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D E C I S I O N
of 17 April 2002

Case Number: T 0660/00 - 3.4.2

Application Number: 92924220.4

Publication Number: 0611486

IPC: H01M 8/00

Language of the proceedings: EN

Title of invention:

Recharging system for battery powered electric vehicles

Patentee:

HSU, Michael S.

Opponent:

Siemens AG
Daimler-Benz Aktiengesellschaft

Headword:

-

Relevant legal provisions:

EPC Art. 56, 123(3)

Keyword:

-

Decisions cited:

T 0069/83, T 0663/94

Catchword:

-



Case Number: T 0660/00 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 17 April 2002

Respondents: Siemens AG
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Representative: -

(Opponent 02) Daimler-Benz Aktiengesellschaft
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Appellant: HSU, Michael S.
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Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 28 April
2000 concerning maintenance of European patent
No. 0 611 486 in amended form.

Composition of the Board:

Chairman: E. Turrini
Members: A. G. M. Maaswinkel
V. Di Cerbo

Summary of Facts and Submissions

I. The appellant (proprietor of the patent) lodged an appeal, received on 30 June 2000, against the interlocutory decision of the opposition division, dispatched on 28 April 2000, on the maintenance in amended form of the European patent No. 0 611 486 (application No. 92 924 220.4). The fee for the appeal was paid on 30 June 2000. The statement setting out the grounds of appeal was received on 7 September 2000.

Opposition had been filed against the patent as a whole on the basis of Article 100(a) EPC, and in particular on the grounds that the subject-matter of the patent was not patentable within the terms of Articles 52(1), 54 and 56 EPC.

During the opposition procedure the patent proprietor filed a new main request and five auxiliary requests. During oral proceedings before the opposition division opponents 1 (Siemens AG) raised an objection under Article 123(3) EPC based on the removal from granted claim 1 of the feature "*said fuel cell system optionally operating as a primary power source for recharging said battery*".

The opposition division held that the grounds of the opposition did not prejudice the maintenance of the patent on the basis of the set of claims according to the fourth auxiliary request then on file, having regard *inter alia* to the following documents:

(E1) US-A-4 962 462,

(E4) ATZ, Automobiltechnische Zeitschrift, Vol.69, Nr. 6, June 1967, pp. 829 - 837, H.G. Plust, "Die Brennstoffzelle als Energiequelle für Fahrzeugantriebe".

II. Oral proceedings were held on 17 April 2002 at the request of the appellant. During the oral proceedings the board made reference to the following technical dictionary:

(C1) IEEE Standard Dictionary of Electrical and Electronics Terms, Fourth Edition, New York, USA, 1992, page 289, Keyword "drain".

III. The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the following sets of claims filed with the letter of 15 March 2002:

Main request:	Claims 1 to 18;
1st auxiliary request:	Claims 1 to 17;
2nd auxiliary request:	Claims 1 to 18;
3d auxiliary request:	Claims 1 to 17.

IV. The respondents 1 and 2 (Siemens AG; Daimler-Benz Aktiengesellschaft) requested that the appeal be dismissed.

V. The wording of claim 1 according to the main request reads as follows:

"A power supply system for powering an electric motor in an electric vehicle, the system comprising
a rechargeable battery (12) having an electric power storage capacity and electrical leads for

connection to the motor to deliver electrical power to the motor (16),

a fuel cell system (10) connected to said battery (12) and arranged to continuously supply power to recharge said battery (12) at a rate which is related to the energy drain of said battery (12), and

means (37,39) arranged to provide a supply of fuel and oxidizer to said fuel cell system said fuel cell system being adapted for the conversion of said fuel to electricity."

Claim 1 according to the first auxiliary request reads as follows:

"A power supply system for powering an electric motor in an electric vehicle, the system comprising

a rechargeable battery (12) having an electric power storage capacity and electrical leads for connection to the motor to deliver electrical power to the motor (16),

a fuel cell system (10) connected to said battery (12) and arranged to continuously supply power to recharge said battery (12) at a rate which is related to the energy drain of said battery (12), said fuel cell system (10) optionally operating as a primary power source for recharging said battery (42), and

means (37,39) arranged to provide a supply of fuel and oxidizer to said fuel cell system said fuel cell system being adapted for the conversion of said fuel to electricity."

Claim 1 according to the second auxiliary request is identical to claim 1 of the main request with replacement of the expression "...at a rate which is related to" by "...at a rate which is *determined by*".

Claim 1 according to the third auxiliary request is identical to claim 1 of the first auxiliary request with replacement of the expression "...at a rate which is related to" by "...at a rate which is *determined by*".

VI. The appellant's arguments may be summarised as follows.

As to the amendments, the deletion from claim 1 as granted of the feature "*said fuel cell system optionally operating as a primary power source for recharging said battery*" in claim 1 of the main and the second auxiliary request is not objectionable under Article 123(3) EPC. The optional character of this feature is supported by the fact that the feature had not been included in claim 1 as originally filed. This feature had been introduced during the examination procedure, wherein the use of the word "*optionally*" clearly expressed that this feature could be included in -but was not a necessary part of- the claimed device. That this feature is not obligatory is also readily visible from the expression prior to the optional feature "a fuel cell system connected to said battery and arranged to continuously supply power to recharge said battery at a rate which is related to the energy drain of said battery". The term "energy drain" in this expression defines the amount of energy that has been taken out of the battery. It relates to the *state* of discharge, not to the *rate* of discharge of the battery. Had the latter be meant, instead of the expression "*energy drain*" the expression "*power drain*" would have been used. The citation C1 for the definition of the word "drain" does not lead to a different view, because this citation only defines the term "drain" and not "energy drain". Therefore the

feature in claim 1 that the fuel cell recharges the battery at a rate which is related to its energy drain (*i.e. the amount of energy left in the battery*) covers both operation modes (the mode wherein an external load is connected to the battery to which the battery delivers energy; or a second mode wherein the battery is recharged without such external load), during which the fuel cell always acts as a trickle charger for the battery. The optional feature only defines that the fuel cell may have a secondary use, such as providing power for uses other than recharging the battery, as explained in column 4, lines 3 to 6 of the patent specification. The further feature in the second and third auxiliary request that the battery is recharged at a rate which is *determined* by the energy drain of the battery is supported by the disclosure, see the patent specification in column 3, line 57 to column 4, line 1.

With respect to the issue of patentability, the closest prior art is represented by document E1, which discloses a hybrid fuel cell stack battery power system in which the fuel cell is used to provide battery recharging power. In the system according to E1 the fuel cell is operated at its designed peak power output to provide maximum efficiency of the fuel cell stack (column 3, lines 37 to 40). If the battery is fully charged the fuel cells are disconnected from the system in order to prevent damage that could be caused to maintaining the power input to a charged battery. This is illustrated in Tables I - III in E1. Therefore the teaching in E1 concerns a hybrid system in which all *individual components* are optimised. This idea is in contrast to the concept underlying the claimed invention, which offers a fuel cell system where the

system as such has been optimised. By defining that the fuel cell is connected to the battery for continuously supplying power to the battery and permanently recharging it in a trickle-charge mode the fuel cell can be designed at a lower rated power output and corresponding reduced cooling requirements. This results in an inherent stable, smaller size device, having less weight, which means that also the vehicle in which the system is installed can be more efficient. Therefore by making the special choice of a smaller size fuel cell recharging the battery via trickle charge there is no risk of overcharging the battery and the switching means which are needed in the device of E1 are avoided. The claimed subject-matter is hence novel over E1 (*all requests*). The further prior art disclosed in E4 is more remote, because that document does not disclose a fuel cell and a battery in combination in a vehicle, which renders this document unsuitable as closest prior art. Furthermore E4 does not teach how the fuel cell and the battery in the embodiment of Figure 16 are connected.

As to the question of inventive step, the power supply system defined in claim 1 differs from the system in E1 in the two features, that the fuel cell system must be *continuously* connected to the battery (*in E1: intermittent connection*); and that the power supplied to the battery from the fuel cell is *not independent* of the load on the battery. In contrast, because the fuel cell in the system according to E1 operates at constant (*maximum*) operating power, it is necessary to connect and disconnect the batteries frequently in order to prevent damaging the battery, see column 8, lines 29 to 41. The skilled person would not be led to *continuously* connect the fuel cell and the battery, because such a

measure would go against the above teaching of document E1. These features are also not known from other prior art documents. In particular document E4 is quite non-committal concerning the electrical arrangement and does not teach or suggest *continuously* recharging a battery with a fuel cell, nor recharging the battery at a rate related to the energy drain thereof. Instead it only discloses charging the battery with the fuel cell during only one state, during *low* drive conditions (*Figure 16, operation regime "a"*), in contrast to the invention, which teaches to charge the battery in relation to the rate of discharge, i.e. the heaviest during *high* loads.

The above arguments are valid for claim 1 according to all requests, because claim 1 of all requests relates to the idea of a power supply system in which the fuel cell is continuously connected to the battery and is always powered on. Furthermore, claim 1 according to the second and third auxiliary requests which recites that the rate in which the power from the fuel cell is supplied to the battery is *determined by* its energy drain should in particular include patentable subject-matter, because this feature expresses more specifically that for a given energy drain on the battery there will be a given power supplied by the fuel cell.

VII. The respondents' arguments may be summarised as follows.

Amended claim 1 of the main request and the second auxiliary request infringes Article 123(3) EPC. Claim 1 according to these requests defines a recharging system in which a fuel cell is arranged to continuously

recharge a battery by means of trickle charging. The concept of trickle charging includes a transfer of energy in small quantities, which is only possible if the battery is permanently connected and is not under an external load. Therefore the feature defining that the fuel cell operates as a primary power source for recharging the battery is in fact not "optional", but defines the trickle charging of the battery under conditions of no energy drain on the battery. In this respect, an "energy drain" is understood to imply a "flow" of energy.

With respect to the issue of novelty, document E1, Figure 1, discloses a power supply system comprising a rechargeable battery 14, connected to a load device (e.g. of a motorized vehicle, see column 4, lines 18 to 20); a fuel cell system 10 and means for supplying fuel and oxidizer to the fuel cell (*implicit in any fuel cell system*). With reference to the appellant's argument that in the system disclosed in E1 the fuel cell is not arranged to continuously supply power to the battery, because according to Tables I - III the contacts between these are disconnected depending on the sensed load, it is pointed out that according to E1, column 7, lines 40 to 47, the battery does not have to be disconnected. The further feature in claim 1 that the battery is recharged at a rate which is related to the energy drain of the battery is a very broad feature. Since recharging the battery is only possible if there is a voltage difference between the fuel cell and the battery, and the claimed feature does not require anything more specific, this feature is automatically met by the system in E1. Therefore in the vast majority of load conditions the system in E1 is not distinguished from the claimed system. Furthermore

document E4, see Figure 16 and the corresponding description on page 182, discloses a voltage-current diagram of a combination of a fuel cell and a battery for an electric vehicle (*caption of Figure 16*). If the external load is small (voltage >40V), the fuel cell recharges the battery. This is the similar case as in the patent in suit of recharging the battery under no-load condition. As the diagram shows, under high-load conditions a current of 611A is drawn mainly from the battery which in this case corresponds to an electric power of 18 kW, which falls within the range of 14.92 - 74.6 kW indicated in column 4, line 10 of the patent specification. Since document E4 does not discuss connecting and disconnecting of the fuel cell and the battery, there is no reason to assume that the system disclosed in E4 would be switched and it is implicit that it is arranged to continuously supply power to recharge the battery according to the diagram in Figure 16. As to the feature in claim 1 according to the second and third auxiliary requests wherein "related to" has been replaced by "determined by", these features are only formally different: since the rate of recharge is in any case dependent on the terminal voltage of the battery and is therefore determined by the height of this voltage, the reworded feature is also anticipated by the systems disclosed in E1 and E4. Therefore the subject-matter of claim 1 of all requests is known from documents E1 and E4.

For the issue of inventive step, if a difference between the subject-matter of claim 1 and the system disclosed in document E1 is to be seen in the switches for connecting and disconnecting in the latter system and the rate of charging of the battery, the question arises which technical problem is addressed by these

differences. If the patent proprietor asserts that these switches are not necessary and that their presence is caused by a technical prejudice in the prior art, it is pointed out that the patent does not offer any solution as to how to overcome this prejudice. The patent does not disclose measures to solve the problem of overcharging the battery if the switches in the system of E1 are eliminated. If the problem were to reside in the simplification of that system, this would be anyway obvious to the skilled person. Therefore the feature "arranged to continuously supply power to recharge the battery" in claim 1 as opposed to the connection/disconnection of the circuit in E1 cannot involve any inventive activity, in particular because the circuit in E1 will be closed under almost all circumstances, and the problem addressed and solved in E1 by opening the switches is not solved in the patent. With respect to the further feature related to the rate at which the fuel cell recharges the battery it is noted that the skilled person in constructing a fuel cell/battery hybrid system as disclosed in E1 would have the option of different fuel cells and batteries, for instance the combination with the performance as shown in Figure 16 of E4. In implementing a combination with this voltage-current characteristic he would obtain a system in which the battery is recharged at a rate "*related to*" or "*determined by*" the energy flow or drain from the battery, because in the operation regime "a" it is mainly recharged, and in the operation regime of high currents there is less recharging. Since the claim does not specify the nature of the relation of the rate of recharging and even the patent does not provide any further quantitative or even qualitative information concerning this relation, the functionality shown in

Figure 16 of E4 also falls under the very general definition in the claim. Therefore, by combining the teachings of documents E1 and E4 the skilled person would arrive at the subject-matter of claim 1 according to all requests without an inventive step being involved.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments*
 - 2.1 *Main and second auxiliary request.*
 - 2.1.1 In claim 1 according to these requests the feature of claim 1 as granted "*said fuel cell system optionally operating as a primary power source for recharging said battery*" has been deleted. Whereas in the decision under appeal the opposition division had argued that this feature was only contained as an option in the claim, which could be excised without infringing Article 123(3) EPC, which view is also shared by the appellant, the respondents are of the opinion that in spite of its wording the feature is not "optional".
 - 2.1.2 In order to establish whether the excision of this feature from the claim would lead to an inadmissible extension of the protection of the granted claim, the feature is considered in the context of the expression in claim 1 as granted defining the charging of the battery by the fuel cell system and in the light of the patent specification. According to granted claim 1 the

following conditions for the recharging are defined:-

- (i) the fuel cell is connected to the battery for continuously supplying power to the battery at a rate which is related to the energy drain of the battery;
- (ii) the fuel cell optionally operates as a primary source for recharging the battery.

2.1.3 Condition (i) defines that the fuel cell will recharge the battery in dependence of the "energy drain" of the battery. The appellant has argued that the meaning of the expression "energy drain" is the amount of energy which has been taken out of the battery, i.e. the state of discharge of the battery, and that this definition with this meaning is commonly used in electrical engineering.

2.1.4 According to the respondents, the term "drain" is to be understood as a "flow", which would imply that an "energy drain" implies a "flow of energy", i.e. a rate of energy taken from the battery, rather than the (dis)charge state of the latter. The patent specification does not offer much information in this respect. The only reference to "energy drain" is the sentence in column 3, line 57 to column 4, line 1, "*The steady power output of the fuel assembly is determined by the energy drain on the battery*". Save the differences in prepositions "drain on the battery" instead of "drain of the battery" which, however, would rather support the view that a drain defines a rate, no further information on the interpretation of this controversial phrase may be found in the patent. Therefore the board has relied on the definition of

"drain" in the dictionary C1, which is an acknowledged American National Standard. According to the keyword "drain", its general meaning is *"The current supplied by a cell or battery when in service"*. In the context of "energy drain" this should accordingly imply "the energy supplied by ..a battery when in service", i.e. *"energy per unit time"* or *"energy rate"*. The appellant's argument that to define an "energy rate" the skilled person would have used the expression *"power drain"* fails to convince the board, because the concept of electric power already implies a flow of energy, therefore "power drain" would appear to include a tautological definition of flow of electric charge. For the record it is pointed out that this dictionary neither has a reference to a keyword "energy drain" nor to "power drain". It is finally remarked that the expression in the claim does not contain the phrase *"the energy drained"* which indeed could be understood as a *state* or *situation* of the battery. Therefore, in the board's opinion, the patent specification leaves no room for applying any other than the commonly used definition to the term "drain" in the technical field of electrical and electronic engineering, as documented in the citation C1, and the expression "energy drain" is read as the "flow of energy" supplied by the battery (to the electric motor) when in service.

- 2.1.5 In this interpretation, the condition (i) therefore defines that the fuel cell system is arranged to continuously supply power to recharge the battery at a rate which is related to the energy flow from the battery to the load (electric motor). This interpretation is supported by the patent specification: see column 6, lines 40 to 42, *"...during full power operation of the motor 16 and, hence, full*

power operation of the fuel stack C", from which it may be concluded that the fuel cell power output is directly related to the energy flow from the battery to the motor. In contrast, if there is no load on the battery, according to this condition (i), there would not be a recharge of the battery, because its energy drain or flow is zero in this case.

2.1.6 The operation of the fuel cell under zero-load conditions appears to be defined in condition ii), according to which the fuel cell operates as a primary power source for recharging said battery. Reference is made to the patent specification. In column 3, lines 50 to 54, it is disclosed that "*(In accordance with the invention) the fuel cell assembly is utilized to continuously provide power for recharging a battery which powers the motor*" and "*In this regard, the fuel cell assembly acts as a trickle charger for the battery*". The expression "trickle charger" in its usual meaning may be understood as a charger that works at a low rate. Furthermore column 4, lines 39 to 41, discloses "*The fuel cell, under steady operation, is primarily utilized for on-board recharging*". It would therefore appear that in addition to the operation of the fuel cell at times where the motor consumes energy and during which the fuel cell system *continuously supplies power to recharge the battery at a rate which is related to the energy drain of the battery* which may even imply "full power operation of the fuel stack" (*see the citation supra*) which would be in contradiction to "trickle charging", the feature ii) defines the operation of the fuel cell at times where there is no active load and that at such times it recharges the battery as a trickle charger.

2.1.7 Hence, to the board's understanding, the feature in granted claim 1 "said fuel cell optionally operating..." should, in the light of the patent specification, be understood as "said fuel cell in addition operating...". Because this feature appears to be an integral part of the claimed device it may not be deleted from the claim without infringing Art.123(3) EPC.

2.1.8 Since this feature from granted claim 1 has been deleted in claim 1 according to the main and the second auxiliary requests these requests are inadmissible under Article 123(3) EPC.

2.2 First and third auxiliary requests

Claim 1 from the first auxiliary request basically corresponds to granted claim 1. Claim 1 of the third auxiliary request is identical to claim 1 of the first auxiliary request with the exception that the expression "...at a rate which is related to" is replaced by "...at a rate which is *determined by*". The respondents have not forwarded any observations against these amendments, nor can the board see an objection under Article 123(2) or (3) EPC.

3. *Novelty - first and third auxiliary request*

3.1 Document E1 discloses a power supply system for powering an electric motor in an electric vehicle ("*load device 16*", see *Figure 1*; and *column 4, lines 18 to 20*). The system comprises one or more rechargeable batteries 12, having an electrical power storage capacity and electrical leads (*Figure 1*) for connection to the motor to deliver electrical power to the motor;

a fuel cell 10 connected to the battery; and means arranged to provide a supply of fuel and oxidizer to the fuel cell system, the fuel cell system being adapted for the conversion of the fuel to electricity (*implicit in any fuel cell system*). The system disclosed in E1 includes switches (*relays 18', 20', 22'*) and control means enabling the fuel cell to be taken out of the system when its predetermined maximum energy output is about to be exceeded by load requirements and to protect the battery from overcharge (*see: Abstract of E1*).

3.2 Since in the system disclosed in E1 the fuel cell and the battery are connected and disconnected in dependence of the charge state of the battery, the feature in claim 1 of the first and third auxiliary request that the system is "arranged to continuously supply power to the battery" is not known from this document.

3.3 Document E4, in particular Figure 16 and page 182, right column, Section 5, discloses a combined energy source - fuel cell / rechargeable battery for an electric traction vehicle (*caption of Figure 16*). From the voltage/current characteristic shown in Figure 16 it is observed, that the system has an operative regime ("a") in which the fuel cell drives both the load and recharges the battery; and a second operative regime (*right hand side of diagram*) in which the current to the load is delivered mainly by the battery. Document E4 does not disclose whether the fuel cell is arranged to *continuously* supply power to the battery. Therefore this feature in claim 1 according to the first and third auxiliary requests is not known from document E4.

3.4 It is concluded that the subject-matter of claim 1 of these requests is therefore novel.

4. *Inventive step - first auxiliary request*

4.1 Closest prior art

4.1.1 The appellant has submitted that document E1 is to be regarded as the closest prior art and that document E4, save the diagram in Figure 16 and a paragraph on page 182, does not present a clear teaching which could be the starting point for a discussion of inventive step based on the problem-solution.

4.1.2 As discussed in Section 3 *supra*, both documents E1 and E4 disclose power supply systems of the generic type defined in claim 1 of the first auxiliary request. In the board's opinion, it therefore appears appropriate to consider each of these documents as a possible starting point for the discussion of inventive step.

4.2 Document E1

4.2.1 The subject-matter of claim 1 differs from the disclosure of E1 in the feature that the fuel cell is connected to the battery and arranged to continuously supply power to the battery, whereas the system disclosed in E1 is switched. In the appellant's opinion a further difference is that in the claimed system the battery is recharged at a rate which is related to the energy drain of the battery.

4.2.2 With respect to the first feature, the connection of the fuel cell to continuously supply power to the battery, the appellant has argued that the idea

underlying this difference resides in a power supply system comprising a fuel cell and a rechargeable battery in which -in contrast to E1 - the system as a whole has been optimised. The solution involves a permanent connection of the fuel cell to the battery and continuously recharging it in a trickle-charge mode, and, furthermore, to design the system with a smaller size fuel cell. The respondents have expressed their view, that the only objective problem which may be identified based on the present disclosure is that of simplifying a system, which would be a constant aim of every skilled person.

- 4.2.3 Having regard to the patent specification as a whole, the board is unable to find unambiguous and convincing support for the appellant's position that the disclosure provides a teaching of a fuel cell / battery system following a quite different philosophy than the prior art. Firstly, the disclosed system does apparently not exclusively recharge the battery with trickle charge in its common meaning (*i.e.*, a charger that works at a low rate). According to the patent specification, see column 2, line 55; and column 6, lines 40 to 42, under full-load conditions the fuel cell delivers full power, which appears contradictory to trickle-charging. Furthermore, neither claim 1 nor the patent specification addresses the problem of overcharging the battery or using the fuel cell beyond its rated capacity, nor does the patent give any information why in the disclosed device these problems do not occur or how they are overcome. Hence, in the board's opinion, it would appear for the skilled person reading the patent in suit, that these problems underlying the teaching in document E1 have not been addressed in the patent.

- 4.2.4 Therefore, the problem originating from the difference of the claimed system over the one disclosed in document E1, the system arrangement without the switches and their controller, may only be seen in a simplification of a prior art system wherein the disadvantages originating from the simplification are accepted. In the opinion of the board, such a measure does not attribute to an inventive step, as has been ruled in earlier cases before the boards of appeal. See, for instance, T0069/83 (OJ 1984, 357); and in particular case T0663/94 (*unpublished*), where in point 3.4 of the Reasons the board ruled that if an objective problem resides in the predictable optimisation of one parameter of system which at the same time accepts as a predictable consequence a deterioration of another property of the system such a solution must be considered as obvious.
- 4.2.5 As to the second feature in claim 1 of the first auxiliary request that the battery is recharged at a rate which is related to the energy drain of the battery, it is noted that the expression "*related to*" stands for a quite unspecific instruction. Indeed it is not specified which functional dependence this should imply (*for instance, a proportionality or an inverse proportionality*). Furthermore, also the patent specification appears to be silent with respect to this "relation". Therefore for the discussion of a contribution to inventive step this feature may only be assessed in the general sense that the recharge of the battery by the fuel cell is at a rate which is (somehow) related to the energy drain.
- 4.2.6 With respect to the particular power supply system of E1 the following is noted. Should the skilled person

wish to simplify this system by abandoning the switches, therewith taking into account possible disadvantages (see 4.2.4 *supra*), for instance, if he were convinced that his particular system would always work within its safety limits (see, for instance, E1, column 7, lines 40 to 47), in such a modified system the current provided by the fuel cell to the battery would, as a matter of course, be related to the particular conditions of the battery. It would depend of the internal resistance of the battery and its terminal voltage, which are bound to be influenced by a current flow between the battery and its load. Hence, within the general meaning of the expression in claim 1 the recharge current rate in the thus modified system of E1 would be "related to" the energy drain of the battery.

4.2.7 Therefore, the skilled person wishing to simplify the power supply system in E1 by removing the switches would necessarily arrive at a system with all features of the one defined in claim 1 of the first auxiliary request.

4.3 Document E4

4.3.1 As discussed in Section 3.3, document E4 is silent with respect to the feature that the fuel cell is arranged to *continuously* supply power to the battery. In the appellant's opinion, from the disclosure in this document the skilled person does not obtain any information how to construct a power supply system including a fuel cell and a rechargeable battery. Furthermore, in his view, the charging behaviour shown in Figure 16, operation regime "a" would be in the opposite direction to the one defined in claim 1.

4.3.2 The board does not concur with this assessment. It is correct that document E4 does not disclose an electrical circuit showing the connections between the fuel cell, battery and a load. However, from the voltage-current characteristic in Figure 16 and the Figure's caption it is evident that this functionality is the result of a combined fuel cell / battery / load system. Document E4 does not address the potential problem of overcharging the battery or overloading the fuel cell, and in this respect it is similar to the patent in suit. Since the skilled person, in wishing to construct a power supply system with a similar behaviour as shown in Figure 16 of E4, is not *a priori* advised against realizing such a system as simple as possible, he would automatically arrive at a system wherein fuel cell, battery and load are connected.

4.3.3 Furthermore, as may be concluded from the voltage-current characteristic in Figure 16 of E4, in dependence of the external load on the system, there is a clear functionality between the current from the fuel cell, the battery current, and the recharge current from fuel cell to battery. Therefore it must be concluded that, within the general meaning of claim 1, the fuel cell in the system in Figure 16 of E4 recharges the battery at a rate which is related to the battery's energy drain.

4.4 In conclusion, the subject-matter of claim 1 according to the first auxiliary request does not involve an inventive step within the meaning of Articles 52(1) and 56 EPC.

5. *Inventive step - third auxiliary request*

- 5.1 Claim 1 of the third auxiliary request is identical to claim 1 of the first auxiliary request with the exception that the expression "...at a rate which is related to" is replaced by "...at a rate which is *determined by*". The appellant has argued that the phrase "*determined by*" is more specific than the phrase "*related to*".
- 5.2 For the assessment of this feature to a contribution to inventive step the observations made in Section 4.2.5 equally apply to the phrase "*determined by*". With the exception of column 3, line 58, the patent specification is silent with respect to this feature. Furthermore, in the board's conviction, also the sentence referred to "The steady power output of the fuel cell assembly is determined by the energy drain on the battery" does not provide any further teaching over the verbal feature in the claim. Therefore the assessments of the modified system of E1 (Section 4.2.6) and the system of E4 (Section 4.3.3) for this feature apply correspondingly.
- 5.3 It is concluded that the subject-matter of claim 1 according to the third auxiliary request does not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

E. Turrini