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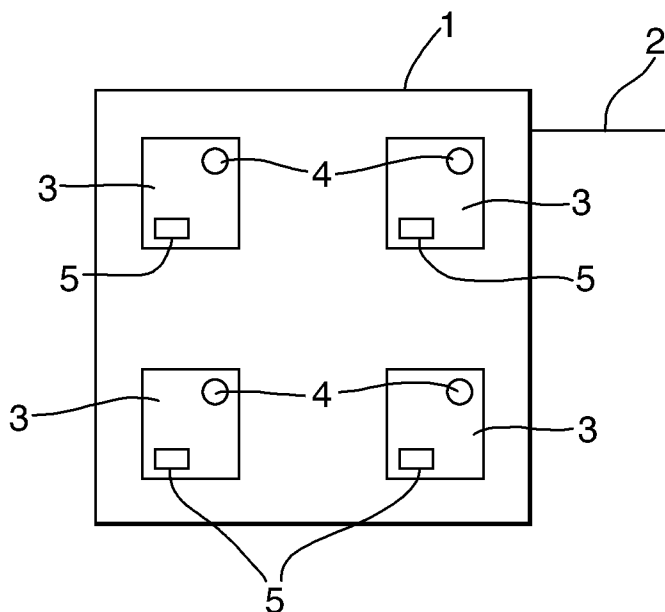
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(54) Title: BATTERY CHARGER



(57) Abstract: A multi-channel charger (1) comprising two or more individual smart chargers (3) that are capable of standing alone which are all connected to a single electrical power input (2).

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Battery ChargerDescription

5           The present invention provides a smart charger.

Background of Invention

10           Secondary batteries are used in many different devices. In some situations it is necessary to recharge secondary batteries in field situations where the main sources of power are from generators or vehicles.

Summary of Invention

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          The present invention aims to provide a charger that can be used in field situations and can be used on a vehicle.

20           Accordingly, the present invention provides a multi-channel charger comprising two or more individual smart chargers that are capable of standing alone which are all connected to a single electrical power input.

25           The power input may be an AC or DC input.

          A smart charger is a charger that complies with Smart Battery Charger Specification Revision 1.1, December 11, 1998. It communicates with a smart battery  
30 via a System Management Bus which complies with System Management Bus Specification Revision 1.1, December 11, 1998. A smart battery is a secondary battery which complies with Smart Battery Data Specification Revision 1.1, December 11, 1998.

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A smart battery may have one of a range of chemistries including but not limited to lithium ion. The battery provides signals to the smart charger in order to instruct the charger how to charge the battery. Thus, it tells the charger the current and voltage to provide and also tells the charger when to stop charging the battery.

The smart chargers can be used alone or can be connected to form a multi-channel charger. It is a particular advantage of the present invention that each of the smart chargers is a fully functional smart charger when used individually. Thus, each charger of the invention is made up of individual smart chargers wherein each of them is capable of standing alone. This arrangement is highly advantageous because if one smart charger fails then the remaining channels of the multi-channel charger of the invention can still be used for charging. In addition, individual operators can remove and use the individual smart chargers and these can be readily transported. Assembling a multi-channel charger as and when required thus allows greater flexibility and availability of chargers than using a specially constructed multi-channel charger which would also be harder to transport.

The multi-channel charger typically comprises a base plate to which the smart chargers are connected and which has a DC or AC input. The present invention therefore also provides a method of assembling a multi-channel charger which method comprises connecting two or more smart chargers to a multi-channel charger base plate wherein the base plate has a DC or AC input. Where the base-plate has an AC input it is typically rectified, that is to say the base plate carries a converter or rectifier to provide a desired DC voltage.

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Since the individual smart chargers are all capable of generating heat individually and/or in the configuration of a multi-channel charger of the invention, they may also be provided with separate heat  
5 dissipation means, such as heat exchangers or heat sinks made of metal plates, and these may in turn be placed in contact with a further heat sink or heat exchanger that may make up a part of the configuration of the multi-channel charger of the invention. Typically, the  
10 configuration of the heat sinks of the individual smart chargers with the heat sink of the multi-charger of the invention is such that heat dissipation away from the multi-charger heat generating components is optimised. In order to optimise heat exchange the heat exchangers of  
15 the individual smart chargers are typically in contact with a system heat exchanger of the multi-channel charger when the smart chargers are assembled to form the multi-channel charger. The system heat exchanger or heat sink associated with the multi-charger of the invention can be  
20 the base plate on which the multi-channel charger of the invention may be mounted or in an alternative the heat exchanger may be itself mounted on a base plate, typically a metal base plate, itself. Where the individual smart chargers do not each comprise a heat  
25 exchanger or heat sink, they may be mounted on a system heat exchanger or heat sink as described above. In such a configuration, the man skilled in the art will appreciate that the contacting means between the individual smart chargers and the system heat exchanger will be such as to  
30 optimise the dissipation of heat away from the multi-charger of the invention. The components that may make up the heat exchanger of the individual smart chargers and/or of the multi-channel charger of the invention typically are of the form of a metal plate which may have  
35 features on it in the form of ribs, flanges or fins or other projections for optimal heat dissipation.

Preferably the smart charger is designed so that any user indicators are visible both when the charger is used individually or in a multi-channel unit.

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The multi-channel charger may comprise any desired number of smart chargers, for example, 2, 3, 4, 5, 6, 7, 8, 9, 10 or more smart chargers. In a preferred embodiment each smart charger can provide a charging  
10 current of up to 6A and can accept voltages of 10-40V DC. Preferably, the smart charger can adjust its charging regime to suit different batteries, to optimise the supply power available and/or in response to the ambient temperature. Preferably, the smart charger has a visual  
15 indicator of the progress of charging the battery. In a particularly preferred embodiment of the invention the multi-channel charger has four channels and the input current of the multi-channel charger is limited to 40A for low voltages.

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The present invention also provides the use of a multi-channel charger of the present invention to charge a smart battery.

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It is envisaged that multi-channel chargers of the present invention will be particularly useful in field situations where there is a continuing requirement to recharge secondary batteries using mobile power sources.

### 30 Brief Description of the Drawings

A specific construction of an apparatus embodying the invention will now be described by way of example and with reference to the drawing filed herewith, in which:

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- 5 -

Figure 1 is a schematic diagram of a multi-channel charger of the present invention.

Detailed Description of the Invention

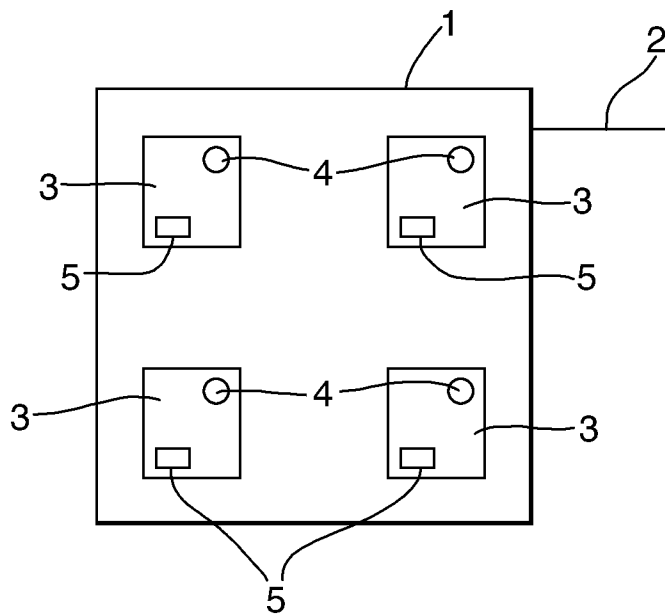
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Figure 1 shows a four channel charger 1 with a DC input 2. Four smart chargers 3 are connected to the input 2 (connections not shown). Each smart charger 3 has a SM Bus connector 4 and an indicator 5. In use a smart  
10 battery is connected to each smart charger 3 for recharging via a cable connected to the SM Bus 4.

Claims

1. A multi-channel charger comprising two or more individual smart chargers that are capable of standing  
5 alone which are all connected to a single electrical power input.
2. A charger according to claim 1 wherein each smart charger has a heat sink in contact with a heat sink on  
10 the multi-channel charger.
3. A charger according to claim 1 or 2 comprising four smart chargers.
- 15 4. A method of assembling a multi-channel charger which method comprises connecting two or more smart chargers to a multi-channel charger base-plate wherein the base-plate has a DC or AC input.
- 20 5. A method according to claim 4 wherein 4 smart chargers are connected to the base-plate.
6. Use of a multi-channel charger according to any one of claims 1 to 3 to charge a smart battery.

Fig.1.



## INTERNATIONAL SEARCH REPORT

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According to International Patent Classification (IPC) or to both national classification and IPC		
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/275372 A1 (CROWELL JONATHAN C [US]) 15 December 2005 (2005-12-15) paragraphs [0008] - [0011], [0043] - [0049], [0099] - [0102]; figures 1,6,8,9	1,3-6
X	US 6 204 632 B1 (NIERESCHER DAVID S [US] ET AL) 20 March 2001 (2001-03-20) abstract column 1, line 62 - column 2, line 39 column 4, line 1 - line 62; figures 1,3 column 6, line 49 - line 65	1-6
A	US 5 218 286 A (VANDUNK GUY J [US]) 8 June 1993 (1993-06-08) the whole document ----- -/--	
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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*A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed		*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family
Date of the actual completion of the international search  18 March 2008		Date of mailing of the international search report  02/04/2008
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  Lorenzo Feijoo, S

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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## INTERNATIONAL SEARCH REPORT

Information on patent family members

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