全て、ニッケル、ニッケルメッキされた銅及びその等価物のうち選択された何れか一つであってもよく、ここでその材質を限定するものではない。さらに、このようなコネクタ１２０Ａ，１２０Ｂ，１２０Ｃは、ニッケルと銅からなるクラッド金属であってもよい。さらに、場合によっては、２層構造のコネクタ１２０Ａ，１２０Ｂの第２の連結部材１２２だけがクラッド金属で形成されてもよい。公知のように、このようなクラッド金属は、メッキではない溶接、圧延、鋳造または圧出などの方法で形成され、母材が有しない新しい特性（例えば、半田付けに対する濡れ性（Ｗｅｔｔａｂｉｌｉｔｙ））が向上する。

【００２３】

このようにして、本発明の一実施形態によるバッテリーパック１００のコネクタ１２０Ａ，１２０Ｂ，１２０Ｃ、特にワイヤ１４１Ａ，１４１Ｂが結合、接続、連結または半田付けされるコネクタ１２０Ａ，１２０Ｂは、１層構造ではなく２層構造からなるので、バッテリーセル１１０とコネクタ１２０Ａ，１２０Ｂとの間の結合力が向上するだけでなく、ワイヤ１４１Ａ，１４１Ｂとコネクタ１２０Ａ，１２０Ｂとの間の結合力も向上する。例えば、コネクタ１２０Ａの第１の連結部材１２１がバッテリーセル１１０に先に結合され、次いで第２の連結部材１２２にワイヤ１４１Ａが結合されるからである。言い換えれば、バッテリーセル１１０に第１の連結部材１２１が結合される工程と、第２の連結部材１２２にワイヤ１４１Ａが結合される工程が互いに影響を与えないからである。

【００２４】

一方、ワイヤ１４１Ｂが結合または半田付けされるコネクタ１２０Ｂは、バッテリーセル１１０Ｂ（図２参照）の下面に位置する。すなわち、コネクタ１２０Ｂは、バッテリーセル１１０Ｂの下面の負極に付着される。よって、実質的に図２でコネクタ１２０Ｂは、バッテリーセル１１０Ｂに遮られて外部から見えない。しかし、このようなコネクタ１２０Ｂはコネクタ１２０Ａと同じ構造及び形状を有するので、その図示は省略する。

【００２５】

図３は、本発明の別の実施形態によるバッテリーパックの概略的な構造を示す斜視図である。

図３に示すように、本発明の別の実施形態によるバッテリーパック１０１は、保護回路モジュール１３０にもコネクタ２２０Ａ，２２０Ｂが結合されてもよい。すなわち、コネクタ２２０Ａが保護回路モジュール１３０の正極パッド１３１Ａに接続され、コネクタ２２０Ｂが負極パッド１３１Ｂに接続される。さらに、コネクタ２２０Ａに正極ワイヤ１４１Ａが接続または半田付けされ、コネクタ２２０Ｂに負極ワイヤ１４１Ｂが接続または半田付けされる。ここで、コネクタ２２０Ａ，２２０Ｂは、上述したコネクタ１２０Ａ，１２０Ｂと実質的に同じものであるので、コネクタ２２０Ａ，２２０Ｂについての詳細な説明は省略する。

このようにして、本発明の別の実施形態は、コネクタ２２０Ａ，２２０Ｂがバッテリーセル１１０だけでなく保護回路モジュール１３０にも適用されるので、ワイヤ１４１Ａ，１４１Ｂと保護回路モジュール１３０の間の結合力もさらに向上する。

【００２６】

図４は、本発明の一実施形態によるバッテリーパックのコネクタ及びワイヤの結合構造を示す部分斜視図である。

図４に示すように、本発明の一実施形態によるバッテリーパック１００のコネクタ１２０Ａは、バッテリーセル１１０に溶接される第１の連結部材１２１と、第１の連結部材１２１上に形成された第２の連結部材１２２と、第１の連結部材１２１及び第２の連結部材１２２を連結する折曲可能な連結領域１２３と、第２の連結部材１２２上に形成され、上部に一定長さ突出した一対の結合部材１２４と、第１の連結部材１２１に形成され、第２の連結部材１２２を加圧する加圧部１２５とを含む。ここで、連結領域１２３と加圧部１２５は、互いに反対側に形成されている。また、一対の結合部材１２４は、上方に向かって相互間の間隔が略近くなる形を有する。

さらに、このようなコネクタ１２０Ａは、第１の連結部材１２１がバッテリーセル１１０の正極端子１１１に溶接され、第２の連結部材１２２に具備された一対の結合部材１２

４に導電性ワイヤ１４１Ａが結合されてもよい。さらに、導電性ワイヤ１４１Ａ及び結合部材１２４に半田付け１５０が形成されてもよい。

【００２７】

図５は、本発明の別の実施形態によるバッテリーパックのコネクタ及びワイヤの結合構造を示す部分斜視図である。

図５に示すように、本発明の別の実施形態によるバッテリーパック１０１のコネクタ２２０Ａは、保護回路モジュール１３０に溶接される第１の連結部材１２１と、第１の連結部材１２１上に形成された第２の連結部材１２２と、第１の連結部材１２１及び第２の連結部材１２２を連結する連結領域１２３と、第２の連結部材１２２上に形成され、上部に一定長さ突出した一対の結合部材１２４と、第１の連結部材１２１に形成され、第２の連結部材１２２を加圧する加圧部１２５とを含む。

【００２８】

さらに、このようなコネクタ２２０Ａは、第１の連結部材１２１が保護回路モジュール１３０の正極パッド１３１Ａに溶接され、第２の連結部材１２２に具備された一対の結合部材１２４に導電性ワイヤ１４１Ａが結合されてもよい。さらに、導電性ワイヤ１４１Ａ及び結合部材１２４に半田付け１５０が形成されてもよい。

実質的に、バッテリーセル１１０に接続されるコネクタ１２０Ａと、保護回路モジュール１３０に接続されるコネクタ２２０Ａとは、互いに同じ構造を有してもよい。よって、以下で説明されるコネクタ１２０Ａ、コネクタ１２０Ａとワイヤ１４１Ａとの連結構造及びコネクタ１２０Ａとワイヤ１４１Ａとの連結方法は、上述した二つの実施形態の両方に適用可能である。

【００２９】

図６ａは、本発明の一実施形態によるコネクタ及びワイヤの結合構造を示す平面図であり、図６ｂは、図６ａの線６ｂ－６ｂに沿った断面図であり、図６ｃは、図６ａの線６ｃ－６ｃに沿った断面図であり、図６ｄは、図６ａの線６ｃ－６ｃに沿った別の断面図である。

図６ａ～図６ｃを参照すると、本発明の一実施形態によるコネクタ１２０Ａは、バッテリーセル（１１０、図４参照）または保護回路モジュール（１３０、図５参照）に接続される第１の連結部材１２１と、第１の連結部材１２１上に形成された第２の連結部材１２２と、第１の連結部材１２１及び第２の連結部材１２２を連結する連結領域１２３と、第２の連結部材１２２上に形成され、上部に一定長さ突出した一対の結合部材１２４と、第１の連結部材１２１に形成され、第２の連結部材１２２を加圧する加圧部１２５とを含む。ここで、第１の連結部材１２１は、下面を第１の面と、上面を第２の面と定義し得る。また、第２の連結部材１２２は、下面を第１の面と、上面を第２の面と定義し得る。このとき、第１の連結部材１２１の上面（第２の面）は第２の連結部材１２２の下面（第１の面）に密着する。

【００３０】

第１の連結部材１２１は、略平らな本体１２１ａと、本体１２１ａから対向する両側に延在された略平らな延長部１２１ｂとを含む。さらに、本体１２１ａ及び延長部１２１ｂには、それぞれ凹溝１２１ｃ，１２１ｄが形成されており、このような凹溝１２１ｃ，１２１ｄには、溶接工程中に溶接工具が位置する。よって、コネクタ１２０Ａは、バッテリーセル（１１０、図４参照）または保護回路モジュール（１３０、図５参照）に容易に溶接される。さらに、本体１２１ａと延長部１２１ｂの間には、切開部１２１ｅが形成されている。よって、溶接工程中に溶接工具による熱が拡散されず凹溝１２１ｃ，１２１ｄに集中され、これにより溶接効率がさらに向上する。このような第１の連結部材１２１は、ニッケル、ニッケルメッキされた銅、ニッケルと銅からなるクラッド金属及びその等価物のうち選択された何れか一つで形成されてもよいが、ここでその材質を限定するものではない。さらに、第１の連結部材１２１は、右側端部を第１の側縁部と、左側端部を第２の側縁部と定義し得る。

【００３１】

第２の連結部材１２２は、略平らであり、第１の連結部材１２１上に形成されている。このような第２の連結部材１２２は、第１の連結部材１２１の本体１２１ａが有する広さより少し小さく形成されてもよいが、このような広さで第２の連結部材１２２を限定するものではない。また、第２の連結部材１２２の対向する両側に、一定の大きさの穴（ｈｏｌｅ）または開口（ｏｐｅｎｉｎｇ）１２２ａが形成されている。すなわち、第２の連結部材１２２の、ワイヤ１４１Ａを中心に対向する両側に、穴１２２ａが形成されている。このような穴１２２ａを通して、第１の連結部材１２１の表面が上部に露出する。このような穴１２２ａは、半田付け１５０の形成時に過剰に形成された半田付けを収容することで、半田付け１５０がコネクタ１２０Ａの外側に流れ出ることを防止する。このような第２の連結部材１２２は、第１の連結部材１２１と同様に、ニッケル、ニッケルメッキされた銅、ニッケルと銅からなるクラッド金属及びその等価物のうち選択された何れか一つで形成されてもよいが、ここでその材質を限定するものではない。さらに、第２の連結部材１２２は、右側端部を第１の側縁部と、左側端部を第２の側縁部と定義し得る。よって、第１の連結部材と第２の連結部材は、共通の第１の側縁部が互いに連結され、第２の側縁部が互いに隣接する形を有する。

【００３２】

連結領域１２３は、第１の連結部材１２１と第２の連結部材１２２の一側端部を連結する。また、連結領域１２３は実質的に折曲されており、第１の連結部材１２１及び第２の連結部材１２２と同じ材質で形成されてもよい。ここで、連結領域１２３は、第１，第２の連結部材１２１，１２２の第１の側縁部に形成されている。

【００３３】

一対の結合部材１２４は、第２の連結部材１２２から上部に一定長さ突出して形成される。このような一対の結合部材１２４は、第２の連結部材１２２の一部領域が切開されて上部に折曲されることにより形成されたものである。勿論、このような切開によって、第２の連結部材１２２には穴１２２ａが形成される。一対の結合部材１２４は、実質的に第２の連結部材１２２と同じ材質で形成される。また、一対の結合部材１２４は、ワイヤ１４１Ａを中心に対向する両側に形成される。さらに、一対の結合部材１２４は、上方に向かって互いに近くなる。よって、一対の結合部材１２４はワイヤ１４１Ａを略囲む形状を有し、これによりワイヤ１４１Ａはコネクタ１２０Ａに強く結合、連結及び接続される。さらに、一対の結合部材１２４は、別途の工具によりクランプ（ｃｌａｍｐｉｎｇ）されてもよい。すなわち、一対の結合部材１２４の上端がプライヤー（ｐｌｉｅｒ）のような工具により互いに密着されて、クランプされてもよい。これによって、一対の結合部材１２４とワイヤ１４１Ａの間の結合力はさらに向上する。

【００３４】

加圧部１２５は、第１の連結部材１２１から上方に折曲された後、また水平方向に折曲されて、第２の連結部材１２２の端部を加圧する。このような加圧部１２５は、連結領域１２３と対向する反対側に形成される。さらに、加圧部１２５は、ワイヤ１４１Ａの端部と対応する位置に形成される。よって、加圧部１２５によりワイヤ１４１Ａの結合深さが制限される。これにより、コネクタ１２０Ａに対するワイヤ１４１Ａの結合深さが一定となるように制御される。ここで、加圧部１２５は第１及び第２の連結部材１２１，１２２の第２の側縁部に形成されている。

【００３５】

一方、ワイヤ１４１Ａは、一対の結合部材１２４の間に挟まれて結合、接続及び連結される。また、ワイヤ１４１Ａとコネクタ１２０Ａの結合力が増加するように、ワイヤ１４１Ａと一対の結合部材１２４に半田付け１５０がさらに形成されてもよい。さらに、ワイヤ１４１Ａは一対の結合部材１２４の間に挟まれて結合、接続及び連結され、追加的に結合部材１２４がクランプされてもよい。さらに、このようにクランプされた後、ワイヤ１４１Ａと結合部材１２４に半田付け１５０が形成されてもよい。

【００３６】

このような半田付け１５０は、実質的にワイヤ１４１Ａと一対の結合部材１２４だけで

なく、第１の連結部材１２１及び第２の連結部材１２２の一部領域を覆ってもよい。もちろん、半田付け１５０のうち過剰に使用された一部は、第２の連結部材１２２に形成された穴１２２ａに収容される。実質的に、このために一対の結合部材１２４が有する幅に比べて穴１２２ａの幅が相対的に大きくなるように形成されることで、過剰に使用された半田付け１５０の一部が穴１２２ａに容易に収容されるようになっている。このようにして、ワイヤ１４１Ａはコネクタ１２０Ａに形成された一対の結合部材１２４に結合、接続及び連結されるだけでなく、半田付け１５０で囲まれることで、ワイヤ１４１Ａとコネクタ１２０Ａの間の結合力はさらに向上する。

【００３７】

また、図６ｄに示すように、第２の連結部材１２２には、穴１２２ａの代わりに凹溝１２２ｂが形成されてもよい。このような凹溝１２２ｂにも半田付け１５０のうち過剰に使用された一部が収容されることで、過剰に使用された半田付けがコネクタ１２０Ａの外側に流れ出ることを防止する。

【００３８】

このようにして、本発明の一実施形態では、ワイヤ１４１Ａがコネクタ１２０Ａに具備された一対の結合部材１２４に結合、接続または連結されることができる。また、本発明の別の実施形態では、ワイヤ１４１Ａがコネクタ１２０Ａに具備された一対の結合部材１２４に結合、接続または連結された後、一対の結合部材１２４がクランプされてもよい。また、本発明の別の実施形態では、ワイヤ１４１Ａがコネクタ１２０Ａに具備された一対の結合部材１２４に結合、接続または連結された後、ワイヤ１４１Ａ及び結合部材１２４に半田付け１５０が形成されてもよい。また、本発明の別の実施形態では、ワイヤ１４１Ａがコネクタ１２０Ａに具備された一対の結合部材１２４に結合、接続または連結され、一対の結合部材１２４がクランプされた後、ワイヤ１４１Ａ及び結合部材１２４に半田付け１５０が形成されてもよい。したがって、本発明の実施形態によれば、コネクタ１２０Ａとワイヤ１４１Ａの間の結合力がさらに向上する。

【００３９】

さらに、本発明の一実施形態によると、ワイヤ１４１Ａに大電流が流れて高熱が発生することで、半田付け１５０が溶融される場合にも、一対の結合部材１２４にワイヤ１４１Ａが結合されているため、コネクタ１２０Ａからワイヤ１４１Ａが分離されることが防止される。

【００４０】

図７ａ～図７ｆは、本発明の別の実施形態によるバッテリーパックのコネクタを用いたワイヤの結合方法を順に示す斜視図である。

本発明の別の実施形態によるバッテリーパック１００のコネクタ１２０Ａ及びワイヤ１４１Ａの結合方法は、コネクタ１２０Ａを準備する段階、コネクタ１２０Ａを折曲する段階、コネクタ１２０Ａをバッテリーセル及び／または保護回路基板に電気的に連結する段階及びワイヤ１４１Ａを結合する段階を含む。

本発明の別の実施形態は、コネクタ１２０Ａに具備された一対の結合部材１２４をクランプする段階をさらに含んでもよい。

本発明の別の実施形態は、ワイヤ１４１Ａに半田付け１５０を形成する段階をさらに含んでもよい。ここで、半田付け１５０を形成する段階は、ワイヤ１４１Ａの結合段階の後に行われたり、または結合部材１２４のクランプ段階の後に行われてもよい。これを順次に説明する。

【００４１】

図７ａに示すように、コネクタ１２０Ａを準備する段階では、第１の連結部材１２１、第２の連結部材１２２、連結領域１２３、一対の結合部材１２４及び加圧部１２５を有するコネクタ１２０Ａを準備する。ここで、第１の連結部材１２１及び第２の連結部材１２２は、略平らな形状を有し、連結領域１２３は、容易な折曲のために、第１の連結部材１２１と第２の連結部材１２２の境界線に沿って凹状にラウンド形状を有している。さらに、連結領域１２３がまだ折曲されていないので、一対の結合部材１２４は上方ではなく下

方に向けて形成されている。さらに、連結領域１２３の反対側に形成された加圧部１２５もまだ上方に折曲された状態ではないので、第１の連結部材１２１と同様に略平らな状態を維持している。

第１の連結部材１２１を構成する本体１２１ａ及び延長部１２１ｂにそれぞれ形成された溶接のための凹溝１２１ｃ，１２１ｄ、溶接時の熱拡散を防止するための切開部１２１ｅ、第２の連結部材１２２に形成された半田付けオーバフロー防止用の穴１２２ａなどについては、既に説明したので、これについての説明は省略する。

【００４２】

図７ｂに示すように、コネクタ１２０Ａを折曲する段階では、第１の連結部材１２１または第２の連結部材１２２を折曲することで、第１の連結部材１２１上に第２の連結部材１２２を位置させる。実質的に、第１の連結部材１２１と第２の連結部材１２２を連結する連結領域１２３を折曲することで、第１の連結部材１２１上に第２の連結部材１２２が位置するようになる。このとき、第１の連結部材１２１から水平方向に突出して形成された加圧部１２５も、上部に折曲される。すなわち、加圧部１２５は略「Ｃ」字形状に折曲される。言い換えれば、加圧部１２５の端部が第２の連結部材１２２の端部を覆うように折曲されることで、第１の連結部材１２１と第２の連結部材１２２の間に隙間が形成されないようにする。上述したように、このような加圧部１２５は第１の連結部材１２１と第２の連結部材１２２を互いに密着させるだけでなく、後述するワイヤ１４１Ａの結合深みを制限する役割も果たす。さらに、このようなコネクタ１２０Ａの折曲段階により、第２の連結部材１２２に形成された穴１２２ａは、第１の連結部材１２１上に位置する。よって、穴１２２ａと対応する第１の連結部材１２１の所定領域が上部に露出する。

【００４３】

図７ｃに示すように、コネクタ１２０Ａをバッテリーセル及び／または保護回路基板に電気的に連結する段階では、コネクタ１２０Ａの第１の連結部材１２１をバッテリーセル１１０及び／または保護回路基板（図示せず）に電気的に連結する。例えば、コネクタ１２０Ａの第１の連結部材１２１をバッテリーセル１１０上に位置させる。より具体的に、第１の連結部材１２１の本体１２１ａと延長部１２１ｂをバッテリーセル１１０上に位置させる。次いで、本体１２１ａ及び延長部１２１ｂにそれぞれ具備された凹溝１２１ｃ，１２１ｄに溶接工具２４０を位置させる。溶接工具２４０からのエネルギーが凹溝１２１ｃ，１２１ｄ及びバッテリーセル１１０に伝達され、これによって凹溝１２１ｃ，１２１ｄを介して第１の連結部材１２１がバッテリーセル１１０に溶接される。ここで、本体１２１ａと延長部１２１ｂの間に形成された切開部１２１ｅは、溶接工程中に溶接工具２４０による熱が拡散せず凹溝１２１ｃ，１２１ｄに集中されるようにし、これによって溶接効率がさらに向上する。

【００４４】

図７ｄに示すように、ワイヤ１４１Ａを結合する段階では、ワイヤ１４１Ａを、第２の連結部材１２２と一対の結合部材１２４が形成する空間に、位置させて結合する。このとき、ワイヤ１４１Ａの結合深みは加圧部１２５により制限されるので、適切な長さのワイヤ１４１Ａが結合部材１２４に結合される。これにより、ワイヤ１４１Ａは、コネクタ１２０Ａに電気的に結合、接続及び連結される。

このようにして、本発明の一実施形態によるコネクタ１２０Ａとワイヤ１４１Ａの結合方法はワイヤ１４１Ａの結合段階で終了されてもよい。

さらに、本発明の別の実施形態によるコネクタ１２０Ａとワイヤ１４１Ａの結合方法は、ワイヤ１４１Ａの結合段階の以後、半田付けを形成する段階がさらに行われた後に終了してもよい。すなわち、半田付けが、ワイヤ１４１Ａ及びワイヤを囲む一対の結合部材１２４に形成されることで、ワイヤ１４１Ａをコネクタ１２０Ａと、より堅固に結合することができる。このとき、半田付けはワイヤ１４１Ａ及び結合部材１２４だけでなく、第１の連結部材１２１及び第２の連結部材１２２の一部領域に形成されてもよい。このとき、過剰に使用された半田付けは第２の連結部材１２２に形成された穴１２２ａの内部に収容されるので、コネクタ１２０Ａの外部に過剰に使用された半田付けが流れ出ることが防止

させる。

【００４５】

図７ｅに示すように、結合部材１２４をクランプする段階では、ワイヤ１４１Ａの外部に形成された結合部材１２４をクランプする。例えば、プライヤー（ｐｌｉｅｒ）のような工具２３０を用いて一対の結合部材１２４の上端を互いに圧着することで、一対の結合部材１２４の上端がワイヤ１４１Ａに、より近く密着される。

ここで、本発明の別の実施形態によるコネクタ１２０Ａとワイヤ１４１Ａの結合方法は、結合部材１２４のクランプ段階後すぐ終了されてもよい。すなわち、半田付けが形成されなくても、結合部材１２４によりワイヤ１４１Ａをコネクタ１２０Ａに強く結合、接続及び連結することができる。

【００４６】

図７ｆに示すように、ワイヤ１４１Ａに半田付け１５０を形成する段階では、ワイヤ１４１Ａ及び一対の結合部材１２４に半田付け１５０を形成する。このとき、半田付け１５０は、ワイヤ１４１Ａ及び結合部材１２４だけでなく、第１の連結部材１２１及び第２の連結部材１２２の一部領域に形成されてもよい。勿論、このような半田付け１５０の形成時、過剰に使用された半田付けは第２の連結部材１２２に形成された穴１２２ａに収容されるので、過剰に使用された半田付けがコネクタ１２０Ａの外側に流れ出ることが防止される。これにより、ワイヤ１４１Ａは結合部材１２４に結合、接続及び連結されるだけでなく、半田付け１５０がワイヤ１４１Ａを略囲む形状を有するので、ワイヤ１４１Ａとコネクタ１２０Ａの結合強度がさらに向上する。

このようにして、本発明の一実施形態によるバッテリーパック１００のコネクタ１２０Ａとワイヤ１４１Ａの結合方法は、コネクタ１２０Ａに具備された結合部材１２４を利用してワイヤ１４１Ａを１次結合し、次に半田付け１５０でワイヤ１４１Ａを２次結合することで、全体の工程時間が短くなり、また工程全体の間において危険要素がないので、作業安全性も向上する。

【００４７】

以上で説明したものは本発明によるバッテリーパックのコネクタ及びこれの結合方法を実施するための一実施形態に過ぎないものであって、本発明は上記の実施形態に限定されず、以下の特許請求の範囲で請求するように本発明の要旨を逸脱することなく当該発明の属する分野における通常の知識を有する者であれば誰でも様々な変更実施が可能な範囲まで本発明の技術的精神がある。

【符号の説明】

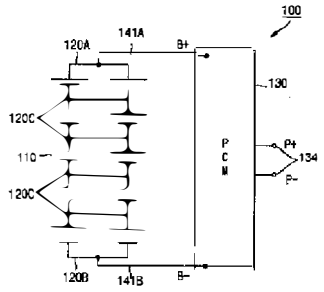
【００４８】

１００　バッテリーパック
１１０　バッテリーセル
１１１　正極端子
１１２　負極端子
１２０Ａ，１２０Ｂ，１２０Ｃ　コネクタ
１２１　第１の連結部材
１２１ａ　本体
１２１ｂ　延長部
１２１ｃ　凹溝
１２２　第２の連結部材
１２２ａ　穴
１２３　連結領域
１２４　結合部材
１２５　加圧部
１３０　保護回路モジュール
１３１Ａ　正極パッド
１３１Ｂ　負極パッド

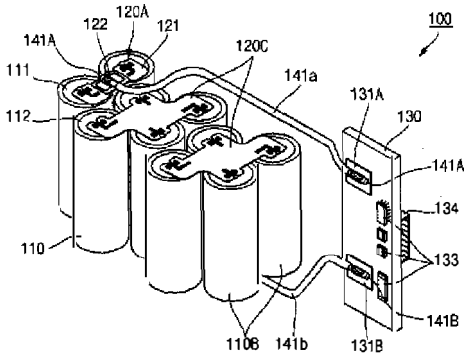
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１３３　　電子素子
１３４　　コネクタ
１４１Ａ，１４１Ｂ　　ワイヤ
１４１ａ，１４１ｂ　　絶縁被覆
１５０　　半田付け

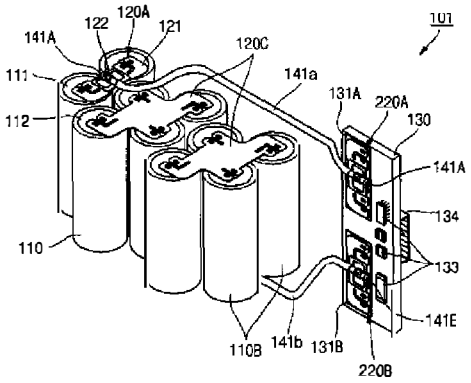
【図１】



【図２】



【図３】



【図４】

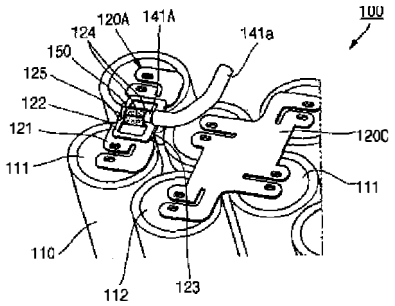
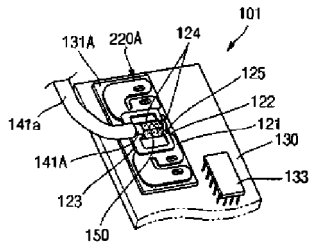
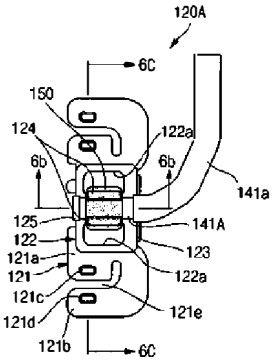


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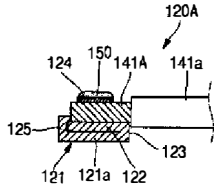
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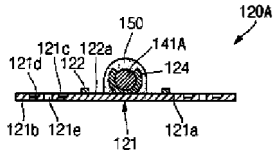
【図６ａ】



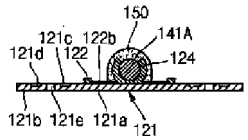
【図６ｂ】



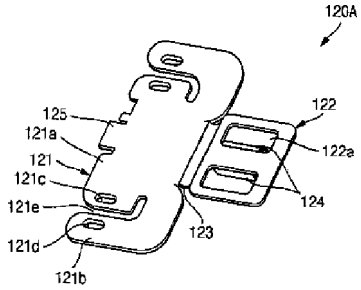
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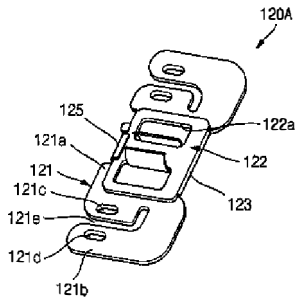
【図６ｄ】



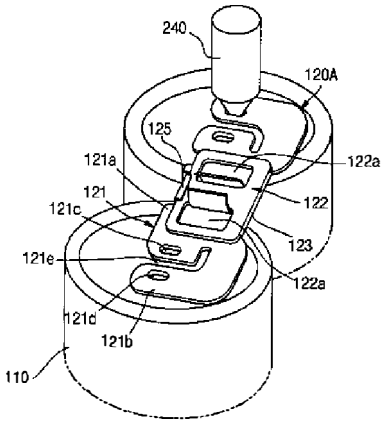
【図７ａ】



【図７ｂ】



【図７ｃ】



【図７ｄ】

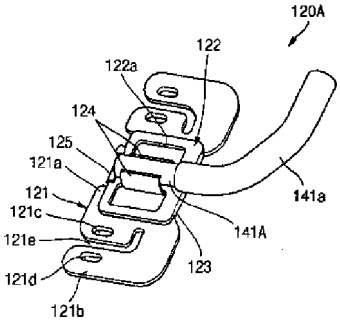
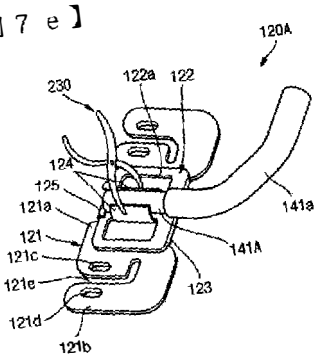


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【図７ｅ】



【図７ｆ】

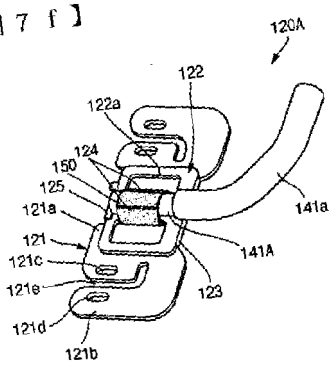


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フロントページの続き

Fターム(参考) 5H040 AA03 AA07 AA22 AS05 AS14 AS19 AT01 AT02 AT04 DD10
JJ02
5H043 AA01 AA03 AA11 AA12 AA19 AA20 BA19 BA20 CA03 CA04
CA08 DA20 FA02 FA22 FA23 FA24 FA40 HA02 HA02D HA02F
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KA07D KA07F KA08D KA08F

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Espacenet

CA137883S BATTERY PACK

Applicants: CHERVON LTD

Inventors:

Classifications:

Priorities: CN201030167879F 2010-05-12

Application: CA137883S·2010-11-12

Publication: CA137883S·2011-06-08

Published as: CA137883S;**USD640196S**

BATTERY PACK

Abstract

The design consists of the features of shape, ornament, pattern and configuration of the BATTERY PACK shown in the attached drawings wherein:FIG. 1 is a right side view of a battery pack according to the new design.FIG. 2 is a left side view of the battery pack shown in FIG. 1.FIG. 3 is a front view of the battery pack shown in FIG. 1.FIG. 4 is a rear view of the battery pack shown in FIG. 1.FIG. 5 is a top view of the battery pack shown in FIG. 1.FIG. 6 is a bottom view of the battery pack shown in FIG. 1.FIG. 7 is a perspective view of the battery pack shown in FIG. 1.In the above drawings, the portions shown in stippled lines do not form part of the design.

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Europäisches Patentamt
European Patent Office
Office européen des brevets

Espacenet

CN203522157U Heavy current protective device for automobile emergency starting power supply

Applicants: SHENZHEN SBASE ELECTRONICS TECHNOLOGY CO LTD

Inventors: CHEN ZHANGSHENG

Classifications:
IPC ***H02H7/18;***

Priorities: CN201320403362U 2013-07-08

Application: CN203522157U·2013-07-08

Publication: CN203522157U·2014-04-02

Published as: CN203522157U;**TWM488428U**

Heavy current protective device for automobile emergency starting power supply

Abstract

The utility model provides a heavy current protective device for an automobile emergency starting power supply. The heavy current protective device comprises an MCU one-chip microcomputer unit, a time switch connected to the MCU one-chip microcomputer unit and an on-off switch controlled by the time switch. One end of the on-off switch is connected with an external battery, the other end of the on-off switch is connected with an automobile storage battery, and a timer is arranged in the MCU one-chip microcomputer. After the set time interval, the MCU one-chip microcomputer automatically outputs a control signal to the time switch, and the on-off switch breaks the connection between the external battery and the automobile storage battery. When ignition is completed, the protective device is automatically closed, if igniting motions do not exist, the protective device automatically breaks the connection between the external battery and the automobile storage battery after one-minute time-delay, and damages of the external battery and the automobile storage battery caused by mutual charging for a long time are avoided.

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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

(10)授权公告号 CN 203522157 U
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代理人 李淑琴 肖伟

(51)Int.Cl.
H02H 7/18(2006.01)

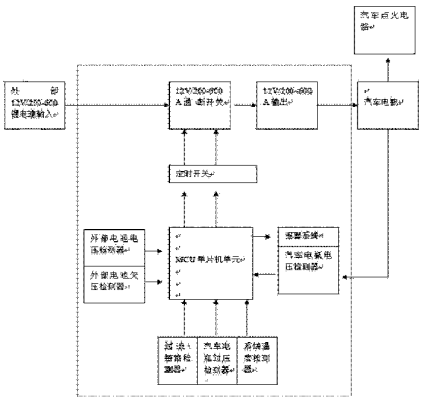
权利要求书1页 说明书3页 附图5页

(54)实用新型名称

一种汽车应急启动电源用的大电流保护装置

(57)摘要

本实用新型提供了一种汽车应急启动电源用的大电流保护装置，包括 MCU 单片机单元，与 MCU 单片机单元连接的定时开关，由定时开关控制的通断开关，通断开关的一端连接外接电池，通断开关的另一端连接汽车电瓶，MCU 单片机内部设置有定时器，设置的时间间隔过后，MCU 单片机自动输出一个控制信号给定时开关，由通断开关断开外接电池与汽车电瓶的连接。点火完成后，本保护装置自动关闭。若无点火动作，本保护装置延时 1 分钟后自动断开外接电池与汽车电瓶的连接，避免长时间相互充电损坏汽车电瓶和外接电池。



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1. 一种汽车应急启动电源用的大电流保护装置，其特征在于：包括MCU单片机单元，与MCU单片机单元连接的定时开关，由定时开关控制的通断开关，通断开关的一端连接外接电池，通断开关的另一端连接汽车电瓶，MCU单片机内部设置有定时器，设置的时间间隔过后，MCU单片机自动输出一个控制信号给定时开关，由通断开关断开外接电池与汽车电瓶的连接。

2. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：该装置外接电池输入端采用EC5接口，正极和负极接口物理尺寸不一样。

3. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：保护装置的输入和输出端连接线的正极和负极用不同颜色线连接。

4. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：还包括过流、短路检测器，所述过流、短路检测器与MCU单片机单元连接，当点火或短路电流大于该保护装置设定保护值时，MCU单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

5. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：还包括与MCU单片机单元连接的外部电池电压检测器和汽车电瓶过压检测器，汽车电瓶过压检测器测量的汽车电瓶的反充电压大于外部电池电压检测器的外接电池电压时，MCU单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

6. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：还包括与MCU单片机单元连接的外部电池欠压检测器，当外部电池电压低于限制值时，MCU单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

7. 根据权利要求1所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：还包括与MCU单片机单元连接的系统温度检测器，当本保护装置关键器件温升达到本保护装置设定值时，MCU单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

8. 根据权利要求1至7任意一项所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：还包括与MCU单片机单元连接的报警系统，保护装置出现异常进入保护状态时由报警系统报警警示。

9. 根据权利要求8所述的一种汽车应急启动电源用的大电流保护装置，其特征在于：所述报警系统为声音报警或者光闪报警。

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一种汽车应急启动电源用的大电流保护装置

技术领域

[0001] 本实用新型涉及一种保护装置，尤其涉及汽车应急启动电源用的大电流保护装置。

背景技术

[0002] 汽车开始点火，通过外接电池提供辅助电流，输出电流辅助汽车点火。若无点火动作，长时间相互充电损坏汽车电池和外部电池。

实用新型内容

[0003] 为了解决现有技术中问题，本实用新型提供了一种汽车应急启动电源用的大电流保护装置。

[0004] 一种汽车应急启动电源用的大电流保护装置，包括 MCU 单片机单元，与 MCU 单片机单元连接的定时开关，由定时开关控制的通断开关，通断开关的一端连接外接电池，通断开关的另一端连接汽车电瓶，MCU 单片机内部设置有定时器，设置的时间间隔过后，MCU 单片机自动输出一个控制信号给定时开关，由通断开关断开外接电池与汽车电瓶的连接。

[0005] 作为本实用新型的进一步改进，该装置外接电池输入端采用 EC5 接口，正极和负极接口物理尺寸不一样。

[0006] 作为本实用新型的进一步改进，保护装置的输入和输出端连接线的正极和负极用不同颜色线连接。

[0007] 作为本实用新型的进一步改进，还包括过流、短路检测器，所述过流、短路检测器与 MCU 单片机单元连接，当点火或短路电流大于该保护装置设定保护值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0008] 作为本实用新型的进一步改进，还包括与 MCU 单片机单元连接的外部电池电压检测器和汽车电瓶过压检测器，汽车电瓶过压检测器测量的汽车电瓶的反充电压大于外部电池电压检测器的外接电池电压时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0009] 作为本实用新型的进一步改进，还包括与 MCU 单片机单元连接的外部电池欠压检测器，当外部电池电压低于限制值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0010] 作为本实用新型的进一步改进，还包括与 MCU 单片机单元连接的系统温度检测器，当本保护装置关键器件温升达到本保护装置设定值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0011] 作为本实用新型的进一步改进，还包括与 MCU 单片机单元连接的报警系统，保护装置出现异常进入保护状态时由报警系统报警警示。

[0012] 作为本实用新型的进一步改进，所述报警系统为声音报警或者光闪报警。

[0013] 本实用新型的有益效果是：

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[0014] 将本保护装置与外接电池连接，同时将本保护装置连接于汽车电瓶，此时本保护装置处于工作模式，本保护装置待机指示灯闪烁，此时汽车开始点火，通过外接电池提供辅助电流，输出 200-600A 以上电流辅助汽车点火。点火完成后，本保护装置自动关闭。若无点火动作，本保护装置延时 1 分钟后自动断开外接电池与汽车电瓶的连接，避免长时间相互充电损坏汽车电瓶和外接电池。

附图说明

[0015] 图 1 是本实用新型汽车应急点火装置框图（中间框内部分）；

[0016] 图 2 是本实用新型一种实现方式的具体电路图；

[0017] 图 3 是图 2 分成 A、B、C、D 四部分；

[0018] 图 4 至图 7 是图 3 中的 A、B、C、D 四部分的放大图。

具体实施方式

[0019] 下面结合附图对本实用新型做进一步说明。

[0020] 一种汽车应急启动电源用的大电流保护装置，包括 MCU 单片机单元，与 MCU 单片机单元连接的定时开关，由定时开关控制的通断开关，通断开关的一端连接外接电池，通断开关的另一端连接汽车电瓶，MCU 单片机内部设置有定时器，设置的时间间隔过后，MCU 单片机自动输出一个控制信号给定时开关，由通断开关断开外接电池与汽车电瓶的连接。

[0021] 该装置外接电池输入端采用 EC5 接口，正极和负极接口物理尺寸不一样。保护装置的输入和输出端连接线的正极和负极用不同颜色线连接。

[0022] 本保护装置外部电池输入端采用 EC5 接口，正极和负极接口物理尺寸不一样，只能一个方向插入，同时在输入和输出端连接线的正极和负极用不同颜色线连接，有效避免反接。

[0023] 汽车电池连接端，当夹子反接时，本保护装置不工作，指示灯不亮。

[0024] 电路实现：本保护装置 BTOUT+ 端接汽车电瓶正极端，当此端接反时，本保护装置单片机 U4 不工作，外部电池与汽车电池之间的连接断开。

[0025] 还包括过流、短路检测器，所述过流、短路检测器与 MCU 单片机单元连接，当点火或短路电流大于该保护装置设定保护值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0026] 当点火或短路电流大于本保护装置设定保护值时，本保护装置自动断开。

[0027] 电路实现：当本保护装置在工作过程电流发生变化时，R23 上的电压将发生变化（注：R23 为串联在大电流放电回路中的电阻），超过限定值，U2B 第 7 脚将输出一个控制信号关断继电器，断开外部电池与汽车电瓶的连接。

[0028] 还包括与 MCU 单片机单元连接的外部电池电压检测器和汽车电瓶过压检测器，汽车电瓶过压检测器测量的汽车电瓶的反充电压大于外部电池电压检测器的外接电池电压时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0029] 当汽车启动后，汽车发动机启动，当汽车电瓶的反充电压大于外接电池电压时本保护装置马上关闭，避免汽车发电机向外部电池充电，保护外部电池不受损坏。

[0030] 电路实现：当汽车电池电压或汽车发电机电压高于本保护装置设置电压时，R31

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和 R35 之间的电压将产生变化，此电压变化将传递给单片机，单片机产生一个控制信号，关断外部电池和汽车电池的连接。

[0031] 还包括与 MCU 单片机单元连接的外部电池欠压检测器，当外部电池电压低于限制值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0032] 当外部电池电压低于限制值时本保护装置自动关闭：

[0033] 电路实现：当汽车电池电压或外接电池在点火过程中因放电电压低于本保护装置设置电压时，R31 和 R35 之间的电压将产生变化，此电压变化将传递给单片机，单片机产生一个控制信号，关断外部电池和汽车电池的连接。

[0034] 还包括与 MCU 单片机单元连接的系统温度检测器，当本保护装置关键器件温升达到本保护装置设定值时，MCU 单片机单元输出控制信号，由通断开关断开外接电池与汽车电瓶的连接。

[0035] 当本保护装置关键器件温升达到本保护装置设定值时本保护装置自动关闭，避免损坏本保护装置。

[0036] 本保护装置设置有温度检测电阻 R29，当 R29 变化时 U2 将输出一个控制信号，驱动本保护装置继电器断开外部电池和汽车电池的连接，避免本保护装置持续工作产生高温损坏。

[0037] 还包括与 MCU 单片机单元连接的报警系统，保护装置出现异常进入保护状态时由报警系统报警警示。所述报警系统为声音报警或者光闪报警。

[0038] 当本保护装置处于保护状态时，单片机第 8、9 脚将输出一个高电平，驱动本保护装置内置的扬声器和 LED 产生声音和光闪烁报警。

[0039] 以上内容是结合具体的优选实施方式对本实用新型所作的进一步详细说明，不能认定本实用新型的具体实施只局限于这些说明。对于本实用新型所属技术领域的普通技术人员来说，在不脱离本实用新型构思的前提下，还可以做出若干简单推演或替换，都应当视为属于本实用新型的保护范围。

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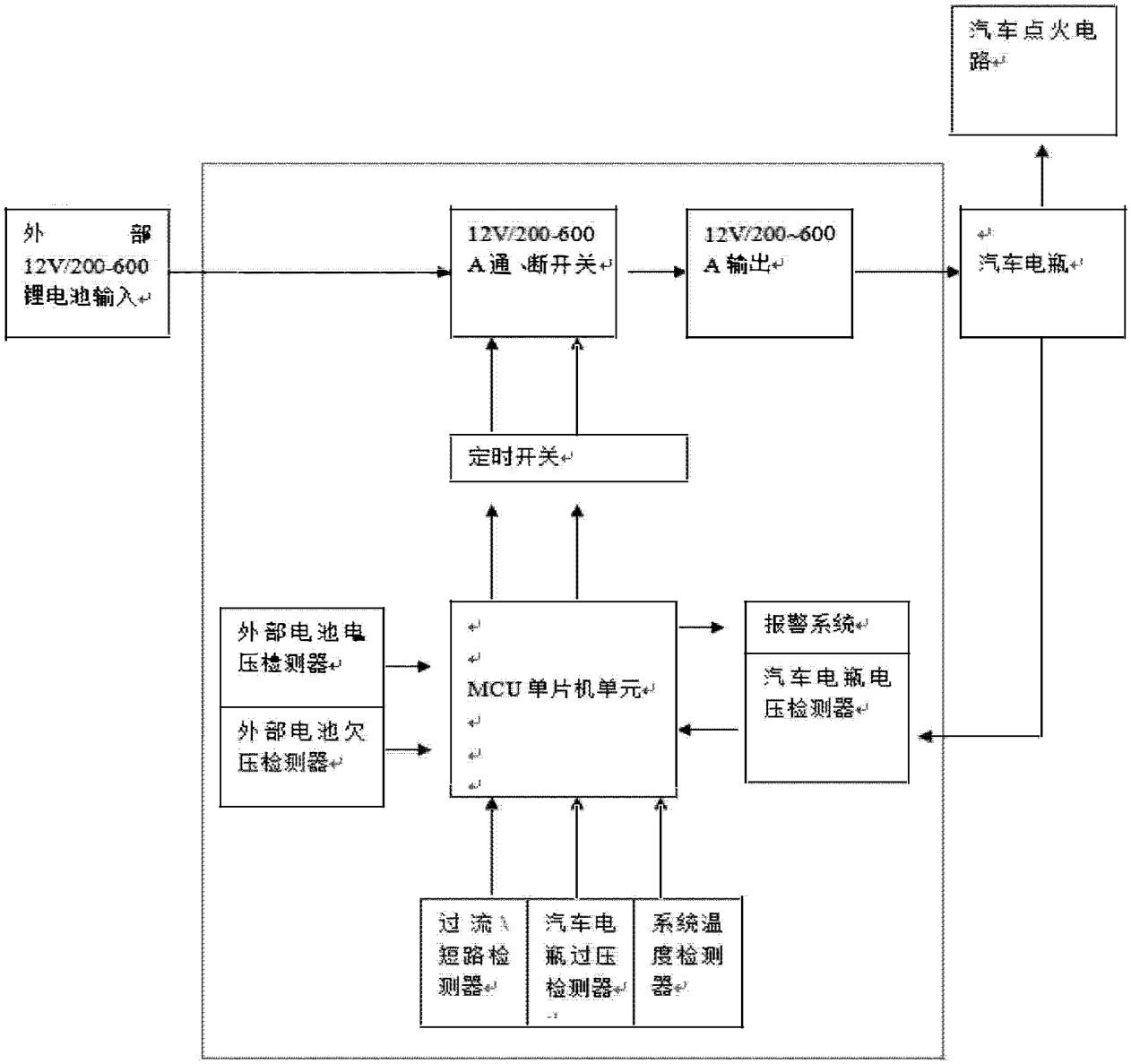


图 1

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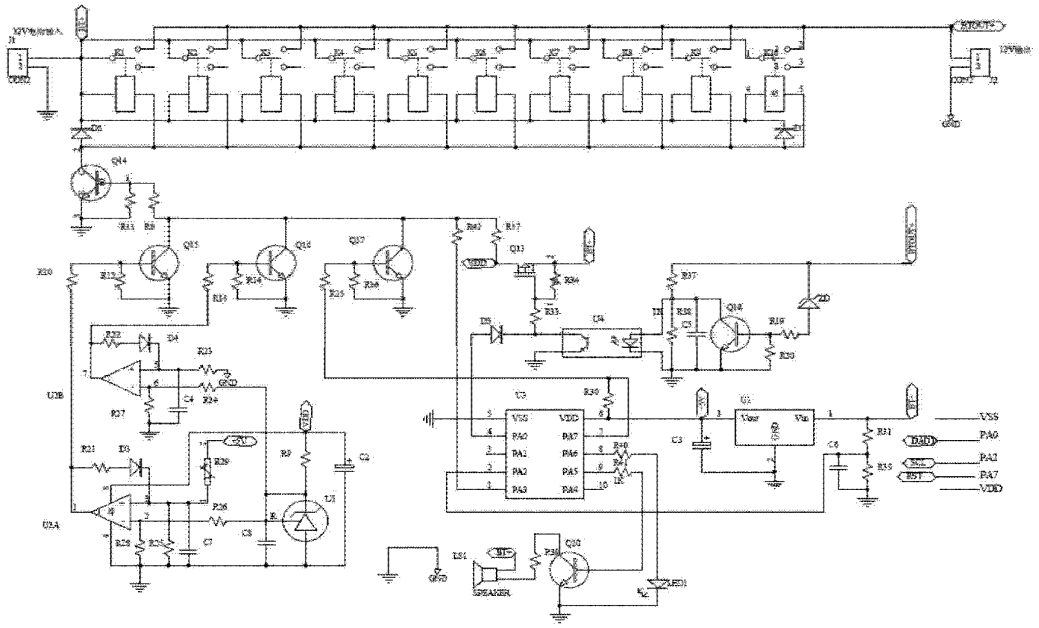


图 2

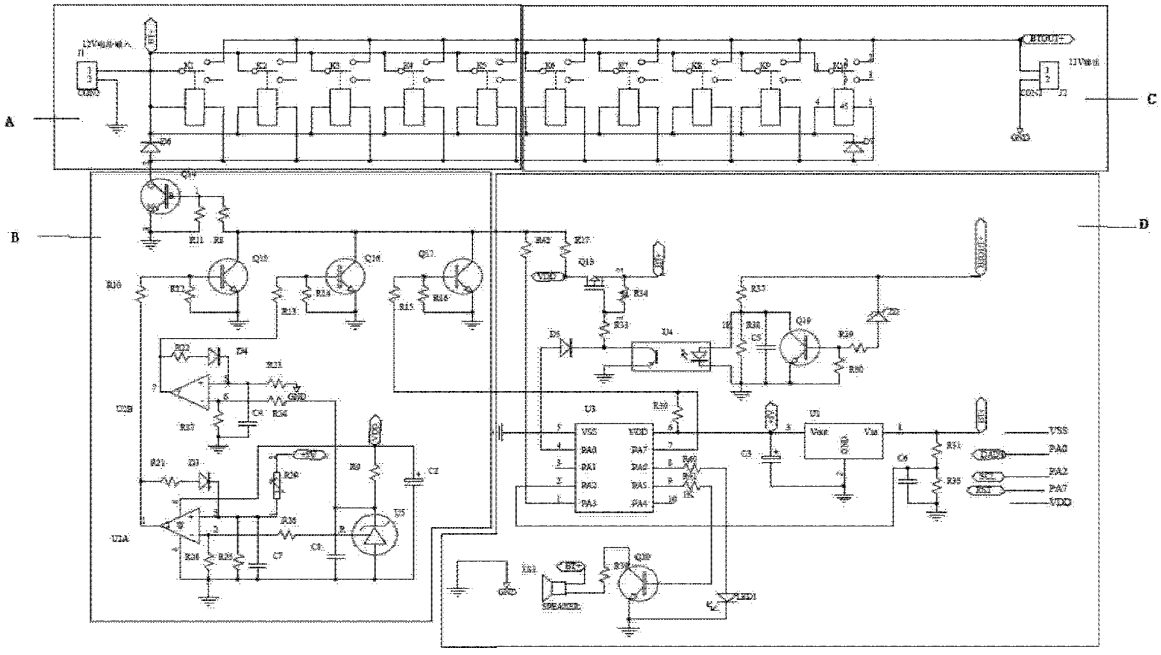


图 3

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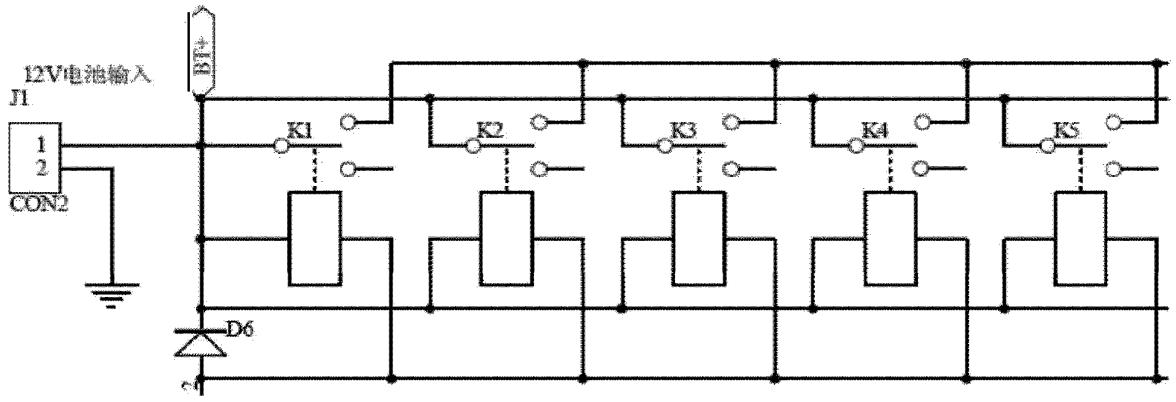


图 4

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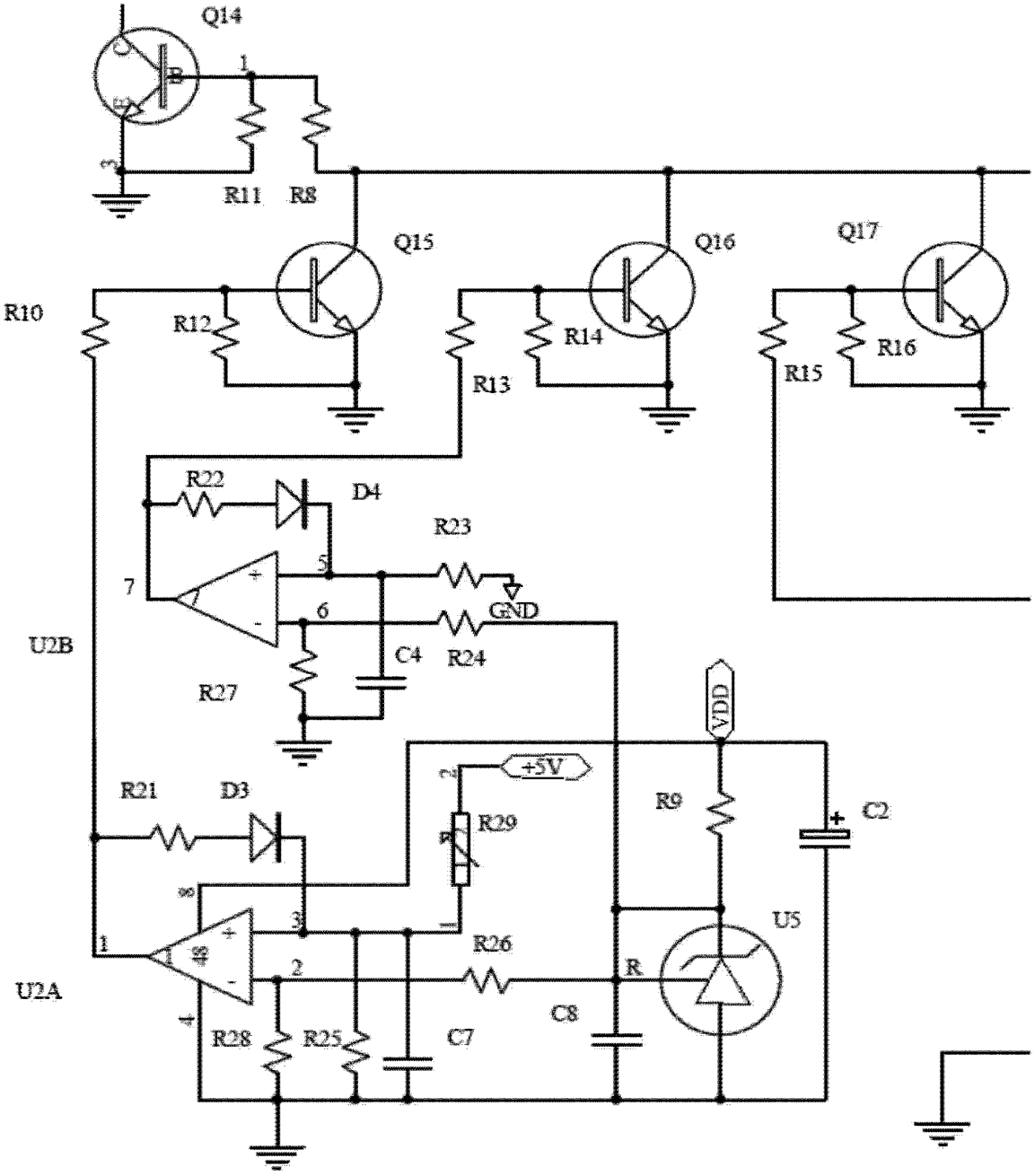

Q14
R11
R8
Q15
Q16
Q17
R10
R12
R13
R14
R15
R16
R22
D4
R23
U2B
GND
C4
R24
R27
VDD
+5V
R21
D3
R29
R9
C2
U5
R26
U2A
R
C8
R28
R25
C7

图 5

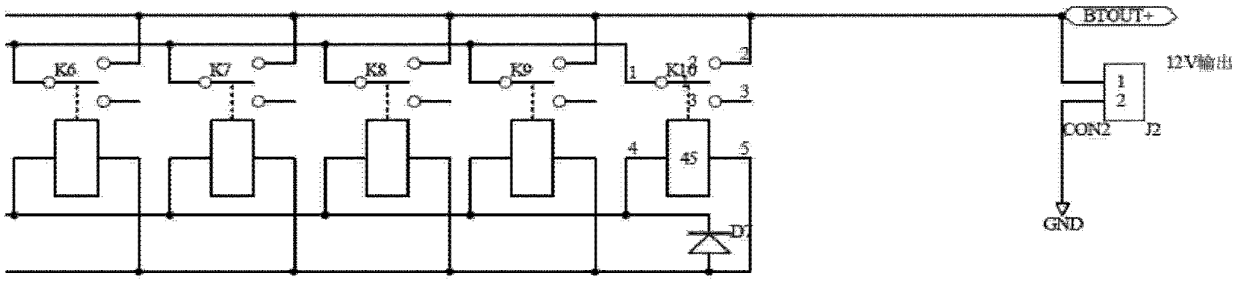


图 6

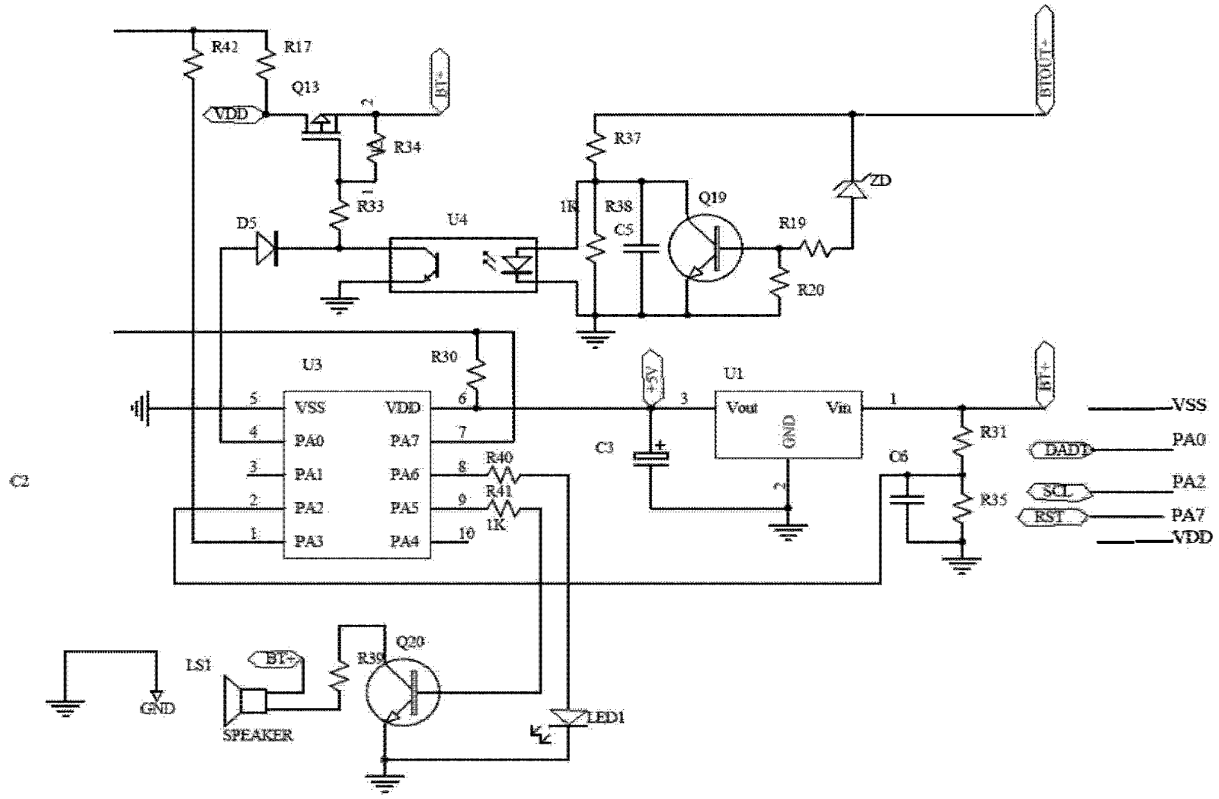


图 7

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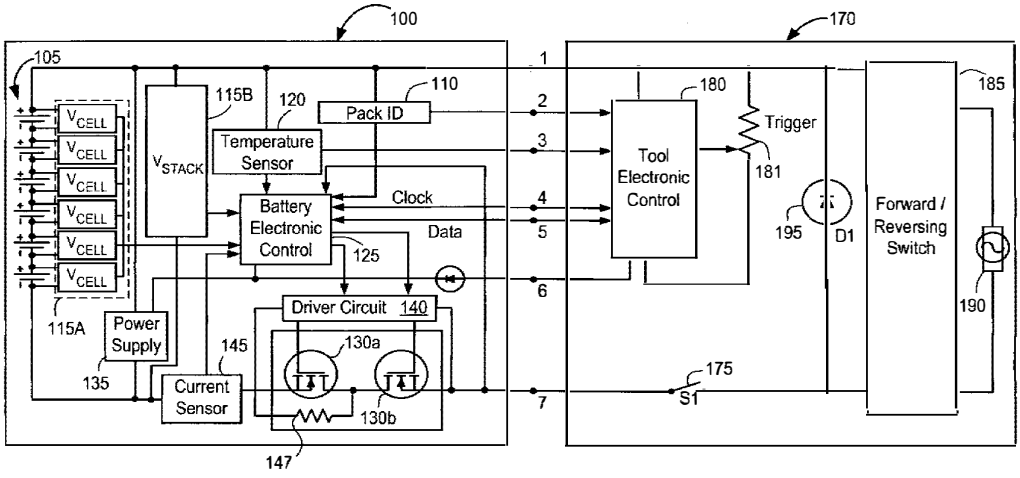
(74) Agent: **LATTIG, Matthew J.**; HARNESS, DICKEY & PIERCE, P.L.C., P.O. Box 8910, Reston, Virginia 20195 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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(54) Title: PROTECTION METHODS, PROTECTION CIRCUITS AND PROTECTIVE DEVICES FOR SECONDARY BATTERIES, A POWER TOOL, CHARGER AND BATTERY PACK ADAPTED TO PROVIDE PROTECTION AGAINST FAULT CONDITIONS IN THE BATTERY PACK



(57) Abstract: In a cordless power tool system, protection methods, circuits and devices are provided to protect against fault conditions within a battery pack that is operatively attached to a power tool or charger, so as to prevent internal or external damage to the battery pack or attached tool or charger. The exemplary methods, circuits and devices address fault conditions such as over-charge, over-discharge, over-current, over-temperature, etc.

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PROTECTION METHODS, PROTECTION CIRCUITS AND PROTECTIVE DEVICES FOR SECONDARY BATTERIES, A POWER TOOL, CHARGER AND BATTERY PACK ADAPTED TO PROVIDE PROTECTION AGAINST FAULT CONDITIONS IN THE BATTERY PACK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims domestic priority under 35 U.S.C. §120 to the following related U.S. Provisional patent applications filed in the United States Patent & Trademark Office: U.S. Provisional Application Serial No. 60/510,128, filed October 14, 2003, and U.S. Provisional Application Serial No. 60/551,803, filed March 11, 2004. The entire contents of the disclosures for each of these provisional applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to protection methods, protection circuits and protective devices for rechargeable batteries, to a power tool and charger adapted to provide protection for cells of an attached battery pack, and to a battery pack including protection control therein, each protecting the battery back against various potential fault conditions.

Description of Related Art

[0003] Over the past few years, lithium-ion (Li-ion) batteries have begun replacing nickel-cadmium (NiCd), nickel-metal-hydride (NiMH), and lead-acid batteries in low-voltage, portable electronic devices such as notebook-type personal computers. As compared to NiCd and NiMH batteries, Li-ion batteries are lighter but have a larger capacity per unit volume. For this reason, the Li-ion batteries have been typically suitable to low-voltage devices that are preferably light and which are required to endure continuous use for a long time. In an over-discharged state, however, the Li-ion batteries deteriorate rapidly, thus Li-ion batteries require over-discharge protection.

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[0004] A battery pack used in a portable electronic device typically has a plurality of battery cells connected in series. The maximum number of battery cells connected in series in one battery pack is determined by the output voltage of the battery pack. For instance, the typical output voltage of one NiCd battery cell or one NiMH battery cell is 1.2 V. Assuming that an 18V output voltage from a battery pack is suitable for most general purpose electronic devices, the maximum number of NiCd or NiMH battery cells connected in series in the battery pack is 15. On the other hand, the typical output voltage of one Li-ion battery cell is approximately 3.6 V. Accordingly, the maximum number of Li-ion battery cells connected in series in one fictional 18V Li-ion battery pack would be 5.

[0005] Unlike a NiCd battery pack and a NiMH battery pack, the Li-ion battery pack may include functionality to protect against fault conditions inside and outside the Li-ion battery pack. This prevents cells in the Li-ion battery pack from deteriorating and shortening useful life of the pack. For instance, if a fault condition such as short-circuiting occurs inside or outside the Li-ion battery, a fuse may be provided to cut off an over-discharging current or an overcharging current, if the discharging current or charging current becomes larger than a given current level.

[0006] Currently, protection circuits in battery packs such as Li-ion battery packs are designed primarily for low-voltage portable electronic devices such as notebook-type personal computers, cellular phones, etc., which require voltage generally on the order of 2 to 4 volts. Such devices are characterized by using battery packs composed of cells (such as Li-ion, NiCd, NiMH cells) that provide a maximum output voltage of about 4.2 volts/cell. For Li-ion battery cells, care must be taken to prevent damage from electrical and mechanical stresses, since lithium is a highly reactive substance.

[0007] Conventional protection circuits for these low-voltage battery packs may monitor cell voltages to prevent a given cell from over-charging or over-discharging, and may monitor current to keep current from rising too high.

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Other protection circuits may have one or more temperature inputs to disable current during charge or discharge until the battery pack cools down. Still other protection circuits may be designed to help maintain the balance of charge on the cells, commonly known as equalization circuits. A typical protection circuit may be connected to a given battery cell or group of cells in the battery pack to avoid these situations. For example, a conventional protection circuit may typically include a pair of MOSFET's or other semiconductors that can stop current flow in either direction.

[0008] However, much higher voltages than described above are required for higher-power electronic devices such as cordless power tools. Accordingly, higher-power battery packs may be in the process of being developed for cordless power tools. Such "high-power" battery packs may provide higher voltage outputs than conventional NiCd and NiMH battery packs (and substantially higher power than conventional Li-ion packs used for PCs and cell phones), and at a much reduced weight (as compared to conventional NiCd or NiMH battery packs used as power sources in conventional cordless power tools). A characteristic of these battery packs is that the battery packs may exhibit substantially lower impedance characteristics than conventional NiCd, NiMH and/or even the lower power Li-ion packs.

[0009] Further, as these battery technologies advance, the introduction of lower impedance chemistries and construction styles to develop secondary batteries generating substantially higher output voltages (of at least 18 V and up, for example) may possibly create several additional protection issues. Battery packs having lower impedance also means that the pack can supply substantially higher current to an attached electronic component, such as a power tool. As current through a motor of the attached power tool increases, demagnetization forces (e.g., the number of armature turns of the motor times the current, ampere-turns) could substantially increase beyond a desired or design limit in the motor. Such undesirable demagnetization could thus potentially burn up the motor.

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[0010] For example, a lower impedance electrical source could cause damage to a tool's motor when the tool is held at stall condition. During motor stall, the motor and battery impedances are the only mechanisms to limit the current since there is no back-EMF created by the motor. With a lower impedance pack, the currents would be higher. Higher currents through the motor will increase the likelihood of de-magnetization of the permanent magnets within the tool's motor.

[0011] Additionally, start-up of the tool could produce excessive starting currents and cause demagnetization of the motor. Thermal overload could also be a result of using a low impedance electrical source in an existing power tool, as the new batteries may be designed to run longer and harder than what the original cordless tool system was designed.

[0012] Accordingly, different protection controls may need to be in place to address potential fault conditions that could occur in high power battery packs that are adapted for use with both existing cordless power tools, and developing lines of power tools that are manufactured for use with these higher power battery packs. In particular, protection controls need to be developed to handle fault conditions such as over-charge, over-discharge, over-current, over-temperature and cell imbalance which could occur in one or more cells of a battery pack (such as a Li-ion or NiCd pack), so as to prevent internal or external damage to the pack, an attached device such as a charger or tool or to a user in the vicinity of a pack connected to a charger or tool.

SUMMARY OF THE INVENTION

[0013] In a cordless power tool system including a battery pack, exemplary embodiments of the present invention are directed to protection methods, protection arrangements and/or devices designed to protect against fault conditions in the battery pack operatively attached to the power tool or charger, so as to prevent internal or external damage to the battery pack or attached tool or charger. The exemplary methods, circuits and devices

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address fault conditions in the battery pack such as over-charge, over-discharge, over-current, over-temperature, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The exemplary embodiments of the present invention will become more fully understood from the detailed description given herein below and the accompanying drawings, wherein like elements are represented by like reference numerals, which are given by way of illustration only and thus are not limitative of the exemplary embodiments of the present invention.

[0015] FIG. 1 illustrates a partial block diagram of a protection circuit arrangement in accordance with an exemplary embodiment of the present invention.

[0016] FIG. 2 illustrates a partial block diagram of a protection circuit arrangement in accordance with another exemplary embodiment of the present invention.

[0017] FIG. 3A is a block diagram illustrating components and connections between an exemplary battery pack and an exemplary battery charger in accordance with an exemplary embodiment of the present invention.

[0018] FIG. 3B is a block diagram illustrating components and connections between an exemplary battery pack and an exemplary power tool in accordance with an exemplary embodiment of the present invention.

[0019] FIG. 4 is a partial block diagram of connections between a battery pack and charger to illustrate over-charge protection in accordance with an exemplary embodiment of the present invention.

[0020] FIG. 5 is a partial block diagram of connections between a battery pack and charger to illustrate over-charge protection in accordance with another exemplary embodiment of the present invention.

[0021] FIG. 6 is a graph of voltage versus time to illustrate an automatic shutdown for over-discharge protection invoked by a protection circuit in accordance with an exemplary embodiment of the present invention.

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[0022] FIG. 7 is a graph of voltage versus time to illustrate a modified threshold for over-discharge protection in accordance with an exemplary embodiment of the present invention.

[0023] FIGS. 8A and 8B illustrate exemplary devices used for over-current protection in accordance with an exemplary embodiment of the present invention.

[0024] FIG. 9 illustrates a device providing over-temperature protection in accordance with the exemplary embodiments of the present invention.

[0025] FIG. 10 illustrates a connection arrangement for a thermistor in accordance with an exemplary embodiment of the present invention.

[0026] FIG. 11 is a flow diagram illustrating a method of alerting an operator of a power tool of an impending fault condition in the battery pack.

[0027] FIG. 12 is a block diagram illustrating an exemplary arrangement for determining SOC and varying motor current switching frequency in accordance with an exemplary embodiment of the present invention.

[0028] FIG. 13A is an isometric view of a single laminate battery cell.

[0029] FIGS. 13B and 13C illustrate a device for protecting against an overcharge condition in accordance with an exemplary embodiment of the present invention.

[0030] FIGS. 14A and 14B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention.

[0031] FIGS. 15A and 15B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention.

[0032] FIGS. 16A and 16B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention.

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[0033] FIGS. 17-19 illustrate exemplary cordless power tools of a cordless power tool system in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0034] With general reference to the drawings, a system of cordless power tools constructed in accordance with the teachings of exemplary embodiments of the present invention is illustrated. Exemplary cordless power tools of the system are shown to include, by way of examples, a circular power saw 10 (FIG. 17), a reciprocating saw 20 (FIG. 18) and a drill 30 (FIG. 19). The tools 10, 20 and 30 each may include a conventional DC motor (not shown) adapted to be powered by a power source having a given nominal voltage rating. In the exemplary embodiments, the tools 10, 20 and 30 may be driven by a removable power source having a nominal voltage rating of at least 18 volts. It will become evident to those skilled that the present invention is not limited to the particular types of tools shown in the drawings nor to specific voltages. In this regard, the teachings of the present invention may be applicable to virtually any type of cordless power tool and any supply voltage.

[0035] With continued reference to the drawings, the removable power source which may be embodied as a battery pack 40. In the exemplary embodiments illustrated, the battery pack may be a rechargeable battery pack 40. Battery pack 40 may include a plurality of battery cells connected in series, and/or a plurality of serially-connected strings of cells, in which the strings are in parallel with one another. For purposes of describing the exemplary embodiments of the present invention, battery pack 40 may be composed of cells having a lithium-ion cell chemistry. As the exemplary embodiments are directed to the cordless power tool environment, which requires power sources having much higher voltage ratings than conventional low voltage devices using Li-ion battery technology, (such as laptop

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computers and cellular phones) the nominal voltage rating of the battery pack 40 may be at least 18V.

[0036] However, pack 40 may be composed of cells of another lithium-based chemistry, such as lithium metal or lithium polymer, or other chemistry such as nickel cadmium (NiCd), nickel metal hydride (NiMH) and lead-acid, for example, in terms of the chemistry makeup of individual cells, electrodes and electrolyte of the pack 40.

[0037] FIG. 1 illustrates a partial block diagram of a protection circuit arrangement in accordance with an exemplary embodiment of the present invention. FIG. 1 illustrates a portion of a battery circuit and in particular illustrates an individual protection device 102 for each cell 105 of a battery pack such as battery pack 40 in FIGS. 17-19. In FIG. 1, each protection device 102 may be adapted to perform a current limiting function. In an example, the protection devices 102 may be embodied as thermistor devices, where a thermistor device is part of or contained inside the cell.

[0038] A thermistor is a term used to describe a range of electronic components whose principle characteristic is that their electrical resistance changes in response to changes in their temperature, a 'thermally sensitive resistor'. Thermistors may be further classified as 'Positive Temperature Coefficient' devices (PTC devices) or 'Negative Temperature Coefficient' devices (NTC devices). PTC devices are devices whose resistance increases as their temperature increases. NTC devices are devices whose resistance decreases as their temperature increases. NTC thermistors are typically manufactured from proprietary formulations of ceramic materials based on transition metal oxides.

[0039] In FIG. 1, the protection devices 102 may be embodied as PTC devices, which may protect the string of cells from thermal overload. If any cell becomes hot, the PTC device within that cell increases in resistance to limit the current through the entire string. This method of protection of battery

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cells may have a drawback in that it requires many devices (PTC's in this example) performing a current limiting function as protection device 102.

[0040] FIG. 2 illustrates a partial block diagram of a protection circuit arrangement in accordance with another exemplary embodiment of the present invention. An alternative approach to using multiple protection devices 102 is to include a dedicated protection circuit 210 for each cell that senses one or more battery pack parameter in a pack such as battery pack 40, for example. These parameters include, but are not limited to current, temperature, voltage and impedance through the pack. A protection circuit 210 may be operatively connected to a corresponding driver circuit 220. The level-shifting circuits 220 may be connected to a plurality of AND gates (shown by box 230) to link the protection circuit(s) 210 to a master device 240 which performs a current limiting or current interrupting function. If any protection circuit detects a problem it can change from an output high to an output low state. The AND gates ensure that all protection circuit outputs are high (OK) to turn master device 240 on. Additionally, it is envisioned that the reverse logic could be used with the protection devices output to be normally low and using NOR gates instead. The master device 240 may be embodied as semiconductor device such as a metal-oxide semiconductor field effect transistor (MOSFET), as shown in FIG. 2. Accordingly, if a battery pack has multiple cells 105 in series, then an exemplary configuration envisions a set of protection circuits 210 (apportioned one per cell) connected to and controlling a master device 240 that enables/disables current flow, such as a MOSFET.

[0041] As discussed above, using multiple, dedicated protection circuits 210 may require a corresponding level-shifting circuit 220 that drops the voltage changes from the highest potential cells down to normal levels to switch the master semiconductor device 240, as shown in FIG. 2 for example. If monitoring each cell is excessive, then groups of cells or the entire battery pack may be monitored with a single protection circuit 210 and a single master device 240 for limiting or interrupting current.

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[0042] FIG. 3A is a block diagram illustrating components and connections between an exemplary battery pack and an exemplary battery charger in accordance with an exemplary embodiment of the present invention. FIG. 3A is merely an exemplary circuit configuration and is provided as a context for more clearly describing the various protection methods, circuits and devices in accordance with the exemplary embodiments.

[0043] Referring to FIG. 3A, battery pack 100 may include a plurality of battery cells 105 connected in series (six shown for simplicity, pack 100 could include more or less than six cells or may be composed of serial strings of cells with the serial strings in parallel with each other). For purposes of describing the exemplary embodiments of battery pack 100 may be composed of cells having a lithium-ion cell chemistry. As the exemplary embodiments are directed to the cordless power tool environment, which requires much higher voltage ratings than conventional devices using Li-ion battery technology, the nominal voltage rating of the battery pack 100 may be at least 18V.

[0044] Thus, battery pack 100 in FIG. 3A (and in FIG. 3B) may be applicable to and/or designed for cordless power tool systems comprising at least a cordless power tool, the battery pack and a charger. Pack 100 may be understood as a removable power source for high-power, power tool operations. In an example, battery pack 100 may have a nominal voltage rating of at least 18 volts and/or have a maximum power output of at least about 385 Watts. However, it should be evident to those skilled in the art that the present invention is not necessarily limited to the particular types of tools shown in FIGS. 17-19 nor to specific voltage ratings and/or power output specifications described above.

[0045] Pack 100 may further be composed of cells of another lithium-based chemistry, such as lithium metal or lithium polymer, or other chemistry such as nickel cadmium (NiCd), nickel metal hydride (NiMH) and lead-acid, for

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example, in terms of the chemistry makeup of individual cells, electrodes and electrolyte of the pack 100.

[0046] In FIG. 3A, seven terminal (terminals 1-7) are shown. However, the exemplary embodiments should not be limited to this terminal configuration, as more or less terminals could be included depending on the desired information passed between, or parameters monitored by, the pack 100 or charger 150.

[0047] The pack 100 may also include a Pack ID 110 connected to an output terminal (terminal 1) for identification of the pack 100 when inserted into a charger 150. The Pack ID 110 may include the model number, version, cell configuration and the battery type (chemistry), such as lithium-ion, NiCd or NiMH, for example. The Pack ID 110 may be embodied as one or more communication codes received from output terminal 1 of the battery pack 100 by an asynchronous full duplex communication system in the pack 100, such as is described in U.S. Patent No. 5,680,027 to Hiratsuka et al. However, this is only one example, as the pack ID 110 may also be embodied by an ID resistor, LED display that displays identification data of the pack, serial data sent upon engagement and sensed by the tool/charger via terminal 2 for example, and/or a field in an frame of data sent over an air interface to the tool/charger, etc.

[0048] The pack 100 may further include one or more temperature sensors 120. Temperature sensor 120 may be embodied as NTC or PTC thermistors, Temperature sensing Integrated Circuits, or thermocouples. The temperature sensor 120 may communicate the temperature inside the battery pack 100 to intelligence in the battery pack 100 and/or to intelligence in a connected charger 150, for example, via terminal 3. As the function of such temperature sensors are known, a detailed explanation of functional operation is omitted for purposes of brevity. Power connections for charging and discharging are represented as terminals 1 and 7.

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[0049] A battery electronic control unit 125 may be responsible for the protection of the cells 105 for any fault condition exposed on the terminals by the user (via charger 150, an attached tool, and/or due to user tampering). The battery electronic control unit 125 may be embodied in hardware or software as a digital microcontroller, a microprocessor or an analog circuit, a digital signal processor or by one or more digital ICs such as application specific integrated circuits (ASICs), for example.

[0050] The discharge current and charge current can be clamped or discontinued by the use of semiconductor devices 130a (discharge FET) and 130b (charge FET), under the control of battery electronic control unit 125. The battery electronic control unit 125 may be powered by an internal power supply 135 as shown, and the semiconductor devices 130a and 130b may be linked through a driver circuit 140.

[0051] Battery pack 100 may further include a current sensor 145 which senses current and provides a signal to battery electronic control unit 125. Current sensor 145 may be embodied as known components for current sensors, such as a shunt resistor, current transformer, etc. which may provide a signal representing sensed current in pack 100 to battery electronic control unit 125. Semiconductor devices 130a may include a pull down resistor 147 which acts to bypass the semiconductor device 130a when device 130a is off and the pack 100 is dormant.

[0052] Pack 100 may also include a voltage monitor circuit 115. Voltage monitor circuit 115 may be embodied by any known voltage monitor circuit, for example, and may be configured to sense individual cell voltage and/or sense total pack voltage of the string of cells 105 ('stack voltage') to provide a signal representing the individual cell or stack voltage to battery electronic control unit 125. As a variant, and instead of a single voltage monitor circuit 115 configured to sense both individual cell and total stack voltage, pack 100 could include a voltage monitor circuit as shown in FIG. 3A, comprising a first plurality of voltage monitor circuits (shown generally as 115A) for sensing

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individual cell voltage and a second voltage monitor circuit 115B for sensing total stack voltage of the cells 110, for example.

[0053] Referring back to FIG. 2, for example, protection circuit 210 may include at least battery electronic control unit 125, current sensor 145, a voltage monitor circuit 115 and temperature sensor 120, and optionally may further include pack ID 110 and an internal power supply such as power supply 135. Driver circuit 140 may be analogous to driver circuit 220 in FIG. 2 and semiconductor devices 130a and 130b may singly or together represent a master device 240 having a current limiting/interrupting functionality under the control of the protection circuit 210.

[0054] Referring to FIG. 3A, during discharge, the battery electronic control unit 125 may output pulse width modulation (PWM) control signals to drive the driver circuit 140. For example, a pulsing semiconductor (pulse width modulator (PWM)) is commonly used in the electronics industry to create an average voltage that is proportional to the duty cycle. PWM is modulation in which the duration of pulses is varied in accordance with some characteristic of the modulating signal. Alternatively pulse frequency modulation could be used to create this average voltage. In either case, the semiconductor devices 130a and 130b (which may be embodied as a discharge FET and charge FET respectively) may be switched between ON and OFF states to create an average voltage that is proportional to the duty cycle at which it is switched.

[0055] During discharge, the driver circuit 140 level shifts the PWM output of battery electronic control unit 125 to drive the gate of semiconductor device 130a, cycling the semiconductor devices 130a on and off depending on sensed conditions. Since the semiconductor device 130b is reverse-biased, the device 130b passes current with only a diode drop in voltage. If the current were at 20 Amps and device 130b had a forward voltage of 0.6 Volts the power loss would be only 12 watts. If lower losses are desired, the battery electronic circuit 125 may output a state to the driver circuit 140 which

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commands the semiconductor device 130b to remain on during the PWM action on semiconductor device 130a. Now, the power lost into device 130b would be its on resistance time the current squared (I^2R_{ON}). Today's MOSFETs typically have an on-resistance (R_{ON}) of 10 milliohms, so at 20 Amps the power loss would only be 4 watts. The result is a controlled discharge and lower losses through the semiconductor device.

[0056] During charge, the reverse logic can be applied. Semiconductor device 130a is reversed-biased with respect to current flow and even though it conducts in the OFF state, device 130a should remain ON for the least amount of losses. Semiconductor device 130b may control the charge current based on information from the battery electronic control 125 going through the driver circuit 140. The component arrangement that comprises driver circuit 140 is known in the art and is not described herein for reasons of brevity.

[0057] When battery pack 100 is connected to charger 150, a charger electronic control unit 155 in the charger 150 may be powered from the battery's internal power supply 135 through terminals 1 and 6. This is only an exemplary connection scheme, as other means for powering the charger electronic control unit 155 can be employed. The charger 150 could have its own supply or derive it directly from the battery voltage. The charger electronic control unit 155 may also be embodied in hardware or software as a digital microcontroller, microprocessor, analog circuit, digital signal processor, or by one or more digital ICs such as application specific integrated circuits (ASICs), for example. Battery and charger data and control information may be exchanged through serial data paths on terminals 4 and 5. The charger electronic control unit 155 may drive a power controller 160 with a set voltage and a set current to deliver the desired voltage and current from a power source 165 to the battery pack 100 via terminals 1 and 7.

[0058] FIG. 3B is a block diagram illustrating components and connections between an exemplary battery pack and an exemplary power tool in accordance with an exemplary embodiment of the present invention. FIG. 3B

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is merely an exemplary circuit configuration and is provided as a context for more clearly describing the various protection methods, circuits and devices in accordance with the exemplary embodiments. The battery pack and tool configuration of FIG. 3B may be applicable to the exemplary cordless tool systems, and equivalents, in any of FIGS. 17-19. In FIG. 3B, a 'smart' power tool 170 is illustrated, it being understood that battery pack 100 may be adapted for powering a 'dumb' power tool, i.e., a power tool without an intelligent device or microelectronic component control such as a microprocessor.

[0059] Referring to FIG. 3B, power tool 170 may be powered from the internal battery power supply 135 via terminals 1 and 6. The tool 170 may include a mechanical switch 175 that pulls terminal 7 high when the semiconductor device 130a (discharge FET) is off. If semiconductor device 130a is left off while the battery pack 100 is dormant, the voltage at terminal 7 is low because of the pull down resistor 147. This resistor value should have a substantially high resistance since it acts to bypass the semiconductor device 130a. With this pull down resistor 147 in place and the semiconductor device 130a in the off state, the voltage at terminal 7 remains low until a switch 175 in tool 170 is activated. The result is that power terminal 7 immediately increases in voltage and the signal through power terminal 7 could be used to wake the battery pack 100 from a dormant mode of operation. Tool 170 may include a tool electronic control unit 180. Tool electronic control unit 180 may also be embodied in hardware or software as a digital microcontroller, microprocessor, analog circuit, digital signal processor, or by one or more digital ICs such as application specific integrated circuits (ASICs), for example.

[0060] The tool electronic control unit 180 may be programmable so as to read a trigger position of a trigger 181 and report the trigger position to the battery electronic control unit 125 via serial data paths at terminals 4 and 5. Based on the trigger position data, the battery electronic control unit 125 may

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vary the PWM duty cycle through semiconductor device 130a to obtain the desired motor speed in tool motor 190. While semiconductor device 130a is off, a diode 195 in the tool 170 may re-circulate residual inductive motor current to prevent voltage spikes from occurring therein. The forward/reversing switch 185 is typical for cordless tools and will not be described here.

[0061] A dumb tool (not shown) may just have a trigger 181 configured as a potentiometer and connected to one of terminals 1, 4 or 5, and to terminal 6. The battery electronic control unit 125 may recognize the lack of serial data communications and perform an analog analysis of the voltage at terminals 4 or 5. Based on the analysis, the battery electronic control unit 125 may send PWM control signals via driver circuit 140 to cause semiconductor device 130a to switch at the desired duty cycle, so as to create an intended motor speed. Even dumber tools could exist as on/off tools. These tools require only the connection to terminals 1 and 7 for operation.

Over-charge Protection

[0062] There are two basic types of battery chargers used for recharging battery packs: trickle chargers and fast chargers. Trickle chargers are significantly less expensive than fast chargers; however a trickle charger requires approximately a 1/2 day for recharging a battery pack. A fast charger can recharge a battery pack within about an hour. An over-charge fault condition may occur because of some fault condition or system failure in either the charger or battery pack. Typically, a protection circuit in the battery pack can detect an over-charge fault condition by monitoring voltage across the battery pack. During charge, the voltage reaches a particular threshold. The charger thus considers the battery pack 'fully charged' and the charge current is terminated. If the charger was locked-on due to a component failure, it is desirable for the battery pack to be able to disable the charging current with its own semiconductor device, such as charge FET

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(semiconductor device 130b) under the control of battery electronic control unit 125.

[0063] Over-charge control may be provided by use of a charge lock-on detection circuit (also known as a 'hardware watchdog circuit') between the battery pack and the charger. In general, if the charger locked-on and pulsing data (e.g., a clock provided from pack to charger via a suitable serial data path) stopped, then the hardware watchdog may automatically turn off the current flow.

[0064] A conventional hardware watchdog circuit is typically located in the charger. This circuit monitors the charge current and looks for a 10ms current off reset pulse in the charging current. In a typical charging scenario, a microprocessor in the charger (such as charger electronic control unit 155) may generate this reset pulse using the charge control line I_{CTRL}. In an abnormal situation (e.g., the charger microprocessor has locked the current solid on or the charger power supply has locked the current solid on), the hardware watchdog circuit would timeout and turn the charge current off using a charge FET. However, in the conventional arrangement, it is still possible to overcharge the battery pack if the microprocessor in the charger were to continually generate the reset pulse without ever terminating the fast charge (due to improper microprocessor behavior, for example).

[0065] FIG. 4 is a partial block diagram of connections between a battery pack and charger to illustrate over-charge protection in accordance with an exemplary embodiment of the present invention. In FIG. 4 seven terminals and six battery cells are shown for convenience, it being understood that more or less terminals and battery cells could be illustrated in the exemplary embodiment.

[0066] In FIG. 4, battery pack 100 includes at least a battery electronic control unit 125, semiconductor device 130b (such as charge control FET) and temperature sensor 120. The temperature sensor 120 may be embodied as an internal NTC thermistor, for example. The charger 150 may include at

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least charger electronic control circuit 155, a charge FET 157 and a hardware watchdog circuit 158.

[0067] The battery electronic control unit 125 may receive a battery temperature value from the internal NTC thermistor and may communicate this information via serial data paths at terminals 3 and/or 4 to the charger electronic control unit 155. In the event of an extreme battery temperature due to an overcharge condition, the charge current may be terminated by the battery electronic control circuit 125 sending a PWM control signal or pulse, via driver circuit 140, to turn semiconductor device 130b off. Alternatively, this control signal may be sent via serial data paths at terminals 3 and/or 4 to charger electronic control circuit 155 to turn off the charge FET 157 in the charger 150. However, it may still be possible to overcharge the battery pack 100 in the event of a two-point failure – a shorted semiconductor device 130b (charge control FET) in the battery pack 100 and improper unit behavior in one of the battery electronic control unit 125 or charger electronic control unit 155.

[0068] The dotted arrowhead lines in FIG. 4 show a hardware watchdog circuit 158 (hereafter watchdog 158) having multiple reset inputs. In addition to monitoring the charge current reset pulse, watchdog 158 also monitors the serial communications clock path (through terminal 3) as a reset pulse. If any of these reset pulses did not occur, the watchdog would timeout and turn the charge current off. It may still be possible to overcharge the battery pack 100 in the event of a 2 point failure–a shorted charge control FET (e.g., device 130b) in the battery pack 100 and improper unit behavior in one of the battery electronic control unit 125 or charger electronic control unit 155.

[0069] In addition to monitoring the charge current reset pulse, watchdog 158 also monitors the pack temperature at temperature sensor 120 (such as an NTC thermistor) directly to sense an overcharge condition. In FIG. 4, a shorted battery charge control FET (semiconductor device 130b) and any failures in the battery electronic control unit 125 or charger electronic control

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unit 155 would not affect the watchdog's 158 ability to monitor the pack temperature for sensing and terminating an overcharge condition.

[0070] In addition to monitoring the charge current reset pulse, watchdog 158 could also monitor the individual cell voltages using circuits 415A and terminal 6 to sense an over voltage condition which would indicate an overcharge condition. In FIG. 4, a shorted battery charge control FET (semiconductor device 130b) and any failures in the battery electronic control unit 125 or charger electronic control unit 155 would not affect the watchdog's 158 ability to monitor the individual cell voltages for sensing and terminating an overcharge condition.

[0071] In addition to controlling the hardware watchdog, the voltage monitor circuits 415A used for monitoring the individual cell voltages could also directly control the charge FET 130b in the battery pack 100 through the driver circuit140 and/or directly control the charge FET in the charger (157) through the AND logic (151) and terminal 6. This is shown by the dotted lines between voltage monitor circuits 415A and driver circuit 140. This control would allow circuits 415A to stop an overcharge condition due to overvoltage of the individual cells.

[0072] In addition to monitoring the charge current reset pulse, watchdog 158 could also monitor the battery stack voltage using voltage monitor circuit 415B and terminal 7 to sense an overvoltage condition which would indicate an overcharge condition. In FIG. 4, a shorted battery charge control FET (semiconductor device 130b) and any failures in the battery electronic control unit 125 or charger electronic control unit 155 would not affect the watchdog's 158 ability to monitor the battery stack voltage for sensing and terminating an overcharge condition.

[0073] In addition to controlling the hardware watchdog, voltage monitor circuit 415B used for monitoring the battery stack voltage could also directly control the charge FET in the battery (130b) (see optional dotted line 425) through the driver circuit (140) and/or directly control the charge FET in the

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charger (157) through the AND logic (151) and terminal (7). This control would allow voltage monitor circuit 415B to stop an overcharge condition due to overvoltage of the entire battery stack voltage.

[0074] FIG. 5 is a partial block diagram of connections between a battery pack and charger of a cordless power tool system to illustrate over-charge protection in accordance with another exemplary embodiment of the present invention. FIG. 5 omits the voltage monitor circuits 415A and 415B for purposes of clarity, it being understood that both individual cell voltage and total stack voltage could be inputs to a hardware watchdog circuit 158' in FIG. 5, similar to as shown in FIG. 4.

[0075] FIG. 5 is a hybrid of FIG. 4 to illustrate a watchdog 158' with multiple inputs. Watchdog 158' monitors the charge reset pulse, clock reset pulse, and the NTC signal, cell voltage, and/or battery stack voltage in order to sense a charge lock-on condition. The charge current could still be shut off even with a shorted charge control FET 130b in the battery and improper unit behavior in one of the battery electronic control unit 125 or charger electronic control unit 155, and may reduce the number of terminals needed by sharing the NTC output terminal with the clock terminal. Accordingly, the exemplary hardware watchdog circuit(s) in FIGS. 4 and 5 may prevent battery overcharging by monitoring the condition of both the battery pack 100 and charger 150. Overcharge prevention remains available even in the event of a two-point failure such as a shorted battery charge FET and improper microprocessor behavior in one (or both) of the battery pack 100 and charger 150.

[0076] Determination of an over-charge fault condition can also be done by other means. If an accurate current measurement is made by a current sensor in the battery pack (such as current sensor 145) during discharge, then a coulomb measurement could be made by the battery electronic control unit 125 to put back in the amount of energy taken out. This could be used in conjunction with or without the voltage measurement that may be made by a

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protection circuit 210 in the battery pack 100 to detect an over-charge fault condition.

Over-Discharge Protection

[0077] Various battery technologies can be damaged when discharged in excess of the manufacturer's recommendations. In accordance with the exemplary embodiments, the battery pack 100, such as is shown above in FIGS. 3A or 3B, may include circuitry to prevent current flow when the battery voltage drops below a given voltage threshold, hence under-voltage lockout. A protection circuit 210 in the battery pack can sense battery voltage and if the voltage drops below a given voltage level, the discharge FET (semiconductor device 130a) is turned off. Battery cells 105 would still be susceptible to charge, but would not discharge any more. The threshold may be an absolute threshold set at time of manufacture, for example, or a threshold that may vary based on a number of given factors.

[0078] FIG. 6 is a graph of voltage versus time to illustrate an automatic shutdown invoked by a protection circuit in accordance with an exemplary embodiment of the present invention. To protect against an over-discharge fault condition in a battery pack of a cordless power tool system, an exemplary protection circuit 210 (such as shown in FIG. 2) and/or the battery electronic control 125 in FIGS. 3A-5, could perform an automatic shutdown of current in pack 100 if the voltage reached a given threshold.

[0079] An improvement to the aforementioned voltage threshold may be to combine the threshold with a proportion of discharge current to compensate for the impedance of the battery pack 100. Basing the threshold on an absolute level and subtracting a portion of the instant current may provide an alternative method for under-voltage lockout.

[0080] FIG. 7 is a graph of voltage versus time to illustrate a modified threshold for over-discharge protection in accordance with an exemplary embodiment of the present invention. For the purposes of describing FIG. 7, the protection current 210 of FIG. 2 or the battery electronic control 125 could

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be configured to make the following calculations and/or perform the automatic shutdown. FIG. 7 shows an example of a battery pack at 10% state-of-charge. By adding in a proportion of discharge current to compensate for the impedance of the battery pack 100, the battery pack 100 is still above a given discharge threshold of 2.7 volts.

[0081] For example, if a 10 amp pulse load is placed on the battery pack 100, the battery impedance would cause the voltage to jump below the threshold momentarily and return to its resting value when the current pulse is removed. Even though the battery pack 100 had 10% of charge left, a protection current would have interrupted current flow. However, if the low-voltage threshold was partially compensated with current as described in the previous paragraph, the threshold would be dropped during the heavy current draw and no shutdown would occur. In other words, the low-voltage threshold may be varied by subtracting a portion of the instantaneous discharge current to compensate for pack impedance so as to avoid an unwanted automatic shutdown.

[0082] Once the impedance of the pack is known, then the portion of the low-voltage threshold related to current can be calculated. Additional battery factors that may influence the low voltage threshold may include battery temperature, battery age, rate of decrease in battery voltage, etc.

Over-current Protection

[0083] FIGS. 8A and 8B illustrate exemplary devices that may be used in the battery pack for over-current protection in accordance with an exemplary embodiment of the present invention. FIGS. 8A and 8B illustrate only a portion of a battery pack circuit for reasons of brevity. However, the devices in FIGS. 8A and 8B could be part of the battery pack 100 as shown in any of FIGS. 3A-5. Another mechanism that can cause cell damage is over-current. Various electronic switching methods may have a drawback, in that electronic switches are prone to failing in a short circuit condition. When this happens, an operator overload the motor of the attached tool. For battery pack circuit

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designs that include separate impedance branches, a device such as a fuse or fusible link could be used to limit the maximum current through that circuit branch.

[0084] Fuses generally are not designed to provide overload protection, as a fuse's basic function is to protect against short circuits. However, a dual-element (two-element) fuse or time delay fuse may provide secondary motor overload protection, although when blown must be replaced, as these fuses are nonrenewable. Accordingly, such a fuse could represent a secondary failure and be intended to prevent further operation, for example.

[0085] Thus, a simple fuse as shown in FIG. 8A may be designed to limit the current through the cells 105, but may also cause permanent damage once its rating is exceeded. Other devices such as Positive Temperature Coefficient (PTC) elements and re-settable fuses may be substituted for the fuse in FIG. 8A for over-current protection. As discussed above, PTC devices or elements are known as protective elements for controlling the current which flows through circuits to be protected, since their resistance value increases as they give off heat in over-current conditions. For example, PTC thermistors have been used as an over-current protection element. When an electronic circuit gets overloaded, conductive polymers of a PTC thermistor, which have PTC properties, emit heat and thermally expand to become high resistance, thereby reducing the current in the circuit to a safe, relatively small current level.

[0086] Accordingly, if a PTC device such as described above is connected in series with the battery, the total pack impedance would increase with increasing current. If substantially low impedance is needed and no commercially available single PTC device can offer the desired low impedance and/or current capability, then multiple PTC's could be connected in parallel with each other to share the current, as shown in FIG. 8B, for example.

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[0087] If separate charge and discharge paths or branches are envisioned in the battery pack, then a thermal fuse such as a PTC element could be placed on each current path. This would be beneficial in that the charge path would use a low current device and the discharge path would use a high current device.

[0088] Proximity placement of a fuse nearer the terminals also may provide an added benefit of isolating the downstream branch of electrical devices from a non-isolated charger. If a battery pack 100 were to melt sufficiently to expose the cells 105 and electronics, the fuses (which would have blown) near the terminals would provide a disconnect of the exposed metal from the non-isolated charger output, hence electric isolation to possible preserve electrical components in an attached charger (or tool). Thus, positioning the fuse (or PTC element) in FIG. 8A nearer the terminal may provide additional over-current protection in pack 100.

[0089] Using current sensing measures (such as current sensor 145 of FIGS. 3A and 3B) and a semiconductor device (such as semiconductor devices 130a and 130b) to stop current flow once an over-current threshold is reached may be a desirable method of preventing cell-damage. For example, current sensor 145 may be adapted to sense pack current to generate a control signal based on sensed current exceeding a given current limit or threshold. A semiconductor device having a current limiting or current interrupting function (e.g., semiconductor devices 130a and 130b) may be directly connected to the current sensor 145. The semiconductor device may be adapted to limit or interrupt current based on the control signal received directly from the current sensor 145 instead of from battery electronic control 125 via driver 140.

[0090] Current sensing could also be coupled with an averaging algorithm if momentarily high current loads were acceptable but steady state high current was not acceptable. A suitable current limit or threshold could also be variable, and proportional, to the temperature of the cells. This may be

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beneficial in that, if the cells were already hot, the maximum current pulled out would not be sufficient to overheat the internal cell chemistry.

Over-temperature protection

[0091] Some batteries may also be damaged by extreme temperatures (extreme high or low temperatures) or have reduced performance (i.e., reduced voltage and/or current output) due to extreme temperatures. This is particularly relevant to battery packs having a Li-ion cell chemistry. A battery temperature threshold may be set to shutdown the battery pack until it cools below a desired or given temperature. Likewise, a battery temperature threshold may be set to shutdown the battery pack until it rises above a desired or given temperature. These thresholds can also be based on a set limit with a partial dependence on current, voltage, age, and rate of rise or fall in temperature, for example. As discussed above, one or more temperature sensors may be used for determining the state of the battery pack temperature.

[0092] FIG. 9 illustrates a device providing over-temperature protection in accordance with the exemplary embodiments of the present invention. An over-temperature fault condition in a battery cell may cause permanent damage. Thus, a protection circuit configured to monitor absolute temperature may be useful in preventing over-temperature conditions. FIG. 9 illustrates only a portion of a battery pack circuit for reasons of brevity. However, the devices in FIG. 9 could be part of the battery pack 100 as shown in any of FIGS. 3A-5.

[0093] As shown in FIG. 9, the protection device 210 may be embodied as a thermal switch 910 that opens high current contacts 920. These contacts may be located within the circuit to stop any current flow in or out of the pack 100 until the temperature drops to an acceptable level. These devices may be typically set to trip at a pre-determined temperature and are usually found in coffee makers, for example. Once the water in a coffee maker is boiled off the heating element temperature rises above 212°F. The temperature switch

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senses this and breaks the temperature controlled switch. When the pack (or a cell) temperature gets too hot, the charge and /or discharge function in pack 100 is disabled.

[0094] Alternatively, a thermally controlled release mechanism could 'pop' the battery pack 100 out of the tool 170 or charger 150 and prevent re-insertion, until the pack 100 has cooled off. This device could be similar to a "pop-up timer" aimed at a latch mechanism which restrains an ejection device within pack 100, as will be seen in further detail below. Another device for protecting against an over-temperature fault condition is the use of a thermistor. A thermistor may be utilized in the battery pack 100 to monitor temperature conditions while maintaining full electrical isolation of the thermistor from the battery cells 105.

[0095] Currently, manufacturers typically may include a thermistor in battery packs to monitor the temperature of the core pack and to terminate charge in the event of an over temperature condition. These thermistors have a connection arrangement in which one end is connected to a terminal going out to the charger 150, and the other end is referenced to ground by tying to the negative terminal lead in the battery pack.

[0096] For high power battery packs adapted for use with both existing cordless power tools, and developing lines of power tools that are manufactured for use with these high power battery packs, such as Li-ion battery packs, this above connection arrangement may be problematic, since the connection arrangement creates the potential for a charge path through the thermistor. If a small amount of current were passed through the thermistor, the battery pack could potentially be charged outside the protection controls and circuitry provided in the pack 100 and charger 150. This could potentially lead to an inadvertent overcharging of the pack 100, a potentially hazardous condition.

[0097] FIG. 10 illustrates a connection arrangement for a thermistor in accordance with an exemplary embodiment of the present invention. In FIG.

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10, only the positive and negative terminals of the pack 100 are shown for clarity. FIG. 10 illustrates only a portion of a battery pack circuit for reasons of brevity. However, the thermistor in FIG. 10 could be part of the battery pack 100 as shown in any of FIGS. 3A-5. The two leads of the thermistor (Th+ and Th-) may be brought out of the pack on independent terminals 2 and 3. These terminals may interface to temperature monitoring circuitry inside of the charger 150, for example, such as temperature monitoring circuitry of the charger electronic control unit 155 (not shown in FIG. 10 for clarity). This may allow monitoring of pack 100 temperature while keeping the thermistor completely isolated from the charge path in the pack 100. By doing this, there is no charge path through the thermistor and no potential to overcharge the battery pack 100 through the thermistor.

Audible/Visual Warning Mechanisms

[0098] Before shutting down the battery power, it may be desirable that some kind of warning be provided to the operator of a cordless tool powered by the attached battery pack. Similar to a scenario when a fault condition occurs, or is in the process of occurring, in an owner's car, the owner may be given a warning light on the dashboard for a given duration of time before the engine breaks down because of the fault condition (i.e., piston damage due to a lack of oil).

[0099] Both under-voltage and temperature limitations can be used as a cut-off, i.e., the battery pack 100 ceases to output current once a threshold is reached. However, before such a fault condition occurs (such as an under-voltage or over temperature threshold) is reached, a warning mechanism in either the battery pack or tool may warn the operator that the operator is approaching an impending operating limit in the pack that may automatically shutdown battery power in the pack. The warning mechanism could be audible (with a horn or buzzer) or visible using a desired illumination scheme such as LEDs, for example.

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[00100] The audible and/or visible warning mechanism may be tied into the existing circuitry in the pack 100 or tool 170. As discussed above, the battery pack 100, tool 170 or charger 150 in any of FIGS. 3A through 5 and may be controlled by intelligence in the pack, tool, charger, etc. Such intelligence as battery electronic control 125 or tool electronic control 180 could be configured to control warning mechanisms for various impending or present fault conditions. As an example, a separate audible or visual warning may be provided to alert the tool operator of an over-discharge condition in the battery pack 100, an over-current condition in the battery pack 100, and over-temperature condition in the pack 100 or in the motor 190 of the attached tool 170, and/or an under-voltage condition in the battery pack 100 due to an excessive amount of current being drawn from the battery pack 100.

[00101] As discussed above, the warning mechanism before an impending automatic battery power shutdown is reached could be embodied in many different forms. The aforementioned audible warnings such as horns, buzzers, and speaker sounds might be acceptable in some working environments, but may not be heard by the tool operator in loud environments. Visual cues such as specified illumination(s) and gauges may also be missed by the tool operator in extremely dark or substantially bright work areas.

[00102] An alternative warning mechanism to alert the tool operator may be embodied in the motor control of the tool motor. In general, an electronic circuit in one of the tool or battery pack could reduce the maximum power output capability of the battery pack and produce a "fold back" condition. The operator would both hear and feel this condition as a 'weakening' of the tool performance. The operator would be prompted to back off and avoid an impending fault condition (e.g., under-voltage, over-temperature, under-temperature condition, etc.).

[00103] An additional method for alerting the user of an impending fault condition would be to vary the motor control's pulse width modulation (PWM)

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to create a "warble" effect in the speed of the motor. This mild cyclic change in motor speed is selected as such it would not adversely affect tool performance. This method provides the user with both audible and tactile feedback on the impending fault condition.

[00104] A third method for alerting the user of an impending fault condition would be to lower the PWM frequency into the audible frequency range and vary the pitch in a periodic fashion. This will present an efficient warning mechanism to get the operator's attention. At the very least, the warning mechanism gives the operator a sense of warning that they may be able to finish the current job, but may not be able to move on to another job before resting or recharging the battery pack to eliminate or overcome the impending fault condition.

[00105] Any of the above warning mechanisms, either singly or in combination with one or more of the above warning mechanisms, could potentially enhance the tool functionality or extend tool and/or battery pack life. The following details the latter warning mechanism as directed to providing the aforementioned warbling effect in the motor of the power tool based on a state of charge in the battery pack.

PWM State of Charge (SOC) Indicator

[00106] The purpose of the PWM State of Charge (SOC) Indicator is to alert the operator of an impending fault condition which could cause automatic battery power shutdown, resulting in a 'dead' battery pack. This may be accomplished by directly determining SOC information in a motor control unit that is part of the battery pack circuitry. Based on the SOC information, a motor control unit in the battery pack would vary the motor current switching frequency to produce the 'warbling effect' in the tool motor that may be heard and/or physically felt by the tool operator.

[00107] FIG. 11 is a flow diagram illustrating a method of alerting an operator of a power tool of an impending fault condition in the battery pack. Referring to FIG. 11, a motor control unit (not shown) in the battery pack may measure

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various battery pack parameters to determine state of charge (SOC) information in the battery pack at a given time instant (S1110). The motor control unit may be embodied in hardware or software as a digital microcontroller or microprocessor or an analog circuit, for example, and/or by a digital IC such as a digital signal processor or an application specific integrated circuit (ASIC). Based on the SOC information, the motor control unit determines a desired motor current switching frequency (S1120) which is imparted to the tool motor to produce the warbling effect (S1130) to alert the operator.

[00108] There are a number of ways to evaluate, track and determine the SOC of the battery pack. For example, battery pack parameters measured by the motor control unit to determine the SOC information may include battery pack voltage, Coulomb count (Ah_{in} - Ah_{out}), total battery pack 100 impedance, etc. The motor control unit would then decide on a motor current switching frequency based on the SOC information.

[00109] The motor current switching frequency for the tool 170 motor could be manipulated in a number of ways to alert the user. Accordingly, adjusting the motor current switching frequency enables the motor of the tool to communicate to the tool operator. A switching frequency could be selected in the audible frequency range, so that the motor would make a noise that is perceptible by the operator. Exemplary audible frequencies could be a constant frequency tone emitted by the tool motor, a varying frequency ring tone, a complex series of multiple frequency tones to mimic a 'voice' speaking to the tool operator, for example. Additionally, the motor control unit could pulse the motor so as to make the tool physically shutter or vibrate in a way that would let the operator know that the battery packing was running out of charge, for example, or approaching a fault condition requiring attention.

[00110] Methods of pulse-width-modulating the motor to alert the operator of an impending fault condition such as a low SOC condition could also be used to communicate other fault conditions. For example, motor current switching

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frequency could be adjusted to alert the tool operator based on sensed information related to an over temperature condition in the battery pack, over temperature condition in the tool motor, over-current condition in the pack and/or under-voltage condition due to an excessive amount of current being drawn from the battery pack. Current, temperature and voltage are merely exemplary measurable parameters that could be tracked for a given fault condition.

[00111] FIG. 12 is a block diagram illustrating an exemplary arrangement for determining SOC and varying motor current switching frequency in accordance with an exemplary embodiment of the present invention. FIG. 12 shows a circuit interface relationship between battery pack 100' and tool 170' somewhat similar to FIG. 3B, although only certain components are shown for reasons of clarity.

[00112] Referring to FIG. 12, IC1, R1, and Q1 contribute to protection circuitry and cell balancing functionality, as discussed above in reference to several of the other figures. IC1 could represent the battery pack electronic control unit 125, for example, in FIGS. 3A and 3B. DATA3 and DATA4 represent serial data paths to carry serial data between IC1 and IC2; IC2 in FIG. 12 may represent the motor control unit. For example, DATA3 could be dedicated to passing data and control signals between IC1 and IC2, and DATA4 for sending a clock to synchronize IC1 with IC2 or vice versa.

[00113] The element REG is a voltage regulator that supplies VCC to digital devices IC2 and IC3. In FIG. 14, IC3 may represent a tool electronic control unit 180 as described in FIG. 3B for example, with DATA1 and DATA2 representing serial data paths for communication of data and control signals between IC3 and IC2. SW1 represents the tool switch to pull current from the battery pack to power motor M1. Resistor R6 and potentiometer R7 make up a variable speed input for the tool. Each of IC1, IC2 and IC3 may be embodied in hardware or software as a digital microcontroller or

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microprocessor or an analog circuit, for example, and/or by a digital IC such as a digital signal processor or an application specific integrated circuit (ASIC)

[00114] Motor control unit IC2 drives the gates of Q5 and Q6 (which may be embodied as MOSFETs) in order to regulate output voltage of the battery pack and thereby control motor current that powers the motor M1 of the tool. IC2 may measure one of more battery pack parameters to determine SOC. For example, IC2 could monitor battery pack output voltage across nodes N1 and N2, or perform Coulomb counting by monitoring current at shunt resistor R5 and keeping track of time (via suitable internal clock). Further, IC2 could also monitor pack impedance by subtracting loaded battery pack output voltage (when current is flowing) from unloaded pack voltage (recorded before current draw) and dividing the result by the current measurement taken at R5. Any of these measurable parameters could serve as a SOC measure. IC2 would then use this SOC information to determine the appropriate switching frequency, and control Q5 and Q6 to achieve that switching frequency.

Redundancy

[00115] The features described above are designed to prevent damage to the battery cells from heavy use or failing components in any part of the control system in the pack 100, charger 150 or tool 170. By adding a secondary form of redundancy, the cells may be less likely to experience cell damage. For example, in FIG. 12, the charger 150 and the tool 170 could also monitor battery temperature and current through external terminals or communications. Battery voltage may also be monitored during charge by the charger 150. It could also be checked by the tool during discharge.

[00116] FIGS. 13-16, in general, illustrate various devices for providing overcharge protection in extreme cases. In the event that an overcharge condition fails to be addressed by the above described watchdog circuit of FIGS. 4 and 5, other current sensory devices, and/or an intelligent device microprocessor in one or more of the battery pack 100 or charger 150 fails

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(multi-point failures in pack or charger), FIGS. 13-16 illustrate potential secondary protection for the battery pack 100 and/or charger 150.

[00117] FIG. 13A is an isometric view of a single laminate battery cell, in which cell 1305 (analogous to cell 105 in any of FIGS. 3A-5) has a tab 1303 (also known as a connector) for connection to an adjacent serially connected cell. FIGS. 13B and 13C illustrate a device for protecting against an overcharge condition in accordance with an exemplary embodiment of the present invention.

[00118] FIGS. 13B and 13C illustrate a device which may reduce the potential for battery cells having a lithium-ion cell chemistry (or other cell chemistries) from rupturing upon a severe overcharge condition that is unattended by other protection circuitry in the pack. In general, during an overcharge event, the laminated lithium-ion battery cells 1305 may exhibit extensive swelling. If the overcharge continues, this may result in a rupture of one or more of the cells 1305. This rupture may result in fire and potentially severe damage to the battery pack 100 attached electrical device (charger 150, tool 170) and/or user of the battery pack 100.

[00119] Accordingly, a battery pack may be designed to take advantage of this swelling phenomenon. FIG. 13B a side view of a steady-state or normal condition in the battery pack, and illustrates tab welds 1306 or similar connections to serially connect the tabs 1303 of adjacent cells 1305 between positive and negative power terminals of the battery pack 100. As shown in FIG. 13C, swelling of one or more given cells 1305 in the battery pack 100 may help to prevent a severe overcharge condition from occurring. The swelling cell(s)1305 creates a tension pressure against its tab 1303, such that two tabs 1303 may separate at a tab weld 1306. In this example, the an opening 1308 is formed in the circuit, thus removing or interrupting charge current to the cells 1305. Thus, as a cell 1305 expands, it pulls the tab connector 1303 away from an adjacent tab 1303 at the tab weld 1306 to break

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the electrical connection between cells 1305, interrupting current flow in the battery pack 100.

[00120] FIGS. 14A and 14B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention. FIG. 14A illustrates a side view of normal or steady state conditions in pack 100 to illustrate another exemplary protection arrangement. In FIG. 14A, the cells 1305 may be serially arranged within a battery housing (shown generally as housing sidewall 1401a and housing sidewall 1401b, which may include an intermediate housing wall 1401c, for example. A plunger 1408 may be provided between the serially connected cells 1305 and the intermediate housing wall 1401c so as to protrude into a recess 1409 through the walls 1401b, 1401c. In an example, the plunger may be restrained via a counter force provided by spring 1410, so that there is a channel 1404 formed between housing sidewall 1401b and intermediate housing wall 1401c. A lead wire (here shown as a positive terminal wire or circuit trace), may extend through the channel 1404.

[00121] Referring now to FIG. 14B, showing one cell 1305 in an overcharged state. As the cell 1305 expands, the expansion force from the cell assists the plunger 1408 in overcoming the counterforce spring pressure from spring 1410. Thus, plunger 1408 travels into recess 1409 to sever lead wire 1405 as shown generally at 1415, thereby interrupting charge current to the cells 1405 of the battery pack. Note also that the swelling cell 1305 also causes the tabs 1303 to come apart as shown generally at 1308, providing further redundancy to sever or break the electrical connections internal to the battery pack. These protective features may thus prevent rupture of one or more cells in the pack 100 by interrupting the current flow.

[00122] FIGS. 15A and 15B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention. FIGS. 15A and 15B illustrate a plunger designed so as to eject a battery pack from a charger.

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[00123] FIG. 15A is similar to FIG. 14A, thus only differences are discussed for reasons of brevity. As shown in FIG. 15A, in steady state or normal operations, plunger 1408 is biased against a counterforce spring pressure of spring 1410, such that the plunger 1408 rests against a charger housing sidewall 1501. Charger housing sidewall 1501 abuts sidewall 1401b of pack 100. Lead wire 1405 of the pack and a charger lead wire 1505 are operatively connected at contacts 1410,1510.

[00124] Referring now to FIG. 15B, as a cell 1305 expands, plunger 1408 overcomes spring 1410 pressure which causes the plunger 1408 to self-eject the pack 100 from the charger, see gap 1508 between cell housing sidewall 1501 and pack sidewall 1401b. This action breaks contacts 1410 and 1510. Accordingly, upon a severe overcharge condition, the swelling of the pack in combination with the placement of the plunger 1408 interrupts charging current and prevents rupture of the pack by ejecting the pack from the charger. Note also that the swelling cell 1305 also causes the tabs 1303 to come apart as shown generally at 1308, providing further redundancy to sever or break the electrical connections internal to the battery pack. These protective features may thus prevent rupture of one or more cells in the pack 100 by interrupting the current flow.

[00125] FIGS. 16A and 16B illustrate a device for protecting against an overcharge condition in accordance with another exemplary embodiment of the present invention. FIGS. 16A-B are similar in some respects to FIGS. 14A-14B, thus the differences are described for purposes of brevity.

[00126] In FIG. 16A, the charger lead wire or trace 1505 is connected to pack lead wire at contacts 1405,1505. Unlike in FIG. 14A, charger lead wire 1505 abuts an inside surface a charger housing sidewall 1501. Plunger 1408 and spring 1410 are as described in FIG. 14A. Referring now to FIG. 16B, showing one cell 1305 in an overcharged state. As the cell 1305 expands, the expansion force from the cell assists the plunger 1408 in overcoming the counterforce spring pressure from spring 1410. Thus, plunger 1408 travels

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into recess 1409 to sever charger lead wire 1505 as shown generally at 1615, thereby interrupting charge current to the cells 1405 of the battery pack. Note also that the swelling cell 1305 also causes the tabs 1303 to come apart as shown generally at 1308, providing further redundancy to sever or break the electrical connections internal to the battery pack. These protective features may thus prevent rupture of one or more cells in the pack 100 by interrupting the current flow.

[00127] The exemplary embodiments of the present invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as departure from the spirit and scope of the exemplary embodiments of the present invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

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What is claimed is:

1. A protection arrangement within a battery pack for protecting against a fault condition in the battery pack, the battery pack adapted to power a cordless power tool and including a plurality of battery cells, comprising:

a plurality of distinct protection devices, each cell having a corresponding protection device adapted to perform a current limiting function.

2. The arrangement of claim 1, wherein each protection device is embodied as a thermistor.

3. The arrangement of claim 1, wherein

the cells are serially connected to form a string of cells, and

each protection device is embodied as a positive temperature coefficient (PTC) that increases in resistance to limit the current through the entire string, when its corresponding cell reaches a fault condition.

4. The arrangement of claim 1, wherein the battery pack is a lithium-ion battery pack.

5. The arrangement of claim 4, wherein the lithium-ion battery pack has a nominal voltage rating of at least 18 volts.

6. A battery pack adapted to power a cordless power tool and including a plurality of serially-connected battery cells, the battery pack including a protection arrangement adapted to limit or interrupt current in the battery pack upon a fault condition that is sensed in the battery pack.

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7. The battery pack of claim 6, the arrangement further comprising:

at least one protection circuit sensing a given battery parameter to determine the fault condition in one or more of the cells and to generate a control signal based on an indication of a fault condition; and

a master device having a current limiting or current interrupting function adapted to limit or interrupt current based on the control signal received from the protection circuit.

8. The battery pack of claim 6, the arrangement further comprising:

a temperature sensor for sensing pack temperature to generate a first signal;

a current sensor for sensing pack current to generate a second signal; and

a battery control circuit adapted to receive said first and second signals to determine a fault condition in the battery pack and generate a control signal.

9. The battery pack of claim 8, wherein

the battery electronic control unit sends the control signal to a semiconductor device operatively connected thereto, and

the semiconductor device has a current limiting or current interrupting function to limit or interrupt current based on the control signal.

10. The battery pack of claim 6, the arrangement further comprising:

a current sensor for sensing pack current to generate a control signal based on a sensed over-current fault condition; and

a semiconductor device having a current limiting or current interrupting function and operatively connected to the current sensor, the semiconductor device adapted to limit or interrupt current based on the control signal received from the current sensor.

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11. The battery pack of claim 10, wherein the over-current fault condition exists if the sensed pack current exceeds a given threshold.

12. The battery pack of claim 11, wherein the current threshold is based on temperature of the cells.

13. The battery pack of claim 6, the arrangement further comprising:

a battery control circuit configured to monitor battery voltage, battery current and battery temperature so as to generate a control signal, and

a semiconductor device operatively controlled by the battery control circuit, the semiconductor device adapted to limit or interrupt current based on the control signal.

14. The battery pack of claim 13, the arrangement further comprising:

a temperature sensor for sensing cell temperature to output a sensed signal to the battery control circuit;

a current sensor for sensing battery current to output a sensed signal to the battery control circuit; and

a voltage monitor circuit for sensing one of individual cell voltage and total pack voltage of the pack to output a sensed signal to the battery control circuit.

15. The battery pack of claim 6, the arrangement further comprising:

at least one communication terminal for communicating information to, and sensing information from, an attached external component.

16. The battery pack of claim 6, the arrangement further comprising:

at least one protection circuit monitoring pack voltage for a potential over-discharge fault condition in the pack and adapted to perform an

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automatic shutdown of current flow in the pack if the monitored voltage reaches a given voltage threshold.

17. The battery pack of claim 6, the arrangement further comprising:

at least one protection circuit monitoring pack voltage for a potential over-discharge fault condition in the pack and adapted to perform an automatic shutdown of current flow in the pack if the monitored voltage reaches a given dynamic voltage threshold,

wherein the dynamic voltage threshold is varied by subtracting a proportion of instant discharge current from an absolute threshold level to compensate for impedance of the battery pack and to avoid a spurious automatic shutdown of current flow, if monitored voltage momentarily drops below the threshold.

18. The battery pack of claim 6, the arrangement further comprising:

a single PTC device placed in series with the serially-connected cells within the battery pack as a protection against an over-current fault condition, the PTC device adapted to increase total pack impedance with increasing current in the pack.

19. The battery pack of claim 6, the arrangement further comprising:

a plurality of PTC devices placed in parallel with each other within the pack to form a parallel PTC string, the parallel PTC string placed in series with the serially-connected cells as a protection against an over-current fault condition, the parallel PTC string adapted to increase total pack impedance with increasing current in the pack.

20. The battery pack of claim 6, the arrangement further comprising:

at least one fuse arranged between the cells and a terminal of the battery pack, wherein the physical placement of the fuse is nearer in proximity

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to the terminal than to the cells, thereby isolating the cells and associated electronics of the pack from a connected charger or power tool in the event of an over-current casualty in the pack.

21. The battery pack of claim 6, wherein the battery pack is a lithium-ion battery pack.

22. The battery pack of claim 21, wherein the lithium-ion battery pack has a nominal voltage rating of at least 18 volts.

23. The battery pack of claim 6, the arrangement further comprising an audible warning mechanism configured to alert the user of the battery pack of an impending or present fault condition in the battery pack.

24. The battery pack of claim 6, the arrangement further comprising a visual warning mechanism configured to alert the user of the battery pack of an impending or present fault condition in the battery pack.

25. A method of providing over-voltage protection in a battery pack removably attachable to a cordless power tool and a charger, the battery pack operatively attached to the charger charging the pack, comprising:

sensing an over-voltage fault condition in the pack; and

terminating charge current in the battery pack or charger based on the sensed fault condition.

26. The method of claim 25, wherein terminating includes generating a control signal in the pack to turn off a semiconductor device in the pack that is adapted to limit or interrupt current in a charge path of the pack.

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27. The method of claim 25, wherein terminating further includes

generating a control signal in the pack, and

communicating the control signal to the charger to turn off a semiconductor device in the charger that is adapted to limit or interrupt current in a charge path of the charger to terminate current flow in the battery pack.

28. A watchdog circuit of a charger, the charger operatively attached to a battery pack for charging the battery pack, the watchdog circuit monitoring parameters in both the battery pack and the charger for one or more control signals from the battery pack or charger to terminate current flow in the battery pack.

29. The watchdog circuit of claim 28, wherein the parameters include one or more of battery pack temperature, individual cell voltages, battery stack voltage, a charge current reset pulse from the battery pack, and a clock reset pulse from the battery pack, and/or a charge current reset pulse from the charger.

30. In a charger adapted to charge a battery pack, the charger and battery pack part of a cordless power tool system, the charger comprising:

a charge current interruption circuit monitoring parameters in both the battery pack and the charger for one or more control signals from the battery pack or charger to terminate current flow in the battery pack.

31. The charge current interruption circuit of claim 30, wherein the parameters include one or more of battery pack temperature, individual cell voltages, battery stack voltage, a charge current reset pulse from the battery pack, a clock reset pulse from the battery pack, and/or a charge current reset pulse from the charger.

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32. A battery pack adapted to power a cordless power tool and to be charged by a charger, the pack including a plurality of battery cells, the battery pack comprising:

a device that terminates an over-temperature condition in the pack based on pack temperature or an individual cell temperature exceeding a given temperature threshold.

33. The battery pack of claim 32, wherein the device further includes

a thermal switch, and

a plurality of high current contacts,

wherein the thermal switch opens the high current contacts when pack or cell temperature exceeds the given threshold.

34. In a battery pack operatively attachable to a charger, the battery pack adapted to power a cordless power tool, a device for providing over-temperature protection in the pack during charging, comprising:

a thermistor;

a first thermistor lead connecting the thermistor to a positive terminal shared by the pack and charger; and

a second thermistor lead connecting the thermistor to a negative terminal shared by the pack and charger.

35. The device of claim 34, wherein the positive and negative terminals connected to the first and second leads interface to temperature monitoring circuitry in the charger to enable monitoring of pack temperature while maintaining the thermistor isolated from the charge path in the pack.

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36. A battery pack, the pack operatively attached to a cordless power tool for powering a motor of the power tool, the battery pack comprising:

a motor control unit for determining at least one measurable parameter in the battery pack that would indicate a fault condition; and

a pair of transistors in communication with the motor control circuit, the motor control circuit controlling the pair of transistors to provide one of audible or tactile feedback to the user of the tool.

37. In a cordless power tool system including a battery pack removably attached to a power tool, a method of providing an audible warning in the motor of the power tool to alert an operator of the tool of an impending fault condition in the pack or tool, comprising:

determining at least one measurable parameter in one of the battery pack or tool, and

providing one of audible or tactile feedback to the user of the tool based on the at least one determined measurable parameter.

38. The method of claim 37, wherein providing includes adjusting motor current switching frequency based on the at least one determined parameter to produce an audible tone in the motor of the tool that warns the tool operator of the impending fault condition.

39. The method of claim 37, wherein providing includes adjusting a desired PWM duty cycle of at least one semiconductor device in the battery pack to produce a warble effect in the motor speed that warns the tool operator of the impending fault condition.

40. The method of claim 39, wherein adjusting further includes reducing the PWM duty cycle to produce a weakening of the tool as felt by the tool user to warn the user of an impending fault condition.

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41. A battery pack having over-charge protection, comprising:

a housing,

a plurality of serially-connected cells therein, and

a current interrupt mechanism to interrupt current in the cells that is triggered upon swelling of at least one cell during an over-charge event.

42. The battery pack of claim 41, wherein

the cells are serially connected between power terminals of the pack and interconnected to each other via tab connectors, the tab connectors of adjacent cells connected to each other.

43. The battery pack of claim 42, wherein the current interrupt mechanism is embodied as at least one tab connector of a swelling cell being pull apart from at least one tab connector of an adjacent cell to interrupt current.

44. The battery pack of claim 41, wherein the current interrupt mechanism comprises:

a plunger, and

a spring, the plunger restrained between the serially-connected cells and a sidewall of the battery housing under a counterforce provided by the spring, the plunger including a portion that extends partially into a recess between formed an intermediate wall and an outer sidewall of the battery pack housing, the recess including a lead wire from the pack electrically connecting the cells of the pack to a charger,

wherein swelling of the at least one cell assists the plunger to overcome spring pressure to sever the lead wire in the recess to interrupt current.

45. The battery pack of claim 44, wherein the cells are serially connected between power terminals of the pack and interconnected to each other via tab

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connectors, the tab connectors of adjacent cells connected to each other, and the current interrupt mechanism further includes at least one tab connector of the at least one swelling cell pulling apart from at least one tab connector of an adjacent cell to interrupt current.

46. The battery pack of claim 41, wherein the current interrupt mechanism comprises:

a plunger, and

a spring, the plunger restrained between the serially-connected cells and a sidewall of the battery housing under a counterforce provided by the spring, the plunger including a portion that extends partially into a recess, the recess extending through a sidewall of the battery pack housing and a sidewall of a charger housing,

wherein a charger lead wire electrically connecting the charger to a corresponding lead wire of the battery pack extends longitudinally along a face of the charger housing sidewall and over the recess, and

wherein swelling of the at least one cell assists the plunger to overcome spring pressure to sever the charger lead wire extending over the recess to interrupt current.

47. The battery pack of claim 46, wherein the cells are serially connected between power terminals of the pack and interconnected to each other via tab connectors, the tab connectors of adjacent cells connected to each other, and the current interrupt mechanism further includes at least one tab connector of the at least one swelling cell pulling apart from at least one tab connector of an adjacent cell to interrupt current.

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48. The battery pack of claim 41, wherein the current interrupt mechanism comprises:

a plunger, and

a spring, the plunger restrained between the serially-connected cells and a sidewall of the battery housing under a counterforce provided by the spring, the plunger including a portion that extends partially into a recess between formed a sidewall of the battery pack housing and a housing of the charger,

wherein a lead wire from the cells is electrically connected to a corresponding lead wire of the charger at a contact interface, and

wherein swelling of the at least one cell assists the plunger to overcome spring pressure to eject the pack housing from the charger housing, causing a break in the contact interface to interrupt current.

49. The battery pack of claim 48, wherein the cells are serially connected between power terminals of the pack and interconnected to each other via tab connectors, the tab connectors of adjacent cells connected to each other, and the current interrupt mechanism further includes at least one tab connector of the at least one swelling cell pulling apart from at least one tab connector of an adjacent cell to interrupt current.

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FIG. 1

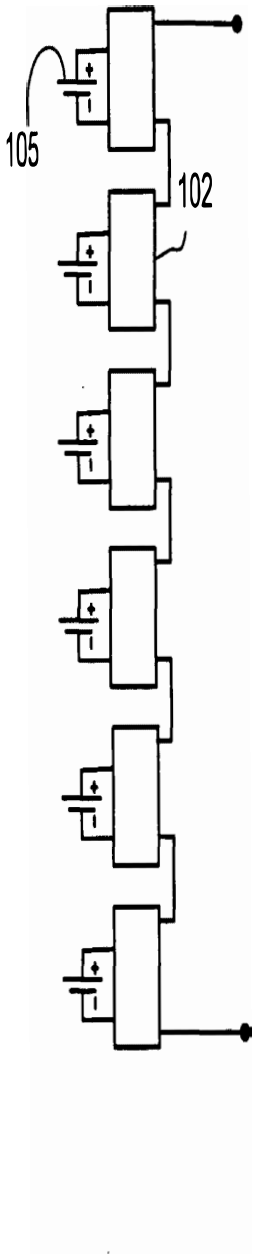

105
102

FIG. 2

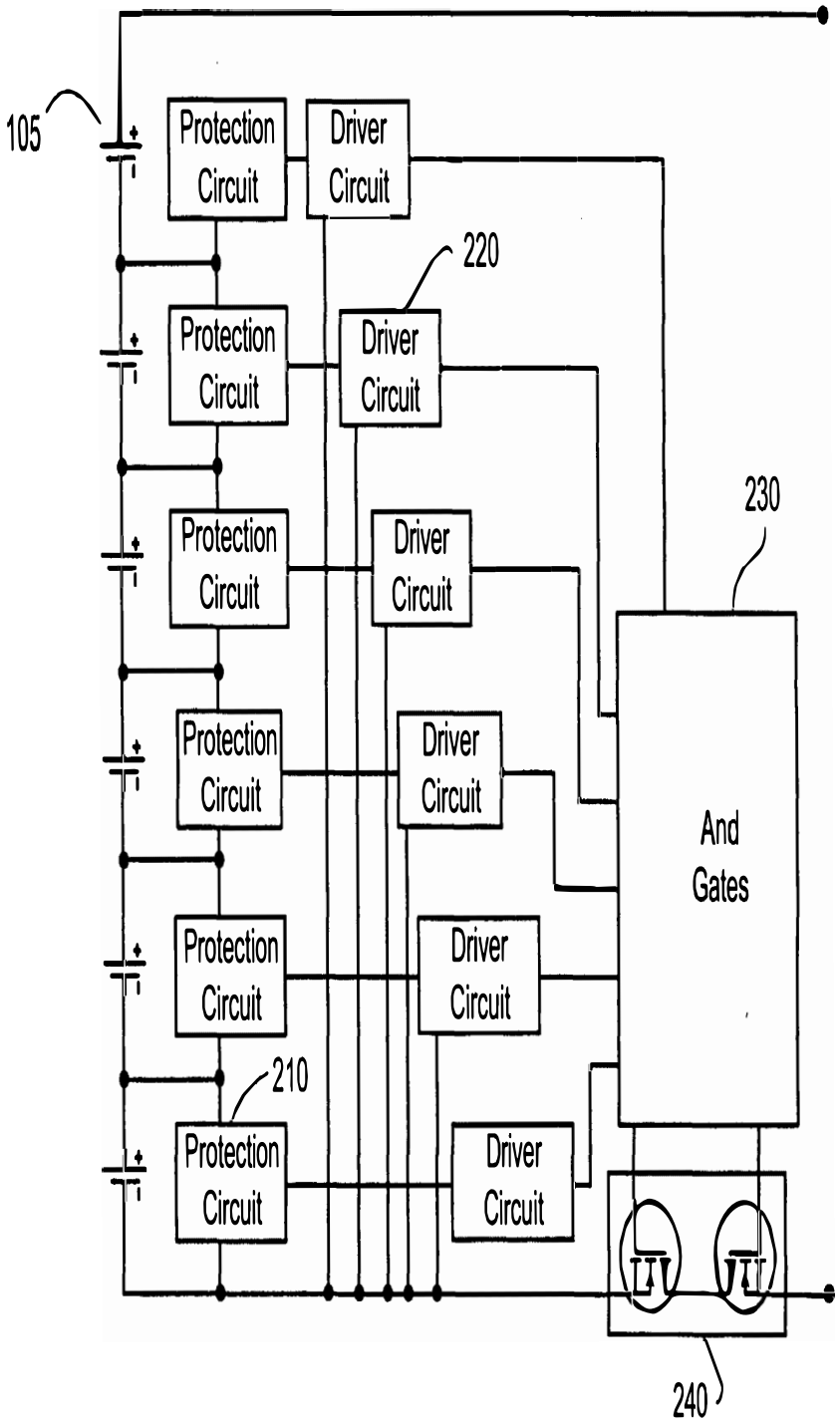

105
Protection Circuit
Driver Circuit
220
230
And Gates
210
240

FIG. 3A

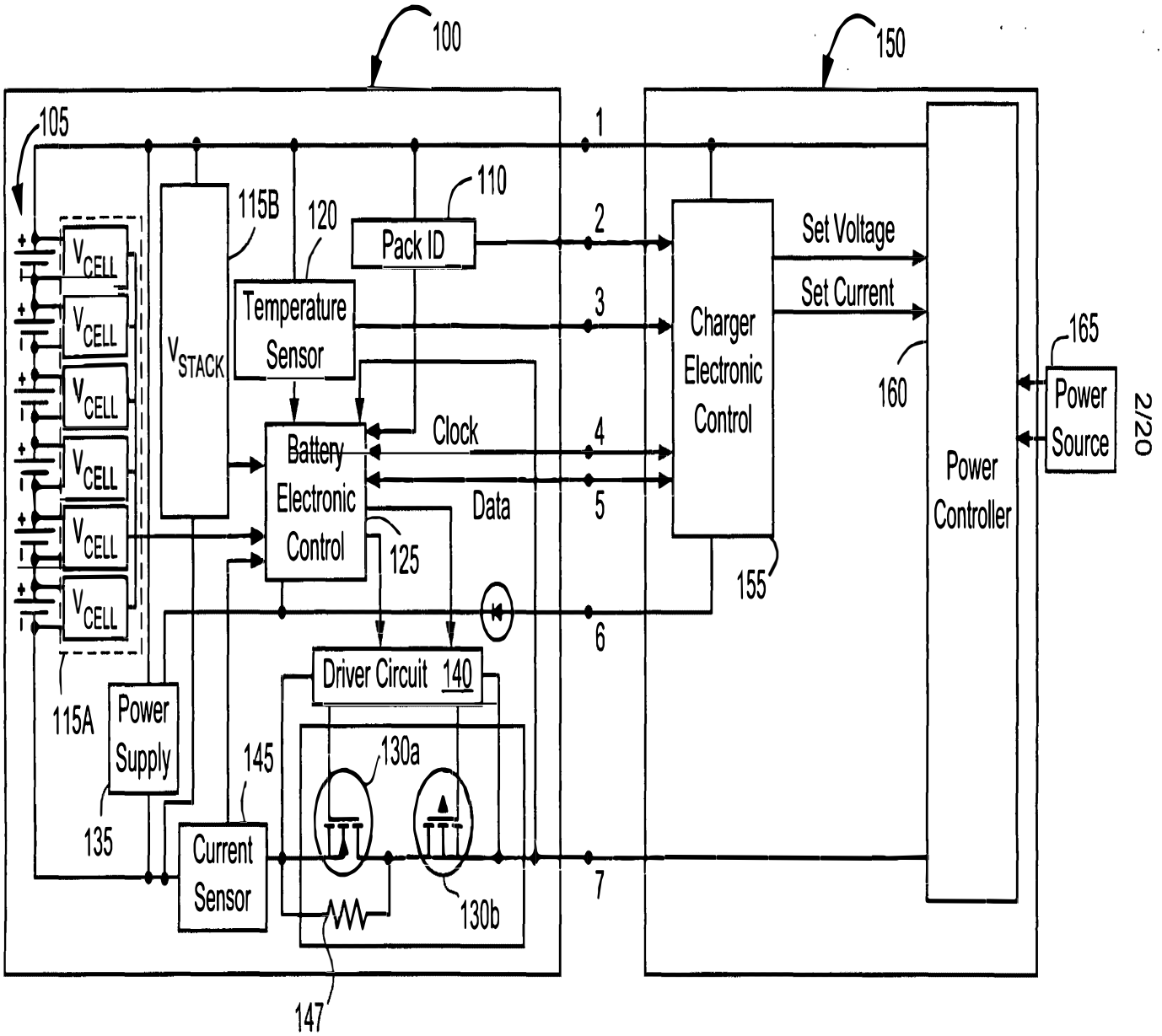

100
150
105
1
110
115B
120
2
Pack ID
Set Voltage
Set Current
3
Temperature Sensor
Charger Electronic Control
165
160
Power Source
V_{CELL}
V_{STACK}
Clock
4
Battery Electronic Control
Data
5
125
155
Power Controller
6
Driver Circuit 140
115A
Power Supply
145
130a
135
Current Sensor
7
130b
147

FIG. 3B

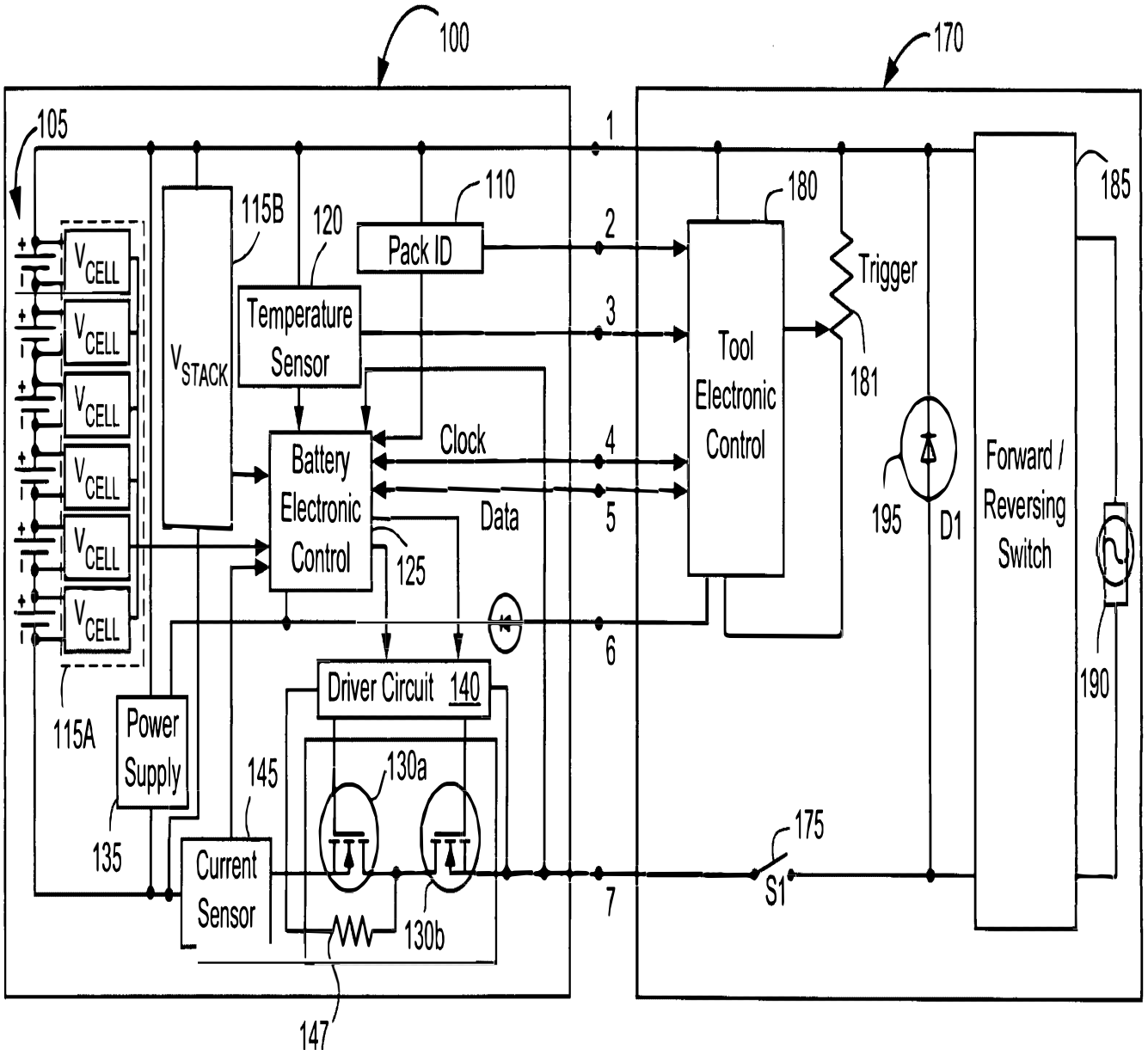

100
170
105
1
2
3
4
5
6
7
110
180
185
115B
120
Pack ID
Trigger
Temperature Sensor
V_{STACK}
V_{CELL}
Tool Electronic Control
181
Clock
Data
Battery Electronic Control
125
195
D1
Forward / Reversing Switch
190
Driver Circuit 140
115A
Power Supply
145
130a
175
S1
135
Current Sensor
130b
147

FIG. 4

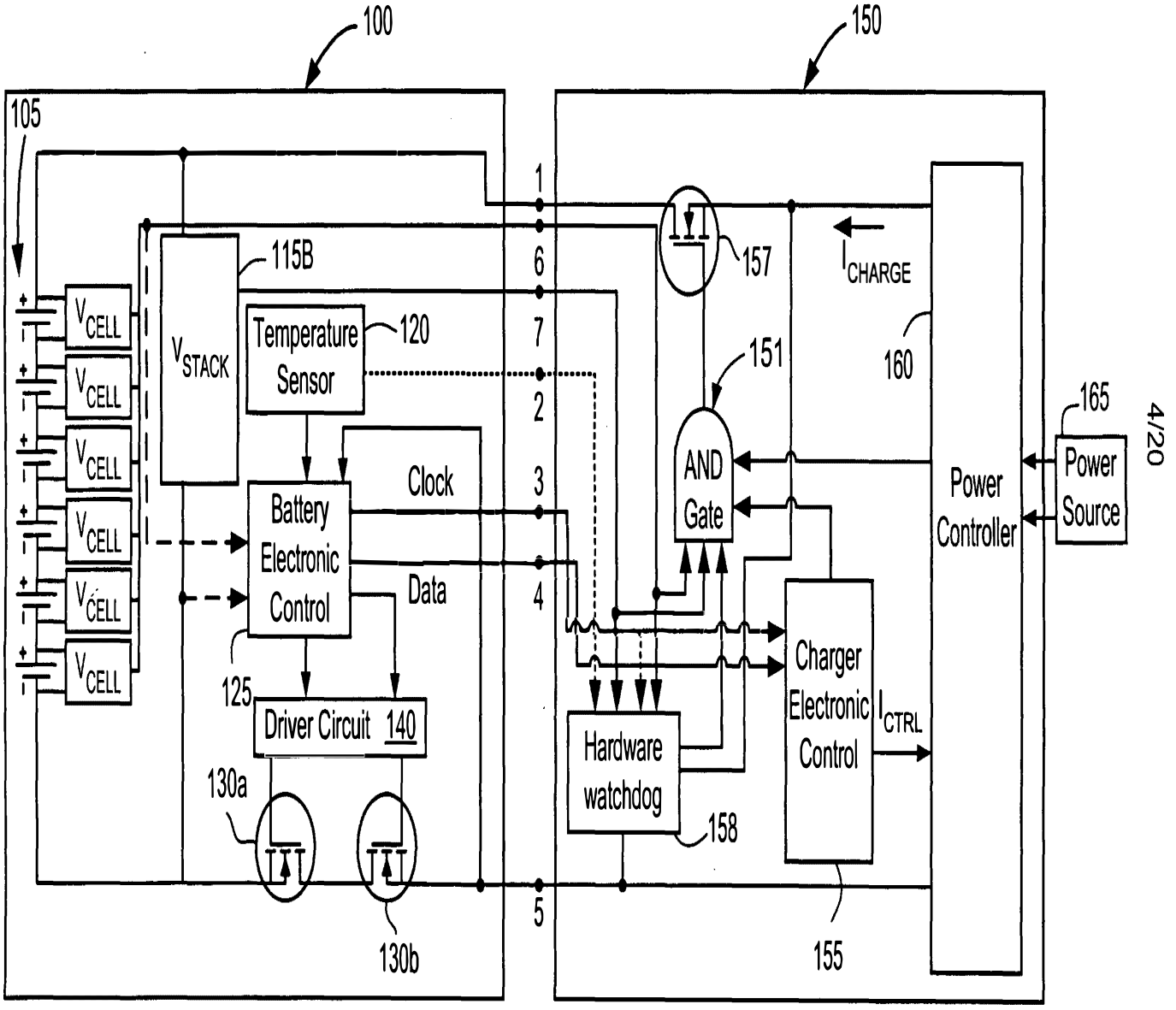

100
150
105
1
6
7
2
3
4
5
115B
V_{CELL}
V_{STACK}
Temperature Sensor
120
Clock
Data
Battery Electronic Control
125
Driver Circuit 140
130a
130b
157
I_{CHARGE}
151
160
165
AND Gate
Power Controller
Power Source
Charger Electronic Control
I_{CTRL}
Hardware watchdog
158
155

FIG. 5

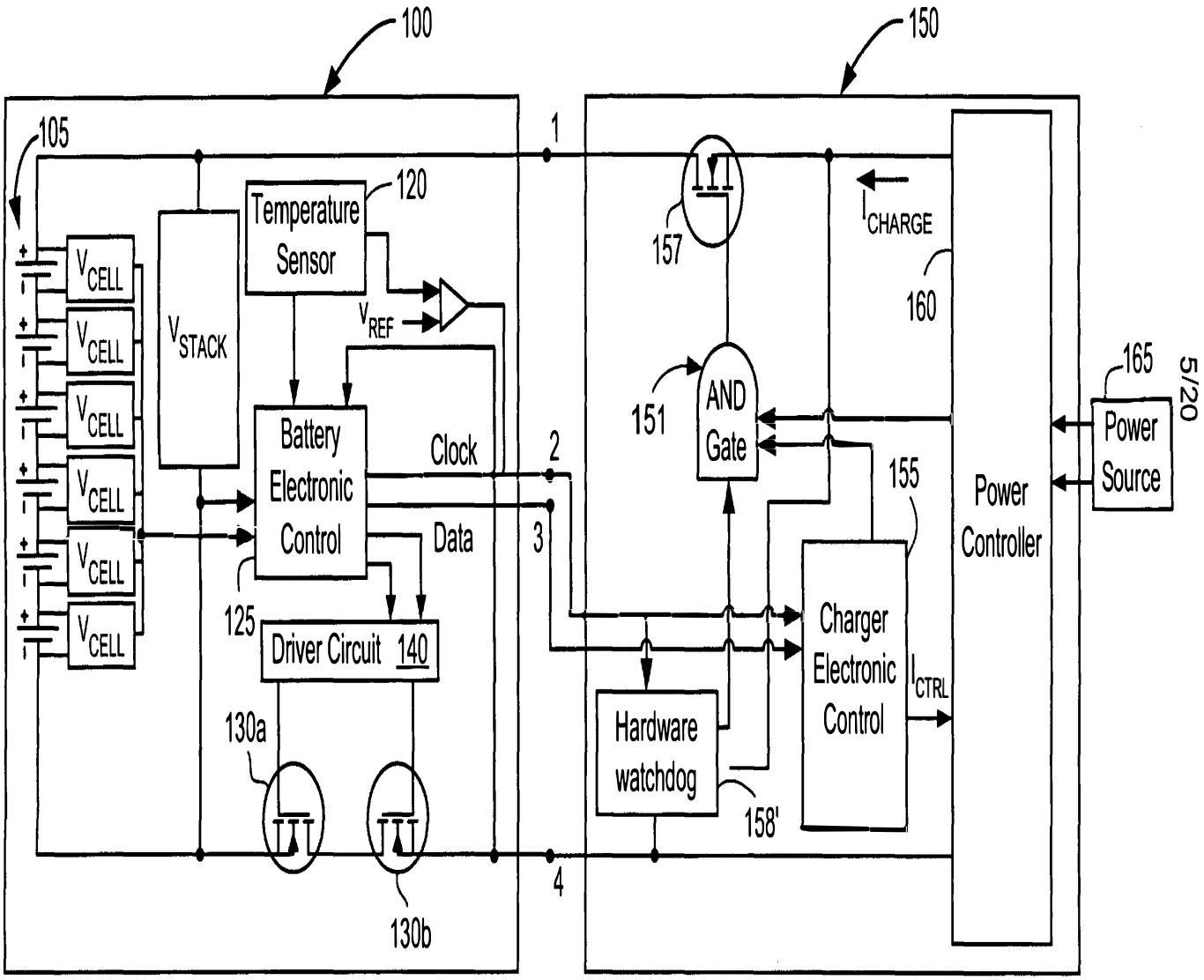

100
150
105
1
120
Temperature Sensor
V_{CELL}
V_{STACK}
V_{REF}
Battery Electronic Control
Clock
Data
2
3
125
Driver Circuit 140
130a
130b
4
157
I_{CHARGE}
160
151
AND Gate
165
Power Source
155
Power Controller
Charger Electronic Control
I_{CTRL}
Hardware watchdog
158'

FIG. 6

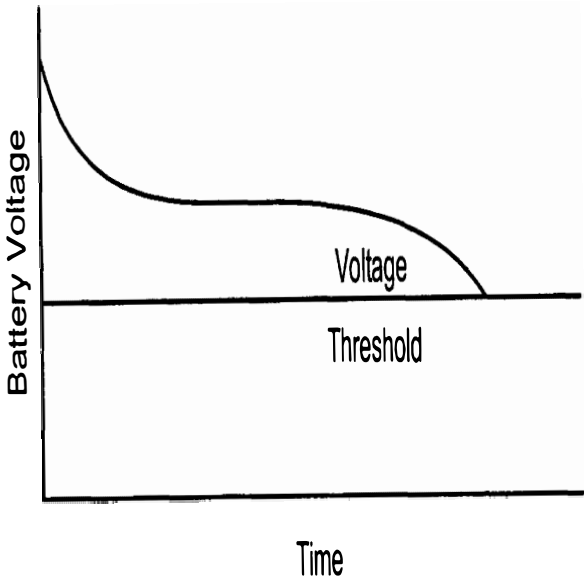


FIG. 7

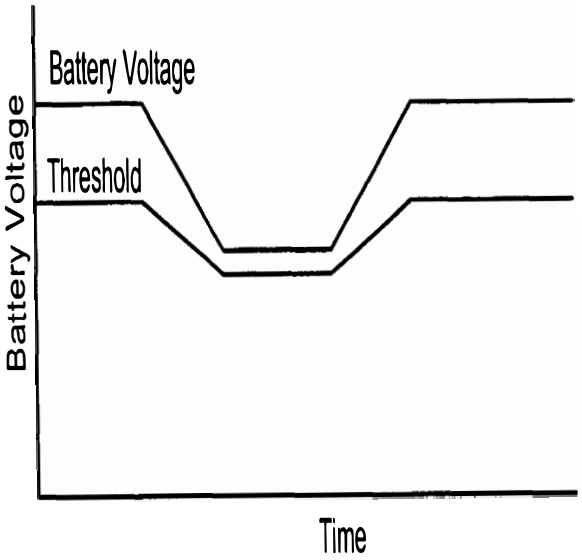


FIG. 8A

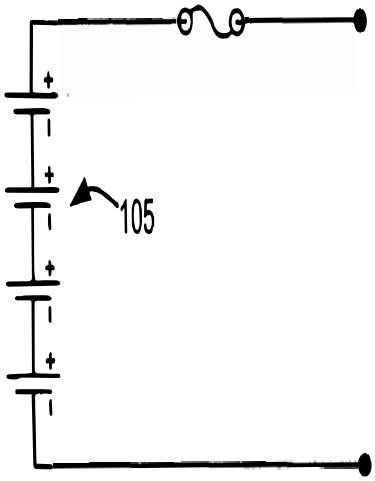


FIG. 8B

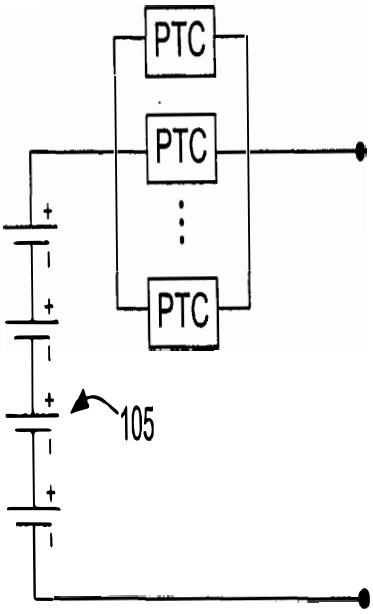


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FIG. 9

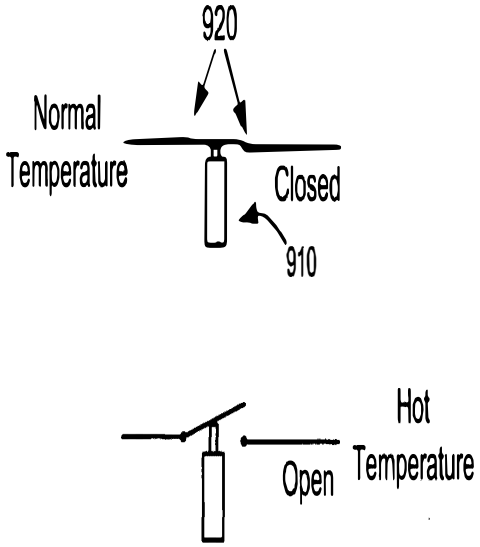


FIG. 10

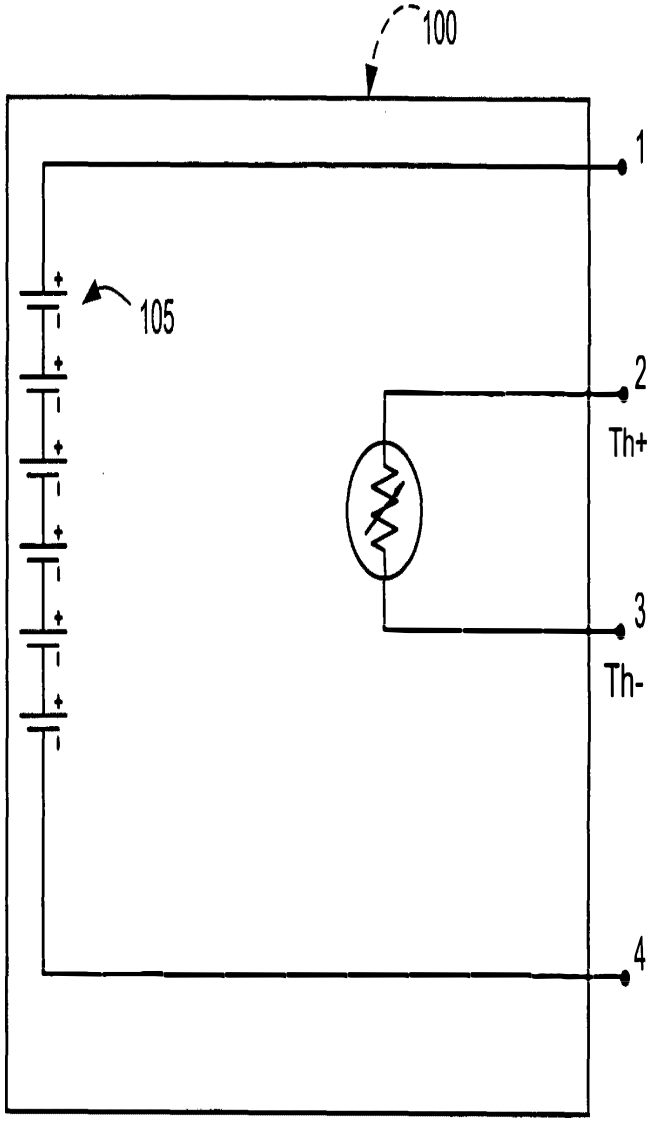


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FIG. 11

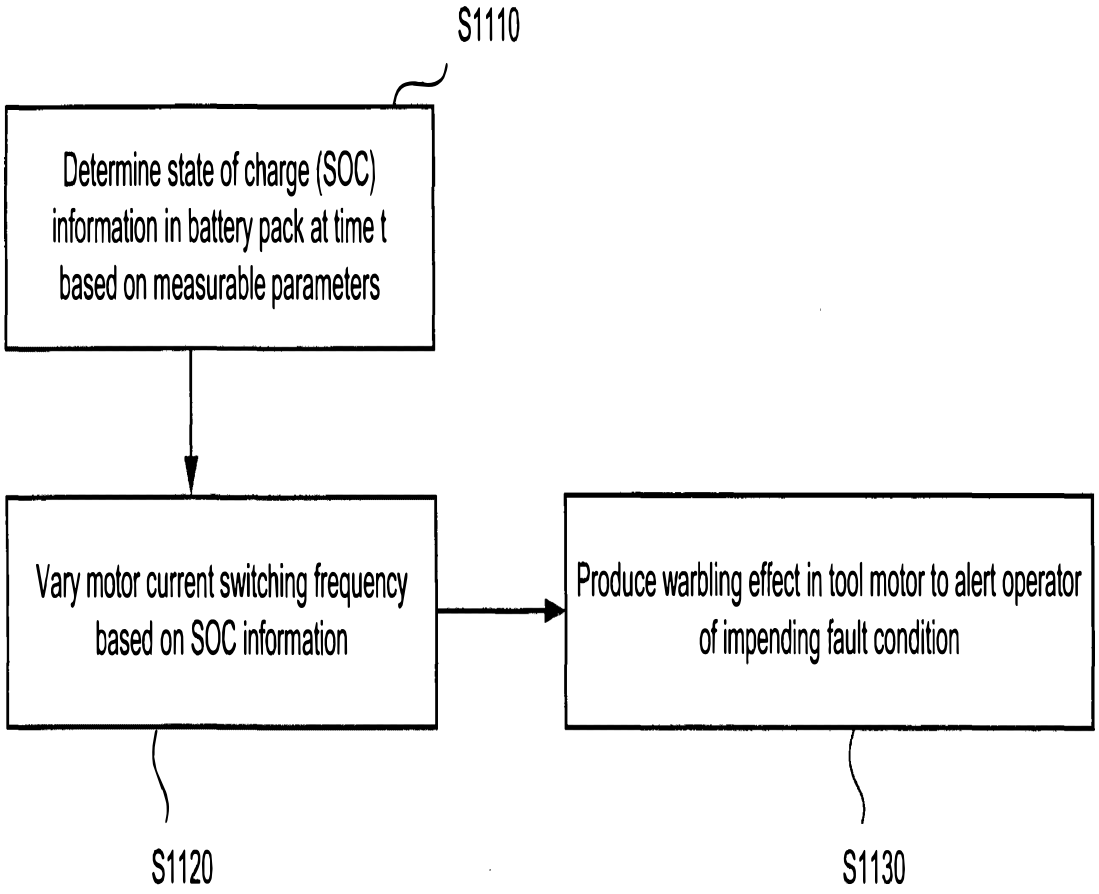


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FIG. 12

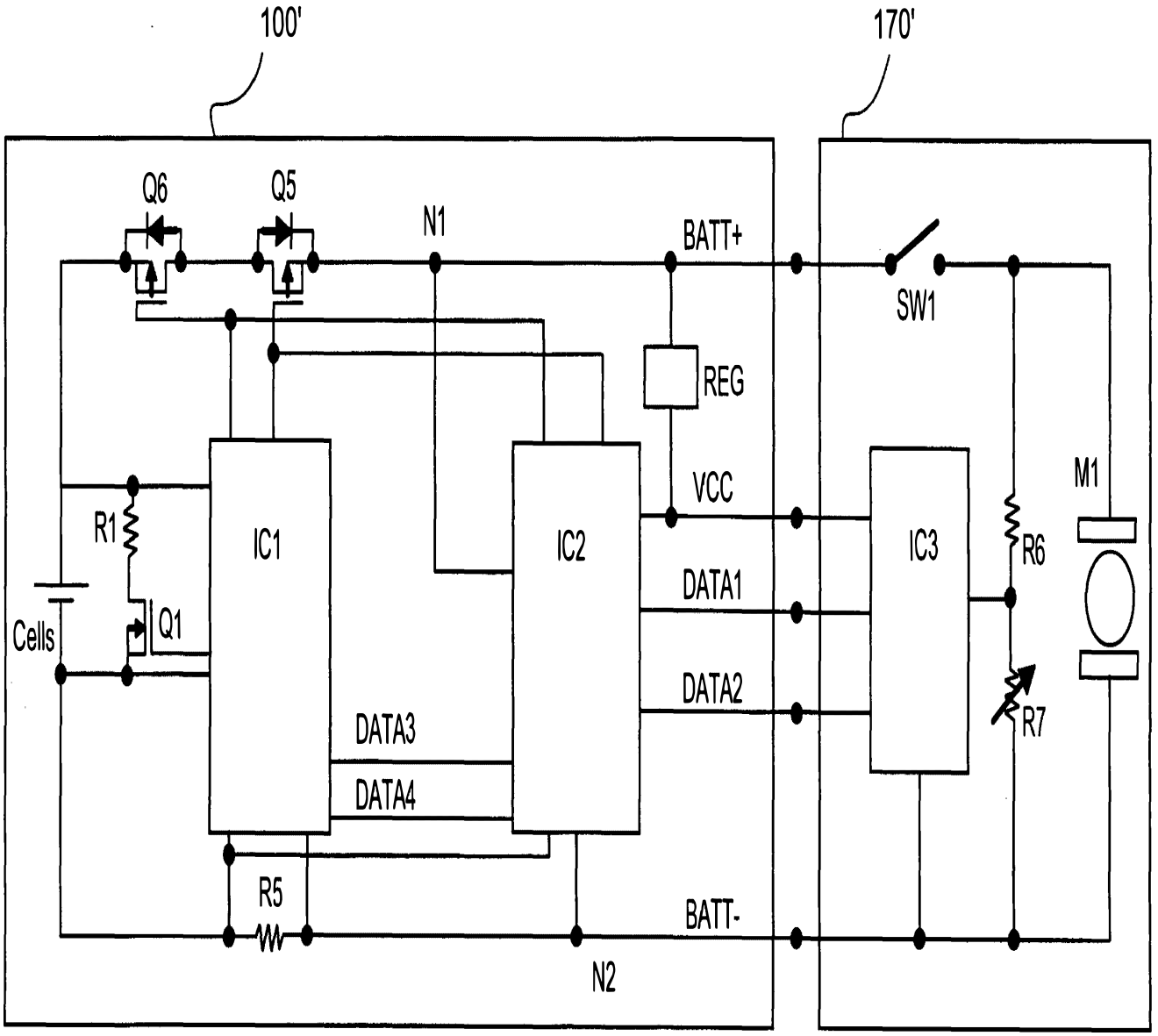


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FIG. 13A

FIG. 13B

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FIG. 13C

1308
1306
+
+
-
+
-
+
cell
cell
swelled
cell
cell
cell
1305
-
+
-
+
-
1308
1305
1303

FIG. 14A

1306
1405
1404
1409
1401a
cell
cell
cell
cell
cell
1303
1408
1410
1401c
1401b

FIG. 14B

1306
1405
+
+
-
+
-
+
cell
cell
swelled
cell
cell
cell
1409
1415
-
+
-
+
-
+
1305
1308
1408
1410
1401b

FIG. 15A

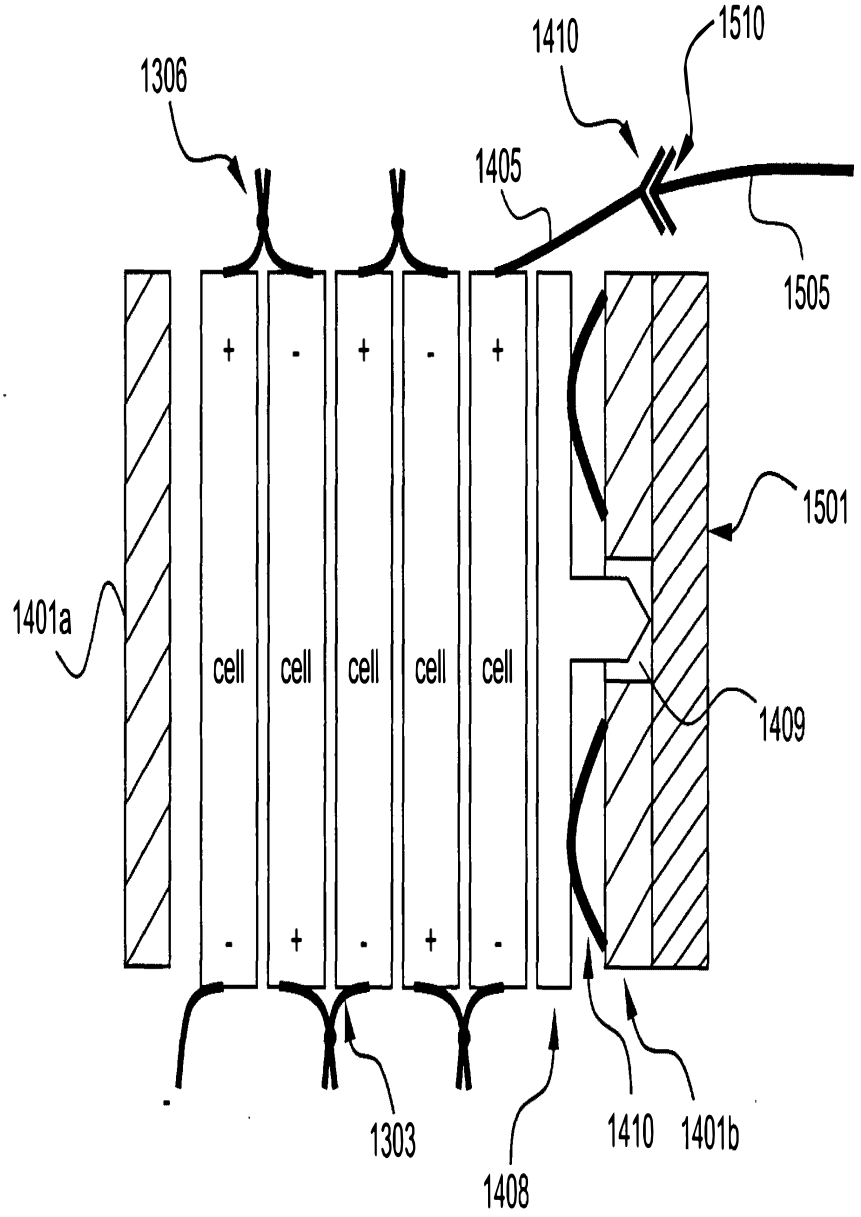


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FIG. 15B

1515
1410
1306
1510
+
+
-
+
-
+
cell
cell
swelled
cell
cell
cell
1501
-
+
-
+
-
1508
1308
1305
1408
1410
1401b

FIG. 16A

1510
1306
+
+
-
+
-
+
1505
1401a
cell
cell
cell
cell
cell
1409
-
+
-
+
-
1501
-
1303
1408
1410
1401b

FIG. 16B

1510
1306
+
+
-
+
-
+
cell
cell
swelled cell
cell
cell
1615
-
+
-
+
-
1505
1501
1308
1305
1408
1410
1401b

FIG. 17

FIG. 18

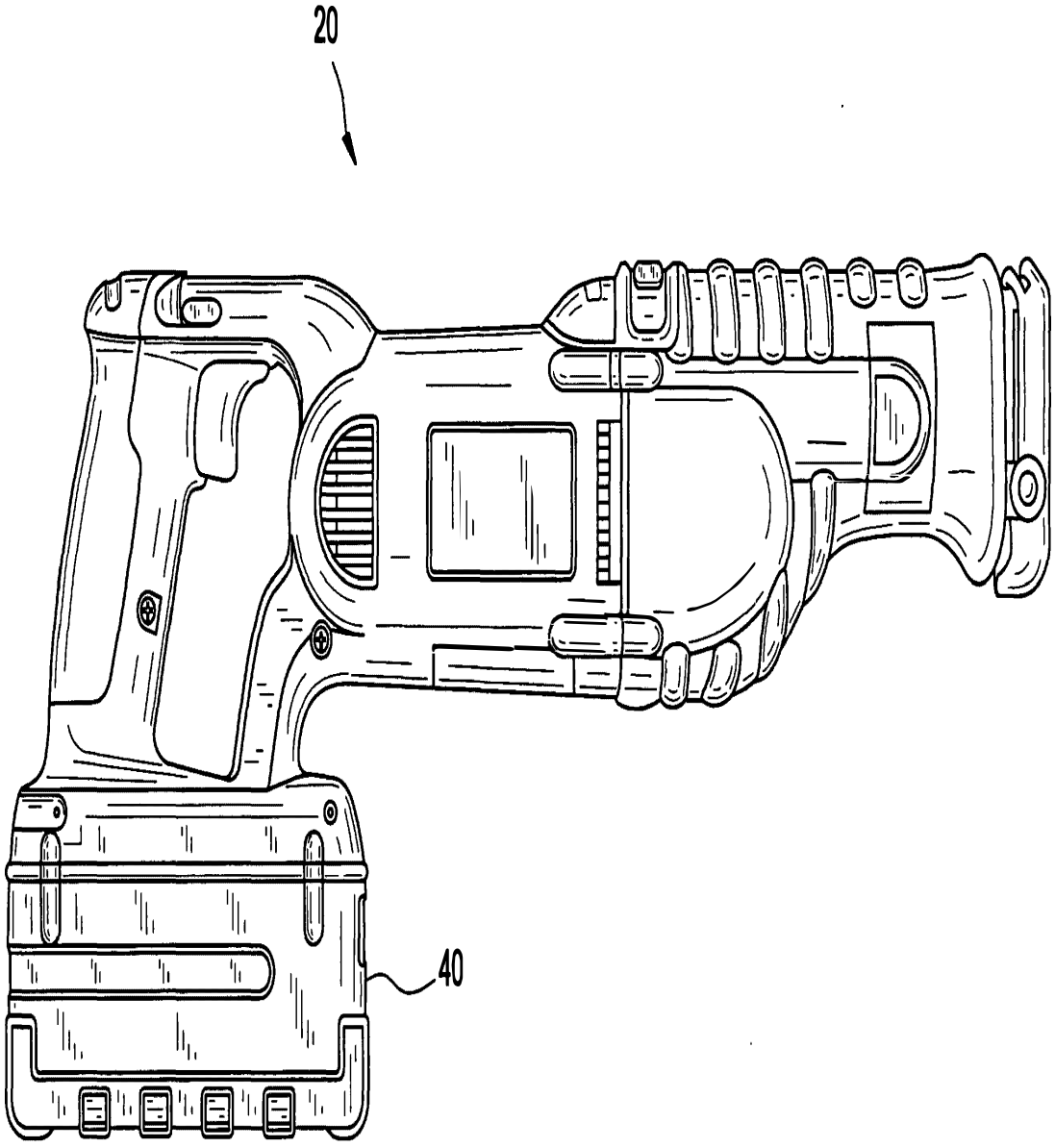


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FIG. 19

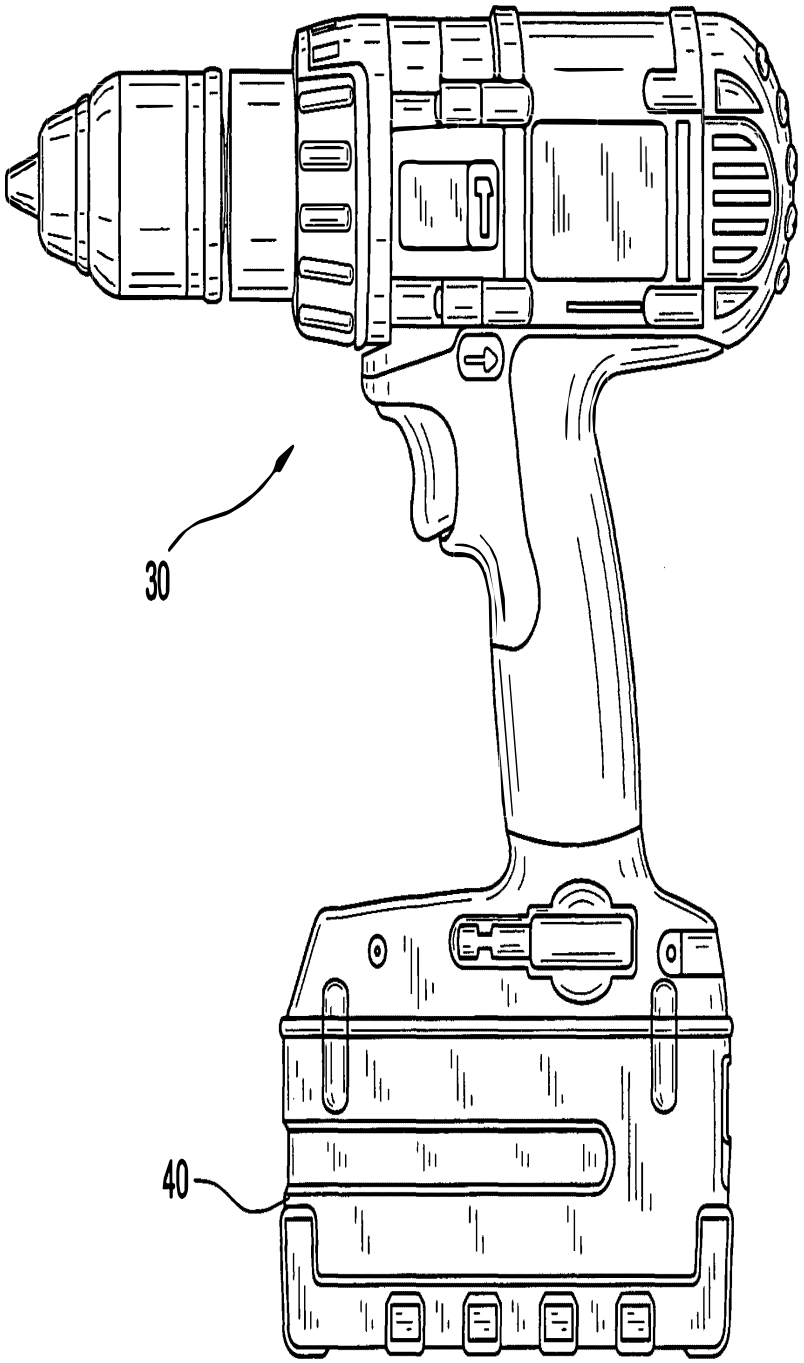


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Espacenet

CN104442429A Vehicle starting power source with double-battery system

Applicants: KE GUOPING

Inventors: KE GUOPING

Classifications:

IPC ***B60L11/18;***

CPC Y02T10/70 (EP);

Priorities: CN201310413538A 2013-09-12

Application: CN201310413538A·2013-09-12

Publication: CN104442429A·2015-03-25

Published as: CN104442429A

Vehicle starting power source with double-battery system

Abstract

The invention relates to a vehicle starting power source with a double-battery system. A battery pack of the vehicle starting power source is composed of a starting battery pack and an energy-storing battery, the starting battery pack is only responsible for starting of an engine, does not power a vehicular electric device and can independently start the engine, and the energy-storing battery pack powers the vehicular electric device and can assist in starting when electric quantity is sufficient. By the vehicle starting power source, the problem that the engine cannot be started due to excessive discharging of batteries can be prevented effectively.

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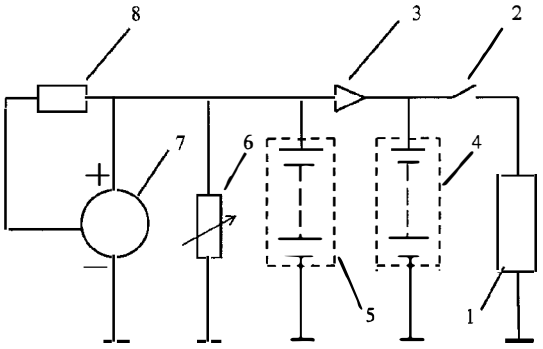
权利要求书1页 说明书3页 附图1页

(54)发明名称

一种双电池系统的车辆启动电源

(57)摘要

本发明涉及一种双电池系统的车辆启动电源。本发明的启动电源的电池组由启动电池组和储能电池组构成。启动电池组只负责发动机的启动，不给车载用电装置供电，并且可以独立启动发动机。储能电池组一方面给车载用电装置供电，同时，在电量较充足的情况下，还可以辅助启动。本发明可以有效防止由于电池过度放电导致发动机无法启动的问题。



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1. 一种双电池系统的车辆启动电源，用于车辆启动和给车载用电装置提供电能，主要由蓄电池系统和导电线缆组成，其特征是：所述的蓄电池系统由启动电池组和储能电池组两个蓄电池组组成，其中启动电池组仅用于车辆的启动，不向车载用电装置供电，该电池组可以独立完成车辆的启动；储能电池组用于给车载用电装置提供电能及辅助启动电池组对车辆进行启动。

2. 如权利要求 1 所述的车辆启动电源，其特征是：所述的两个蓄电池组通过单向二极管或者由多个单向二极管并联形成的单向二极管的阵列并联连接，电流只能由储能电池组向启动电池组方向单向流动，而不能由启动电池组向储能电池组方向流动。

3. 如权利要求 1 和 2 所述的车辆启动电源，其如权利要求 1 和 2 所述的车辆启动电源特征是：所述的启动电池组的容量比储能电池组的容量小。

4. 如权利要求 1 和 2 所述的车辆启动电源，其特征是：所述的启动电池组的单体电池是卷绕式高倍率铅酸电池。

5. 如权利要求 1 和 2 所述的车辆启动电源，其特征是：所述的启动电池组的单体电池是锂离子电池。

6. 如权利要求 1 和 2 所述的车辆启动电源，其特征是：所述的储能电池组的单体电池是铅酸电池。

7. 如权利要求 1 和 2 所述的车辆启动电源，其特征是：所述的储能电池组的单体电池是锂离子电池。

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一种双电池系统的车辆启动电源

[0001] 【技术领域】本发明涉及各种内燃机车辆的启动电源。

[0002] 【背景技术】各种内燃机车辆已经成为人们日常的交通和运输工具，如载人的轿车和客车，运输货物的卡车等。这些车辆的启动都是依靠主要由电池组成的启动电源来实现的，由启动电源驱动启动电机，再由电机驱动发动机工作。在车载发电机停止工作的状态下，启动电源还负责给车载用电装置供电，这些装置如车灯、音响、电动门窗等。

[0003] 启动电源的核心部件是蓄电池组。现行的各类车辆的启动电源采用的技术方案中，都是采用一个蓄电池组同时完成和肩负车辆启动和给车载用电装置供电的两重功能，表现在启动电源中只有一个蓄电池组。在运行实践中，这种方案暴露出很大的问题：

[0004] 其一，常常出现因为各种原因导致在车载发电机不工作的状况下，车载用电装置长时间用电的情况，这导致启动电源的核心部件——蓄电池组储电量不足，从而无法完成车辆的下次启动。出现这种情况时，将不得不请专业服务公司进行服务；或者备用一个称之为 jump starter 的应急电源帮助启动。

[0005] 其二，启动电源的两种不同功能对电池性能要求差异很大，启动功能要求电池放电倍率性能优异，而给车载用电装置供电功能则要求电池容量大，倍率性能要求不高。这种情况导致启动电源核心部件的蓄电池组的选配的困难。如，目前绝大多数启动电源的蓄电池组都使用极板式铅酸电池，这往往导致低温下的启动困难。而如果全部使用放电倍率高（尤其是低温放电性能优异）的卷绕式铅酸电池，则成本太高，而且占用体积过大。

[0006] 本发明即是针对现有技术方案的不足，提出一种新的解决方案。

[0007] 【发明内容】本发明旨在克服现有技术的不足，提出一种新的车辆启动电源方案。

[0008] 本发明的技术方案是：采用双电池系统，启动电源核心部件——蓄电池系统由启动电池组和储能电池组两个蓄电池组组成，其中启动电池组仅用于车辆的启动，不向车载用电装置供电，该电池组可以独立完成车辆的启动；储能电池组用于给车载用电装置提供电能及辅助启动电池组对车辆进行启动。所述的两个蓄电池组通过单向二极管或者由多个单向二极管并联形成的单向二极管的阵列并联连接，电流只能由储能电池组向启动电池组方向单向流动，而不能由启动电池组向储能电池组方向流动。

[0009] 本发明的车辆启动电源中，蓄电池系统的的启动电池组的容量比储能电池组的容量小。一般地，启动电池组的容量占整个蓄电池系统容量的 15-35％左右。

[0010] 本发明的车辆启动电源中，蓄电池系统的启动电池组的单体电池是卷绕式高倍率铅酸电池。这种电池不仅放电倍率性能好，而且也具有出色的低温放电性能。

[0011] 本发明的车辆启动电源中，蓄电池系统的启动电池组的单体电池也可以是锂离子电池。目前，锂离子电池的技术得到长足发展，许多电池体系（如磷酸铁锂系、三元系、锰酸锂系、钛酸锂系等）可以做到很高倍率的放电，并且一些体系还具有出色的低温性能。

[0012] 本发明的车辆启动电源中，蓄电池系统的储能电池组的单体电池是铅酸电池，可以是传统的极板式铅酸电池，也可以是先进的卷绕式铅酸电池。作为储能电池，铅酸电池有很多优点，主要是价廉物美，技术成熟。

[0013] 本发明的车辆启动电源中，蓄电池系统的储能电池组的单体电池是锂离子电池，

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可以是锰酸锂电池、磷酸铁锂电池、三元电池、钛酸锂电池等其中的任意一种。

[0014] 本发明的车辆启动电源的蓄电池系统因为采用启动电池组和储能电池组双电池组，启动电池组只承担启动任务，不给车载用电装置供电，并且可以独立完成启动任务，储能电池组除了给车载装置供电外，还能辅助启动，因而可以有效克服现有技术的不足，防止因电池放电过度导致不能启动的情况。此外，因为采用双电池组，可以选择倍率性能及低温性能优异的电池作为启动电池，克服低温下的启动困难，又不太多的增加成本。

[0015] 【附图说明】附图为本发明的原理示意图，图中：

[0016] 1——启动电机

[0017] 2——启动开关

[0018] 3——单向二极管（或二极管阵列）

[0019] 4——启动电池组

[0020] 5——储能电池组

[0021] 6——车载用电装置

[0022] 7——车载发电机

[0023] 8——调节器

[0024] 下面结合附图进一步阐述本发明的技术方案。单向二极管（或二极管阵列）3 的作用是保证启动电池组 4 只能够向启动电机 1 供电，而不能向车载用电装置 6 以及储能电池组 5 供电，这就有效防止启动电池组 4 用电过度导致不能进行后续的启动的问题。单向二极管（二极管阵列）3 允许储能电池组向启动电机 1 供电，实现辅助启动功能；同时，单向二极管（单向二极管阵列）3 还允许车载发电机 7 给启动电池组 4 充电。调节器 8 用于实现各种调节功能。启动时，闭合启动开关 2，启动电池组 4 向启动电机 1 放电，同时，在电量较充分时，储能电池组 5 经过单向二极管 3 向启动电机 1 放电，辅助启动电池组 4 实现启动功能。

[0025] 启动完成后，启动开关 2 断开，同时车载发电机 7 开始向车载用电装置 6 供电，并且给启动电池组 4 和储能电池组 5 充电。当发电机 7 停止工作时，若车载用电装置 6 继续工作，则此时所需电能完全由储能电池组 5 提供，单向二极管（人际关系战略）3 阻止启动电池组 4 放电，从而保证启动电池组 4 能够继续进行以后的启动。

[0026] 【具体实施方式】下面举例说明本发明的实施方式。

[0027] 实施例一

[0028] 对于一个 1.5L 排量的家用轿车，采用 12V 的车辆启动电源，其中启动电池组为容量 10Ah、标称电压 12V 的卷绕式铅酸电池组，储能电池组采用容量 45Ah、标称电压 12V 的极板式铅酸电池组。选用 6 个过流 50A 的单向二极管并联构成单向二极管阵列。按照说明书附图的连接方式进行连接，即可实现本发明的目的。

[0029] 实施例二

[0030] 将储能电池组换成 12.6V 的磷酸铁锂电池组，其余同实施例一。

[0031] 实施例三

[0032] 对于载货卡车，采用 24V 的车辆启动电源，其中启动电池组为容量 20Ah、标称电压 24V 的卷绕式铅酸电池组，储能电池组采用 80AH、标称电压 24V 的极板式铅酸电池组。选用 12 个过流 50A 的单向二极管并联构成单向二极管阵列。按照说明书附图的连接方式进行连

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接,即可实现本发明的目的。

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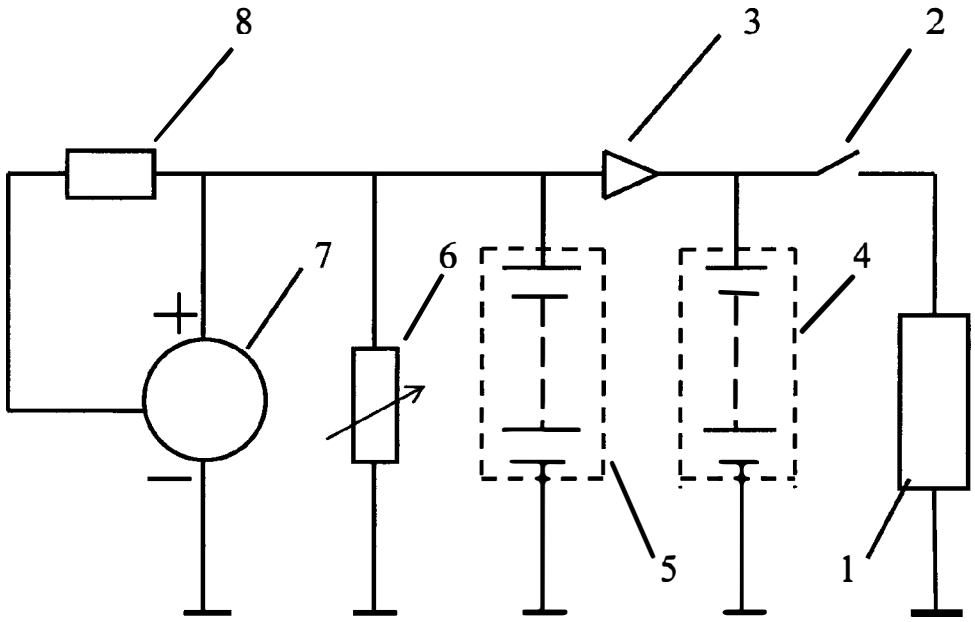


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CN1440892A Power supply controlling system for vehicle and its controlling method

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Power supply controlling system for vehicle and its controlling method

Abstract

本发明公开了一种用于车辆的供电控制系统，该系统中设置有放电密度较高、但能量密度较低的铅酸蓄电池(12)，并设置有放电密度较低、但能量密度较高的锂离子电池(14)。在伴随车辆驾驶员执行点火操作的发动机起动过程中，由铅酸蓄电池(12)向起动机(18)供电，从而起动发动机。在执行空转停机控制所伴随的发动机重新起动过程中，由锂离子电池(14)向起动机(18)供电，从而使发动机起动。

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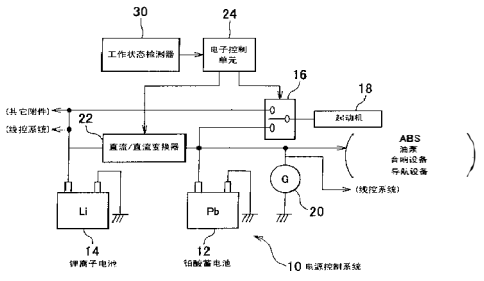
代理人 王 琼

权利要求书 3 页 说明书 14 页 附图 2 页

[54] 发明名称 用于车辆的供电控制系统及其控制方法

[57] 摘要

本发明公开了一种用于车辆的供电控制系统，该系统中设置有放电密度较高、但能量密度较低的铅酸蓄电池(12)，并设置有放电密度较低、但能量密度较高的锂离子电池(14)。 在伴随车辆驾驶员执行点火操作的发动机起动过程中，由铅酸蓄电池(12)向起动机(18)供电，从而起动发动机。 在执行空转停机控制所伴随的发动机重新起动过程中，由锂离子电池(14)向起动机(18)供电，从而使发动机起动。



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1. 一种用于车辆的供电控制系统，在该车辆中，执行一种空转停机控制，从而能根据车辆的运行状态自动完成对发动机的停机操作和起动操作，所述供电控制系统包括：

第一电池，其与车辆的一起动机相连接；

第二电池，其与车辆的起动机相连接，且该电池的能量密度大于第一电池的能量密度，但其放电密度低于第一电池的放电密度；以及

控制器，该控制器的工作状况是这样的：在第一条件下—即需要起动发动机来使车辆发动的条件下，选择第一电池与起动机接通，从而由第一电池向起动机供电；在第二条件下—即通过空转停机控制来起动发动机的条件下，选择第二电池与起动机接通，从而由第二电池向起动机供电。

2. 根据权利要求 1 所述的供电控制系统，其特征在于：第二电池是锂离子电池和镍氢电池中的一种。

3. 根据权利要求 1 或 2 所述的供电控制系统，其特征在于：第一电池是铅酸蓄电池。

4. 根据权利要求 1 所述的供电控制系统，其特征在于：系统根据车辆操作人员要发动车辆的意愿，而执行在第一条件下的发动机起动。

5. 根据权利要求 1 所述的供电控制系统，其特征在于：系统按照一种无线通讯的识别认证来执行在第一条件下的发动机起动，其中的无线通讯是在车辆上安装的一个装置与车辆操作人员持有的一个便携式装置之间发生的。

6. 根据权利要求 1 所述的供电控制系统，其特征在于：控制器判断第二电池向起动机输送的电力是否能足以起动发动机；如果判断出在第二条件下从第二电池输送给起动机的电力是不充足的，则控制

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器就选择第一电池与起动机相接通，从而由第一电池向起动机供电。

7. 根据权利要求 1 所述的供电控制系统，其特征在于：控制器判断第一电池向起动机输送的电力是否能足以起动发动机；如果判断出在第一条件下从第一电池输送给发动机的电力是不充足的，则控制器就选择第二电池与起动机相接通，从而由第二电池向起动机供电。

8. 根据权利要求 6 所述的供电控制系统，其特征在于：控制器判断第一电池向起动机输送的电力是否能足以起动发动机；如果判断出在第一条件下从第一电池输送给发动机的电力是不充足的，则控制器就选择第二电池与起动机相接通，从而由第二电池向起动机供电。

9. 根据权利要求 8 所述的供电控制系统，其特征在于：控制器是在一个参数的基础上判断第一电池和第二电池输送给起动机的电能是否充足，所述参数包括第一、第二电池的电量、温度、电压、以及电流。

10. 根据权利要求 1 所述的供电控制系统，其特征在于：当第一电池和第二电池的电压和电量中的至少一个参数都小于一预定值时，取消在第二条件下的发动机起动。

11. 一种用于车辆的供电控制方法，在该车辆中，执行一种空转停机控制，从而能根据车辆的运行状态自动完成对发动机的停机操作和起动操作，且将一起动机与一第一电池和一第二电池相连接，其中，第二电池的能量密度大于第一电池的能量密度，但其放电密度低于第一电池的放电密度，该供电控制方法包括：

在第一条件下—即需要起动发动机来使车辆发动的条件下，选择第一电池与起动机接通，从而由第一电池向起动机供电；以及

在第二条件下—即通过空转停机控制来起动发动机的条件下，选择第二电池与起动机接通，从而由第二电池向起动机供电。

12. 根据权利要求 11 所述的供电控制方法，其特征在于：在第一条件下的发动机起动是根据车辆操作人员要发动车辆的意愿而执行

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的。

13. 根据权利要求 11 所述的供电控制方法，其特征在于：在第一条件下的发动机起动是根据一种无线通讯的识别认证来执行的，其中的无线通讯是在车辆上安装的一个装置与车辆操作人员持有的一个便携式装置之间发生的。

14. 根据权利要求 11 所述的供电控制方法，其还包括步骤：判断第二电池向起动机输送的电力是否能足以起动发动机；如果判断出在第二条件下从第二电池输送给起动机的电力是不充足的，则控制器就选择第一电池与起动机相接通，从而由第一电池向起动机供电。

15. 根据权利要求 11 或 14 所述的供电控制方法，其还包括步骤：判断第一电池向起动机输送的电力是否能足以起动发动机；如果判断出在第一条件下从第一电池输送给发动机的电力是不充足的，则控制器就选择第二电池与起动机相接通，从而由第二电池向起动机供电。

16. 根据权利要求 15 所述的供电控制方法，其特征在于：判断第一电池和第二电池输送给起动机的电能是否充足的步骤是在一个参数的基础上进行，所述参数包括第一、第二电池的电量、温度、电压、以及电流。

17. 根据权利要求 11 所述的供电控制方法，其还包括：当第一电池和第二电池的电压和电量中的至少一个参数都小于一预定值时，取消在第二条件下的发动机起动。

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用于车辆的供电控制系统及其控制方法

技术领域

本发明涉及一种用于车辆的供电控制系统。更具体来讲，本发明涉及一种车辆供电控制系统，其可执行一种空转停机控制，这种控制能根据车辆的工作状态而自动地完成发动机的停机和起动。

背景技术

带有铅酸蓄电池和锂离子电池的电源系统在现有技术中是存在的。例如，在第 2001-313082 号日本专利公开文件中就公开了这种系统的一个实例。这种电源系统能将车辆减速时的能量再生回收，并将能量输送向铅酸蓄电池以及锂离子电池，其中，锂离子电池具有更高的再生蓄电能力。因而，该车载电源系统作为一个整体，其能量效率得以提高。另外，对于这种电源系统，当起动发动机时，是由铅酸蓄电池向发动机供电的。

有的车辆上装备有一种系统，该系统可执行这样的控制工作：例如当车辆在等绿灯或由于其它原因而停车时，停止发动机的转动；且当车辆起步时，能再次起动发动机（这种控制在本文中被称为“空转停机控制”）。在这样的情况下：对车辆执行空转停机控制，且如上文讨论的系统那样，车辆上安装有前述的铅酸蓄电池以及锂离子电池，如果无论是在伴随着车辆常规发动的发动机起动过程中、还是在伴随着空转停机控制的发动机起动过程中，都始终是由铅酸蓄电池进行供电，则由于铅酸蓄电池处于始终带载工作的状态下，其性能的恶化将是很迅速的。因而，在这样的设计中，发动机起动的可靠性将会降低，这反过来就会使一种可能性增大：用户拒绝执行空转停机控制。

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发明内容

本发明的一个目的是提供一种用于车辆的供电控制系统，其能可靠地执行车辆发动时的发动机起动工作、以及伴随着空转停机控制的发动机起动工作，同时还不会加速电池的性能劣化。

本发明提供了一种用于车辆的供电控制系统，在该车辆中，执行一种空转停机控制，从而能根据车辆的运行状态自动完成对发动机的停机操作和起动操作。该供电控制系统包括：第一电池，其与车辆的起动机相连接；第二电池，其也与车辆的起动机相连接，且该电池的能量密度大于第一电池的能量密度，但其放电密度低于第一电池的放电密度；以及一控制器，该控制器的工作状况是这样的：在一种第一条件下—即需要起动发动机来使车辆发动的条件下，选择第一电池与起动机接通，从而由第一电池向起动机供电；在一种第二条件下—即通过空转停机控制来起动发动机的条件下，选择第二电池与起动机接通，从而由第二电池向起动机供电。

一般来讲，对于车辆正常发动时的发动机起动工作（下文将把此类起动称为“常规起动”），由于发动机是冷起动，所以需要电池有较大的负载。在另一方面，对于空转停机控制模式所涉及的发动机起动工作（下文将称为“重新起动”），由于发动机已经被暖机加热了，所以电池的负载相对较小。因而，为了能可靠地保证常规起动时的易起动性，合适的作法是：此时所用电池的放电密度应当大于重新起动时所用电池的放电密度。在车辆的运行过程中，会以一定的时间间隔频繁地执行空转停机控制。因而，为了能可靠地保证在重新起动时发动机的起动性能，合适的作法是：采用一种能量密度较高的电池，其能量密度高于常规起动时所用电池的能量密度。

在本发明中，在常规起动时，由第一电池向起动机供电。另外，在重新起动时，是由相比于第一电池其能量密度较高、但放电密度较

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低的第二电池向起动机供电。因而，无论是在常规起动、还是在重新起动的过程中，都能保证发动机的起动性。此外，在常规起动时，负载相对较大，由于放电密度相对较低的第二电池并不向起动机供电，所以能可靠地保证发动机的起动性能。另外，对于重新起动，由于执行这种起动的频率很高，所以，因为能量密度较低的第一电池并不向起动机供电，因此可避免第一电池出现加速恶化的情况。

第二电池可以是锂离子电池和镍氢电池中的一种。

第一电池可以是铅酸蓄电池。

可根据车辆操作人员要发动车辆的意愿，而执行在第一条件下的发动机起动。

可按照一种无线通讯的识别认证来执行在第一条件下的发动机起动，其中的无线通讯是在车辆上安装的一个装置与车辆操作人员持有的一个便携式装置之间发生的。如上文讨论的那样，无论是车辆发动时的发动机起动工作、还是空转停机控制模式时的发动机起动工作能被可靠地完成，而且不会加速电池的性能劣化。

如果由于电量下降、温度改变等原因，从第一电池或第二电池输送给起动机的电力不足以保证发动机的起动，则采用当前电池很难使发动机起动。

控制器判断第二电池向起动机输送的电力是否能足以起动发动机。如果判断出在第二条件下从第二电池输送给起动机的电力是不充足的，则控制器就选择第一电池与起动机相接通，从而由第一电池向起动机供电。因而，即使发动机不能被第二电池驱动而重新起动，也可以通过第一电池来实现重新起动。这样就可以避免出现这样的情况：由于第二电池向起动机输送的电力不足，发动机无法重新起动。

控制器还判断第一电池向起动机输送的电力是否能足以起动发动机。如果判断出在第一条件下从第一电池输送给发动机的电力是不充足的，则控制器就选择第二电池与起动机相接通，从而由第二电池向

起动机供电。因而，即使发动机不能被第一电池驱动而完成常规起动，也可以通过第二电池来实现常规起动。这样就可以避免出现这样的情况：由于第一电池向起动机输送的电力不足，发动机无法完成常规起动。

附图说明

图 1 是一个结构示意图，表示了根据本发明一示例性实施方式的车用供电控制系统；以及

图 2 中的流程图表示了一种控制程序，当在空转停机控制模式下进行发动机的重新起动时，执行该控制程序。

具体实施方式

图 1 中的结构示意图表示了一种根据本发明示例性实施方式的车用供电控制系统 10。如图 1 所示，该供电控制系统 10 中设置有两个电池 12 和 14。电池 12 是电压约为 12V 的铅酸蓄电池，电池 14 是电压约为 14.4 伏的锂离子电池。在下文中，电池 12 将被称为铅酸蓄电池 12，电池 14 将被称为锂离子电池 14。相比于锂离子电池 12，铅酸蓄电池 12 每一单位体积的输出电量（放电密度的单位：W/I）较高，但每一单位体积所能蓄储的电量（能量密度的单位：Wh/I）则较少。换言之，锂离子电池 14 的放电密度低于铅酸蓄电池 12，但其能量密度高于铅酸蓄电池 12。

一起动机 18 通过一转换开关 16 既与铅酸蓄电池 12 连接、也与锂离子电池 14 连接。起动机 18 与作为车辆动力源的发动机（图中未示出）相连接。起动机 18 利用经过转换开关 16 从铅酸蓄电池 12 或锂离子电池 14 输送来的电力，来起动处于停机状态的发动机。

发动机上设置有一直流发电机 20，其能利用发动机的转动而发出电能。铅酸蓄电池 12 与直流发电机 12 相连接。当执行再生制动时，

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直流发电机 20 通过将车辆的动能转变为电能，而向铅酸蓄电池 12 供电，从而对铅酸蓄电池 12 进行充电。可通过将直流发电机 20 连接向锂离子电池 14 一侧来提高其再生发电效率。在此情况下，从直流发电机 20 向电池 14 的充电电流要经过一 DC/DC（直流/直流）变换器 22，下文将对此电流变换器进行讨论。

锂离子电池 14 通过一直流对直流的变换器（下文将称作“DC/DC”变换器）22 与铅酸蓄电池 12 相连接。DC/DC 变换器 22 利用其内安装的一功率晶体管的关断—导通操作，而将铅酸蓄电池 12 一侧的电压升高，从而可向锂离子电池 14 一侧送电，或者是将锂离子电池 14 一侧的电压降低，从而可向铅酸蓄电池 12 一侧送电。由于直流发电机 20 是通过 DC/DC 变换器 22 与锂离子电池 14 相连接的，所以直流发电机 20 能向锂离子电池 14 输送其发出的电能，以对其进行充电。

在直流发电机 20、铅酸蓄电池 12 以及锂离子电池 14 上连接了多个利用电能进行工作的附件以及所谓的线控系统（by-wire system），其中的附件例如为空调器、音响设备等等，线控系统例如为加速器、制动器等等。每个线控系统既连接到铅酸蓄电池 12 一侧，也连接到锂离子电池 14 一侧。因而，由于线控系统既能由铅酸蓄电池 12 供电、也能由锂离子电池 14 供电，所以利用当前电源系统就能可靠地保证车辆的工作正常，而无需设置电容等用于提供后备电源的装置。

另外，附件还包括设置在铅酸蓄电池 12 一侧的那些部件（例如：音响设备、汽车导航设备、ABS 系统、油泵等）、以及设置在锂离子电池 14 一侧的那些部件（例如：仪表、除雾器、雨刷器、电动车窗等）。当车辆由发动机驱动时，每一附件以及每一线控系统都由直流发电机 20、铅酸蓄电池 12 以及锂离子电池 14 供电。在另一方面，当发动机停机时，则是由铅酸蓄电池 12 或锂离子电池 14 供电的。当车辆的点火开关处于电器附件工作位置或处于点火接通位置时，诸如音

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响设备、汽车导航设备等的附件是通电的，当点火开关处于点火接通位置时，诸如油泵、ABS 系统、空调器等的附件是通电的。

DC/DC 变换器 22 与一带有微型计算机的电子控制单元 24（下文将称为“ECU”）相连接。ECU24 对 DC/DC 变换器 22 进行操作，以便于合适地控制铅酸蓄电池 12 一侧与锂离子电池 14 一侧之间的电力输送与接收。转换开关 16 也与 ECU24 相连接。转换开关 16 的功能是按照 ECU24 的指令将起动机 18 选择性地连接向铅酸蓄电池 12 或锂离子电池 14。ECU24 能基于一个条件来确定出应当是那一个电池与起动机 18 连接，并控制转换开关 16 来选择所确定的电池，其中，下文将对所述的条件进行讨论。

在 ECU24 上还连接有一个工作状态检测器 30。工作状态检测器判断发动机是否处于暖机状态、发动机起动后车辆的行驶里程或速度是否达到了一个预定值、车辆操作人员是否执行了制动操作、以及变速器的档位，其中，如果车辆上安装的是自动变速箱，则判断制动踏板上的作用力是否达到一预定值，如果车辆上安装的是手动变速箱，则判断是否对离合器踏板进行了操作。ECU24 根据工作状态检测器 30 的检测结果来判断车辆是否处于停车状态（即车速基本为零的状态）。ECU24 还判断执行控制工作的条件是否已被满足，其中的控制工作可将发动机从运转状态转换到停机状态、以及将发动机从停机状态转换为运转状态（这种控制在下文中被称为“空转停机控制”）。

下面，将对根据该示例性实施例的供电控制系统 10 进行介绍。

按照该实施例，如果在发动机处于停机状态的情况下，车辆驾驶员将点火开关从断电位置转动到电器附件工作位置，则那些当点火开关处于电器工作位置时应当工作的附件一旦接收到从铅酸蓄电池 12 输送来的电力，就进入到工作状态。此外，如果点火开关从电器工作位置转到点火接通位置，那些当点火开关处于点火接通位置时应当工作的附件一旦开始由铅酸蓄电池 12 进行供电，就进入到工作状态。

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另外，如果点火开关从点火接通位置转到起动机接通位置，则就断开铅酸蓄电池 12 向各个附件的供电，并经过转换开关 16 将起动机 18 与铅酸蓄电池 12 连通。起动机 18 在由铅酸蓄电池 12 供电后就进入到其工作状态。在此情况下，起动机 18 带动发动机，使其从停机状态开始起动。一旦发动机起动完成、并进入到正常工作状态之后，尽管点火开关从起动机接通位置回到了点火接通位置，发动机也能保持该工作状态。

当发动机处于工作状态时，利用直流发电机 20，可将车辆的再生制动时的动能转换为电能。在此情况下，铅酸蓄电池 12 由直流发电机 20 输出的充电电压进行充电，且每一附件等都处于工作状态。另外，通过 DC/DC 变换器 22 对直流发电机 20 充电电压进行升压，还可对锂离子电池 14 进行充电。并使其它附件等的设备处于工作状态。如果此时锂离子电池已充电饱和，则 DC/DC 变换器 22 的工作能防止对锂离子电池的过充，且切断从铅酸蓄电池 12 一侧向锂离子电池 14 一侧的电能输送。

此外，在车辆发动机已经起动、并进入到工作状态之后，工作状态检测器 30 的工作能根据如下的条件而判断出车辆是否处于停车状态：是否发生了制动操作、以及存在制动踏板力；以及是否对离合器进行了操作、变速箱的档位。工作状态检测器根据车辆的停车状态、车辆的暖机状态、发动机起动后车辆的行驶里程以及速度变化历程等，判断用于执行空转停机控制的条件是否已经满足。如果判断出用于执行空转停机控制的条件已经满足，则无需车辆驾驶员执行将点火开关从点火接通位置转换到点火断开位置的操作，就自动将燃料喷射、点火线圈供电等工作停止。因而，发动机就从工作状态转换到了停机状态。

在发动机于空转停机控制模式下进入到停机状态的情况下，点火开关保持在点火接通位置。因而，空调器、动力转向装置以及仪表等

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的附件、以及加速器和制动器等的线控系统仍保持着工作状态，此状态下，它们仍然由锂离子电池 14 进行供电。需要电压稳定的附件以及线控系统—例如音响设备和汽车导航系统、ABS、油泵保持在工作状态下，在该状态下，由铅酸蓄电池 12 对它们进行供电，或者是通过 DC/DC 变换器 22 由锂离子电池 14 进行供电。

当在空转停机控制模式下将发动机停机时，利用工作状态检测器 30 来判断是否已经满足了取消空转停机控制的条件，工作状态检测器 30 的判断基于如下的条件：如果车辆上安装的是自动变速箱，则变速箱的档位是否从“N”档换到了“D”档（驱动档）或“R”档（倒车档）；制动操作是否已被释放；或者在车辆上安装手动变速箱的情况下，离合器踏板是否已被踩下。结果就是，在判断出取消空转停机控制的条件已满足的条件下，无需车辆驾驶员将点火开关从点火接通位置转到起动机接通位置，起动机 18 就能变为工作状态，从而使发动机起动，重新变为工作状态。下文中，将上述的发动机起动操作称为“重新起动”。与此同时，将安装常规程序、将点火开关转到起动机接通位置的发动机起动操作称为“常规起动”。

按照这样的方式，对于根据本实施例的车辆，在发动机进入到工作状态之后，如果车辆停车时就执行空转停机控制。因而，根据该示例性实施方式，可避免将发动机保持在无用的空转状态，因此，发动机的运行更为高效，并能提高燃油经济性。

对于执行空转停机控制的系统，由于相比于不执行空转停机控制的系统，发动机起动和熄火的次数更为频繁，所以起动机 18 工作的频率（换言之：即从电池向起动机供电的频度）是很高的。在这样的条件下，如果始终是由放电密度较高/能量密度较低的铅酸蓄电池 12 向起动机 18 供电，则铅酸蓄电池始终工作在负载条件下的状况将造成铅酸蓄电池 12 的劣化过程加速。

可通过相对增大铅酸蓄电池 12 的容量来解决上述的问题。但在

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本实施例的结构设计中，这就必须要为铅酸蓄电池 12 留出足够大的安装空间，另外，这样作还会带来成本的增加。

在执行常规起动时，由于发动机通常是冷机，所以电池的负载相对较大。在另一方面，在采用空转停机控制的情况下，当发生发动机重新起动时，发动机处于暖机状态，所以电池的负载相对较小。因而，为了能可靠地保证发动机的起动性能，合适的作法是采用高放电密度的电池，单位质量的这种电池能在单位时间内输出很高的电能。在另一方面，在执行重新起动时，无须高放电密度的电池，采用低放电密度的电池也能足够胜任。在车辆运行过程中，要以一定的时间间隔频繁地执行空转停机控制。因而，为了能可靠地保证发动机在重新起动时的起动性，合适的作法是采用一种能量密度很高的电池，这种电池的单位质量具有很高的蓄电量。

因而，如上文所述，根据该实施例，在按照车辆驾驶员的意愿而起动发动机时（常规起动），起动机 18 由铅酸蓄电池 12 供电而变为工作状态，其中，驾驶员的意愿体现为其所执行的点火操作。当在空转停机控制下起动发动机时（重新起动），转换开关 16 的工作可将与起动机 18 相连接的电池从铅酸蓄电池 12 转换为锂离子电池 14，从而，起动机 18 由锂离子电池 14 供电而变为工作状态，并将发动机起动。

按照这样的设计，由于在常规起动时采用的是高放电密度的铅酸蓄电池 12，所以即使在低温条件下，也能可靠地保证发动机的起动性能，并且由于在重新起动是采用的是高能量密度的锂离子电池 14，所以即使频繁地执行空转停机控制，也能可靠地起动发动机，同时还不会导致铅酸蓄电池 12 的加速老化。因而，根据该示例性实施方式，即使对于这样的两种情况：车辆驾驶员执行点火操作时所涉及的发动机起动、以及执行空转停机控制所涉及的发动机情况，也能始终可靠地起动发动机，且不会导致铅酸蓄电池 12 的老化加速。

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图 2 中的流程图表示了一控制程序的示例，该程序是实现上述功能所必须的，其由根据该实施例的供电控制系统 10 中的 ECU24 来执行。图 2 所示的程序以一定时间周期不断地反复执行。当图 2 所示的程序开始运行时，首先执行步骤 100 中的过程。

在步骤 100 中，在空转停机控制处于有效状态时，工作状态检测器 30 根据空转停机控制的取消条件，检测是否需要重新起动发动机。结果就是，如果判断出不需要重新起动发动机，则程序结束，从而并不执行下面的任何过程。而在另一方面，如果判断出需要重新起动发动机，则逻辑过程就进入到步骤 102。

在步骤 102 中，判断锂离子电池 14 的蓄电量是否降到了一预定水平、或低于该预定水平。如果判断结果是否定的，也就是说，如果锂离子电池 14 的蓄电量并未降低，则就可以断定锂离子电池 14 完全能够驱动起动机 18，并足以将发动机带到其工作状态。然后，过程进入到步骤 104 中。

在步骤 104 中，将锂离子电池 14 转接为与起动机 18 相连接的那个电池，并操作转换开关 16，从而使锂离子电池 14 向起动机 18 供电。在步骤 104 中，随后起动机 18 就接收锂离子电池 14 输送来的电能，进入到工作状态，从而重新起动发动机。当步骤 104 中的过程结束时，程序终止。

如果步骤 102 的判断结果是肯定的，也就是说，锂离子电池 14 的蓄电量已经降到或低于预定的水平，因而，即使接通锂离子电池 18 供电，起动机 18 也将不会工作。因此，不足以使发动机转变到其工作状态。之后，逻辑过程转向步骤 106。

在步骤 106 中，与起动机 18 相连接的电池被换接为铅酸蓄电池 12，并对转换开关 16 进行操作，以使得铅酸蓄电池 12 向起动机 18 供电。在步骤 106 中，而后就由铅酸蓄电池 12 向起动机 18 输送电能，使起动机变为工作状态而重新起动发动机。当步骤 106 中的过程执行

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完毕后，程序终止。

按照图 2 所示的程序，在空转停机控制所涉及的发动机重新起动过程中，如未发生锂离子电池蓄电量降低的情况，则电能是从锂离子电池 14、而非铅酸蓄电池 12 输送给起动机 18 的。因而，根据该实施例的设计，在车辆驾驶员执行点火操作所伴随的常规起动过程中，起动机 18 由铅酸蓄电池 12 供电。与此同时，在伴随着空转停机控制的重新起动过程中，起动机 18 由锂离子电池 14 供电。

按照这样的设计，当发动机为冷机状态时—换言之当电池负载很大时，所执行的常规起动为冷机起动，由于是用放电密度较高的铅酸蓄电池 12 来驱动起动机 18，所以能可靠地保证发动机的起动性。另外，在伴随空转停机控制的重新起动过程中，尽管是用放电密度较低的锂离子电池 14 来驱动起动机 18，但由于空转停机控制所伴随的重新起动是在发动机暖机状态下进行的（也就是说，电池的负载很小），所以仍然能可靠地保证发动机的起动性。另外，在重新起动时，由于是用高能量密度的锂离子电池 14 来驱动起动机 18，所以即使发动机重新起动的次数很频繁，也不会加速铅酸蓄电池 12 的老化，并可靠地保证发动机的起动性。

根据该实施例中的供电控制系统 10，对于执行空转停机控制的车辆，尽管发动机频繁起动，但能减少用铅酸蓄电池 12 来起动发动机的次数。另外，考虑到在发动机常规起动与重新起动时电池负载的差异，可以转换向起动机 18 供电的电池。因而，根据该实施例中的供电控制系统 10，无论是发动机的常规起动、还是重新起动，都能可靠地完成，同时还不会导致铅酸蓄电池 12 的加速老化。因此，可以避免由于电池损坏或老化而造成系统失效。

在根据该实施例的系统中，在空转停机控制所伴随的发动机重新起动过程中，是由锂离子电池 14 向起动机 18 供电的，从而，由于铅酸蓄电池 12 在重新起动时并不与起动机 18 相连接，所以可避免铅酸

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蓄电池 12 的电压出现下降。因而，对于那些连接在铅酸蓄电池 12 一侧的音响设备、导航设备、ABS、以及油泵等电器附件，即使在利用锂离子电池 14 来执行重新起动时，它们仍能接收到电源电压，从而能保持或继续它们的工作。在发动机重新起动时，如果铅酸蓄电池 12 的性能由于电量下降等原因而减弱，则可由锂离子电池 14 经 DC/DC 变换器 22 来向附件供电。因而，根据该实施例的控制系统，在执行发动机重新起动时，可避免那些要求电压恒定的附件出现故障或停止工作（例如，音响设备的中断、导航器屏幕的重设等），从而能可靠地保证附件的工作。

同样，在发动机重新起动过程中，与起动机 18 连接的锂离子电池 14 的电压会出现下降。但是，对于那些连接到锂离子电池 14 一侧的附件（例如除雾器和雨刷器），除了供电电压降低了一些之外，它们的正常工作并不会受到太大影响，或者不会产生一些严重的问题。因而，对于根据该实施例的系统，不必考虑由于发动机重新起动时锂离子电池 14 电压降低而带来的影响。

此外，在该实施例中，如果在空转停机控制所伴随的发动机重新起动的过程中，锂离子电池 14 的电量发生了下降，则由铅酸蓄电池 12 取代锂离子电池 14 向起动机 18 供电。因而，在发动机重新起动时，即使由于锂离子电池 14 的电量降低而不能用锂离子电池 14 来完成发动机的起动，也能用铅酸蓄电池 12 来可靠地起动发动机。因此，根据该实施例的供电控制系统 10，可避免这样的情形出现：由于锂离子电池 14 的电量降低，发动机无法完成重新起动。

在该实施例中，ECU24 的作用在于：通过控制转换开关 16，当常规起动时，使铅酸蓄电池 12 向起动机 18 供电；当重新起动时，使锂离子电池 14 向起动机 18 供电。此外，对电池的换接控制是通过执行图 2 所示程序中的步骤 102、106 来完成的。

在上述的实施例中，如果满足了执行空转停机控制的条件，则就

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将发动机熄火；并且如果在空转停机控制所伴随的发动机重新起动过程中，锂离子电池 14 的电量出现了不足，则就用铅酸蓄电池 12 来起动发动机。如果铅酸蓄电池 12 和锂离子电池 14 的电量都降低了，则停止执行空转停机控制。在这样的条件下停止执行空转停机控制：铅酸蓄电池 12 与锂离子电池 14 的电池电量和电池电压中的至少一项指标出现了不足。

另外，在上述的实施例中，在伴随空转停机控制的发动机重新起动过程中，当锂离子电池 14 的电量不足时，用铅酸蓄电池 12 来起动发动机。但是，在车辆驾驶员执行点火操作所伴随的发动机常规起动过程中，如果铅酸蓄电池 12 的电量降低到、或低于一预定值，则在此情况下将用锂离子电池 14 来起动发动机。在这样的设计中，在发动机的常规起动过程中，即使铅酸蓄电池 12 由于电量降低而不足以使发动机起动，通过采用锂离子电池 14 来起动发动机，也能可靠地避免出现这样的情形：由于蓄电量下降，无法完成发动机的常规起动。在该实施例中，当判断出铅酸蓄电池 12 的电量已经不足时，ECU24 工作而将铅酸蓄电池 12 与锂离子电池 14 换接。从而由锂离子电池 14 向起动机供电。

另外，在上述的实施例中，尽管是基于电池的电量来进行判断的—判断从铅酸蓄电池 12 和锂离子电池 14 向起动机 18 输送的电力是否足够，但这样的判断并不仅限于电池的电量。还可用其它的参数来进行判断，其它的参数例如为电池温度、电池电压或电池电流。

此外，在上述的实施例中，尽管是用锂离子电池 14 作为放电密度较低、但能量密度较高的电池，但也可采用镍氢电池或其它铅酸电池等的电池。

另外，在上述的示例性实施例中，如果车辆驾驶员将点火开关转到了起动机接通位置，则就由铅酸蓄电池 12 向起动机 18 供电，使其进入工作状态而起动发动机。还可应用于这样的设计：无需要由车辆

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驾驶员来进行操作，如果获得了某种认证，就开始从铅酸蓄电池 12 向起动机 18 供电，使其进入到工作系统，进而起动发动机，其中，所述认证是基于一无线通讯来进行的，所述无线通讯是在车辆驾驶员持有的一便携式装置与车辆一侧的一车载单元之间进行的。

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图1

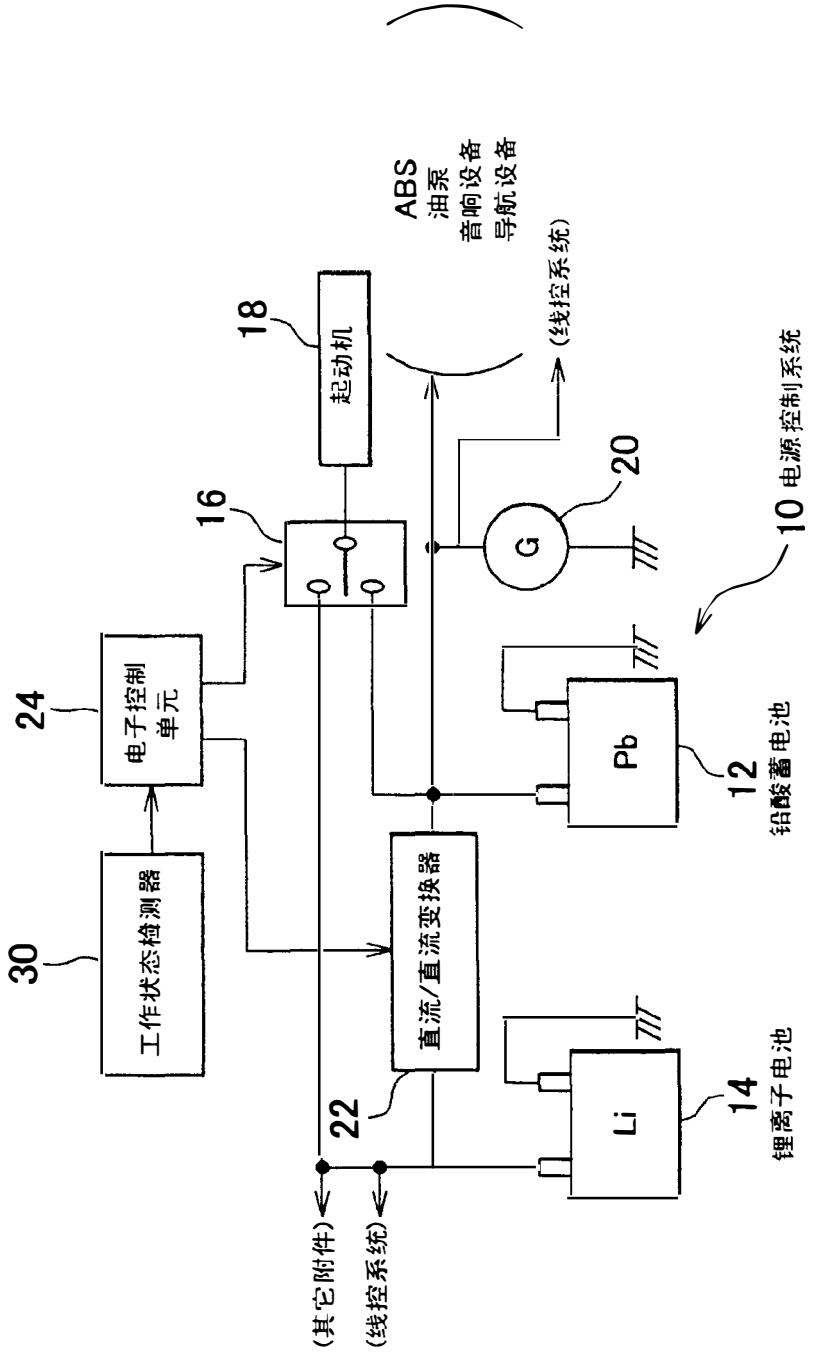
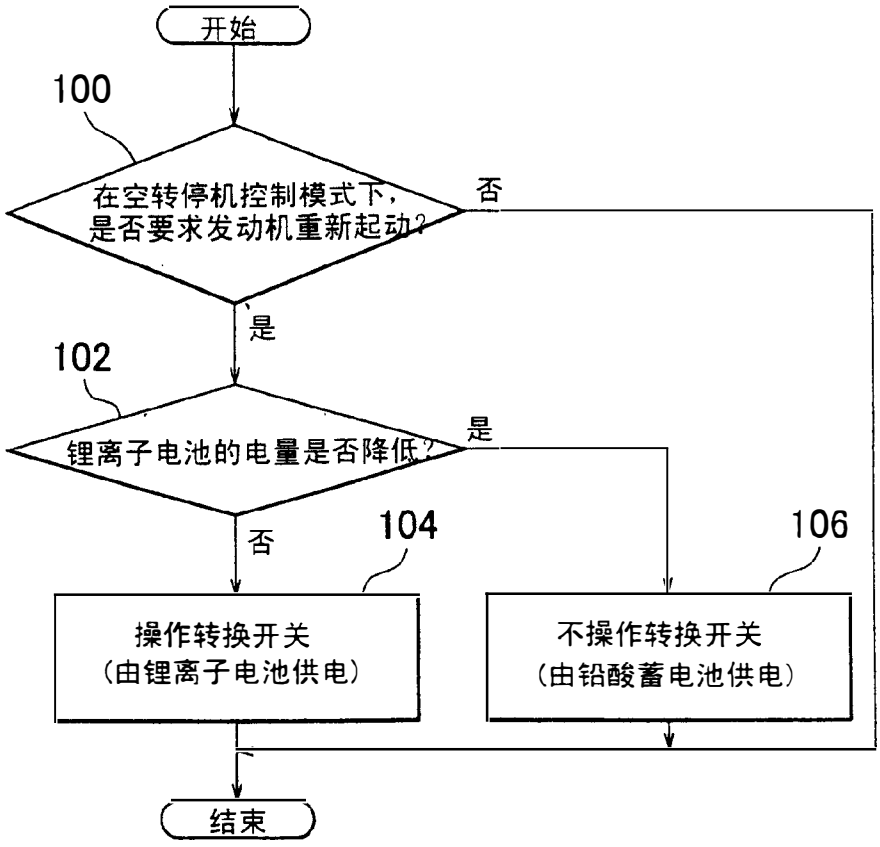

ABS
油泵
音响设备
导航设备
(线控系统)
18
起动机
16
20
G
10 电源控制系统
24
电子控制单元
Pb
12
铅酸蓄电池
30
工作状态检测器
直流/直流变换器
22
Li
14
锂离子电池
(其它附件)
(线控系统)

图2


开始
100
在空转停机控制模式下，是否要求发动机重新起动？
否
是
102
锂离子电池的电量是否降低？
是
否
104
106
操作转换开关（由锂离子电池供电）
不操作转换开关（由铅酸蓄电池供电）
结束

Europäisches Patentamt
European Patent Office
Office européen des brevets

Espacenet

WO2013015539A1 BATTERY MODULE HAVING IMPROVED RELIABILITY AND MID-TO-LARGE BATTERY PACK COMPRISING SAME

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BATTERY MODULE HAVING IMPROVED RELIABILITY AND MID-TO-LARGE BATTERY PACK COMPRISING SAME

Abstract

The present invention provides a battery module having a plurality of battery cells in sheet-form which are sequentially laminated, in which the battery module is formed from two or more hexahedral cell units, laminated and connected in series, and the cell unit consists of two or more battery cells connected in series, and adhered to each other. Electrode terminals (outermost electrode terminals) of the outermost battery cells from among the cell units are connected to an external input/output terminal of the battery module, and have wider vertical cross-sectional areas than remaining the electrode terminals of the battery cells so that a break due to an external impact can be prevented.

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

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(54)【発明の名称】信頼性の向上した電池モジュール及びこれを備えた中大型電池パック

(57)【要約】
本発明は、複数の板状型電池セルが順次に積層されている電池モジュールであって、前記電池モジュールは、２つ以上の直方体のセルユニットが積層された状態で直列連結された構造になっており、前記セルユニットは、２つ以上の電池セルが互いに密着した状態で直列連結された構造になっており、前記セルユニットのうち、最外側に配置された電池セルの電極端子（最外側電極端子）は電池モジュールの外部入出力端子と連結されており、外力による破たんを防止するように、残り電池セルの電極端子に比べて垂直断面積が広くなっている電池モジュールを提供する。

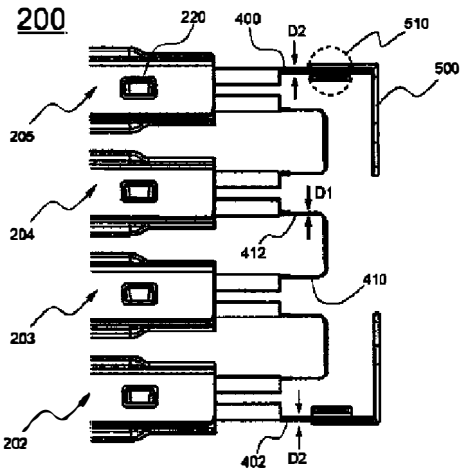


EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

【特許請求の範囲】
【請求項１】
複数の板状型電池セルが順次に積層されている電池モジュールであって、
前記電池モジュールは、２つ以上の直方体のセルユニットが積層された状態で直列連結された構造になっており、
前記セルユニットは、２つ以上の電池セルが互いに密着した状態で直列連結された構造になっており、
前記セルユニットのうち、最外側に配置された電池セルの電極端子（最外側電極端子）は電池モジュールの外部入出力端子と連結されており、外力による破たんを防止するように、残り電池セルの電極端子に比べて垂直断面積が広くなっていることを特徴とする、電池モジュール。
【請求項２】
前記最外側電極端子の垂直断面積は、残り電池セルの電極端子の垂直断面積を基準に１１０％乃至５００％の大きさになっていることを特徴とする、請求項１に記載の電池モジュール。
【請求項３】
前記最外側電極端子は、残り電池セルの電極端子に比べて厚さがより大きいことを特徴とする、請求項１に記載の電池モジュール。
【請求項４】
前記最外側電極端子は、外部入出力端子と連結されるバスバーに結合されていることを特徴とする、請求項１に記載の電池モジュール。
【請求項５】
前記最外側電極端子の厚さは、残り電池セルの電極端子の厚さを基準に１２０％乃至３００％の大きさになっていることを特徴とする、請求項３に記載の電池モジュール。
【請求項６】
前記電池セルの電極端子は、アルミニウムからなる正極端子と、ニッケルメッキ銅からなる負極端子とで構成されることを特徴とする、請求項１に記載の電池モジュール。
【請求項７】
前記正極端子の厚さは前記負極端子の厚さよりも大きいことを特徴とする、請求項５に記載の電池モジュール。
【請求項８】
前記最外側電極端子のうち、正極端子の厚さは負極端子の厚さよりも大きいことを特徴とする、請求項１に記載の電池モジュール。
【請求項９】
前記最外側電極端子のうち、正極端子の厚さは０．３乃至０．５ｍｍであり、負極端子の厚さは、前記正極端子の厚さよりも小さい範囲において０．１乃至０．３ｍｍであることを特徴とする、請求項８に記載の電池モジュール。
【請求項１０】
前記最外側電極端子は、残り電池セルの電極端子に比べて幅（横幅）が大きいことを特徴とする、請求項１に記載の電池モジュール。
【請求項１１】
前記最外側電極端子の幅は、残り電池セルの電極端子の幅を基準に１３０％乃至２００％の大きさであることを特徴とする、請求項１０に記載の電池モジュール。
【請求項１２】
前記バスバーは、ニッケルメッキ銅からなることを特徴とする、請求項４に記載の電池モジュール。
【請求項１３】
前記板状型電池セルは、樹脂層及び金属層を含むラミネートシートの電池ケースに正極／分離膜／負極構造の電極組立体が内蔵されており、前記電池ケース両端に正極端子及び負極端子が突出していることを特徴とする、請求項１に記載の電池モジュール。

【請求項１４】
前記セルユニットは、電池セルが互いに密着した状態で金属ハウジングに内蔵されていることを特徴とする、請求項１に記載の電池モジュール。
【請求項１５】
金属ハウジングは、２つ以上の電池セル、及び前記正極端子及び負極端子の部位を除いた電池セル積層体の外面全体を覆うように相互結合されていることを特徴とする、請求項１４に記載の電池モジュール。
【請求項１６】
前記金属ハウジングは、電池セル積層体の外面形状に対応する内面構造を有しており、組立締結方式で結合されることを特徴とする、請求項１５に記載の電池モジュール。
【請求項１７】
前記金属ハウジングの断面結合部は、金属ハウジングが互いに対面するように接触させた状態で加圧した時、弾力的な結合により噛み合う雌雄の締結構造になっていることを特徴とする、請求項１５に記載の電池モジュール。
【請求項１８】
前記金属ハウジングは金属板材からなることを特徴とする、請求項１に記載の電池モジュール。
【請求項１９】
前記セルユニットは、２つの電池セルが直列連結されていることを特徴とする、請求項１に記載の電池モジュール。
【請求項２０】
前記セルユニットの直列連結は、第１セルユニットの電極端子端部と第２セルユニットの電極端子端部がそれぞれ断面
【数１】

「┐」

状に折れ曲がり、互いに重なる面が溶接されてなることを特徴とする、請求項１に記載の電池モジュール。
【請求項２１】
出力及び容量に対応して、請求項１に記載の電池モジュールを２つ以上備える、高出力・大容量の中大型電池パック。
【請求項２２】
電気自動車、ハイブリッド電気自動車、又はプラグ－インハイブリッド電気自動車の電源として用いられることを特徴とする、請求項２１に記載の中大型電池パック。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、複数の板状型電池セルが順次に積層されている電池モジュールであって、該電池モジュールは、２つ以上の直方体のセルユニットが積層された状態で直列連結されている構造になっており、当該セルユニットは、２つ以上の電池セルが互いに密着した状態で直列連結されている構造になっており、セルユニットのうち、最外側に配置された電池セルの電極端子（最外側電極端子）は、電池モジュールの外部入出力端子と連結されており、外力による破たんを防止できるように、残りの電池セルの電極端子に比べて垂直断面積がより広いことを特徴とする電池モジュールに関する。
【背景技術】
【０００２】
充放電可能な二次電池は、化石燃料を使用する既存のガソリン車両、ディーゼル車両などにおける大気汚染の問題などを解決するための方案として提示されている電気自動車（ＥＶ）、ハイブリッド電気自動車（ＨＥＶ）、プラグ－インハイブリッド電気自動車（Ｐ

ｌｕｇ－Ｉｎ　ＨＥＶ）などを含めて、高出力・大容量が要求されるデバイスの動力源として注目されている。

【０００３】

このようなデバイスには、高出力・大容量を提供するべく、複数の電池セルを電気的に連結した中大型電池モジュールが使用されている。

【０００４】

中大型電池モジュールは、可能な限り小さい大きさ及び重量で作製されるのが好ましい。そのため、高い集積度で充積可能であり且つ容量対比重量が小さい角形電池、パウチ形電池などが、中大型電池モジュールの電池セル（単位電池）として主に使用されている。特に、近年、アルミニウムラミネートシートなどを外装部材とするパウチ形電池は、軽量、低コスト、及び形態変形の容易さなどの利点から高い関心を集めている。

【０００５】

一方、現在、車両用電池パックに装着される電池モジュールを構成する各電池セルの電極端子の大きさは、１つの電池パック内においていずれも同一になっている。

【０００６】

また、電極端子としては、一般に、厚さが０．５ｍｍ以下である箔（ｆｏｉｌ）が使用されるため、車両に装着されて振動と衝撃を持続して受ける場合には破たんの可能性が高くなる。

【０００７】

特に、アルミニウム素材からなる正極端子であると、銅素材からなる負極端子に比べて素材自体の特性の上強度が弱いため、外部衝撃と振動に対して素材的に弱いという不具合がある。

【０００８】

また、バスバーは電池モジュールに固定されるため、電池モジュールが振動を受けて電池セルと電池モジュールとの相対運動が発生する場合、バスバーと電池セルとを連結する電極端子が、電池セルと電池セルとを連結する電極端子よりも構造的に弱いという不具合もある。

【０００９】

その上、電極端子と電極端子とを又は電極端子とバスバーとを連結する方法には、レーザー溶接又は超音波溶接が、量産の側面から有利であるため、一般に用いられている。しかし、電極端子の厚さを厚くするほど、溶接に必要なエネルギー消耗が大きくなり、不良率が高くなるという不具合がある。

【００１０】

そのため、高出力・大容量の電力を提供する上で、電池セルの電極端子が外部衝撃により内部短絡及び破たんすることを防止できる電池モジュールが強く要望されている。

【発明の概要】

【発明が解決しようとする課題】

【００１１】

本発明は、上記のような従来技術の問題点、及び過去から要請されてきた技術的課題を解決することを目的とする。

【００１２】

本発明の目的は、セルユニットのうち最外側に配置された電池セルの電極端子を、残り電池セルの電極端子に比べて垂直断面積をより広くすることによって、衝撃又は振動のような外力が電池モジュールに印加されても、電極リード同士の連結信頼性を確保することができる電池モジュールを提供することにある。

【００１３】

本発明の他の目的は、電池セルの低い機械的剛性を効果的に補強しながら、重量と大きさの増加を最小化できるセルユニット及び電池モジュールで構成された高出力・大容量の中大型電池パックを提供することにある。

【課題を解決するための手段】

【００１４】
上記目的を達成するための本発明に係る電池モジュールは、複数の板状型電池セルが順次に積層されている電池モジュールであって、前記電池モジュールは、２つ以上の直方体のセルユニットが積層された状態で直列連結された構造になっており、前記セルユニットは、２つ以上の電池セルが互いに密着した状態で直列連結された構造になっており、前記セルユニットのうち、最外側に配置された電池セルの電極端子（最外側電極端子）は電池モジュールの外部入出力端子と連結されており、外力による破たんを防止するように、残り電池セルの電極端子に比べて垂直断面積が広くなっている。
【００１５】
したがって、本発明に係る電池モジュールは、電池セルの電極端子のうち、電池モジュールの外部入出力端子と連結されている最外側電極端子を、残り電池セルの電極端子に比べて垂直断面積を広く形成することによって、外部の衝撃や振動により破たんすることを未然に防止し、電池モジュールの信頼性と安全性を大きく向上させることができる。また、最外側電極端子以外の残り電池セルの電極端子は、最外側電極端子に比べて垂直断面積をより小さくすることによって、溶接などの製作容易性を満たすことができる。
【００１６】
前記最外側電極端子の垂直断面積は、例えば、残り電池セルの電極端子の垂直断面積を基準に１１０％乃至５００％の大きさであってよい。
【００１７】
一好適例において、前記最外側電極端子の厚さが残り電池セルの電極端子の厚さよりも大きくなっているとよい。
【００１８】
この場合、最外側電極端子は、残り電極端子に比べて、幅（横幅）が同一で且つ厚さが大きい構造、又は幅（横幅）も厚さも大きい構造を考慮でき、前者の構造の方がより好ましい。
【００１９】
このように、電池セルの電極端子のうち最外側電極端子を残り電池セルの電極端子に比べて厚く形成することによって、向上した信頼性及び安全性を達成でき、且つ電極端子の溶接などの製作容易性が得られる。
【００２０】
一方、前記最外側電極端子は、例えば、外部入出力端子に連結されるバスバーと結合される構造であってもよい。
【００２１】
したがって、バスバーに直接連結される最外側電極端子の厚さを、残り電池セルの電極端子の厚さよりも大きくすることによって、電池モジュールの構造的脆弱性を補強することができる。
【００２２】
前記バスバーは、ニッケルメッキ銅からなり、最外側電極端子との容溶接が容易になっている。
【００２３】
具体例において、前記最外側電極端子の厚さは、残り電池セルの電極端子の厚さを基準に１２０％乃至３００％の大きさであるとよい。具体的に、最外側電極端子の厚さが残り電池セルの電極端子の厚さを基準に１２０％未満であると、所望する最外側電極端子の破たんを防止し難く、最外側電極端子の厚さが残り電池セルの電極端子の厚さを基準に３００％を超えると、バスバーとの溶接性が低下するので、好ましくない。
【００２４】
より好ましくは、最外側電極端子の厚さは、残り電極端子の厚さを基準に１５０％乃至２５０％にするとよい。
【００２５】
前記電池セルの電極端子は、アルミニウムからなる正極端子と、ニッケルメッキ銅から

なる負極端子とで構成されるとよく、好ましくは、正極端子の厚さは負極端子の厚さよりも大きくなっていればよい。

【００２６】

したがって、アルミニウム正極端子の厚さをニッケルメッキ銅負極端子の厚さよりも大きくすることによって、素材の脆弱性を補強することができる。

【００２７】

具体的な例として、下記の＜表１＞は、正極端子及び負極端子の素材別の機械的特性を示しており、＜表１＞から確認できるように、アルミニウム素材の正極端子の方が銅素材の負極端子に比べて引張強度が低い。

【００２８】

【表１】

＜表１＞電池セルの電極リード素材別の引張強度

	素材	方法	内容
正極端子	材料	JIS H 4170	ALN90H－O アルミニウム
	引張強度	JIS Z 2241	≧40N/mm^2 ≦110N/mm^2
負極端子	材料	JIS H 3100	C1020R-O 銅ニッケルメッキ
	引張強度	JIS Z 2241	≧195N/mm^2

【００２９】

これに対し、本発明に係る電池モジュールは、負極端子に比べて強度の低い正極端子の厚さを、負極端子よりも大きく構成することによって、外部の衝撃又は振動による外力が発生しても、正極端子とバスバーとの溶接部位が破たんすることを防止することができる。

【００３０】

すなわち、電池セルの電極端子のうち、銅素材の負極端子に比べて素材上強度の弱い正極端子を厚く構成することによって、正極端子とバスバーとの連結部品が外力により破たんすることを最小化することができる。

【００３１】

一方、前記最外側電極端子のうち、正極端子の厚さは負極端子の厚さよりも大きくなっているのが好ましい。

【００３２】

その具体例として、最外側電極端子のうち、正極端子の厚さは０．３乃至０．５ｍｍであり、負極端子の厚さは、前記正極端子の厚さよりも小さい範囲において０．１乃至０．３ｍｍであってよい。

【００３３】

具体的に、前記正極端子の厚さが０．３ｍｍ未満であると、所望する正極端子の強度を維持できず、正極端子の厚さが０．５ｍｍを超えると、正極端子とバスバーとの溶接性が低下するので、好ましくない。

【００３４】

同様に、負極端子の厚さが０．１ｍｍ未満であると、所望する負極端子の強度を維持できず、負極端子の厚さが０．３ｍｍを超えると、負極端子とバスバーとの溶接性が低下するので、好ましくない。

【００３５】

電極端子の垂直断面積が互いに異なる好適例において、最外側電極端子は残りの電極端

子に比べて幅（横幅）が広い構造であってもよい。
【００３６】
この構造において、前記最外側電極端子の幅又は横幅は、残り電池セルの電極端子の幅（横幅）を基準に１３０％乃至２００％であればよい。
【００３７】
このような構造の電池モジュールは、電池セルの電極端子のうち、電池モジュールの外部入出力端子と連結されている最外側電極端子の幅又は横幅を、残り電池セルの電極端子に比べて広く形成することによって、向上した信頼性と安全性を達成することができる。
【００３８】
本発明において、前記板状型電池セルは、電池モジュールの構成のために充積された時に全体大きさを最小化できるように、薄い厚さと相対的に広い幅及び長さを有する二次電池である。
【００３９】
このような二次電池の好ましい例としては、樹脂層及び金属層を含むラミネートシートの電池ケースに正極／分離膜／負極構造の電極組立体が内蔵されており、前記電池ケースの両端に正極端子及び負極端子が突出している構造の二次電池が挙げられ、具体的に、アルミニウムラミネートシートのパウチ形ケースに電極組立体が内蔵されている構造であってよい。このような構造の二次電池を「パウチ形電池セル」と呼ぶものとする。
【００４０】
好ましくは、セルユニットは、電池セルが互いに密着した状態で金属ハウジングに内蔵されていればよく、金属ハウジングは、２つ以上の電池セル、及び前記正極端子及び負極端子の部位を除いた電池セル積層体の外面全体を覆うように相互結合されていればよい。
【００４１】
一例として、前記金属ハウジングは、電池セル積層体の外面形状に対応する内面構造を有しており、且つ組立締結方式で結合されるとよい。
【００４２】
他の例として、前記金属ハウジングにおいて断面結合部は、金属ハウジングが互いに対面するように接触させた状態で加圧した時、弾力的な結合により噛み合うことができるように雌雄の結合構造にしてもよい。
【００４３】
一方、二次電池では、充放電過程で発熱がおき、発生した熱を外部に効果的に放出することが電池の寿命延長に重要な要素となる。そのため、前記金属ハウジングは、内部の電池セルで発生する熱が外部へより放出しやすくなるように、高い熱伝導性の金属板材で作製されるとよい。
【００４４】
前記セルユニットは、上述したように、２つ以上の電池セルが直列連結された状態で金属ハウジングに内蔵された構造になっており、好ましくは、２つの電池セルからなるとよい。
【００４５】
好ましい例において、前記セルユニットの直列連結は、第１セルユニットの電極端子の端部と第２セルユニットの電極端子の端部がそれぞれ断面
【００４６】
【数１】

「┐」

【００４７】
状に折れ曲がり、互いに重なる面が溶接されてなるとよい。
【００４８】
一方、中大型電池パックでは高出力・大容量の性能確保のために複数の電池セルが使用

されるが、このような中大型電池パックを構成する電池モジュールには、限られた装着空間内での安全性の確保のために、より高い装着効率性、構造的安全性及び放熱効率性が要求される。

【００４９】

そこで、本発明は、前記電池モジュールを所望の出力及び容量に応じて複数個組み合わせてなる中大型電池パックを提供する。

【００５０】

本発明に係る中大型電池システムは、所望の出力及び容量に応じて電池パックを組み合わせて製造でき、よって、上述のような装着効率性、構造的安全性などの側面から、限られた装着空間を有し且つ頻繁な振動及び強い衝撃などに露出される電気自動車、ハイブリッド電気自動車、プラグ－インハイブリッドなどに好適に使用可能である。

【図面の簡単な説明】

【００５１】

【図１】パウチ形電池の斜視図である。

【図２】図１のパウチ形電池２個が直列に連結された電池セルの斜視図である。

【図３】図１のパウチ形電池２個が直列に連結された電池セルの斜視図である。

【図４】本発明の一実施例に係るセルユニット積層体の斜視図である。

【図５】本発明の他の実施例に係る電池モジュールの分解斜視図である。

【図６】図４のセルユニット積層体の平面図である。

【図７】図６のＡ部分を拡大した部分拡大図である。

【図８】本発明の他の実施例に係るセルユニットにおいて電極端子部位の部分詳細図である。

【発明を実施するための形態】

【００５２】

以下、添付の図面を参照して本発明の実施例について説明するが、これは、本発明のより容易な理解を助けるためのもので、本発明の範ちゅうを限定するものではない。

【００５３】

図１には、パウチ形電池の斜視図が模式的に示されている。図１を参照すると、パウチ形電池１００は、２つの正極端子１１０と負極端子１２０が互いに対向して電池本体１３０の上端部と下端部にそれぞれ突出している構造になっている。電池ケース１４０は、上下２単位からなっており、その内面に形成されている収納部に電極組立体（図示せず）を装着した状態で、相互接触部位である両側面１４０ｂ、上端部及び下端部１４０ａ，１４０ｃを貼り合わせることによって電池１００が作製される。電池ケース１４０は、樹脂層／金属箔層／樹脂層のラミネート構造からなり、互いに接する両側面１４０ｂ、上端部及び下端部１４０ａ，１４０ｃに熱と圧力を加えて樹脂層を相互融着させることで貼り合わせることができ、場合によっては接着剤にて張り合わせてもよい。

【００５４】

両側面１４０ｂは、上下電池ケース１４０の同一の樹脂層が直接接するから、溶融により均一な密封が可能である。一方、上端部１４０ａと下端部１４０ｃには正極端子１１０と負極端子１２０が突出しているため、電極端子１１０，１２０の厚さ及び電池ケース１４０との素材異質性から、電極端子１１０，１２０との間にフィルム上のシーリング部材１６０を挟んだ状態で熱融着を行い、密封性を高めている。

【００５５】

図２及び図３には、図１のパウチ形電池２個が直列に連結された電池セルの斜視図が模式的に示されている。

【００５６】

図２及び図３を図１と共に参照すると、２個のパウチ形電池セル１００，１０１をその電極端子１１０，１２０が連続的に相互隣接するように長さ方向に直列配列した状態で、電極端子１１０，１２０を溶接して互いに結合させた後、２つの単位に電池セル１００，１０１が重なるように畳む。図３に示すように、重なるように折り畳まれた状態の電池セ

ル積層体１００ａにおいて、溶接により結合された電極端子連結部位１５０は、平面上
【００５７】
【数２】

「□」

【００５８】
状に折れ曲がっている。
【００５９】
図４には、本発明の一実施例に係るセルユニット積層体の斜視図が模式的に示されており、図５には、本発明の他の実施例に係る電池モジュールの分解斜視図が模式的に示されている。
【００６０】
図４及び図５を参照すると、電池モジュール３００は、４個の直方体のセルユニット２０２，２０３，２０４，２０５が積層された状態で直列連結されたセルユニット積層体２００を側面で直立させた状態で、上下組立型の上部ケース３１１と下部ケース３１２に装着した構造になっており、下部ケース３１２の前面には外部入出力端子３１４が装着されている。
【００６１】
セルユニット積層体２００は、電池セルを金属ハウジング２１０で外囲した構造にした４個のセルユニット２０２，２０３，２０４，２０５を互いに直列に連結された後、ジグザグ状に積層した構造になっている。
【００６２】
一方、金属ハウジング２１０の外面には、長さ方向に間隔を空けて線形突出部２１１ａ，２１１ｂ，２１１ｃ，２１１ｄ、２１１ｅが形成されており、特に、金属ハウジング２１０の両端には、幅方向の長さが金属ハウジング２１０のそれよりも短い線形突出部２１１ａ，２１１ｅが、互いに対角線位置に形成されている。
【００６３】
図６には、図４のセルユニット積層体の平面図が模式的に示されており、図７には、図６のＡ部分を拡大した部分拡大図が模式的に示されている。
【００６４】
図６及び図７を図４及び図５と共に参照すると、セルユニット２０２，２０３，２０４，２０５のうち、最外側に配置された電池セルの最外側電極端子４００，４０２は、残りの電池セルの電極端子４１０，４１２に比べて厚さがより厚く形成されており、外力による破たんを防止するようになっている。
【００６５】
具体的に、最外側電極端子４００，４０２の厚さＤ２は、残り電池セルの電極端子４１０、４１２の厚さＤ１よりも厚くなっている。すなわち、電極端子４００，４０２，４１０，４１２の幅（横幅）は互いに同一であるが、厚さが異なっており（Ｄ１＞Ｄ２）、結果的に電極端子４００，４０２の垂直断面積は電極端子４１０，４１２よりも大きい。
【００６６】
最外側電極端子４００，４０２は、電池モジュールの外部入出力端子３１４と連結されているバスバー５００に溶接により結合されており、最外側電極端子４００，４０２の厚さは、残り電池セルの電極端子の厚さを基準に２００％以上の大きさで形成されている。
【００６７】
具体例において、最外側電極端子のうち、正極端子の厚さは０．４ｍｍであり、負極端子の厚さは、正極端子の厚さよりも薄い範囲において０．２ｍｍとなっている。
【００６８】
電池セルの電極端子は、アルミニウムからなる正極端子４１０とニッケルメッキ銅からなる負極端子４１２とで構成され、バスバー５００は、ニッケルメッキ銅からなっている

。
【００６９】
セルユニット２０２，２０３，２０４，２０５は、電池セルが互いに密着した状態で金属ハウジング２１０に内蔵されている構造であり、金属ハウジング２１０は、２個の電池セル、及び正極端子及び負極端子の部位を除いた電池セル積層体の外面全体を覆うように相互結合されている。
【００７０】
また、金属ハウジング２１０は金属板材であって、電池セル積層体の外面形状に対応する内面構造を有しており、且つ組立締結方式で結合される。金属ハウジング２１０の断面結合部は、雌雄の締結構造２２０になっており、金属ハウジング２１０が互いに対面するように接触させた状態で加圧すると弾力的な結合により噛み合うこととなる。
【００７１】
セルユニット２０２，２０３，２０４，２０５の直列連結は、第１セルユニット２０４の電極端子４１２の端部と第２セルユニット２０３の電極端子４１０の端部がそれぞれ断面
【００７２】
【図３】

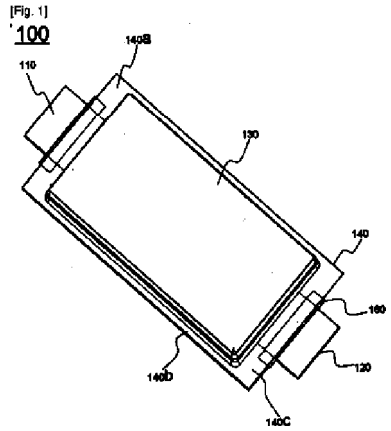
「┐」

【００７３】
状に折れ曲がり、互いに重なる面が溶接されてなる。
【００７４】
図８は、本発明のさらに他の実施例に係るセルユニットにおいて電極端子の部位を示す部分詳細図である。
【００７５】
図８を参照すると、セルユニットを構成する電池セル１００ｂ，１００ｃはそれぞれ、Ｗ１及びＷ２の幅（横幅）を持つ電極端子４０３，４０４を有している。
【００７６】
具体的に、最外側の電極端子を形成する電池セル１００ｃの電極端子４０４の幅Ｗ２は、電池セル１００ｂの電極端子４０３の幅Ｗ１を基準に１３０％乃至２００％の大きさで相対的に広く形成されている。すなわち、厚さは同一であるが、幅が異なっており（Ｗ２＞Ｗ１）、結果として、電池セル１００ｃの電極端子４０４の垂直断面積は電池セル１００ｂの電極端子４０３のそれよりも大きくなっている。
【００７７】
以上、図面を参照して本発明の実施例を説明してきたが、本発明の属する分野における通常の知識を有する者にとっては、上記内容に基づいて本発明の範ちゅう内で様々な応用及び変形が可能であろう。
【産業上の利用可能性】
【００７８】
以上説明した通り、本発明に係る電池モジュールは、セルユニットのうち、最外側に配置された電池セルの電極端子が残り電池セルの電極端子に比べて垂直断面積が広くなっているため、衝撃又は振動のような外力が電池モジュールに付加されても、電極リード同士の連結信頼性を確保することができる。
【符号の説明】
【００７９】
１００、１０１　パウチ形電池
１１０　正極端子
１２０　負極端子
１３０　電池本体

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

１４０　電池ケース
１６０　シーリング部材
２００　セルユニット積層
２０２，２０３，２０４，２０５　セルユニット
２１０　金属ハウジング
３００　電池モジュール
３１１　上部ケース
３１２　下部ケース
３１４　外部入出力端子
４００，４０２　最外側電極端子
４１０，４１２　電極端子

【図１】



【図２】

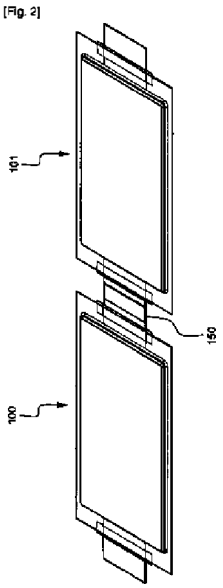
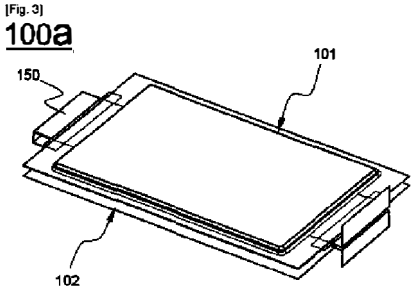
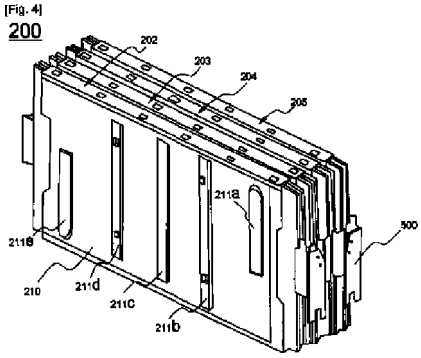


EXHIBIT 1002
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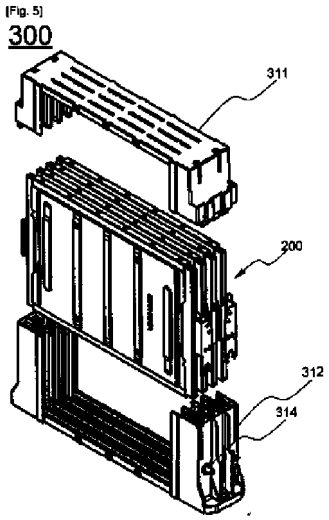
【図３】



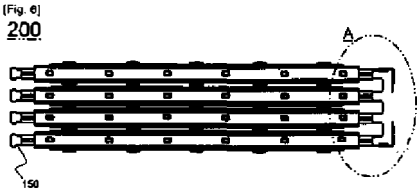
【図４】



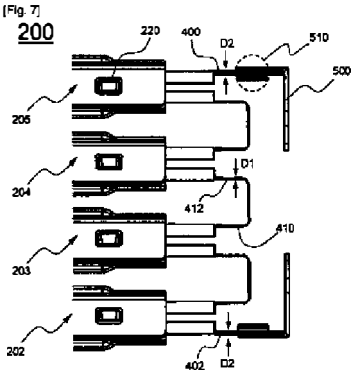
【図５】



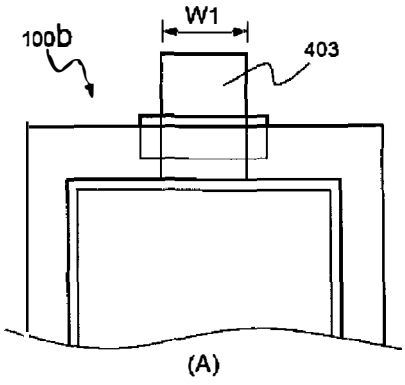
【図６】



【図７】



【図８（Ａ）】



【図８（Ｂ）】

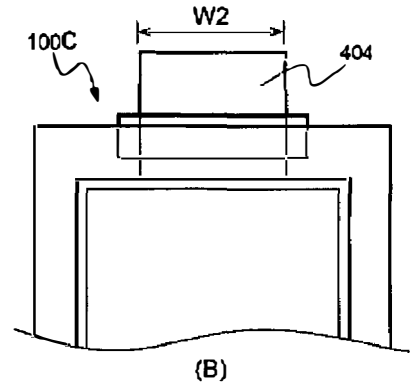


EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2012/005320

A. CLASSIFICATION OF SUBJECT MATTER

H01M 2/30(2006.01)i, H01M 2/26(2006.01)i, H01M 2/10(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 2/30; H01M 10/46; H01M 2/10; H01G 9/00; H01M 10/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: battery pack, battery module, outmost electrode terminal, cross section

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2009-0000292 A (LG CHEM. LTD.) 07 January 2009 See abstract, claims 1-15, paragraphs 29-58, and figures 1-4.	1-22
A	KR 10-2008-0107047 A (LG CHEM. LTD.) 10 December 2008 See abstract, claims 1-10, and figures 1-4.	1-22
A	KR 10-2007-0106814 A (LG CHEM. LTD.) 06 November 2007 See abstract, claims 1-16, and figures 1-16.	1-22
A	JP 2005-149882 A (SII MICRO PARTS LTD) 09 June 2005 See abstract, claims 1-8, and figures 1-5.	1-22

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
29 OCTOBER 2012 (29.10.2012)	**31 OCTOBER 2012 (31.10.2012)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

EXHIBIT 1002
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2012/005320

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2009-0000292 A	07.01.2009	NONE	
KR 10-2008-0107047 A	10.12.2008	NONE	
KR 10-2007-0106814 A	06.11.2007	CN 101479864 A	08.07.2009
		EP 2013928 A1	14.01.2009
		JP 2009-535777 A	01.10.2009
		US 2009-0305126 A1	10.12.2009
		WO 2007-126243 A1	08.11.2007
JP 2005-149882 A	09.06.2005	NONE	

Form PCT/ISA/210 (patent family annex) (July 2009)

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

국제조사보고서

국제출원번호
PCT/KR2012/005320

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H01M 2/30(2006.01)i, H01M 2/26(2006.01)i, H01M 2/10(2006.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)
H01M 2/30; H01M 10/46; H01M 2/10; H01G 9/00; H01M 10/04

조사된 기술분야에 속하는 최소문헌 이외의 문헌
한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))
eKOMPASS(특허청 내부 검색시스템) & 키워드: 전지팩, 전지모듈, 외외곽 전극단자, 단면적.

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	KR 10-2009-0000292 A (주식회사 엘지화학) 2009.01.07 요약, 청구항 1-15, 문단 29-58, 및 도면 1-4 참조.	1-22
A	KR 10-2008-0107047 A (주식회사 엘지화학) 2008.12.10 요약, 청구항 1-10, 및 도면 1-4 참조.	1-22
A	KR 10-2007-0106814 A (주식회사 엘지화학) 2007.11.06 요약, 청구항 1-16, 및 도면 1-16 참조.	1-22
A	JP 2005-149882 A (SII MICRO PARTS LTD) 2005.06.09 요약, 청구항 1-8, 및 도면 1-5 참조.	1-22

☐ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오

* 인용된 문헌의 특별 카테고리:

"A" 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

"E" 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

"L" 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

"O" 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

"P" 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

"T" 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

"X" 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

"Y" 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

"&" 동일한 대응특허문헌에 속하는 문헌

국제조사의 실제 완료일	국제조사보고서 발송일
2012년 10월 29일 (29.10.2012)	**2012년 10월 31일 (31.10.2012)**

ISA/KR의 명칭 및 우편주소
대한민국 특허청
(302-701) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)
팩스 번호 82-42-472-7140

심사관
이성준

전화번호 82-42-481-8501

서식 PCT/ISA/210 (두 번째 용지) (2009년 7월)

EXHIBIT 1002
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국제조사보고서
대응특허에 관한 정보

국제출원번호
PCT/KR2012/005320

국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
KR 10-2009-0000292 A	2009.01.07	없음	
KR 10-2008-0107047 A	2008.12.10	없음	
KR 10-2007-0106814 A	2007.11.06	CN 101479864 A	2009.07.08
		EP 2013928 A1	2009.01.14
		JP 2009-535777 A	2009.10.01
		US 2009-0305126 A1	2009.12.10
		WO 2007-126243 A1	2007.11.08
JP 2005-149882 A	2005.06.09	없음	

서식 PCT/ISA/210 (대응특허 추가용지) (2009년 7월)

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

フロントページの続き

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

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Fターム(参考) 5H011 AA01 EE04 FF04 GG09 HH01 KK01 KK02
5H040 AA01 AA07 AA19 AS02 AS07 AT04 AT06 AY05 AY10 CC13
CC23 CC34 DD03 DD04 DD09 DD24 JJ02 JJ03 JJ04 JJ06
LL01 NN01 NN03
5H043 AA01 AA02 AA05 AA13 AA15 BA16 BA19 CA05 CA08 CA22
DA05 DA06 DA07 DA13 DA15 FA02 FA04 FA22 FA26 FA37
FA38 HA02F HA06F HA16F HA17F HA23D HA23F JA07F JA13D JA13F
KA07D KA07F KA08D KA08F KA09D KA44D KA44F LA02D LA02F LA11D
LA11F LA21D LA21F LA22F

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Petitioner ADC (IPR2024-00577)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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(43) International Publication Date
31 May 2012 (31.05.2012)

WIPO | PCT

(10) International Publication Number
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(51) International Patent Classification:
H01R 13/648 (2006.01) *H01R 31/06* (2006.01)
H02J 7/00 (2006.01) *H05K 5/04* (2006.01)

(21) International Application Number:
PCT/AU2011/001532

(22) International Filing Date:
25 November 2011 (25.11.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2010905218 25 November 2010 (25.11.2010) AU

(71) Applicant *(for all designated States except US)*: **CLIPSAL AUSTRALIA PTY LTD** [AU/AU]; 78 Waterloo Road, MacQuarie Park, NSW 2113 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **DE MAN, Gerrit** [AU/AU]; 78 Waterloo Road, MacQuarie Park, NSW 2113 (AU).

(74) Agent: **MADDERNS PATENT AND TRADE MARK ATTORNEYS**; Level 4, 19 Gouger Street, Adelaide, S.A. 5000 (AU).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: USB OUTLET CHARGER

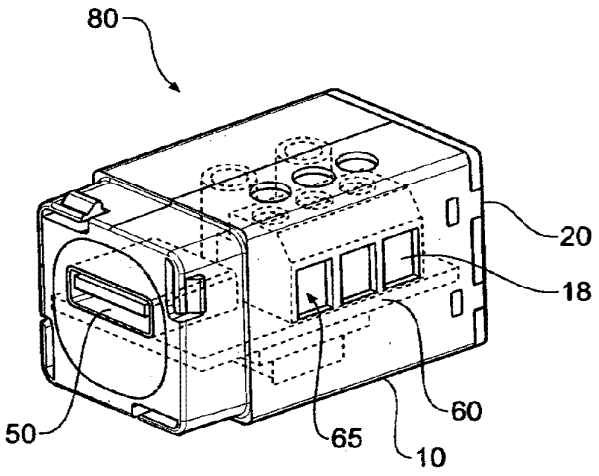


Figure 8

(57) **Abstract**: Disclosed is a Universal Serial Bus (USB) charging module for installation with a surface mounted power outlet. The charging module allows convenient and flexible installation in certain new and already installed power outlets to provide a convenient charging facility of devices with USB connection. Also disclosed is a housing for the charging module, a charging circuit and a method of installation.

WO 2012/068635 A1

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USB OUTLET CHARGER

FIELD OF THE INVENTION

The present invention relates to an electrical power outlet in a building such as a hotel, office or home. In a particular form, the invention relates to a power outlet providing an interface for charging Universal Serial Bus (USB) compatible devices.

PRIORITY

The present application claims priority from Australian Provisional Patent Application No. 2010905218 entitled "USB Outlet Charger" filed on 25 November 2010.

The entire contents of this document are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Many electronic devices such as mobile phones, mp3 players and digital cameras are charged through USB ports in either a computer or a USB Alternating Current (AC) adaptor which may be plugged into a wall socket or power outlet. Charging devices through a USB port on a computer requires the computer to be switched on and also prevents other peripheral devices such as mice and memory devices from accessing the port while in use. By using a USB AC adaptor the electronic device may be charged at a wall socket or power outlet. One portion of the adaptor has AC prongs which engage into AC receptacles of the wall socket while another portion of the adaptor has a USB port to interface with a USB connector of an appliance or electronic device to be charged. The disadvantage with this arrangement is that the USB AC adaptor is a separate component that must be purchased and carried around and also that the AC prongs will only be suitable for a particular country or region. This leads to another drawback with using USB AC adaptors in foreign countries, namely that additional AC adaptors are necessary to engage with sockets found in different areas around the world.

There are also USB wall outlets wherein the USB charger is integral with the power outlet. Having the USB charger integral with the power outlet can lead to increased complexity during installation and costly repair and replacement of parts.

An object of the present invention is to ameliorate one or more of the above described difficulties or at least provide a useful alternative for charging USB compatible devices.

Other advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, several aspects and embodiments of the present invention are disclosed.

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SUMMARY

In one aspect of the invention, there is proposed a Universal Serial Bus (USB) charging module housing adapted for securement to a surface mountable power outlet, the housing including:

an engaging portion for connecting the housing to a supporting portion of the power outlet;

access means to allow a USB charging circuit to be inserted into the housing; and

an aperture for allowing external access to a USB port.

In one form, the USB charging module housing further includes at least one aperture for receiving wires carrying mains power.

In one form, the access means to allow the USB charging circuit to be inserted into the housing is provided by an aperture in an external face of the housing.

In one form, the aperture is covered by a removable portion.

In one form, the removable portion includes at least one aperture for receiving wires carrying mains power.

In one form, the supporting portion of the power outlet is an integral portion of a grid or face plate.

In another form, the supporting portion of the power outlet is located in a mounting plate that is adapted to be connected to the rear of a grid or face plate.

In one form, the housing is connected to the supporting portion of the power outlet from the front of the grid or face plate.

In one form, the housing is connected to the supporting portion of the power outlet from the rear of the grid or face plate.

In one form, the engaging portion of the USB charging module housing includes a plurality of clips extending outwardly from one or more exterior faces of the housing, said clips for engagement with one or more surfaces of the supporting portion of the power outlet in a snap fit arrangement.

In one form, the clips have a tapered front face and a substantially vertical rear face.

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In one form, the USB charging module housing has an aperture located on the front face of the housing for allowing external access to a USB port.

In a further aspect of the invention there is proposed a USB charging module adapted for securement to a surface mountable power outlet, the charging module including:

a USB port;

a USB charging circuit that is capable of receiving a mains power input;

a housing, said housing including an engaging portion for connecting the housing to a supporting portion of the power outlet; access means to allow the USB charging circuit to be inserted into the housing and an aperture for allowing external access to the USB port.

In one form, the USB charging module includes a USB charging circuit with a printed circuit board (PCB).

In one form, the USB charging module includes a plurality of wires that are soldered directly to the PCB for connection to mains power either directly or via a switch.

In another form, the USB charging module includes a terminal block mounted on the PCB for connection to wires carrying mains power either directly or via a switch.

In other embodiments, there are provided screwed terminals for wire termination.

In a further aspect of the invention there is proposed a surface mountable power outlet for allowing a user to charge a USB compatible device, the power outlet including:

a supporting portion;

a USB charging module including a USB port; a USB charging circuit that is capable of receiving a mains power input; a housing, said housing including an engaging portion for connecting the housing to the supporting portion of the power outlet; access means to allow the USB charging circuit to be inserted into the housing and an aperture for allowing external access to the USB port;

a grid or face plate adapted to allow a user to access the USB port;

a connection between the USB charging module and mains power; and

mounting means for mounting the power outlet to a mounting surface.

In one form, the mounting surface is a wall or floor.

In one form, the power outlet further includes a cover plate.

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In one form, the mains power is between about 100-240V alternating current (AC).

In a further aspect of the invention there is proposed a method of installing a power outlet for allowing a user to charge a USB compatible device as herein described, comprising the steps of:

connecting the engaging portion of the USB charging module housing to the supporting portion of the power outlet;

connecting the mains power to the USB charging module; and

mounting the power outlet to the mounting surface.

In a further aspect of the invention there is proposed a method of installing a power outlet for allowing a user to charge a USB compatible device as herein described, comprising the steps of:

connecting the engaging portion of the USB charging module housing to the supporting portion of the power outlet;

connecting the mounting plate to the rear of a grid or face plate.

connecting the mains power to the USB charging module; and

mounting the power outlet to the mounting surface.

In one form, the power outlet is attached or mounted to the mounting surface by fastening the grid or face plate to the surface by screws.

It will be understood that the term "comprise" and any of its derivatives (e.g. comprises, comprising) as used in this specification is to be taken to be inclusive of features to which it refers, and is not meant to exclude the presence of any additional features unless otherwise stated or implied.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that such prior art forms part of the common general knowledge of the technical field.

DRAWINGS

Various aspects of the present invention will be described in detail with reference to the following drawings in which:

FIGURE 1 is a front perspective view of a USB charging module housing according to a first aspect of the present invention;

FIGURE 2 is a rear perspective view of the USB charging module housing of Figure 1;

FIGURE 3 is a detailed view of part of an engaging portion of the USB charging module housing as shown in Figure 1;

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FIGURE 4 is a view of a removable cover that fits into the rear opening of a USB charging module housing;

FIGURE 5 shows an embodiment of a supporting portion of a surface mountable power outlet adapted to engage with a USB charging module housing;

FIGURE 6 is a detailed view of the mating interface of the supporting portion shown in Figure 5;

FIGURE 7 is a perspective view of a USB charging module according to an embodiment of a second aspect of the present invention;

FIGURE 8 is a perspective view of a USB charging module according to another embodiment of the second aspect of the present invention;

FIGURE 9 is a side view of the USB charging module shown in Figure 8;

FIGURE 10 is an end or rear view of the USB charging module shown in Figure 7 (wires not shown);

FIGURE 11 is a view of a USB charging module engaged with a grid or face plate of a surface mountable power outlet according to an embodiment of the present invention;

FIGURE 12 is a view of a USB charging module engaged with a grid or face plate of a surface mountable power outlet according to another embodiment of the present invention;

FIGURE 13 is a surface mountable power outlet according to an embodiment of a third aspect of the present invention;

FIGURE 14 shows a surface mountable power outlet according to another embodiment of the third aspect of the present invention;

FIGURE 15 is a circuit schematic depicting an embodiment of the AC mains voltage step down and regulation component of the USB charging circuit;

FIGURE 16 is a circuit schematic of a power conditioning circuit with a DC-DC converter to regulate the current and voltage suitable for the USB charging module;

FIGURE 17 is a top view of a USB charging circuit adapted to fit inside the USB charging module housing of Figure 1;

FIGURE 18 is a perspective view of the USB charging circuit as shown in Figure 17;

FIGURES 19a-19c depict a sequential series of views of a method of installing a USB charging module to a surface mountable power outlet according to a fourth aspect of the present invention; and

FIGURE 20 shows a flow diagram illustrating a general method of installing a USB charging module into a surface mountable power outlet according to a fourth aspect of the present invention.

FIGURE 21 is a perspective view of an embodiment of a USB charging module suitable for front entry engagement with a power outlet.

FIGURE 22 is a section view through A-A of the engaging portion of the USB charging module housing of Figure 23;

FIGURE 23 is a front view of the USB charging module housing as depicted in Figure 21;

FIGURE 24 is a section view B-B of the supporting portion of the grid or face plate depicted in Figure 25;

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FIGURE 25 is a front view of a grid or face plate suitable for engagement with the USB charging module of Figure 21;

FIGURE 26 shows the USB charging module of Figure 21 to be connected from the front of the grid or face plate according to an embodiment of the present invention; and

FIGURE 27 shows the USB charging module of Figure 21 to be connected from the front of the grid or face plate according to another embodiment of the present invention.

In the following description, like reference characters designate like or corresponding parts throughout the several views of the drawings.

DESCRIPTION

Referring now to Figures 1-4, there is shown a USB charging module housing 10 according to a first aspect of the present invention. The housing 10 has an aperture 12 through a front face 11 that is large enough to provide access for a USB connector to plug into a USB port or socket 50 enclosed within the housing (see Figure 7). At the rear of the housing 10 (see Figure 2) is an opening or aperture 13 which enables access for inserting a USB charging circuit 60 (see Figure 7) into the housing 10. Although this embodiment shows the rear of the housing as being open to provide an access means for the USB charging circuit 60, it is possible that the opening 13 could be located on a different face and may constitute an entire face or a part thereof. Figure 4 shows a removable cover 20 that engages with the rear of the housing 10 to substantially seal the enclosure from dust and ingress. The removable cover 20 has angled clips 26 and 27 that engage into mating apertures 16 and 15 respectively of the housing 10 in a snap fit arrangement. The lip of the angled clips 27 are inserted directly into apertures 15 and then the cover 20 is closed by applying force proximate the clips 26 until they snap into apertures 16. The clips 26, 27 are flexible and resilient so that they may bend sufficiently to allow fitment into the apertures 15, 16 whereupon they return to their undeformed positions.

In one embodiment, a feature of the housing 10 is the clip interface comprising four clips 14 that are positioned around the four side faces of the housing 10. These clips form an engaging portion that connects the housing 10 to a supporting portion 30 (see Figure 5) of a surface mountable power outlet. The supporting portion 30 may be integral with a grid or face plate of the power outlet or located on a mounting plate that is adapted to be connected to the rear of a grid or face plate. Figure 3 shows a detailed view of a clip 14, in particular illustrating a type of clip with a tapered front face 14b and substantially vertical rear face 14a. These clips are designed to engage with the mating interface 34 of the supporting portion 30 which is most clearly illustrated in Figure 6. Figure 6 shows detail of a typical mating interface 34 which will connect to a USB charging module housing 10. As the housing 10 is inserted into the supporting portion 30, the tapered surface 14b of the clip 14 will engage a corresponding tapered surface 35 of the supporting portion 30. As more insertion force is applied, the

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clip 14 will deflect slightly as it passes the vertical surface 37 of the supporting portion 30. The substantially vertical rear face 14a of the clip 14 will eventually pass the lowest point of the vertical surface 37, upon which it reaches the recessed horizontal surface 36 of the supporting portion 30. The compression force acting on the clip 14 is then released and it deflects back to its undeformed position and the substantially vertical rear face 14a engages in surface to surface contact with the horizontal recessed surface 36 of the supporting portion 30 to thereby retain housing 10 to the supporting portion 30. In the embodiment shown in Figure 5, the supporting portion 30 has only two mating interfaces 34 requiring that only two of the four clips 14 be used to connect the housing 10 to the supporting portion 30. In practice, two or more of the clips 14 may be used to secure the housing, and the supporting portion 30 may also have two or more mating interface 34.

Referring now to Figure 7, there is shown a USB charging module 40 according to an embodiment of a second aspect of the present invention. Enclosed inside the housing 10 is a USB port 50 and a USB charging circuit 60. Wires 70, 71 to be connected to mains power are soldered directly onto a printed circuit board (PCB) 62 of the charging circuit 60 (see Figure 16). The wires 70, 71 exit the housing 10 through apertures 22 located through the removable cover 20 (see Figure 10). During installation these wires may be connected to mains power either directly or via a switch. In other embodiments, there may be simply provided screwed terminals for wire termination instead of a terminal block.

Referring now to Figures 8 and 9, there is shown a USB charging module 80 according to another embodiment of the second aspect of the present invention. Enclosed inside the housing 10 is USB port 50 and USB charging circuit 60 with a terminal block 65 to be connected to mains power. During installation, wires carrying mains power either directly or via a switch are connected to the terminal block 65 to power the USB charging circuit 60. The wires enter the housing 10 through apertures 18 located on one side of the housing 10.

In the USB charging module embodiments described above, the power input to the module is mains power (also known as household, supply or grid power) supplied between about 100-240V alternating current (AC). The USB charging circuit 60 regulates the voltage and steps it down to a usable 4.75-5.25V direct current (DC) which is typically required to charge many electronic devices.

Referring now to Figures 11-14, there are shown various embodiments of the USB charging module 40 or 80 connected to a grid or face plate of a surface mountable power outlet. Figure 11 shows USB charging module 40 engaged with a supporting portion 30 which is integral with a grid or face plate 100. In one example, the supporting portion 30 is integrally machined into the grid or face plate 100 during manufacture. In other embodiments, the supporting portion 30 is provided as a separate piece and is attached to the grid or faceplate during or before installation. The grid or face plate 100 can be

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constructed from plastic, metal or any other suitable materials. Figure 11 shows a grid or face plate 100 with two apertures 102 (only one visible in this view) capable of receiving switches or other electrical connectors in addition to USB ports. Further, as the USB charging module is modular in design, it can always be easily interchanged for a switch or other desired user interface. The grid or face plate 100 shown in Figure 11 may be adapted in many ways such as providing for AC receptacles as commonly found in most household power outlets. The grid or face plate 100 is fastened to a wall by screws or other suitable fasteners through mounting lugs 101. These may be arranged in any suitable position on the grid or face plate 100 and may vary in quantity.

Figure 12 shows a USB charging module 80 engaged with a supporting portion 30 located in a mounting plate 200 that is adapted to be inserted into the rear of a grid or face plate 110. In this arrangement the supporting portion 30 is integrally machined into mounting plate 200. Such a mounting plate 200 (also known as a base or base plate) in standard power outlets, commonly includes electrical contacts for AC receptacles, switch mounting and terminals to connect mains power wiring. The mounting plate 200 is designed to be received by the rear of a grid or face plate 110. As shown in Figure 12, the mounting plate 200 is fastened to the grid or face plate 110 by screws at mounting positions 201. The grid or face plate 110 is mounted onto a wall by screws at mounting locations 111, 112.

Figure 13 more specifically shows a surface mountable power outlet 500 according to a third aspect of the present invention allowing a user to charge USB compatible devices. In this arrangement the USB charging module 40 or 80 is connected to a supporting portion 30 that may either by integral with the grid or face plate or located on a mounting plate adapted to be connected to the rear of the grid or face plate. In this embodiment the power outlet 500 has a pair of switches and AC receptacles in addition to the USB charging module 40 or 80. A power outlet 500 such as this allows a user to plug in normal AC type connectors with power switched on or off and advantageously also provides a user with access to a USB port 50 for charging electronic devices. If the USB charging module 40 or 80 is wired directly to mains without a switch then the charging module 40 or 80 is constantly connected to mains power so that when a user connects their device into the USB port; charging will begin automatically. If the USB charging module 40 or 80 is wired to mains via a switch, then power will not be drawn until the user engages the switch to an "ON" position. As shown in Figure 14 in another embodiment of a wall mounted power outlet 510, there is a USB charging module 40 or 80 provided additionally with LED status lights 55 that indicate whether the device connected to the port is charging or not. In both Figures 13 and 14 there is also shown a cover plate 90, 91 that is adapted to fit around the periphery of the power outlet. The cover plate 90, 91 usually snap fits around the grid or face plate and is provided primarily for aesthetics when the power outlet is mounted to a surface such a wall or floor.

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It will be appreciated by those skilled in the art that the surface mountable power outlet embodiments illustrated in this text are by no means limiting to how the invention may be performed. The geometric arrangement of switches, AC receptacles, USB ports or other network connection ports may be customised to suit a particular application. The supporting portion 30 also need not necessarily be limited to being an integral portion of a grid or face plate or located on a mounting plate adapted to be inserted into the rear of a grid or face plate. The supporting portion 30 could be mounted or machined into almost any structure, including a box or other structural housing. Further, the engaging portion of the USB charging module housing and supporting portion of the power outlet may be designed with alternative interfaces to the clip arrangement shown which achieves the principle aim of the invention in providing a modular USB housing which is adapted to be installed in a surface mountable power outlet thereby allowing a user to charge USB compatible devices.

Referring now to Figures 15-19, there is shown the USB charging circuit 60 that receives a 240V AC mains power input and provides a 5V DC output to the USB port 50, suitable for charging USB compatible electronic devices. The USB charging circuit 60 comprises the following stages. In the first stage, shown in Figure 15, the 240V AC mains input is first stepped down using a transformer 61 to reduce the high AC voltage to a low AC voltage (e.g. 15V, 1.2A). This stepped down AC voltage is then passed through a rectifier circuit 63 (e.g. bridge rectifier) that outputs a full wave varying rectified voltage shown as the output across load R_L. As shown in Figure 16, this varying voltage is then smoothed with a capacitor to produce a relatively smooth DC voltage with a small ripple. A voltage regulator (e.g. 7812 Integrated Circuit (IC)) is then used to output a regulated 12V DC output as will be understood by the person skilled in the art.

In the second stage, an embodiment of which is shown in Figure 16, a DC-DC converter (e.g. Texas Instruments TPS40210 current mode boost controller) is then used to regulate the output suitable for the USB charger. The TPS40210 implements a DC-DC single-ended primary inductance converter (SEPIC) with input and output current regulation, as well as output voltage regulation implemented by closed loop feedback control. The TPS40210 ensures that the output voltage of the USB charger is between about 4.75 and 5.25 V (nominally 5V DC) with an operating current of about 1A and also prevents overcharging. The voltage input in Figure 16 is the regulated 12V from the first stage, which is converted to a regulated 5V DC voltage output by the circuit shown. It should be understood that this is just one example of how a USB charging circuit may be implemented and any other suitable circuit arrangement may be used.

Referring specifically to Figures 17 and 18 there is shown an embodiment of the physical circuit layout of the USB charging circuit 60. A double layered PCB 62 is used which provides a compact

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and efficient way to house all of the components inside the housing 10. On one layer of the PCB 62 there is mounted the USB port 50, an optional terminal block 65 and the circuit components for the AC mains voltage step down and first stage regulation (including transformer, capacitors, 7812 IC voltage regulator and rectifier circuit). On the second layer of the PCB 62 there is provided the power conditioning circuitry for the USB charger output (including the TPS40210 and various other capacitors, inductors, resistors and diodes).

In other embodiments, there is provided 2 or 3 or more PCBs over which the circuit components are arranged, rather than (or as well as) a double layered arrangement.

Referring now to Figures 19a-19c there is shown a sequential series of views of a method of installing the USB charging module 80 to a surface mountable power outlet according to a fourth aspect of the present invention. In this embodiment, the mounting surface is a wall 90. In Figure 19a there is shown the step of connecting the engaging portion of the USB charging module housing 10 to a supporting portion 30 of the power outlet. Figure 19a shows the USB charging module 80 already having been engaged with the supporting portion 30. Figure 19b illustrates the next step of connecting the mains power to the USB charging circuit 60. The USB charging module 80 and grid or face plate assembly is held in close proximity to a wall opening where the power outlet is to be located. The wiring from the mains (typically active and neutral wires, with earth optional) is physically connected to the USB charging circuit 60. The particular embodiment illustrated in Figures 19a-19c shows a USB charging module 80 with a terminal block 65 for terminating the mains wires. The final step in the installation is to attach or mount the power outlet to the wall 90 as illustrated in Figure 19c. The grid or face plate is held flat against the wall 90 and screws or other suitable fastening means are inserted through mounting apertures in the grid or face plate and fastened securely to the wall 90. In another example, the USB charging module 40 may be connected using wires 70, 71 as previously described.

Figure 20 illustrates a flow diagram of a method of installing the USB charging module 40 or 80 to a surface mountable power outlet. In step 600, the installer begins with the USB charging module. In step 601, the engaging portion of the USB charging module housing 10 is connected to the supporting portion 30 of the power outlet. In step 602, a determination is made as to whether the supporting portion is located in a mounting plate that is not integral with the grid or faceplate. If the supporting portion 30 is integral with the grid or face plate, the mains power is connected to the USB charging circuit 60 and the power outlet is attached or mounted to the mounting surface (which may be a wall or floor or other appropriate surface) in step 604. If the supporting portion 30 is located in a mounting plate that is not integral with the grid or face plate, then there is an additional step 603 of connecting the mounting plate to the grid or face plate.

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In step 605, the installer then connects the AC mains power to the USB and then in step the power outlet assembly is mounted or attached to the mounting surface such as the wall 90 or a floor. In step 606, the resulting product of the method is a surface mounted USB power or charging outlet.

Once installation is complete, the power outlet provides an interface to charge USB compatible devices. The USB charging module 40,80 receives a mains input power between about 100-240V AC and converts this to a regulated 5V DC output suitable for charging USB compatible electronic devices. The modular housing 10 enables the power outlet to have interchangeable interfaces to suit operational requirements. The USB charging module 40,80 may be removed from the power outlet and replaced with a switch or any other interface without having to replace the entire power outlet.

Referring now to Figures 21-27, there is shown a further embodiment whereby the USB charging module 40,80 is connected to the supporting portion 130 of a grid or face plate 120 of a surface mountable power outlet from the front thereby providing a 'front entry' insertion option. Whereas previously described the USB charging module 40,80 is connected into a supporting portion 30 in the rear of the grid or face plate, it is also desirable to be able to insert the module from the front of the grid or face plate. It will be appreciated that this connection may be facilitated in many ways, an example of which is shown in Figures 21-27. Figure 21 generally shows a USB charging module 40,80 which can be connected to mains power as previously described. In one form, the module may have a clip interface comprising clips 18 as shown in more detail in Figures 22-23. Figure 23 is a front view of a USB charging module housing 10 showing the location of two clips 18 suitable for front entry connection of the module. Figure 22 is a sectional view through A-A of Figure 23 providing detail of a possible clip arrangement. This clip arrangement allows the housing 10 to engage with a supporting portion 130 of a grid or face plate 120 as shown in Figure 25. Figure 24 shows as a sectional view through B-B of Figure 25 which generally shows the supporting portion 130 in more detail. The housing 10 of the USB charging module 40,80 is inserted through aperture 132 of the supporting portion 130. The clip arrangement facilitates a snap-fit connection between the clips 18 and the supporting portion 130. As the module is inserted into the grid or face plate, the resilient clips 18 bend slightly as force is applied such that the outer most surface 18b of the clips 18 can pass the inner most surface 133 of the supporting portion 130.Once engaged, surface 19 of the housing 10 mates with recessed surface 131 of the supporting portion 130 and surface 18a of the clips 18 is in contact with surface 134 of the supporting portion 130.

Figures 26-27 show exploded views of the USB charging module 40,80 and grid or face plate front entry installation. Figure 26 shows a grid or face plate 120 with two apertures 132 which enables more than one USB charging module 40,80 to be inserted. Figure 27 shows a grid or face plate 140 with a single aperture 132 for receiving a USB charging module 40,80 from the front. In addition, Figure 27

shows a cover plate 145 that is attached or mounted to the grid or face plate after the USB charging module 40,80 has been connected and screws 146 for attaching or mounting the grid or face plate to a surface such as a wall or floor.

Although various illustrative embodiments of the present invention have been described in the foregoing detailed description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

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CLAIMS:

1. A Universal Serial Bus (USB) charging module housing adapted for securement to a surface mountable power outlet, the housing including:

an engaging portion for connecting the housing to a supporting portion of the power outlet;

access means to allow a USB charging circuit to be inserted into the housing; and

an aperture for allowing external access to a USB port.

2. The housing according to claim 1 further including at least one aperture for receiving wires carrying mains power.

3. The housing according to claim 1 wherein the access means is provided by an aperture in an external face of the housing.

4. The housing according to claim 3 wherein the aperture is covered by a removable portion.

5. The housing according to claim 4 wherein the removable portion includes at least one aperture for receiving wires carrying mains power.

6. The housing according to claim 1 wherein the supporting portion of the power outlet is an integral portion of a grid or face plate.

7. The housing according to claim 1 wherein the supporting portion of the power outlet is located in a mounting plate that is adapted to be connected to the rear of a grid or face plate.

8. The housing according to claim 1 wherein said housing is connected to the supporting portion of the power outlet from the front of the grid or face plate.

9. The housing according to claim 1 wherein said housing is connected to the supporting portion of the power outlet from the rear of the grid or face plate.

10. The housing according to any one of the preceding claims wherein the engaging portion includes:

a plurality of clips extending outwardly from one or more exterior faces of the housing, said clips for engagement with one or more surfaces of the supporting portion of the power outlet in a snap fit arrangement.

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11. The housing according to claim 10 wherein the clips have a tapered front face and a substantially vertical rear face.

12. The housing according to any one of the preceding claims wherein the aperture for allowing external access to a USB port is located on a front face of the housing.

13. A Universal Serial Bus (USB) charging module adapted for securement to a surface mountable power outlet, the charging module including:

a USB port;

a USB charging circuit that is capable of receiving a mains power input;

a housing, said housing including an engaging portion for connecting the housing to a supporting portion of the power outlet; access means to allow the USB charging circuit to be inserted into the housing and an aperture for allowing external access to the USB port.

14. The USB charging module according to claim 13 wherein the USB charging circuit includes a printed circuit board (PCB).

15. The USB charging module according to claim 14 wherein a plurality of wires are soldered directly to the PCB for connection to mains power either directly or via a switch.

16. The USB charging module according to claim 14 wherein a terminal block is mounted on the PCB for connection to wires carrying mains power either directly or via a switch.

17. The USB charging module according to claim 14 wherein there are provided screwed terminals for wire termination.

18. A surface mountable power outlet for allowing a user to charge a USB compatible device, the power outlet including:

a supporting portion;

a USB charging module including a USB port; a USB charging circuit that is capable of receiving a mains power input; a housing, said housing including an engaging portion for connecting the housing to the supporting portion of the power outlet; access means to allow the USB charging circuit to be inserted into the housing and an aperture for allowing external access to the USB port;

a grid or face plate adapted to allow a user to access the USB port;

a connection between the USB charging module and mains power; and

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mounting means for mounting the power outlet to a mounting surface.

19. The power outlet according to claim 18 wherein the supporting portion is an integral portion of the grid or face plate.

20. The power outlet according to claim 18 wherein the supporting portion is located in a mounting plate that is adapted to be connected to the rear of the grid or face plate.

21. The power outlet according to claim 18 wherein the USB charging module housing is connected to the supporting portion from the front of the grid or face plate.

22. The power outlet according to claim 18 wherein the USB charging module housing is connected to the supporting portion from the rear of the grid or face plate.

23. The power outlet according to claim 18 wherein the mounting surface is a wall or floor.

24. The power outlet according to claim 18 further including a cover plate.

25. The power outlet according to claim 18 wherein the mains power is between about 100-240V alternating current (AC).

26. A method of installing a power outlet for allowing a user to charge a USB compatible device, the power outlet according to claim 18, comprising the steps of:

connecting the engaging portion of the USB charging module housing to the supporting portion of the power outlet;

connecting the mains power to the USB charging module; and

mounting the power outlet to the mounting surface.

27. A method of installing a power outlet allowing a user to charge USB compatible devices, the power outlet according to claim 20, comprising the steps of:

connecting the engaging portion of the USB charging module housing to the supporting portion of the power outlet;

connecting the mounting plate to the rear of a grid or face plate;

connecting the mains power to the USB charging module; and

mounting the power outlet to the mounting surface.

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28. The method of installing a power outlet according to any one of claims 26 or 27 wherein the power outlet is mounted to the mounting surface by fastening the grid or face plate to the surface by screws.

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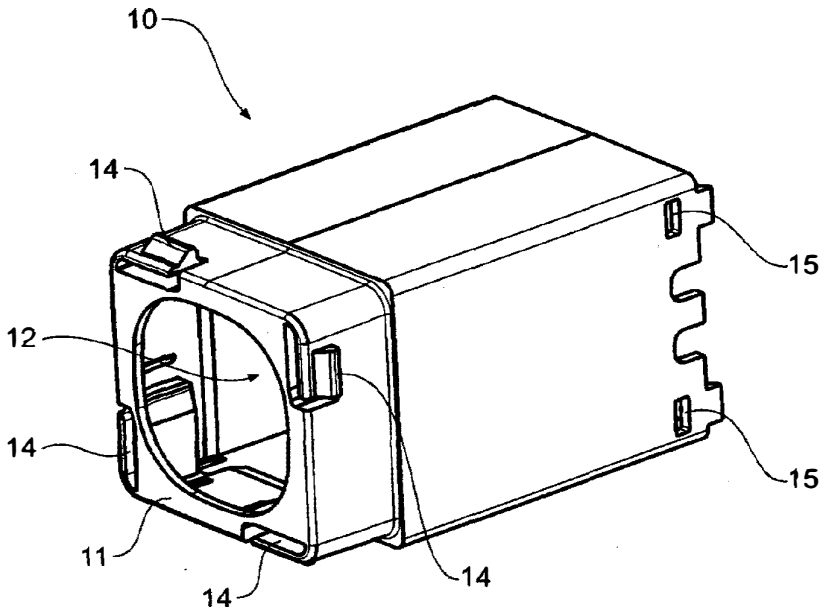


Figure 1

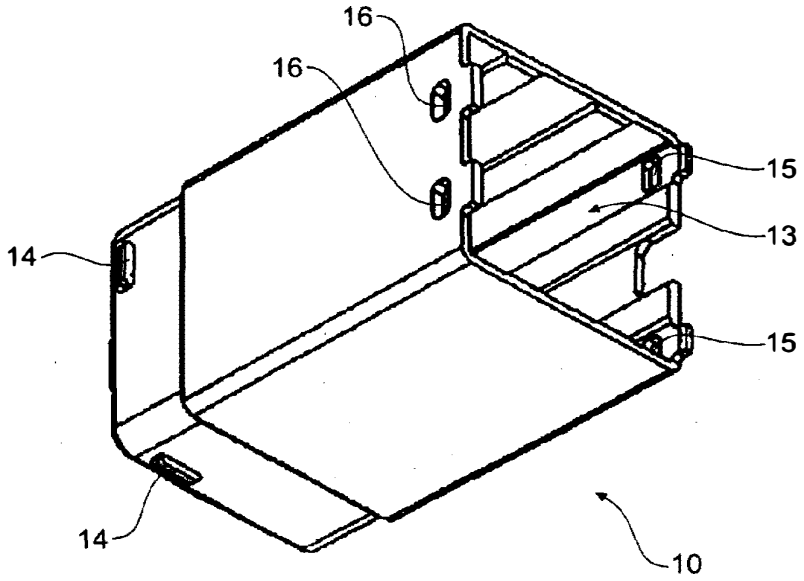


Figure 2

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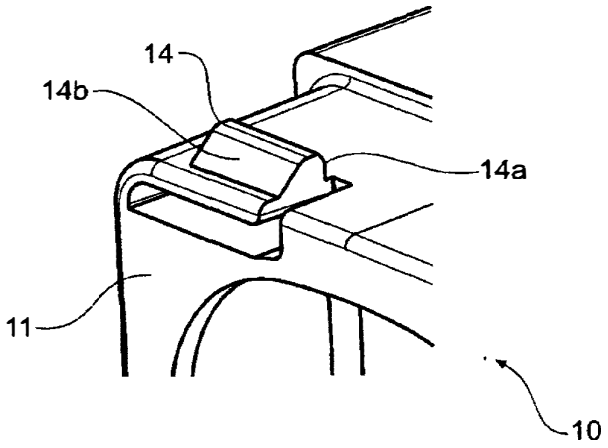


Figure 3

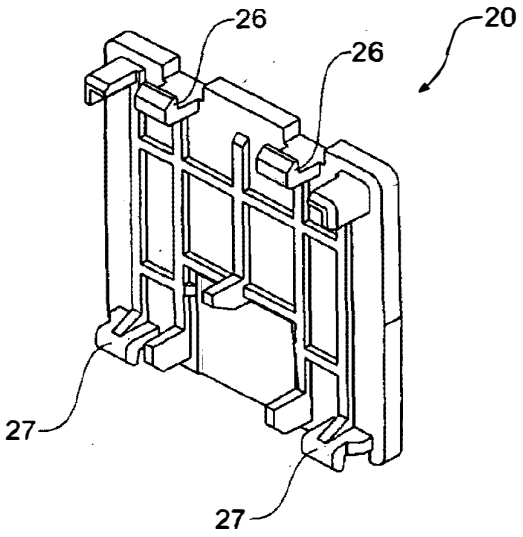


Figure 4

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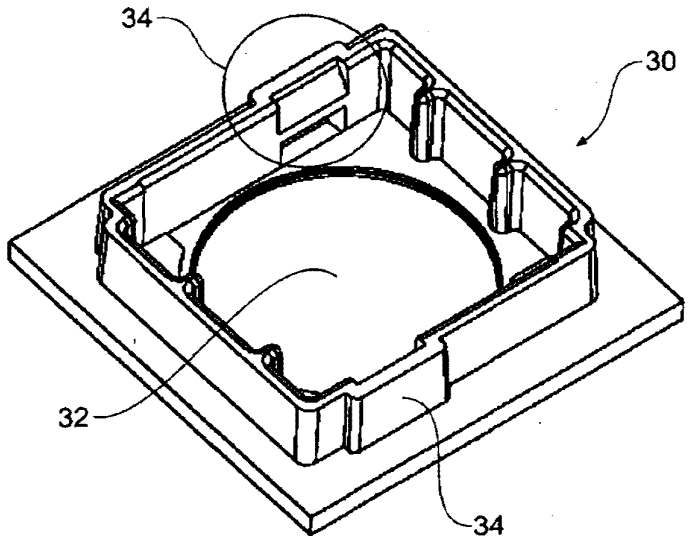


Figure 5

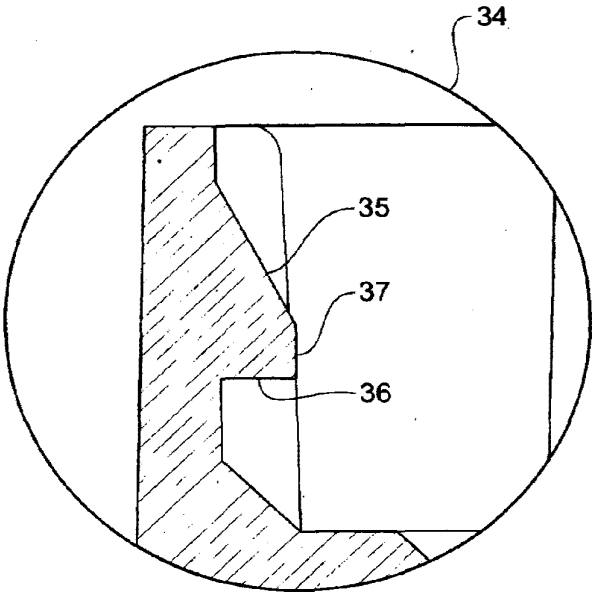


Figure 6

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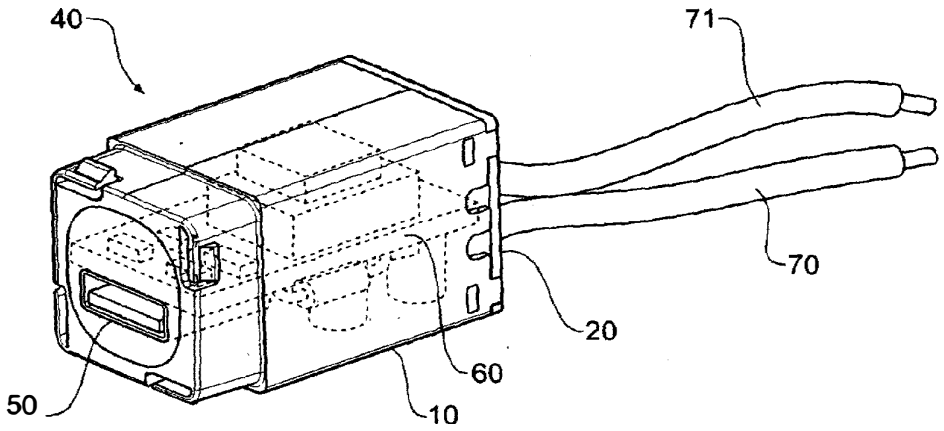


Figure 7

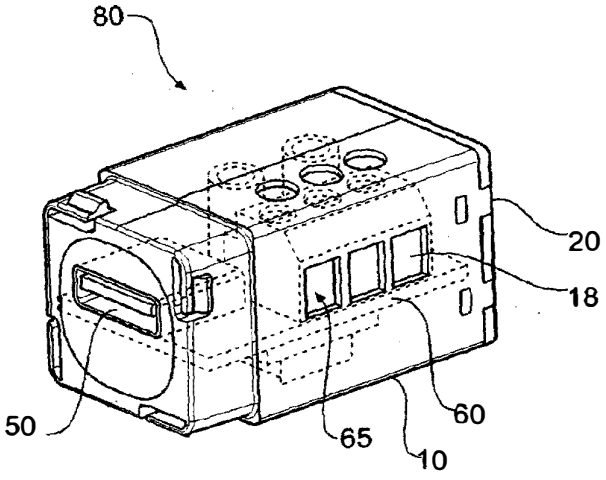


Figure 8

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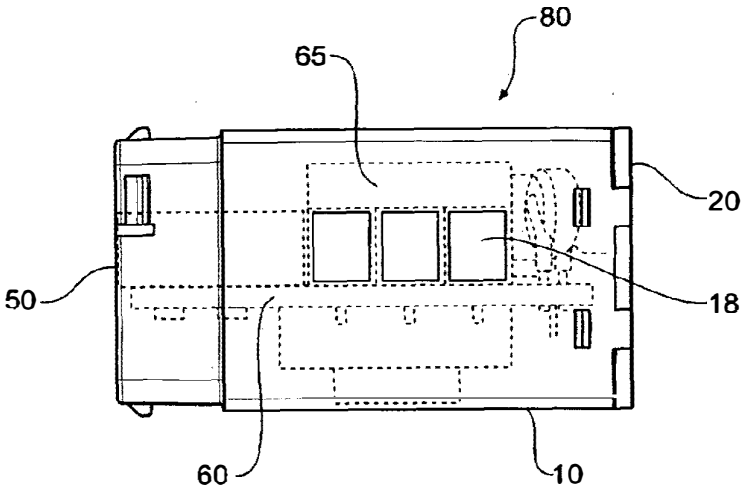


Figure 9

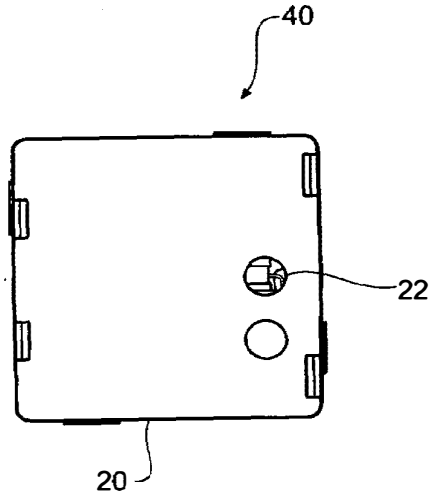


Figure 10

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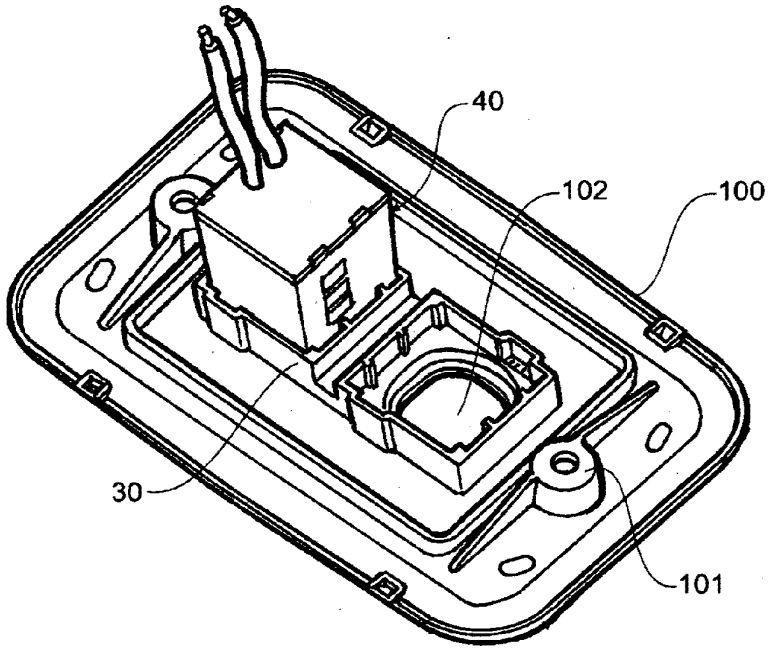


Figure 11

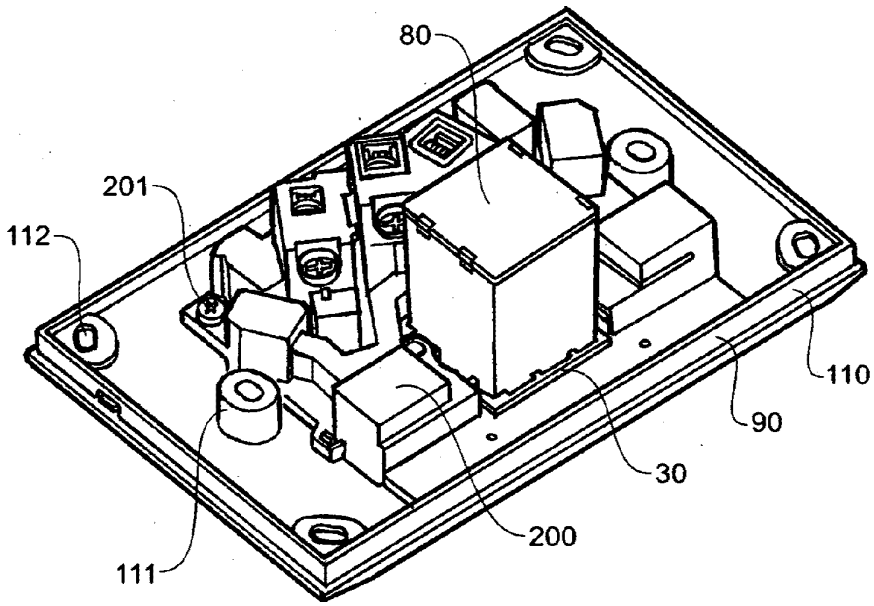


Figure 12

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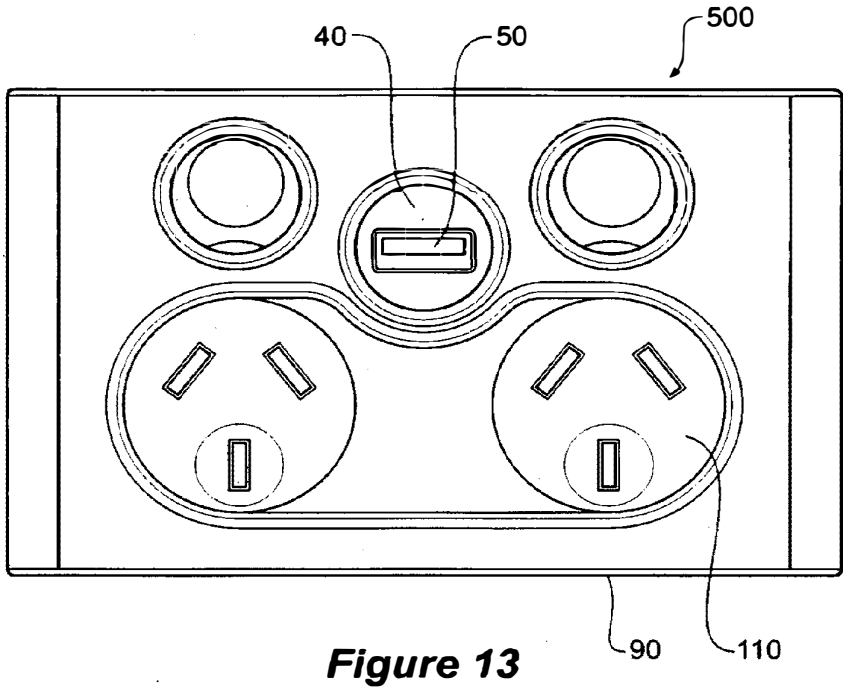


Figure 13

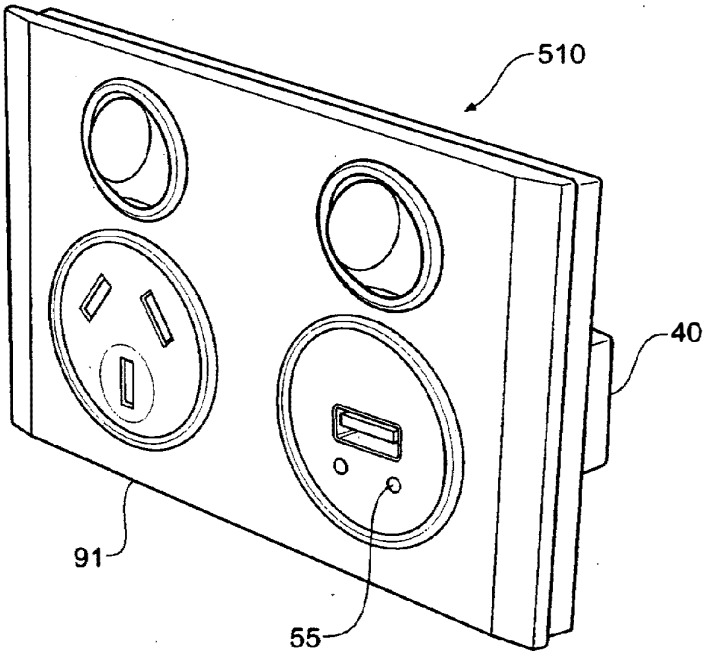


Figure 14

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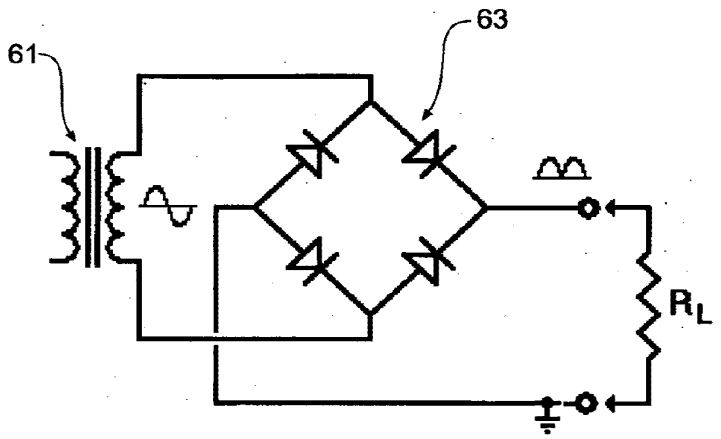


Figure 15

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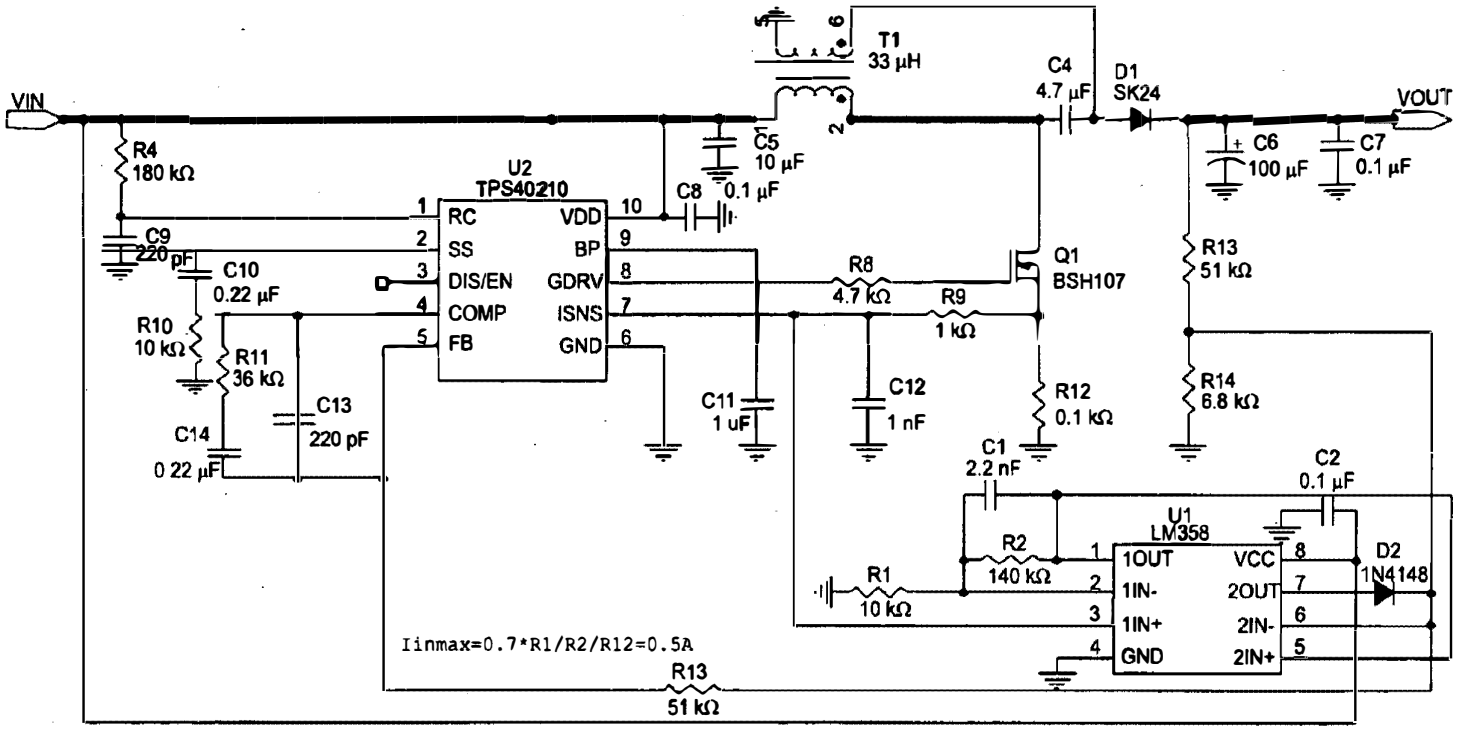


Figure 16

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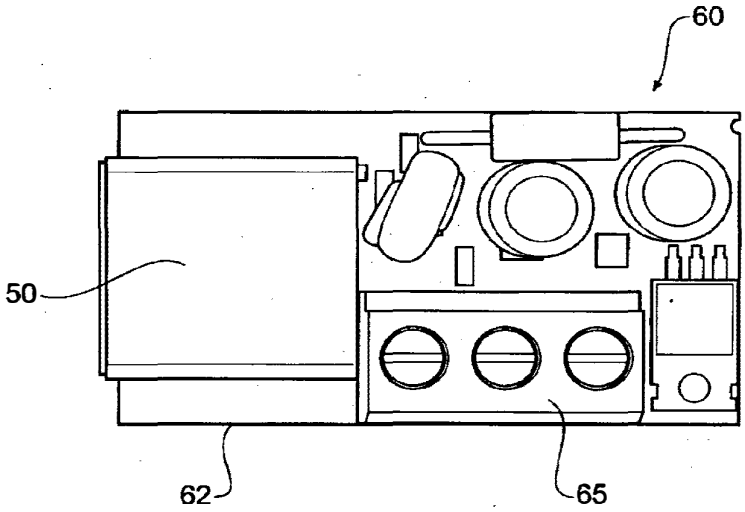


Figure 17

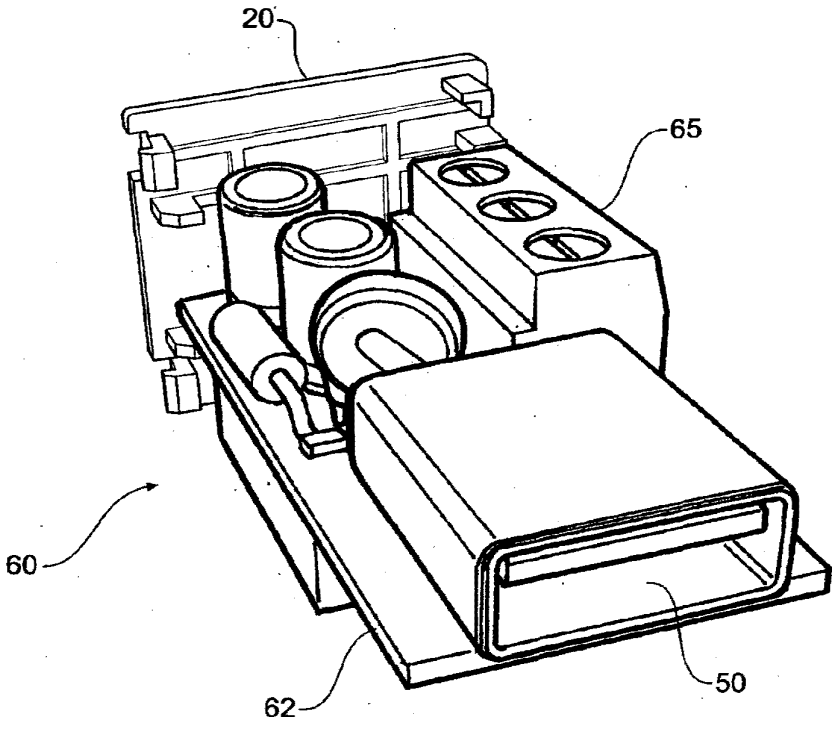


Figure 18

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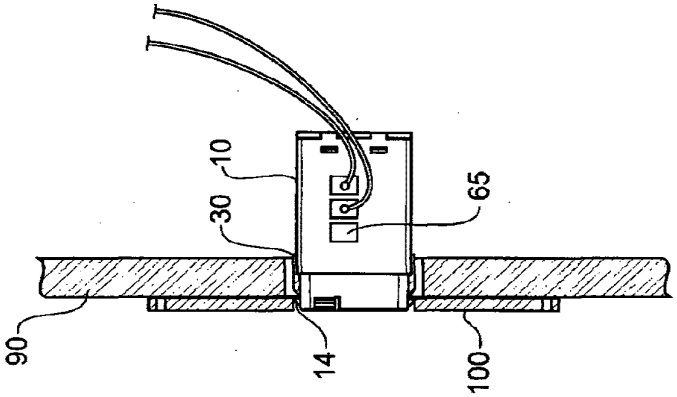


Figure 19c

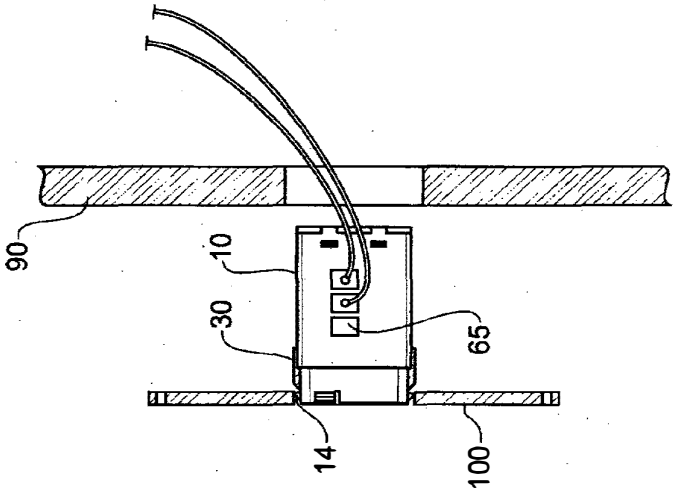


Figure 19b

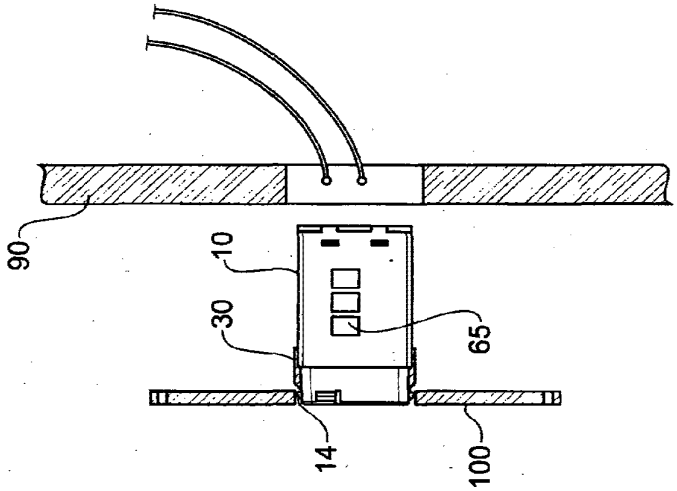


Figure 19a

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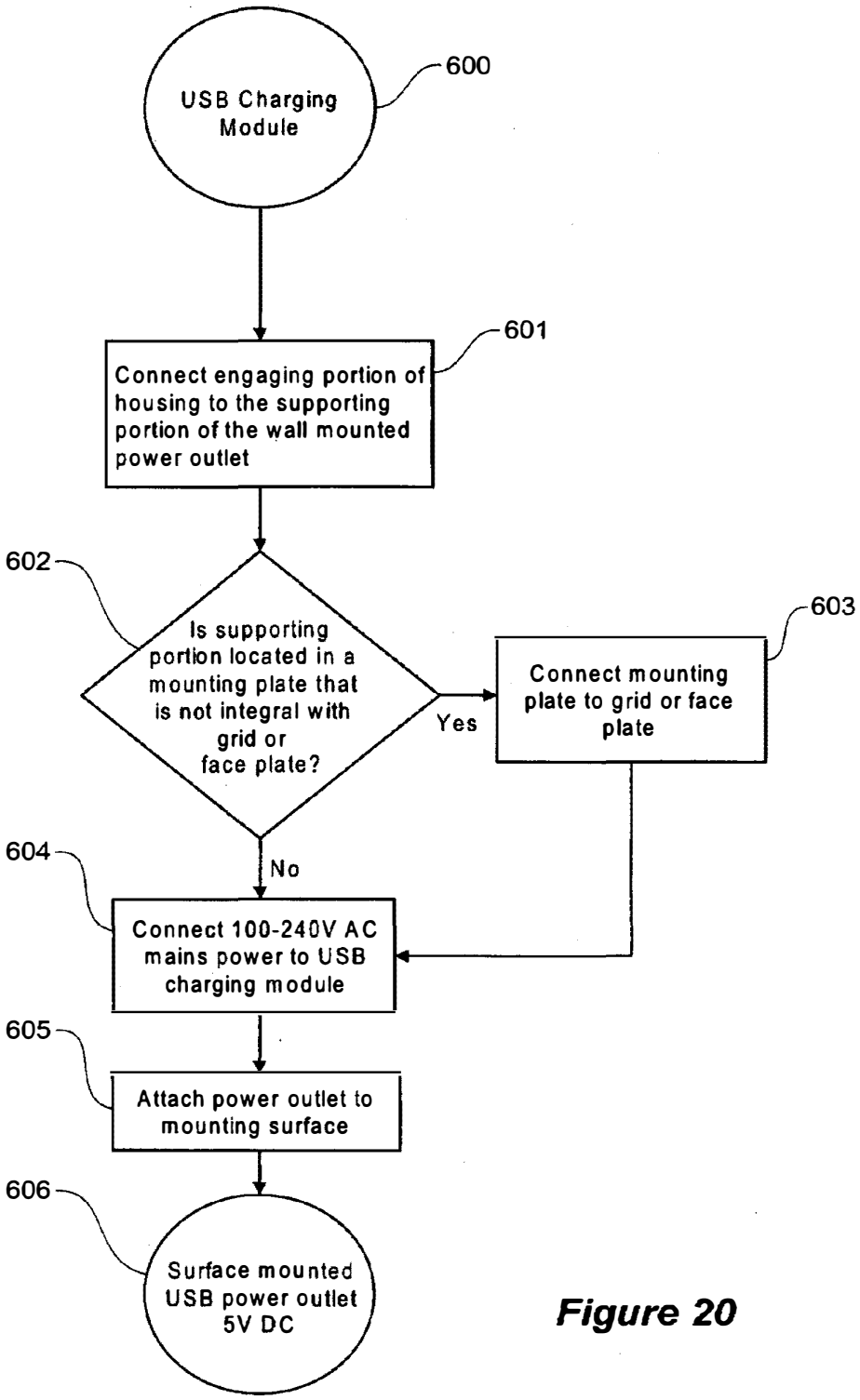


Figure 20

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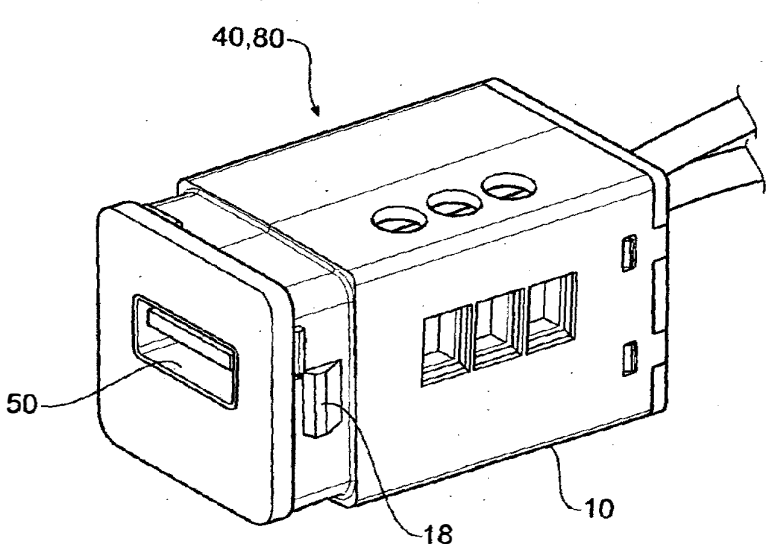


Figure 21

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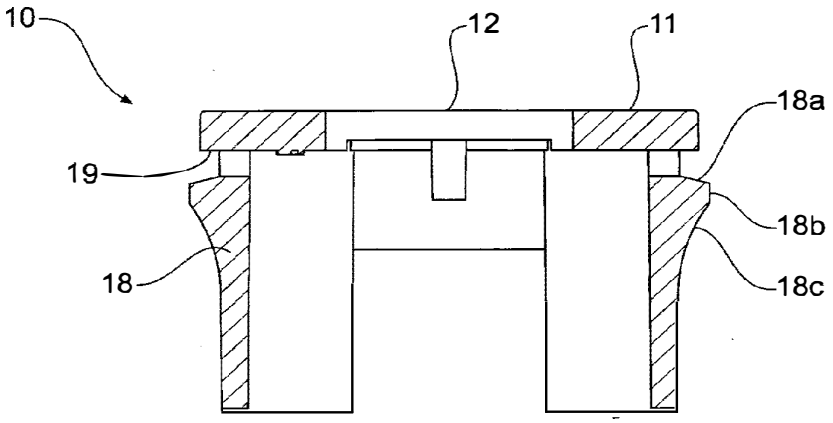


Figure 22

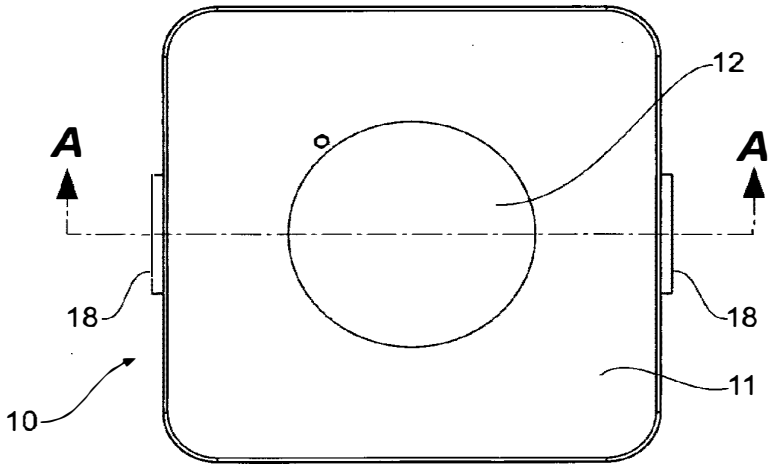


Figure 23

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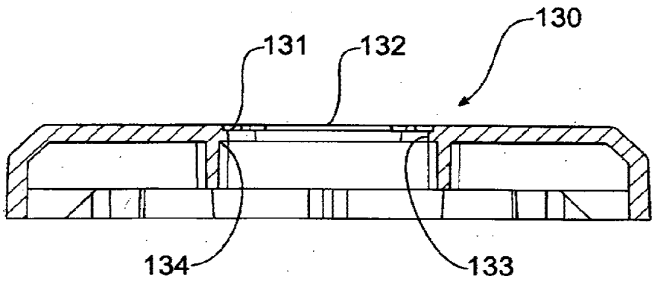


Figure 24

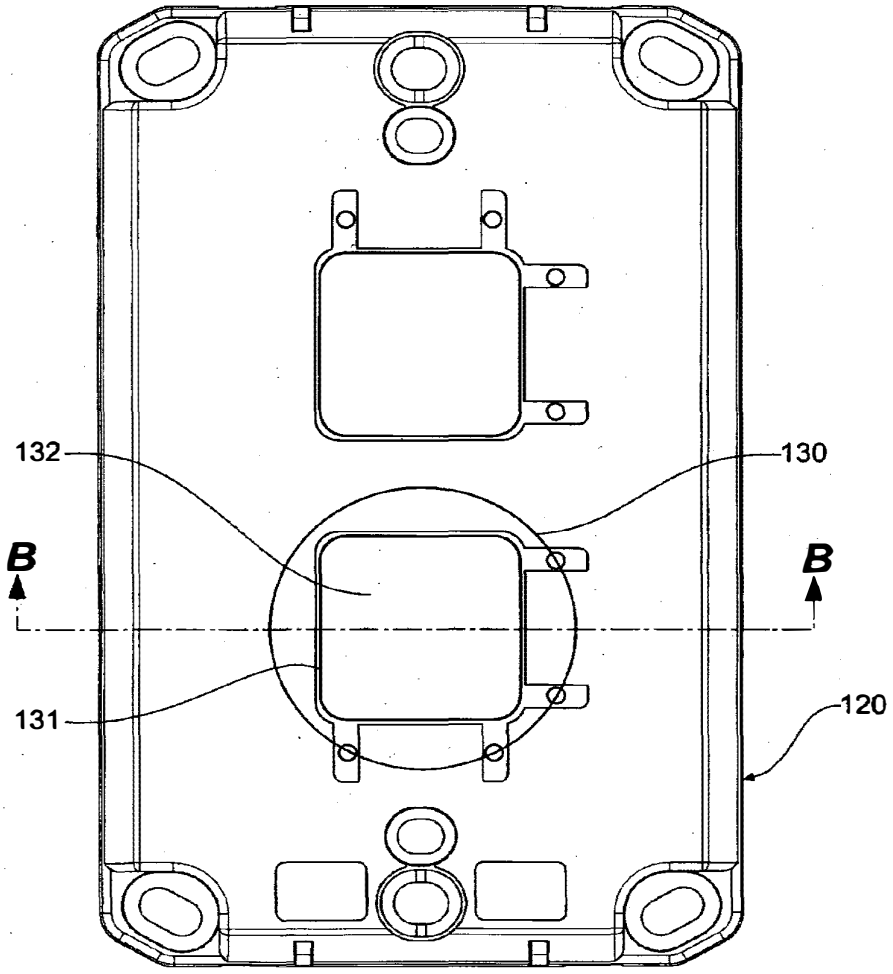


Figure 25

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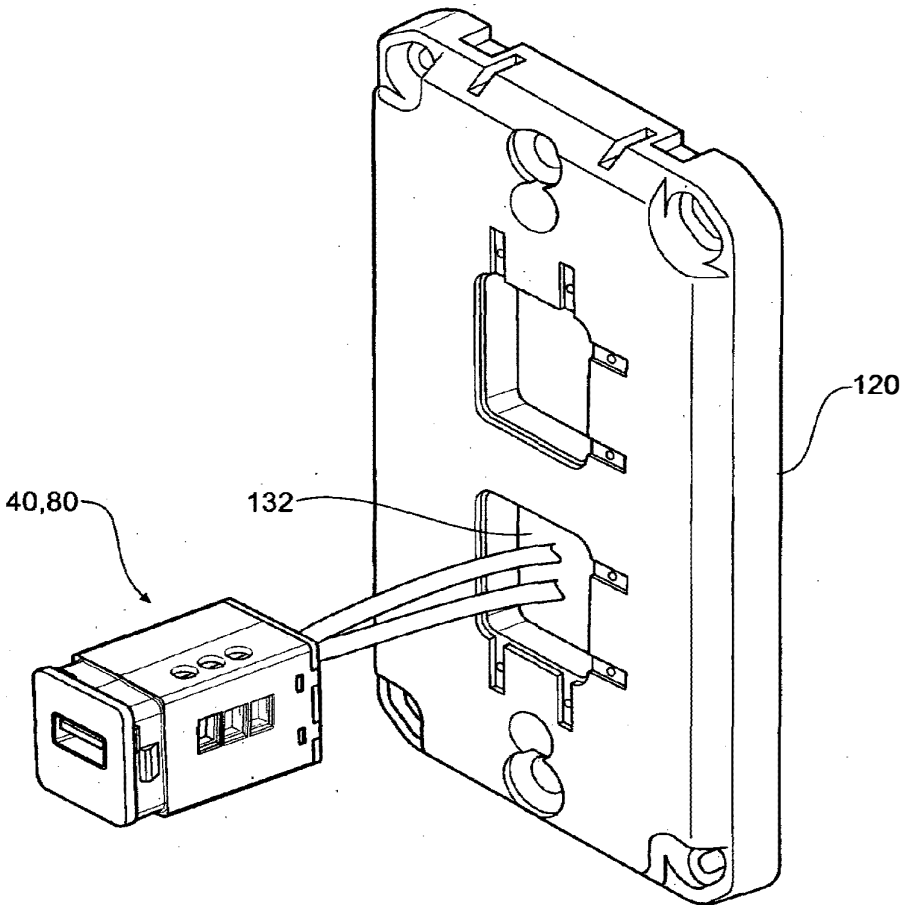


Figure 26

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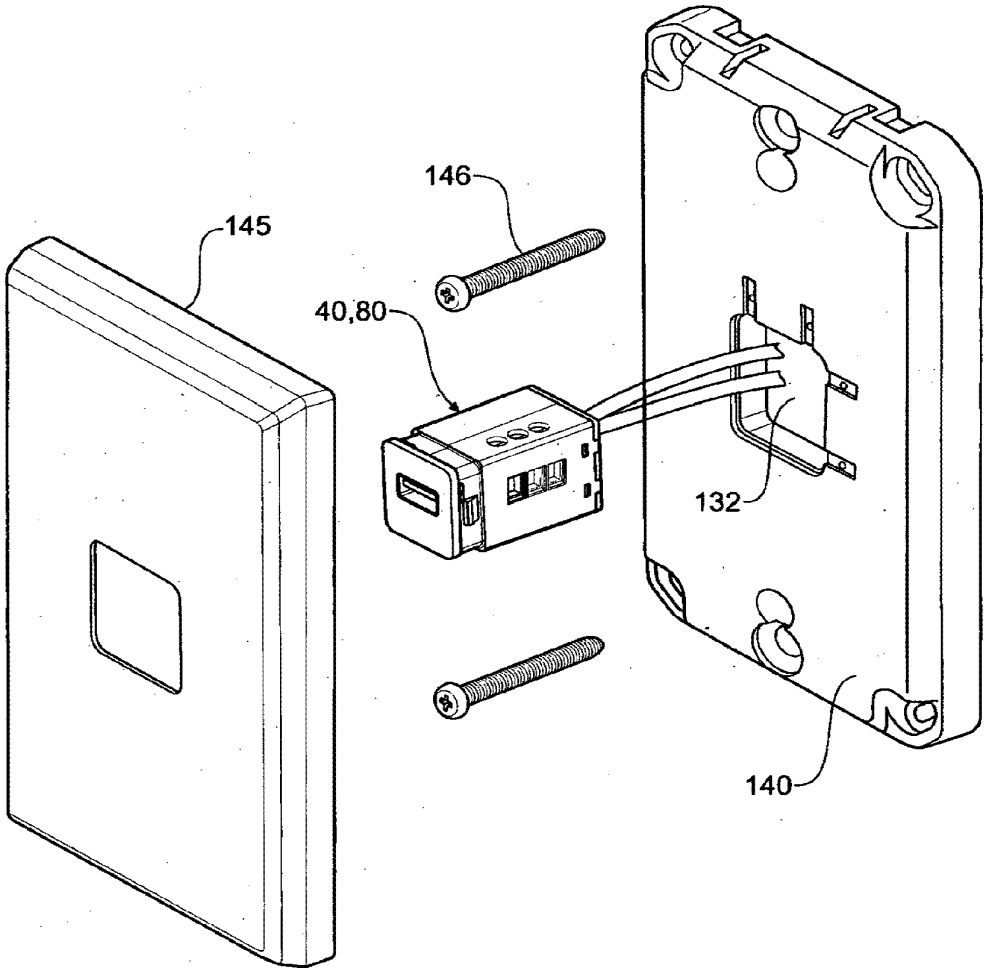


Figure 27

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Espacenet

CN102414923A LIQUID LEAKAGE PROPAGATION RESTRAINING STRUCTURE FOR ELECTRICITY STORAGE DEVICE AND BUS BAR MODULE

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Classifications:
IPC ***H01M10/42; H01M10/48; H01M2/20; H01M2/32; H01R11/28; H01R4/18; H01R4/30;***

CPC **H01M10/482 (EP,US); H01M50/502 (EP,US); H01M50/571 (EP,US);** H01M10/4228 (EP,US); H01R4/023 (EP,US); H01R4/187 (EP,US); H01R4/20 (EP,US); Y02E60/10 (EP);

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Published as: CN102414923A;**DE112010001711T5; JP2010257686A; JP5144582B2; US20120038365A1; WO2010122412A1**

LIQUID LEAKAGE PROPAGATION RESTRAINING STRUCTURE FOR ELECTRICITY STORAGE DEVICE AND BUS BAR MODULE

Abstract

In a liquid leakage propagation restraining structure, a voltage detection terminal that detects the voltage of an electricity storage device is connected to an electrode of the electricity storage device so that a crimp contact surface side of the voltage detection terminal to which an electric cable is crimped faces in the direction opposite the direction to the electrode. Therefore, the structure restrains the electrolytic solution that has leaked out and propagated to the electric cable from entering the interior of the core wire of the electric cable.

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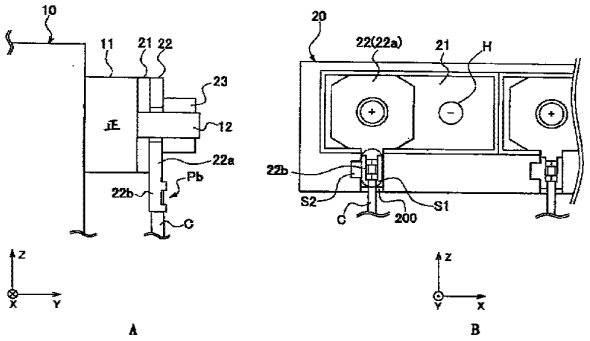
权利要求书 2 页 说明书 7 页 附图 6 页

(54)发明名称

用于蓄电装置的液体泄漏扩散抑制结构以及母线模块

(57)摘要

在液体泄漏扩散抑制结构中，检测蓄电装置电压的电压检测端子连接到蓄电装置的电极，使得电缆被压接到的电压检测端子的压接接触表面侧朝向与电极相反的方向。因此，该结构抑制已经泄漏并扩散到电缆的电解溶液进入电缆的芯线内部。



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1. 一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构，其特征在于包含：

检测蓄电装置的电压的电压检测端子；以及

电极，其属于蓄电装置，

其中，电压检测端子连接到电极，使得电压检测端子的压接接触部分的压接接触表面侧朝向与蓄电装置的电极相反的方向，其中，电缆压接到压接接触部分。

2. 权利要求 1 的液体泄漏扩散抑制结构，其中，吸附或吸收在电极上泄漏的电解溶液的密封材料被设置在电缆内。

3. 权利要求 1 或 2 的液体泄漏扩散抑制结构，其中，电压检测端子被电气连接到位于蓄电装置的正电极侧的电极。

4. 权利要求 1-3 中任意一项的液体泄漏扩散抑制结构，其进一步包含母线模块，母线模块电气连接组成蓄电装置的多个蓄电元件，

其中，母线模块包含母线，母线电气连接一个蓄电元件的电极与另一个蓄电元件的电极，

其中，检测连接到母线的至少一个蓄电元件的电压的电压检测端子的电缆压接到压接接触部分，

其中，在容纳电缆的布线空间中形成密封材料注入部分和 / 或用于在电极上泄漏的电解溶液的贮槽部分。

5. 权利要求 4 的液体泄漏扩散抑制结构，其中，布线空间在母线模块纵向方向上的宽度为这样的长度：其包含电缆的直径以及设置在电缆的两个相反侧上的空隙。

6. 权利要求 4 或 5 的液体泄漏扩散抑制结构，其中，贮槽部分和 / 或密封材料注入部分被设置在电缆 C 的两个相反侧的至少一个上。

7. 权利要求 4-6 中任意一项的液体泄漏扩散抑制结构，其中，

贮槽部分和 / 或密封材料注入部分为密封材料注入部分；且

密封材料注入部分和布线空间均以密封材料填充。

8. 权利要求 1-7 中任意一项的液体泄漏扩散抑制结构，其中，压接接触部分被密封。

9. 权利要求 8 的液体泄漏扩散抑制结构，其中，压接接触部分通过焊接来密封。

10. 权利要求 1-9 中任意一项的液体泄漏扩散抑制结构，其中，压接接触部分被设置在电极的上方。

11. 一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构，其特征在于包含：

检测蓄电装置的电压的电压检测端子；

属于蓄电装置的电极，

其中，电压检测端子电气连接到电极的正电极侧。

12. 权利要求 11 的液体泄漏扩散抑制结构，其中，在电极上方设置电压检测端子的压接接触部分，电缆压接到该部分。

13. 一种电气连接多个蓄电元件的母线模块，蓄电元件包含电解溶液并组成蓄电组件，所述母线模块的特征在于包含：

母线，其电气连接一个蓄电元件的电极和另一个蓄电元件的电极；

压接接触部分，检测一个或多于一个蓄电元件的电压的电压检测端子的电缆压接到该部分，且该部分被连接到母线；和 / 或

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密封材料注入部分和 / 或用于在电极上泄漏的电解溶液的贮槽部分，其在容纳电缆的布线空间中。

14. 权利要求 13 的母线模块，其中，布线空间在母线模块纵向方向上的宽度为这样的长度 ：其包含电缆的直径以及设置在电缆的两个相反侧上的空隙。

15. 权利要求 13 或 14 的母线模块，其中，贮槽部分和 / 或密封材料注入部分被设置在电缆的两个相反侧的至少一个上。

16. 权利要求 13-15 中任意一项的母线模块，其中，

贮槽部分和 / 或密封材料注入部分为密封材料注入部分 ；且

密封材料注入部分和布线空间均以密封材料填充。

17. 一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构，其特征在于包含检测蓄电装置电压的电压检测端子的压接接触部分，

其中，压接接触部分被密封。

18. 权利要求 17 的液体泄漏扩散抑制结构，其中，压接接触部分通过焊接来密封。

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用于蓄电装置的液体泄漏扩散抑制结构以及母线模块

技术领域

[0001] 本发明涉及用于蓄电装置的电解溶液的液体泄漏扩散抑制结构，还涉及母线模块，蓄电装置例如为二次电池或类似物。

背景技术

[0002] 如日本专利申请公开 No. 2000-333343(JP-A-2000-333343) 所述（图 7、图 8、图 14 等），在安装在混合动力车或电动车上的例如二次电池或类似物的电池中，母线模块（电池连接模块）被附着到电池组件的两侧，以便串联连接构成电池组件的多个电单体 (electric cell)。母线模块由合成树脂或类似物构成。各个母线模块具有：母线，各个母线电气连接电单体的电极与另一电单体的电极；电压检测端子，各个电压检测端子被设置为用于检测一个或多于一个电单体的电压。电单体的电极、母线以及电压检测端子通过旋拧螺母或类似物固定在一起。各个电压检测端子包含：电气接触部分，其接触母线，以便检测电单体的电压；压接接触部分，用于将在电气接触部分上检测到的电压输出到电池控制器（未示出）的电缆通过压接连接到该部分。

[0003] 图 6A 为电单体和母线模块之间的连接位置的放大的截面图。如图 6A 所示，母线 21 的两个相反端面中的一个被放置为与电单体 10 的电池电极柱 11 接触。母线 21 的两个相反端面中的另一个与电压检测端子 22 的电气接触部分 22a 接触。于是，将螺母 23 紧紧地旋拧到设置在电池电极柱 11 上的螺纹部分 12，使得母线 21 和电压检测端子 22 紧紧地旋拧和固定到电池电极柱 11。

[0004] 图 6B 为从安装方向（Y 方向）看的母线模块 20 的视图。在各个电单体 10 的正电极 P 和负电极 N 中，负电极 N 具有电压检测端子 22。母线模块 20 具有布线空间 S，其中，设置有电缆 C 和电压检测端子 22 的压接接触部分 22b。

[0005] 例如二次电池以及类似物的电池在其中以密封的方式容纳电解溶液。取决于反应机制或温升，发生蠕变现象 (creep phenomenon)，且电解溶液有时在电极上泄漏到外部。有时，由于母线模块的电压检测端子或电缆暴露于电解溶液，这导致故障等等，例如，由于电解溶液泄漏（液体泄漏）经由电缆扩散到另一电气部件部分，或是由于电解溶液泄漏在电缆的芯线上移动的，在电池功能中产生的问题。

[0006] 另外，对于电池，针对电解溶液泄漏的对策并不充分。特别地，母线模块的上述电压检测端子 22 各自具有这样的结构：电压检测端子 22 的压接接触部分 22b（特别地，电缆 C 的芯线在其上压接以便电气连接电缆 C 与电气接触部分 22a 的压接接触表面侧）朝向电池电极柱 11 侧。在此结构中，当电解溶液从电池电极柱 11 泄漏、沿着电池电极柱 11 直接流动并由于重力下行到较低侧时，电解溶液容易进入压接接触部分 22b。因此，该结构允许泄漏的电解溶液容易地进入电缆的芯线，这一点是不受欢迎的。除此之外，电池具有允许电解溶液泄漏经由电缆容易地进入另一电气部件部分的结构。

[0007] 除此之外，如前面的日本专利申请公开 No. 2000-333343(JP-A-2000-333343) 所述（图 7、图 8、图 14 等），各个电压检测端子被设置在两个电池电极的负电极上。关于容

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纳碱性电解溶液的电池——例如镍金属氢化物蓄电池（Ni-MH 电池）、镍镉蓄电池（Ni-Cd 电池）等——内电解溶液的封装，电解溶液的泄漏通过在正或负电极端子部分的电池槽中布置用橡胶、尼龙（注册商标）或类似物制成的衬垫并向之施加适当的压力来防止。然而，已经知道，碱性电解溶液表现出蠕变现象，其中，电解溶液在金属表面上蠕变，因此使得完全密封非常困难。特别地，已经知道，比起正电极，此现象更可能在负电极上发生。因此，在电压检测端子连接到负电极侧的情况下，在负电极上泄漏的电解溶液扩散到电压检测端子的距离短。因此，在这种情况下，提供了这样的结构：在负电极上泄漏的电解溶液可能被引导到电压检测端子。

[0008] 除此之外，如图 6B 所示，形成布线空间 S（在母线模块 20 上形成的挖剪部分（cutout））以便压接电缆 C，布线空间 S 是在合成树脂制成的母线模块 20 上形成的，电线 C 和电压检测端子 22 的压接接触部分 22b 将被布置在其中。在布线空间 S 中，电线 C 和电压检测端子 22 的压接接触部分 22b 被布置，而不在母线模块 20 的纵向方向留下间隙。因此，在电解溶液在正电极 P 或负电极 N 上泄漏并扩散到邻近电压检测端子的压接接触部分 22b 的情况下，由于布线空间 S 的壁和压接接触部分 22b 或电缆 C 之间没有空隙，电解溶液泄漏不存在逸出电压检测端子 22 的压接接触部分 22b 并在压接接触部分 22b 附近累积的出口，故电解溶液可能进入电缆 C 的芯线，并可能由于毛细管作用而在电缆 C 的芯线内扩散。

[0009] 另外，由于布线空间 S 的壁和压接接触部分 22b 或电缆 C 之间没有间隙，由于缺乏密封材料被充入的空间，用于阻止电解溶液泄漏的密封材料不能充入压接接触部分 22b 的附近。因此，针对液体泄漏的密封不能进行。

发明内容

[0010] 本发明涉及用于蓄电装置的液体泄漏扩散抑制结构和母线模块，该结构抑制蓄电装置的电解溶液泄漏沿着电缆流出以及通过毛细管作用在电缆芯线内部扩散。

[0011] 本发明的第一实施形态涉及一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构。液体泄漏扩散抑制结构包含：电压检测端子，其被设置为检测蓄电装置的电压；电极，其属于蓄电装置。电压检测端子连接到电极，使得电压检测端子的压接接触部分的压接接触表面侧朝向与蓄电装置的电极相反的方向，其中，电缆被压接到压接接触部分。

[0012] 在第一实施形态中，吸附或吸收在电极上泄漏的电解溶液的密封材料可被设置在电缆内。

[0013] 在第一实施形态中，电压检测端子可电气连接到位于蓄电装置正电极侧的电极。

[0014] 在第一实施形态中，液体泄漏扩散抑制结构可进一步包含母线模块，其电气连接构成蓄电装置的多个蓄电元件。母线模块可包含：母线，其电气连接一个蓄电元件的电极与另一个蓄电元件的电极。检测连接到母线的至少一个蓄电元件的电压的电压检测端子的电缆可压接到压接接触部分。密封材料注入部分和 / 或用于在电极上泄漏的电解溶液的贮槽部分可在容纳电缆的布线空间中形成。

[0015] 在第一实施形态中，布线空间在母线模块长度方向上的宽度可为这样的长度：其包含电缆的直径，以及设置在电缆的两个相反侧上的空隙。

[0016] 在第一实施形态中，贮槽部分和 / 或密封材料注入部分可被设置在电缆的两个相反侧的至少一个上。

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[0017] 在第一实施形态中，贮槽部分和 / 或密封材料注入部分可以为密封材料注入部分。密封材料注入部分和布线空间可均填充密封材料。

[0018] 在第一实施形态中，压接接触部分可被密封。

[0019] 在第一实施形态中，压接接触部分可通过焊接来密封。

[0020] 在第一实施形态中，压接接触部分可设置在电极的上方。

[0021] 本发明的第二实施形态涉及一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构。液体泄漏扩散抑制结构包含：检测蓄电装置的电压的电压检测端子；属于蓄电装置的电极。电压检测端子电气连接到电极的正电极侧。

[0022] 在第二实施形态中，可在电极上方设置电压检测端子的压接接触部分，电缆压接到该部分。

[0023] 本发明的第三实施形态涉及一种电气连接多个蓄电元件的母线模块，蓄电元件包含电解溶液并构成蓄电组件。母线模块包含：母线，其电气连接一个蓄电元件的电极和另一个蓄电元件的电极；压接接触部分，检测一个或多于一个蓄电元件的电压的电压检测端子的电缆压接到该部分，且该部分连接到母线；和 / 或容纳电缆的布线空间中的密封材料注入部分和 / 或用于在电极上泄漏的电解溶液的贮槽部分。

[0024] 在第三实施形态中，布线空间在母线模块长度方向上的宽度可为这样的长度：其包含电缆的直径，以及设置在电缆的两个相反侧上的空隙。

[0025] 在第三实施形态中，贮槽部分和 / 或密封材料注入部分可被设置在电缆的两个相反侧的至少一个上。

[0026] 在第三实施形态中，贮槽部分和 / 或密封材料注入部分可以为密封材料注入部分。密封材料注入部分和布线空间可均填充密封材料。

[0027] 本发明的第四实施形态涉及一种用于包含电解溶液的蓄电装置的液体泄漏扩散抑制结构。液体泄漏扩散抑制结构包含检测蓄电装置电压的电压检测端子的压接接触部分。压接接触部分是密封的。

[0028] 在第四实施形态中，压接接触部分可通过焊接来密封。

[0029] 根据第一实施形态，由于电压检测端子连接到蓄电装置的电极中邻近的一个，使得电缆压接到的电压检测端子的压接接触表面朝向与电极相反的方向，可以抑制在电极上泄漏的电解溶液经由电缆进入电缆的芯线。

[0030] 根据第二实施形态，由于电压检测端子电气连接到位于蓄电装置正电极侧的电极，可以使得由于使用碱性电解溶液的电池——例如镍金属氢化物蓄电池 (Ni-MH 电池）、镍镉蓄电池 (Ni-Cd 电池）等等——中的负电极蠕变现象产生的来自负电极侧的电解溶液泄漏扩散到电压检测端子的可能性较小。

[0031] 根据第三实施形态，由于在设置母线模块中的电压检测端子的压接接触部分和 / 或电缆的布线空间中设置了贮槽部分（空隙），在布线空间的壁和压接接触部分和 / 或电缆之间给出间隙，故而使泄漏的电解溶液扩散到电压检测端子的可能性较小。除此之外，贮槽部分用作密封材料注入空间，密封材料被充入或放入该空间。因此，可以在使用密封材料的情况下采取对电解溶液泄漏的对策。

[0032] 根据第四实施形态，由于电压检测端子的压接接触部分（电缆被压接到该部分）被密封，即使在电解溶液已经到达压接接触部分的情况下，电解溶液进入电缆（电压检测

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线）芯线内部的入口可得到抑制。顺便提及，尽管压接接触部分可通过焊接来密封，这并不是限制性的。例如，可使用黏接以及其他的密封材料。由于这一点，泄漏的电解溶液扩散到其他电气部件部分的可能性较低。

附图说明

[0033] 由下面参照附图对优选实施例的介绍，将会明了本发明的前述以及其他目的、特征和优点，在附图中，类似的标号用于表示类似的元件，且其中：

[0034] 图 1 为本发明第一实施例中的蓄电装置的分解透视图；

[0035] 图 2A 为电池电极和母线模块之间的连接位置的放大截面图，用于示出本发明第一实施例中的蓄电装置的母线模块的连接构造；

[0036] 图 2B 为母线模块的前视图，用于示出本发明第一实施例中的蓄电装置的母线模块的连接构造；

[0037] 图 3A 示出了本发明第二实施例中的电压检测端子的焊接连接；

[0038] 图 3B 为本发明第二实施例中的电压检测端子的透视图；

[0039] 图 3C 为电缆的截面图，其示出了本发明第二实施例中的电压检测端子；

[0040] 图 4A 和 4B 用于示出本发明的第一变型；

[0041] 图 5 用于示出本发明的第二变型；

[0042] 图 6A 为电池电极和母线模块之间的连接位置的放大截面图，示出了现有技术的母线模块的连接构造；以及

[0043] 图 6B 为母线模块的前视图，示出了现有技术的母线模块的连接构造。

具体实施方式

[0044] 下面将介绍本发明的实施例。

[0045] [第一实施例] 图 1 为本发明的母线模块和液体泄漏扩散抑制结构所应用的蓄电装置 1 的分解透视图。蓄电装置 1 包含：电池组件（蓄电组件）15，其由多个电单体 10 构成；母线模块 20，其电气连接电单体 10 的正电极 P(+) 和负电极 N(-)，并串联连接整个电池组件 15 的电单体。

[0046] 蓄电装置 1 用作安装在混合动力车或电动车辆上的电源装置，例如：使用碱性电解溶液的二次电池，包括镍金属氢化物蓄电池 (Ni-MH 电池)、镍镉蓄电池 (Ni-Cd 电池) 等；锂离子二次电池；电气双层电容器等。各个电单体 10 在其中容纳电解溶液，并具有在电池组件 15 的左右方向 Y 突出的正电极 P 和负电极 N(与电单体 10 的堆叠方向 X 正交的电单体的左右方向 Y)。

[0047] 母线模块 20 为树脂容器，其由合成树脂或类似物构成，并包含多个母线 21。各个母线 21 由金属制成，以便电气连接两个相邻电单体 10 的不同电极，也就是说，两个相邻电单体 10 中的一个的正电极 P 和另一电单体 10 的负电极 N。母线 21 具有插入孔 H，用于设置在各个电单体的各个电极上的电池电极柱 11 的螺纹部分 12。于是，母线模块 20 设置在电池组件 15 的左右侧（两侧表面），以便串联连接整个电池组件 15 的电单体 10。也就是说，被设置的母线模块 20 的数量为 2。当电池电极柱 11 的螺纹部分 12 插入母线 21 的插入孔 H 时，母线模块 20(母线 21) 串联连接电池组件 15 的电单体。

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[0048] 除此之外，各个母线 21 具有用于检测一个或多于一个的电单体 10 的电压的电压检测端子 22。各个母线模块 20 具有：保持机构（未示出），其保持电压检测端子 22；布线空间 S1，用于连接到电压检测端子 22（见图 2B）的电缆（电压检测电缆）C。

[0049] 下面将参照图 2A 和图 2B 详细介绍本实施例的母线模块 20、电压检测端子 22 及其结构。

[0050] 如图 2A 和 2B 所示，电压检测端子 22 包含电气接触部分 22a，其电气接触母线 21，以便检测一个或多于一个的电单体 10 的电压；压接接触部分 22b，用于将在电气接触部分 22a 上检测的电压输出到电池控制器（未示出）的电缆 C 通过压接连接到该部分。电缆 C 由用铜或类似物制成的芯线 C1、覆盖芯线 C1 的覆盖元件 C2 构成。电缆 C，特别是暴露的芯线 C1，通过压接连接到压接接触部分 22b，因此电气连接到电压检测端子 22（见图 3C）。

[0051] 母线模块 20 的各个布线空间 S1（在母线模块 20 中形成的挖剪部分）被形成为提供母线模块 20 的布线空间 S1 的壁表面与邻近压接接触部分 22b 的电缆 C 和电压检测端子 22 的压接接触部分 22b 的单元之间的空隙（在图 2B 中，在被包含的电缆 C 和压接接触部分 22b 的单元的两个相反侧）。至少与压接接触部分 22b 邻近的电缆 C 以及压接接触部分 22b 不与母线模块 20 的挖剪部分接触。离开压接接触部分 22b 的电缆 C 由母线模块 20 的保持部分 200 保持。

[0052] 也就是说，不像压接接触部分 22b 和电缆 C 在布线空间 S 中钳紧且不在压接接触部分 22b 和 / 或电缆 C 与母线模块 20 中形成的挖剪部分的壁表面之间形成空隙的相关技术中的母线模块（见图 6A 和图 6B）那样，此实施例的母线模块 20 具有这样的布线空间：其中，可布置电压检测端子 22，且包含母线模块 20 的挖剪部分和邻近压接接触部分 22b 的电缆 C 及电压检测端子 22 的压接接触部分 22b 的单元之间的间隙。

[0053] 除此之外，在压接接触部分 22b 的附近，贮槽部分 S2 被连接到布线空间 S1。也就是说，在 X-Y 平面上取得的合并布线空间 S1 和贮槽部分 S2 的空间（见图 2B）的截面面积大于布线空间 S1 的截面积。这一贮槽部分 S2 具有用于从母线模块 20 的外部充入密封材料的密封材料注入开口（未示出），该材料吸附 / 吸收电解溶液。密封材料可在密封材料注入开口中充入。密封材料在被充入时填充由布线空间 S1 和贮槽部分 S2 构成的空间，并吸附 / 吸收扩散到电压检测端子 22 的压接接触部分 22b 的电解溶液泄漏。顺便提及，密封材料具有对电极溶液进行吸收或类似能力就够了。密封擦料可以为例如吸水聚合物片或粉。

[0054] 如上所述，对于电池——例如二次电池或类似物，密封在电池中的电解溶液有时由于依赖于反应机制或温升发生的蠕变现象在电极上泄漏到电单体外部。如图 1 所示，各个电压检测端子 22 的压接接触部分 22b 和电缆 C 被布置在受到液体泄漏的电池电极柱 11 下方。因此，从电池电极柱 11 泄漏的电解溶液立即沿着电池电极柱 11 流动，并由于重力行进到较低侧，使得电解溶液被引导到电压检测端子 22。也就是说，在电池电极柱 11 在电池组件 15 的左右方向（在 Y 方向上）突出的情况下，母线模块 20 被布置在电池组件 15 的左右侧表面上。因此，在电池组件 15 的左右侧表面上，在电池电极柱 11 以及电压检测端子之间的 Z 方向的位置关系上，电压检测端子 22 被定位在受到液体泄漏的电池电极柱 11 下方。因此，提供了这样的结构：从位于电单体 10 的左右侧表面的任何一个电池电极柱 11 泄漏的电解溶液被容易地引导到邻近电压检测端子 22 的电缆 C 和压接接触部分 22b。

[0055] 因此，在此实施例中，母线模块 20 的电压检测端子 22 通过旋拧到电池电极柱 11

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而与母线 21 连接，使得电压检测端子 22 的压接接触部分 22b——电缆 C 的芯线部分压接于其上以便电气连接电气接触部分 22a——的压接接触表面 Pb 朝向与电池电极柱 11（电极）相反的方向，如图 2A 所示，而不像图 6A 所示的现有技术那样，在图 6A 所示的现有技术中，电压检测端子 22 的压接接触部分 22b 的压接接触表面 Pb 被布置为朝向电池电极柱 11 侧。

[0056] 也就是说，压接接触表面 Pb 为这样的表面：剥去覆盖元件的电缆 C 的芯线通过压接到电压检测端子 22 而被电气连接到该表面。具体地，电压检测端子 22 设置在电池电极柱 11（电极）上，使得安装电缆 C 的芯线的压接接触部分 22b 的一侧朝向与电池电极柱 11 相反的方向（不暴露于电池电极柱一侧）。也就是说，电压检测端子 22 被布置为使得压接接触部分 22b 的远离其压接接触表面 Pb 的相反侧朝向电池电极柱 11 侧。

[0057] 因此，即使在电池电极柱 11 上泄漏的电解溶液立即沿着电池电极柱 11 流动，由于重力向下行进到较低侧，并扩散到电压检测端子 22，由于电解溶液沿着压接接触部分 22b 离开其压接接触表面 Pb 的相反侧的表面扩散，电解溶液泄漏与电缆 C 的芯线的接触可得到避免或抑制。另外，电解溶液泄漏的扩散——其中，电解溶液进入电缆 C 的芯线内部并通过毛细管作用行进——能够得到抑制。

[0058] 除此之外，此实施例中的各个电压检测端子 22 仅仅被布置在连接正电极 P 和负电极 N 的母线的正电极 P 侧部分，并通过旋拧而连接到母线的正电极 P 侧部分。在例如镍金属氢化物蓄电池（Ni-MH 电池）、镍镉蓄电池（Ni-Cd 电池）等的使用碱性电解溶液的电池中，已经知道，电解溶液容易由于蠕变现象从负电极 N 侧泄漏。因此，将电压检测端子 22 连接到正电极 P 侧增大了在负电极 N 上泄漏的电解溶液扩散到电压检测端子 22 的距离。这产生了在负电极 N 侧泄漏的电解溶液不容易被引导到电压检测端子 22 的结构。

[0059] 另外，如图 2B 所示，在用合成树脂构成的各个母线模块 20 中，用于电压检测端子 22 的压接接触部分 22b 和电缆 C 的各个布线空间 S1 被构成为使得在合并了电缆 C 和压接接触部分 22b 的单元与布线空间 S1 的壁表面之间设置间隙。因此，即使在电解溶液在正电极 P 或负电极 N 上泄漏并扩散到电压检测端子 22 的压接接触部分 22b 的情况下，电解溶液的泄漏不会存在于电压检测端子 22 或接近电压检测端子 22，而是在电缆 C 和布线空间 S1 壁之间的空隙中向下扩散。这抑制了电解溶液泄漏进入电缆 C 的芯线并因此通过毛细管作用在芯线内扩散。

[0060] 除此之外，如图 2B 所示，贮槽部分 S2 连接到布线空间 S1。因此，由于布线空间 S1 和贮槽部分 S2，密封材料被充入以便阻塞电解溶液泄漏的密封材料注入空间被固定在布线空间 S1 的壁和所并入的贮槽部分 S2 以及所并入的电缆 C 及压接接触部分 22b 的单元之间。因此，接近压接接触部分 22b 的针对泄漏的密封可被实现。

[0061] [第二实施例] 图 3A 到 3C 示出了第二实施例中的电压检测端子 22。图 3A 示出了电压检测端子 22 的焊接连接。图 3B 为电压检测端子 22 的透视图。图 3C 为电缆的截面图。

[0062] 在此实施例的电压检测端子 22 中，压接接触腿部分 221b（前腿）和另一压接接触腿部分 222b（后腿）完全被焊接剂（在图 3A 中用阴影示出）覆盖和密封，故电解溶液泄漏将不会进入电缆 C 的芯线。也就是说，一般在现有技术中，电缆 C 通过经由压接接触腿部分 221b 和 222b 压接到压接接触部分 22b 而连接，接近电气接触部分 22a 的压接接触腿部分 221b 被焊接（即仅暴露的芯线 C1 电气连接到的部分被焊接）。在此实施例中，进行焊接，

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以便覆盖也包含压接接触腿部分 222b 的整个压接接触部分 22b，使得电解溶液泄漏进入电缆 C 的芯线 C1 内部的入口能够得到抑制。顺便提及，除了焊接剂以外，黏接剂或其他密封材料也可用于对压接接触部分 22b 进行密封。

[0063] 除此之外，如图 3B 所示，还可以使用电压检测端子 220，其中，电缆 C 的暴露的芯线 C1 电气连接到的压接接触部分 22b 具有伞的形状。具体地，代替图 3A 所示电缆 C 通过两个压接接触腿部分 221b 和 222b 以压接方式连接的构造的是，压接接触部分 22b 具有管状孔部 220，其容纳图 3B 和 3C 所示的电缆 C 的未覆盖的芯线 C1 的插入，并具有伞状，孔部 220 的电气接触部分 22a 侧的部分被封闭在其中。因此，电缆 C 可通过压接而不使其芯线 C1 从压接接触部分 22b 暴露来连接，因此使得电解溶液泄漏的从压接接触部分 22b 进入电缆 C 的芯线 C1 内部得到抑制。除此之外，可省略例如焊接或类似的操作的劳动（工作量）。

[0064] 图 3C 示出了电缆 C 的覆盖元件 C2 和芯线 C1 之间的空隙用密封材料 C3 填充的构造。在此构造中，进入芯线 C1 内部的电解溶液泄漏由密封材料 C3 吸附 / 吸收。因此，即使电解溶液泄漏进入电缆 C 的芯线 C1 内部，由于毛细管作用的电解溶液扩散可到抑制。

[0065] [变型] 图 4A、4B 示出了第一实施例的第一变型。在此变型中，由于在布置在电池组件 15 左右侧的任一电极上泄漏的电解溶液由于重力被如上所述地引导到电池组件 15 的较低部分，电压检测端子 22 如各个形成的母线模块 20 所决定的那样地被布置，使得各个电压检测端子 22 的压接接触部分 22 在电池组件 15 的方向 Z 上被定位在邻近电极（电池电极柱 11）上方。由于这种构造，在电解溶液在正电极 P 或负电极 N 的任意一个上泄漏并由于重力引导到较低侧的情况下，电解溶液不会扩散到压接接触部分 22b 或电缆 C，这是由于压接接触部分 22b 被定位在泄漏电极的上方。因此，电解溶液泄漏的扩散可得到抑制。另外，由于压接接触部分 22b 和电缆 C 不接触电解溶液，压接接触部分 22b 和电缆 C 的腐蚀等等能得到抑制。

[0066] 图 5 示出了第二变型，其中，从被布置在母线模块 20 上的电压检测端子 22 延伸的多个电缆 C 一同连接到连接器 300。除此之外，来自电压检测端子 22 的电缆 C 连接到电池控制器（未示出），电压检测端子 22 检测的电压检测信号被输入到电池控制器。在此布置中，连接器 300 被设置为用于连接电池控制器和电缆 C，电缆 C 经由连接器 300 连接到电池控制器。

[0067] 注意，毛细管作用不发生，如果电缆 C 的两个端部之一闭合的话。因此，为了实质上防止电解溶液泄漏在任一电缆 C 的芯线内部行进，各个电缆 C 的两端之一闭合于外部或外部空气，以便防止空气或类似物进入电缆 C 内部。在第二变型中，连接到电池控制器（未示出）的连接器 30 受到对于电缆 C 的密封处理，由此，从任何压接接触部分 22b 行进到电缆 C 内部的芯线的电解溶液由于毛细管作用的扩散受到抑制。

[0068] 实质上，包含电缆 C 的端部的连接器 300 的区域（图 5 中的阴影所示的部分）受到灌注 (potting) 处理，其中，树脂或类似物被封装在布置有电缆 C 的端部的连接器 300 的内部。因此，空气或类似物不会进入任一电缆 C 的内部。

[0069] 尽管参照其示例性实施例对本发明进行了介绍，将会明了，本发明不限于所介绍的实施例或构造。相反，本发明旨在覆盖多种变型和等价布置。另外，尽管所公开发明的多种元件以多种示例性组合和配置示出，包括更多、更少或仅一个元件的其他的构造和配置也在所附权利要求的范围内。

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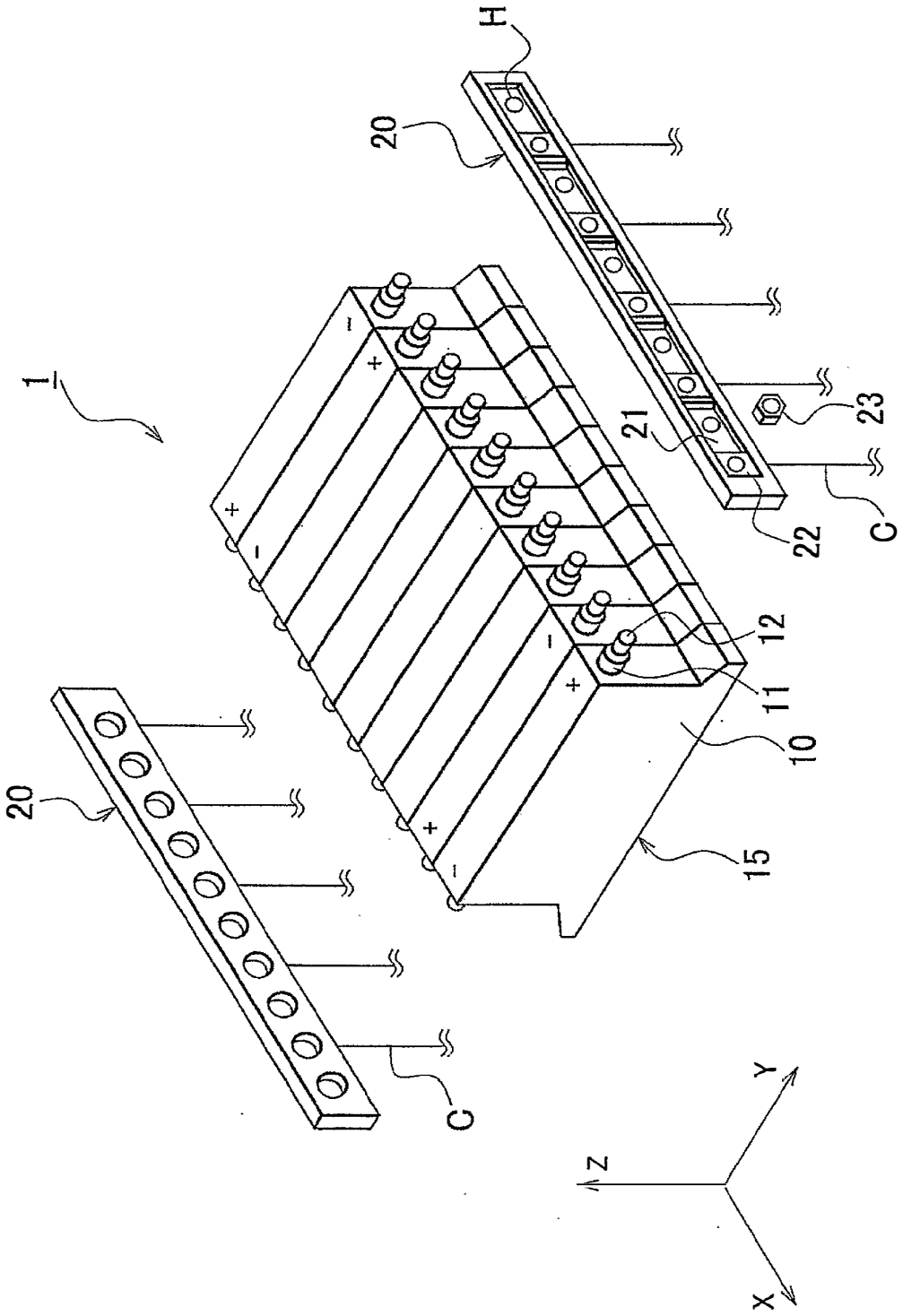


图 1

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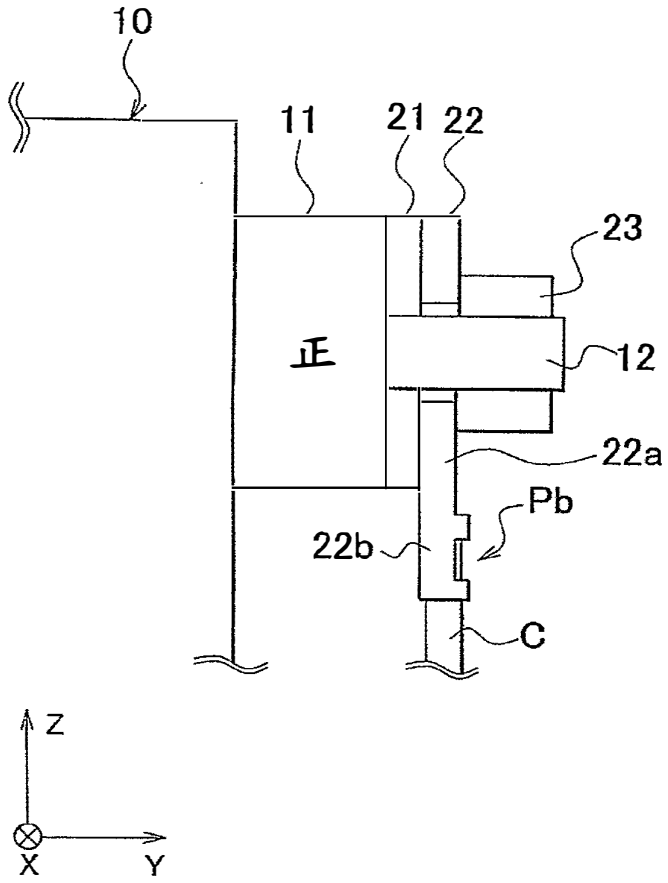


图 2A

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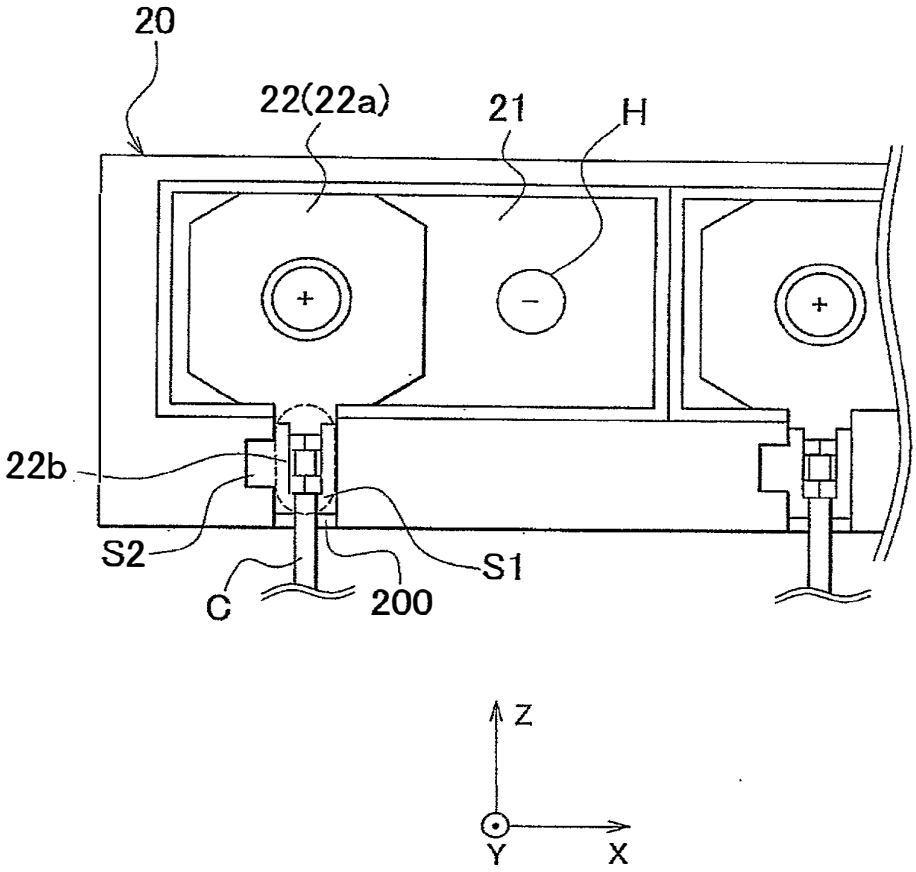


图 2B

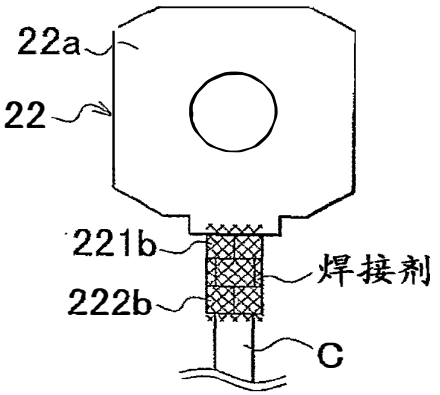


图 3A

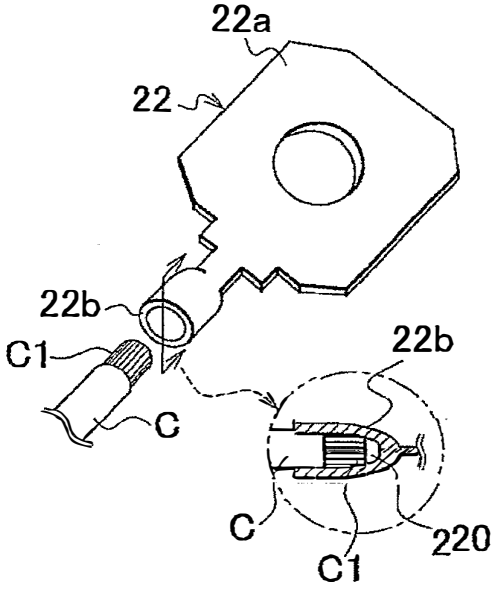


图 3B

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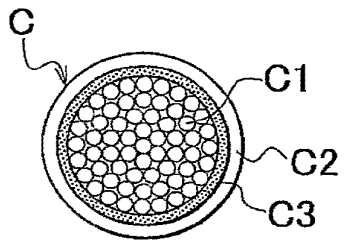


图 3C

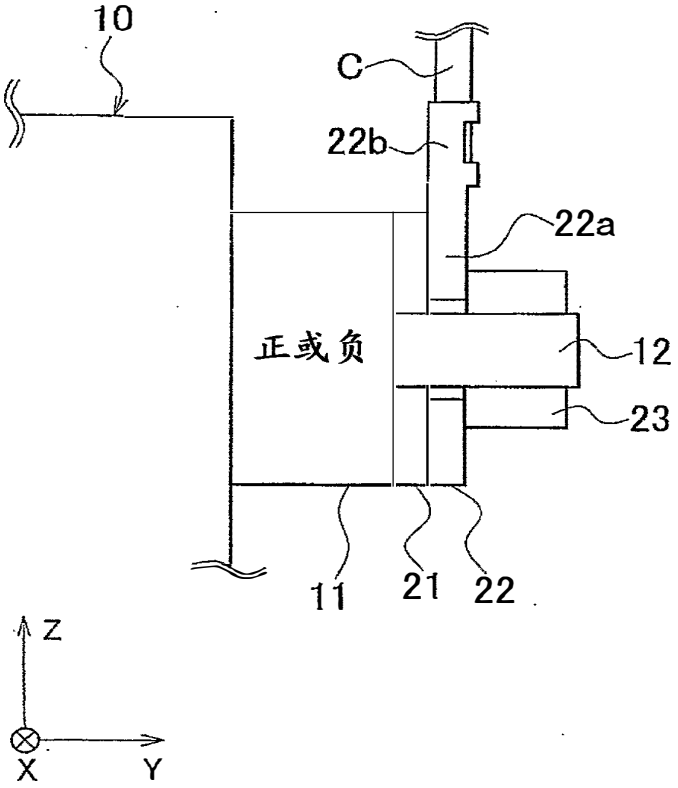


图 4A

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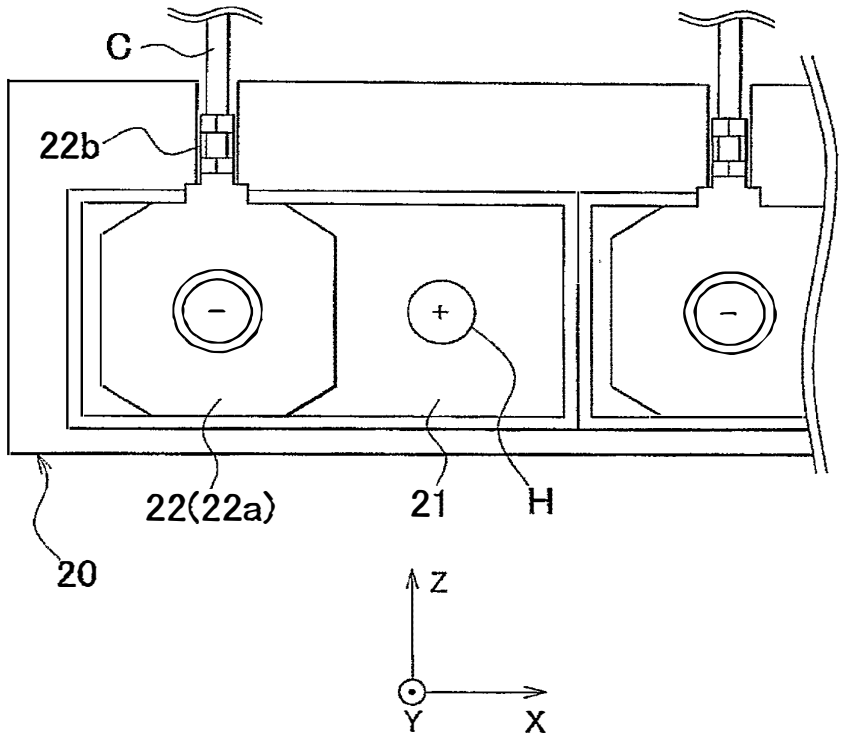


图 4B

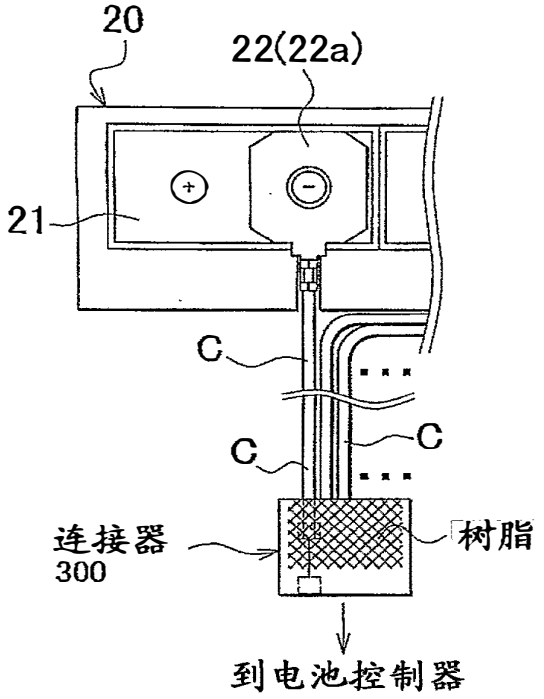
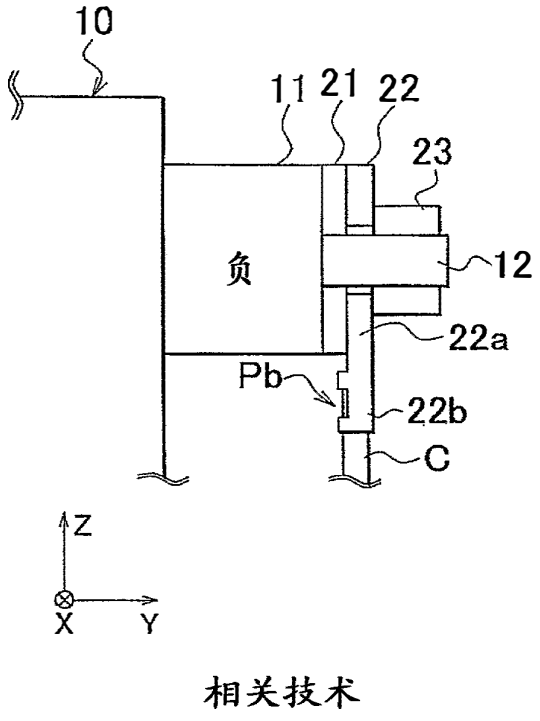


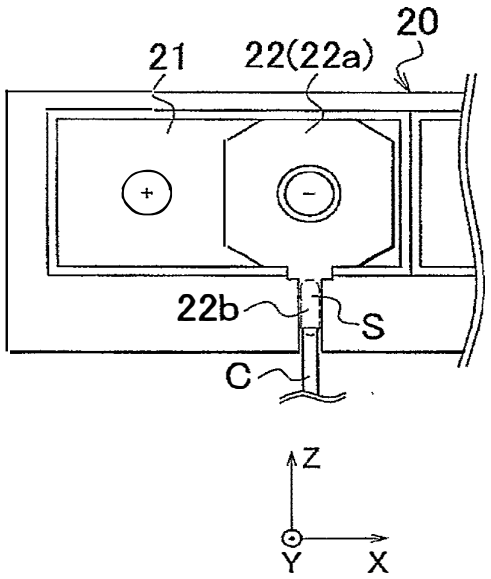
图 5



相关技术

图 6A

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相关技术

图 6B

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WO2016003471A1 PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

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CPC **F02N11/12 (EP); F02N11/14 (EP); H02J7/00302 (EP,GB); H02J7/00306 (EP,GB); H02J7/0034 (EP,GB); H02J7/0036 (EP,GB); H02J7/342 (EP,GB);** F02N11/10 (EP); H02J7/00309 (EP,GB);

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PORTABLE VEHICLE BATTERY JUMP START APPARATUS WITH SAFETY PROTECTION

Abstract

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

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(74) Name und Wohnsitz des Vertreters:
TER MEER STEINMEISTER & PARTNER PATENTANWÄLTE mbB, 80335 München, DE

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen.

(54) Bezeichnung: **Tragbare Starthilfevorrichtung für Fahrzeugbatterien mit Sicherheitsschutzvorrichtung**

(57) Hauptanspruch: Starthilfevorrichtung zum Boosten oder Aufladen einer verbrauchten oder entladenen Batterie, die einen positiven und negativen Batterieanschluss aufweist, die Starthilfevorrichtung umfasst:
- eine Spannungsversorgung (32);
- einen positiven Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem positiven Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen negativen Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem negativen Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen Leistungsschalter (15), der über eine Schaltung mit der Spannungsversorgung (32) und den positiven und negativen Batterieverbindern verbunden ist,
- wobei der Leistungsschalter (15) eingerichtet ist, die Spannung von der Spannungsversorgung (32) zur verbrauchten oder entladenen Batterie (72) ein- oder auszuschalten, wenn diese mit den positiven und negativen Batterieverbindern verbunden ist,
- ein Leistungsschaltersteuerungssystem oder eine Leistungsschaltersteuerungsschaltung, die mit dem Leistungsschalter (15) verbunden ist und zur Steuerung des Leistungsschalters (15) vorgesehen ist,
- wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung eingerichtet ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) und die Polarität der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen die positiven und negativen Batterieverbinder geschaltet ist,
- wobei ...

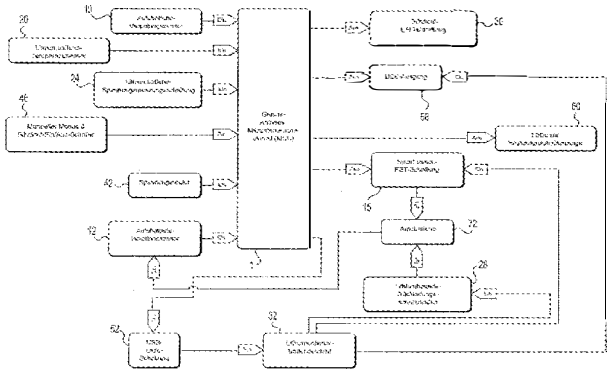


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Beschreibung

Hintergrund der Erfindung

[0001] Die vorliegende Erfindung bezieht sich im Allgemeinen auf eine Starthilfevorrichtung für ein Fahrzeug, das eine verbrauchte oder entladene Batterie aufweist. Gemäß dem Stand der Technik sind Vorrichtungen bekannt, die entweder ein Paar von elektrischen Verbindungskabeln aufweisen, die eine vollständig aufgeladene Batterie eines anderen Fahrzeugs mit der Fahrzeugstartschaltung des Fahrzeugs verbinden, das die erschöpfte Batterie enthält, oder tragbare Starthilfevorrichtungen, die eine vollständig geladene Batterie aufweisen, und die mit der Startvorrichtung des Fahrzeugmotors über ein Kabelpaar in einer Schaltung verbunden werden können

[0002] Probleme entstanden beim Stand der Technik, wenn entweder die Drahtbrückenanschlüsse oder -klemmen der Kabel irrtümlich miteinander in Kontakt gebracht wurden, während die anderen Enden an eine geladenen Batterie angeschlossen waren, oder wenn die positiven und negativen Anschlüsse mit den Anschlüssen entgegengesetzter Polung im zu überbrückenden Fahrzeug verbunden wurden, wodurch ein Kurzschluss verursacht wurde, der zu einer Funkenbildung und einer potentiellen Beschädigung der Batterien und/oder einem körperlichen Schaden führte.

[0003] Gemäß dem Stand der Technik wurden unterschiedliche Versuche zur Beseitigung dieser Probleme unternommen. US 6,212,054 B1, erteilt am 3. April 2001, offenbart eine Batteriestarthilfeeinheit, die empfindlich auf die Polung reagiert und passende oder unpassende Verbindungen detektieren kann, bevor ein Pfad für den elektrischen Ladungsfluss bereitgestellt wird. Die Vorrichtung verwendet einen Satz von LEDs, die mit durch eine Steuerschaltung ausgerichteten optischen Kopplern verbunden sind. Die Steuerschaltung steuert eine Spulenanordnung, die den Pfad eines Leistungsstroms steuert. Der Steuerschaltkreis lässt einen Leistungsstromfluss durch die Spulenanordnung nur dann zu, wenn die Kontaktpunkte der Starthilfekabelklemmenverbindungen richtig angelegt wurden.

[0004] US 6,632,103 B1, erteilt am 14. Oktober 2003, offenbart ein adaptives Starthilfekabel, das durch zwei Klemmenpaare verbunden ist, wobei die beiden Klemmenpaare jeweils an zwei Batterien angeschlossen sind, um Strom von einer Batterie zu einer anderen Batterie zu übertragen. Das adaptive Starthilfekabel enthält eine mit jeder Klemme verbundene Polungsdetektionseinheit, eine Schalteinheit und eine Stromdetektionseinheit, die beide zwischen den beiden Klemmenpaaren vorhanden sind. Nachdem die Polung jeder Klemme durch die Polungsdetektionseinheit abgetastet wurde, erzeugt die Schalteinheit eine geeignete Verbindung zwischen den beiden Batterien. Daher sind die positiven und negativen Anschlüsse der beiden Batterien basierend auf dem detektierten Ergebnis der Polungsdetektionseinheit passend verbunden.

[0005] US 8,493,021 B2, erteilt am 23. Juli 2013, offenbart eine Vorrichtung, die die Spannung einer Fahrzeugbatterie, welche Starthilfe bekommt und den durch die Starthilfebatterien gelieferte Strom überwacht, um zu bestimmen, ob eine passende Verbindung hergestellt wurde und um eine Fehlerüberwachung bereitzustellen. Nur wenn die geeignete Polung detektiert wird, kann das System betrieben werden. Die Spannung wird überwacht, um einen offenen Stromkreis, getrennte leitende Klemmen, Nebenschlusskabelfehler und Spulenfehlerzustände zu erfassen. Der Strom durch das Nebenschlusskabel wird überwacht, um das Bestehen eines Batterieexplosionsrisikos und eines einen Überhitzungszustand darstellenden Überschussstromzustands zu erkennen, der zu einem Feuer führen kann. Das System enthält eine interne Batterie zum Bereitstellen der Spannung für die Batterie des Fahrzeugs, das Starthilfe bekommen soll. Sobald das Fahrzeug gestartet ist, findet eine automatische elektrische Trennung der Einheit von der Fahrzeugbatterie statt.

[0006] US 5,189,359 A, veröffentlicht am 23. Februar 1993, offenbart eine Starthilfekabelvorrichtung, die zwei Brückengleichrichter zum Ausbilden einer Referenzspannung, einen Dekodierer mit vier Eingängen zum Erkennen, welche Anschlüsse verbunden werden sollen, basierend auf einem Vergleich der Spannung an jedem der vier Anschlüsse mit der Referenzspannung, und ein Relaispaar aufweist, zum Bewirken der passenden Verbindung in Abhängigkeit von der Erkennung durch den Dekodierer. Es wird keine Verbindung hergestellt, es sei denn, dass nur ein Anschluss einer jeden Batterie eine höhere Spannung als die Referenzspannung aufweist, so dass „positive“ Anschlüsse angezeigt werden, und ein Anschluss eine geringere Spannung als die Referenzspannung aufweist, so dass „negative“ Anschlüsse angezeigt werden, und dass deshalb die beiden Hochspannungsanschlüsse und die beiden Niedrigspannungsanschlüsse verbunden werden können. Der Strom fließt, sobald die entsprechende Relaisvorrichtung geschlossen wird. Die Relaisvorrichtung ist vorzugsweise eine Metall-Oxid-Halbleiter-Feldeffekttransistor (MOSFET), der mit einer Serienanordnung von Photodioden, die ein MOSFET-gate-Schließ-Potential entwickeln, wenn der Dekodierer-Ausgang eine LED zum Leuchten bewirkt.

[0007] US 5,795,182 A, veröffentlicht am 18. August 1998, offenbart einen polungsunabhängigen Satz von Batteriestarthilfekabeln, um eine erste Batterie mit einer zweiten Batterie zu überbrücken. Die Vorrichtung weist einen Detektor der relativen Polung

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auf, um zu detektieren, ob zwei Batterien über Kreuz oder parallel angeordnet sind. Ein Drei-Punkt-Hochspannungskapazitätsquerriegeldrehschalter reagiert auf den Detektor der relativen Polung zum automatischen Verbinden des Plus-Anschlusses der beiden Batterien miteinander und der Minus-Anschlüsse der beiden Batterien miteinander, ungeachtet dessen, ob die detektierte Anordnung über Kreuz oder parallel ist, und ein Unterstrom-Detektor und eine Verzögerungsschaltung zum Zurücksetzen der Vorrichtung in ihren Anfangs- und nicht angeschlossenen Zustand, nachdem die Vorrichtung von einer der Batterien getrennt wurde. Der Querriegeldrehschalter weist zwei Kontaktpaare und einen Dreharm auf, der sich um zwei getrennte Punkte dreht, um vollen elektrischen Kontakt zwischen den Kontaktpaaren zu sichern. Die Erfindung kann auch verwendet werden, um eine Batterieladevorrichtung herzustellen, die mit einer Batterie ungeachtet der Batteriepolung verbunden werden kann

[0008] US 6,262,492 B1, erteilt am 17. Juli 2001, offenbart ein Autobatteriestarterkabel zur passenden Kopplung einer effektiven Spannungsquelle an eine fehlerhafte oder ungeladene Batterie, die eine Relaisschaltungsstromkreis aufweist, welcher mit der Spannungsquelle und der Batterie durch zwei Stromleitungspaare verbunden ist. Erste und zweite Spannungspolungserkennungsschaltungen werden jeweils mit der Spannungsquelle und der Batterie durch ein entsprechendes Spannungsleitungspaar verbunden, um die Polung der Spannungsquelle und der Batterie zu erkennen. Eine Logikerkennungsschaltung erzeugt ein Steuersignal, das abhängig von der Polung der Spannungsquelle und der Batterie ist, und eine Treiberschaltung, die durch ein Steuersignal des Logikerkennungsschaltung gesteuert wird, steuert den Relaisschaltungsstromkreis an, so dass das genaue Koppeln der beiden Pole der Spannungsquelle an die beiden Pole der Batterie ermöglicht wird.

[0009] US 5,635,817A, veröffentlicht am 3. Juni 1997, offenbart eine Fahrzeugbatterie-Ladevorrichtung, die ein Steuergehäuse aufweist, das Kabel enthält und, die eine Strombegrenzungsvorrichtung zum Verhindern des Überschreitens eines vorbestimmten maximalen Ladestroms von ungefähr 40 bis 60 A enthält. Das Steuergehäuse weist eine Polungsdetektionsvorrichtung zur Überprüfung der passenden Polung der Verbindung der Anschlüsse der beiden Batterien und zur elektrischen Trennung der beiden Batterien im Falle des Vorliegens einer falschen Polung auf.

[0010] US 8,199,024 B2, erteilt am 12. Juni 2012, offenbart eine Sicherheitsschaltung in einem Niedrigspannungsverbindungssystem, das die beiden Niedrigspannungssysteme getrennt lässt, bis es bestimmt, dass es sicher ist, eine Verbindung aufzubauen. Wenn die Sicherheitsschaltung bestimmt, dass keine unsicheren Bedingungen vorliegen, und dass es sicher ist, die beiden Niedrigspannungssysteme zu verbinden, kann die Sicherheitsschaltung die beiden Niedrigspannungssysteme durch einen „sanften Start“ verbinden, der eine Verbindung zwischen den beiden Systemen über eine Zeitdauer bereitstellt, die induzierte Spannungsspitzen auf einem oder mehreren der Niedrigspannungssysteme reduziert oder verhindert. Wenn in einem der Niedrigspannungssysteme eine vollständig entladene Batterie eingebaut ist, wird ein Verfahren für die Detektion der passenden Polung der Verbindungen zwischen den Niedrigspannungssystemen verwendet. Die Bestimmung der Polung der entladenen Batterie erfolgt durch das Durchschicken von einem oder mehreren Testströmen durch die entladene Batterie und durch die Bestimmung, ob ein entsprechender Spannungsanstieg beobachtet wird.

[0011] US 5,793,185 A, veröffentlicht am 11. August 1998, offenbart eine tragbare Starthilfevorrichtung, die Steuerkomponenten und Schaltungen zur Verhinderung von Überladung und falscher Verbindung von Batterien aufweist.

[0012] US 5,820,407 A beschreibt Starthilfekabelklemmen.

[0013] Während der Stand der Technik Lösungen für die obengenannten Probleme, wie oben diskutiert, vorschlägt, leidet jede der Lösungen des Stands der Technik an anderen Defiziten, entweder in Bezug auf Komplexität, Kosten oder die Anfälligkeit für Fehlfunktionen. Folglich existiert ein Bedarf in diesem technischen Gebiet nach weiteren Verbesserungen für Starthilfevorrichtungen von Fahrzeugen. Zusammenfassung der Erfindung.

[0014] Die Aufgabe der Erfindung wird durch die Merkmale der unabhängigen Ansprüche gelöst. Vorteilhafte Ausgestaltungen sind den Unteransprüchen zu entnehmen.

[0015] Gemäß einem Aspekt der Erfindung, wird eine Vorrichtung zur Starthilfe eines Fahrzeugmotors bereitgestellt, die Folgendes aufweist: eine interne Spannungsversorgung; einen positiv und negativ gepolte Ausgänge aufweisenden Ausgangsanschluss; einen Fahrzeugbatterie-Isolationssensor, der mit den positiv und negativ gepolten Ausgängen in einer Schaltung verbunden ist und zur Detektion des Vorhandenseins einer Fahrzeugbatterie konfiguriert ist, die zwischen den positiv und negativ gepolten Ausgängen angeschlossen ist; einen Verpolungssensor, der in einer Schaltung mit den positiv und negativ gepolten Ausgängen verbunden ist und zur Detektion der Polarität einer Fahrzeugbatterie konfiguriert ist, die zwischen den positiv und negativ gepolten Ausgängen angeschlossen ist; einen Spannungs-FET-

Schalter, der zwischen der internen Spannungsversorgung und dem Ausgangsanschluss angeschlossen ist; und ein Mikrocontroller, der zum Empfangen von Eingabesignalen vom Fahrzeug-Isolationssensor und Verpolungssensor und zum Bereitstellen eines Ausgabesignals an den Spannungs-FET-Schalter so konfiguriert ist, dass der Spannungs-FET-Schalter als Antwort auf Signale der Sensoren, die das Vorhandensein einer Fahrzeugbatterie am Ausgangsanschluss und die passende Polverbindung von positiven und negativen Anschlüssen der Fahrzeugbatterie mit positiv und negativ gepolten Ausgängen anzeigen, eingeschaltet wird, um die interne Spannungsversorgung mit dem Ausgangsanschluss zu verbinden.

[0016] Gemäß einem weiteren Aspekt der Erfindung, besteht die interne Spannungsversorgung aus einer wieder aufladbaren Lithiumionenbatterieeinheit.

[0017] Gemäß noch einem weiteren Aspekt der Erfindung, wird eine Starthilfekabelvorrichtung bereitgestellt, die einen Stecker aufweist, der zum Einstecken in einen Ausgangsanschluss einer tragbaren Vorrichtung zur Batterieladestarthilfe, die eine interne Spannungsversorgung aufweist, konfiguriert ist; ein Kabelpaar, an dessen jeweiligem einen Ende der Stecker integriert ist; wobei das Kabelpaar zum getrennten Anschließen an die Anschlüsse einer Batterie an dessen jeweiligem anderen Ende konfiguriert ist.

Figurenliste

Fig. 1 stellt einen Funktionsplan einer tragbaren Vorrichtung zur Batteriestarthilfe von Fahrzeigen gemäß einem Aspekt der vorliegenden Erfindung dar;

Fig. 2A-**Fig. 2C** stellen schematische Schaltpläne einer beispielhaften Ausführungsform einer tragbaren Vorrichtung zur Batteriestarthilfe von Fahrzeugen gemäß einem Aspekt der vorliegenden Erfindung dar;

Fig. 3 stellt eine perspektivische Ansicht einer tragbaren Vorrichtung zur Starthilfe gemäß einer beispielhaften Ausführungsform der vorliegenden Erfindung dar; und

Fig. 4 stellt eine Draufsicht eines Starthilfekabels dar, das mit der tragbaren Vorrichtung zur Starthilfe gemäß einem weiteren Aspekt der vorliegenden Erfindung verwendbar ist.

Detaillierte Beschreibung der Erfindung

[0018] **Fig. 1** stellt einen Funktionsplan einer tragbaren Vorrichtung zur Batteriestarthilfe gemäß einem Aspekt der vorliegenden Erfindung dar. Das Herzstück der tragbaren Vorrichtung zur Batteriestarthilfe ist eine Lithiumpolymerbatterieeinheit **32** , die genügend Energie speichert, um einem Fahrzeugmotor Starthilfe zu leisten, welcher von einer konventionellen 12 Volt Bleisäure- oder von einer durch ein Ventil regulierten Bleisäure-Batterie beliefert wird. In einer beispielhaften Ausführungsform weist eine Überspannungslithiumpolymerbatterieeinheit drei 3,7 V, 2666 mAh Lithiumpolymerbatterien in einer 3S1P-Konfiguration auf. Die sich ergebende Batterieeinheit liefert 11,1 V, 2666 Ah (8000 Ah bei 3,7 V, 29,6 Wh). Ein kontinuierlicher Entladungsstrom beträgt 25 C (oder 200 A), und eine Entladungsstromspitze beträgt 50 C (oder 400 A). Der maximale Ladungsstrom der Batterieeinheit beträgt 8000 mA (8 A).

[0019] Eine programmierbare Mikrocontrollereinheit (MCU) 1 erhält verschiedene Eingaben und erzeugt Informations- als auch Steuerungsausgaben. Die programmierbare MCU 1 stellt ferner eine Flexibilität für das System bereit, in dem es Aktualisierungen der Funktionalität und der Systemparameter zulässt, ohne eine Änderung der Hardware zu benötigen. Gemäß einer beispielhaften Ausführungsform wird ein 8-bit-Mikrocontroller mit einem 2K × 15-bit-Flash-Speicher verwendet, um das System zu steuern. Ein solcher Mikrocontroller ist HT67F30, der kommerziell bei Holtek Semiconductors Inc. erhältlich ist.

[0020] Eine Autobatterie-Verpolungssensor **10** überwacht die Polung der Fahrzeugbatterie **72**, wenn die tragbare Vorrichtung zur Batteriestarthilfe mit dem elektrischen System des Fahrzeugs verbunden wird. Wie unten erklärt, verhindert die Starthilfevorrichtung, dass die Lithiumbatterieeinheit mit der Fahrzeugbatterie **72** verbunden wird, wenn die Anschlüsse der Batterie **72** mit den falschen Anschlüssen der Starthilfevorrichtung verbunden sind. Ein Autobatterie-Isolationssensor **12** detektiert, ob ein eine Fahrzeugbatterie **72** mit der Starthilfevorrichtung verbunden ist oder nicht, und verhindert, dass die Lithiumbatterieeinheit mit den Ausgangsanschlüssen der Starthilfevorrichtung verbunden wird, es sei denn, dass eine gute (z. B. aufladbare) Batterie an die Ausgangsanschlüsse angeschlossen ist.

[0021] Ein smart-switch-FET-Schaltung **15** schaltet die Lithiumbatterie der tragbaren Vorrichtung zur Batteriestarthilfe elektrisch an das elektrische System des Fahrzeugs, nur wenn bestimmt wird, dass die Fahrzeugbatterie durch die MCU **1** als vorhanden erfasst wird (als Antwort auf ein von einem Isolationssensor **12** bereitgestelltes Detektionssignal) und mit der passenden Polung angeschlossen ist (als Antwort auf ein von einem Verpolungssensor **10** bereitgestelltes Detektionssignal). Ein Lithiumbatterie-Temperatursensor **20** überwacht die Temperatur der Lithiumbatterieeinheit **32**, um eine Überhitzung aufgrund von hohen Umgebungstemperaturbedingungen und übermäßiger Stromabgabe während des Starthilfevorgangs zu detektieren. Eine Lithiumbatterie-Spannungsmessungsschaltung **24** überwacht

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die Spannung der Lithiumbatterieeinheit **32**, um das Spannungspotential daran zu hindern, während eines Ladevorgangs zu hoch zusteigen, und während eines Entladevorgangs zu tief zu fallen

[0022] Lithiumbatterie-Rückladungsschutzdioden **28** verhindern, dass irgendein Ladungsstrom, der an die Fahrzeugbatterie **72** geliefert wird, vom elektrischen System des Fahrzeugs in die Lithiumbatterieeinheit **32** zurückfließt. Eine Blitzlicht-LED-Schaltung **36** wird bereitgestellt, um eine Blitzlicht-Funktion zur Verstärkung des Lichts unter der Fahrzeughaube bei dunklen Bedingungen zu liefern, sowie SOS- und Stroboskoplichtfunktionen aus Sicherheitsgründen bereitzustellen, wenn ein Fahrzeug an einem potentiell gefährlichen Ort fahruntauglich wird. Ein Spannungsregler **42** stellt eine Regulierung der internen Betriebsspannung für den Mikrocontroller und die Sensoren bereit. Ein manueller Modus- und Blitzlicht-Ein/Aus-Schalter **46** erlauben es dem Nutzer, das Einschalten der tragbaren Vorrichtung zur Batterieladestarthilfe zu steuern, um den manuellen Starthilfebetrieb zu steuern, wenn das Fahrzeug keine Batterie aufweist, und die Blitzlichtfunktion zu steuern. Der manuelle Knopf funktioniert nur, wenn die Starthilfevorrichtung eingeschaltet ist. Dieser Knopf erlaubt es dem Nutzer, Fahrzeugen Starthilfe zu leisten, denen entweder eine Batterie fehlt, oder deren Batteriespannung so niedrig ist, dass eine automatische Detektion durch die MCU nicht möglich ist. Wenn der Nutzer den manuellen Starthilfeknopf drückt und für eine vorbestimmte Zeit (wie z. B. drei Sekunden) gedrückt hält, um eine ungewollte Betätigung des manuellen Modus zu verhindern, wird die Spannung der internen Lithiumionenbatterie auf den Fahrzeugbatterie-Verbindungsanschluss geschaltet. Die einzige Ausnahme zum manuellen Starthilfebetrieb erfolgt, wenn die Autobatterie verpolt wurde. Wenn die Autobatterie verpolt wurde, sollte die Spannung der internen Lithiumbatterie niemals auf den Fahrzeugbatterie-Verbindungsanschluss geschaltet werden.

[0023] Eine USB-Ladeschaltung **52** wandelt eine Spannung von irgendeiner der USB-Ladespannungsquellen um, so dass Spannung und Strom zum Laden der Lithiumbatterieeinheit **32** geladen werden. Ein USB-Ausgang **56** stellt eine tragbare USB-Ladevorrichtung zum Laden von Smartphones, Tablet-Computern (im Folgenden Tablet genannt) und weiteren wieder aufladbaren elektronischen Vorrichtungen bereit. LEDs zur Betriebszustandsanzeige **60** stellen eine visuelle Anzeige des Lithiumbatterie-Kapazitätsstatus sowie eine Anzeige des Aktivierungsstatus des smart-switchs dar (die anzeigt, dass dem elektrischen System eine Spannung bereitgestellt wird).

[0024] Ein detaillierter Betrieb der tragbaren Starthilfevorrichtung wird nun gemäß den schematischen Diagrammen der **Fig. 2A** bis **Fig. 2C** beschrieben werden. Wie in **Fig. 2A** gezeigt, stellt die Mikrocontrollereinheit **1** das Zentrum aller Ein- und Ausgänge dar. Der Batterie-Verpolungssensor **10** umfasst einen optisch gekoppelten Isolationsphototransistor (**4N27**), der mit den Anschlüssen der Fahrzeugbatterie **72** an den Eingangspins **1** und **2** mit einer Diode **D8** im Leiterdraht des Pins **1** (der am negativen Anschluss **CB-** angeschlossen ist), so dass, falls die Batterie **72** mit den Anschlüssen der Starthilfevorrichtung mit passender Polung verbunden ist, die LED des optischen Kopplers **11** keinen Strom leiten wird, und deshalb ausgeschaltet wird, wobei der MCU **1** eine „**1**“ oder ein hohes Ausgabesignal bereitgestellt wird. Der Autobatterie-Isolationssensor **12** umfasst einen optisch gekoppelten Isolationsphototransistor (**4N27**), der mit den Anschlüssen der Fahrzeugbatterie **72** an den Eingangspins **1** und **2** mit einer Diode **D7** im Leitungsdraht des Pins **1** (angeschlossen an den positiven Anschluss **CB+**) verbunden ist, so dass, falls die Batterie **72** an die Anschlüsse der Starthilfevorrichtung mit der passenden Polung verbunden ist, die LED des optischen Kopplers **11A** einen Strom leiten wird, und deshalb eingeschaltet wird, wobei der MCU eine „0“ oder ein niedriges Ausgabesignal bereitgestellt wird, und das Vorhandensein einer Batterie über die Starthilfeausgangsanschlüsse der tragbaren Starthilfevorrichtung anzeigt.

[0025] Falls die Autobatterie **72** mit der tragbaren Starthilfevorrichtung verpolt verbunden ist, wird die LED des optischen Kopplers **11** des Verpolungssensors **10** den Strom leiten, wobei der Mikrocontrollereinheit **1** eine „0“ oder ein niedriges Signal bereitgestellt wird. Ferner, falls keine Batterie mit der tragbaren Starthilfevorrichtung verbunden ist, wird die LED des optischen Kopplers **11A** des Isolationssensors **12** keinen Strom leiten und wird deshalb ausgeschaltet, wobei der MCU eine „1“ oder ein hohes Ausgabesignal bereitgestellt wird, das die Abwesenheit irgendeiner mit der tragbaren Starthilfevorrichtung verbundener Batterie anzeigt. Unter Verwendung dieser spezifischen Eingaben kann die Mikrocontrollersoftware der MCU **1** bestimmen, wann es sicher ist, den smart-switch-FET **15** einzuschalten, wodurch die Lithiumbatterieeinheit mit den Starthilfeanschlüssen der Starthilfevorrichtung verbunden wird. Folglich kann die MCU **1** den smart-switch-FET-Schaltung **15** davor bewahren, eingeschaltet zu werden und somit das Erzeugen von Funken/Kurzschlüssen der Lithiumbatterieeinheit verhindert werden, wenn die Autobatterie **72** entweder überhaupt nicht mit der Starthilfevorrichtung verbunden ist oder verpolt verbunden ist.

[0026] Wie in **Fig. 2B** gezeigt, wird der smart-switch-FET **15** durch eine Mikrocontrollerausgabe **1** angesteuert. Der FET-smart-switch **15** weist drei FETs (**Q15**, **Q18** und **Q19**) in Parallelschaltung auf, die die Spannung der Lithiumbatterieeinheit verteilt. Wenn diese Mikrocontrollerausgabe in einen logisch niedrigen Zustand gesteuert wird, befinden sich die FETs

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16 alle in einem Hochwiderstandszustand, weswegen kein Stromfluss vom negativen Kontakt **17** der internen Lithiumbatterie zum negativen Kontakt der Autobatterie **72** zugelassen wird. Wenn die Mikrocontrollerausgabe in einen logisch hohen Zustand gesteuert wird, sind die FETs **16** (**Q15**, **Q18**, **Q19**) in einem Niedrigwiderstandszustand, der einen freien Stromfluss vom negativen Kontakt **17** (LB-) der internen Lithiumbatterieeinheit zum negativen Kontakt (**CB-**) der Autobatterie **72** zulässt. Auf diese Art steuert die Mikrocontrollersoftware die Verbindung der internen Lithiumbatterieeinheit **32** mit der Fahrzeugbatterie **72**, um dem Fahrzeugmotor Starthilfe zu leisten.

[0027] Gemäß **Fig. 2A**, kann die Spannung der internen Lithiumbatterieeinheit unter Verwendung der Schaltung **24** und einem der Analog-zu-Digital-Eingänge des Mikrocontrollers **1** präzise gemessen werden. Die Schaltung **24** ist vorgesehen, um zu erfassen, wann die Spannung des Haupt-3,3 V-Reglers **42** eingeschaltet ist und den Transistor **23** einzuschalten, wenn die Spannung des Reglers **42** eingeschaltet ist. Wenn der Transistor **23** leitet, schaltet er den FET **22** ein, womit dem positiven Kontakt (LB+) der internen Lithiumbatterie ein leitender Pfad zu einem Spannungsteiler **21** bereitgestellt wird, der es zulässt, der Mikrocontroller einen niedrigeren Spannungsbereich zum Einlesen zuzuführen. Durch Verwendung dieser Eingabe kann die Mikrocontrollersoftware bestimmen, ob die Lithiumbatteriespannung während des Entladevorgangs zu niedrig oder während des Aufladevorgangs zu hoch ist, und sie kann eine entsprechende Maßnahme zur Verhinderung der Beschädigung der elektronischen Komponenten unternehmen.

[0028] Weiterhin kann gemäß **Fig. 2A** durch zwei Vorrichtungen **20** mit negativem Temperaturkoeffizienten (NTC) die Temperatur der internen Lithiumbatterieeinheit **32** präzise gemessen werden. Dies sind Vorrichtungen, die ihren Widerstand verringern, wenn ihre Temperatur steigt. Die Schaltung stellt einen Spannungsteiler dar, der das Ergebnis den beiden Analog-zu Digital-(A/D)-Eingänge dem Mikrocontroller zuführt. Die Mikrocontrollersoftware kann dann bestimmen, wann die interne Lithiumbatterie zu heiß ist, um einen Starthilfevorgang zuzulassen, wodurch der Aufbau Betriebssicherheit erhält.

[0029] Die Hauptspannungsreglerschaltung **42** ist so gestaltet, dass die Spannung der internen Lithiumbatterie in einen geregelten Wert von 3,3 V umgewandelt wird, der vom Mikrocontroller **1** sowie von anderen Komponenten der Starthilfevorrichtung für die interne Betriebsspannung verwendet wird. Drei Lithiumbatterie-Rückaufladungs-(backcharging)-Schutzdioden **28** (siehe **Fig. 2B)** werden eingesetzt, um den Stromfluss nur von der internen Lithiumbatterieeinheit **32** zur Autobatterie **72** zuzulassen, und nicht von der Autobatterie zur internen Lithiumbatterie. Auf diese Art kann, falls das elektrische System des Autos von seiner Lichtmaschine geladen wird, die interne Lithiumbatterie nicht rückaufladen (und hierbei beschädigt werden), was eine weitere Stufe der Betriebssicherheit bereitstellt.

[0030] Der Hauptspannungseinschalter **46** (**Fig. 2A)** ist eine Kombination, die einen Doppelpol- oder Zweiwegebetrieb zulässt, so dass das Produkt mit einem Drücken eingeschaltet werden kann, wenn es sich im Aus-Zustand befindet, oder ausgeschaltet werden kann, wenn es sich im EIN-Zustand befindet. Diese Schaltung verwendet auch einen Mikrocontrollerausgang **47**, um die Spannung aufrecht zu erhalten, wenn die Schaltung durch den Ein-Schalter aktiviert wurde. Wenn der Schalter gedrückt wird, schiebt der Mikrocontroller diesen Ausgang auf eine Hochlogikstufe, um die Spannung „am Leben" zu erhalten, wenn der Schalter losgelassen wird. Auf diese Art behält der Mikrocontroller die Kontrolle, wenn die Spannung ausgeschaltet wird, wenn der Ein-/Aus-Schalter wieder aktiviert wird, oder wenn die Lithiumbatteriespannung zu niedrig wird. Die Mikrocontrollersoftware weist auch einen Zeitschalter auf, der die Spannung nach einer vorbestimmten Zeitdauer (wie z. B. 8 Stunden) bei Nichtverwendung ausschaltet.

[0031] Die Blitzlicht-LED-Schaltung **45**, die in **Fig. 2B** gezeigt wird, steuert den Betrieb der Blitzlicht-LEDs. Zwei Ausgänge des Mikrocontrollers **1** sind den beiden separaten LEDs zugeordnet. Daher können die LEDs zur Ausbildung von Stroboskopen und SOS-Mustern unabhängig software-gesteuert werden, was der Starthilfevorrichtung noch ein weiteres Sicherheitsmerkmal hinzugefügt. LED-Anzeigen geben dem Betreiber die Rückmeldung, die dieser braucht, um zu verstehen, was mit dem Produkt passiert. Vier separate LEDs **61** (**Fig. 2A)** werden durch entsprechende einzelne Ausgänge des Mikrocontrollers **1** gesteuert, um eine Anzeige der verbleibenden Kapazität der internen Lithiumbatterie bereitzustellen. Diese LEDs werden in einem Format vergleichbar dem einer „Kraftstoffanzeige" mit 25%-, 50%-, 75%- und 100%-(rot, rot, gelb, grün)-Kapazitätsanzeigen gesteuert. Eine LED-Anzeige **63** (**Fig. 2B)** gibt dem Benutzer eine visuelle Warnung, wenn die Fahrzeugbatterie **72** verpolt angeschlossen worden ist. Starthilfe- und Ein-/Aus-LEDs **62** stellen jeweils visuelle Anzeigen bereit, wenn die Starthilfevorrichtung Starthilfespannung bereitstellt, und wenn die Starthilfevorrichtung eingeschaltet wird.

[0032] Eine USB-Ausgangsschaltung **56** (**Fig. 2C**) weist einen USB-Ausgang auf, zum Laden von tragbaren elektronischen Vorrichtungen, wie z. B. Smartphones durch die interne Lithiumbatterieeinheit **32**. Eine Steuerschaltung **57** des Mikrocontrollers **1** lässt es zu, den USB-Ausgang **56** durch die Softwaresteuerung ein- oder auszuschalten, um zu verhindern, dass die interne Lithiumbatterie eine zu niedrige

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Kapazität erreicht. Die USB-Ausgabe wird mittels einer Standard-USB-Verbindung **58** an das Äußere der Vorrichtung geführt, wobei die Standard-USB-Verbindung **58** den erforderlichen Standardspannungsteiler aufweist, um es zu ermöglichen, Smartphones eine bestimmte Spannung zuzuführen, die sie benötigenden

[0033] Die USB-Ladeschaltung **52** lässt es zu, dass die interne Batterieeinheit **32** durch eine Standard-USB-Ladevorrichtung geladen wird. Dieser Spannungseingang verwendet eine Standard-Mikro-USB-Verbindung **48**, die es erlaubt, Standardkabel zu verwenden. Das von der Standard-USB-Ladevorrichtung bereitgestellte Potential von 5 V wird in 12,4 V DC-Spannung hochgewandelt, das zum Laden der internen Lithiumbatterieeinheit unter Verwendung eines DC-DC-Konverters **49** benötigt wird. Der DC-DC-Konverter **49** kann durch die Schaltung **53** mittels eines Mikrocontrollerausgangs **1** ein- und ausgeschaltet werden.

[0034] 036 Auf diese Art kann die Mikrocontrollersoftware den Ladevorgang ausschalten, falls die Batteriespannung durch den A/D-Eingang **22** als zu hoch bestimmt worden ist. Zusätzliche Betriebssicherheit wird zur Abhilfe der Beseitigung von Überladung der internen Lithiumbatterie durch Verwendung einer Lithiumbatterie-Ladesteuerung **50** bereitgestellt, die einen Ladungsausgleich der internen Lithiumbatteriezellen **51** bereitstellt. Diese Steuerung stellt auch eine redundante Betriebssicherheit zur Beseitigung von Überladung der internen Lithiumbatterie bereit.

[0035] **Fig. 3** stellt eine perspektivische Ansicht einer tragbaren Vorrichtung **300** gemäß einer beispielhaften Ausführungsform der Erfindung dar. **301** ist ein Spannungseinschalter. **302** zeigt die LED-„Kraftstoff"-Anzeigen **61** . **303** zeigt einen 12 V-Ausgangsanschluss, der mit einer weiter unten beschriebenen Kabelvorrichtung **400** verbindbar ist. **304** zeigt einen Blitzlichtsteuerungsschalter zum Aktivieren der Blitzlicht-LEDs **45**. **305** stellt einen USB-Eingangsanschluss zum Laden der internen Lithiumbatterie dar, und **306** ist ein USB-Ausgangsanschluss, um anderen tragbaren Vorrichtungen, wie z. B. Smartphones, Tablets, Musikspieler, usw., Ladung durch die Lithiumbatterie bereitzustellen. **307** stellt eine „Starthilfe-Ein"-Anzeige dar, die anzeigt, dass die Spannung dem 12 V-Ausgangsanschluss bereitgestellt wird. **308** stellt eine Verpolungsanzeige dar, die anzeigt, dass die Fahrzeugbatterie in Bezug auf die Polung falsch verbunden ist. **309** stellt eine „Spannung-Ein"-Anzeige dar, die anzeigt, dass die Vorrichtung für den Betrieb hochgefahren ist.

[0036] **Fig. 4** zeigt eine Starthilfekabelvorrichtung **400**, die insbesondere für eine Verwendung mit der tragbaren Vorrichtung **300** ausgestaltet ist. Die Vorrichtung **400** weist einen Stecker **401** auf, der so gestaltet ist, dass er in den 12 V-Ausgangsanschluss **303** der tragbaren Vorrichtung **300** einsteckt werden kann. Der Stecker **401** ist in einem Kabelpaar **402a** und **402b** integriert, und die Kabel sind jeweils mit den Batterieanschlussklemmen **403a** und **403b** mittels Ringanschlüssen **404a** und **404b** verbunden. Der Anschluss **303** und der Stecker **401** können so dimensioniert werden, dass der Stecker **401** nur in den Anschluss **303** in einer bestimmten Orientierung passt, wodurch gesichert ist, dass die Klemme **403a** einer positiven Polung entsprechen wird, und die Klemme **403b** einer negativen Polung entsprechen wird, wie darauf angegeben. Zusätzlich können die Ringanschlüsse **404a** und **404b** von den Klemmen getrennt werden und direkt mit den Anschlüssen der Fahrzeugbatterie verbunden werden. Dieses Merkmal kann nützlich sein, um beispielsweise die Kabel **402a** bis **402b** dauerhaft mit der Fahrzeugbatterie zu verbinden. Im Falle einer Erschöpfung der Batteriespannung könnte die tragbare Starthilfevorrichtung **300** durch Einstecken des Steckers **401** in den Anschluss **303** in sehr einfacher Weise passend mit der Batterie verbunden werden.

[0037] Es folgen Ausführungsbeispiele:

1. Vorrichtung zur Starthilfe eines Fahrzeugmotors, umfassend: eine interne Spannungsversorgung (**32**); einen positiv und negativ gepolte Ausgänge (**CB-**, **CB+**) aufweisenden Ausgangsanschluss (**303**); einen Fahrzeugbatterie-Isolationssensor (**12**), der mit den positiv und negativ gepolten Ausgängen (**CB-**, **CB+**) in einer Schaltung verbunden ist, und zur Detektion des Vorhandenseins einer Fahrzeugbatterie (**32**), die zwischen den positiv und negativ gepolten Ausgängen (**CB-**, **CB+**) angeschlossen ist, konfiguriert ist; einen Verpolungssensor (**10**), der in einer Schaltung mit den positiv und negativ gepolten Ausgängen (**CB-**, **CB+**) verbunden ist, und zur Detektion der Polarität einer Fahrzeugbatterie (**72**), die zwischen den positiv und negativ gepolten Ausgängen (**CB-**, **CB+**) angeschlossen ist, konfiguriert ist; ein Spannungs-FET-Schalter (**15**), der zwischen der internen Spannungsversorgung (**32**) und dem Ausgangsanschluss (**305**) angeschlossen ist; und ein Mikrocontroller (**1**), der zum Empfangen von Eingabesignalen vom Fahrzeug-Isolationssensor (**12**) und vom Verpolungssensor (**10**) und zum Bereitstellen eines Ausgabesignals an den Spannungs-FET-Schalter (**15**) so konfiguriert ist, dass der Spannungs-FET-Schalter (**15**) als Antwort auf Signale der Sensoren, die das Vorhandensein einer Fahrzeugbatterie (**72**) am Ausgangsanschluss (**303**) und die passende Polverbindung von positiven und negativen Anschlüssen der Fahrzeugbatterie (**72**) mit positiv und negativ gepolten Ausgängen (**CB-**, **CB+**) anzeigen, eingeschaltet wird, um die interne Spannungsver-

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sorgung (**32**) mit dem Ausgangsanschluss (**303**) zu verbinden.

2. Die Vorrichtung gemäß Ausführungsbeispiel 1, wobei die interne Spannungsversorgung (**32**) eine Lithiumionenbatterie umfasst.

3. Vorrichtung gemäß Ausführungsbeispiel **2**, wobei die Lithiumionenbatterie eine Batterieeinheit aus mehreren Lithiumionenbatterien umfasst.

4. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, wobei der Spannungs-FET-Schalter (**15**) eine Vielzahl von FETs in Parallelschaltung (**16**) umfasst.

5. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, wobei der Fahrzeug-Isolationssensor (**12**) und der Verpolungssensor (**10**) optisch gekoppelte Isolationsphototransistoren umfassen.

6. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend eine Vielzahl von Spannungsdioden (**28**), die zwischen den Ausgangsanschluss (**303**) und der internen Spannungsversorgung (**32**) gekoppelt sind, um eine Rückaufladung der internen Spannungsversorgung (**32**) durch ein an den Ausgangsanschluss (**303**) angeschlossenes elektrisches System zu verhindern.

7. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend einen Temperatursensor (**20**) zur Detektion der Temperatur der internen Spannungsversorgung (**32**) und zum Bereitstellen eines Temperatursignals an den Mikrocontroller (**1**).

8. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend eine Spannungsmessungsschaltung (**24**), die zur Messung der Ausgabespannung der internen Spannungsversorgung (**32**) und zum Bereitstellen eines Spannungsmessungssignals an den Mikrocontroller (**1**) konfiguriert ist.

9. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend ein Spannungsregler (**42**), der zur Umwandlung der Ausgabespannung der internen Spannungsversorgung (**32**) in einen Spannungspegel konfiguriert ist, der geeignet ist, um internen Komponenten der Vorrichtung eine Betriebsspannung bereitzustellen.

10. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispielen, ferner umfassend einen USB-Ausgangsanschluss (**56**), der zum Bereitstellen einer Ladungsspannung der internen Spannungsversorgung (**32**) an eine USB-ladbare Vorrichtung konfiguriert ist.

11. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend einen USB-Ladeanschluss (**52**), der zum Bereitstellen einer Ladespannung von einer externen Spannungsquelle an die interne Spannungsversorgung (**32**) konfiguriert ist.

12. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend einen Blitzlicht-Schaltung (**36**, **45**), die zum Bereitstellen einer Lichtquelle für einen Nutzer konfiguriert ist.

13. Vorrichtung gemäß Ausführungsbeispiel **12**, wobei die Lichtquelle mindestens eine LED ist.

14. Vorrichtung gemäß Ausführungsbeispiel **13**, wobei der Mikrocontroller (**1**) zur Kontrolle der mindestens einen LED konfiguriert ist, um einen visuellen Alarm zur Anzeige einer Notsituation bereitzustellen.

15. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend eine Vielzahl von visuellen Anzeigen (**61**), die zur Anzeige des verbleibenden Kapazitätszustands der internen Spannungsversorgung (**32**) konfiguriert sind.

16. Vorrichtung gemäß Ausführungsbeispiel **15**, wobei die Vielzahl von visuellen Anzeigen (**61**) eine Vielzahl von LEDs umfassen, die Licht verschiedener Farben ausgeben.

17. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend eine visuelle Anzeige (**63**), die zur Warnung eines Benutzers konfiguriert ist, wenn eine Batterie verpolt angeschlossen ist.

18. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend getrennte visuelle Anzeigen (**62**), die zur Anzeige des Spannung-An-Status der Vorrichtung und zur Anzeige des Status der Starthilfespannung der dem Ausgangsanschluss (**303**) bereitgestellten Spannung konfiguriert ist.

19. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend einen manuelle Starthilfeschalter, der zum Aktivieren eines manuellen Starthilfemodus konfiguriert ist, der es einem Benutzer ermöglicht, die Starthilfespannung mit dem Ausgangsanschluss (**303**) zu verbinden, wenn der Fahrzeugbatterie-Isolationssensor (**12**) das Vorhandensein einer Fahrzeugbatterie nicht detektieren kann.

20. Vorrichtung gemäß Ausführungsbeispiel **19**, wobei der Mikrocontroller (**1**) zur Detektion der manuellen Starthilfeschaltung für mindestens eine vorbestimmte Zeitdauer vor dem Aktivieren des manuellen Starthilfemodus konfiguriert ist.

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21. Vorrichtung gemäß irgendeinem der vorangehenden Ausführungsbeispiele, ferner umfassend eine Starthilfekabelvorrichtung (**400**), die einen Stecker (**401**) umfasst, zum Einstecken in den Ausgangsanschluss, ein Kabelpaar (**402a**, **402b)**, an dessen jeweiligem einen Ende der Stecker (**401**) integriert ist und zum Anschließen an die Anschlüsse einer Batterie an dessen jeweiligem anderen Ende konfiguriert sind.

22. Vorrichtung gemäß Ausführungsbeispiel **21**, wobei das Starthilfekabel ferner ein Paar von Ringanschlüssen (**404a**, **404b)** umfasst, die zum jeweiligen Verbinden des Kabelpaars (**402a**, **402b**) an dessen anderem Ende mit einem Ende eines Batterieanschlusses oder einer Batterieanschlussklemme konfiguriert sind.

23. Vorrichtung gemäß irgendeinem der Ausführungsbeispiele **21** oder **22**, wobei der Ausgangsanschluss (**303**) und der Stecker (**401**) so dimensioniert sind, dass der Stecker (**401**) nur in einer bestimmten Orientierung in den Ausgangsanschluss (**303**) passt.

24. Eine Starthilfekabelvorrichtung (**400**), umfassend: einen Stecker (**401**), der zum Stecken in einen Ausgangsanschluss (**303**) einer tragbaren Vorrichtung zur Batterieladestarthilfe (**300**) konfiguriert ist, die eine interne Spannungsversorgung aufweist; ein Kabelpaar (**402a**, **402b)**, das mit dem Stecker (**401**) an dessen einen entsprechenden Ende integriert ist; wobei das Kabelpaar (**402a**, **402b)** so konfiguriert ist, dass es gesondert an Anschlüssen einer Batterie mit dessen entsprechend anderem Ende angeschlossen werden soll.

25. Starthilfekabelvorrichtung (**400**) gemäß Ausführungsbeispiel **24**, ferner umfassend ein Paar von Ringanschlüssen (**404a**, **404b)**, die zum jeweiligen Verbinden des Kabelpaars (**402a**, **402b)** an dessen anderen Ende mit einem Batterieanschluss oder einer Batterieanschlussklemme konfiguriert sind.

26. Starthilfekabelvorrichtung (**400**) gemäß irgendeinem der Ausführungsbeispiele **24** oder **25**, wobei der Ausgangsanschluss (**303**) und der Stecker (**401**) so dimensioniert sind, dass der Stecker (**401**) nur in einer bestimmten Richtung in den Ausgangsanschluss (**303**) passt.

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ZITATE ENTHALTEN IN DER BESCHREIBUNG

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Schutzansprüche

1. Starthilfevorrichtung zum Boosten oder Aufladen einer verbrauchten oder entladenen Batterie, die einen positiven und negativen Batterieanschluss aufweist, die Starthilfevorrichtung umfasst:
- eine Spannungsversorgung (32);
- einen positiven Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem positiven Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen negativen Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem negativen Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen Leistungsschalter (15), der über eine Schaltung mit der Spannungsversorgung (32) und den positiven und negativen Batterieverbindern verbunden ist,
- wobei der Leistungsschalter (15) eingerichtet ist, die Spannung von der Spannungsversorgung (32) zur verbrauchten oder entladenen Batterie (72) ein- oder auszuschalten, wenn diese mit den positiven und negativen Batterieverbindern verbunden ist,
- ein Leistungsschaltersteuerungssystem oder eine Leistungsschaltersteuerungsschaltung, die mit dem Leistungsschalter (15) verbunden ist und zur Steuerung des Leistungsschalters (15) vorgesehen ist,
- wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung eingerichtet ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) und die Polarität der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen die positiven und negativen Batterieverbinder geschaltet ist,
- wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung die Spannungsversorgung (32) nur dann einschaltet, um die Spannungsversorgung (32) mit der verbrauchten oder entladenen Batterie (72) zu verbinden, wenn die verbrauchte oder entladene Batterie (72) vorhanden ist und zwischen den positiven und negativen Batterieverbinder verbunden ist, und wenn die verbrauchte oder entladene Batterie (72) mit der richtigen Polarität zwischen den positiven und negativen Batterieverbinder verbunden ist.

2. Die Vorrichtung gemäß Anspruch 1, wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung einen Mikrocontroller (1) enthält, der eingerichtet ist, eine Ausgabe zur Steuerung des Leistungsschalters (15) bereitzustellen.

3. Die Vorrichtung gemäß Anspruch 2, wobei der Mikrocontroller (1) eine Eingabe von einem oder mehreren Sensoren empfängt, die eingerichtet sind, das Vorhandensein der verbrauchten oder entladenen Batterie (72) und eine Polarität der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen den positiven und negativen Batterieverbinder verbunden ist.

4. Die Vorrichtung gemäß Anspruch 3, wobei der eine oder die mehreren Sensoren (10, 12) einen Sensor (12) umfassen, der eingerichtet ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen den positiven und negativen Batterieverbinder verbunden ist und einen anderen Sensor (10), der eingerichtet ist, die Polarität der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen den positiven und negativen Batterieverbinder verbunden ist.

5. Die Vorrichtung gemäß Anspruch 3 oder 4, wobei der eine oder die mehreren Sensoren (10, 12) eine oder mehrere Erfassungsschaltungen enthalten.

6. Die Vorrichtung gemäß Anspruch 2, wobei der Mikrocontroller (1) den Leistungsschalter (15) nur dann einschaltet, um eine Spannung von der Spannungsversorgung (32) zu der verbrauchten oder entladenen Batterie (72) zu liefern, wenn die verbrauchte oder entladene Batterie (72) vom Mikrocontroller (1) als vorhanden und mit der richtigen Polarität verbunden erkannt wird.

7. Die Vorrichtung gemäß Anspruch 2, wobei der Mikrocontroller (1) ein programmierbarer Mikrocontroller (1) ist, der eingerichtet ist, Funktionsupdates und Systemparameterupdates zu ermöglichen.

8. Die Vorrichtung gemäß Anspruch 7, wobei der programmierbare Mikrocontroller (1) einen Speicher enthält.

9. Die Vorrichtung gemäß Anspruch 1, wobei der positive Batterieverbinder ein positives Batteriekabel (402a) und der negative Batterieverbinder ein negatives Batteriekabel (402b) enthält.

10. Die Vorrichtung gemäß Anspruch 9, wobei das positive Batteriekabel (402a) eine positive Batterieklemme (403a) und das negative Batteriekabel (402b) eine negative Batterieklemme (403b) aufweist.

11. Die Vorrichtung gemäß Anspruch 1, wobei die Spannungsversorgung (32) eine Lithiumionenbatterie enthält, die in der Starthilfevorrichtung vorhanden ist.

12. Die Vorrichtung gemäß Anspruch 11, wobei die Lithiumionenbatterie ein Batteriepack enthält, welches mehrere Lithiumionenbatterien aufweist.

13. Die Vorrichtung gemäß Anspruch 1, wobei der Leistungsschalter (15) mehrere FETs enthält, die parallel geschaltet sind.

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14. Die Vorrichtung gemäß Anspruch 4, wobei der eine Sensor (12) ein Sensor ist, der das Vorhandensein einer verbrauchten oder entladenen Batterie (72) erfasst und der andere Sensor (10) ein Verpolungssensor ist.

15. Die Vorrichtung gemäß Anspruch 14, wobei der Fahrzeugisolationssensor (12) und der Verpolungssensor (10) optisch gekoppelte Isolationsphototransitoren enthalten.

16. Die Vorrichtung gemäß Anspruch 1, weiter umfassend mehrere Leistungsdioden (28), die zwischen die positiven und negativen Batterieverbinder und die Spannungsversorgung (32) gekoppelt sind, um eine Rückaufladung der Spannungsversorgung (32) durch ein an die verbrauchte oder entladene Batterie (72) angeschlossenes elektrisches System zu verhindern.

17. Die Vorrichtung gemäß Anspruch 1, weiter enthaltend einen Ausgangsanschluss (303), der positive und negative gepolte Anschlüsse zu den positiven und negativen Batterieverbindern aufweist.

18. Die Vorrichtung gemäß Anspruch 2, weiter enthaltend einen Temperatursensor (20) zur Detektion der Temperatur der Spannungsversorgung (32) und zum Bereitstellen eines Temperatursignals an den Mikrocontroller (1).

19. Die Vorrichtung gemäß Anspruch 2, ferner umfassend eine Spannungsmessungsschaltung (24), die zur Messung der Ausgabespannung der Spannungsversorgung (32) und zum Bereitstellen eines Spannungsmessungssignals an den Mikrocontroller (1) konfiguriert ist.

20. Die Vorrichtung gemäß Anspruch 1, weiter enthaltend einen Spannungsregler (42), der zur Umwandlung der Ausgabespannung der Spannungsversorgung (32) in einen Spannungspegel konfiguriert ist, der geeignet ist, um internen Komponenten der Vorrichtung eine Betriebsspannung bereitzustellen.

21. Vorrichtung gemäß Anspruch 1, ferner umfassend einen USB-Ausgangsanschluss (56) und eine USB-Ausgangsladeschaltung, die zum Bereitstellen einer Ladungsspannung von der Spannungsversorgung (32) an eine USB-ladbare Vorrichtung konfiguriert sind.

22. Vorrichtung gemäß Anspruch 1, ferner umfassend einen USB-Ladeanschluss (52), der zum Bereitstellen einer Ladespannung von einer externen Spannungsquelle an die Spannungsversorgung (32) konfiguriert ist.

23. Vorrichtung gemäß Anspruch 22, ferner umfassend: eine USB Ladeschaltung, die den USB-Ladeanschluss (52) mit der Spannungsversorgung (32) verbindet.

24. Vorrichtung gemäß Anspruch 23, wobei die USB Ladeschaltung einen DC-DC Konverter (49) enthält.

25. Vorrichtung gemäß Anspruch 24, wobei der DC-DC Konverter (49) eingerichtet ist, ein 5V Potenzial von einem USB Ladegerät auf 12.4V DC umzuwandeln.

26. Vorrichtung gemäß Anspruch 24, wobei der DC-DC Konverter (49) eingerichtet ist, über eine Schaltung durch eine Ausgabe von einem Mikrocontroller (1) ein und ausgeschaltet zu werden.

27. Vorrichtung gemäß Anspruch 14, weiter enthaltend einen manuellen Starthilfeschalter (46), der eingerichtet ist, einen manuellen Starthilfemodus zu aktivieren, um es einem Benutzer zu ermöglichen, eine Starhilfespannung an eine verbrauchte oder entladene Batterie (72) anzulegen, wenn diese zwischen den positiven und negativen Batterieverbindern verbunden ist, und wenn der Sensor (12), der das Vorhandensein der verbrauchten oder entladenen Batterie (72) erfasst, nicht in der Lage ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) zu detektieren.

28. Vorrichtung gemäß Anspruch 27, wobei der Mikrocontroller (1) eingerichtet ist, eine Betätigung des manuellen Starthilfeschalters (46) für wenigstens eine vorbestimmte Zeitperiode zu erkennen, bevor der manuelle Starthilfemodus aktiviert wird.

29. Vorrichtung gemäß Anspruch 1, wobei die positiven und negative Batterieverbinder durch ein Starthilfekabel (400) gebildet sind, das einen Stecker (401), der eingerichtet ist, in einen Ausgangsanschluss (303) gesteckt zu werden, und ein Kabelpaar (420a, 402b) aufweist, das mit dem Stecker (401) an einem Ende vom Kabel (400) integriert ist und eingerichtet ist, an die positiven du negativen Batterieanschlüsse der verbrauchten oder entladenen Batterie (72) am anderen Ende vom Kabel (400) verbunden zu werden.

30. Vorrichtung gemäß Anspruch 29, wobei der Ausgangsanschluss (303) und der Stecker (401) so dimensioniert sind, dass der Stecker (401) nur in einer spezifischen Orientierung in den Ausgangsanschluss (303) passt.

31. Starthilfevorrichtung zum Boosten oder Aufladen einer verbrauchten oder entladenen Batterie (72), die einen positiven Batterieanschluss und negativen Batterieanschluss aufweist, die Starthilfevorrichtung umfasst:
- eine Spannungsversorgung (32);

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- einen positiven Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem positiven Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen negativen Batterieverbinder zur Verbindung der Starthilfevorrichtung mit dem negativen Batterieanschluss der verbrauchten oder entladenen Batterie (72);
- einen Leistungsschalter (15), der über eine Schaltung mit der Spannungsversorgung (32) und den positiven und negativen Batterieverbindern verbunden ist,
- wobei der Leistungsschalter (15) eingerichtet ist, die Spannung von der Spannungsversorgung (32) zur verbrauchten oder entladenen Batterie (72) ein- oder auszuschalten, wenn diese mit den positiven und negativen Batterieverbindern verbunden ist,
- ein Leistungsschaltersteuerungssystem oder eine Leistungsschaltersteuerungsschaltung, die mit dem Leistungsschalter (15) verbunden ist und zur Steuerung des Leistungsschalters (15) vorgesehen ist,
- wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung eingerichtet ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) und die Polarität der verbrauchten oder entladenen Batterie (72) zu detektieren, wenn diese zwischen den positiven und negativen Batterieverbinder verbunden ist,
- wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung die Spannungsversorgung (32) nur dann einschaltet, um die Spannungsversorgung (32) mit der verbrauchten oder entladenen Batterie (72) zu verbinden, wenn das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung sowohl erkennt, dass die verbrauchte oder entladene Batterie (72) vorhanden ist und zwischen den positiven und negativen Batterieverbinder verbunden ist, und die verbrauchte oder entladene Batterie (72) mit der richtigen Polarität zwischen den positiven und negativen Batterieanschlüssen verbunden ist.

32. Vorrichtung gemäß Anspruch 31, wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung die Spannungsversorgung (32) nicht einschaltet, um die Spannungsversorgung (32) mit der verbrauchten oder entladenen Batterie (72) zu verbinden, wenn das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung erkennt, dass entweder (i) die verbrauchte oder entladene Batterie (72) nicht vorhanden ist oder nicht zwischen den positiven und negativen Batterieverbindern verbunden ist oder (ii) die verbrauchte oder entladene Batterie (72) nicht mit der richtigen Polarität zwischen den positiven und negativen Batterieanschlüssen verbunden ist

33. Vorrichtung gemäß Anspruch 31, wobei das Leistungsschaltersteuerungssystem oder die Leistungsschaltersteuerungsschaltung eingerichtet ist, das Vorhandensein der verbrauchten oder entladenen Batterie (72) zu erkennen, wenn diese zwischen die positiven und negativen Batterieverbinder geschaltet ist und die Polarität der verbrauchten oder entladenen Batterie zu erkennen, wenn diese zwischen die positiven und negativen Batterieverbinder geschaltet ist bevor die Spannung von der Spannungsversorgung (32) zu der der verbrauchten oder entladenen Batterie (72) eingeschaltet wird

Es folgen 13 Seiten Zeichnungen

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Anhängende Zeichnungen

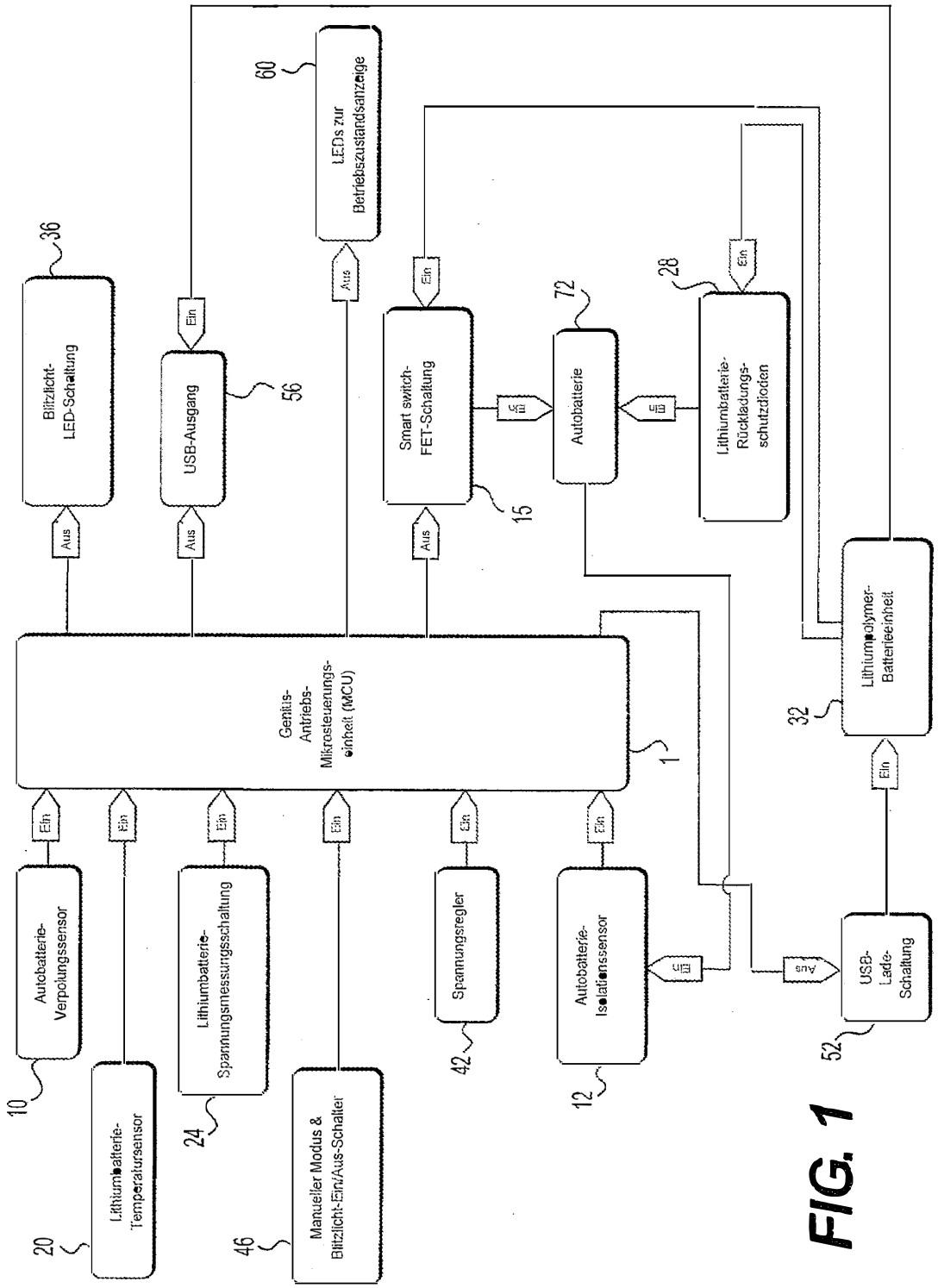


FIG. 1

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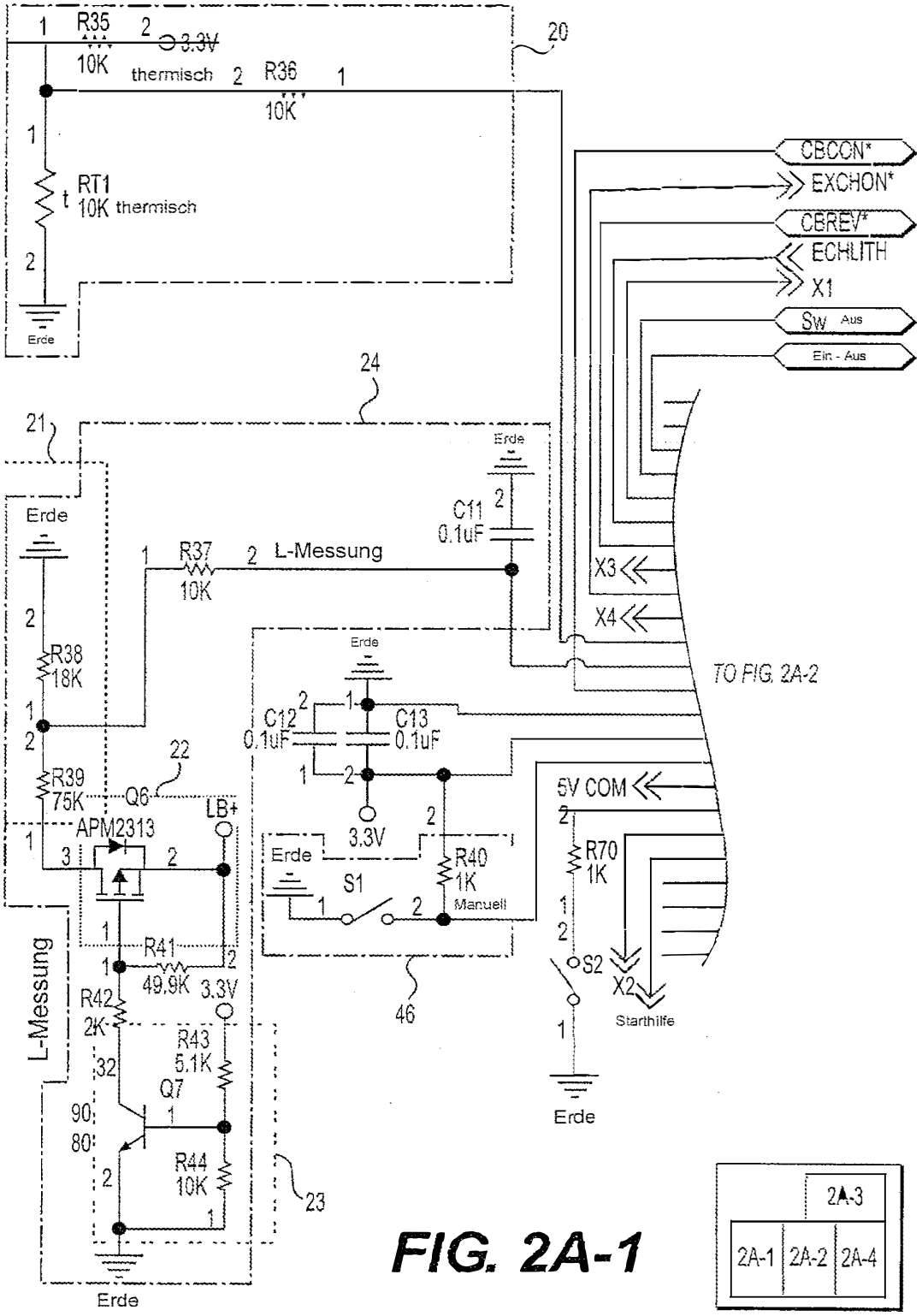

R35
10K
3.3V
thermisch
R36
10K
RT1
10K thermisch
Erde
20
24
21
C11
0.1uF
R37
10K
L-Messung
R38
18K
R39
75K
Q6
APM2313
LB+
22
C12
0.1uF
C13
0.1uF
3.3V
S1
R40
1K
Manuell
46
R41
49.9K
R42
2K
R43
5.1K
Q7
R44
10K
23
CBCON*
EXCHON*
CBREV*
ECHLITH
X1
SW Aus
Ein - Aus
X3
X4
TO FIG. 2A-2
5V COM
R70
1K
S2
X2
Starthilfe
2A-3
2A-1
2A-2
2A-4

FIG. 2A-1

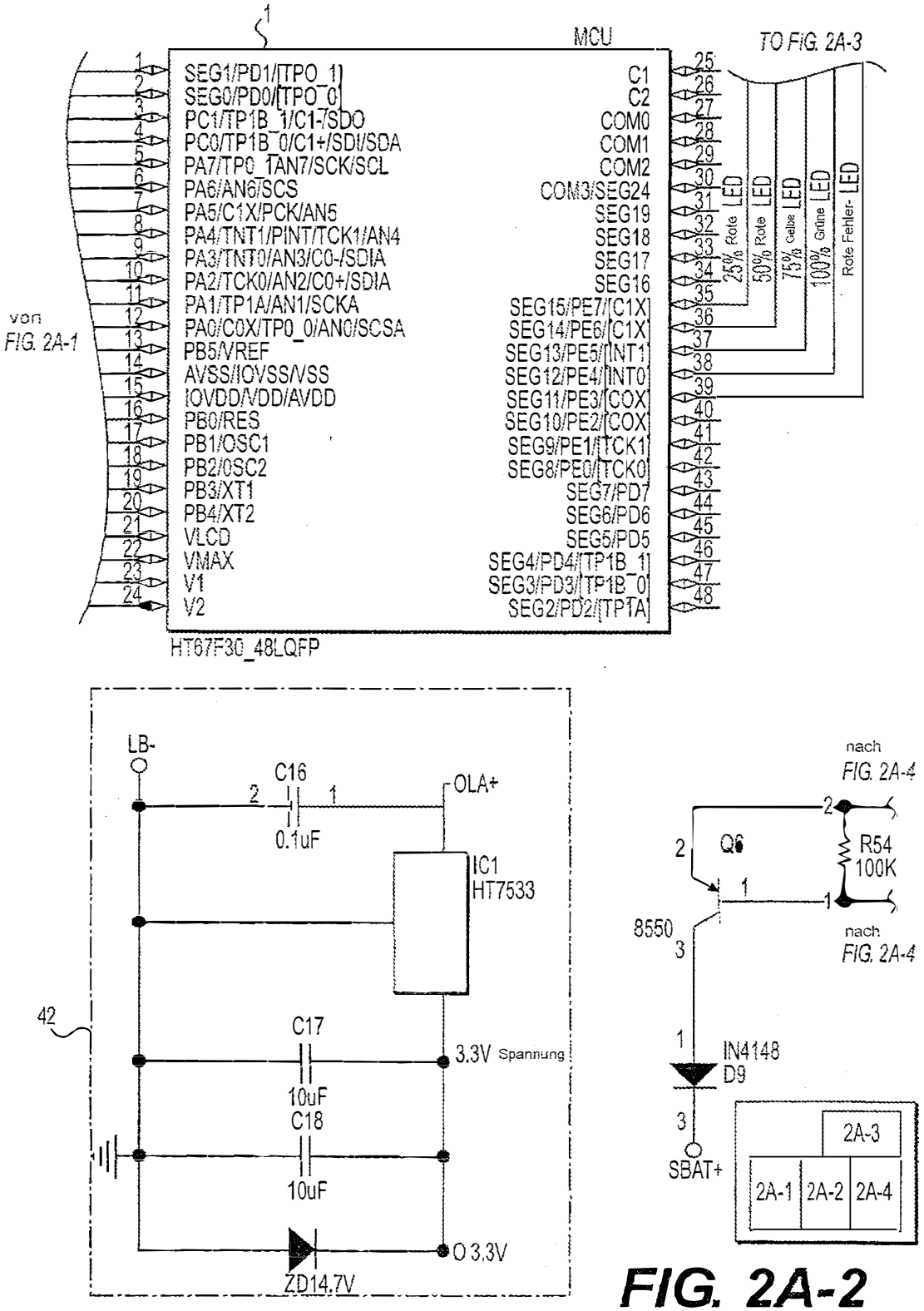

1
MCU
TO FIG. 2A-3
von FIG. 2A-1
SEG1/PD1/TPO_1
SEG0/PD0/TPO_0
PC1/TP1B_1/C1-/SDO
PC0/TP1B_0/C1+/SDI/SDA
PA7/TP0_1AN7/SCK/SCL
PA6/AN6/SCS
PA5/C1X/PCK/AN5
PA4/TNT1/PINT/TCK1/AN4
PA3/TNT0/AN3/C0-/SDIA
PA2/TCK0/AN2/C0+/SDIA
PA1/TP1A/AN1/SCKA
PA0/C0X/TP0_0/AN0/SCSA
PB5/VREF
AVSS/IOVSS/VSS
IOVDD/VDD/AVDD
PB0/RES
PB1/OSC1
PB2/OSC2
PB3/XT1
PB4/XT2
VLCD
VMAX
V1
V2
C1
C2
COM0
COM1
COM2
COM3/SEG24
SEG19
SEG18
SEG17
SEG16
SEG15/PE7/C1X
SEG14/PE6/C1X
SEG13/PE5/INT1
SEG12/PE4/INT0
SEG11/PE3/COX
SEG10/PE2/COX
SEG9/PE1/TCK1
SEG8/PE0/TCK0
SEG7/PD7
SEG6/PD6
SEG5/PD5
SEG4/PD4/TP1B_1
SEG3/PD3/TP1B_0
SEG2/PD2/TP1A
25% Rote LED
50% Rote LED
75% Gelbe LED
100% Grüne LED
Rote Fehler- LED
HT67F30_48LQFP
LB-
C16
0.1uF
OLA+
IC1
HT7533
42
C17
10uF
3.3V Spannung
C18
10uF
3.3V
ZD14.7V
nach FIG. 2A-4
Q6
8550
R54
100K
nach FIG. 2A-4
IN4148
D9
SBAT+
2A-3
2A-1
2A-2
2A-4

FIG. 2A-2

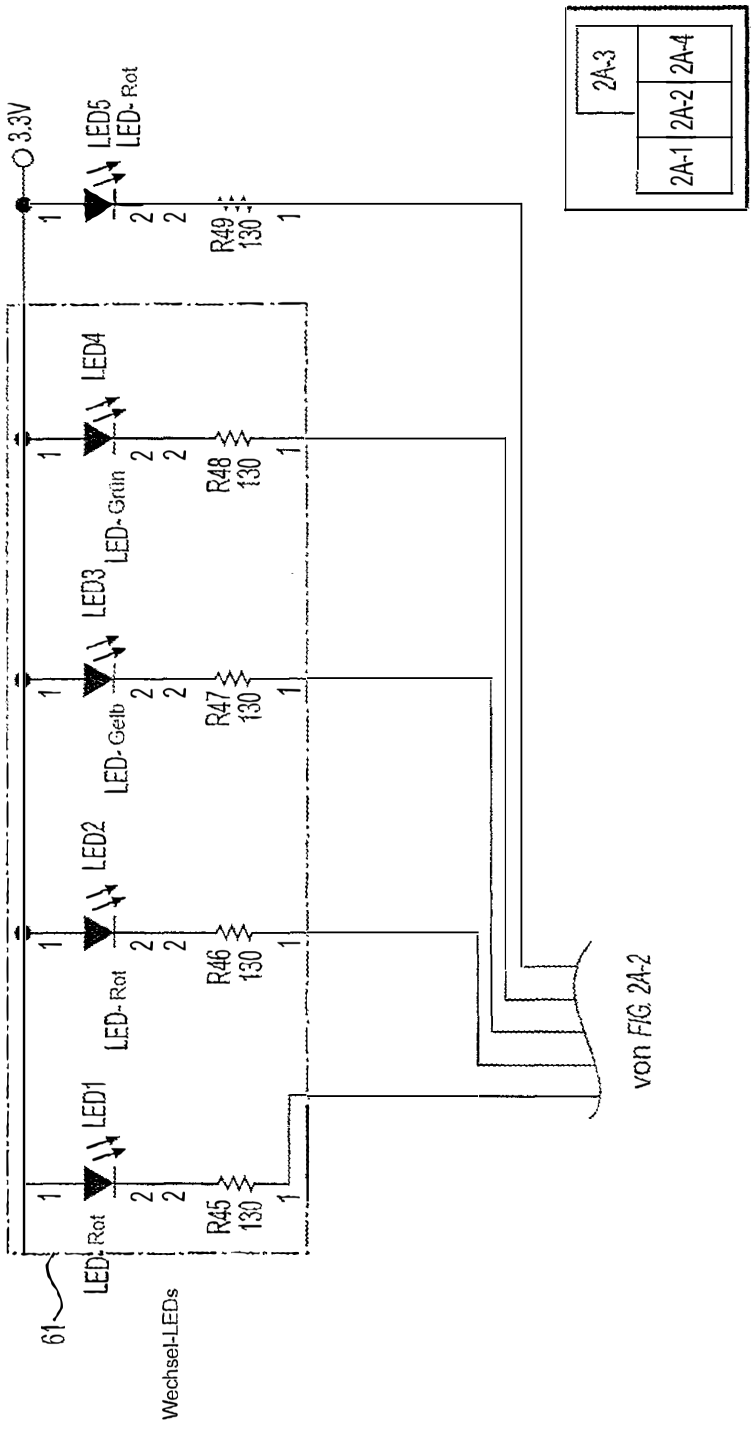


FIG. 2A-3

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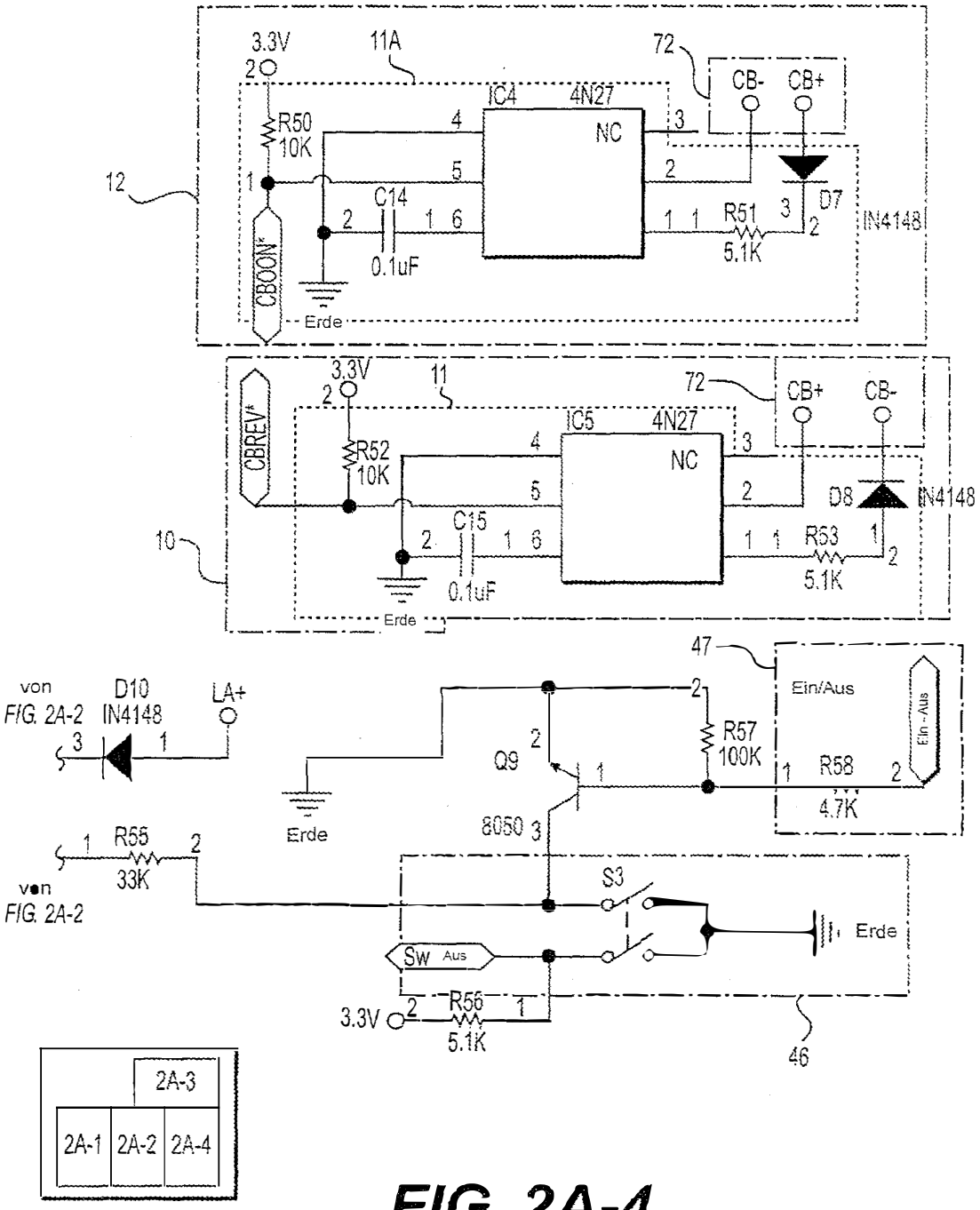

3.3V
11A
72
CB-
CB+
IC4
4N27
NC
R50
10K
12
C14
0.1uF
R51
5.1K
D7
IN4148
CBOON*
Erde
CBREV*
11
IC5
R52
C15
D8
10
R53
47
Ein/Aus
von
FIG. 2A-2
D10
IN4148
LA+
R57
100K
Q9
8050
R58
4.7K
R55
33K
S3
Sw Aus
R56
46
2A-3
2A-1
2A-2
2A-4

FIG. 2A-4

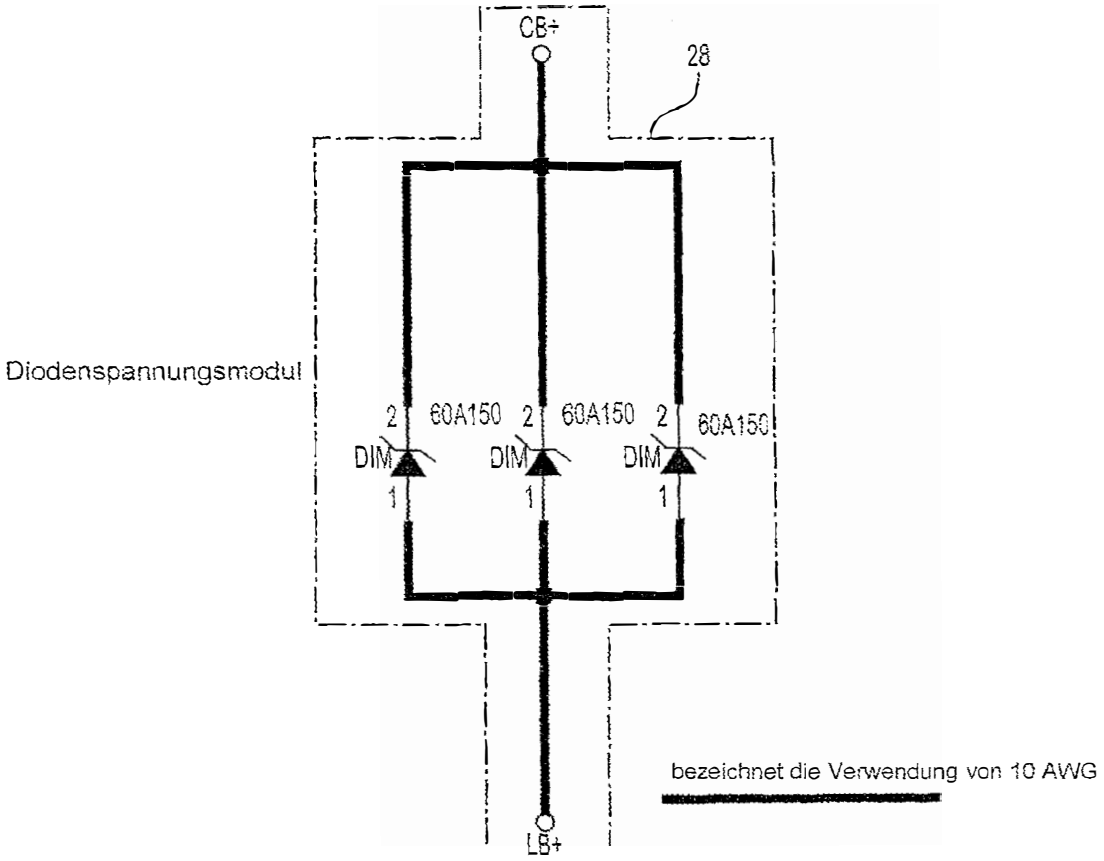
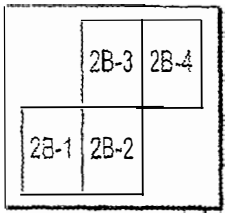

CB+
28
Diodenspannungsmodul
2
60A150
DIM
1
2
60A150
DIM
1
2
60A150
DIM
1
bezeichnet die Verwendung von 10 AWG
LB+

FIG. 2B-1


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

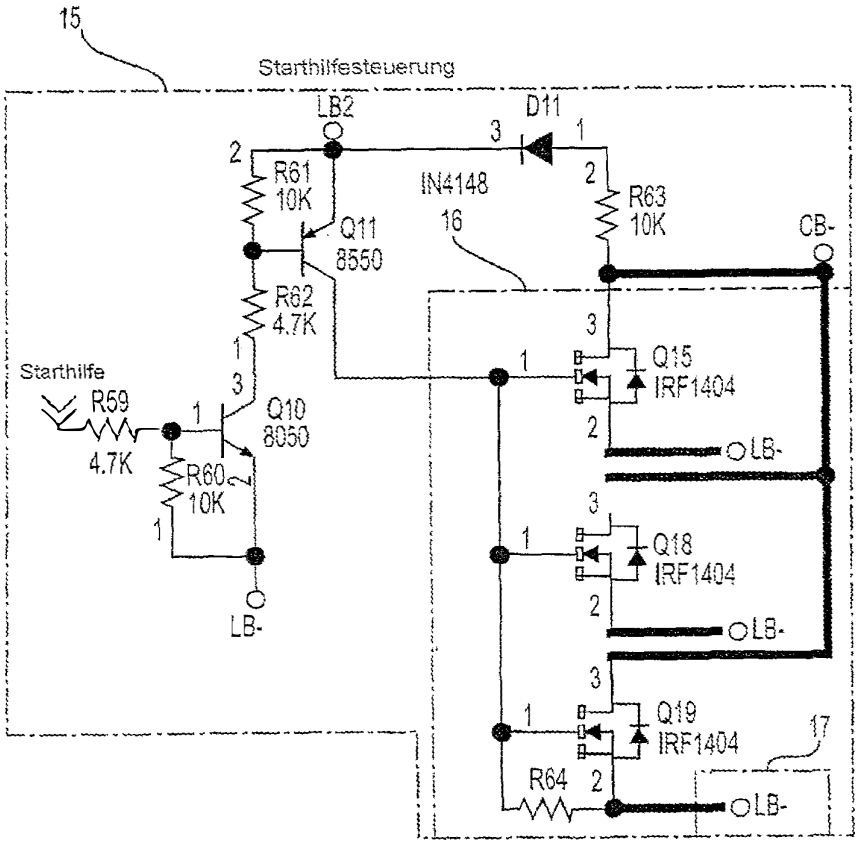
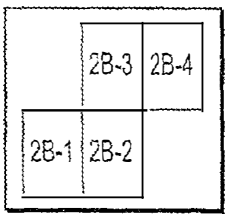

15
Starthilfesteuerung
LB2
D11
IN4148
R61
10K
Q11
8550
R62
4.7K
R63
10K
CB-
16
Starthilfe
R59
4.7K
Q10
8050
R60
10K
LB-
Q15
IRF1404
LB-
Q18
IRF1404
LB-
Q19
IRF1404
17
R64
LB-

FIG. 2B-2


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

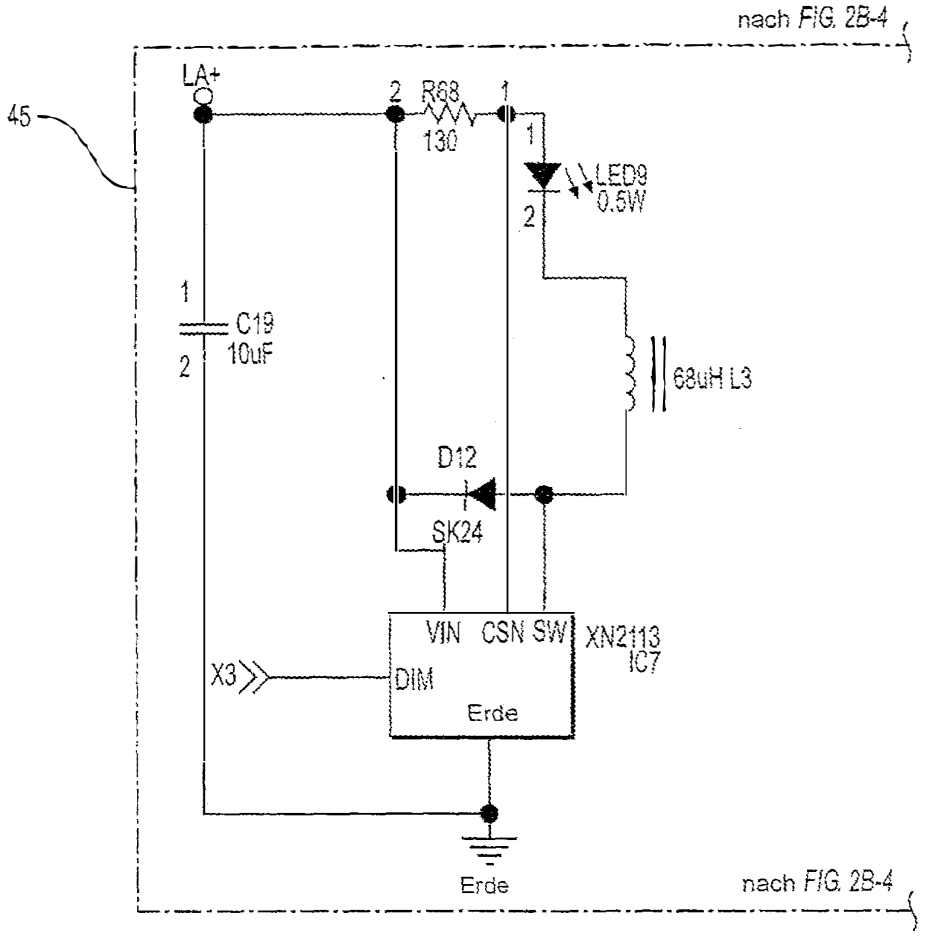
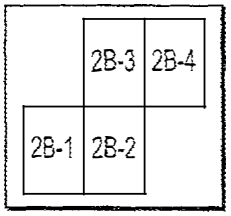

nach FIG. 2B-4
45
LA+
2
R68
130
1
1
LED9
0.5W
2
1
C19
10uF
2
68uH L3
D12
SK24
VIN
CSN
SW
XN2113
IC7
X3
DIM
Erde
Erde
nach FIG. 2B-4

FIG. 2B-3


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

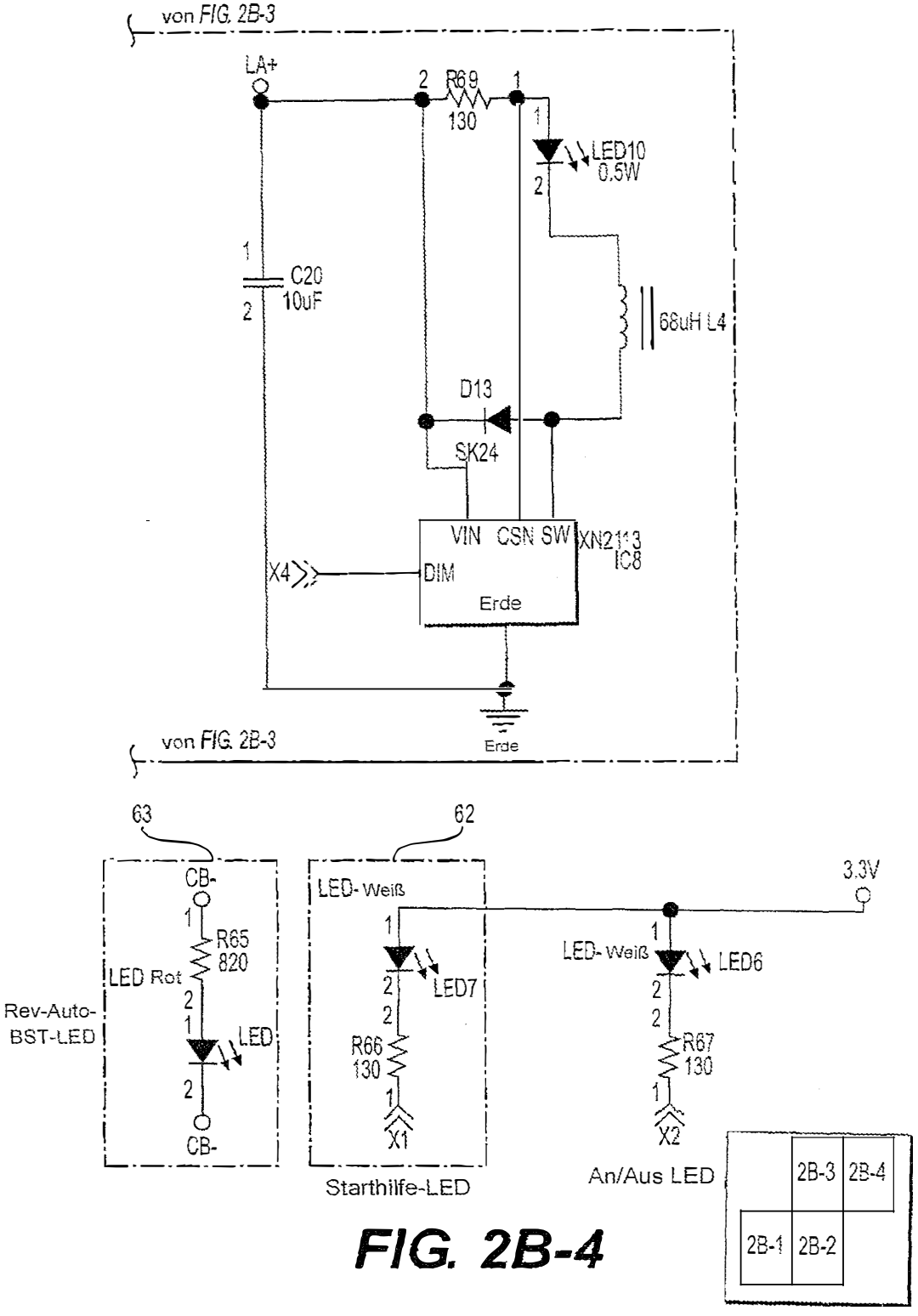


FIG. 2B-4

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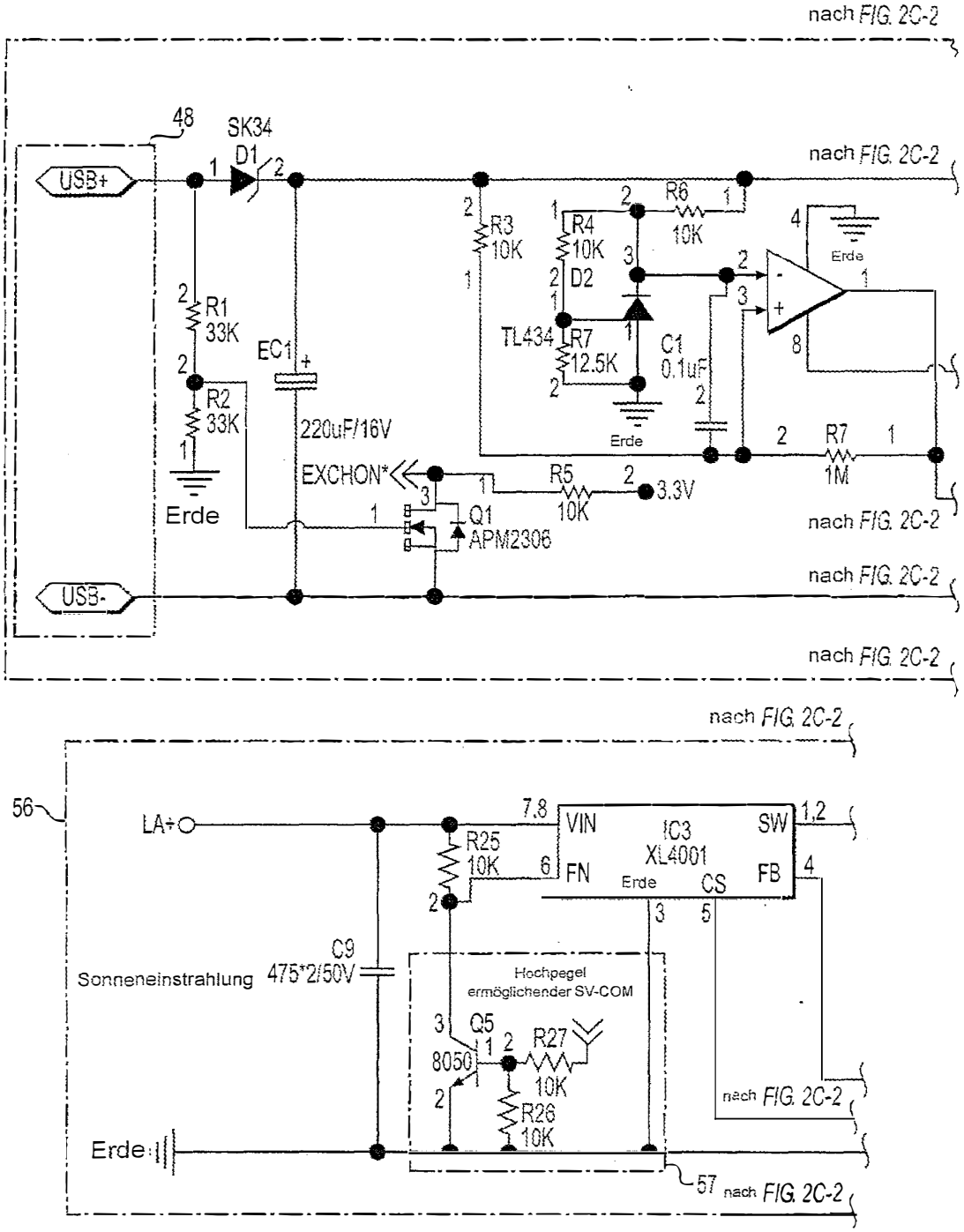
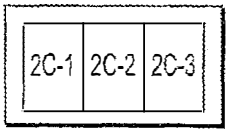

nach FIG. 2C-2
48
SK34
D1
USB+
USB-
R1
33K
R2
33K
Erde
EC1
220uF/16V
EXCHON*
Q1
APM2306
R3
10K
R4
10K
D2
TL434
R7
12.5K
R6
10K
C1
0.1uF
R5
10K
3.3V
R7
1M
56
LA+
R25
10K
IC3
XL4001
VIN
FN
SW
FB
CS
Erde
C9
475*2/50V
Sonneneinstrahlung
Hochpegel
ermöglichender SV-COM
Q5
8050
R27
10K
R26
10K
57

FIG. 2C-1


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

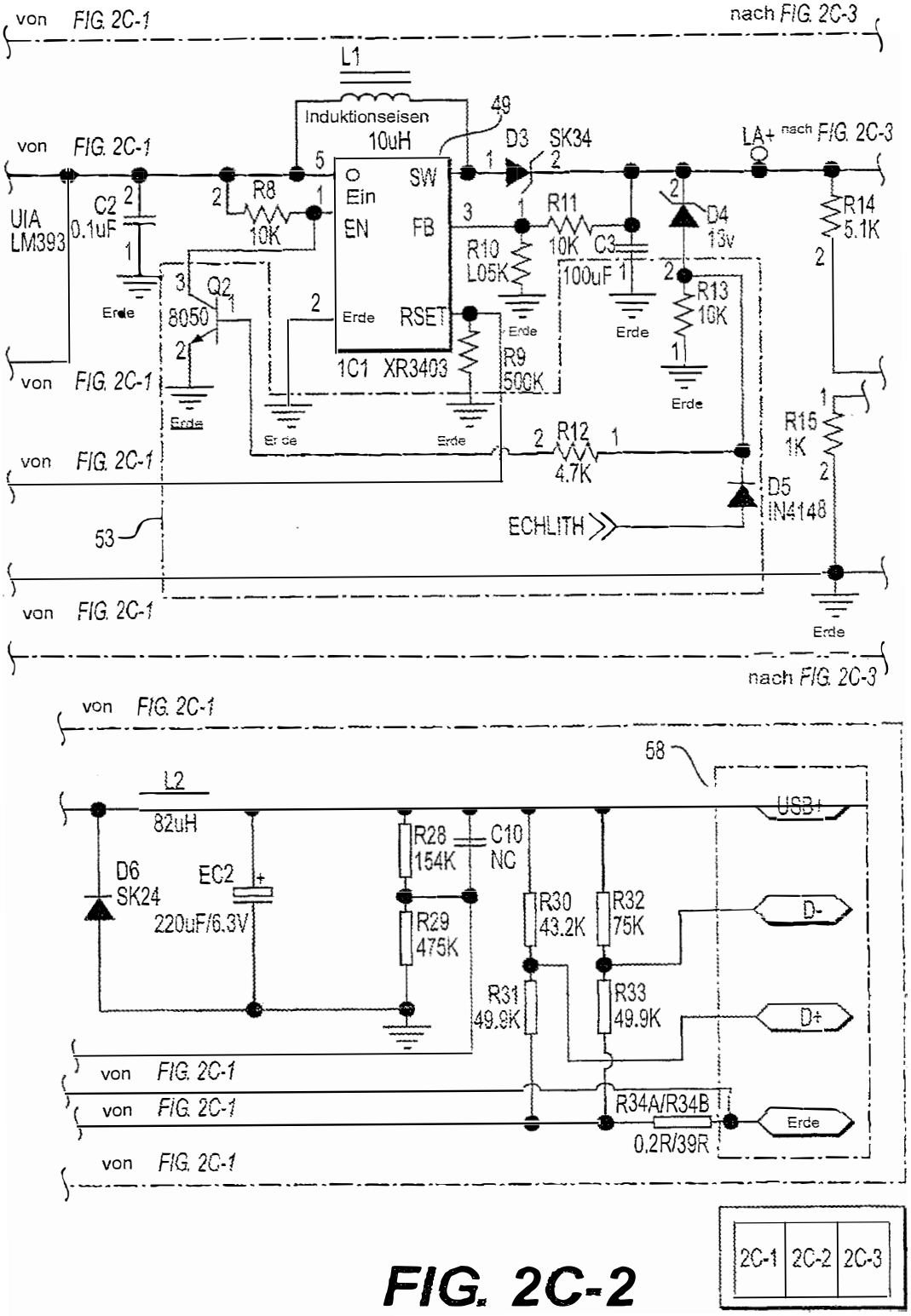
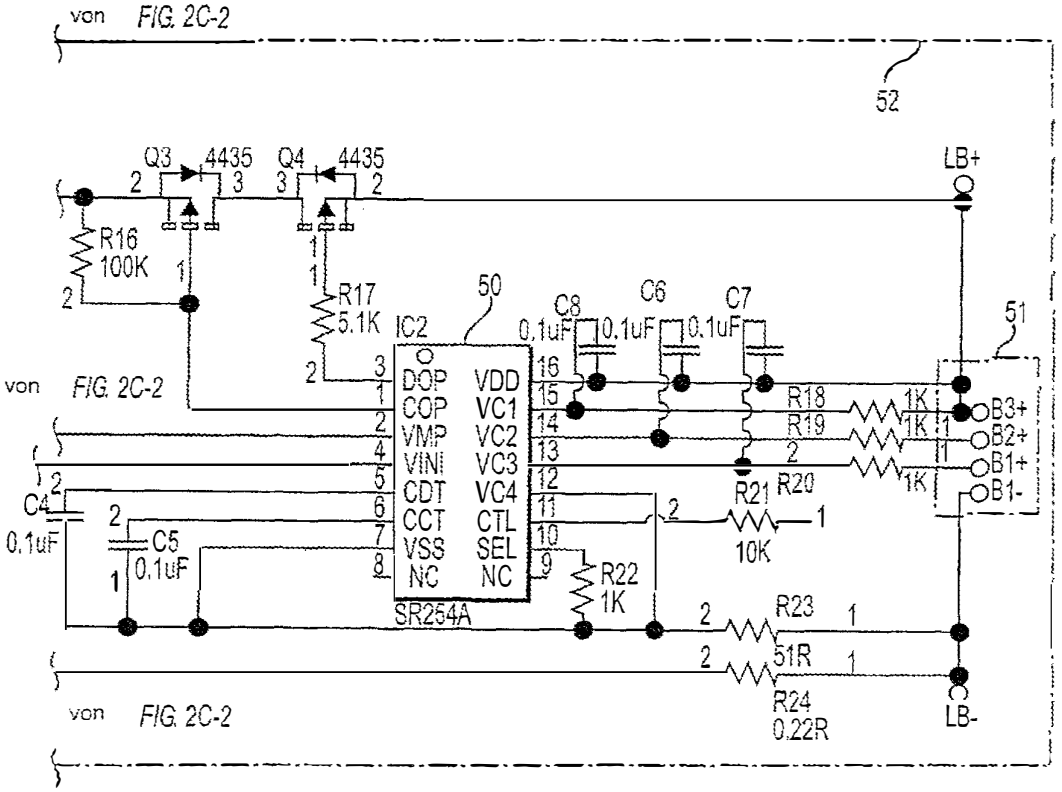

von FIG. 2C-1
nach FIG. 2C-3
L1
Induktionseisen
10uH
49
D3 SK34
LA+
UIA
LM393
C2
0.1uF
R8
10K
SW
Ein
EN
FB
R10
L05K
R11
10K
C3
100uF
D4
13v
R14
5.1K
R13
10K
Q2
8050
Erde
RSET
1C1 XR3403
R9
500K
R12
4.7K
R15
1K
D5
IN4148
ECHLITH
53
58
USB+
L2
82uH
D6
SK24
EC2
220uF/6.3V
R28
154K
C10
NC
R29
475K
R30
43.2K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

FIG. 2C-2


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

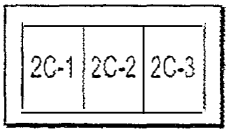

2C-1
2C-2
2C-3

FIG. 2C-3

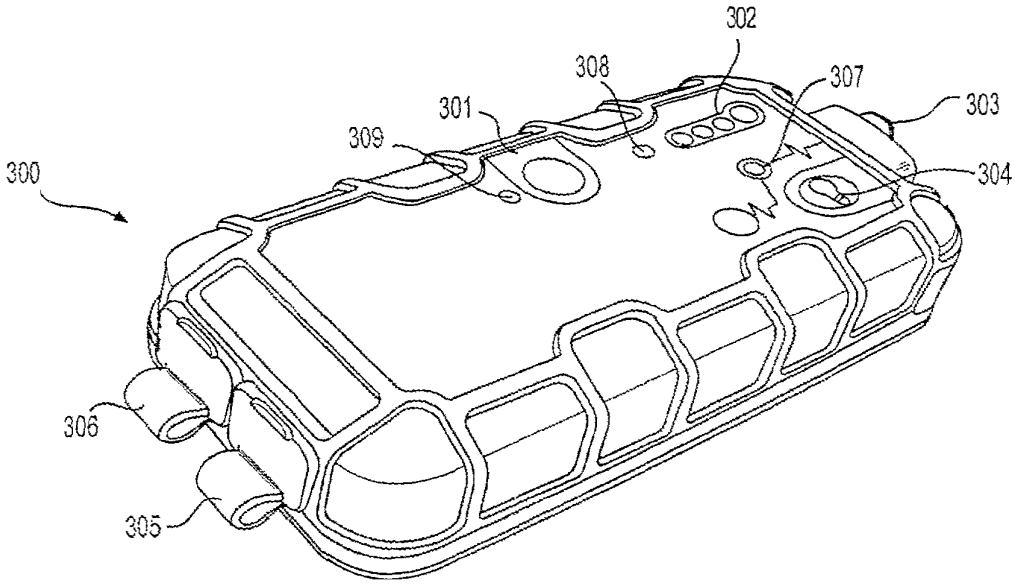


FIG. 3

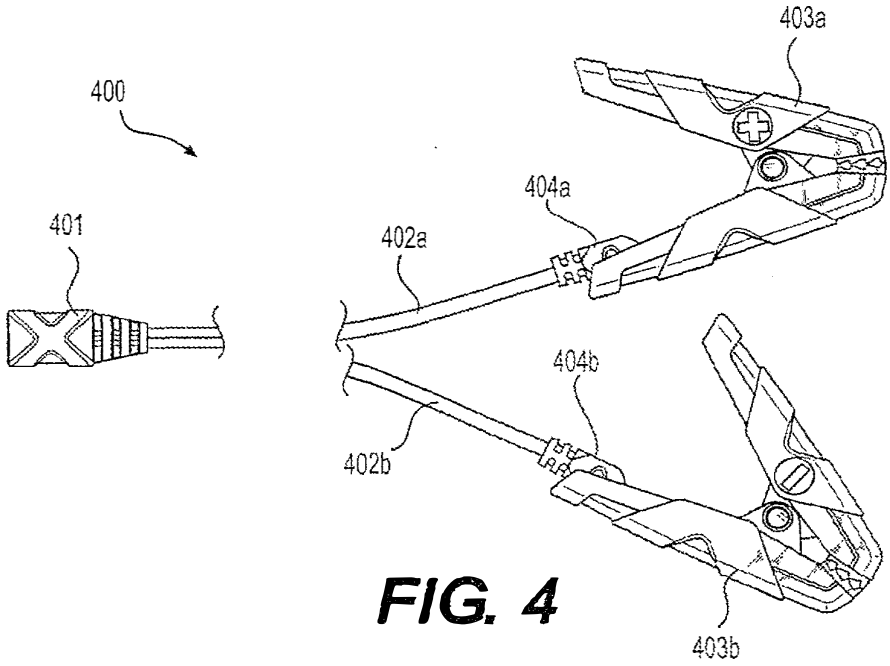


FIG. 4

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(54) **Title**: ENGINE START AND BATTERY SUPPORT MODULE

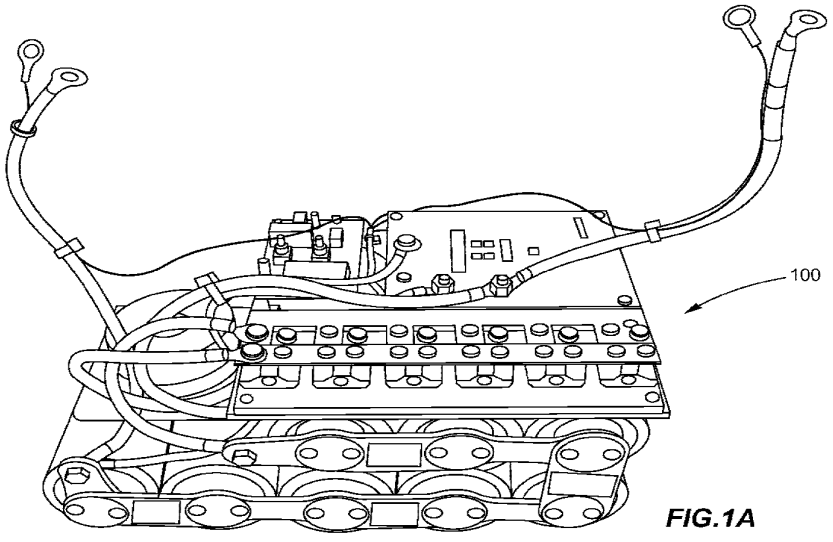


FIG.1A

(57) **Abstract**: An Engine Start and Battery Support Module for a vehicle is provided that utilizes a bank of Ultra Capacitors (UCs) charged with or without running the vehicles alternator to levels that support both engine starting assistance and hotel load support. The UCs per-cell charge can be adjusted and raised during periods of low temperatures and even higher during ultralow temperatures. The adjustment, which can be dynamic and/or automatic, increases the UC energy storage capability. Further, the release of energy from the UCs is controlled by a pulse width modulation (PWM) controller based on the DC bus voltage. The UCs can be charged either from an onboard DC/DC converter, an AC hook up, or from smartly switching the banks of UCs between parallel and serial configurations.

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Engine Start and Battery Support Module

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the priority benefit, under 35 U.S.C. 119(e), of U.S. Application No. 62/014,910, entitled "Energy Start and Battery Support Module" and filed on June 20, 2014. The aforementioned application is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Changes to common practice, laws, and accepted behavior in both the automotive and trucking industries has forced the shutdown of engines during stops. Shutting down a car or truck engine causes stress on the battery and starter motor, leading to weakened batteries and overall lower system performance. Harsh conditions such as extreme cold environments exacerbate the problem and may lead to outright battery failure and/or starter failure.

[0003] The number of shutdowns per day for an engine may depend on the vehicle architecture, vehicle use, etc. In general, there are two types of vehicle architectures: "local delivery" vehicles, which can have, for example, as many as 250 shut-off events per day, and "long haul" vehicles, which can have up to, for example, 25 shut-off events per day. These shut-off events create low voltage conditions on the vehicle's DC electrical bus, which result in higher power requirements from the on-board energy storage system. Low voltage conditions on the DC electrical bus can also stress other vehicle components, including Electronic Control Units (ECUs), relays, switches, and pumps.

SUMMARY

[0004] Embodiments of the present invention include an energy start and battery support module configured to support the supply of energy directly to the vehicle's direct current (DC) voltage bus using Ultra Capacitors (UCs) that allow both the spinning of the starter motor and voltage support for short term battery loads during stops when the vehicle's engine is off. This module does not necessarily require any wiring changes to the vehicle, nor does it necessarily require or involve any vehicle alterations or changes to vehicle operating procedures.

[0005] The module can automatically stabilize the vehicle's DC voltage during off sequences regardless of the static load variations or engine starter variations by modulating the transfer of energy—including during engine start—in order to support a healthy battery

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and longer starter life. It can automatically adjust the amount of energy it stores in order to prolong the lives of the UCs and the electronics within the module. In some cases, the module supplies the proper voltage for the vehicle's electronics and/or the vehicle's starter in the event that the vehicle's battery is totally dead.

[0006] Some embodiments of the module can recharge the UCs automatically based on the ability of the vehicle to supply power. For example, the module may include a DC boost converter that recharges the UCs or a switch that splits the UCs into two or more equal or unequal stacks and buck charges the stacks in parallel. The module may transfer more power to the UCs if the alternator is running and less power if the vehicle's batteries do not have enough energy to initiate a vehicle starting sequence. The module can also transfer energy from the UCs when the vehicle's alternator is not running. In some cases, the module may not drain the vehicle's battery below a preset voltage level, e.g., 9 volts in a 12-volt system or 18 volts in a 24-volt system.

[0007] In some embodiments, the module allows a vehicle's operator to re-initiate the charging of the module in the event the vehicle does not start on the first try or the batteries are too weak to supply enough power on their own, eliminating the use of a separate jump start. In some embodiments, the module can fit into a standard battery area on the vehicle using a standard battery case size or can be scaled for any vehicle as desired.

[0008] In some embodiments, the system can pass the 30-day airport test in any vehicle without causing the batteries to go dead. As understood by those of skill in the art, the 30-day airport test simulates leaving a vehicle parked at an airport, at temperatures down to –20 °C, for 30 days. During these 30 days, the vehicle's electrical system consumes energy from the battery or energy storage system to run critical vehicle systems, such as alarms, computers, locking mechanisms, clocks, etc. When the vehicle owner returns, the vehicle should have enough energy remaining in its energy storage system (traditionally a lead acid battery) to initiate the cranking event and support the engine starting systems. Passing the 30-day airport test is a common requirement for automotive battery and electrical systems.

[0009] The module can be implemented as a solid-state system (e.g., without relays to transfer of energy in either direction). For example, the module's electronics may include one or more enhancement mode n-channel field-effect transistors (N-FETS), which can be used in parallel to reduce the Equivalent Series Resistance (ESR) of the delivery of the energy or even in the split mode recharging scheme. In some embodiments, the total quiescent current of the electronics may be less than 50 mA so that excess drain does not occur over extended periods of time.

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[0010] A module may include a DC converter whose input and output voltage and current can be controlled, allowing: (1) the voltage on the back of UCs to be controlled precisely; (2) the charge current on the UCs to be controlled, facilitating the ability to bring a completely dead set of UCs up to full charge; (3) the input current to be set so as not to draw too much power out of the system, allowing the vehicle's DC bus to operate other devices; and/or (4) the minimum input voltage to be set for throttling back the UCs charging in order to avoid operating the battery systems outside of a desired or predetermined (e.g., safe) operating regime.

[0011] The DC converter can be broken up into multiple phase angles, enabling lower peak currents, less electromagnetic interference (EMI), and/or smaller more efficient components. The multiple phases may be equally spaced on a 360° basis. For example, a 4-phase DC converter splits the current pump charge into four equal parts that are 90 degrees apart in the time spectrum. The DC converter can control the current and/or voltage on the input side and the current and/or voltage on the output side. For instance, the voltage output can set the maximum voltage potential that is stored on the UCs, which may equal the stored energy (the energy may be expressed by the equation $E = 0.5CV^2$). Current output control may allow the DC converter to charge a completely empty bank of UCs without excessive current (e.g., current that would normally collapse the converter). In some embodiments, the input voltage limit and the input current control may allow the system to operate when the alternator is not running and energy being transferred off the battery is limited to prevent the DC bus from going below a predetermined voltage (e.g., 9 V for a 12 V system or 18 V for a 24 V system).

[0012] The module can be packaged to have only two terminal connections to the outside world and can be connected to an engine just like a battery is connected to the engine. Installation may be simple and safe, and little to no current may flow when the module is initially connected. The controls can be co-located on a single printed circuit board assembly (PCBA) for simplicity and lower cost.

[0013] Control of the entire system can be based on the DC voltage, which enables the bidirectional transfer of energy using acceptable set points and predetermined battery voltages. This control can be accomplished in either the analog or digital domain; control can also be asynchronous and therefore adaptable to just about any vehicle. The control has appreciably zero built-in hysteresis, thus allowing fast and extremely steady voltage levels. Stability may be achieved because it is asynchronous and has no forced frequency domain in the response. In other words, the transfer of energy may not be forced at any rate or regulator repeated pulses. In some cases, only enough energy is transferred to satisfy the set points.

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Since each vehicle and each vehicle's wiring loads are unique, this allows a one-size-fits-all module architecture.

[0014] An example module can include active balancing circuits for controlling (e.g., equalizing) the Ultra Capacitor charge, thereby preventing any single Ultra Capacitor from taking too much energy. The UC balancing circuit can be dynamic and the set points may vary with temperature. Because the energy is modulated back to the vehicle's DC bus, the energy stored in the UCs can be higher than that of the vehicle's rated system itself. This allows more energy to be stored and fewer peak currents to occur than is the case when energy is stored at a nearly equipotential. This method supports extended static vehicle load support for longer periods, including those in the delivery vehicle use case. There is no practical limit to the number of Ultra Capacitors used to store energy or their exact parallel/series configurations as long as the total cell voltage is higher than the voltage level of the vehicle's battery system.

[0015] In some embodiments, the module can include multiple voltage comparators (e.g., three for each DC converter) and logic coupled to the voltage comparators. The logic determines whether or not to recharge or deliver energy based on the values of some or all of the voltage comparators (e.g., two of the three voltage comparators). This substantially increases the system's overall reliability and dependability. It can also include two smaller DC converters that support the operation of the system's electronics over a very wide DC bus operating range and overcome the gate-source voltage threshold.

[0016] The module can be compatible with batteries of any chemistry, including but not limited to lead acid batteries.

[0017] Additional embodiments of the present technology include methods for regulating a voltage level of a vehicle battery in a vehicle. In an example method, control logic determines if the voltage level is below a predetermined voltage threshold, which may be based on the vehicle battery age, vehicle age, vehicle battery condition, vehicle battery quantity, vehicle battery type, vehicle starter type, starter age, temperature, and experience of the vehicle driver. If the voltage level is below the predetermined voltage threshold, the control logic initiates a discharge of at least one ultracapacitor in electrical communication with the vehicle battery. The control logic modulates the discharge of the ultracapacitor so as to raise the voltage level at least to the predetermined voltage threshold, e.g., by by controlling current flow through at least one transistor in electrical communication with the ultracapacitor.

[0018] In addition, the control logic may transfer energy from the vehicle battery to the ultracapacitor while the vehicle alternator is off. This transfer of energy can be initiated after

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determining that the voltage level exceeds a recharge voltage threshold. In some cases, the transfer of energy is initiated only when voltage amount of the vehicle battery exceeds the recharge voltage threshold. Energy may also be transferred from the vehicle battery to the ultracapacitor when the voltage level is less than a voltage level required to start the vehicle.

[0019] In some cases, there may a plurality of ultracapacitors that are switched by the control logic between a parallel configuration for charging and a serial configuration for discharging.

[0020] Another example of the present technology includes an apparatus for regulating a voltage level of a vehicle battery. This apparatus may comprise a plurality of ultracapacitors connected in series to store charge; at least one voltage comparator in electrical communication with the vehicle battery and the ultracapacitors; and control logic in electrical communication with the voltage comparator and the ultracapacitors. In operation, the comparator performs a comparison of the voltage level to a predetermined voltage threshold. And the control logic modulate discharges of the ultracapacitors based on the comparison so as to raise the voltage level to at least the predetermined voltage threshold.

[0021] In some embodiments, the control logic comprises at least one transistor, in electrical communication with the ultracapacitors, to control current flow into and/or out of the ultracapacitors. The comparator can be in electrical communication with a gate of the transistor to control the current flow into and/or out of the ultracapacitors.

[0022] The apparatus may also comprising a direct current (DC) converter in electrical communication with the ultracapacitors and the voltage comparator(s). In operation, the DC converter charges the ultracapacitors in response to a comparison of the voltage level and a recharge voltage threshold. In these examples, the voltage comparator may comprises a first voltage comparator in electrical communication with the DC converter and a second voltage comparator in electrical communication with the control logic. The first voltage comparator enables the DC converter if the voltage level exceeds the recharge voltage threshold, and the second voltage comparator performs the comparison of the voltage level to the predetermined voltage threshold. The DC converter can also be configured to transfer charge from the vehicle battery to the ultracapacitors in response to an output from the voltage comparator indicating that voltage level is above the recharge voltage threshold. And the DC converter can deliver energy to a vehicle bus of the vehicle in response to an output from the comparator(s).

[0023] The apparatus may also include a temperature sensor, operably coupled to the DC converter, to monitor a temperature of the vehicle battery. If desired, the DC converter can be

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configured to vary the predetermined voltage threshold and/or the recharge voltage threshold based on the temperature of the vehicle battery.

[0024] The apparatus may also include a switch, in electrical communication with the ultracapacitors, to switch the ultracapacitors between a serial configuration and a parallel configuration, e.g., for discharging and charging, respectively. And the apparatus may include a manual interface, operably coupled to the control logic, that enables a driver of the vehicle to engage and/or disengage the apparatus.

[0025] Another embodiment includes an apparatus for regulating a voltage level of a vehicle battery that includes: a plurality of ultracapacitors; a first voltage comparator in electrical communication with the vehicle battery; control logic in electrical communication with the first voltage comparator and the ultracapacitors; a second voltage comparator in electrical communication with the vehicle battery; control logic in electrical communication with the first voltage comparator and the ultracapacitors; a DC converter in electrical communication with the ultracapacitors and the second voltage comparator; and a temperature sensor operably coupled to the DC converter. In operation, the first voltage comparator compares the voltage level to a first voltage threshold. The control logic discharges the ultracapacitors if the voltage level is below the first voltage threshold. The second voltage comparator compares the voltage level to a second voltage threshold. The control logic discharges the ultracapacitors if the voltage level is above the second voltage threshold. The DC converter charges the plurality of ultracapacitors if the voltage level is above the second voltage threshold. And the temperature sensor monitors a temperature of the vehicle battery. The DC converter can also vary the first voltage threshold and/or the second voltage threshold based on the temperature of the vehicle battery.

[0026] It should be appreciated that all combinations of the foregoing concepts and additional concepts discussed in greater detail below (provided such concepts are not mutually inconsistent) are contemplated as being part of the inventive subject matter disclosed herein. In particular, all combinations of claimed subject matter appearing at the end of this disclosure are contemplated as being part of the inventive subject matter disclosed herein. It should also be appreciated that terminology explicitly employed herein that also may appear in any disclosure incorporated by reference should be accorded a meaning most consistent with the particular concepts disclosed herein.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The skilled artisan will understand that the drawings primarily are for illustrative purposes and are not intended to limit the scope of the inventive subject matter described herein. The drawings are not necessarily to scale; in some instances, various aspects of the inventive subject matter disclosed herein may be shown exaggerated or enlarged in the drawings to facilitate an understanding of different features. In the drawings, like reference characters generally refer to like features (e.g., functionally similar and/or structurally similar elements).

[0028] FIG. 1A is a photograph of an example Engine Start and Battery Support Module.

[0029] FIGS. 1B-C are schematic diagrams illustrating example use of Engine Start and Battery Support Module installed in a vehicle (e.g., a car or truck).

[0030] FIGS. 2A-B show circuit diagrams depicting an overall master architecture for an example Engine Start and Battery Support Module.

[0031] FIGS. 3A-C show several embodiments of a DC converter that may be used in the Engine Start and Battery Support Module to recharge a bank of expended ultracapacitors.

[0032] FIGS. 3D-E show example features of the isolated DC converters of FIG. 3C.

[0033] FIG. 4 shows switches in an Engine Start and Battery Support Module for switching inter-cell connections between ultracapacitors from series connections to parallel connections and vice versa.

[0034] FIGS. 5A-B shows ultracapacitors arranged in a non-split (FIG. 5A) and split (FIG. 5B) series configuration for use in an Energy Start and Battery Support Module.

[0035] FIGS. 6A-B show circuit diagrams of example direct current converters that can be used in the Engine Start and Battery Support Module.

[0036] FIG. 7 shows a flow diagram illustrating an example operation of an Engine Start and Battery Support Module.

DETAILED DESCRIPTION

[0037] Ultracapacitor-based engine cranking systems can be used to assist vehicle battery systems to crank when initiating an engine starting sequence. With these systems, existing vehicle wiring systems may be rerouted to create a direct connection from the ultracapacitors to the starter motor. In some cases, the ultracapacitors may be in parallel with the vehicle batteries. As the starting sequence is initiated, the ultracapacitors are discharged, providing

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energy to spin the starter motor. After the engine is started, the vehicle's alternator/generator is used to generate electricity and thus recharge the ultracapacitors. This system may also include a DC/DC converter that recharges the ultracapacitors from the parallel connected batteries.

[0038] An Example Engine Start and Battery Support Module

[0039] FIG. 1 shows an example ultracapacitor (UC)-based Engine Start and Battery Support Module (hereinafter a "Module") 100 that can be used to assist a vehicle battery system during an engine starting sequence. The Module 100 shown in FIG. 1 is a two-wire system and can be included into any standard DC bus in parallel with any number of batteries. The Module 100 can be used to maintain a healthy DC bus voltage for a vehicle that is starting (e.g., by vehicle starter 101) or consuming a large load while stopped. It may be used to augment existing batteries 102 in vehicles, e.g., as shown in FIGS. 1B-C, or as a replacement for traditional lead acid batteries. Some of the advantages of such a module are that it can be installed safely and without special tools and may require little or no wiring changes to existing infrastructures.

[0040] In some embodiments, the Module 100 can include a bank of UCs that supports both engine 103 starting assistance and "hotel load" 104a support. The term "hotel load" refers to the non-driving energy demands on a vehicle, including energy use for lights, air conditioning, heating, computers, tracking systems, safety systems, etc., which are indicated in FIG. 1C as vehicle loads 104a and accessory loads 104b. When a vehicle's engine 103 is off, the vehicle's energy demands constitute the hotel load. The Module 100 can be used to start a vehicle and/or to deliver energy back to the vehicle in a controlled fashion to support either the vehicle's static loads during short term stops and/or to supply energy to get the vehicle's electronics functioning, thus allowing the vehicle to start once the engine 103 is cranked. Examples of static loads during short stops may be the electronics, air-conditioning, lighting systems, etc., left on once the vehicle's engine 103 has stopped. In some embodiments, the static loads may include accessory loads 104b.

[0041] In some embodiments, the Module 100 can be configured to address the difficulty/inability of vehicles to start in adverse weather, under duress from extremely weak batteries, and/or from the effects of an excessively high number of engine starts. Further, the Module 100 enhances the health of the vehicle's battery 102 and starter motor 101 by maintaining (e.g., increasing if it has fallen) the voltage on the vehicle's direct current (DC) bus 106, which comprises, for example, negative DC bus 106a and positive DC bus 106b (FIG. 1C), during short off times and cranking. For example, maintaining a higher and/or

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more stable voltage allows for increases in the life of the batteries 102 and the starter motor 101, in some cases dramatically.

[0042] In some embodiments, the Module 100 may be all solid-state. As understood in the art of electronic, solid-state components, including field-effect transistors (FETs) and insulated gate bipolar transistors (IGBT), tend to be faster, more reliable, and consume less power than relays and contactors. Further, the Module 100 may provide capabilities to allow a driver a manual "Redo" button that would start the transfer of energy from the batteries 102 to the UCs. For example, this may be used in the situation where the vehicle may not start the first time. Such may allow the system to recharge on command even when the alternator 105 is not running. While the duration-to-charge time may be longer, the net result may be the same. In addition, more and/or larger banks of UCs can be added to increase the system's total energy storage capabilities, for example, for an Auxiliary Power Unit (APU).

[0043] In some embodiments, the Module 100 can, physically and/or energetically, be scaled to meet most or all applications. For example, the Module 100 can be designed to fit into battery group Battery Council International (BCI) size 31 (e.g., corresponding to heavy-duty commercial grade batteries). In some embodiments, the overall shape can be approximately rectangular, and the two wires can correspond to the positive and negative battery terminals. In some embodiments, the Module 100 may be compatible with existing vehicle battery systems and may not require special installation methods, tools, and/or safety requirements, serving as a one size fits all type of architecture. For example, the Module 100 can be designed to fit into housing that is a standard battery size, and can also tie directly on the bus. In some embodiments, the Module 100 can fit into a Group 31 size with a height that is slightly higher than the standard Group 31 battery or "bumped out" to support 18 cells with electronics. A newly tooled case can be used to maximize space as the Module 100 can be lighter than a heavy lead battery. FIGS. 1B-C show schematic diagrams illustrating example use of Engine Start and Battery Support Module 100 installed in a vehicle.

[0044] Engine Start and Battery Support Module Architectures

[0045] FIGS. 2A-B show circuit diagrams depicting an overall master architecture 200 for an example Engine Start and Battery Support Module 100 with a two wire system corresponding to a positive battery terminal 212a and a negative battery terminal 212b. The architecture 200 allows for independent adjustments of the voltage levels at which hotel loads and engine starts are supported, thus providing for variable energy delivery depending on the specific application and/or exact installation. The Module 100 is capable of modulating the transfer of energy between the UCs 201 and the system batteries 102 in both directions. For

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example, the Module 100 recognizes when to deliver charge to keep batteries 102 alive for short stops without the engine running. It also recognizes the static loads to reset the electronics in some applications prior to starting. In addition, it may automatically connect any remaining energy in the UC bank 201 directly in parallel to the batteries 102 during an engine start, thereby keeping the system voltage above some determined lower levels that may cause premature battery and starter motor failures. In effect, it changes the ESR of the entire vehicles DC system. Different combinations of series and parallel cell configurations may be used depending on the amount of ESR to be used in comparison to hotel load.

[0046] For example, the architecture 200 contains a serial string of UCs 201, each of which can be high specific capacitance electrochemical capacitor that stores energy electrostatically. A typical UC 201 has a capacitance value that is about 10,000 times that of an electrolytic capacitor, an energy density approximately 10% that of a conventional battery, and a power density up to 100 times that of the battery. This allows for a faster charge and discharge cycles for ultra-capacitors 201 compared to conventional batteries. It can also give UCs 201 extremely long cycle lives compared to batteries.

[0047] Each UC 201 can be charged to a predetermined level of per cell voltage. As a specific example, the UCs 201 may be charged to support 2.7 V/cell. The per-cell voltage value may be shifted automatically higher (e.g., 3.0 V/cell) when a low temperature is reached (e.g., 0° F) and even higher per-cell voltage (e.g., 3.3 V/cell) when the temperature falls even lower (e.g., below –20° F). In some embodiments, the temperature may be measured by a sensor 202. In some embodiments, each pack of UCs 201 may use a DC/DC converter (e.g., a 500 W DC/DC converter) 203 that can be settable in a factory to a voltage range, e.g., from 16.2 V to 24 V. The converter 203 may have either a boost or single-ended primary inductor converter (SEPIC) topography.

[0048] In some embodiments, the energy stored in the UCs 201 may be taken from the DC bus, and in some instances, it may be transferred directly back from the UCs 201 onto the same DC bus, allowing for a controlled charging process of batteries 102 in a vehicle. Effectively, the Module 100 dynamically adjusts the Equivalent Series Resistance (ESR) of the vehicle's electrical system substantially constantly. In some embodiments, the Module 100 comprises UCs 201 that may have significantly lower ESR than a typical battery and offer the ability to store energy quickly and to deliver the stored energy back to the vehicle with minimal interface based on the vehicle's changing needs both instantly and/or on a continuous basis. The lower the ESR of the UCs 201, the more efficient the overall energy transfer can be. The system can be scalable to the desired energy, which may be dictated by

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the size of the vehicle and its "work flow." The Module 100, by modulating the transfer of energy from the UCs 201 back to the DC battery bus, delivers the desired amount of energy, instead of delivering too much energy (and wasting excess energy) or falling short and not delivering enough energy, as may happen when a module delivers a predetermined amount of power. In some embodiments, the modulation of the transfer of energy and/or the charging and/or discharging of UCs 201 may be controlled by a logic control 210 that may be in electrical communication with the DC converter 203 and the UCs 201, and can be accomplished via FET 220. The Module 100 determines how to modulate the energy transfer based on variations in voltage and/or current caused by several variables, including but not limited to vehicle DC bus loads, starter motor sizes, battery age, wiring conditions, battery conditions, battery quantity, accessories, starter type, starter age, battery type, temperature, experience of the driver, etc.

[0049] For example, the Module 100 may allow for energy to be drawn from otherwise dead batteries over an extended period of time without further collapsing them below a destructive voltage level. For example, a lead-acid battery that is discharged to a point where its voltage is not high enough to start an internal combustion engine may still possess enough energy to completely charge one or more UCs (e.g., if the UC stores less energy than the battery). The Module 100 may charge the UCs 201 from the battery 102 using a DC converter 203 that controls both the current and voltage on both the input side and the output side of the UC 201 and battery 102 couple.

[0050] In supporting the DC bus voltage of the vehicle's battery 102, in some embodiments, the transfer of energy to the DC bus may be pulsed, e.g., by a buck converter. For example, the pulse may not be a fixed pulse-width modulation (PWM) 204 but rather may be at the natural frequency of the specific truck that it is installed in. In short, energy transferred from the UCs 201 to the battery 102 is based on the vehicle's demand at that moment. The recharge of the UCs 201 can be either pulsed if the cells are divided to enable a buck converter or recharged using a DC converter 203. In either case, the total voltage on the bank of UCs 201 may be actively adjusted both upwards and downwards depending on some parameter of interest, a particular example being the temperature in the module, as measured by a temperature sensor 202, for example. Such an embodiment may make efficient use of the potential energy that can be stored in each cell as well as extend the life of the cells.

[0051] In some embodiments, the Module may recharge the UCs 201 when the alternator 105 isn't running. The DC converter 203 may recharge the bank of UCs 201 by transferring the energy proportional to the vehicle's ability to deliver it. For example, the Module 100

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may not take too much energy out of the batteries 102 that the batteries 102 would drain below some lower limit potential (e.g., lower than 9 V). In addition, the power transfer to recharge the UCs 201 can be scalable using parallel combinations of controller chips arranged in a master and (many) slave organization where each controller contributes an additional phase worth of energy up to 12 phases. As such, a 250 W, 500 W, 750 W, etc. charger could be used with little expense. In implementing multiple phases, one phase controls the master timing and the other "slave" phases are shifted by equal intervals from the master. The use of multiple phases allows the power transfer to be spread over time, thus effecting smaller peak currents and smaller more efficient components.

[0052] In some embodiments, the UCs 201 can be charged primarily using the vehicle's alternator 105 (shown in FIGS. 1B and 1C). In some embodiments, the UCs 201 can be charged by drawing energy from the batteries 102 of the vehicle. The recharging of the UCs 201 may be either automatic and can occur when the engine103 is running (*i.e.,* alternator 105 is on) or it may be when commanded to do so during an emergency situation where the vehicle is without enough power to start on its own. For example, the Module 100 can power up and reset itself automatically upon being connected into a live battery system. For example, if the Module 100 is connected in parallel to the battery system 102, when the vehicle is started, the alternator 105 charges the batteries 102 as originally intended while the Module 100 draws energy from the batteries 102. The Module 100 can balance the voltage on the power bus between the UC's 201 and batteries 102 until the UC's 201 have reached capacity.

[0053] In some embodiments, each Module 100 may be able to operate in either an automatic and/or manual mode, e.g., via the manual interface 214 shown in FIG. 2A. The automatic mode may be utilized for delivery applications and very short haul uses where the number of engine starts per day are large, where it will be used to keep the battery bus alive for hotel support during a delivery stop. The manual mode may be utilized to start the truck where it will be used to energize the starter 101 with minimal energy used to operate the truck, enough to keep alive the electronics during a start sequence. In some embodiments, whether the Module 100 is in a manual mode or an automatic mode may be controlled by a switch 216 that, when turned on, allows the driver to engage the Module 100 via the manual interface 214.

[0054] In the automatic mode of operation, the energy is released initially slowly to maintain a specified battery bus voltage until the UC bank 201 is expended. When the bus voltage equals the UCs voltage, the two systems are effectively in parallel from then on. In

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the automatic mode, the actual battery bus voltage determines when the system goes from charging to neutral to discharging. When the mode of operation is manual, the energy is released slowly initially to maintain a specified battery bus voltage and then when the UC voltage equals the battery bus voltage the two systems are effectively in parallel. In manual mode, the Module senses an attempt to start the engine as indicated, e.g., by a turn of the ignition key or the voltage on a voltage meter on the instrument panel. Otherwise this system operates just like in the automatic mode except the beginning of the event is triggered intentionally. In the manual mode, the UC system does not lengthen the starting sequence and the driver starts the truck as normal.

[0055] Further, in some embodiments, the UCs' per-cell charge can be adjusted and raised during periods of low temperatures (e.g., less than 0° F) and even higher during ultra-low temperatures (e.g., less than –20° F). The raising of the cell voltage, which can be dynamic and/or automatic, may lead to an increase in the UC energy storage capability. In addition, some embodiments allow for the slow release of this energy based on the DC bus voltage using a pulse-width modulation (PWM) controller. The charging can be either from an onboard DC/DC converter 203, an alternating current (AC) hook up, and/or from smartly switching the banks of UCs 201 between parallel and serial connections.

[0056] The cell charging system has three characteristics, the first being where possible the alternator 105 may be used to recharge the UCs 201 up to a predetermined voltage, e.g., 14.5 V. This may be accomplished using a FET 220 when the bus voltage is higher than the voltage across the UC bank 201. Second, above 14.5 V, each product can use a 500 W DC/DC converter 203 that is settable in the factory to a desired voltage range, e.g., from 16.2 V to 24 V. The converter 203 may be designed on a boost or SEPIC topography, and is capable of working down to 9 V in the event a future re-start option is included. Third, when the voltage on the pack reaches its predetermined set point, even when the truck is off for extended periods, the converter 203 may be designed to minimize its quiescent current to keep the overall system's drain low, yet with the dependability of being available for a start at any time. The current drain may be approximately 1 W per 100 kJ of stored energy, once charged, for example.

[0057] Cell balancing can be a clamping type in order to reduce or minimize self-drain. It can have temperature compensated set points with one or more distinct levels, e.g., three levels at 2.7 V, 3 V, and 3.3 V. In some embodiments, the voltage set points may be maintained at the DC system voltage regulator 230, e.g., the DC system voltage regulator 230 may be set to match various ultracapacitor cell voltages for balancing. In some cases, the

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balancing may be supplied by the ultracapacitors 201 and/or the DC system voltage regulator 230 to reduce or minimize self-drain. In some embodiments, this compensation may happen automatically. In some embodiments, the cell balancing can be on the same Printed Circuit Board Assembly (PCBA) as the control logic 210 in FIG. 2A.

[0058] In the exemplary implementations discussed herein and/or any other implementations of the embodiments of the present technology, additional features may be available. For example, a smart user interface 107 could be included (e.g., connected to the Module 100 via a cable as shown in FIG. 1B) to indicate to the driver the status of the UC pack 201 (e.g., UC power level). The smart user interface 107 may include LED status indicators or a "smart" UC fuel gauge display that indicate the status of the UC pack 201. It may also include "Redo" button that gives the driver the option to redo a charge sequence. Further, connections to the controller area network bus (CANbus) of the vehicle could be offered for better integration into the vehicle's system, in some cases by the vehicle manufacturer as an integral part of the built-in display.

[0059] In some embodiments, the energy in the Module 100 may be stored at a level that is higher than the nominal voltage on the bus and may then be released as desired to support the healthy DC bus voltage of a vehicle regardless of the static load 104 or even during the vehicle's starting sequence. In some embodiments, the vehicle starting event may be regarded as a big static load, and the Module's support of the DC bus may cover both the vehicle starting sequence and the static load. In these embodiments, rewiring the vehicle or delivering energy to the starter motor 101 may become unnecessary. The module architecture 200 keeps the voltage stored in the UC bank 201 at a higher level than the battery bus and releases it slowly depending on the dip of that bus voltage due to load changes. Pure DC is pushed to the bus using a PWM buck converter with N-channel FETs 205 delivering the power with an inductor sized for the hotel or truck electronics load only after which it saturates when the FETs 205 are on fully. The PWM 204 puts the UC bank 201 in parallel to the battery 102 when the PWM 204 reaches 100% on. The loop maintains a predetermined battery bus voltage level with a time response rated at >10 kHz.

[0060] In some embodiments, the Module 100 delivers energy directly to the DC bus and does so in an asynchronous way without (intentional) hysteresis. As such, even during an engine cranking, the system may maintain a voltage as close to a set point (e.g., 12.5 V) as possible even as the load of the system changes by a large factor (e.g., 1000 or more) during a starting cycle. In some embodiments, the recharge may be multi-phase and dynamic with four quadrants being controlled allowing the system to adjust to the environment, the state of

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charge of the UCs, and the system batteries. (Here, the term "quadrants" refers to the current and voltage control of the input and output of the converter.) Further, the transfer of energy is pulsed in variable amounts, thereby reducing pseudo Electro-Magnetic Interference (EMI) emitted from the module. The Module 100 acts very much like a frequency-hopping radio in this regard. The pulses may occur at a fixed repetition frequency or have fixed pulse widths.

[0061] DC Converters for Recharging Ultracapacitors

[0062] FIGS. 3A-C show several embodiments of a DC converter 303 that may be used in the Module 100 to recharge the bank of UCs 301 when they are expended. The recharge may occur in between start cycles and while the engine is running. Further, in some embodiments, the converters 303 may be used to charge the UC bank 301 initially when the Module 100 has been installed and to recharge the UC bank 301 when the batteries 302 and the bank of UCs 301 are depleted either by extended vehicle off-time or when the vehicle will not start after the initial attempt(s). In such embodiments, the DC converter 303 may be able to control the input voltage cutoff so as not to ruin an otherwise depleted battery (e.g., when it is drawing energy from the battery 302 to charge up the UCs 301), control both the input and output current in order to be able to charge nearly empty UCs 301, and/or control a variable output voltage set point in order to control the energy stored on the bank of UCs 301 as the temperature varies.

[0063] Exemplary embodiments of DC converters 303 that can be used in the Module 100 comprise enhancement mode (normally open) N-FETs that allow for the modulation of the transfer of power to a vehicle's DC bus. In some embodiments, the DC converter 303 may be bi-directional, while in others it may not be bi-directional, but rather may comprise separate converters that regulate the transfer of power by monitoring the currents on either side. Further, in some embodiments, the DC converters 303 in the Module 100 may have no limitations as to how much energy can be transmitted on the delivery side. In addition, they may be scalable. For example, during an engine start the energy may be transferred without much delay and with as much energy as the UCs 301 have stored in order to keep that DC bus at some desired voltage (e.g., 12.5 V), which may effectively result in the UCs 301 being in parallel to the battery 302 in a starting sequence.

[0064] FIG. 3A shows an example module architecture 300a coupled to a conventional battery 302 in vehicle. The module includes a bank of UCs 301 connected in series with a DC voltage bus that is electrically connected to the battery's 302 positive terminal and an isolated DC converter 303a. The DC converter 303a may be electrically isolated as the positive is connected to the positive battery terminal (BAT+) through the inductor, effectively changing

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its ground potential. In these embodiments, the control of voltage and current on its input and output may have to be transferred over the isolated barrier.

[0065] The ground side of the UC bank 301 is coupled to the drain side of a set of N-FETs 305, which have sources coupled to the battery's 302 negative terminal and the DC converter 303a. In some embodiments, the gates of the N-FETs 305 are coupled to the output of a first voltage comparator 306, which has an input coupled to the DC voltage bus. A second voltage comparator 307 has an input coupled to the DC voltage bus and an output that enables or disables the isolated DC converter 303a. In operation, the first voltage comparator 306 compares the bus voltage to a set point voltage (e.g., 12 V) and triggers a pulse from the UC bank 301 whenever the bus voltage falls below the set point voltage, thereby maintaining the bus voltage at or above the set point voltage. The second voltage comparator 307 compares the bus voltage to charge voltage (e.g., 13.5 V) and enables the DC converter 303a whenever the bus voltage falls below the charge voltage. In response to the enable signal, the DC converter 303a charges the UC bank 301.

[0066] FIG. 3B shows a non-isolated DC converter 303b where the N-FETs 305 are in the high side and the DC converter 303b charges the "tops" of the UCs 301 maintaining a ground connection all the time. This allows the DC converter 303b not to be isolated, reducing the cost of it significantly in both prototyping and production terms. In some embodiments, the drive circuit for the N-FETs 305 may have the gate-source voltage $V_{gate\text{-}source}$ to be at least several volts (e.g., 10 V) higher than the source voltage V_{source} (and in some instances, the V_{source} may be BAT+). Since, in such embodiments, BAT+ may be sitting between 9 volts and 14.5 volts above ground, this may cause $V_{gate\text{-}source}$ to be approximately 24 volts, which could result in the use of a small separate boost circuit. In some embodiments, one may also use isolated high side FET drivers that can switch this voltage level into the high gate capacitance for the parallel bank of N-FETS that may be used to deliver the current during an engine start. The exemplary embodiment shown in FIG. 3B has the advantages of having fewer connections and components.

[0067] FIG. 3C shows a system comprising two DC converters 303c and 303d, where one converter 303d is used to charge or recharge the bank of UCs and the other converter 303c is used to deliver the energy back to the DC bus. Each of these converters in their "normal" mode may have a set point that triggers the converter to turn on. For example, to promote a healthy battery, an exemplary 12.5 V set-point may be chosen to deliver energy back to the DC bus and a 13.75 V set-point to initiate a recharge cycle. Other set points can be determined differently as these are adjustable. However, the Module architecture 300c also

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monitors the input and output currents. This feature allows the recharging of the UCs 301 to begin at times other than just when the alternator 105 is running, such as but not limited to when the batteries 302 are too weakened to perform a start and the bank of UCs 301 are exhausted such as during an extended stop.

[0068] FIG. 3E and FIG. 3D show details of some example features of the isolated DC converters 303c and 303d, respectively. In some embodiments, these converters may be bi-directional, and in others, they may not be bi-directional. In the examples shown in FIGS. 3D-E, the separate isolated converters regulate the transfer of power by monitoring currents on the charge input side (FIG. 3E) and the discharge output side (FIG. 3D).

[0069] As discussed above, in some embodiments, a Module's energy may be stored in UCs 201 that may be configured in series and/or parallel configurations. The amount of capacitance and/or the type of battery a Module 100 is compatible with may not be restricted, and in most embodiments, the voltage on the capacitors 201 may be higher than the voltage in the vehicle. The method of boosting the voltage can employ a conventional boost style converter that can be configured as a flyback, straight boost, or SEPIC, and may be either isolated or non-isolated. The converter can use a multi-phase approach to minimize the peak switching currents, which can in turn allow smaller, more efficient components, better EMI performance, and lower cost. In increments of a set amount of power (e.g., 250 W), more phases can be added that may increase the recharge power level and reduce the recharge time. When each phase is added its switching frequency may intentionally be out of phase with the first switch.

[0070] Internal Ultracapacitor Connections for Charging and Discharging

[0071] FIG. 4 shows an embodiment depicting the changing of inter-cell connections within UCs 401 between series and parallel connections to accommodate a buck-only charge and discharge scheme is shown. In some embodiments, the UCs 401 may be recharged by splitting them up into equal banks of cells 401a and 401b where their fully charged total voltage is less than the vehicle's system. In some embodiments, the UCs 401 may be charged by splitting the UCs 401 into several banks, each bank containing same and/or different number of UCs 401. In such embodiments, the UCs 401 can be recharged in a buck mode where energy is pulsed down to the caps. Such embodiments require more solid state switches and additional current control. When charged, the packs may be put back in series and readied for delivering power. In some embodiments, a series/parallel switch 402 can split the UCs 401 into two parallel banks 401a and 401b with equal numbers UCs 401 with total voltages below the vehicle's system voltage, or connect them to form a single UC bank with

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a total voltage above the vehicle's system voltage. In some embodiments, this may allow a single buck converter to be used for charging and discharging the UCs 401.

[0072] FIGS. 5A and 5B show converters 503 that can be used in some exemplary methods of charging the UCs 501 in the Module 100. FIG. 5A shows a separate and dedicated non-isolated DC converter 503a that boosts the voltage up to the UCs 501a during a recharge cycle. FIG. 5B shows splitting the cell stack in two 501b and 501c (e.g., equal halves each containing half of total number of cells) and then buck charging each half in parallel using the vehicle's nominal DC bus as the point where the energy is taken from. In some embodiments, the vehicle's voltage may be higher than each of the split cells. The energy may be pulsed in a controlled manner to each stack in a buck mode concept. The switches 502 represent points where the stacks are "put together" and then "separated" to accomplish this. Once charged to a given voltage, the two stacks are then put back in series for use in the "delivery" mode, *i.e.*, energy out mode. The mechanical switches 502 shown represent the "solid state" switching that may occur in real time.

[0073] In some embodiments, the switches 502 may be comprised of enhancement mode N-FETs and may carry the appropriate maximum current when connected in the delivery (energy out) mode (e.g., up to 2500 A). In some embodiments, the FETs can be sized to handle the charging current which may be in the range of 10–25 A. The switching of FIG. 5B may be less expensive and may provide for smaller electronics and allow for the re-usage of the on-board inductor in both directions. In some embodiments, the current mode controller may monitor and limit the root mean square (RMS) current that flows from the vehicle's battery to the two stacks of UCs 501b and 501c smartly and under most or all circumstances of the state of the charge on the capacitors. In some embodiments, more capacitors 501, and more stacks of UCs (e.g., 3, 4, 5, etc.) may be used, where each stack may contain same and/or different number of UCs.

[0074] In some embodiments, the DC converters shown in FIG. 5B can be utilized to buck switch the charging of the bank of UCs 501 by splitting the UCs 501 into two equal stacks 501b and 501c, then recombining them in series when they are charged and readied for use. The splitting of the UCs 501 in two equal stacks may allow the UCs' fully charged voltage to be double when recombined (e.g., each is charged to 12.0 V, or 24.0 V when recombined). The example as shown in FIG. 5B includes four switch circuits 502a, 502b, 502c and 502d where two of those switches 502c and 502d may be capable of handling the high currents during an engine start and the other two 502 a and 502b can be sized smaller as they are used

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to let charging currents pass through them. An example of a switch that can be used is N-FET.

[0075] In some embodiments of FIG. 5B, several N-FETs may be used to modulate power back to the DC bus. For example, if a Module 100 in a non-split configuration (e.g., FIG. 5A) includes ten N-FETs, the total number of N-FETs for split cell configuration (e.g., FIG. 5B) could increase to 22 N-FETs. In such embodiments, depending on the current level, inductive current sensing instead of standard current sense resistors may be used for sensing high current. Some embodiments may include one or more voltage sensors to measure small voltage drop across the inductor and then create the closed loop controls around their values.

[0076] FIGS. 6A-B shows detailed circuit diagram schematics of exemplary DC converters that may be used in the Module. The DC converters can be multi-phase boost converters capable of delivering 250 W/phase with four-quadrant current and voltage control on both the input and output. This system can have an efficiency of approximately 95% and can be single phase. As each phase gets added, the power can increase proportionally. Each successive phase is intentionally "out of phase" with the preceding one by 360°/n where n is the total number of phases. This reduces the peak currents and keeps the component sizes small. The system may allow for faster recharge rates where these phases could be added at the request of the customer, or they may be proportional to the size of the vehicle where the module is to be installed.

[0077] Operation of an Engine Start and Battery Support Module

[0078] FIG. 7 shows a flow diagram illustrating an example operating process for an Engine Start and Battery Support Module 100. In some embodiments, the DC converter may be able to control or set the thresholds and maximum values for both the input and output voltages and current. Charging UCs 701 when they are empty may present a problem in that they may act like dead shorts, and unless the output current is sensed and controlled the DC converter may hiccup, collapse, or burn up. Setting an output current limit should help avoiding or limiting such complications.

[0079] In some embodiments, the output voltage setting may set the desired voltage on the UCs 701 and may be variable based on temperature in order to increase or maximize the capacitor's life and deliver the appropriate energy when desired, especially in ultra-cold environments. And the input current limit and minimum voltage can be useful in avoiding the collapse of the batteries 702 below their safe operating region (e.g., 9 volts in a 12-volt system) when the DC bus is being drained during a recharge recycle while the alternator is off. In some embodiments, this function may be dynamic and the control may be

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proportional—the more power is available for the recharge, the more power the system (e.g., converter 703) may take. For example, at 9 volts, the power consumed by the converter may be zero, and at 13.75 volts the power may be 250 Watts for a single phase system and for any voltage in between, the power consumed may be proportionally in between 0 Watts and 250 Watts. In some embodiments, the converter may also have a quiescent current of less than 25 mA when it is disabled which may be useful in maintaining overall system performance.

[0080] Example Engine Start and Battery Support Modules

[0081] The following non-limiting examples are intended to highlight aspects of Engine Start and Battery Support Modules according to principles of the present disclosure.

[0082] *Example device 1*: Number of cells: eight in series; UC cell capacitance: 3000 F; Total Capacitance: 375 F; Voltage: 21.6 V when the temperature is greater than about 0° F and 24 V when the temperature is less than about 0° F.

[0083] Example device 1 can provide "hotel load" support as a primary function with the secondary function being reserving energy for the actual starting sequence. The ratio is approximately 10:1 with the hotel load support getting more energy. The system automatically supports a battery bus voltage from a string of UCs stacked in series and charged up to 2.7 V/cell or 3.0 V/cell depending on temperature. When the voltage on the cells equals the battery voltage they are then put in parallel by the design of the architecture. Exemplary application of this device is when vehicles are used for delivery.

[0084] *Example device 2*: Number of cells: two parallel strings of six cells each in series; UC cell capacitance: 3000 F; Total Capacitance: 1000 F; Voltage: 16.2 V when the temperature is greater than about 0° F and 18.0 V when the temperature is less than about 0° F.

[0085] Example device 2 can deliver energy to crank the vehicle while providing a reduced or minimal amount of energy to keep alive the vehicle electronics during that process. Exemplary application of this device is when vehicles are used for capacitance without auxiliary power units.

[0086] *Example device 3*: Number of cells: three parallel strings of six cells each in series; UC cell capacitance: 3000 F; Total Capacitance: 1500 F; Voltage: 16.2 V when the temperature is greater than about 0° F and 18.0 V when the temperature is less than about 0° F.

[0087] Example device 3 can deliver energy to crank the vehicle while providing a reduced minimal amount of energy to keep alive the vehicle electronics during that process. This

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application supports delivering more energy for vehicle electronics during vehicle starting event, especially on vehicles where there are more than four batteries in parallel. Exemplary application of this device is when vehicles are used for capacitance with auxiliary power units.

[0088] *Example device 4*: Number of cells: three parallel strings of six cells each in series UC cell capacitance: 3000 F; Total Capacitance: 1500 F; Voltage: 16.2 V when the temperature is greater than about 0° F, 18.0 V when the temperature is less than about 0° F, and 19.8 V when the temperature is less than about –20° F.

[0089] Example device 4 delivers increased or maximum energy to crank the vehicle in ultra-low temperature applications.

[0090] Conclusion

[0091] While various inventive embodiments have been described and illustrated herein, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the inventive embodiments described herein. More generally, those skilled in the art will readily appreciate that all parameters, dimensions, materials, and configurations described herein are meant to be exemplary and that the actual parameters, dimensions, materials, and/or configurations will depend upon the specific application or applications for which the inventive teachings is/are used. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific inventive embodiments described herein. It is, therefore, to be understood that the foregoing embodiments are presented by way of example only and that, within the scope of the appended claims and equivalents thereto; inventive embodiments may be practiced otherwise than as specifically described and claimed. Inventive embodiments of the present disclosure are directed to each individual feature, system, article, material, kit, and/or method described herein. In addition, any combination of two or more such features, systems, articles, materials, kits, and/or methods, if such features, systems, articles, materials, kits, and/or methods are not mutually inconsistent, is included within the inventive scope of the present disclosure.

[0092] The above-described embodiments can be implemented in any of numerous ways. For example, embodiments of the present technology may be implemented using hardware, firmware, software or a combination thereof. When implemented in firmware and/or software, the firmware and/or software code can be executed on any suitable processor or

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collection of logic components, whether provided in a single device or distributed among multiple devices.

[0093] In this respect, various inventive concepts may be embodied as a computer readable storage medium (or multiple computer readable storage media) (e.g., a computer memory, one or more floppy discs, compact discs, optical discs, magnetic tapes, flash memories, circuit configurations in Field Programmable Gate Arrays or other semiconductor devices, or other non-transitory medium or tangible computer storage medium) encoded with one or more programs that, when executed on one or more computers or other processors, perform methods that implement the various embodiments of the invention discussed above. The computer readable medium or media can be transportable, such that the program or programs stored thereon can be loaded onto one or more different computers or other processors to implement various aspects of the present invention as discussed above.

[0094] The terms "program" or "software" are used herein in a generic sense to refer to any type of computer code or set of computer-executable instructions that can be employed to program a computer or other processor to implement various aspects of embodiments as discussed above. Additionally, it should be appreciated that according to one aspect, one or more computer programs that when executed perform methods of the present invention need not reside on a single computer or processor, but may be distributed in a modular fashion amongst a number of different computers or processors to implement various aspects of the present invention.

[0095] Computer-executable instructions may be in many forms, such as program modules, executed by one or more computers or other devices. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Typically the functionality of the program modules may be combined or distributed as desired in various embodiments.

[0096] Also, data structures may be stored in computer-readable media in any suitable form. For simplicity of illustration, data structures may be shown to have fields that are related through location in the data structure. Such relationships may likewise be achieved by assigning storage for the fields with locations in a computer-readable medium that convey relationship between the fields. However, any suitable mechanism may be used to establish a relationship between information in fields of a data structure, including through the use of pointers, tags or other mechanisms that establish relationship between data elements.

[0097] Also, various inventive concepts may be embodied as one or more methods, of which an example has been provided. The acts performed as part of the method may be

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ordered in any suitable way. Accordingly, embodiments may be constructed in which acts are performed in an order different than illustrated, which may include performing some acts simultaneously, even though shown as sequential acts in illustrative embodiments.

[0098] All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

[0099] The indefinite articles "a" and "an," as used herein in the specification and in the claims, unless clearly indicated to the contrary, should be understood to mean "at least one."

[0100] The phrase "and/or," as used herein in the specification and in the claims, should be understood to mean "either or both" of the elements so conjoined, i.e., elements that are conjunctively present in some cases and disjunctively present in other cases. Multiple elements listed with "and/or" should be construed in the same fashion, i.e., "one or more" of the elements so conjoined. Other elements may optionally be present other than the elements specifically identified by the "and/or" clause, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, a reference to "A and/or B", when used in conjunction with open-ended language such as "comprising" can refer, in one embodiment, to A only (optionally including elements other than B); in another embodiment, to B only (optionally including elements other than A); in yet another embodiment, to both A and B (optionally including other elements); etc.

[0101] As used herein in the specification and in the claims, "or" should be understood to have the same meaning as "and/or" as defined above. For example, when separating items in a list, "or" or "and/or" shall be interpreted as being inclusive, i.e., the inclusion of at least one, but also including more than one, of a number or list of elements, and, optionally, additional unlisted items. Only terms clearly indicated to the contrary, such as "only one of" or "exactly one of," or, when used in the claims, "consisting of," will refer to the inclusion of exactly one element of a number or list of elements. In general, the term "or" as used herein shall only be interpreted as indicating exclusive alternatives (i.e. "one or the other but not both") when preceded by terms of exclusivity, such as "either," "one of," "only one of," or "exactly one of." "Consisting essentially of," when used in the claims, shall have its ordinary meaning as used in the field of patent law.

[0102] As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements

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and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") can refer, in one embodiment, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another embodiment, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another embodiment, to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

[0103] In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," "composed of," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of" shall be closed or semi-closed transitional phrases, respectively, as set forth in the United States Patent Office Manual of Patent Examining Procedures, Section 2111.03.

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CLAIMS

1. A method for regulating a voltage level of a vehicle battery in a vehicle, the method comprising:

determining if the voltage level is below a predetermined voltage threshold;

if the voltage level is below the predetermined voltage threshold, initiating a discharge of at least one ultracapacitor in electrical communication with the vehicle battery; and

modulating the discharge of the at least one ultracapacitor so as to raise the voltage level at least to the predetermined voltage threshold.

2. The method of claim 1, wherein the predetermined voltage threshold is determined based on at least one of vehicle battery age, vehicle age, vehicle battery condition, vehicle battery quantity, vehicle battery type, vehicle starter type, starter age, temperature, and experience of a driver of the vehicle.

3. The method of claim 1, wherein modulating the discharge of the at least one ultracapacitor comprises controlling current flow through at least one transistor in electrical communication with the at least one ultracapacitor.

4. The method of claim 1, further comprising:

while a vehicle alternator is off, transferring energy from the vehicle battery to the at least one ultracapacitor.

5. The method of claim 4, wherein the transfer of energy is initiated after determining that the voltage level exceeds a recharge voltage threshold.

6. The method of claim 5, wherein the transfer of energy is initiated only when voltage amount of the vehicle battery exceeds the recharge voltage threshold.

7. The method of claim 1, further comprising:

transferring energy from the vehicle battery to the at least one ultracapacitor when the voltage level is less than a voltage level required to start the vehicle.

8. The method of claim 1, wherein the at least one ultracapacitor comprises a plurality of ultracapacitors, and further comprising:

switching the plurality of ultracapacitors between a parallel configuration for charging and a serial configuration for discharging.

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9. An apparatus for regulating a voltage level of a vehicle battery, the apparatus comprising:

a plurality of ultracapacitors connected in series to store charge;

at least one voltage comparator, in electrical communication with the vehicle battery and the plurality of ultracapacitors, to perform a comparison of the voltage level to a predetermined voltage threshold; and

control logic, in electrical communication with the at least one voltage comparator and the plurality of ultracapacitors, to modulate discharge of the plurality of ultracapacitors based on the comparison so as to raise the voltage level to at least the predetermined voltage threshold.

10. The apparatus of claim 9, wherein the control logic comprises at least one transistor, in electrical communication with the plurality of ultracapacitors, to control current flow into and/or out of the plurality of ultracapacitors.

11. The apparatus of claim 10, wherein the at least one comparator is in electrical communication with a gate of the at least one transistor to control the current flow into and/or out of the plurality of ultracapacitors.

12. The apparatus of claim 9, further comprising:

a direct current (DC) converter, in electrical communication with the plurality of ultracapacitors and the at least one voltage comparator, to charge the plurality of ultracapacitors in response to a comparison of the voltage level and a recharge voltage threshold.

13. The apparatus of claim 12, wherein the at least one voltage comparator comprises:

a first voltage comparator, in electrical communication with the DC converter, to enable the DC converter if the voltage level exceeds the recharge voltage threshold; and

a second voltage comparator, in electrical communication with the control logic, to perform the comparison of the voltage level to the predetermined voltage threshold.

14. The apparatus of claim 13, wherein the DC converter is configured to transfer charge from the vehicle battery to the plurality of ultracapacitors in response to an output from the voltage comparator indicating that voltage level is above the recharge voltage threshold.

15. The apparatus of claim 12, further comprising:

a temperature sensor, operably coupled to the DC converter, to monitor a temperature of the vehicle battery.

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16. The apparatus of claim 15, wherein the DC converter is configured to vary the predetermined voltage threshold and/or the recharge voltage threshold based on the temperature of the vehicle battery.

17. The apparatus of claim 12, wherein the DC converter is further configured to deliver energy to a vehicle bus of the vehicle in response to an output from the at least one comparator.

18. The apparatus of claim 9, further comprising:

a switch, in electrical communication with the plurality of ultracapacitors, to switch the plurality of ultracapacitors between a serial configuration and a parallel configuration.

19. The apparatus of claim 9, further comprising:

a manual interface, operably coupled to the control logic, to enable a driver of the vehicle to engage the apparatus.

20. An apparatus for regulating a voltage level of a vehicle battery, the apparatus comprising:

a plurality of ultracapacitors;

a first voltage comparator, in electrical communication with the vehicle battery, to compare the voltage level to a first voltage threshold;

control logic, in electrical communication with the first voltage comparator and the plurality of ultracapacitors, to discharge of the plurality of ultracapacitors if the voltage level is below the first voltage threshold;

a second voltage comparator, in electrical communication with the vehicle battery, to compare the voltage level to a second voltage threshold;

control logic, in electrical communication with the first voltage comparator and the plurality of ultracapacitors, to discharge of the plurality of ultracapacitors if the voltage level is above the second voltage threshold;

a direct current (DC) converter, in electrical communication with the plurality of ultracapacitors and the second voltage comparator, to charge the plurality of ultracapacitors if the voltage level is above the second voltage threshold; and

a temperature sensor, operably coupled to the DC converter, to monitor a temperature of the vehicle battery,

wherein the DC converter is configured to vary the first voltage threshold and/or the second voltage threshold based on the temperature of the vehicle battery.

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Petitioner ADC (IPR2024-00577)

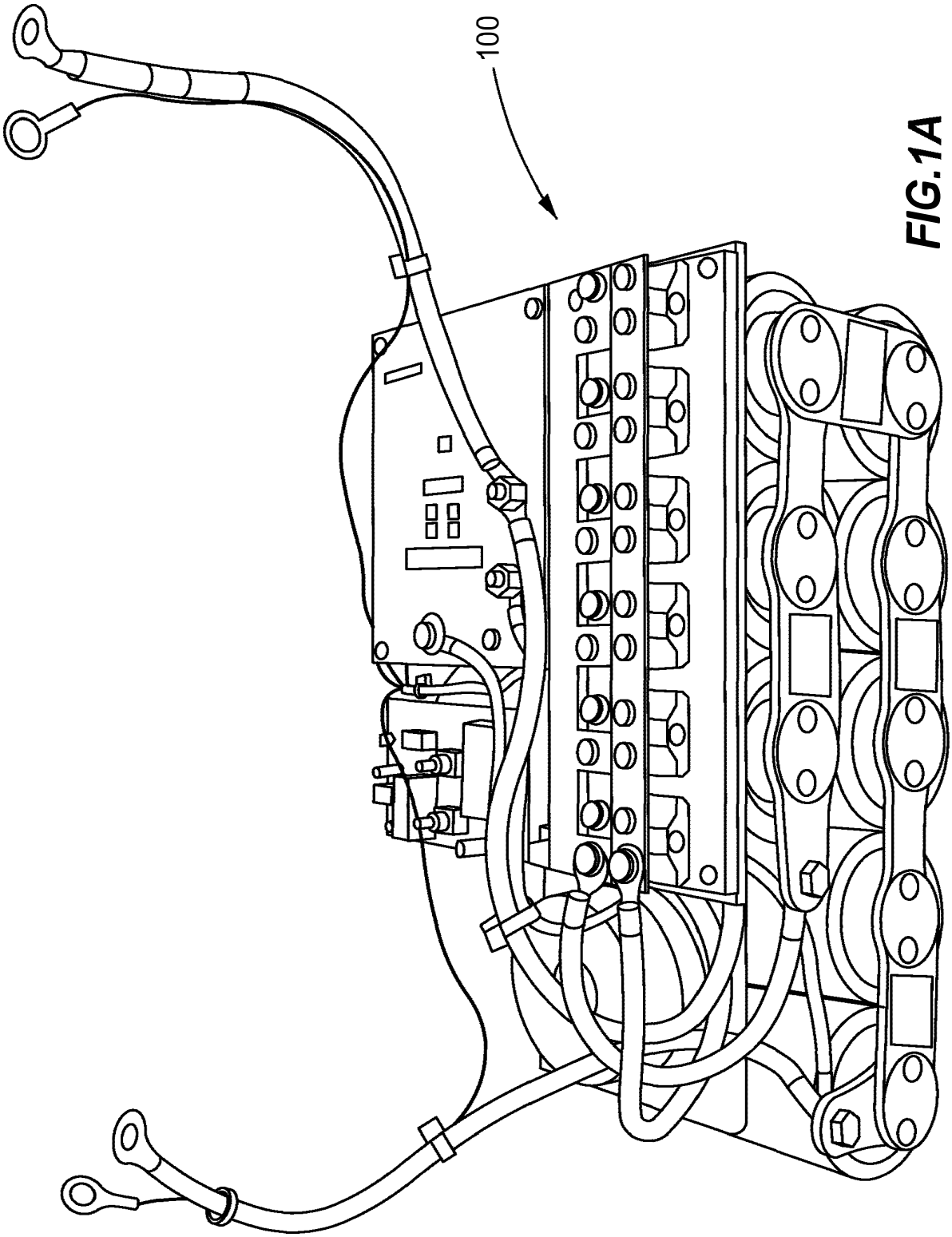


FIG.1A

EXHIBIT 1002
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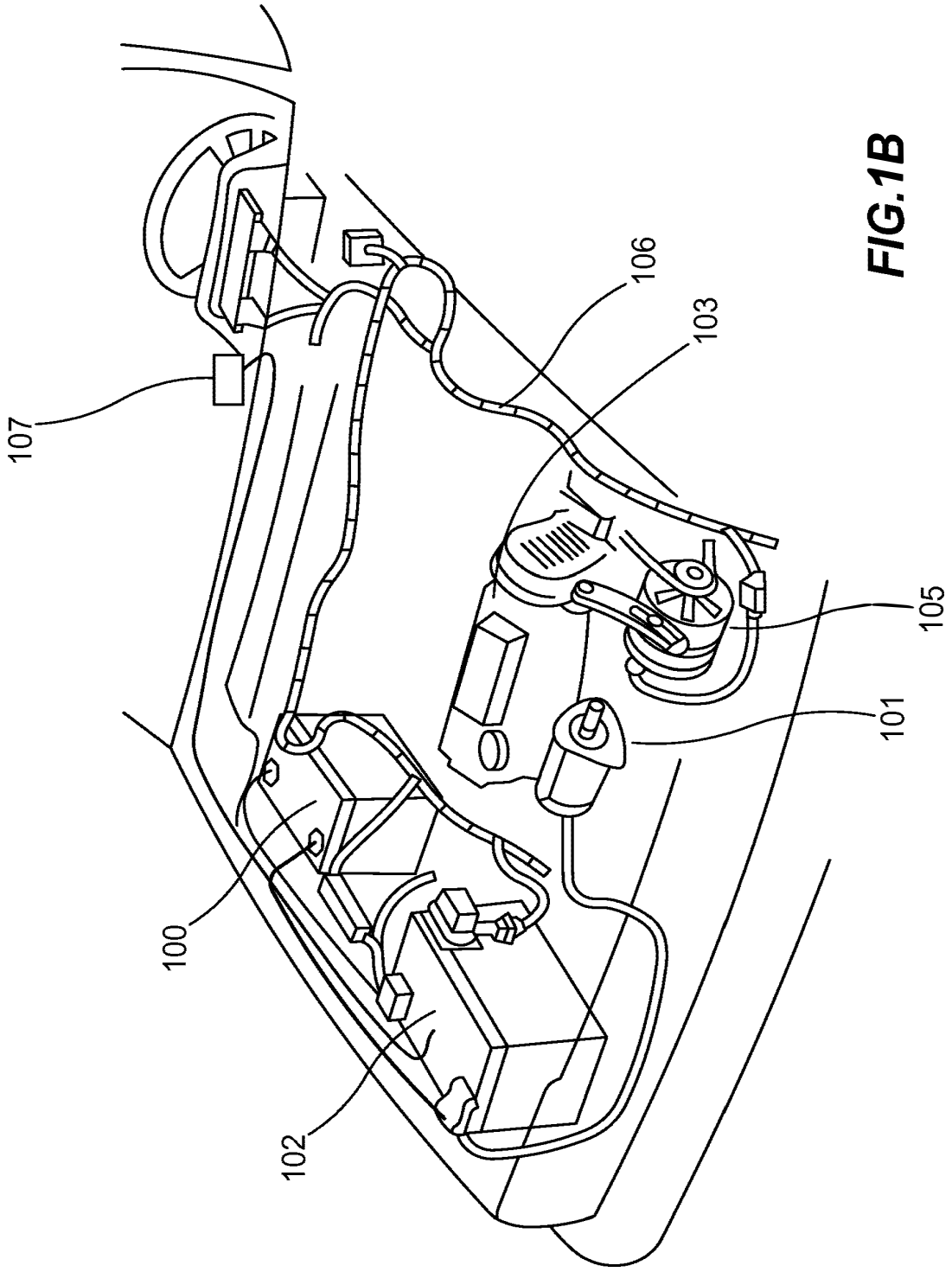


FIG.1B

EXHIBIT 1002
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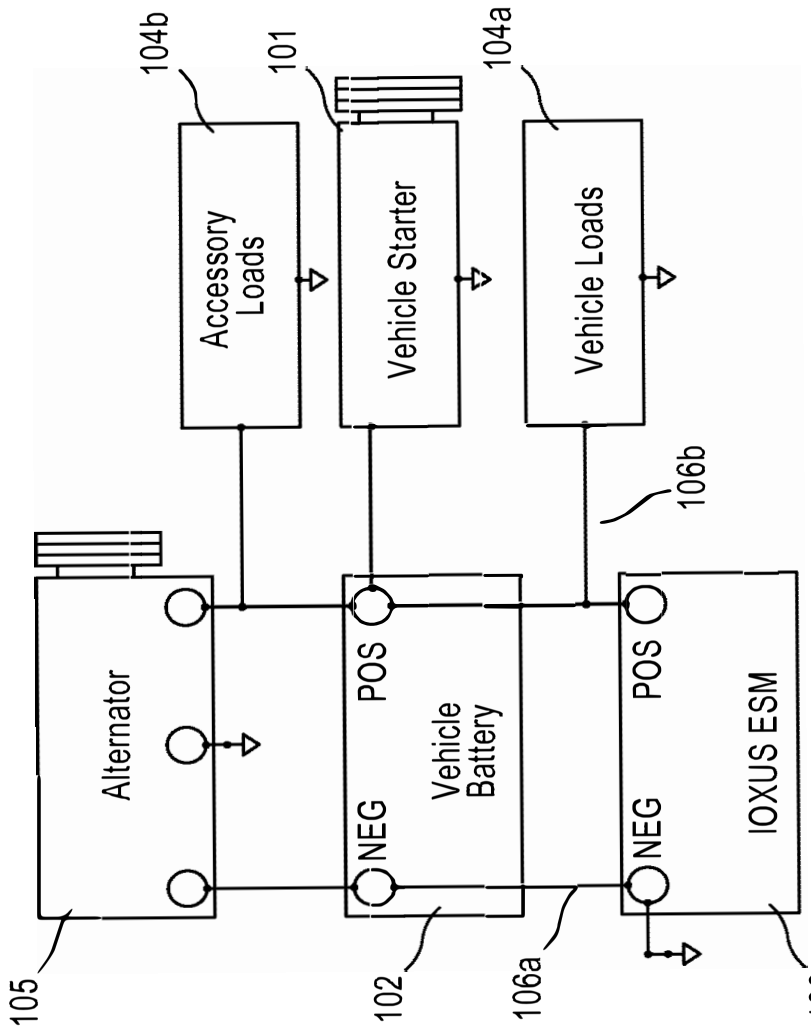


FIG.1C

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

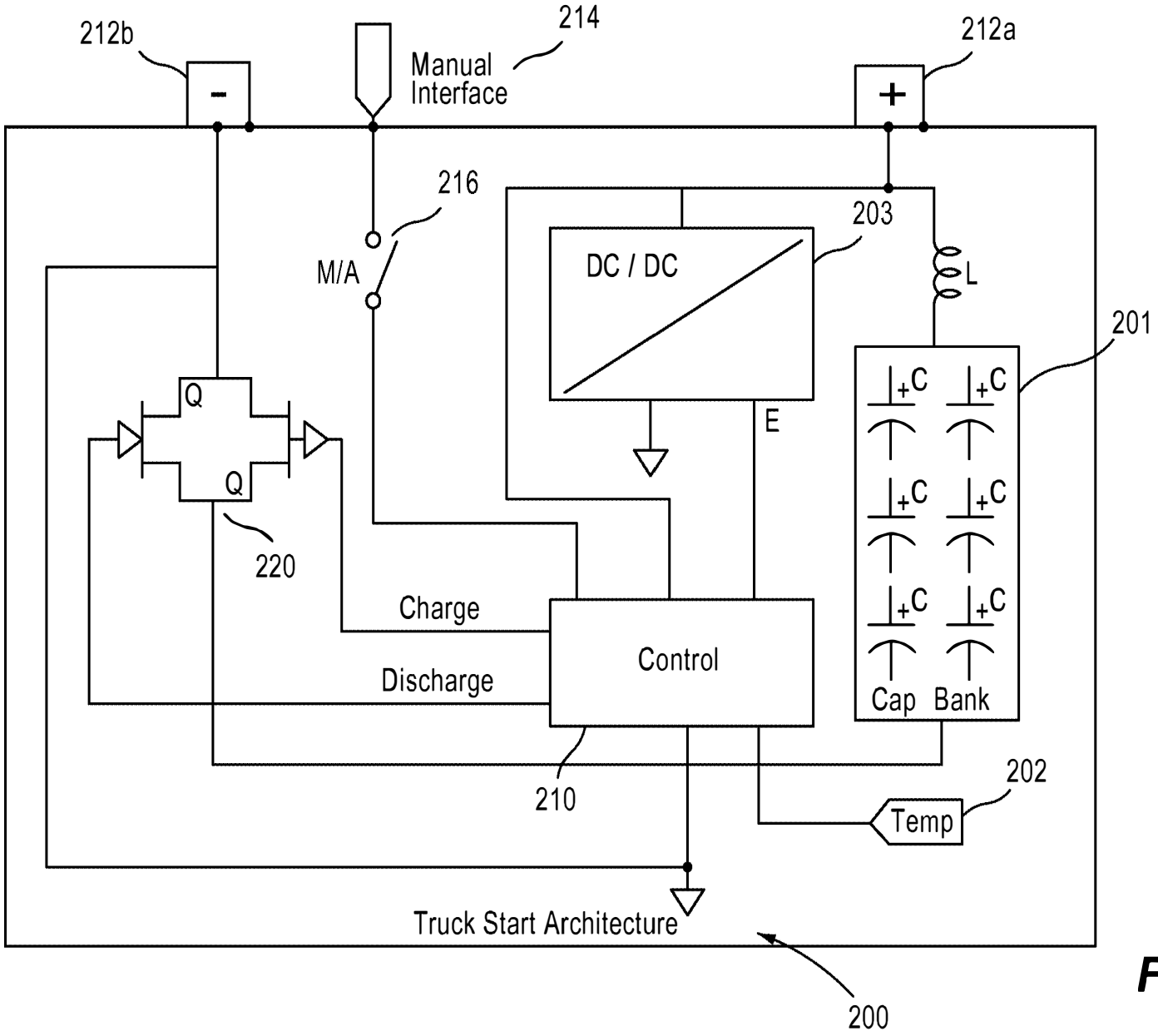


FIG.2A

EXHIBIT 1002
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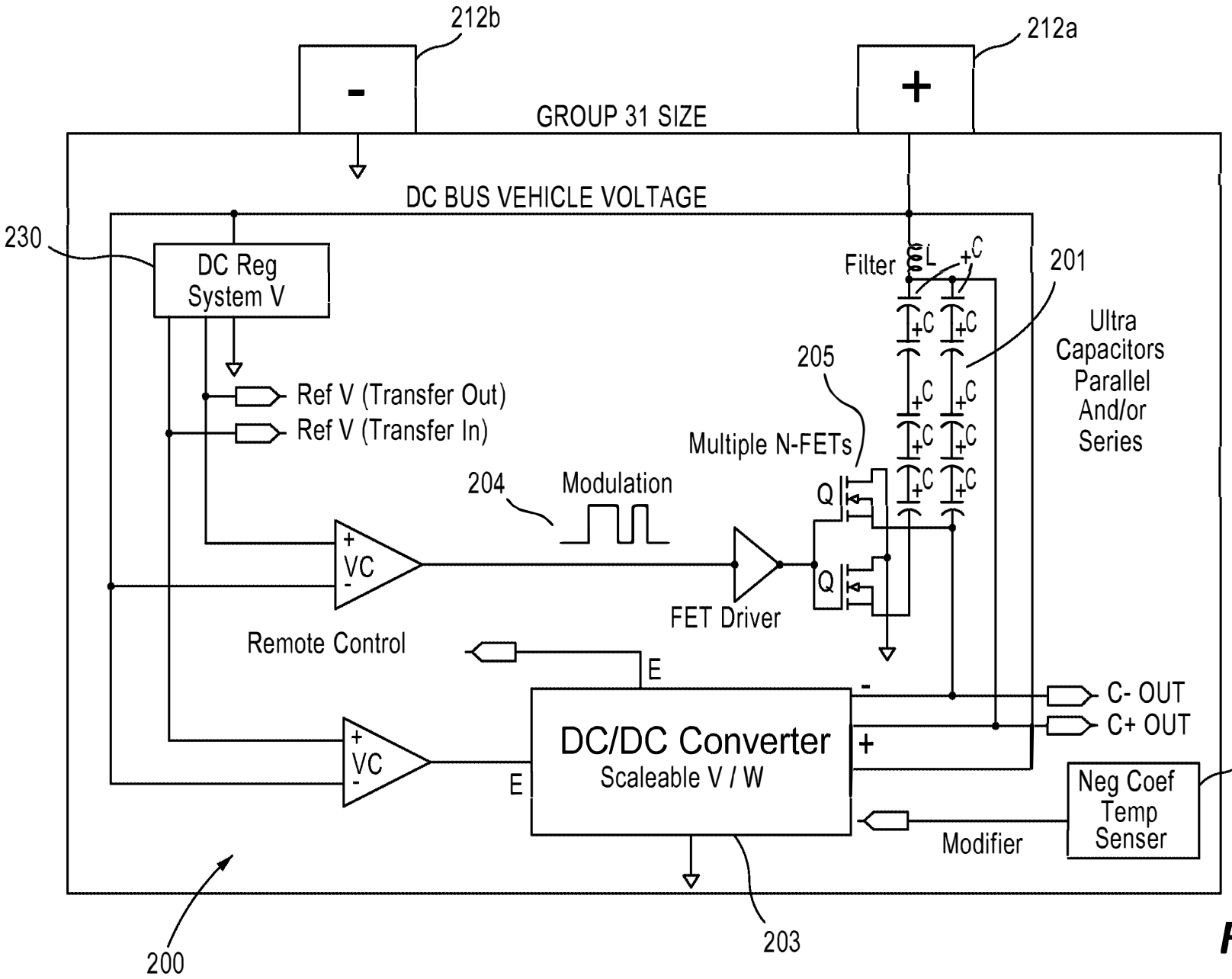

212b
212a
-
+
GROUP 31 SIZE
DC BUS VEHICLE VOLTAGE
230
DC Reg System V
Filter
L
+C
201
Ultra Capacitors Parallel And/or Series
205
Multiple N-FETs
Ref V (Transfer Out)
Ref V (Transfer In)
204
Modulation
Q
+ VC -
FET Driver
Remote Control
E
C- OUT
C+ OUT
DC/DC Converter
Scaleable V / W
202
Neg Coef Temp Senser
Modifier
200
203

FIG.2B

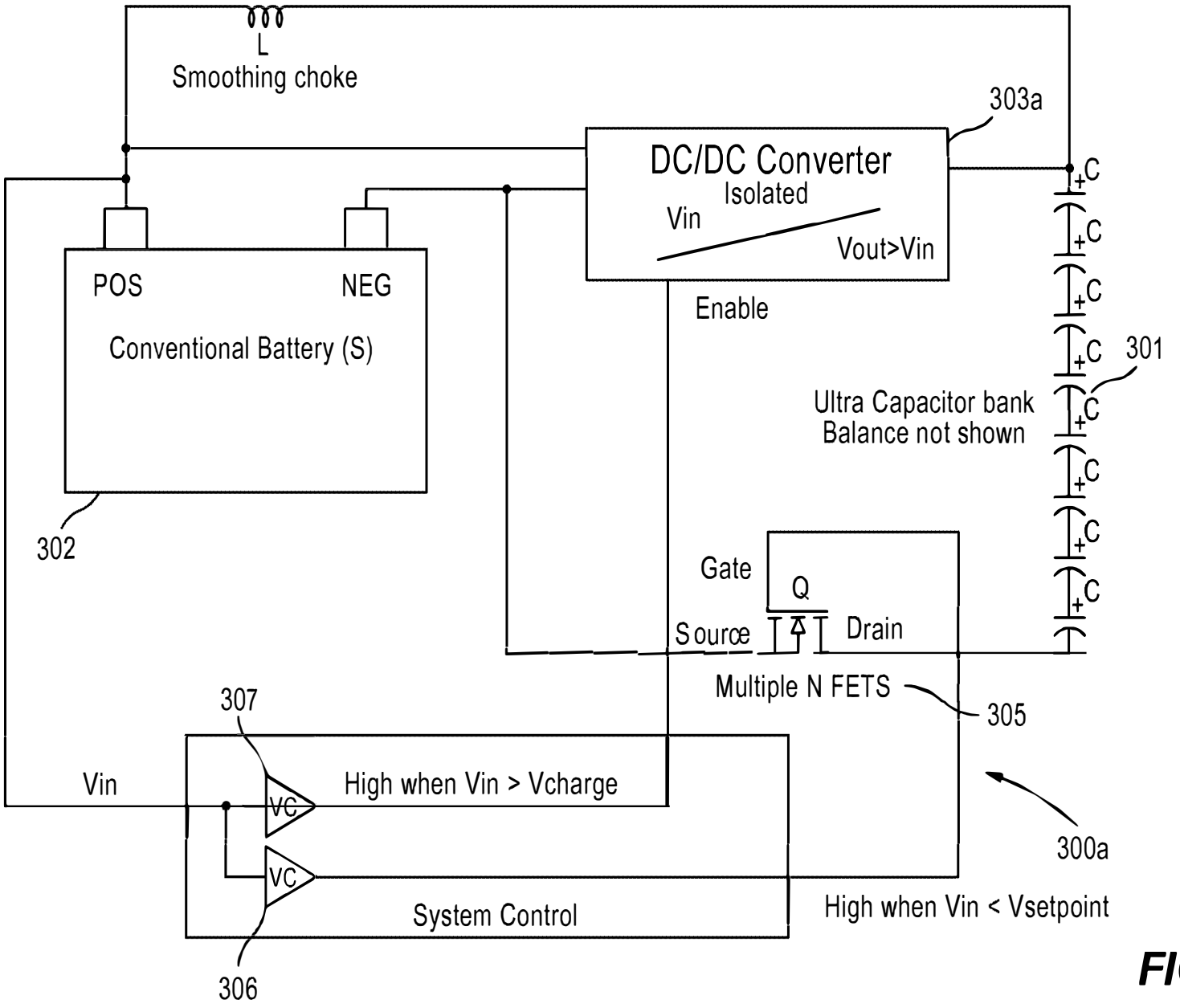


FIG.3A

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

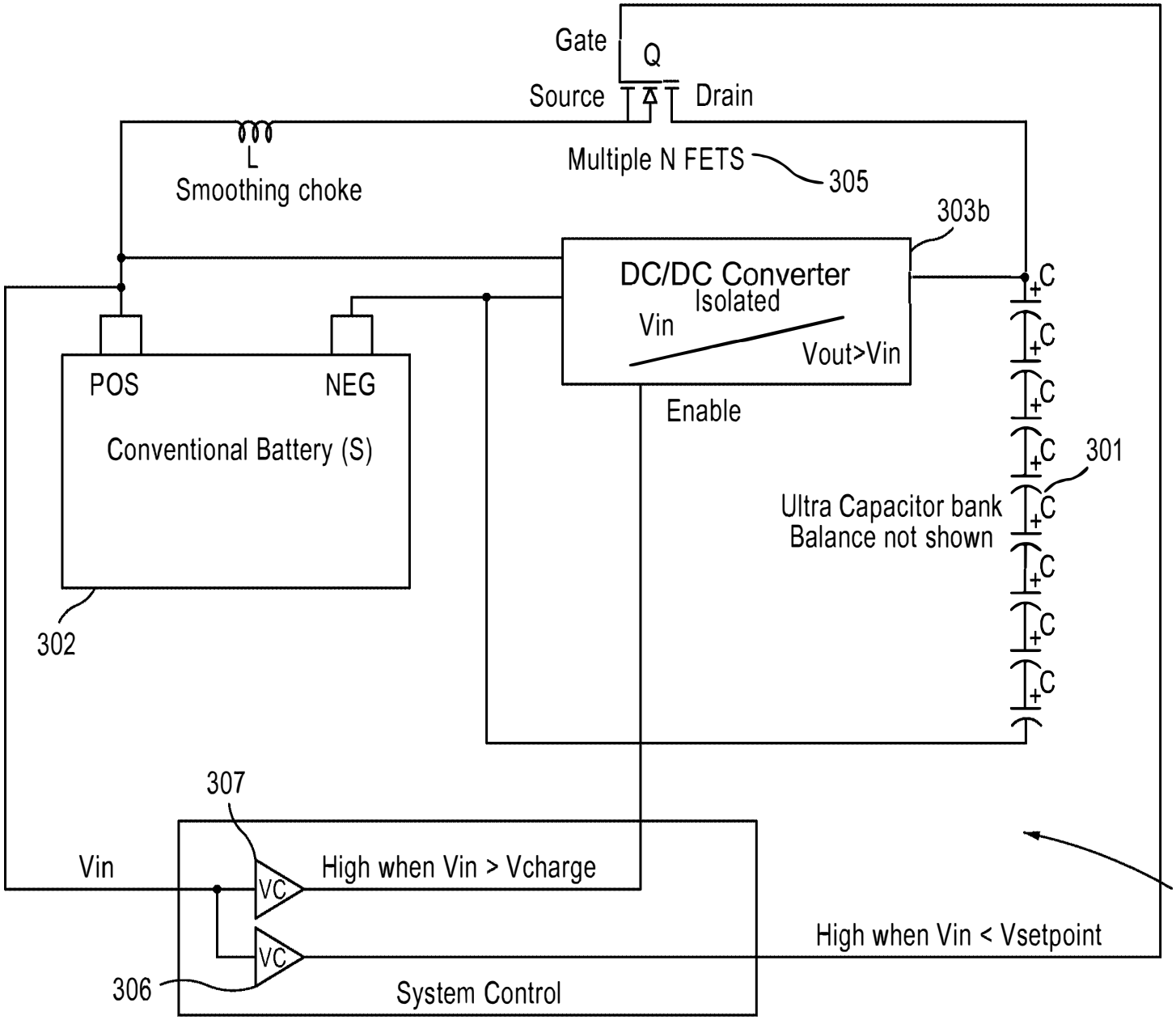


FIG.3B

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

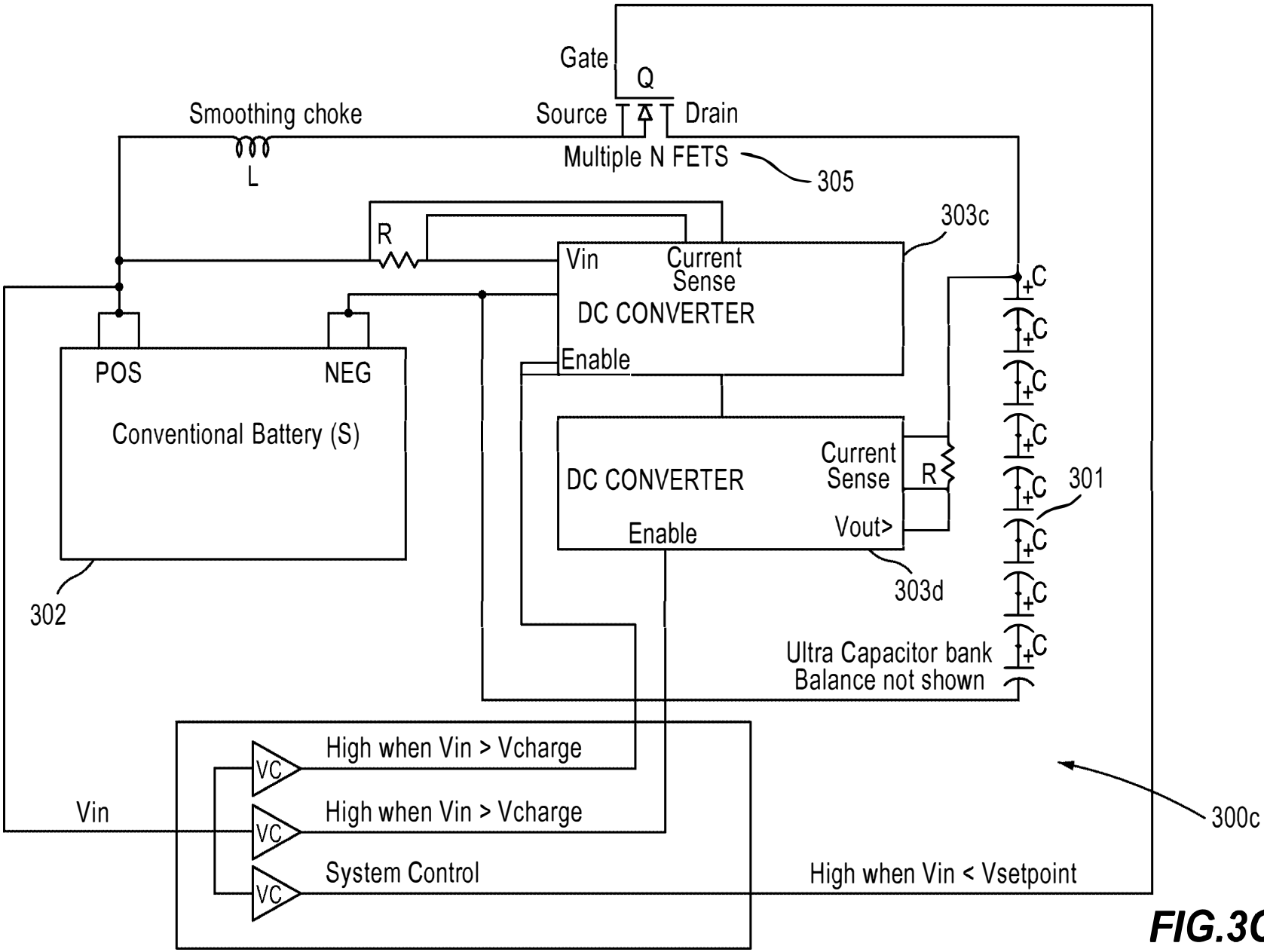


FIG.3C

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

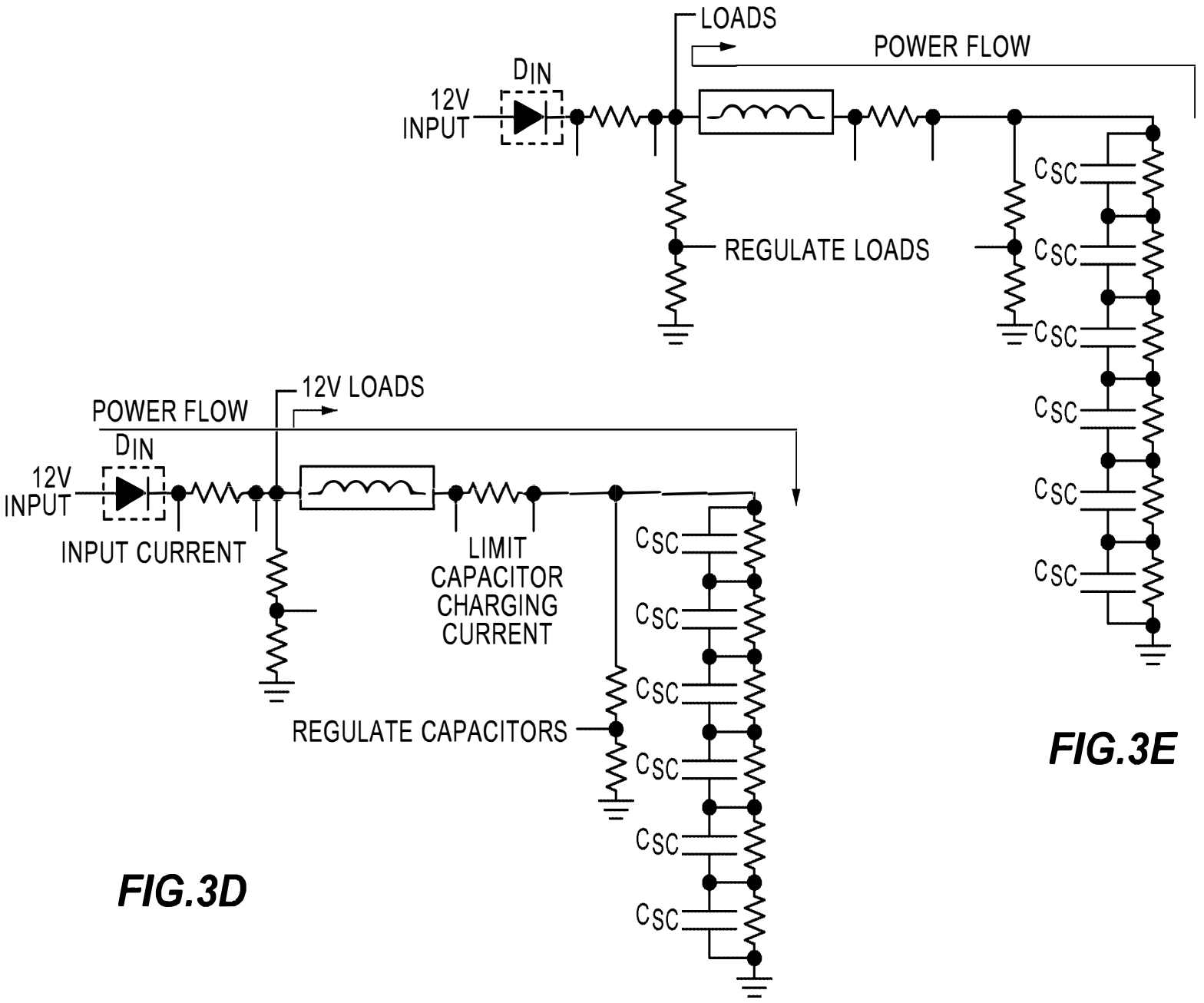


FIG.3D

FIG.3E

EXHIBIT 1002
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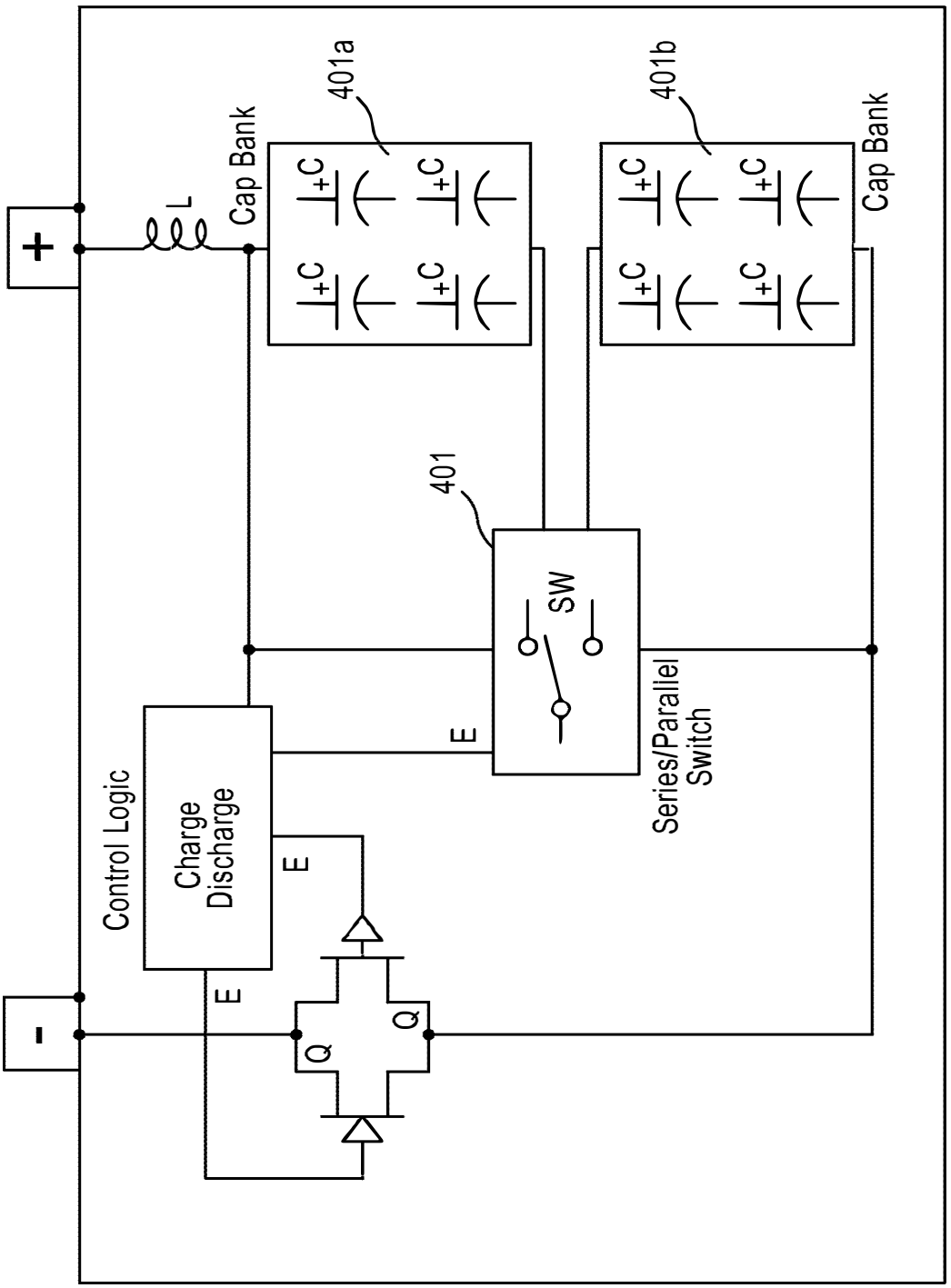

+
-
L
Cap Bank
401a
401b
Cap Bank
+C
401
SW
E
Series/Parallel
Switch
Control Logic
Charge
Discharge
E
E
Q
Q

FIG.4

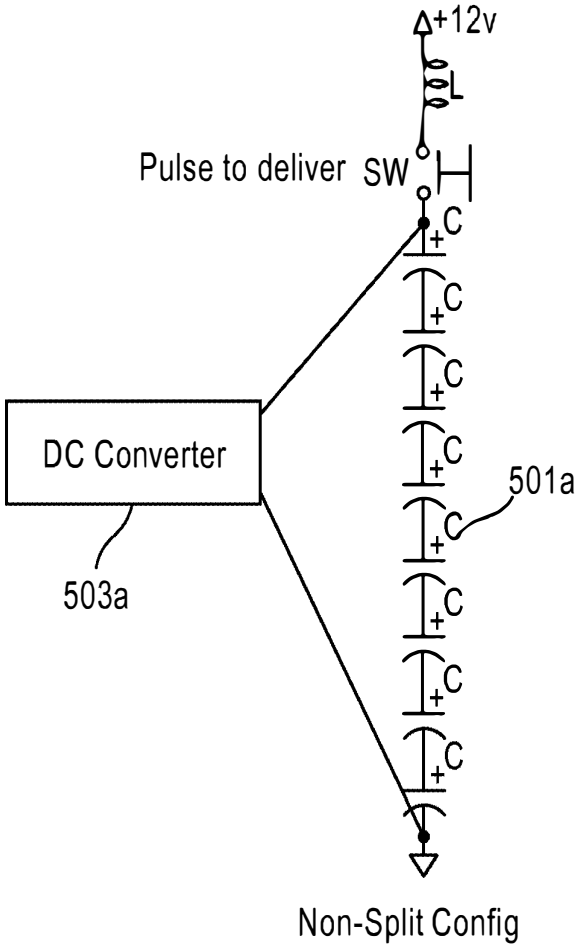


FIG.5A

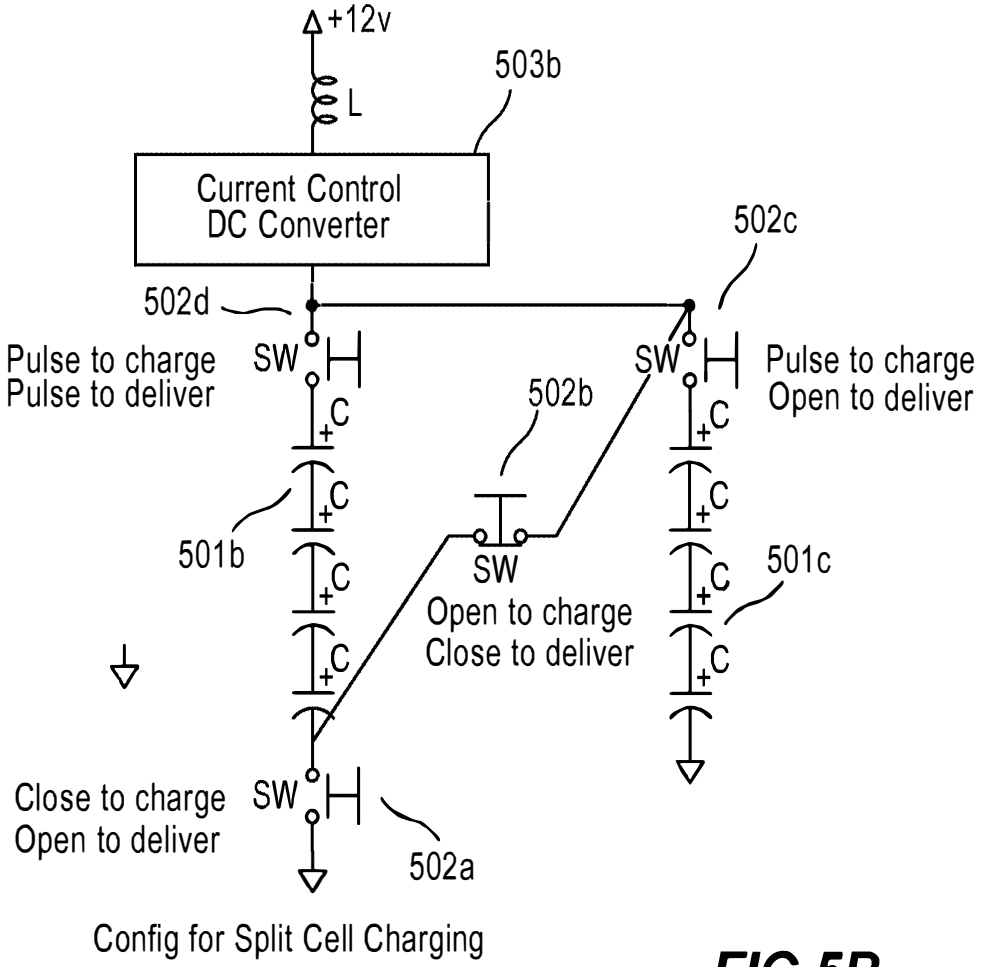


FIG.5B

EXHIBIT 1002
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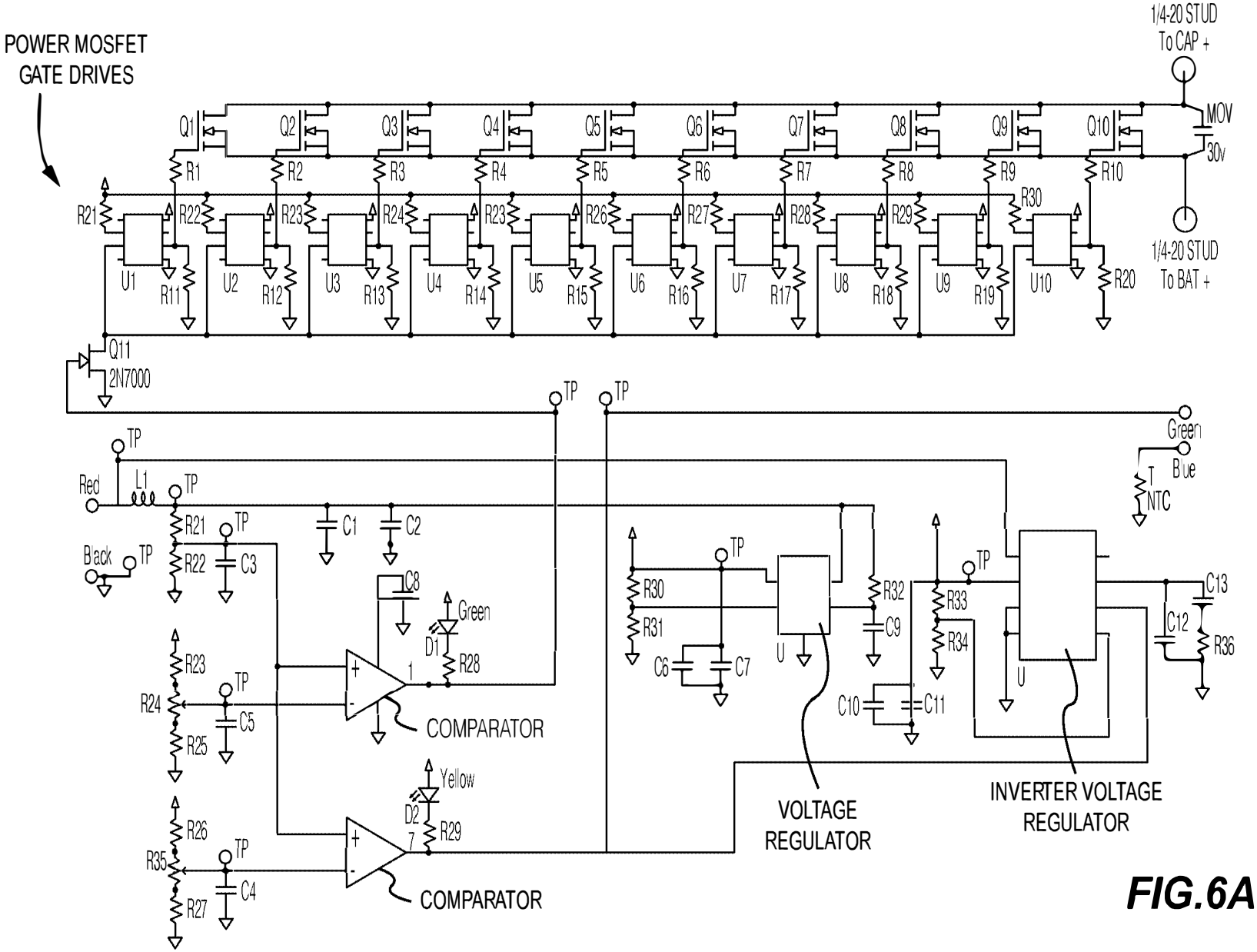

POWER MOSFET GATE DRIVES
1/4-20 STUD To CAP +
MOV 30v
1/4-20 STUD To BAT +
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R21
R22
R23
R24
R23
R26
R27
R28
R29
R30
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
Q11
2N7000
TP
Red
L1
Back
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
D1
D2
Green
Yellow
R25
R31
R32
R33
R34
R35
R36
T NTC
Green
Blue
1
7
COMPARATOR
COMPARATOR
VOLTAGE REGULATOR
INVERTER VOLTAGE REGULATOR

FIG.6A

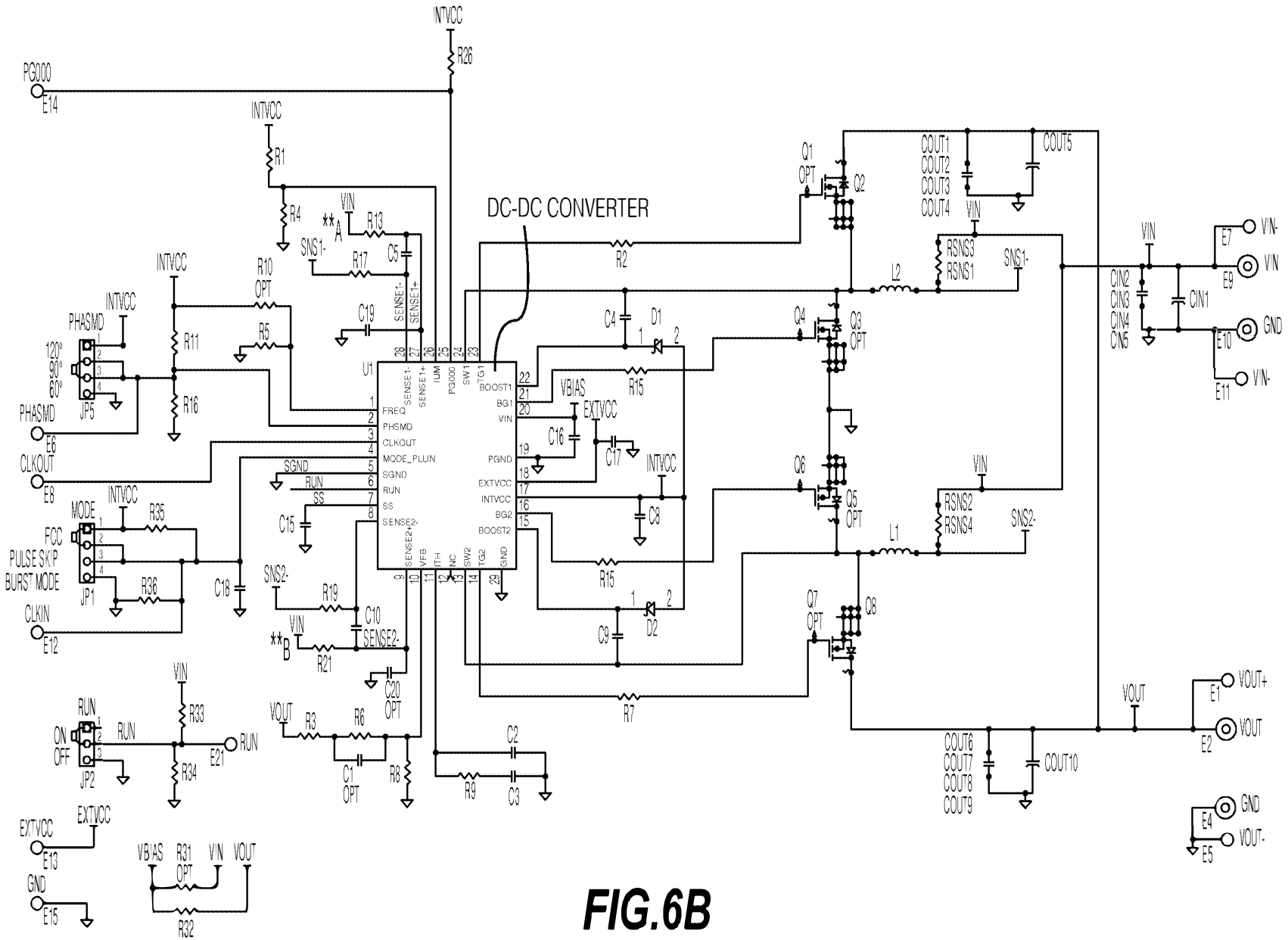


FIG.6B

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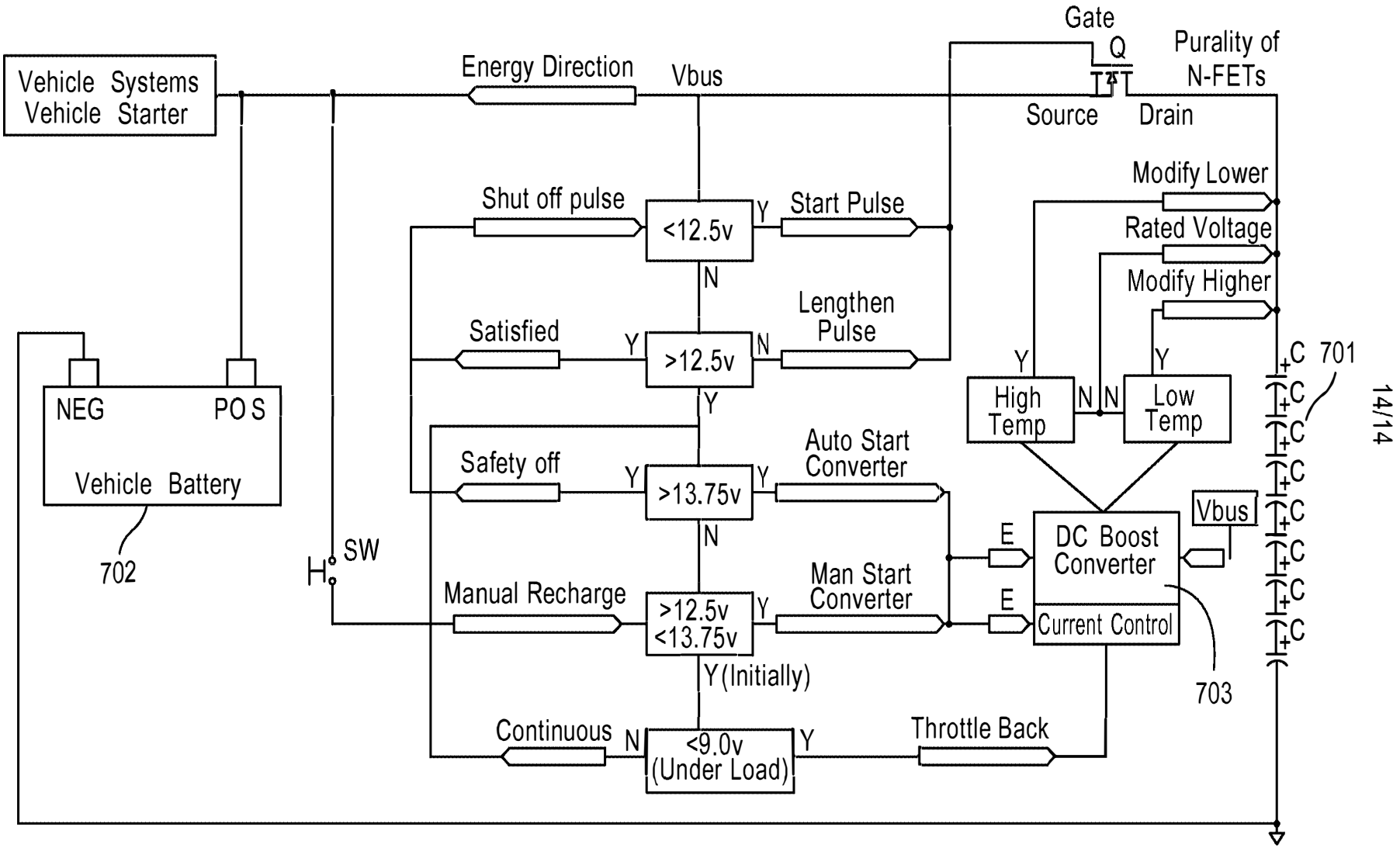


FIG.7

EXHIBIT 1002
Petitioner ADC (IPR2024-00577)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/033743

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/00 (2015.01)
CPC - H02J 7/00 (2015.04)
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) - (B60K 6/00, 6/448; B60L 1/00, 11/00; B60R 16/02, 16/03; G05B 23/00, 23/02; H02J 7/00, 7/02, 7/34 2015.01)
USPC -180/65.1, 65.21, 65.22, 65.225, 65.24, 65.275, 65.29; 307/9.1; 320/137, 162, 167

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - see last page

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar, ProQuest
Search terms used: vehicle, battery, ultracapacitor, voltage, regulate, monitor, control, threhsold, limit, charge, discharge, communication, transistor, temperature, sensor, dc, converter.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2010/0148582 A1 (CARTER) 17 June 2010 (17.06.2010) entire document	1-12,15-18 --- 13,14,19,20
Y	US 2003/0151875 A1 (NGUYEN et al.) 14 August 2003 (14.08.2003) entire document	13,14, 20
Y	US 2014/0041179 A1 (CLEAN EMISSIONS TECHNOLOGIES, INC) 13 February 2014 (13.02.2014) entire document	19
A	US 6,799,070 B2 (WOLFE et al.) 28 September 2004 (28.09.2004) entire document	1-20
A	US 2013/0031318 A1 (CHEN et al.) 31 January 2013 (31.01.2013) entire document	1-20
A	US 2012/0237799 A1 (JIANG et al.) 20 September 2012 (20.09.2012) entire document	1-20
A	US 7,633,271 B2 (SCHULTE et al.) 15 December 2009 (15.12.2009) entire document	1-20
A	US 5,710,699 A (KING et al.) 20 January 1998 (20.01.1998) entire document	1-20

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot he 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
05 August 2015	25 AUG 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2015/033743

Continuation of Box B Fields Searched

CPC Class/Subclass(es): B60K 6/00, 6/448; B60L 1/00, 11/00, 11/005, 11/18, 11/1861, 11/1866, 2210/20, 2220/44, 2270/36, 2200/26; B60R 16/03; B60W 10/08, 10/26, 20/00; B60Y 2400/114; G05B 23/00, 23/02; H02J 7/00, 7/0018, 7/025, 7/345; Y02T 10/7005, 10/7022, 10/7055 (2015.04) (keyword delimited)

Espacenet

AU6997198A Portable booster battery

Applicants: CLORE AUTOMOTIVE LLC

Inventors: ROZON LUC

Classifications:

IPC ***B60R16/04; H01M10/46; H01M10/48; H01M2/02; H01M2/10; H01M2/22;*** *H01M2/20; H01M6/50; H02J7/00;* (IPC1-7): H01M10/46; H01M2/10;

CPC **B60R16/04 (EP,US); H01M10/46 (EP,US); H01M50/20 (EP,US);** H01M50/50 (EP,US); H01M6/5044 (EP,US); H02J7/342 (EP,US); Y02E60/10 (EP); Y02P70/50 (EP);

Priorities: AU7851194A 1994-10-25; CA2109166A 1993-10-25

Application: AU6997198A 1998-06-09

Publication: AU6997198A 1998-07-30

Published as: **AU694452B2**; AU6997198A;**AU709769B2**; **AU7851194A**; **CA2109166A1**; **CA2109166C**; **CA2175074A1**; **DE69415922T2**; **DE9422177U1**; **EP0651456A1**; **EP0651456B1**; **EP0911902A2**; **EP0911902A3**; **EP0911902B1**; **JP3233363B2**; **JPH09507604A**; **US5589292A**; **WO9512221A1**

Portable booster battery

Abstract

No abstract found. Please consult other publications of this patent family in "Available in", if displayed above.

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AU6997198A Portable booster battery

Data originating from sources other than the EPO may not be accurate, complete, or up to date.

4/ P/00/01 1 Regulation 3.2 AUSTRALIA Patents Act 1990 ORIGINAL COMPLETE SPECIFICATION STANDARD PATENT 4SIS I 5, 4 'I SI C C S 9.

SC 4., 9., I 4..

Invention Title: Portable Booster Battery The following statement is a full description of this invention, including the best method of performing it known to me/us: □br/□ tIMM\W ICMt "114% C 1/'1A PORTABLE BOOSTER BATTERY Field of the Invention The present invention relates to batteries and more specifically to batteries that are moved from location to location, to connect to different devices, especially discharged for dead batteries of motor vehicles.

Background of the Invention Most automobiles are presently powered by an internal combustion engine which must be spun up to speed externally before they can operate. The engines are usually spun up to speed by an electric motor that is powered by battery. The As battery is then charged by a generator connected to the engine once the engine is operating or running. The battery is usually able to store enough charge for the periods that the engine is not running in order to start the engine when needed.

When the battery does not have sufficient charge to start the engine, a way must be found to recharge the battery or bypass the battery with a separate charge.

Since very often a discharged battery is caused by an external drain such as leaving the lights on or playing the radio, once the engine is started by either recharging the battery or bypassing it by sending a separate charge the 01automobile will continue to operate properly.

t Since there are many things that will temporally cause a battery to lose its charge, the need to recharge or bypass batteries with separate charges is common. Very often another or booster battery is brought to the vicinity of the dead battery and electrical cables are used to connect the booster battery to the dead battery in parallel in order to recharge and/or bypass the dead battery. This often known as boosting or jump starting the dead battery or engine.

In this method of boosting, the cables are disconnected from the batteries after each use so as to prevent short circuits. This method and structure however, is cumbersome since there are at least two parts and they demand great attention 2since there are 4 connections to make and a bad connection in either one will result in a short circuit or failure to start the engine.

Some manufacturers have tried to resolve the problem by combining the battery and cables in one unit, The problems that have arisen with these units are that the cables which are permanently connected to the battery are always live so they have to be protected as to not touch each other. The amount of amperage available in these batteries is very large and if the cables touch each other it would create a short circuit and damage the cables and batteries. To isolate the live cables, some manufacturers have used protective pouches. These are not practical to use since they are often in the way when trying to boost. Also it is time consuming to put the cables in and out of the pouches.

Other manufacturers have incorporated a male cigar lighter plug at the end of the cables permitting the user to plug this into the female cigar lighter plug of the vehicle. The problem with this unit is that one can only use this tool on vehicles equipped with the female cigar lighter plugs. Also, since the plugs almost always Ip.. have a maximum amperage rating of 30 amps and that most starter motors draw much more than 30 amps, the capacity is not adequate.

Summary and Objects of the Invention V It is any object of the present invention to provide a portable booster battery which can be easily carried to a car with a dead battery and connected to the dead battery of the car in order to provide sufficient charge to start the engine. It is also an object of the present invention to make the portable booster battery easy to use, maintain and safe from electrical short circuits which could damage the battery, the cables and the surrounding environment.

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The present invention addresses these objectives by providing a portableI automobile booster including: □br/□ an electrical storage device having a positive terminal and a negative terminal; □br/□ CD/981600086 3 a housing for containing said electrical storage device; □br/□ a first cable having a first end and a second end, the first end connected to the positive terminal of said electrical storage device; □br/□ a second cable having a first end and a second end, the first end connected to the negative terminal of said electrical storage device; □br/□ a first clamp connected to the second end of said first cable, said first clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said first cable to a positive terminal of an automobile battery, said hand gripping end operable to selectively open and close said clamping end; □br/□ 1se a second clamp connected to the second end of said 15 second cable, said second clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said second cable to one of a negative terminal of said automobile battery and a ground of an automobile, said hand gripping end operable to selectively open and close said clamping end; □br/□ a first holster connected to said housing and provided for receiving said first clamp; and a second holster connected to said housing and provided for receiving said second clamp.

Preferably the housing includes a plastic material. More preferably the electrical storage device includes a battery. The battery may be a sealed, non-spillable battery. Advantageously, the first holster is pivotably connected to said housing 4with the pivotal connection to the housing being preferably at least 90 degrees.

More advantageously, the first holster includes a bit, and the clamping end of said first clamp is attached to said bit. Also, the first holster may include a cover.

The various features of novelty which characterize the invention are pointed out with particularly in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference is made to the accompanying drawings and descriptive matter in which preferred embodiments of the invention are illustrated.

Brief Description of the Drawings In the drawings: □br/□ Fig 1 is a plan view of an embodiment of the present invention; □br/□ 0 Fig 2 is a partial cross sectional side view according to section line I-11 of Fig 1 and with the holster pivoted approximately 300; □br/□ Fig 3 is a view of the bit means without the cover of the holster and with a portion a 0 *1 #rr" 15 of the housing; □br/□ Fig 4 is a perspective view of another embodiment of the present invention; □br/□ Fig 5 is a view of one recharging plug; □br/□ Fig 6 is a view another recharging plug.

Detailed Description of the Preferred Embodiments Referring to the drawings, in particular Fig 1, the unit comprises of a housing 1 which is preferably made out of plastic. Inside the housing 1 is the electrical storage device which is preferably a sealed non-spillable battery. First and second electrical cables 6 are connected to terminals of the battery inside the housing 1.

The cable 6 extend outside the housing and are preferably held to the housing by Vgrooves 10 when the cables are not in use.

4 4I 4t 4 At the other end of the cable 6 from the battery which is inside the housing 1, are clamp means 7 for electrically connecting the cable to the terminals of a dead battery or portions of an electrical system. As can be seen in the drawings, especially Figs 1 and 2, the housing has a box-like shape. First and second dimensions of the box-like shape are of a size that is roughly or approximately similar to the two largest dimensions of the clamp means 7.

Holster means 4 are preferably positioned on opposite sides of the housing 1. The holster means 4 includes a cover 8 which is rounded at one end and opened at another end 22. The holster means 4 also includes bit means 5 for connecting with the clamp means 7 when the clamps means is inside the holster means 4.

The cover 8 is made of non-electrically conductive material and is preferable that the bit means 5 and the housing 1 are also non-conducting. The holster means 4 is pivotably connected to the housing 1 by at least 900. This allows easier insertion 15 and removal of the clamps means 7 independent of the position of the housing 1.

The bit means 5 is preferably positioned in substantially the middle of the holster with regard to the length of the housing 1.

The unit also can have a recharging connection 12 for charging the energy storage device. Preferably this recharging connection 12 is male cigar lighter plug which can extend from the housing 1 in order to plug into

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the cigar lighter receptacle of an automobile. An accessory power connection 11 is also provided for a powering accessories with the unit. This accessory connection 11 is preferably a female cigar lighter receptacle and can be used power such equipment as portable lights, invertors, compressors, vacuum cleaners and refrigerators.

In order to determine the amount of charge in the energy storage device, the present invention has a display means 13 which displays the present charge of the device. The preferred embodiment the display means consists of a test button 14 and indicator lights CD/98160008 6 6 To use the unit, one puts the housing 1 close to the engine one wishes to boost, either on its bottom 3 or on its back side 9. Next one pivots the holster 4 to the desired angle, opens the clamp 7, and removes the clamp 7 from the holster. The positive claim is connected to the positive post of the battery one wishes to boost, the negative clamp is connected to a good ground of the engine. The engine, is then started. To use the booster as a power supply, the male cigar plug of any 12 volt accessory is plugged into the female cigar plug on the unit.

In another embodiment of the present invention, as shown in Fig 4, the recharging connection can also be the same as the accessory connection 11. A special recharging plug 16 as shown in Fig 5, or 17 as shown in Fig 6, is connected to the accessory connection 11. With the recharging plug 16 of Fig 5, one end is plugged Vftllinto the accessory connection 11, and the other end is plug into the female cigar 4..,og lighter receptacle in an automobile. With the recharging plug 17 of Fig 6, the male 4. cigar lighter plug 18 is plugged into the accessory connection 11 and the other end has a wall outlet plug 19 which is plugged into a wall outlet. The embodiment of Fig 4 also has a recharging light 20 indicating that the battery is recharging.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be '44C I44tt understood that the invention may be embodied otherwise without departing from such principles.

It will be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of those different combinations constitute various alternative aspects of the invention.

It will also be understood that where the term "comprises" or its grammatical variants, is employed herein, it is equivalent to the term "includes" and is not to be taken as excluding the presence of other elements or features.

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AU6997198A Portable booster battery

Data originating from sources other than the EPO may not be accurate, complete, or up to date.

4 44 t4 4 4 L4,4 414£ '4 a housing for containing said electrical storage device;□br/□ a first cable having a first end and a second end, the first end connected to the positive terminal of said electrical storage device;□br/□ a second cable having a first end and a second end, the first end connected to the negative terminal of said electrical storage device;□br/□ a first clamp connected to the second end of said first cable, said first clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said first cable to a positive terminal of an automobile battery, said hand gripping end operable to selectively open and close said clamping end;□br/□ a second clamp connected to the second end of said second cable, said second clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said second cable to one of a negative terminal of said automobile battery and a ground of an automobile, said hand gripping end operable to selectively open and close said clamping end;□br/□ a first holster connected to said housing and provided for receiving said first clamp; and CD/9160008 6 x 'I o FI.ir 444o ro a second holster connected to said housing and receiving said clamp.

2 A portable automobile booster according to claim 1, housing includes a plastic material.

3 A portable automobile booster according to claim 1 wherein the electrical storage device includes a battery.

4 A portable automobile booster according to claim 3, battery includes a sealed, non-spillable battery.

provided for wherein the or claim 2, wherein the A portable automobile booster according to any one of claims 1 to 4, wherein said first holster is pivotably connected to said housing.

6 A portable automobile booster according to claim 5, wherein said first holster is pivotably connected to said housing by at least degrees.

7 A portable automobile booster according to any one of claims 1 to 6, wherein said first holster includes a bit, and the clamping end of said first clamp is attached to said bit.

8 A portable automobile booster according to any one of claims 1 to 7, wherein said first holster includes a cover.

9 A portable automobile booster substantially as hereinbefore described with reference to the accompanying drawings.

CENTURY MFG. CO by their Registered Patent Attorneys FREEHILLS PATENT ATTORNEYS 9 June 1998 CD/9816.

6 ABSTRACT i A portable automobile booster including an electrical storage i device having a positive terminal and a negative terminal; a housing for containing said electrical storage device; a first cable (6) having a first end and a second end, the first end connected to the positive terminal of said electrical storage device; a second cable (6) having a first end and a second end, the first end connected to the negative terminal of said electrical storage device; a first clamp (7) connected to the second end of said first cable said first clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said first cable to a 1,o ~positive terminal of an automobile battery, said hand gripping end i ooperable to selectively open and close said clamping end; a second i, ;clamp connected to the second end of said second cable .4 o0 i 15 said second clamp including a hand gripping end and a clamping end, said clamping end constructed for electrically connecting said second cable to one of a negative terminal of said automobile battery and a ground of an automobile, said hand gripping end operable to selectively open and close said clamping end; a first holster (4) connected to said housing and provided for receiving said first clamp and a second holster connected to said housing (1) iX", and provided for receiving said second clamp iIi.

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(54) **VAPOUR BURNING APPARATUS**
(54) **APPAREIL BRULEUR DE VAPEURS**

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To all whom it may concern:

Be it known that I, Jacob Henry Hiess, of Radcliffe House, Radcliffe Avenue, Harlesden, in the County of Middlesex, England, foreman mechanic, having invented certain new and useful improvements in Vapour Burning Apparatus, do hereby declare that the following is a full, clear, and exact description of the same.

Hiess.

J. A. LAW, C.P.A.
BIRKBECK BANK CHAMBERS
LONDON, W.C.

Vapour

Vapour burning apparatus - particularly vapour burning apparatus employed for the production of light by rendering mantles or the like ~~incandescent~~ by flames of vaporized kerosine or similar burning oil - have hitherto been subject to the objection that the orifices of the tubes or chambers (hereinafter referred to as vaporizing tubes) in which the oil has been vaporized have been liable to become stopped up by the deposition of carbon and it has consequently been necessary to clean the orifices somewhat frequently, which, though facilities for cleaning are provided, is a considerable drawback, if not prohibitive, to the use of the apparatus.

Now I have found by experiment that the serious obstruction of the orifice of a vaporizing tube in this way can be prevented for a very considerable time by the use in the tube of a filling comprising a section of suitable fibrous material, as fibrous asbestos or slag wool, extending for say one third to one half of the length of the vaporizing tube from the orifice thereof, from which it is suitably separated as by a layer or layers of wire gauze, and a section of suitable coarsely divided material, as pumice-stone, brick, flint, coke, or iron or copper filings, extending from the fibrous material to, or nearly to, the inlet end of the vaporizing tube. To produce the best results the fibrous material must be somewhat loosely arranged, for if it were too much compressed it would interfere unduly with the flow of vapour through the tube; good results may be obtained by charging the tube in such a manner that the

glass.

J. A. LAW, C.P.A.
BIRKBECK BANK CHAMBERS
LONDON, W.C.

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