systems. Non-limiting examples include jumper cable sets, retrofit modules for installation on existing jumper cable

sets, booster boxes, battery chargers, ground power units for aircraft, temporary power units for recreational vehicles, trailers, boats, and the like, battery-powered equipment charging cords (fork lifts, floor scrubbers, tugs, etc.), DC power connections for solar cells, fuel cells, and other DC-generating equipment, and DC power connections for electronics. It will be understood that embodiments may be used in a variety of situations.

Embodiments of the invention provide a wide variety of benefits. Such benefits include the soft start procedure that eliminates inductive voltage spikes. Another benefit is the small size of the safety circuit 18, such that the safety circuit 18 can often be provided in-line with the connecting cable, such as illustrated in the jumper cable set 10 shown in Figure 1. Figure 3 also illustrates this benefit, showing a perspective view of a representative circuit board that may be used to implement embodiments of the invention. Another benefit is that embodiments keep the power between various terminals off when there are problems that could cause damage or injury, such as reversed cable connections, arcing from short circuits if cable clamps are touching, and prevention of connection to a failed battery incorporated in a low-voltage system. Still other benefits include providing audible and/or visual warnings of unsafe conditions and/or safe connections.

For example, the following is provided by way of sample actions that can be taken using a jumper cable embodiment. If the cables are connected properly, a steady green LED lamp may be lit to indicate that the connection is safe and ready. The power is applied by a soft start as described above, and the user is able to start the car being jumped. However if the cables are connected backward (and the system does not provide the ability to correct reversed connections), a red LED lamp might flash and the power remains off. The user could then reconnect the cables correctly and try again. Similarly, if the cable clamps accidentally are touching or if the positive clamp is also touching a ground source, the red LED could flash (possibly in a different timing pattern or a different LED), the connection would not be completed, and the user could adjust or reconnect the cables correctly and try again. If a connection is attempted to a low-voltage system having a discharged battery with an internal short circuit, the red LED could flash, the power stays off, and the car could not be jump started, even after attempted repositioning of the cables.

Other conditions may result in disconnection of the power between the cable clamps in at least some embodiments. For example, the safety circuit 18 may be programmed to detect a successful starting of a car with a low/dead battery. Upon detection of a successful start, the connection between low-voltage systems is no longer necessary, so the safety circuit 18 may be

programmed to automatically electrically disconnect the two systems for safe removal of the jumper cables. Similarly, if the safety circuit 18 determines that a previously-good connection fails (such as one of the cable clamps falls off), it may automatically and rapidly interrupt the connection, thereby preventing potential damage or injury. As yet another example, if a user attempts to crank the engine on the discharged car for longer than a selected period of time (such as thirty seconds), the safety circuit 18 may automatically shut off the connection between systems for a predetermined time (such as one minute) to allow the starter and the jumper cables (e.g. the controller itself) to cool. If the power is interrupted in this fashion, a red LED might be lit (again, a different pattern or different light might be used) while the connection is interrupted, and a green LED re-lit when the user is permitted to re-try engine starting.

As discussed above, when jumper cables are connected to a car having a discharged battery, the polarity of the connection must be correct to avoid damage to the cars. In many instances, a discharged battery still has a significant residual voltage, but lacks sufficient starting power to start the car. In such instances, upon connection of jumper cables in accordance with embodiments of the invention, the polarity of the made connection may be determined by way of measuring the voltage at the connection. However, in some instances, the discharged battery is completely discharged, such as when the headlights have been left on for an extended period. In other instances, a battery may not be completely dead, but a sufficient electrical load is attached to the battery such that the voltage is too low to allow reliable polarity detection. For example, if a polarity determination is attempted with a low battery when the vehicle's headlights are on, the brake pedal is depressed, or the heater is on, etc., the detected voltage may be close to zero, even if the polarity would be detectable if the load were removed. In such instances, the discharged battery provides insufficient voltage to reliably determine correctness of the polarity of the attempted connection by way of measuring the voltage of the discharged battery alone. Instead, a different method is used to determine whether the connection has been made using proper polarity. This allows an automatic jumper cable controller using this method to prevent damage if the cables are accidentally connected backward while still allowing the car with the discharged battery to be started safely.

To understand the method, Figure 4 provides an electrical circuit diagram that models the car with the discharged battery. The polarity of the discharged battery can be determined by passing a small amount of current through it (and potentially simultaneously through any connected electrical components). The polarity is determined by observing the resulting voltage created in the battery-car system. When a proper-polarity connection is made, the discharged

battery's voltage will rise in a normal fashion; however, when the cables are connected backward, the voltage is limited by the nonlinear behavior of the discharged battery and the automotive equipment attached to it. This allows the control circuitry to identify an incorrectly-connected charging system before it can cause a problem.

In Figure 4, a resistance 36 and a capacitance 38 model headlights, interior lights, and other electrical loads of the automotive equipment that may be present. Meanwhile, a diode 40 represents/models the non-linear behavior of the discharged battery and the diodes in the car's alternator. When the jumper cables are connected correctly, the diode 40 conducts only a negligible amount of current, allowing the voltage to rise in response to the test current. In contrast, when the jumper cables are connected backwards, the diode conducts most of the test current, thus limiting the resulting voltage to a small value. When a reversed connection is detected, the controller can respond in any fashion discussed above (e.g. prevent completing the connection, sound an alarm or illuminate a warning light, automatically reverse the connection, etc.).

Figures 5 and 6 illustrate two embodiments for detecting correct polarity of a discharged battery. In Figure 5, a test current source 42 is electrically connected to a system containing a discharged battery 44 and other electrical loads 46. In this embodiment, a single test current is passed through the discharged battery 44. If the voltage rises above a voltage threshold (say approximately two volts for a twelve-volt battery), the associated charging equipment or other controller determines that the polarity correction is correct, and proceeds to complete the connection to the low-voltage system so the battery can be charged. If the voltage does not rise above the threshold, the connection is not completed. This embodiment has an advantage of simplicity when compared with the embodiment of Figure 6.

In the embodiment of Figure 6, a bidirectional current source 48 is used in place of the test current source 42. Thus, in this embodiment, two test currents are used in succession, one in each direction. The two induced voltages are compared with the voltage threshold, where one will commonly be found to be above the threshold while the other voltage is below the threshold. This embodiment, while more complicated than the embodiment of Figure 6, can identify other problem cases, which may be less likely. For example, if both voltages are below the threshold, this condition may be indicative of a battery having an internal short circuit. As another example, if both voltages are above the threshold, it may be indicative of a broken battery cable on the car having the discharged battery. As may be appreciated, these methods of detecting proper polarity of connection to a discharged battery as well as other battery

conditions may be implemented into a wide variety of applications, including battery charging systems, battery boosting systems, jumper cable systems, and the like.

Figure 7 provides a circuit diagram of one embodiment of the safety circuit 18. The view of Figure 7 has been expanded to show illustrative components and component values in Figures 8-12, according to the areas marked in Figure 7: area 50 is shown in more detail in Figure 8, area 52 is shown in more detail in Figure 9, area 54 is shown in more detail in Figure 10, area 56 is shown in more detail in Figure 11, and area 58 is shown in more detail in Figure 12. While an illustrative circuit has been shown and illustrative component values have also been shown, it is anticipated that many different circuit components, values, and variations could alternatively be used. Therefore, the illustrated circuit and component values are provided by way of description of one circuit for implementing an embodiment of the invention, and not by way of limitation.

Figures 13-17 illustrate flow charts describing one set of processes that may be implemented using the circuitry illustrated in Figures 7-12, and are illustrative of features of some embodiments of the invention. In the description that follows, references to pin numbers are in reference to pins of a microcontroller 60 contained in the illustrated circuitry, and the pin numbers so referenced are shown in more detail in Figure 9. The pin number references should be understood to be illustrative, and it is anticipated that microcontrollers similar to microcontroller 60 can be programmed to respond to a wide variety of circumstances on varying pins and to provide responses to a wide variety of pins. It is anticipated that one or more of the circuit components (including any microcontrollers similar to microcontroller 60) may include programmed or programmable components incorporating logic and/or software configured to effect processes similar to those discussed with respect to Figures 13-17, and embodiments of the invention embrace and incorporate such logic and/or software.

Figure 13 provides a flow chart for a main process of the circuitry of Figures 7-12. Execution begins at step 62, where at least one pair of contact claims (e.g. the first pair of contact clamps 12 and/or the second pair of contact clamps 14) is connected to a voltage source of at least a minimum voltage (here six volts). Connection of one or more of the contact clamps to a voltage supply serves to provide power to the circuit and any components thereof that require such supply to begin working, such as the microcontroller 60. Once at least one of the pairs of contact clamps is connected, any ports needing initialization are initialized.

Execution then proceeds to decision block 64, where a determination is made as to whether to calibrate the system. Whether to calibrate may be determined by an external input

that drives one of the pins of the microcontroller to low (or to high), such as by a jumper or other device. If calibration is to occur, execution proceeds to the calibration processes illustrated in Figure 16, otherwise, execution proceeds to decision block 66. At decision block 66, it is determined whether the user is done connecting cables. This may be determined by way of determining whether voltages measured at the cable clamps are within a few counts of the last several measurements. The measured voltages remain fairly stable once a particular connection has been made. If the user is still connecting the cables, execution loops back for further evaluation of whether the user has completed connecting the cables.

Otherwise, execution proceeds to decision block 68, where a determination is made as to whether both pairs of clamps are above a minimum reference voltage. In the illustrated flow chart, the minimum reference voltage is 2.5 volts, but other reference voltages may be used. If both pairs of clamps are not above the minimum reference voltage, execution proceeds to reverse polarity detection processes illustrated in Figure 14. If, however, both pairs of clamps are above the minimum reference voltage, execution proceeds to decision block 70, where a determination is made as to whether batteries are connected to both ends of the jumper cables, such as by determining whether the low voltage cable is not at the open circuit voltage. If it is determined that batteries are not connected to both ends, execution loops back to decision block 66. If, however, batteries are connected at both ends, execution proceeds to step 72, where the two low-voltage power systems are electrically connected (such as by making pin 10 of the microcontroller high to control high-current transistors). As discussed above, the electrical connection of the two low-voltage systems can be made by way of a soft start.

Execution then proceeds to decision block 74, where a determination is made as to whether too much current is flowing. This determination is made by determining whether the absolute value of the difference in currents in the two cables (positive and negative) is greater than a selected reference current. If too much current is flowing, execution proceeds to cool down procedures illustrated in Figure 15. If the reference current is not exceeded, execution proceeds to decision block 76, where a determination is made as to whether a brown-out condition (a condition where there is an under-voltage on the supply side that may cause the power transistors to fail to turn on completely) is detected. If such a condition is detected, execution proceeds to the cool-down procedures of Figure 15. If not, execution proceeds to decision block 78, where a determination is made as to whether at least a minimum amount of current (illustrated as ten amps) is flowing through the cables. If the minimum current is flowing, then the cables are still needed, and execution loops back to step 72. If, however, the

current flow has dropped below the minimum current (e.g. the car with the discharged battery has been started, etc.), execution proceeds to step 80, where the microcontroller 60 electrically disconnects the two low-voltage systems (e.g. by making pin 10 low). Thereafter, execution either terminates (not shown) or loops back to decision block 66 for detection of a need to electrically re-connect the cable ends.

Figure 14 shows an illustrative polarity detection procedure that may be used when both pairs of cable clamps are not determined to be above a minimum reference voltage, as determined at decision block 68 of Figure 13. Execution proceeds to decision block 82, where a determination is made as to which cable is low voltage. If Cable A (corresponding, for example, to the first pair of contact clamps 12) is low voltage, execution proceeds to step 84, where one or more red LEDs (or some other signal) corresponding to Cable A are turned on to provide a signal to the user of the cables (e.g. pin 7 is made high). Alternatively, if Cable B is low voltage, execution proceeds to step 86, where one or more red LEDs (or some other signal) corresponding to Cable B are turned on to provide a signal to the user of the cables (e.g. pin 8 is made high).

In either instance, execution then proceeds to decision block 88, where a determination is made as to whether the cable having the lower voltage is at a voltage below a negative reference voltage (illustrated as negative 2.5 volts). If the voltage of the cable having the lower voltage is determined to have such a voltage, that cable is connected in reverse polarity, and execution returns to Figure 13, Location 13A, immediately prior to decision block 66. Thus, whichever red LEDs (or other signal) were turned on will remain on until the cable connected in reverse polarity is removed and reconnected with proper polarity.

If, the lower voltage clamp is not more negative than the negative reference voltage, one of two circumstances may be present. First, the polarity may be correct, but the lower-voltage cable (e.g. the portion of the control circuit connected to the lower-voltage system) may be connected to a battery so discharged as to prevent reliable detection of the polarity based on voltage measurements alone. Second, the polarity may be incorrect, but the lower-voltage cable (e.g. portion of the control circuit) may be connected to a battery so discharged as to prevent reliable detection of the polarity based on voltage measurements alone. In either case, the control circuit may apply a small current to the system to determine which circumstance is occurring, so execution proceeds to step 90, where a small current is permitted to flow from the high-voltage cable to the low-voltage cable (e.g. pin 5 is made high). In the illustrated case, the current is shown as being five amps.

Execution then proceeds to decision block 92, where a determination is made as to whether any noise associated with opening a short on the cable has been detected. If so, execution proceeds to step 94 where the current is turned off (e.g. pin 5 made low). Execution then proceeds to step 96, where the red LEDs are turned off (pins 7 and/or 8 made low), and then proceeds to Figure 13, Location 13A, immediately prior to decision block 66. As long as the short circuit condition exists, execution will then return to the processes of Figure 14 and loop back to Location 13A of Figure 13, causing the process to repeatedly pass through one of steps 84 and 86, followed by step 96, causing one set of LEDs (or other signal) to flash, thereby indicating to the user the presence of a short circuit.

As discussed above, a reversed connection, such as to a system having a very discharged battery, may conduct current similarly to a short circuit, which may therefore also signal a reversed connection. Therefore, a user seeing a flashing red LED may be instructed (or know from instructions for the cables) to attempt to reverse the connection. Then, if the flashing red LED continues, the user may be instructed to make no further attempts to connect the two low voltage systems or to jump start the discharged vehicle because a short circuit appears to exist.

If no short circuit is detected at decision block 92, execution proceeds to decision block 98, where a determination is made whether both pairs of clamps are above a reference voltage (here illustrated as 2.5 volts). If the polarity of the low voltage cable connection is correct, the small current will eventually raise the voltage of the discharged system above this reference voltage. Therefore, until both pairs of clamps are above 2.5 volts, execution loops back to decision block 92 as shown. Once both pairs of clamps are above 2.5 volts, execution proceeds to step 100, where the small current is turned off (e.g. pin 5 made low), and then execution proceeds to step 102, where all red LEDs are turned off (e.g. pins 7 and/or 8 made low). Execution then returns to Figure 13 at Location 13B, just prior to step 72, where the low-voltage systems are electrically connected. Thus, the low-voltage systems are electrically connected at step 72 after the process of Figure 14 determines that the connections have been made with proper polarity.

Figure 15 illustrates a representative cool-down procedure that may be used in situations where either an over-current condition (e.g. decision block 74) or a brown-out condition (e.g. decision block 76) is detected. If either condition lasts for too long, the condition can lead to failure of the power transistors, especially when less-expensive power transistors are used. In the case of a brown-out, the lower voltage prevents the power transistors from turning on (or staying on) completely, which may increase the heat losses experienced by the transistors,

leading to failure. Over-current conditions can also destroy the transistors. To allow for the use of less-expensive power transistors, the process illustrated in Figure 15 permits shutoff of the transistors before failure occurs and gives the transistors time to cool off before use of the transistors resumes. Although the description of Figure 15 is directed to the primary power transistors, it should be understood that similar processes may be used for the transistors providing the low-current current discussed with respect to Figure 14.

In Figure 15, execution begins at step 104, where a logo LED (which, when on, may be indicative that the cables are powered and ready for normal use) is turned off (e.g. pin 6 made low). Execution then proceeds to step 106, where all the red LEDs (or other indicators) are turned on (e.g. pins 7 and 8 made high), indicative of the overheat fault condition. At step 108, the low-voltage systems are electrically disconnected (e.g. pin 10 made low and pin 9 made high). At step 110, the power connect system is reset (e.g. pin 9 made low), while at step 112, the system waits for a period of time to allow the transistors to cool. The microcontroller 60 may be programmed with a model (such as linear over time) approximating heat losses of the transistors over time to ensure that the period of time where the transistors are turned off is adequate to permit sufficient cooling of the transistors before a restart is attempted. Similarly, a thermal model (such as a time integration of current squared times resistance losses) may be used by the microcontroller to approximate heating of the transistors in normal use for protective shut-off and restart procedures as outlined in somewhat more detail in Figure 17.

Once sufficient time has passed to allow the transistors to be safely turned on again, execution proceeds to step 114, where the logo LED is turned on (e.g. pin 6 made high), and to step 116, where the red LEDs (or other signals) are turned back off (e.g. pins 7 and 8 made low). Thereafter, execution returns to Location 13A of Figure 13, just prior to decision block 66, where safety checks are re-executed before the low-voltage systems are re-connected at step 72. Thus, if one or more of the connections to one of the low-voltage systems has changed or if any other circumstance has changed during the cool-down procedure of Figure 15, power may not be reconnected immediately or at all.

Figure 16 shows an example calibration process that may be used when calibration is desired (such as after decision block 64 in Figure 13. Execution begins at step 118, where a wait period passes to allow equilibrium has been reached in the system. Execution then proceeds to decision block 120, where a determination is made as to whether both cables are close to a predetermined calibration reference voltage, illustrated in this case as thirteen volts. If not, execution loops at this point (or back to before the wait period of step 118) until this

condition is met. It is assumed at this point that both cables are connected to the same voltage source, and at step 122 the difference is stored as a difference offset between the cables. Once calibration is complete, the logo LED is turned on (e.g. pin 6 made high) at step 124, and all red LEDs are turned on (e.g. pins 7 and 8 made high) at step 126, signaling the completion of the calibration to the user. Execution may then end, or may return to Location 13A of Figure 13 for regular use of the cables.

Figure 17 shows an example interrupt process that may occur at any time during any of the other processes discussed above. For example, the microcontroller 60 may be programmed to run the interrupt process at fixed intervals to monitor conditions of the cables and circuitry. Execution begins with decision block 128, where it is determined whether there is demand for the LED lights (or other signals). If so, execution proceeds to decision block 130, where the microcontroller 60 determines whether the B light (corresponding to one of the cables) is on. If yes, it is turned off at step 130, and if no, it is turned on at step 134. Similarly, at decision block 136, the microcontroller 60 determines whether the A light (corresponding to the other cable) is on. If yes, it is turned off at step 138, and if no, it is turned on at step 140. Execution then proceeds to decision block 142 (where execution also proceeds if there is no demand for the LED lights.

At decision block 142, a determination is made as to whether there is demand for the low-current supply (in this case illustrated as five amps). If yes, execution proceeds to a determination of whether the low-current transistor is over its power dissipation limit (e.g. is in danger of overheating or failing due to heat) at decision block 144. If yes, the low-current transistor is turned off at step 146. If not, the low-current transistor is left on. After the low-current supply check (and change, if any), execution proceeds to decision block 150, where a determination is made as to whether there is demand for the main power transistors. If yes, execution proceeds to a determination of whether the main power transistors are over their power dissipation limits (e.g. in danger of overheating or failing due to heat) at decision block 152. If yes, the main power transistors are turned off at step 154. If not, the main power transistors are left on at step 156. After the main power transistors check, execution returns to whatever point in the process where the interrupt procedure was begun.

Although the processes illustrated in Figures 13-17 have been illustrated in particular orders, it should be understood that the order of specific steps and decisions is not always critical. For example, many of the steps and decisions may be taken essentially simultaneously or simultaneously. In addition, in any situation where it is possible to vary the order of steps to

an order other than the specifically-illustrated order, it should be understood that such orders are embraced by the embodiments of the invention. Thus the particular ordering of steps illustrated is provided by way of instruction and illustration only, and not by way of limitation.

Embodiments of the invention have been described above with respect to connecting two low-voltage systems together, such as with jumper cables. In addition, it has been indicated that embodiments of the invention can be incorporated into other devices, such as booster boxes, battery chargers, ground power units for aircraft, temporary power units, battery-powered equipment charging cords, etc. In some instances, embodiments of the invention may be incorporated into batteries and battery packs. In such embodiments, internal elements of the battery or battery pack, or the battery or battery pack itself may be viewed as or considered a first low-voltage system, and the item to be powered by the battery or battery pack may be viewed as or considered a second low-voltage system. Such embodiments of the invention may be used to prevent injury and damage that may be caused by connecting or attempting to connect the battery or battery pack to the item incorrectly or when a dangerous condition such as a short circuit exists in the item.

For example, Figure 18 shows a battery 160 of a type illustrating certain battery-incorporated embodiments. The battery 160 includes a positive terminal 162 and a negative terminal 164. The positive terminal 162 and the negative terminal 164 serve to provide connections for electrically connecting the battery 160 to a low-voltage system. For example, many vehicles utilize batteries of a type similar to the battery 160, and the battery 160 may be used to replace a standard battery for a vehicle. Batteries or battery packs similar to or incorporating features of the battery 160 (as discussed below and herein) may be used for any of a variety of low-voltage systems utilizing one or more batteries or battery packs.

The battery 160 of Figure 18 incorporates the safety features discussed herein. To do this, circuitry similar to that discussed herein is incorporated into the battery 160. Such circuitry may include a detection circuit and a power-controlling circuit. Thus, with reference to Figure 2, the input terminals 20 of the circuit depicted in Figure 2 may be connected internally to portions of the battery 160 so as to be provided with or receive the energy supplied by one or more cells of the battery 160. The output terminals 22 are electrically connected to the positive terminal 162 and the negative terminal 164 of the battery, thereby providing power to the positive terminal 162 and the negative terminal 164, and to any low-voltage system connected thereto, as long as the safety circuit 18 determines that it is safe to provide power to the positive terminal 162 and the negative terminal 164.

The battery 160 of Figure 18 may include any of a variety of features designed to communicate with a user of the battery 160. For example, the battery 160 may include an indicator 166. The indicator 166 may include one or more indicator lights or LEDs and/or one or more audible alarms to communicate a status of the battery 160 and/or a connection thereto. In some embodiments, the battery 160 may include a display 168. The display 168 may be a static display (such as instructions explaining how to interpret signals communicated by the indicator 166), or it may be a variable display, such as a LCD or other variable display capable of displaying information to a user in a more complex manner (such as by way of changing text or icons displayed on the variable display). The illustrated indicator 166 and display 168 are provided by way of example only, and it should be understood that any of a variety of mechanisms may be used to provide information to a user of the battery 160.

Various embodiments of the battery 160 provide any or all of the functions discussed herein with respect to the various embodiments of jumper cables. For example, if circuitry incorporated into the battery 160 detects a short circuit between the positive terminal 162 and the negative terminal 164 (such as might be caused by a metal tool inadvertently laid across the positive terminal 162 and the negative terminal 164 of the battery 160), the circuitry determines either not to supply power to the positive terminal 162 and the negative terminal 164 or, if power was previously being supplied, determines to interrupt power to the positive terminal 162 and the negative terminal 164. This prevents/reduces the chances of sparks, electrical shocks, arcs, inadvertent draining of the energy stored in the battery 160, and other problems. When a short circuit is detected, one or more of the indicator 166 and the display 168 may provide a visible or audible indication that a short circuit condition exists.

Similarly, the circuitry in the battery (or other device) may respond to any of a variety of events while power is being supplied. There are several non-limiting examples of situations where the circuitry may determine to interrupt power. In one example, an over-current condition is detected. In another example, an undesirable temperature is detected, such as at a cell of the battery 160, at a terminal of the battery 160, at some point of the circuitry, or at some other point of the low-voltage system to which the battery 160 is connected. Thus, certain embodiments embrace the use of thermal detectors in communication with the circuitry of the battery 160 (or other device in which the circuitry is incorporated (e.g. jumper cables) by any method of communication discussed herein or later invented. In another example, the circuitry may detect a voltage/current waveform associated with a fault such as a ground fault or an arc

fault, or any other fault, and may determine to interrupt power accordingly. Any other fault criteria may be used to make a determination to interrupt power.

The battery 160 may also incorporate off-until-needed features similar to those incorporated into the jumper cables. Thus, when the battery 160 is disconnected (physically and/or electrically) from any normal load, no voltage difference may be provided between the positive terminal 162 and the negative terminal 164, or only a minimal (e.g. test) voltage difference may be detected between the positive terminal 162 and the negative terminal 164. This further improves safety of the battery 160. The battery 160 may be programmed with a variety of behaviors for a variety of desired functionalities. For example, while the flow chart of Figure 13 illustrates disconnecting power systems when less than ten amps is flowing between low voltage systems (analogous here to less than ten amps flowing to/from the battery from/to the connected system, e.g. car), it should be understood that it may be desirable to maintain power supplied by the battery 160 at much lower current flows. For example, in a battery connected to a vehicle, it may be desirable to run one or more accessories of the vehicle that may use significantly less than ten amps.

Thus, with respect to implementing the flow charts depicted in Figures 13-17 in a battery-integrated system, it should be understood that some aspects of the flow charts may be modified as desired to achieve the desired functionality for a given situation. For example, because the system is integrated into the battery 160 itself, the system may be programmed and the flow charts simplified according to known information. In such a system, the safety circuitry is presumably correctly connected to the internal cell or cells of the battery, so any steps directed to ensuring that the first connection is correctly made may be omitted or modified appropriately.

Embodiments of the battery 160 incorporate the reverse-polarity detection features discussed herein. Thus, the battery 160 is able to detect not only short circuit conditions, but will also detect when it has been improperly installed into a low-voltage system, such as a vehicle. These features are most advantageous in batteries designed for low voltage systems such as vehicles where the polarity of the low-voltage system is detectable using the test functionalities discussed herein with respect to Figures 4-6. It will be understood that in a vehicle or other low-voltage system designed for a single battery, the only voltage source is the battery 160 itself, so the response of the vehicle or other low-voltage system to test currents/voltages supplied by the battery 160 are used to determine whether a proper-polarity connection has been made. Thus, the battery 160 may include a polarity test circuit configured

to supply a test current to the connected low-voltage system and measure a resulting voltage to determine a proper polarity of a low-voltage system connected to the battery 160. When an improper-polarity connection is made/attempted, the battery 160 uses one or both of the indicator 166 and the display 168 to communicate to the user that the polarity has been reversed and that remedial action should be taken.

Figures 19 and 20 depict a circuit diagram for an alternative exemplary circuit that may be used with certain embodiments of the invention. Because of the size of the circuit diagram depicted in Figures 19 and 20, expanded views of the circuit are depicted in Figures 21-27. Specifically, areas of Figures 19 and 20 defined by the dashed lines are depicted in Figures 21-27 as follows: area 170 of Figure 19 is depicted in more detail in Figure 21, area 172 of Figure 19 is depicted in more detail in Figure 22, area 174 of Figure 19 is depicted in more detail in Figure 23, area 176 of Figure 19 is depicted in more detail in Figure 24, area 178 of Figure 19 is depicted in more detail in Figure 25, area 180 of Figure 19 is depicted in more detail in Figure 26, and area 182 of Figure 19 is depicted in more detail in Figure 27. In the expanded views of Figures 21-27, representative components and component values have been illustrated by way of example only. It will be understood that other circuits, components, and component values may be used to create circuits of varying degrees of similarity to the illustrated circuit having functionality similar to that discussed herein. Such embodiments are embraced within the scope of the present invention.

In the control circuit embodiment shown in Figures 19-27 two pairs of field-effect transistors (FETs) are used in a back-to-back configuration. One transistor of each pair controls the current flow in one direction. In the illustrated embodiment of Figures 19, the first pair of transistors are labeled Q2 and Q3 in Figures 21-22, and the second pair of transistors is labeled Q1 and Q4. Two pairs of FETs are used in the current example to provide a desired amount of maximum current flow. Therefore, certain embodiments embrace the use of a single pair of transistors, as well as the use of three, four, five, or more pairs of transistors, as desired to achieve particular performance characteristics. Benefits are achieved through the independent control of these two pairs (or other amounts of pairs) of transistors. One of the pair of transistors is used to provide feedback to precisely control the current through the other of the pair of transistors, thereby controlling the total current flow through the jumper cable controller. In situations where the direction of current flow is known, such as where the controller is incorporated into a battery or battery pack, one transistor from each pair may be replaced by a static resistor as a current feedback device (current shunt resistor), as will be discussed below.

In the illustrated embodiment, the controller first determines a direction of current flow through the circuit to choose which transistor of the pair of transistors is to function as a current shunt resistor. After identifying the transistor(s) to serve as a current shunt resistor, those transistors are turned fully on, establishing a known resistance through the transistors acting as the current shunt. An amplifier circuit permits the voltage drop to be measured by a micro-controller. The micro-controller uses the measured voltage drop to determine the gate voltage for the controlling set of transistors and thereby the current through the entire circuit. The direction of flow of current through the jumper cables does not affect function of the circuit. Cost of the circuit components is relatively low.

Thus, if current is to flow from left to right in Figure 19, one or both of transistors Q3 and Q4 are turned fully on to serve as the current shunt resistor. Then, the controller measures the voltage drop across the transistors Q3 and Q4 as one or both of transistors Q1 and Q2 is slowly turned on, and sets the gate voltage for the transistor(s) Q1 and Q2 accordingly to achieve the desired current flow through the transistor(s) Q1 and Q2 and thus through the entire circuit. When current is to flow from right to left in Figure 19, one or both of transistors Q1 and Q2 are turned fully on to serve as the current shunt resistors, and the controller measures the voltage drop across those transistors as one or both of transistors Q3 and Q4 are turned on to the desired level.

In an embodiment where less current is needed, one of the pairs of transistors may be omitted from the circuit shown in Figure 19. Thus, either the pair of transistors Q2, Q3 may be omitted, or the pair of transistors Q1, Q4 may be omitted. Conversely, if greater current flow is needed, additional pairs of transistors may be provided until the desired current capacity is met, with each pair of transistors connected to all other pairs through extension of the cross configuration shown connecting the transistors Q1, Q2, Q3, and Q4 in Figures 19, 21, and 22.

As mentioned above, in certain embodiments, it may be known that the current will only flow in a certain direction. For example, the controller may be incorporated into a battery to provide safety features as discussed herein. In this instance, it may not be necessary to utilize one or more transistors as a current shunt resistor: instead one or more static resistors may be used to reduce costs. While multiple static resistors may be used for multiple transistors, it will be appreciated from the parallel configuration of the circuit of Figure 19 that a single static resistor may be used for multiple transistors. In such embodiments, the voltage drop may be measured across the static resistor(s) and this may be used to control the gate voltage at the transistor(s) in a fashion similar to that described above.

There are significant benefits of circuits such as the embodiment of Figures 19-27. As one example, a jumper cable or other connection system incorporating the embodiment of Figures 19-27 can be used to control current for jump starting vehicles having low-voltage systems of dissimilar voltages. Thus, a person could jump start a vehicle having a six-volt electrical system using a vehicle having a twelve-volt electrical system or a twenty-four-volt electrical system. The controller recognizes the lower-voltage system and then uses the two-transistor pair to supply sufficient current while preventing the voltage from rising higher than is safe or desirable for the six-volt system. The same could be true for jump starting between an overland truck having a twenty-four-volt system and a light car or truck having a twelve-volt electrical system.

As another example of benefits provided by such embodiments, jumper cables incorporating such embodiments may be used to test the viability of a battery in a vehicle. To perform the test, one end of the jumper cables (e.g. one set of either the first pair of contact clamps 12 or the second pair of contact clamps 14) is connected together to form a short circuit between the positive and negative leads. The other end of the jumper cables is connected to the battery to be tested. The controller initiates a battery test and uses the control circuitry to flow a known significant amount of current through the battery while monitoring the voltage drop of the battery. For example, if the controller allows three hundred amps to flow through the module for a few seconds, the battery is presumably good if it is able to maintain proper voltage during the test.

Another example of benefits provided by embodiments such as illustrated in Figures 19-27 is permitting the jumper cable to be used to test the viability of a vehicle's alternator. One end of the jumper cables is shorted as with the battery test, and various current load profiles can be imposed on the alternator up to and beyond the charging limit of the vehicle's alternator. The controller monitors the voltage of the alternator while the test is being performed. The voltage behavior of the alternator under these electric loads allows the controller to determine if the alternator is functioning properly or not.

Jumper cables incorporating the circuit embodiment of Figures 19-27 and similar circuits may be used to provide trickle charging to a battery. For example, in some instances it may be desirable to keep a battery charged, but do no more than that. Using jumper cables incorporating embodiments of the invention, the controller permits a precise trickle charge rate to be supplied to keep a battery charged.

Additionally, such embodiments of the jumper cables/jumper cable control circuitry permit the setting of an over-current threshold. This permits certain measures of protection, such as while the jumper cables are connected to a vehicle being simultaneously worked on. For example, if an individual is planning on working on a vehicle while jumper cables are connected to the vehicle's electric system, an over-current threshold may be set, such as to twenty amps, to provide a certain amount of power to the vehicle without supplying so much as to be potentially dangerous for either the person or the vehicle's components. Thus, embodiments of the invention provide further safety improvements over existing systems for connecting low-voltage systems such as vehicles.

Certain controller/circuit embodiments, such as that illustrated in Figures 19-27, incorporate the ability to communicate status, performance levels, and any parameter the controller measures. Communication directed to the controller/controller circuit is provided by way of imposing a communication signal onto the jumper cable wires. The micro-controller can detect this signal using the same detection circuit that is used to measure the cable voltage. For example, this could include a five volt peak-to-peak signal imposed on the cable voltage. The micro-controller could filter or otherwise segregate the AC and DC components of the cable voltage, allowing input communication simultaneous with jumper cable use.

Communication out from the device can be accomplished in several ways. One way to communicate out from the controller is using the jumper cable wires in the same fashion as just described for communications to the controller. Thus, the control module imposes the communication signal on the jumper cable lines. A second communications technique out from the device may be accomplished using one or more user-feedback LEDs as optical transmitter. In this instance, the micro-controller implements an optical communication protocol that is clocked out through the LED or LEDs. An optical receiver decodes the information passed out through the LED or LEDs as encoded by the jumper cable control unit.

Communication ability such as provided in the described embodiments provides several benefits to jumper cables incorporating this ability. As one example, an external tool can provide an enhanced user interface with the jumper cable control module. For example, an external device could slide over the jumper cable up to the control module, or could be otherwise placed over the control module so as to sense one or more LED lights of the control module. A user might then be able to see a display of the amount of current flowing during a jump start, could view relevant performance criteria detected by a battery test as described

above, or could view relevant performance criteria detected by an alternator test as described above.

Furthermore, integration with other tools may be achieved. For example, a vehicle analyzer, engine diagnostic tool, or other test system could obtain real-time information about the electrical system performance. Additionally, the test systems could command the jumper cable control module to apply variable or large electrical loads as part of a testing protocol. This may enhance the test systems' diagnostic capabilities.

In at least some embodiments, the communication capability of the jumper cable controller may be used for reprogramming of the controller. For example, updated firmware may be programmed after manufacture is complete, or even after a customer has taken possession of the product. In addition, the communication capability permits interactive testing of the jumper cable set after manufacture and before it leaves the production facility.

The battery-integrated low-voltage safety features discussed herein may be used in a wide variety of circumstances and systems, including as batteries and battery packs of vehicles such as standard gas- or diesel-powered vehicles, hybrid vehicles, plug-in hybrid vehicles, marine vehicles, and the like, or in any system using one or more batteries and/or battery packs.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

What is claimed and desired to be secured by Letters Patent is:

1. A safety circuit for use in establishing connections between low-voltage systems to transfer energy from a first low-voltage system to a second low-voltage system, comprising:

a pair of input terminals;

a pair of output terminals;

a detection circuit operatively connected to the input terminals and the output terminals for detecting whether the input terminals and the output terminals are properly connected to first and second low-voltage systems, respectively; and

a connection-controlling circuit configured to electrically connect the input terminals to the output terminals only when a proper connection has been detected and using a soft start procedure that reduces inductive voltage spikes.

2. A safety circuit as recited in claim 1, wherein the connection-controlling circuit controls one or more power transistors that are used to electrically connect the input terminals to the output terminals using the soft start procedure.

3. A safety circuit as recited in claim 2, wherein the soft start procedure connects the first low-voltage system to the second low-voltage system over a period of tens of milliseconds.

4. A safety circuit as recited in claim 1, wherein the safety circuit is incorporated into a jumper cable.

5. A safety circuit as recited in claim 1, wherein the safety circuit is incorporated into a battery charger.

6. A safety circuit as recited in claim 1, wherein the safety circuit is incorporated into a battery boost.

7. A safety circuit as recited in claim 1, further comprising a discharged battery test circuit configured to supply a test current to the output terminals and measure a resulting voltage to determine a proper polarity of a discharged battery connected to the output terminals.

8. A safety circuit as recited in claim 7, wherein the discharged battery test circuit is configured to supply test currents of different directions and to compare the voltages caused by the test currents.

9. A safety circuit as recited in claim 1, wherein the safety circuit is configured to detect whether a battery is connected to one of the pair of input terminals and the pair of output terminals by biasing the desired terminals to a voltage unlikely to occur naturally in one of the low-voltage systems and determining whether the voltage aberrates from the biased voltage by a given amount.

10. A safety circuit as recited in claim 1, wherein the safety circuit is configured to discriminate between a short circuit and a discharged battery by measuring the rise and fall time of a voltage measured across one of the pair of input terminals and the pair of output terminals as a limited current is allowed to flow.

11. A method of testing a polarity of a discharged battery connected to a first low-voltage system comprising:

connecting a test current source to a first low-voltage system containing a discharged battery;

supplying a first test current to the first low-voltage system; and

measuring a first resulting voltage of the first low-voltage system.

12. A method as recited in claim 11, further comprising making an electrical connection between the first low-voltage system and a second low-voltage system only if the first resulting voltage exceeds a predetermined threshold voltage.

13. A method as recited in claim 11, further comprising:

supplying a second test current to the first low-voltage system, wherein the second test current is in an opposite direction to the first low-voltage system; and

measuring a second resulting voltage of the first low-voltage system.

14. A method as recited in claim 13, further comprising making an electrical connection between the first low-voltage system and a second low-voltage system only if only one of the first resulting voltage and the second resulting voltage exceeds a predetermined threshold

voltage and if the electrical connection will be of a proper polarity indicated by the measured first and second resulting voltages.

15. A method as recited in claim 11, wherein the method is incorporated as a test method upon connection of a battery charger to a system having a discharged battery.

16. A method as recited in claim 15, wherein the system having a discharged battery is a vehicle.

17. A method as recited in claim 11, wherein the method is incorporated as a test method upon connection of a battery boost to a system having a discharged battery.

18. A method as recited in claim 11, wherein the method is incorporated as a test method upon connection of a jumper cable to a vehicle having a discharged battery.

19. A jumper cable for use in establishing connections between low-voltage systems to transfer energy from a first low-voltage system to a second low-voltage system, comprising:

a safety circuit comprising:

a pair of input terminals;

a pair of output terminals;

a detection circuit operatively connected to the input terminals and the output terminals for detecting whether the input terminals and the output terminals are properly connected to first and second low-voltage systems, respectively; and

a connection-controlling circuit configured to electrically connect the input terminals to the output terminals only when a proper connection has been detected and using a soft start procedure that reduces inductive voltage spikes;

a first cable connected to the input terminals and comprising first contact clamps for connecting to the first low-voltage system; and

a second cable connected to the output terminals and comprising second contact clamps for connecting to the second low-voltage system.

20. A jumper cable as recited in claim 19, wherein the safety circuit comprises a transistor protection system for protecting transistors used to electrically connect the input terminals to the output terminals, the transistor protection system comprising:

a microcontroller that maintains a thermal model of heating of the transistors when power is flowing and a thermal model of cooling of the transistors when power is not flowing, that monitors for over-current conditions that could destroy the transistors, and that monitors for under-voltage conditions on the supply side.

21. A jumper cable as recited in claim 19, wherein the safety circuit is contained in a control box proximate one of the first contact clamps and the second contact clamps.

22. A jumper cable as recited in claim 21, wherein the control box comprises a plurality of light emitting diodes for signaling conditions detected by the safety circuit to a user of the jumper cable.

23. A battery-integrated safety circuit for use in establishing that a low-voltage system is safely and properly connected to a battery, comprising:

a pair of output terminals;

a detection circuit operatively connected to the output terminals and configured to detect whether the output terminals are properly connected to a low-voltage system with a correct polarity; and

a power-controlling circuit configured to provide electrical power to the output terminals only when a proper connection of correct polarity has been detected.

24. A battery-integrated safety circuit as recited in claim 23, wherein the power-controlling circuit provides electrical power to the output terminals using a soft start procedure that reduces inductive voltage spikes.

25. A battery-integrated safety circuit as recited in claim 24, wherein the power-controlling circuit controls one or more power transistors that are used to provide electrical power to the output terminals using the soft start procedure.

26. A battery-integrated safety circuit as recited in claim 24, wherein the soft start procedure provides electrical power to the output terminal over a period of approximately a millisecond to tens of milliseconds.

27. A battery-integrated safety circuit as recited in claim 23, further comprising a polarity test circuit configured to supply a test current to the output terminals and measure a resulting voltage to determine a proper polarity of a low-voltage system connected to the output terminals.

28. A battery-integrated safety circuit as recited in claim 27, wherein the polarity test circuit is configured to supply test currents of different directions and to compare the voltages caused by the test currents.

29. A battery containing a battery-integrated safety circuit comprising:

a positive terminal;

a negative terminal; and

a safety circuit operatively connected to the positive terminal and the negative terminal and configured to supply power through the positive and negative terminals only when a connection between the terminals and a low-voltage system has been properly made with a correct polarity.

30. A battery as recited in claim 29, wherein the battery prevents the supply of power to the positive and negative terminals when a short circuit exists between the positive and negative terminals.

31. A battery as recited in claim 29, wherein the safety circuit comprises a polarity test circuit configured to supply a test current to the terminals and measure a resulting voltage to determine a proper polarity of a low-voltage system connected to the battery.

32. A battery as recited in claim 29, wherein the safety circuit comprises:

a detection circuit operatively connected to the terminals and configured to detect whether the terminals are connected to the low-voltage system with the correct polarity; and

a power-controlling circuit configured to provide electrical power to the terminals.

33. A battery as recited in claim 32, wherein the power-controlling circuit is configured to interrupt power to the positive and negative terminals after it has been supplied when an improper condition is detected.

34. A battery as recited in claim 33, wherein the improper condition comprises a condition selected from the group of:

an overcurrent;

a temperature that is higher than desired;

a ground fault;

an arc fault; and

a short circuit.

35. A battery as recited in claim 29, wherein the safety circuit comprises one or more field-effect transistors configured to permit precise control of the flow of current from the battery.

36. A safety circuit for use in connecting two low-voltage systems comprising:

a first pair of terminals for connecting the safety circuit to a first low-voltage system;

a second pair of terminals for connecting the safety circuit to a second low-voltage system;

at least one pair of transistors in a back-to-back configuration, whereby one transistor of each pair of transistors controls a flow of current between the first and second pairs of terminals in one direction so that the safety circuit can control the flow of current between the first and second pairs of terminals in either direction;

an amplifier circuit configured to measure a voltage drop of a selected transistor of each pair of transistors when the selected transistor is switched fully on as a current shunt; and

a micro-controller operatively connected to the amplifier circuit and to each pair of transistors and configured to use the measured voltage drop to determine a gate voltage for the other of each pair of transistors to control the current between the first and second pairs of terminals.

37. A safety circuit as recited in claim 36 incorporated into a jumper cable.

38. A safety circuit as recited in claim 36 adapted to connect and transfer power between two low-voltage systems of dissimilar operating voltages.

39. A safety circuit as recited in claim 36, wherein the safety circuit is capable of being configured to limit current flow between the first and second pairs of terminals to a maximum current.

40. A safety circuit as recited in claim 36 wherein the micro-controller is adapted to perform a low-voltage system test of one of:

a battery, by allowing a certain known amount of current to flow through the battery for a short time when the first pair of terminals is electrically connected to the battery and when the second pair of terminals is short-circuited; and

an alternator, by imposing various current load profiles on the alternator when the first pair of terminals is electrically connected to the alternator and when the second pair of terminals is short-circuited.

41. A safety circuit as recited in claim 36, further comprising a communication system permitting communication with devices external to a device incorporating the safety circuit.

42. A safety circuit as recited in claim 41, wherein the communication system is configured with external devices using one of:

an AC signal imposed on a DC voltage at one of the first and second pairs of terminals; and

an optical transmission and receiving system between the safety circuit and the external devices.

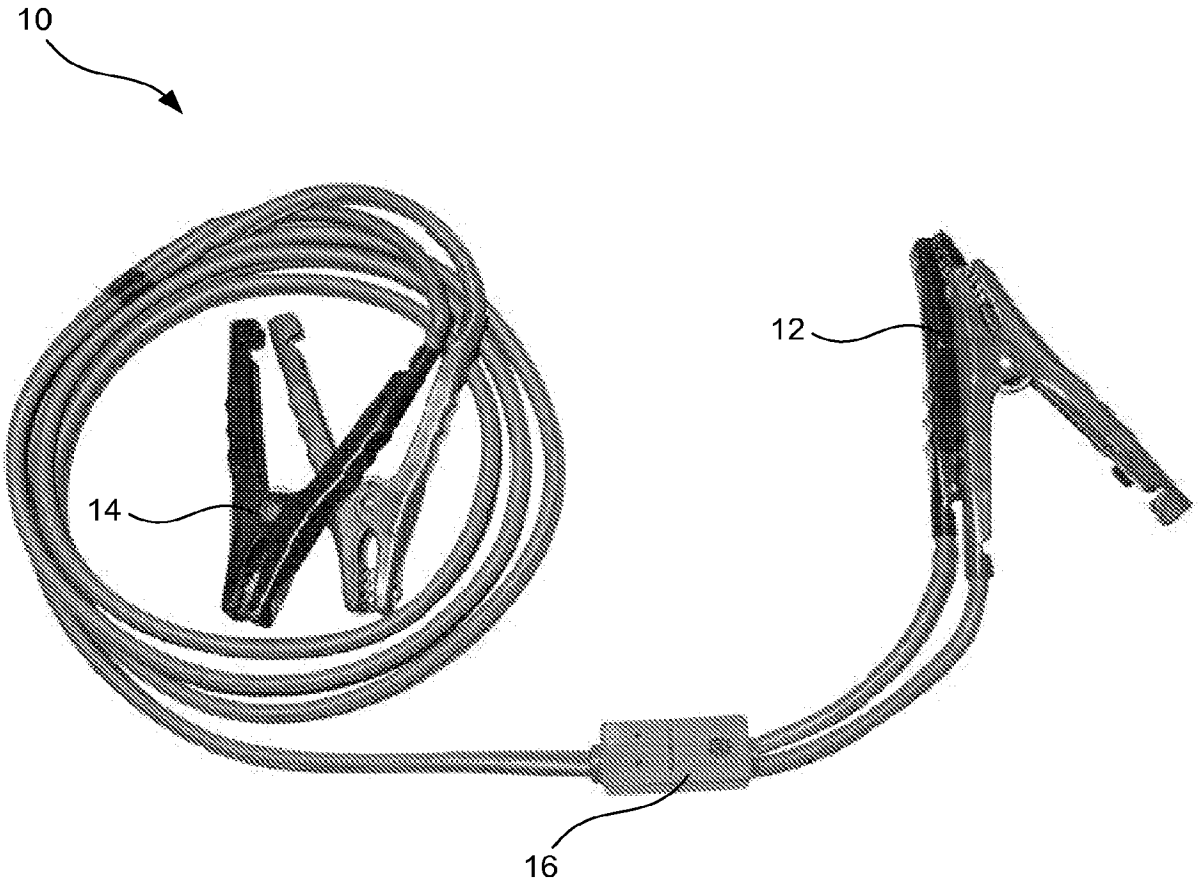


FIG. 1

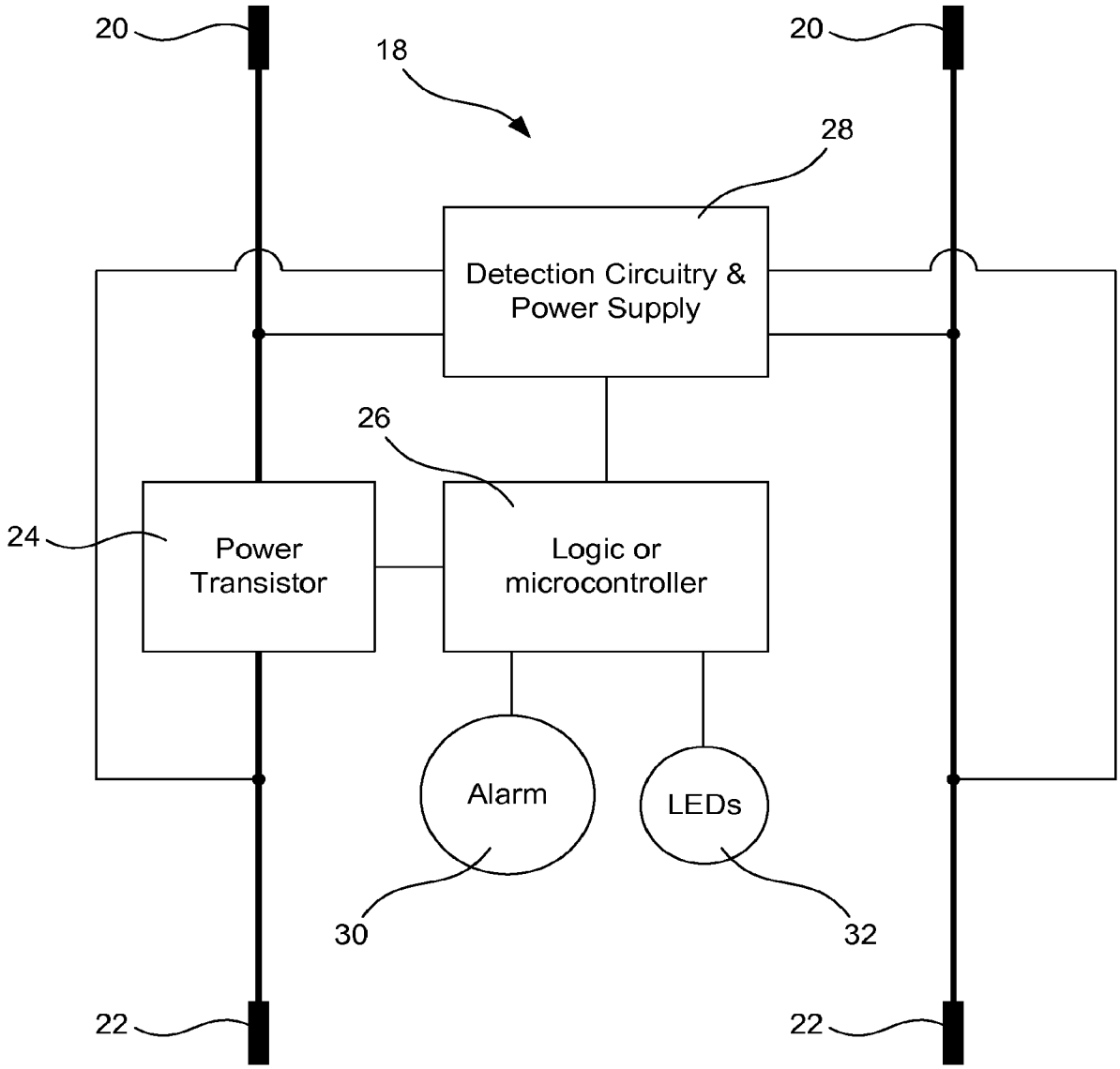

20
18
20
28
Detection Circuitry & Power Supply
26
24
Power Transistor
Logic or microcontroller
Alarm
LEDs
30
32
22
22

FIG. 2

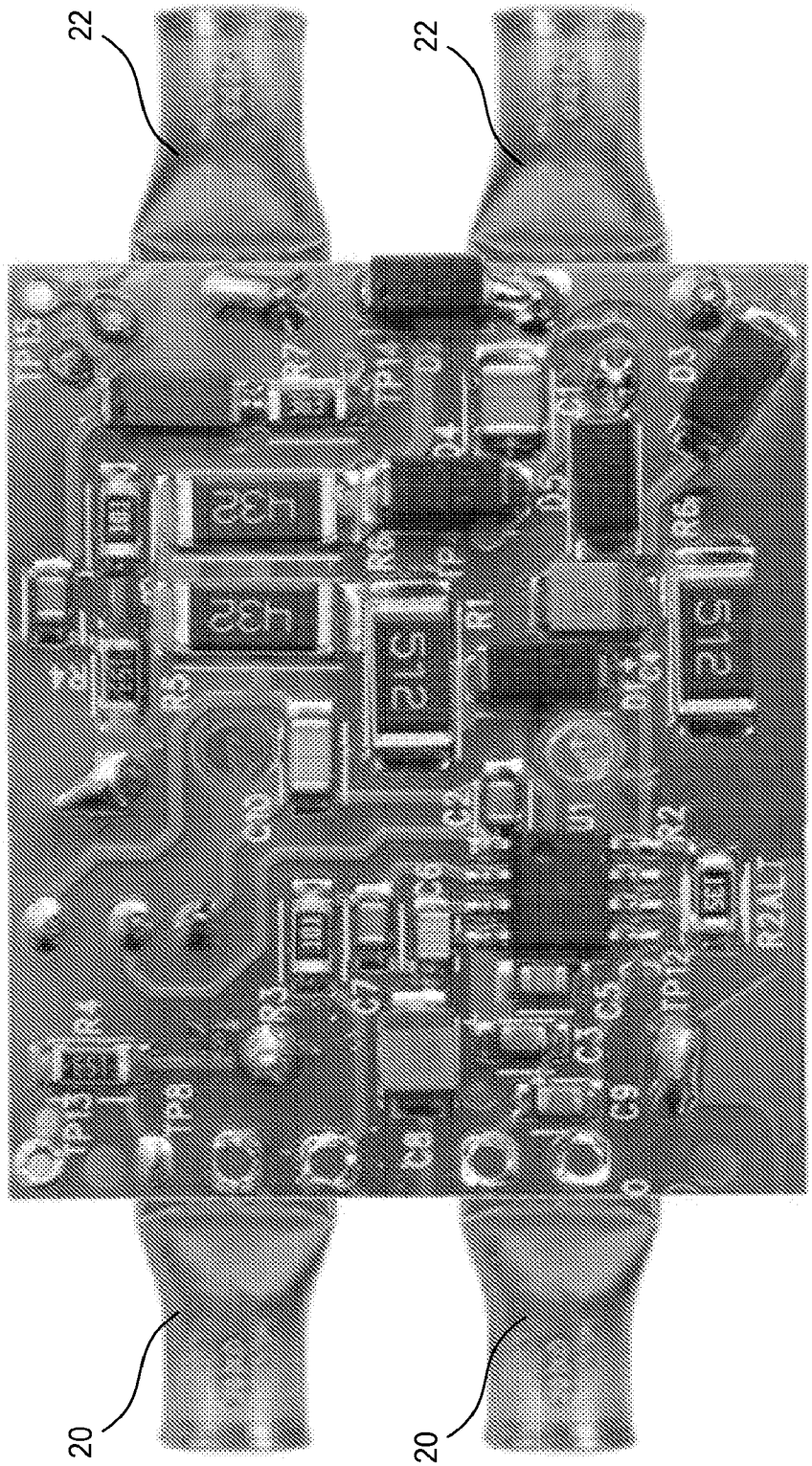


FIG. 3

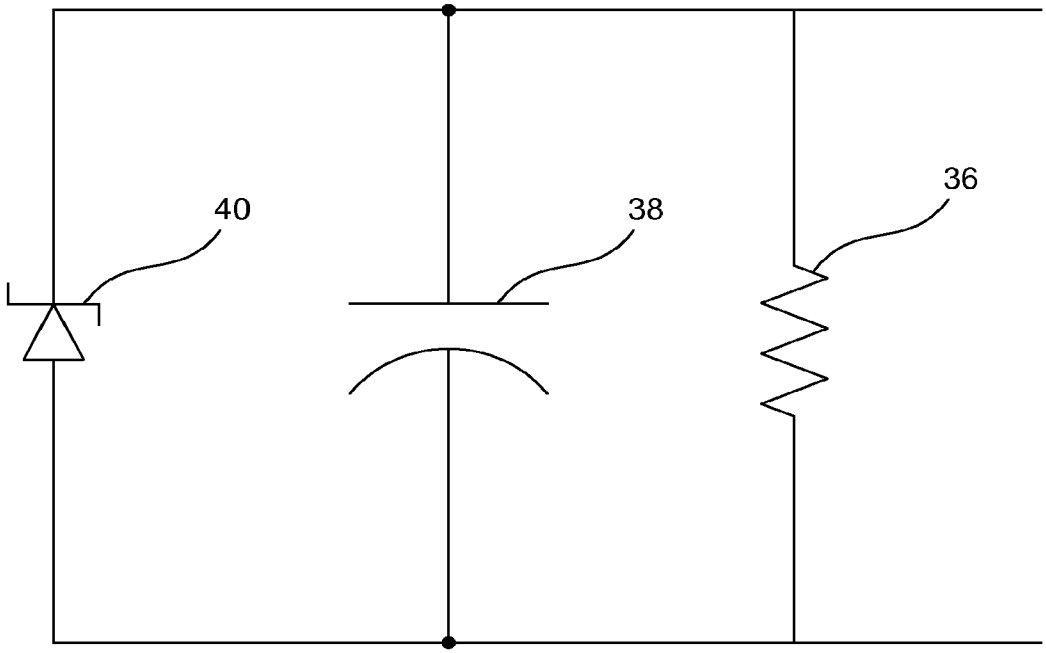
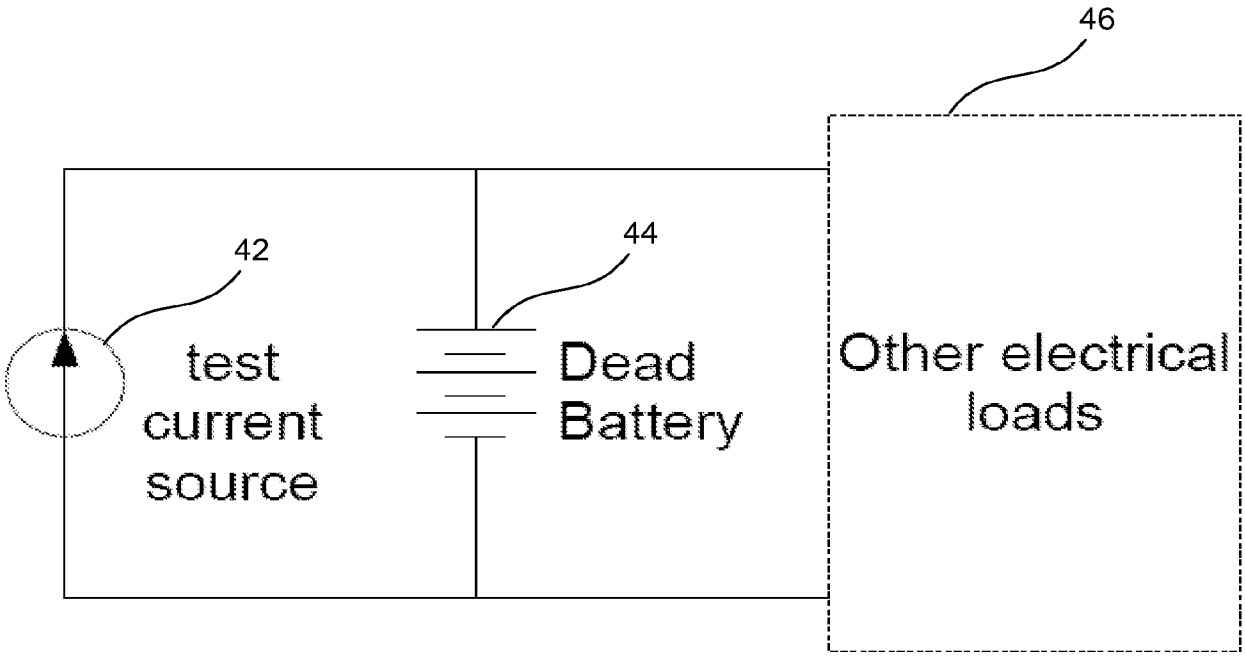
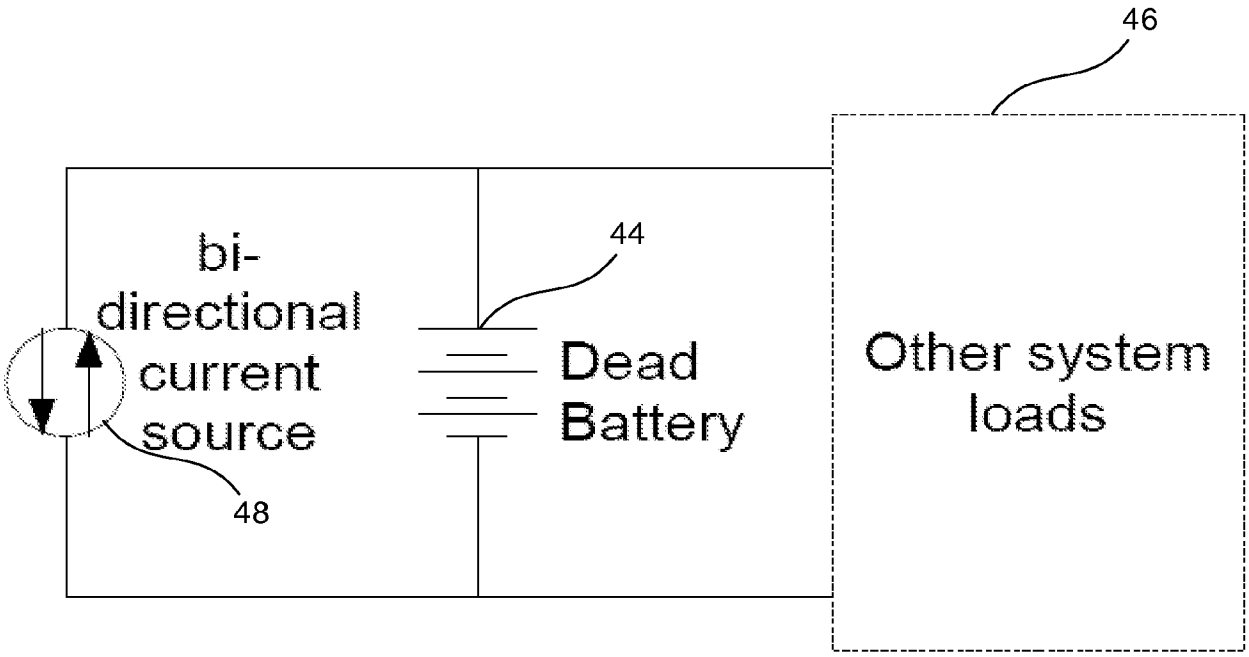


FIG. 4



Single test current direction

FIG. 5



Bi-directional test current direction

FIG. 6

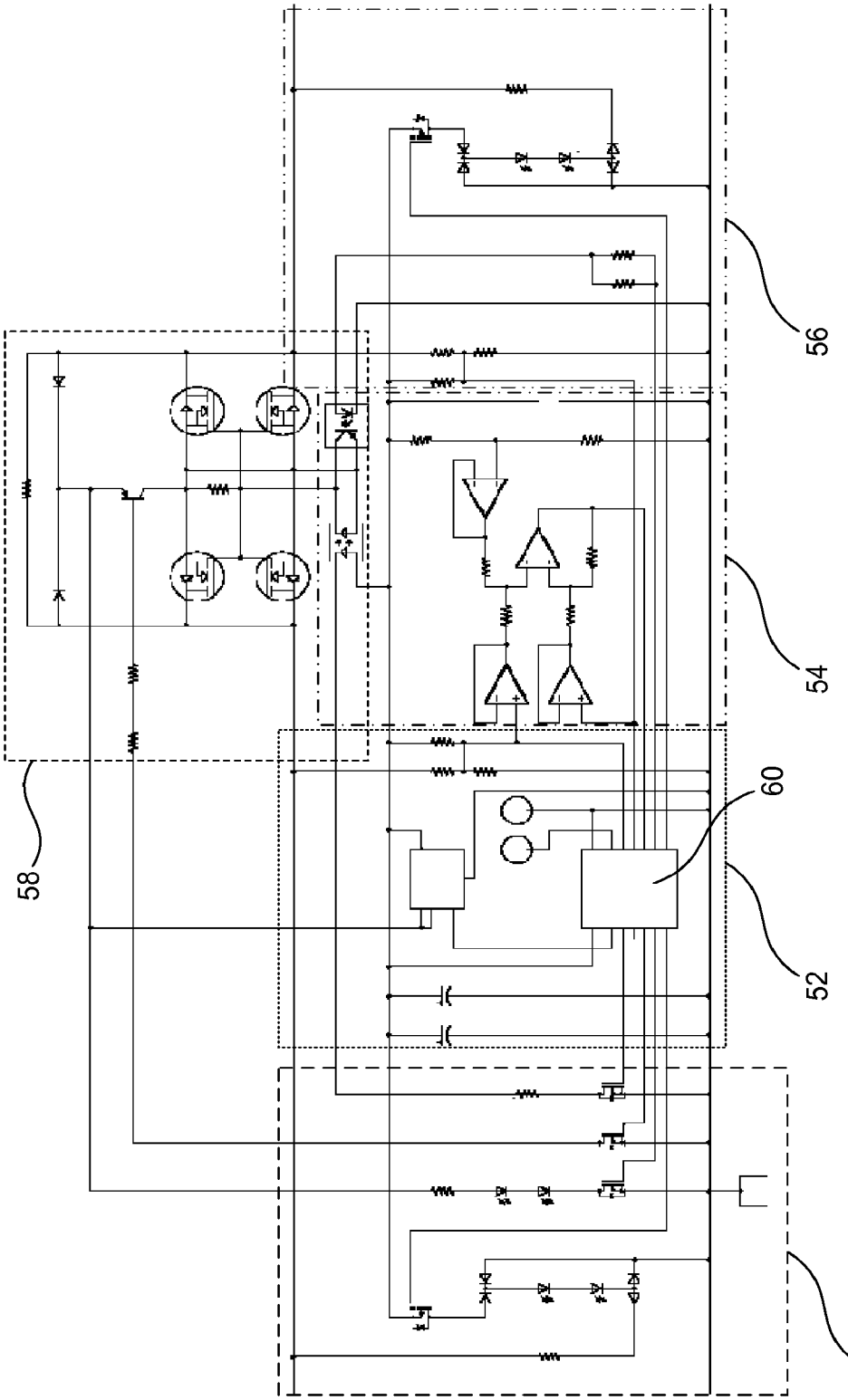


FIG. 7

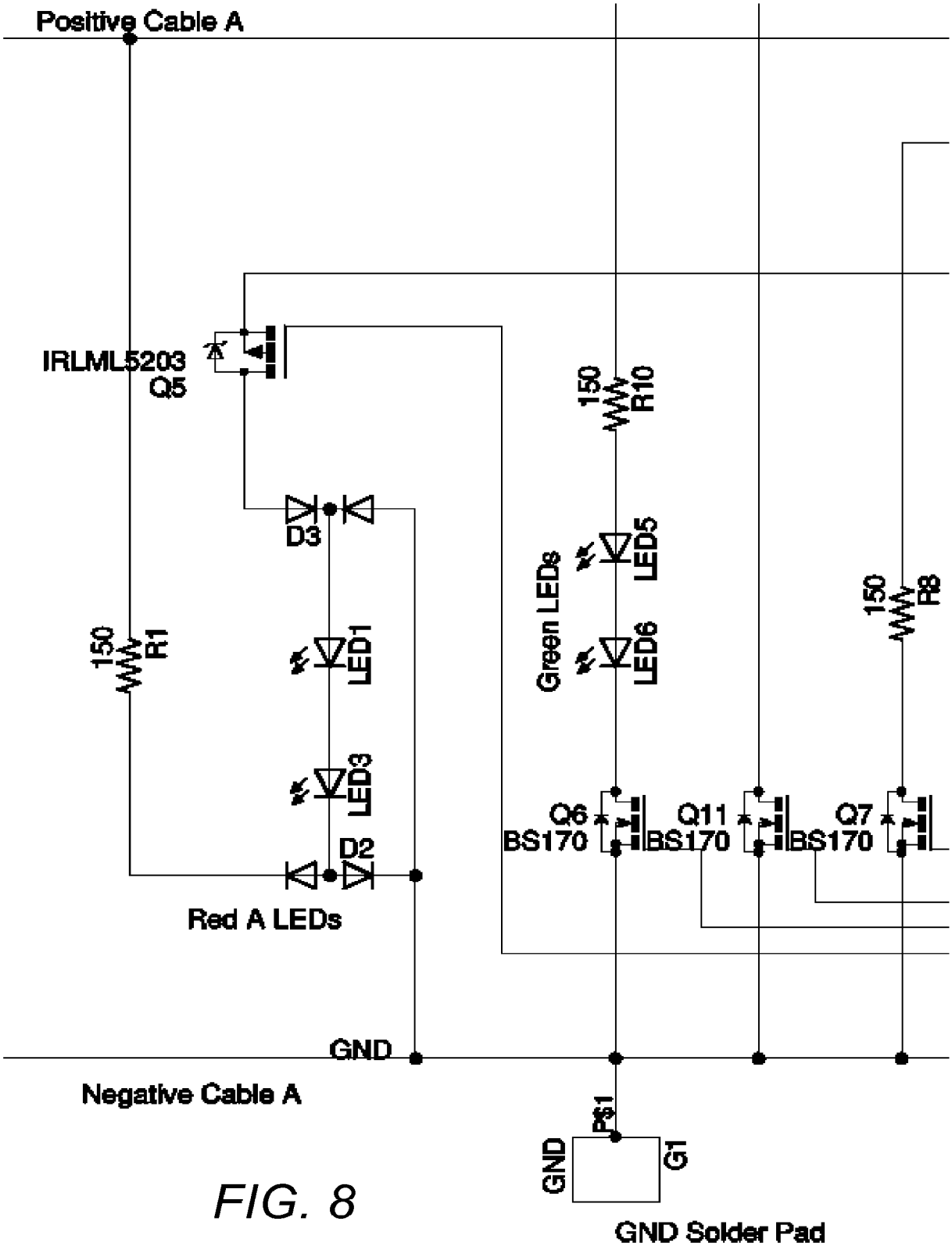

Positive Cable A
IRLML5203
Q5
150
R10
D3
LED5
Green LEDs
LED6
150
R8
150
R1
LED1
LED3
D2
Q6
BS170
Q11
BS170
Q7
BS170
Red A LEDs
GND
Negative Cable A
P$1
GND
G1
GND Solder Pad

FIG. 8

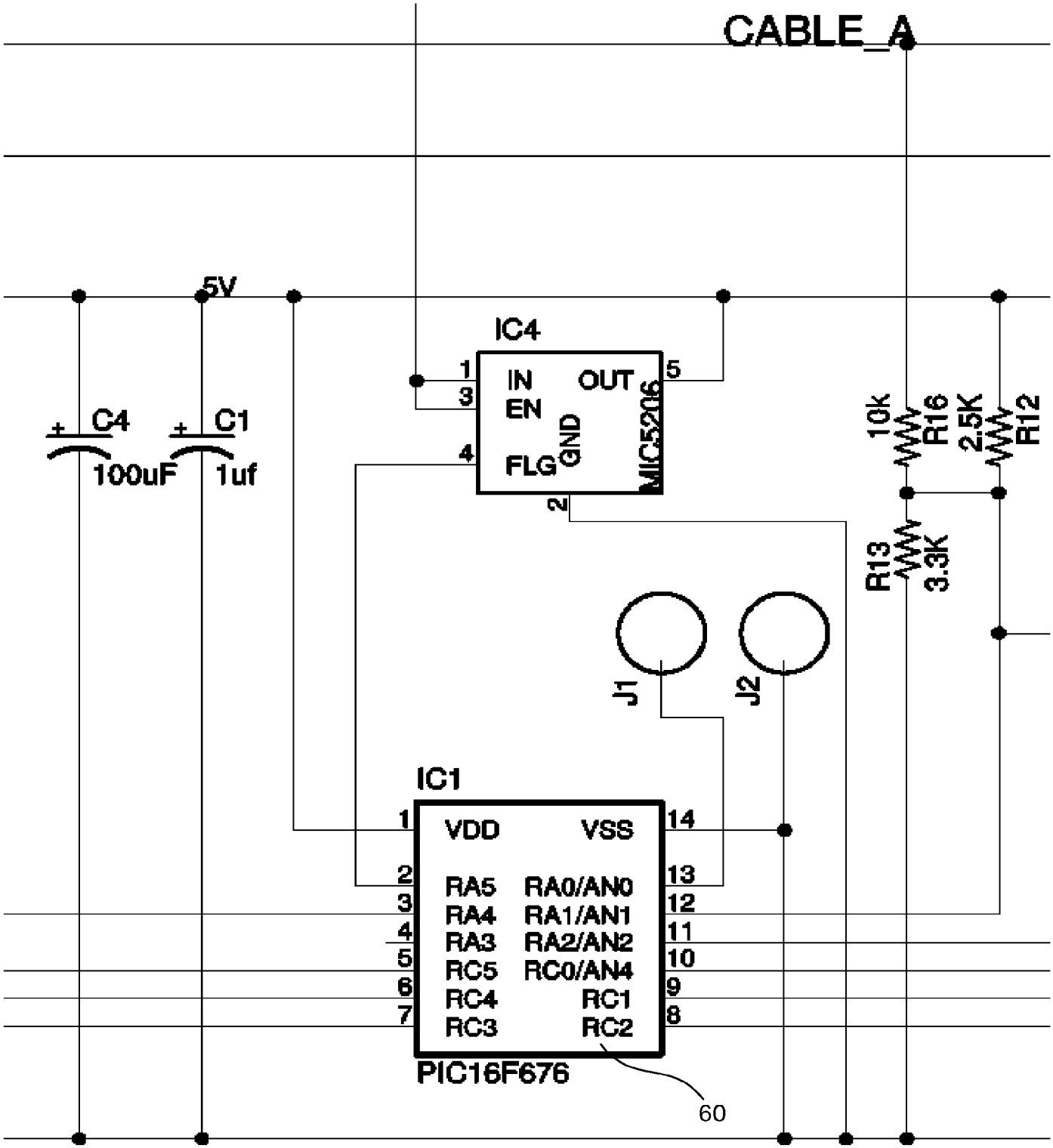

CABLE_A
5V
IC4
IN
OUT
EN
GND
FLG
MIC5206
C4
100uF
C1
1uf
10k
R16
2.5K
R12
R13
3.3K
J1
J2
IC1
VDD
VSS
RA5
RA0/AN0
RA4
RA1/AN1
RA3
RA2/AN2
RC5
RC0/AN4
RC4
RC1
RC3
RC2
PIC16F676
60

FIG. 9

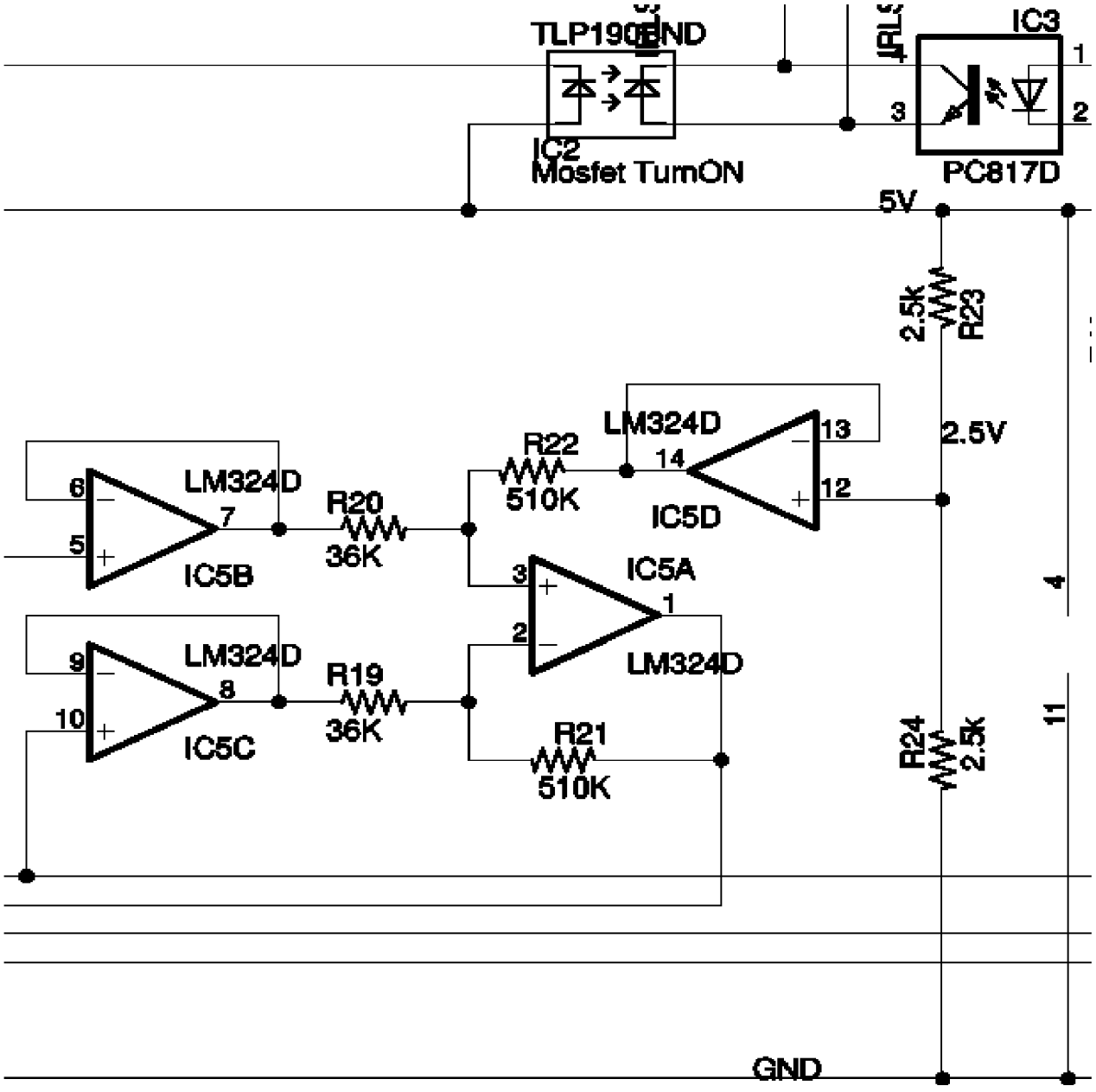

TLP190B
IC2
Mosfet TurnON
IC3
PC817D
5V
2.5k
R23
2.5V
LM324D
R22
510K
IC5D
LM324D
IC5B
R20
36K
IC5A
LM324D
LM324D
IC5C
R19
36K
R21
510K
R24
2.5k
GND

FIG. 10

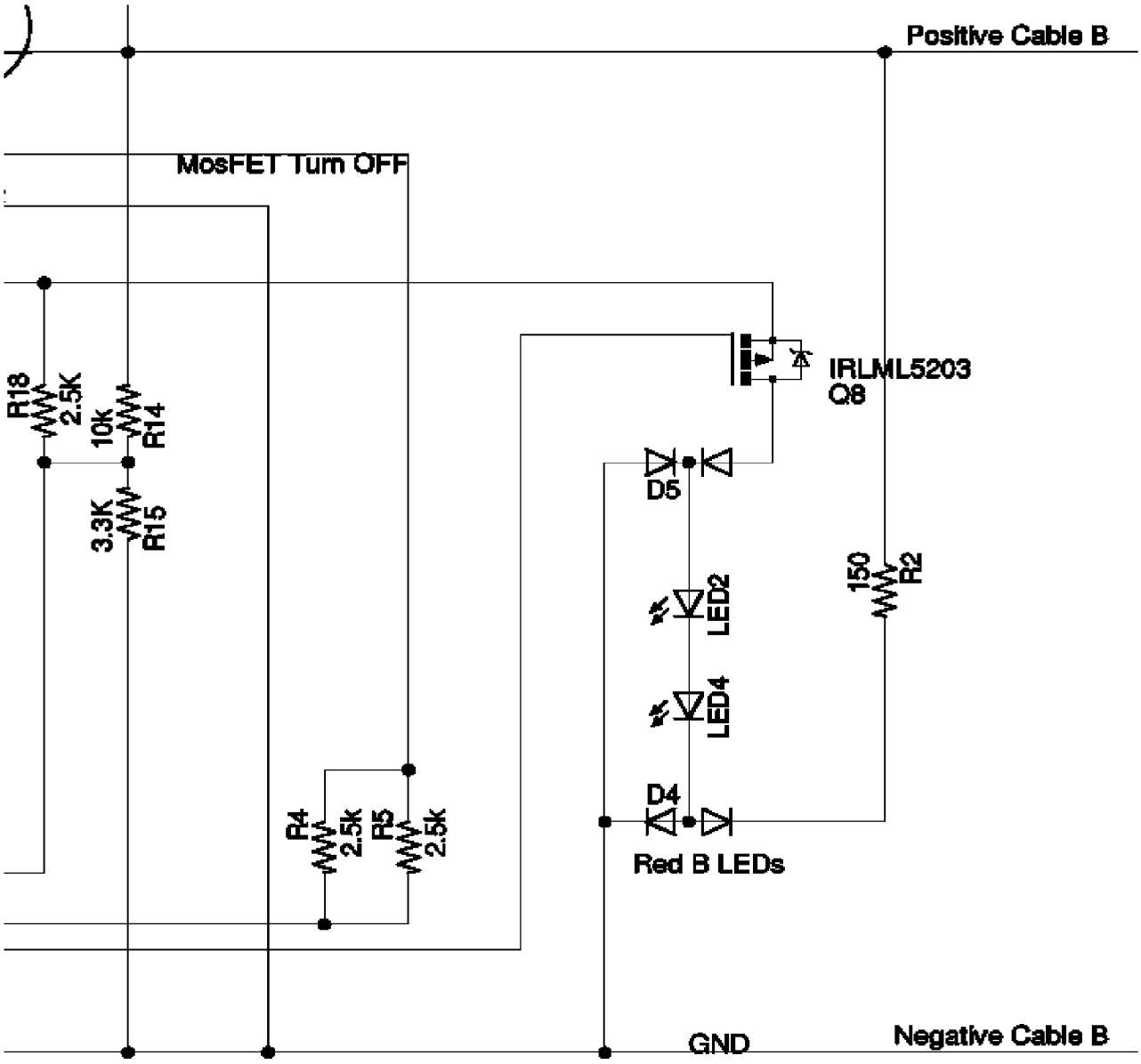

Positive Cable B
MosFET Turn OFF
R18
2.5K
10k
R14
3.3K
R15
IRLML5203
Q8
D5
LED2
LED4
D4
Red B LEDs
150
R2
R4
2.5k
R5
2.5k
GND
Negative Cable B

FIG. 11

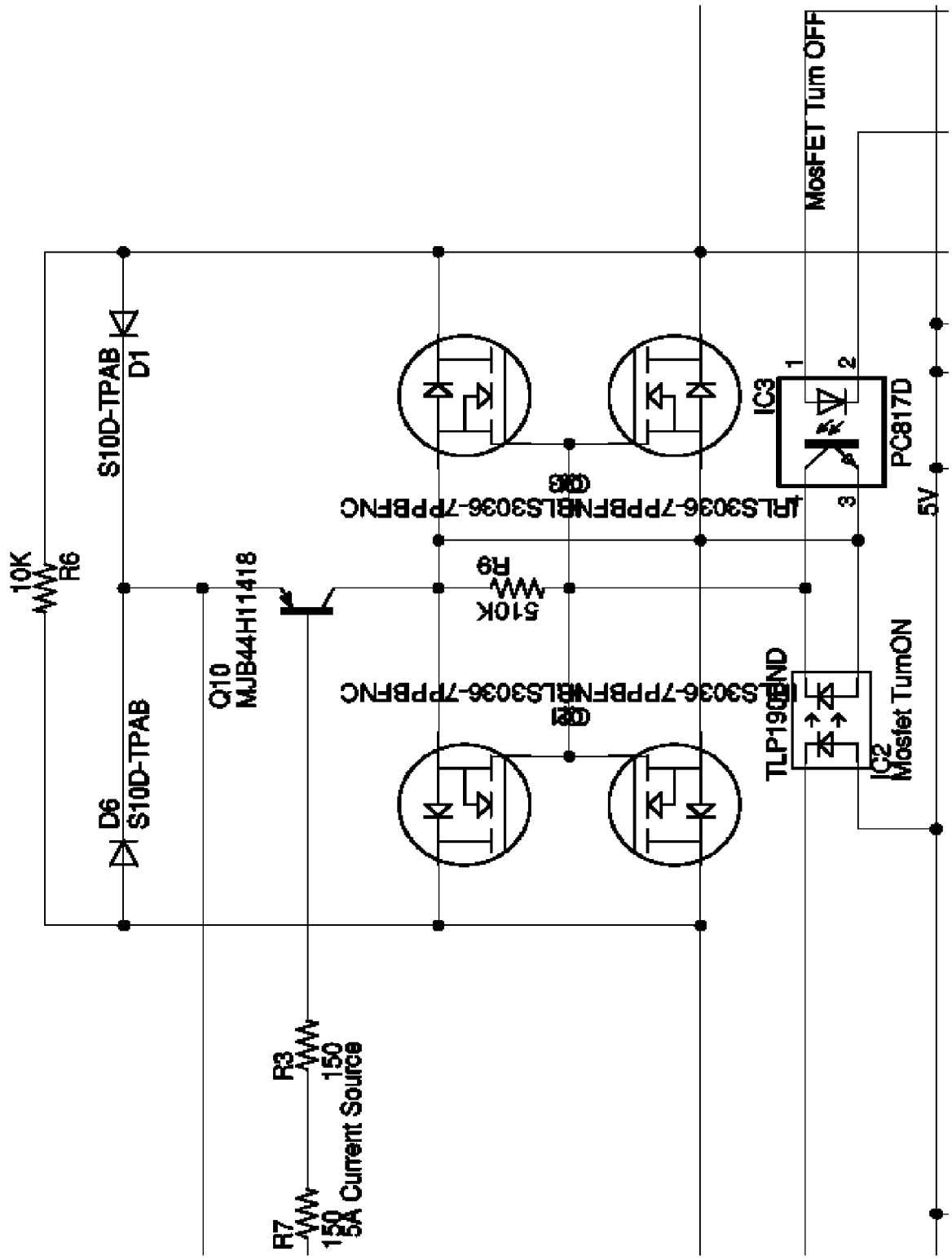

MosFET Turn OFF
S10D-TPAB
D1
IC3
PC817D
5V
10K
R6
R9
510K
Q10
MJB44H11418
D6
S10D-TPAB
TLP190B
IC2
Mosfet TurnON
R3
150
5A Current Source
R7
150

FIG. 12

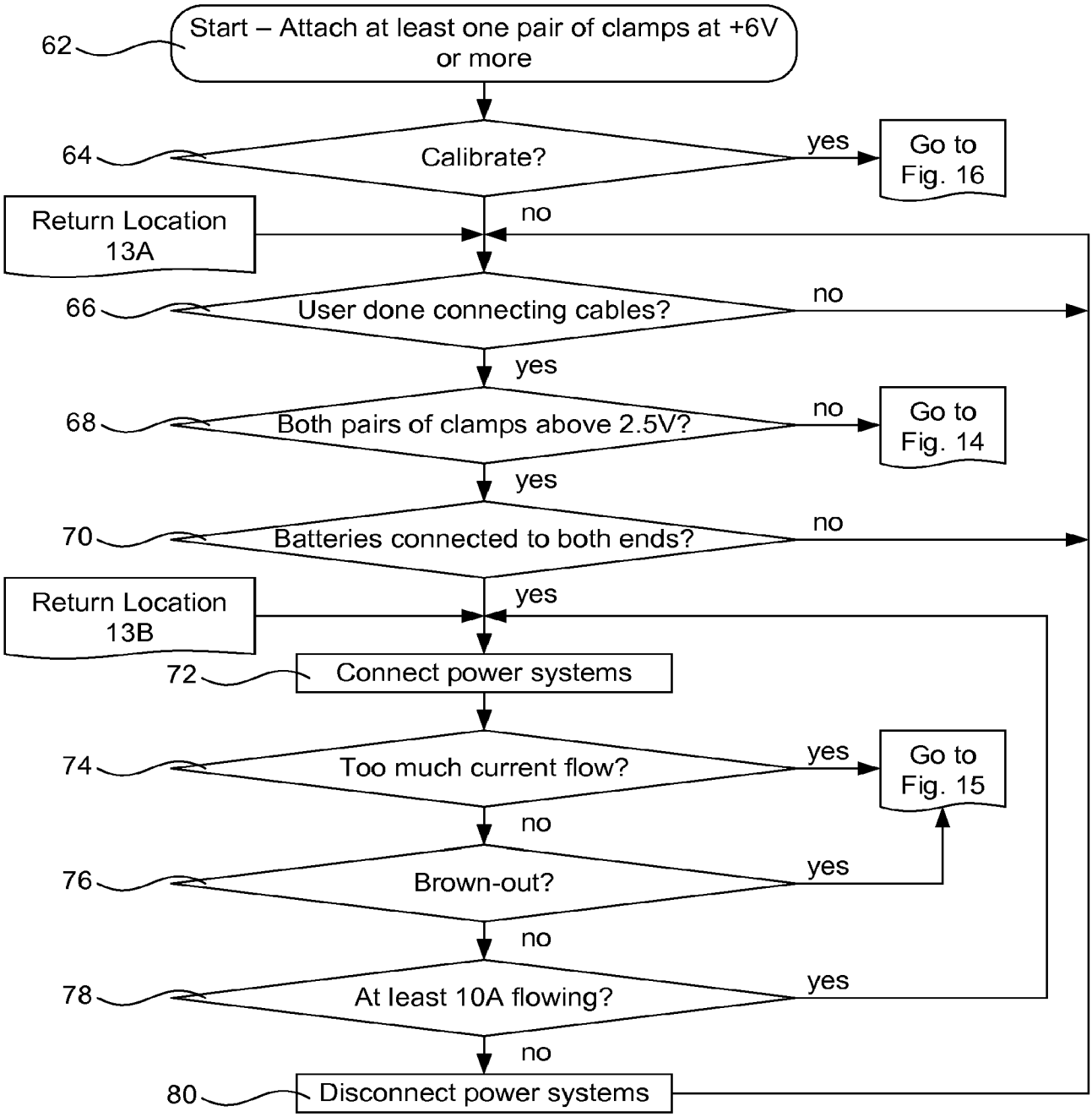

62
Start – Attach at least one pair of clamps at +6V or more
64
Calibrate?
yes
Go to Fig. 16
Return Location 13A
no
66
User done connecting cables?
no
yes
68
Both pairs of clamps above 2.5V?
no
Go to Fig. 14
yes
70
Batteries connected to both ends?
no
Return Location 13B
yes
72
Connect power systems
74
Too much current flow?
yes
Go to Fig. 15
no
76
Brown-out?
yes
no
78
At least 10A flowing?
yes
no
80
Disconnect power systems

FIG. 13

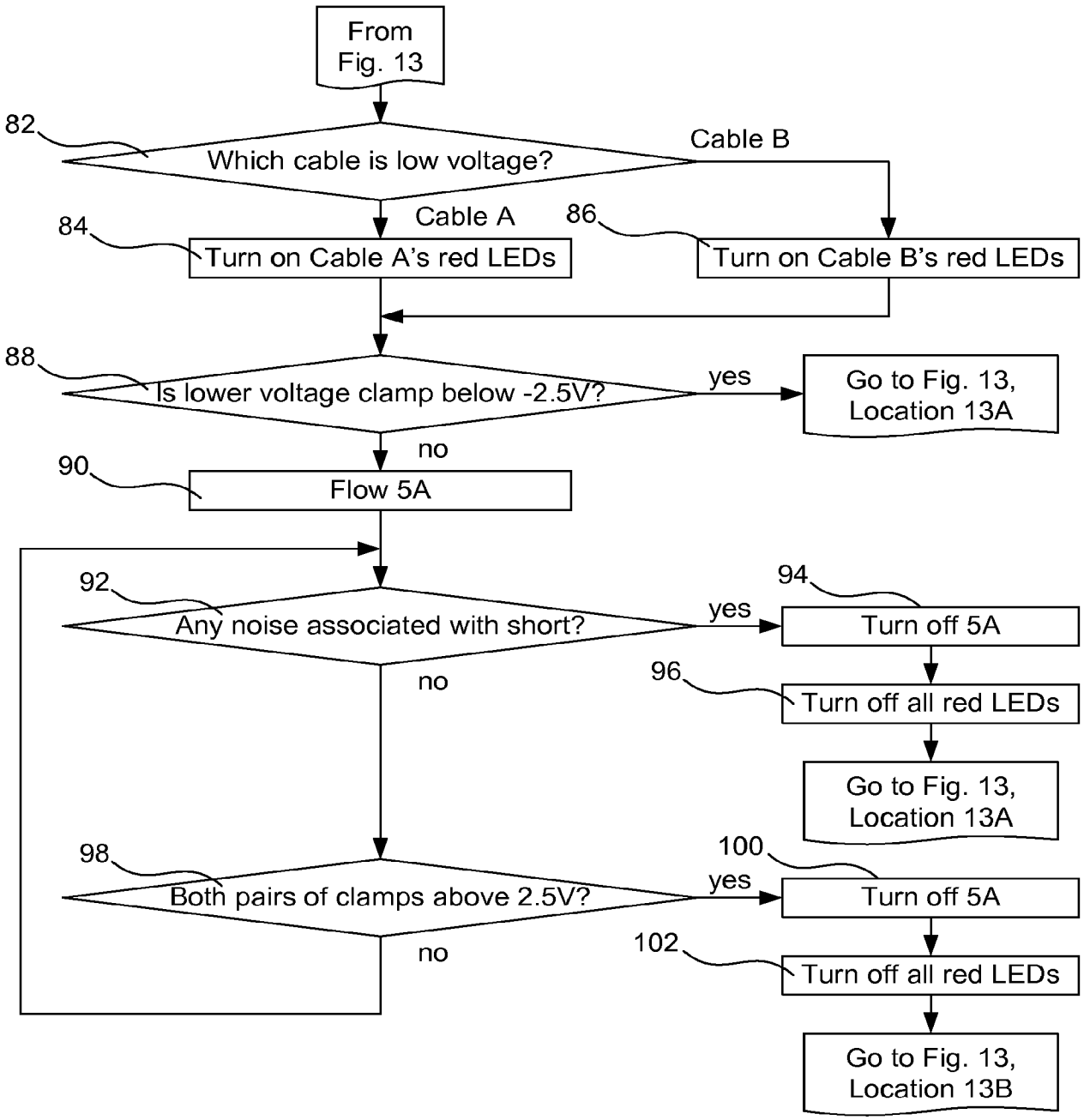

From Fig. 13
82
Which cable is low voltage?
Cable B
Cable A
84
Turn on Cable A's red LEDs
86
Turn on Cable B's red LEDs
88
Is lower voltage clamp below -2.5V?
yes
Go to Fig. 13, Location 13A
no
90
Flow 5A
92
Any noise associated with short?
yes
94
Turn off 5A
no
96
Turn off all red LEDs
Go to Fig. 13, Location 13A
98
Both pairs of clamps above 2.5V?
yes
100
Turn off 5A
no
102
Turn off all red LEDs
Go to Fig. 13, Location 13B

FIG. 14

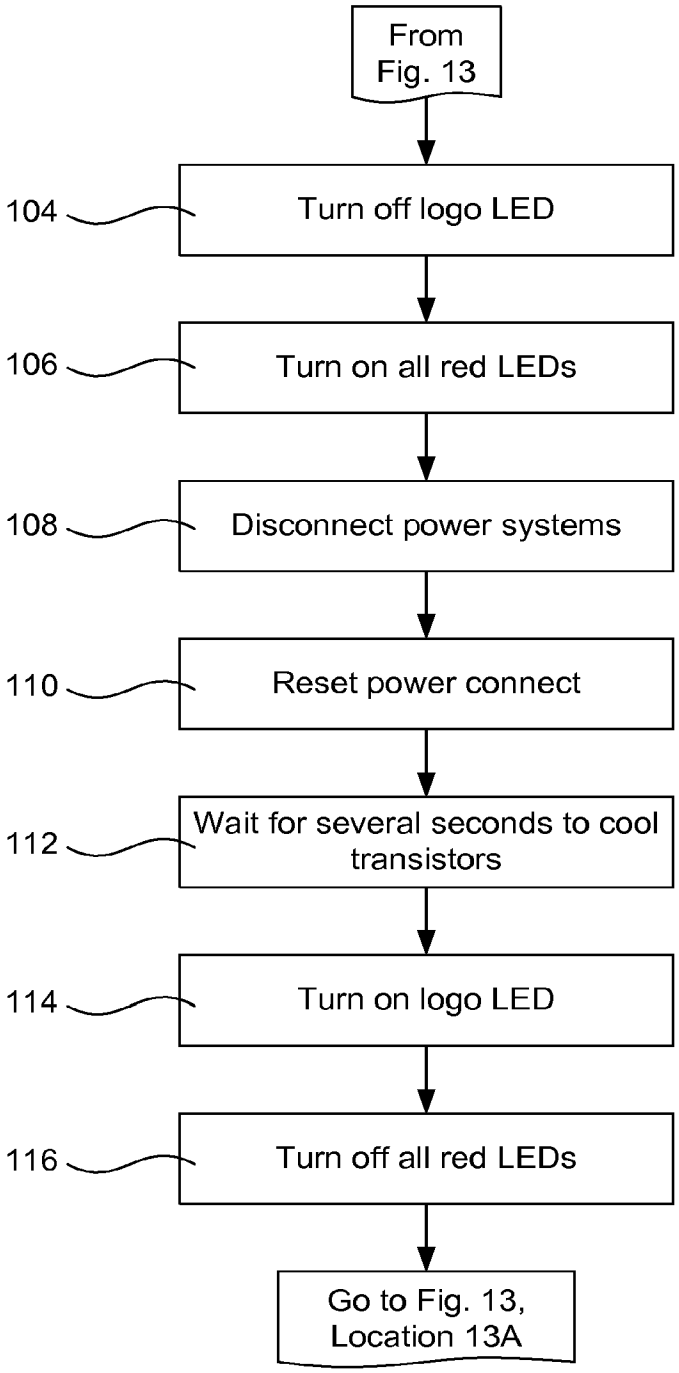

From Fig. 13
104
Turn off logo LED
106
Turn on all red LEDs
108
Disconnect power systems
110
Reset power connect
112
Wait for several seconds to cool transistors
114
Turn on logo LED
116
Turn off all red LEDs
Go to Fig. 13, Location 13A

FIG. 15

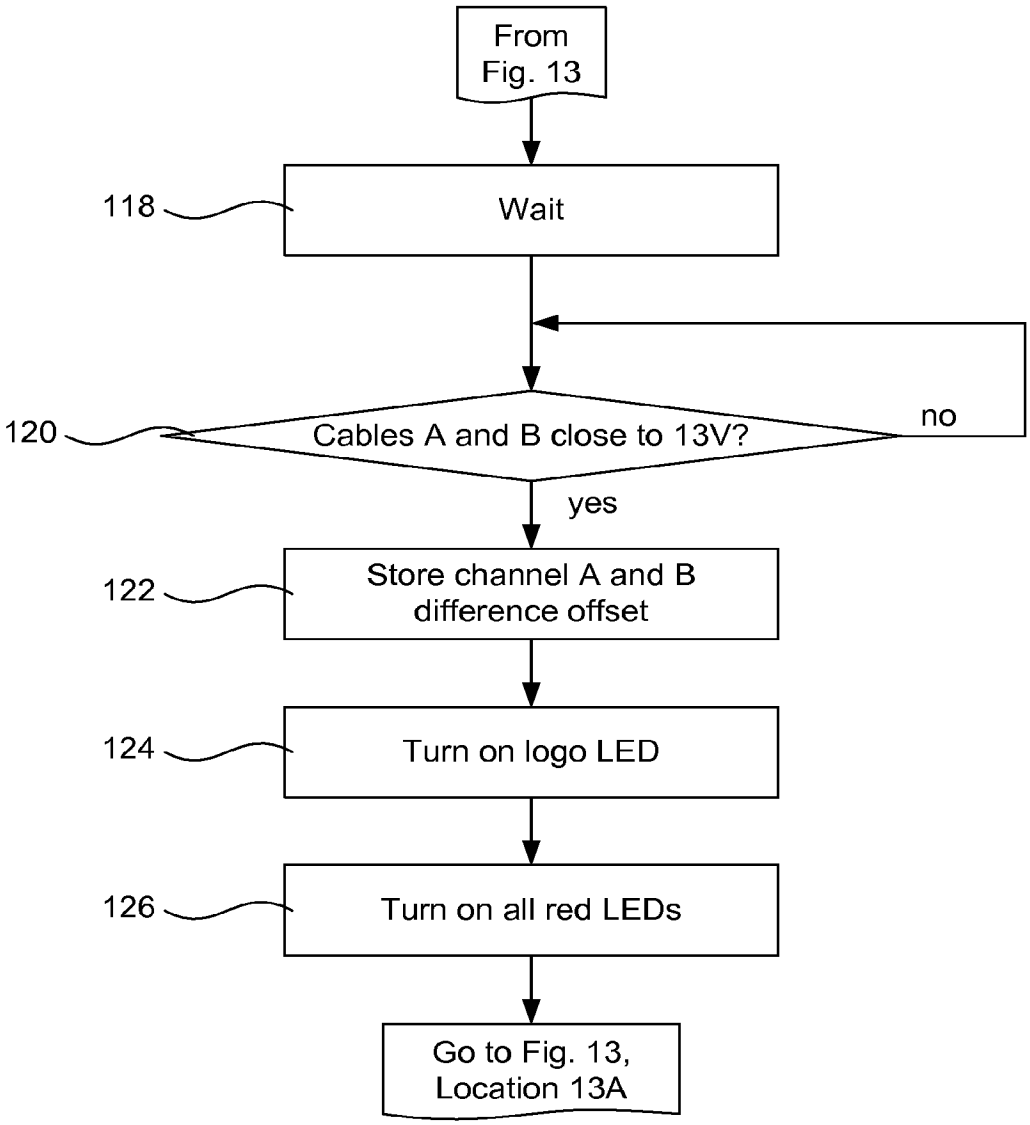

From Fig. 13
118
Wait
120
Cables A and B close to 13V?
no
yes
122
Store channel A and B difference offset
124
Turn on logo LED
126
Turn on all red LEDs
Go to Fig. 13, Location 13A

FIG. 16

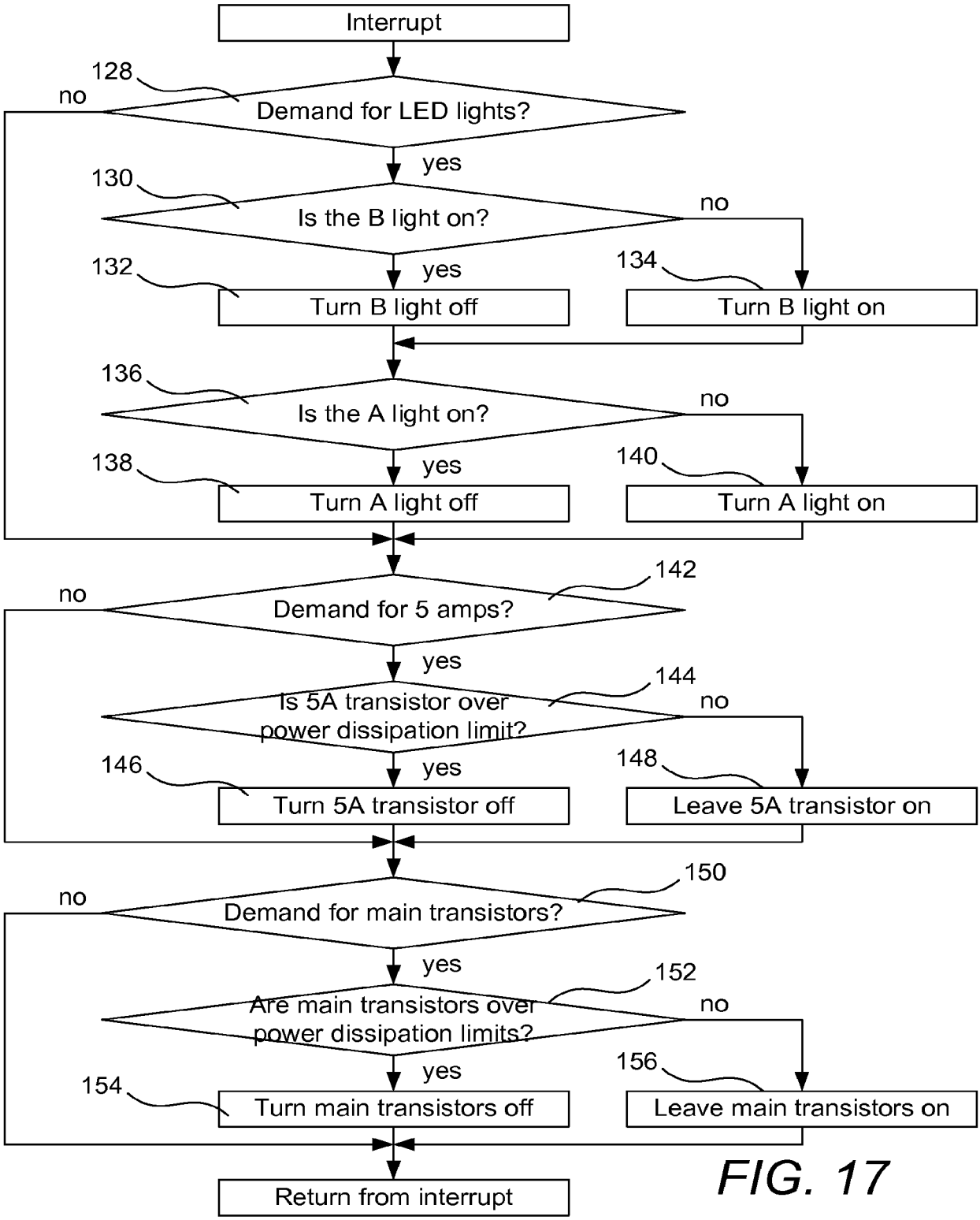

Interrupt
128
Demand for LED lights?
no
yes
130
Is the B light on?
no
yes
132
Turn B light off
134
Turn B light on
136
Is the A light on?
no
yes
138
Turn A light off
140
Turn A light on
142
Demand for 5 amps?
no
yes
144
Is 5A transistor over power dissipation limit?
no
yes
146
Turn 5A transistor off
148
Leave 5A transistor on
150
Demand for main transistors?
no
yes
152
Are main transistors over power dissipation limits?
no
yes
154
Turn main transistors off
156
Leave main transistors on
Return from interrupt

FIG. 17

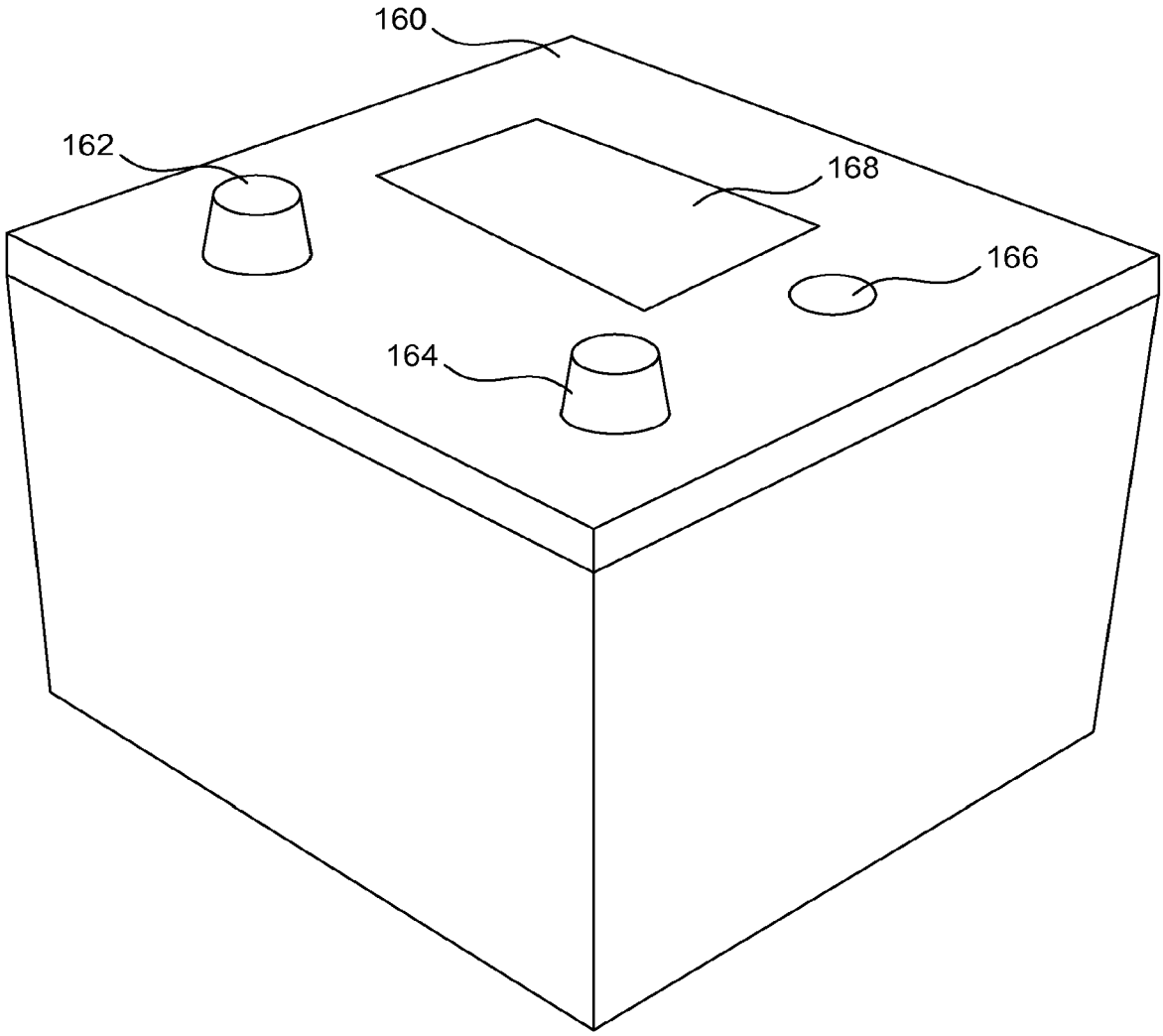


FIG. 18

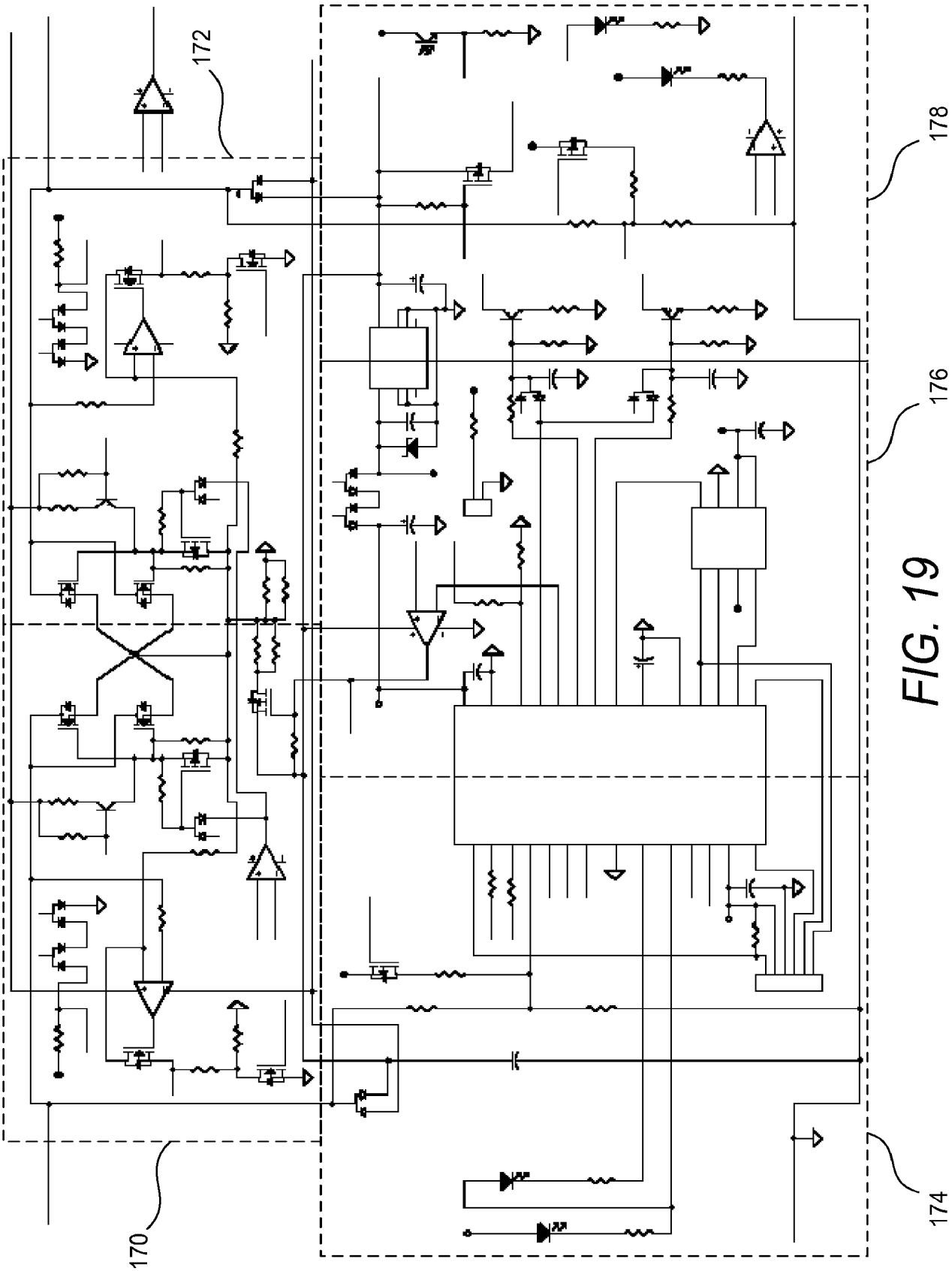


FIG. 19

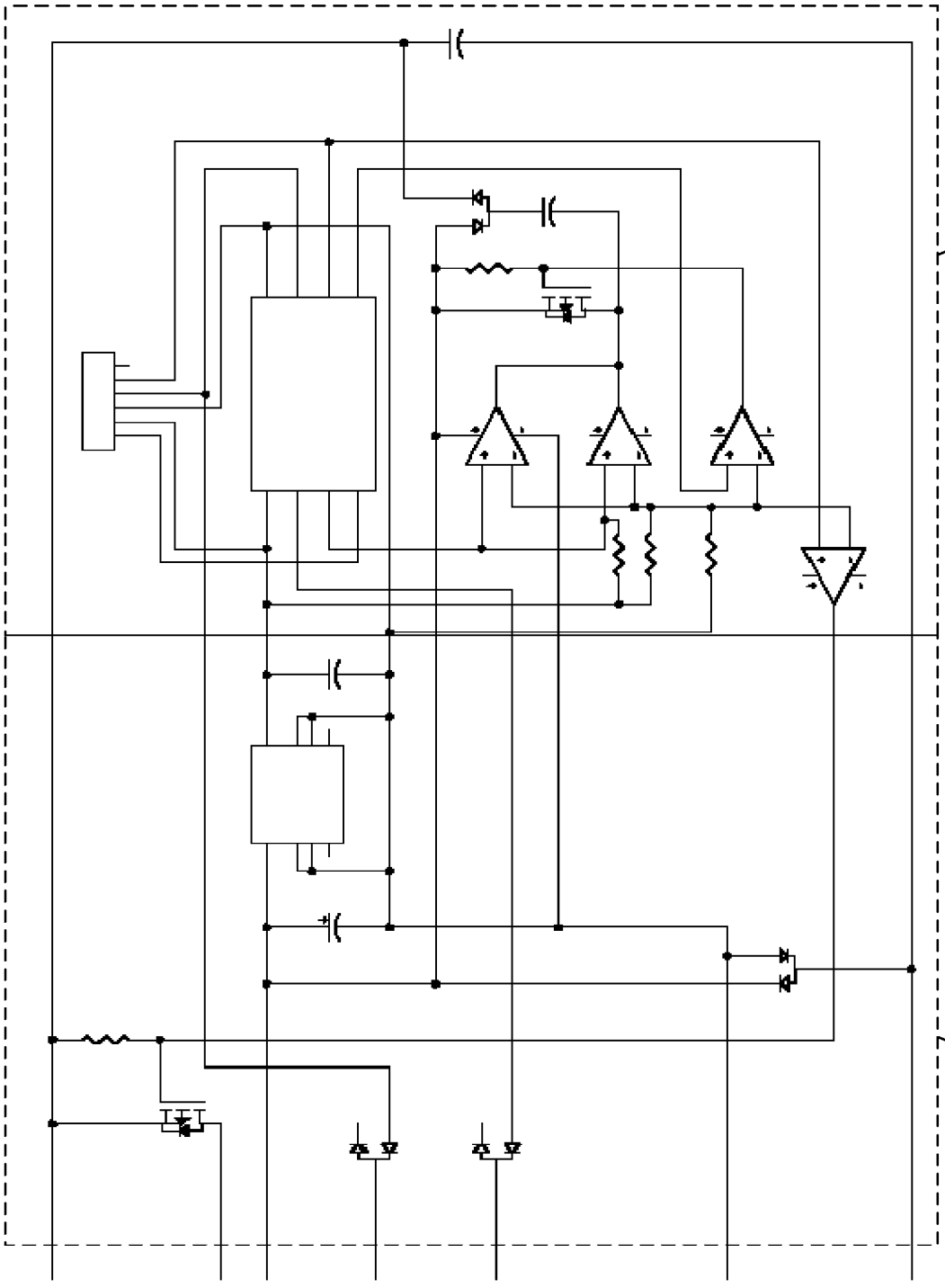


FIG. 20

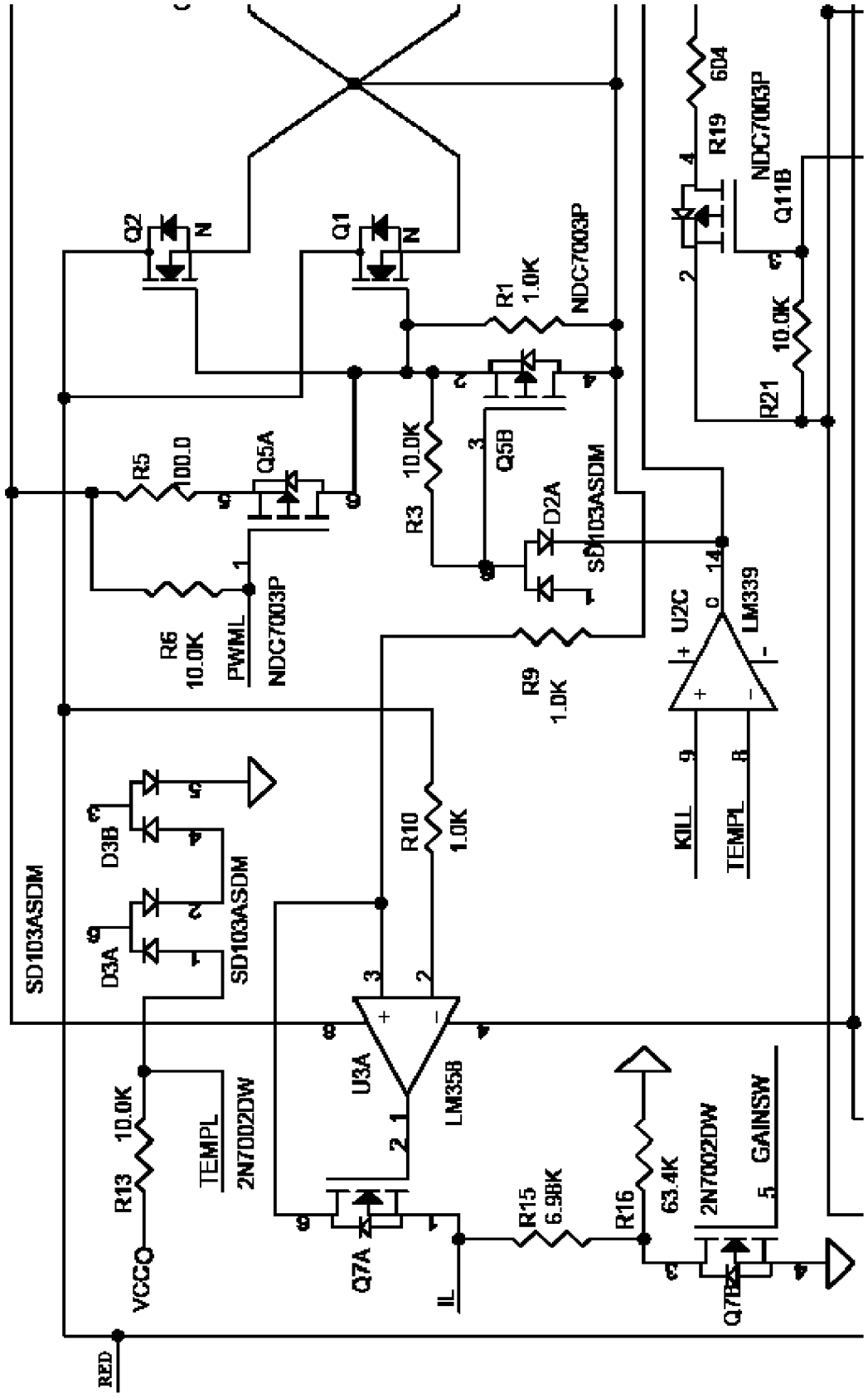

Q2
Q1
R1
1.0K
NDC7003P
R19
604
Q11B
R21
10.0K
R5
100.0
Q5A
R3
10.0K
Q5B
D2A
SD103ASDM
R6
10.0K
PWML
R9
1.0K
U2C
LM339
KILL
TEMPL
D3B
D3A
SD103ASDM
R10
1.0K
U3A
LM358
R13
10.0K
TEMPL
2N7002DW
VCCO
Q7A
IL
R15
6.9BK
R16
63.4K
2N7002DW
GAINSW
Q7B
RED

FIG. 21

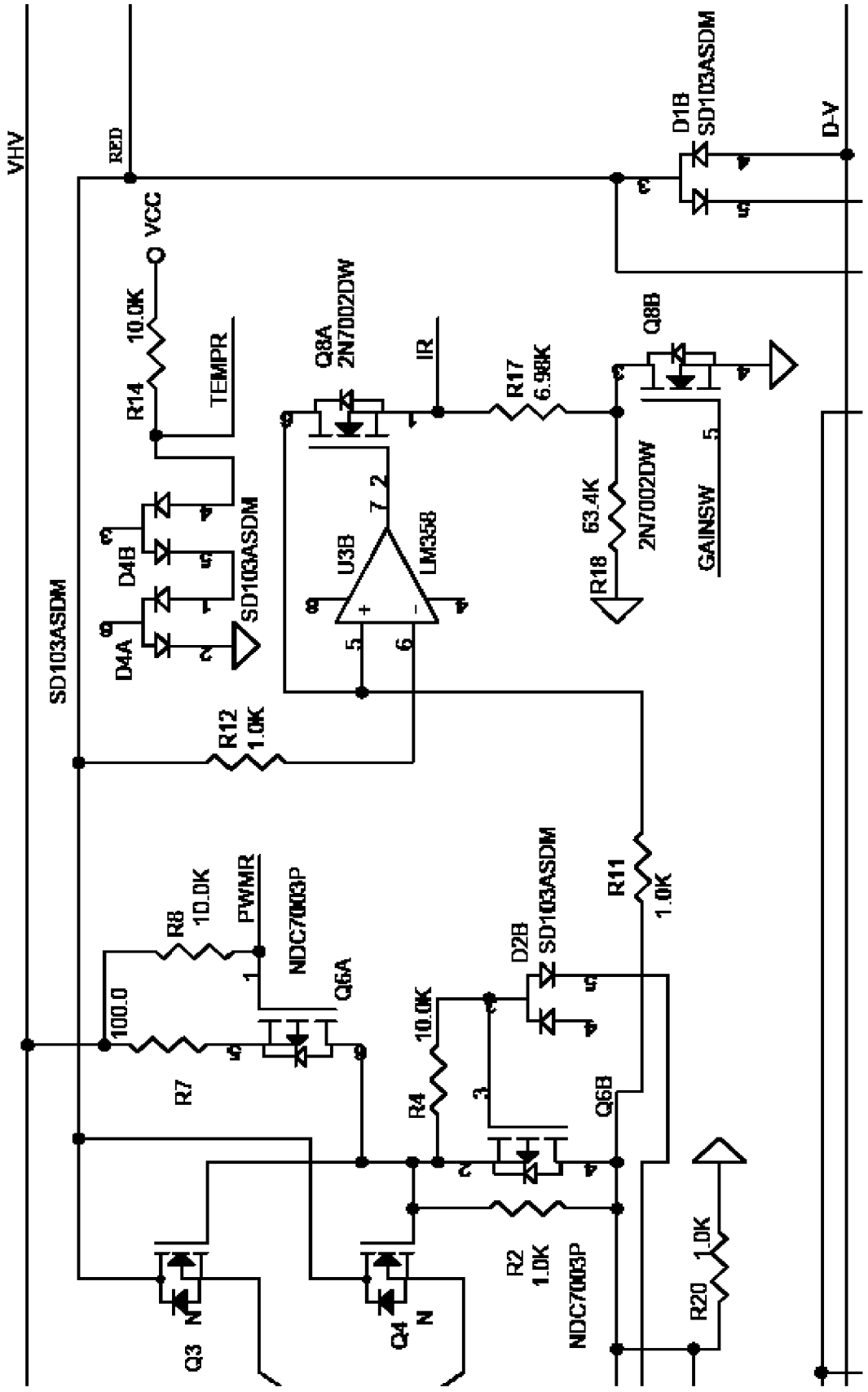

VHV
RED
VCC
D1B
SD103ASDM
D-V
R14
10.0K
TEMPR
Q8A
2N7002DW
IR
R17
6.98K
Q8B
D4B
D4A
SD103ASDM
U3B
LM358
R18
63.4K
2N7002DW
GAINSW
R12
1.0K
R8
10.0K
PWMR
NDC7003P
Q6A
100.0
R7
R4
10.0K
D2B
SD103ASDM
R11
1.0K
Q6B
Q3
N
Q4
N
R2
1.0K
NDC7003P
R20
1.0K

FIG. 22

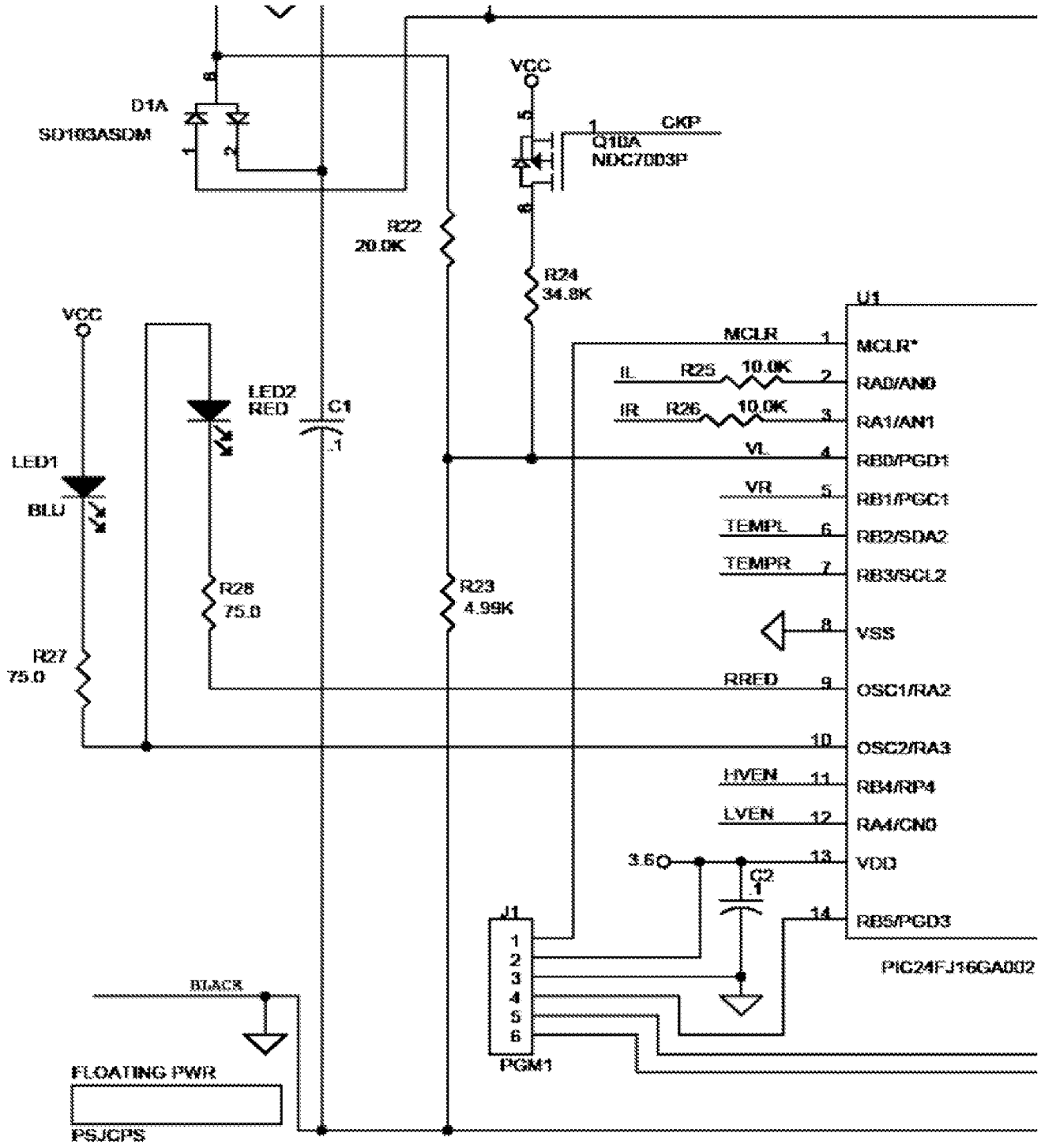

D1A
SD103ASDM
VCC
Q1BA
NDC7003P
CKP
R22
20.0K
R24
34.8K
U1
MCLR
MCLR*
IL
R25
10.0K
RA0/AN0
IR
R26
10.0K
RA1/AN1
VL
RB0/PGD1
VR
RB1/PGC1
TEMPL
RB2/SDA2
TEMPR
RB3/SCL2
VSS
RRED
OSC1/RA2
OSC2/RA3
HVEN
RB4/RP4
LVEN
RA4/CN0
3.6
VDD
C2
RB5/PGD3
PIC24FJ16GA002
LED2
RED
C1
.1
LED1
BLU
R28
75.0
R23
4.99K
R27
75.0
J1
PGM1
BLACK
FLOATING PWR
PSJCPS

FIG. 23

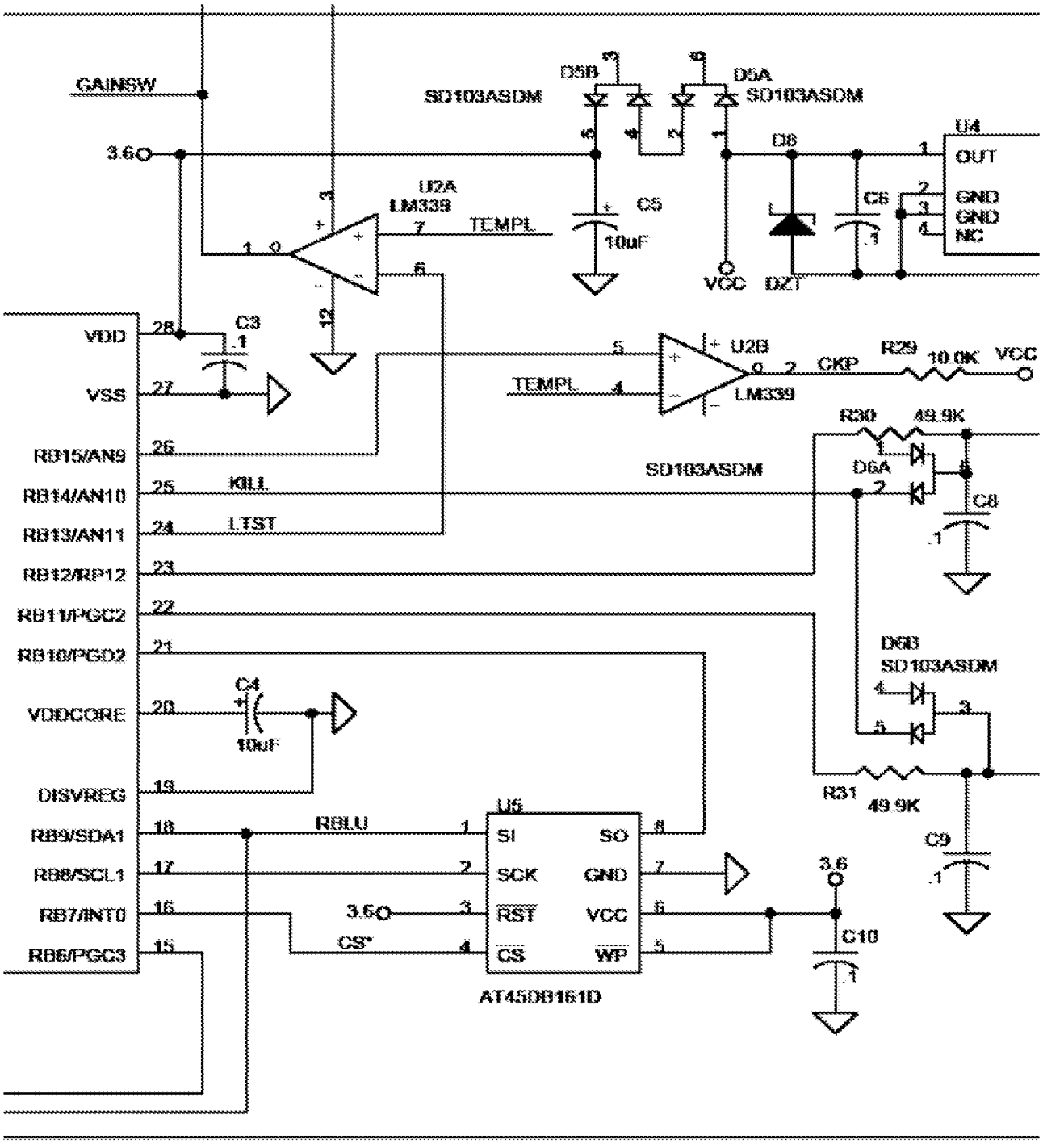

GAINSW
3.6
D5B
SD103ASDM
D5A
SD103ASDM
U4
OUT
GND
GND
NC
D8
C6
.1
U2A
LM339
TEMPL
C5
10uF
VCC
DZT
VDD
C3
.1
VSS
U2B
LM339
CKP
R29
10.0K
VCC
TEMPL
R30
49.9K
SD103ASDM
D6A
C8
.1
RB15/AN9
RB14/AN10
KILL
RB13/AN11
LTST
RB12/RP12
RB11/PGC2
RB10/PGD2
D6B
SD103ASDM
VDDCORE
C4
10uF
DISVREG
R31
49.9K
C9
.1
RB9/SDA1
RBLU
RB8/SCL1
RB7/INT0
3.6
RB6/PGC3
CS*
U5
SI
SCK
RST
CS
SO
GND
VCC
WP
AT45DB161D
3.6
C10
.1

FIG. 24

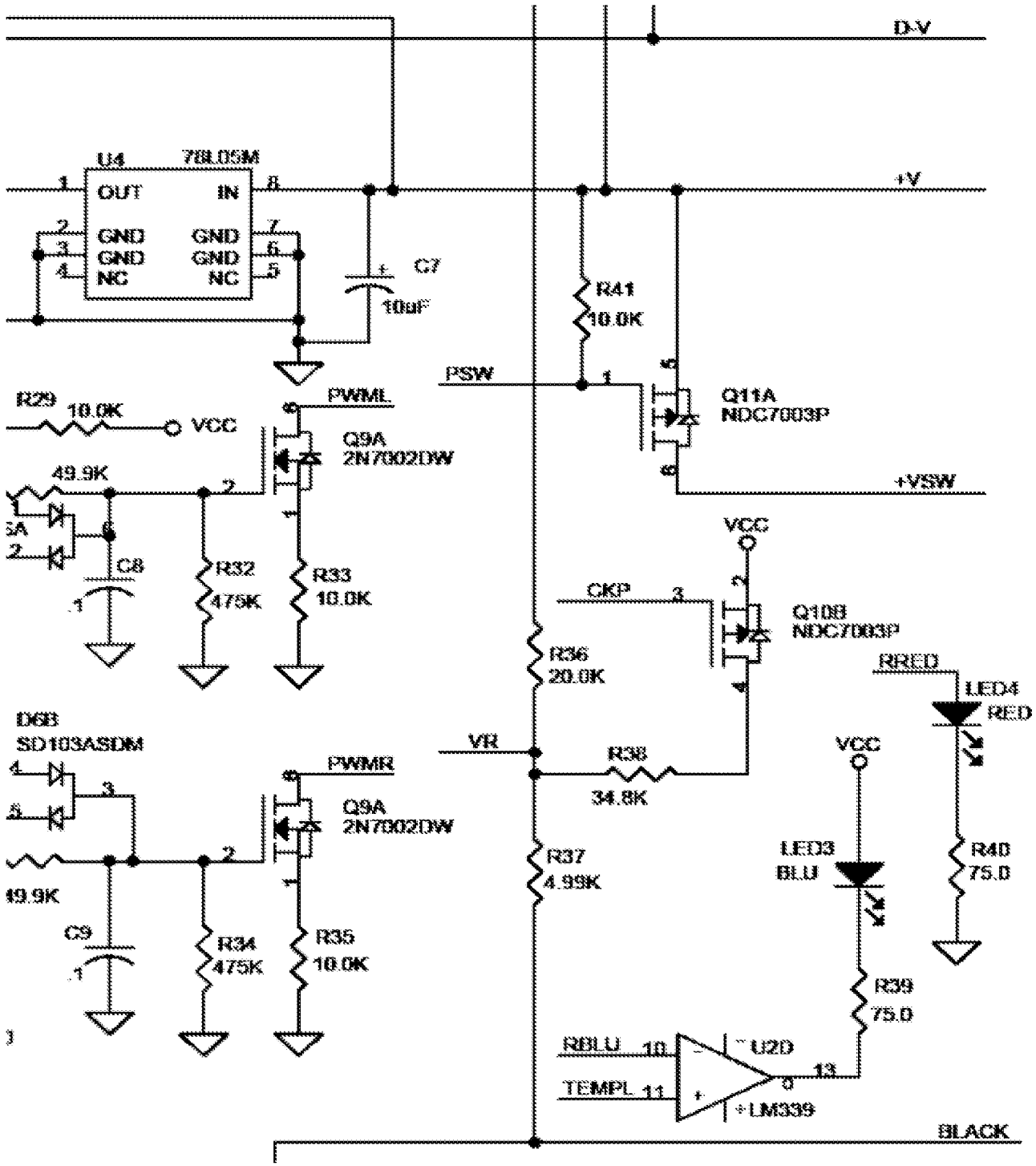

D-V
+V
U4
78L05M
OUT
IN
GND
GND
NC
C7
10uF
R41
10.0K
PSW
Q11A
NDC7003P
+VSW
R29
10.0K
VCC
PWML
Q9A
2N7002DW
49.9K
C8
R32
475K
R33
10.0K
CKP
Q10B
NDC7003P
R36
20.0K
VCC
RRED
LED4
RED
D6B
SD103ASDM
VR
R38
34.8K
PWMR
Q9A
2N7002DW
R37
4.99K
LED3
BLU
R40
75.0
C9
R34
475K
R35
10.0K
R39
75.0
RBLU
TEMPL
U2D
LM339
BLACK

FIG. 25

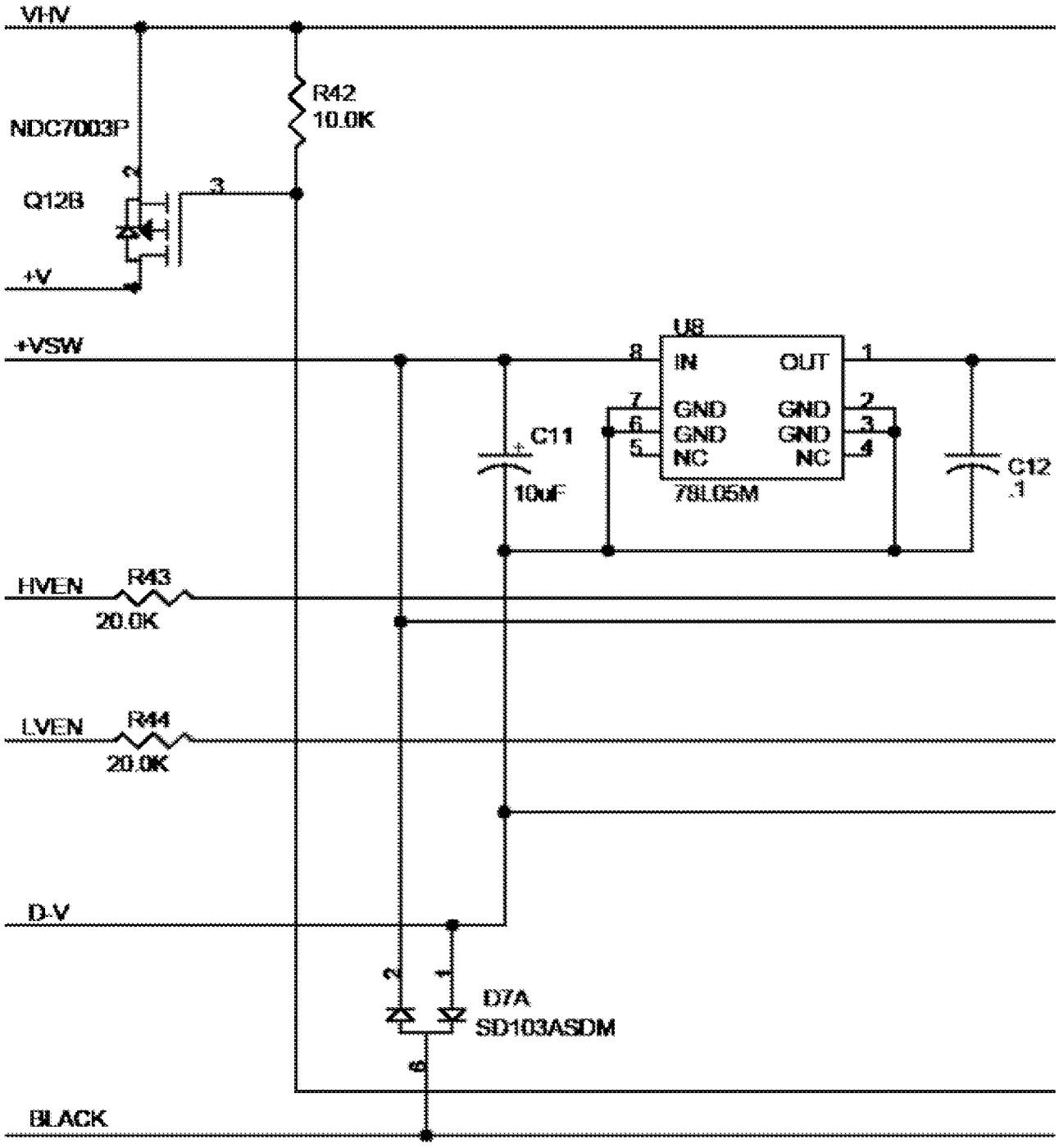

VHV
R42
10.0K
NDC7003P
Q12B
+V
+VSW
U8
IN
OUT
GND
GND
GND
GND
NC
NC
78L05M
C11
10uF
C12
.1
HVEN
R43
20.0K
LVEN
R44
20.0K
D-V
D7A
SD103ASDM
BLACK

FIG. 26

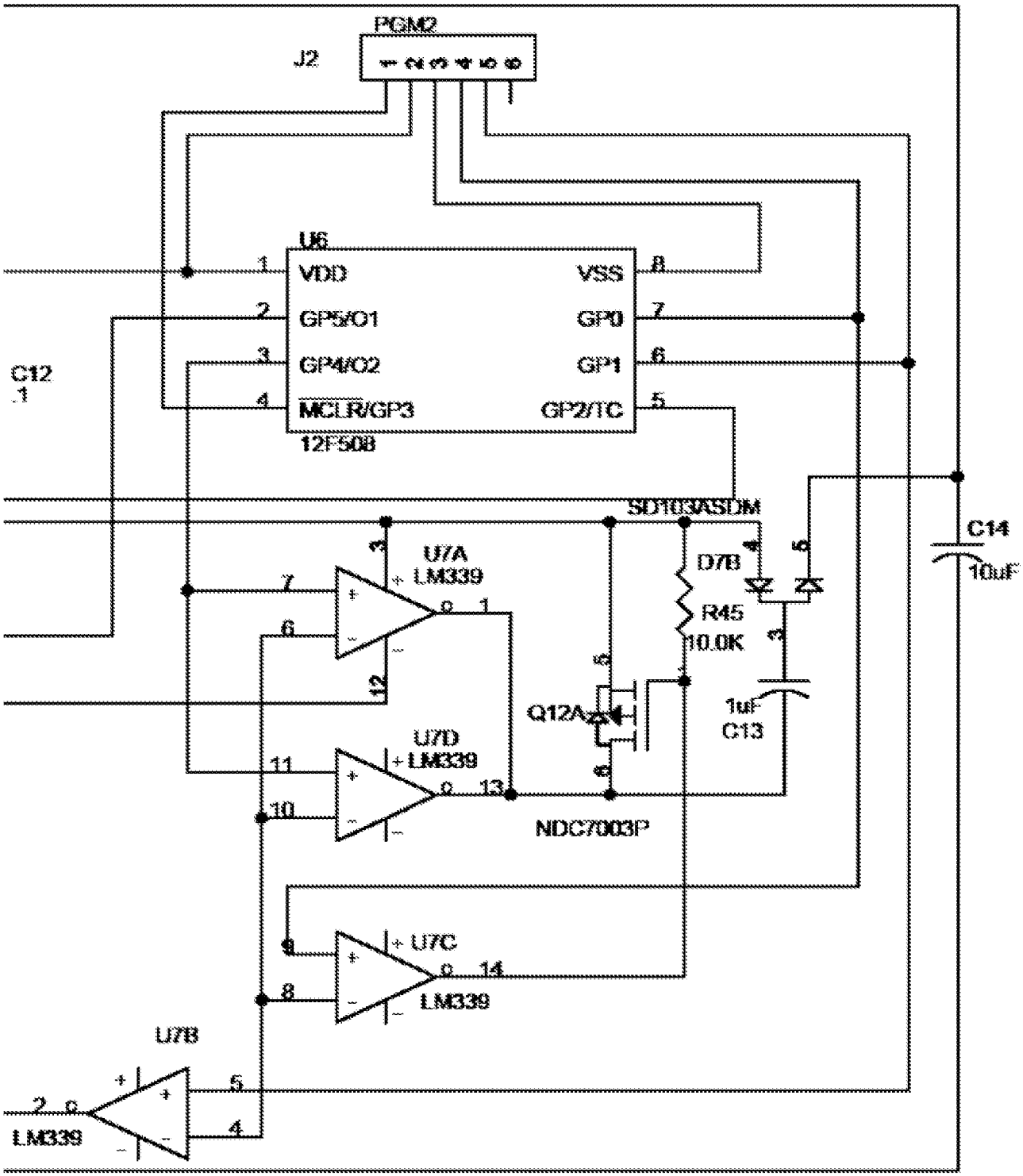

PGM2
J2
U6
VDD
VSS
GP5/O1
GP0
GP4/O2
GP1
MCLR/GP3
GP2/TC
12F508
C12
.1
SD103ASDM
C14
10uF
U7A
LM339
D7B
R45
10.0K
1uF
C13
Q12A
U7D
LM339
NDC7003P
U7C
LM339
U7B
LM339

FIG. 27

Espacenet

Bibliographic data: WO2013137873 (A1) — 2013-09-19

PORTABLE POWER SUPPLY

Inventor(s): DAO YUAN [US] ± (DAO, YUAN)

Applicant(s): ELITE POWER SOLUTIONS LLC [US]; DAO YUAN [US] ± (ELITE POWER SOLUTIONS, LLC, ; DAO, YUAN)

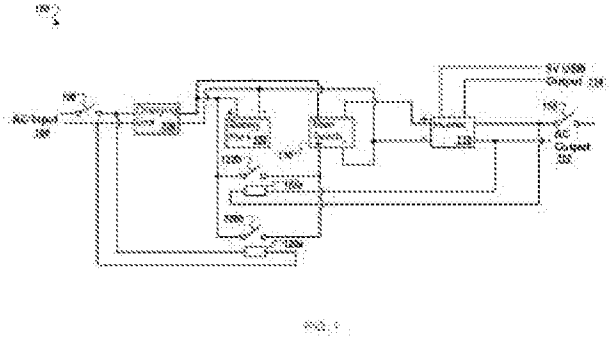
Classification: **- international:** ***H02J7/00; H02J9/06***
- cooperative: **H01M10/0525 (EP); H01M10/48 (EP); H02J7/0031 (EP); H02J7/0036 (EP); H02J9/062 (EP);** H01M10/4207 (EP); H01M10/441 (EP); H01M10/482 (EP); H01M2/1066 (EP); H01M2010/4271 (EP); H02J2207/20 (EP); Y02E60/122 (EP)

Application number: WO2012US29058 20120314 Global Dossier

Priority number(s): WO2012US29058 20120314

Abstract of WO2013137873 (A1)

In one aspect, the present disclosure describes an apparatus that may include a battery unit including one or more lithium-ion battery cells, and a charging unit configured with a first automatic shut-off, where the automatic shut-off is responsive to detection of an upper threshold voltage level of the battery unit. The apparatus may include an inverter configured with a second automatic shut-off, where the second automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit, and an input connection functionally connected to the charging unit. The apparatus may be configured to isolate the battery unit from the inverter responsive to detecting both (a) the input connection is disconnected from an input voltage source, and (b) the inverter is shut off.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 September 2013 (19.09.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/137873 A1

(51) International Patent Classification:
H02J 7/00 (2006.01) *H02J 9/06* (2006.01)

(21) International Application Number:
PCT/US2012/029058

(22) International Filing Date:
14 March 2012 (14.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **ELITE POWER SOLUTIONS, LLC** [US/US]; 2259 W Shangri-La Road, Phoenix, AZ 85029 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **DAO, Yuan** [US/US]; 6605 W. Brookhart Way, Phoenix, AZ 85083 (US).

(74) Agents: **GRACE, Natalie, J.** et al.; Choate, Hall & Stewart LLP, Two International Place, Boston, MA 02110 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: PORTABLE POWER SUPPLY

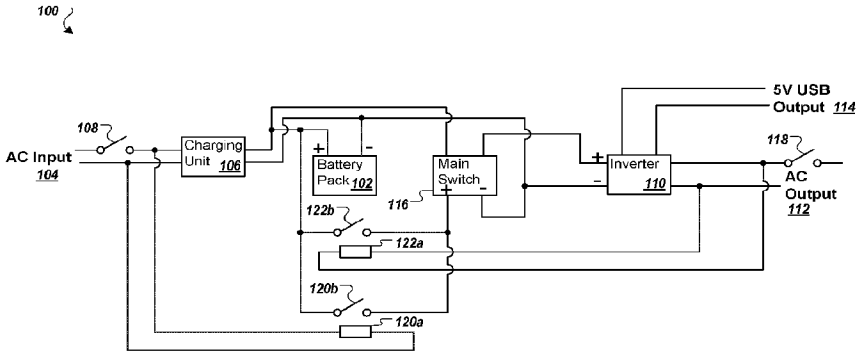


FIG. 1

(57) Abstract: In one aspect, the present disclosure describes an apparatus that may include a battery unit including one or more lithium-ion battery cells, and a charging unit configured with a first automatic shut-off, where the automatic shut-off is responsive to detection of an upper threshold voltage level of the battery unit. The apparatus may include an inverter configured with a second automatic shut-off, where the second automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit, and an input connection functionally connected to the charging unit. The apparatus may be configured to isolate the battery unit from the inverter responsive to detecting both (a) the input connection is disconnected from an input voltage source, and (b) the inverter is shut off.

WO 2013/137873 A1

PORTABLE POWER SUPPLY

Background

A back up power supply may be used to provide power when a wired electricity supply is unavailable. For example, during power outages or while away from a building (e.g., while camping or hunting, when providing an outdoor presentation, etc.), a back up power supply may be used to power one or more devices or pieces of equipment. In another example, a portable power supply may be used to jump start a vehicle. The source of power for the back up power supply, in some examples, may include propane, gas, and/or battery.

Summary

In one aspect, the present disclosure describes an apparatus that may include a battery unit including one or more lithium-ion battery cells, and a charging unit configured with a first automatic shut-off, where the automatic shut-off is responsive to detection of an upper threshold voltage level of the battery unit. The apparatus may include an inverter configured with a second automatic shut-off, where the second automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit, and an input connection functionally connected to the charging unit. The apparatus may be configured to isolate the battery unit from the inverter responsive to detecting both (a) the input connection is disconnected from an input voltage source, and (b) the inverter is shut off.

The apparatus may include a first switching unit connected between the battery unit and a main switching unit. Detecting the inverter is shut off may include failing to detect a threshold output voltage of the inverter at an output connection. The first switching unit may be configured to move to a closed position responsive to detecting the threshold output voltage. The threshold output voltage may be substantially equivalent to 110 Volts.

The apparatus may include a second switching unit connected between the battery unit and the main switching unit. Detecting the input connection is disconnected from an input voltage source may include failing to detect a threshold input voltage at the input connection. The second switching unit may be configured to move to a second closed position upon detecting the threshold input voltage at the input connection. The threshold input voltage is substantially equivalent to 110 Volts.

The apparatus may include a three-way switch including a charging position, a discharging position, and an off position. The apparatus may be configured to isolate the battery unit from the inverter when the three-way switch is in the off position.

WINPLUS Ex. 1003, p. 1421

The apparatus may include two or more light emitting diodes presented in series. A relative number of activated light emitting diodes of the two or more light emitting diodes may correlate to an approximate percentage of charge of the battery unit.

A capacity of the battery unit may be at least 400 Watt hours. The battery unit may include at least four lithium-ion battery cells. The battery unit may include a potential of approximately twelve Volts.

The input connection may include an A/C plug interface for providing a wired connection to a household electrical output socket. The apparatus may include at least one A/C output socket connection functionally connected to the inverter. The apparatus may include at least one USB output connection functionally connected to the inverter.

The apparatus may include a balancing system connected to the battery unit, where the balancing system includes a discharging circuit configured to, responsive to detecting a battery cell voltage of a predetermined voltage threshold, draw a constant discharging current from at least a first battery cell of the one or more lithium-ion battery cells. The balancing system may draw the constant discharging current until detecting the battery cell voltage is below the predetermined voltage threshold.

In one aspect, the present disclosure describes a system including a rechargeable battery unit including one or more lithium-ion battery cells, a charging unit, an inverter functionally connected to an output connection, and an input connection functionally connected to the charging unit. The input connection may be configured for connection to a recharging power source. The system may include a main switching unit and a first switching unit connected between the battery unit and the main switching unit. The first switching unit may be configured to activate the main switching unit responsive to detecting a threshold output voltage of the inverter at an output connection. The system may include second switching unit connected between the battery unit and the main switching unit. The second switching unit may be configured to activate the main switching unit responsive to detecting a threshold input voltage at the input connection. The first switching unit and the second switching unit may be configured to prevent over-discharging the rechargeable battery unit by isolating the battery unit from a parasitic load of the inverter.

The output connection may be configured for connection to at least one of a universal serial bus port and an A/C socket outlet. At least one of the first switching unit and the second switching unit may include a solenoid. The charging unit may be configured with an automatic shut-off, where the automatic shut-off is responsive to detection of an upper

threshold voltage level of the battery unit. The inverter may be configured with an automatic shut-off, where the automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit.

Brief Description of the Figures

The foregoing and other objects, aspects, features, and advantages of the present disclosure will become more apparent and better understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic diagram of an example battery unit configuration for a portable power supply;

FIGS. 2A and 2B provide views of an example portable power supply.

The features and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings, in which like reference characters identify corresponding elements throughout. In the drawings, like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements.

Detailed Description

In some implementations, a portable power supply may include a lithium-ion battery pack, and an alternating current (A/C) input for charging the lithium-ion battery pack, for example by connecting the A/C input to a household wall socket. The portable power supply may further include an A/C output in communication with an A/C socket connector. In some implementations, a device such as a small household appliance, electronic device, or power tool may be plugged into the A/C socket connector to supply power to the device. In some examples, the device may include a television, laptop computing device, electric cook top, miniature refrigerator, blender, electric light, or stereo system. In some implementations, the portable power supply may include two or more A/C socket connectors, for example to temporarily supply power to a number of items such as both a household computer and a computer monitor. In other examples, the portable power supply may be used to provide power to both a television and a blender during a tailgate party, or to a sound system and display unit for an information booth at an outdoor fair or festival.

In some implementations, the portable power supply may further include one or more universal serial bus (USB) output connectors. For example, one or more USB ports may be

available to attach a USB cord between the portable power supply and a USB-powered device such as a smart phone, personal digital assistant (PDA), tablet computer, or portable digital media player.

In some implementations, the portable power supply may further include a direct current output port. For example, the portable power supply may be configured for use as a jump starter to jump start a car battery using a 12 Volt D/C output.

In some implementations, the portable power supply may be configured to provide power to one or more devices, such as a television, for more than ten hours. In some implementations, the portable power supply may include a forty, sixty, or one hundred amp output. In some implementations, the portable power supply may be capable of providing approximately five hundred Watts per hour. The portable power supply, in some implementations, may weigh approximately twenty to seventy pounds. For example, based upon 100 Amp-hour lithium-ion battery cells arranged in a 12 Volt D/C configuration, the portable power supply may weigh approximately twenty-five to forty pounds.

In some implementations, the portable power supply may be designed to protect the lithium-ion battery pack from damage due to overcharging and/or over-discharging. For example, a battery charging unit may be designed to shut off automatically when a voltage of the lithium-ion battery pack reaches an approximate upper threshold level. In another example, an inverter unit may be designed to shut off automatically when a voltage of the lithium-ion battery pack reaches an approximate lower threshold level. In some implementations, the portable power supply may include circuitry for isolating the lithium-ion battery pack from an inverter unit while the portable power supply is not in use to remove a potential parasitic load due to the inverter.

FIG. 1 illustrates a schematic diagram 100 of an example battery unit configuration for a portable power supply. The portable power supply, in some implementations, may include a lithium-ion battery pack 102 connected to a charging unit 106. In some implementations, the lithium-ion battery pack 102 may include a 12 Volt direct current (D/C) lithium-ion battery. In other implementations, the lithium-ion battery pack 102 may include a number of smaller battery units connected together to equal a 12 V D/C battery. For example, the lithium-ion battery pack 102 may contain four 3.3 V lithium-ion battery cells in serial connection.

The charging unit 106, in some implementations, may accept an A/C voltage input 104, such as an 110V or 220V input provided through a connection to a wall socket. A switch 108, in some implementations, may be activated (e.g., caused to move to a closed position) to

connect the A/C voltage input 104 to the charging unit 106. In some implementations, the charging unit 106 may output a 12V D/C power supply for charging the lithium-ion battery pack 102. The charging unit 106, in some implementations, may be programmed for automatic shut-off upon detecting that the voltage of the lithium-ion battery pack 102 has reached a threshold voltage. For example, the charging unit 106 may shut off upon determining that the voltage of the lithium-ion battery pack 102 has reached approximately 14.4 Volts D/C.

To provide power to one or more devices, in some implementations, the portable power supply may include an inverter 110 connected to one or more output power supplies, such as an A/C output 112 and a 5V D/C output 114. The A/C output 112, in some implementations, may be connected to one or more input plugs such as two- or three-pronged power sockets, for providing an 110V or 220V A/C power supply to one or more devices. In some implementations, an output switch 118 may be activated (e.g., closed) to connect the output of the inverter 110 to the A/C output 112 (e.g., one or more outlets, plug connections, or cords configured to supply A/C power to one or more devices). The output switch 118, in some implementations, may be triggered manually, for example using a switch button (e.g., two way "on/off" or three-way switch) on the exterior of the power supply. In some implementations, the output switch 118 may be triggered automatically, for example upon detecting a device plugged into the portable power supply. In some implementations, the 5V D/C output 114 may be connected to one or more USB ports to supply power to one or more USB-tethered devices. In Some implementations, the 5V D/C output 114 may be connected to theinverter 110 via the output switch 118 or a separate output switch (not illustrated). Additionally, in some implementations, a 12V D/C output (not illustrated) may be provided, for example to allow the option of jump-starting a car battery using the portable power supply.

In some implementations, the inverter 110 may be designed to automatically shut off upon detecting that the charge of the lithium-ion battery pack 102 has fallen to a threshold voltage level. For example, the inverter 110 may be designed to shut off upon detecting that the lithium-ion battery pack 102 is at or below a charge level of approximately 11.2 Volts. In some implementations, shutting off the inverter 110 upon detection of a threshold voltage level may protect the lithium-ion battery pack 102 from over-discharging.

To further protect the lithium-ion battery pack 102 of the portable power supply from over-discharging, in some implementations, a main switching unit 116 may be provided between the lithium-ion battery pack 102 and the inverter 110. For example, the inverter 110

may continue to drain the lithium-ion battery pack 102 through a parasitic load, even in times of shut-off. To avoid the drain on the lithium-ion battery pack 102 due to this parasitic load, in some implementations, the main switching unit 116 may be configured to electrically isolate the lithium-ion battery pack 102 from the inverter 110. In some implementations, the main switching unit 116 may be a solid state relay (SSR). The main switching unit 116, in some implementations, may be controlled by both an input relay 120 (e.g., solenoid 120a and switch 120b) and an output relay 122 (e.g., solenoid 122a and switch 122b). The switch 120b of the input relay 120, for example, may be configured to close when the corresponding solenoid 120a receives an approximate A/C voltage input (e.g., 110V, 220V, etc.). For example, the solenoid 120a may detect the A/C voltage input 104. When the input relay 120 is in the active, or closed, position (e.g., upon receiving an input voltage to the charging unit 106), the main switching unit 116 may be activated, placing the lithium-ion battery pack 102 in electrical communication with the inverter 110. If, instead, the charging unit 106 is not being supplied with power, the inverter 110 may be placed in electrical communication with the lithium-ion battery pack 102, in some implementations, if the output switch 118 is in a closed position. For example, if the solenoid 122a of the output relay 122 detects an approximate A/C voltage output (e.g., 110 V, 220 V, etc.) at the A/C output 112, the solenoid 122a may cause the output relay switch 122b to move to the closed position. In this manner, the inverter 110 may be in electrical communication with the lithium-ion battery pack 102 only when the portable power supply is in either a charging mode or a discharging mode. If, instead, the portable power supply is in a powered down mode (e.g., offline, unplugged, or otherwise not in use), the main switching unit 116 may effectively isolate the lithium-ion battery pack 102 from the inverter 110.

In some implementations, a three-way switch on the portable power supply may be used to select the current input state (e.g., charging, discharging, or offline). Turning to FIGS. 2A and 2B, example portable power supplies 200 and 250, in some implementations, may include a three-way switch 202 to select an operational mode of the portable power supply 200, 250. In some implementations, a visual indicator may provide a user an indication of the current operational state of the portable power supply 200. For example, a series of light emitting diodes (LEDs) 204 may include one or more power indicators (e.g., a green LED indicating "on," or a red LED indicating "off"). In some implementations, the series of LEDs 204 may further include a series of LEDs configured to indicate a relative charge level of a battery unit of the portable power supply 200. For example, as illustrated in FIG. 2B, a first LED 204 may indicate on/off (e.g., lit/unlit), while the remaining five LEDs

204 may indicate an approximate percentage charge level of the battery unit (e.g., one light for twenty percent full, two lights for forty percent full, etc.).

Returning to FIG. 2A, within an exterior enclosure 206, the portable power supply 200, in some implementations, may include a series of rechargeable battery cells 208, such as lithium-ion battery cells. In a particular example, the rechargeable battery cells 208 may be 3.3 Volt rechargeable lithium-ion battery cells connected in series to achieve a 12 Volt battery unit. In some implementations, a balancing unit 220 may be provided for equalizing the charge levels of the lithium-ion battery cells. The balancing unit 220, for example, may be positioned beneath a battery unit cap 236, as illustrated in FIG. 2B. An example implementation of a balancing unit is described in relation to U.S. Patent Application Serial Number 12/939,889 entitled "Battery Unit Balancing System" and filed November 4, 2010, now published as U.S. Patent Publication Number 2011/0074355, the contents of which is herein incorporated in its entirety.

A balancing unit, in some implementations, may be connected to each rechargeable battery cell 208. For example, as illustrated in FIG. 2A, each of the four rechargeable battery cells 208a, 208b, 208c, and 208d may include a correlating balancing unit including a discharging circuit. The discharging circuit, in some implementations, may be configured for automatic activation. For example, upon detection of the voltage of one of the battery cells 208 exceeding a predetermined threshold, the discharging circuit may draw a constant discharging current from the particular battery cell 208 until the voltage of the particular battery cell 208 falls below the predetermined threshold. In some implementations, the predetermined threshold may be set to approximately 3.60 Volts.

In some implementations, the discharging circuit may include a voltage dividing circuit, a comparator circuit, and one or more current source circuits. The voltage dividing circuit may be connected to the comparator circuit that is activated to conduct when the voltage of a particular battery cell 208 exceeds the predetermined threshold. The voltage dividing circuit, in some implementations, may be configured to generate a predetermined voltage that activates the one or more current source circuits via the comparator circuit. The discharging current of the discharging circuit, in some implementations, may be configured to discharge at approximately 0.5% of the ampere-hour rate of the particular rechargeable battery cell 208. The discharging current, in some examples, may be selected from 0.22 A, 0.33 A, 0.5 A, 0.89 A or 1.11 A.

Although illustrated in FIG. 2A as a series of four rechargeable battery cells 208a, 208b, 208c, and 208d, in other implementations more or fewer rechargeable battery cells 208

may be included in the portable power supply 200. For example, the portable power supply 250, described in relation to FIG. 2B, may include three rechargeable battery cells 208a, 208b, and 208c. The number of rechargeable battery cells 208, in some implementations, may be increased or decreased to adjust an available total power supply, for example as described in Watt-hours capacity. In some examples, the battery capacity of the rechargeable battery cells 208 may be 480 Watt-hours (Wh), 720 Wh, and 1.2 kiloWatt-hours (kWh). The battery capacity, in some implementations, may be indicative of an ampere-hour (Ah) charge transfer ability of each cell. For example, a 480 Wh capacity may correlate to 40 Ah battery cells, while a 720 Wh capacity may correlate to 60 Ah battery cells, and a 1.2 kWh capacity may correlate to 100 Ah battery cells.

In some implementations, a charging unit 210 may provide a mechanism for recharging the rechargeable battery cells 208, for example through an exterior electrical connection. Turning to FIG. 2B, an A/C wall cord port 230 may be provided for connecting the portable power supply 250 to an electrical source. In some implementations, upon plugging in the portable power supply 250, the portable power supply 250 may recognize the availability of charging electricity and automatically engage the charging unit 210. In some implementations, while the portable power supply 250 is connected to a power source, the charging unit 210 may supply a trickle charge or float charge feature. For example, the charging unit 210 may detect that a current level of charge in the rechargeable battery cells 208 has dropped to a threshold level and initiate charging the rechargeable battery cells 208. In some implementations, the charging unit 210 may charge the rechargeable battery cells 208 to an upper voltage threshold (e.g., approximately 14.4 Volts), then automatically end the charging cycle to protect the rechargeable battery cells 208 from becoming over-charged.

An inverter 212, in some implementations, may be provided for converting the power stored by the rechargeable battery cells 208 to an appropriate output (e.g., 110 V A/C, 220 V A/C, 5V D/C, etc.). The inverter 212, for example, may supply one or more output ports, such as, in some examples, a two- or three-prong A/C supply port, a USB port, and a vehicle jumper cable connection. As illustrated in relation to FIG. 2B, in a particular example, the portable power supply 250 may include a set of three-prong A/C supply ports 232a, 232b and a set of five Volt USB ports 234a, 234b.

In some implementations, the inverter 212 may be selectively placed in electrical communication with the rechargeable battery cells 208 through a main switching unit 214. The main switching unit 214, for example, may include a solid state relay. The main switching unit 214, in some implementations, may be controlled by an output voltage-

triggered switching unit 216 (e.g., an output relay such as the output relay 122 described in relation to FIG. 1) and/or an input voltage-triggered switching unit 218 (e.g., an input relay such as the input relay 120 as described in relation to FIG. 1). Turning to FIG. 2B, for example, the output-voltage triggered switching unit 216 may activate the main switching unit 214 upon detecting an output voltage. The output voltage, for example, may be detected from an A/C output supplied from the inverter 212 to at least one of the A/C supply ports 232a, 232b. In another example, the output voltage may be detected from a D/C output supplied from the inverter 212, such as a 5 V D/C output supplied to at least one of the five Volt USB ports 234a, 234b or a 12 Volt supply provided to a vehicle jumper cable connection (not illustrated). The input-voltage triggered switching unit 218 may activate the main switching unit 214 upon detecting an input voltage. The input voltage, for example, may be detected from an A/C input supplied to the charging unit 210, such as 110 V or 220 V A/C input connected to the A/C wall cord port 230. If neither the input-voltage triggered switching unit 218 nor the output voltage-triggered switching unit 216 is triggered, the main switching unit 218 may be deactivated, thus isolating the battery unit 208 from the inverter 212. In this manner, the battery unit 208 may be protected from over-discharging via a parasitic load from the inverter 212, for example in the circumstance where the portable power supply 250 is left activated (e.g., when the three-way switch 202 is in a discharge or charge position rather than in an off position).

In view of the structure, functions and apparatus of the systems and methods described here, in some implementations, an apparatus and method of use for a portable power supply are provided. Having described certain implementations of methods and apparatus for supporting analysis of genetic sequence data, it will now become apparent to one of skill in the art that other implementations incorporating the concepts of the disclosure may be used. Therefore, the disclosure should not be limited to certain implementations, but rather should be limited only by the spirit and scope of the following claims.

What is claimed:

1. An apparatus comprising:
a battery unit comprising one or more lithium-ion battery cells;
a charging unit configured with a first automatic shut-off, wherein the automatic shut-off is responsive to detection of an upper threshold voltage level of the battery unit;
an inverter configured with a second automatic shut-off, wherein the second automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit; and
an input connection functionally connected to the charging unit;
wherein the apparatus is configured to isolate the battery unit from the inverter responsive to detecting both
(a) the input connection is disconnected from an input voltage source; and
(b) the inverter is shut off.

2. The apparatus of claim 1, further comprising a first switching unit connected between the battery unit and a main switching unit, wherein
detecting the inverter is shut off comprises failing to detect a threshold output voltage of the inverter at an output connection, and
the first switching unit is configured to move to a closed position responsive to detecting the threshold output voltage.

3. The apparatus of claim 2, wherein the threshold output voltage is substantially equivalent to 110 Volts.

4. The apparatus of claim 2, further comprising a second switching unit connected between the battery unit and the main switching unit, wherein
detecting the input connection is disconnected from an input voltage source comprises failing to detect a threshold input voltage at the input connection; and
the second switching unit is configured to move to a second closed position upon detecting the threshold input voltage at the input connection.

WINPLUS Ex. 1003, p. 1430

5. The apparatus of claim 4, wherein the threshold input voltage is substantially equivalent to 110 Volts.

6. The apparatus of claim 1, further comprising a three-way switch, wherein the three-way switch comprises a charging position, a discharging position, and an off position; and
the apparatus is configured to isolate the battery unit from the inverter when the three-way switch is in the off position.

7. The apparatus of claim 1, further comprising a plurality of light emitting diodes presented in series, wherein a relative number of activated light emitting diodes of the plurality of light emitting diodes correlates to an approximate percentage of charge of the battery unit.

8. The apparatus of claim 1, wherein a capacity of the battery unit is at least 400 Watt hours.

9. The apparatus of claim 1, wherein the battery unit comprises at least four lithium-ion battery cells.

10. The apparatus of claim 1, wherein the battery unit comprises a potential of approximately twelve Volts.

11. The apparatus of claim 1, wherein the input connection comprises an A/C plug interface for providing a wired connection to a household electrical output socket.

12. The apparatus of claim 1, further comprising at least one A/C output socket connection functionally connected to the inverter.

13. The apparatus of claim 12, further comprising at least one USB output connection functionally connected to the inverter.

14. The apparatus of claim 1, further comprising a balancing system connected to the battery unit, wherein the balancing system comprises a discharging circuit configured

to, responsive to detecting a battery cell voltage of a predetermined voltage threshold, draw a constant discharging current from at least a first battery cell of the one or more lithium-ion battery cells.

15. The apparatus of claim 14, wherein the balancing system draws the constant discharging current until detecting the battery cell voltage is below the predetermined voltage threshold.

16. A system, comprising:

a rechargeable battery unit comprising one or more lithium-ion battery cells;

a charging unit;

an inverter functionally connected to an output connection;

an input connection functionally connected to the charging unit, wherein the input connection is configured for connection to a recharging power source;

a main switching unit;

a first switching unit connected between the battery unit and the main switching unit, wherein the first switching unit is configured to activate the main switching unit responsive to detecting a threshold output voltage of the inverter at an output connection; and

a second switching unit connected between the battery unit and the main switching unit, wherein the second switching unit is configured to activate the main switching unit responsive to detecting a threshold input voltage at the input connection;

wherein the first switching unit and the second switching unit are configured to prevent over-discharging the rechargeable battery unit by isolating the battery unit from a parasitic load of the inverter.

17. The system of claim 16, wherein the output connection is configured for connection to at least one of a universal serial bus port and an A/C socket outlet.

18. The system of claim 16, wherein at least one of the first switching unit and the second switching unit comprises a solenoid.

19. The system of claim 16, wherein the charging unit is configured with an automatic shut-off, wherein the automatic shut-off is responsive to detection of an upper threshold voltage level of the battery unit.

20. The system of claim 16, wherein the inverter is configured with an automatic shut-off, wherein the automatic shut-off is responsive to detection of a lower threshold voltage level of the battery unit.

WINPLUS Ex. 1003, p. 1433

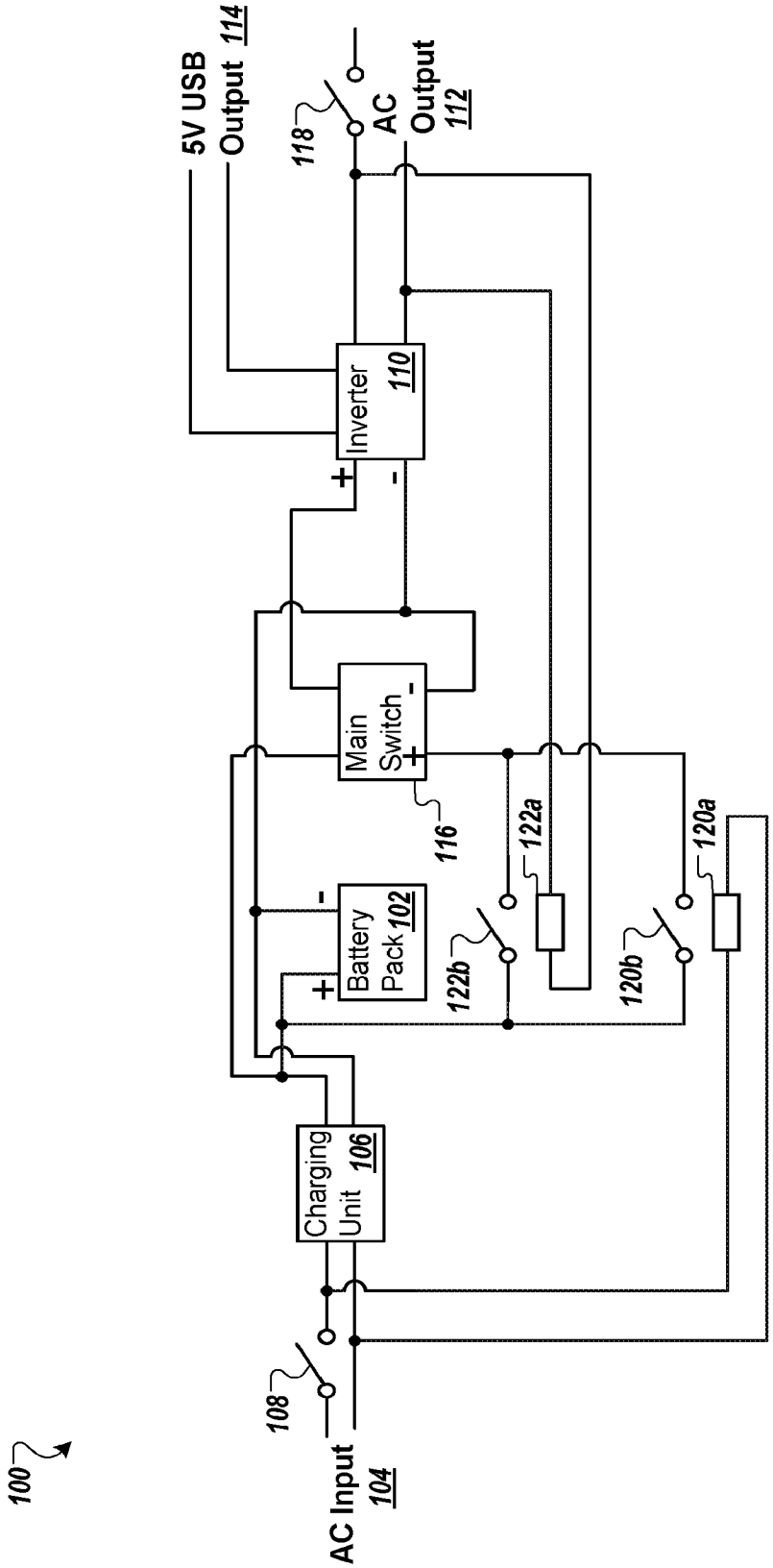

5V USB Output 114
AC Output 112
118
Inverter 110
+
-
Main Switch
116
122a
120a
Battery Pack 102
122b
120b
Charging Unit 106
108
AC Input 104
100

FIG. 1

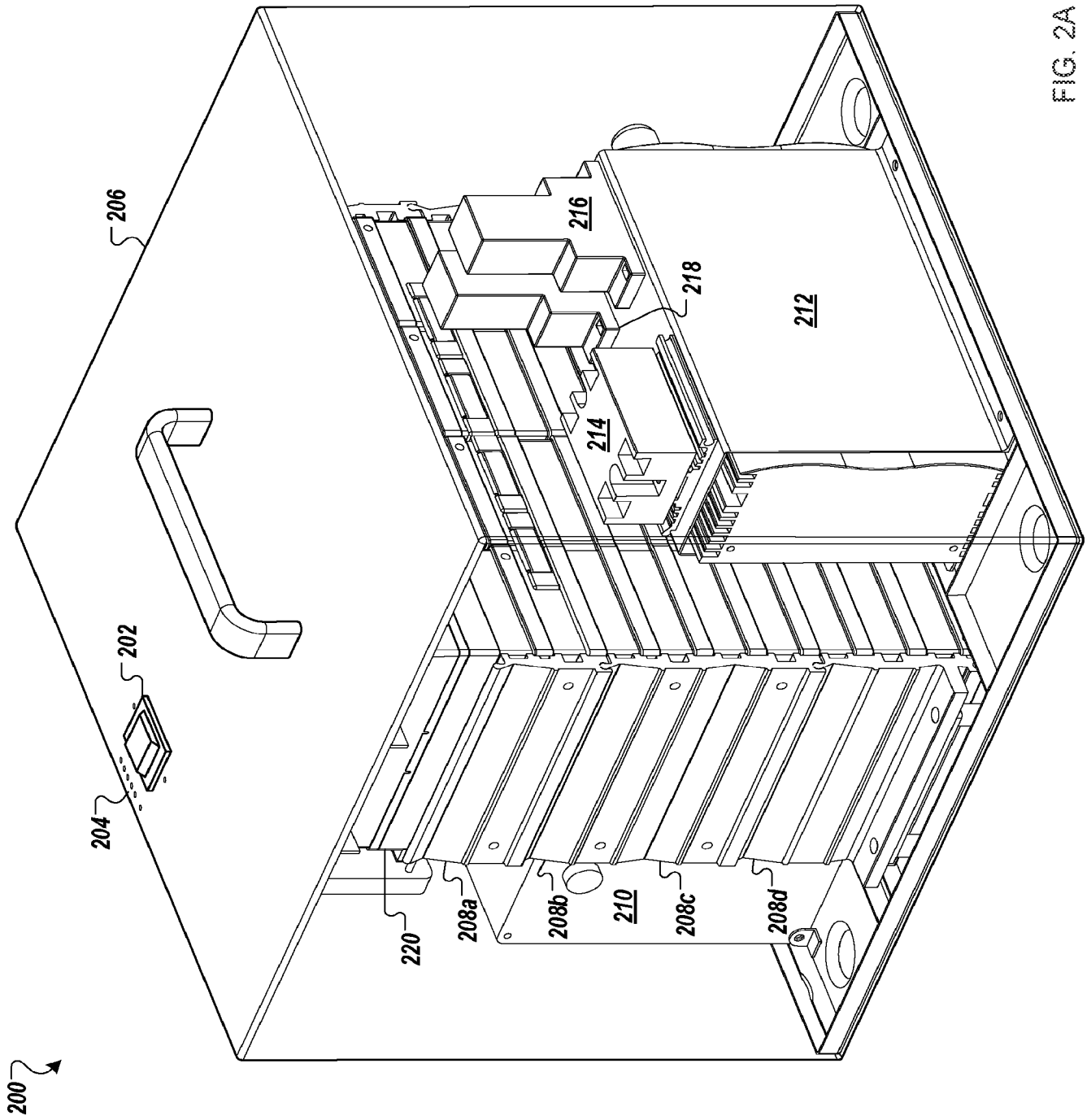


FIG. 2A

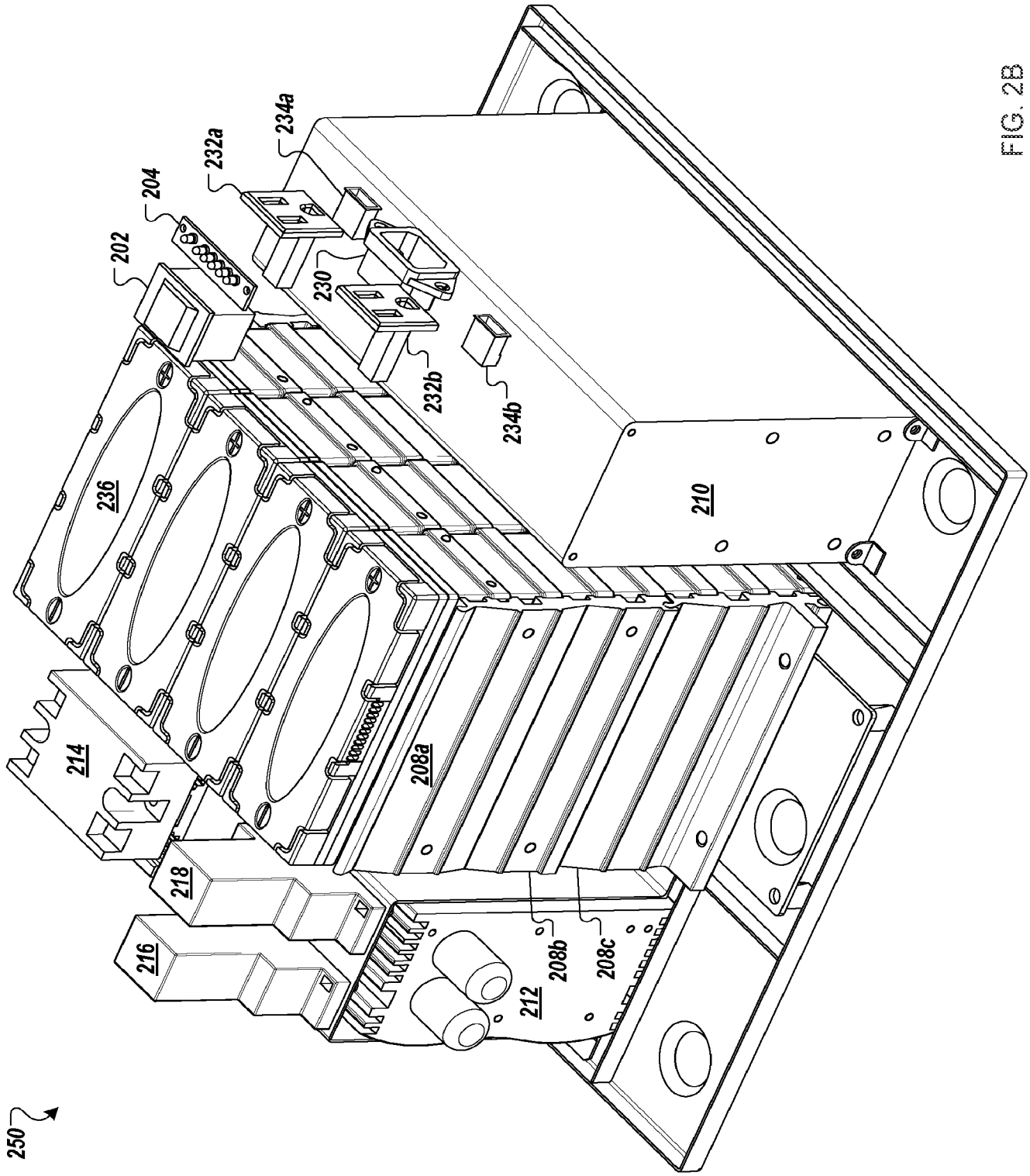

250
214
218
216
212
208a
208b
208c
236
210
202
204
232a
234a
230
232b
234b

FIG. 2B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/029058

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02J7/00 H02J9/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/090726 A1 (BROTTO DANIELE C [US] ET AL) 21 April 2011 (2011-04-21) the whole document	1-20
A	JP 2009 201275 A (OKAMURA MFG CO LTD) 3 September 2009 (2009-09-03) the whole document	1-20
A	JP 2007 295684 A (SANYO ELECTRIC CO) 8 November 2007 (2007-11-08) the whole document	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 December 2012	14/12/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Moje, Andreas

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/029058

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011090726 A1	21-04-2011	US 2011090726 A1	21-04-2011
		WO 2012061044 A2	10-05-2012
JP 2009201275 A	03-09-2009	NONE	
JP 2007295684 A	08-11-2007	NONE	

WINPLUS Ex. 1003, p. 1438

Espacenet

Bibliographic data: WO2017138963 (A1) — 2017-08-17

BATTERY ASSEMBLY DEVICE

Inventor(s): NOOK JONATHAN LEWIS [US]; NOOK WILLIAM KNIGHT [US]; STANFIELD JAMES RICHARD [US]; UNDERHILL DEREK MICHAEL [US] ± (NOOK, Jonathan, Lewis, ; NOOK, William, Knight, ; STANFIELD, James, Richard, ; UNDERHILL, Derek, Michael)

Applicant(s): NOCO CO [US] ± (THE NOCO COMPANY)

Classification: **- international:** ***H02J7/00; H02J7/14***
- cooperative: **H01M2/30 (US)**; **H01R11/24 (US)**; **H02J1/122 (EP)**; **H02J7/14 (EP, GB, US)**; **H02J7/342 (GB)**; F02N11/12 (EP); F02N11/14 (EP); H02J1/122 (US)

Application number: WO2016US24680 20160329 Global Dossier

Priority number(s): US201662294067P 20160211

Also published as: AU2016392707 (A1) AU2016392707 (B2) AU2020200268 (A1) CA2957431 (A1) CN107852004 (A) more

Abstract of WO2017138963 (A1)

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

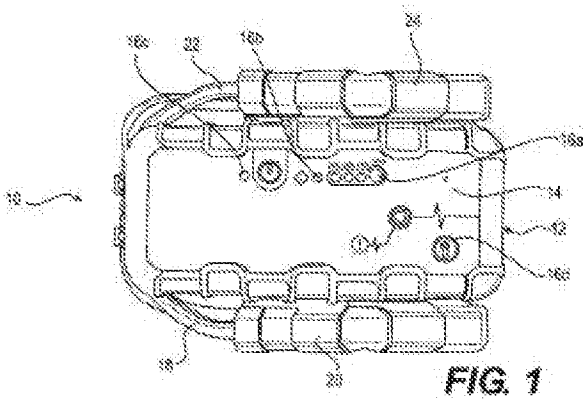


FIG. 1

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 August 2017 (17.08.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/138963 A1

(51) International Patent Classification:
H02J 7/00 (2006.01) *H02J 7/14* (2006.01)

(21) International Application Number:
PCT/US2016/024680

(22) International Filing Date:
29 March 2016 (29.03.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/294,067 11 February 2016 (11.02.2016) US

(71) Applicant: **THE NOCO COMPANY** [US/US]; 30339 Diamond Parkway, #102, Glenwillow, OII 44139 (US).

(72) Inventors: **NOOK, Jonathan, Lewis**; 1659 Berkshire Road, Gates Mills, OH 44040 (US). **NOOK, William, Knight**; 2726 Dryden Road, Shaker Heights, OH 44122 (US). **STANFIELD, James, Richard**; 6802 West Banff Lane, Peoria, AZ 85381 (US). **UNDERHILL, Derek, Michael**; 6094 West Trovita Place, Chandler, AZ 85226 (US).

(74) Agent: **KLIMA, William, L.**; Vorys, Sater, Seymour and Pease LLP, 1909 K St., NW #900, Washington, DC 20006 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: BATTERY ASSEMBLY DEVICE

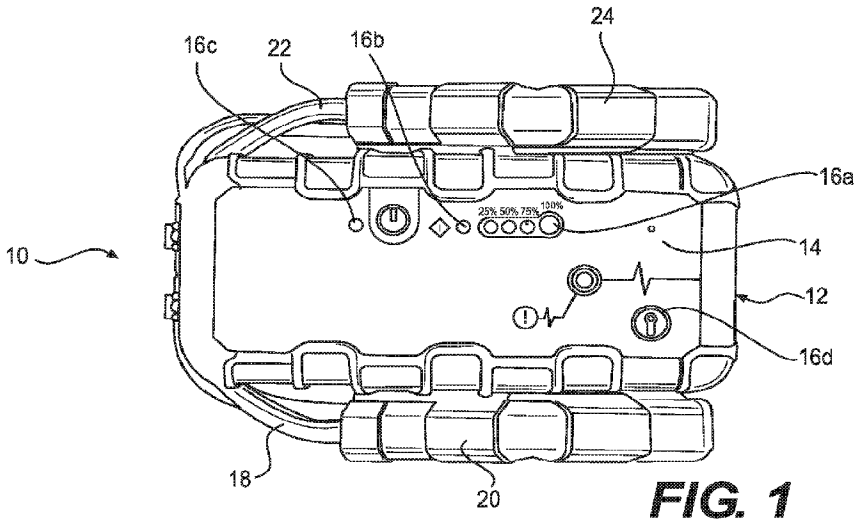


FIG. 1

(57) **Abstract**: The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device. A battery assembly device for a battery jump starting device. The battery assembly is configured to maximize electrical conductivity from a battery pack of the battery jump starting device to a battery to be recharged.

WO 2017/138963 A1

TITLE

BATTERY ASSEMBLY DEVICE

FIELD

A battery assembly device, for example, for use in a battery jump starting device.

BACKGROUND

The exists a portable vehicle battery jump start apparatus as disclosed in U.S. Patent No. 9,007,015 to Nook et al. The apparatus utilizes a lithium ion battery pack. In this type of apparatus, there exists a need to maximize conductivity from the battery pack of the apparatus to the vehicle battery of the vehicle being jump started.

For successful car jump-starts, there are two main factors dictating the results. The first factor is the amount of power provided by the lithium ion battery pack, and the second factor is the maximum conductivity. You need both factors to have the best chance to jump-start big engines. One factor without the other factor is not enough.

SUMMARY

The subject matter relates to a battery assembly device for use with an apparatus for jump starting a vehicle, and an apparatus for jump starting a vehicle comprising the battery assembly device.

The subject matter relates to the following objects.

A battery assembly device comprising or consisting of a battery having at least one battery conductor connected to a terminal of the battery.

A battery assembly device comprising or consisting of a battery having at least one battery conduct connected to a terminal tab of the battery.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery, the battery conductors being soldered to the respective terminal contacts of the battery.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to one of the battery conductors of the battery.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery, and a relay connected to the negative battery conductor.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative

battery conductor connected to a negative terminal contact of the battery, and multiple relays connected to the negative battery conductor.

A battery assembly device comprising or consisting of a battery having a positive battery conductor connected to a positive terminal contact of the battery and a negative battery conductor connected to a negative terminal contact of the battery, and a positive cable connected to the positive battery conductor.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front perspective view of the battery jump starting device with the clamps undeployed.

FIG. 2 is a rear perspective view of the battery jump starting device shown in FIG. 1.

FIG. 3 is an end perspective view of the battery jump starting device shown in FIGS. 1 and 2.

FIG. 4 is a front perspective view of the battery jump starting device shown in FIG. 1, however, with the clamps deployed.

FIG. 5 is a perspective view of a battery assembly device contained within the battery jump starting device shown in FIG. 1 when installed therein , however, with the negative cable not yet installed.

FIG. 6 is a top planer view of the battery assembly device shown in FIG. 5.

FIG. 7 is a front elevational view of the battery assembly device shown in FIG. 5.

FIG. 8 is a side view of the bent cable connector for the positive cable.

WINPLUS Ex. 1003, p. 1443

FIG. 9 is a perspective view of the battery assembly device shown in FIG. 5, with the negative cable connected to the battery assembly device.

FIG. 10 is a perspective view of the battery assembly device shown in FIG. 5 with a diode device installed on the positive cable.

FIG. 11 is a perspective view of the battery assembly device connected to other components or devices of the battery jump starting device.

FIG. 12 is a perspective view of the battery pack device contained within the battery jump starting device shown in FIG. 1 when installed therein.

DETAILED DESCRIPTION

A battery jump starter device 10 is shown in FIGS. 1 and 2. The battery jump starting device 10 comprises a casing 12 having a display 14 provided with an arrangement of light emitting diodes 16 (LEDs). The battery jump starting device 10 further comprises a positive cable 18 having a positive clamp 20 and a negative cable 22 having a negative clamp 24. The positive cable 18 and negative cable 22 pass through openings 12a, 12b in the casing 12, and are wired to an internally located component (i.e. battery assembly device) to be described in detail below.

The clamps 20, 24 are stowed away or docked in an undeployed mode by clamping each to a respective side posts 26 extending outwardly on opposite sides of the casing 12, as shown in FIG. 1. The side posts 26 are shown in FIG. 2. The clamps 20, 24 are docked when the battery jump starter device 10 is in non-use, and unclamped from the side post 26 during use.

The battery jump starting device 10 is configured for jump starting a vehicle battery. For example, the battery jump starting device 10 can be the PORTABLE VEHICLE JUMP START APPARATUS WITH SAFETY PROTECTION disclosed in U.S. Patent No. 9,007,015, which is fully incorporated herein by reference, or an apparatus similar thereto.

The battery jump starting device 10 comprises a variety of electrical components or parts located inside the casing 12. For example, the battery jump starting device 10 comprises the battery assembly 110 shown in FIGS. 5-10 and internal electrical components shown in FIG. 11.

As shown in FIGS. 5-10, the battery assembly 110 comprises a battery 112. For example, the battery 112 is a lithium ion rechargeable type battery. The battery assembly 110 is configured to maximize electrical conductivity from the battery 112 to the cables 18, 22 and clamps 20, 24 of the battery jump starter device 10. The battery 112 comprises a casing, for example, a rectangular-shaped casing 112a.

The battery assembly 110 further comprises a positive terminal conductor bar 114 connected (e.g. soldered) at one end to the positive terminal tab (i.e. contact) of the battery 112. The other end of the positive terminal conductor bar 114 is provided with a conductive loop 116 wrapping around and connected (e.g. crimped and/or soldered) to an exposed conductor end 18a of a cable conductor for the positive cable 18.

As shown in FIGS. 5 and 6, the positive terminal conductor bar 114, for example, can be L-shaped so as to wrap around a square-shaped corner of the rectangular-shaped casing 112a of the battery 112 (e.g. when viewing the battery 112 in plan view).

The L-shaped positive terminal conductor bar 114 extends along an end of the battery 112 and along at least a portion of the side of the battery 112, as shown in FIG. 6.

The positive terminal conductor bar 114 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional structural support and stability thereof (e.g. to survive mechanical shock in the event of accidentally dropping battery jump starter device 10). For example, the positive terminal conductor bar 114 can be mechanically connected to the battery casing 112a by adhesive (e.g. silicone adhesive), double sided tape, double sided foam tape, insulating plastic or ceramic connector with snap fit connection and/or mechanical fastener.

The positive cable 18 comprises a bent cable portion 118 connecting the positive cable 18 to the positive terminal conductor bar 114. The bent cable portion 118 comprises an outer sleeve portion 118a transitioning into flexible sleeve 120. The flexible sleeve 120 comprises an outer sleeve portion 120a located externally relative to the casing 112 of the battery jump starter device 10, and a flexible inner sleeve portion 120b located internally relative to the casing 112 of the battery jump starter device 10.

The flexible sleeve 120 is configured to reinforce the connection between the positive cable 18 and the casing 12 of the battery jump starter device 10 while remaining flexible. For example, the flexible sleeve 120 is provided with one or more grooves 124 (three (3) shown in FIG. 3) exposing the outer sleeve 18a of the positive cable 18. The one or more grooves 124 act as hinges to ease bending of the positive cable 18 at the location of the flexible outer sleeve portion 120.

The flexible sleeve 120 further comprises an outer flange 124 spaced apart from an inner flange 126 defining a groove 125 therebetween. For example, the outer flange

124 is spaced apart a distance equal to the wall thickness of the casing 12 from the inner flange 126. The flanges 124, 126 are configured to anchor the flexible connector 120 along with the positive cable 18 to the casing 12 of the battery jump starter device 10. A sleeve portion 128 (FIG. 6) of the flexible connector 120 connects together the outer flange 126 and inner flange 128. For example, the flexible sleeve 120 is molded separately and assembled onto the positive cable 18, or molded onto the positive cable 18 to form a single unit. For example, the flexible outer sleeve portion 120 is insert injection molded with a portion of the positive cable 18 inserted within the mold during the molding process. Alternatively, the flexible outer sleeve portion 120 is made (e.g. molded) separately, and then installed or assembled onto a portion of the positive cable 18. For example, the positive cable 18 comprises an inner conductor (e.g. solid wire conductor or multi-strand metal wire conductor, e.g. made of copper, aluminum) and an outer insulating sleeve 18a (e.g. molded plastic sleeve). The flexible sleeve 120 can be applied (e.g. molded or installed or assembled) onto and surrounding the outer sleeve 18a of the positive cable 18.

The battery assembly 110 further comprises a negative terminal conductor bar 130 connected (e.g. soldered) at one end to the negative terminal tab (i.e. contact) of the battery 112. The other end of the negative terminal conductor bar 130 is provided with a negative terminal conductor bar connector portion 132, as shown in FIG. 5.

The negative terminal conductor bar 130 can be L-shaped to wrap around a corner of the rectangular-shaped battery 112, as shown in FIG. 6. The L-shaped negative terminal conductor bar 130 extends along an end of the battery 112 and along at least a portion of the side of the battery 112.

The negative terminal conductor bar 130 can also be mechanically coupled and/or adhered to the outer surface of the battery casing 112a to provide additional support and stability thereof (e.g. to survive mechanical shock in the event of accidental dropping battery jump starter device 10). For example, the negative terminal conductor bar 114 can be mechanically connected to the battery casing 112a by adhesive (e.g. silicon adhesive), double sided tape, double sided foam tape, insulating plastic or ceramic connector with snap fit connection and/or mechanical fastener.

The battery assembly 110 further comprises a smart switch battery interface 134, as shown in FIG. 5. The smart switch battery interface 134 comprises a circuit board 136 having a first circuit board conductor bar 138 spaced apart from a second circuit board conductor bar 140 both located on one side of the circuit board 136, as shown in FIG. 5.

A pair of relays 142 are mounted on an opposite side of the circuit board 136. The relays 142 include relay anchoring pins 142a extending through the slots 136a in the circuit board 136 (FIG. 5). The relays 142 further include first relay connector pins 142b extending through the slots located in both in the circuit board 136 and through slots 132a in the negative terminal conductor bar connector portion 132. The relays 142 even further include second relay connector pins 142c extending through the slots located in both the circuit board 136, windows 138a of the first circuit board conductor bar 138, and the slots 132a provided in the first conductor bar 138. The relay anchoring pins 136a are soldered in place to mechanically connect the relays 142 to the circuit board 136. The relay connecting pins 142b and 142c are soldered in place to

mechanically and electrically connect the relays 142, respectively, to the circuit board conductor plates 138, 140.

The slots 136a in the circuit board 136, for example, are rectangular-shaped (FIG. 5), and accommodate the rectangular-shaped relay anchoring pins 142a. Specifically, a base portion of the relay anchoring pins 142a are rectangular-shaped transitioning to square-shaped ends. The square-shaped ends are dimensionally less wide verses the base portions creating transverse edges oriented flush with the outer surface of the circuit board 136. When solder is applied to the exposed ends of the relay anchoring pins 142a, the solder connects to the sides of the square-shaped ends and transverse edges to anchor and lock the relay anchoring pins 142a to the circuit board 136.

The slots 132a are provided in negative terminal conductor bar connector portion 132, and the slots 138a in the first circuit board conductor bar 138 are rectangular-shaped. The slots140a in the second circuit board conductor bar 140 (FIG. 5) are T-shaped to accommodate the three (3) horizontally oriented relay connector pins 142b. The ends of the relay connector pins 142b are shown flush with the outer surface of the negative terminal conductor bar connector portion 132. When solder is applied to the exposed ends of the relay connector pins 142b, the solder fills in the slots 132a in the negative terminal conductor bar connector portion 132 and the slots 138a of the first circuit board conductor bar 138, and connects the sides of the connector pins 142b with inner edges of the slots 132a and slots 138a to anchoring the relays 142 to the circuit board 136 and negative terminal conductor bar connector portion 132. This applied

solder also electrically connects the negative terminal conductor bar connector portion 132 to the first circuit board conductor bar 138.

The slots 140a provided in the second circuit board conductor bar 140 are T-shaped to accommodate the three (3) vertically oriented second relay connecting pins 142c. The second relay connector prongs 142c extend outwardly from the outer surface of the circuit board 136 to connect with the exposed cable end 14a of the negative cable 14, as shown in FIG. 9. When solder is applied to the ends of the second relay connector prongs 142c, the solder fills in the T-shaped slots 140a (FIG. 5) and electrically connects the second relay connector prongs140c to the second circuit board conductor bar 140. The exposed cable end 22a of the negative cable 22 is soldered to the second relay connector prongs 142c (FIG. 5), as shown in FIG. 9.

The negative terminal conductor bar connector portion 132 of the negative terminal conductor bar 130 is connected (e.g. by soldering) to the first circuit board conductor bar 138 of the circuit board 136. Again, the exposed cable end 22a (i.e. with the insulating sleeve removed) of the negative cable 22 is connected (e.g. by soldering) to the second circuit board conductor bar 140, as shown in FIG. 9. The negative cable 22 is fitted with a flexible sleeve 118, as shown in FIG. 11.

As an alternative to the arrangement of the bent cable connector 118 (FIG. 5), a diode device 150 is installed onto (i.e. spliced into) the flexible cable connector 118, as shown in FIG. 10. The diode device 150 comprises a circuit board 152 provided with a set of back-charge diodes 154 located on one side thereof, and a conductor bar 156 provided on an opposite side of the circuit board 152.

ASSEMBLY

The battery jump starting device 10 comprises the casing 12 having an upper casing portion 12a and a lower casing portion 12b, as shown in FIG. 11. The upper casing portion 12a and the lower casing portion 12b are configured to be connected together when assembling the battery jump starting device 10.

The battery jump starting device 10 further comprises the battery assembly 110 and controller assembly 210 both disposed within the casing 12 when assembling the battery jump starting device 10, as shown in FIG. 11. The controller assembly 210 comprises a circuit board 212 located adjacent to another circuit board 214.

The positive terminal of the battery assembly 110 is connected to the circuit board 212 via a positive power wire 216, as shown in FIG. 11. For example, the positive power wire 216 is soldered to the positive conductor bar 114 (FIG. 5). The negative terminal of the battery assembly 110 is connected to the circuit board 214 via a negative power wire 218.

The relay circuit board 136 is provided with a wire set 220 having a connector 222, as shown in FIG. 11. The connector 222 is configured to connect with the relay board connector 224 located on the circuit board 212 of the controller assembly 210 during assembly of the battery jump starting device 10, as shown in FIG. 11.

The battery assembly 110 further comprises a wire set 226 having a connector 228, as shown in FIG. 11. The connector 228 is configured to connect with the battery cell charging/monitoring connector 230 located on the circuit board 212 of the controller assembly 220.

The battery assembly 110 also comprises a battery temperature sensor having a wire set 232 having a connector 234, as shown in FIG. 11. The connector 234 is configured to connect with the temperature sensor connector 236 located on the circuit board 212 of the controller assembly 220.

The circuit board 212 is provided with in charge power resistors 240 and an out relay 242, as shown in FIG. 11. Further, the lower casing portion 12a is provided with a main user out connector 244 having a wire set 246 connected to the circuit board 214, and a main user in connector 248 having a wire set 250 connected to the circuit board 214.

The battery assembly 110 is connected to battery jump starting device 10, as shown in FIG. 11. The battery connector device 110 is installed within the casing 12 of the battery jump starting device 10 when assembled.

CLAIMS

1. A battery assembly device for a battery jump starting device having a smart switch, the device comprising:

a battery comprising a positive terminal tab and a negative terminal tab;

a positive terminal conductor bar connected to the positive terminal tab of the battery;

a negative terminal conductor bar connected to the negative terminal tab of the battery;

a positive cable connected to the positive terminal conductor bar; and

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar and a second circuit board conductor spaced apart from each other on the circuit board, the smart switch interface further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery and a battery being jump started.

2. A battery assembly device for a battery jump starting device having a smart switch, the device comprising:

a rectangular-shaped battery comprising a positive terminal tab and a negative terminal tab;

a positive terminal conductor bar connected to the positive terminal tab of the battery;

a negative terminal conductor bar connected to the negative terminal tab of the battery;

a positive cable connected to the positive terminal conductor bar by a flexible cable connector; and

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar and a second circuit board conductor spaced apart from each other on the circuit board, the smart switch interface further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery being jump started.

WINPLUS Ex. 1003, p. 1454

3. A battery assembly device for a battery jump starting device having a smart switch, the device comprising:

a rectangular-shaped battery comprising a positive terminal tab and a negative terminal tab each located at opposite ends of the battery;

an L-shaped positive terminal conductor bar connected to the positive terminal tab of the battery, the L-shaped positive terminal bending around a corner of the battery and extending along at least a portion of a side of the battery;

an L-shaped negative terminal conductor bar connected to the negative terminal tab of the battery, the L-shaped negative terminal bending around a corner of the battery and extending along at least a portion of a side of the battery;

a positive cable connected to the positive terminal conductor bar; and

a smart switch interface connectable to the smart switch of the jump starting device, the smart switch interface comprising a circuit board having a first circuit board conductor bar and a second circuit board conductor spaced apart from each other on the circuit board, the smart switch interface further comprising one or more relays connected between the first circuit board conductor bar and the second circuit board conductor bar for providing isolation between the negative terminal tab of the battery being jump started.

4. The device according to claim 1, wherein the relay is multiple relays connected in parallel between the first circuit board conductor bar and the second circuit board conductor bar.

5. The device according to claim 1, wherein the negative terminal conductor bar mechanically and electrically connects the battery to the smart switch battery interface.

6. The device according to claim 5, wherein the smart switch battery interface is positioned above and adjacent to the battery by the negative terminal conductor bar.

7. The device according to claim 1, wherein one end of the positive cable is configured to at least partial wrap around an exposed cable conductor end of the positive cable.

8. The device according to claim 1, wherein the positive terminal conductor bar is ultrasonically welded to the positive terminal tab of the battery and the negative terminal conductor bar is ultrasonically welded to the negative terminal tab of the battery.

9. The device according to claim 1, wherein the battery is rectangular-shaped, and the positive terminal conductor bar and the negative terminal conductor bar are L-shaped and wrap around a respective corner of the battery.

10. The device according to claim 9, wherein the battery tabs aremounted flush with a casing of the battery.

11. The device according to claim 1, wherein the positive cable is connected to the positive terminal conductor bar by a flexible cable connector.

12. The device according to claim 11, wherein the flexible cable connector comprises a flexible outer sleeve portion and a flexible inner sleeve portion.

13. The device according to claim 12, wherein the flexible outer sleeve portion comprises an outer flange, and the flexible inner sleeve portion comprises an inner flange, the outer flange and inner flange sandwiching a casing wall of the battery jump starting device.

14. The device according to claim 11, wherein the flexible cable connector comprises an inner serpentine cable portion.

15. The device according to claim 14, wherein the flexible cable connector is configured to accommodate the positive cable oriented at an angle relative to a casing wall of the battery jump starting device, and the inner serpentine cable portion is configured to accommodate a misalignment between the angle relative to the casing wall and an angle of attachment of the inner serpentine cable portion with the positive terminal conductor bar.

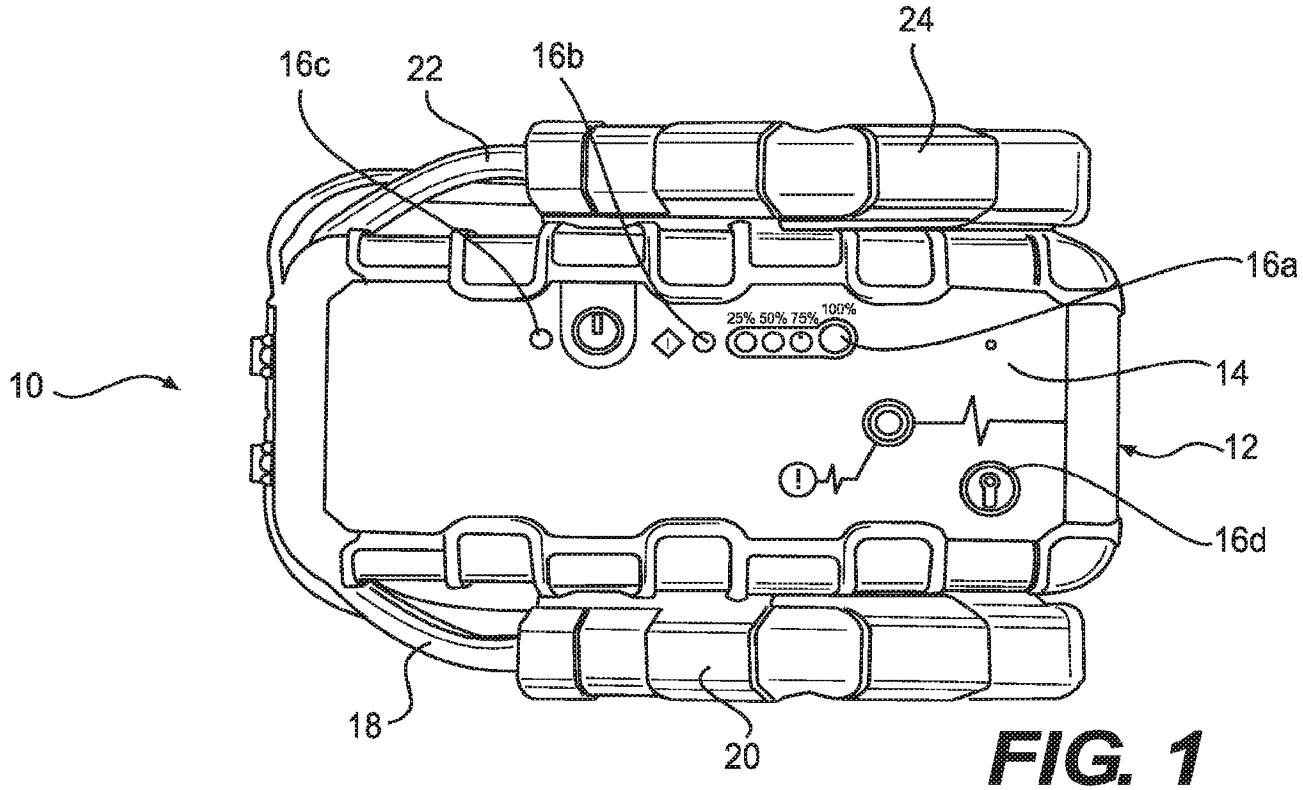


FIG. 1

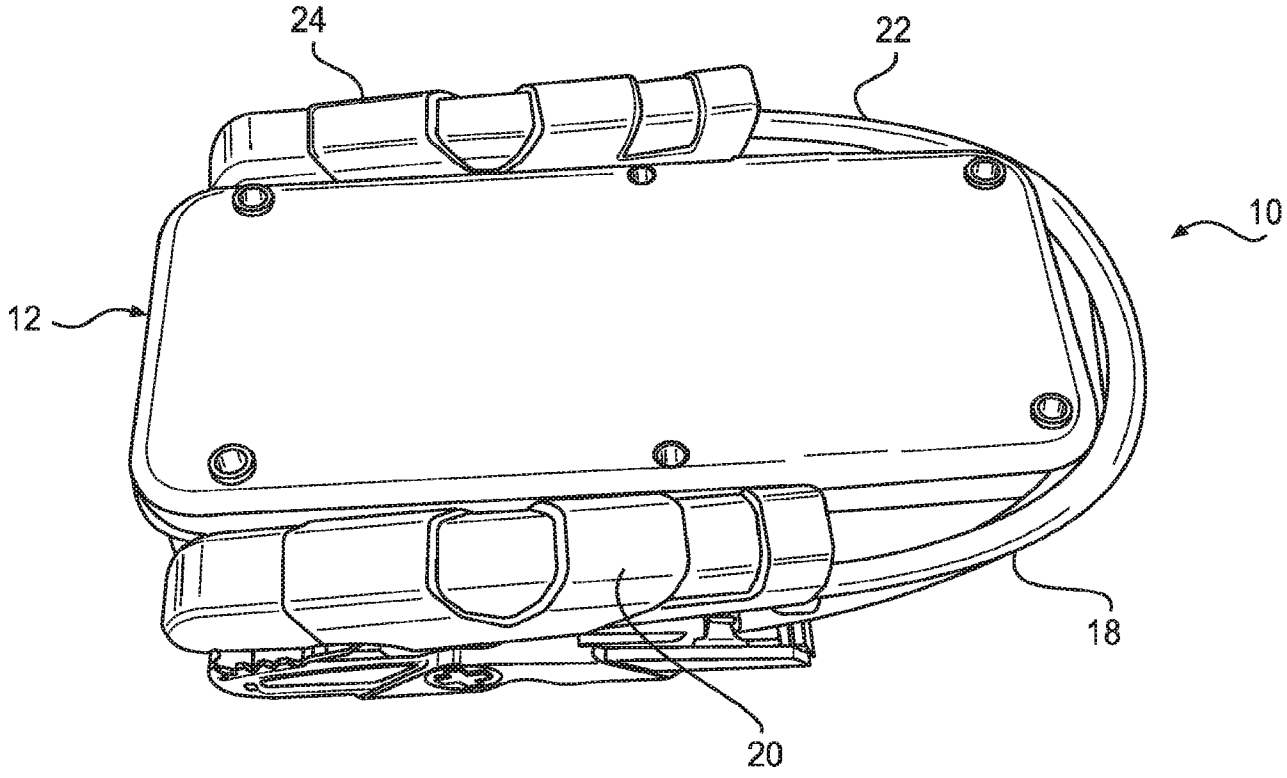


FIG. 2

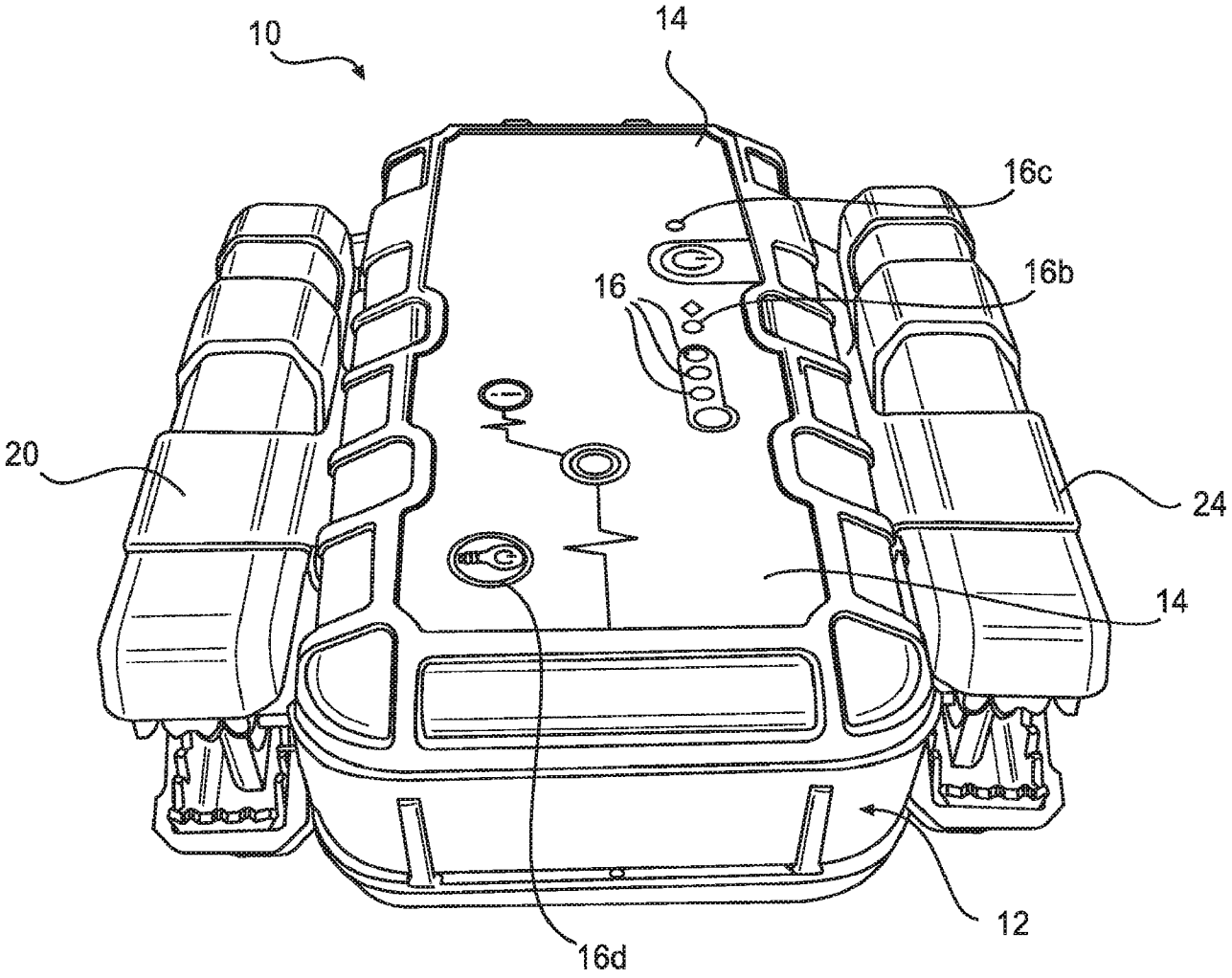


FIG. 3

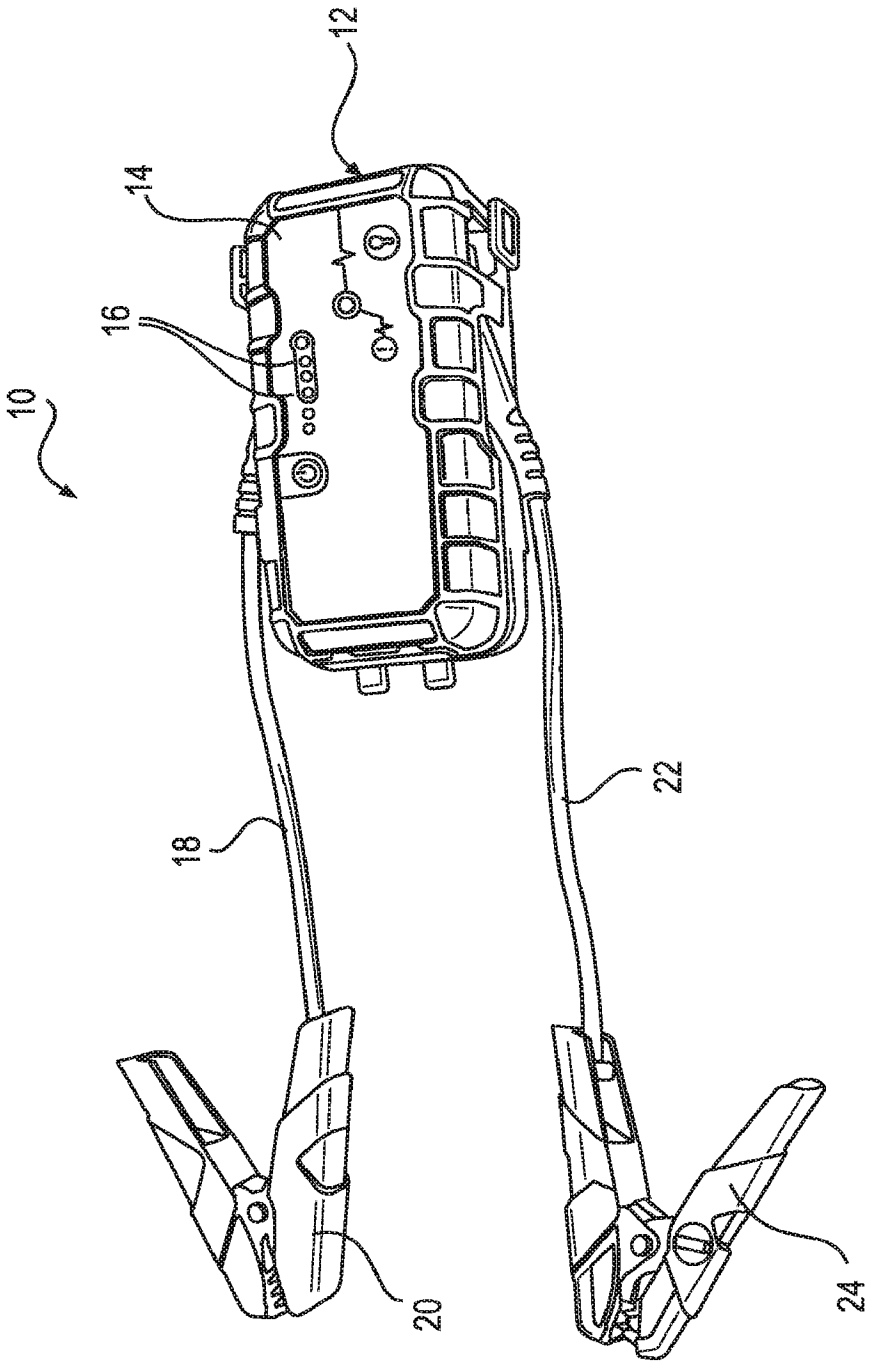


FIG. 4

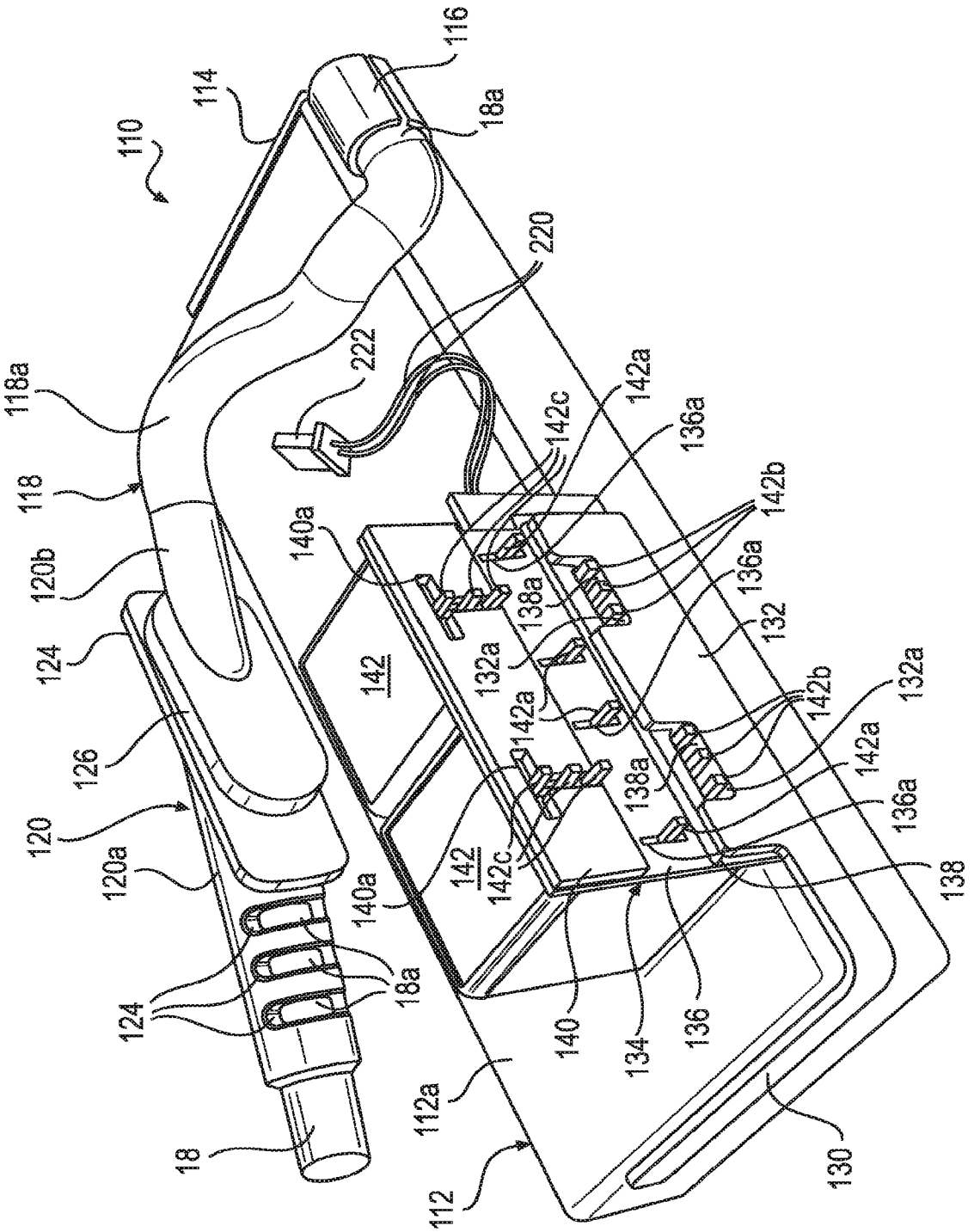

110
114
116
18a
220
222
118a
118
120b
124
126
120
120a
124
18
112
112a
140a
142
142c
140
134
136
138
130
132
132a
136a
138a
142a
142b

FIG. 5

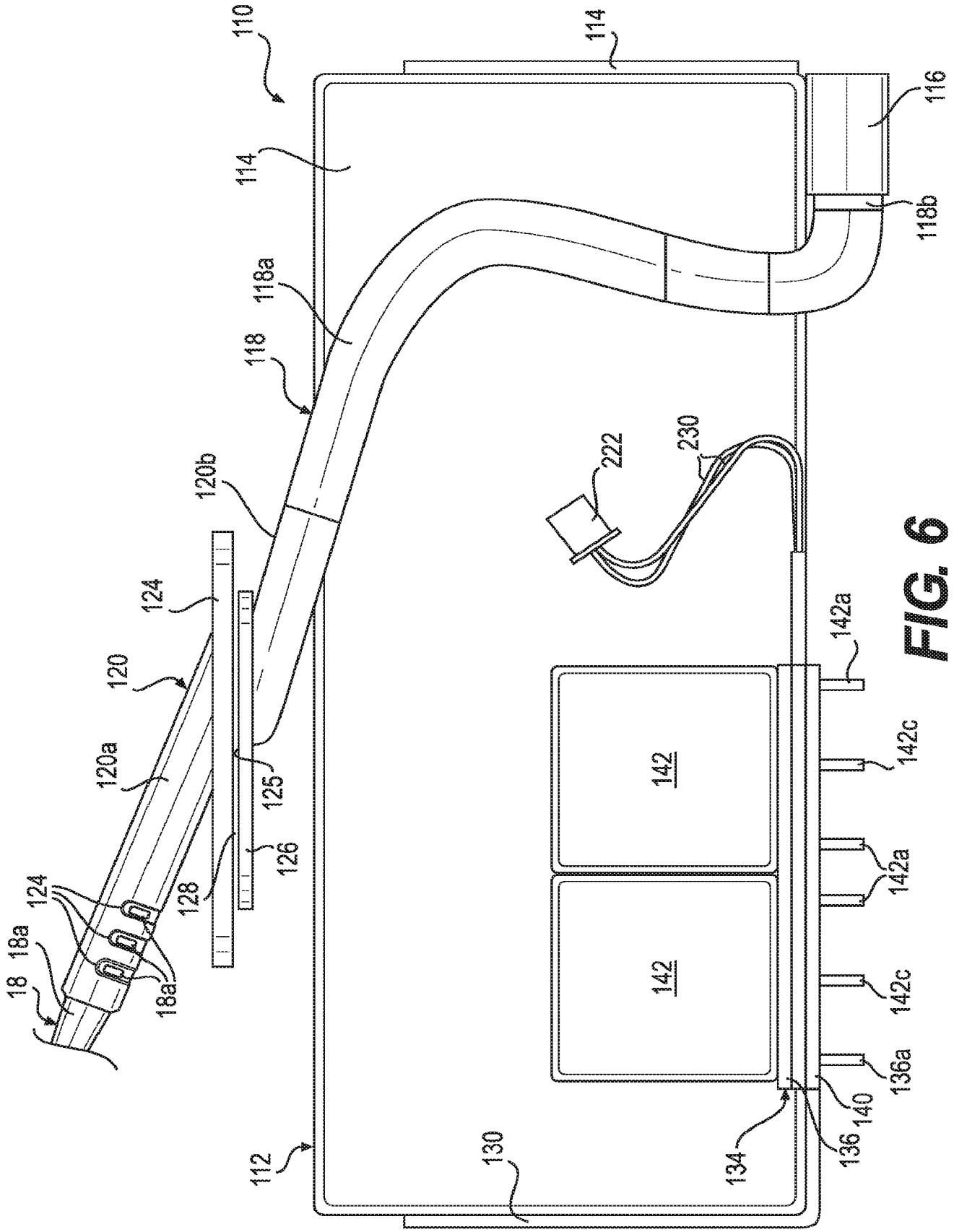

110
114
116
114
118b
118a
118
230
222
120b
124
120
142a
120a
142
142c
125
126
142a
128
124
18a
142c
18
18a
136a
140
136
134
112
130

FIG. 6

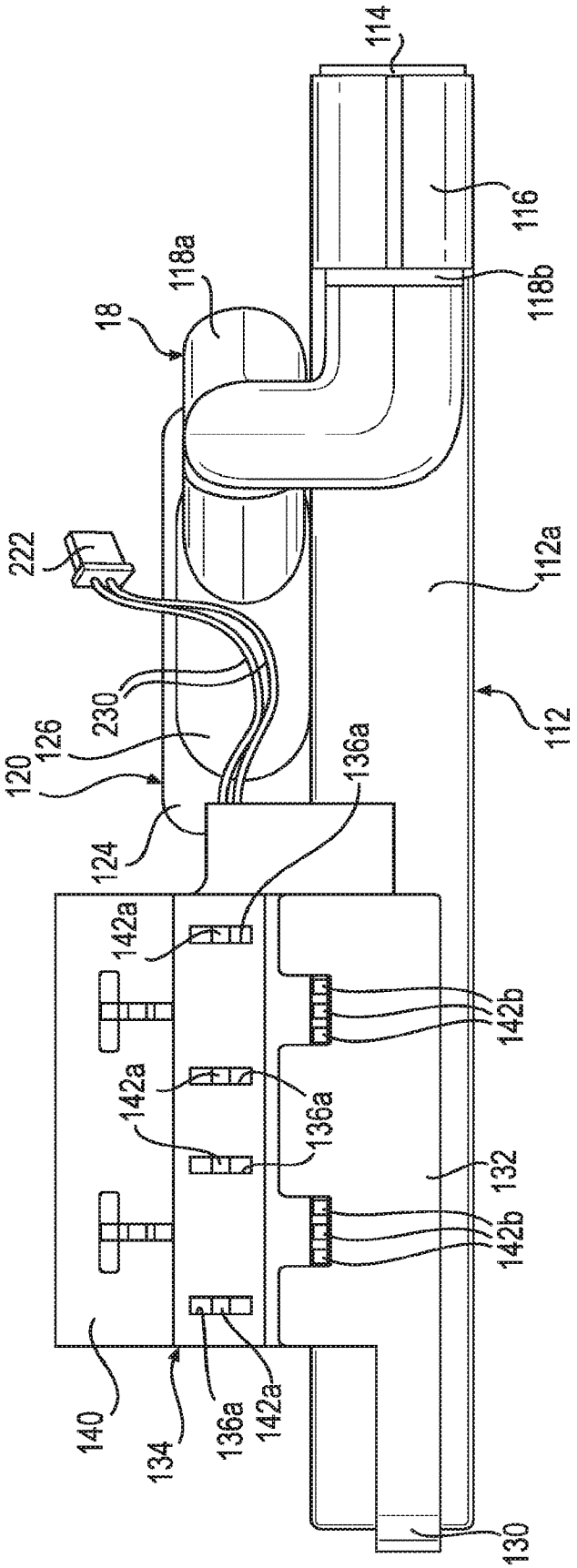

114
116
118a
118b
18
222
112a
230
126
120
112
136a
124
142a
142b
142a
136a
132
142b
140
134
136a
142a
130

FIG. 7

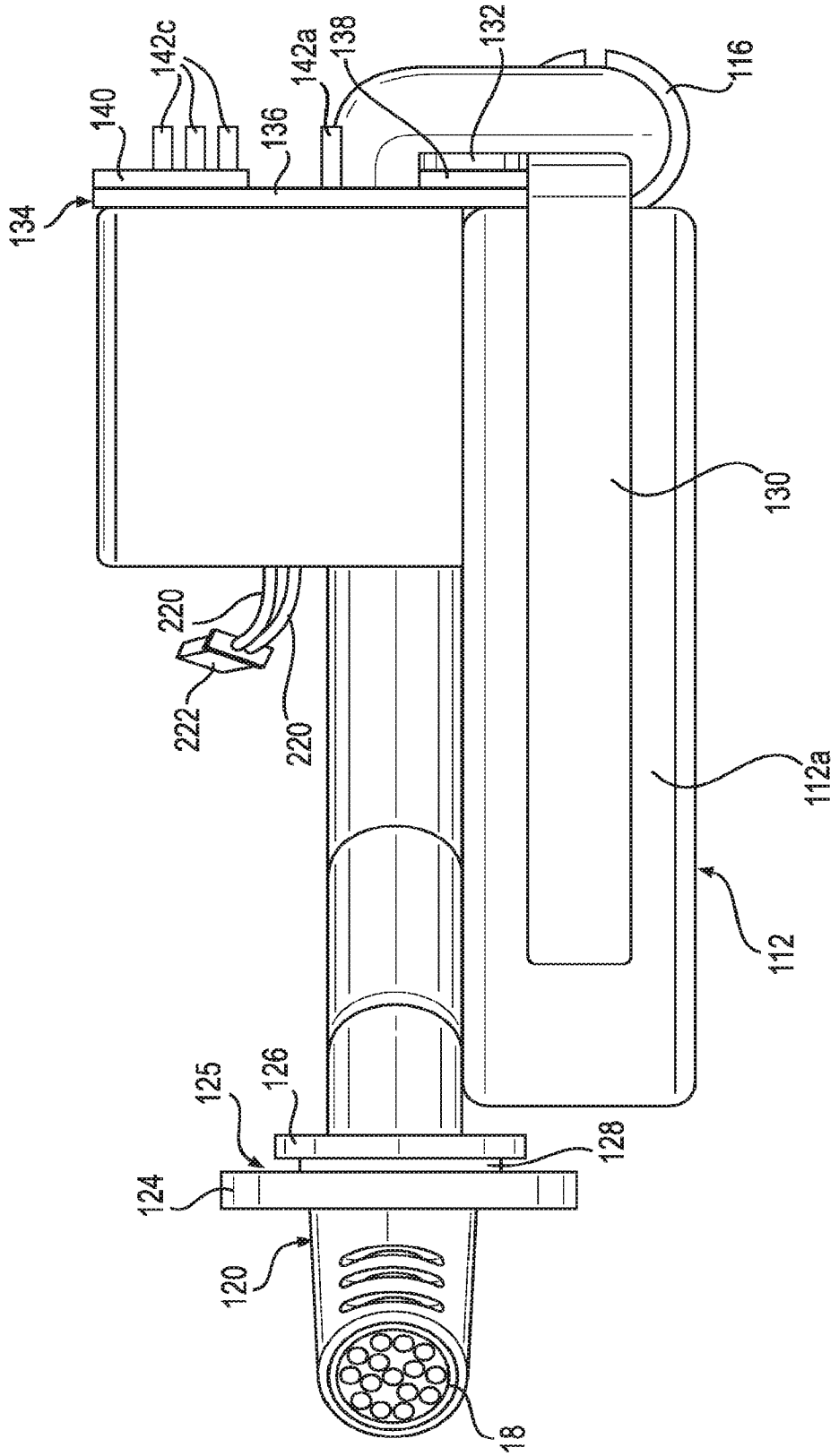

142c
142a
138
132
116
140
136
134
130
220
222
220
112a
112
125
126
128
124
120
18

FIG. 8

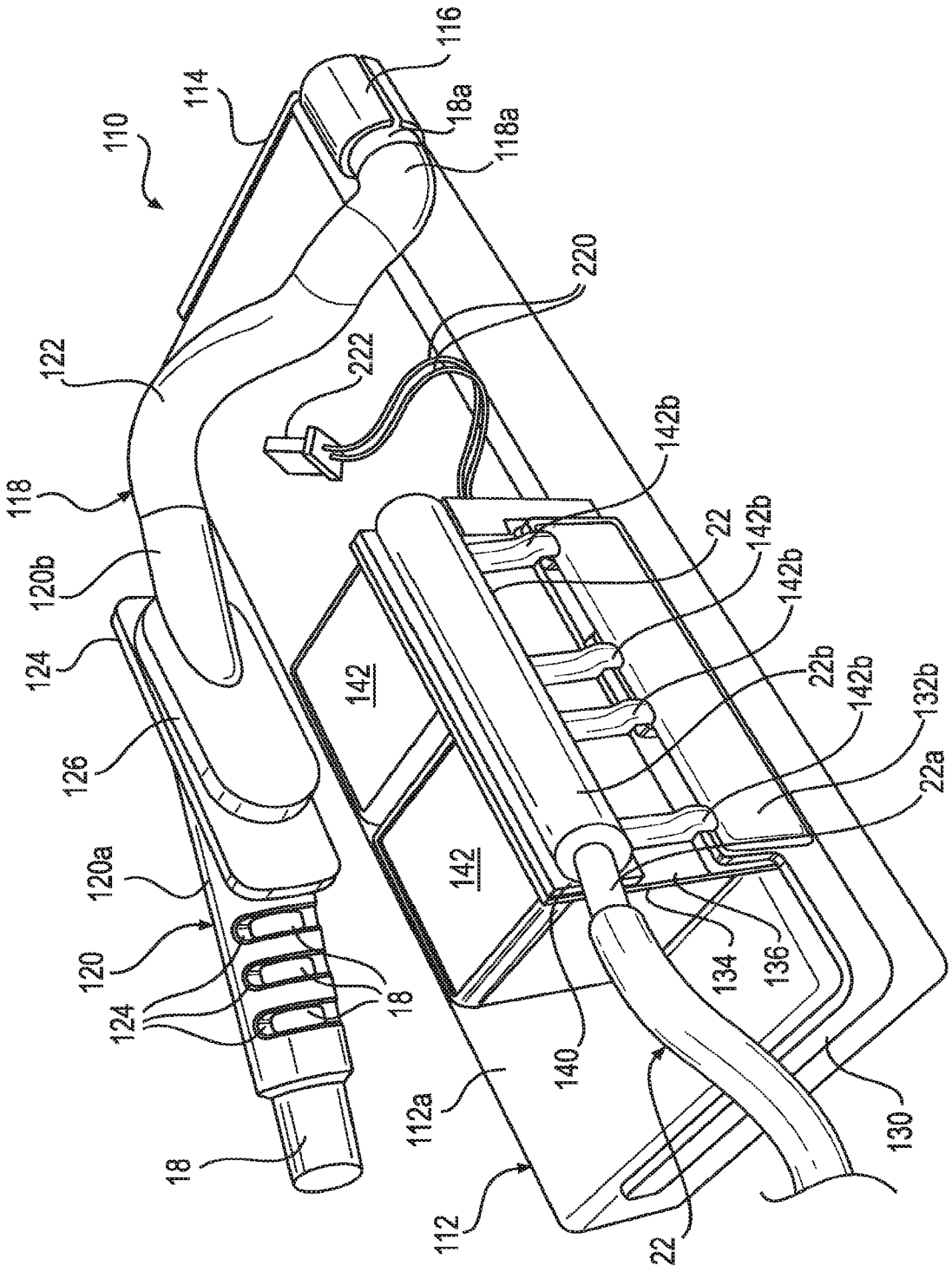

110
114
116
18a
118a
220
222
122
118
142b
22
120b
124
126
142
120a
120
18
112a
140
112
130
132b
22a
22b
134
136

FIG. 9

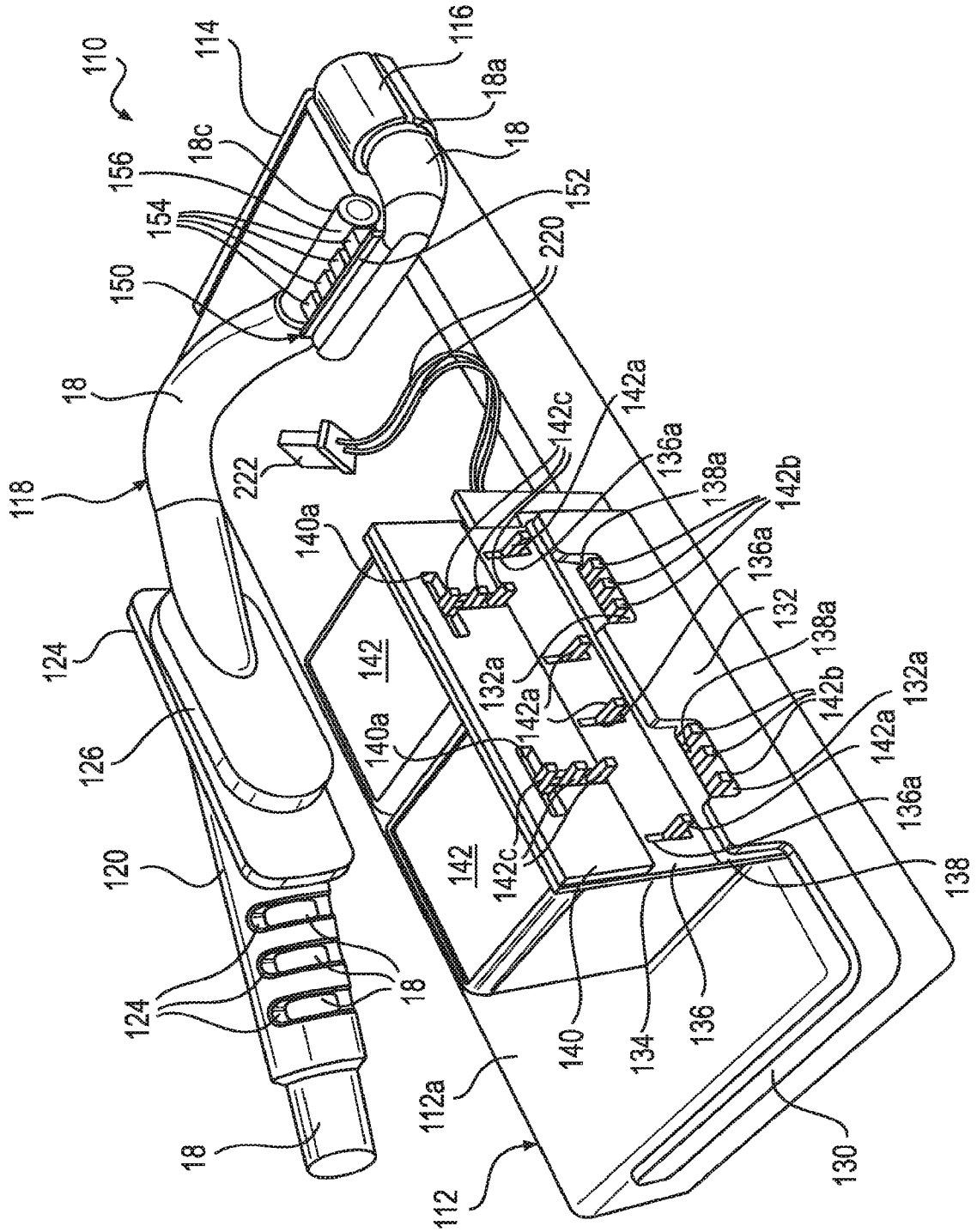

110
114
116
18a
18
18c
156
154
152
150
220
18
222
142a
142c
136a
138a
142b
118
140a
142
132
132a
124
126
120
112a
140
134
136
138
130
112

FIG. 10

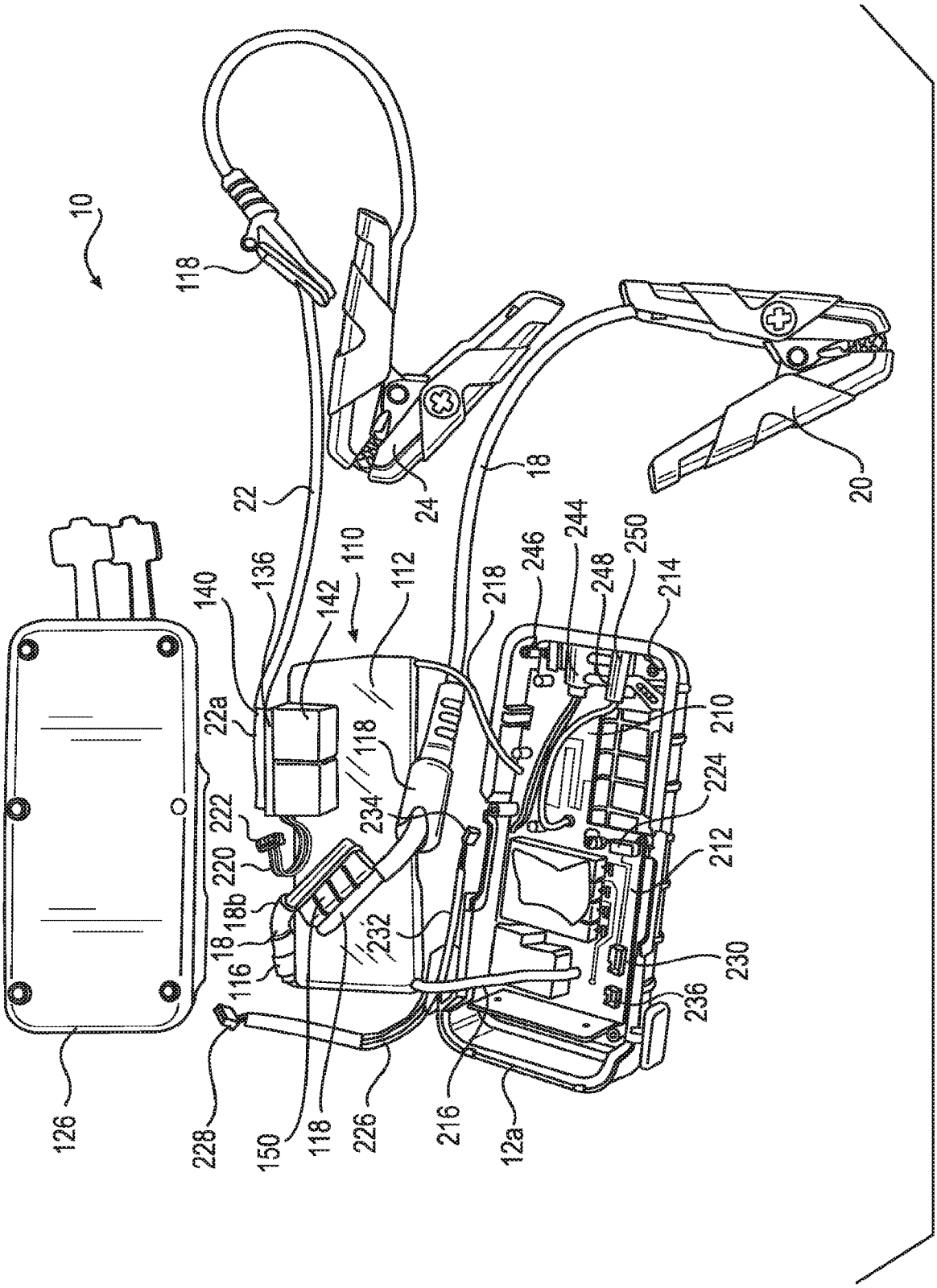

10
118
22
24
18
20
140
136
142
110
112
218
246
244
248
250
214
210
224
212
230
236
22a
222
220
18b
18
116
234
232
126
228
150
118
226
216
12a

FIG. 11

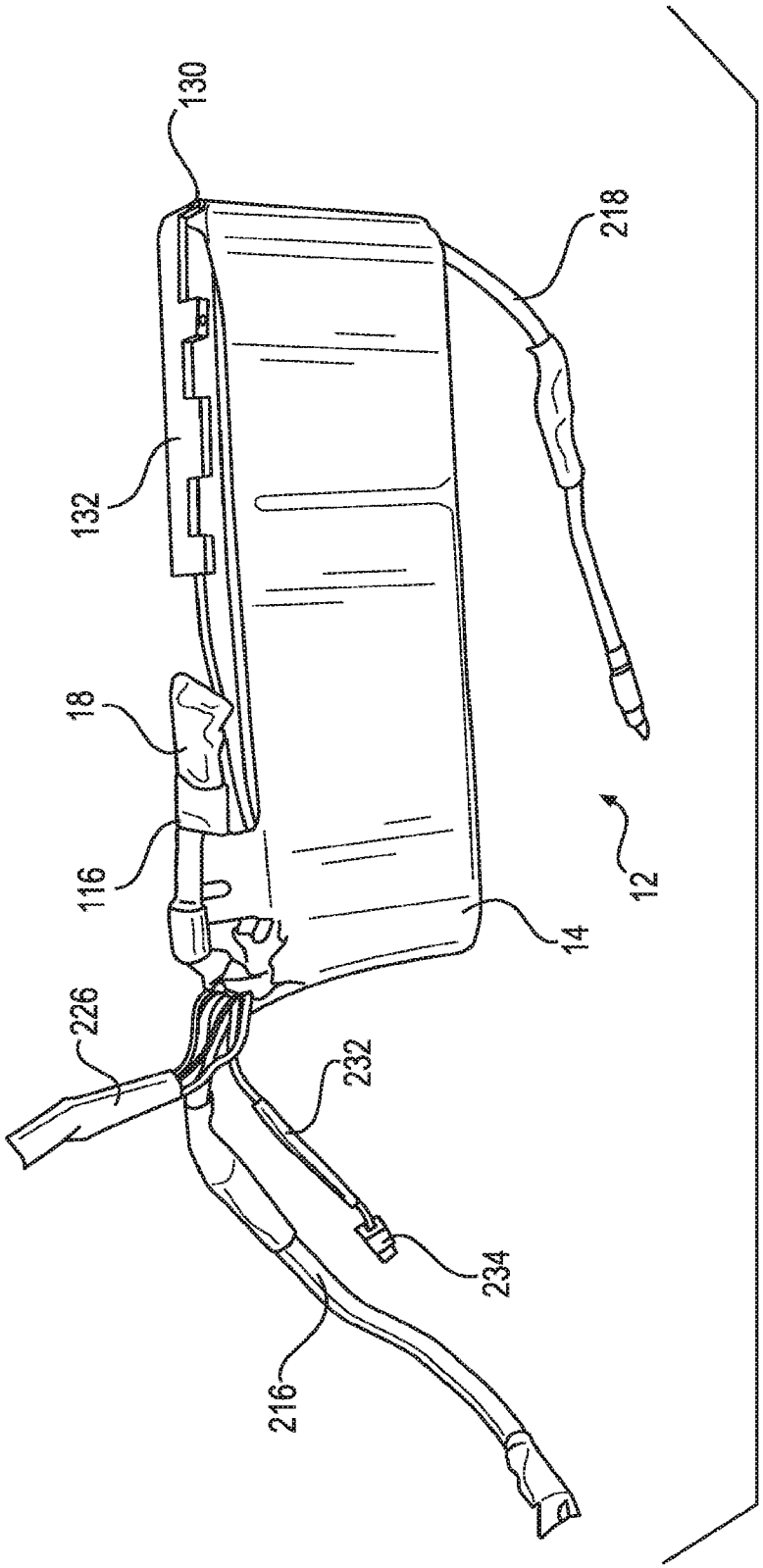


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/024680

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/00, H02J 7/14 (2016.01)
CPC - H02J 7/0054, H02J 7/0034, H02J 7/0042, H02J 7/0047, H02J 7/0052, H02J 2007/0095 (2016.02)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H02J 7/00, H02J 7/14 (2016.01)
CPC - H02J 7/0054, H02J 7/0034, H02J 7/0042, H02J 7/0047, H02J 7/0052, H02J 2007/0095 (2016.02)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 320/103, 104, 105, 107 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Orbit, Google Patents, Google Scholar
Search terms used: battery, jump start, portable, relay, L-shaped, conductor, bus, bar, isolation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,002,235 A (CLORE) 14 December 1999 (14.12.1999) entire document	1-15
Y	US 9,007,015 B1 (THE NOCO COMPANY) 14 April 2015 (14.04.2015) entire document	1-15
Y	US 6,679,708 B1 (DEPP et al.) 20 January 2004 (20.01.2004) entire document	1-15
Y	US 2015/0087182 A1 (TYCO ELECTRONICS CORPORATION) 26 March 2015 (26.03.2015) entire document	2, 3, 8-15
Y	US 4,990,723 A (ZIBERNA et al.) 05 February 1991 (05.02.1991) entire document	13
Y	US 2005/0213867 A1 (RAJENDRAN et al.) 29 September 2005 (29.09.2005) entire document	14, 15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2016	24 JUN 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 June 2012 (21.06.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/080996 A1

(51) International Patent Classification:
H01M 2/20 (2006.01) *H01M 10/052* (2010.01)
H01M 10/44 (2006.01) *H01R 11/24* (2006.01)
H01M 10/46 (2006.01) *H01M 4/58* (2010.01)

(21) International Application Number:
PCT/IE2011/000066

(22) International Filing Date:
14 December 2011 (14.12.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2010/0785 16 December 2010 (16.12.2010) IE

(71) Applicant *(for all designated States except US)*: **JTM POWER LIMITED** [IE/IE]; 20 Village Mill, Enterprise Park, Rathnew, Country Wicklow (IE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **TRACEY, James** [IE/IE]; 8 Sandy Lane, Ballymoney, Gorey, County Wexford (IE). **MAGUIRE, Damien** [IE/IE]; 26 Burnaby Court, Greystones, County Wicklow (IE). **O'DONOVAN, John** [IE/IE]; Siochain, Kilmurray, Gorey, County Wexford (IE).

(74) Agents: **O'BRIEN, John, A.** et al.; c/o John A. O'Brien & Associates, Third Floor, Duncairn House, 14 Carysfort Avenue, Blackrock, County Dublin (IE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH,

[Continued on next page]

(54) Title: A JUMP STARTER

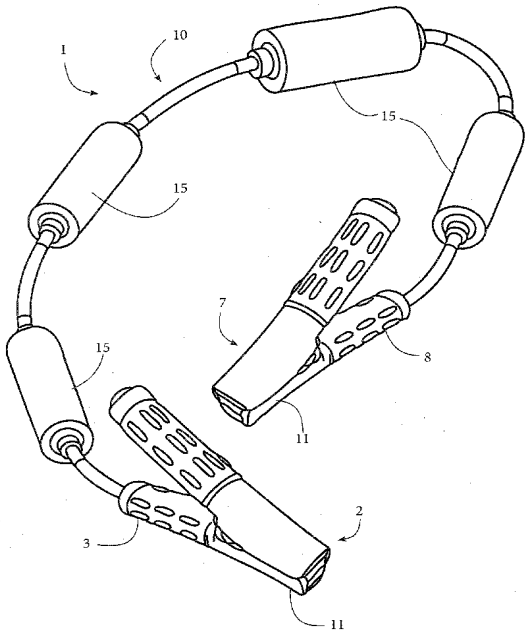


Fig.1

(57) Abstract: A jump starter (1, 30, 50) for a flat battery, such as a vehicle battery has a first clip (2, 20) having. a first handle (3, 25) for connection to one terminal (4) of a battery (5); a second clip (7, 21) having a second handle (15, 25) for connection to a second terminal of a battery, The clips are interconnected (10, 28, 53) and on-board starter batteries (15, 26) are provided along the interconnecting cable (10) and/or at least one of the clips (20, 21). The on-board starter battery (15, 26) may comprise a lithium iron phosphate battery. There may be a control circuit (100, 200) to prevent damage from events such as accidental shorting of the clips.

WO 2012/080996 A1

GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

"A Jump Starter"

INTRODUCTION

Field of the Invention

This invention relates to a jump starter system for a battery, especially a vehicle battery.

Prior Art Discussion

Jump starter systems for jump starting a flat vehicle battery comprise a pair of leads, each with a clip such as a crocodile clip at each end to connect with the terminals of the flat battery and a charged battery of another vehicle. One lead connects the positive terminal of the flat battery to the positive terminal of a charged battery and a second lead connects the negative terminal of the flat battery to the negative terminal of the charged battery.

Such systems are effective. However in many cases a vehicle with a charged battery is required and it is often difficult to arrange the vehicles to allow the leads to safely extend between the batteries.

It is also known to provide starter packs comprising a lead acid battery within a battery housing and leads for extending from the battery housing to the terminal of the flat battery. Such units are costly, bulky, and heavy, and can generally only be used for large scale commercial applications. Very often, the unit is not used for some time and the battery charge diminishes so that it is not effective when required.

US5607794, US6002235, US2006/0128209, and US2008/0241653 describe various portable starter systems. In these arrangements, starter cables are connected to a battery.

This invention is directed towards providing an engine jump starter system which will address these issues.

SUMMARY OF THE INVENTION

According to the invention, there is provided a jump starter for a battery such as a vehicle battery, the jump starter comprising:-

a first clip having a first handle for connection to one terminal of a battery;

a second clip having a second handle for connection to a second terminal of a battery;

an interconnection means extending between the first clip and the second clip; and

an on-board starter battery means provided along the interconnection means and/or adjacent at least one of the clips.

In one embodiment, the on-board starter battery means comprises a lithium iron phosphate battery.

In one embodiment, there is a plurality of on-board starter batteries along the interconnection means.

In one embodiment, the on-board starter battery means comprises a plurality of separate batteries which are electrically interconnected.

In one embodiment, at least some of the battery means comprises batteries housed within at least one of the first and second handles.

Preferably, said batteries are housed within both the first handle and the second handle.

In one embodiment, the first clip and the second clip are configured to nest together for storage in compact manner.

In one embodiment, the first clip has a housing within which there is a battery, and a pair of jaws linked with the housing; and the second clip is configured to fit alongside the jaws of the first clip in a manner without protruding parts.

Preferably, the first clip has a groove to accommodate the interconnection means during storage.

In one embodiment, the jump starter further comprises a control circuit having positive and negative leads connected between the on-board starter battery and the clips, and protection means to provide over-voltage and/or over-current protection.

In one embodiment, the protection means comprises a current-limiting component.

In one embodiment, the control circuit further comprises a switch in the negative lead which is turned on for use. In one embodiment, the switch is a solid state switch. In one embodiment, the switch comprises a MOSFET switch. In one embodiment, the switch is an SCR. In one embodiment, there is a plurality of switches arranged in parallel.

In one embodiment, a gate of the switch is connected to the positive lead by a user-activated switch. In one embodiment, the user-activated switch is of the type for momentary closing. In one embodiment, the user-activated switch is connected to the gate via a diode, preferably a Zener diode. In one embodiment, the switch is solid state and is reverse biased to prevent current flow if a system to which the clamps are connected attempts to return charge.

In one embodiment, the protection means comprises a circuit to short gate current to ground in the event of accidental reverse polarity connection.

In one embodiment, the positive lead includes one or more positive thermal coefficient fuses protecting against short circuit conditions and excessive power demands by achieving a very high resistance, thus limiting current flow, and once normal conditions are restored dropping to a low resistance.

In one embodiment, there is a resistor and an LED in parallel with the fuse such that if the fuse resistance goes high almost all of the battery voltage will appear across the resistor thus providing a current flow to illuminate the LED, and when the fuse is in a low resistance state and operating normally the resistor and the fuse are effectively short circuited, providing a visual indication of overload conditions.

In one embodiment, the positive lead includes a bank of switches connected in such a way as to utilise their intrinsic diodes for the purposes of reverse blocking of current, in which gate to source is short circuited, thus holding the switches in a permanent OFF state.

In one embodiment, an RC time constant circuit is linked with the negative lead switch or switches, said time constant circuit being arranged to set the run time of the jump starter and preventing the jump starter from being left in a constant ON condition.

In one embodiment, the time constant circuit is arranged to provide a soft turn on of the jump starter power, preventing transient voltage damage as a result of arcing or high di/dt induced voltages in an electrical system to which the starter is connected.

DETAILED DESCRIPTION OF THE INVENTION

Brief Description of the Drawings

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a perspective view of an engine jump starter system according to the invention;

Fig. 2 is an elevational view of the jump starter system of Fig. 1, in use;

Fig. 3 is a perspective view of another engine jump starter system according to the invention;

Fig. 4 is an enlarged view of the battery connection clips of the jump starter system of Fig. 3;

Fig. 5 is an elevational view of the starter system of Figs. 3 and 4, in use;

Figs. 6 and 7 are perspective views of an alternative starter system ready for use;

Figs. 8 and 9 are perspective views of this system when in the storage position; and

Figs. 10 to 12 are circuit diagrams for circuits of starter systems of various embodiments.

Description of the Embodiments

Referring to Figs. 1 and 2 there is illustrated a jump starter system 1 according to the invention. The jump starter system comprises a first crocodile clip 2 having a first handle 3 for connection to one terminal 4 of a flat vehicle battery 5. The system also comprises a second crocodile clip 7 having a second handle 8 for connection to another terminal 9 of the flat vehicle battery 5. An electrical interconnection lead 10 extends between the first clip 2 and the second clip 7. Each clip has spring biased jaws 11. In the invention there is an on-board starter battery which comprises a plurality of interconnected batteries 15 which may be of the lithium iron phosphate type. The battery cells can be of either cylindrical, prismatic or pouch type. The voltage is between 3.2 and 3.7 V nominal and of lithium iron chemistry.

As illustrated, the on-board starter batteries 15 extend along the interconnection lead 10. They are relatively small and lightweight and can be readily interconnected to form the jump starter system as illustrated.

To jump start a flat battery only one jump lead is required with two simple clip connections 2, 7 to the flat battery 5. Immediate power is supplied to the flat battery 5 without the requirement of another vehicle with a charged battery. The unit is lightweight and easily stored, for example, in a vehicle boot or glove compartment. The system has superior starting ability, lifespan, and energy retention than other jump starter systems.

Referring now to Figs. 3 to 5 there is illustrated another jump starter system, 30, according to the invention. In this case, clips 20, 21 have the clip jaws 11 and have handles 25 of cylindrical shape. In this embodiment there are two batteries 26 housed within each handle 25, and finger-gripping features 27 are provided to aid user operation. The clips are interconnected by a cable 28, with no need for batteries along the length of the cable in this case.

Referring to Figs. 6 to 9 an alternative jump starter, 50, is shown. The jump starter 50 comprises a first clip 51 and a second clip 52 interconnected by a power cable 53. The first clip 51 has a

housing 55 for a battery of sufficient capacity to provide the full starting power, in this embodiment of the lithium iron phosphate type. Also, the first clip 51 comprises a pair of jaws 56 having finger grips 57 for pressing together for opening and closing. The housing 55 has a groove along one side to accommodate the cable 53 during storage. The clip 52 has a similar pair of jaws 56 with finger grips 57.

The starter 50 is used with the clips 51 and 52 separate as shown in Figs. 6 and 7. Power is provided by the batteries within the housing 55. When not being used, the second clip 52 nests into the first clip 51 alongside the jaws 56 of the first clip 51, as shown in Figs. 8 and 9.

The jump starter 50 involves use of close-proximity high-power batteries of the lithium iron phosphate type. In this case it is more important to provide safety controls, and this is achieved by use of a control circuit in the housing 55. Figs. 10, 11, and 12 illustrate circuits 100, 200, and 300 respectively which may be used in the starter of any embodiment. In this case the starter 50 employs the circuit 300, however it may employ a different circuit depending on the safety requirements and battery types and capacities.

Referring to Fig. 10 the circuit 100 comprises batteries 102, a positive lead 103 with a clamp conductor 104, and a negative lead 105 with a clamp conductor 106. In the positive lead there is a light emitting diode LED2 and a resistor R3 in parallel with a positive thermal coefficient (PTC) resettable fuse 110.

An integrated circuit IC1 is connected via a resistor R2 to the positive lead 103 and is connected to the negative lead 105 via reverse polarity indicator (LED1). Also, a manual contact switch 115 (SW1) is connected on one side to the positive lead 3, and on the other to a Zener diode ZD1, a resistor R1, in turn linked with a bank of MOSFET switches Q1, Q2, and Q3.

The circuit of the jump starter circuit 100 protects from voltage mismatch, reverse polarity, short circuit, over-discharge, and over-use.

The over-current protection element PTC 110 comprises a number of parallel connected positive thermal coefficient PCB mounted resettable fuses. The number and type thereof is determined by the power output requirement. The PTC 110 enables normal usage but protects against short circuit conditions and excessive power demands by achieving a very high resistance, thus

limiting current flow. Once normal conditions are restored, the PTC 110 drops to a low resistance. Light emitting diode LED2 and 1k 0.25w resistor R3 provide an over-current indicator. When the PTC 110 goes high resistance, almost all of the jump starter battery 102 voltage will appear across this device thus providing a current flow to illuminate LED2. When the PTC 110 is in a low resistance state and operating normally, R3 and LED2 are effectively short circuited.

The battery 102 positive terminal is also connected to the momentary action single pole normally open switch SW1 115. This switch, the Zener diode ZD1, the resistor R1 and Metal Oxide Semiconductor Field Effect Transistors (MOSFETS) Q1 to Q3 comprise the power-switching and over-discharge elements.

To activate the jump-starter system it must be connected to a vehicle battery by means of the positive and negative jaws 56 linked to the conductors 104 and 106. The activation switch 115 (SW1) is then briefly depressed. This switch may be located at any convenient location of the housing Current flows from the battery (BAT) via ZD1 and R1 to the gates of International Rectifier IRF1324s MOSFETS (or alternates) Q1, Q2 and Q3 via their respective gate resistors R4, R5 and R6. Capacitor C1 is also charged. Once a Vgs of 10V is applied to the MOSFETS Q1, Q2, and Q3 they begin conducting from drain to source with a very low ON state resistance, typically about 0.00033 Ohms for three parallel connected parts.

After the PTC, the positive supply lead 103 is connected to another trio of International Rectifier IRF1324s MOSFETS (or alternates) Q4, Q5 and Q6. These devices are connected in such a way as to utilise their intrinsic diodes for the purposes of reverse blocking of current. The gate to source is short circuited, thus holding the devices in a permanent OFF state. Should the jump starter circuit 100 be connected to a vehicle with a greater voltage than the unit is intended for, the diodes become reverse biased and no current may flow. This feature protects the jump-starter's internal battery 102 from potentially dangerous overcharge conditions.

Once a successful start has been achieved, the vehicle alternator or charging system will attempt to return charge to the still-connected jump-starter battery 102 (BAT) via the crocodile clamp jaws 56. This could be undesirable for certain battery types. Should this situation occur, the intrinsic diodes in Q4, Q5 and Q6 will become reverse biased, thus preventing this condition

A resistor R7 and a capacitor C1 form an RC time constant circuit. When the switch 15 (SW1) is depressed, C1 rapidly charges via R1. Once in an ON state the gate to source resistance of the MOSFETS is very high, in the order of tens of mega Ohms. Thus the run time of the jump starter circuit 100 can be configured by choice of C1 and R7. Once SW1 is released, C1 begins to discharge via R7. When the voltage across C1 drops below the gate threshold voltage of the MOSFETS, they will rapidly come out of conduction and switch off the output. This auto – off feature prevents the unit from being left in a constant ON condition with resultant live crocodile clamps.

The RC circuit of R7 and C1 provides another important element. As the voltage across C1 will require a certain time to reach the gate threshold voltage of the MOSFETS Q1, Q2, and Q3, they will spend a small amount of time in their active region and provide a soft turn on of the jump starter circuit 100 power. This prevents transient voltage damage as a result of arcing or high di/dt induced voltages in the vehicle electrical system.

The circuit also protects against accidental reverse polarity connection. Should the operator inadvertently connect the jump starter circuit 100 backwards to the vehicle battery (i.e. positive clamp 4 to negative terminal and vice versa), the system offers two levels of protection. The first level is passive. As the MOSFETS Q1 through Q3 are non-conductive, no current flow takes place upon connection. This eliminates any potentially dangerous and destructive electrical arcing at the vehicle battery terminals. Such arcing conditions have been linked with the destruction of modern vehicle electronic controls. Secondly, current from the vehicle battery flows via the resistor R2, reverse polarity indicator LED1 and the input side of the semiconductor photo-relay type TLP222 (IC1) thus illuminating LED1 and the input photo LED in IC1. Even if the vehicle battery is severely discharged, the current requirement of IC1 is very small and will in most cases be less than 5 mA. Should the user ignore the reverse polarity indicator LED1 and depress SW1, MOSFET gate current is shunted to ground via an output MOSFET in IC1 thus preventing the successful triggering of Q1-Q3 and damage to the vehicle or to the jump starter 1.

The Zener diode ZD1 in the gate trigger circuit protects against excessive discharge of the jump starter battery 102 (BAT). If the battery has been drained past an acceptable point its potential is no longer sufficient to overcome ZD1 and thus no gate current reaches the MOSFETS Q1-Q3.

The jump starter circuit 100 may not then be used until it has been recharged, thus preserving the life of the battery 102.

Unlike other jump starter protection circuits that require a vehicle battery to be present for correct operation, this jump starter circuit 100 can operate with a completely dead battery or none at all. However in this case, reverse polarity detection is not available.

The following are advantageous aspects of the invention.

- Solid state switching. There are no contacts to weld, burn out, or arc.
- Soft switching.
- Electrical transient protection for modern motor vehicle electronics.
- Operator protection from arcing, explosion etc.
- Jump starter product protection from misuse.
- Battery protection. Ensures long life.
- Low component count
- Cost effective
- Passive safety
- Visual indicators of fault conditions
- No possibility of damage through operator error such as short circuit etc.
- Low power dissipation. Can be used with traditional lead acid batteries without power loss.

In other embodiments the role of the switches Q1-Q3 may alternatively be performed by a device such as s silicon controlled rectifier for example. This is a simpler circuit, and also would have the benefit of automatic power off upon disconnection and automatic reverse blocking. Referring to Fig. 11 a circuit 200 has a positive lead 203 with a clamp conductor 204 and a negative lead 205 with a clamp conductor 206. There are a PTC fuse 210, a battery 212, and a momentary switch 215 for performing the same functions as for the circuit 100. However, in this case the switch 215 is linked with an SCR. Other alternatives may include use of insulated gate bipolar transistors (IGBTs) or standard bipolar transistors.

In a still further embodiment, referring to Fig. 12, a 4-cell Lithium iron battery is connected to a positive jump-starter clamp by means of a number of parallel connected positive thermal coefficient (PTC) type resettable fuses. The negative battery lead is directly connected to the

negative jump starter clamp. A warning light emitting diode LED1 and its associated series limiting resistor are connected in parallel with the PTC devices. During normal engine starting operation the PTC devices are cold and exhibit a low resistance thus permitting normal current flow. As there is little voltage drop across the devices in this state, LED1 is extinguished.

Should any of the following fault conditions occur: clamp short circuit, reverse connection to vehicle or incorrect voltage selection, then a larger than normal current flow will result causing the PTC devices to rapidly warm up and exhibit a high resistance thus limiting current flow to a very low level and preventing damage to the jump starter unit or the flat battery. As most of the battery (BAT1) voltage will now be developed across the PTC devices, LED1 is illuminated thus informing the user that a fault condition has occurred. Once the fault is removed, LED1 is extinguished and after a short delay the PTCs return to normal temperature and resistance and normal operation is resumed.

Transient voltage suppression diodes (TVS) D1 and D2 are connected across the output leads. These devices (typical rating of 5kW each) prevent any transient or induced voltages from damaging the vehicle or the starter. Unlike the typical sure protection employed in a traditional jump starter which employs voltage dependent resistor (VDR) type devices, the TVS can respond much quicker and quench much more energy thus providing a better solution.

It will be appreciated that the invention provides for much more convenient jump starting. It allows a user to carry the starter in the vehicle, and avoids need to hook up to another vehicle and all of the attendant disadvantages.

The invention is not limited to the embodiments described but may be varied in construction and detail.

Claims

1. A jump starter for a battery such as a vehicle battery, the jump starter comprising:-

a first clip (2, 20) having a first handle (3, 25) for connection to one terminal (4) of a battery (5);

a second clip (7, 21) having a second handle (15, 25) for connection to a second terminal of a battery;

an interconnection means (10, 28) extending between the first clip and the second clip; and

an on-board starter battery means (15, 26) provided along the interconnection means (10) and/or adjacent at least one of the clips (20, 21).

2. A jump starter as claimed in claim 1, wherein the on-board starter battery means (15, 26) comprises a lithium iron phosphate battery.

3. A jump starter as claimed in claims 1 or 2, wherein there is a plurality of on-board starter batteries (15) along the interconnection means.

4. A jump starter as claimed in claim 1 or 2 or 3, wherein the on-board starter battery means (15, 26) comprises a plurality of separate batteries which are electrically interconnected.

5. A jump starter as claimed in claim 4, wherein at least some of the battery means comprises batteries (26) housed within at least one of the first and second handles.

6. A jump starter as claimed in claim 5, wherein said batteries are housed within both the first handle (25) and the second handle (25).

7. A jump starter as claimed in claims 5 or 6, wherein the first clip (56) and the second clip (56) are configured to nest together for storage in compact manner.

8. A jump starter as claimed in claim 7, wherein the first clip (51) has a housing (55) within which there is a battery, and a pair of jaws (56) linked with the housing; and the second clip (52) is configured to fit alongside the jaws of the first clip in a manner without protruding parts.

9. A jump starter as claimed in claim 8, wherein the first clip (51) has a groove (60) to accommodate the interconnection means (53) during storage.

10. A jump starter as claimed in any preceding claims, further comprising a control circuit having positive and negative leads connected between the on-board starter battery and the clips, and protection means to provide over-voltage and/or over-current protection.

11. A jump starter as claimed in claim 10, wherein the protection means comprises a current-limiting component.

12. A jump starter as claimed in claims 10 or 11, wherein the control circuit further comprises a switch (Qi-Q3) in the negative lead which is turned on for use.

13. A jump starter as claimed in claim 12, wherein the switch is a solid state switch.

14. A jump starter as claimed in claims 12 or 13, wherein the switch comprises a MOSFET switch.

15. A jump starter as claimed in claim 13, wherein the switch is an SCR.

16. A jump starter as claimed in any of claims 12 to 15, wherein there is a plurality of switches (Q1-Q3) arranged in parallel.

17. A jump starter as claimed in any of claims 12 to 16, wherein a gate of the switch is connected to the positive lead by a user-activated switch (115, 215).

18. A jump starter as claimed in claim 17, wherein the user-activated switch is of the type for momentary closing.

19. A jump starter as claimed in claims 17 or 18, wherein the user-activated switch is connected to the gate via a diode (ZD1), preferably a Zener diode.

20. A jump starter as claimed in any of claims 12 to 19, wherein the switch is solid state and is reverse biased to prevent current flow if a system to which the clamps are connected attempts to return charge.

21. A jump starter as claimed in any of claims 17 to 20, wherein the protection means comprises a circuit to short gate current to ground in the event of accidental reverse polarity connection.

22. A jump starter as claimed in any of claims 10 to 21, wherein the positive lead includes one or more positive thermal coefficient fuses (10, 110) protecting against short circuit conditions and excessive power demands by achieving a very high resistance, thus limiting current flow, and once normal conditions are restored dropping to a low resistance.

23. A jump starter as claimed in claim 22, wherein there is a resistor and an LED in parallel with the fuse such that if the fuse resistance goes high almost all of the battery voltage will appear across the resistor thus providing a current flow to illuminate the LED, and when the fuse is in a low resistance state and operating normally the resistor and the fuse are effectively short circuited, providing a visual indication of overload conditions.

24. A jump starter as claimed in any of claims 10 to 23, wherein the positive lead includes a bank of switches connected in such a way as to utilise their intrinsic diodes for the purposes of reverse blocking of current, in which gate to source is short circuited, thus holding the switches in a permanent OFF state.

25. A jump starter as claimed in any of claims 10 to 24, wherein an RC time constant circuit is linked with the negative lead switch or switches, said time constant circuit being arranged to set the run time of the jump starter and preventing the jump starter from being left in a constant ON condition.

26. A jump starter as claimed in claim 25, wherein the time constant circuit is arranged to provide a soft turn on of the jump starter power, preventing transient voltage damage as a result of arcing or high di/dt induced voltages in a electrical system to which the starter is connected.

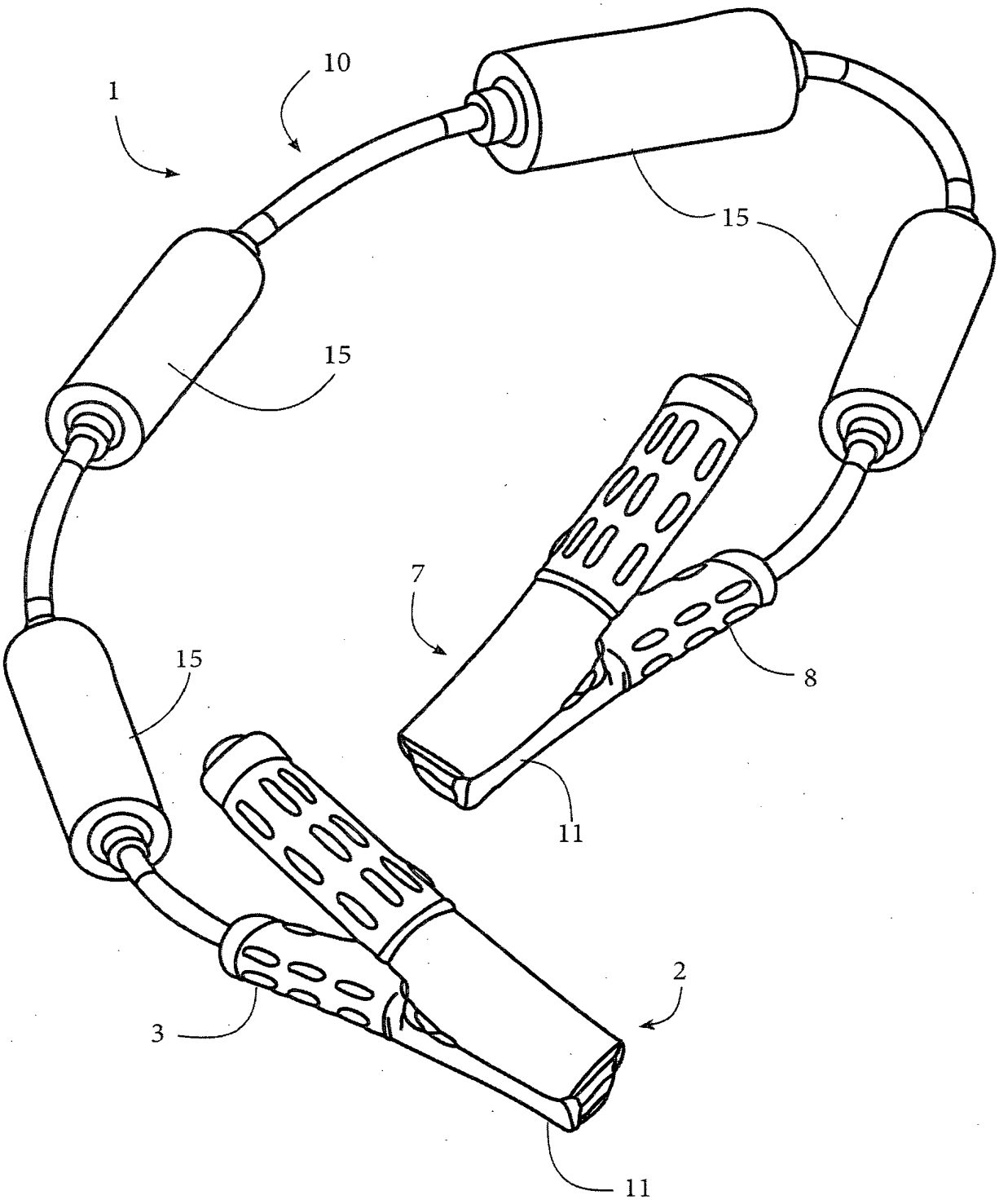


Fig.1

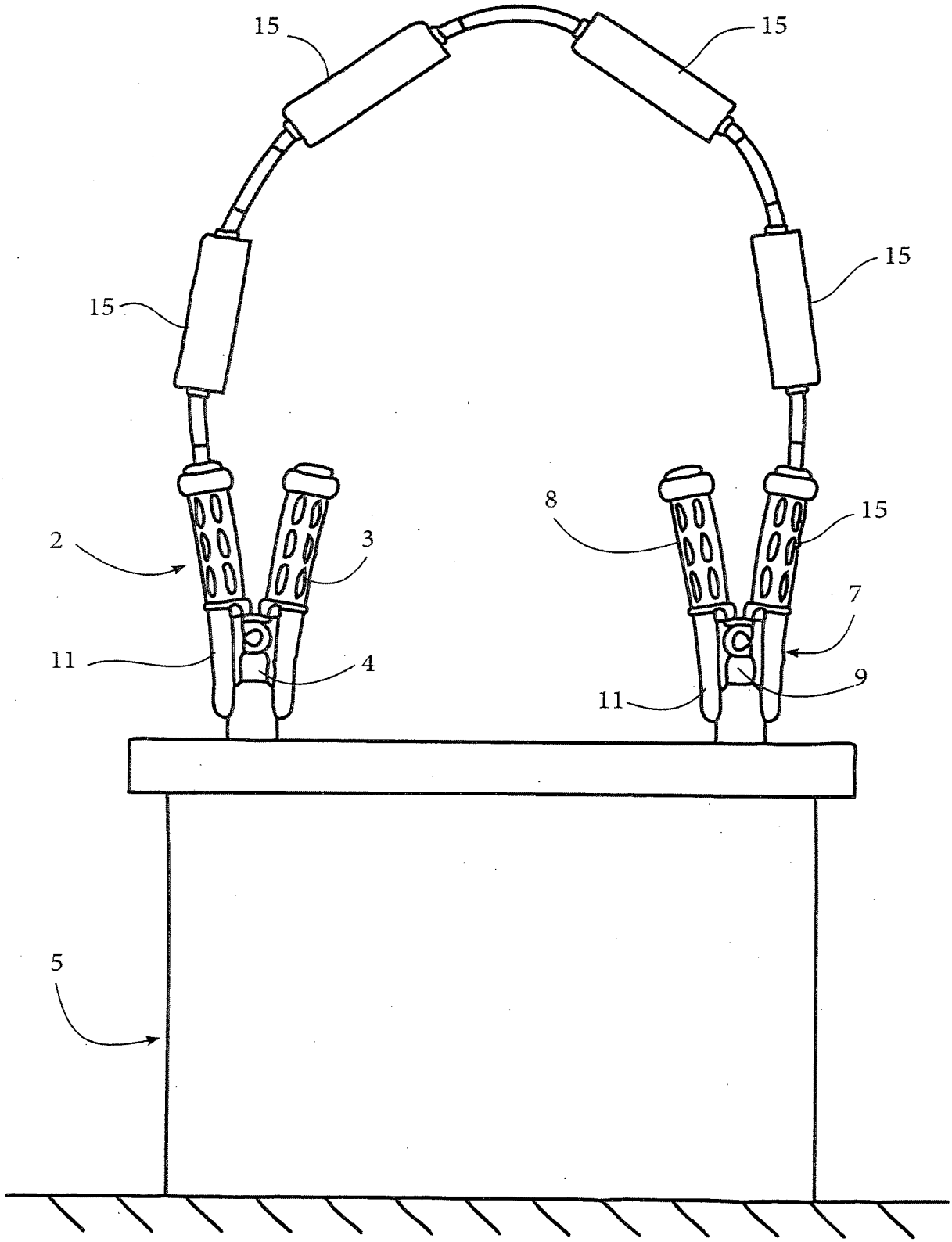


Fig.2

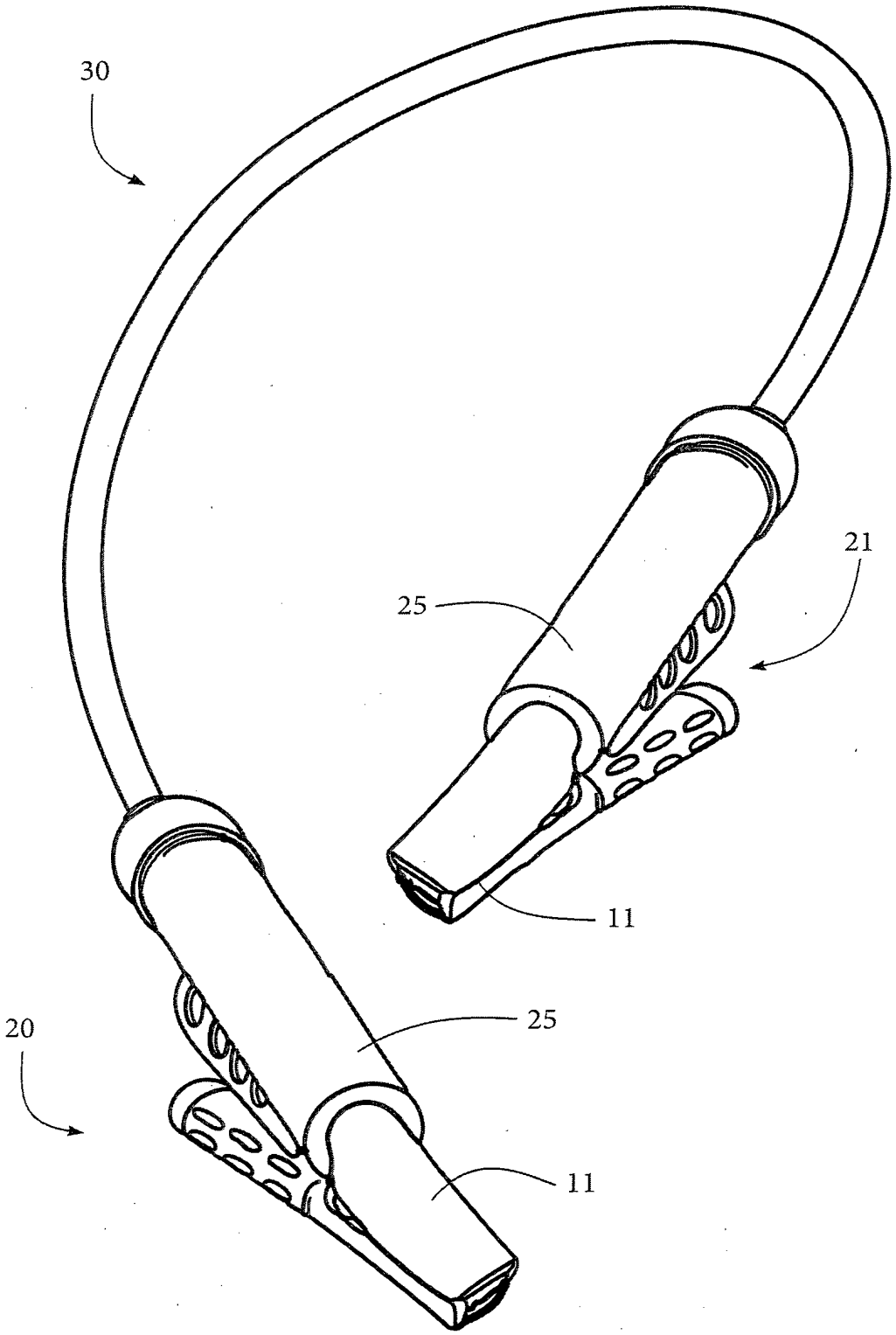


Fig.3

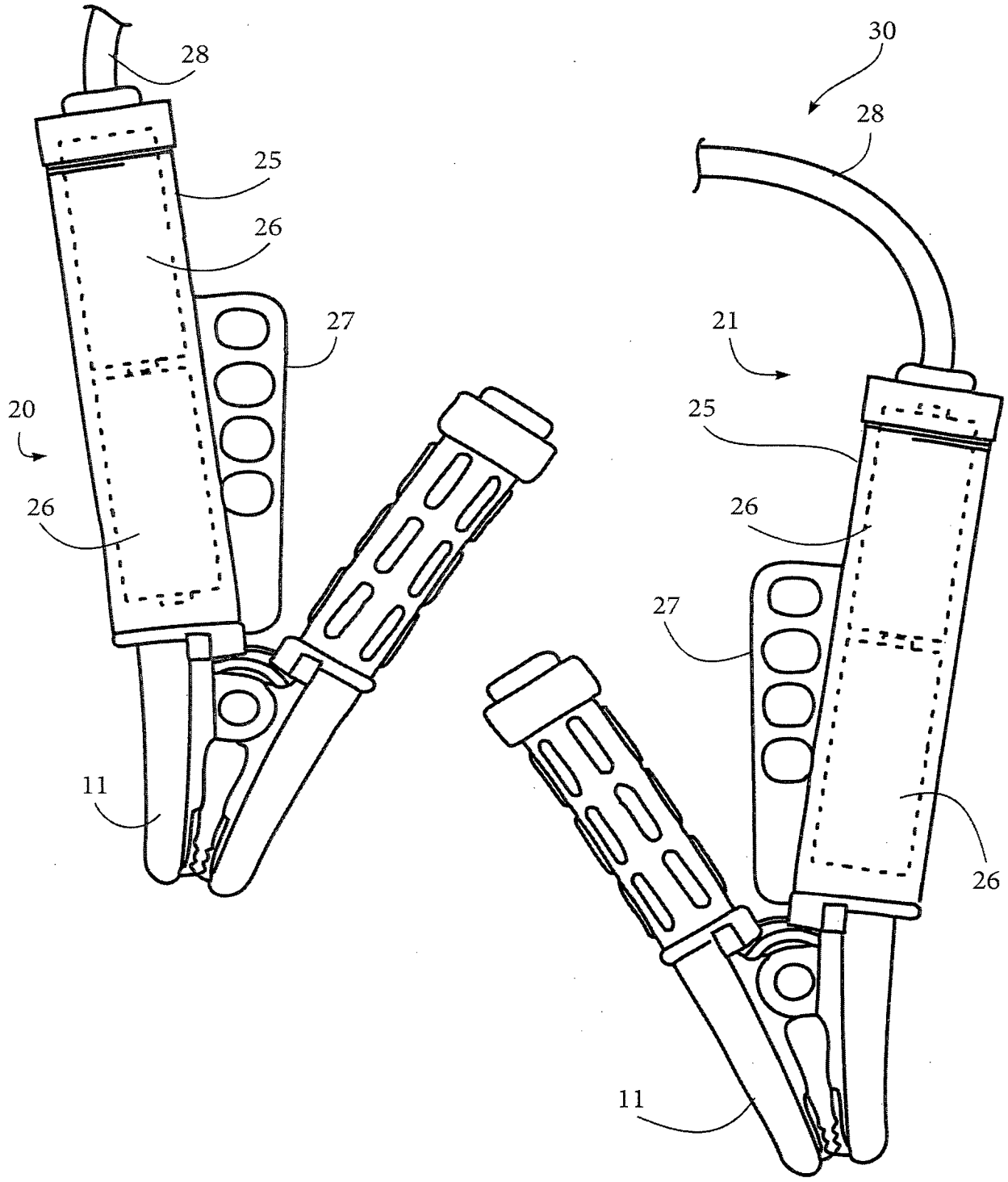


Fig.4

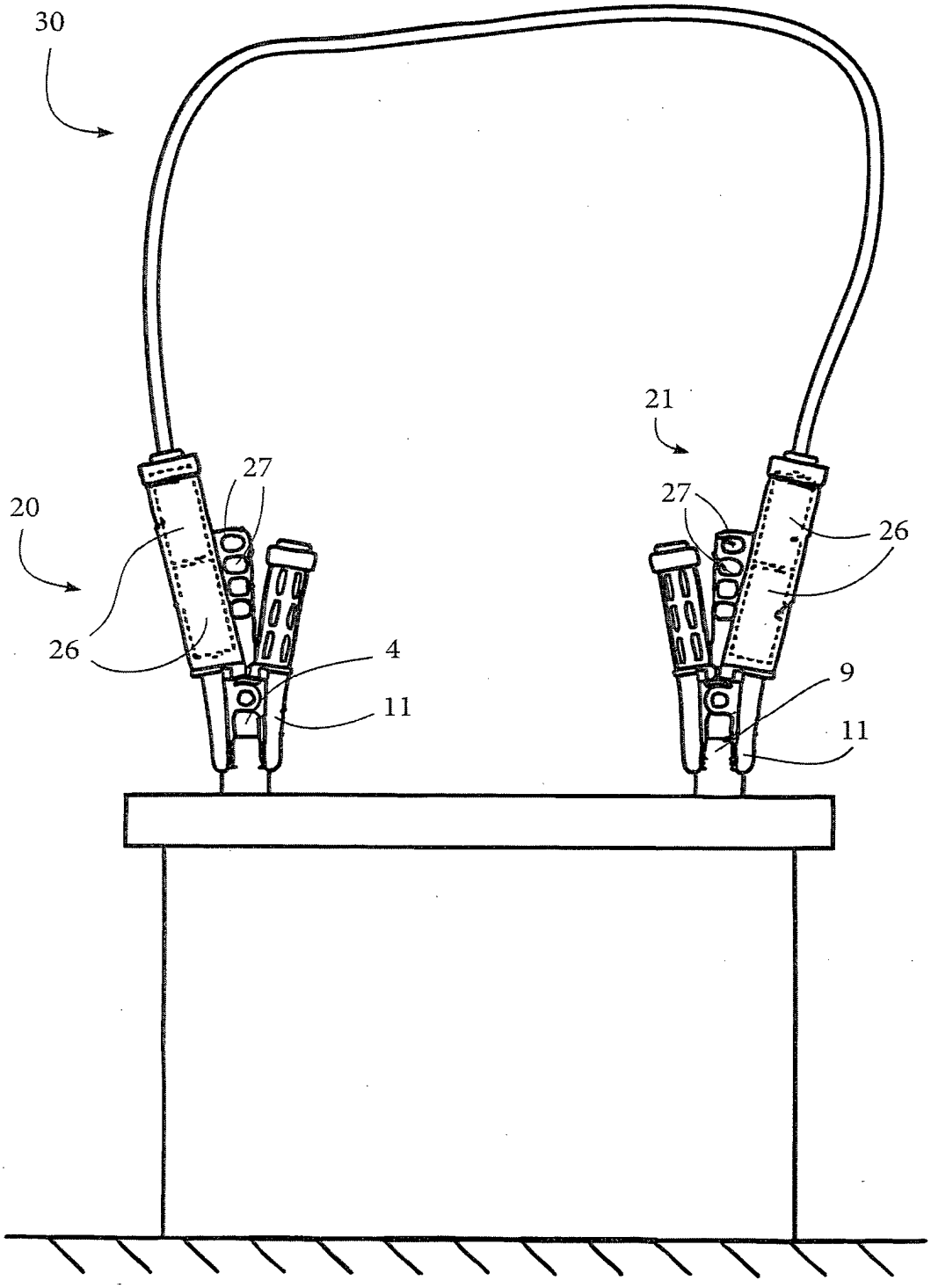


Fig.5

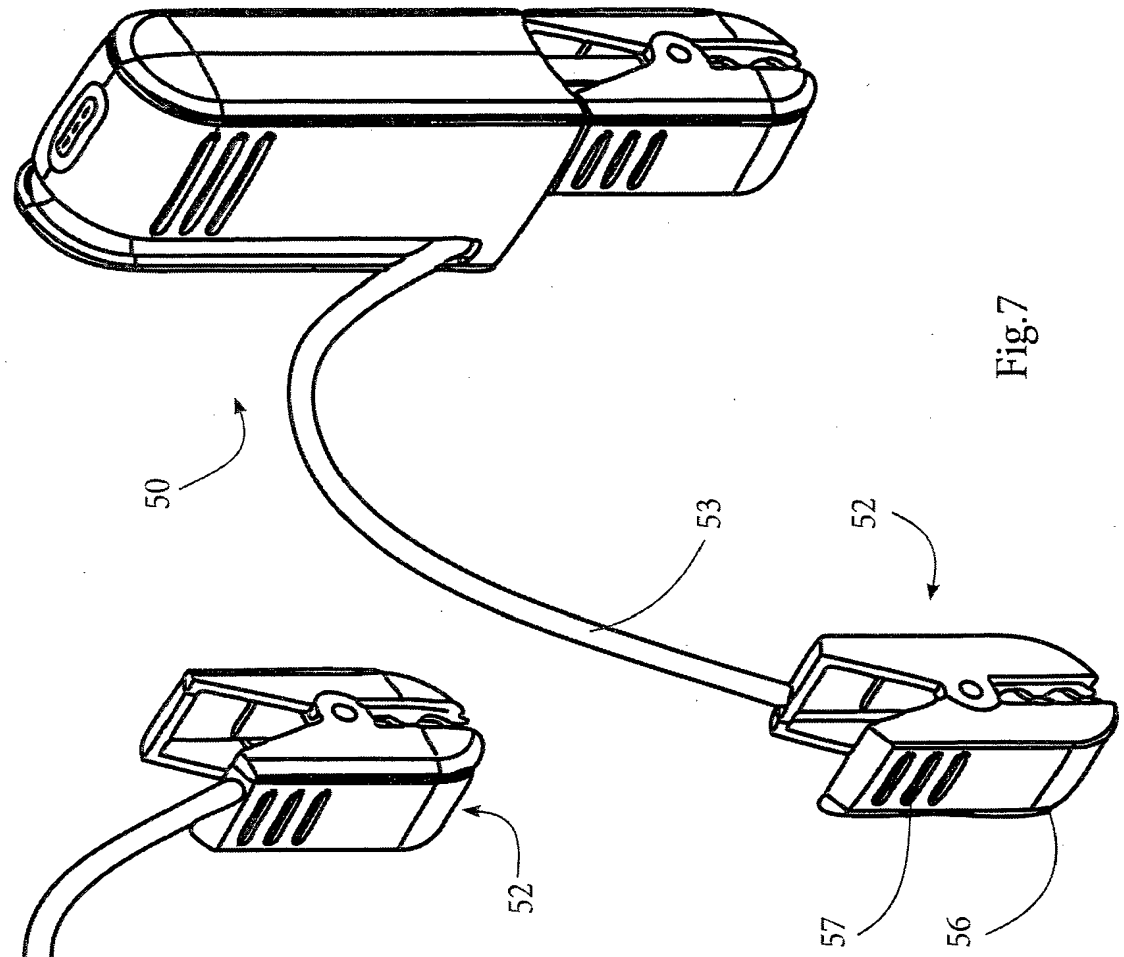


Fig.7

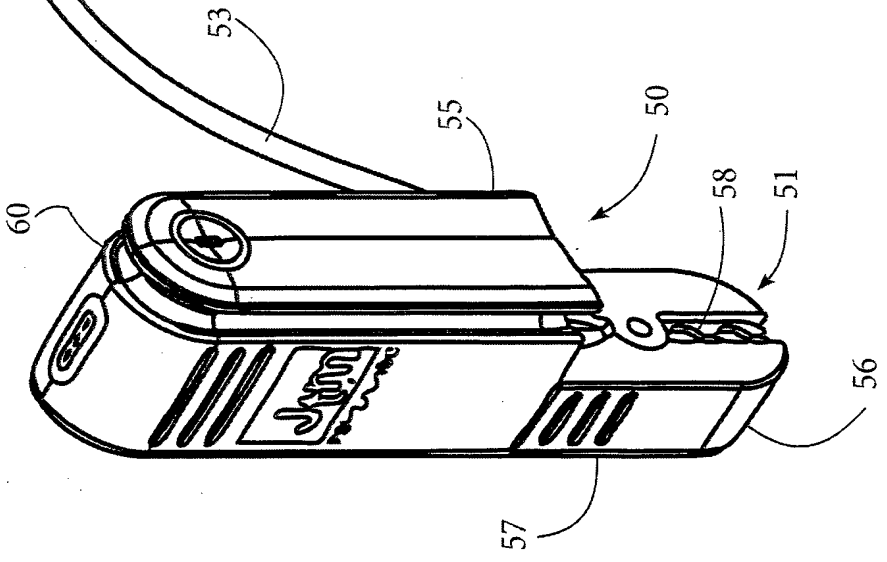


Fig.6

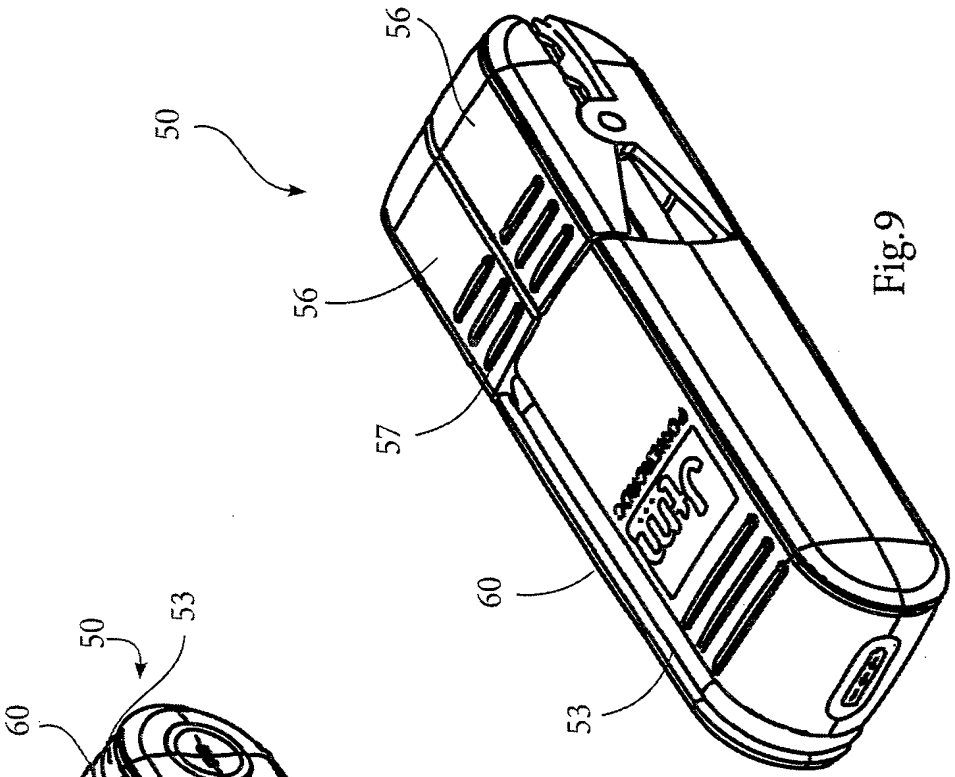


Fig.9

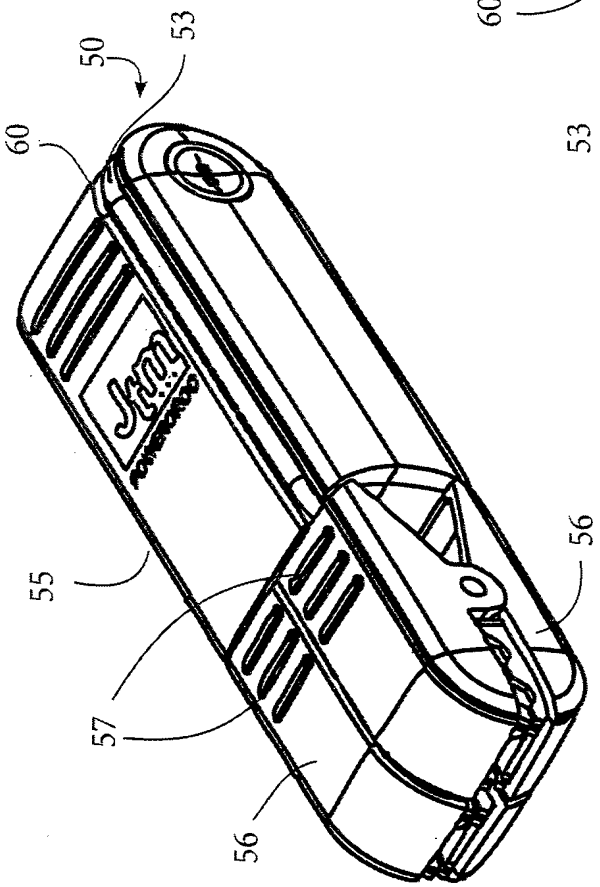


Fig.8

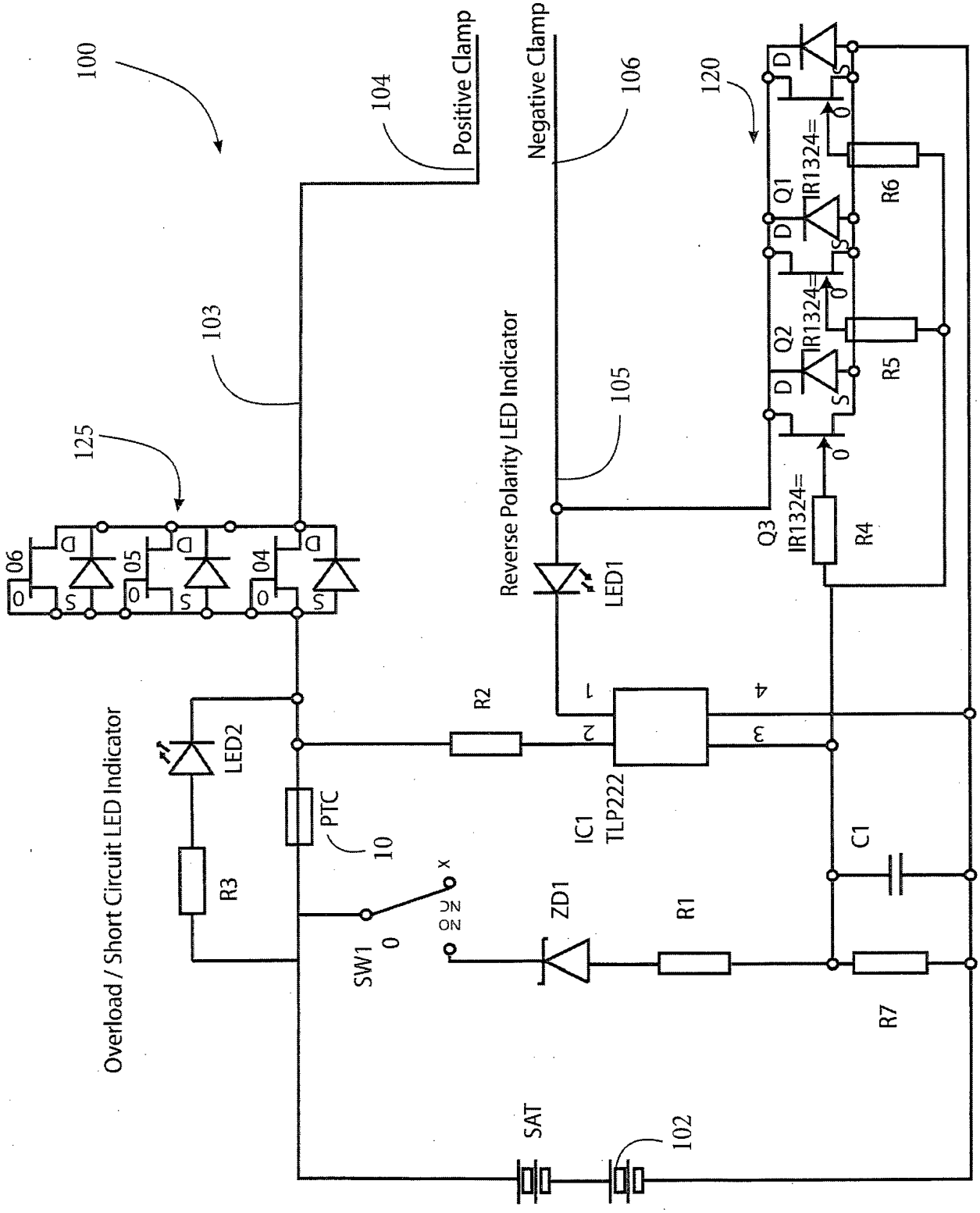

100
104
Positive Clamp
Negative Clamp
106
120
103
125
105
Reverse Polarity LED Indicator
Overload / Short Circuit LED Indicator
LED1
LED2
R2
R3
R4
R5
R6
R7
R1
PTC
10
SW1
IC1
TLP222
ZD1
C1
Q1
Q2
Q3
IR1324=
SAT
102

Fig.10

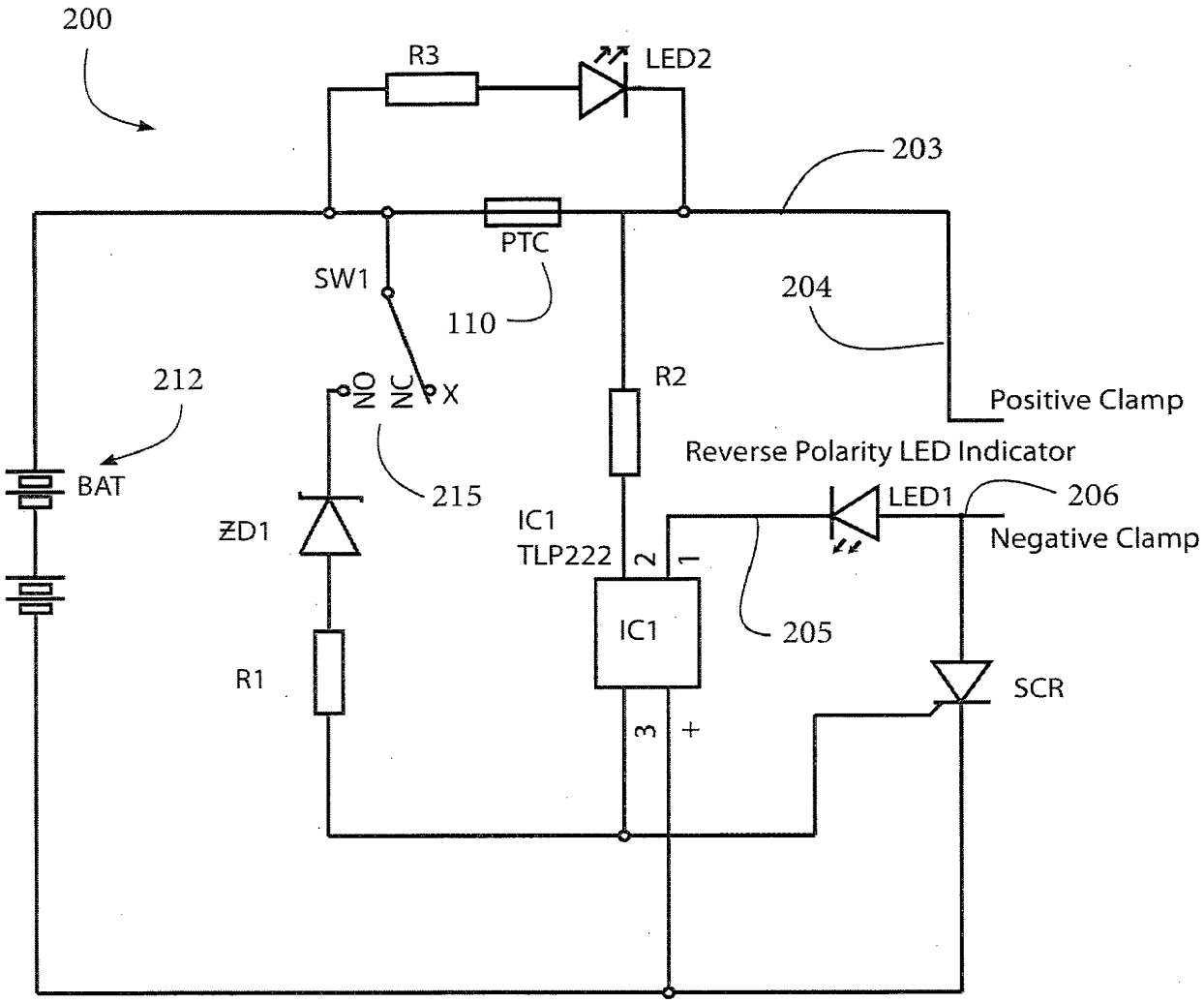

200
R3
LED2
203
PTC
SW1
110
204
212
NO
NC
X
R2
Positive Clamp
Reverse Polarity LED Indicator
BAT
215
LED1
206
ZD1
IC1
TLP222
Negative Clamp
2
1
IC1
205
R1
SCR
3
+

Fig.11

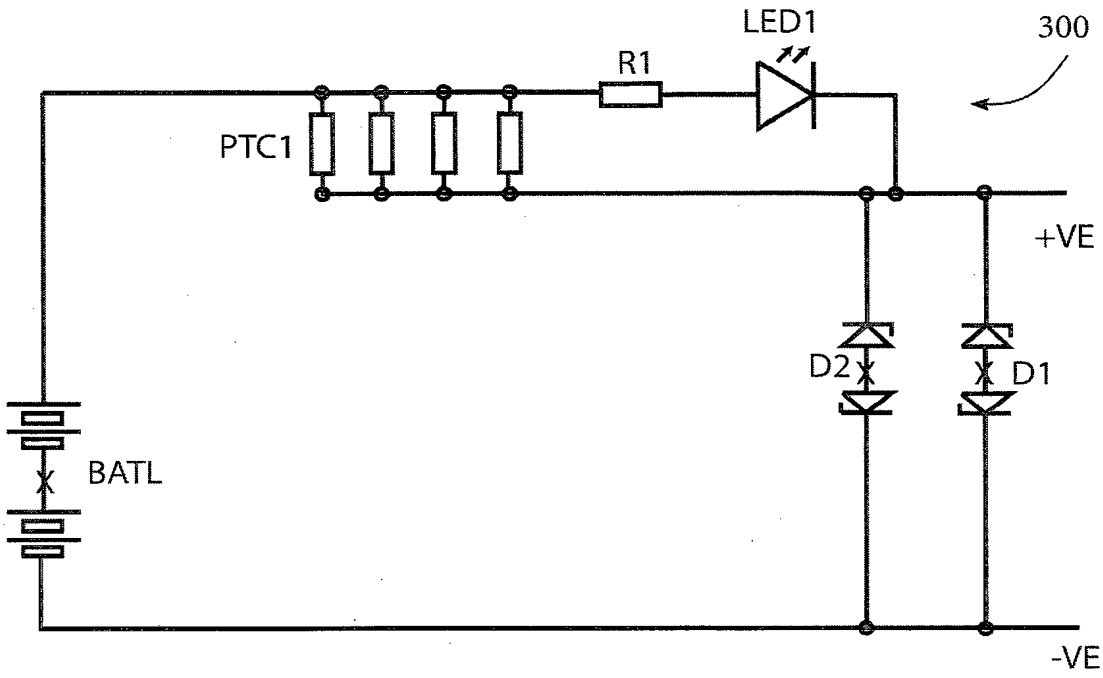


Fig.12

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2011/000066

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01M2/20 H01M10/44 H01M10/46 H01M10/052 H01R11/24
H01M4/58
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 002 235 A (CLORE KEVIN L [US]) 14 December 1999 (1999-12-14) cited in the application	1-4, 10-26
A	abstract column 2, lines 23-59 figures 1-6	5-9

X	US 5 985 481 A (CHAMPAGNE RICHARD F [US] ET AL) 16 November 1999 (1999-11-16)	1-4, 10-26
A	column 2, line 39 - column 4, line 55 figures 1-10	5-9

A	US 5 083 076 A (SCOTT CLYDE A [US]) 21 January 1992 (1992-01-21) abstract figures 1-9 column 1, line 45 - column 2, line 29	1-26

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 February 2012	29/02/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kelly, Michael

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2011/000066

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 840 583 A (MOORE DONALD M [US]) 20 June 1989 (1989-06-20) figures 1-4 abstract column 2, line 6 - column 3, line 44	1-26
A	US 4 163 134 A (BUDROSE CHARLES R [US]) 31 July 1979 (1979-07-31) abstract figures 1-9 column 1, line 43 - column 2, line 29	1-26
A	EP 2 209 153 A1 (HENGDIAN GROUP DMEGC MAGNETIC [CN] HENGDIAN GROUP DMEGC MAGNETIC LTD C) 21 July 2010 (2010-07-21) page 2, paragraph 0001-0005	1-26
A	US 6 254 426 B1 (IACOVELLI MARC [US] ET AL) 3 July 2001 (2001-07-03) column 1, line 48 - column 3, line 14 figures 1-2	1-26

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IE2011/000066

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6002235 A	14-12-1999	NONE	
US 5985481 A	16-11-1999	NONE	
US 5083076 A	21-01-1992	NONE	
US 4840583 A	20-06-1989	NONE	
US 4163134 A	31-07-1979	NONE	
EP 2209153 A1	21-07-2010	AT 543227 T	15-02-2012
		EP 2209153 A1	21-07-2010
		US 2010167127 A1	01-07-2010
US 6254426 B1	03-07-2001	CN 1264191 A	23-08-2000
		DE 19957873 A1	03-08-2000
		GB 2347562 A	06-09-2000
		US 6254426 B1	03-07-2001

Electronic Patent Application Fee Transmittal

Application Number:	17112920
Filing Date:	04-Dec-2020
Title of Invention:	BATTERY CLAMP
First Named Inventor/Applicant Name:	Yun LEI
Filer:	Yichen Cao
Attorney Docket Number:	240001.00005

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	130	130
		Total in USD ($)		**130**

Electronic Acknowledgement Receipt

EFS ID:	46727510
Application Number:	17112920
International Application Number:	
Confirmation Number:	5982
Title of Invention:	BATTERY CLAMP
First Named Inventor/Applicant Name:	Yun LEI
Customer Number:	153979
Filer:	Yichen Cao
Filer Authorized By:	
Attorney Docket Number:	240001.00005
Receipt Date:	30-SEP-2022
Filing Date:	04-DEC-2020
Time Stamp:	04:33:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$130
RAM confirmation Number	E20229T533452795
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	sb0021_IDS.pdf	248414 a148e22e0ecd3eb74cb75e0845f01ee76fca6a3d	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	17112920_IDS.pdf	234508 d72a7734c5dda74705b9529abf9b6f7902730925	no	6
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Foreign Reference	AU081.pdf	2375744 7c8947a4486ae29a2073a903c732f01e4cf4558a	no	65
Warnings:					
Information:					
4	Foreign Reference	AU299.pdf	3484153 49cddc15ddf1ff857e080b174c13c1cdb1d6c0b0	no	74
Warnings:					
Information:					
5	Foreign Reference	AU555.pdf	1134700 de4658a8c1823f589aa6ebbe20e9cc0775e59e39	no	34
Warnings:					
Information:					
6	Foreign Reference	AU559.pdf	1149726 c366f7cf274a145fc637a0ac9846c5c382b3f6fa	no	34
Warnings:					

Information:					
7	Foreign Reference	AU661.pdf	2493976 4ffc6b9570db2e5a8e048f1fcfa5ba555e638610	no	63
Warnings:					
Information:					
8	Foreign Reference	AU707.pdf	1305253 429d85cfa589b3238a8df1f6b0a1761fa0f1affa	no	30
Warnings:					
Information:					
9	Foreign Reference	CA431.pdf	1044781 e4bbc63f689f92e757522b9dac5afa1061185efe	no	31
Warnings:					
Information:					
10	Foreign Reference	CA782.pdf	1203095 8cf994b42a16273f21f07df4325e78719ee529d4	no	33
Warnings:					
Information:					
11	Foreign Reference	CA971.pdf	2614394 27062377ee226f8021427c385fb816b4c5232dc7	no	63
Warnings:					
Information:					
12	Foreign Reference	CN004.pdf	1438767 c41b36b8607a7c06c89c9ba533fc71bdfd1d05b9	no	20
Warnings:					
Information:					
13	Foreign Reference	CN004_T.pdf	737407 72c9401395c7901640c8f5a367e0f804638faaf8	no	9
Warnings:					
Information:					

14	Foreign Reference	CN139.pdf	1507450 85c3098c08391835879bb6093d3a548c7eb13139	no	14
Warnings:					
Information:					
15	Foreign Reference	CN139_T.pdf	571613 f53346a81944ec2073c855459ffee1ef42256154	no	7
Warnings:					
Information:					
16	Foreign Reference	CN173.pdf	621099 70e38ef55d95a7b5b38ef74c745cc9a065e4dfbf	no	7
Warnings:					
Information:					
17	Foreign Reference	CN173_T.pdf	191992 6002355d26a79918491ef136ef1e3ad982c914b9	no	11
Warnings:					
Information:					
18	Foreign Reference	CN190.pdf	1364342 fa97546b2d7116bceddcf8a54287a6ce9f71a1fe	no	13
Warnings:					
Information:					
19	Foreign Reference	CN190_T.pdf	297284 18a363ee919d6bf01c764f947d8aa1afe73f84aa	no	7
Warnings:					
Information:					
20	Foreign Reference	CN234.pdf	664313 4e0f249d53691b8d86f8769361c2a5d664607525	no	11
Warnings:					
Information:					

21	Foreign Reference	CN234_T.pdf	231490 06918e51ee1769a328a0c2aefe3a3472d9e2bcee	no	5
Warnings:					
Information:					
22	Foreign Reference	CN235.pdf	398484 3e4d7e5cc63ef15f61df71fef35055d72df5d877	no	5
Warnings:					
Information:					
23	Foreign Reference	CN235_T.pdf	246985 ade7c6a1f3b4c7b1c9483aa15dae0b3ca555d49a	no	4
Warnings:					
Information:					
24	Foreign Reference	CN555.pdf	534637 38d3b71ff989249bccfa980d0f2108259d57cbda	no	11
Warnings:					
Information:					
25	Foreign Reference	CN555_T.pdf	686159 28328c80781703efffbcf91bc2e7294b75af75ff	no	8
Warnings:					
Information:					
26	Foreign Reference	CN801.pdf	3209342 45990598da62455a4d14eda17f1f87a62f0686ef	no	48
Warnings:					
Information:					
27	Foreign Reference	CN878.pdf	974462 0626f33c8a81830fc9f7686645cba7ad5cfc0d3d	no	16
Warnings:					
Information:					

28	Foreign Reference	CN878_T.pdf	736040 d21f346e43851f16a44bf7e78a3a0c3edc44c03a	no	8
Warnings:					
Information:					
29	Foreign Reference	CN985.pdf	577951 c554c68424d9175014dae70974cecac3c0bb51af	no	13
Warnings:					
Information:					
30	Foreign Reference	CN985_T.pdf	444273 c1f5bd8de5cc740165c2a0f1aae1989e81732b8b	no	7
Warnings:					
Information:					
31	Foreign Reference	DE206.pdf	1138646 68288259ea0f4b0ac23f59e68904e9afdb868f0f	no	19
Warnings:					
Information:					
32	Foreign Reference	DE206_T.pdf	726320 77625284b12eb240b2251bc8266c5083133b6bbd	no	12
Warnings:					
Information:					
33	Foreign Reference	DE260.pdf	579180 15c7352a78d45a0048cdc9651510a6309d85dbcb	no	10
Warnings:					
Information:					
34	Foreign Reference	DE260_T.pdf	634514 79355b00d18d4050db470789fc24286271df7d62	no	8
Warnings:					
Information:					

35	Foreign Reference	DE501.pdf	431548 0c98b238772810db4410fe1b45792de4a1747978	no	11
Warnings:					
Information:					
36	Foreign Reference	DE501_T.pdf	390364 caf67dff707d5fc17c4d8e1215ef96a665d834de	no	9
Warnings:					
Information:					
37	Foreign Reference	DE599.pdf	666926 c132ff3895fbaef7656bde0313b10f139004807d	no	12
Warnings:					
Information:					
38	Foreign Reference	DE599_T.pdf	714402 849b97b49cfdf1459491dd947f42c82c8dc542fd	no	11
Warnings:					
Information:					
39	Foreign Reference	DE997.pdf	1147730 ddb329addb7d4542c87560650afb79b00e71a8b9	no	25
Warnings:					
Information:					
40	Foreign Reference	DE997_T.pdf	960950 c63fc4308d145a2926e7eed7f1460eeabd589292	no	13
Warnings:					
Information:					
41	Foreign Reference	EP405.pdf	2232403 1604fab39e60e5fea5084b72b2be4b465777dd79	no	45
Warnings:					
Information:					

42	Foreign Reference	EP446.pdf	89530 9ff50095511ff0222d30814ed01eb66839afff4f	no	2
Warnings:					
Information:					
43	Foreign Reference	EP698.pdf	916050 7c06e58a6269c028164a8c3afc50eb297e5fd54d	no	16
Warnings:					
Information:					
44	Foreign Reference	TW714.pdf	912194 48abf6742f9ce461ba61349c686699533a943fac	no	15
Warnings:					
Information:					
45	Foreign Reference	TW714_T.pdf	951174 90c6c753a342210277eefb639c2ac2b7c1684552	no	9
Warnings:					
Information:					
46	Foreign Reference	GB733.pdf	116340 278d45b4794b0ad06a399e3dda1a6c0e3bda4f36	no	2
Warnings:					
Information:					
47	Foreign Reference	GB858.pdf	1179367 728a2f047992c04d5c08bdb9f2e656e69966f3c7	no	35
Warnings:					
Information:					
48	Foreign Reference	GB950.pdf	116359 4e258a336bc0f9286ec51171ee82e4359bf40d80	no	2
Warnings:					
Information:					

49	Foreign Reference	JP789.pdf	1179435 6a263bbf3bcea2733dc5361518622f5a931b3623	no	29
Warnings:					
Information:					
50	Foreign Reference	JP789_T.pdf	1248720 72390ab6fd49147c1f6010a1d3d0cc200b3b35f6	no	17
Warnings:					
Information:					
51	Foreign Reference	JP892.pdf	733961 4f617bcf02dccbf1f4261b7a25429fd8db4ac791	no	17
Warnings:					
Information:					
52	Foreign Reference	JP892_T.pdf	760414 e1efd5c2096c290278bc8c0c70eb168ab03dbfaf	no	11
Warnings:					
Information:					
53	Foreign Reference	WO471.pdf	1163280 acfc5efb71c20a54e8683529d458a86c99c07c25	no	24
Warnings:					
Information:					
54	Foreign Reference	WO524.pdf	2578363 2c47be88214e1cfc629f4ebb21e5c53611f249ac	no	65
Warnings:					
Information:					
55	Foreign Reference	WO548.pdf	2106240 e8c6b0c4a00cd17b86c664b490c93cc3f5e6d782	no	29
Warnings:					
Information:					

56	Foreign Reference	WO714.pdf	2633126 3ecb4c131f1cff51b2de12a0f90093cf4a40928f	no	63
Warnings:					
Information:					
57	Foreign Reference	WO723.pdf	2999100 7a7f71ff32eb88c458721301ff6ba9ae61b68a7b	no	65
Warnings:					
Information:					
58	Foreign Reference	WO873.pdf	940939 a49b920c05518ed3c580f5b171ab9298ba6fb6c0	no	20
Warnings:					
Information:					
59	Foreign Reference	WO963.pdf	1361379 ed322eb848b9c4b639733c7eda3c2c3eb9662ada	no	31
Warnings:					
Information:					
60	Foreign Reference	WO996.pdf	1678033 e219d6fd9e1b6158358075741a3a5c8d373bfe69	no	29
Warnings:					
Information:					
61	Fee Worksheet (SB06)	fee-info.pdf	37512 0c88d6c2454cd17d9a8cc6558ff737b2cb5b0def	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	66047333	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET

Document Description: Transmittal Letter

PTO/SB/21 (07-09)
Approved for use through 12/31/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	17/112,920
Filing Date	12/04/2020
First Named Inventor	Yun LEI
Art Unit	3992
Examiner Name	Wittington, Kenneth
Attorney Docket Number	240001.00005

Total Number of Pages in This Submission

ENCLOSURES *(Check all that apply)*

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [x] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [ ] Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Arch & Lake LLP		
Signature	/Yichen Cao/		
Printed name	Yichen Cao		
Date	2022-09-30	Reg. No.	73,489

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name		Date	

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	46727548
Application Number:	17112920
International Application Number:	
Confirmation Number:	5982
Title of Invention:	BATTERY CLAMP
First Named Inventor/Applicant Name:	Yun LEI
Customer Number:	153979
Filer:	Yichen Cao
Filer Authorized By:	
Attorney Docket Number:	240001.00005
Receipt Date:	30-SEP-2022
Filing Date:	04-DEC-2020
Time Stamp:	04:52:57
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	Holtek.pdf	916532 e0fcff237c21b5f471880ffe9dc13447d288636b	no	14

Warnings:

WINPLUS Ex. 1003, p. 1514

Information:					
2	Non Patent Literature	MC78XX_P.pdf	510696 2996fb3e4ad748ce925bb3ad3b5da02b06d06e0c	no	28
Warnings:					
Information:					
3	Non Patent Literature	Fairchild_Regulator.pdf	1509101 e9d7b9b3c52903931849f69101deeb14351c3201	no	28
Warnings:					
Information:					
4	Non Patent Literature	2008_AAA.pdf	486099 9fdd50d7e0fe1668c618db9bd9d452db54bb6efa	no	2
Warnings:					
Information:					
5	Non Patent Literature	Stanley_dps109_P.pdf	6893252 b66f12156892fff1842e8cfafba1c9254432447b	no	12
Warnings:					
Information:					
6	Non Patent Literature	Stanley_LI1000_2011_P.pdf	6926827 fc4bfe536ead97719f7482d7f5f5e1afa038a538	no	10
Warnings:					
Information:					
7	Non Patent Literature	Projecta.pdf	1289077 6af8e16e4b30a2b1d7de1cfc1a2291bdc6050661	no	20
Warnings:					
Information:					
8	Non Patent Literature	Multi_Function_Starter_2013.pdf	2017748 7b368aaec194dbe469335dc7fd9ef2eb45811be5	no	13
Warnings:					
Information:					

9	Non Patent Literature	Misc_Epower.pdf	2252025 de75151171c3c68d63a8ac7187fc4d9a17c67976	no	17
Warnings:					
Information:					
10	Non Patent Literature	Epower20.pdf	240578 632dfd313e958a3ff0f750bedb82b3eb29082827	no	1
Warnings:					
Information:					
11	Non Patent Literature	Epower21.pdf	1150041 677a958e3d1dd21edefba37de28cb4fdc77a05f3	no	6
Warnings:					
Information:					
			Total Files Size (in bytes):	24191976	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.