[0010] 作为本实用新型电池组多功能采样端子结构的一种改进，所述电压采样段包括搁置板及设置于所述搁置板两侧的侧板，所述侧板与所述搁置板形成为“V”形、“U”形或“C”形结构。

[0011] 作为本实用新型电池组多功能采样端子结构的一种改进，所述侧板设置为两组，每组的数量为两个，且每组的两个所述侧板均沿所述搁置板对称设置。

[0012] 作为本实用新型电池组多功能采样端子结构的一种改进，两组所述侧板之间设置有间隙。

[0013] 本实用新型的有益效果在于：本实用新型提供的端子结构包括插设于电极连接片的快插连接段、包裹温度传感器探头的温度采样段及与电压采样导线压接的电压采样段，电压采样段通过温度采样段与快插连接段连接。通过上述结构将电池组温度采样和电压采样集成到一个端子结构上，可以根据需要只实现温度采样或者电压采样，也可以实现同时采样。本实用新型在实现电池组电压和温度采样的同时，既简化了工艺(仅应用了胶水粘接工艺、导线裁剪工艺和导线压接工艺)，又降低了生产成本，适合于批量生产。

附图说明

[0014] 图 1 为现有技术的结构示意图。

[0015] 其中：1’- 导线，2’- 裸铜线芯，3’- 电极连接片，4’- 温度传感器探头，5’- 金属端子。

[0016] 图 2 为本实用新型的结构示意图。

[0017] 图 3 为本实用新型与电极连接片连接的结构示意图。

[0018] 其中：1- 快插连接段，

[0019] 11- 连接头部，12- 连接中部，13- 连接尾部，14- 开槽；

[0020] 2- 温度采样段；

[0021] 3- 电压采样段，

[0022] 31- 搁置板，32- 侧板，33- 间隙；

[0023] 4- 电极连接片；

[0024] 5- 温度传感器探头；

[0025] 6- 电压采样导线。

具体实施方式

[0026] 下面结合具体实施方式和说明书附图，对本实用新型作进一步详细的描述，但本实用新型的实施方式不限于此。

[0027] 如图 1~3 所示，电池组的多功能采样端子结构，包括插设于电极连接片 4 的快插连接段 1、包裹温度传感器探头 5 的温度采样段 2 及与电压采样导线 6 压接的电压采样段 3，电压采样段 3 通过温度采样段 2 与快插连接段 1 连接。快插连接段 1 为端子结构与电极连接片 4 的接触结合部分，通过快插连接段 1 传递采样信号给温度采样段 2 和电压采样段 3 进而完成采样；温度采样段 2 为包裹温度传感器探头 5 的部分，而且在温度传感器探头 5 和温度采样段 2 之间涂有导热胶，导热胶的胶水固化后既能达到强度的要求，也能满足导热要求，从而保证了温度采样的及时性；电压采样段 3 与电压采样导线 6 进行压接，实现了可

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靠的电连接，既工艺简单，又保证了电压采样的有效性。快插连接段 1、温度采样段 2 和电压采样段 3 的材质为铜镍硅合金或铍铜合金，因为这样的材质在温度和电压采样时传导性更好，可以有效地快速地对温度和电压进行采样。

[0028] 优选地，快插连接段 1 包括连接头部 11、连接中部 12 和连接尾部 13，连接头部 11 通过连接中部 12 与连接尾部 13 连接为一体。快插连接段 1 还包括开槽 14，连接头部 11、连接中部 12 和连接尾部 13 通过开槽 14 形成一“C”形或“U”形结构的弹簧体，其中开槽 14 是为实现快插连接段 1 伸缩功能而设置的。电极连接片 4 与上述弹簧体结合时，通过弹簧体产生的反弹力和电极连接片 4 的圆孔实现紧密配合，从而将快插连接段 1 固定在电极连接片 4 的圆孔内，该弹簧体为一中空结构，弹簧体过盈配合安装有 TPA 材质的弹性柱塞。该弹性柱塞具有的弹性保持能力可以进一步保证快插连接段 1 与电极连接片 4 可靠接触。当连接头部 11、连接中部 12 和连接尾部 13 为圆形结构时，连接头部 11 和连接尾部 13 的最大直径均大于连接中部 12 的直径，使得快插连接段 1 与电极连接片 4 不会发生相对移动，实现可靠配合。

[0029] 优选地，温度采样段 2 设置为“U”形、“C”形或“O”形结构，以满足温度采样段 2 能包裹温度传感器探头 5 为标准，具体结构可根据温度传感器探头 5 的形状而确定。

[0030] 优选地，电压采样段 3 包括搁置板 31 及设置于搁置板 31 两侧的侧板 32，侧板 32 与搁置板 31 形成为“V”形、“U”形或“C”形结构，这样的结构是为容纳电压采样导线 6 而设置的，侧板 32 与搁置板 31 还可以形成其他结构，这里不作具体限定。侧板 32 设置为两组，每组的数量为两个，且每组的两个侧板 32 均沿搁置板 31 对称设置，两组侧板 32 之间设置有间隙 33，两组侧板 32 一前一后排列。其中前一组与电压采样导线 6 的导体压接实现电连接，后一组与电压采样导线 6 的绝缘线皮压接固定连接。

[0031] 需要说明的是：本实用新型的端子结构与电极连接片也可以通过焊接连接为一体，不一定是弹性接触实现连接。本实用新型可以应用在镍氢电池和镍镉电池中，同时也适用于具有电池的电动车、混合电动车和储能等项目中。

[0032] 根据上述说明书的揭示和教导，本实用新型所属领域的技术人员还能够对上述实施方式进行变更和修改。因此，本实用新型并不局限于上述的具体实施方式，凡是本领域技术人员在本实用新型的基础上所作出的任何显而易见的改进、替换或变型均属于本实用新型的保护范围。此外，尽管本说明书中使用了一些特定的术语，但这些术语只是为了方便说明，并不对本实用新型构成任何限制。

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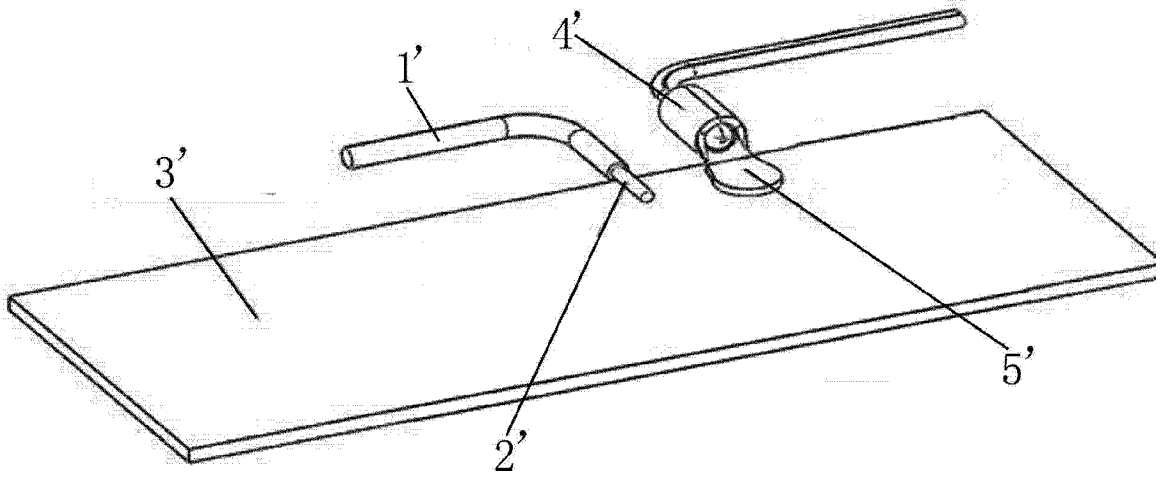


图 1

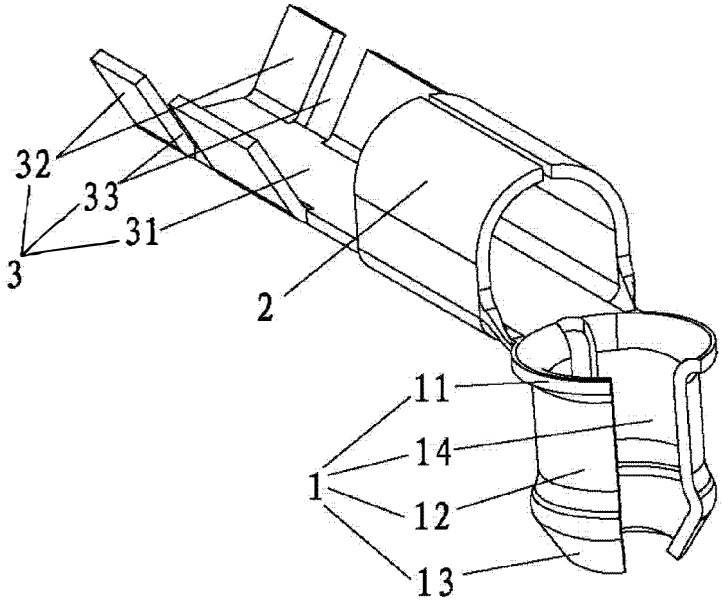


图 2

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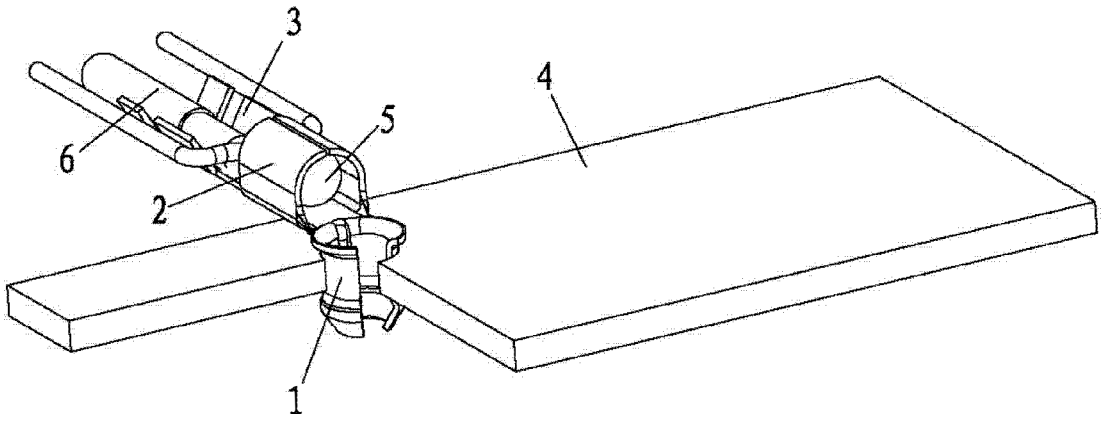


图 3

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Espacenet

CN202696190U Intelligent emergent start power source with self-equipped voice prompt function

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Intelligent emergent start power source with self-equipped voice prompt function

Abstract

The utility model discloses an intelligent emergent start power source with a self-equipped voice prompt function. The intelligent emergent start power source comprises a battery pack, wherein the power supply end of the battery pack is connected with an alternation switch which is connected with an output electric clip through a direct current (DC) contactor. The intelligent emergent start power source further comprises a central processing unit (CPU) main control circuit, wherein an output end of the CPU main control circuit is connected with an audio broadcast system. An input end of the CPU main control circuit is connected with a sampling and driving control circuit which is connected with the alternation switch, the DC contactor and the output electric clip. The battery pack is connected with a charge port through a power source control circuit, and the power source control circuit and the charge port are connected with the CPU main control circuit. The output electric clip and the alternation switch are respectively connected with the power source control circuit. The output end of the CPU main control circuit also is connected with a display circuit, and the sampling and driving control circuit is connected with a force started button. The emergent start power source can timely and accurately send relative operation information to users under different environments.

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Intelligent emergent start power source with self-equipped voice prompt function

Abstract

The utility model discloses an intelligent emergent start power source with a self-equipped voice prompt function. The intelligent emergent start power source comprises a battery pack, wherein the power supply end of the battery pack is connected with an alternation switch which is connected with an output electric clip through a direct current (DC) contactor. The intelligent emergent start power source further comprises a central processing unit (CPU) main control circuit, wherein an output end of the CPU main control circuit is connected with an audio broadcast system. An input end of the CPU main control circuit is connected with a sampling and driving control circuit which is connected with the alternation switch, the DC contactor and the output electric clip. The battery pack is connected with a charge port through a power source control circuit, and the power source control circuit and the charge port are connected with the CPU main control circuit. The output electric clip and the alternation switch are respectively connected with the power source control circuit. The output end of the CPU main control circuit also is connected with a display circuit, and the sampling and driving control circuit is connected with a force started button. The emergent start power source can timely and accurately send relative operation information to users under different environments.

Claims

1.

An intelligent emergency starting power supply with a voice prompt function, including a battery pack, the battery pack The power supply terminal is connected with a transfer switch, and the transfer switch is connected to the output clamp through a DC contactor. Its characteristics is that

It also includes a CPU master control circuit. The output of the CPU master control circuit is connected with an audio playback system. System

The input end of the CPU master control circuit is connected with a sampling and driving control circuit, the sampling and driving The control circuit is connected with the transfer switch, DC contactor and output electric clamp;

The battery pack is connected to the charging interface through a power control circuit, and the power control circuit is connected to the charging interface Connect to the CPU master control circuit;

The output electric clamp and the changeover switch are respectively connected with the power control circuit;

The output terminal of the CPU master control circuit is also connected with a display circuit;

The sampling and driving control circuit is connected with a forced start button.

2.

An intelligent emergency start power supply with a voice prompt function according to claim 1, which

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The feature is that the audio playback system includes a voice storage control circuit, the voice storage control circuit The input terminal is connected to the CPU master control circuit, and the output terminal is connected to the audio control circuit, the audio control circuit Connect with speakers.

3.

The intelligent emergency start power supply with its own voice prompt function according to claim 1, which

It is characterized in that, the display circuit includes an LED digital tube display and LED indicators of different colors.

DESCRIPTION CN202696190U

An intelligent emergency starting power supply with voice prompt function Technical field

The utility model relates to an emergency starting power supply, in particular to an intelligent emergency starting power supply with a voice prompt function.

Background technique

12 The V/24V conversion emergency start power supply is difficult to be 100% correct under different operating environments. Without any protection and prompts, any misoperation may cause permanent damage to the product, or even cause the battery to explode in severe cases, endangering the personal and property safety of the user. Although some of the existing products are equipped with operating instructions and some simple sound and light alarm functions, the simple buzzer alarm and the wear and tear of the operation cause the defect or blur of the operation prompt content, so that the emergency start power supply lacks the necessary safety instructions , At the same time, the user is confused when the user cannot find the cause in time after the problem occurs. If you add necessary voice prompts and photoelectric instructions for each operation of the user at the same time, it can not only reduce the impact of different environments on the user, but also directly inform the user of the real-time operating status in time, which can more effectively prevent mistakes The generation of, allows users to operate more directly and clearly. Therefore, it is necessary to optimize the structure of the existing emergency power supply.

Utility model content

The purpose of the utility model is to provide an intelligent emergency starting power supply with its own voice prompt function, which uses voice to prompt the user's current operation to reduce misoperations, so that the emergency starting power supply can be safely protected during operation and extend its use life.

The technical scheme adopted by the utility model to solve its technical problems is:

An intelligent emergency starting power supply with a voice prompt function, including a battery pack, the power supply end of the battery pack is connected with a transfer switch, the transfer switch is connected to the output clamp through a DC contactor, and it also includes a CPU master control circuit, The output terminal of the CPU master control circuit is connected with an audio playback system, the audio playback system includes a voice storage control circuit, the input terminal of the voice storage control circuit is connected to the CPU master control circuit, and the output terminal is connected to the audio control circuit. The circuit is connected to the speaker;

The input end of the CPU master control circuit is connected with a sampling and driving control circuit, which is connected with the changeover switch, the DC contactor and the output electric clamp; the battery pack is connected with the charging interface through the power control circuit, and the power supply The control circuit and the charging interface are connected to the CPU master control circuit; the output clip and the switch are respectively connected to the power control circuit; the output end of the CPU master control circuit is also

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connected to a display circuit, which includes an LED digital tube display And LED indicators of different colors; the sampling and driving control circuit is connected with a forced start button.

The advantage of the utility model is that the emergency start power supply can provide safety protection for gear selection, correct connection, wrong connection, and low voltage or high voltage, and at the same time, it can select charging gear, battery low voltage warning, output overcurrent protection, Electric clip output short-circuit protection and man-made forced start safety prompts are added with corresponding voice prompts and photoelectric prompts; in different use environments, they can promptly and accurately deliver relevant operating information to users, so that users can use sound, light, etc. The type of prompt method to obtain operating information allows users to more intuitively understand the real-time operating conditions and the reasons for use errors, facilitate better next operations or timely and effective corrective measures, ensure the personal safety of users, and make the entire product better Humanized and intelligent.

Description of the drawings

Figure 1 is an electrical schematic diagram of the emergency starting power supply proposed by the utility model;

Figure 2 is a power control circuit diagram;

Figure 3 is a circuit diagram of the CPU master control circuit and LED digital tube display;

Figure 4 is a circuit diagram of voice storage and audio control;

Figure 5 is a sampling and drive control circuit diagram.

Detailed ways

In order to make the technical means, creative features, goals and effects of the utility model easy to understand, the following figures and specific embodiments are combined to further explain the utility model.

As shown in Figure 1, the intelligent emergency starting power supply with its own voice prompt function proposed by the present invention includes a battery pack, the power supply end of the battery pack is connected with a switch, and the switch is connected to the output clip through a DC contactor. It also includes a CPU master control circuit. The output of the CPU master control circuit is connected to an audio playback system. The audio playback system includes a voice storage control circuit. The input of the voice storage control circuit is connected to the CPU master control circuit. The terminal is connected to the audio control circuit, and the audio control circuit is connected to the speaker;

The input end of the CPU master control circuit is connected with a sampling and driving control circuit, which is connected with the changeover switch, the DC contactor and the output electric clamp; the battery pack is connected with the charging interface through the power control circuit, and the power supply The control circuit and the charging interface are connected to the CPU master control circuit; the output clip and the switch are respectively connected to the power control circuit; the output end of the CPU master control circuit is also connected to a display circuit, which includes an LED digital tube display And LED indicators of different colors; the sampling and driving control circuit is connected with a forced start button.

At present, car batteries are mainly divided into two types: 12V and 24V. In the circuit design, the default is 12VDC battery within 0VDC～15.5VDC; the default is 24VDC battery within 15.5～30.0VDC. The switch connects the two batteries in parallel or in series, so that it can realize the function of two voltage outputs in one machine. At the same time, two small linkage switches are embedded in the transfer switch. The linkage switch is synchronized with the 12V and 24V gears, that is, when the transfer switch is in the 12V or 24V gear, the linkage opening is also closed synchronously, and the linkage switch is automatically turned off when the switch is in the OFF position. Open, used to realize the judgment of input or disconnection of external connection signal.

The emergency starting power supply uses a high-power DC contactor as an automatic control electronic switch, and controls its on and off states through a circuit. At the same time, the circuit judges the voltage drop across

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the DC contactor after it is pulled in to determine whether the output clip appears One of the conditions for short circuit.

The emergency start power supply samples from the two ends of the battery pack, the small teeth of the electric clamp, the output end of the transfer switch, the two ends of the DC contactor, the charging interface, the internal voltage test reset switch, the forced start button and other key points to be sent to the CPU master control circuit. After processing and judging, and knowing the user's operating information, the corresponding pulse signal is sent to the voice storage control circuit, and the pre-stored voice content is retrieved, and after the power of the audio control circuit is amplified, the field sounder emits the corresponding voice message. The emergency start power supply can provide safety protection for gear selection, correct connection, wrong connection, and low or high voltage. At the same time, it can be used for charging gear selection, battery low voltage warning, output overcurrent protection, electric clip output short circuit protection, and artificial force The corresponding voice prompts and photoelectric prompts are added in aspects such as starting safety prompts. The voice is clear, loud, and standard pronunciation. In a 40dB noise environment, the effective sound transmission distance is more than 5 meters. In addition to the standard English prompts, two other languages are prepared for voice types, namely French and Spanish. Users can switch directly with simple buttons to improve the versatility of the product.

In one embodiment, the circuit configuration of the emergency start power supply is shown in Figure 2, Figure 3, Figure 4, and Figure 5. In this embodiment, the main key components used in the emergency start power supply are: IC1-7805 three-terminal integrated voltage regulator, IC2-MC96F32Q microcontroller, IC3-BLA4208 voice storage integrated chip, IC4-TDA2822 integrated audio power amplifier, LS1-full frequency band Speaker 2W/8 ohm, LED-LG5631AH seven-segment digital tube display, IC5 (IC6)-PC817 optocoupler, IC7-LM358 integrated operational amplifier, high-power DC contactor, high-current conversion switch (for 12/24V gear switching), linkage Switch, forced start button, output positive and negative electric clamp.

In this embodiment, the main functions that the emergency power supply can realize are:

1、

The 12V/24V gear position is automatically recognized and prompted when the emergency start power switch is operated, the corresponding gear position voice prompt and LED3/LED4 light up indication;

2、

Emergency start power supply battery low voltage automatic alarm prompt, when the battery voltage is lower than 8.0≤U＜10.0V, the voice automatic alarm prompt;

3、

The emergency start power supply battery voltage is too low automatic shutdown protection and prompts, when the battery voltage is continuously lower than 8V, the emergency start power supply automatically shuts off the output circuit of the electric clamp, and at the same time, the low-voltage shutdown protection voice prompt is issued;

4、

The output electric clamp is connected correctly to prompt the conduction, and it will automatically be turned on when it is correctly connected, with voice prompts and LED4 lights to prompt;

5、

The output electric clamp connection polarity is reversed wrongly to shut off protection and prompt. When the output electric clamp polarity is reversed, the DC contactor will produce shut-off protection. At the same time, the corresponding voice information prompt and reverse connection indication LED7 light will be lit to prompt. The nixie tube flashes and displays the error code "Er1";

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6、

Output electric clamp connection voltage error shutdown protection and prompt, that is, the internal and external connection battery voltage does not match, generally means that the 12V and 24V battery are connected incorrectly or the 24V is connected to an external battery with a voltage higher than 30.0V, and the emergency start power supply automatically emits a wrong connection voice information prompt and wrong connection indicator LED6 lights up, and the digital tube flashes to display the error code "Er2" information;

7、

Output electric clamp overload shutdown protection and prompt. When the output electric clamp has excessive current, it will automatically shut down for protection. The emergency power supply will send out corresponding voice information prompts and the digital tube flashes to display the overload protection code "P1" information;

8、

The output clip is short-circuited and automatically cut off protection and prompts. When the output clip is short-circuited again, the output is automatically turned off for protection, and the corresponding voice information prompts and the digital tube flashes to display the short-circuit protection code. "P2" information;

9、

Charging gear prompt and charging status indicator, the emergency start power charging of the conversion model is only charging at the 12V gear, that is, the two batteries must be connected in parallel and then charged together to ensure that the charging voltage of the two batteries is balanced, that is, after the charger is inserted, such as When the switch is not in the 12V position, the emergency start power supply will automatically send out a voice message prompt, and the charging indicator will not light up until the gear is selected correctly, the charging indicator LED2 will light up, and LED1 will light up when the charging is completed;

10、

Forced start output function, when there is no external battery voltage input or the input voltage signal is too low, the emergency start power can not be automatically recognized normally, after human judgment and correct and reliable connection, press the forced start button to force the emergency start power to pull in Conduction.

When the forced start button is pressed, the emergency start power supply will automatically send out a safety warning message voice and the digital tube will simultaneously display "10----9----8----.....0" countdown time counting prompt information to the user, reminding the user to pay attention to the external connection The polarity of the load and the safe working voltage need to be pressed continuously for 10 seconds before the emergency power supply is automatically turned on to ensure that the user has enough time to confirm the connection safely.

In this embodiment, the voice content stored in the voice storage control circuit is as follows (take the English version as an example):

A.12V

B.24V

C. Low voltage, recharging recommended

D. Power is connected

E. Wrong Voltage

F. Wrong Polarity

G. Recharging ON, Turn the switch at back to 12V

H.charge immediately

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I. Overload

J. Short Circuit

The specific working process is as follows:

1、When the switch is switched from the OFF position to the 12V or 24V position, the switch will send the parallel or series voltage of the battery pack to the input terminal of the DC contactor, and the "OUT+" terminal has a high level (OUT+ sampling point is actually connected At the input end of the DC contactor, "BAT/External" is connected to the output end of the DC contactor), and after the voltage is limited by the diode D1, the current limiting resistor R1 and the Zener diode DW1, the switch Q1 is driven by the resistor R2 to make Relay JK1 is turned on; the battery BAT+ voltage is added to the input terminal of the three-stable integrated voltage regulator 7805 through the diode D4, so that pin 3 outputs a stable 5VDC voltage to supply power to the CPU and other circuits;

When the external electric clamp is correctly connected and the voltage is greater than 1.5V, after the voltage of the "BAT/external" terminal passes through the diode D6, it is also added to the base of the switch tube Q1 to turn on the relay, so that the 7805 enters the normal working state; Similarly, when the charging port "CH+" is connected to the power source, the 7805 also enters the normal working state.

2、After the MCU is powered on, it first detects whether the transfer switch is turned on. When the voltage at the "OUT+" terminal is detected to be less than 15.5VDC, then it is compared with the voltage from the positive terminal "BAT1+" of the single battery. When the voltage at the two reference points is basically the same At the same time, the CPU defaults that the switch has been placed in the 12V position at this time; on the contrary, when the voltage at this point is greater than or equal to 15.5V and the voltage value of the "BAT1+" terminal is significantly different, the CPU defaults that the switch has been placed in the 24V position; confirm the good gear After the position, the single-chip microcomputer outputs a high level from the P52 port or the P53 port to drive the corresponding gear indicator LED3 or LED4 to light up; at the same time, a pulse signal is output from the P21 port or the P23 port to drive the voice chip, and the corresponding voice information is extracted through the power amplifier , Speakers and other devices report the corresponding gear information to the user;

When the MCU detects that the voltage of "OUT+" is too low, and the voltage of the 12V file is lower than 10.0VDC (the voltage of the 24V file is lower than 20.0VDC), the emergency power supply automatically defaults to the battery is broken and should not be used anymore. The battery should be refilled in time ; The P16 pin of the single-chip microcomputer will automatically cycle the output pulse signal to the voice memory chip, extract the low-voltage alarm prompt voice, and promptly report the low-voltage information to the user through the speaker; at the same time, it will automatically shut off all loads, that is, turn off the cigarette lighter and DC contactor Output;

When the MCU detects that the voltage of "UOT+" is 0V and at the same time detects a certain positive voltage at the "OUT+/external" terminal, it means that the emergency start power switch is not turned on, but the user has correctly connected the output clamp to the external battery Connected; at this time, the emergency start power supply defaults that the user wants to test the external battery voltage through the JS digital display voltmeter, that is, the microcontroller will automatically display the actual voltage value read from the "OUT+/external" terminal through the digital tube;

When the microcontroller detects that the voltage of "UOT+" is 0V, and at the same time detects that the charger is connected to the "CH+" terminal, it means that the switch is not turned on at this time, but the charger is connected, and the microcontroller will automatically output a Pulse signal to the voice memory chip, extract the charging position limit prompt voice, and tell the user to place the switch at 12V when charging. If the switch is in other gears, the microcontroller will automatically output the trigger signal in a cycle until the user switches the switch Turn to the correct 12V gear position; when the emergency start power supply enters normal charging, the single-chip computer judges by detecting the voltage drop on the sampling resistor R31. When the charging current is less than 300mA, the voltage drop on the resistor is 0.03V, indicating the end of charging Otherwise, it means charging. When LED2 is on, it means charging, and when LED1 is on, it means charging is over.

3、Start, its working principle is as follows:

3.1、12V file is correctly connected, conduction and prompt: switch and start production and set it to 12V file. When the MCU detects that the voltages of "OUT+" point and "BAT1+" point are both within the range of 12V file, the emergency power supply will automatically report the 12V file prompt voice; At the same time, the voltage at both ends of the external 12V battery is sampled in two ways, one is connected to the output terminal of the DC contactor, so that the single-chip microcomputer can detect the effective voltage value within the range of 12V in the "BAT+/external" point; the other is sampled by the small teeth of the electric clamp 、Connect the internal

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wire of the electric clamp wire to the "J1" port of the control board, and after the positive signal is converted through R5, D8 and IC5, the external positive signal "RIGHT-Ctrl" is sent to the P13 port of the MCU, and the MCU determines the emergency power supply It has switched to the 12V gear, and the electric clamp has been correctly and reliably connected. At this time, the single-chip microcomputer outputs a high level to the DC contactor control circuit to turn it on, and sends a pulse signal to the voice chip to extract the correct connection and conduction prompt Voice, promptly inform the user of the correct connection information; other indications: the 12V gear indicator is on; the corresponding correct connection indicator is on; the digital tube automatically displays the integrated voltage value of the internal and external batteries in parallel.

3.2、12V-range polarity reverse connection protection and prompt: the switch is turned to 12V, the corresponding gear detection and prompt content are the same as above; at the same time, the voltage at both ends of the external 12V (or 24V) battery is sampled by the small teeth of the electric clamp, and the electric clamp is inside The wire is connected to the "J1" port of the control board, after the reverse signal is converted through D9, IC6 and R5, the external reverse signal "Reverse-Ctrl" is sent to the P12 port of the single-chip microcomputer, and the single-chip microcomputer judges that the emergency start power has been transferred At the 12V gear, when the polarity of the external battery is detected to be reversed, the DC contactor will remain disconnected at this time, and continuously send pulse signals to the voice chip to extract the reverse connection prompt voice information, and inform the user of the reverse connection information in time; other indication: The 12V gear indicator is on; the reverse connection alarm indicator LED7 is on; the digital tube displays the reverse connection error code "Er1" and flashes.

3.3、12V-range external voltage is too high error protection and prompt: the switch is turned to 12V, the corresponding detection and prompt content is the same as above; at the same time, the electric clamp is connected to the output terminal of the DC contactor from the voltage of both ends of the external battery, so that the MCU is in the "BAT+/ When "External" detects that the voltage of the connected battery at this time has exceeded the safety range of "12V", the microcontroller directly defaults that the voltage of the external battery does not match the gear selected by the emergency power supply, and the DC contactor remains closed for protection; The chip continuously sends pulse signals to extract the voltage error connection prompt voice information, and promptly informs the user of the error connection information; other indications: the 12V gear indicator lights up; the voltage error connection alarm indicator LED6 lights up; the digital tube displays reverse connection error The code "Er2" flashes.

3.4、24

The V file is connected correctly, and the prompt: Switch to the 24V file. The MCU detects that the voltage between the "OUT+" point and the "BAT1+" point is relatively related, and should belong to the 24V range.

The emergency start power supply automatically reports the 24V gear to prompt the voice; at the same time, the voltage at both ends of the external 24V battery is sampled in two ways, and one is connected to the output terminal of the DC contactor, so that the single-chip microcomputer can detect the validity within the range of 24 gears at the "BAT+/external" point Voltage value; No. 1 is sampled by the small teeth of the electric clamp, and the internal wire of the electric clamp is connected to the "J1" port of the control board. After the positive signal is converted through R5, D8 and IC5, the external positive signal "RIGHT-Ctrl" Send to the P13 port of the microcontroller, the microcontroller judges that the emergency start power has been turned to 24V, and the electrical clamps have been correctly and reliably connected. At this time, the microcontroller outputs a high level to the DC contactor control circuit to make it pull in and turn on, and voice The chip sends a pulse signal to extract the correct connection and conduction prompt voice, and promptly informs the user of the correct connection information; other instructions: the 24V gear indicator lights up; the corresponding correct connection indicator lights up; the digital tube automatically displays , The comprehensive voltage value after the external battery is connected in parallel.

3.5、24V-range polarity reverse connection protection and prompt: the switch is turned to 24V, and the corresponding gear detection and prompt content are the same as above; at the same time, the voltage at both ends of the external 24V (or 12V) battery is sampled by the small teeth of the electric clamp, and the electric clamp is internal After the wire is connected to the "J1" port of the control board, the reverse signal is converted through D9, IC6 and R5, and then the external reverse signal "Reverse-Ctrl" is sent to the P12 port of the single-chip microcomputer. The single-chip microcomputer judges that the emergency start power has been transferred When it reaches the 24V position, when the polarity of the external battery is detected to be reversed, the DC contactor will remain disconnected at this time, and continuously send pulse signals to the voice chip to extract the reverse connection prompt voice information, and inform the user of the reverse connection information in time; Other indications: the 24V gear indicator is on; the reverse connection alarm indicator LED7 is on; the digital tube displays the reverse connection error code "Er1" flashing.

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V-range external voltage is too low (or too high, when it exceeds 30.0V) error protection and prompt: the switch is turned to 24V, the corresponding gear detection and prompt content are the same as above; at the same time, the electric clamp is connected to the DC voltage from both ends of the external battery The output terminal of the contactor makes the single-chip microcomputer detect at the "BAT+/external" point that the voltage of the connected battery at this time has exceeded the safety range of "24V". If the external voltage is lower than 15.5V or higher than 30.0V, the single-chip microcomputer directly The default external battery voltage does not match the gear selected by the emergency power supply, and the DC contactor remains closed for protection.

And continuously send pulse signals to the voice chip to extract the voltage error connection prompt voice information, and inform the user of the error connection information in time; other instructions: 24V gear indicator lights; voltage error connection alarm indicator LED6 lights up; digital tube display The reverse connection error code "Er2" flashes.

4、Start-up overload automatic shutdown protection: When the emergency start-up power supply is started, a large current is generated in the start-up system. The emergency start-up power supply takes a sample from the small teeth of the black electric clamp and reads the big tooth of the black electric clamp to the internal battery The voltage drop between the negative poles is sent to the "J1" port through the small teeth of the black electric clip and the internal signal line, and then amplified by the circuit such as D0, IC7, and the overcurrent signal "OVERLOAE-TEST" is sent to the P11 port of the microcontroller. When the voltage value is continuously higher than a set value for a certain period of time (the resistance between the big teeth of the black electric clip and the negative terminal of the battery is tested in advance, the reference voltage of the overcurrent protection is calculated by referring to the maximum discharge capacity of the battery of the emergency starter Value), the emergency start power supply defaults to the externally connected load being too heavy, and when the maximum endurance range of the entire system is exceeded, the microcontroller cuts off the DC contactor control signal to force the DC contactor to shut off the output; the microcontroller simultaneously extracts the corresponding The over-current protection prompts voice information and informs the user in time; other instructions: the digital tube displays the over-current protection code "P1" flashing.

5、Electric clamp output short circuit automatic shutdown protection: When the emergency start power supply is short-circuited after the electric clamp is turned on, a large current will be generated in the starting system. The emergency start power supply also takes samples from the small teeth of the black electric clamp, and read Take the voltage drop between the big tooth of the black electric clip and the negative electrode of the internal battery, and send it to the "J1" port through the small tooth of the black electric clip and the internal signal line, and then after the D0, IC7 and other circuits amplify, the overcurrent signal "OVERLOAE" -TEST" is sent to the P11 port of the MCU; at the same time, the MCU judges the voltage difference between the two points "OUT+" and "BAT/outside" at both ends of the DC contactor. When these two voltage values are continuously higher than a certain value for a certain period of time When the setting value is set, the emergency start power supply defaults that the external electric clamp connection has a short-circuit fault; the microcontroller will immediately cut off the DC contactor control signal to force the DC contactor to shut off the output; the microcontroller will simultaneously extract the corresponding short-circuit protection prompt voice to the voice memory information and inform the user in time; other instructions: the digital tube displays the overcurrent protection code "P2" flashing.

6、Forced start output: When the external battery voltage is too low or there is no battery, the user can first turn on the switch to the required voltage range (the corresponding range detection and prompt content is the same as above), and then clamp the positive and negative electrodes Respectively connect to the positive and negative terminals of the input power supply of the load, pay attention to the reliable connection of the large and small teeth of the electric clamp at the same time, and confirm that the power required by the load is consistent with the voltage range selected by the emergency start power switch; press and hold the forced start switch, The forced start switch will short-circuit the "J3" port so that the internal 5V power supply will be sampled by the resistors R15 and R16, and then sent to the P25 port of the microcontroller. The microcontroller will automatically start timing and extract the forced start voice safety prompt from the voice chip. After continuously pressing for 10s, the MCU will automatically issue a switch-on command to force the DC contactor to be turned on; when the emergency start power supply is connected before the automatic pull-in (within 10s), there is an abnormal connection (such as reverse connection, high voltage misconnection)), the single chip microcomputer will automatically determine that the forced start operation is invalid, and it needs to be restored after troubleshooting; to ensure the safety of the user's operation; other tips: after pressing this switch, the digital tube will display "10s countdown timer" flashing within 10s, and the pull-in guide After the power is turned on, the emergency power supply will give a voice prompt for correct conduction, and at the same time, the correct connection indicator LED5 will light up.

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7、The working principle of the voice control circuit: First, all the functional voices are stored in the voice storage chip in PCM compression mode. The voice chip uses the BLA4206 chip of the BLA series. The chip supports a total voice length of 42s and can store up to 30 different voice content. ; Voice reading is controlled by a total of 8 separate trigger pins S1-S8, and it also supports different pins for triggering in different combinations, so that it can support the needs of 30-segment voice triggering; then arbitrary extraction is controlled by the CPU For each segment of voice content, the voice signal is output through the 8th pin. After being amplified by the audio power amplifier IC4, it directly drives the speaker SL1 to pronounce; the voice trigger signal is active at high level. Each time the microcontroller sends out a pulse trigger signal, the voice chip will automatically extract the corresponding When the trigger is a continuous high level, the chip will automatically broadcast the same voice content in a loop.

8、Working principle of sampling circuit and control circuit: as shown in Figure 5, J1 is the positive and negative electric clamp small tooth sampling signal input terminal. When the external positive connection is connected, the voltage is converted through resistors R5, D8 and IC5, and the AD signal is sent to The P31 port of the stand-alone device is used as the basis for judging whether the external electric clamp is connected or disconnected; when the polarity of the external battery voltage is reversed, the microcontroller cannot directly read the negative pressure of the "BAT/external" terminal, but through J1, D9, IC6 After the conversion of R5, the reverse connection signal is sent to the P12 port of the single-chip microcomputer as a basis for judging the polarity of the external electric clamp connection; when the output electric clamp line has excessive load current, the large current will be in the negative electric clamp A certain voltage drop is generated on the line. This voltage will be taken out through the small teeth of the negative electric clip and sent to D0, R11 and IC7 for amplification and then sent to the P11 pin of the microcontroller for judgment. When it is detected that the voltage is continuously greater than a certain setting within 1s When setting the value, the single-chip microcomputer defaults that the external load is too heavy, and immediately shuts off the DC contactor for protection; in the same way, when it is detected that the voltage value is higher than the other set value in an instant, and the two DC contactors are separated from each other. When the voltage drop detected by the terminal is also greater than a certain set value, the emergency start power supply will automatically default to the short circuit of the output clamp, and immediately turn off the DC contactor for protection;

J5 is the charging power input terminal; J6 is the input terminal for internal output voltage detection and external voltage detection, as well as the sampling point of the voltage drop across the DC contactor; J7 is the DC contactor control coil interface; among them are the main components R25, R26 , Q2, JK2, and RT1 constitute the cigarette lighter output control circuit; the main components R29, R30, Q3 constitute the buzzer alarm control circuit; the main components R27, R28, Q3 constitute the DC contactor control circuit; the main components R17, R18, R31, C25, and C21 constitute the charging power sampling and charging current sampling circuit, which is used to judge the connection of the charger and the detection of the charging state; the main components are R19, R20, R21, R22, R23, R24, C22, C23, C20 constitutes the internal and external battery voltage sampling circuit and the conversion switch gear judgment sampling circuit; the main components LED, Q5, Q6, Q7, etc. constitute a digital display control circuit.

The above shows and describes the basic principles, main features and advantages of the present invention.

Those skilled in the industry should understand that the present utility model is not limited by the foregoing embodiments. The foregoing embodiments and descriptions only illustrate the principles of the present utility model, and the present utility model does not deviate from the spirit and scope of the present utility model. There will be various changes and improvements, and these changes and improvements fall within the scope of the claimed utility model.

The scope of protection claimed by the utility model is defined by the appended claims and their equivalents.

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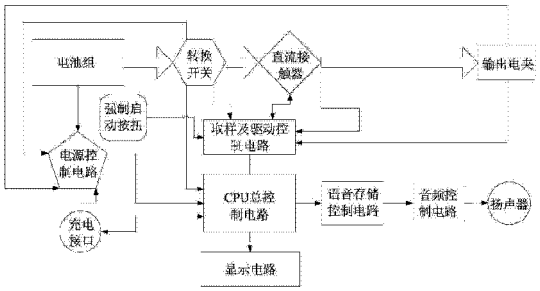
权利要求书 1 页 说明书 7 页 附图 4 页

(54)实用新型名称

一种自带语音提示功能的智能型应急启动电源

(57)摘要

本实用新型公开一种自带语音提示功能的智能型应急启动电源，包括有电池组，电池组的供电端连接有转换开关，转换开关通过直流接触器连接至输出电夹，还包括有 CPU 总控制电路，该 CPU 总控制电路的输出端连接有音频播放系统；CPU 总控制电路的输入端连接有取样及驱动控制电路，该取样及驱动控制电路与转换开关、直流接触器及输出电夹相连；电池组通过电源控制电路与充电接口相连，电源控制电路与充电接口连接至 CPU 总控制电路；输出电夹及转换开关分别与电源控制电路相连；CPU 总控制电路的输出端还连接有显示电路；取样及驱动控制电路连接有强制启动按钮。该应急启动电源在不同的使用环境下，都能够及时准确地向用户传递相关操作信息。



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1. 一种自带语音提示功能的智能型应急启动电源，包括有电池组，该电池组的供电端连接有转换开关，转换开关通过直流接触器连接至输出电夹，其特征在于，

还包括有 CPU 总控制电路，该 CPU 总控制电路的输出端连接有音频播放系统；

所述 CPU 总控制电路的输入端连接有取样及驱动控制电路，该取样及驱动控制电路与转换开关、直流接触器及输出电夹相连；

所述电池组通过电源控制电路与充电接口相连，电源控制电路与充电接口连接至 CPU 总控制电路；

所述输出电夹及转换开关分别与电源控制电路相连；

所述 CPU 总控制电路的输出端还连接有显示电路；

所述取样及驱动控制电路连接有强制启动按钮。

2. 根据权利要求 1 所述的一种自带语音提示功能的智能型应急启动电源，其特征在于，所述音频播放系统包括语音存储控制电路，该语音存储控制电路的输入端连接于 CPU 总控制电路，其输出端连接于音频控制电路，音频控制电路与扬声器相连。

3. 根据权利要求 1 所述的一种自带语音提示功能的智能型应急启动电源，其特征在于，所述显示电路包括 LED 数码管显示器和不同颜色的 LED 指示灯。

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一种自带语音提示功能的智能型应急启动电源

技术领域

[0001] 本实用新型涉及应急启动电源，尤其涉及一种自带语音提示功能的智能型应急启动电源。

背景技术

[0002] 12V/24V 转换应急启动电源在不同的使用环境下，单靠人为控制操作难以做到百分之百正确。在没有任何保护和提示的前提下，任何出现一次误操作都将可能给产品带来永久损坏，严重时甚致可导致电池爆炸，危及到用户的人身财产安全。虽然现有的部分产品设有操作指导说明和一些简单的声光报警功能，但由于简单的蜂鸣器报警和使用的磨损导致操作提示内容的缺损或模糊，使应急启动电源缺少必要的安全指示，同时也给用户操作出现问题后却无法及时找到原因而困惑。如果在用户每一项操上同时增加必要的语音提示和光电指示，这样既能减少不同环境给用户带来的影响，同时也能及时地直接告知用户实时的操作状况，更能有效地预防失误的产生，让用户操作更直接、更清楚。因此，有必要对现有应急启动电源的结构进行优化。

实用新型内容

[0003] 本实用新型的目的是提供一种自带语音提示功能的智能型应急启动电源，用语音对用户的当前操作给予提示，以减少误操作，使应急启动电源在操作时得到安全防护，延长其使用寿命。

[0004] 本实用新型为解决其技术问题所采用的技术方案是，

[0005] 一种自带语音提示功能的智能型应急启动电源，包括有电池组，该电池组的供电端连接有转换开关，转换开关通过直流接触器连接至输出电夹，还包括有 CPU 总控制电路，该 CPU 总控制电路的输出端连接有音频播放系统，该音频播放系统包括有语音存储控制电路，语音存储控制电路的输入端连接于 CPU 总控制电路，其输出端连接于音频控制电路，音频控制电路与扬声器相连；

[0006] 所述 CPU 总控制电路的输入端连接有取样及驱动控制电路，该取样及驱动控制电路与转换开关、直流接触器及输出电夹相连；所述电池组通过电源控制电路与充电接口相连，电源控制电路与充电接口连接至 CPU 总控制电路；所述输出电夹及转换开关分别与电源控制电路相连；所述 CPU 总控制电路的输出端还连接有显示电路，该显示电路包括 LED 数码管显示器和不同颜色的 LED 指示灯；所述取样及驱动控制电路连接有强制启动按钮。

[0007] 本实用新型的优点在于，该应急启动电源可对档位选择、正确连接、错误连接和电压过低或电压过高等进行安全保护，同时在充电档位选择、电池低压预警、输出过流保护、电夹输出短路保护以及人为强制启动安全提示等方面都加入相应的语音提示和光电提示；在不同的使用环境下，都能够及时准确地向用户传递相关操作信息，使用户通过声、光等不同类型的提示方式获取操作信息，使用户更加直观地了解实时的操作情况及使用错误的原因，便于更好地进行下一步操作或及时有效地纠正措施，确保使用者的人身安全，使整个产

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品更具人性化、智能化。

附图说明

[0008] 图 1 是本实用新型提出的应急启动电源的电气原理图；

[0009] 图 2 是电源控制电路图；

[0010] 图 3 是是 CPU 总控制电路及 LED 数码管显示器电路图；

[0011] 图 4 是语音存储及音频控制电路图；

[0012] 图 5 是取样及驱动控制电路图。

具体实施方式

[0013] 为了使本实用新型实现的技术手段、创作特征、达成目的与功效易于明白了解，下面结合图示与具体实施例，进一步阐述本实用新型。

[0014] 如图 1 所示，本实用新型提出的自带语音提示功能的智能型应急启动电源包括有电池组，该电池组的供电端连接有转换开关，转换开关通过直流接触器连接至输出电夹，还包括有 CPU 总控制电路，该 CPU 总控制电路的输出端连接有音频播放系统，该音频播放系统包括有语音存储控制电路，语音存储控制电 路的输入端连接于 CPU 总控制电路，其输出端连接于音频控制电路，音频控制电路与扬声器相连；

[0015] 所述 CPU 总控制电路的输入端连接有取样及驱动控制电路，该取样及驱动控制电路与转换开关、直流接触器及输出电夹相连；所述电池组通过电源控制电路与充电接口相连，电源控制电路与充电接口连接至 CPU 总控制电路；所述输出电夹及转换开关分别与电源控制电路相连；所述 CPU 总控制电路的输出端还连接有显示电路，该显示电路包括 LED 数码管显示器和不同颜色的 LED 指示灯；所述取样及驱动控制电路连接有强制启动按钮。

[0016] 目前汽车电池主要分为 12V 和 24V 两种，在电路设计中以 0VDC ～ 15.5VDC 以内默认为是 12VDC 电池；以 15.5 ～ 30.0VDC 内默认为是 24VDC 电池。转换开关将两个电池实现并联或串联两种方式，使之能够实现一机两个电压输出的功能。同时在转换开关上镶入两个联动小开关，联动开关与 12V 档和 24V 档保持同步，即转换开关在 12V 或 24V 档时，联动开也同步闭合，在 OFF 档时，联动开关也自动断开，用于实现外部连接信号的输入或断开等判断。

[0017] 该应急启动电源利用大功率直流接触器作为自动控制电子开关，通过电路进行控制其通和断两种状态，同时电路在吸合后判断直流接触器两端电压降，作为判断输出电夹是否出现短接的条件之一。

[0018] 应急启动电源分别从电池组两端、电夹小齿、转换开关输出端、直流接触器两端、充电接口、内部电压测试复位开关、强制启动按扭等关键点分别取样送至 CPU 总控制电路处理、判断，从而得知用户的操作信息后，将对应的脉冲信号发到语音存储控制电路，调取预先保存好的语音内容，再经过音频控制电路功率放大后，由场声器发出相应的语音信息。该应急启动电源可对档位选择、正确连接、错误连接和电压过低或过高等进行安全保护，同时在充电档位选择、电池低压预警、输出过流保护、电夹输出短路保护以及人为强制启动安全提示等方面都加入相应的语音提示和光电提示。语音清晰、响亮，发音标准，在 40dB 噪声环境下，声音有效传输距离在 5 米以上。语音种类除了标准的英语提示外还预备另外两个

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语种，即法语和西班牙语，用户可直接通过简单的按键任意切换，提高产品的通用性。

[0019] 在一个实施例中，该应急启动电源的电路构成如图2、图3、图4、图5所 示。本实施例中，该应急启动电源采用的主要关键器件有：IC1-7805 三端集成稳压器、IC2-MC96F32Q 单片机、IC3-BLA4208 语音存储集成芯片、IC4-TDA2822 集成音频功放、LS1- 全频段扬声器 2W/8 欧、LED-LG5631AH 七段数码管显示器、IC5（IC6）-PC817 光耦、IC7-LM358 集成运放、大功直流接触器、大电流转换开关（12/24V 档切换用）、联动开关、强制启动按钮、输出正、负极电夹。

[0020] 本实施例中，该应急启动电源可实现的主要功能有：

[0021] 1、应急启动电源转换开关操作时 12V/24V 档位自动识别提示，对应的档位语音提示及 LED3/LED4 点亮指示；

[0022] 2、应急启动电源电池低压自动报警提示，当电池电压低于 8.0 ≤ U ＜ 10.0V 时，语音自动报警提示；

[0023] 3、应急启动电源电池电压过低自动关断保护及提示，当电池电压持续低于 8V 时，应急启动电源自动关断电夹输出回路，同时发出低压关断保护语音提示；

[0024] 4、输出电夹正确连接导通提示，正确连接时自动吸合导通，并带语音提示及 LED4 灯点亮提示；

[0025] 5、输出电夹连接极性反向错误关断保护和提示，输出电夹极性接反时，直流接触器产关断保护，同时发出相应的语音信息提示及反接指示 LED7 灯点亮提示，同时数码管闪烁显示错误代码“Er1”信息；

[0026] 6、输出电夹连接电压错误关断保护和提示，即，内外连接的电池电压不匹配，一般指 12V 与 24V 电池对接错误或 24V 接外部电压高于 30.0V 的电池，应急启动电源自动发出错误连接语音信息提示和错接指示 LED6 灯点亮提示，同时数码管闪烁显示错误代码“Er2”信息；

[0027] 7、输出电夹过载关断保护和提示，当输出电夹出现电流过大时，自动关断而保护，应急启动电源发出相应的语音信息提示及数码管闪烁显示过载保护代码“P1”信息；

[0028] 8、输出电夹短路自动关断保护和提示，在吸合导通下，当输出电夹再次出现短接时，自动关断输出而保护，同时发出相应的语音信息提示及数码管闪烁显示短路保护代码“P2”信息；

[0029] 9、充电档位提示及充电状态指示，转换款应急启动电源充电仅现于 12V 档充电，即要把两电池并联后再一起充电，以确保两电池的充电电压平衡，即， 插入充电器后，如转换开关不在 12V 档位时，应急启动电源自动发出语音信息提示，同时充电指示灯也不会点亮，直到档位选择正确为止，正在充电指示灯 LED2 点亮、充电结束时 LED1 点亮；

[0030] 10、强制启动输出功能，当外部没有电池电压输入或输入电压信号过低，应急启动电源无法正常自动识别时，通过人为判断并正确可靠连接后，按下强制启动按扭，使应急启动电源强制吸合导通。当按下强制启动按开关后，应急启动电源自动发出安全预警信息语音和数码管同步显示“10—9—8—.....0”倒数时间计数提示信息给用户，提醒用户注意外接负载的极性和安全工作电压，需要持续按下 10s 后，应急启动电源才自动吸合，确保用户有足够的时间再对连接进行安全确认。

[0031] 本实施例中，语音存储控制电路中存储的语音内容如下（以英文版为例）：

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[0032] A.12V

[0033] B.24V

[0034] C.Low voltage,recharging recommended

[0035] D.Power is connected

[0036] E.Wrong Voltage

[0037] F.Wrong Polarity

[0038] G.Recharging ON,Turn the switch at back to 12V

[0039] H.charge immediately

[0040] I.Overload

[0041] J.Short Circuit

[0042] 其具体工作过程如下：

[0043] 1、当转换开关由 OFF 档转入 12V 或 24V 档位时，转换开关将电池组并联或串联后的电压送至直流接触器的输入端，同时“OUT+”端有高电平（OUT+ 取样点实际连接于直流接触器的输入端，“BAT/ 外部”连接于直流接触器的输出端），并通过二极管 D1、限流电阻 R1 和稳压二极管 DW1 限压后，由电阻 R2 驱动开关管 Q1，使继电器 JK1 吸合导通；电池 BAT+ 电压经过二极管 D4 加入三稳集成稳压器 7805 的输入端，使 3 脚输出一个稳定的 5VDC 电压给 CPU 及其他电路供电；

[0044] 当外部电夹正确连接且电压大于 1.5V 时，“BAT/ 外部”端电压经过二极管 D6 后，同样也加到开关管 Q1 的基极使继电器吸合导通，从而使 7805 进入正常工作状态；同理，当充电接口“CH+”接入电源时，7805 也进入正常工作状态。

[0045] 2、单片机上电工作后，首先检测转换开关是否打开，当“OUT+”端检测到电压 < 15.5VDC 时再与单电池正极“BAT1+”端取到的电压进行对比，当两个参考点的电压基本相同时，CPU 默认此时转换开关已置于 12V 档位；反之，当该点电压≥ 15.5V 且与“BAT1+”端的电压值相差较大时，CPU 默认转换开关已置于 24V 档；确定好档位后，单片机由 P52 端口或 P53 端口输出高电平，驱动对应的档位指示灯 LED3 或 LED4 点亮；同时由 P21 端口或 P23 端口输出一个脉冲信号驱动语音芯片，提取对应的语音信息经功放、扬声器等器件将对应的档位信息报告给用户；

[0046] 当单片机检测到“OUT+”的电压过低时，12V 档电压低于 10.0VDC（24V 档电压低于 20.0VDC）时，应急启动电源自动默认为电池已经馈电，不宜再使用，应及时补充电量；单片机 P16 脚将自动循环输出脉冲信号给语音存储芯片，提取低压报警提示语音，并通过扬声器及时地把低压信息报告给用户；同时将自动关断所有负载，即关闭点烟器和直流接触器的输出；

[0047] 当单片机检测到“UOT+”的电压为 0V，同时在“OUT+/ 外部”端检测到一定的正电压时，则表示应急启动电源的转换开关没有开，只是用户将输出电夹与外部电池已正确连接上；时此，应急启动电源默认用户想通过 JS 的数显电压表去测试外部电池电压，即单片机自动将从“OUT+/ 外部”端读到的实际电压值通过数码管显示出来；

[0048] 当单片机检测到“UOT+”的电压为 0V，同时在“CH+”端检测到充电器有接入电压时，表示此时转换开关没有开，只是充电器已接入，此时单片机自动将输出一个脉冲信号给语音存储芯片，提取充电档位置限制提示语音，告诉用户充电时请将转换开关置于 12V 档，

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如转换开关在其他档位时，单片机将自动循环输出触发信号，直到用户将转换开关转到正确的12V档位为止；当应急启动电源进入正常充电后，单片机通过检测取样电阻R31上的压降进行判断，当充电电流小于300mA时该电阻上的压降为0.03V，表示充电结束，反之则表示正在充电，当LED2点亮表示正在充电，当LED1点亮时表示充电结束。

[0049] 3、启动，其工作原理如下：

[0050] 3.1、12V档正确连接导通和提示：转换开产置于12V档，单片机检测到“OUT+”点和“BAT1+”点的电压均在12V档范围内时，应急启动电源自动报12V档位提示语音；同时外部12V电池两端电压分两路取样，一路接入直流接触器的输端，使单片机在“BAT+/外部”点检到12V档范围内的有效电压值；另一路通过电夹小齿取样、电夹线内部导线接至控制板的“J1”端口，使正接信号通过R5、D8和IC5进行转换后，将外部正接信号“RIGHT-Ctrl”送至单片机的P13端口，单片机判断应急启动电源已转到12V档，同时电夹已经正确可靠连接，此时单片机再向直流接触器控制电路输出高电平使其吸合导通，并向语音芯片发送一个脉冲信号提取正确连接及导通提示语音，将正确连接接信息及时地告诉用户；其他指示：12V档位指示灯点亮；对应的正确连接指示灯点亮提示；数码管自动显示内、外池电并联后的综合电压值。

[0051] 3.2、12V档极性反向连接保护和提示：转换开关转到12V档，相应的档位检测和提示内容同上；同时外部12V（或24V）电池两端电压通过电夹小齿取样、电夹线内部导线接至控制板的“J1”端口，使反接信号通过D9、IC6和R5进行转换后，将外部反接信号“Reverse-Ctrl”送至单片机的P12端口，单片机判断应急启动电源已转到12V档，同时检测到外部电池极性接反，此时直流接触器将保持断开状态，并向语音芯片连续发送脉冲信号提取反接提示语音信息，并将反接信息及时地告诉用户；其他指示：12V档位指示灯点亮；反接报警指示灯LED7点亮；数码管显示反接错误代码“Er1”闪烁。

[0052] 3.3、12V档外接电压过高错误保护和提示：转换开关转到12V档，相应的检测和提示内容同上；同时电夹从外部电池两端电压接入直流接触器的输端，使单片机在“BAT+/外部”点检到此时连接的电池电压已超出“12V”的安全范围内时，单片机直接默认外接电池电压与应急启动电源所选择的档位不匹配，直流接触器保持关闭保护；并向语音芯片连续发送脉冲信号提取电压错误连接提示语音信息，并将错接信息及时地告诉用户；其他指示：12V档位指示灯点亮；电压错误连接报警指示灯LED6点亮；数码管显示反接错误代码“Er2”闪烁。

[0053] 3.4、24V档正确连接导通和提示：转换开产置于24V档，单片机检测到“OUT+”点和“BAT1+”点的电压相关较大，应属于24V档位。应急启动电源自动报24V档位提示语音；同时外部24V电池两端电压分两路取样，一路接入直流接触器的输端，使单片机在“BAT+/外部”点检到24档范围内的有效电压值；中一路通过电夹小齿取样、电夹线内部导线后接至控制板的“J1”端口，使正接信号通过R5、D8和IC5进行转换后，将外部正接信号“RIGHT-Ctrl”送至单片机的P13端口，单片机判断应急启动电源已转到24V档，同时电夹已经正确可靠连接，此时单片机再向直流接触器控制电路输出高电平使其吸合导通，并向语音芯片发送一个脉冲信号提取正确连接及导通提示语音，将正确连接接信息及时地告诉用户；其他指示：24V档位指示灯点亮；对应的正确连接指示灯点亮提示；数码管自动显示内、外池电并联后的综合电压值。

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[0054] 3.5、24V 档极性反向连接保护和提示：转换开关转到 24V 档，相应的档位检测和提示内容同上；同时外部 24V（或 12V）电池两端电压通过电夹小齿取样、电夹线内部导线后接至控制板的“J1”端口，使反接信号通过 D9、IC6 和 R5 进行转换后，将外部反接信号“Reverse-Ctrl”送至单片机的 P12 端口，单片机判断应急启动电源已转到 24V 档，同时检测到外部电池极性接反，此时直流接触器将保持断开状态，并向语音芯片连续发送脉冲信号提取反接提示语音信息，并将反接信息及时地告诉用户；其他指示：24V 档位指示灯点亮；反接报警指示灯 LED7 点亮；数码管显示反接错误代码“Er1”闪烁。

[0055] 3.6、24V 档外接电压过低（或过高，超过 30.0V 时）错误保护和提示：转换开关转到 24V 档，相应的档位检测和提示内容同上；同时电夹从外部电池两端电压接入直流接触器的输端，使单片机在“BAT+/ 外部”点检到此时连接的电池电压已超出“24V”的安全范围内时，如外部电压低于 15.5V 或高于 30.0V 时，单片机直接默认外接电池电压与应急启动电源所选的档位不匹配，直流接触器保持关闭保护。并向语音芯片连续发送脉冲信号提取电压错误连接提示语音信息，并将错接信息及时地告诉用户；其他指示：24V 档位指示灯点亮；电压错误连接报警指示灯 LED6 点亮；数码管显示反接错误代码“Er2”闪烁。

[0056] 4、启动过载自动关断保护：当应急启动电源在启动的瞬间，整过启动系统中产生很大电流，应急启动电源通过从黑电夹小齿上取样，读取黑电夹的大齿到内部电池负极之间的压降，通过黑电夹小齿、内部信号线送到“J1”端口，再 经过 D0、IC7 等电路放大后，将过流信号“OVERLOAE-TEST”送到单片机的 P11 端口，当该电压值在一定时间内持续高于某一设定值（预先测试出黑电夹大齿到电池负极端子之间的电阻，参考应急启动电源电池最大放电能力计算出过流保护的参考电压值）时，应急启动电源就默认外部连接负载过重，已超出整个系统最大承受范围时，单片机切断直流接触器控制信号，使直流接触器强制关断输出；单片机同时向语音存片提取对应的过流保护提示语音信息，并将信息及时告知用户；其他指示：数码管显示过流保护代码“P1”闪烁。

[0057] 5、电夹输出短路自动关断保护：当应急启动电源在吸合导通后电夹出现短路时，整过启动系统中产生很大电流，应急启动电源同样通过从黑电夹小齿上取样，读取黑电夹的大齿到内部电池负极之间的压降，通过黑电夹小齿、内部信号线送到“J1”端口，再经过 D0、IC7 等电路放大后，将过流信号“OVERLOAE-TEST”送到单片机的 P11 端口；同时单片机判断直流接触器两端“OUT+”和“BAT/ 部外”两点之间压差，当这两个电压值在一定时间内持续高于某一设定值时，应急启动电源就默认外部电夹连接出现短路故障；单片机将立即切断直流接触器控制信号，使直流接触器强制关断输出；单片机同时向语音存片提取对应的短路保护提示语音信息，并将信息及时告知用户；其他指示：数码管显示过流保护代码“P2”闪烁。

[0058] 6、强制启动输出：当外部电池电压过低或没有电池时，用户可以先将转换开关打开到所需的电压档位（此时相应的档位检测和提示内容同上），再将正、负极电夹分别接到负载的输入电源正、负极上，注意电夹的大小齿同时可靠连接，并确认负载所需电源与应急启动电源转换开关选择的电压档位一致后；按持续按下强制启开关，强制启动开关将“J3”端口短接，使内部 5V 电源通过电阻 R15、R16 分压取样后，送至单片机的第 P25 端口，单片机将自动开始计时，并向语音芯片提取强制启动语音安全提示，持续按下 10S 后，单片机将自动发出接通指令，使直流接触器强制吸合导通；当应急启动电源在动自吸合之前（10S 内）

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出现连接异常(如、反接、高压错接)时,单片机将自动判断强制启动操作无效,需要排除故障后恢复;确保用户的操作安全;其他提示:按下此开关后,在 10s 内数码管显示“10s 倒数计时器”闪烁,吸合导通后,应急启动电源将发出正确导通语音提示,同时正确连接提示灯 LED5 点亮。

[0059] 7、语音控制电路工作原理:首先把所有的功能语音以 PCM 压缩模式存入语音存储芯片中,语音芯片选用 BLA 系列的 BLA4208 芯片,该芯片总共支持语音长度为 42s,最多可存储 30 段不同的语音内容;语音的读取是通过 S1-S8 共 8 个单独触发引脚控制,同时还支持不同引脚以不同的组合方式进行触发,使其能够支持 30 段语音触发的需要;再通过 CPU 控制任意提取每一段语音内容,通过第 8 脚输出语音信号,经过音频功放 IC4 放大后,直接驱动扬声器 SL1 发音;语音触发信号为高电平有效,单片机每发出一个脉冲触发信号,语音芯片将自动提取一次相应的语音内容进行播报;当触发为持续高电平时,芯片将自动循环播报相同语音内容。

[0060] 8、取样电路及控制电路工作原理:如图 5 所示,J1 为正、负极电夹小齿取样信号输入端,当外部正接时,电压通过电阻 R5、D8 及 IC5 进行转换后,将 AD 信号送入单机的第 P31 端口,作为判断外部电夹是否正接或断开的依据;当外接电池电压极性反向时,单片机无法直接读取“BAT/ 外部”端的负压,而通过 J1、D9、IC6、R5 进行转换后,将反接信号送入单片机的第 P12 端口,作为判断外部电夹连接极性反向依据;当输出电夹线出现负载电流过大时,大电流将会在负极电夹线上产生一定压降,这个电压将通过负极电夹的小齿取出送至 D0、R11 和 IC7 放大后送入单片机的第 P11 脚进行判断,当检测到该电压在 1s 内持续大于某一设定值时,单片机就默认为外接负载过重,立即关断直流接触器进行保护;同理,当检测到该电压值在瞬间内高于另一设定值,同时又分别从直流接触器两端检测到的压降也大于某一设定值时,应急启动电源就自动默认为输出电夹存在短路现象,立即关断直流接触器而保护;

[0061] J5 为充电电源接入端;J6 为内输出电压检测和外部电压检测输入端,同时也是直流接触器两端压降的取样点;J7 为直流接触器控制线圈接口;其中由主要元件 R25、R26、Q2、JK2、RT1 组成点烟器输出控制电路;由主要元件 R29、R30、Q3 组成蜂鸣器报警控制电路;由主要元件 R27、R28、Q3 组成直流接触器控制电路;由主要元 R17、R18、R31、C25、C21 组成充电电源取样及充电电流取样电路,用于判断充电器的接入以及充电状态的检测;由主要元件 R19、R20、R21、R22、R23、R24、C22、C23、C20 组成了内、外电池电压取样电路及转换开关档位判断取样电路;由主要元件 LED、Q5、Q6、Q7 等组成数码显 示控制电路。

[0062] 以上显示和描述了本实用新型的基本原理、主要特征和本实用新型的优点。本行业的技术人员应该了解,本实用新型不受上述实施例的限制,上述实施例和说明书中描述的只是说明本实用新型的原理,在不脱离本实用新型精神和范围的前提下本实用新型还会有各种变化和改进,这些变化和改进都落入要求保护的本实用新型范围内。本实用新型要求保护范围由所附的权利要求书及其等同物界定。

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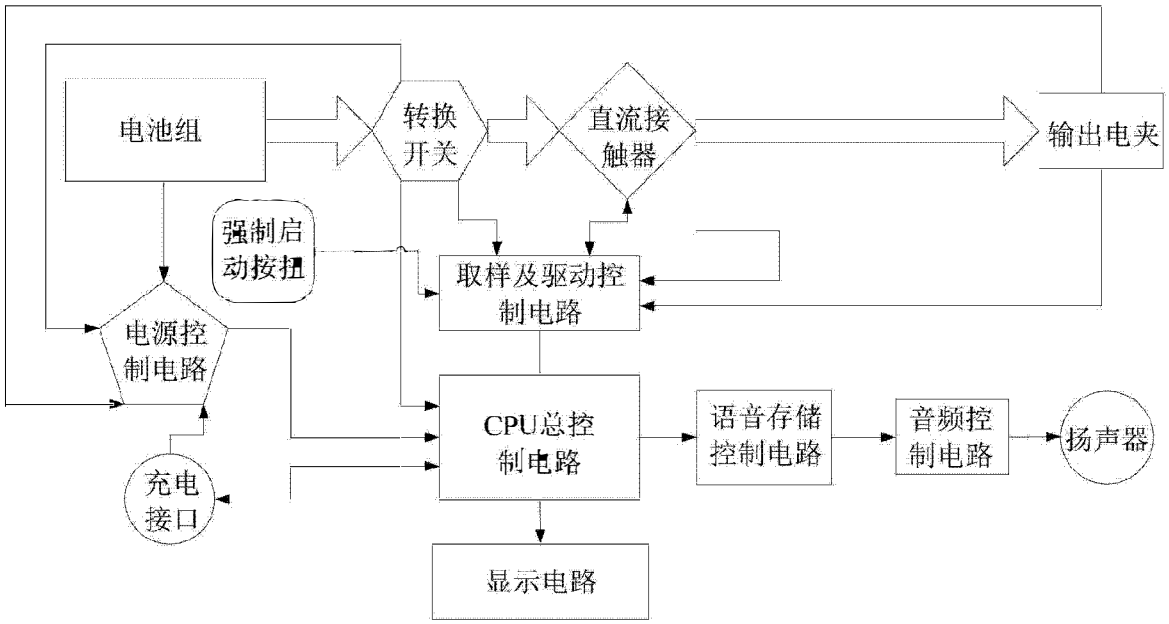


图 1

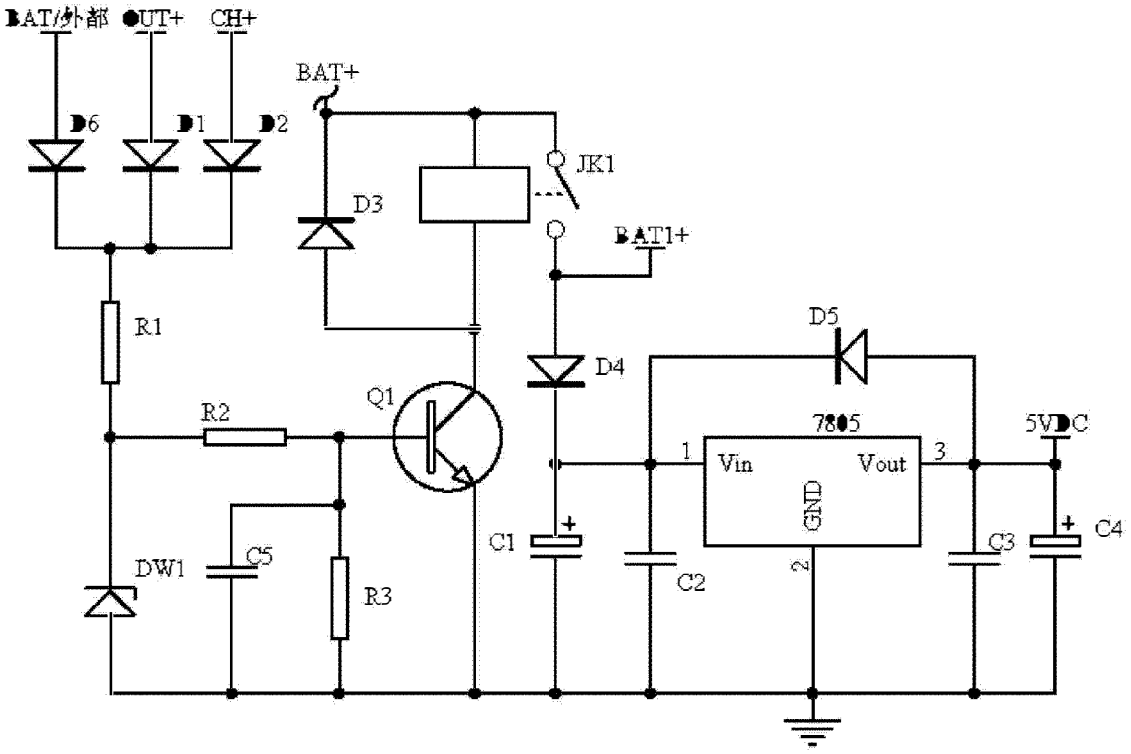


图 2

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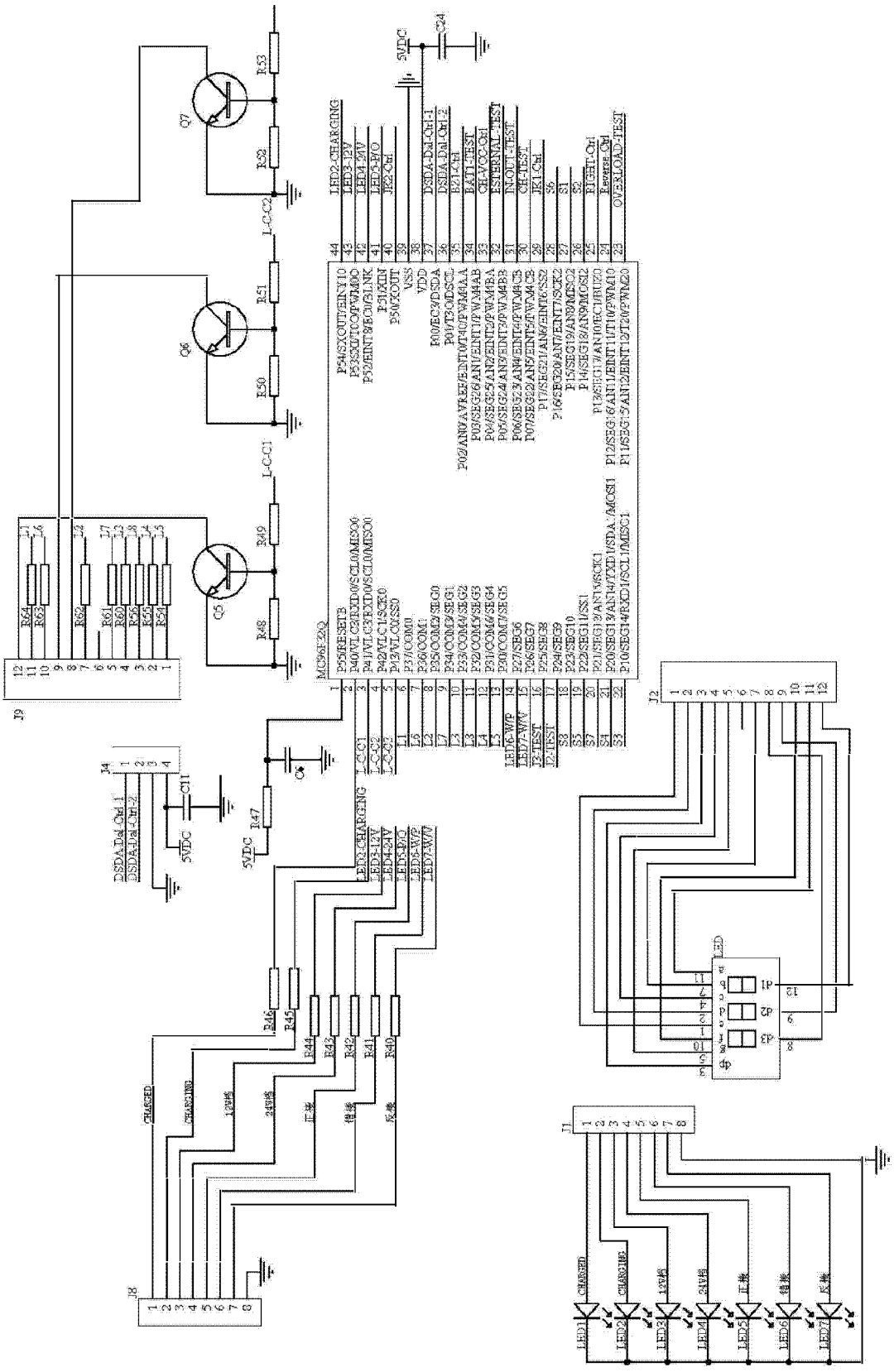


图 3

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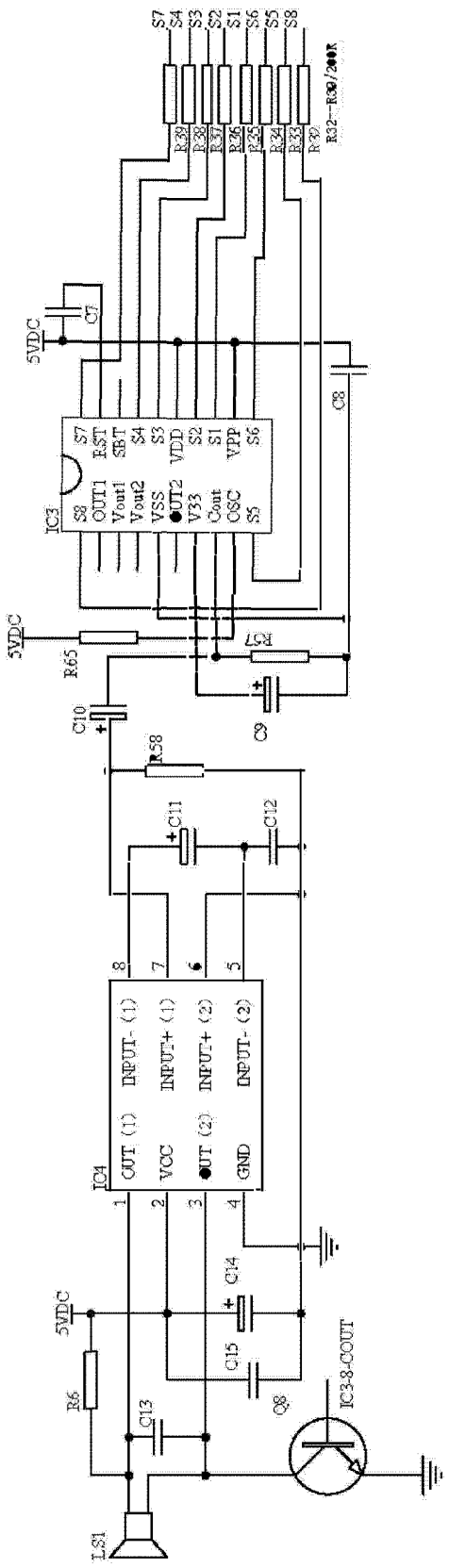


图 4

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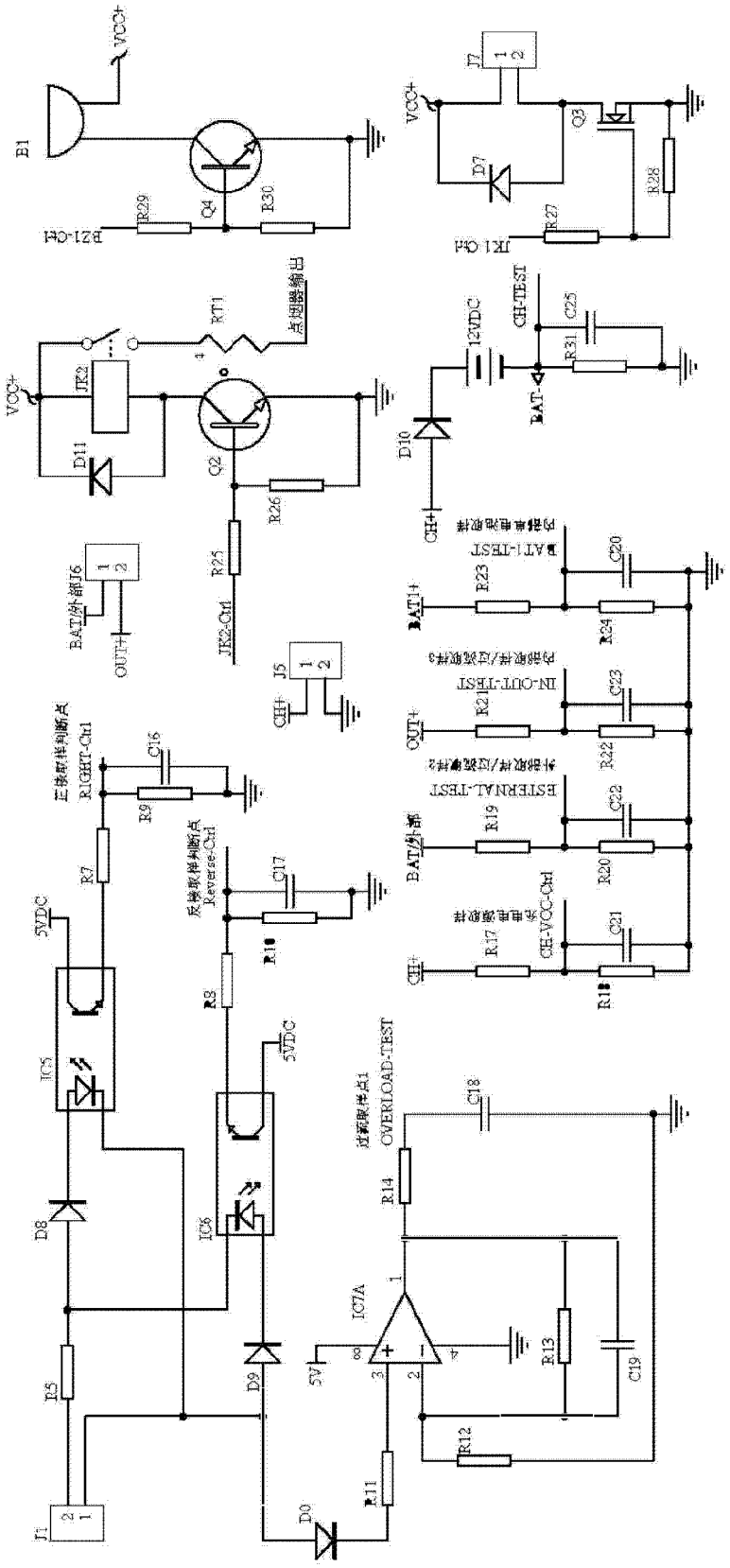


图 5

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ABSTRACT JP3185027U

[]

13 PROBLEM TO BE SOLVED: To provide a booster cable for a portable auxiliary power feeding device having a function as a jump starter, which is compact and lightweight and has excellent portability, which can withstand relatively intense bending motion and does not cause disconnection of a core wire. Provide booster cables. SOLUTION: A connector cover 240 is attached to a two-pole connector 230 having a male-female structure for connecting two connection cables 120A and 120B to a portable auxiliary power supply device, and two cables are derived from the two-pole connector 230. The lead-out portion of the connection cable is fixed by the connector cover 240. When the booster cable is grasped and the auxiliary power supply device is lifted and moved as it is, a strong pulling force is applied and the lead-out portion of the cable that is repeatedly bent is pinched and protected by the connector cover, so that there is no risk of disconnection in the core wire. [Selection diagram] Fig. 6

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25 【課題】ジャンプスタータとしての機能を有し、小型軽量で携帯性に優れた可搬型補助給電装置用のブースタケーブルであって、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞のないブースタケーブルを提供する。【解決手段】２本の接続ケーブル１２０Ａ，１２０Ｂを可搬型補助給電装置に接続するための雄雌同体構造の２極コネクタ２３０にコネクタカバー２４０を取り付け、２極コネクタ２３０から導出される２本の接続ケーブルの導出部分をコネクタカバー２４０により固定する。ブースタケーブルを掴んで補助給電装置を持ち上げそのまま移動した場合、強い引っ張り力が加わり、繰り返し屈曲されるケーブルの導出部分がコネクタカバーにより挟持保護されるので、心線に断線の虞がなくなる。【選択図】図６

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要約 開く ＋

請求の範囲 開く ＋

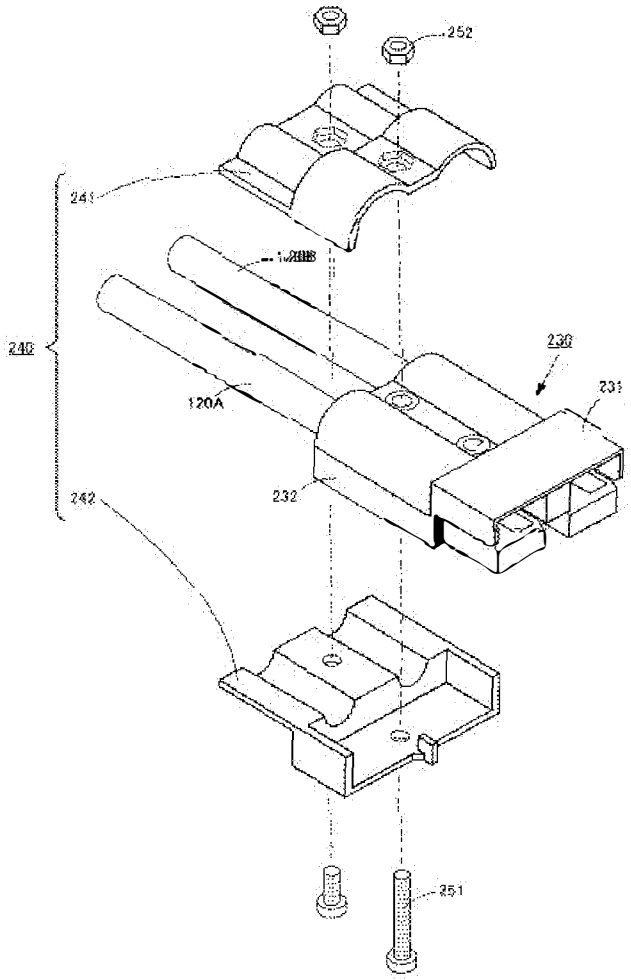
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最終頁に続く

(54)【考案の名称】可搬型補助給電装置用のブースタケーブル

(57)【要約】　(修正有)
【課題】ジャンプスタータとしての機能を有し、小型軽量で携帯性に優れた可搬型補助給電装置用のブースタケーブルであって、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞のないブースタケーブルを提供する。
【解決手段】２本の接続ケーブル１２０Ａ，１２０Ｂを可搬型補助給電装置に接続するための雄雌同体構造の２極コネクタ２３０にコネクタカバー２４０を取り付け、２極コネクタ２３０から導出される２本の接続ケーブルの導出部分をコネクタカバー２４０により固定する。ブースタケーブルを掴んで補助給電装置を持ち上げそのまま移動した場合、強い引っ張り力が加わり、繰り返し屈曲されるケーブルの導出部分がコネクタカバーにより挟持保護されるので、心線に断線の虞がなくなる。
【選択図】図６

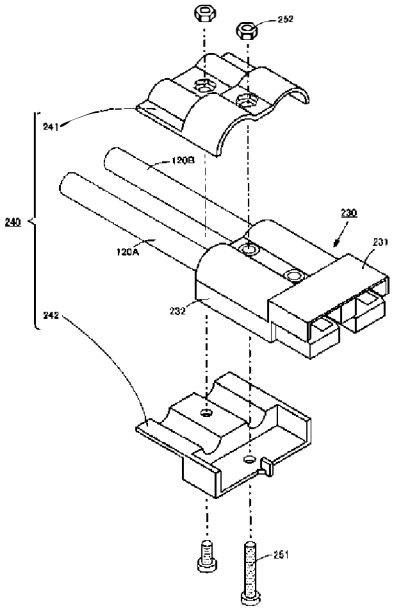


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【実用新案登録請求の範囲】
【請求項１】
ジャンプスータとしての機能を有する可搬型補助給電装置用のブースタケーブルであって、
２本の接続ケーブルと、
上記２本の接続ケーブルの一端部に接続された２つのジャンプスータ用鰐口クリップと、
上記２本の接続ケーブルの他端端部に設けられ、上記２本の接続ケーブルを上記可搬型補助給電装置に接続するための雄雌同体構造の２極コネクタと、
上記２極コネクタに取り付けられ、上記２本の接続ケーブルの上記２極コネクタから導出される導出部分を固定するコネクタカバーと
を備える可搬型補助給電装置用のブースタケーブル。
【請求項２】
上記２極コネクタは、上記接続ケーブルに接続された接触子が挿入される接触子挿入部と、上記接触子に接続された上記接続ケーブルを覆うケーブル導出部とが設けられたコネクタハウジングを有し、
上記コネクタカバーは、上記接続ケーブルに沿った面で二分割された上ハーフと下ハーフからなり、上記上ハーフと下ハーフにより構成される上記コネクタハウジングの上記ケーブル導出部を覆う取り付け部と、上記２極コネクタのハウジングから導出された上記２本の接続ケーブルを挟持するケーブル支持部と有し、上記取り付け部において上記ケーブル導出部に一体的に組み付け固定されることを特徴とする請求項１記載の可搬型補助給電装置用のブースタケーブル。
【考案の詳細な説明】
【技術分野】
【０００１】
本考案は、車両のバッテリが上がった場合に、車載バッテリに接続されて、エンジンを始動させるスータを含む車両の電気負荷に対して電力を供給して、上記エンジンを始動させるジャンプスタートさせるための可搬型補助給電装置用のブースタケーブルに関する。
【背景技術】
【０００２】
従来より、例えば路上等において、消費電気量の増加等により、車両に搭載されたバッテリが放電気味となりバッテリ容量が不足して電圧が低下し、電装品が作動しなくなった場合（いわゆるバッテリあがりの場合）に、他の自動車のバッテリや非常携帯電源（ジャンプスータ）からブースタケーブルを介して電力を供給することによりエンジンを始動させるジャンプスタートが行われている。そして、ジャンプスタートのための電気的な接続を容易にする技術（例えば、特許文献１，２参照）や、ジャンプスタートを判定する技術（例えば、特許文献３参照）など各種提案がなされている。
【０００３】
従来、ジャンプスータでは、コストと容量の関係から密閉式鉛蓄電池が用いられていた。
【０００４】
また、ＡＣアダプタを用いて充電可能なバッテリ駆動型のノートＰＣやその付帯機器などの情報機器が広く普及している。また、車両の車内に標準的に搭載されているＤＣ１２Ｖ／２４Ｖの車内用電源ソケット、いわゆるシガーソケットに接続して利用可能な車載対応の電気機器が数多く提供されている。また、近年の携帯電話やＵＳＢ（Universal Serial Bus）で給電可能な携帯音楽プレーヤ等の省電力で駆動可能な電子機器が広く使用されている。従来から、屋外で電気機器を使用するためにポータブル電源装置が用いられている。
【０００５】

ところで、一般的な密閉式鉛蓄電池を用いた従来のジャンプスタータでは、５～７ｋｇ程度の重量があり、携帯性に欠けるという問題点があった。また、満充電に平均１０～１５時間程度を要し、満充電状態での始動（ジャンプスタート）可能回数は平均で５回程度であった。さらに、鉛蓄電池は、過放電や過充電を行うと劣化が早くなり、自己放電も進みやすい性質があり、通常の鉛蓄電池の放電率は３０％程度であって、不使用状態でも自己放電して充電の必要性が出てくる。なれない人では適正な時期に充電操作が行えず、過充電や過放電を起こしてしまうことが多く、誰でも簡単に取り扱いができるものではなく、使い勝手が非常に悪いものであった。

【０００６】

また、従来のポータブル電源装置においても、鉛蓄電池が使われていたので重く、可搬性や使い勝手等の観点から従来のジャンプスタータと同様な問題点があった。

【先行技術文献】

【特許文献】

【０００７】

【特許文献１】特開２００４－１３４２７８号公報

【特許文献２】特開２０１１－９７７１０号公報

【特許文献３】特開２００７－２７８２１６号公報

【考案の概要】

【考案が解決しようとする課題】

【０００８】

本件出願人は、上述の如き従来の実情に鑑み、ジャンプスタータとしての機能を有し、しかも、バッテリ駆動型のノートＰＣやその付帯機器などの情報機器、シガーソケットに接続して利用可能な車載対応の電気機器、携帯電話やＵＳＢで給電可能な携帯音楽プレーヤ等の使用を可能にするポータブル電源としての機能を有し、さらに、ＯＢＤ（On-Board Diagnostic system）システムに対応した車両のメモリバックアップ用のポータブル電源として機能する小型軽量で携帯性に優れ、使い勝手のよい車両用補助給電装置を先に提案し、提供している。

【０００９】

ところで、上記車両用補助給電装置の場合、小型軽量で携帯性に優れることから、当該給電装置にブースタケーブルを接続した状態で、上記ブースタケーブルを掴んで当該給電装置を持ち上げそのまま移動するユーザが多いことが判明した。

【００１０】

上記ブースタケーブルを掴んで上記車両用補助給電装置を持ち上げそのまま移動した場合、上記ブースタケーブルは、上記車両用補助給電装置の重量により強い引っ張り力が加わった状態で、当該ブースタケーブルに設けられたコネクタの近傍において繰り返し屈曲されることになり、心線に断線の虞が生じる。

【００１１】

本考案は、上述の如き従来の実情に鑑みてなされたものであり、その目的は、ジャンプスタータとしての機能を有し、小型軽量で携帯性に優れた可搬型補助給電装置用のブースタケーブルであって、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞のないブースタケーブルを提供することにある。

【００１２】

本考案のさらに他の目的、本考案によって得られる具体的な利点は、以下において図面を参照して説明される実施に形態から一層明らかにされる。

【課題を解決するための手段】

【００１３】

本考案は、ジャンプスタータとしての機能を有する可搬型補助給電装置用のブースタケーブルであって、２本の接続ケーブルと、上記２本の接続ケーブルの一端部に接続された２つのジャンプスタータ用鰐口クリップと、上記２本の接続ケーブルの他端端部に設けられ、上記２本の接続ケーブルを上記可搬型補助給電装置に接続するための雄雌同体構造の

２極コネクタと、上記２極コネクタに取り付けられ、上記２本の接続ケーブルの上記２極コネクタから導出される導出部分を固定するコネクタカバーとを備えることを特徴とする。

【００１４】

本考案に係る可搬型補助給電装置用のブースタケーブルにおいて、上記２極コネクタは、上記接続ケーブルに接続された接触子が挿入される接触子挿入部と、上記接触子に接続された上記接続ケーブルを覆うケーブル導出部とが設けられたコネクタハウジングを有し、上記コネクタカバーは、上記接続ケーブルに沿った面で二分割された上ハーフと下ハーフからなり、上記上ハーフと下ハーフにより構成される上記コネクタハウジングの上記ケーブル導出部を覆う取り付け部と、上記２極コネクタのハウジングから導出された上記２本の接続ケーブルを挟持するケーブル支持部と有し、上記取り付け部において上記ケーブル導出部に一体的に組み付け固定されるものとすることができる。

【考案の効果】

【００１５】

本考案によれば、ジャンプスタータとしての機能を有し、小型軽量で携帯性に優れた可搬型補助給電装置用のブースタケーブルであって、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞のないブースタケーブルを提供することにある。

【図面の簡単な説明】

【００１６】

【図１】本考案を適用したブースタケーブルを接続した車両用補助給電装置を前方側斜め上方から見た外観斜視図である。

【図２】上記車両用補助給電装置の電気的な構成を示すブロック図である。

【図３】２極コネクタにコネクタカバーを取り付けた状態を示すブースタケーブルの平面図である。

【図４】上記ブースタケーブルに接続されている２極コネクタのコネクタハウジングと接触子を示す平面図である。

【図５】上記２極コネクタの接続状態を示す要部縦断面である。

【図６】上記２極コネクタに取り付けられるコネクタカバーの分解斜視図である。

【図７】上記２極コネクタに上記コネクタカバーを取り付けた状態を示す外観斜視図であり、（Ａ）は上面側から見た状態を示し、（Ｂ）は上記２極コネクタを裏返した状態を示している。

【考案を実施するための形態】

【００１７】

以下、本考案の実施の形態について、図面を参照しながら詳細に説明する。なお、本考案は、以下の実施の形態のみに限定されるものではなく、本考案の要旨を逸脱しない範囲内において種々の変更が可能であることは言うまでもない。

【００１８】

本考案は、例えば図１に示すように、車両用補助給電装置１００に接続されるブースタケーブル２００に適用される。

上記車両用補助給電装置１００は、ジャンプスタータとしての機能を有する可搬型補助給電装置であって、図１の外観斜視図に示すように薄型箱状の筐体１０を備え、また、図２のブロック図に示すように上記筐体１０の内部に設置された充電回路部１、リチウムイオン蓄電池２、出力回路部３及び制御回路部４を備えている。

【００１９】

そして、この車両用補助給電装置１００では、家庭用電源や自動車バッテリから例えば１２Ｖの電源供給を受けるための充電用の給電ケーブルがＤＣプラグを介して外部接続されるＤＣジャックからなるＤＣ入力端子２０が上記筐体１０の左側面壁に設置されている。このＤＣ入力端子２０には、上記充電回路部１が内部接続されている。上記充電回路部１には、上記リチウムイオン蓄電池２が内部接続されている。また、上記リチウムイオン蓄電池２には、上記出力回路部３が内部接続されている。さらに、上記充電回路部１及び

出力回路部３には、上記制御回路部４が内部接続されている。

【００２０】

また、この車両用補助給電装置１００は、上記出力回路部３に内部接続されたジャンプスタート用の第１のＤＣ出力端子３１、ＰＣ電源用の第２のＤＣ出力端子３２、ＵＳＢ電源用の第３のＤＣ出力端子３３及びメモリバックアップ電源用の第４のＤＣ出力端子３４を備える。

【００２１】

上記第１のＤＣ出力端子３１は、ブースタケーブル２００が雄雌同体構造の所謂アンダーソンコネクタを用いたプラグを介して外部接続されるジャックからなる。

【００２２】

上記第２のＤＣ出力端子３２は、ＰＣ電源ケーブルがプラグを介して外部接続されるジャックからなる。

【００２３】

上記第３のＤＣ出力端子３３は、ＵＳＢケーブルがＵＳＢプラグを介して外部接続されるＵＳＢソケットからなる。

【００２４】

上記第４のＤＣ出力端子３４は、外部電源ケーブルがシガープラグを介して外部接続されるシガーソケットからなる。

【００２５】

上記ジャンプスタート用の第１のＤＣ出力端子３１と、ＰＣ電源用の第２のＤＣ出力端子３２は、上記筐体１０の右側面壁に設置されている。また、上記ＵＳＢ電源用の第３のＤＣ出力端子３３は、上記筐体１０の正面壁１３に設置されており、上記メモリバックアップ電源用の第４のＤＣ出力端子３４は、上記筐体１０の左側面壁１１に設置されている。

【００２６】

また、この車両用補助給電装置１００は、上記制御回路部４に内部接続された電源スイッチ４１、ジャンプスタートスイッチ４２、ライトセレクトスイッチ４３及びサイドライト・オン／オフ・スイッチ４４を備える。上記電源スイッチ４１、ジャンプスタートスイッチ４２、ライトセレクトスイッチ４３及びサイドライト・オン／オフ・スイッチ４４は、上記筐体１０の正面壁１３に設置されている。

【００２７】

さらに、この車両用補助給電装置１００は、上記制御回路部４に内部接続された充電量表示部５１、バッテリロー表示灯５２、一対の非常用警告灯５３Ａ，５３Ｂ及び一対の側面照明灯５４Ａ，５４Ｂを備える。

【００２８】

上記充電量表示部５１及び一対の非常用警告灯５３Ａ，５３Ｂは、上記筐体１０の正面壁１３に設置されている。

【００２９】

上記充電量表示部５１は、直線状に配置された発光色の異なる複数（この実施の形態では、赤・橙・黄・緑の４色）のＬＥＤにより構成されている。この充電量表示部５１は、上記制御回路部４により制御されて、充電量をバー表示する機能を果たすばかりでなく、緑点灯によりパワーランプとして機能し、また、黄点灯によりジャンプスタートランプとして機能する。また、上記一対の非常用警告灯５３Ａ，５３Ｂは、赤色ＬＥＤと白色ＬＥＤからなり、上記制御回路部により制御されて、交互に点滅することにより非常用警告灯として機能する。

【００３０】

また、上記バッテリロー表示灯５２は、上記筐体１０の右側面壁に設置されている。

【００３１】

上記バッテリロー表示灯５２は、赤色ＬＥＤからなり、上記制御回路部４により制御されて、上記リチウムイオン蓄電池２の電圧が所定値まで低下すると点滅状態あるいは点灯

状態となることにより、バッテリロー表示灯として機能する。

【００３２】

また、上記一対の側面照明灯５４Ａ，５４Ｂは、それぞれ直線状に配置された複数の白色ＬＥＤにより構成されている。

【００３３】

このような構成の車両用補助給電装置１００において、上記筐体１０内に設置された制御回路部４は、上記充電回路部１の動作を制御する充電制御部、上記出力回路部１の動作を制御する出力制御部、充電量表示部５１等の動作を制御する表示制御部として機能するマイクロコンピュータからなり、内部接続された上記充電回路部１及び出力回路部３の動作を次のように制御する。

【００３４】

ここで、この車両用補助給電装置１００に接続される充電用の給電ケーブルとしては、家庭用電源から充電用の１２Ｖの電源供給するためのＡＣアダプタケーブルと、自動車バッテリから例えば１２Ｖの電源供給を供給するためのシガープラグケーブルが準備されている。

【００３５】

そして、上記車両用補助給電装置１００における上記制御回路部４は、上記ＤＣ入力端子２０にＡＣアダプタケーブル又はシガープラグケーブルが外部接続され、家庭用電源又は自動車バッテリから充電用の電源が供給されることにより、上記ＤＣ入力端子２０に所定電圧値以上の電圧が印加されたことを検出すると、充電モードの制御を行う。

【００３６】

この充電モードの制御において、上記制御回路部４は、充電制御部により上記充電回路部１の動作を制御して、上記充電回路部１を介して上記リチウムイオン蓄電池２を充電し、上記リチウムイオン蓄電池２が満充電まで充電されると過充電保護回路を機能させ、充電を終了する。

【００３７】

また、上記制御回路部４は、充電制御中には、出力制御部により上記出力回路部３の動作を制御して、上記出力回路部３から外部への電源供給を禁止する。

【００３８】

さらに、上記制御回路部４は、充電制御中には、表示制御部により上記充電量表示部５１の動作を制御して、上記充電量表示部５１を制御して充電量をバー表示する。

【００３９】

上記充電量表示部５１は、上記制御回路部４により動作が制御されて、未充電状態から、バッテリ残量２０％以下を示す赤色点状態、バッテリ残量２０％から３０％を示す赤色点灯、バッテリ残量３０％から４０％を示す橙色点滅状態、バッテリ残量４０％から７０％を示す黄色点灯状態、バッテリ残量７０％から１００％を示す緑色点灯状態へと、満充電状態まで充電が進むに従って、点灯状態が順次変化する。

【００４０】

上記車両用補助給電装置１００は、上記リチウムイオン蓄電池２を充電した状態で、可搬型ジャンプスタータとして機能し、また、屋外で電気機器を使用するためにポータブル電源装置として使用することができる。

【００４１】

ここで、この車両用補助給電装置１００には、上記ジャンプスタート用の第１のＤＣ出力端子３１を構成している雄雌同体構造の所謂アンダーソンコネクタからなるジャック１３０にプラグ２３０を介して外部接続されるジャンプスタート用のブースタケーブル２００が準備されている。

【００４２】

上記ブースタケーブル２００は、図３に示すように、２本の接続ケーブルケーブル２１０Ａ、２１０Ｂの一端部に接続された２つのジャンプスタータ用鰐口クリップ２２０Ａ、２２０Ｂと、上記２本の接続ケーブルケーブル２１０Ａ、２１０Ｂの他端端部に設けられ

、上記２本の接続ケーブルケーブル２１０Ａ、２１０Ｂを上記車両用補助給電装置１００に接続するための雄雌同体構造の２極コネクタ２３０と、上記２極コネクタ２３０に取り付けられ、上記２本の接続ケーブル２１０Ａ、２１０Ｂの上記２極コネクタ２３０から導出される導出部分を固定するコネクタカバー２４０とを備える。

【００４３】

上記２極コネクタ２３０は、図４に示すように、上記接続ケーブル２１０Ａ、２１０Ｂに接続された接触子２３５Ａ，２３５Ｂが挿入される接触子挿入部２３１と、上記接触子に接続された上記接続ケーブル２１０Ａ、２１０Ｂを覆うケーブル導出部２３２とが設けられ、図５に接続状態の要部縦断面図を示すように、雄雌の区別がないにも拘わらず誤接続を物理的に不可能とした構造のコネクタハウジング２３３を有する雄雌同体構造の所謂アンダーソンコネクタからなる。

【００４４】

また、上記コネクタカバー２４０は、図６に示すように、上記接続ケーブル２１０Ａ、２１０Ｂに沿った面で二分割された上ハーフ２４１と下ハーフ２４２からなり、上記上ハーフ２４１と下ハーフ２４２により構成される上記コネクタハウジング２３３の上記ケーブル導出部２３２を覆う取り付け部２４４と、上記コネクタハウジング２３３から導出された上記２本の接続ケーブル２１０Ａ、２１０Ｂを挟持するケーブル支持部２４５と有する。そして、上記コネクタカバーは、図７の（Ａ），（Ｂ）に示すように、上記取り付け部において上ハーフ２４１と下ハーフ２４２が上記ケーブル導出部２３２にネジ２５１とナット２５２により一体的に組み付け固定される。

【００４５】

このような構造のコネクタカバー２４０を上記２極コネクタ２３０のケーブル導出部２３２に取り付けた上記ブースタケーブル２００では、上記２極コネクタ２３０のケーブル導出部２３２から導出された上記２本の接続ケーブルケーブル２１０Ａ、２１０Ｂの導出部分が上記コネクタカバー２４０のケーブル支持部２４５により挟持されるので、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞がなくなる。

【００４６】

そして、この車両用補助給電装置１００は、上記ブースタケーブル２００を介してジャンプスタートさせる車両の車載バッテリに接続され、次のようにしてジャンプスタータとして使用される。

【００４７】

すなわち、この車両用補助給電装置１００をジャンプスタータとして使用する場合、当該車両用補助給電装置１００の電源スイッチ４１がＯＦＦの状態で、上記ジャンプスタート用のブースタケーブル２００がユーザにより上記第１のＤＣ出力端子３１に接続される。

【００４８】

上記車両用補助給電装置１００のユーザは、上記充電量表示部５１を構成している複数のＬＥＤが全て消灯していることで、電源スイッチ４１がＯＦＦの状態であることを確認することができる。

【００４９】

次に、ユーザが電源スイッチ４１を押して電源ＯＮにすると、この車両用補助給電装置１００の制御回路部４は、電源ＯＮを検知して上記表示制御部により充電量表示部５１の動作を制御し、上記充電量表示部５１を緑色点灯状態とする。上記充電量表示部５１は、緑色点灯により電源ＯＮを表示するパワーランプとして機能する。

【００５０】

そして、この電源ＯＮ状態でユーザがジャンプスタートスイッチ４２を押してジャンプスタートすると、この車両用補助給電装置１００の制御回路部４は、上記ジャンプスタートスイッチ４２の短時間操作によるジャンプスタートを検知して、ジャンプスタートモードの制御を行う。

【００５１】

このジャンプスタートモードの制御において、上記制御回路部４は、上記ジャンプスタート用の第１のＤＣ出力端子３１にブースタケーブル２００を介してジャンプスタートさせる自動車の車載バッテリの電圧を正常に検知できた場合に、上記出力制御部により出力回路部３の動作を制御し、上記リチウムイオン蓄電池２をジャンプスタート用の電源として上記出力回路部３を介して上記ジャンプスタート用の第１のＤＣ出力端子３１に接続するとともに、上記表示制御部により充電量表示部５１の動作を制御し、上記充電量表示部５１を黄色点灯状態とする。上記充電量表示部５１は、黄色点灯によりジャンプスタートを表示するジャンプスタートランプとして機能する。このジャンプスタートモードでは、上記充電量表示部５１は、緑色点灯により電源ＯＮを表示するとともに黄色点灯によりジャンプスタートを表示している。

【００５２】

このジャンプスタートモードの状態で、ユーザは、この車両用補助給電装置１００が接続されている上記車載バッテリを搭載した自動車のエンジンを始動させるジャンプスタートを行うことができる。

【００５３】

ここで、従来の一般的な鉛蓄電池を用いた１２Ｖ／４．５Ａｈ程度の容量のジャンプスタータは、本体重量が５ｋｇ～７ｋｇ程度あり、満充電電状態での始動可能回数は平均５回程度であったのに対し、本考案を適用した上記車両用補助給電装置１００は、例えば３０ｍｍ×１５０ｍｍ×１００ｍｍ（縦×幅×奥行き）の大きさの筐体１０内に例えば３．６Ｖの充電式リチウムイオンを３個直列接続して実装することにより、重さ８３０ｇ程度で３０００ｃｃまでのガソリン乗用車に対応する１２Ｖ／４．５Ａｈの容量の可搬型ジャンプスタータとして機能し、小型軽量で、しかも、満充電電状態での始動可能回数も１０～２０回程度に向上している。

【００５４】

また、上記車両用補助給電装置１００は、例えば４５ｍｍ×１９０ｍｍ×１８０ｍｍ（縦×幅×奥行き）の大きさの筐体１０を用いて、２倍の６個の充電式リチウムイオンを実装することにより、重さ１３００ｇ程度でガソリン乗用車全般及び３０００ｃｃ４気筒までのディーゼル車に対応する１２Ｖ／９Ａｈの容量の可搬型ジャンプスタータとして機能する。

【００５５】

なお、この車両用補助給電装置１００における上記制御回路部４は、上記電源ＯＮ状態でユーザがジャンプスタートスイッチ４２を長時間操作すなわち例えば５秒以上長押しすると、チャージブーストモードの制御状態となり、上記リチウムイオン蓄電池２に充電されている電気を１度に放出するように、上記出力制御部により上記出力回路部３の動作を制御する。このチャージブーストモードの制御状態では、上記表示制御部により充電量表示部５１の動作を制御し、上記充電量表示部５１を黄色点灯状態とする。すなわち、上記充電量表示部５１は、黄色点灯によりチャージブーストモードを表示するチャージブーストモードとして機能する。このチャージブーストモードは、車載バッテリが深放電状態になっている場合に使用される。

【００５６】

また、この車両用補助給電装置１００は、上述の如く１２Ｖ／４．５Ａｈの容量のもので重さ８３０ｇ程度、１２Ｖ／９Ａｈの容量のものでも１３００ｇ程度の重量で小型軽量であるので、可搬性に優れ、しかも、上記ジャンプスタート用の第１のＤＣ出力端子３１の他に、屋外で電気機器を使用するための外部接続用の第２乃至第４のＤＣ出力端子３２～３４を備えているので、次のようにポータブル電源として使用することができる。

【００５７】

すなわち、この車両用補助給電装置１００において、上記第２のＤＣ出力端子３２には、ＰＣ電源ケーブルを介してＰＣを外部接続することができる。

【００５８】

また、この車両用補助給電装置１００において、上記第３のＤＣ出力端子３３には、Ｕ

ＳＢ（Universal Serial Bus）で給電可能な携帯音楽プレーヤ等の電子機器を市販のＵＳＢケーブルを介して接続することができる。

【００５９】

また、この車両用補助給電装置１００は、上記第４のＤＣ出力端子３４に外部接続されるシガーケーブルを介して車載対応の電気機器を駆動するポータブル電源として機能する

•

さらに、この車両用補助給電装置１００は、上記第４のＤＣ出力端子３４に外部接続されるシガーケーブルを介してＯＢＤ（On-Board Diagnostic system）システムに対応した車両のメモリバックアップ用のポータブル電源として機能する。

【００６０】

すなわち、この車両用補助給電装置１００は、ジャンプスタータとしての機能を有し、しかも、バッテリ駆動型のノートＰＣやその付帯機器などの情報機器、シガーソケットに接続して利用可能な車載対応の電気機器、携帯電話やＵＳＢで給電可能な携帯音楽プレーヤ等の使用を可能にするポータブル電源としての機能を有し、さらに、ＯＢＤ（On-Board Diagnostic system）システムに対応した車両のメモリバックアップ用のポータブル電源として機能する小型軽量で携帯性に優れ、使い勝手のよい車両用補助給電装置となっている。さらに、この車両用補助給電装置１００は、上述の如きジャンプスタータやポータブル電源として機能するばかりでなく、非常時に使用する警告表示灯や照明灯として機能する。

【００６１】

以上説明した本考案の実施の形態のように、可搬性に優れた小型軽量でジャンプスタータとしての機能を有する車両用補助給電装置１００に接続される可搬型補助給電装置用のブースタケーブル２００では、上記２極コネクタ２３０のケーブル導出部２３２から導出された上記２本の接続ケーブルケーブル２１０Ａ、２１０Ｂの導出部分が上記コネクタカバー２４０のケーブル支持部２４５により挟持されるので、比較的激しい屈曲運動に耐え、心線の断線を引き起こす虞がなく、所期の目的を達成することができる。

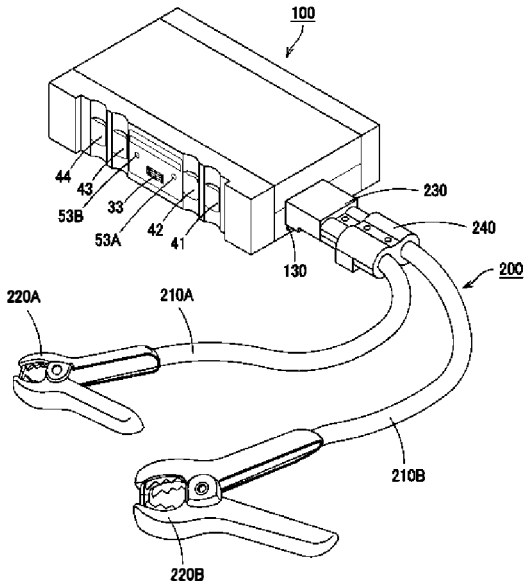
【符号の説明】

【００６２】

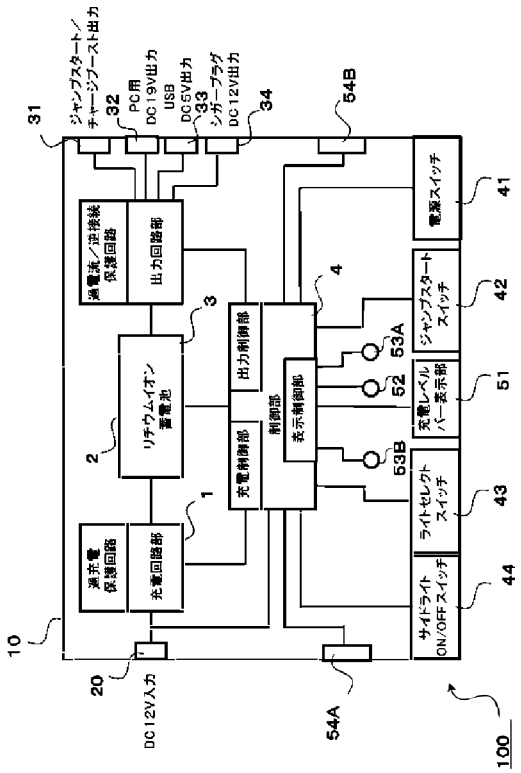
１　充電回路部、２　リチウムイオン蓄電池、３　出力回路部、４　制御回路部、１０　筐体、１１　左側面壁、１２　右側面壁、１３　正面壁、２０　ＤＣ入力端子、３１　第１のＤＣ出力端子、３２　第２のＤＣ出力端子、３３　第３のＤＣ出力端子、３４　第４のＤＣ出力端子、４１　電源スイッチ、４２　ジャンプスタートスイッチ、４３　ライトセレクトスイッチ、４４　サイドライト・オン／オフ・スイッチ、５１　充電量表示部、５２　バッテリロー表示灯、５３Ａ，５３Ｂ　非常用警告灯、５４Ａ，５４Ｂ　側面照明灯、１００　車両用補助給電装置、２００　ブースタケーブル、２１０Ａ，２１０Ｂ　ケーブル、２２０Ａ，２２０Ｂ　ジャンプスタータ用鰐口クリップ、２３０　２極コネクタ、２３１　接触子挿入部、２３２　ケーブル導出部、２３３　コネクタハウジング、２３５Ａ，２３５Ｂ　接触子、２４０　コネクタカバー、２４１　上ハーフ、２４２　下ハーフ、２４４　取り付け部、２４５　ケーブル支持部

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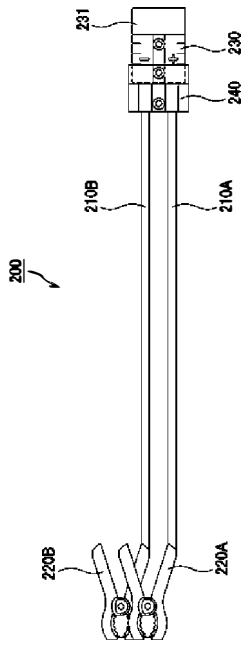
【図１】



【図２】



【図３】



【図６】

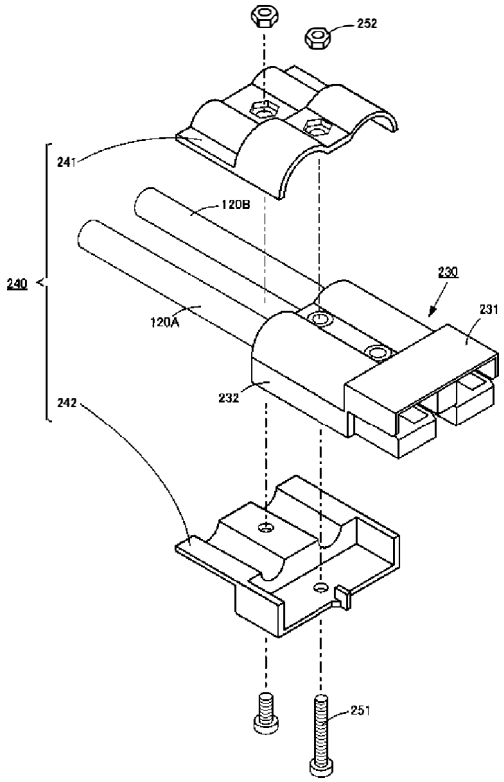
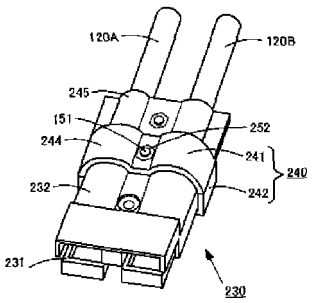
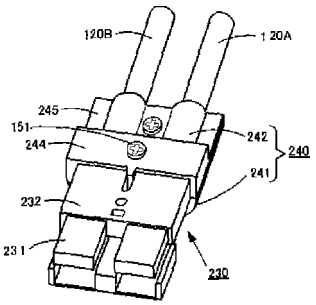


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【図７】



(A)



(B)

【図４】

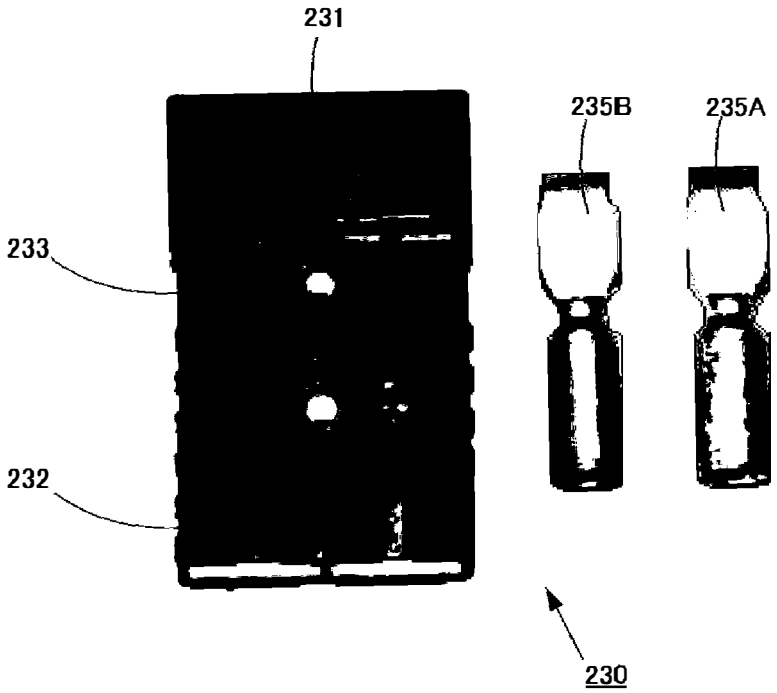


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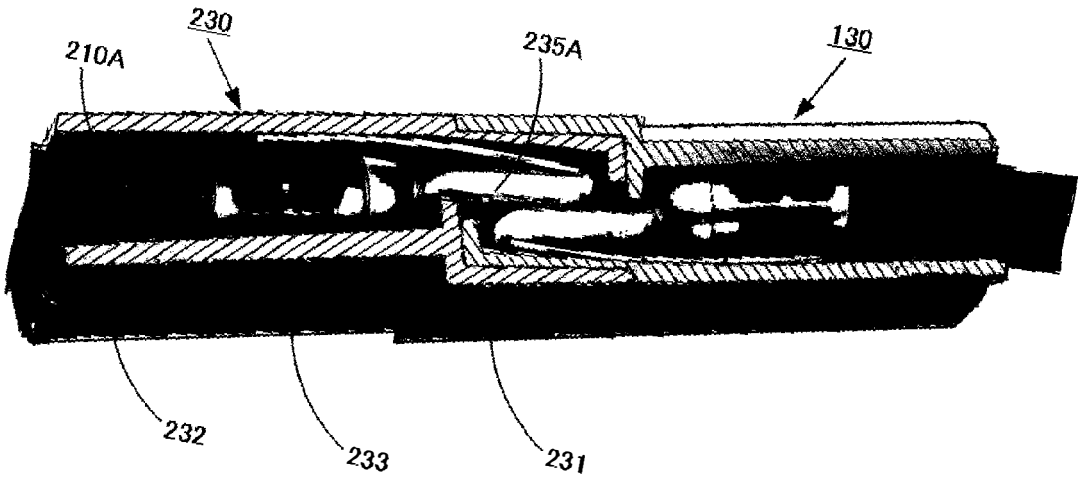


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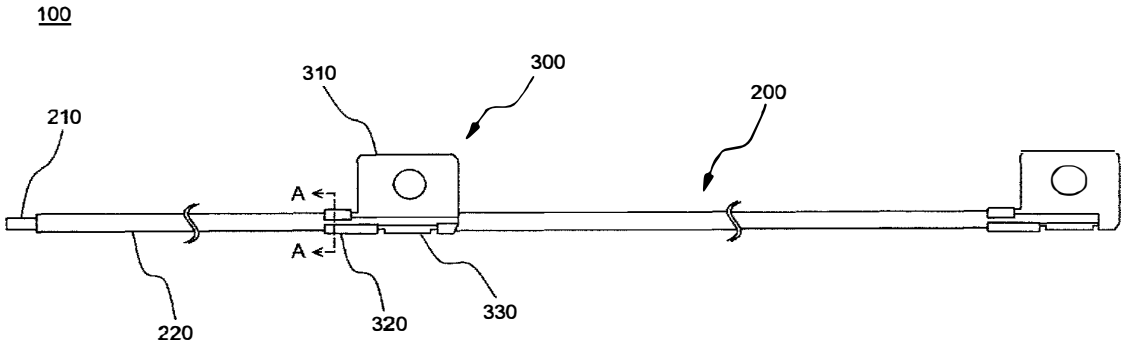
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ELECTRODE CONNECTOR CONTAINING PLATE AND BATTERY MODULE EMPLOYED WITH THE SAME



(57) Abstract: An electrode connector includes a conductive wire and plates mounted on the wire such that the plates can be electrically connected to electrodes of cells. The plates are electrically connected to the wire. A battery module is manufactured with the electrode connector. The electrode connector is electrically connected to the electrodes of the cells by means of the plates. Consequently, the coupling of the electrode connector to the electrodes of the cells is easily accomplished by welding while damage to the cells is minimized. Furthermore, the electrical connection between the plates is accomplished by means of the flexible wire. Consequently, the assembly operation for the electrode connection is very easily carried out, and the electrode connector can be manufactured inexpensively.

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ELECTRODE CONNECTOR CONTAINING PLATE AND BATTERY MODULE EMPLOYED WITH THE SAME

FIELD OF THE INVENTION

The present invention relates to an electrode connector for connecting electrodes of cells with each other, and, more particularly, to an electrode connector having plates, which are weldable to electrodes, mounted on a wire, thereby accomplishing easy and convenient electrical connection between the electrodes while minimizing damage to the cells and enabling inexpensive manufacture of the electrode connector. Also, the present invention relates to a battery module manufactured with such an electrode connector.

BACKGROUND OF THE INVENTION

As mobile devices have been increasingly developed, and the demand of such mobile devices has increased, the demand of secondary batteries has also sharply increased as a power source for the mobile devices. One of the secondary batteries is a lithium secondary battery having high energy density and discharge voltage, into which much research has been carried out and which is now commercially and widely used.

Based on kinds of external devices in which the secondary battery is used, the secondary battery may be used in the form of a single unit cell or in the form of a battery pack including a plurality of unit cells electrically connected with each other.

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For example, small-sized devices, such as a mobile phone, can be operated for a predetermined period of time from the output and the capacity of a single unit cell. On the other hand, large-sized devices, such as lap-top computers or electric vehicles, require use of a medium- or large-sized battery pack because a high output and a large capacity are necessary.

The battery pack is a battery structure including a plurality of unit cells electrically connected in series and/or parallel with each other. A wire, a plate, and a flexible printed circuit board (FPCB) are used in the battery pack so as to accomplish the electrical connection between electrodes of the unit cells.

The wire is a linear conductive member. Generally, an insulating resin is covered on the outer surface of the wire, and therefore, the wire has advantages in that the linear conductive member is easily deformed, and the costs of the liner conductive member are inexpensive. However, the wire has problems in that it is difficult to accomplish the electrical connection between the electrodes of the cells by a welding process, such as spot welding, ultrasonic welding, or laser welding, and a large amount of heat is transferred to the cells during the welding process, which causes damage to the cells.

The plate, which is a plate-shaped conductive member, has an advantage in that the electrical connection between the electrodes of the cells can be easily accomplished by the above-mentioned welding process. However, the plate has a problem in that it is difficult to accomplish the electrical connection between the electrodes of the cells even with only a slight-degree error.

The FPCB, which is widely used in recent years, has advantages in that the electrical connection between the electrodes of the cells can be easily accomplished like

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the plate, and it is suitable for the electrical connection in a complicated structure. However, the FPCB has problems in that the FPCB is very expensive, the formability is lowered, and the assembly operation is difficult.

Processes for constituting a battery module through the electrical connection between electrodes of a plurality of cells using an FPCB are partially shown in FIGS. 1 and 2. FIG. 1 illustrates a normal assembly process of the battery module in which the connection between the electrodes is normally accomplished, and FIG. 2 illustrates an abnormal assembly process of the battery module in which the connection between the electrodes is abnormally accomplished.

Referring to FIGS. 1 and 2, an FPCB 10 includes a flexible board 12, on which a circuit 14 is formed. To the circuit 14 are connected electrodes 22 of cells 20. When the connection circuit 14 of the FPCB 10 is properly arranged on the electrodes 22 of the cells 20, which are disposed regularly, as shown in FIG. 1, normal electrical connection between the electrodes is accomplished. When an error occurs at the first connection process as shown in FIG. 2, on the other hand, it is difficult to accomplish subsequent electrical connections between the electrodes. Consequently, the assembly operation is inaccurately carried out.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to substantially obviate the above-mentioned problems of the conventional arts as well as the technical problems requested from the past.

The inventors have performed various experiments and research, and finally have developed an electrode connector having advantages of both the wire and the

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plate. Specifically, the electrode connector includes a flexible wire and plates, which can be easily welded to electrodes of cells, mounted on the wire. Consequently, the electrode connector can be manufactured inexpensively, the assembly operation is easily carried out due to the characteristics of the deformable wire, and the electrical connection between the electrodes of the cells is accomplished by the plates, which can be easily welded to the electrodes.

In accordance with one aspect of the present invention, the above and other objects can be accomplished by the provision of an electrode connector comprising: a conductive wire; and plates mounted on the wire such that the plates can be electrically connected to electrodes of cells, wherein the plates are electrically connected to the wire.

The conductive wire is a linear conductive member. Preferably, the conductive wire is covered with an insulating resin such that a short circuit to a peripheral device is prevented. The material for the wire is not particularly restricted so long as the material is conductive. For example, conductive materials generally used in electrical engineering applications, such as copper, iron, and lead, may be used for the wire. Preferably, the wire is made of copper, which has excellent flexibility and electrical conductivity.

The plates are plate-shaped conductive members, which are parts of the electrode connector and which are electrically connected to the electrodes of the cells. The material for the plates is not particularly restricted so long as the electrical connection between the plates and the electrodes of the cells is accomplished. For example, nickel, aluminum, copper, iron, and alloy thereof may be used for the plates. Preferably, the plates are made of nickel or nickel alloy, which is excellent in terms of

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cost and electrical conductivity.

The electrical connection between the plates and the electrodes of the cells may be accomplished in various manners. For example, the plates and the electrodes of the cells may be electrically connected with each other by welding, mechanical coupling, or adhesion. Preferably, the electrical connection between the plates and the electrodes of the cells is accomplished by spot welding, ultrasonic welding, laser welding, or soldering.

The present invention is characterized in that the electrical connection between the electrode connector and the electrodes of the cells is accomplished by the plates, and the interconnection of the plates is accomplished by the wire. Consequently, the coupling between the electrodes and the plate is easy, and the electrical connection of the plates is accomplished using the flexible wire irrespective of the distance between the electrodes.

The electrode connector according to the present invention may be constructed by separately manufacturing the wire and the plates and then coupling the wire and the plates with each other. Alternatively, the wire and the plates are integrally formed in a single body to construct the electrode connector. In a preferred embodiment, the electrode connector is constructed by clamping a plurality of plates to a single wire. According to circumstances, a plurality of unit members, each of which is manufactured by coupling a single plate to a single wire, are connected with each other to construct the electrode connector according to the present invention.

In accordance with another aspect of the present invention, there is provided a battery module manufactured with the electrode connector as described above.

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The battery module includes two or more cells, which are electrically and mechanically connected with each other to provide high-output, large-capacity current, which cannot be obtained by a single cell. In the battery module is used a connector for connecting the unit cells in series and/or parallel with each other. The electrode connector serves to electrically connect a plurality of cells (unit cells), and therefore, the electrode connector is useful to connect the electrodes of the unit cells with each other and to connect the electrodes of the unit cells to a predetermined external device when manufacturing a medium- or large-sized battery module.

The structure of the battery module manufactured with two or more unit cells to provide high output and large capacity may be various. The structure of the battery module is well known to those skilled in the art to which the present invention pertains, and therefore, a detailed description thereof will not be given. It should be noted, however, that the structure of the battery module using the electrode connector according to the present invention falls into the scope of the present invention.

Preferably, the battery module according to the present invention is used in a battery pack, which is a power source for small-sized devices, such as lap-top computers, and large-sized devices, such as electric vehicles or hybrid electric vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIGS. 1 and 2 are typical views respectively illustrating normal and abnormal

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assembly processes when electrodes of cells are connected with each other using a flexible printed circuit board (FPCB) according to a conventional art;

FIG. 3 is a partial typical view illustrating an electrode connector according to a preferred embodiment of the present invention;

FIG. 4 is a typical view illustrating an exemplary plate used in the electrode connector according to the present invention; and

FIG. 5 is a sectional view taken along line A-A of FIG. 3.

<Description of Main Reference Numerals of the Drawings>

100: electrode connector

200: wire

300: plate

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Now, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings. It should be noted, however, that the scope of the present invention is not limited by the illustrated embodiment.

FIG. 3 is a partial typical view illustrating an electrode connector 100 according to a preferred embodiment of the present invention.

Referring to FIG. 3, the electrode connector 100 includes a wire 200 and a plurality of plates 300 mounted on the wire 200. The wire 200 includes a conductive core member 210 and an insulating sheath 220 for covering the conductive core member 210.

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The structure of the plate 300 is shown in more detail in FIG. 4. As shown in FIG. 4, the plate 300 has a side clamping part 320 formed at one side end of a plate-shaped body 310 and a lower clamping part 330 formed at the lower end of the plate-shaped body 310. The plate 300 is securely mounted on the wire core member 210 (chain double-dashed line) by the clamping parts 320 and 330, and therefore, the electrical connection between the plate and the wire is accomplished. The side clamping part 320 may be formed at the other side end of the plate-shaped body 310. Each electrode of cells (not shown) is electrically connected to the plate-shaped body 310, preferably, by welding.

Referring back to FIG. 3, the conductive core member 210 is exposed at the area of the wire 200 where the plate 300 is mounted. Consequently, the plate 300 is connected to the wire 200 by the clamping parts 320 and 330 of the plate 300, and therefore, the electrical connection between the plate and the wire is accomplished.

FIG. 5 is a sectional view taken along line A-A of FIG. 3. The insulating sheath 220 (chain double-dashed line) is not present at the area of the wire where the plate is connected to the wire. Consequently, the conductive core member 210 is brought into direct contact with the side clamping part 320 of the plate 300, and therefore, the electrical connection between the plate and the wire is accomplished.

Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

For example, the structure of the plate and the electrical connection between the plate and the wire may be modified in various ways based on the illustrative

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example of FIG. 3.

INDUSTRIAL APPLICABILITY

As apparent from the above description, the electrode connector according to the present invention is electrically connected to the electrodes of the cells by means of the plates. Consequently, the coupling of the electrode connector to the electrodes of the cells is easily accomplished by welding while damage to the cells is minimized. Furthermore, the electrical connection between the plates is accomplished by means of the flexible wire. Consequently, the assembly operation for the electrode connection is very easily carried out, and the electrode connector can be manufactured inexpensively.

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WHAT IS CLAIMED IS:

1. An electrode connector comprising:

a conductive wire; and

plates mounted on the wire such that the plates can be electrically connected to electrodes of cells, wherein

the plates are electrically connected to the wire.

2. The electrode connector as set forth in claim 1, wherein the wire is covered with an insulating resin.

3. The electrode connector as set forth in claim 1, wherein the wire is made of copper, and the plates are made of nickel.

4. The electrode connector as set forth in claim 1, wherein the electrical connection between the plates and the electrode of the cells is accomplished by spot welding, ultrasonic welding, laser welding, or soldering.

5. The electrode connector as set forth in claim 1, wherein the electrode connector is constructed by clamping a plurality of plates to a single wire.

6. A battery module manufactured with an electrode connector as set forth in any one of claims 1 to 5.

7. The battery module as set forth in claim 6, wherein the electrode connector is used to connect electrodes of a plurality of cells (unit cells) with each other or to connect the electrode of one of the unit cells with a predetermined external device.

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DRAWINGS

FIG. 1

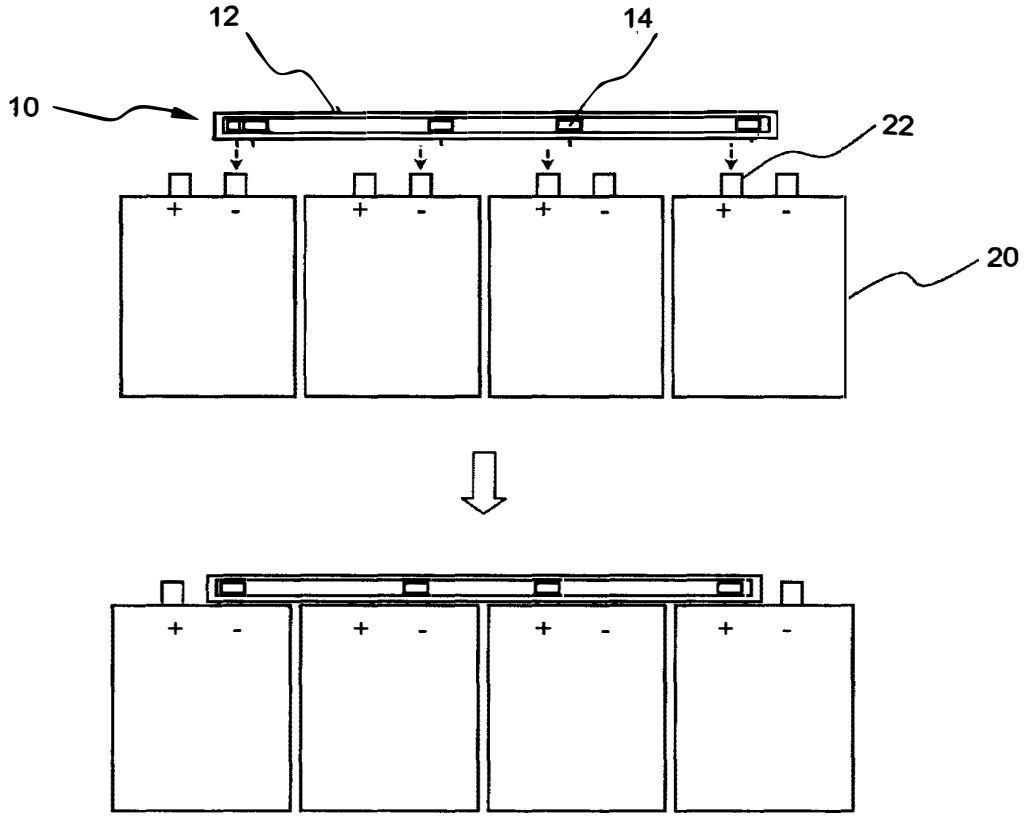


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FIG. 2

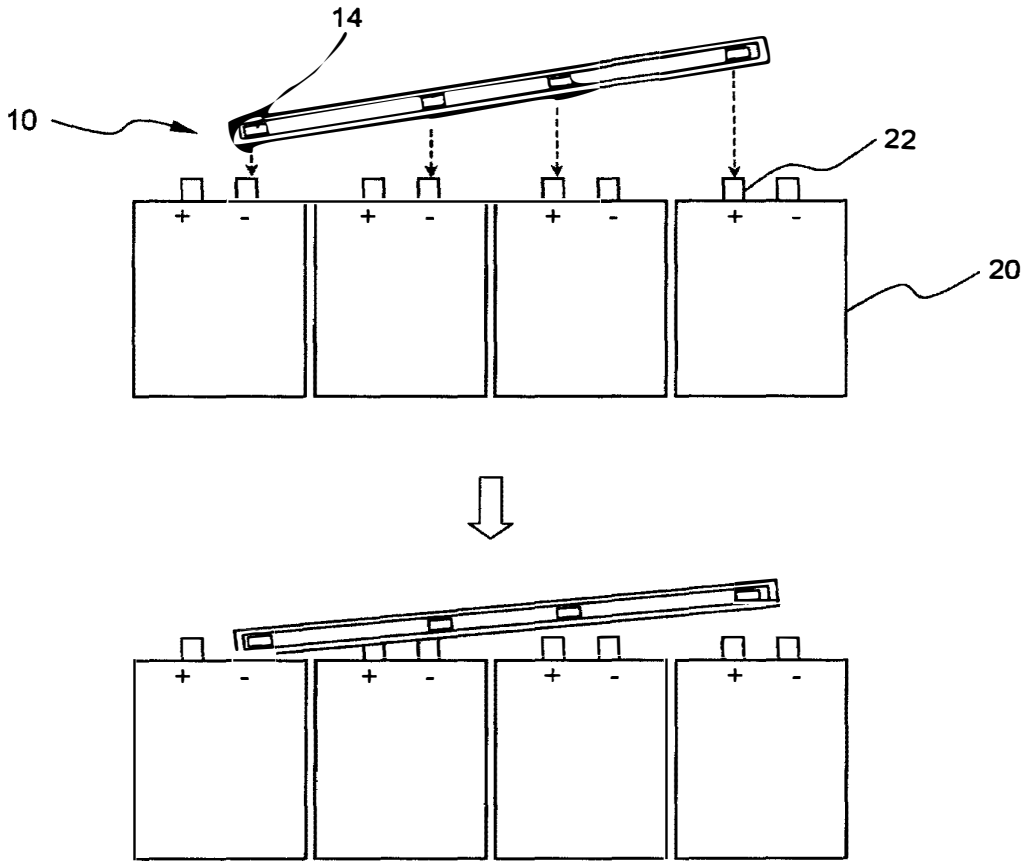


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FIG. 3

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FIG. 4

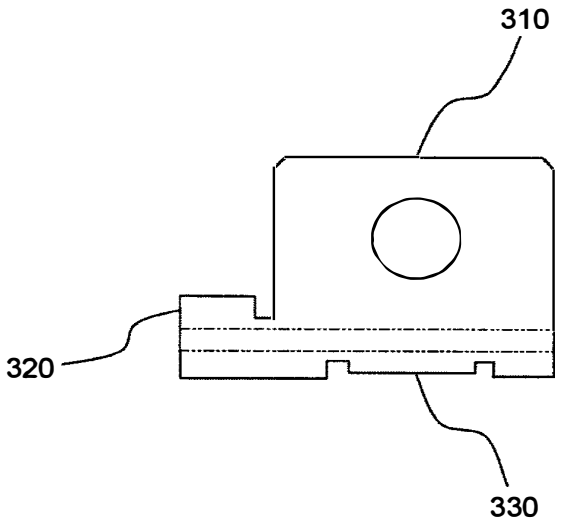


FIG. 5

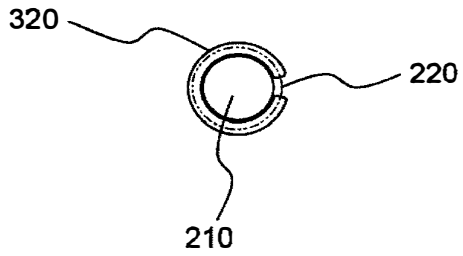


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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/003899

A. CLASSIFICATION OF SUBJECT MATTER

H01M 2/20(2006.01)i

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)
H01M 2/10(2006.01)i, H01M 2/20(2006.01)i, H01M 2/22(2006.01)i, H01M 2/26(2006.01)i

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1976.
Korean Utility models and applications for Utility models since 1976.

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)
KIPONET II

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-6644 A2 (MATSUSHITA ELECTRIC IND. CO. LTD.) 12 JANUARY 2001 * the whole document *	1 - 7
A	US 5158842 A (ACME ELECTRIC CORPORATION) 27 OCTOBER 1992 * the whole document *	1 - 7

☐ 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 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
02 MARCH 2006 (02.03.2006)	**03 MARCH 2006 (03.03.2006)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	SONG, Won Seon Telephone No. 82-42-481-5735

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(54) Connecting contact leads to lithium-based electrodes

(57) There is disclosed a method of connecting a lithium electrode to a contact lead in a rechargeable battery. The electrode comprises a sheet or foil of lithium or lithium alloy with a tab protruding from an edge of the sheet or foil. The contact lead comprises an electrically conductive lead with an end portion made of a second metal that does not alloy with lithium and has a plurality of through holes. The end portion of the contact lead and the tab of the electrode are positioned so that there is substantial overlap between the end portion and the tab. The metal of the tab is then caused, for example by pressing and welding, to penetrate through the through holes of the end portion so as to join the electrode to the contact lead. A combination electrode/contact lead assembly made by this method is also disclosed.

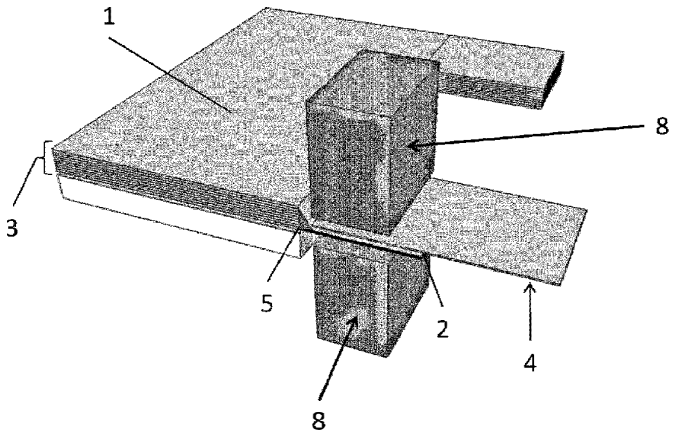


Figure 3

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Description

[0001] The present invention relates to the connection of a lithium or lithium alloy foil electrode or electrodes to a contact lead, so as to promote good electrical and mechanical contact therebetween.

BACKGROUND

[0002] Primary and rechargeable batteries using metallic lithium as the active material for the negative electrode are known to have the highest energy per unit weight and per unit volume.

[0003] For the purposes of the present application, the following definitions are to be considered:

[0004] A negative electrode, or anode, is a lithium or lithium alloy foil component having a negative potential. A negative electrode typically features a current collector and a contact tab.

[0005] A current collector is an electrically conductive metallic foil used to provide a path for electrons from the external electrical circuit to the electrochemically active portion of the battery. A current collector will typically feature a contact tab.

[0006] A contact tab is a metal foil portion of the current collector, which does not take part in the electrochemical process. It may extend from an edge of the main body of the current collector and is used to form the mechanical base for a weld to a contact lead.

[0007] A contact lead is a piece of electrically conductive metallic material used to form an electrical contact from the contact tab through a hermetically sealed battery container to the external electrical circuit. It is typically welded (in cells where metallic lithium is not used) or mechanically connected to the contact tab.

[0008] The contact lead must be connected or joined to the lithium in such a manner that a low resistance electrical connection is formed. Further, the connection or join must be mechanically strong enough to last for the expected life of the battery.

[0009] The current collectors in lithium primary batteries are typically composed of a metallic conductor other than lithium. The contact lead may be exposed to the electrolyte in an electrochemically active zone of the battery. This is not generally a problem in primary batteries; however it may cause problems in rechargeable (or secondary) batteries. In secondary batteries, lithium must be electrochemically deposited when the battery is recharged. In order to provide good reproducibility of performance, when the battery is repeatedly recharged, an excess of lithium is used so that lithium is only ever deposited onto lithium. If the contact lead or current collector is left exposed, then lithium will be plated onto a non-lithium substrate. This greatly increases the probability of unpredictable lithium deposition and hence poor cycling performance. This typically takes the form of active dendrite formation resulting in the quick degradation of the rechargeable lithium system. Examples of such failure mechanisms are described in US5368958, the full disclosure of which is incorporated into the present application by reference.

[0010] In a secondary battery with a lithium-based anode, the lithium is typically connected to the external circuit by one of two methods. Either a contact lead similar in design to that described for primary lithium batteries is used; as in US7335440, the full disclosure of which is incorporated into the present application by reference. US7335440 discloses the provision of a current collector in the form of a flat, solid piece of titanium, nickel, copper or an alloy of nickel or copper. The current collector is provided with a contact tab. A relatively long strip of alkali metal foil, having a width similar to the height of the current collector, is placed under the current collector and the two are pressed together. It is to be noted that, following assembly of the battery, the current collector (which is not made of an alkali metal) is immersed in electrolyte. Moreover, US7335440 states that this arrangement has problems in coiled, anode-limited cells of the type disclosed therein since there is a potential for a short circuit to be formed between the cathode material and the anode current collector when the thin layer of lithium has substantially depleted into the cathode in the outermost winding.

[0011] A variation of this method uses the metallic cell casing for the dual purpose of collecting current from the lithium, as in US7108942, the full disclosure of which is incorporated into the present application by reference. Additionally, the reverse face of the lithium electrode may be pressed or rolled against a thin metal current collector, as in US5368958, the full disclosure of which is incorporated into the present application by reference. The current collector can then be welded to a metal contact lead. However, if the current collector becomes exposed to the electrolyte, there is a risk that lithium will be plated onto the non-lithium current collector with the possible formation of dendrites that may short-circuit the battery. The metal current collector also adds unnecessary mass to the battery and reduces its specific energy.

[0012] In all of the examples described above, the contact of metallic lithium with the current collector is purely mechanical, which may be acceptable for primary batteries. However, for lithium metal rechargeable batteries such mechanical contact is not reliable. Indeed due to the reactive character of metallic lithium, corrosion layers may readily form on the interface of the mechanical connection between the lithium and the current collector. This may result in lower battery reliability as well as faster degradation in the capacity and cycle life of rechargeable lithium metal batteries.

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BRIEF SUMMARY OF THE DISCLOSURE

[0013] Viewed from a first aspect, there is provided a method of connecting at least one electrode to a contact lead, wherein the electrode comprises a sheet or foil of a first metal with a tab protruding from an edge of the sheet or foil, and wherein the contact lead comprises an electrically conductive lead with an end portion made of a second metal that does not alloy with the first metal and having a plurality of through holes, the method comprising the steps of:

i) positioning the end portion of the contact lead and the tab of the at least one electrode so that there is substantial overlap between the end portion and the tab;

ii) causing the metal of the tab to penetrate through the through holes of the end portion so as to join the at least one electrode to the contact lead.

[0014] In step ii), the metal of the tab may be caused to penetrate through the through holes by pressing and welding, for example by way of ultrasonic welding, thermal contact welding, laser welding or induction welding. Advantageously, the welding is effected in such a way so as not to cause significant thermal deformation or changes in the main laminar sheet or foil of the at least one electrode, but to concentrate the applied energy in the locality of the tab.

[0015] The end portion of the contact lead may be substantially flat or planar, or may take other shapes or configurations depending, for example, on the shape or configuration of any welding equipment that is used.

[0016] In some embodiments, there may be provided a plurality of electrodes, each comprising a sheet or foil of the first metal with a tab protruding from each sheet in substantially the same location, so that the tabs of the stack of electrodes are substantially aligned when the electrodes are aligned with each other and arranged as an electrode stack.

[0017] In these embodiments, the perforated end portion of the contact lead may be placed on top of the tabs of the electrode stack, underneath the tabs of the electrode stack, or at an intermediate position between the top and the bottom (i.e. with at least one tab above and at least one tab below). The tabs and the perforated end portion are then pressed together and the first metal (of the tabs) is caused to penetrate through the holes in the perforated planar end portion (made of the second metal) of the contact lead. Alternatively, the tabs of the electrode stack may be pressed together before the perforated end portion is placed on top of or underneath the compressed tabs and the penetration of step ii) is performed.

[0018] In embodiments where there is provided a stack of electrodes, the pressing and welding step causes the tabs to join together physically as well as to penetrate into the through holes of the contact lead.

[0019] Particularly preferred metals for the first metal are lithium and lithium alloys, since these tend to be useful as anode materials in secondary batteries, and are also soft and malleable, which allows a good connection to be made with the perforated end portion of the contact lead when the pressing and welding step is performed.

[0020] The end portion of the contact lead may be perforated, punched or have a mesh-like or reticulated form. What is important is that when the first metal of the tabs is sufficiently malleable that it can pass through the through holes so as to cause the second metal of the end portion to become embedded in what is preferably a single phase of the first metal. This forms an intimate contact between the first and second metals, and thus between the contact lead and the electrodes.

[0021] The greater the openness or surface area of the end portion of the contact lead, the better the electrical (and physical) connection between the contact lead and the electrodes. The openness of the end portion may be defined as the ratio of open area to the full surface area of the end portion. The openness of the end portion of the contact lead may be in the range of 5% to 95%.

[0022] The electrically conductive lead of the contact lead may itself be generally planar, for example in the form of a ribbon, although other profiles may be useful. The electrically conductive lead may be made of the same metal as the second metal forming the end portion, or of a different metal.

[0023] In this way, it is possible for form a reliable connection with a contact lead made of a metal other than the metal of the electrode. It will be understood that the contact lead, which will generally be exposed outside the casing of the battery, must be made of a metal that has good electrical conductivity but is not highly reactive when exposed to air or moisture. Suitable metals include nickel, copper, stainless steel or various alloys.

[0024] Moreover, the metal of the contact lead, since it is connected only to the protruding tabs of the electrodes, is not directly exposed to electrolyte when the battery is assembled.

[0025] A further advantage is that a good connection can be made to the at least one electrode without the electrode as a whole needing to be formed or disposed on a current collector made of a metal other than the first metal. In other words, the main part of the electrode that is exposed to the electrolyte consists solely of the first metal (e.g. lithium or a lithium alloy), with no need for a copper or nickel or other current collector that would add unnecessary weight and act as a substrate for the formation of dendrites during cycling.

[0026] Moreover, it is important that the second metal (of the contact lead) is selected so that it does not form an alloy

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with the first metal (of the electrode). This is in order to avoid reduction of the amount of the first metal that is available to the electrochemical system of the battery. For example, lithium will form an alloy with aluminium, but not with nickel or copper.

[0027] In certain embodiments, the electrode is configured as an anode, or negative electrode, for a battery. However, it will be appreciated that the method is applicable also to cathodes, or positive electrodes, where these are made of a metal that is suitable for pressing and welding to a perforated second metal as described.

[0028] Viewed from a second aspect, there is provided, in combination, at least one electrode for a battery and a contact lead, wherein the electrode comprises a sheet or foil of a first metal with a tab protruding from an edge of the sheet or foil, and wherein the contact lead comprises an electrically conductive lead with an end portion made of a second metal that does not alloy with the first metal and having a plurality of through holes, wherein the first metal of the tab has been pressed and welded so as to penetrate through the through holes of the second metal end portion.

[0029] Embodiments of the present invention seek to provide a negative electrode (anode) eliminating the need for the current collector, and a method of forming a reliable physical contact between different pieces of metallic lithium and the contact lead, thereby to promote good electrical contact between metallic lithium and the material of the contact lead.

[0030] In preferred embodiments, an excess of metallic lithium is used such that at the end of the battery life there is a substantial amount of lithium metal which serves as the current collector for the negative electrode. The use of lithium as the current collector eliminates mechanical contact between metal lithium and another current collector material.

[0031] In some embodiments, there may be provided a plurality of electrodes, each comprising a sheet or foil of the first metal with a tab protruding from each sheet in substantially the same location, so that the tabs of the stack of electrodes are substantially aligned when the electrodes are aligned with each other and arranged as an electrode stack.

[0032] The lithium metal of the negative electrode in the region of the tabs may form a single phase connection from lithium electrode to lithium electrode in the electrode stack. Such connection is achieved by using pressing and welding as hereinbefore described.

[0033] The contact lead, or at least the end portion thereof, may be thin (for example, with a thickness of 5 to 50μm), or may be thick (for example, with a thickness of 50 to 10,000μm).

[0034] The contact lead may be substantially linear, or may have a 'T'-shaped or 'L'-shaped configuration.

[0035] The end portion of the contact lead may be an integral part of the contact lead (in other words, formed from the same material as the rest of the contact lead and integral therewith), or may be a separate metal component, not necessarily of the same material as the rest of the contact lead, and welded thereto (for example by ultrasonic welding, thermal contact welding, laser welding, induction welding or other types of welding).

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] Embodiments of the invention are further described hereinafter with reference to the accompanying drawings, in which:

FIGURES 1a to 1c shows a battery stack with anodes, cathodes and tabs, and three alternative positionings for a contact lead;

FIGURES 2a to 2e shows possible designs for the contact lead; and

FIGURE 3 shows the contact lead being ultrasonically welded to the tabs.

DETAILED DESCRIPTION

[0037] A battery can be formed by an alternating stack of numerous cathodes and anodes. Each of these layers is divided by a separator. An ionic pathway is maintained by the presence, between each electrode, of an electrolyte. Each electrode 1 features a tab 2 protruding from its electrochemically active area and beyond the edge of the separator. These tabs 2 provide the first surface through which the stack 3 of lithium anodes will be welded to each other and joined to a contact lead 4. The tabs 2 are first folded and/or formed by pressing. A contact lead 4 is then positioned at the top (**Figure 1a)** or bottom **(Figure 1b)** of the stack 5 of tabs 2, or it may be positioned between any two lithium tabs 2 **(Figure 1c)**.

[0038] The contact leads 4 may take a number of forms **(Figures 2a to 2e)**. The body 6 is composed of a conductive metal ribbon, typically nickel, copper, stainless steel or some composite conductor. The end portion 7 (the area to be welded) is typically perforated, meshed or punched. The end portion 7 may be an integral part of the metal ribbon 6, or it may be a separate piece welded to the ribbon 6. Where the end portion 7 is a separate piece welded to the ribbon 6, it may be made of a different metal to that of the ribbon 6. The contact may be linear, "T" or "L" shaped. The perforations may be rhombic, circular, square, rounded, polygonal or any other suitable shape.

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[0039] The tabs 2 and the contact lead 4 are then positioned between the two weld fixtures 8 of an ultrasonic welder (**Figure 3**). The ultrasonic welder then simultaneously applies pressure and an ultrasonic wave to the weld area. This causes the numerous lithium layers 2 to fuse together to form a lithium-lithium weld. Further, the softened lithium percolates through the perforated or meshed area 7 of the contact lead 4. The contact lead 4 is hence joined to the lithium 2 as the mesh 7 is intimately surrounded by lithium. The high surface area contact between the mesh 7 of the contact lead 4 and the lithium electrode 1 produces a low resistance and a mechanically strong electrical contact. When the ultrasonic wave ceases and the pressure is released, the contact lead 4 will be joined to the lithium anodes 1.

EXAMPLE 1

[0040] A linear nickel contact lead, composed of 50μm thick nickel ribbon, was used. The endmost 5mm of the contact lead was expanded to form a mesh. A battery with 60 lithium anodes, each of 78μm thickness, was assembled. A stack of lithium contact tabs protruded from the battery. The lithium contact tabs were formed and trimmed to produce a flat welding area and to ensure that each of the tabs, regardless of its position, in the stack used the minimum quantity of lithium. The formed stack of lithium tabs was then positioned between the welding fixtures of an ultrasonic welder. The contact lead was then positioned on top of the stack of lithium tabs, such that the meshed region overlapped with the flat lithium welding zone. The welding conditions listed in **Table 1** were then entered into an AmTech 900B 40kHz ultrasonic welder. A single weld was then performed. Each of the 60 lithium layers were welded firmly to each other. A strong join was produced between the lithium and the contact lead. This join had been created by the softened lithium penetrating through the mesh of the contact lead.

Table 1 - The welder setting used in Example 1.

Energy / J	Amplitude / μm	Trigger Pressure / Psi	Pressure / Psi
180	5	20	20

EXAMPLE 2

[0041] A "T" shaped contact lead was made by welding a piece of nickel ribbon (50μm thick) to a piece of copper mesh. The mesh opening was approximately 200x700μm, with a bar width of 100μm. The mesh was thrice as long as the nickel ribbon was wide. The mesh was 5mm wide; the same as the welding zone. The mesh was positioned centrally to form the cross of the "T" and welded into position by an ultrasonic welder using the conditions given in **Table 2, weld A.** The contact lead was positioned between the welding fixtures of an ultrasonic welder such that the meshed region fell into the welding zone.

[0042] A battery with 20 lithium anodes, each of 78μm thickness, was assembled. A stack of lithium contact tabs protruded from the battery. The stack of lithium contact tabs was formed and trimmed to produce a flat welding area and to ensure that each of the contact tabs, regardless of its position, in the stack used the minimum quantity of lithium.

[0043] The stack of lithium contact tabs was then positioned on top of the contact lead, between the welding fixtures of an ultrasonic welder. The copper mesh "arms" of the "T" shaped contact lead were then folded around the stack of lithium contact tabs. The welding conditions listed in **Table 2, weld B** were then entered into an AmTech 900B 40kHz ultrasonic welder. A single weld was then performed. Each of the 20 lithium layers were welded firmly to each other. A strong join was produced between the lithium and the contact lead. This join had been created by the softened lithium penetrating through the mesh of the contact lead.

Table 2 - The welder settings used in Example 2

Weld	Energy / J	Amplitude / μm	Trigger Pressure / Psi	Pressure / Psi
A	70	80	80	5
B	10	5	20	20

EXAMPLE 3

[0044] An "L" shaped contact lead was manufactured by photochemical etching from a sheet of 100μm thick stainless steel. The upright section of the "L" is continuous steel foil. The base of the "L" was etched with a mesh pattern. The mesh opening was 500x500μm and the bar width was 100μm. The base of the "L" was twice the width of the upright section. The width of the base section was 5mm, the same as the weld zone.

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[0045] A battery with 20 lithium anodes, each of 78μm thickness, was assembled. A stack of lithium contact tabs protruded from the battery. The contact lead was positioned between the top face to the lowermost lithium contact tab and the bottom face of the remainder of the stack. The remainder of the stack of lithium contact tabs was pushed down onto the meshed region of the contact lead. The protruding meshed section of the contact lead was folded over the stack of contact tabs. The contact assembly was positioned between the welding fixtures of an ultrasonic welder such that the meshed regions fell into the welding zone.

[0046] The welding conditions listed in **Table 3** were then entered into an AmTech 900B 40kHz ultrasonic welder. A single weld was then performed. Each of the 20 lithium layers were welded firmly to each other. A strong join was produced between the lithium and the contact lead. This join had been created by the softened lithium penetrating through the mesh of the contact lead.

Table 3 - The welder settings used in Example 3

Energy / J	Amplitude / μm	Trigger Pressure / Psi	Pressure / Psi
40	5	20	20

[0047] Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of them mean "including but not limited to", and they are not intended to (and do not) exclude other moieties, additives, components, integers or steps. Throughout the description and claims of this specification, the singular encompasses the plural unless the context otherwise requires. In particular, where the indefinite article is used, the specification is to be understood as contemplating plurality as well as singularity, unless the context requires otherwise.

[0048] Features, integers, characteristics, compounds, chemical moieties or groups described in conjunction with a particular aspect, embodiment or example of the invention are to be understood to be applicable to any other aspect, embodiment or example described herein unless incompatible therewith. All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

[0049] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

Claims

1. A method of connecting at least one electrode to a contact lead, wherein the electrode comprises a sheet or foil of a first metal with a tab protruding from an edge of the sheet or foil, and wherein the contact lead comprises an electrically conductive lead with an end portion made of a second metal that does not alloy with the first metal and having a plurality of through holes, the method comprising the steps of:

   i) positioning the end portion of the contact lead and the tab of the at least one electrode so that there is substantial overlap between the end portion and the tab;
   ii) causing the metal of the tab to penetrate through the through holes of the end portion so as to join the at least one electrode to the contact lead.

2. A method according to claim 1, wherein, in step ii), the metal of the tab is caused to penetrate through the through holes by pressing and welding.

3. A method according to claim 2, wherein the welding is ultrasonic welding.

4. A method according to claim 2, wherein the welding is thermal contact welding, laser welding or induction welding.

5. A method according to any one of claims 2 to 4, wherein the welding does not cause significant thermal deformation or changes in the laminar sheet or foil of the at least one electrode, but concentrates the applied energy in the locality of the tab.

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6. A method according to any one of the preceding claims, wherein there is provided a plurality of electrodes, each comprising a sheet or foil of the first metal with a tab protruding from each sheet in substantially the same location, so that the tabs of the stack of electrodes are substantially aligned when the electrodes are aligned with each other and arranged as an electrode stack.

7. A method according to claim 6, wherein the perforated end portion of the contact lead is placed on top of the tabs of the electrode stack in step i).

8. A method according to claim 6, wherein the perforated end portion of the contact lead is placed underneath the tabs of the electrode stack in step i).

9. A method according to claim 6, wherein the perforated end portion of the contact lead is placed at an intermediate position between the top and the bottom of the electrode stack in step i).

10. A method according to any one of claims 7 to 9, wherein the tabs and the perforated end portion are then pressed together and the first metal is caused to penetrate through the holes in the perforated end portion of the contact lead.

11. A method according to claim 7 or 8, wherein the tabs of the electrode stack are pressed together before the perforated end portion is placed on top of or underneath the compressed tabs and the penetration of step ii) is performed.

12. A method according to any preceding claim, wherein the end portion of the contact lead is an integral part of the contact lead.

13. A method according to any one of claims 1 to 11, wherein the end portion of the contact lead is a separate metal component that is welded to the contact lead.

14. A method according to any preceding claim, wherein the first metal is lithium or a lithium alloy.

15. A method according to any preceding claim, wherein the second metal is selected from a group comprising: nickel, copper, a nickel or copper alloy that does not alloy with lithium, and stainless steel.

16. In combination, at least one electrode for a battery and a contact lead, wherein the electrode comprises a sheet or foil of a first metal with a tab protruding from an edge of the sheet or foil, and wherein the contact lead comprises an electrically conductive lead with an end portion made of a second metal that does not alloy with the first metal and having a plurality of through holes, wherein the first metal of the tab has been pressed and/or welded so as to penetrate through the through holes of the second metal end portion.

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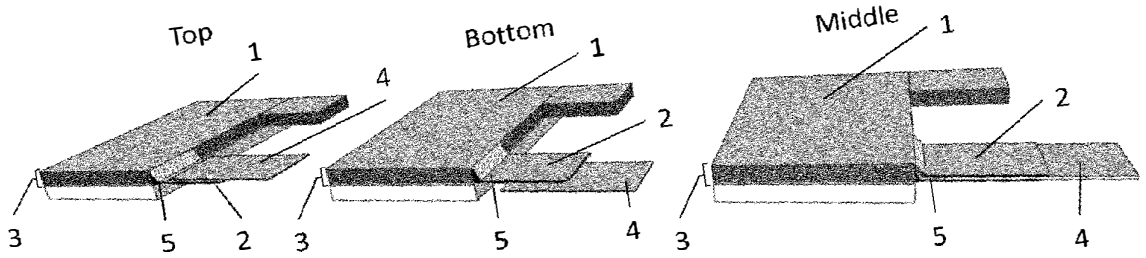


Fig 1a

Fig 1b

Fig 1c

Figure 1

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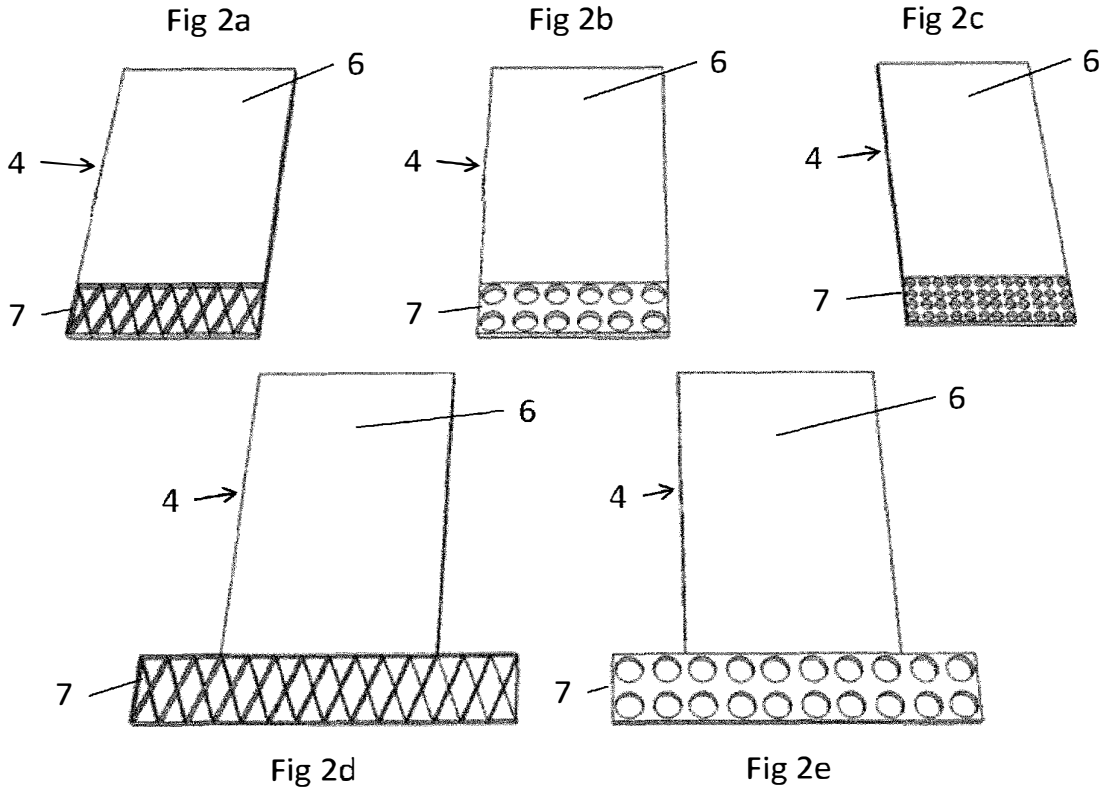


Figure 2

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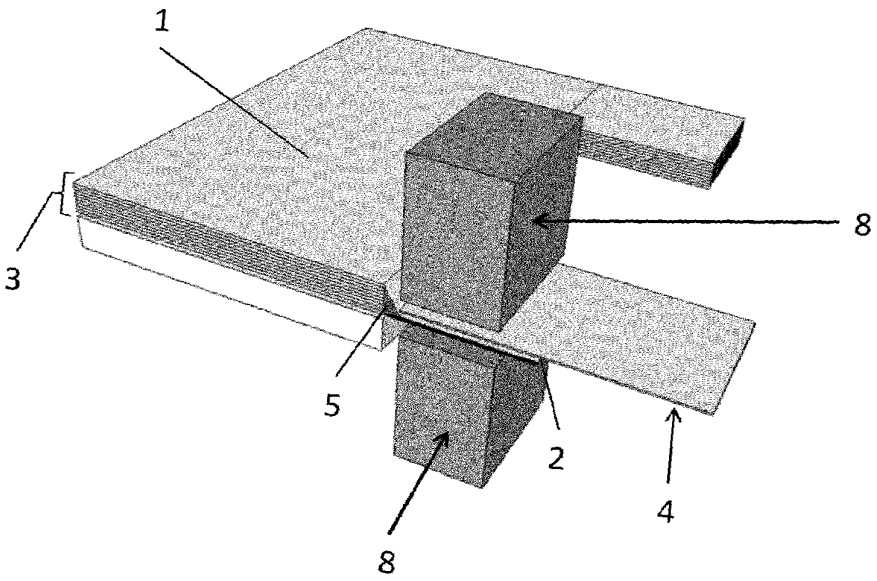


Figure 3

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Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 11 19 3678

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 7 335 440 B2 (AAMODT PAUL B [US] ET AL) 26 February 2008 (2008-02-26) * column 4, line 52 - column 5, line 2; figure 1C * * column 5, line 53 - line 57 *	1-12, 14-16	INV. H01M2/26 H01M2/30
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A	EP 0 924 783 A1 (JAPAN STORAGE BATTERY CO LTD [JP]; GS MELCOTEC CO LTD [JP]) 23 June 1999 (1999-06-23) * paragraph [0025]; figures 1A,1B * * paragraph [0034] * * paragraph [0042] *	1-4,6-12	
A	EP 2 026 402 A1 (NISSAN MOTOR [JP]) 18 February 2009 (2009-02-18) * paragraph [0010] - paragraph [0011] * * paragraph [0014] * * paragraph [0018] * * paragraph [0035] * * paragraph [0047]; figure 4 * * paragraph [0076] - paragraph [0077]; figure 10 *	1-12, 14-16	TECHNICAL FIELDS SEARCHED (IPC) H01M
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 May 2012	Engert, Andrea

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)

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 19 3678

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03-05-2012

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

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REFERENCES CITED IN THE DESCRIPTION

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Espacenet

JP2014232666A NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

Applicants: KANEKA CORP

Inventors: IMAMURA YUICHI,NIWA YUKIMASA,SAWADA YUKI

Classifications:

IPC ***H01M10/052; H01M10/0585; H01M10/0587; H01M10/52; H01M2/02; H01M2/06; H01M2/08; H01M2/30; H01M2/34; H01M4/13; H01M4/131; H01M4/48; H01M4/485; H01M4/505;***

CPC Y02E60/10 (EP);

Priorities: JP2013113362A 2013-05-29

Application: JP2014232666A·2013-05-29

Publication: JP2014232666A·2014-12-11

Published as: JP2014232666A

NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

Abstract

PROBLEM TO BE SOLVED: To provide a nonaqueous electrolyte secondary battery arranged so that gas generated when charge and discharge is repeated can be absorbed, and an outer sheath can be prevented from being swelled.SOLUTION: A nonaqueous electrolyte secondary battery comprises: an internal power-generation body 8 including a positive electrode including a positive electrode active material, a negative electrode including a negative electrode active material, and a separator interposed between the positive and negative electrodes; at least two metal tab leads 14 connected to the positive and negative electrodes respectively; and a film-like outer sheath 10 which houses the internal power-generation body 8 together with an electrolytic solution 20 of nonaqueous electrolyte in a hermetic condition. The nonaqueous electrolyte secondary battery further comprises a resin part 26 used to prevent the short circuit inside the battery and provided between the outer sheath 10 and the internal power-generation body 8. The resin part 26 has a gas-absorbing material such as a hydrogen-absorbable alloy mixed therein.

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H01M 2/34	(2006.01)	H01M 2/34	B	5H029
H01M 2/08	(2006.01)	H01M 2/08	K	5H031
H01M 2/06	(2006.01)	H01M 2/06	K	5H043
H01M 2/30	(2006.01)	H01M 2/30	D	5H050

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最終頁に続く

(54)【発明の名称】非水電解質二次電池

(57)【要約】
【課題】充放電を繰り返すときに発生するガスを吸収し、外装体の膨れを防止できる非水電解質二次電池を提供する。
【解決手段】正極活物質を含む正電極と、負極活物質を含む負電極と、前記正電極と負電極との間に介在するセパレータとで構成される内部発電体８と、正電極と負電極とにそれぞれ接合された少なくとも２本の金属タブリード１４と、内部発電体８を非水電解質の電解液２０と共に密封状態に収容するフィルム状の外装体１０とを備え、前記外装体１０と前記内部発電体８との間に、電池内部の短絡防止のために使用されている樹脂部品２６を有し、前記樹脂部品２６に水素吸蔵合金などのガス吸着材を混入させている。
【選択図】図３

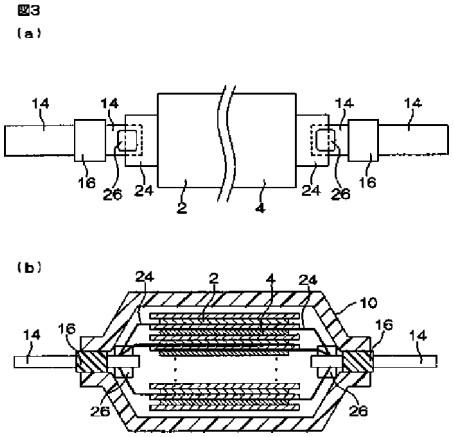


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【特許請求の範囲】
【請求項１】
正極活物質を集電箔に塗工した正電極と、負極活物質を集電箔に塗工した負電極と、前記正電極と前記負電極との間に介在するセパレータとで構成される内部発電体と、前記正電極と前記負電極とにそれぞれ接合された少なくとも２本の金属タブリードと、前記内部発電体を非水電解質の電解液と共に密封状態に収容するための少なくとも一層の金属膜を積層したフィルム状の外装体と、前記外装体と前記内部発電体との間に、電池内部の短絡防止のために使用されている樹脂部品とを有し、前記樹脂部品にガス吸着材が混入していることを特徴とする、非水電解質二次電池。
【請求項２】
前記短絡防止のために使用されている樹脂部品が、
（ａ）前記内部発電体の絶縁固定のために使用される樹脂テープ、
（ｂ）前記金属タブリードと前記集電箔とが接合される部分に形成される樹脂材、又は
（ｃ）前記正極活物質の前記金属タブリード側の端部若しくは前記負極活物質の前記金属タブリード側の端部に形成される樹脂材、
のいずれかである、請求項１に記載の非水電解質二次電池。
【請求項３】
前記負極活物質が、前記リチウムイオンの脱離及び挿入が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行する負極活物質である、請求項１又は請求項２に記載の非水電解質二次電池。
【請求項４】
前記負極活物質が、チタン酸リチウムあるいはチタン酸化物である、請求項３に記載の非水電解質二次電池。
【請求項５】
前記正極活物質が、前記リチウムイオンの脱離及び挿入の電位が４．５Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上４．９Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）未満の正極活物質である、請求項１～請求項４のいずれか１項に記載の非水電解質二次電池。
【請求項６】
前記正極活物質が、リチウムマンガン化合物である、請求項５に記載の非水電解質二次電池。
【請求項７】
前記外装体の金属膜の材質はアルミニウムである、請求項１～請求項６のいずれか１項に記載の非水電解質二次電池。
【請求項８】
前記内部発電体は、前記正電極と前記負電極と前記セパレータとの積層体で構成される、請求項１～請求項７のいずれか１項に記載の非水電解質二次電池。
【請求項９】
前記内部発電体は、前記正電極と前記負電極と前記セパレータとの積層体を倦回したものである、請求項１～請求項７のいずれか１項に記載の非水電解質二次電池。
【請求項１０】
請求項１～請求項９のいずれか１項に記載の非水電解質二次電池を複数個接続してなる組電池。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明はリチウムイオン二次電池等の非水電解質二次電池に関するものである。
【背景技術】
【０００２】
近年、携帯機器などの電子機器、ハイブリット自動車、電気自動車、家庭用蓄電用途に、リチウムイオン二次電池等の非水電解質二次電池の研究開発が盛んにおこなわれている

。これらの分野に用いられる非水電解質二次電池は、長期間、充放電サイクルが繰り返されて使用される。

非水電解質二次電池の構造は、正極活物質を集電箔に塗工したシート状正電極と、負極活物質を集電箔に塗工したシート状負電極とをセパレータを介して交互に積層又は倦回した内部発電体と、当該内部発電体を電解液と共に密封状態に収容したフィルム状の外装体とを有している。フィルムは、ガスバリア性を向上させるため、アルミニウムなどの金属膜を内部に配置している。

【０００３】

内部発電体から電流を引き出すための金属タブリードは、密封された外装体の、融着されたフィルム同士の隙間から外に露出している。

非水電解質二次電池は、電解液として有機溶媒を含んでいて、これが電極活物質と作用しあって、充放電時に水素ガスなどのガスが発生することがある。外装体の内部は完全に密封された状態になっているので、このことが原因で、非水電解質二次電池が膨れてしまい、この電池が組み込まれている電子機器内部のプリント基板や端子部等に異常な圧力を加えて、変形を生じさせるおそれがあり、機器の信頼性を損なう原因となる。

【０００４】

特に、従来のカーボン系負極活物質を用いた非水電解質二次電池では、通常の使用条件ではガスの発生は少ないものの、過充電時や高温保存時に急激に大量のガスが発生することがあり、非水二次電池の膨れによる影響を十分に抑制するため、相当な量のガス吸着材を、電池の内部に配置することが必要となる。

特許文献１は、電池上部の空き空間、電池底部、正電極と負電極とセパレータを巻回して作成した発電要素の中心部、または電池ケースの内側などに水素吸蔵合金を配置して、発生した水素を吸収する構造を示している（実施例２）。特許文献２では、ラミネート型非水電解質二次電池において、ラミネートフィルムの内面のうち、封止した部分以外の内面に水素吸蔵合金からなるガス吸着層を貼り付ける技術が開示されており、特許文献３では、ラミネートフィルムに、電極群を収容する収納部を形成し、この収納部におけるコーナー部の少なくとも一箇所以上の内面に水素吸蔵合金からなるガス吸着材を配置する技術が開示されている。特許文献４は、外装体と内部発電体との間にガス吸着材を配置する技術を示している。

【先行技術文献】

【特許文献】

【０００５】

【特許文献１】特開平１１－３１２５４０号公報
【特許文献２】特開２０１１－２４９２６９号公報
【特許文献３】特開２０１２－５９４８９号公報
【特許文献４】特開２００１－１５５７９０号公報
【特許文献５】特開２００８－１４６９６３号公報
【特許文献６】特開平１１－１９１４００号公報

【発明の概要】

【発明が解決しようとする課題】

【０００６】

しかし何れの技術も、電極、セパレータなどの二次電池の本来の構成部品とは別に、ガス吸収剤を用意し、外装体の内部に設置する技術である。二次電池の構成部品とは別のガス吸着材を配置するための余分なスペースが必要になり、またそれを設置する工程若しくは貼り付ける工程が必要になる。このため電池の体積が増え、エネルギー密度が低下するといった問題がある。

【０００７】

ガス吸着材を二次電池の本来の構成部品に、ガス吸着材を混合する技術もある。特許文献５は、ガス吸収剤をセパレータ基材に混ぜ込む例を示し、特許文献６は、フィルム状の外装体の一層に、ガス吸収剤を練り込む技術を開示している。

しかし、ガス吸着材は直径の大きなザラザラした粒子であり、内部発電体の構成部品にガス吸着材を混合すると、構成部品の物性を変えてしまい、充放電性能を劣化させるおそれがある。フィルム状の外装体自体にガス吸着材の粒子を混ぜる場合も、外装体のガスバリア性能を低下させるおそれがある。

【０００８】

一方、カーボン系負極活物質に変わる材料として、高安全性、高耐久性であることから、リチウムの脱離及び挿入の平均電位が金属リチウム基準で０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）未満である負極活物質（チタン酸リチウムあるいはチタン酸化物）を用いた非水電解質二次電池が開発されている。

このような非水電解質二次電池は、従来のカーボン系負極活物質では見られない、２５℃～４５℃といった通常の使用温度域で少量のガスが徐々に発生するという傾向がある。このため、通常の使用温度域での充放電時における長期に渡る微量のガス発生に対応するには、特許文献１～４のように特別の場所に大量のガス吸着材を配置しなくてもよいと考えられる。

【０００９】

そこで、本発明者は、外装体の内部の特別の場所に大量のガス吸着材を配置しないで済み、かつ二次電池の本来の構成部品であって、電池の性能に影響を与えない部品にガス吸着材を含ませることを想定した。

本発明は、小スペースであるが非水二次電池に使用されている短絡防止樹脂にガス吸着材を含ませることで、エネルギー密度を低下させることなく非水二次電池の外装体の膨れを防止することを目的とする。

【課題を解決するための手段】

【００１０】

本発明の非水電解質二次電池は、正極活物質を集電箔に塗工した正電極と、負極活物質を集電箔に塗工した負電極と、正電極と負電極との間に介在するセパレータとで構成される内部発電体と、正電極と負電極とにそれぞれ接合された少なくとも２本の金属タブリードと、内部発電体を非水電解質の電解液と共に密封状態に収容するための少なくとも一層の金属膜を積層したフィルム状の外装体と、フィルム状の外装体と内部発電体との間に、電池内部の短絡防止のために使用されている樹脂部品とを有し、樹脂部品にガス吸着材を混入させていることを特徴とする。

【００１１】

この構成であれば、二次電池に従来から用いられる小さな構成部品であって、電池の性能に影響を与えない部品にガス吸着材を含ませて、内部発電体から発生するガスを吸収するので、電池の性能に悪い影響を与えることはない。また外装体の内部の特別の場所を占める物ではないので、電池が大型化することもない。

短絡防止のために使用されている樹脂部品の具体例は、（ａ）内部発電体の固定のために使用される樹脂テープ、（ｂ）金属タブリードと集電箔とが接合される部分に形成される樹脂材、又は（ｃ）正極活物質の金属タブリード側の端部又は負極活物質の金属タブリード側の端部に形成される樹脂材、のいずれかであってもよい。

【００１２】

負極活物質が、リチウムイオンの脱離及び挿入が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行する負極活物質（例えばチタン酸リチウムあるいはチタン酸化物）である場合は、通常の使用温度域で長期にわたって発生する少量のガスを吸着すればよいので、本発明のようにフィルム状の外装体と内部発電体との間に、電池内部の短絡防止のために使用されている樹脂部品にガス吸着材を混入させておけば、非水二次電池の外装体の膨れを防止するのに十分である。

【００１３】

正極活物質が、リチウムイオンの脱離及び挿入の電位が４．５Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上４．９Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）未満の正極活物質（例えばリチウムマンガン化合物）である場合は、通常の使用温度域でも電解液の酸化分解によりガスが発生するといった問題

があったが、本発明の構造を採用することにより、ガスを吸収することができる。

【発明の効果】

【００１４】

本発明によれば、フィルム状の外装体と内部発電体との間に、電池内部の短絡防止のために使用されている樹脂部品にガス吸着材を混入させることにより、電池性能の低下を回避し、電池容積の無駄な増大を回避しながら、非水二次電池の外装体の膨れを防止することができる。特に、チタン酸リチウムを負電極に用いた非水二次電池特有の問題である、通常の使用温度域での充放電時における長期に渡る微量のガスの発生に対応することができる。

【図面の簡単な説明】

【００１５】

【図１】非水電解質二次電池の内部発電体の構造を示す断面図である。

【図２】本発明の実施の形態に係る非水電解質二次電池の全体構造を示す平面図（ａ）及び側断面図（ｂ）である。

【図３】本発明の他の実施の形態に係る非水電解質二次電池の全体構造を示す平面図（ａ）及び側断面図（ｂ）である。

【図４】本発明のさらに他の実施の形態に係る非水電解質二次電池の内部発電体を示す平面図である。

【図５】図５の変形例に係る内部発電体を示す平面図である。

【発明を実施するための形態】

【００１６】

以下、本発明の実施の形態を添付図面を参照して説明する。本発明の範囲は特許請求の範囲によって示され、特許請求の範囲と均等の意味及び範囲内でのすべての変更が含まれることが意図されている。

＜非水電解質二次電池＞

図１は、非水電解質二次電池の内部発電体８の構造を示す断面図である。内部発電体８は、正電極２と、負電極４と、正電極２と負電極４との間に介在するセパレータ６とで構成される。正電極２は、正極活物質をシート状の集電箔２４に塗工したものであり、負電極４は、負極活物質をシート状の集電箔２４に塗工したものである。

【００１７】

非水電解質二次電池の集電箔２４は、セパレータ６を挟んで両側に配置されており、そのうち片側の集電箔２４は正極活物質を塗工したものであり、他側の集電箔２４は負極活物質を塗工したものである。正極活物質の集電箔２４が形成されていない方の面と負極活物質の集電箔２４が形成されていない方の面とは、他のセパレータ６を挟んで向かい合っている。このようにして、正電極２と負電極４とセパレータ６とで１つの発電単位を構成する。発電単位が１層又は複数層積層されて内部発電体８を構成している。積層数は、所望の電池容量を発現する数までとすることができる。

【００１８】

内部発電体８は、リチウムイオンの伝導を担う非水電解質の電解液に浸されている。集電箔２４の材質と電解液の成分については後述する。

なお、本発明の非水電解質二次電池の内部発電体の構造は図１の構造に限定されることはない。例えば、集電箔の片面に正電極、他面に負電極を形成させた形態、すなわち、バイポーラ電極を用いて内部発電体を構成してもよい。この場合は、隣り合うバイポーラ電極の正電極側と負電極側との間にセパレータを配置する。１枚の集電箔を挟んで正電極側と負電極側とが対向している層には、液絡を防止するため周辺部に絶縁材料を配置する必要がある。

【００１９】

図２は、本発明の実施の形態に係る非水電解質二次電池の全体構造を示す平面図（ａ）と側断面図（ｂ）である。非水電解質二次電池は、内部発電体８と、内部発電体８の正電極側の集電箔２４と負電極側の集電箔２４とにそれぞれ接合された金属タブリード１４を

有している。さらにこの内部発電体８を、２枚のフィルム状の外装体１０の間に収容し、非水電解質の電解液２０と共に密封状態に収容している。

【００２０】

フィルム状の外装体１０の内壁と内部発電体８との空間に満たされている非水電解質の電解液２０は、あらかじめ正電極２、負電極４及びセパレータ６に含ませておいてもよいし、正電極側と負電極側との間にセパレータ６を配置したものを巻回あるいは積層し、フィルム状の外装体１０の中に収容した後に添加してもよい。電解液２０の量は、特に限定されないが、正極合剤、負極合剤及びセパレータの総空隙体積以上であることが好ましく、前記総空隙体積の１２０％以上が更に好ましい。正極合剤、負極合剤及びセパレータの総空隙体積未満であると充放電に寄与する部分への電解液の未充填部位が発生し、充放電に寄与できなくなってしまう。

【００２１】

フィルム状の外装体１０は、一般的に少なくとも３層を有しており、最外層は物理的保護を目的にポリエチレンなどの合成樹脂フィルムが用いられ、中間層にはガスバリア性を向上させるため、アルミニウム金属箔などが用いられ、最内層には、ラミネート接着性、ガスバリア性及び耐電解液性を目的に変性ポリプロピレンなどの合成樹脂フィルムが用いられる。合成樹脂層は複数の機能を持たせるため多層構造となる場合もある。

【００２２】

２本の金属タブリード１４は薄い板状であり、そのうち１本の金属タブリード１４は、内部発電体８の正電極２の集電箔２４に接合され、他の１本の金属タブリード１４は、内部発電体８の負電極４の集電箔２４に接合されている。図示するように、内部発電体８が積層したものであれば、積層された複数の正電極２の各集電箔２４が１本の金属タブリード１４に接合され、積層された複数の負電極４の各集電箔２４が他の１本の金属タブリード１４に接合される。

【００２３】

金属タブリード１４の材質は、導電性に優れた金属であればよく、例えばアルミニウム、銅、ニッケルなどがあげられる。集電箔２４の金属タブリード１４への接合法には、超音波溶接、半田付け、抵抗溶接などがあげられる。

金属タブリード１４の一部には、ポリプロピレンなどの熱融着樹脂１６が金属タブリード１４の上面から下面にわたって塗布されている。この熱融着樹脂１６は、金属タブリード１４を上下の外装体１０どうしの間に挟んで熱処理するときに融解して、外装体１０と金属タブリード１４とを接着するのに役立つように、予め形成されたものである。

【００２４】

本発明の非水電解質二次電池では、正電極２と負電極４とセパレータ６とが離れないように、積層された内部発電体８を固定する電極固定テープ２２を用いる。

この電極固定テープ２２は、フィルム状の外装体１０の中にラミネートされている金属層を通した電気的な短絡を防止するために絶縁性を有している。この絶縁性は内部発電体８を構成する正電極２と負電極４との間の電気的な短絡を防止するのにも役立つ。この電極固定テープ２２が、「電池内部の短絡防止のために使用されている樹脂部品」に該当する。

【００２５】

電極固定テープ２２は、テープの強度を保つための基材層と接着層とで構成されるが、本発明では、基材層、接着層のいずれか又は両方にガス吸着材が混入されている。

ガス吸着材としては、特に限定しないがシリカゲル、ゼオライト、活性炭、ステアリン酸金属塩、ハイドロタルサイト、水素吸蔵合金、活性アルミナ、遷移金属酸化物、ソーダ石灰、酸化カルシウム、酸化マグネシウム、アスカライトなどから、発生ガス種に応じて選ばれる少なくとも一種以上であることが好ましい。

【００２６】

ガス吸着材は粒子状のものを用いることが好ましい。その粒子径は、特に限定しないが、作業性、表面積、混入後の凹凸から1～50μm程度が好ましい。

ガス吸着材の混入量は、テープとして接着性が維持される限り、特に限定されない。ただしガス吸着材の混入量が多すぎると、粒子同士が接触して導電性が発現することがあるが、テープによってセパレータ上を固定するので、極板や端子等には触れない限り、差し支えない。

【００２７】

ガス吸着材のテープ基材層への混入の場合は、基材フィルムの製膜時に混入させる。また接着樹脂層に混入する場合は、テープ基材へ塗工する際の塗工液に混入する。

テープ基材層の材質は、特に限定しないが、耐熱性（熱収縮）、強度、耐久性、耐電解液性からポリイミド等が好ましい。

電極固定テープ２２にガス吸着材が混入されていることにより、内部発電体８から発生し外装体１０の中に閉じ込められた水素ガスなどのガスを吸収することができる。

【００２８】

図３は、本発明の他の実施の形態に係る非水電解質二次電池の全体構造を示す平面図（ａ）と側断面図（ｂ）である。平面図（ａ）では右側に負極活物質の層を示し、左側に正極活物質の層を示している。積層された内部発電体８を固定する電極固定テープは図示していない。

図２から追加された点を説明すると、外装体１０の中であって、薄い板状の金属タブリード１４の、正電極２の集電箔２４に接合されている部分が短絡防止樹脂２６で覆われ、他の１本の金属タブリード１４の、負電極４の集電箔２４に接合されている部分が短絡防止樹脂２６で覆われていることである。

【００２９】

短絡防止樹脂２６の材質として、一般的には、ポリイミドが用いられるが、ポリイミドに限定されず、強度、耐熱性（熱収縮）、耐久性、耐電解液性があれば他の種類の樹脂でも良い。

正電極２又は負電極４の集電箔２４を、超音波溶接法などで金属タブリード１４に接合するときに、集電箔２４や金属タブリード１４上に鋭利な金属切片が生じる可能性があり、この短絡防止樹脂２６は、その金属切片がラミネートフィルム内の金属膜に接触するのを防止するために形成されるものである。

【００３０】

短絡防止樹脂２６の形成方法は限定されないが、例えば、正電極２の集電箔２４を金属タブリード１４に超音波溶接した後、小さくカットした短絡防止樹脂２６片を、金属タブリード１４の両面の溶接された部分に置き、負電極側の短絡防止樹脂２６も他方の金属タブリード１４の両面の溶接された部分に置き、前述した熱融着樹脂１６とともに、上下の外装体１０どうしの間に挟んで熱融解させると、短絡防止樹脂２６が金属タブリード１４上に、かつ集電箔２４を覆った状態で形成される。またこれ以外に、ポリイミドテープを金属タブリード１４に貼り付ける方法もある。この短絡防止樹脂２６が、「電池内部の短絡防止のために使用されている樹脂部品」に該当する。

【００３１】

本発明では、短絡防止樹脂２６の中にガス吸着材が混入されている。

ガス吸着材としては、特に限定しないがシリカゲル、ゼオライト、活性炭、ステアリン酸金属塩、ハイドロタルサイト、水素吸蔵合金、活性アルミナ、遷移金属酸化物、ソーダ石灰、酸化カルシウム、酸化マグネシウム、アスカライトなどから、発生ガス種に応じて選ばれる少なくとも一種以上であることが好ましい。

【００３２】

ガス吸着材は粒子状のものを用いることが好ましい。その粒子径は、特に限定しないが、作業性、表面積、混入後の凹凸から1～50μｍ程度が好ましい。

ガス吸着材の混入量が多すぎると粒子同士が接触して導電性が発現することがあるので、ガス吸着材の混入量の上限は、短絡防止樹脂２６の絶縁性が維持されるかどうかに応じて決められる。このような導電性が発現するような混入量の上限は、実際に短絡防止樹脂２６にガス吸着材を混入させてみて抵抗率を測定して、定めるとよい。

【００３３】
短絡防止樹脂２６にガス吸着材が混入されていることにより、内部発電体８から発生し外装体１０の中に閉じ込められる水素ガスなどのガスを吸収することができる。
図４は、本発明のさらに他の実施の形態に係る非水電解質二次電池の内部発電体８を示す平面図（ａ）及び断面図（ｂ）である。
この図（ａ）は、図１に示した構造の内部発電体８を負電極側から見た平面図になる。負電極４の一端部において、負極活物質が塗工されていない部分があり、集電箔２４が露出している。ここに負電極側の金属タブリード１４を溶接している。なお図示しないが、正電極側（図の紙面裏側）においても、正電極２の一端部において、正極活物質が塗工されていないで集電箔２４が露出していて、ここに正電極側の金属タブリード１４が溶接されている。
【００３４】
この内部発電体８を巻回して、フィルム状の外装体１０の中に入れて、電解液２０で満たしながら、金属タブリード１４を残してフィルム状の外装体１０を密閉することにより、非水電解質二次電池を製造することができる。
巻回する前、集電箔２４が露出している部分において、超音波溶接法などで金属タブリード１４を接合するときに、集電箔２４や金属タブリード１４上に鋭利な金属切片が生じる可能性がある。その金属切片が、巻回された内部発電体８の正電極２と電気的に接触するのを防止するために、短絡防止樹脂２８を、図４に示すように、集電箔２４上に金属タブリード１４を覆う状態で形成している。また短絡防止樹脂３０を、集電箔２４と活物質４の端部との境界上にも形成している。
【００３５】
短絡防止樹脂２８，３０の形成方法は限定されないが、例えば金属タブリード１４を集電箔２４の片面に超音波溶接した後、小さくカットした短絡防止樹脂片を、金属タブリード１４の溶接された部分上に置き、上下から熱と圧力を加えながら熱融解させるとよい。また短絡防止樹脂片を集電箔２４と活物質の端部との境界上に置き、同時に熱融解させる。この短絡防止樹脂２８，３０が、「電池内部の短絡防止のために使用されている樹脂部品」に該当する。
【００３６】
この実施形態においても、短絡防止樹脂２８，３０の中にガス吸着材が混入されている。ガス吸着材の混入量、混入方法などは図３に関連して前述した実施形態と同様である。短絡防止樹脂２８，３０にガス吸着材が混入されていることにより、巻回された内部発電体８から発生するガスをガス吸着材に吸収することができる。
以上に説明した本発明の非水電解質二次電池は、内部発電体が外装体に包まれ、金属タブリードが外装体から露出した形状のものであり、このまま二次電池として、電子機器内部に組み込んで使用する。
【００３７】
本発明の非水電解質二次電池は、複数接続することによって組電池とすることができる。本発明の組電池は、所望の大きさ、容量、電圧によって適宜直列、並列に接続することによって作製することができる。また、各電池の充電状態の確認、安全性向上のため、前記組電池に制御回路が付属されていることが好ましい。
以下、本発明の非水電解質二次電池の各構成部分である、負電極、正電極、セパレータ、非水電解質の材質、製造方法などを説明する。
【００３８】
＜負電極＞
本発明の非水電解質二次電池に用いる負電極は、特に、リチウムイオンの挿入・脱離反応が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行する負極活物質を含む。
リチウムイオンの挿入反応が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行するとは、負極活物質へのリチウムイオン挿入が２．０Ｖ（ｖｓ

．Ｌｉ$^{+}$／Ｌｉ）以下で開始し、０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上で終了することである。一方、リチウムイオンの脱離反応が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行するとは、負極活物質からのリチウムイオン脱離が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上で開始し、２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で終了することである。

【００３９】

リチウムイオン挿入・脱離反応の電圧値（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）は、例えば、負極活物質を用いた動作極、リチウム金属を対極とした半電池の充放電特性を測定し、プラトー開始時、及び終了時の電圧値を読み取ることによって求めることができる。プラトーが２箇所以上あった場合は、もっとも低い電圧値のプラトーが０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上であればよく、もっとも高い電圧値のプラトーが２．０Ｖ（ｖｓ．Ｌｉ+／Ｌｉ）以下であればよい。前記半電池に用いる動作極、電解液、セパレータは後述のものと同様のものを用いることができる。

【００４０】

リチウムイオンの挿入・脱離反応が０．３Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以上２．０Ｖ（ｖｓ．Ｌｉ$^{+}$／Ｌｉ）以下で進行する負極活物質は、チタン酸リチウム、二酸化チタン、五酸化ニオブ及び二酸化モリブデンなどが好ましく、負極活物質の安定性が高い点から、チタン酸リチウム、二酸化チタンがより好ましく、チタン酸リチウムがさらに好ましい。これら負極活物質は１種類でもよいし、２種類以上用いてもよい。

【００４１】

チタン酸リチウムは、スピネル構造であることが好ましく、分子式として$Li_4Ti_5O_{12}$で表されるものが好ましい。スピネル構造の場合、リチウムイオンの挿入・脱離の反応における活物質の膨張収縮が小さい。チタン酸リチウムには、たとえばＮｂなどのリチウム、チタン以外の元素が微量含まれていてもよい。

チタン酸リチウムは、ＣｕＫαによる粉末Ｘ線回折の（４００）面の半値幅が０．５°以下であることが好ましい。０．５°より大きいと、チタン酸リチウムの結晶性が低いため、電極の安定性が低下する場合がある。

【００４２】

チタン酸リチウムは、Ｘ線回折によるリートベルト解析法による８ａサイトに占めるリチウム含有率が９０％以上であることが好ましい。９０％未満であると、チタン酸リチウムの結晶中の欠陥が多いため、電極の安定性が低下する場合がある。

チタン酸リチウムは、リチウム化合物、チタン化合物を５００℃以上１５００℃以下で加熱処理することによって得ることができる。５００℃未満、又は１５００℃より高いと、所望の構造をしたチタン酸リチウムを得ることができにくい傾向がある。チタン酸リチウムの結晶性を向上させるため、加熱処理後、再び５００℃以上１５００℃以下で再加熱処理してもよい。再加熱処理の温度は、最初におこなった温度と同じでもよいし、違っていてもよい。加熱処理は、空気存在下でもよいし、窒素あるいはアルゴンなどの不活性ガスの存在下でおこなってもよい。加熱処理には、特に限定されないが、例えば、箱型炉、管状炉、トンネル炉、ロータリーキルン等を用いることができる。

【００４３】

前記リチウム化合物としては、例えば、水酸化リチウム、炭酸リチウム、硝酸リチウム、酢酸リチウム、シュウ酸リチウム、ハロゲン化リチウムなどを用いることができる。これらリチウム化合物は、１種類でもよいし、２種類以上用いてもよい。

前記チタン化合物としては、特に限定されないが、例えば、二酸化チタン、一酸化チタンなどのチタン酸化物を用いることができる。

【００４４】

リチウム化合物、及びチタン化合物の配合比は、原料の性状や加熱条件によってリチウム、及びチタンの原子比、Ｔｉ／Ｌｉ＝１．２５前後で多少の幅をもたせてもよい。

チタン酸リチウムの表面には、導電性向上、あるいは安定性向上のため、炭素材料、金属酸化物、あるいは高分子等で覆われてもよい。

チタン酸リチウムの粒子径は、０．５μｍ以上５０μｍ以下であることが好ましく、１μｍ以上３０μｍ以下であることは取り扱いの観点からさらに好ましい。前記粒子径はＳＥＭ、ＴＥＭ像から各粒子の大きさを測定し、平均粒子径を算出した値である。

【００４５】

チタン酸リチウムの比表面積は、０．１m^2／ｇ以上５０m^2／ｇ以下であることは所望の出力密度を得やすいことから好ましい。前記比表面積は、水銀ポロシメータ、ＢＥＴ法での測定により算出するのがよい。

チタン酸リチウムの嵩密度は、０．２ｇ／ｃm^3以上１．５ｇ／ｃm^3以下であることが好ましい。０．２ｇ／ｃm^3未満の場合では後述のスラリー作製時に多量の溶媒が必要となるため経済的に不利となる傾向があり、１．５ｇ／ｃm^3より大きいと後述の導電助材、バインダーとの混合が困難となる傾向がある。

【００４６】

本発明の負電極は炭素材料を含む導電助材を含有している。導電助材を構成する炭素材料としては、例えば、天然黒鉛、人造黒鉛、気相成長炭素繊維、カーボンナノチューブ、アセチレンブラック、ケッチェンブラック、又はファーネスブラックなどが挙げられる。これら炭素材料は１種類でもよいし、２種類以上用いてもよい。

本発明において、負電極に含まれる導電助材の量は、負極活物質１００重量部に対して、好ましくは０重量部以上１０重量部以下、より好ましくは０重量部以上８重量部以下である。前記範囲であれば、バインダーとの接着性が維持され、集電箔との接着性が十分に得ることができる。

【００４７】

本発明の負電極にはバインダーを使用してよい。バインダーとしては、特に限定されないが、例えば、ポリフッ化ビニリデン（ＰＶｄＦ）、ポリテトラフルオロエチレン（ＰＴＦＥ）、スチレン－ブタジエンゴム、ポリイミド及びそれらの誘導体からなる群からえらばれる少なくとも１種を用いることができる。バインダーは負電極の作製しやすさから、非水溶媒又は水に、溶解又は分散されていることが好ましい。非水溶媒は、特に限定されないが、Ｎ－メチル－２－ピロリドン（ＮＭＰ）、ジメチルホルムアミド、ジメチルアセトアミド、メチルエチルケトン、酢酸メチル、酢酸エチル、及びテトラヒドロフランなどを挙げることができる。これらに分散剤、増粘剤を加えてもよい。

【００４８】

本発明において、負電極に含まれるバインダーの量は、負極活物質１００重量部に対して、好ましくは１重量部以上２０重量部以下、より好ましくは２重量部以上１５重量部以下である。前記範囲であれば、負極活物質と導電助材との接着性が維持され、集電箔との接着性が十分に得ることができる。

本発明において好ましい負電極の一形態としては、負極活物質、導電助材、及びバインダーの混合物を集電箔上に形成することによって作製されるが、作製方法の容易さから、前記混合物及び溶媒でスラリーを作製し、得られたスラリーを集電箔上に塗工した後に、溶媒を除去することによって負電極を作製する方法が好ましい。

【００４９】

本発明の負電極に用いることのできる集電箔は、０．３Ｖ（ｖｓ．Li^+／Ｌｉ）以上２．０Ｖ（ｖｓ．Li^+／Ｌｉ）以下で安定な金属、例えば、銅、ＳＵＳ、ニッケル、チタン、アルミニウム又はそれらの合金が好ましく、安定性が高いことからアルミニウムであることが特に好ましい。アルミニウムは、正電極及び負電極の電極反応雰囲気下で安定であることから、その組成は特に限定されないが、ＪＩＳ規格１０３０、１０５０、１０８５、１Ｎ９０、１Ｎ９９等に代表される高純度アルミニウムであることが好ましい。

【００５０】

集電箔の表面粗度Ｒａは、０．０５μｍ以上０．５μｍ以下であることが好ましい。０．０５μｍ未満であると、負電極との接着性が低下する場合があり、０．５μｍより大きいと、負電極を均一に形成することが困難となる場合がある。なお、表面粗度Ｒａは、光波干渉式表面粗さ測定器などを用いて測定できる。

集電箔の電気抵抗は、５μΩ・ｃｍ以下であることが好ましい。５μΩ・ｃｍより高い場合は、電池の性能が低下する恐れがある。電気抵抗は、四端子法で測定することができる。

【００５１】

集電箔の厚みは、特に限定されないが、１０μｍ以上１００μｍ以下であることが好ましい。１０μｍ未満では作製の観点から取り扱いが困難となり、１００μｍより厚い場合は経済的観点から不利になる。

なお、集電箔は、アルミニウム以外の金属材料（銅、ＳＵＳ、ニッケル、チタン、及びそれらの合金）の表面にアルミニウムを被覆したものも用いることもできる。

【００５２】

前記スラリーの作製方法は、特に限定されないが、負極活物質、導電助材、バインダー、及び溶媒を均一に混合できることから、ボールミル、プラネタリミキサ、ジェットミル、薄膜旋回型ミキサーを用いることが好ましい。スラリーの作製は、特に限定されないが、負極活物質、導電助材、及びバインダーを混合した後に溶媒を加えて作製してもよいし、負極活物質、導電助材、バインダー、及び溶媒を一緒に混合して作製してもよい。

【００５３】

スラリーの固形分濃度は、３０ｗｔ％以上８０ｗｔ％以下であることが好ましい。３０ｗｔ％未満の場合、スラリーの粘度が低すぎる傾向があり、一方、８０ｗｔ％より高い場合は、スラリーの粘度が高すぎる傾向があるため、後述の電極の形成が困難となる場合がある。

スラリーに用いる溶媒は、非水溶媒、あるいは水であることが好ましい。非水溶媒は、特に限定されないが、例えば、Ｎ－メチル－２－ピロリドン（ＮＭＰ）、ジメチルホルムアミド、ジメチルアセトアミド、メチルエチルケトン、酢酸メチル、酢酸エチル、及びテトラヒドロフランなどを挙げることができる。また、これらに分散剤、増粘剤を加えてもよい。

【００５４】

集電箔上への負電極の形成方法は、特に限定されないが、例えば前記スラリーをドクターブレード、ダイコータ、コンマコータ等により塗布した後に、溶剤を除去する方法、あるいはスプレーにより塗布した後に溶剤を除去する方法が好ましい。溶媒を除去する方法は、オーブンや真空オーブンを用いた乾燥が簡単であり好ましい。雰囲気としては室温、あるいは高温とした空気、不活性ガス、真空状態などが挙げられる。また、溶媒を除去する温度は特に限定されないが、６０℃以上２００℃以下であることが好ましい。６０℃未満では溶媒の除去に時間を要する場合があり、２００℃より高いとバインダーが劣化する場合がある。負電極の形成は、前述の正電極を形成する前でも、後でもよい。また、負電極作製後、ロールプレス機などを用いて負電極を圧縮させてもよい。前記電極の圧縮は、前述の正電極を形成する前でも、後でもよい。

【００５５】

本発明において、負電極の厚みは、１０μｍ以上２００μｍ以下であることが好ましい。１０μｍ以下では、所望の容量を得ることが難しい場合があり、２００μｍより厚い場合は、所望の出力密度を得ることが難しい場合がある。

本発明において、負電極の重量密度は、１．０ｇ／ｃｍ^{3}以上３．０ｇ／ｃｍ^{3}以下であることが好ましい。１．０ｇ／ｃｍ^{3}未満であれば、負極活物質、導電助材との接触が不十分となり電子伝導性が低下する場合がある。３．０ｇ／ｃｍ^{3}より大きい場合は、後述の電解液が負電極内に浸透しにくくなり、リチウム伝導性が低下する場合がある。負電極は、所望の厚み、密度まで圧縮させてもよい。圧縮は、特に限定されないが、例えば、ロールプレス、油圧プレス等を用いておこなうことができる。電極の圧縮は、前述の正電極を形成する前でも、後でもよい。

【００５６】

本発明において、負電極の面積１ｃｍ^{2}あたりの電気容量は、０．５ｍＡｈ以上３．６ｍＡｈ以下であることが好ましい。０．５ｍＡｈ未満である場合は所望する容量の電池の

大きさが大きくなる場合があり、一方、３．６ｍＡｈより多い場合は所望の出力密度を得ることが難しい場合がある。負電極の１ｃｍ^{2}あたりの電気容量の算出は、負電極作製後、リチウム金属を対極とした半電池を作製した後に、充放電特性を測定することによって算出できる。負電極の面積１ｃｍ^{2}あたりの電気容量は、特に限定されないが、集電箔単位面積あたりに形成させる負電極の重量で制御する方法、例えば、前述の負電極塗工時の塗工厚みで制御することができる。

【００５７】

＜正電極＞

本発明の非水電解質二次電池に用いる正電極は、特に、リチウムイオンの挿入・脱離反応が４．５Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以上４．９Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以下で進行する正極活物質を含む。このように４．５Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以上４．９Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以下である場合、前述した負極活物質と組み合わせて高い電池電圧を発現できる。

【００５８】

リチウムイオン挿入・脱離反応の電圧値（ｖｓ．Ｌｉ$^+$／Ｌｉ）は、例えば、正極活物質を用いた動作極、リチウム金属を対極とした半電池の充放電特性を測定し、プラトー開始時、及び終了時の電圧値を読み取ることによって求めることができる。プラトーが２箇所以上あった場合は、もっとも低い電圧値のプラトーが４．５Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以上であればよく、もっとも高い電圧値のプラトーが４．９Ｖ（ｖｓ．Ｌｉ$^+$Ｌｉ）以下であればよい。前記半電池に用いる動作極、電解液、セパレータは後述のものと同様のものを用いることができる。

【００５９】

リチウムイオンの挿入・脱離反応が４．５Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以上４．９Ｖ（ｖｓ．Ｌｉ$^+$／Ｌｉ）以下で進行する正極活物質は、特に限定されないが、充放電サイクルの安定性効果が高いことから、リチウムマンガン化合物であることが好ましい。

リチウムマンガン化合物としては、例えば、Li_2MnO_3、$Li_aM_bMn_{1-b}N_cO_4$（０＜ａ≦２、０≦ｂ≦０．５、１≦ｃ≦２、Ｍは２～１３族でかつ第３、４周期に属する元素、Ｎは１４～１６族でかつ第３周期に属する元素）、$Li_{1+x}M_yMn_{2-x-y}O_4$（０≦ｘ≦０．２、０＜ｙ≦０．６、Ｍは２～１３族でかつ第３～４周期に属する元素からなる群から選ばれる少なくとも１種）で表されるリチウムマンガン化合物が挙げられる。ここでの”Ｍ”は、２～１３族でかつ第３～４周期に属する元素から選ばれる少なくとも１種であるが、安定性向上の効果が大きい点から、Ａｌ、Ｍｇ、Ｚｎ、Ｎｉ、Ｃｏ、Ｆｅ、Ｔｉ、Ｃｕ及びＣｒが好ましく、Ａｌ、Ｍｇ、Ｚｎ、Ｎｉ、Ｔｉ、Ｃｕ及びＣｒがより好ましく、Ａｌ、Ｍｇ、Ｚｎ、Ｔｉ、Ｃｕ及びＮｉがさらに好ましい。また、ここでの”Ｎ”は安定性向上の効果が大きい点から、Ｓｉ、Ｐ及びＳが好ましい。

【００６０】

中でも、正極活物質の安定性が高いことから、$Li_{1+x}M_yMn_{2-x-y}O_4$（０≦ｘ≦０．２、０＜ｙ≦０．６、Ｍは２～１３族でかつ第３～４周期に属する元素からなる群から選ばれる少なくとも１種）で表されるリチウムマンガン化合物であることが特に好ましい。ｘ＜０の場合は、正極活物質の容量が減少する傾向がある。また、ｘ＞０．２の場合は炭酸リチウムなどの不純物が多く含まれるようになる傾向がある。ｙ＝０の場合は、正極活物質の安定性が低くなる傾向がある。また、ｙ＞０．６の場合はＭの酸化物などの不純物が多く含まれるようになる傾向がある。例えば、Ｍ＝Ｎｉ，ｘ＝０，ｙ＝０．４の場合、化合物は$LiNi_{0.4}Mn_{1.6}O_4$であり、ｘ＝０，ｙ＝０．５の場合、化合物は$LiNi_{0.5}Mn_{1.5}O_4$である。

【００６１】

前記$Li_{1+x}M_yMn_{2-x-y}O_4$は、スピネル構造であることが好ましい。スピネル構造の場合、リチウムイオンの挿入・脱離の反応における活物質の膨張収縮が小さいので好ましい。

前記$Li_{1+x}M_yMn_{2-x-y}O_4$は、ＣｕＫαによる粉末Ｘ線回折の（４００）面

の半値幅が０．５°以下であることが好ましい。０．５°より大きいと、正極活物質の結晶性が低いため、電極の安定性が低下する場合がある。

【００６２】

前記$Li_{1+x}M_yMn_{2-x-y}O_4$は、Ｘ線回折によるリートベルト解析法による８ａサイトに占めるリチウム含有率は、９０％以上であることが好ましい。９０％未満であると、正極活物質の結晶中の欠陥が多いため、電極の安定性が低下する場合がある。

前記$Li_{1+x}M_yMn_{2-x-y}O_4$の粒子径は、０．５μｍ以上５０μｍ以下であることが好ましく、１μｍ以上３０μｍ以下であることは取り扱いの観点からさらに好ましい。ここでの粒子径はＳＥＭ、ＴＥＭ像から各粒子の大きさを測定し、平均粒子径を算出した値である。

【００６３】

前記$Li_{1+x}M_yMn_{2-x-y}O_4$の比表面積は、０．１m^2／ｇ以上５０m^2／ｇ以下であることは所望の出力密度を得やすいことから好ましい。比表面積はＢＥＴ法での測定により算出できる。

前記$Li_{1+x}M_yMn_{2-x-y}O_4$の嵩密度は、０．２ｇ／cm^3以上２．５ｇ／cm^3以下であることが好ましい。０．２ｇ／cm^3未満の場合では後述のスラリー作製時に多量の溶媒が必要となるため経済的に不利となり、２．５ｇ／cm^3より大きい場合では後述の導電助剤、バインダーとの混合が困難となる傾向がある。

【００６４】

前記$Li_{1+x}M_yMn_{2-x-y}O_4$は、リチウム化合物、マンガン化合物、Ｍの化合物を５００℃以上、１５００℃以下で加熱処理することによって製造することができる。５００℃未満、又は１５００℃より高いと、所望の構造をした正極活物質を得ることができない場合がある。加熱処理は、リチウム化合物、マンガン化合物、及びＭの化合物を混合して加熱処理もよいし、マンガン化合物とＭの化合物とを加熱処理した後に、リチウム化合物と加熱処理してもよい。正極活物質の結晶性を向上させるため、加熱処理後、再び５００℃以上、１５００℃以下で再加熱処理してもよい。再加熱処理の温度は、最初におこなった温度と同じでもよいし、違っていてもよい。加熱処理は、空気存在下でもよいし、窒素あるいはアルゴンなどの不活性ガスの存在下でおこなってもよい。加熱処理には、特に限定されないが、例えば、箱型炉、管状炉、トンネル炉、ロータリーキルン等を用いることができる。

【００６５】

前記リチウム化合物としては、例えば、水酸化リチウム、炭酸リチウム、硝酸リチウム、酢酸リチウム、シュウ酸リチウム、ハロゲン化リチウムなどを用いることができる。これらリチウム化合物は、１種類でもよいし、２種類以上用いてもよい。

前記マンガン化合物としては、例えば、二酸化マンガン等のマンガン酸化物、炭酸マンガン、硝酸マンガン、マンガン水酸化物などを用いることができる。これらマンガン化合物は、１種類でもよいし、２種類以上用いてもよい。

【００６６】

前記Ｍの化合物としては、例えば、炭酸化物、酸化物、硝酸化物、水酸化物、硫酸化物などを用いることができる。$Li_{1+x}M_yMn_{2-x-y}O_4$に含まれるＭの量は、加熱処理時におけるＭの化合物の量で制御することができる。Ｍの化合物は、１種類でもよいし、２種類以上用いてもよい。

リチウム化合物、マンガン化合物及びＭの化合物の配合比は、リチウム、マンガン及びＭの原子比をそれぞれ１＋ｘ（リチウム）、２－ｘ－ｙ（マンガン）、及びｙ（Ｍ）、但し、０≦ｘ≦０．２、０＜ｙ≦０．６を満たす範囲で選択される。例えば、Ｍｎ／Ｌｉの原子比１．５の正極活物質を作製する場合、原料の性状や加熱条件によって前記配合比１．５前後で多少の幅をもたせてもよい。

【００６７】

本発明の正極活物質の表面は、導電性向上、あるいは安定性向上のため、炭素材料、金属酸化物、あるいは高分子等で覆われてもよい。

本発明の正電極は、好ましくは導電助材を含有している。導電助材としては、特に限定されないが、炭素材料が好ましい。例えば、天然黒鉛、人造黒鉛、気相成長炭素繊維、カーボンナノチューブ、アセチレンブラック、ケッチェンブラック、及びファーネスブラックなどが挙げられる。これら炭素材料は１種類でもよいし、２種類以上用いてもよい。

【００６８】

本発明の正電極に含まれる導電助材の量は、正極活物質１００重量部に対して、好ましくは１重量部以上２０重量部以下、より好ましくは２重量部以上１５重量部以下である。前記範囲であれば、正電極の導電性が確保される。また、後述のバインダーとの接着性が維持され、集電箔との接着性が十分に得ることができる。

本発明の正電極にはバインダーを含有させてよい。バインダーは、特に限定されないが、例えば、ポリフッ化ビニリデン（ＰＶｄＦ）、ポリテトラフルオロエチレン（ＰＴＦＥ）、スチレンーブタジエンゴム、ポリイミド、及びそれらの誘導体からなる群からえらばれる少なくとも１種を用いることができる。バインダーは正電極の作製しやすさから、非水溶媒又は水に溶解又は分散されていることが好ましい。非水溶媒は、特に限定されないが、例えば、Ｎ－メチル－２－ピロリドン（ＮＭＰ）、ジメチルホルムアミド、ジメチルアセトアミド、メチルエチルケトン、酢酸メチル、酢酸エチル、及びテトラヒドロフランなどを挙げることができる。これらに分散剤、増粘剤を加えてもよい。

【００６９】

本発明の正電極に含まれるバインダーの量は、正極活物質１００重量部に対して、好ましくは１重量部以上２０重量部以下、より好ましくは２重量部以上１５重量部以下である。前記範囲であれば、正極活物質と導電助材との接着性が維持され、集電箔との接着性が十分に得ることができる。

本発明の正電極の作製方法としては、正極活物質、導電助材、及びバインダーの混合物を集電箔上に塗工することによって作製する方法が挙げられるが、作製方法の容易さから、前記混合物及び溶媒でスラリーを作製し、得られたスラリーを集電箔上に塗工した後に、溶媒を除去することによって正電極を作製する方法が好ましい。

【００７０】

本発明の正電極に用いる集電箔は、アルミニウム及びその合金であることが好ましい。前記アルミニウムは、正電極反応雰囲気下で安定であることから、特に限定されないが、ＪＩＳ規格１０３０、１０５０、１０８５、１Ｎ９０、１Ｎ９９等に代表される高純度アルミニウムであることが好ましい。

集電箔の表面粗度Ｒａは、０．０５μｍ以上０．５μｍ以下であることが好ましい。０．０５μｍ未満であると、正電極との接着性が低下する場合があり、０．５μｍより大きいと、正電極を均一に形成することが困難となる場合がある。なお、表面粗度Ｒａは、光波干渉式表面粗さ測定器などを用いて測定できる。

【００７１】

集電箔の電気抵抗は、５μΩ・ｃｍ以下であることが好ましい。５μΩ・ｃｍより高い場合は、電池の性能が低下する恐れがある。電気抵抗は、四端子法で測定することができる。

集電箔の厚みは、特に限定されないが、１０μｍ以上１００μｍ以下であることが好ましい。１０μｍ未満では作製の観点から取り扱いが困難となり、１００μｍより厚い場合は経済的観点から不利になる。

【００７２】

なお、集電箔は、アルミニウム以外の金属（銅、ＳＵＳ、ニッケル、チタン、及びそれらの合金）の表面にアルミニウムを被覆したものも用いることもできる。

スラリーの作製方法は、特に限定されないが、正極活物質、導電助材、バインダー、及び溶媒を均一に混合できることから、ボールミル、プラネタリミキサ、ジェットミル、薄膜旋回型ミキサーを用いることが好ましい。スラリーの作製は、特に限定されないが、正極活物質、導電助材、及びバインダーを混合した後に溶媒を加えて作製してもよいし、正極活物質、導電助材、バインダー、及び溶媒を一緒に混合して作製してもよい。

【００７３】
スラリーの固形分濃度は、３０ｗｔ％以上８０ｗｔ％以下であることが好ましい。３０ｗｔ％未満の場合スラリーの粘度が低すぎる傾向があるため、一方、８０ｗｔ％より高い場合はスラリーの粘度が高すぎる傾向があるため、後述の電極の形成が困難となる場合がある。
スラリーに用いる溶媒は、非水溶媒、あるいは水であることが好ましい。非水溶媒は、特に限定されないが、例えば、Ｎ－メチル－２－ピロリドン（ＮＭＰ）、ジメチルホルムアミド、ジメチルアセトアミド、メチルエチルケトン、酢酸メチル、酢酸エチル、及びテトラヒドロフランなどを挙げることができる。また、これらに分散剤、増粘剤を加えてもよい。
【００７４】
集電箔上への正電極の形成方法は、特に限定されないが、例えば前記スラリーをドクターブレード、ダイコータ、コンマコータ等により塗布した後に、溶剤を除去する方法、あるいはスプレーにより塗布した後に溶剤を除去する方法が好ましい。溶媒を除去する方法は、オーブンや真空オーブンを用いた乾燥が簡単であり好ましい。溶媒を除去する雰囲気としては、空気、不活性ガス、真空状態などが挙げられる。また、溶媒を除去する温度は、特に限定されないが、６０℃以上２００℃以下であることが好ましい。６０℃未満では溶媒の除去に時間を要する場合があり、２００℃より高いと、バインダーが劣化する場合がある。なお、正電極の形成は、後述の負電極を形成する前でも、後でもよい。
【００７５】
本発明の正電極の厚みは、１０μｍ以上２００μｍ以下であることが好ましい。１０μｍ未満では所望の容量を得ることが難しい場合があり、一方、２００μｍより厚い場合は所望の出力密度を得ることが難しい場合がある。
本発明の正電極の重量密度は、１．０ｇ／ｃｍ^{3}以上４．０ｇ／ｃｍ^{3}以下であることが好ましい。１．０ｇ／ｃｍ^{3}未満であると、正極活物質、導電助材との接触が不十分となり電子伝導性が低下する場合がある。一方、４．０ｇ／ｃｍ^{3}より大きいと、電解液が正電極内に浸透しにくくなり、リチウム伝導性が低下する場合がある。
【００７６】
本発明の正電極は、所望の厚み、密度まで圧縮させてもよい。圧縮は、特に限定されないが、例えば、ロールプレス、油圧プレス等を用いておこなうことができる。電極の圧縮は、前述の負電極を形成する前でも、後でもよい。
本発明の正電極は、面積１ｃｍ^{2}あたりの電気容量が０．５ｍＡｈ以上３．６ｍＡｈ以下であることが好ましい。０．５ｍＡｈ未満である場合は所望する容量の電池の大きさが大きくなる傾向があり、３．６ｍＡｈより多い場合は所望の出力密度を得ることが難しくなる傾向がある。面積１ｃｍ^{2}あたりの電気容量の算出は、正電極作製後、リチウム金属を対極とした半電池を作製した後に、充放電特性を測定することによって算出してもよい。
【００７７】
前記正電極の面積１ｃｍ^{2}あたりの電気容量は、特に限定されないが、集電箔単位面積あたりに形成させる正電極の重量で制御する方法、例えば、前述のスラリー塗工時の塗工厚みで制御することができる。
＜セパレータ＞
本発明の非水電解質二次電池に用いるセパレータは、前述の正電極と負電極との間に設置され、電子伝導性がなくかつリチウムイオン伝導性を有する物質であればよく、例えば、ナイロン、セルロース、ポリスルホン、ポリエチレン、ポリポロピレン、ポリブテン、ポリアクリロニトリル、ポリイミド、ポリアミド、及びそれらを２種類以上複合したものの織布、不織布、微多孔膜などが挙げられる。セパレータには、各種可塑剤、酸化防止剤、難燃剤が含まれてもよいし、金属酸化物等が被覆されていてもよい。
【００７８】
セパレータの厚みは、１０μｍ以上１００μｍ以下であることが好ましい。１０μｍ未

満の場合、正電極と負電極との接触する場合があり、１００μｍより厚い場合は電池の抵抗が高くなる場合がある。経済性、取り扱いの観点から、１５μｍ以上５０μｍ以下であることがさらに好ましい。

＜非水電解質＞

本発明の非水電解質二次電池に用いる非水電解質は、特に限定されないが、非水溶媒に溶質を溶解させた電解液、非水溶媒に溶質を溶解させた電解液を高分子に含浸させたゲル電解質などを用いることができる。

【００７９】

非水溶媒としては、環状の非プロトン性溶媒及び／又は鎖状の非プロトン性溶媒を含むことが好ましい。環状の非プロトン性溶媒としては、環状カーボネート、環状エステル、環状スルホン及び環状エーテルなどが例示される。鎖状の非プロトン性溶媒としては、鎖状カーボネート、鎖状カルボン酸エステル及び鎖状エーテルなどが例示される。また、前記に加えアセトニトリルなどの一般的に非水電解質の溶媒として用いられる溶媒を用いても良い。より具体的には、ジメチルカーボネート、メチルエチルカーボネート、ジメチルカーボネート、ジプロピルカーボネート、メチルプロピルカーボネート、エチレンカーボネート、プロピレンカーボネート、ブチレンカーボネート、γ－ブチルラクトン、１，２－ジメトキシエタン、スルホラン、ジオキソラン、プロピオン酸メチルなどを用いることができる。これら溶媒は１種類で用いてもよいし、２種類以上混合しても用いてもよいが、後述の溶質を溶解させやすさ、リチウムイオンの伝導性の高さから、２種類以上混合した溶媒を用いることが好ましい。また、高分子に電解液をしみこませたゲル状電解質も用いることができる。

【００８０】

前記溶質は、特に限定されないが、例えば、ＬｉＣｌＯ４、ＬｉＢＦ４、ＬｉＰＦ６、ＬｉＡｓＦ６、ＬｉＣＦ３ＳＯ３、ＬｉＢＯＢ（Ｌｉｔｈｉｕｍ Ｂｉｓ （Ｏｘａｌａｔｏ） Ｂｏｒａｔｅ）、ＬｉＮ（ＳＯ２ＣＦ３）２などは溶媒に溶解しやすいことから好ましい。電解液に含まれる溶質の濃度は、０．５ｍｏｌ／Ｌ以上２．０ｍｏｌ／Ｌ以下であることが好ましい。０．５ｍｏｌ／Ｌ未満では所望のリチウムイオン伝導性が発現しない場合があり、一方、２．０ｍｏｌ／Ｌより高いと、溶質がそれ以上溶解しない場合がある。

【００８１】

＜負電極と正電極の好ましい容量比及び面積比＞

本発明の電極活物質混合物より製造された非水電解質二次電池用電極を用いて作製した二次電池における正電極と負電極の電気容量の比は、下記式（ａ）を満たすことが望ましい。

０．７≦Ｂ／Ａ≦１．３ （ａ）

但し、上記式（ａ）中、Ａは正電極１ｃｍ^{2}あたりの電気容量を示し、Ｂは負電極１ｃｍ^{2}あたりの電気容量を示す。

【００８２】

Ｂ／Ａが０．７未満である場合は、過充電時に負電極の電位が負電極集電体とリチウムが反応する電位又はリチウムの析出電位になる場合があり、一方、Ｂ／Ａが１．３より大きい場合は電池反応に関与しない負極活物質多いために副反応が起こる場合がある。

本発明の非水電解質二次電池における正電極と負電極との面積比は、特に限定されないが、下記式（ｂ）を満たすことが好ましい。

【００８３】

１≦Ｄ／Ｃ≦１．２ （ｂ）

但し、Ｃは正電極の面積、Ｄは負電極の面積を示す。Ｄ／Ｃが１未満である場合は、例えば前述のＢ／Ａ＝１の場合、負電極の容量が正電極よりも小さくなるため、過充電時に負電極の電位がリチウムの析出電位になる恐れがある。一方、Ｄ／Ｃが１．２より大きい場合は、正電極と接していない部分の負電極が大きいため、電池反応に関与しない負極活物質が副反応を起こす場合がある。正電極及び負電極の面積の制御は特に限定されないが、

例えば、電極作製の際、塗工幅を制御することによって行うことができる。

【００８４】

本発明の非水電解質二次電池に用いるセパレータと負電極との面積比は特に限定されないが、下記式（ｃ）を満たすことが好ましい。

$$1 \leqq F/E \leqq 1.5 \qquad (c)$$

但し、Ｅは負電極の面積、Ｆはセパレータの面積を示す。Ｆ／Ｅが１未満である場合は、正電極と負電極とが接触し、１．５より大きい場合は外装に要する体積が大きくなり、電池の容量密度及び出力密度が低下する場合がある。

【実施例】

【００８５】

以下、実施例により本発明をさらに具体的に説明するが、本発明はこれらの実施例によって限定されるものではなく、その要旨を変更しない範囲において適宜変更実施が可能である。

（正電極の製造）

正電極用活物質の$Li_{1.1}Al_{0.1}Mn_{1.8}O_4$を、文献（"Lithium Aluminum Manganese Oxide Having Spinel-Framework Structure for Long-Life Lithium-Ion Batteries" Electrochemical and Solid-State Letters Volume9, Issue12, Pages A557 (2006)）に記載されている方法で作製した。

【００８６】

すなわち二酸化マンガン、炭酸リチウム、水酸化アルミニウム、及びホウ酸の水分散液を調製し、スプレードライ法で混合粉末を作製した。このとき、二酸化マンガン、炭酸リチウム及び水酸化アルミニウムの量は、リチウム、アルミニウム及びマンガンのモル比が１．１：０．１：１．８となるように調製した。次に、この混合粉末を空気雰囲気下９００℃で１２時間加熱した後、再度６５０℃で２４時間加熱した。最後に、この粉末を９５℃の水で洗浄後、乾燥させることによって正極活物質を作製した。

この正極活物質を、導電助材（アセチレンブラック）、及びバインダー（固形分濃度１２ｗｔ％、ＮＭＰ溶液）を８８／６／６の重量比で混合して、スラリーを作製した。このスラリーをアルミニウム箔（厚さ２０μｍ）に塗工し、１２０℃でＮＭＰを除去した後に、１５０℃で真空乾燥することによって正電極（面積５０cm^2）を作製した。

正電極の容量を、次の充放電試験で測定した。前述と同様にアルミニウム箔の片面に塗工した電極を１６ｍｍΦに打ち抜き動作極、Ｌｉ金属を１６ｍｍΦに打ち抜き対極とした。これらの電極を用いて、動作極（片面塗工）／セパレータ／Ｌｉ金属の順に試験セル（ＨＳセル、宝泉社製）内に積層し、非水電解質（プロピレンカーボネート／エチルメチルカーボネート＝３０／７０ｖｏｌ％、ＬｉＰＦ６　１ｍｏｌ／Ｌ）を０．１５ｍＬ入れ、半電池を作製した。この半電池を２５℃で一日放置した後、充放電試験装置（ＨＪ１００５ＳＤ８、北斗電工社製）に接続した。この半電池を２５℃、０．４ｍＡで定電流充電（終止電圧：５．０Ｖ）及び定電流放電（終止電圧：２．０Ｖ）を行い、初回の充電容量を正電極の容量とした。その結果、正電極の容量は、１．０ｍＡｈ／ｃｍ２であった。この半電池は、４．７Ｖ付近にプラトー領域を示した。この電圧４．７Ｖが、従来のコバルト酸リチウム等の４Ｖ（ｖｓ．Li^+／Ｌｉ）以下の領域で動作する物質を用いた正極活物質に比べて、高い電位（ｖｓ．Li^+／Ｌｉ）を有する正極活物質であることを裏付けている。

【００８７】

（負電極の製造）

負極活物質の$Li_4Ti_5O_{12}$を、文献（"Zero-Strain Insertion Material of Li[Li1/3Ti5/3] O4 for Rechargeable Lithium Cells" J. Electrochem. Soc., Volume 142, Issue 5, pp. 1431-1435 (1995)）に記載されている方法で作製した。

すなわち、まず二酸化チタンと水酸化リチウムを、チタンとリチウムとのモル比を５：４となるように混合し、次にこの混合物を窒素雰囲気下８００℃で１２時間加熱することによって負極活物質を作製した。

【００８８】
この負極活物質を、導電助材（アセチレンブラック）、及びバインダー（固形分濃度１２ｗｔ％、ＮＭＰ溶液）を８８／６／６の重量比で混合してスラリーを作製した。このスラリーをアルミニウム集電体（厚さ２０μｍ）に塗工し、１２０℃でＮＭＰを除去した後に、１５０℃で真空乾燥することによって負電極（面積６６ｃｍ^2）を作製した。
負電極の容量は次の充放電試験で測定した。前述と同様の条件でアルミニウム箔の片面に電極を塗工し、１６ｍｍΦに打ち抜き動作極を作製した。Ｌｉ金属を１６ｍｍΦに打ち抜き対極とした。これらの電極を用いて、動作極（片面塗工）／セパレータ／Ｌｉ金属の順に試験セル（ＨＳセル、宝泉社製）内に積層し、非水電解質（プロピレンカーボネート／エチルメチルカーボネート＝３０／７０ｖｏｌ％、ＬｉＰＦ６　１ｍｏｌ／Ｌ）を０．１５ｍＬ入れ、半電池を作製した。この半電池を２５℃で一日放置した後、充放電試験装置（ＨＪ１００５ＳＤ８、北斗電工社製）に接続した。この半電池を２５℃、０．４ｍＡで定電流放電（終止電圧：１．０Ｖ）及び定電流充電（終止電圧：２．０Ｖ）を行い、初回の充電容量を負電極の容量とした。その結果、負電極の容量は、１．１ｍＡｈ／ｃｍ２であった。
【００８９】
（非水電解質二次電池の製造）
非水電解質二次電池を次のとおりに作製した。
＜実施例１＞
前記作製した正電極（片面塗工）、負電極（片面塗工）、およびセパレータを、正電極（片面塗工）／セパレータ／負電極（片面塗工）の順に積層し、水素吸蔵合金を含む固定テープにより電極群を固定した。セパレータには、セルロース不織布（２５μｍ）を用いた。
【００９０】
水素吸蔵合金を含む固定テープは、ポリイミドテープの接着樹脂に平均粒子径30μｍのLaMgNi合金系水素吸蔵合金を5wt%混入して作製した。固定テープのサイズは3cmｘ4cmで、これにより極板群を二箇所固定した。
次に、両端の正電極および負電極にアルミニウムタブを振動溶着させた後に、袋状のアルミラミネートフィルムに入れた。非水電解質（プロピレンカーボネート／エチルメチルカーボネート＝３０／７０ｖｏｌ％、ＬｉＰＦ$_6$　１ｍｏｌ／Ｌ）を２ｍＬ入れた後に、減圧しながら封止することによって非水電解質二次電池を作製した。
【００９１】
＜実施例２＞
前記作製した正電極（片面塗工）、負電極（片面塗工）、およびセパレータを、正電極（片面塗工）／セパレータ／負電極（片面塗工）の順に積層し、固定テープにより電極群を固定した。セパレータには、セルロース不織布（２５μｍ）を用いた。次に、正電極及び負電極の集電箔とアルミニウムタブとを振動溶着させた後に、正電極の集電箔とアルミニウムタブとの接合部、及び負電極の集電箔とアルミニウムタブとの接合部に、水素吸蔵合金を含む短絡防止用樹脂を形成した。
【００９２】
短絡防止樹脂にはポリイミドテープを用いた。このポリイミドテープの接着樹脂に平均粒子径30μｍのLaMgNi合金系水素吸蔵合金を5wt％混入させた。このポリイミドテープ（サイズ1.5cmｘ4cm）を用いて、正負極タブリード溶接部の上下に計4枚貼り付けた。
袋状のアルミラミネートフィルムに入れて、非水電解質（プロピレンカーボネート／エチルメチルカーボネート＝３０／７０ｖｏｌ％、ＬｉＰＦ$_6$　１ｍｏｌ／Ｌ）を２ｍＬ入れた後に、減圧しながら封止することによって非水電解質二次電池を作製した。
【００９３】
＜比較例１＞
水素吸蔵合金を用いない以外は実施例１と同様に非水電解質二次電池を作製した。
（ガス量の測定）

実施例１，２及び比較例１で作製された非水電解質二次電池を、充放電装置（ＨＪ１００５ＳＤ８、北斗電工社製）に接続し、５０ｍＡ定電流充電、５０ｍＡ定電流放電を６０℃で１００回繰り返し、サイクル直後、一ヶ月間室温で静置後、六ヶ月間室温で静置後に前後の体積変化からガス量を測定した。このときの充電終止電圧および放電終止電圧は３．４Ｖおよび２．５Ｖとした。充放電サイクルの前後の体積変化から測定したガス発生量を表１に示す。

【００９４】

【表１】

表1

	水素吸蔵合金	配置場所	100サイクル後のガス量（cc/Ah）	静置一ヶ月後のガス量（cc/Ah）	静置六ヶ月後のガス量（cc/Ah）
実施例1	有	電極群の固定テープ	18.2	16.5	4.1
実施例2	有	合剤端部の短絡防止樹脂	17.9	16.2	3.7
比較例1	無	-	18.9	18.5	18.3

【００９５】

表１から明らかなとおり、本発明の実施例１，２の非水電解質二次電池は、同じ条件で測定した比較例１の非水電解質二次電池よりも残留ガス量が減少している 。例えば、実施例１の残留ガス量は４．１ｃｃ／Ａｈ、実施例２の残留ガス量は３．７ｃｃ／Ａｈであるのに対して、比較例１の残留ガス量は１８．３ｃｃ／Ａｈである。一ヶ月放置する間に、実施例１では、１６．５－４．１＝１２．４ｃｃ／Ａｈのガスが水素吸蔵合金に吸収されたものと考えられる。実施例２では、１６．２－３．７＝１２．５ｃｃ／Ａｈのガスが水素吸蔵合金に吸収されたものと考えられる。

【符号の説明】

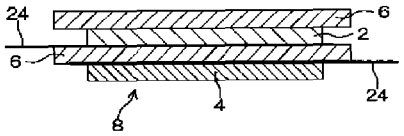
【００９６】

２…正電極、４…負電極、６…セパレータ、８…内部発電体、１０…外装体、１４…金属タブリード、１６…熱融着樹脂、２０…電解液、２２…電極固定テープ、２４…集電箔、２６，２８，３０…短絡防止樹脂

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【図１】

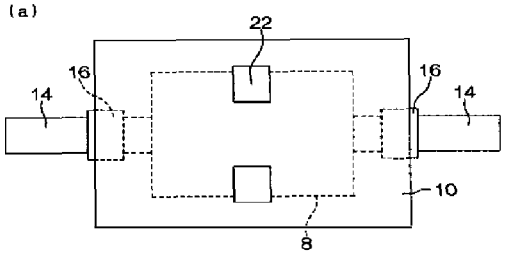
図1



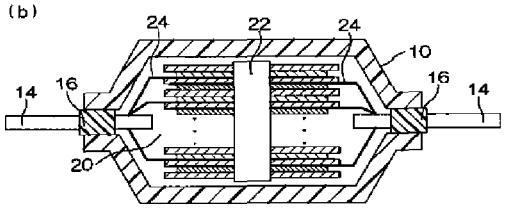
【図２】

図2

(a)



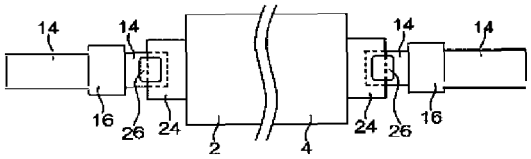
(b)



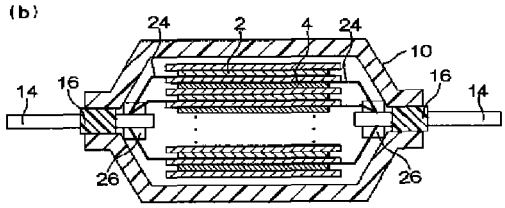
【図３】

図3

(a)



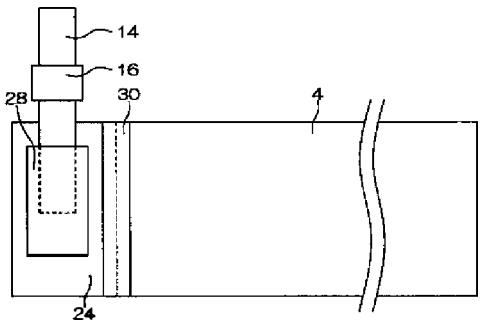
(b)



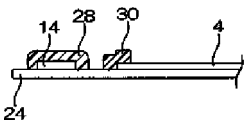
【図４】

図4

(a)



(b)



【図５】

図5

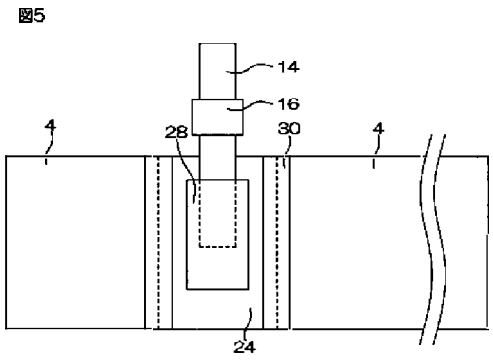


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5H031 AA00 AA08 BB03 EE03 EE04 EE08 HH01
5H043 AA04 AA19 BA19 CA08 CA12 CA13 CA21 DA02 DA10 DA13
FA22 FA23 GA22 GA26 GA27 HA13D HA16D HA17D HA22 HA22D
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LA31
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EA23 FA02 FA05 GA02 GA22 HA18

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Espacenet

CN204113515U Remote control vehicle storage battery auxiliary starting device

Applicants: ZHANG KAILONG

Inventors: ZHANG KAILONG

Classifications:
IPC ***F02N11/08;***

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Remote control vehicle storage battery auxiliary starting device

Abstract

The utility model provides a remote control vehicle storage battery auxiliary starting device which is characterized by comprising a lithium battery pack, a control chip, a power management chip, a first controllable switch circuit, a second controllable switch circuit, a battery voltage detection circuit, a storage battery voltage detection circuit, a starting circuit, an electric heater, a wireless receiving head and a remote controller corresponding to the wireless receiving head, a negative electrode of the lithium battery pack is connected with a negative electrode of a vehicle storage battery, a positive electrode of the lithium battery pack is connected with a positive electrode of the vehicle storage battery through the first controllable switch circuit, the vehicle storage battery, the second controllable switch circuit and the electric heater form a circuit loop, and connection and disconnection of the loop are controlled by the second controllable switch circuit. The remote control vehicle storage battery auxiliary starting device effectively solves the problem that a vehicle cannot be started due to insufficient power supply caused by low temperature or aging of the vehicle storage battery, a remote control heating function is added, the vehicle storage battery is preheated in advance, and the remote control vehicle storage battery auxiliary starting device has high practicability in actual life.

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(19)中华人民共和国国家知识产权局

(12)实用新型专利

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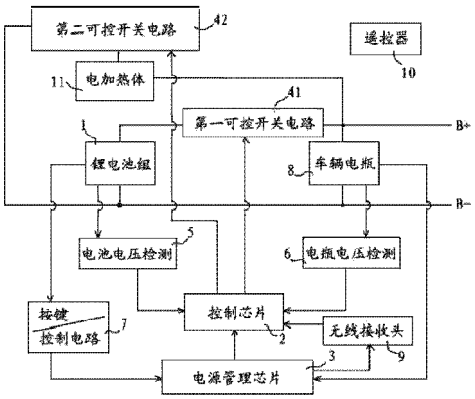
权利要求书2页 说明书4页 附图2页

(54)实用新型名称

遥控型车辆电瓶辅助启动装置

(57)摘要

本实用新型提出一种遥控型车辆电瓶辅助启动装置，其特征在于：包括锂电池组、控制芯片、电源管理芯片、第一可控开关电路、第二可控开关电路、电池电压检测电路、电瓶电压检测电路、启动电路、电加热体、无线接收头及与所述无线接收头对应的遥控器；所述锂电池组的负极与车辆电瓶的负极连接，锂电池组的正极经第一可控开关电路与车辆电瓶正极连接；所述车辆电瓶、第二可控开关电路及电加热体构成电路回路，并由所述第二可控开关电路控制其所在回路的通断。本实用新型很好地解决了车辆电瓶因温度低或老化而供电不足导致的车辆不能启动的问题，同时增添遥控加热功能，实现车辆电瓶的提前预热，在实际生活中具有较高的实用性。



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1. 一种遥控型车辆电瓶辅助启动装置，其特征在于：包括锂电池组、控制芯片、电源管理芯片、第一可控开关电路、第二可控开关电路、电池电压检测电路、电瓶电压检测电路、启动电路、电加热体、无线接收头及与所述无线接收头对应的遥控器；所述锂电池组的负极与车辆电瓶的负极连接，锂电池组的正极经第一可控开关电路与车辆电瓶正极连接；所述车辆电瓶、第二可控开关电路及电加热体构成电路回路，并由所述第二可控开关电路控制其所在回路的通断；所述第一可控开关电路和第二可控开关电路由控制芯片控制其通断；所述电源管理芯片分别连接锂电池组与车辆电瓶，电源管理芯片与锂电池组之间设有启动电路，所述启动电路控制电源管理芯片与锂电池组线路的通断；所述电池电压检测电路用于获取锂电池组两端输出的实时电压，并将其反馈至控制芯片；所述电瓶电压检测电路用于获取车辆电瓶两端输出的实时电压，并将其反馈至控制芯片；所述无线接收头的输出端与所述控制芯片连接。

2. 根据权利要求 1 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述启动电路包括接于电源管理芯片与锂电池组之间的按键开关 K1、NPN 晶体管 Q2 与 PNP 晶体管 Q3；所述 PNP 晶体管 Q3 的发射极连接锂电池组的正极，其集电极连接电源管理芯片的输入端，其基极连接 NPN 晶体管 Q2 的集电极；所述 NPN 晶体管 Q2 的发射极接地，其基极通过按键开关 K1 与锂电池组的正极连接。

3. 根据权利要求 1 或 2 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述第可控开关电路包括继电器 T1、NPN 晶体管 Q1、二极管 D1 以及电阻 R3、R4、R5，所述二极管 D1、电阻 R3 与 NPN 晶体管 Q1 依次串接；所述二极管 D1 的阴极与锂电池组的正极连接，其阳极与电阻 R3 连接；所述 NPN 晶体管 Q1 的集电极与电阻 R3 连接，其发射极接地，其基极经电阻 R5 与控制芯片连接，所述 NPN 晶体管 Q1 的发射极与基极之间接有电阻 R4；所述继电器 T1 的开关部接于锂电池组正极与车辆电瓶正极之间的线路上，其电磁部与所述二极管 D1 并联。

4. 根据权利要求 3 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述第二可控开关电路包括继电器 T2、NPN 晶体管 Q31、二极管 D31 以及电阻 R33、R34、R35，所述二极管 D31、电阻 R33 与 NPN 晶体管 Q31 依次串接；所述二极管 D31 的阴极与车辆电瓶的正极连接，其阳极与电阻 R33 连接；所述 NPN 晶体管 Q31 的集电极与电阻 R33 连接，其发射极接地，其基极经电阻 R35 与控制芯片连接，所述 NPN 晶体管 Q31 的发射极与基极之间接有电阻 R34；所述车辆电瓶与电加热体两端并联，所述继电器 T2 的开关部接于车辆电瓶与电加热体之间的线路上，其电磁部与所述二极管 D31 并联。

5. 根据权利要求 4 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述电池电压检测电路包括与锂电池组并联连接两个分压电阻 R1、R2，电阻 R1 与 R2 串联，二者的连结点与控制芯片连接。

6. 根据权利要求 5 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述电瓶电压检测电路包括与车辆电瓶并联连接两个分压电阻 R6、R7，电阻 R6 与 R7 串联，二者的连结点与控制芯片连接。

7. 根据权利要求 6 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述无线接收头包括无线收发芯片、匹配电路及天线，所述匹配电路包括电感 L、电容 C24 和下拉电阻 R26，所述电感 L 两端分别连接天线和无线收发芯片，所述电感 L 与天线连接的一端接有电容 C24，所述电感 L 与无线收发芯片连接的一端接有下拉电阻 R26。

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8. 根据权利要求 7 所述的遥控型车辆电瓶辅助启动装置，其特征在于：所述电加热体包括内置有电热丝或电热膜层的电加热垫。

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遥控型车辆电瓶辅助启动装置

技术领域

[0001] 本实用新型涉及一种遥控型车辆电瓶辅助启动装置。

背景技术

[0002] 目前，车辆基本上都是通过电子打火的方式启动，而电子点火装置是靠蓄电池来供给电源的。蓄电池的内阻较大，从而导致其在启动时瞬时电流输出值偏小，且其内阻的阻值会随使用时间或气温的下降而变大。因此，在使用较长时间后或是在气温较低的情况下，蓄电池输出的启动电流显著变小，常常导致车辆很难打着火。特别是在低温条件下，车辆的电子点火装置对启动电流的要求比平时更高，而此时蓄电池的输出电流又比平时小，因而会造成点火失败，车辆不能启动。

实用新型内容

[0003] 针对背景技术中提及的问题，本实用新型提出一种带遥控型车辆电瓶辅助启动装置，旨在解决车辆电瓶因温度低或老化而供电不足导致的车辆不能启动的问题，同时，有效延长车辆电瓶的使用寿命。其采用的技术方案如下：

[0004] 一种遥控型车辆电瓶辅助启动装置，包括锂电池组、控制芯片、电源管理芯片、第一可控开关电路、第二可控开关电路、电池电压检测电路、电瓶电压检测电路、启动电路、电加热体、无线接收头及与所述无线接收头对应的遥控器；所述锂电池组的负极与车辆电瓶的负极连接，锂电池组的正极经第一可控开关电路与车辆电瓶正极连接；所述车辆电瓶、第二可控开关电路及电加热体构成电路回路，并由所述第二可控开关电路控制其所在回路的通断；所述第一可控开关电路和第二可控开关电路由控制芯片控制其通断；所述电源管理芯片分别连接锂电池组与车辆电瓶，电源管理芯片与锂电池组之间设有启动电路，所述启动电路控制电源管理芯片与锂电池组线路的通断；所述电池电压检测电路用于获取锂电池组两端输出的实时电压，并将其反馈至控制芯片；所述电瓶电压检测电路用于获取车辆电瓶两端输出的实时电压，并将其反馈至控制芯片；所述无线接收头的输出端与所述控制芯片连接。

[0005] 上述方案的原理：所述启动电路接通，由锂电池组为电源管理芯片供电，从而唤醒控制芯片；所述控制芯片分别获取的锂电池组与车辆电瓶两端电压，并作判比；在车辆电瓶电两端电压较低的情况下，所述控制芯片令继电器开关电路导通，从而使得锂电池组与车辆电瓶并联，同时向点火装置供电；同时，在接收到所述遥控器的控制信号（启动加热）时，所述控制芯片令继电器开关电路导通，闭合电加热体所在回路，实现对车辆电瓶的加热。随着电瓶温度的回升，电瓶电压趋于正常（即比锂电池组两端电压高）的情况下，所述控制芯片令继电器开关电路断开，仅由车辆电瓶为电源管理芯片和点火装置供电。

[0006] 本实用新型的技术方案进一步包括：

[0007] 所述启动电路包括接于电源管理芯片与锂电池组之间的按键开关 K1、NPN 晶体管 Q2 与 PNP 晶体管 Q3；所述 PNP 晶体管 Q3 的发射极连接锂电池组的正极，其集电极连接电源

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管理芯片的输入端，其基极连接 NPN 晶体管 Q2 的集电极；所述 NPN 晶体管 Q2 的发射极接地，其基极通过按键开关 K1 与锂电池组的正极连接。

[0008] 作为优选方案，所述第一可控开关电路包括继电器 T1、NPN 晶体管 Q1、二极管 D1 以及电阻 R3、R4、R5，所述二极管 D1、电阻 R3 与 NPN 晶体管 Q1 依次串接；所述二极管 D1 的阴极与锂电池组的正极连接，其阳极与电阻 R3 连接；所述 NPN 晶体管 Q1 的集电极与电阻 R3 连接，其发射极接地，其基极经电阻 R5 与控制芯片连接，所述 NPN 晶体管 Q1 的发射极与基极之间接有电阻 R4；所述继电器 T1 的开关部接于锂电池组正极与车辆电瓶正极之间的线路上，其电磁部与所述二极管 D1 并联。

[0009] 作为优选方案，所述第二可控开关电路包括继电器 T2、NPN 晶体管 Q31、二极管 D31 以及电阻 R33、R34、R35，所述二极管 D31、电阻 R33 与 NPN 晶体管 Q31 依次串接；所述二极管 D31 的阴极与车辆电瓶的正极连接，其阳极与电阻 R33 连接；所述 NPN 晶体管 Q31 的集电极与电阻 R33 连接，其发射极接地，其基极经电阻 R35 与控制芯片连接，所述 NPN 晶体管 Q31 的发射极与基极之间接有电阻 R34；所述车辆电瓶与电加热体两端并联，所述继电器 T2 的开关部接于车辆电瓶与电加热体之间的线路上，其电磁部与所述二极管 D31 并联。

[0010] 作为优选方案，所述电池电压检测电路包括与锂电池组并联连接两个分压电阻 R1、R2，电阻 R1 与 R2 串联，二者的连结点与控制芯片连接。

[0011] 作为优选方案，所述电瓶电压检测电路包括与车辆电瓶并联连接两个分压电阻 R6、R7，电阻 R6 与 R7 串联，二者的连结点与控制芯片连接。

[0012] 作为优选方案，所述无线接收头包括无线收发芯片、匹配电路及天线，所述匹配电路包括电感 L、电容 C24 和下拉电阻 R26，所述电感 L 两端分别连接天线和无线收发芯片，所述电感 L 与天线连接的一端接有电容 C24，所述电感 L 与无线收发芯片连接的一端接有下拉电阻 R26。

[0013] 作为优选方案，所述电加热体包括内置有电热丝或电热膜层的电加热垫。

[0014] 本实用新型采用锂电池组与车辆电瓶配合供电结构，很好地解决了车辆电瓶因温度低或老化而供电不足导致的车辆不能启动的问题，延长车辆电瓶的使用寿命。同时，更增添遥控加热功能，实现车辆电瓶的提前预热。本实用新型电路结构简单，在实际生活中具有较高的实用性与良好的应用前景，十分适合推广使用。

附图说明

[0015] 图 1 为本实用新型的结构框架示意图。

[0016] 图 2 为本实用新型的电路结构示意图。

具体实施方式

[0017] 如下结合附图，对本申请方案作进一步描述：

[0018] 如图 1 至 2 所示，一种遥控型车辆电瓶辅助启动装置，包括锂电池组 1、控制芯片 2、电源管理芯片 3、第一可控开关电路 41、第二可控开关电路 42、电池电压检测电路 5、电瓶电压检测电路 6、启动电路 7、电加热体 11、无线接收头 9 及与所述无线接收头 9 对应的遥控器 10；

[0019] 所述锂电池组 1 的负极与车辆电瓶 8 的负极连接，锂电池组 1 的正极经第一可控

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开关电路 41 与车辆电瓶 8 正极连接；所述车辆电瓶 8、第二可控开关电路 42 及电加热体 11 构成电路回路，并由所述第二可控开关电路 11 控制其所在回路的通断；所述第一可控开关电路 41 和第二可控开关电路 42 由控制芯片 2 控制其通断；所述电源管理芯片 3 分别连接锂电池组 1 与车辆电瓶 8，电源管理芯片 3 与锂电池组 1 之间设有启动电路 7，所述启动电路 7 控制电源管理芯片 3 与锂电池组 1 线路的通断；所述电池电压检测电路 5 用于获取锂电池组 1 两端输出的实时电压，并将其反馈至控制芯片 2；所述电瓶电压检测电路 6 用于获取车辆电瓶 8 两端输出的实时电压，并将其反馈至控制芯片 2；所述无线接收头 9 的输出端与所述控制芯片 2 连接。

[0020] 上述方案为本实用新型的优选实施方式之一，可以理解，所述启动电路 7 还可以为具有控制电源管理芯片 3 与锂电池组 1 线路通断功能的其它开关电路，该开关电路可由车载系统控制。

[0021] 所述启动电路 7 包括接于电源管理芯片 3 与锂电池组 1 之间的按键开关 K1、NPN 晶体管 Q2 与 PNP 晶体管 Q3；所述 PNP 晶体管 Q3 的发射极连接锂电池组的正极，其集电极连接电源管理芯片的输入端，其基极连接 NPN 晶体管 Q2 的集电极；所述 NPN 晶体管 Q2 的发射极接地，其基极通过按键开关 K1 与锂电池组的正极连接。

[0022] 所述第一可控开关电路 41 包括继电器 T1、NPN 晶体管 Q1、二极管 D1 以及电阻 R3、R4、R5，所述二极管 D1、电阻 R3 与 NPN 晶体管 Q1 依次串接；所述二极管 D1 的阴极与锂电池组的正极连接，其阳极与电阻 R3 连接；所述 NPN 晶体管 Q1 的集电极与电阻 R3 连接，其发射极接地，其基极经电阻 R5 与控制芯片连接，所述 NPN 晶体管 Q1 的发射极与基极之间接有电阻 R4；所述继电器 T1 的开关部接于锂电池组正极与车辆电瓶正极之间的线路上，其电磁部与所述二极管 D1 并联。

[0023] 所述第二可控开关电路 42 包括继电器 T2、NPN 晶体管 Q31、二极管 D31 以及电阻 R33、R34、R35，所述二极管 D31、电阻 R33 与 NPN 晶体管 Q31 依次串接；所述二极管 D31 的阴极与车辆电瓶 8 的正极连接，其阳极与电阻 R33 连接；所述 NPN 晶体管 Q31 的集电极与电阻 R33 连接，其发射极接地，其基极经电阻 R35 与控制芯片 2 连接，所述 NPN 晶体管 Q31 的发射极与基极之间接有电阻 R34；所述车辆电瓶 8 与电加热体 11 两端并联，所述继电器 T2 的开关部接于车辆电瓶 8 与电加热体 11 之间的线路上，其电磁部与所述二极管 D31 并联。

[0024] 所述电池电压检测电路 5 包括与锂电池组 1 并联连接两个分压电阻 R1、R2，电阻 R1 与 R2 串联，二者的连结点与控制芯片 2 连接。

[0025] 所述电瓶电压检测电路 6 包括与车辆电瓶 8 并联连接两个分压电阻 R6、R7，电阻 R6 与 R7 串联，二者的连结点与控制芯片 2 连接。

[0026] 上述实施方案中，控制芯片 2 对应附图 2 中的 U1，控制电源管理芯片 3 对应附图 2 中的 U2。

[0027] 所述无线接收头 9 包括无线收发芯片 U3、匹配电路及天线，所述匹配电路包括电感 L、电容 C24 和下拉电阻 R26，所述电感 L 两端分别连接天线和无线收发芯片，所述电感 L 与天线连接的一端接有电容 C24，所述电感 L 与无线收发芯片连接的一端接有下拉电阻 R26。

[0028] 所述无线收芯片 U3 的型号为 LT8900。

[0029] 所述电加热体 11 包括内置有电热丝 RL 的电加热垫。

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[0030] 上述优选实施方式应视为本申请方案实施方式的举例说明，凡与本申请方案雷同、近似或以此为基础作出的技术推演、替换、改进等，均应视为本专利的保护范围。

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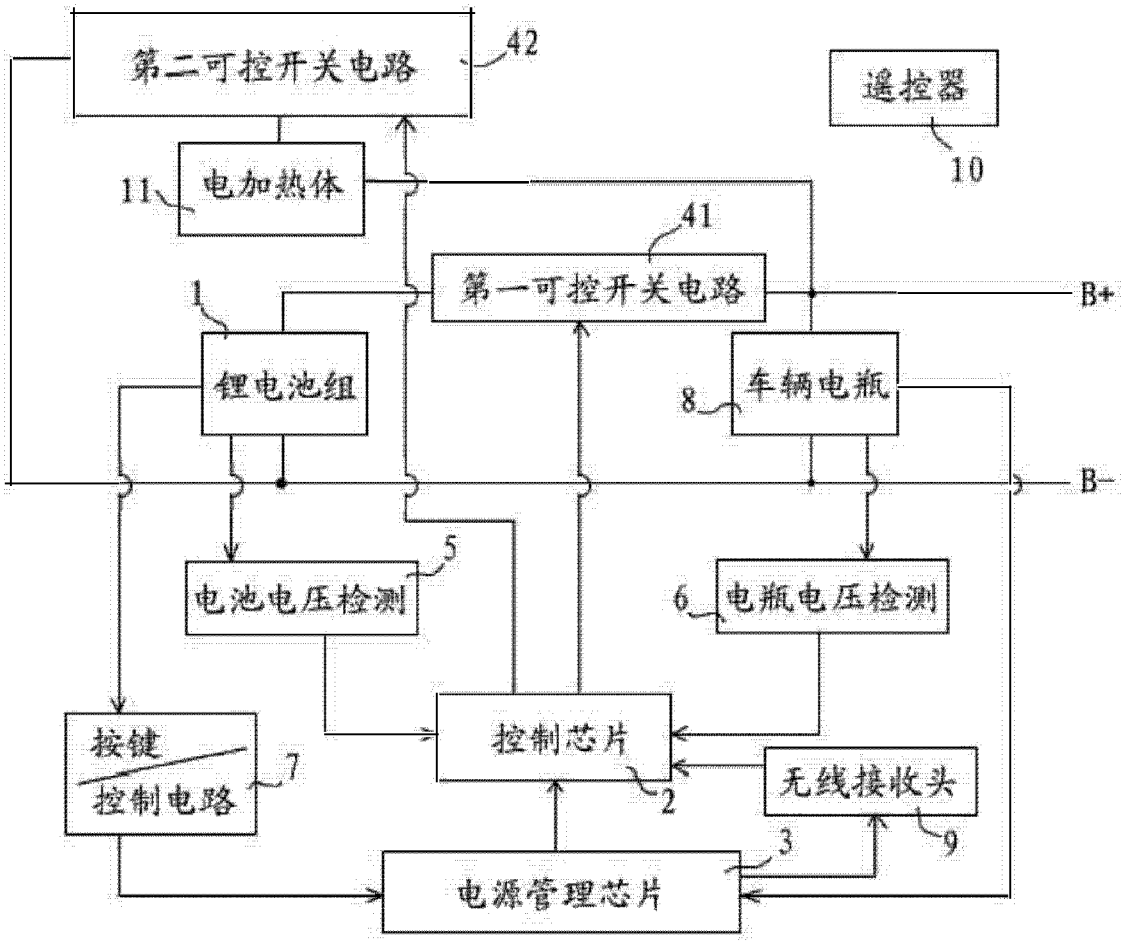


图 1

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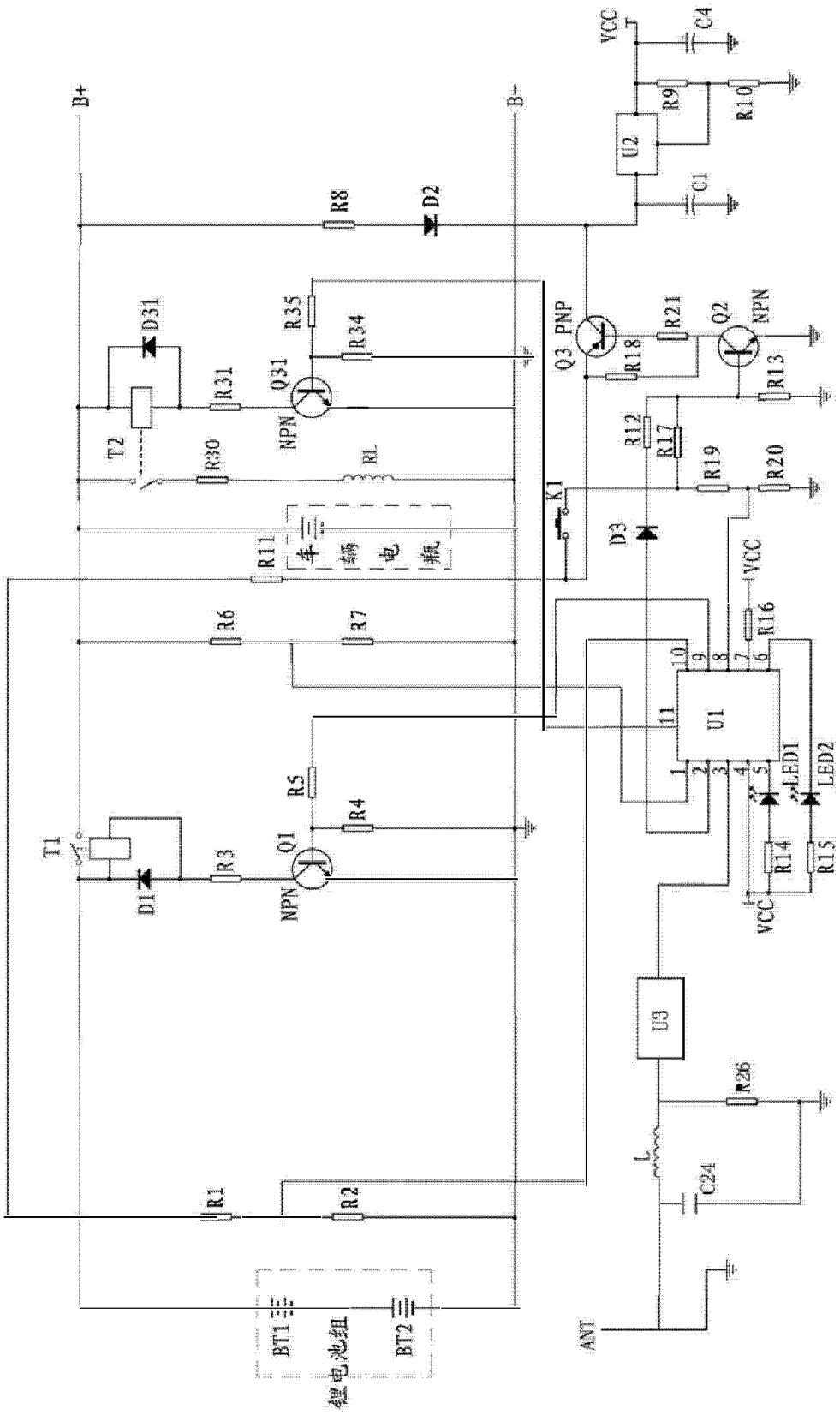


图 2

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UNITED STATES
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/450,422	**06/10/2022 04:32:55 PM ET**	**054985-000055-US-05**

Title of Invention

PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION AND JUMPER CABLE DEVICE THEREOF

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1008	FILED BY	Lisa Elliott
PATENT CENTER #	60713392	FILING DATE	06/24/2019
CUSTOMER #	20230	FIRST NAMED INVENTOR	Jonathan Lewis Nook
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	William Klima

Documents

TOTAL DOCUMENTS: 63

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Petitioner ADC (IPR2024-00577)

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for 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.

Espacenet

CN104795527A Battery module

Applicants: MICROVAST POWER SYSTEMS CO LTD

Inventors: DENG GUOYOU,GUO FENG,WU YANG

Classifications:

IPC ***H01M10/058; H01M2/26;***

CPC **H01M10/04 (CN); H01M10/0486 (EP,US); H01M10/0525 (US); H01M10/058 (CN); H01M10/0585 (US); H01M10/482 (US); H01M10/486 (EP,US); H01M2/0237 (EP,US); H01M2/1077 (EP,US); H01M2/18 (EP,US); H01M2/26 (CN,US); H01M2/266 (EP,US); H01M2/305 (US); H01M4/661 (EP,US);** H01M10/052 (EP,US); H01M10/647 (EP,US); H01M10/654 (EP,US); H01M2/1235 (EP,US); H01M2004/027 (US); H01M2004/028 (US); H01M2220/20 (EP,US); Y02E60/10 (EP,US);

Priorities: CN201410026625A 2014-01-21

Application: CN104795527A·2014-01-21

Publication: CN104795527A·2015-07-22

Published as: CN104795527A;**CN104795527B; US2017084899A1; US9819001B2**

Battery module

Abstract

The invention discloses a battery module. The battery module comprises battery units and current collectors; the opposite two ends of each battery unit are provided with a cathode electrode ear and an anode electrode ear respectively; adjacent battery units are connected in a Z-shaped pattern by series connection of the electrode ears with the current collectors. The cathode electrode ears are aluminium foil electrode ears or copper foil electrode ears; the anode electrode ears are copper foil electrode ears or aluminium foil electrode ears; the cathode electrode ears and the anode electrode ears are made of different materials; the current collectors are combined current collectors, and are composed of aluminium sheets and copper sheets.

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(19)中华人民共和国国家知识产权局

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H01M 10/058(2010.01)

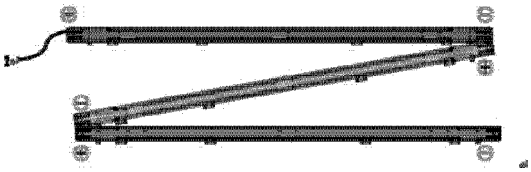
权利要求书1页 说明书6页 附图4页

(54)发明名称

电池模块

(57)摘要

本发明公开了一种电池模块，它包括电池单元和集流片，所述电池单元设置正极极耳及负极极耳，所述正极极耳及负极极耳分别位于电池单元的相对两端，相邻的电池单元通过集流片将极耳串联连接形成Z型排列。所述电池单元的正极极耳为铝箔极耳或铜箔极耳，负极极耳为铜箔极耳或铝箔极耳，且正极极耳和负极极耳的材料不相同，所述集流片为组合式集流片，所述集流片由铝片和铜片组合而成。



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1. 一种电池模块，包括电池单元和集流片，所述电池单元设置正极极耳及负极极耳，所述正极极耳及负极极耳分别位于电池单元的相对两端，相邻的电池单元通过集流片串联或并联连接形成 Z 型排列。

2. 根据权利要求 1 所述的电池模块，其特征在于：所述电池单元的长宽比为 2:1 至 8:1。

3. 根据权利要求 1 所述的电池模块，其特征在于：所述电池单元的长宽比为 4:1 至 6:1。

4. 根据权利要求 1 所述的电池模块，其特征在于：所述电池单元的正极极耳为铝箔极耳或铜箔极耳，负极极耳为铜箔极耳或铝箔极耳，且单个电池单元的正极极耳和负极极耳的材料不相同，所述集流片为组合式集流片，所述集流片由铝片和铜片组合而成。

5. 根据权利要求 4 所述的电池模块，其特征在于：所述铝片和铜片之间铆接固定或焊接固定。

6. 根据权利要求 5 所述的电池模块，其特征在于：所述铝片和铜片上分别设置焊接槽。

7. 根据权利要求 6 所述的电池模块，其特征在于：所述铜箔极耳焊接在铜片的焊接槽上，所述铝箔极耳焊接在铝片的焊接槽上。

8. 根据权利要求 1 所述的电池模块，其特征在于：所述相邻电池单元之间设置隔片，所述隔片的表面积大于电池单元的表面积。

9. 根据权利要求 8 所述的电池模块，其特征在于：所述隔片上设置凹凸纹，所述凹凸纹分布在整个隔片上。

10. 根据权利要求 9 所述的电池模块，其特征在于：所述凹凸纹选自菱形凹凸纹、方形凹凸纹、三角形凹凸纹、条形凹凸纹和橘纹中的至少一种。

11. 根据权利要求 1 所述的电池模块，其特征在于：所述电池模块上还设置温度传感器，温度传感器设置在电池模块的极耳处。

12. 根据权利要求 1 所述的电池模块，其特征在于：所述电池模块两端极耳的位置设置线束部件，线束部件上设置线束通道。

13. 根据权利要求 1 所述的电池模块，其特征在于：所述电池单元的极耳两端均设置固定框，固定框上设置夹持电池单元极耳的阻挡部分，将电池单元夹持在两个固定框的中间。

14. 根据权利要求 13 所述的电池模块，其特征在于：所述固定框之间设置缓冲环，所述缓冲环套设在电池单元上。

15. 根据权利要求 1 所述的电池模块，其特征在于：所述电池模块的两个端面分别设置缓冲垫。

16. 根据权利要求 1 至 15 任一所述的电池模块，其特征在于：所述电池模块被设置在电池箱内，所述电池箱的开口由盖板密封。

17. 根据权利要求 16 所述的电池模块，其特征在于：所述箱体的外壁上设置数根纵向加强筋。

18. 根据权利要求 16 所述的电池模块，其特征在于：所述箱体的外表面设置防爆槽，所述防爆槽的切口深度为箱体壁厚度的 20% ～ 50%。

19. 根据权利要求 18 所述的电池模块，其特征在于：所述防爆槽包括 U 型槽。

20. 根据权利要求 16 所述的电池模块，其特征在于：所述箱体上设置与盖板连接的柔性连接条。

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电池模块

技术领域

[0001] 本发明涉及一种软包电池模块。

背景技术

[0002] 锂离子电池是一种平均输出电压高，输出功率大，自放电小，无记忆效应，工作温度范围宽（为 -20℃～ 60℃），循环性能优越，充放电效率高，使用寿命长，不含有毒有害物质的绿色电池。它是依靠锂离子在正、负极之间的往返嵌入、脱嵌完成电池充电和放电工作的。

[0003] 虽然电动汽车与传统汽车相比存在诸多优势，但是将锂离子电池组应用到电动汽车中还存在诸多问题，其中最待解决的就是锂离子电池的成组技术，其中涉及最多的就是电池组的能量密度问题，直接影响电动汽车的续航里程。

[0004] 锂离子电池组的能量密度主要由电池组的构架决定，一般是先将锂离子电池单元并联之后，再将并联模块串联组成，而电池单元的极耳的连接需要使用集流片，现有技术中，电池单元的并联是直接将电池单元的极耳焊接在集流片上，而串联是使用导线将集流片连接起来；但是这种电池模块的组合存在以下缺点：1、电池组在运行过程中，容易将导线与集流片的焊点震松，从而导致虚焊和脱焊；2、由于电池组中还存在其他采样用的采样线等线材，再加入导线，使得电池组内部较为凌乱，占用过多空间。

[0005] 申请号为 CN201010142205.5，名称为“电池组”的发明专利公开了一种由数个软包电池单元构成的电池组，包括与两电池连接的连接装置，通过导线的作用将电池和连接装置连接在一起，大大占用了电池组的空间，降低了能量密度，且导线与连接装置为点焊接，在使用过程中，容易被震松，导致虚焊和脱焊的发生。

[0006] 又如，Tesla 公司投放在市场上，能量密度最大的产品 ModelS 采用的电池模块，其尺寸为长 2.7m，宽 1.5m，厚度为 0.1m 至 0.18m，由 7600 个 18650 电池组成，一节 18650 电池单元中，电池外壳大约为 0.02dm，去除电池顶部和底部的部件之后极片的长度为 0.65-0.05，故单节 18650 电池单元的极片的体积为 $3.14*((0.18-0.004)/2)^2*(0.6)=0.0146$ 升，整个车辆所用的电池的极片的体积为 0.0146*7600=111 升，电池模块的体积为 27*15*1+3*15*0.8=441L。综上，此电池组中极片所占体积比（Electrode Volume Ratio 下文简称 EVR）为 111/441=25.2%，在其他材料相同的情况下，极片所占比例越高，电池组的能量密度越高，反之也就越低，25.2% 的 EVR 对于电动体积能量密度的提高制约较大，不利于动力电池的布置使电动车行驶里程达到传统燃油车的指标从而满足顾客的需求（传统汽车单次加油行驶里程大多在 600 公里左右，而 Tesla 的行驶里程最长的也只有单次充电 400 公里左右）。

[0007] 而且此电池组采用的是圆柱型电池单元，将圆柱型电池单元焊接到连接片上只能通过点焊的方式，且由于电池单元两极与连接片的接触面积较小，减小了电流通过能力，也增加了发热量，而将如此数量的圆柱型电池单元组合成电池组，产生的热量将非常巨大，用于散热的设计也更加复杂，浪费的电能也就更多，又进一步降低了整个锂离子动力电池组

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能量的有效利用。

发明内容

[0008] 本发明的目的是提供一种电池模块，包括电池单元和集流片，所述电池单元设置正极极耳及负极极耳，所述正极极耳及负极极耳分别位于电池单元的相对两端，相邻的电池单元通过集流片将极耳串联或并联连接形成 Z 型排列。

[0009] 根据本发明的电池模块，其中，电池单元的长宽比为 2:1 至 8:1；采用长宽比为 2:1 至 8:1 的软包电池单元有利于提高体积密度，进而提高整个电池组的能量密度。优选地，电池单元的长宽比为 4:1 至 6:1。

[0010] 所述电池单元的正极极耳为铝箔极耳或铜箔极耳，负极极耳为铜箔极耳或铝箔极耳，且正极极耳和负极极耳的材料不相同，所述集流片为组合式集流片，所述集流片由铝片和铜片组合而成。根据本发明的另一种实施方式，电池单元的正极极耳和负极极耳可以同时为铝箔极耳或铜箔极耳，此时，集流片可以采用单一金属铝或铜的集流片。

[0011] 当电池单元的正极极耳为铝箔极耳或铜箔极耳，负极极耳为铜箔极耳或铝箔极耳，且正极极耳和负极极耳的材料不相同，在组装成电池组的过程中，将电池单元并联连接，仅需将相同材料的极耳焊接在一起；若要对电池单元进行串联，则需要将铜箔极耳和铝箔极耳焊接到集流片上，由于集流片由铝片和铜片组合而成，故只需将铜箔极耳焊接到铜片上，将铝箔焊接到铝片上，电池单元之间通过集流片串联连接并形成 Z 型排列。此种电池组结构增加了电池组的 EVR（Electrode Volume Ratio），从而增加了电池组的能量密度，下文的实施例将通过对传统圆柱形电池组与本方案中的电池组的 EVR 作对比来做进一步说明。

[0012] 作为优选，所述铝片和铜片之间可以铆接固定，也可以焊接固定在一起。

[0013] 将铝片和铜片连接在一起，而铆接的方式既能保证连接的稳定性，也能保证大电流的通过能力。

[0014] 作为优选，所述铝片和铜片上分别设置焊接槽。

[0015] 在铝片和铜片上分别设置焊接槽，便于电池单元的正极极耳和负极极耳的焊接。

[0016] 作为优选，所述铜箔极耳焊接在铜片的焊接槽上，所述铝箔极耳焊接在铝片的焊接槽上。

[0017] 将铜箔极耳焊接在铜片的焊接槽上，铝箔极耳焊接在铝片的焊接槽上可以保证电池单元的极耳与集流片的焊接强度。作为优选，所述铜箔极耳与铜片的焊接槽完全焊接，所述铝箔极耳与铝片的焊接槽完全焊接。

[0018] 现有技术中，极耳与集流片的焊接多为点焊，而且使用导线连接集流片的方式必须通过导线才能实现串并联，而点焊在长期使用之后存在虚焊或脱焊现象，极大影响了电池组的使用寿命，也容易导致危险的发生；本方案中由于采用新型集流片的缘故，可以避免导线连接的传统方式，将极耳与集流片上的焊接槽完全焊接，增加了接触面积，减小内阻，对于抑制电池组的产热有优异效果。并且使用独特涉及的电池单元和集流片，配合 Z 型排列极大提高了电池组的能量密度。

[0019] 作为优选，所述相邻电池单元之间设置隔片，所述隔片的表面积大于电池单元的表面积。

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[0020] 将电池单元成组设计之后，为了追求电池组的稳定性并兼顾电池组的能量密度电池单元之间的间距尽可能压缩，容易导致热量散布不均。在电池单元之间设置隔片，有助于将电池单元产生的热量均匀分布。

[0021] 作为优选，所述隔片上设置凹凸纹，所述凹凸纹分布在整个隔片上。在隔片上设置凹凸纹，有利于增加隔片的表面积，增大了隔片与电池单元的接触面积，增强了隔片的散热能力，有利于使得电池组内部温度更均匀。

[0022] 作为优选，所述凹凸纹选自菱形凹凸纹、方形凹凸纹、三角形凹凸纹、条形凹凸纹和橘纹中的至少一种。

[0023] 凹凸纹选自菱形凹凸纹、方形凹凸纹、三角形凹凸纹、条形凹凸纹和橘纹中的至少一种，纹路从隔片的底部延伸至顶部，便于加工，同时增大隔片表面积以获得更好的散热效果。

[0024] 电池单元的极耳两端均设置固定框，固定框上设置夹持电池单元极耳的阻挡部分，将电池单元夹持在两个固定框的中间。同时在固定框之间设置套设在电池单元上的缓冲环。

[0025] 由于本技术方案中使用软包电池单元，缓冲环可以为橡胶制成，将缓冲环套设在电池单元上，对电池单元起到缓冲作用，将其夹在两个固定框的中间，保证在使用过程中位置固定不移动，可以达到如下效果：在电池组受到冲击时，可以有效地起到缓冲作用；在电池单元成组过程中，收紧电池模块的过程中，保护软包电池单元不受挤压。

[0026] 作为优选，电池模块上还设置温度传感器。当电池组发生异常时，温度传感器可以监测到电池单元的温度参数变化。电池组在正常工作时，其各项参数都是稳定的，一旦发生故障后，电池组内的某个电池单元可能会发生膨胀，温度急剧上升，在电池组内设置温度传感器可以检测这些变化，并且在温度传感器预设几组对比数值，可以根据温度传感器的检测结果对电池组作出相应的调整，例如使得电池组从供电电路中断路或者减小电池组的放电电压等。

[0027] 作为优选，温度传感器设置在电池模块的极耳处。对于软包电池来说，其发热量最大的部位位于极耳周围，若其发生故障，温度变化最为剧烈的也是这个部位，将温度传感器设置在电池模块的极耳处可以在电池单元发生异常的初期就发现，在及时做出补救措施之后，可以避免危险的扩散，保证电池组的安全。

[0028] 作为优选，所述电池模块两端极耳的位置设置线束部件，线束部件上设置线束通道，从电池模块上引出的采样线束从线束通道内穿过，比如温度传感器线束等。

[0029] 作为优选，所述电池单元的极耳两端均设置固定框，固定框上设置夹持电池单元极耳的阻挡部分，将电池单元夹持在两个固定框的中间；这种设计可以将电池单元夹在固定框中间，使得电池单元保持较好的稳定性，并且使得极耳露出，便于连接。

[0030] 作为优选，所述固定框之间设置缓冲环，所述缓冲环套设在电池单元上。

[0031] 本发明中使用软包电池单元，缓冲环为橡胶制成，将缓冲套套设在电池单元上，对电池单元起到缓冲作用，将其夹在两个固定框的中间，保证在使用过程中位置固定不移动，可以达到如下效果：在电池组受到冲击时，可以有效地起到缓冲作用；在电池单元成组过程中，收紧电池模块的过程中，保护软包电池单元不受挤压。

[0032] 作为优选，所述电池模块的两个端面分别设置缓冲垫。

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[0033] 电池组在充电时会发生膨胀，在电池模块的两个端面分别设置缓冲垫可以起到缓冲的作用，避免将电池箱胀破后发生事故。

[0034] 作为优选，所述箱体的外壁上设置数根纵向加强筋。

[0035] 当电池箱由铝合金制成时，在箱体的外壁上设置数根纵向加强筋可以增加电池箱的强度，加强抗压和抗扭曲能力，同时也增大了箱体的表面积，优化了散热性能。当电池箱由强度较高的不锈钢制成时，箱体外壁上可以不另设置加强筋。

[0036] 作为优选，所述箱体的外表面设置防爆槽，所述防爆槽的切口深度为箱体壁厚度的 20% ～ 50%。

[0037] 作为优选，所述防爆槽包括 U 型槽。

[0038] 当电池组内部发生异常，体积急剧膨胀的时候防爆槽，比如 U 型槽，可以在达到箱体破裂压力前提前破开以达到泄压的目的，并且可以引导爆破方向，从而避免电池箱的内压积聚过大而发生更剧烈的爆炸，同时也可防止端板与箱体分离被炸飞。

[0039] 作为优选，所述箱体上设置与两块盖板连接的柔性连接条。

[0040] 箱体上设置柔性连接条，柔性连接条的另一端固定在盖板上，并且两块盖板均通过柔性连接条与箱体连接，当电池箱内压过大，防爆槽也不能完全保证不发生爆炸时，为防止端板被炸飞伤及人员，柔性连接条能够将端板牢牢锁住，即使电池箱爆炸也能保证端板不炸飞，进一步提升电池组的安全性能。

[0041]

附图说明

[0042] 图 1 是电池模块的结构示意图；

图 2 是电池模块的集流片的结构示意图；

图 3 是 Z 字型电池模块的俯视图；

图 4 是本发明的一种实施方式的电池模块的结构示意图；

图 5 是本发明的一种实施方式的电池模块的爆炸图；

图 6 是本发明的一种实施方式的电池模块的结构示意图；

图 7 是本发明公开的一种实施方式的电池箱的结构示意图；

图 8 是本发明公开的一种实施方式的电池箱的爆炸图；

其中 1、电池模块，11、电池单元，2、集流片，21、铜片，22、铝片，23、焊接槽，12、固定框，13、线束部件，132、线束通道，14、缓冲环，15、温度传感器，16、密封片，3、电池箱，33、加强筋，34、箱体，35、盖板，36、柔性连接条，37、U 型槽。

[0043] 实施方式

实施例 1

如图 1 至图 3 所示，本实施例提供一种电池模块 1，包括电池单元 11 和集流片 2，电池单元 11 设置正极极耳及负极极耳，正极极耳及负极极耳分别位于电池单元 11 的相对两端，电池单元 11 的正极极耳为铝箔极耳，负极极耳为铜箔极耳，集流片 2 为组合式集流片，集流片 2 由铝片 22 和铜片 21 组合而成，铝片 22 和铜片 21 之间铆接固定，铝片 22 和铜片 21 上分别设置焊接槽 23。

[0044] 在组装电池模块 1 的过程中，首先将电池单元 11 串联连接，把需要串联的电池单

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元 11 的铝箔极耳焊接在铝片 22 的焊接槽 23 上，将铜箔极耳焊接在铜片 21 的焊接槽 23 上，使得电池模块中的电池单元首尾连接形成 Z 字型。

[0045] 此实施例的优点在于超高的能量密度和电池组结构的稳定性；本实施例中电池组的长为 14dm、宽为 4.3dm、高为 1dm，电池组由 3 并，96 串电池单元组成，电池单元中极片的长为 3.6dm、宽为 0.8dm、厚为 0.036dm，电池箱 3 的容量为 14*4.3*1=60L，电池组中所有极片体积为 3.6*0.8*0.036*3*96=30L，故 EVR 为 30/60=50%，远大于背景技术中 Tesla 使用的 EVR 仅为 25.2% 的电池组，在极片隔膜等材料完全一致前提下，极大提高了电池组的能量密度。

[0046] 实施例 2

如图 1 至图 4 所示，本实施例提供一种电池模块 1，包括电池单元 11 和集流片 2，电池单元 11 设置正极极耳及负极极耳，正极极耳及负极极耳分别位于电池单元 11 的相对两端，电池单元 11 的正极极耳为铝箔极耳，负极极耳为铜箔极耳，集流片 2 为组合式集流片，集流片 2 由铝片 22 和铜片 21 组合而成，铝片 22 和铜片 21 之间铆接固定，铝片 22 和铜片 21 上分别设置焊接槽 23；电池单元 1 的长宽比为 4:1。

[0047] 在组装电池模块 1 的过程中，首先将三个同样的电池单元 11 并联连接，把需要并联的电池单元 11 的铝箔极耳焊接在铝片 22 的焊接槽 23 上，将铜箔极耳焊接在铜片 21 的焊接槽 23 上。然后再将并联好的电池单元的铜箔极耳焊接在上一个并联好的电池单元正极集流片的铜片 21 的焊接槽 23 上，铝箔极耳焊接在下一个并联好的电池单元正极集流片的铝片 22 的焊接槽 23 上。使得电池模块中并联后的电池单元首尾连接形成 Z 字型。

[0048] 电池模块 1 的末端均设置固定框 12，将电池单元夹持在两个固定框 12 的中间，同时在固定框 12 之间设置套设在电池单元上的缓冲环 14，固定框 12 上设置夹持电池单元极耳的阻挡部分。

[0049] 此实施例的优点在于保证较高的能量密度情况下，设计的缓冲结构使得电池组具备一定的防震和抗冲击能力。

[0050] 实施例 3

如图 1 至图 8 所示，本实施例提供一种电池模块 1，包括电池单元 11、集流片 2 和电池箱，盖板将电池箱的开口密封，箱体 34 的外壁上设置数根纵向加强筋 33，箱体 34 和盖板 35 之间设置缓冲环 14 和密封片 16，电池单元 11 设置正极极耳及负极极耳，正极极耳及负极极耳分别位于电池单元 11 的相对两端，电池单元 11 的正极极耳为铝箔极耳，负极极耳为铜箔极耳，集流片 2 为组合式集流片，集流片 2 由铝片 22 和铜片 21 组合而成，铝片 22 和铜片 21 之间铆接固定，铝片 22 和铜片 21 上分别设置焊接槽 23；箱体 34 的外表面设置切口深度为箱体 34 壁厚度的 20% 的 U 型槽 37；箱体 34 上设置与盖板 35 连接的柔性连接条 36；电池单元 1 的长宽比为 4:1。

[0051] 在组装电池模块 1 的过程中，首先将三个同样的电池单元 11 并联连接，把需要并联的电池单元 11 的铝箔极耳焊接在铝片 22 的焊接槽 23 上，将铜箔极耳焊接在铜片 21 的焊接槽 23 上。然后再将并联好的电池单元的铜箔极耳焊接在上一个并联好的电池单元正极集流片的铜片 21 的焊接槽 23 上，铝箔极耳焊接在下一个并联好的电池单元正极集流片的铝片 22 的焊接槽 23 上。使得电池模块中并联后的电池单元首尾连接形成 Z 字型；相邻电池单元 11 之间设置表面积大于电池单元 11 的铝制隔片，隔片上设置条形凹凸纹。

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[0052] 电池模块 1 的末端均设置固定框 12，将电池单元夹持在两个固定框 12 的中间，同时在固定框 12 之间设置套设在电池单元上的缓冲环 14，固定框 12 上设置夹持电池单元极耳的阻挡部分；固定框之间设置缓冲环，缓冲环套设在电池单元上，电池模块的两个端面分别设置缓冲垫。

[0053] 电池模块 1 上还设置温度传感器 15，温度传感器 15 设置在电池模块 1 的极耳处，当电池组发生异常时，温度传感器 15 可以监测到电池单元的温度参数变化。电池模块 1 两端极耳的位置设置线束部件 13，线束部件 13 上设置线束通道 132，从电池模块 1 上引出的采样线束从线束通道 132 内穿过。

[0054] 此实施例的优点在于保证较高的能量密度情况下，同时可以提供对电池模块温度的检测，更有利于提高电池模块的安全性能。

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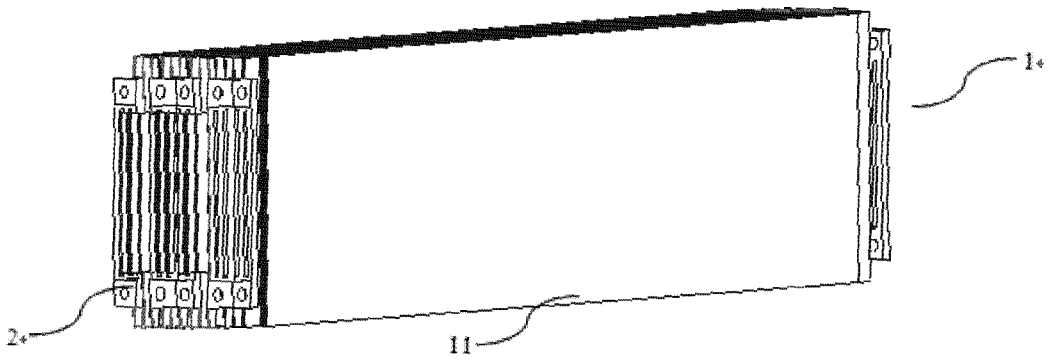


图 1

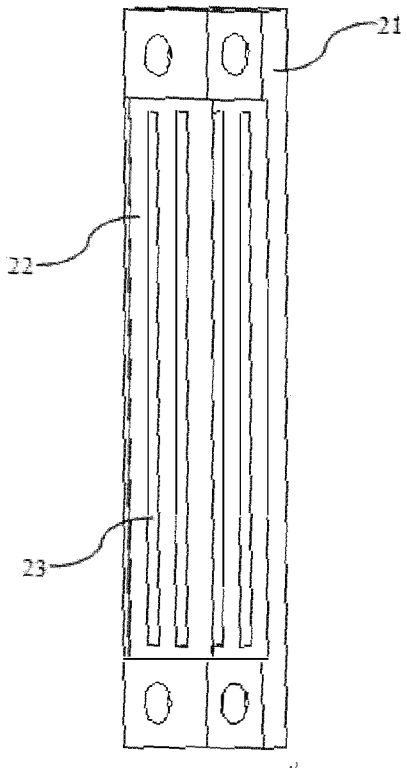


图 2

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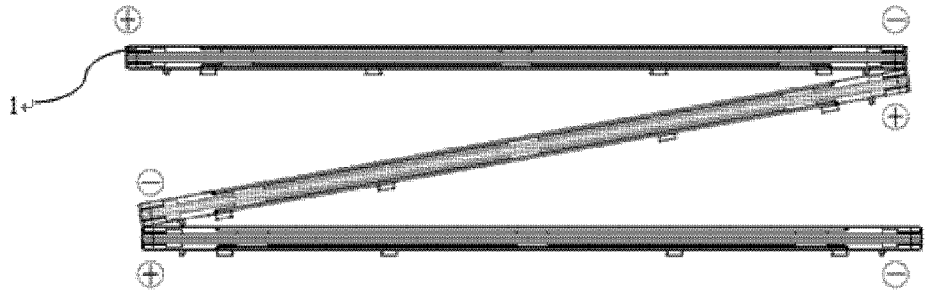


图 3

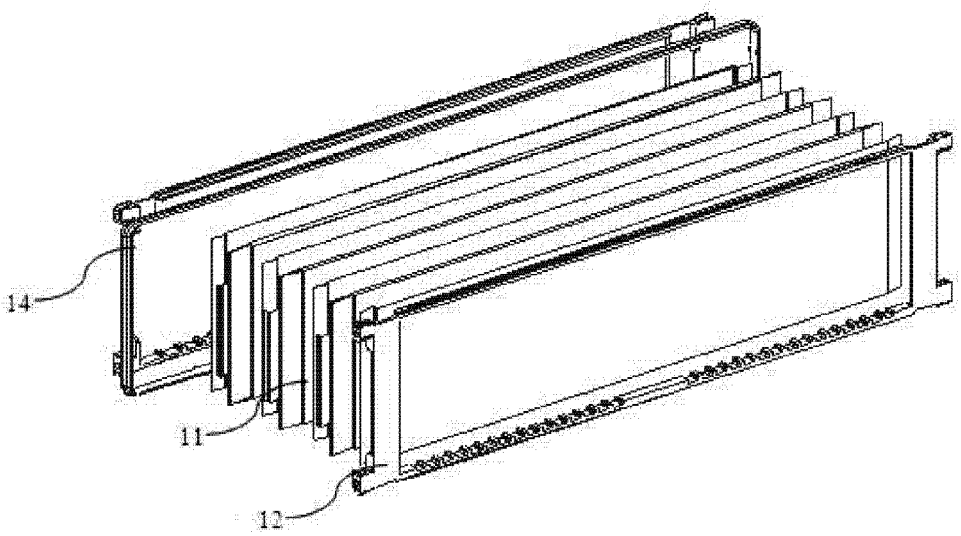


图 4

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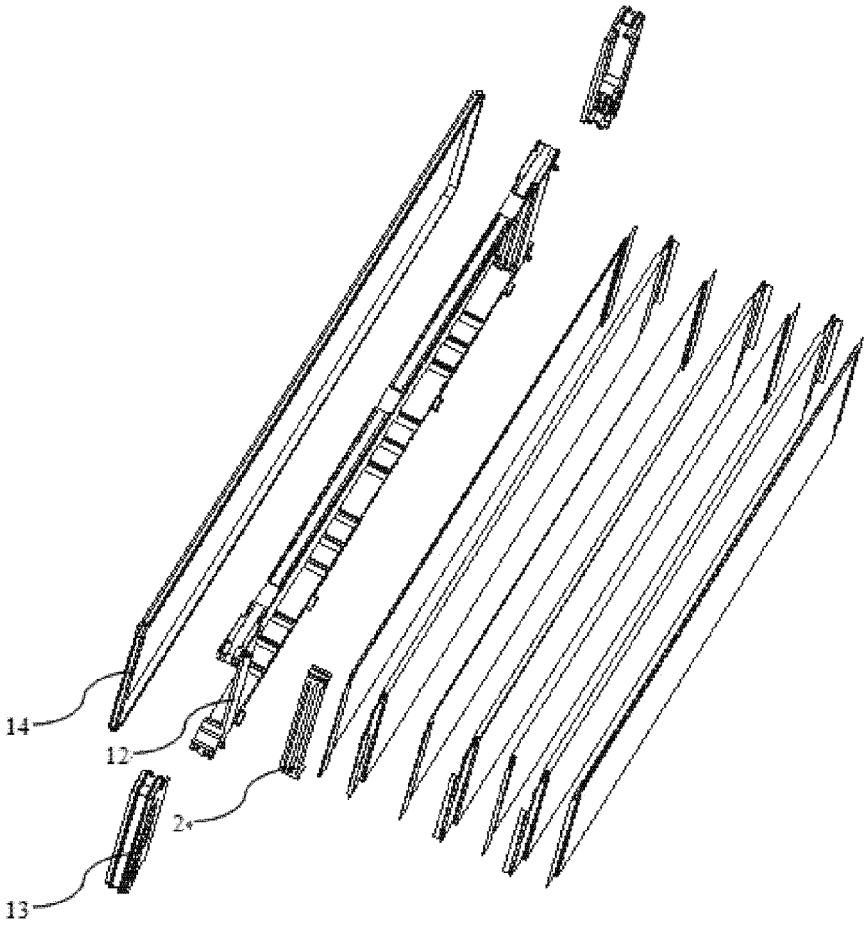


图 5

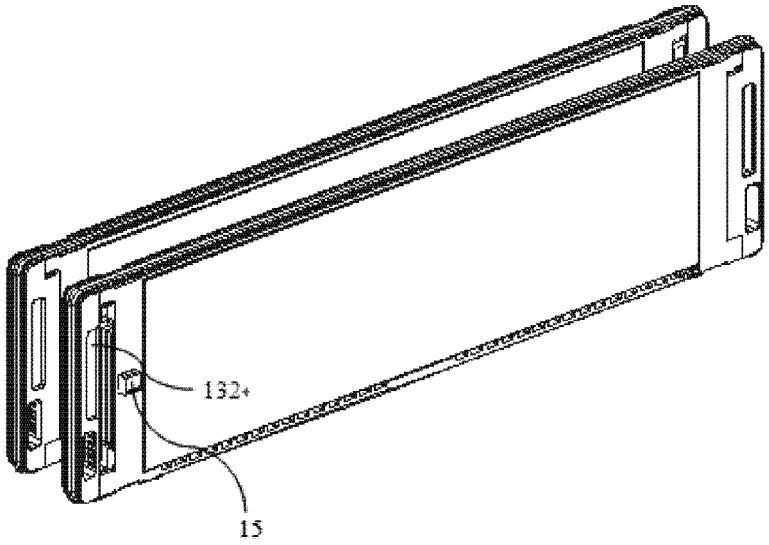


图 6

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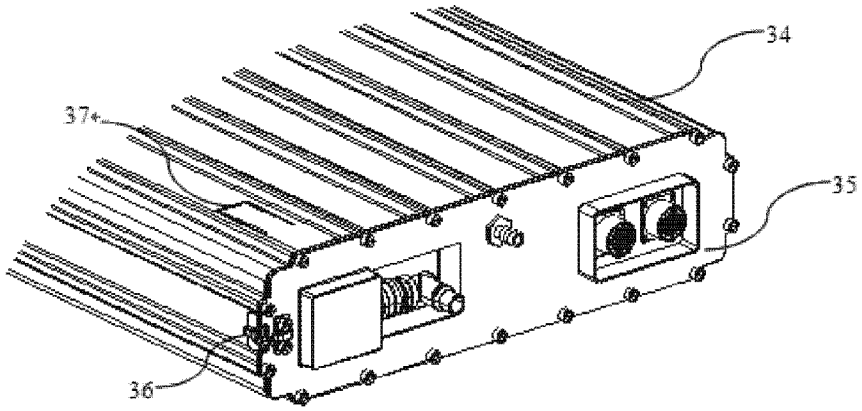


图 7

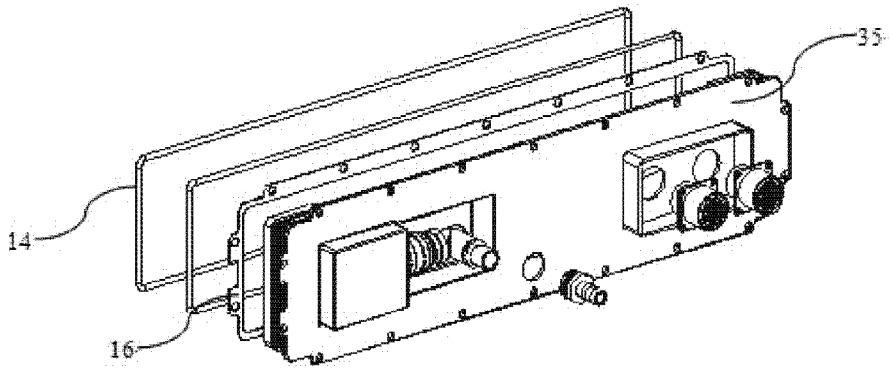


图 8

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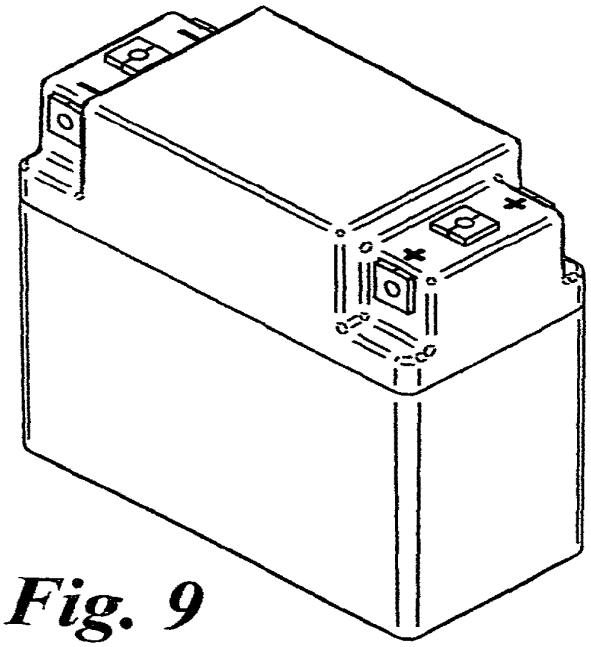


Fig. 9

(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

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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

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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.

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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

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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

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

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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

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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:

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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

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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.

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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.

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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.

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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.

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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.

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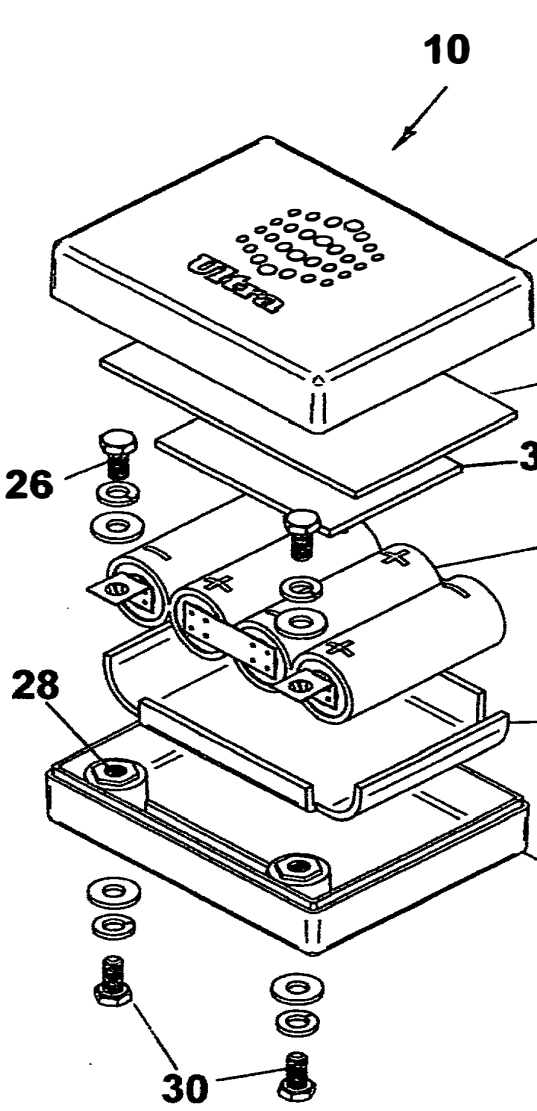


Fig. 1

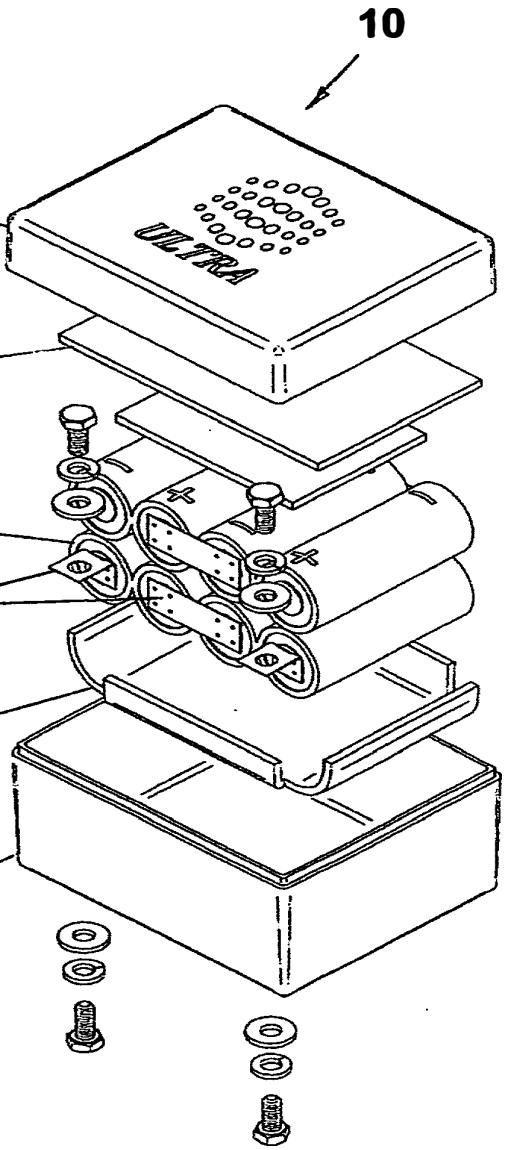


Fig. 2

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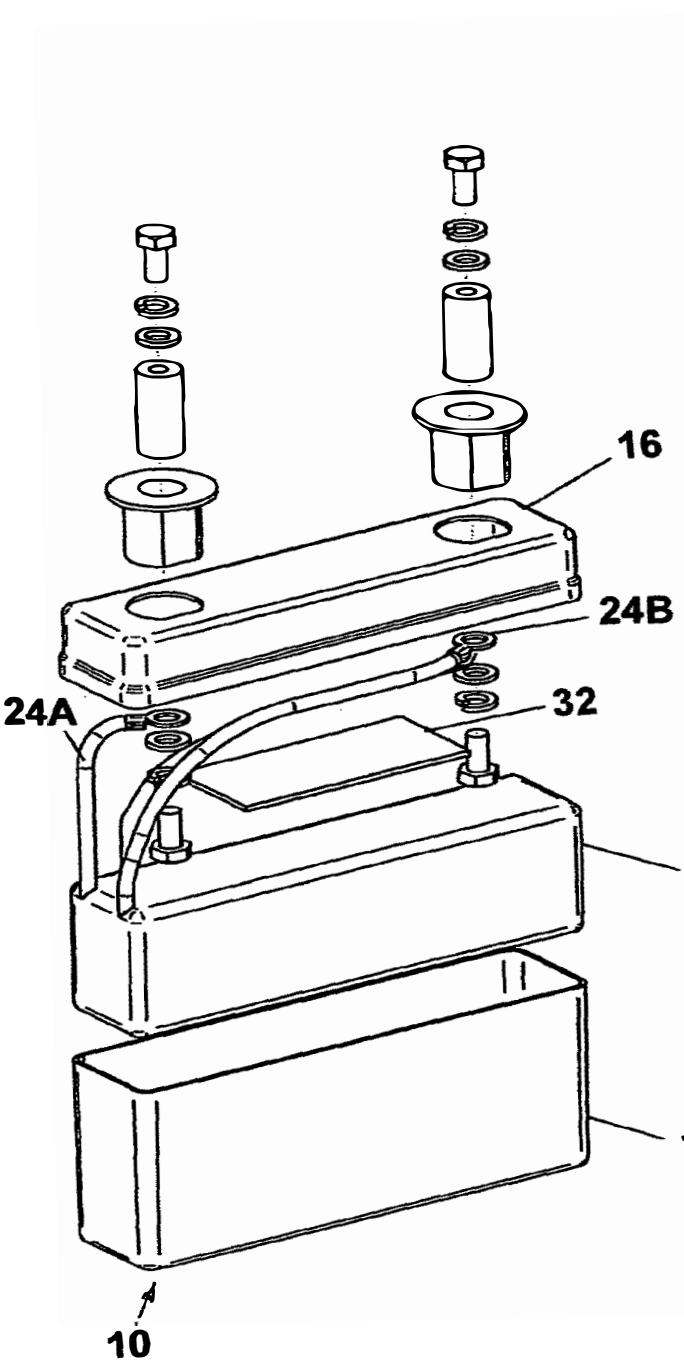


Fig. 3

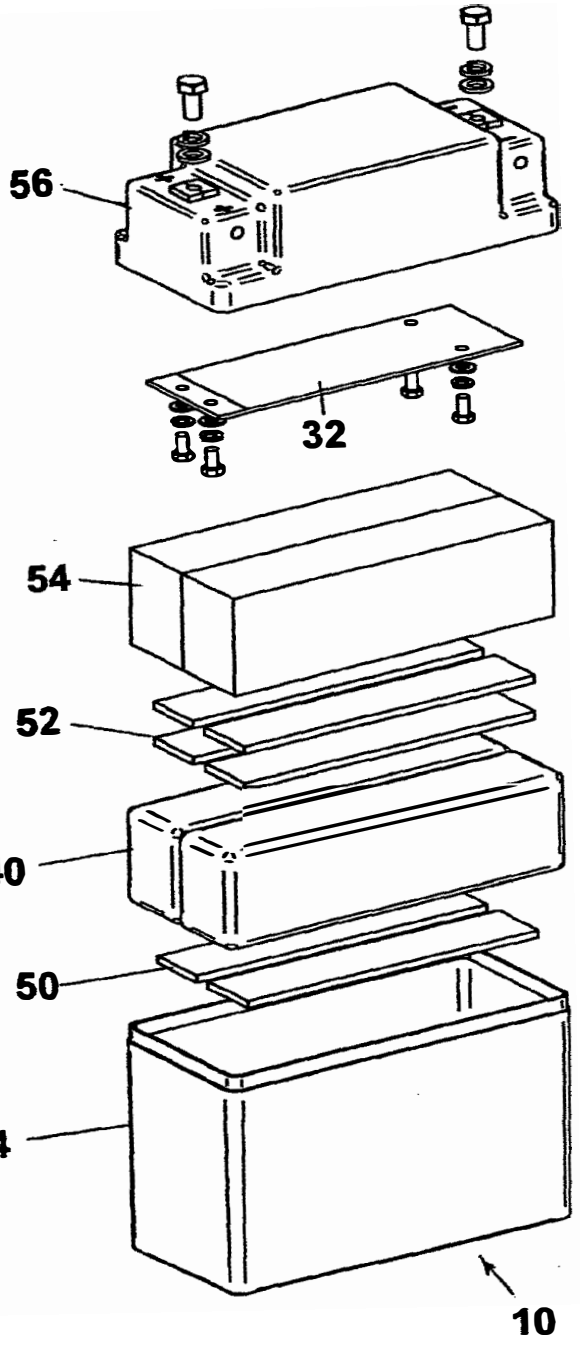


Fig. 13

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Fig. 5

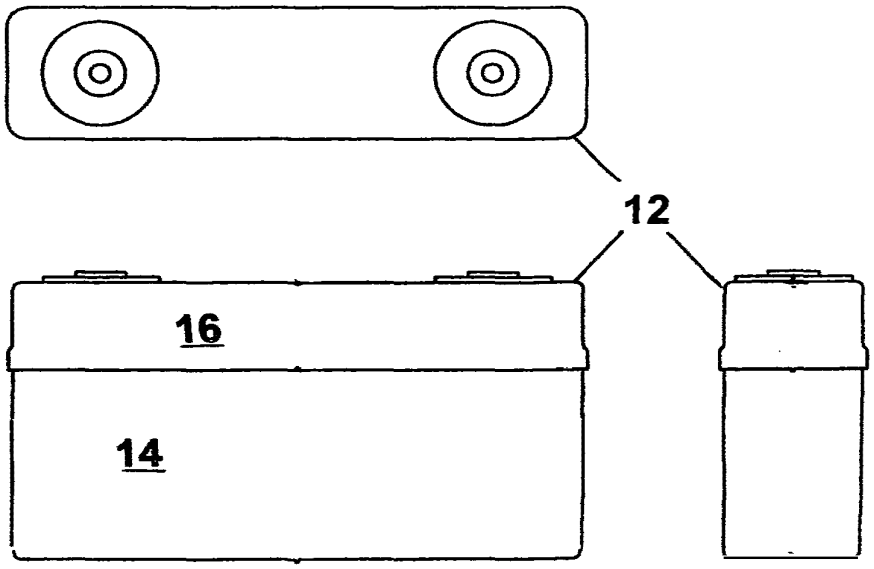


Fig. 4

Fig. 6

Fig. 7

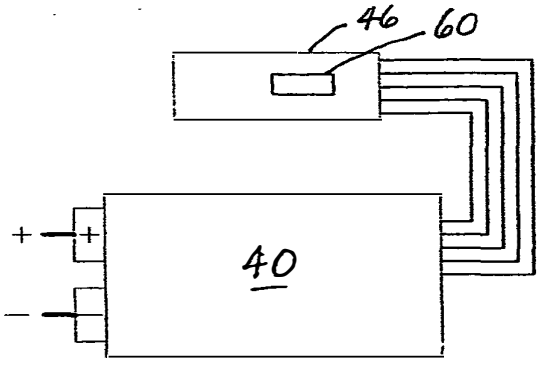


Fig. 8

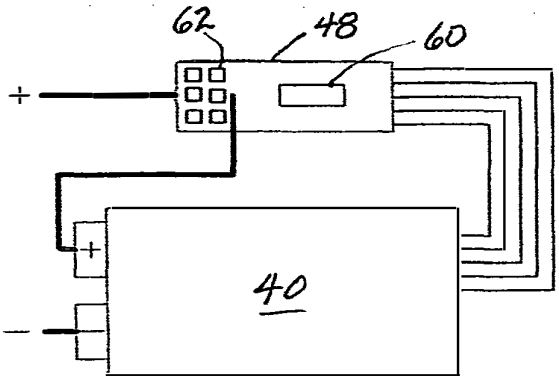


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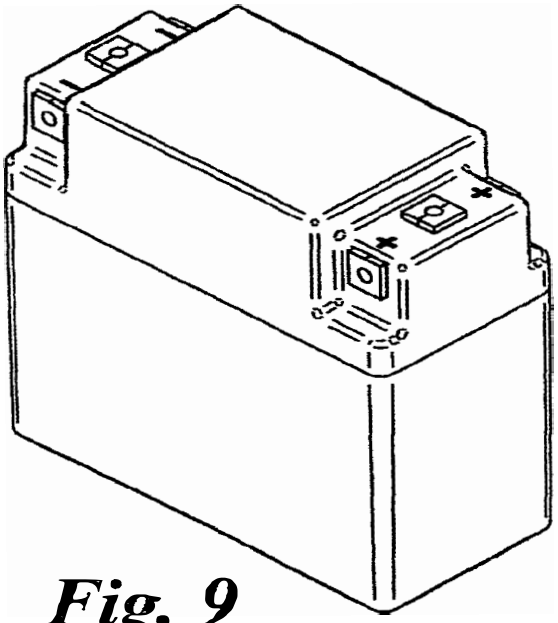


Fig. 9

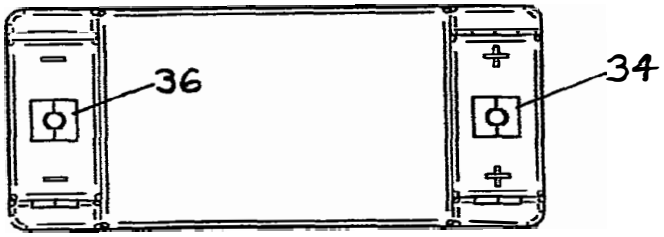


Fig. 10

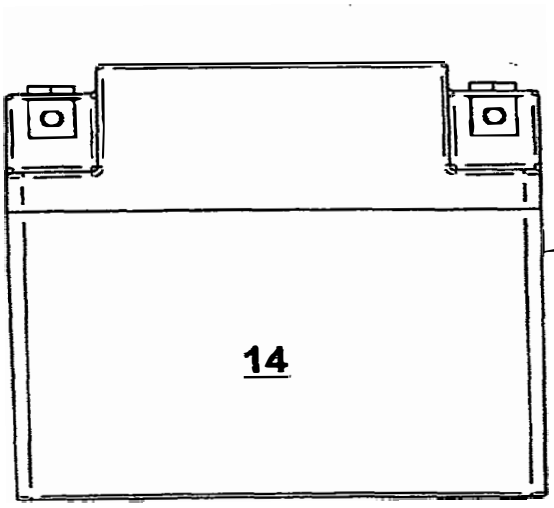


Fig. 11

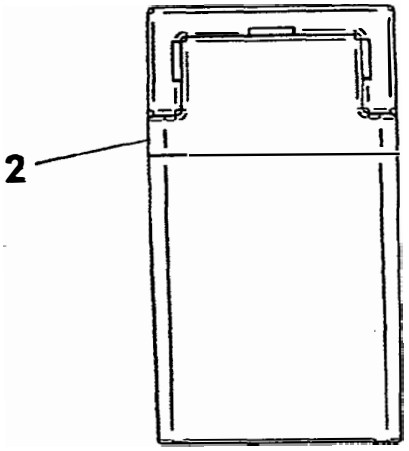


Fig. 12

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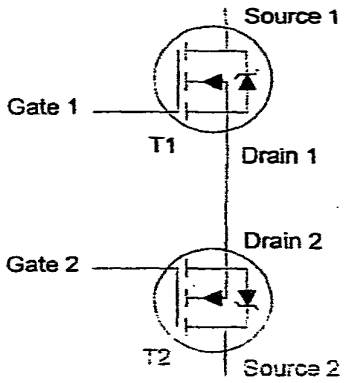


Fig. 14

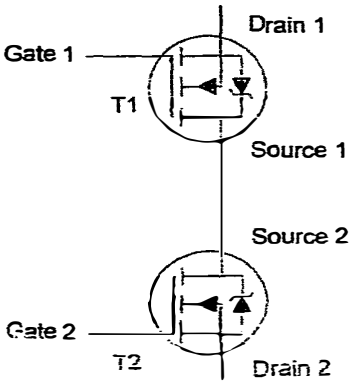


Fig. 15

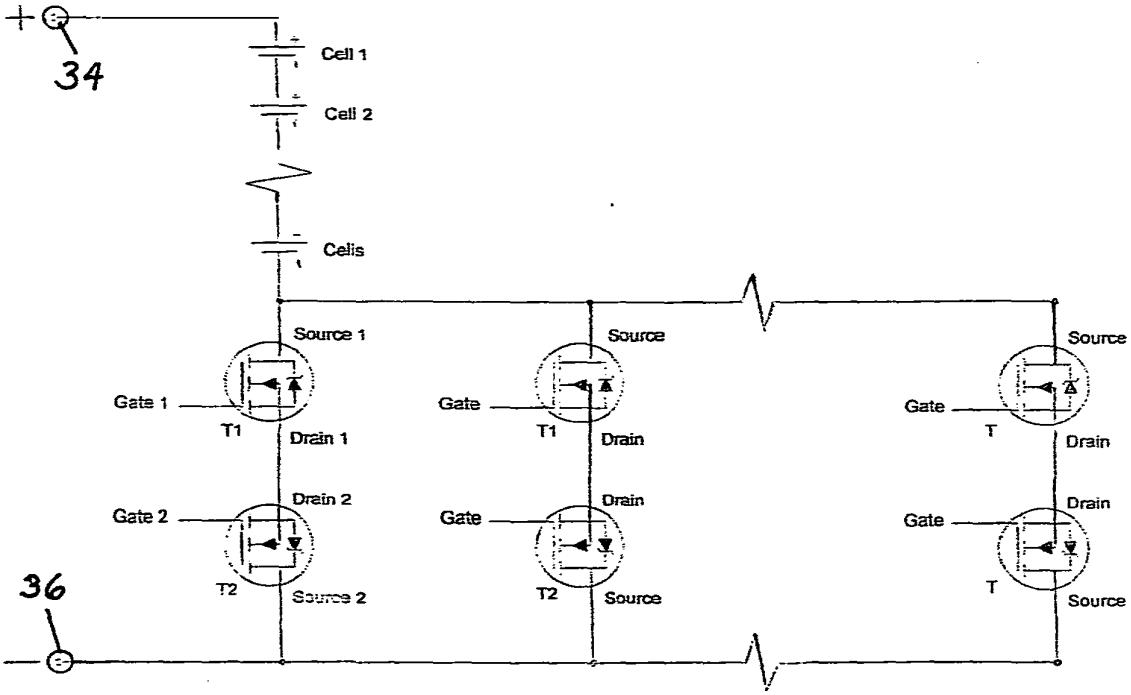


Fig. 16

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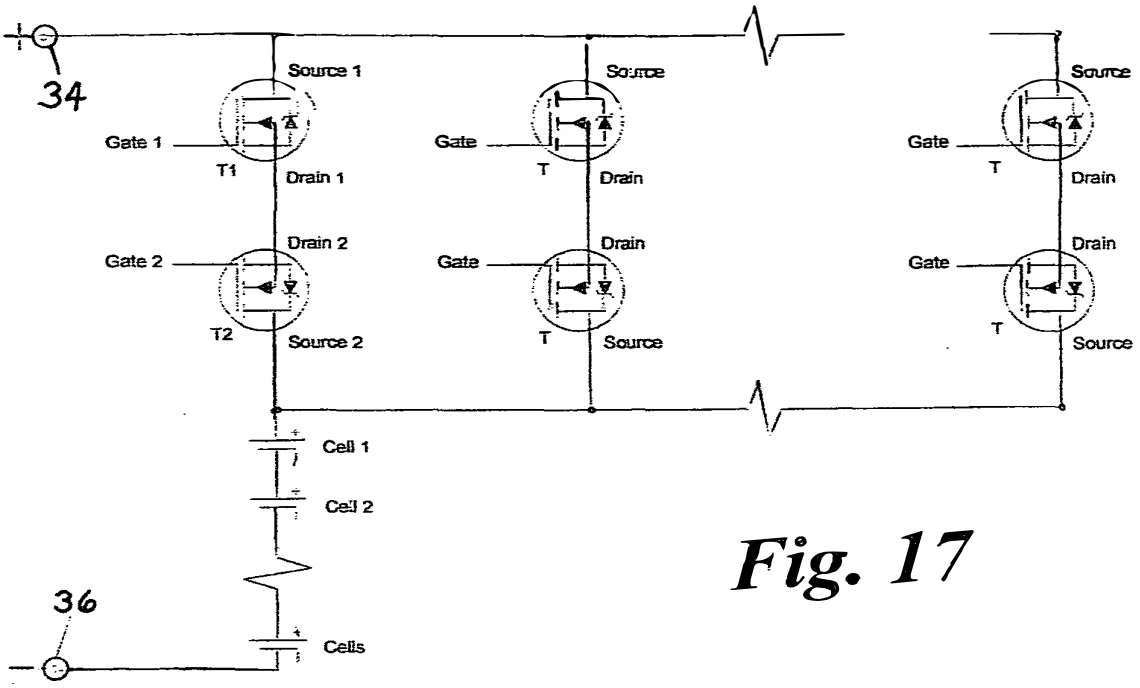


Fig. 17

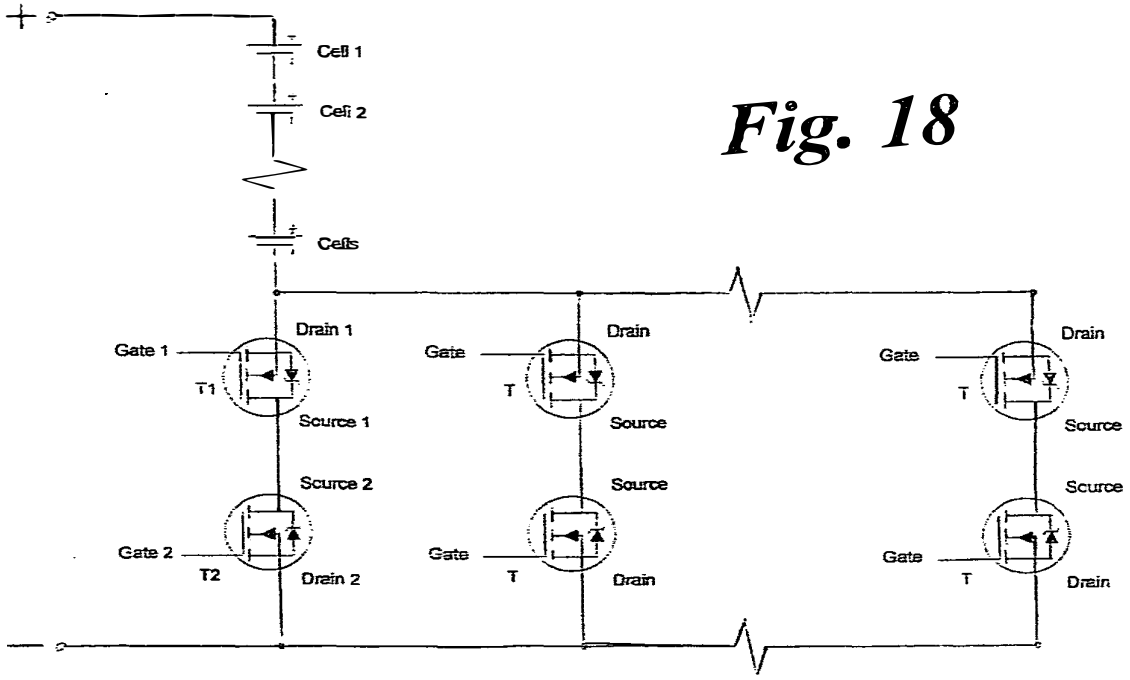


Fig. 18

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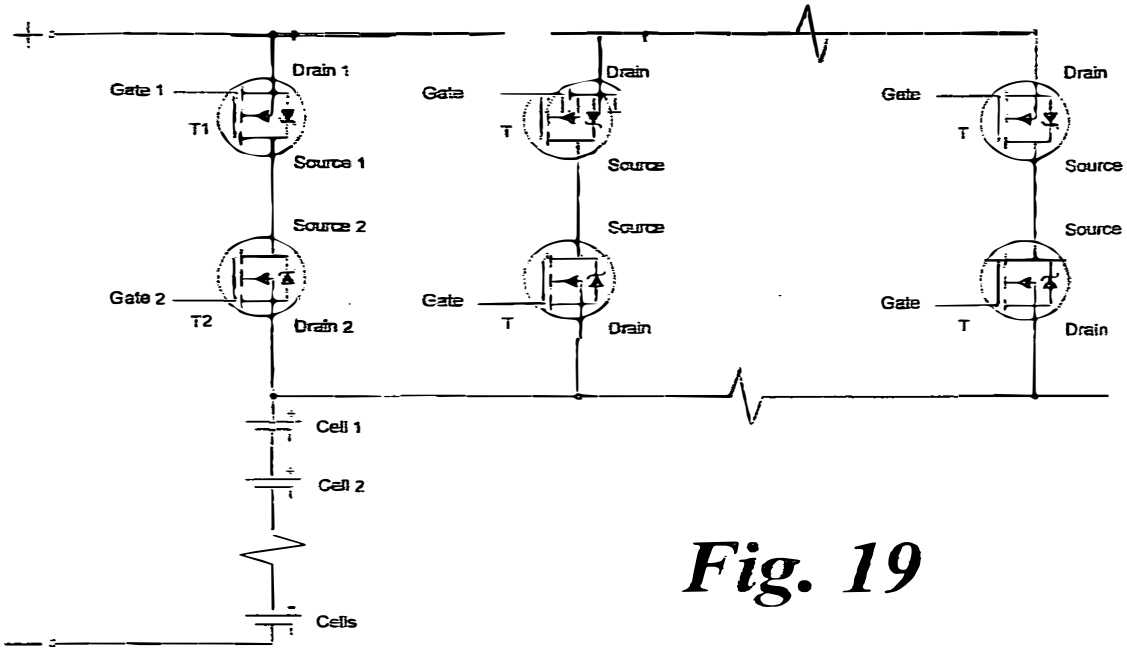


Fig. 19

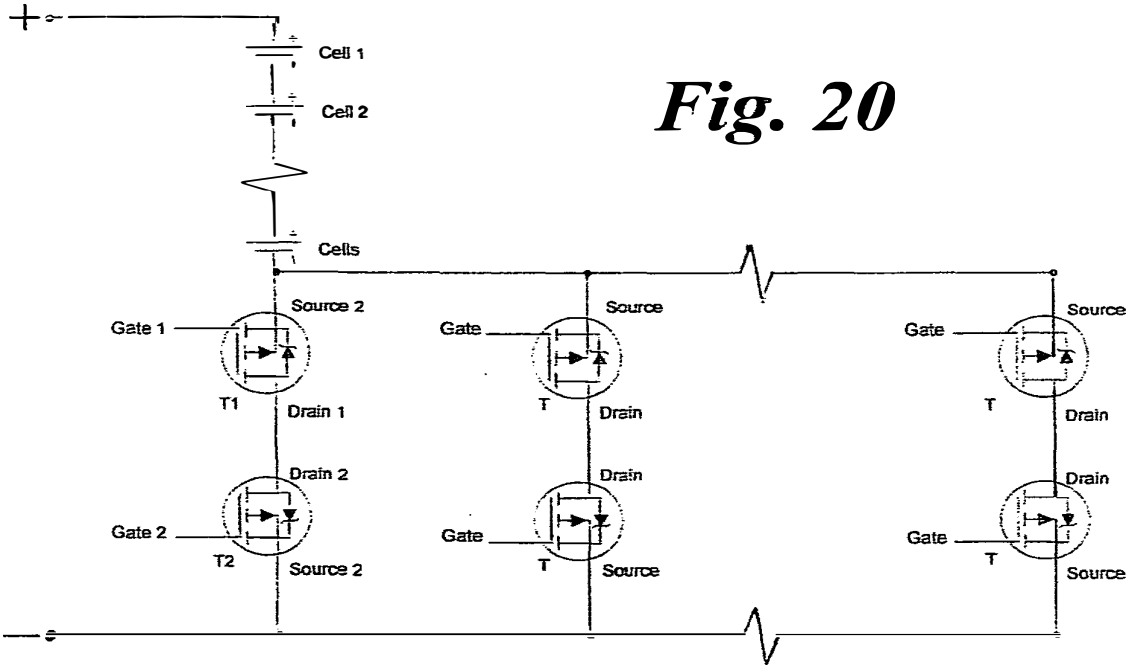


Fig. 20

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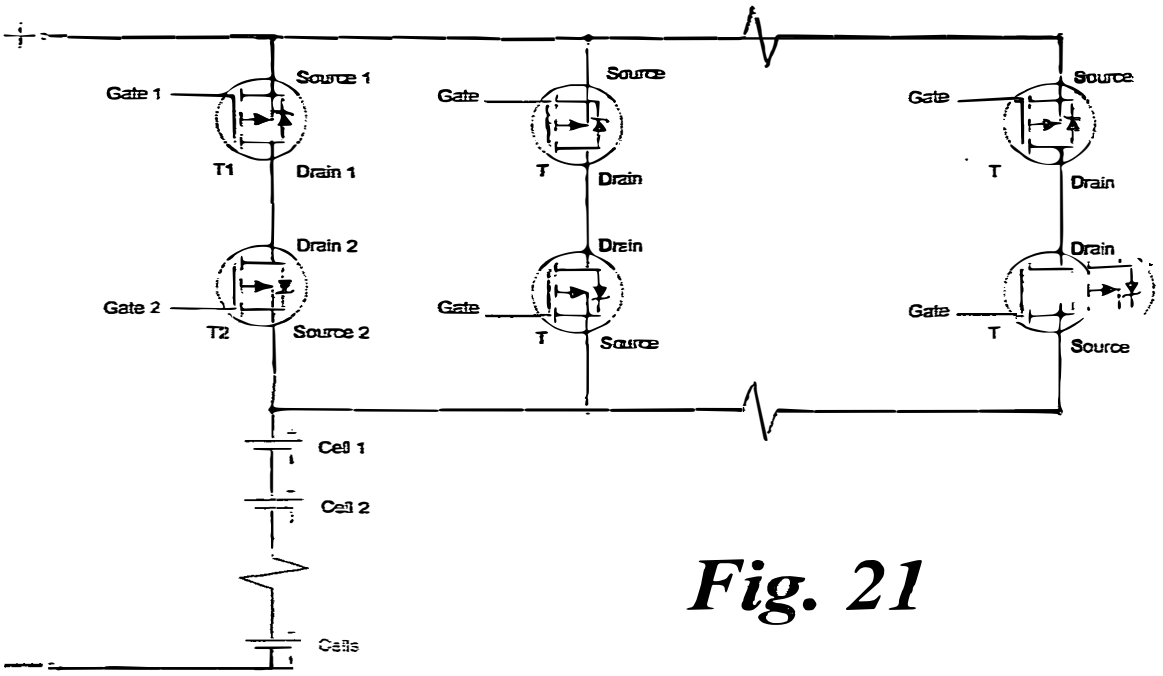


Fig. 21

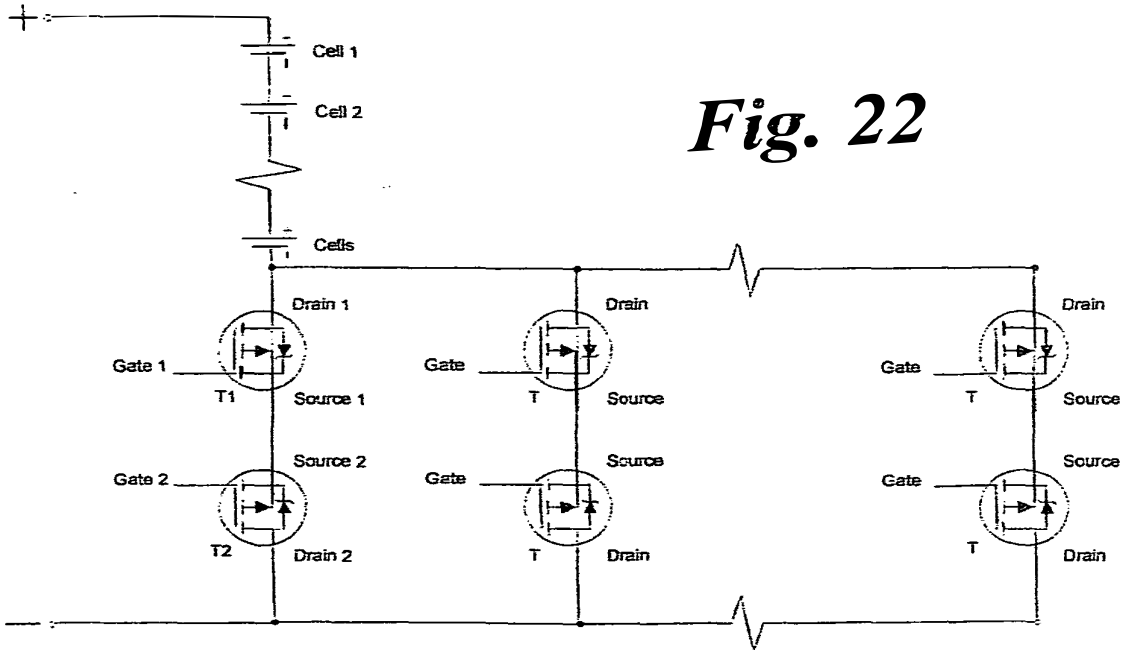


Fig. 22

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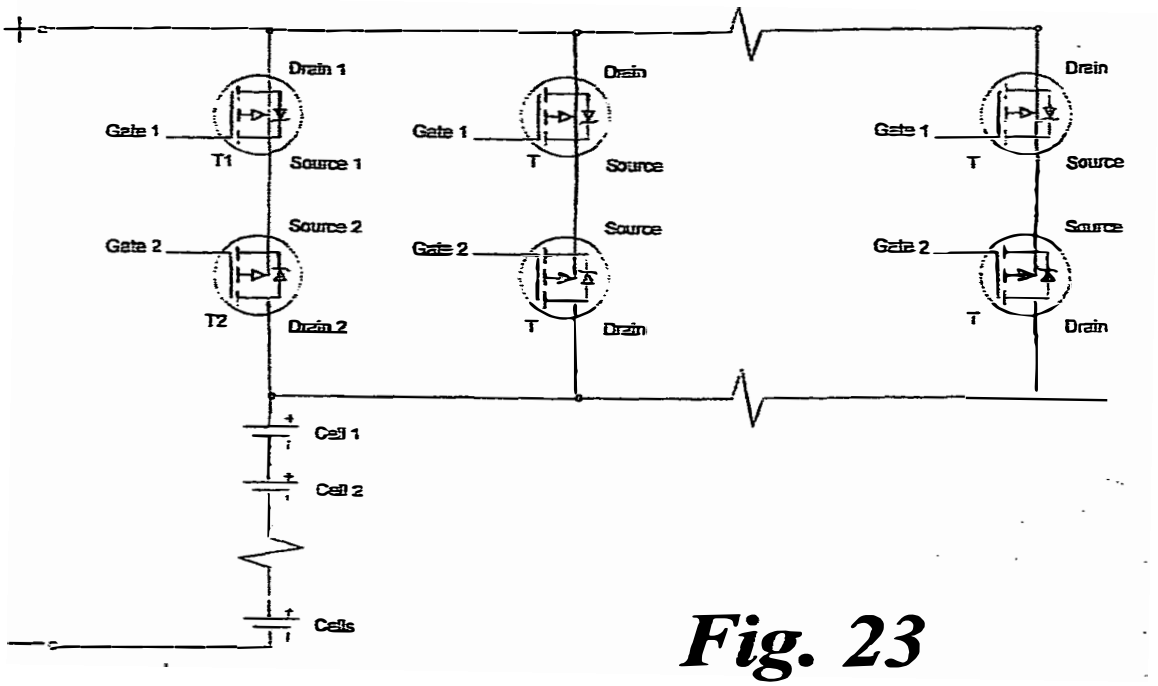

Drain 1
Gate 1
T1
Source 1
Source 2
Gate 2
T2
Drain 2
Drain
Gate 1
T
Source
Source
Gate 2
T
Drain
Drain
Gate 1
T
Source
Source
Gate 2
T
Drain
Cell 1
Cell 2
Cells

Fig. 23

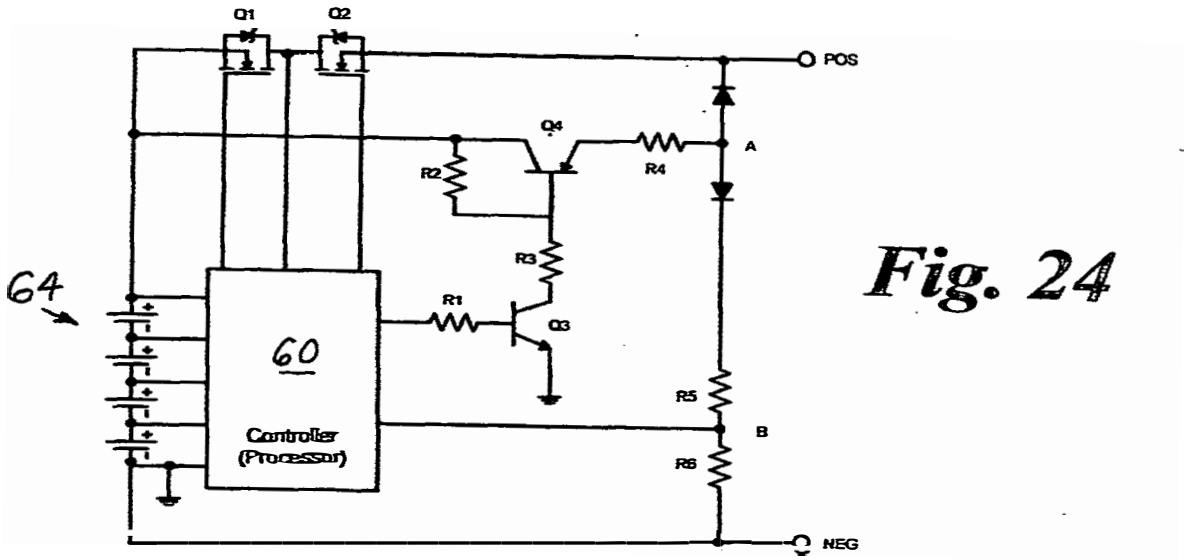

Q1
Q2
POS
Q4
R2
R4
A
R3
R1
Q3
64
60
Controller
(Processor)
R5
B
R6
NEG

Fig. 24

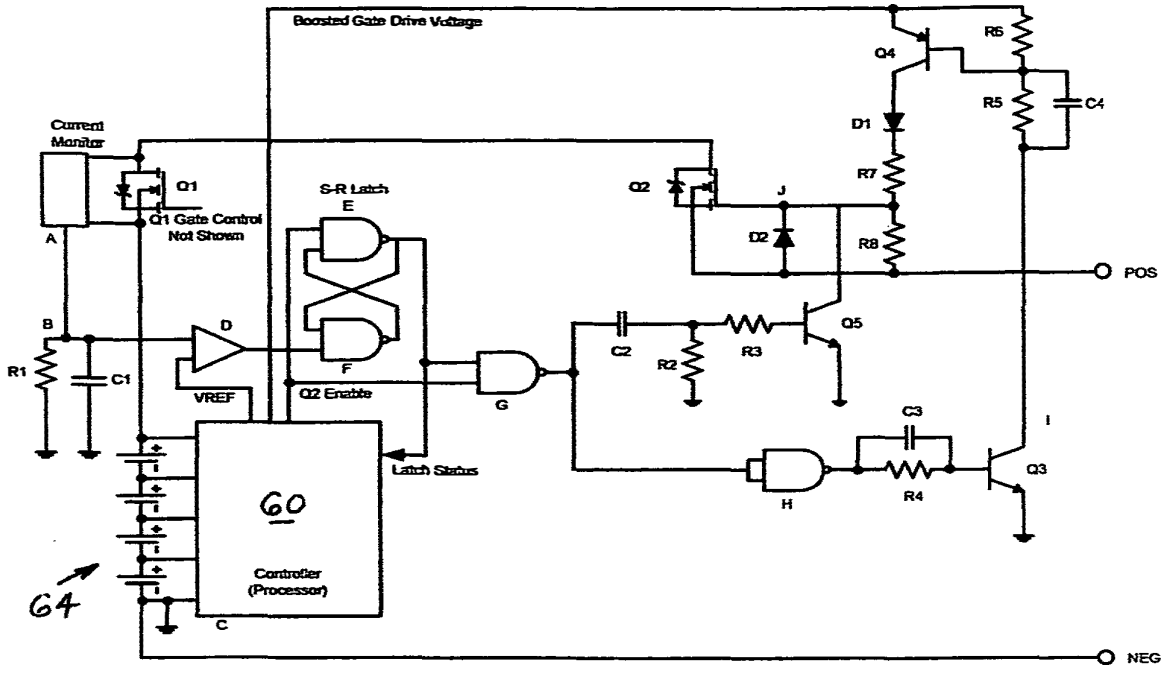


Fig. 25

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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
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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
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"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
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"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	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(54) Title: A JUMP STARTER

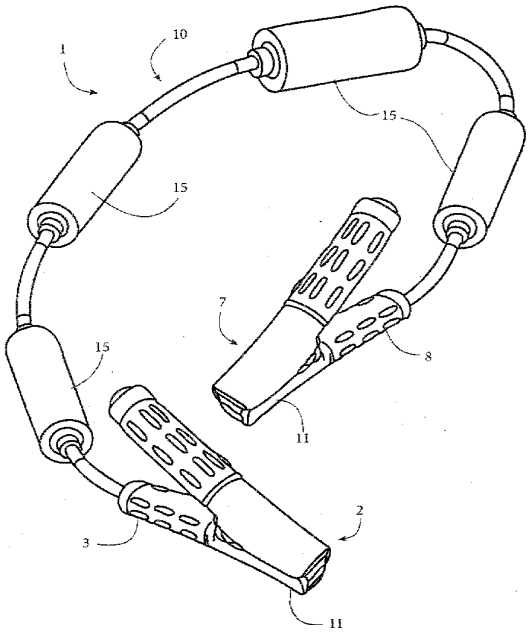


Fig.1

(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.

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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:

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"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

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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.

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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.

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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;

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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

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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

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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

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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.

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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

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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.

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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.

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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.

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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.

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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.

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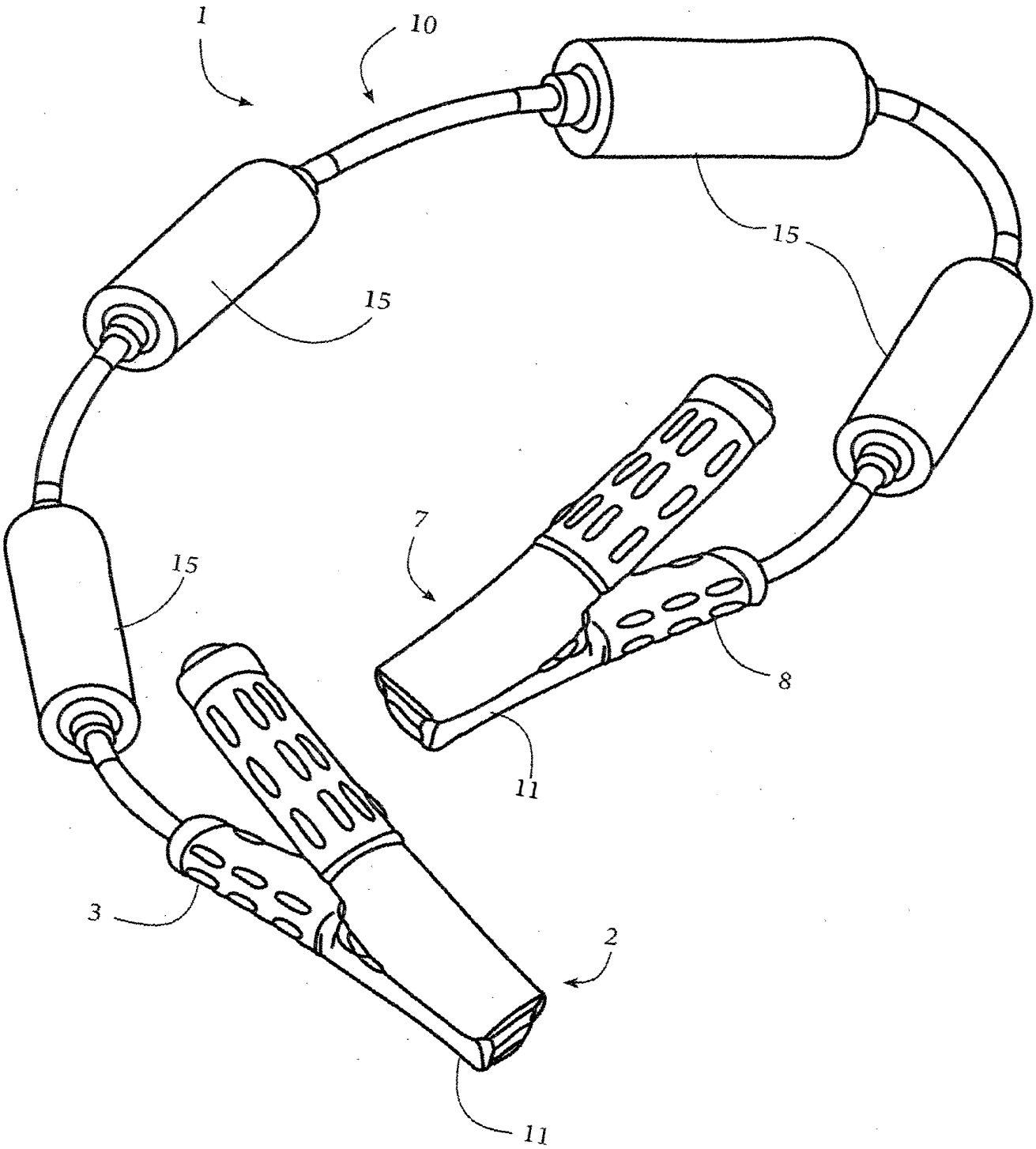


Fig.1

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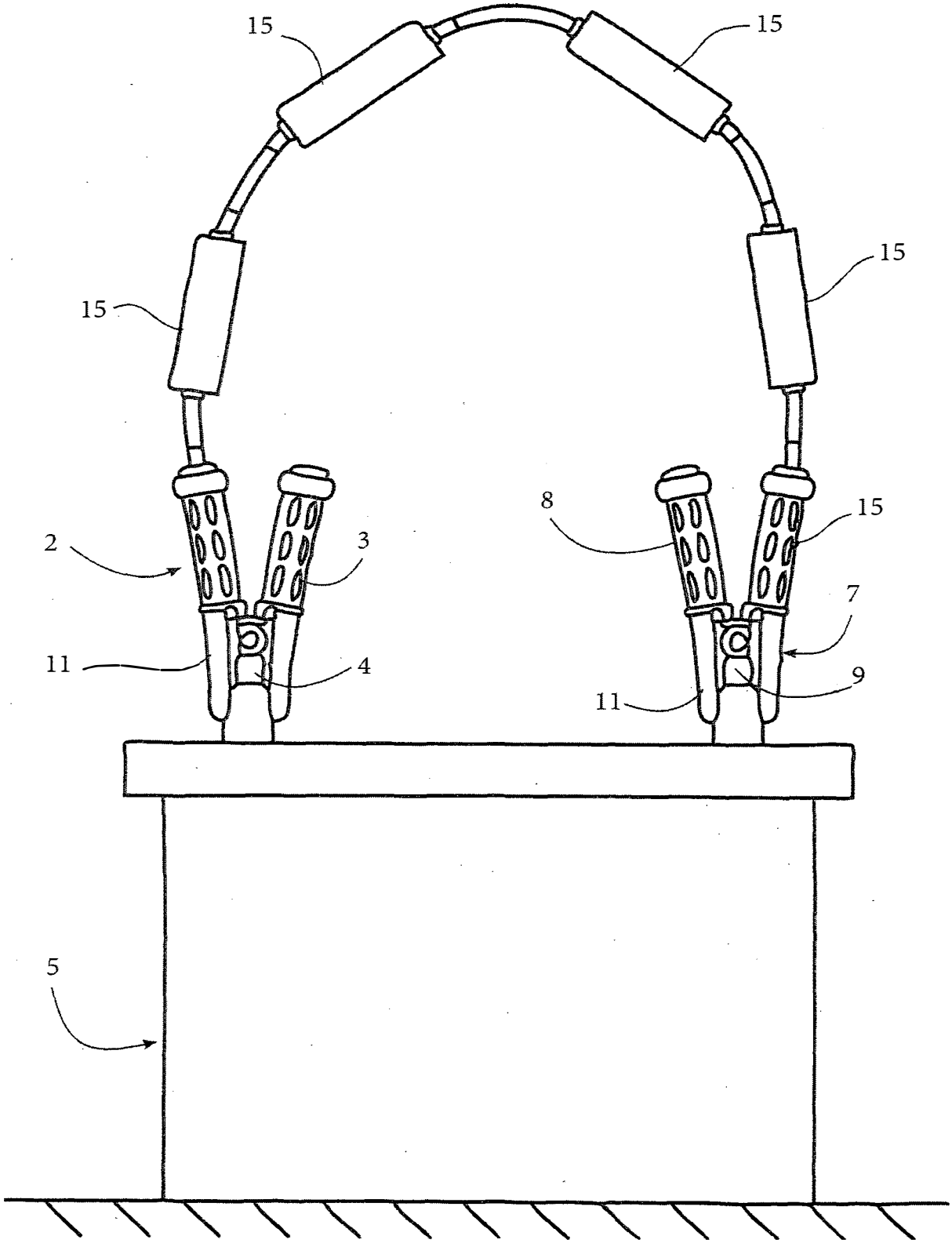


Fig.2

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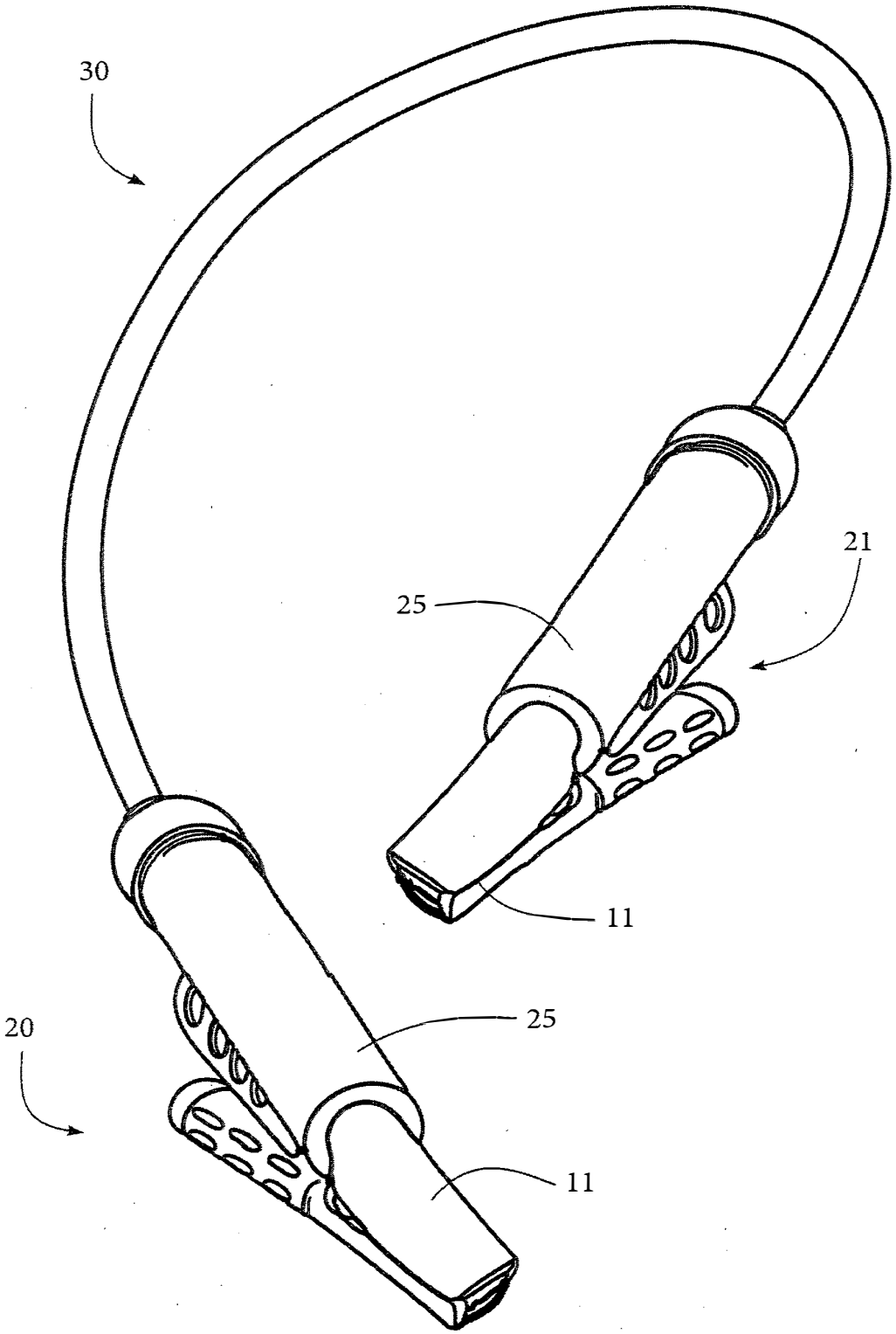


Fig.3

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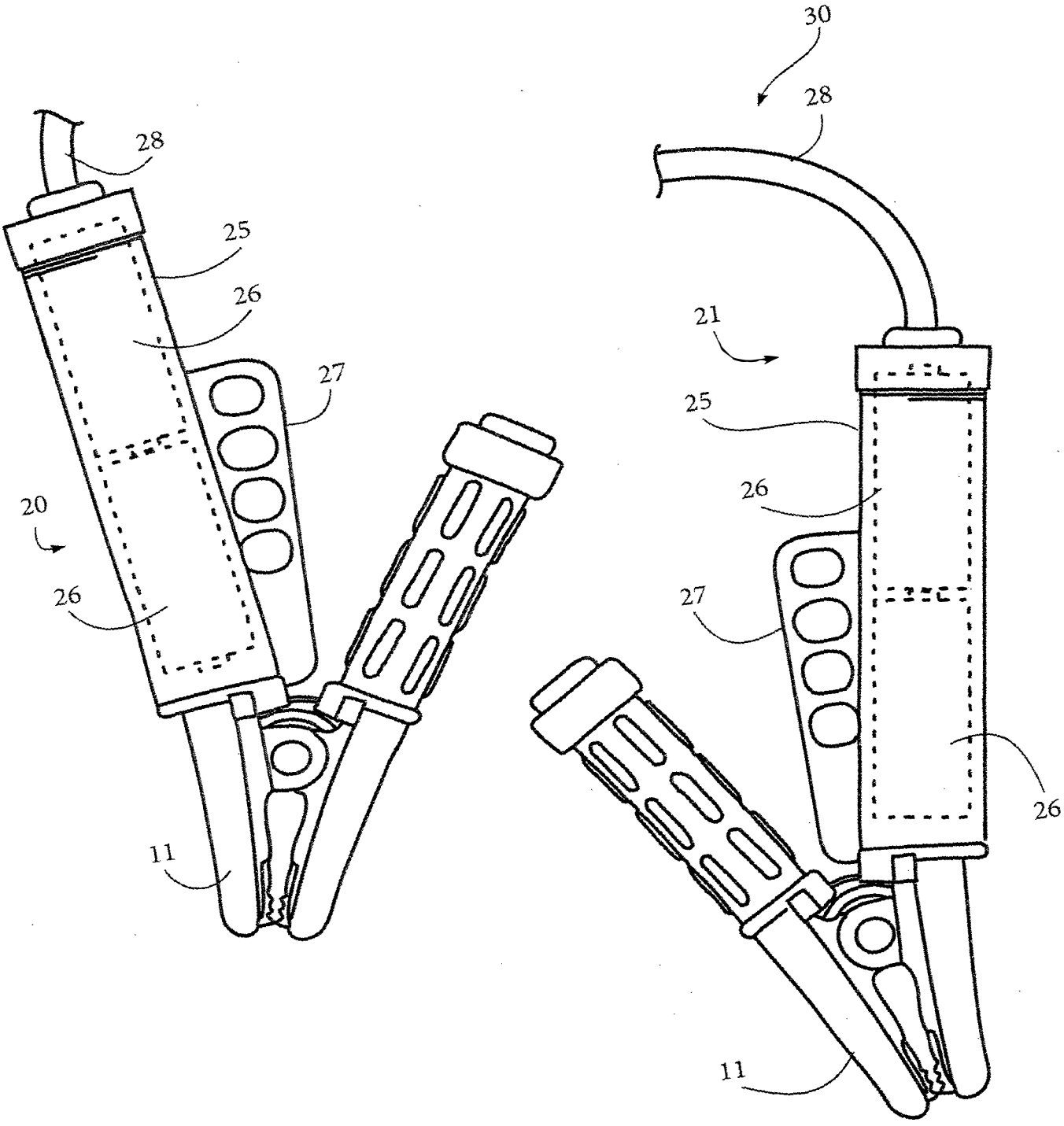


Fig.4

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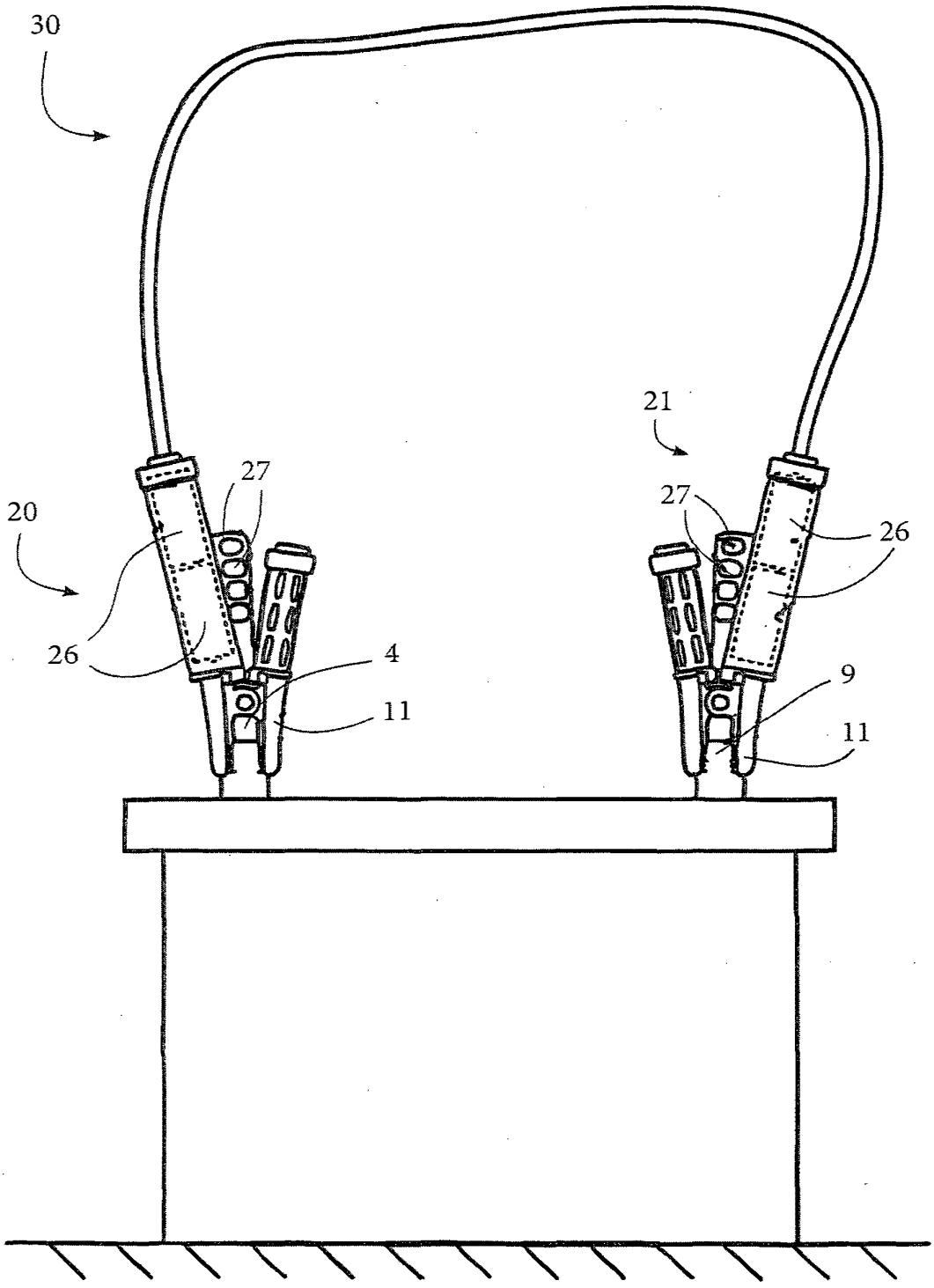


Fig.5

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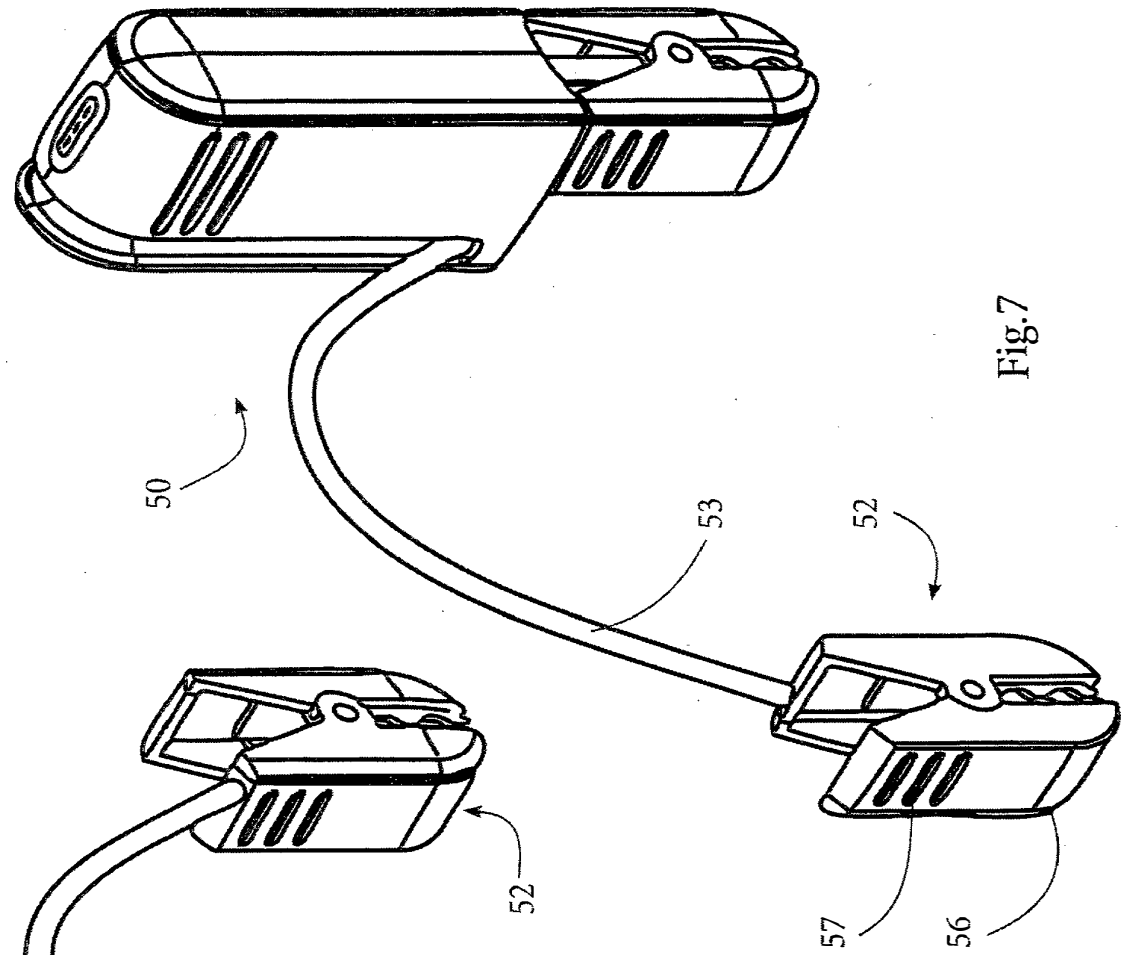


Fig.7

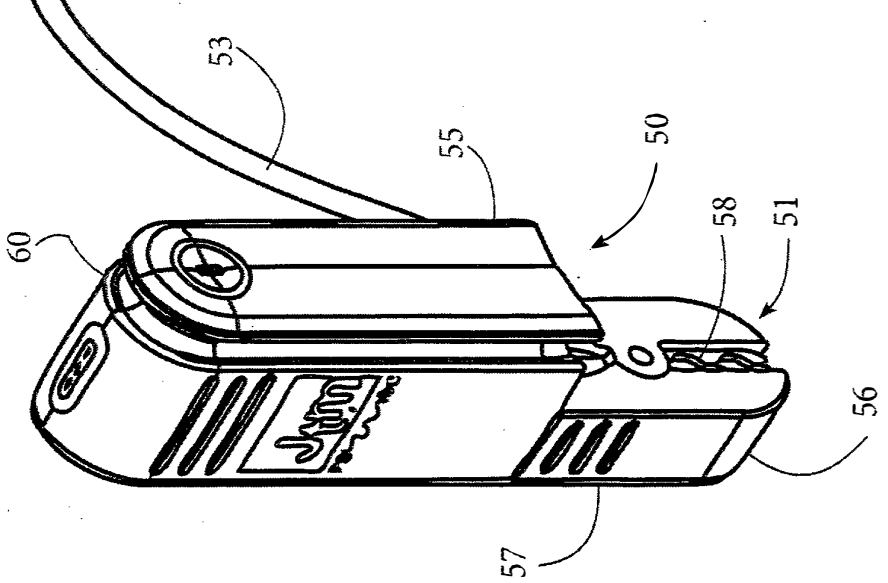


Fig.6

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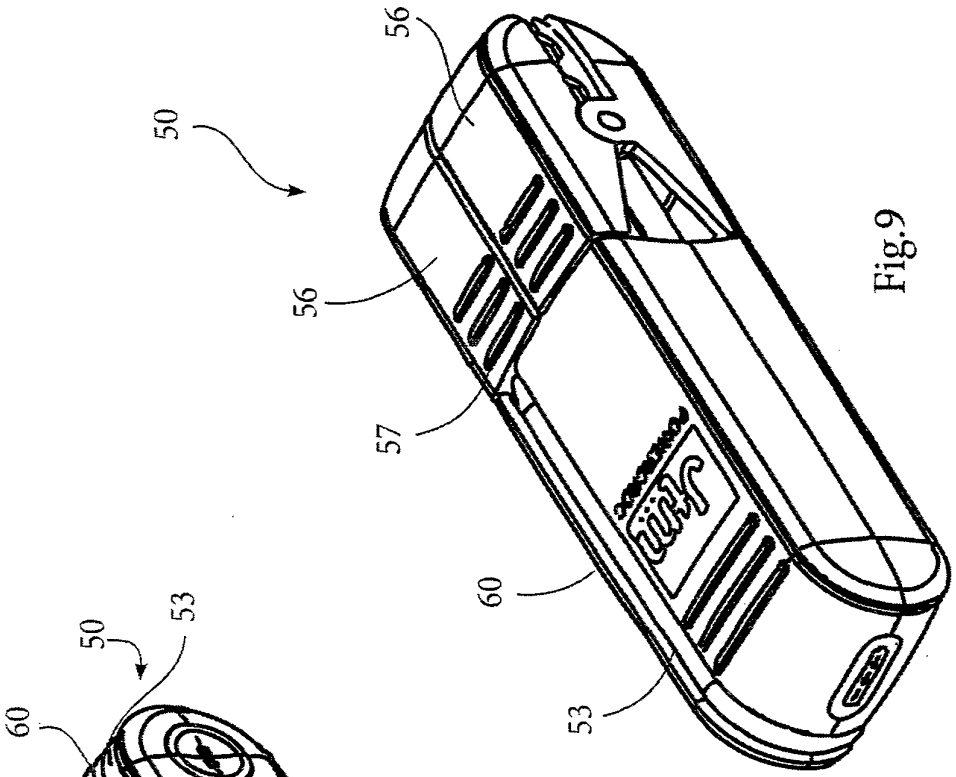


Fig.9

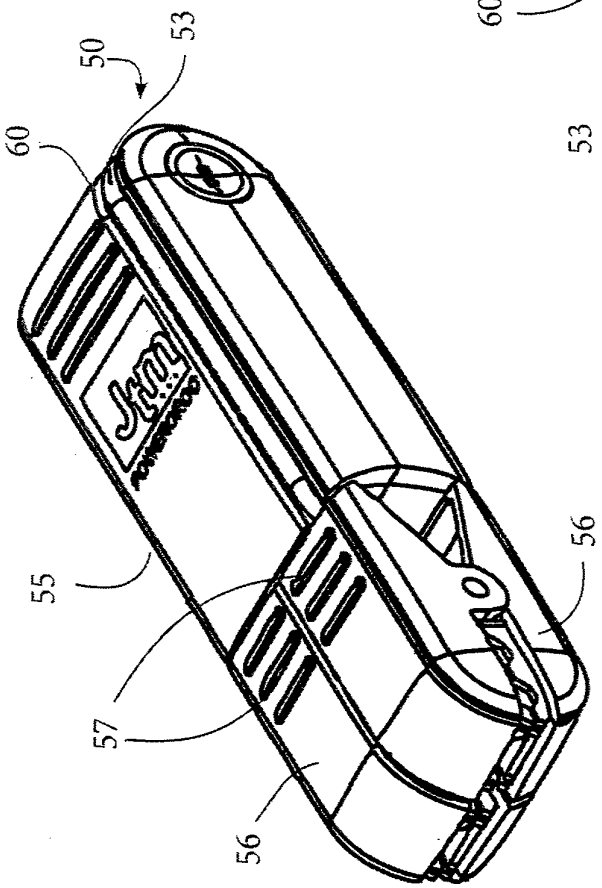


Fig.8

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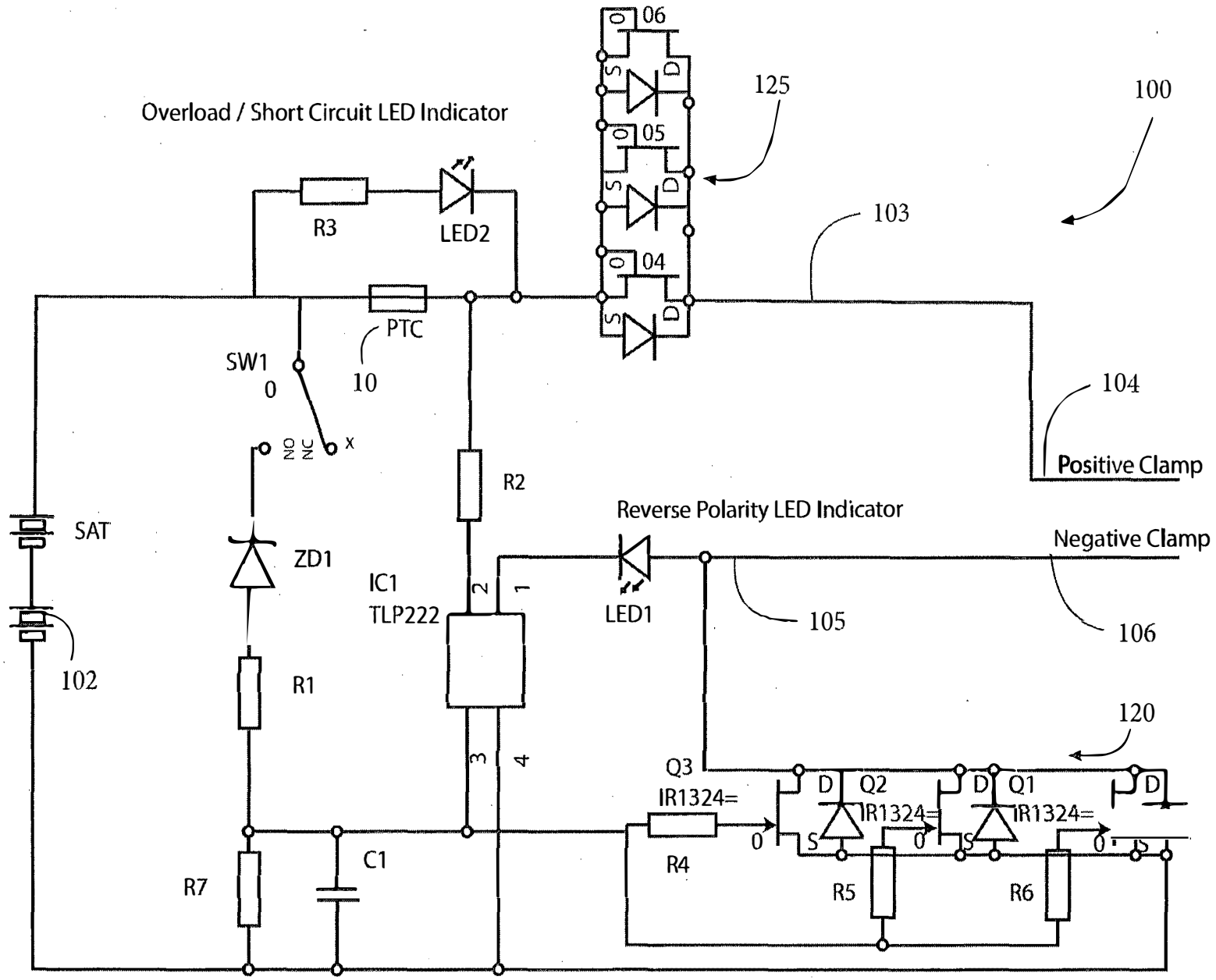


Fig.10

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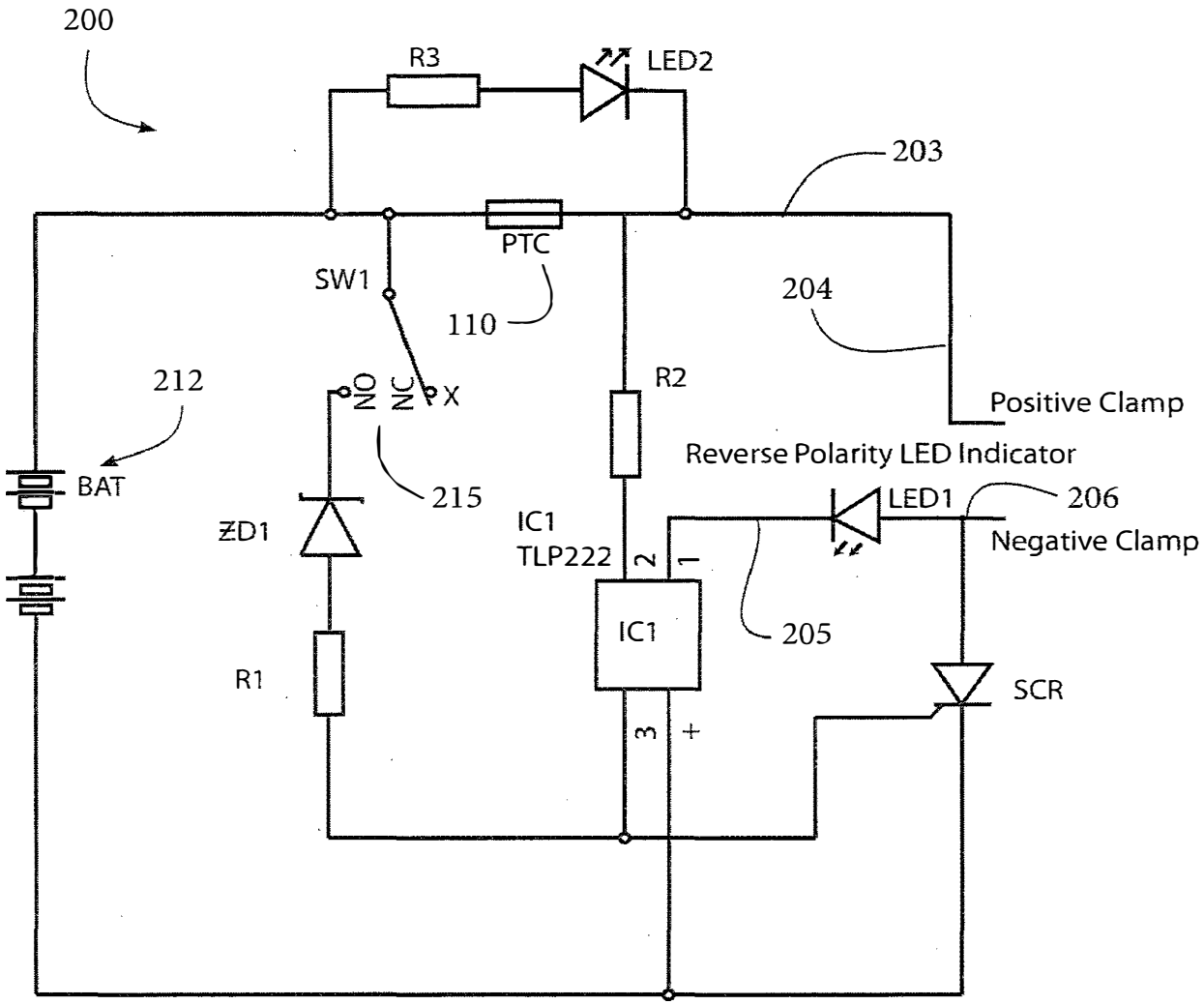


Fig.11

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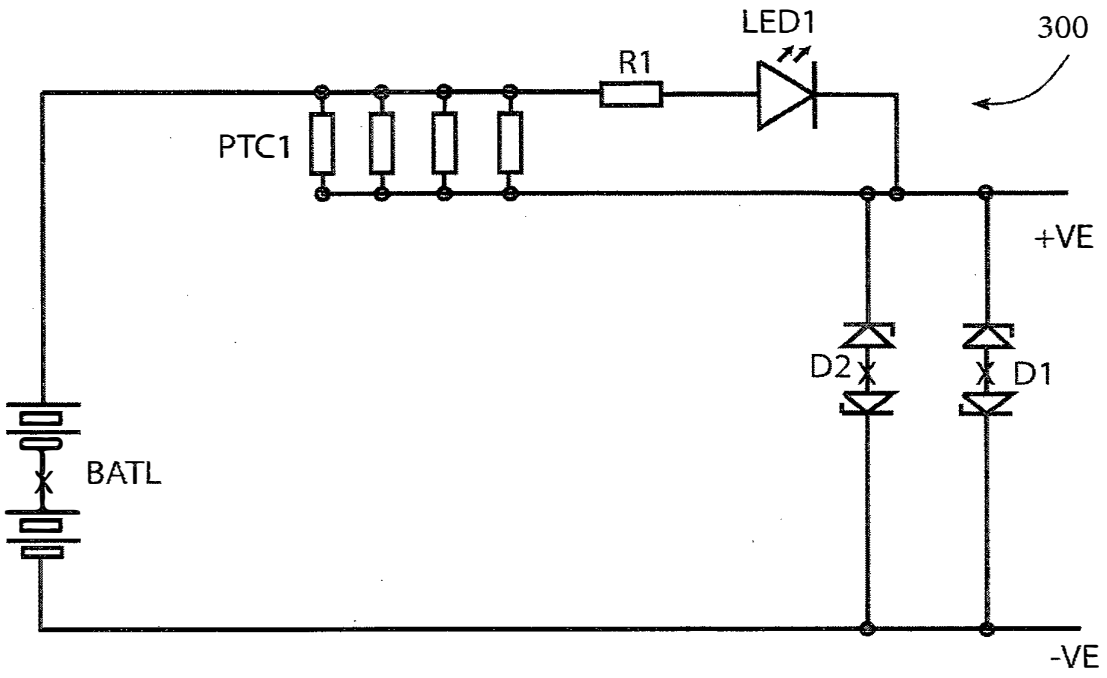


Fig.12

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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

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[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

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"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

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"&" 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

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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

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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
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US 5985481 A	16-11-1999	NONE	
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Espacenet

JP2001069673A POWER SUPPLY FOR VEHICLE

Applicants: HITACHI LTD

Inventors: SAITO HIROYUKI

Classifications:

IPC ***B60R16/02; B60R16/04; F02D45/00; F02N11/08; H02G3/16; H02J7/00;*** (IPC1-7): B60R16/02; F02D45/00; F02N11/08; H02G3/16; H02J7/00;

Priorities: JP24475299A 1999-08-31

Application: JP2001069673A·1999-08-31

Publication: JP2001069673A·2001-03-16

Published as: JP2001069673A

POWER SUPPLY FOR VEHICLE

Abstract

PROBLEM TO BE SOLVED: To omit a harness for connection between a fuse relay box and a battery by placing an electric circuit unit at the upper part of a battery fixing means and connecting only the positive-pole terminal of the battery to the electric circuit unit. SOLUTION: To secure a battery 123 on a vehicle body, a frame 118 is put over the top of the battery 123, and the battery is installed on the vehicle body with stays 121 and 122 and tightened with nuts 119 and 120. A fuse relay box 103 of an electric circuit units fastened to and secured on the upper part of the frame 118 as a battery fixing means by a means such as an adhesive. A booster cable is connected only to the positive-pole terminal of the battery 123, and an insulating protective cover 107 is secured detachably on the fuse relay box 103 so as to cover the positive-pole terminal.

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2001－69673
（P2001－69673A）
(43)公開日　平成13年３月16日(2001.3.16)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード（参考）
Ｈ０２Ｊ　7/00		Ｈ０２Ｊ　7/00	Ｐ	
	３０１		３０１Ｂ	
Ｂ６０Ｒ　16/02	６１０	Ｂ６０Ｒ　16/02	６１０Ｚ	
16/04		16/04	Ｃ	
Ｆ０２Ｄ　45/00	３９５	Ｆ０２Ｄ　45/00	３９５Ａ	

審査請求　未請求　請求項の数２　ＯＬ　（全　５　頁）　最終頁に続く

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(22)出願日　平成11年８月31日(1999.8.31)

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(54)【発明の名称】　車両用電源装置

(57)【要約】
【課題】車両用バッテリに積み重ねて搭載されるヒューズ・リレーボックスに関し、バッテリの大きさに依存せず、ジャンパスタートが可能なヒューズ・リレーボックスを構成することが可能な車両用電源装置の構造を提供する。
【解決手段】バッテリを固定するフレームにヒューズ・リレーボックスを取り付け、バッテリの大きさ毎にフレームを用意して、ヒューズ・リレーボックスは標準化されたものを組み合わせることにより、バッテリの大きさに依存しないヒューズ・リレーボックスを構成する。ヒューズ・リレーボックスに、バッテリ（＋）端子保護カバーを設けておき、ジャンパスタート時には、カバーを取り外すことにより、バッテリ（＋）ターミナルにブースターケーブルを接続して、ジャンプスタートが可能となる。

図　１

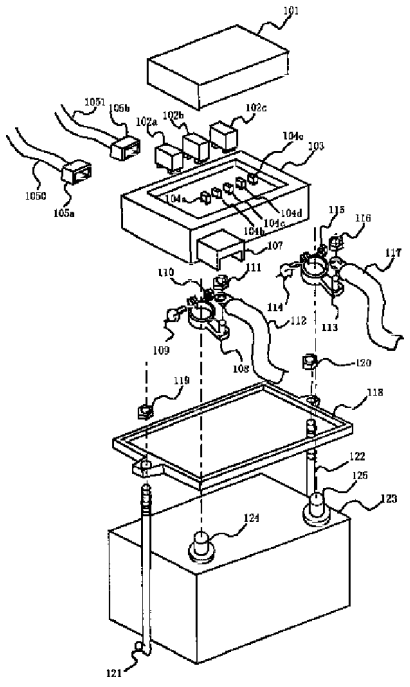


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