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**Datasheet for the decision
of 15 May 2012**

Case Number: T 1775/08 - 3.5.02

Application Number: 98965476.9

Publication Number: 1050092

IPC: H02H 9/00, H03H 7/03

Language of the proceedings: EN

Title of invention:
Power conditioning circuit

Applicant:
Leveler

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - (yes after amendment)"

Decisions cited:
-

Catchword:
-



Case Number: T 1775/08 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 15 May 2012

Appellant: Leveler
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 17 April 2008
refusing European patent application
No. 98965476.9 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: M. Ruggiu
Members: M. Léouffre
P. Mühlens

Summary of Facts and Submissions

- I. This is an appeal of the applicant against the decision of the examining division to refuse the European patent application No. 98965476.9.
- II. The reason given for the refusal was that the subject-matter of claim 1 filed at the oral proceedings of 1 April 2008 was not novel.
- III. The following documents of the state of the art have been cited during the procedure before the first instance:
D1: US 4 802 055 A;
D3: WO 96/39735 A.
- IV. In a communication dated 13 January 2012 summoning the appellant to oral proceedings, the Board referred additionally to the following state of the art:
D4 = US 5 617 284 A; and
D5 = WO 90/02431 A.
- V. In response to the summons to attend oral proceedings with a letter dated 16 April 2012, the appellant filed four sets of claims corresponding to four auxiliary requests.
- VI. Oral proceedings before the board took place on 15 May 2012.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main request filed at the oral proceedings of 1 April 2008, or on the basis of the auxiliary requests

1 to 3, filed with the letter of 16 April 2012 or on the basis of the revised auxiliary request 4 filed at the oral proceedings of 15 May 2012.

VII. Claim 1 of the main request reads as follows:

"Power conditioning circuit for conditioning power supplied by a power source at a nominal frequency over line, neutral and ground conductors to first, second and third output lines, respectively, wherein the first, second and third output lines are coupled to a load, comprising

- first, second and third independent inductors, coupled in series between the line, neutral and ground conductors, respectively, and the first, second and third output lines, respectively, wherein all of the power supplied by the power source to the first, second and third output lines flows through the first, second and third inductors;

- at least one capacitor coupled between the conductors wherein one end of the capacitor is coupled to at least one of the conductors at a point between the power source and the inductors,

wherein the inductors are sized to prevent power at frequencies greater than the nominal frequency from reaching the load; and

wherein the at least one capacitor is sized to shunt power at frequencies greater than the nominal frequency."

Claims 2 to 8 are dependent on claim 1.

VIII. Claim 1 of the first auxiliary request reads as follows:

"Power conditioning circuit for conditioning power supplied by a power source at a nominal frequency over line, neutral and ground conductors to first, second and third output lines, respectively, wherein the first, second and third output lines are coupled to a load, comprising

- first, second and third independent inductors, coupled in series between the line, neutral and ground conductors, respectively, and the first, second and third output lines, respectively,

wherein all of the power supplied by the power source to the first, second and third output lines flows through the first, second and third inductors;

wherein the line, neutral and ground conductors are coupled to the power source and the first, second and third inductors are directly coupled to the line, neutral and ground conductors, respectively;

- at least one capacitor coupled between the conductors wherein one end of the capacitor is coupled to at least one of the conductors at a point between the power source and the inductors,

wherein the inductors are sized to prevent power at frequencies greater than the nominal frequency from reaching the load; and

wherein the at least one capacitor is sized to shunt power at frequencies greater than the nominal frequency."

Claims 2 to 8 are dependent on claim 1.

IX. Claim 1 of the second auxiliary request adds to claim 1 of the first auxiliary request the following feature:

"and wherein the inductors have substantially equal inductance values".

Claims 2 to 7 are dependent on claim 1.

- X. Claim 1 of the third auxiliary request adds to claim 1 of the first auxiliary request the following features:
"wherein the at least one capacitor comprises:
- a first capacitor which is coupled across the line conductor and the neutral conductor, wherein a first end of the first capacitor is coupled to the line conductor at a point that is located between the power source and the first inductor that is coupled in series with the line conductor, and wherein a second end of the first capacitor is coupled to the neutral conductor at a point that is located between the power source and the second inductor that is coupled in series with the neutral conductor; and
- a second capacitor which is coupled across the line conductor and the ground conductor and wherein a first end of the second capacitor is coupled to the line conductor at a point that is located between the power source and the first inductor that is coupled in series with the line conductor, and wherein a second end of the second capacitor is coupled to the ground conductor at a point that is located between the power source and the third inductor that is coupled in series with the ground conductor."

Claims 2 to 7 are dependent on claim 1.

- XI. Claim 1 of the revised fourth auxiliary request reads as follows:

"Power conditioning circuit for conditioning power supplied by a power source at a nominal frequency over line, neutral and ground conductors to first, second and third output lines, respectively, wherein the first, second and third output lines are coupled to a load, comprising

- first, second and third independent inductors (L1, L2, L3), coupled in series between the line, neutral and ground conductors, respectively, and the first, second and third output lines, respectively, wherein all of the power supplied by the power source to the first, second and third output lines flows through the first, second and third inductors (L1, L2, L3);

wherein the line, neutral and ground conductors are coupled to the power source and the first, second and third inductors are directly coupled to the line, neutral and ground conductors, respectively;

- at least one capacitor (C1, C2, C3) coupled between the conductors wherein one end of the capacitor is coupled to at least one of the conductors at a point between the power source and the inductors, wherein the inductors (L1, L2, L3) are sized to prevent power at frequencies greater than the nominal frequency from reaching the load; and

wherein the at least one capacitor (C1, C2, C3) is sized to shunt power at frequencies greater than the nominal frequency; and

- an autotransformer (40) coupled between the first and second inductors (L1, L2) and the first and second output lines, in order to compensate for the voltage drops across the first and second inductors (L1, L2)."

Claims 2 to 7 are dependent on claim 1.

XIII. The appellant essentially argued as follows:

The subject-matter of the claims was novel over D3. According to the appellant "Figure 14 of D3 does not disclose first, second and third independent inductors coupled to a load via first, second and third output lines, as inductors 52, 154 or 194 are bypassed by a series resonant circuit on their load side" (cf. D3, page 25, lines 2 to 10). Consequently not all of the power supplied by the power source to the first, second and third output lines flowed through the first, second and third inductors. D3 did not show either a capacitor coupled between the line and neutral conductors such that one end of the capacitor was coupled to one of the conductors at a point between the power source and the inductors.

The subject-matter of the claims was also novel over documents D1 and D5 because D5 did not disclose a third inductor coupled in series between the ground conductor and the third output line and D1 neither disclosed independent inductors nor a capacitor coupled between the inductors with one end of the capacitor coupled to at least one of the conductors at a point between the power source and the inductors.

The claimed invention involved an inventive step: the ferromagnetic core coupling the inductors of D1 might enhance the effect of the inductors. The skilled person had therefore no incentive for replacing the coupled inductors by independent inductors. Starting from D1 and trying to achieve the object of providing a power conditioning circuit which limits power at high frequencies more efficiently, the skilled person would also not have had combined the teachings of D1 and D4

without prior knowledge of the present invention, because D4 was concerned with improving the functionality of a MOV.

Starting from D5, the person skilled in the art had also no incentive to modify a complex circuit as shown in D5 to couple a third inductor in series between the ground conductor and the output line. Even a combination with D1 would not have provided a conditioning circuit with three independent inductors, and a combination with D3 would have led to a parallel arrangement of an inductor and a resistor coupled in series with the ground conductor, thereby having "clearly different properties compared with a single inductor".

Reasons for the Decision

1. The appeal is admissible.

2. *Main request (Novelty, Article 54 EPC)*

D3 discloses a power conditioning circuit for conditioning power supplied by a power source at a nominal frequency over line, neutral and ground conductors to first, second and third output lines 36, 38, and 40 (cf. page 23, lines 9 to 11 and figure 14) coupled to a load 34. First, second and third independent inductors 152, 154 and 194 are coupled in series between the line, neutral and ground conductors L, N, EG, respectively, and the first, second and third output lines 36, 38 and 40, respectively. At least one capacitor 66, 68 is coupled between the conductors wherein one end of the capacitor is coupled to at least

one of the conductors at a point between the power source L, N and the inductors 152, 154.

The circuit of D3 is a power conditioning circuit. It is therefore implicit that the inductors are sized to prevent power at frequencies greater than the nominal frequency from reaching the load, and that the at least one capacitor is sized to shunt power at frequencies greater than the nominal frequency.

The argument of the applicant that not "all of the power supplied by the power source to the first, second and third output lines flows through the first, second and third inductors" cannot be followed. Actually in normal operating conditions, i.e. when no short circuit is present between the line and neutral conductors, the switches 198 and 200 shown in figure 14 are closed and the GFCI (Ground fault circuit interrupter) 188 comprising the series-resonant circuit 207 (cf. page 25, lines 8 to 10 and 21 to 23) is connected in parallel with the load on the output lines 36, 38 and 40. All of the power supplied by the power source to the first, second and third output lines 36, 38 and 40 flows through the inductors 152, 154 and 194 to the load and to the fault detection circuit. The subject-matter of claim 1 of the main request is therefore known from D3.

3. *Novelty of auxiliary requests 1 to 4 (Article 54 EPC)*

The subject-matter of claim 1 of each of the auxiliary requests differs from D3, D5 and D1 at least in that:
- D3 does not show first, second and third inductors directly coupled to the line, neutral and ground conductors together with at least one capacitor coupled

between the conductors at a point between the power source and the inductors;

- D5 does not disclose a third inductor coupled in series between the ground conductor and the third output line; and

- D1 does not disclose first, second and third independent inductors and at least one capacitor coupled between the conductors at a point between the power source and the inductors.

The subject-matter of claim 1 of each of the auxiliary requests is therefore novel over the available prior art.

4. *Inventive step (Article 56 EPC)*

4.1 *First Auxiliary request*

Taking D5 as a starting point, the subject-matter of claim 1 differs from D5 (cf. the figure) only in that a third independent inductor is coupled in series between the ground conductor and the third output line. The circuit of D5 privileges the safety of the users by making sure that no impedance is coupled in series between the ground conductor and the output line. The safety is at the expense of the protection of the load against transients induced on the ground conductor as acknowledged in D3 (cf. sentence bridging pages 2 and 3).

Both D1 and D3 propose to break ground loops or to block ground surge currents from propagating into the load by inserting an inductor in series between the ground conductor and the third output line (cf. D3 page 20, line 11 to 21, page 21, lines 4 to 16 and figure 10). It would therefore be obvious to the person

skilled in the art looking for a compromise between protection of the users and protection of the load to apply the teaching of D3 to the circuit of D5 and to couple an inductor (cf. D3, inductor 194 in figure 14 and the sentence bridging pages 23 and 24) between the ground conductor and the output line of the circuit of D5 in order to improve the protection against the transients propagating on the ground conductor. The subject-matter of claim 1 of the first auxiliary request does therefore not involve any inventive step.

4.2 *Second auxiliary request*

Claim 1 of the second auxiliary request specifies further that "the inductors have substantially equal inductance values".

The first and second inductors of D5 have equal inductance values (cf. D5, page 10, lines 10 to 15). At least for economical reasons, the first choice of a person skilled in the art would be to choose a third inductor having an inductance value equal to the value of the two other inductors. This choice of an inductance value for the third inductor coupled in series with the ground line equal to the value of the two other inductances might however not be an optimal choice as taught in D3, since the impedance inserted in the ground line is chosen for a compromise between electrical fault protection and transient suppression (cf. D3, page 20, line 13 to 15). The choice might not be optimal and does not appear to result in any unexpected effect. The choice of an equal inductance value for the three inductors appears therefore as an arbitrary choice in which no inventive step can be seen.

4.3 *Third auxiliary request*

Claim 1 of the third auxiliary request bases on claim 1 of the first auxiliary request and specifies the "at least one capacitor" as comprising

"a first capacitor which is coupled across the line conductor and the neutral conductor, wherein a first end of the first capacitor is coupled to the line conductor at a point that is located between the power source and the first inductor that is coupled in series with the line conductor, and wherein a second end of the first capacitor is coupled to the neutral conductor at a point that is located between the power source and the second inductor that is coupled in series with the neutral conductor; and

a second capacitor which is coupled across the line conductor and the ground conductor and wherein a first end of the second capacitor is coupled to the line conductor at a point that is located between the power source and the first inductor that is coupled in series with the line conductor, and wherein a second end of the second capacitor is coupled to the ground conductor at a point that is located between the power source and the third inductor that is coupled in series with the ground conductor."

The first feature mentioned above and characterising the first capacitor is known from D5 (cf. figure 1 and page 8, lines 3 to 8).

The connection of the second capacitor is defined with respect to a third inductor. As explained for the first

auxiliary request, it would be obvious to the person skilled in the art to insert a third inductor in series between the ground conductor and the output line of D5 in order to protect the load against the transients induced in the ground conductor. D5 teaches that the inductors L1, L2 serve to attenuate and delay the "very fast pulse edges" (cf. D5, page 11, lines 18 to 20) and serve to protect the TVS (transient voltage suppression) devices until the MOVs, which exhibit slower response times (cf. D5, page 10, lines 7 to 10) begin conducting. The characteristics of the MOVs and the TVS (transient voltage suppression) devices of D5 impose to couple the MOVs at the input side of the inductors while the TVS devices are coupled on the load side (cf. D5 page 11, line 13 to page 12, line 8). For the same reasons the person skilled in the art would have coupled the third inductor in series with the ground conductor and the output line between the ground connection of the MOVs M2 and M3 and the ground connection of the TVS devices T2 and T3 to avoid delaying the response of the MOVs M2 and M3 connected to the ground conductors.

The capacitor C2 of D5 forms a filter together with the inductor L1 (cf. D5, sentence bridging pages 9 and 10 and figure 1) and is "interchangeable" in its position (cf. page 12, lines 20 to 23). Indeed it is obvious for a person skilled in the art that the LC filter of D5 can be replaced by an equivalent CL filter. In a CL configuration capacitor C2 would be "coupled to the line conductor H at a point that is located between the power source and the first inductor L1 that is coupled in series with the line conductor". Since capacitor C2 might divert current from the line conductor to the

ground conductor, the second end of capacitor C2 would then be connected on the input side of the third inductor and not on the load side to avoid current flowing to the ground input of the load.

The person skilled in the art would also find in D4 another incentive to couple the capacitors C2 and C3 of D5 in parallel with the MOVs M3 and M2. Actually D4 teaches that capacitors may help the MOVs to respond faster to the transients (cf. D4, column 4, lines 55 to 60 and figure 2). No exercise of inventive skill can therefore be seen in the subject-matter of claim 1 of the third auxiliary request.

4.4 *Fourth auxiliary request (inventive step - Article 56 EPC)*

The fourth auxiliary request bases on the first auxiliary request and adds thereto the feature of "an autotransformer (40) coupled between the first and second inductors (L1, L2) and the first and second output lines, in order to compensate for the voltage drops across the first and second inductors (L1, L2)".

This feature is not disclosed in any of the documents cited in the procedure and none of them suggests the need to compensate for the voltage drops across the inductors. Thus, there is no evidence that the skilled person would consider compensating the voltage drops. The size of the autotransformer to compensate the voltage drops might have to be calculated according to the load supplied over the power conditioning circuit. This calculation is however considered as falling within the abilities of a person skilled in the art.

The subject-matter of the fourth auxiliary request is therefore not obvious in view of the cited prior art and sufficiently disclosed. The fourth auxiliary request is therefore considered to meet the requirements following from Articles 52, 54 and 56 and 83 EPC.

- 4.5 Claims 2 to 7 are dependent on claim 1. Their subject-matter is therefore new and involves an inventive step.

5. The description of the fourth auxiliary request has been amended to be consistent with the claims and the background art disclosed in documents D3 and D5 has been acknowledged therein. These amendments to the application do not contravene Article 123(2) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:
 - description pages 1 to 8.
 - claims 1 to 7 of the revised Auxiliary Request 4.
 - drawing: sheets 1/9 to 9/9

all filed during the oral proceedings of 15 May 2012.

The Registrar:

The Chairman:

U. Bultmann

M. Ruggiu