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D E C I S I O N
of 9 May 2006

Case Number: T 0546/03 - 3.5.04

Application Number: 95904879.4

Publication Number: 0734569

IPC: G11B 5/55

Language of the proceedings: EN

Title of invention:
Voice coil driven positioner for coarse and fine positioning of magnetic head in multi-track tape drive

Applicant:
SEAGATE REMOVABLE STORAGE SOLUTIONS LLC

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
"Main request, auxiliary request 1: amendments - added subject-matter (yes)"
"Auxiliary request 2: inventive step - no"

Decisions cited:
T 1105/92

Catchword:
-

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Case Number: T 0546/03 - 3.5.04

D E C I S I O N
of the Technical Board of Appeal 3.5.04
of 9 May 2006

Appellant: Seagate Removable Storage Solutions LLC
920 Disc Drive
Scotts Valley, CA 95066 (US)

Representative: Kenyon, Sarah Elizabeth
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 18 November 2002 refusing European application No. 95904879.4 pursuant to Article 97(1) EPC**

Composition of the Board:

Chairman: F. Edlinger
Members: A. Dumont
T. Karamanli

Summary of Facts and Submissions

I. This is an appeal from the decision of the examining division to refuse European patent application No. 95 904 879.4, filed as an international application and published as WO 95/16986 A2, for the reason that the subject-matter of claim 1 lacked novelty with regard to the prior art document:

D1: EP 0 529 930 A1

II. Oral proceedings before the Board took place on 9 May 2006, during which the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claim 1 of either the main request or (first) auxiliary request as filed with the letter dated 10 April 2006, or claim 1 of the second auxiliary request as filed in the oral proceedings.

III. Claim 1 according to the main request reads as follows:

"A head positioning apparatus for positioning a magnetic head in a multi-track tape drive, said apparatus comprising:
a stator assembly (120);
a moveable carriage (160) supported by and moveable with respect to said stator assembly, said carriage for supporting said magnetic head;
a voice coil (140) supported by said moveable carriage;
a voice coil drive means (144, 159) for delivering a current (I_C) to the voice coil to thereby generate a magnetic motive force (F) that moves the voice coil; and

a head indicating means;
said head positioning apparatus characterised in that:
said stator assembly is shaped as an inner and an outer cylinder of annular cross-section and is arranged for generating a magnetic flux between the inner and outer cylinders of annular cross-section, said voice coil being shaped as a cylinder of annular cross-section and arranged to intersect the magnetic flux generated by said stator, and
said head indicating means is a means for detecting the position of the voice coil and comprises a movable member and a stationary member, the movable and stationary members being disposed inside a volume bounded by the inner cylinder of annular cross-section, and the movable member being coupled to the voice coil for moving with the voice coil;
whereby said head positioning apparatus is arranged to drive the voice coil through the voice coil drive means so as to coarsely position the magnetic head in open-loop manner to a predetermined accuracy, and is then arranged to drive the voice coil through the voice coil drive means so as to provide closed-loop fine positioning of the magnetic head."

IV. Claim 1 according to the first auxiliary request reads as claim 1 according to the main request except for the last paragraph ("whereby …") which has been replaced by the following text:

"and said voice coil drive means includes a nominal track positioner subsystem for receiving a nominal track position signal (157) such that said voice coil drive means outputs said current (I_C) to move said head to a nominal position to within a predetermined

accuracy and said voice coil drive means (159) further includes a closed-loop servo subsystem for receiving servo signals and for outputting said current (I_C) to move said head to a desired position and maintain said head at said position;
whereby said head positioning apparatus uses said head indicating means and said voice coil to provide open-loop coarse positioning of said magnetic head, and then uses said voice coil to provide closed-loop fine positioning of said magnetic head."

V. Claim 1 according to the second auxiliary request reads as follows:

"A head positioning apparatus for positioning a magnetic head in a multi-track tape drive, said apparatus comprising:
a stator assembly (120);
a moveable carriage (160) supported by and moveable with respect to said stator assembly, said carriage for supporting said magnetic head;
a voice coil (140) supported by said moveable carriage;
a voice coil drive means (144, 159) for delivering a current (I_C) to the voice coil to thereby generate a magnetic motive force (F) that moves the voice coil; and
a head indicating means;
said head positioning apparatus characterised in that:
said stator assembly is shaped as an inner and an outer cylinder of annular cross-section and is arranged for generating a magnetic flux between the inner and outer cylinders of annular cross-section, said voice coil being shaped as a cylinder of annular cross-section and

arranged to intersect the magnetic flux generated by said stator;
said head indicating means is a means for detecting the position of the voice coil relative to the stator assembly and comprises a movable member and a stationary member, the movable and stationary members co-operating with each other and being disposed inside a region that is bounded by a path traveled by outer bounds of the cylindrical shape of the voice-coil, and the movable member being coupled to the voice coil for moving with the voice coil; and
said voice coil drive means includes a nominal track positioner subsystem for receiving a nominal track position signal (157) such that said voice coil drive means outputs said current (I_C) to move said head to a nominal position representing a desired track to within a predetermined accuracy and said voice coil drive means (159) further includes a closed-loop servo subsystem for receiving servo signals and for outputting said current (I_C) to bring said head into fine alignment with said desired track and to maintain said head at said desired track;
whereby said head positioning apparatus uses the voice coil and positional information received from said head indicating means to provide coarse positioning of said magnetic head at said nominal position, and then uses said voice coil to provide closed-loop fine positioning of said magnetic head at said desired track."

VI. The Appellant's arguments regarding novelty and inventive step can be summarised as follows:

(a) The Appellant questions the disclosure relating to figure 4 of D1 and contends that it does not show

the relevant features of the present application so clearly and unambiguously as to constitute an appropriate and technically realistic starting point, citing T 1105/92 (not published in OJ EPO). Instead, figure 2 of D1 should be regarded as closest prior art, from which the claimed subject-matter cannot be derived in an obvious manner.

(b) Figure 4 of D1 does not show inner and outer cylinders of annular cross-section, but a stator with a centre post.

(c) The geometric arrangement of its constituent parts, once assembled, cannot be gathered with certainty from figure 4 of D1. This exploded view in particular does not show how the moving coil engages in the stator and how the movable member of the head indicating means engages inside the stationary member.

(d) It is also unclear whether the voice coil is disposed on or partially within the centre post of the stator.

(e) The operation of the mechanism for positioning the head over a track is too unclear and ambiguous to disclose a coarse positioning followed by a fine positioning, as claimed. The description relating to figure 4 and the related claims 13 and 14 are to be interpreted as disclosing two alternative or combined mechanisms for fine positioning but no mechanism for coarse positioning.

Reasons for the Decision

1. *Main request*

1.1 The application as filed discloses a position of the stationary member of the head indicating means within the stationary inner cylinder (the inner pole piece 124 of the stator 120; see page 8, lines 20 to 22 and figure 1). The position of the head indicating means as a whole may be within the movable voice coil (see page 27, lines 26 to 34). This is also reflected in features (d.2) and (d.3) of independent claim 33 of the application as filed, on which present claim 1 is allegedly based. The position of the moveable voice coil is detected relative to the stationary member within the inner cylinder (claim 4; claim 33, feature (d.4); figure 1).

1.2 Present claim 1 specifies a head indicating means comprising a movable member and a stationary member both "being disposed inside a volume bounded by the inner cylinder of annular cross-section". The applicant argues that this arrangement is clearly and unambiguously derivable for the embodiment as depicted in figure 1, in which the stationary member and the end of a dip stick constituting the active part of the movable member (123d) reciprocate with each other inside the said volume.

1.3 However, the volume occupied by the moveable member depends on the path travelled by the voice coil to which the moveable member is coupled for moving therewith. Even the active part of the movable member in figure 1 (LVDT core piece 123d) does not necessarily

remain disposed inside the volume bounded by the inner cylinder because there is no direct and unambiguous disclosure about the path travelled by the voice coil. No passage can be found in the application as filed disclosing a head indicating means comprising a movable member that remains disposed inside the volume bounded by the inner cylinder and where the position of the voice coil may be detected relative to other parts (e.g. the tape).

1.4 The Board judges therefore that the main request cannot be allowed because claim 1 contains subject-matter which extends beyond the content of the application as filed and thus infringes Article 123(2) EPC.

2. *First auxiliary request*

Claim 1 contains the same amendment as claim 1 according to the main request. The features which distinguish claim 1 from that of the main request do not relate to the undisclosed features and do not alter their meaning. As a result, the first auxiliary request is not allowable under Article 123(2) EPC for the same reasons as the main request.

3. *Second auxiliary request*

3.1 Amendments (Article 123(2) EPC)

Claim 1 defines that the movable and stationary members are "disposed inside a region that is bounded by a path travelled by outer bounds of the cylindrical shape of the voice-coil". This definition can be derived from features (d.2) and (d.3) of independent claim 33 of the

application as originally filed. Further amendments reintroduce parts of a feature (d.4) of original claim 33 and clarify the definition of the coarse and the fine positioning. The Board is satisfied that these amendments do not infringe Article 123(2) EPC.

3.2 Background of the invention

In a head positioning apparatus for a multi-track tape the magnetic head is brought to a desired track position (coarse positioning, open-loop). Coarse positioning may be traditionally provided for example by a stepper motor counting the number of rotations on a lead screw. Alignment with the desired track is maintained by a closed-loop control compensating for the tape's tendency to wander laterally using a voice coil controlled in response to servo signals pre-recorded on the tape (fine positioning; see application, page 2, line 21 to page 3, line 24). The invention aims at reducing the number of parts, the manufacturing costs as well as the combined size and complexity by using a single voice coil to effect both coarse and fine positioning. In a preferred embodiment, an LVDT (linear variable differential transformer) detector is used to position the voice coil relative to the stator structure, thereby coarsely positioning it ("in open-loop fashion") to the desired nominal track position (page 3, line 25 to page 5, line 26; page 19, lines 3 to 10).

3.3 Disclosure of D1

3.3.1 D1 generally relates to coarse and fine positioning of a magnetic head utilizing "a voice coil, or a voice

coil and stepper motor combination" (D1, column 1, line 53 to column 2, line 7). Most embodiments relate to the combination. Column 4, lines 43 to 52 of D1 relates to a (single) voice coil because it explicitly states that "no stepper motor is employed in this embodiment" (of figure 3), but coarse positioning is not mentioned in this context. The following embodiment (figure 4) adds a means (LVDT) for sensing the position of the magnetic head (D1, column 4, line 58 to column 5, line 26; claims 13 and 14). A person skilled in the art would derive that the LVDT position detector makes coarse positioning to one of a multiplicity of parallel tracks possible, but cannot normally provide accurate enough information for fine positioning because only the servo signals provide position information taking the lateral misalignments of the tape into account (cf D1, figure 5 and column 5, lines 27 to 39).

3.3.2 The disclosure of D1 relating to figure 4 may be unclear with respect to certain constructional details, such as the guiding along guide posts and the exact shape, position and function of the sensing means (LVDT 102A and 102B), but this does not make the disclosure relating to figure 4 unclear and ambiguous as to the general teaching of the combination of a single voice coil and sensing means in a multi-track tape drive. A person skilled in the art is assumed to interpret the figure, the fairly succinct related description and the related claims in the context of the whole document, resorting to the common general knowledge in the technical field to determine what has been made available to the public, thereby also filling remaining gaps on the basis of the common general knowledge. In the judgment of the Board, the embodiment

of figure 4 of D1 constitutes a technically realistic starting point and, because of the combination of a single voice coil (to effect both coarse and fine positioning) and an LVDT, it has to be considered as the closest prior art. The Board sees no reason to discard figure 4 of D1 and, concerning the question of a realistic starting point, comes to a similar conclusion as another board in T 1105/92 (in point 4.4 of the reasons) to which the Appellant referred.

3.3.3 It is not contested that the features of the preamble of claim 1 are known from D1, figure 4. D1 discloses to a person skilled in the art that the stator assembly is shaped as an inner and an outer cylinder of annular cross-section and is arranged for generating a magnetic flux between the inner and outer cylinders of annular cross-section. Two elliptical rims representing an inner and an outer cylinder and magnets (120) for generating a magnetic flux are shown in figure 4. In order to operate properly, the voice coil actuator must intersect the magnetic flux generated by the magnets in order to generate a magnetic motive force. Therefore the voice coil has to be shaped as a cylinder of annular cross-section and arranged to intersect the magnetic flux generated by said stator. A flat bottom of the voice coil which merely sits on top of the cylinders would imply that it intersects, if at all, the flux only marginally at its fringe. In the absence of a particular disclosure about such an unusual operation in D1, this option has to be discarded.

3.3.4 As set out under point 3.3.1 above, D1 discloses an LVDT for detecting the position of the voice coil relative to the stator assembly. An LVDT is generally

known to comprise a movable member (102A) disposed at least partly inside the voice coil and co-operating with a stationary member (102B), as shown in figure 4 of D1, which also shows that the movable member is coupled to the voice coil for moving with the voice coil. Although the stationary member (102B) is described in D1 as being mounted in the housing (column 5, lines 5 to 7), figure 4 only shows it on top of the inner cylinder or at least partially protruding from it. The precise shape of the entire members and their axial placing with respect to the path travelled by outer bounds of the voice coil cannot be determined with certainty in D1.

3.3.5 D1, figure 4, further discloses that the voice coil drive means positions the head at a selected one of a multiplicity of parallel tracks (see point 3.3.1 above). This implies to a skilled person that the known apparatus includes a nominal track positioner "subsystem" for receiving a nominal track position signal, such that said voice coil drive means outputs said current to move said head to a nominal position representing a desired track to within a predetermined accuracy (one of a multiplicity of parallel tracks). This derives from the normal function of a voice coil (see also figure 5 of D1). The specification of a "subsystem" does not add any particular technical information to the already known distinction between a nominal track positioning and a closed-loop servo positioning.

3.3.6 The voice coil drive means of D1, figure 4, further includes a closed-loop servo "subsystem" for receiving servo signals and for outputting said current to bring

said head into fine alignment with said desired track and to maintain said head at said desired track. The head positioning apparatus uses the voice coil and positional information received from said head indicating means to provide coarse positioning of said magnetic head at said nominal position, and then uses said voice coil to provide closed-loop fine positioning of said magnetic head at said desired track. These features derive from the explicitly stated use in claim 13 of D1 that a magnetic head is coarsely positioned to one of the multiplicity of parallel tracks (the nominal track position) before a closed loop servo control maintains the head aligned at said position. Claim 14 of D1 states that the magnetic coil and LVDT (sensing the position of the head, claim 13 of D1) operate together so as to position said at least one head in relation to the centre of a selected recording track and column 5, lines 22 to 26 of D1 discloses that servo control signals are used to accurately maintain the head over the selected track as in the other embodiments of D1 (see e.g. column 2, lines 3 to 7). As already set out under point 3.3.1 above, an LVDT cannot normally be used for closed-loop fine positioning because of lateral misalignments of the tape, but servo signals pre-recorded on a tape can compensate for such track-to-head misalignments (cf page 3, first paragraph of the published application). Again, the specification of a servo "subsystem" does not add any particular technical information to the already known distinction between a nominal track positioning and a closed-loop servo positioning.

3.4 Novelty

It follows from the analysis set out under section 3.3 that only the location of the head indicating means with respect to the path travelled by the voice coil distinguishes the claimed apparatus from the prior art. Therefore the claimed subject-matter is novel.

3.5 Inventive step

3.5.1 Disposing the movable and stationary members of the head indicating means inside a region that is bounded by a path travelled by outer bounds of the cylindrical shape of the voice-coil reduces the size and the weight of the arrangement (see the published application, page 3, line 25 to page 4, line 4). These technical benefits are commonly sought after in the technical field of tape drives.

3.5.2 As already set out under point 3.3.4 above, D1 (column 5, lines 5 to 7) mentions the mounting of the stationary member in the housing, whereas figure 4 shows a stationary member at least partially protruding out of the inner cylinder inside the travel path of the voice coil. Since the central region of the inner cylinder is not used for other purposes, the Board judges that a person skilled in the art reading D1 would have readily contemplated the mounting of the head indicating means (completely) inside that region, to further reduce the height of the drive. Disposing the head indicating means as specified in a head positioning apparatus of claim 1 was therefore obvious to a person skilled in the art at the date of priority of the present application.

3.5.3 As a result, the subject-matter of claim 1 of the second auxiliary request does not involve an inventive step within the meaning of Articles 52(1) and 56 EPC.

3.6 For the reasons set out above, the second auxiliary request is not allowable either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

D. Sauter F. Edlinger