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Bezeichnung der Erfindung: Read only storage using a four state cell
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : G11C 11/56

ENTSCHEIDUNG / DECISION
vom / of / du 28 June 1988

Anmelder / Applicant / Demandeur : IBM, N.Y. USA

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE

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

Leitsatz / Headnote / Sommaire

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Case Number : T 220/87

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 28 June 1988

Appellant : International Business Machines Corporation
Armonk, N.Y. 10504
USA

Representative : Rudolph, Wolfgang, Schönaicher
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Decision under appeal : **Decision of Examining Division 067 of the European Patent Office dated 5 March 1987 refusing European patent application No. 82 109 608.8 pursuant to Article 97(1) EPC**

Composition of the Board :

Chairman : P.K.J. Van den Berg
Members : W. Riewald
E. Persson

Summary of Facts and Submissions

I. European patent application No. 82 109 608.8 was filed on 18 October 1982, claiming priority from an application in the United States of 3 November 1981.

The application was refused by a decision of the Examining Division dated 5 March 1987. The decision was based on Claim 1 as filed with letter of 8 December 1986 and Claims 2 to 13 as originally filed.

The reason given for the refusal was that the subject-matter of the claims was considered as lacking an inventive step having regard to the following prior art documents:

D1: US-A-4 174 521
D2: US-A-4 192 014.

II. The Appellant filed a notice of appeal together with a statement of the grounds of appeal and paid the appeal fee on 5 May 1987.

In a communication dated 26 April 1988 the Rapporteur made additional reference to a further document cited in the search report:

D3: US-A-4 202 044

and expressed the provisional opinion that no inventive merit could be perceived in the subject-matter claimed and that, therefore, the appeal was likely to be dismissed.

Oral proceedings were held on 28 June 1988.

III. The Appellant requested that the decision of the Examining Division be set aside and that a European patent be granted on the basis of Claim 1 of 8 December 1986 and Claims 2 and 4 to 13 as originally filed.

IV. The independent Claim 1 reads as follows (with correction of two minor clerical errors):

"Read only storage using a variety of two terminal, bipolar devices in single devices storage cells, each of said devices having a predetermined one of n different non-linear characteristics, characterised in that each of said devices having a predetermined one of four different non-linear VI characteristics to achieve four levels of storage for each cell, that the devices take the form of a pn junction, a high barrier Schottky diode, a low barrier Schottky diode, and no diode, and that the devices provide readily sensed differences in forward voltage responses when addressed on word (W) and bit lines (B); and that sensing means for sensing the four distinct forward voltage levels on said devices (20) responsive to input signals are connected to the bit lines (B)."

V. The Appellant argues essentially as follows:

Read only storage systems using storage cells having a predetermined one of n (e.g.: n = 4) different voltage current characteristics are only known to be based on the application of field effect transistors (D2 and D3).

D1 describes the manufacture of multi level memory cells for programmable read only memories, e.g. in the form of two terminal bipolar devices.

However, there is no teaching in any of the prior art references for using such two terminal bipolar devices in

read only storage systems having storage cells with different non-linear voltage current characteristics as disclosed in D2 and D3.

Such teaching cannot be regarded as obvious since field effect transistors on the one hand and two terminal bipolar devices on the other hand are technical fields dealt with by different experts.

It should be appreciated that with the Appellant's invention an integrated circuit storage array can be fabricated using only a single two terminal or two-electrode diode layout. As a consequence, when compared with the conventional techniques, only a few simple additional masks need be utilized in applying the different metals required for forming the three different diode devices. There is absolutely no need to form additional elements such as resistors in creating or defining some of the cell devices as in the case of the prior art. The personalisation of each storage cell can be effected in a very late state of the manufacturing process.

It should also be noted, that in the event that anyone of the three different diodes is selected in the Appellant's array (Figure 2) the same current, or "current of substantially the same magnitude," flows through any one of these devices (see Figure 4, which shows the same sense current in dotted lines flowing through each of them). However, the different diodes in the Appellant's array have different forward voltages for that same, or substantially the same, sense current (see Figures 3 and 4).

Bipolar storage cells are, furthermore, faster than field effect transistors, consume less current and have less leakage problems.

Reasons for the Decision

1. The appeal is admissible.

2. Novelty.

It has never been contested that, in view of the cited prior art documents, the substitution of four level two terminal,bipolar devices for the four level field effect transistors in storage devices according to D2 or D3 is novel.

Therefore, no further discussion of novelty is necessary.

3. Inventive step.

3.1 As set out in the Rapporteur's communication of 26 April 1988, the subject-matter of Claim 1 differs from the prior art (in particular US-A-4 202 044) in that the storage cells, which are conductive when addressed, are two terminal, bipolar devices each of which has a predetermined one of non-linear voltage-current characteristics and which take, in the order of decreasing voltage levels, the form of a PN junction, a high barrier Schottky diode and a low-barrier Schottky diode.

The Board is satisfied, contrary to the Appellant's submissions, that the skilled person working in the technical field of read only storage systems can be expected not only to focus his attention to a single type of storage means, as e.g. field effect transistors, but also to take into consideration all the other possibilities, e.g. two terminal devices, i.e. diodes, as means for producing storage cells. It is undisputed that

ROM-arrays having single device storage cells selectively formed of bipolar diodes or of open circuits and connected to word and bit lines and each holding one bit of data (two levels of storage) are commonly known in the art. This fact was also noted in the decision of the Examining Division, (sheet 2, last paragraph). Therefore, the possibility of applying multi-level storage devices in the form of two terminal bipolar devices, as disclosed in D1, can be immediately understood by a skilled person as a feasible alternative to the multi-level field effect devices used in D2 and D3.

3.2 The particular two terminal storage devices specified in the characterising part of Claim 1, i.e. pn junction diode or Schottky diode, respectively, are disclosed in the Figures 3 and 5 of D1 (see in particular column 3, lines 33 to 41 and 46 to 55). The same document teaches to program the storage devices during the manufacturing process in such a way that multi storage level cells are produced. This aim is achieved by a proper selection of materials as well as by creating in a programmed way a cross-sectional area of a crystal column by solid-phase epitaxial growth (see the abstract, column 1, line 53 to column 2, line 6 and column 4, lines 35 to 50).

The Board is, therefore, satisfied that the replacement of four-level field effect transistor storage devices in a read only memory according to D2 or D3 by pn junction diodes and Schottky diodes according to D1 would readily be envisaged by a skilled person. Any advantages brought forward by the Appellant rely merely on inherent properties of the known bipolar devices and cannot support inventive step.

The Appellant did not disclose any particular manufacturing methods directed to the provision of the different storage

levels of the two types of Schottky diodes. Therefore, the Appellant's submission in respect of the possibility of a personalisation in a very late state of the manufacturing process cannot be considered as an argument which would support inventive step.

3.3 Thus, the subject-matter of Claim 1 is not considered to involve an inventive step within the meaning of Article 56 EPC and Claim 1 is, therefore, not allowable under Article 52(1) EPC.

4. Claims 2 and 4 to 13 are dependent on Claim 1 and for this reason not allowable either.

Order

For these reasons, it is decided:

The appeal is dismissed.

The Registrar: **The Chairman:**

S. Fabiani **P.K.J. Van den Berg**