



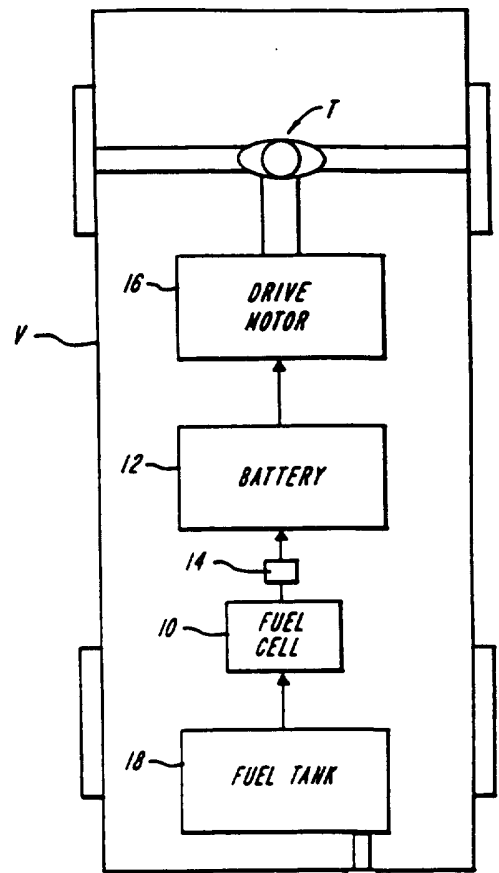
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁵ : H01M 8/00, 8/04, 10/44 H01M 16/00, B60L 11/18 H02J 7/34</p>	<p>A3</p>	<p>(11) International Publication Number: WO 93/09572 (43) International Publication Date: 13 May 1993 (13.05.93)</p>
<p>(21) International Application Number: PCT/US92/09408 (22) International Filing Date: 3 November 1992 (03.11.92) (30) Priority data: 787,218 4 November 1991 (04.11.91) US (71)(72) Applicant and Inventor: HSU, Michael, S. [US/US]; Round Hill Road, Lincoln, MA 01773 (US). (74) Agents: ENGELLENER, Thomas, J. et al.; Lahive & Cockfield, 60 State Street, Boston, MA 02109 (US). (81) Designated States: AU, CA, JP, KR, NO, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE).</p>		<p>Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 19 August 1993 (19.08.93)</p>

(54) Title: ON-BOARD RECHARGING SYSTEM FOR BATTERY POWERED ELECTRIC VEHICLES

(57) Abstract

A power supply system for powering an electric motor (16) in an electric vehicle includes a rechargeable battery (12) connected to the motor for driving the motor and a fuel cell assembly (10) connected to the battery for recharging the battery. The system further includes structure (18) for providing a supply of fuel to the fuel cell assembly which in turn converts the fuel to electricity.



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INTERNATIONAL SEARCH REPORT

PCT/US 92/09408

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶				
According to International Patent Classification (IPC) or to both National Classification and IPC				
Int.Cl. 5 H01M8/00; B60L11/18;	H01M8/04; H02J7/34	H01M10/44; H01M16/00		
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁷				
Classification System	Classification Symbols			
Int.Cl. 5	H01M ; B60L ; H02J			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸				
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹				
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³		
X	GB,A,2 004 140 (BERND MULLER-WERTH) 21 March 1979 see page 3, line 56 - line 73; claim 1; figure 1 see page 2, line 18 - line 29	1,6		
Y	---	2,4,5, 11,23		
Y	PROCEEDINGS OF THE 23RD INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE 31 JULY - 5 AUGUST 1988 DENVER, COLORADO vol. 2, 1988, pages 233 - 238 CHANG V. CHI ET AL 'AIR-COOLED PAFC AND Ni-Cd BATTERIES - A MARRIAGE THAT WORKS?' see page 233, right column, paragraph 2 see page 234, left column, last paragraph; figure 6	4		
X	---	7,9,12, 26		

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<p>¹⁰ Special categories of cited documents:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"A" document member of the same patent family</p> </td> </tr> </table>			<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"A" document member of the same patent family</p>
<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"A" document member of the same patent family</p>			
IV. CERTIFICATION				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
07 JULY 1993	22.07.93			
International Searching Authority	Signature of Authorized Officer			
EUROPEAN PATENT OFFICE	D'HONDT J.W.			

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	DE,A,4 001 684 (MERCK PATENT GMBH) 25 July 1991 see abstract ---	5,11,23, 24
P,X	DE,A,4 116 899 (NISSAN MOTOR CO) 28 November 1991 see column 5, line 51 - line 54; claims 1,2 see column 1, line 40 - column 2, line 67; figure 6 ---	1,6
P,X	JOURNAL OF POWER SOURCES. vol. 37, no. 1/2, January 1992, LAUSANNE CH pages 201 - 207 P.L. ADCOCK ET AL 'Prospects for the application of fuel cells in electric vehicles' see page 201, paragraph 2 see page 204, paragraph 2 -paragraph 3 ---	1,6
Y	US,A,4 988 283 (MAKOTO NAGASAWA ET AL) 29 January 1991 see column 8, line 51 - line 62; claims 33,35; figures 1B,1C see column 10, line 8 - line 11 ---	7,8,9, 12,24
Y	US,A,3 443 115 (JULIUS W. TIMMERMAN) 6 May 1969 see column 23, line 7 - line 14; figure 1 see abstract ---	2,7,8,9, 12,24
X		1,2,6
Y	PATENT ABSTRACTS OF JAPAN vol. 12, no. 261 (E-636)(3108) 22 July 1988 & JP,A,63 045 765 (FUJI ELECTRIC CO LTD) 26 February 1988 see abstract ---	7,8,9, 12,24
X	GB,A,2 132 108 (GENERAL ELECTRIC COMPANY) 4 July 1984 see abstract see page 2, line 52 - line 57 ---	25
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 263 (M-342)4 December 1984 & JP,A,59 136 006 (SHINKOUBE DENKI KK) 4 August 1984 see abstract ---	1
		-/--

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	EP,A,0 334 474 (FUJI ELECTRIC CO.) 27 September 1989 see abstract ---	1,6,26
X	EP,A,0 136 187 (ENGELHARD CORPORATION) 3 April 1985 see claims 1,9 ---	1,6
A	US,A,3 441 444 (RAMON J. CHESNER ET AL) 29 April 1969 see claim 1; figure 3 ---	13
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 204 (E-620)(3051) 11 June 1988 & JP,A,63 002 263 (MATSUSHITA ELECTRIC IND CO LTD) 7 January 1988 see abstract ---	14
A	US,A,4 713 303 (MOHAMMAD FAROOQUE ET AL) 15 December 1987 see claim 1; figure 1 ---	14
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 130 (E-901)(4073) 12 March 1990 & JP,A,01 320 773 (MITSUBISHI HEAVY IND LTD) 26 December 1989 see abstract ---	18
A	US,A,3 595 699 (JOHN BAUDE) 27 July 1971 see abstract; figure 2 ---	18
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 403 (E-674)(3250) 26 October 1988 & JP,A,63 143 756 (TOSHIBA CORP) 16 June 1988 see abstract ---	18
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 437 (E-826)(3785) 29 September 1989 & JP,A,01 166 470 (MITSUBISHI ELECTRIC CORP) 30 June 1989 see abstract ---	19
A	US,A,3 843 410 (DIETER SPAHRBIER) 22 October 1974 see column 5, line 3 - column 29; figure 2 -----	19

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 92/09408

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

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).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

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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 fee, this Authority did not invite payment of any additional fee.

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.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

US 9209408
SA 67221

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 07/07/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2004140	21-03-79	DE-A- 2740438	15-03-79
		FR-A, B 2402961	06-04-79
		NL-A- 7809147	12-03-79
		US-A- 4277737	07-07-81
DE-A-4001684	25-07-91	None	
DE-A-4116899	28-11-91	JP-A- 4029504	31-01-92
		GB-A- 2245438	02-01-92
		US-A- 5212431	18-05-93
US-A-4988283	29-01-91	WO-A- 8906866	27-07-89
US-A-3443115	06-05-69	None	
GB-A-2132108	04-07-84	US-A- 4473622	25-09-84
		DE-A- 3345958	28-06-84
		JP-A- 59141406	14-08-84
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		JP-A- 60109728	15-06-85
		US-A- 4962462	09-10-90
		CA-A- 1231129	05-01-88
		US-A- 4931947	05-06-90
		CA-A- 1238361	21-06-88
US-A- 4961151	02-10-90		
US-A-3441444	29-04-69	None	
US-A-4713303	15-12-87	JP-A- 63304579	12-12-88
US-A-3595699	27-07-71	None	
US-A-3843410	22-10-74	None	

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