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Datasheet for the decision of 18 July 2007

Case Number: T 0080/06 - 3.5.02

Application Number: 02254235.1

Publication Number: 1271766

IPC: H03F 3/217

Language of the proceedings: EN

Title of invention:
A digital power amplifier

Applicant:
Flying Mole Corporation

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 123(2)

Keyword:
"Added subject-matter - yes, if claim 1 is interpreted as suggested by the appellant"
"Novelty - no, if claim 1 is interpreted in the light of the original disclosure"

Decisions cited:
-

Catchword:
-

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Case Number: T 0080/06 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 18 July 2007

Appellant: Flying Mole Corporation
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 1 July 2005 refusing European application No. 02254235.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: M. Ruggiu
Members: M. Rognoni
E. Lachacinski

Summary of Facts and Submissions

I. The appellant (applicant) appealed against the decision of the examining division refusing European patent application No. 02 254 235.1.

II. In the contested decision, the examining division found, *inter alia*, that the subject-matter of claim 1 then on file lacked an inventive step over the following document:

D2: WO-A-01/22 564.

III. In a communication dated 23 April 2007 accompanying the summons to attend oral proceedings, the Board observed that claim 1 filed with a letter dated 10 November 2005 seemed to contain subject-matter which extended beyond the content of the application as originally filed (Article 123(2) EPC). Furthermore, as far as it was supported by the application documents, the subject-matter of claim 1 appeared to lack novelty over D2 (Article 54 EPC).

IV. Oral proceedings before the Board were held on 18 July 2007.

V. The appellant requested that the decision under appeal be set aside and that a patent be granted in the following version:

Description: pages 1 to 3 and 7 to 17 as originally filed and pages 4 to 6 as filed with a letter of 10 June 2004;

Claims: No. 1 filed with the letter of 10 November 2005 and No. 2 to 4 filed with the letter of 10 June 2004;

Drawings: Sheets 1/4 to 4/4 as originally filed.

VI. Claim 1 of the appellant's request reads as follows:

"A digital power amplifier comprising:

four switches SW1, SW2, SW3 and SW4 connected in a bridge arrangement;

a load connecting section (59, 61) provided between a first connection point of adjacent switches SW1 and SW2 and a second connection point of adjacent switches SW3 and SW4 to connect a load (9);

a power source section (7) provided between a third connection point of adjacent switches SW1 and SW4 and a fourth connection point of adjacent switches SW2 and SW3 to apply a single polarity voltage to the third connection point;

the power source being adapted to provide a zero potential to the fourth connection point of adjacent switches SW2 and SW3;

a grounding section grounding the second connection point of the adjacent switches SW3 and SW4;

a signal processing unit (1) for converting an input signal into a 4-line digital signal;

a driving unit (51, 53, 55, 57) for controlling opening-and-closing drive of the switches SW1, SW2, SW3 and SW4 according to a digital signal supplied from the signal processing unit (1);

an isolating unit (3) for electrically isolating between the signal processing unit (1) and the driving unit;

a feed-back unit (21, 23) for feeding back a signal at the first connection point of the adjacent switches SW1 and SW2 to the signal processing unit (1)."

VII. The appellant's arguments relevant to the present decision may be summarised as follows:

A switching amplifier was a power amplifier where the active devices in the output stage were operated in the on/off mode, *i.e.* as switches. As illustrated in Figure 2 of the present application, the amplifier's output current was switched to go through the load either in one direction when switches SW1 and SW3 were closed, or in the opposite direction when switches SW4 and SW2 were closed. This allowed the current to flow in one direction or in the other direction from a positive voltage EV to a zero potential 0V. The claimed amplifier thus enabled a current flow in opposite directions with a single power source such as a battery.

The connection point between switches SW2 and SW3, which was set at 0V in Figure 1 of the present application, defined a zero potential with respect to the ground potential of the signal processing section.

The grounding of the switching section, however, assumed a different potential level equal to half the potential difference between the output leads of the power source, *i.e.* E/2 V.

The feature added to claim 1 as originally filed and relating to a power source adapted to provide zero potential to the fourth connection point of adjacent switches SW2 and SW3 had been introduced on the basis of the disclosure of Figure 1 and the associated portions of the description in order to clarify that, in contrast to the conventional plus/minus dual polarity power source, the invention used a single polarity power source supplying a DC voltage EV at its one terminal and a zero potential at its other terminal. This feature thus did not imply subject-matter that extended beyond the content of the application as originally filed and claim 1 did not contravene Article 123(2) EPC.

Though it was known to have a single power supply with an ungrounded switching section, before the priority date of the present application it was not considered possible to ground the output of a digital power amplifier which had a switching section supplied by a single voltage power source. In fact, none of the prior art documents showed a digital power amplifier comprising a single voltage power supply according to the present application, *i.e.* with one of the output leads set at a positive voltage and the other one at 0V, and a grounding section grounding the connection point of the adjacent switches SW3 and SW4.

D2 showed a digital power amplifier with a grounded switching section. However, as shown in Figure 5, the power source had a positive terminal at voltage V+ and a negative terminal at voltage V-, and thus it was not a power supply providing a single positive voltage. Furthermore, as it was not clear from D2 how the switches 501 and 502 should be electrically connected in the circuit and in particular how the control signals were applied to them, a skilled person would not be prompted by the disclosure in this document to choose a bridge arrangement for the switches which controlled the flow of current through the load and to arrange a signal processing unit for converting audio input signal into a four-line digital signal in such a manner as to drive the bridge arrangement of switches as claimed in the present application.

Hence, the combination of features recited in claim 1 was novel with respect to D2 (Article 54 EPC).

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

2.1 Apart from some minor amendments directed to clarifying the bridge arrangement of the four switches SW1, SW2, SW3 and SW4, claim 1 of the appellant's request differs from the originally filed independent claim essentially in that it further comprises the following feature:

"the power source being adapted to provide a zero potential to the fourth connection point of adjacent switches SW2 and SW3".

2.2 According to the appellant, this feature implied that the switching section of the claimed digital amplifier was supplied by a single positive voltage EV and that its ground level, which was different from the ground level of the signal processing section, assumed a value equal to EV/2 with respect to the zero potential 0V of the power source section.

2.3 As explained in the description of the published application (column 5, paragraph [0028], lines 33 to 42), the *"power source section 7 is configured with a converter 71 for AC-DC conversion, a transformer 73 for isolation between the power source side and the device side, a diode 75 for stabilizing a direct current and a chemical capacitor 77. Due to this, the power source section 7 functions as a direct-current voltage source which inputs, for example, an alternating current 100V, lowers the voltage thereof down to a predetermined voltage, and converts it into a direct current of E(V) for an output."*

The connection between the power source section and the switching section is detailed in paragraph [0019], column 4, lines 10 to 14, as follows: "*A voltage EV, supplied from the power source section 7, is applied to a power-supply connecting section between a connection point of adjacent switches SW1 and SW4 and a connection point of adjacent switches SW2 and SW3."*

In other words, the present application does not qualify the power source as *"being adapted to provide a zero potential"* but describes the basic arrangement of a power unit which supplies a floating voltage EV across its two output leads connected to the switching section of a digital power amplifier. In fact, only Figure 1, which is a block diagram showing a schematic configuration of an embodiment of the present invention, and Figure 4, which is supposed to illustrate a conventional digital power amplifier, refer to the two output terminals of the power source section as "0V" and "EV".

2.4 There is, furthermore, no basis in the application as originally filed for the appellant's allegation that the zero potential of the power source section was meant to be referenced to the ground level of the signal processing section and that the latter was different from the grounding of the switching section.

All the figures of the application as originally filed use the same conventional symbol for the grounding of the signal processing section and of the switching section and there is no reason to assume that different sections of the amplifier should have grounds which must be kept at different potential levels in order to allow the amplifier's normal operation. As to the power source section, there is no indication in the figures or in the description that the voltages at its output terminals should be referenced to the ground of the signal processing section or to any other particular ground potential.

2.5 In conclusion, the only technical meaning that the skilled person reading the present application can derive from the fact that the output terminals of the power source shown in Figures 1 and 4 are defined as "0V" and "EV", respectively, is that the voltage supplied by the positive terminal of the power source is "EV" when referenced to the voltage level of the other terminal, *i.e.* that the voltage across the two terminals of the power supply is "E" (see also application as published, paragraph [0011], column 2, lines 46 to 50).

Thus, as far as it is interpreted as meaning that the power source is adapted to provide a zero potential with respect to the ground potential of the signal processing section and that the signal processing section and the switching section have different ground potentials, the above feature of claim 1 (see point 2.1 of this decision) implies subject-matter which extends beyond the content of the application as originally filed and thus contravenes Article 123(2) EPC.

2.6 On the other hand, if the above feature is interpreted in the light of the application as originally filed, it can only mean that the power source of the claimed amplifier is adapted to provide a single voltage E between the third connection point of adjacent switches SW1 and SW4 and the fourth connection point of adjacent switches SW2 and SW3.

3. *Novelty*

3.1 If claim 1 were interpreted in the light of the description and thus were assumed to be in compliance with Article 123(2) EPC, its subject-matter would not be new within the meaning of Article 54 EPC for the reasons given below.

3.2 Document D2 relates to "*an output stage for Class D amplifiers and the like, including a power supply that is floating with respect to ground or any other reference except the supply pins*" (page 1, lines 4 to 6).

As shown in Figure 5, the digital power amplifier according to D2 comprises two single pole double throw (SPDT) switches 501 and 502, whose respective terminals A, B and C, D are connected in parallel between the leads Vp and Vm of a floating power supply 500. The two SPDT's are bridged by a load 105, which has one of its two terminals connected to ground. As specified in the description (page 5, lines 15 to 20), the switch 501 alternatively connects terminals A and B, *i.e.* the outputs Vp and Vm of the power supply 500, to ground via an optional current sense resistor 510 (D2, page 6, lines 23 to 25). The second switch 502 alternatively connects its terminals C and D, *i.e.* the outputs Vp and Vm of the power supply 500, to the other ungrounded terminal of the load 105 via a low pass filter 503. The switches 501 and 502 are controlled by the signal processing block 512 via a control signal 514 in order to alternatively drive a current in opposite directions through the load 105.

In other words, the known digital power amplifier according to Figure 5 of D2 has a signal processing section 512 for converting an input signal into digital signals which control the switching sections 501 and 502 and thus allow a current to flow from the power source section 500 through the load 105.

As pointed out on page 5, lines 23 and 24 and shown in Figure 4 of D2, each of the switches 501 and 502 can be designed as in the prior art by connecting in series two field effect transistors, which are driven by a transformer 400 with complementary outputs (page 3, lines 1 and 2). Four transistors corresponding to the paralleled switches 501 and 502 linked to the power supply 500 (see Figure 5) of D2 form the bridge arrangement referred to in claim 1 of the application. D2 also specifies that in *"other known designs, the switches may be bipolar transistors, insulated gate bipolar transistors, or other devices"*, and that the *"drive may come from other transformer configurations, level shifters, or optical couplers*" (page 3, lines 3 to 6). Thus, D2 teaches explicitly to have an isolating unit for electrically isolating between the signal processing unit and the drive unit.

The power amplifier according to D2 (see Figure 5) further comprises a feedback unit 506 for feeding back to the processing unit 512 a signal at the connection point of the adjacent switches which constitute the switch unit 501.

3.3 In summary, D2 discloses a digital power amplifier which operates as explained in the present application and which shows or necessarily implies all the features

recited in claim 1 of the appellant's request, as interpreted in the light of the originally filed application documents.

4. As the appellant's only request does not provide a basis for an allowable claim, the application has to be refused.

Order

For the above reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Sauter M. Ruggiu