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Bezeichnung der Erfindung: Monolithic microwave integrated circuit with
Title of invention: integral array antenna
Titre de l'invention :

Klassifikation / Classification / Classement : H01Q 1/38

ENTSCHEIDUNG / DECISION
vom / of / du 14 November 1989

Anmelder / Applicant / Demandeur : Ball Corporation

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence : Monolithic microwave integrated circuit/BALL

EPÜ / EPC / CBE Article 123(2), Rule 86(3)

Schlagwort / Keyword / Mot clé : "Inadmissible amendment - Unsupported claim
broadening"

Leitsatz / Headnote / Sommaire

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Office européen
des brevets

Chambres de recours



Case Number : T 118/88 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal
of 14 November 1989

Appellant : Ball Corporation
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Decision under appeal : Decision of Examining
Division 2.2.06.046 of the European
Patent Office dated 29 September 1987
refusing European patent application
No. 81 106 988.9 pursuant to
Article 97(1) EPC

Composition of the Board :

Chairman : W.B. Oettinger
Members : J.A.H. van Voorthuizen
F. Benussi

Summary of Facts and Submissions

- I. European patent application No. 81 106 988.9, filed on 5 September 1981 claiming a priority of 17 November 1980 and published under No. 55 324, was refused by a decision of Examining Division 2.2.06.046 dated 29 September 1987.

The reason given for the refusal was that

- the Examining Division felt unable to give its consent under Rule 86(3) EPC to the amendments made on 31 January 1986 to the claims (1 to 9);
- the Applicant disapproved of the claims (1 to 8) filed on 8 November 1985 for which the Examining Division had issued an "Advance Notice of the communication under Rule 51(4) EPC" dated 10 July 1986.

The ultimate reason why the Examining Division did not give its consent to the late-filed amendments of 31 January 1986 was that it considered that the amended claims did not comply with Article 123(2) EPC.

The originally filed independent Claims 1 and 5 were directed respectively to a "microwave antenna system" with receiving array elements and "an integrated monolithic microwave system" with transmitting array elements, both systems comprising a phasing network and microprocessor-based controller therefore, but this phasing network and microprocessor-based controller were absent from Claim 1 filed on 31 January 1986.

The Examining Division held that there was no support for this broadening of claims in the description.

II. On 13 November 1987, the Applicant lodged an appeal against this decision in its entirety, paid the appeal fee and filed a statement of grounds.

Supplementary appeal reasons were filed on 22 January 1988 accompanied by new claims in two versions (primary and first auxiliary motion) and a reference to the claims filed on 8 November 1985 (second auxiliary motion).

III. In a communication, the Board analysed the features by which Claim 1 (primary motion) filed on 22 January 1988 was broader in scope than the original Claims 1 and 5 and expressed the provisional opinion that

- some of the amendments were clearly inadmissible,
- some of them might be admissible, but
- even if the clearly inadmissible amendments were undone so as to arrive at a possibly admissible form for Claim 1, its subject-matter would appear to lack an inventive step.

For the purposes of the latter objection, reference was made to the following prior art documents, number (2) of which had also been cited by the Examining Division:

- (1) US-A-3 921 177
- (2) US-A-3 454 906
- (3) US-A-4 033 788.

The Board based its respective doubts on the consideration that document (2) shows that the insulating substrate

normally required for transmission lines can be replaced by a semi-insulating substrate (GaAs) and that it would appear obvious for the skilled person to replace, or at least try to replace, the insulating substrate normally required for antenna elements, too, by a semi-insulating substrate (GaAs).

Claim 1 of the first auxiliary motion was also considered to be unacceptable for similar reasons as the primary motion.

- IV. In oral proceedings held on 14 November 1989 on the Appellant's request, he filed new Claims 1-6 replacing both his former primary and first auxiliary motions.

He requests that the decision under appeal be set aside and a patent granted on the basis of these claims (main request) or, subsidiarily, on the basis of the claims, description and drawings as specified in the Advance Notice of the communication under Rule 51(4) EPC issued by the Examining Division on 10 July 1986 (auxiliary request).

Claim 1 of the main request reads as follows:

"A non-optical microwave antenna structure comprising a substrate of semi-insulating gallium-arsenide having a resistivity of about 10^8 ohm x cm, at least two metallisations defining an array of antenna elements arranged for transmitting or receiving non-optical microwaves, and a feeding network coupled to said array and including one or more active and/or passive RF components, said antenna elements, feeding network and active and/or passive RF components integrally formed on said substrate."

Claim 1 of the auxiliary request reads as follows:

"A monolithic integrated circuit microwave circuit formed on a gallium-arsenide substrate including a phasing and r.f. feeding network (38, 40, 42, 44, 62) and plural integrated circuit structures electrically connected to control the electrical phase shift in r.f. paths through the circuit characterised by including a monolithic antenna system comprising:

a plurality of microstrip antenna elements (46, 48, 50, 52) arranged in an array for transmitting/receiving electromagnetic waves;

said phasing and r.f. feeding network (38, 40, 42, 44, 62) being connected to control the electrical phase shift of electrical currents flowing to/from each said element,

said antenna elements and said phasing network being integrated on a single substrate (30) of semi-insulating GaAs semiconductor material having a resistivity of about 10^8 ohm-cm; and

an integrated circuit digital microprocessor-based controller means (32, 34, 36) electrically connected to the integrated circuit structures of said phasing network for controlling their operations and said controller means also being monolithically integrated onto said single substrate of semi-insulating GaAs."

- V. The Appellant's arguments in support of his main request can be summarised as follows:

The description refers, on page 8, lines 27-30, to Figure 3 as showing "a third embodiment of the monolithic microwave integrated circuit according to the present

invention". In this - self-contained - embodiment only receiving array elements, a diode network and a power collection network are integrated onto a common substrate (page 8, line 33 to page 9, line 7), but no phase shifters and no microprocessor-based controller therefor. The omission of these latter elements from Claim 1 has thus a clear basis in the description. The situation is exactly as in the earlier decision of this Board, T 66/85 (to be published, Headnote in OJ EPO 1988, 463), in which such claim broadening was allowed.

The skilled reader would readily see that the implementation of the embodiment of Figure 3 for visible light frequencies was unfeasible and the references to visible light, even to a particular frequency range (10^5 to 10^6 GHz), could be corrected to the effect that Figure 3 shows an embodiment for microwave frequencies and thus concurs with the other embodiments disclosed.

In the Appellant's opinion, the subject-matter of this claim is unobvious for the following reasons:

Generally, the fields of antenna techniques and semiconductor technology are very remote from each other; experts in these fields go to different schools. For antennas, the expert is a high-frequency technician; for semiconductors, the expert is a physicist or chemist. They hardly understand each other's problems. It was the inventors who combined these fields by depositing antenna elements on a semi-insulating substrate and thus combining them with other IC components. The normally skilled antenna expert would not have done this. It is difficult enough to make antennas, built in conventional techniques, radiate into the desired part of space, and it would appear to cause interference problems between the antenna and the other circuitry if one tried to combine them in a

single integrated circuit on a common semiconducting, or semi-insulating, substrate.

Document (2) does not teach, or suggest, to integrate antenna elements on a GaAs substrate but only transmission lines in phase shifters and the like, and antenna elements are quite distinct from transmission lines in that the former functions to radiate signals into space whereas the latter functions to keep them propagating along the line.

Reasons for the Decision

1. The appeal is admissible.
2. After an applicant has amended the application documents in reply to a first communication from the Examining Division, any further amendment may only be made with the consent of the Examining Division; Rule 86(3) EPC.

For the execution of this discretion, the Examining Division has to take into account a number of factors. In a rather advanced stage of the examination procedure such as when allowable claims have already been agreed upon, the consent should only be given if, as a minimum requirement, there is a reasonable chance that the amendment is admissible.

In the present case, the Examining Division considered that there was no such chance and therefore rightly executed its discretion in the way it did by not giving its consent to the amendment made.

3. From the Appellant's submissions in the appeal procedure, it was not without any further investigations clear to the Board whether the Examining Division's finding that the

amended claims contravened Article 123(2) EPC was, in substance, correct or not.

The Board exercised, for this reason, the discretion given to it by Rule 86(3) in combination with Rule 66(1) EPC in its own way by considering the issue in more detail and not refusing its consent to the amendments on a merely formal basis.

4. However, having heard the Appellant in oral proceedings and having considered his arguments, the Board came to the conclusion that Claim 1 of the Appellant's main request does indeed contravene Article 123(2) EPC.

This conclusion is based, in essence, on the following considerations:

- 4.1 The original statement of claims contained three independent claims, one of which (9) defining a method for fabricating a planar phase shifter was cancelled for the reason that it lacked unity with the other items claimed and was made the subject of a divisional application.

The remaining independent claims (1 and 5) defined respectively a microwave antenna system and an integrated monolithic microwave system. Both systems comprised at least two array elements, a phasing network in their feedlines, and a microprocessor-based controller therefor. The system of Claim 1 was intended for receiving purposes, and the system of Claim 5 for transmitting purposes. A system of this kind, whether for receiving or transmitting purposes, is generally called a phased array.

As the feature common to both phased arrays claimed, all the aforementioned parts are integrated on a single semiconducting substrate.

Phased arrays being well-known in the art, it is clear that the feature which was presented, by the Applicant who drafted the original claims, to the skilled reader as the novel contribution to the art, was the feature that all the aforementioned parts of the phased array are integrated on a single semiconducting substrate.

- 4.2 Except for the description of the "third embodiment" with reference to Figure 3, the original description and drawings are in full accordance with this claiming.

According to the "Summary of the Invention" (page 2), it is "the primary objective of the claimed invention to provide a non-optical microwave system incorporating all of the system components including active and/or passive RF components, a microprocessor controller, and digital control circuits into a single monolithic substrate to provide a monolithic phased array antenna system for use at X-band frequencies and above".

With reference to Figure 1, a receiver embodiment of the claimed microwave phased array is described (page 4, lines 29-31 and page 6, line 9 to page 8, line 12) and with reference to Figure 2 a transmitter embodiment of the same phased array is described (page 5, lines 1-3 and page 8, lines 13-26).

There is no suggestion anywhere in the description that in the systems shown in Figures 1 and 2, the phase shifters (38-44) and their controllers (32, 70-78, 82-88) could, or should, be omitted to form a simple (non-phased) receiving or transmitting array.

The controllers being sufficiently described on pages 6-8, the other parts of the claimed systems are more fully described on pages 9-18 and include the substrate (page 9, line 12 to page 10, line 32), the antenna elements (page 11, line 1 to page 13, line 30) and the phase shifters (page 13, line 31 to page 18, line 24).

- 4.3 The "third embodiment" described with reference to Figure 3 appears in contradiction with the "Summary of the Invention", with the invention as claimed in Claims 1 and 5 and with the description of the first and second embodiment in several respects.

This "third embodiment" is "adapted to receive visible light" (page 5, lines 4-6) and "illustrates a possible application of the underlying concepts of the monolithic microwave integrated circuit to the visible light spectrum of 10^5 - 10^6 GHz" (page 8, lines 30-33). The receiving array elements would "gather visible light, such as solar energy" (page 9, line 1). This reference to visible light, and the reference to 10^5 to 10^6 GHz (3000 to 300 nm which extends into the near infrared), i.e. to optical waves, is in clear contradiction to the "Summary of the Invention" referring to a non-optical microwave system.

There is no uniform definition of "microwave" frequencies in the literature. Various lower and upper limits can be found in books published before the priority date or before the application date, but a definition including visible light or 10^5 to 10^6 GHz was not found in any of them. The Appellant has also not evidenced that the skilled person would understand the expression "microwave" as including visible light or optical waves.

He would, therefore, understand the reference in the description of the application to "a wide range of system frequencies, i.e., 10 GHz through 10^8 GHz (ultraviolet)" (page 3, lines 16-18) as a speculative extension from microwave frequencies to lower and higher non-microwave frequency ranges and he would understand the reference to "visible light of 10^5 to 10^6 GHz" (page 8, lines 32-33) as a speculative application to a non-microwave optical spectrum, viz. visible light or optical waves of the frequency range mentioned.

The alleged "third embodiment" is thus clearly not disclosed as a microwave circuit but as a solar power collector similar in its effects to photoelectric cells for collecting solar power.

It is true that Figure 3 shows dipoles and diodes but the skilled person of the priority or application date will clearly not have been able to implement a visible light collector with such means. The Appellant has not demonstrated its feasibility. This does not, however, mean, that the skilled person would understand this "embodiment" definitely alleged to be a solar power collector as intentionally being a microwave receiving array.

For this reason, the skilled person, unbiased by the amendments made later during the examination procedure, would not have understood the subject-matter of Figure 3 as a real "third embodiment of the monolithic microwave integrated circuit according to the present invention" as defined in the original Claims 1 and 5, the "Summary of the Invention" and the description of two embodiments with reference to Figures 1 and 2.

He will rather see the alleged "embodiment" of Figure 3 as something outside the proper description of the claimed invention, and will probably not even understand for what reason it has been included.

No basis for the omission of the phasing network and the microprocessor-based controller from Claim 1 can, therefore, be derived from Figure 3 and its description.

- 4.4 The situation is thus essentially different from the earlier case T 66/85 in which the person skilled in the art could "clearly and unambiguously recognise the embodiment" to be covered by the broadened claim from the drawing.

It may be obvious that the "embodiment" of Figure 3 as described is not feasible and it may even be obvious that for a different frequency range than disclosed it would be feasible. Obviousness is not, however, an allowable replacement for disclosure. According to standing practice and jurisdiction, in the examination of what has been disclosed, novelty criteria may be applied, but not inventive step criteria such as obviousness.

Claim broadening cannot therefore be allowed in the present case on the basis of that earlier decision and Claim 1 filed on 14 November 1989 is unacceptable under Article 123(2) EPC.

For this reason, the Appellant's main request must be refused.

5. In the circumstances, it need not finally be decided whether the Board's doubts as to the inventiveness of the subject-matter of Claim 1, main request, are justified or not.

6. The Examining Division indicated that it held Claims 1-8 filed on 8 November 1985 allowable, even having regard to prior art document (2). It reached this conclusion even though it was clearly aware also of prior art document (1) which was not only mentioned in the European Search Report but a copy of which was filed by the Applicant on 27 October 1984 for the attention of the examiner. This document discloses to integrate antenna elements and phase shifters including switchable diodes of a phased array on a single printed circuit board. The document also mentions that the diodes may be controlled by an appropriately programmed mini-computer but does not give any indication as to where this could be located. No objection under Article 52(1) was raised in the communication of 7 February 1985 and from the Examining Division's later actions it follows positively that it regarded the subject-matter of Claim 1 (auxiliary request) as unobvious.

Apparently it considered that document (2) might render it obvious to implement the digitally controlled phase shifters of a phased array such as that of document (1) in GaAs semiconductor technology but not to extend this technology both to the antenna elements and to the microprocessor-based controller, thus arriving at a phased array fully monolithically integrated on a single semi-insulating GaAs substrate.

The Examining Division's conclusion drawn for this combination appears not unreasonable to the Board, and the Board sees, therefore, no reason to re-examine in more detail Claim 1 filed on 8 November 1985 in respect of its patentability which was not, in effect, a subject of the appeal but always the basis of an auxiliary request.

The auxiliary request is, therefore, allowed.

Order

For these reasons, it is decided that:

1. The Appellant's main request is rejected.
2. The decision under appeal is set aside and the case remitted to the first instance with the order to grant a patent according to the auxiliary request on the basis of the claims, description and drawings as specified in the Advance Notice of the communication under Rule 51(4) EPC from the Examining Division dated 10 July 1986.

The Registrar:

The Chairman:



S. Fabiani



W.B. Oettinger

