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D E C I S I O N
of 31 January 1994

Case Number: T 0091/93 - 3.5.2

Application Number: 87904951.8

Publication Number: 0276326

IPC: G11B 7/00

Language of the proceedings: EN

Title of invention:
Optical disc recording/reproducing apparatus

Applicant:
Sony Corporation

Opponent:
-

Headword:
-

Relevant legal norms:
EPC Art. 56

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

Decisions cited:
-

Catchword:
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Case Number: T 0091/93

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 31 January 1994

Appellant: Sony Corporation
7-35 Kitashinagawa 6-chome
Shinagawa-ku
Tokyo 141 (JP)

Representative: Thomas, Christopher Hugo
D. Young & Co.
21 New Fetter Lane
London EC4A 1DA (GB)

Decision under appeal: **Decision of the Examining Division 067 of the European Patent Office dated 23 September 1992 refusing European patent application No. 87904951.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: E. Persson
Members: W.J.L. Wheeler
A.G. Hagenbucher

Summary of Facts and Submissions

I. The present appeal contests the decision of the Examining Division to refuse the Appellant's European patent application No. 87 904 951.8.

II. The reason given for the refusal was that the subject-matter of the claims then on file did not involve an inventive step, having regard to the following prior art documents:

D1: EP-A-0 164 745
D2: JP-A-53 153 239
D3: JP-A-57 181 429
D4: EP-A-0 169 579
D5: US-A-3 778 785
D6: JP-A-60 239 929.

III. During the appeal proceedings the Appellant amended the claims and adapted the description.

IV. The Appellant requested that the decision under appeal be set aside and a patent granted on the basis of the following documents:

Description:
page 1, as filed with the statement of grounds of appeal on 15 January 1993, pages 1a and 1b, as filed on 30 November 1993, and pages 2 to 14, as filed with letter of 24 July 1991;

Claims:
Claim 1 and Claim 2 (part), as appearing on page 15 filed with the statement of grounds of appeal on 15 January 1993, and Claim 2 (part) and Claims 3 to 6, as appearing on pages 16 and 17 filed on 30 November 1993;

Drawings:
Figures 1 to 15 on sheets 1/7 to 7/7 as originally filed.

V. Claim 1 is worded as follows:

"1. An optical disc recording and reproducing apparatus comprising:

a disc drive means (14) for rotating an optical disc (1) at a constant angular velocity;

said disc (1) including pit regions (2a) having servo pits and data regions (2b) in which data will be recorded, said pit and data regions (2a, 2b) being alternately provided along the circumferential direction of said disc (1);

an optical head (20) including a laser diode (21) for emitting laser light irradiating said disc (1);

synchronizing means for controlling reading and writing, said synchronizing means comprising pulse generating means (44) for forming reference clock pulses synchronized with said servo pits in said disc (1), said pulse generating means (44) being connected (31, 41, 42, 43) to said optical head (20) and responsive to an output therefrom obtained by detecting said servo pits; and

means (13) for supplying drive pulses to said laser diode (21) in synchronism with said reference clock pulses, whereby said laser diode (21) is driven to write data onto said data regions (2b) in synchronism with said reference clock pulses;

characterized in that:

said synchronizing means further controls erasing;

said means (13) for supplying drive pulses to said laser diode (21) further drives said laser diode (21) to erase data from said data regions (2b) in synchronism with said reference clock pulses;

said means (13) for supplying drive pulses includes means causing a relatively small current to flow through said laser diode (21) during the intervals between said drive pulses effecting data erasure or data writing; and

data are recorded in said data regions (2b) by drive pulses synchronized with said reference clock pulses at the rate of one bit of data per pulse, with data being erased from said data regions (2b) on a bit-by-bit basis."

Claims 2 to 5 are dependent on Claim 1.

Claim 6 is worded as follows:

"6. An optical disc recording and reproducing apparatus comprising:

a disc drive means (14) for rotating an optical disc (1) at a constant angular velocity;

said disc (1) including pit regions (2a) having servo pits and data regions (2b) in which data will be recorded, said pit and data regions (2a, 2b) being alternately provided along the circumferential direction of said disc (1);

an optical head (20) including a laser diode (21) for emitting laser light irradiating said disc (1);

synchronizing means for controlling reading and writing, said synchronizing means comprising pulse generating means (44) for forming reference clock pulses synchronized with said servo pits in said disc (1), said pulse generating means (44) being connected (31, 41, 42, 43) to said optical head (20) and responsive to an output therefrom obtained by detecting said servo pits; and

means (13) for supplying drive pulses to said laser diode (21) in synchronism with said reference clock pulses, whereby said laser diode (21) is driven by drive pulses of a first pulse width (W_{WR}) to write data onto said data regions (2b) in synchronism with said reference clock pulses;

characterized in that:

said synchronizing means further controls erasing;

said means (13) for supplying drive pulses to said laser diode (21) further drives said laser diode (21) with drive pulses of a second pulse width (W_{ER}) to erase data from said data regions (2b) in synchronism with said reference clock pulses, said second pulse width (W_{ER}) being greater than said first pulse width (W_{WR}); and

data are recorded in said data regions (2b) by said drive pulses of said first pulse width (W_{WR}) synchronized with said reference clock pulses at the rate of one bit of data per pulse, with data being erased from said data regions (2b) on a bit-by-bit basis."

VI. The Appellant argued essentially that the invention as now claimed addressed the three problems of accurate erasure, extending the lifetime of the laser diode, and improving the rise time of the write and erase pulses. Apparently conflicting requirements were imposed on the operation of the laser diode. The need for complete erasure suggested the use of a single erase pulse to cover an entire sector on the disc, as discussed in D1. The laser diode should be switched off whenever possible to extend its lifetime, but switching it off between pulses worsened the rise time, with possible impact on the positional accuracy of data erasure. In the present invention data were recorded and erased in synchronism with reference clock pulses whose temporal precision could be refreshed by the servo pits prior to writing or erasing each data region. The lifetime of the laser diode was improved without losing positional accuracy during both writing and erasing, by maintaining a relatively small (though non-zero) current through the laser diode between pulses (Claim 1), or by using longer pulses for erasure than for writing (Claim 6).

Reasons for the Decision

1. The appeal is admissible.

2. The preamble of the present Claim 1 is the same as the preamble of Claim 1 as refused by the Examining Division. The Appellant has not contested the Examining Division's finding that an apparatus according to the preamble of Claim 1 is known from D3 (JP-A-57 181 429).

2.1 The Board has considered D3 on the basis of its drawings and the English abstract in Patent Abstracts of Japan, Vol. 7, No. 26 (P-172)[1171], which disclose an optical disc recording and reproducing apparatus comprising:

a disc drive means for rotating an optical disc (1);

the disc (1) including prebits (11) and data regions (12) alternately provided along the circumferential direction of the disc (1);

an optical head (3) for emitting light irradiating the disc (1); and

synchronizing means for controlling reading and writing, comprising pulse generating means (20) connected to the optical head (3) and responsive to an output therefrom to form clock pulses synchronized with the prebits;

data being recorded on the data regions in synchronism with said clock pulses at the rate of one bit of data per pulse (see Fig. 3).

2.2 The abstract does not mention that the disc is rotated at a constant angular velocity, nor does it mention servo pit regions, or that the optical head includes a

laser diode. None of these features are recognisable in the drawings. However, such features are usually included in optical disc recording and reproducing apparatus, so that their presence in the prior art device described in D3 may be regarded as implicit. It may also be regarded as implicit that some sort of synchronizing means must be provided for controlling reading and writing in relation to the servo pit regions. The Board sees no reason to object to these implicit features being recited in the preamble.

3. The subject-matter of Claim 1 differs from the prior art known from D3 (abstract and drawings) in that:

(a) data are recorded in the data regions by drive pulses synchronized with clock pulses which are synchronized with the servo pits;

(b) the synchronizing means further controls erasure of data from the data regions on a bit-by-bit basis in synchronism with said clock pulses; and

(c) a relatively small current flows through the laser diode during the intervals between drive pulses effecting data erasure or data writing.

4. The features (a) to (c) cooperate to solve the problem of extending the lifetime of the laser diode while ensuring accurate erasure.

4.1 As pointed out by the Appellant, apparently conflicting requirements are imposed on the operation of the laser diode. The need for complete erasure suggests the use of a single continuous erase pulse to cover an entire sector, because if the laser diode is switched on and off during erasure of a sector, the finite rise time of the pulses could result in incomplete erasure of data.

On the other hand, the laser diode should not be driven for longer than is absolutely necessary in order to extend (or conserve) its lifetime.

4.2 In the present invention, these difficulties are overcome by writing and erasing data in synchronism with reference clock pulses whose temporal precision is refreshed by the servo pits before writing or erasing in each data region. Thus, the erasing pulses are correctly timed with respect to the recorded data bits.

4.3 By maintaining a small current through the laser diode during the intervals between the drive pulses the rise time of the pulses is reduced, offering greater positional accuracy of data writing and erasure.

4.4 Alternatively, according to Claim 6, instead of feature (c) mentioned in paragraph 3 above, the width of the drive pulses used for erasing data is greater than the width of the drive pulses used for writing, increasing the margin for positional error of the erasing drive pulses.

5. Regarding the erasure of data on a bit-by-bit basis, it is noted that EP-A-0 164 745 (D1) discloses an optical disc recording and reproducing apparatus comprising a rotating optical disc (1), divided into sectors, each comprising a data portion preceded by a header portion including a pit region having servo pits for synchronization, an optical head including a semiconductor laser (5), and means (15) connected to the optical head and responsive to detection of the servo pits for controlling reading, writing and erasing of data. How the laser is controlled to erase data is explained on page 14, lines 9 to 18. Although pulsed driving of the laser is mentioned there in lines 11 to 13, there is no suggestion that the pulses are short

enough to erase data on a bit-by-bit basis. As shown in Figure 3F and described in lines 15 to 18 on page 14 and lines 6 to 11 on page 7 relatively long pulses having a constant DC level are used to erase several sectors with one pulse.

5.1 Pulsed driving of a laser to effect selective erasure of recorded data is described in US-A-3 778 785 (D5). There is no suggestion that the erase pulses could be so short as to erase data on a bit-by-bit basis.

5.2 None of the other cited documents (D2, D4 and D6) is concerned with erasing.

5.3 Thus, there is no disclosure in any of the cited documents of erasing data from an optical disc on a bit-by-bit basis. This does not appear to be an inherently obvious thing to do.

6. The Board therefore concludes that the subject-matters of Claims 1 and 6 are novel and involve an inventive step over the cited prior art. The same applies to the subject-matters of Claims 2 to 5, which are dependent on Claim 1.

7. In the opinion of the Board, the amendments comply with Article 123(2) EPC and the application as amended meets the requirements of the EPC.

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 grant a patent according to the Appellant's request (paragraph IV above).

The Registrar: The Chairman:

M. Beer E. Persson