Europäisches Patentamt
Beschwerdekammern

European Patent Office
Boards of Appeal

Office européen des brevets
Chambres de recours

Veröffentlichung im Amtsblatt	Ja/Nein
Publication in the Official Journal	Yes/No
Publication au Journal Officiel	Oui/Non

Aktenzeichen / Case Number / N° du recours : T 294/89 - 3.4.1

Anmeldenummer / Filing No / N° de la demande : 82 300 736.4

Veröffentlichungs-Nr. / Publication No / N° de la publication : 0 059 053

Bezeichnung der Erfindung: Switched mode power supply
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : H05B 41/24

ENTSCHEIDUNG / DECISION

vom / of / du 25 October 1990

Anmelder / Applicant / Demandeur : THORN EMI plc

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (no)"

Leitsatz / Headnote / Sommaire

Europäisches Patentamt
Beschwerdekammern

European Patent Office
Boards of Appeal

Office européen des brevets
Chambres de recours

Case Number : T 294/89

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 25 October 1990

Appellant : THORN EMI plc
THORN EMI House
Upper Saint Martin's Lane
London, WC2H 9ED (GB)

Representative : Marsh, Robin Geoffrey
Thorn EMI Patents Limited
The Quadrangle
Westmount Centre, Uxbridge Road
Hayes
Middlesex, UB4 0HB (GB)

Decision under appeal : Decision of Examining Division 045 of the European Patent Office dated 25 November 1988 refusing European patent application No. 82 300 736.4 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : K. Lederer
Members : H. Reich
L. Mancini

Summary of Facts and Submissions

I. European patent application No. 82 300 736.4 (publication No. 0 059 053) was refused by decision of the Examining Division.

II. The reason for the refusal was that the subject-matter of Claim 1 as filed on 7 March 1988 with letter dated 24 February 1988 lacked an inventive step within the meaning of Article 56 EPC, inter alia, in view of the following documents:

D1: GB-A-1 496 129 or alternatively
D2: GB-A-1 496 130 and
D3: "Das Linear Spektrum '80", Texas Instruments Deutschland GmbH, München, 1980, pages 30-41.

III. The Appellant lodged an appeal against this decision. Annexed to the Statement of Grounds he filed a new set of claims as his main request and a further set of claims as his auxiliary request.

IV. The independent claims of the main request read as follows:

"1. A switched mode power supply operative on input unidirectional current derived by a full-wave rectifier from an alternating current supply to provide an output unidirectional current to a load, the power supply including switching means; control means for controlling the switching means to render it successively conductive and non-conductive to maintain the instantaneous magnitude of the input unidirectional current within a predetermined range

of the instantaneous magnitude of a reference signal which is a predetermined function of at least the alternating supply voltage characterised in that a capacitance is connected across the output of the power supply via a series arrangement of an inductor and a device which is rendered conductive alternately with the switching means, said capacitance allowing a substantially constant output voltage to be supplied to a load, the switching means being in parallel with the series connection of the device and the capacitance to control the current supplied to the load without breaking the input current path.

3. A switched mode power supply, operative on unidirectional current derived by a full wave rectifier from an alternating current supply, to provide a unidirectional output current to a load, the power supply including a converter circuit and control means responsive to the load or input current to generate a reference signal to control the converter circuit so that the phase difference between the input current and the input voltage is maintained within predetermined limits characterised in that the converter comprises a step-up voltage converter which includes a switch which does not break the input current path and a capacitance connected across the output of the supply which allows a substantially constant output voltage to be supplied to a load."

Claim 2 is dependent on Claim 1, Claim 4 is dependent on Claim 3 and Claims 5 to 9 are referred back to both independent claims.

V. Claim 1 of the auxiliary request corresponds to Claim 2 of the main request, i.e. to the wording of Claim 1 of the

main request wherein after its last words "input current path" the following wording is added:

"and in that the reference signal is a signal derived from the output of the full-wave rectifier to maintain a power factor substantially at unity."

Independent Claim 2 of the auxiliary request corresponds to Claim 4 of the main request, i.e. to the wording of Claim 3 of the main request wherein after its last words "supplied to a load" the following wording is added:

"and in that the converter circuit is arranged to respond to the reference signal to match the waveform of the input current to the waveform of the input voltage within predetermined limits."

Claims 3 to 7 of the auxiliary request, corresponding to Claims 5 to 9 of the main request, are referred back to both independent claims.

VI. In his Statement of Grounds the Appellant argued essentially as follows:

(a) There would be no technical basis for replacing in the power supply of document D1 or D2 part of the circuit by the circuit of Figure 7 of document D3, i.e. in essence no basis for changing the circuit position of the switching means from being in series with the load to being in parallel with the load and for modifying thus a step-down converter into a step-up converter. The advantage stated in document D3, page 30, middle column, last paragraph, with regard to lack of feedback into the alternating current supply (means) refers to Figure 3 of D3 which represents no step-up converter as Figure 7 but a

step-down converter. Such a redesign of the step-down converter circuit of document D1 or D2 into a step-up converter as claimed would not be an obvious development even if the step-up converter of D3 would be known to have advantages.

(b) Due to the fact that document D3 on page 31, middle column explicitly states that in the circuit of Figure 7 exists a time (t_3) during which the switching means are open but the inductor is not delivering any energy, a circuit according to Figure 7 of document D3 would not overcome the problem of a discontinuous input current, whereas the claimed invention would match input current and input voltage as to the waveform and so avoid harmonic distortion; see the application, page 4, lines 17-23.

(c) The circuits shown in Figures 5 and 7 of document D3 have been well known in the art before the priority dates of documents D1 and D2 as documents A to F annexed to the Statement of Grounds would prove:

If it had been obvious at the priority date of the present application to incorporate the circuit according to document D3 into a power supply of document D1 or D2, already in these two known power supplies, the problem of reducing the feedback of switching harmonics (i.e. isolating the high frequency chopping from the 60 Hz supply line) mentioned in document D2, page 3, lines 29-36, would have been solved by a step-up converter instead by using an additional high frequency filter in a step-down converter.

(d) In the power supplies of documents D1 and D2 the reference signal would only be in phase with the line voltage - as stated in document D2, page 3, lines 72-74 - but not be matched as to waveform for a unity power factor (as defined in Claims 1 and 2 of the auxiliary request).

VII. In a communication pursuant to Article 110(2) EPC doubts were expressed that the subject-matter as claimed in both the main and the auxiliary requests would involve an inventive step.

VIII. In response to the communication of the Board of Appeal the Appellant maintained his requests to grant a patent with the claims according to his main request (see point IV above) or, in the alternative, with the claims according to his auxiliary request (see point V above), both sets of claims submitted together with his Statement of Grounds.

In support of his requests he emphasised the arguments in his grounds of appeal according to points VI-b and VI-d above.

Reasons for the Decision

1. The appeal is admissible.

2. There is no objection to the claims of the main and auxiliary requests as far as Article 123(2) EPC is concerned.

3. **Novelty - Main and Auxiliary Requests**

3.1 From document D1 or D2 only the features defined by the identical wording of the preambles of Claims 1 of the main and auxiliary requests and the features defined by the identical wording of the preambles of Claim 3 of the main request and Claim 2 of the auxiliary request are known; see for instance document D2, Figure 1 with regard to full-wave rectifier 22, alternating current supply 20, 21, load 30, switching means 25, control means 34, 35, 36 and Figures 2 and 3 and page 4 with regard to the claimed effects of the reference signal in the control means. The essential difference of the subject-matter claimed in all said claims with regard to the switched mode power supply known from documents D1 or D2 is the fact that the claimed switching means are located "in parallel to a capacitance across the output", i.e. in parallel to the load and "do not break the input current path", whereas the known switching means are located in series with the load and break the input current path.

3.2 From Figure 7 of document D3 there is known a switch mode power supply according to the features of the characterising parts of Claims 1 and 3 of the main request. However, document D3 is silent about control means for controlling the known switching means and where the input current is derived from.

3.3 The above facts have not been contested by the Appellant.

3.4 The remaining documents cited in the Search Report or mentioned by the Appellant do not come closer to the subject-matter of the independent claims of the main and auxiliary requests.

3.5 For these reasons, the subject-matter of Claim 1 and Claim 3 of the main request and the subject-matter of Claim 1 and Claim 2 of the auxiliary request is considered novel within the meaning of Article 54 EPC.

4. **Inventive step - Main Request**

4.1 It is in accord with that expressed in a host of decisions of the Boards of Appeal that the problem has to be determined objectively by comparing what is achieved by the subject-matter of a claim under consideration with that achieved by the nearest prior art.

Starting from the nearest prior art as disclosed for instance in document D2, the objective technical problem solved by the essential identical technical means defined in independent Claims 1 and 3 of the main request is, in the Board's view, to provide from a specific AC supply voltage a smoothed unidirectional voltage output at a level appropriate to the load to be supplied in such a way that either less switch-operation generated harmonics are fed back to the mains or that feedback is held at an acceptable level without the use of the filters employed in the power supply known from document D2.

The problem to prevent harmonics from getting back into a mains is well known in the art, see for instance document D1, page 4, lines 106 to 110. Thus, no contribution to inventive step is to be found in the recognition of the above-stated objective problem underlying the claimed subject-matter.

4.2 The above problem is solved by the technical means defined by the wording of the characterising parts of independent Claims 1 and 3. Both said claims describe with different

words the circuit arrangement known from Figure 7 of document D3. This fact was not contested by the Appellant.

4.3 However, the Board is not able to see in the arguments presented by the Appellant - in particular those stated in points VI-a - any concrete points, why the redesign of the step-down converter known for instance from Figure 1 of document D2 according to the teaching of Figure 7 of document D3 would surpass the routine capabilities of a skilled person. Due to the fact that there is nothing in the present application to indicate that any serious difficulties had in practise to be solved, and that in the cited prior art documents there is no suggestion of a problem going beyond the routine in redesigning a series type converter into a parallel-type converter, the Board takes the view that there exists no intellectual impedement of the skilled person in realising technically the teaching of document D3 in the supply of document D2. The skilled man could not have failed to realise that the parallel circuit of document D3 maintains its essential functions as a chopper circuit with as well a DC input (such as present in documents A to F cited by the Appellant) as an AC input (such as present in document D2). In particular, the Board is convinced that a skilled person will be able to verify that the control of the input current "within a predetermined range of the instantaneous magnitude of the reference signal" - such as presented in Figure 2 of document D2 - is also possible when the known control means 34, 35, 36 in Figure 1 of document D2 are reorganised to deliver their control signal to a switching means not in series but in parallel with the load without influencing the feedback properties of the circuit known from document D3.

4.4 The Board is not able to follow the Appellant's view that a skilled person will attribute the advantage mentioned in

document D3, page 30, middle column, last paragraph, i.e. no retroaction back to the mains, to the input-output voltage relationship, i.e. to the fact that Figure 3 of document D3 is a step-down converter. In the Board's view the skilled person is able to recognise that said advantages are caused by the parallel position of the switching means, which he finds again in Figure 7 of document D3. At any rate, a skilled person would recognise that a parallel circuit is a better means to prevent harmonics from getting back into the mains, in particular because the HF current would have an alternative path through the known diode-capacitor series circuit, whereas the series circuit includes the inductor (29 in Figure 1 of D2). Hence, in the Board's view, a skilled person would be incited to make use of the above-mentioned advantageous properties of the parallel circuit according to Figure 7 of document D3 in the closely analogous situation of the power supply known from Figure 1 of document D2.

4.5 The argument according to point VI-c in support of inventive step, based on the fact that although the circuit of Figure 7 of document D3 had been known for a long time it had not been used by the authors of document D2, is unconvincing in the absence of any solid evidence that these circuits were generally regarded as unsatisfactory or that others had tried without success to find a solution to the problems solved by the present application.

4.6 For the above reasons, the subject-matter of independent Claims 1 and 3 of the main request is not considered to involve an inventive step within the meaning of Article 56 EPC.

5. Therefore, independent Claims 1 and 3 of the main request are not allowable under Article 52(1) EPC. Claim 2 of the main request is dependent on Claim 1 and Claims 4 to 9 of the main request are dependent on Claim 3 and, therefore, also not allowable. Hence, the Appellant's main request has to be rejected.

6. **Inventive step - Auxiliary Request**

6.1 For the reasons set out in point 4.1 above, the objective problem underlying Claims 1 and 2 of the auxiliary request remains the prevention of harmonics from getting back into the supply, which is regarded not to contribute to inventive step.

6.2 The feature stated in point V, which distinguishes the auxiliary Claim 1 from main Claim 1 - and which was present in the version of Claim 1 on which the refusal of the Examining Division was based - is regarded as being an alternative way of deriving the reference voltage (see document D2, page 2, lines 8-23), which way is deemed to be an obvious one for a skilled person wishing to simplify the control circuits according to Figures 11 and 14 of document D2. Moreover, said additional feature provides no surprising advantage and, above all, it does not make any contribution to solving the problem indicated in point 6.1 above. Hence, said additional feature of Claim 1 of the auxiliary request is not relevant for assessing the inventive step of the combination of features claimed in auxiliary Claim 1 (see also decision T 37/82, OJ EPO 1984, 71). Thus, the reasoning of lack of inventive step as set out in detail in points 4.1 to 4.5 above applies also to auxiliary Claim 1.

6.3 The feature stated in point V, which distinguishes Claim 2 of the auxiliary request from Claim 3 of the main request, is known from document D2, page 2, lines 30 to 35 and page 4, lines 98 to 102 in conjunction with Figure 3. In particular, Figure 3 of document D2 clearly shows that in the known power supply the waveform of the input current is matched to the input voltage. The Appellant has not challenged this fact nor has he argued why it should be inventive to incorporate the known waveform-matching additionally in a power supply having the features of Claim 3 of the main request. In the Board's view, no inventive step is involved in applying said additional feature to the power supply of Claim 3 of the main request. It is basic knowledge that an undistorted current waveform increases the power factor. Hence, the effects of said additional features are foreseeable to a skilled person.

6.4 For the reasons set out in points 6.1 to 6.3 above, Claims 1 and 2 of the auxiliary request lack inventive step within the meaning of Article 56 EPC.

7. For the above reasons, independent Claims 1 and 2 of the auxiliary request are not allowable under Article 52(1) EPC. Claims 3 to 7 of the auxiliary request depend on Claims 1 and 2 and are, therefore, also not allowable. Hence, the Appellant's auxiliary request has to be rejected as well.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: **The Chairman:**

P. Martorana **K. Lederer**