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File Number: T 742/91 - 3.5.2

Application No.: 86 114 617.3

Publication No.: 0 229 891

Title of invention: Head positioning system for floppy disk drives

Classification: G11B 5/55

D E C I S I O N
of 30 June 1992

Applicant: NEC CORPORATION

Headword:

EPC Article 56

Keyword: "Inventive step (no)"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 742/91 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 30 June 1992

Appellant : NEC CORPORATION
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Decision under appeal : Decision of Examining Division of the European
Patent Office dated 26 April 1991 refusing
European patent application No. 86 114 617.3
pursuant to Article 97(1) EPC.

Composition of the Board :

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

Summary of Facts and Submissions

I. The present appeal contests the decision of the Examining Division to refuse Appellant's European patent application No. 86 114 617.3. The reason given for the refusal was that Claims 1 to 4 of the main request and Claims 1 to 3 of the auxiliary request then on file did not involve an inventive step having regard to the following prior art documents:

D1: US-A-3 881 184

D2: US-A-4 518 904.

II. In the course of oral proceedings held before the Board on 30 June 1992, the Appellant filed a main request and three auxiliary requests. Claim 1 according to the main request is worded as follows:

"A head positioning system for positioning a magnetic head (7) at a target track of a magnetic disk (8) which rotates at a disk rotational frequency, comprising

- (a) a drive motor (6) for driving said magnetic head (7) in a radial direction of said magnetic disk (8),
- (b) means for detecting the position of the magnetic head (7) relative to a center line of said target track and for supplying a head position signal (x)
- (c) a position error detector (1) for receiving the head position signal (x) and for generating a position error signal (e) which indicates a deflection of said magnetic head (7) with respect to said center line of said target track,

- (d) a feedback control system having
- (d₁) a compensation digital filter (3; 9) for generating a compensation signal ($b_1, b_2; i_1$ to i_{32}) having a frequency which is an integer times the disk rotational frequency and being synchronized with the track eccentricity, and
- (d₂) a stabilization digital filter (4; 10) connected to said position error detector (1) and said compensation digital filter (3; 9) for compensating the phase differences of the position error signal (e) and the compensation signal ($b_1, b_2; i_1$ to i_{32}) for stabilizing the feedback control system and for generating an equilibrium point signal (u) of said drive motor (6) in accordance with said position error signal (e) and said compensation signal, and
- (e) a motor driver (5) for generating the drive current (d, d') for said drive motor (6) in response to said equilibrium point signal (u)."

Claim 1 according to the first auxiliary request differs from Claim 1 according to the main request in that section d₁) reads as follows:

"d₁) a compensation digital filter (3; 9) for generating a compensation signal ($b_1, b_2; i_1$ to i_{32}) having a frequency which is twice the disk rotational frequency and being synchronized with the track eccentricity, and"

Claim 1 according to the second and third auxiliary requests differ from Claim 1 according to the main and first auxiliary request respectively by including the features recited in Claim 4 according to the main request, namely "wherein said motor driver (5) further includes

memory means for storing the value of said drive current in correspondence with said equilibrium point signal (u)."

III. The Appellant argued essentially that the stabilization digital filter (4 or 10) of the Appellant's invention operated on both the position error signal (e) and the compensation signals (b_1 , b_2 or i_1 to i_3) in order to stabilize the feedback control system by compensating the phase differences of the position error signal and the compensation signals. This ensured a faster and more accurate positioning of the magnetic head on the target track than was possible with the system known from D1, in which the output of the track correction profile sequencer (2) was not fed to the compensator filter (5) but directly (without any phase compensation) to the adder (6). D1 was concerned with optical systems, which had higher track densities and slower actuators than magnetic systems, and would not be taken into account by a person skilled in the art who was trying to improve the tracking accuracy of a magnetic system. Concerning the first and third auxiliary requests, it was not obvious from D1 to limit compensation to the second harmonic. Concerning the second and third auxiliary requests, the memory means for storing the value of the drive current in correspondence with the equilibrium point signal (u) contributed to the speed of response by allowing the motor (6) to be driven with the optimum current. This was not mentioned in D1 or in any of the other documents cited in the search report. With hindsight it was possible to analyse the Appellant's invention into a combination of the teaching of D1, D2 and general knowledge in the art, but that did not mean the Appellant's invention was obvious.

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

main request, or on the basis of the first, second or third auxiliary request (in that order of preference).

Reasons for the Decision

1. The appeal is admissible.
2. The question to be decided is whether Claim 1 according to the main request or any of the auxiliary requests involves an inventive step within the meaning of Article 56 EPC, having regard to the prior art known from D1 and D2 and general knowledge in the art.
3. Document D1 discloses, as its preferred embodiment, a prior art adaptive digital servo system for positioning a light beam at a target track of a disk which rotates at a disk rotational frequency, comprising
 - (a) a drive motor (9, Fig. 1) for driving a mirror (17) in a radial direction of the disk (11),
 - (b) means (13, 15) for detecting the position of the light beam (reflected from the mirror 17) relative to a centre line of the target track and for supplying a beam position signal (PRESENT POSITION),
 - (c) a position error detector (4) for receiving the beam position signal and for generating a position error signal which indicates a deflection of the beam with respect to the centre line of the target track,
 - (d) a feedback control system having
 - (d₁) a compensation digital filter (3, Fig. 1, details Fig. 8 and column 10, lines 23 to 66) for generating compensation signals having frequencies which are an

integer (2 to 8) times the disk rotational frequency and being synchronised with the track eccentricity, and

- (d₂) a stabilisation digital filter (blocks 2, 5 and 6, Fig. 1, details of block 2 shown in Fig. 7) connected to the position error detector (4) and the compensation digital filter (3) for compensating the phase differences of the position error signal and the compensation signals (as explained in D1, column 7, line 20, to column 8, line 5) for stabilizing the feedback control system (as explained in D1, column 11, lines 23 to 63) and for generating an equilibrium point signal of the drive motor in accordance with the position error signal and the compensation signal, and
- (e) a motor driver (8) for generating the drive current for the drive motor in response to the equilibrium point signal.

3.1 The Appellant argued that the blocks 2, 3, 5 and 6 of D1 did not correspond with the definition of the feedback control system recited in sections (d), (d₁) and (d₂) of Claim 1 of the main request (see paragraph II above). In particular, it was argued that the Appellant's feedback control system had a shorter response time and was more stable than the system disclosed in D1. However, sections (d), (d₁) and (d₂) of the claim are couched in very general functional terms and do not recite any features which would in fact distinguish the feedback control system from what is known from D1.

4. It therefore appears to the Board that Claim 1 of the main request differs from the prior art known from D1 only in that the system is for use with magnetic disks and that

the drive motor drives a magnetic head (as the "member being moved" in the terminology used in Claim 1 of D1, or instead of the mirror in the preferred embodiment of D1).

- 4.1 As explained in the introductory part of the description of the present application, the object of the invention is to provide a head positioning system capable of positioning a magnetic head at the centre line of a target track on a magnetic data storage disk with high accuracy so as to be able to increase the track density of the disk.
- 4.2 The Appellant argued that D1 was only relevant to systems for optical disks and the skilled person concerned with magnetic disks would not consider it. However, although the preferred embodiment disclosed in D1 concerns a system for optical disks, in the opinion of the Board it is clear that the teaching of D1 is not confined to systems for optical disks (see columns 1 to 3 of the description and Claims 1 to 5, 8 and 9 of D1). Furthermore, in the opinion of the Board, the fact that higher track densities have been achieved with optical disks than with magnetic disks would not be a reason to ignore the teaching of D1 when one is trying to increase the track density of a system for magnetic disks. On the contrary, it would appear to be a very good reason to consider it.
- 4.3 In the opinion of the Board, a person skilled in the art who was trying to develop a more accurate tracking system for use with magnetic disks would consider it worth while to apply the teaching of D1 to magnetic disk systems, and, in doing so, would inevitably arrive at a head positioning system falling within the scope of Claim 1 according to the main request.

- 4.4 Thus, Claim 1 according to the main request does not involve an inventive step and for this reason the main request must be refused.
5. Regarding the first auxiliary request, it is noted that in D1 the track correction profile generator (3), which corresponds to the compensation digital filter in the present application, includes a Fourier analyser (82) which extracts sets of values corresponding to the fundamental and second to eighth harmonics of the repeatable error in the error signal (see Fig. 8 and column 10, lines 23 to 66). To the skilled person it is evident that the second harmonic has a frequency which is twice the disk rotational frequency. The Appellant's claims do not actually specify that only this component of the error signal is used, but even if they did, it is obvious to a person skilled in the art that if he does not require the finer degrees of correction obtainable by processing the higher (third to eighth) harmonics, he can simplify the system by leaving them out.
- 5.1 Thus, Claim 1 according to the first auxiliary request does not involve an inventive step and for this reason the request must be refused.
6. Regarding the second and third auxiliary requests, it is noted that it is known from D2 to use a two-phase step motor to position the head in a magnetic disk system, and, as is acknowledged on page 5 of the present application, it is well known that an appropriate combination of the two-phase motor currents can stop the motor at an arbitrary position. In the opinion of the Board, it is obvious to use such an arrangement to position the magnetic head in the system according to D1 adapted to magnetic disks in the manner defined in Claim 1 according to the main request or first auxiliary request, and, given

that the equilibrium signal (u) is in a digital form, it is obvious to use a table, stored in a memory, for deriving the appropriate values of the motor currents (d, d') corresponding to different values of the equilibrium signal.

6.1 Thus, Claim 1 according to the second and third auxiliary requests does not involve an inventive step and for this reason these requests must be refused.

7. In the result, the Board concludes that none of the Appellant's requests can be allowed.

Order

For these reasons, it is decided that:

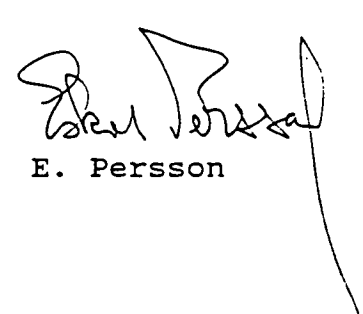
The appeal is dismissed.

The Registrar



M. Köhl

The Chairman



E. Persson

lgm
Jgk