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D E C I S I O N
of 4 August 1997

Case Number: T 0520/95 - 3.5.2

Application Number: 90915836.2

Publication Number: 0574379

IPC: H03K 3/282

Language of the proceedings: EN

Title of invention:
Coupled regenerative oscillator circuit

Applicant:
TELEFONAKTIEBOLAGET LM ERICSSON

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 84, 54, 56

Keyword:
"Claims clear and supported by the description - after amendment - yes"
"Subject-matter of claims new - yes"
"Subject-matter of claims involves an inventive step - yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0520/95 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 4 August 1997

Appellant: TELEFONAKTIEBOLAGET LM ERICSSON
Telefonplan
Hägersten (SE)

Representative: de Bruijn, Leendert C.
Nederlandsch Octrooibureau
P.O. Box 29720
2502 LS Den Haag (NL)

Decision under appeal: Decision of the Examining Division of the European Patent Office posted 31 January 1995 refusing European patent application No. 90 915 836.2 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: R. G. O'Connell
B. J. Schachenmann

Summary of Facts and Submissions

I. The appeal contests the decision of the examining division to refuse European patent application No. 90 915 836.2 (International publication No. WO 91/06151). The reason given for the refusal was that claim 1 was not clear. It was also indicated that in view of the lack of clarity the circuitry understandable from figure 3 was "not patentably distinguished over the available prior art." The circuitry shown in figure 4 was considered to be new and inventive.

II. In response to a communication from the board, the appellant filed on 11 June 1997 a revised set of claims 1 to 3 and amended pages 1 and 3 of the description.

III. The appellant requests that the decision under appeal be set aside and a patent be granted on the application in its thus amended form.

IV. The application documents now consist of:

Claims: 1 to 3, as filed 11 June 1997;

Description: pages 1 and 3, as filed 11 June 1997; pages 2, 4 and 5, as filed with letter dated 11 December 1991; and pages 6 to 9 as originally filed;

Drawings: figures 1 to 5, as originally filed.

V. Claim 1 is now worded as follows:

"Oscillator circuit of the regenerative type, comprising a first regenerative oscillator capable of self-oscillating, at least including a first feedback amplifier (V1) and a first integrator (C1), wherein the first oscillator has an output signal having two stable levels alternating in one oscillation cycle and an unstable or regenerative switching state between them, in which the loop gain is greater than unity, and wherein the first integrator provides an integrator signal (U) to the input of the first feedback amplifier which varies time-dependently in a positive or negative sense towards an associated threshold level (Ud1 or Ud2) of the first feedback amplifier (V1), a separate excitation signal being added to the integrator signal (U) for the first feedback amplifier in order to fix the instant of exceeding the threshold level and thereby of the switching, characterized in that a second regenerative oscillator identical to the first is provided, at least including a second feedback amplifier (V2) and a second integrator (C2), having an oscillation cycle equal to the said oscillation cycle or a multiple thereof and shifted in phase with respect thereto; and in that a first (C01) and second (C02) comparator is provided which is associated with the first and second oscillator respectively and which detects the passage through zero, situated between two threshold levels, of the integrator signal for the associated first (V1) and second (V2) feedback amplifier and derives therefrom the separate excitation signal for the second or first feedback amplifier respectively."

Claims 2 and 3 are dependent on claim 1.

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

The preamble of claim 1 was based on the state of the art mentioned on page 1 of the present application, namely "A new model for regenerative circuits" by C. J. M. Verhoeven. In the present invention each individual oscillator was capable of self-oscillation (with some phase jitter), but the instants of switching of the amplifiers V1 and V2 were fixed by the output signals of the comparators, which were added to the time-dependent varying signals of the integrators to force the input signal of each amplifier to exceed the associated threshold level. An explanation of the way in which the circuit operated was annexed to the statement of grounds.

Reasons for the Decision

1. The appeal is admissible.

2. The present amended form of the application does not contain any subject-matter extending beyond the content of the application as filed. In particular, the present claims 1 to 3 are fully supported in all their features by the disclosure in the application as filed, see pages 5 to 9 in combination with figures 3 to 5 of the drawings. The only amendments made to the description are to adapt it to the present claims, to insert the page number of the prior art article acknowledged on page 4 and to correct a few minor linguistic errors. Thus all the amendments performed are allowable under Article 123(2) EPC.

3. The reason given by the examining division for refusing the application was that claim 1 then on file was not clear. The particular points mentioned in the decision under appeal as being unclear will now be considered.

3.1 The first point concerned the use of the terms first and second "oscillator", which were considered to be unclear because neither of the so-called oscillators necessarily performed as a self-oscillating circuit. The claim as now worded makes it clear that the first oscillator is a regenerative oscillator **capable of** self-oscillating and that the second regenerative oscillator is identical to the first. It is clear to a person skilled in the art that even though the excitation signals fix the instants at which switching occurs, each of the first and second oscillators could oscillate by itself without the excitation signal. The claims are now clear in this respect.

3.2 The second point concerned the use of the term "output signal" of the first and second oscillators, which was considered to be unclear because the output voltages of the amplifiers had triangular waveforms without any stable levels and the output currents of the amplifiers flowed only into the integrating capacitors and thus could not be regarded as "output signals" of the oscillators. It appears that the examining division assumed that the output signal must be at the **emitters** of the transistors Qa1, Qa2 shown in figure 4. The board can see no reason for this assumption. Although no output terminals are shown in the drawings, it is clear to a person skilled in the art that "an output signal having two stable levels alternating in one oscillation cycle" as specified in claim 1 exists at the **collectors** of the transistors Qa1, Qa2 shown in figure 4. It would be quite usual in practice to take the output of the circuit from there. Here it is worth

noting that figure 3 is a simplified schematic diagram which does not show all the details specified in claim 1. But this does not mean the claim is inconsistent with the description and/or drawings, taken as a whole. In the judgement of the board, the claims are clear and supported by the description in respect of the output signal having two stable levels.

3.3 The third point concerned the use of the term "input signal" of the first and second oscillators, which was considered to be unclear because the "input signal" was specified as originating from the integrator, which was part of the oscillator. Claim 1 as now worded makes it clear that the first integrator provides an integrator signal to the input of the first feedback amplifier. In the embodiment shown in figure 4, feedback occurs in the feedback amplifiers V1, V2 during their unstable, regenerative states.

3.4 In the judgement of the Board the claims, in their present form, are clear, and they are also supported by the description. Thus, the requirements of Article 84 EPC are met.

4. Now that the features of the first and second regenerative oscillators have been clarified in claim 1, the objection mentioned under point 2) of the reasons for the decision under appeal, namely that since the term "oscillator" as used in claim 1 was meaningless there was no substantial difference between the subject-matter claimed and the prior art circuit disclosed in the paper by J. R. Pimentel in Electronics, vol. 51, No. 24, page 147: "One-chip oscillator generates in-quadrature waveforms" (reference D1), cannot be maintained. The integrating amplifiers A2 and A4 in the circuit disclosed there cannot possibly be regarded as regenerative oscillators

capable of self-oscillating. Thus it is quite clear that subject-matter of the present claim 1 is new and involves an inventive step having regard to this piece of prior art.

5. The board has looked at all the prior art cited in the international search report for the present application and the prior art acknowledged in the application itself and has come to the conclusion that the subject-matter of the present claim 1 is new and involves an inventive step having regard to all this prior art. The main points noted are explained below.

5.1 The paper by C. J. M. Verhoeven in 30th Midwest Symposium on Circuits and Systems, Syracuse, New York, August 1987: A new model for regenerative circuits, which is acknowledged on page 1 of the present application, is considered to be the closest prior art. It discloses a regenerative oscillator according to the preamble of claim 1. There is no disclosure or suggestion in this paper that a second regenerative oscillator could be provided at all, let alone that the two oscillators could be arranged in the manner specified in claim 1.

5.2 DD-A-139 060 discloses a circuit for producing two phase shifted pulse trains comprising two astable multivibrators, each comprising a loop consisting of two threshold gates and a feedback capacitor connected between the output of the second gate and the input of the first gate. The inputs of the first gates are connected together through a resistor. The first gate of each multivibrator is connected to the input of the second gate of the other multivibrator through a diode. The multivibrators do not include a feedback amplifier

whose input receives both an integrator signal and a separate excitation signal to fix the instant of switching. Nor does the circuit include any comparators detecting the passage through zero of an integrator signal.

5.3 EP-A-0 137 363 discloses a circuit for producing two phase shifted triangular waveforms which drive respective sine generators to produce sine and cosine waveforms. A first capacitor is alternately charged and discharged according as its voltage has reached a negative or positive threshold. A second capacitor is alternately charged and discharged, switching between charging and discharging occurring as the voltage on the first capacitor passes through zero. The circuit containing the second capacitor is not capable of self-oscillating.

5.4 Neither of the documents DD-A-139 060 and EP-A-0 137 363 suggests providing first and second comparators to detect the passage through zero of integrator signals in first and second regenerative oscillators, respectively, and deriving therefrom separate excitation signals to be applied to the inputs of feedback amplifier in the second and first regenerative oscillators, respectively. The other prior art documents are even less relevant.

6. In the judgement of the board, the application, in its present amended form, meets the requirements of the EPC for the grant of a patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of:

Claims: 1 to 3, as filed 11 June 1997;

Description: pages 1 and 3, as filed 11 June 1997; pages 2, 4 and 5, as filed with letter dated 11 December 1991; and pages 6 to 9 as originally filed;

Drawings: figures 1 to 5, as originally filed.

The Registrar: The Chairman:

S. Fabiani W. J. L. Wheeler