Title: METHOD AND APPARATUS FOR CONTROLLING HEAT IN POWER CONVERSION SYSTEMS

Abstract: A power conversion module, such as a power adapter, includes a heat removal system such as an active heat removal system, a passive heat removal system or a hybrid heat removal system. A small-size power conversion module having a heat removal system is described.
(88) Date of publication of the international search report:
13 November 2014
A. CLASSIFICATION OF SUBJECT MATTER
INVT. H05K7/20 G06F1/20
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
H05K G06F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>Y</td>
<td>EP 1 656 009 A2 (COMARCO WIRELESS TECHNOLOGIES [US]) 10 May 2006 (2006-05-10) paragraphs [0001], [0002], [0006], [0-10]; figure 1</td>
<td>1-4,10, 11,16</td>
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<td>X</td>
<td>EP 0 948 248 A1 (LUCENT TECHNOLOGIES INC [US]) 6 October 1999 (1999-10-06) paragraphs [0009], [0012] - [0015]; figure 1</td>
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* Special categories of cited documents:

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Date of the actual completion of the international search 8 July 2014

Date of mailing of the international search report 19/09/2014

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer Schneider, Florian
This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   1-6, 9-11, 16

Remark on Protest

☐ The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6, 9-11, 16

The prior art has been identified as us 6 081 425 (DI). The document DI discloses (see column 3, line 67 - column 4, line 29; column 4, line 60 - column 5, line 15; figures 2,3,5) a power adapter (100), comprising:

- a housing comprising an outer enclosure (105) (see column 4, lines 1-2) and an inner enclosure (120), wherein a plenum separates the outer enclosure (105) from the inner enclosure (102) (see figure 2), the outer enclosure (105) having at least one opening (110) to allow air flow between the plenum and an exterior or of the power adapter (see column 4, lines 17-24; figure 2); and

- an AC/DC converter within the inner enclosure, the AC/DC converter being configured to convert an AC input signal into a DC output signal (see column 4, lines 7-12).

Furthermore, the outer enclosure of DI is made of plastic materials (see column 4, lines 1-2) and the inner enclosure of DI is sealed and made of metal (see column 1, lines 60-61 and column 4, lines 5-12).

The subject-matter of claims 1-4 are thus disclosed in DI. The subject-matter of claim 5, that is "the inner enclosure has protrusions extending into the plenum." can be considered to be the Special Technical Feature of the first invention (STF1).

With these protrusions extending into the plenum, the heat transfer surface is obviously increased.

The objective problem to be solved is to improve the heat transfer rate to the air flow circulating in the plenum.

(Pb1).

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2. claims: 7, 8, 24-50, 53-55

From the comparison of claims 7,8,24-50,53-55 and the disclosure of DI, the potential Special Technical Feature of the second invention relates to the ratio between the volume of the power adapter and the output power delivered (STF2). The objective problem to be solved is to minimize the package dimensions of the power adapter for a given output power (Pb2).

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3. claim: 12

From the comparison of claim 12 and the disclosure of DI, the potential Special Technical Feature of the third invention is the plurality of DC output connectors on ports provided on the power adapter (STF3). The objective problem to be solved is to provide a power adapter that is capable of charging a plurality of different devices simultaneously (Pb3).
4. Claims: 13, 14

From the comparison of claims 13-14 and the disclosure of D1, the potential technical feature of the fourth invention concerns the plurality of cords for charging different consumer electronic devices (STF4).
The objective problem to be solved is to provide a universal power adapter that is capable of charging different types of consumer electronic devices (Pb4).

5. Claim: 15

From the comparison of claim 15 and the disclosure of D1, the potential technical feature of the fifth invention concerns the control of the temperature that changes an amount of output power produced by the AC/DC converter based on a temperature of the power adapter (STF5).
The objective problem to be solved is to prevent an overheating of the power adapter by limiting the output power (Pb5).

6. Claims: 17-23

From the comparison of claims 17-23 and the disclosure of D1, the potential technical feature of the sixth invention concerns the compartment in the housing comprising a phase change material having a transition temperature between 25°C and 85°C (STF6).
When the power adapter is in use, the heat generated by the AC/DC converter is absorbed by the phase-change material, which limits the surface temperature increase of the power adapter.
The objective problem to be solved is thus to limit the surface temperature of the power adapter to a desired operating range (Pb6).

7. Claims: 51, 52

From the comparison of claims 51-52 and the disclosure of D1, the potential technical feature of the seventh invention concerns the system for sensing, controlling and indicating the proximity or touch of a human hand (STF7).
The objective problem to be solved is thus to assist a user in finding a power adapter that is in the dark or in a difficult to reach location (Pb7).
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<th>Publication date</th>
<th>Patent family member(s)</th>
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<tbody>
<tr>
<td></td>
<td>JP 2000166238 A</td>
<td>16-06-2000</td>
<td></td>
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<tr>
<td></td>
<td>TW 470873 B</td>
<td>01-01-2002</td>
<td></td>
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<td></td>
<td>US 6081425 A</td>
<td>27-06-2000</td>
<td></td>
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<tr>
<td></td>
<td>EP 1656009 A2</td>
<td>10-05-2006</td>
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<td></td>
<td>US 2006087815 Al</td>
<td>27-04-2006</td>
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<td>US 2006279928 Al</td>
<td>14-12-2006</td>
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<td></td>
<td>US 2007297134 Al</td>
<td>27-12-2007</td>
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<tr>
<td>EP 0948248 Al 06-10-1999</td>
<td>AU 2129299 A</td>
<td>07-10-1999</td>
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<td></td>
<td>CA 2261555 Al</td>
<td>24-09-1999</td>
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<td>CN 1235509 A</td>
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<td>EP 0948248 Al</td>
<td>06-10-1999</td>
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<td>JP H11330751 A</td>
<td>30-11-1999</td>
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<td>US 6101090 A</td>
<td>08-08-2000</td>
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