



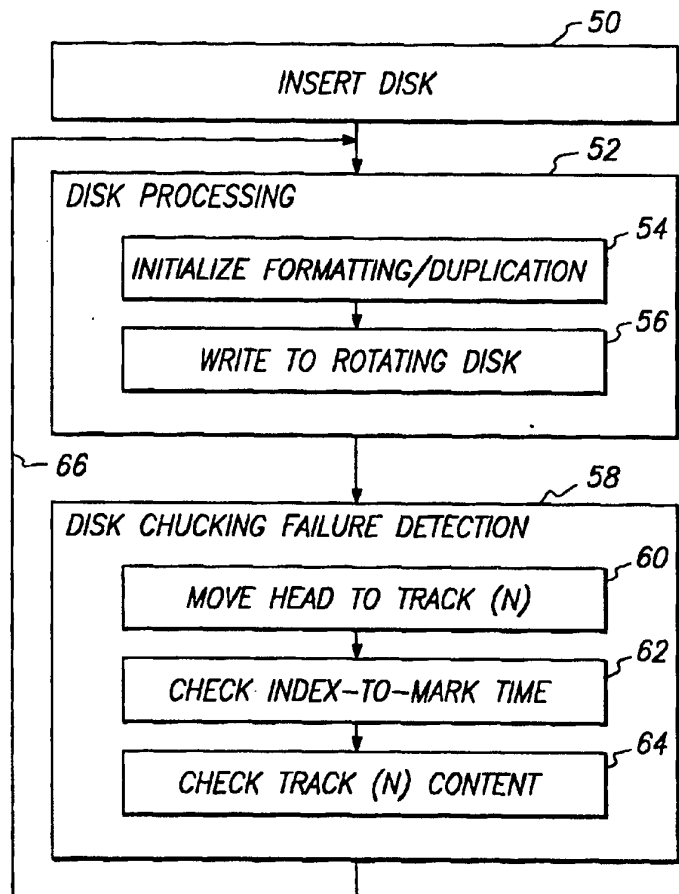
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US94/09260 (22) International Filing Date: 16 August 1994 (16.08.94) (30) Priority Data: 08/107,937 17 August 1993 (17.08.93) US (71) Applicant: TRACE MOUNTAIN PRODUCTS, INC. [US/US]; 1040 East Brokaw Road, San Jose, CA 95131 (US). (72) Inventors: McDONNELL, Kevin; 9944 Longview Lane, Pleasanton, CA 94588 (US). DICKERSON, James, S.; 441- 12 Camille Circle, San Jose, CA 95134 (US). (74) Agents: FERNANDEZ, Dennis, S. et al.; Fenwick & West, Suite 500, Two Palo Alto Square, Palo Alto, CA 94306 (US).</p>		<p>(81) Designated States: JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.</p>

(54) Title: DISK CHUCKING FAILURE DETECTION SYSTEM

(57) Abstract

In a magnetic or optical disk duplication or recording system (10) with a disk drive and a recording head (20) axial mis-alignment ("mis-chucking") of a disk installed to rotate about a disk drive axis is detected. A digital data signal is written by the recording head to tracks on the rotating disk (24), the head being positioned initially at a certain track position. The duration between when the recording head (20) detects an index provided on the rotating disk and when the recording head (20) detects a mark thereon is determined. Preferably after the disk is removed and reinserted in the same disk drive, the recording head (20) is then re-positioned at the initial track position, such that another digital data signal may be read at the initial track position. Another duration is determined, between when the recording head detects the index and the mark on disk. Disk chucking failure is detected when the durations, as well as the digital data signals, are substantially different.



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DISK CHUCKING FAILURE DETECTION SYSTEMBACKGROUND OF THE INVENTION

5 1. Field of the Invention

The invention relates to electronic storage systems, particularly to disk duplication or recording systems.

10 2. Description of the Background Art

In many computer and peripheral systems, digital data are commonly stored in electronic media, such as magnetic or optical disks. Typically, a mechanical drive subsystem and a read/write head coupled thereto cooperate to
15 store and retrieve data to and from the disk. Thus, while the disk is caused by the mechanical drive to rotate, digital signals may be written to or read from certain locations on the disk surface by the head.

To ensure proper signal recording, the disk must
20 be positioned in the disk drive such that the center of the disk is aligned axially to rotate about the drive axis of disk drive. The step of seating the disk properly in the disk drive is referred to as "chucking." Sometimes when the
25 disk rotates out of alignment, or "mis-chucks," improper signal recording results. It would be desirable, therefore, to provide a technique for detecting disk mis-chucking.

SUMMARY OF THE INVENTION

30 The invention resides in a magnetic or optical disk duplication or recording system having a disk drive and a recording head, wherein axial mis-alignment or chucking failure of a disk positioned to rotate about a disk drive axis is detected. Initially a first digital data signal is
35 written by the recording head to tracks on the rotating disk, the head being positioned at an initial track position. A first duration is pre-specified, between when

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the recording head detects an index provided on the rotating disk and when the recording head detects a mark or pattern thereon. After additional data is written on various tracks, the disk is removed and re-inserted in the same disk drive, and then the recording head is re-positioned at the initial track position. A second digital data signal is then read from the initial track position, and a second duration is determined, between when the recording head detects the index and the pattern from the disk. Disk chucking failure is detected when the first and second durations, and/or the first and second digital data signals, are determined to be substantially different.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a generalized block diagram of disk duplication or recording system 10.

FIG. 2 is a simplified flow chart of a process for detecting disk chucking failure, per the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a simplified diagram of disk duplication or recording system 10 for storing (writing) or retrieving (reading) digital data in the form of electronic signals in magnetic or optical media or disks 24. System 10 includes controller 12, which preferably includes microprocessor 14 and digital memory 16, disk drive assembly 38, and recording head mechanism 20.

When operating normally, system 10 receives 22 diskette or disk 24 which is inserted into disk drive 38, wherein digital data may be read from or written to disk 24. Using a conventional disk drive motor mechanism (not shown), disk 24 may be mounted or "chucked" on a rotating fixture and thereby caused to rotate about rotational axis 28.

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During rotation of disk 24, recording head 20 is positioned to read or write digital data signals to or from various storage locations on the disk surface, which is typically partitioned into pre-defined regions called sectors or tracks.

Thus, assuming that disk 24 rotates properly about rotational axis 28 of disk drive 38, processor 14 in controller 12 may cause recording head mechanism 20 to store and retrieve digital data from the pre-defined sectors and tracks on disk 24.

However, when disk 26 is positioned improperly, such that center 30 of disk 26 is not aligned to coincide axially with intended rotational axis 28, disk chucking failure arises, and proper data recording is thereby prevented. Disk chucking failure may arise either initially during disk 24 placement or subsequently during disk drive 38 operation.

By promptly detecting disk 26 chucking failure, system 10 performance is improved to the extent that early corrective action 66 may be implemented. In accordance with the present invention, a disk chucking failure technique is applied to disk duplication or recording system 10, as illustrated generally in the flow chart of FIG. 2.

Firstly, disk 24, 26 is inserted for seating or chucking into disk drive 38. Then, generally, disk processing 52 and disk chucking failure detection 58 steps are performed under control of processor 14 in controller 12. During processing and detection steps 52, 58, disk drive 38 causes inserted disk 24 (chucked), 26 (mis-chucked) to rotate conventionally about rotational axis 28, assuming disk 24, 26 is chucked successfully.

Optionally, after disk processing 52, disk

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insertion step 50 may be repeated, prior to disk chucking failure detection step 58. In particular, using an "auto-loader" disk loading and un-loading device coupled thereto, available commercially from Trace Mountain Products, Inc. (San Jose, California), or other similar loading device, disk 24, 26 may be removed from disk drive 38, and then re-inserted 50, 22 shortly thereafter for seating or chucking in the same disk drive 38. In this way, disk 24, 26, if previously mis-chucked, is likely to be re-chucked properly, or at least differently, thereby facilitating disk replacement comparison for chucking failure detection, in accordance with the present invention.

During disk processing 52, controller 12 causes inserted disk 24, 26 to be initialized or formatted by recording head mechanism 20, for example, according to pre-specified, conventional sectors and tracks. Preferably during disk 24, 26 formatting cycle, controller 12 causes a first digital data signal, including an identifiable binary pattern or data signature, to be written 56 by recording head 20 to certain storage locations on disk 24, 26. Preferably, recording head 20 is positioned radially from center axis 28 at an initial, user-specified track position (N), such that first digital data signal may be written to disk 24, 26 beginning at a first concentric track (N) 32 corresponding to the initial track position of recording head 20.

A first duration representing a pre-determined or measured time delay or temporal difference between when recording head 20 detects or senses reference line or index 34, 36 provided radially on disk 24, 26 and when recording head 20 detects or senses a variable, pre-specified "mark" or identifiable digital pattern provided on disk 24, 26, preferably during disk formatting 54, is provided or stored in memory 16 or pre-calculated accordingly by processor 14. Ordinarily, additional recording or duplication data are

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also written by recording head 20 on subsequent tracks (N+1, N+2, etc.) of disk 24, 26.

5 Disk chucking failure detection 58 occurs after recording or duplication data are written 56 on various tracks (N, N+1, N+2, etc.) of disk 24, 26. Controller 12 first causes recording head 20 to return or be re-positioned 60 for reading (or writing) initially at the same, initial track (N) position. Then, a second, previously-written 10 digital data signal is read by recording head 20 from disk 24, 26, when positioned at the initial track position.

Controller 12 calculates or determines a second duration, which is the time delay or temporal difference 15 between when recording head 20 detects or senses index 34, 36 on disk 24, 26 and when recording head 20 reads or senses the mark provided on disk 24, 26.

In accordance with the present invention, disk 20 chucking failure detection 58 occurs generally when the first and second durations, and/or the first and second digital data signals, are determined to be substantially different. This determination may arise, for example, as a result of disk 24 being shifted laterally to off-center 25 position of disk 26.

In particular, axial mis-alignment of disk 26 is indicated by controller 12 when there has been a substantial change in index-to-mark time 62, before and after data 30 duplication or recording, or when data signals or content written in initial track (N) and read 64 therefrom after subsequent data duplication or recording, are compared and determined to be substantially different. Either checking step 62, 64 may be performed by controller 12, in any 35 sequence, to detect disk chucking failure.

Preferably, substantial change which is indicative

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of disk chucking failure arises when the difference in compared data signals or index-to-mark times exceeds a user-specified tolerance; for example, 26 microseconds for index-to-mark time. Thus, when controller 12 detects disk
5 chucking failure, an error signal may be generated for user warning purpose.

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CLAIMS

We claim:

1. In a disk duplication system comprising a disk drive coupled to a recording head, a method for detecting axial mis-alignment of a disk mounted to rotate about a disk drive axis, the method comprising the steps of:

writing a first signal to at least one track of a rotating disk by a recording head positioned initially at an initial track position;

re-positioning the recording head at the initial track position;

reading a second signal from the rotating disk after the recording head is re-positioned at the initial track position; and

comparing the first and second signals.

2. The method of Claim 1 wherein the writing step further comprises the step of:

providing a first duration, wherein the first duration comprises a measured duration between a first time when the recording head detects an index provided on the rotating disk and a second time when the recording head detects a pattern on the rotating disk.

3. The method of Claim 2 wherein the reading step further comprises the step of:

determining a second duration between a third time when the recording head detects the index provided on the rotating disk and a fourth time when the recording head detects the pattern on the rotating disk.

4. The method of Claim 3 wherein:
axial mis-alignment is indicated when the first and second durations are substantially different.

5. The method of Claim 1 wherein:
the first and second signals are compared to

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determine whether the first and second signals are substantially identical during an initial track period.

6. The method of Claim 1 wherein:

5 an axial mis-alignment signal is generated when the first and second signals are determined to be substantially different.

7. The method of Claim 1 wherein:

10 the first and second signals comprise digital data signals; and the disk comprises a magnetic recording disk.

8. The method of Claim 1 further comprising the 15 steps of:

before reading the second signal, removing the disk from the disk drive; and re-inserting the disk in the disk drive.

20 9. In a disk duplication system comprising a disk drive coupled to a recording head, a method for detecting axial mis-alignment of a disk mounted to rotate about a disk drive axis, the method comprising the steps of:

25 writing a first signal to at least one track of a rotating disk by a recording head positioned initially at an initial track position;

30 providing a first duration, wherein the first duration comprises a measured duration between a first time when the recording head detects an index provided on the rotating disk while writing the first signal and a second time when the recording head detects a pattern on the rotating disk;

re-positioning the recording head at the initial track position;

35 reading a second signal from the rotating disk after the recording head is re-positioned at the initial track position; and

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determining a second duration between a third time when the recording head detects the index provided on the rotating disk while reading the second signal and a fourth time when the recording head detects the pattern on the rotating disk;

wherein axial mis-alignment is indicated when the first and second durations are substantially different.

10 10. The method of Claim 9 further comprising the steps of:

 comparing the first and second signals to determine whether the first and second signals are substantially identical during an initial track period.

 11. The method of Claim 9 further comprising the steps of:

 before reading the second signal, removing the disk from the disk drive; and
20 re-inserting the disk in the disk drive.

 12. In a disk duplication system, a subsystem for detecting axial mis-alignment of a disk mounted to rotate about a rotational axis of a disk drive in the disk duplication system, the subsystem comprising:

 a recording head for writing a first signal to at least one track of a rotating disk, the recording head being positioned initially at an initial track position; and
30 a controller for causing the recording head to be re-positioned at the initial track position;

 wherein after the recording head is re-positioned at the initial track position, the recording head reads a second signal from the rotating disk, and the controller
35 compares the first and second signals.

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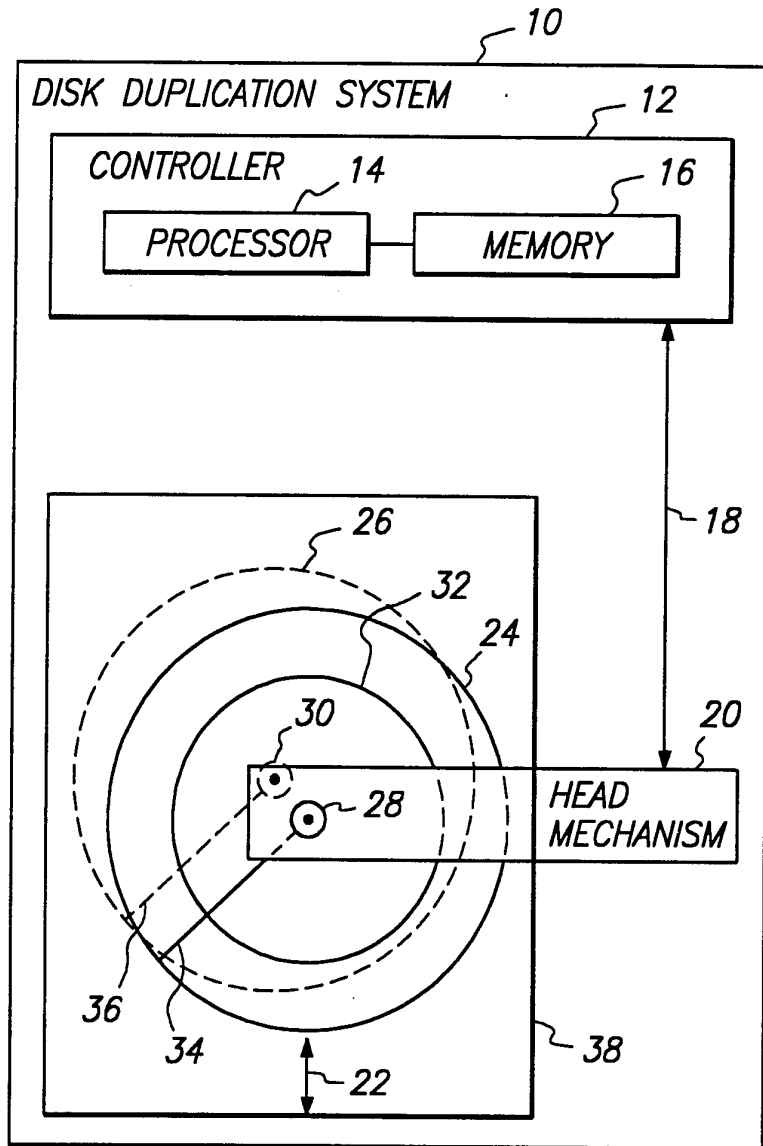


FIG. 1

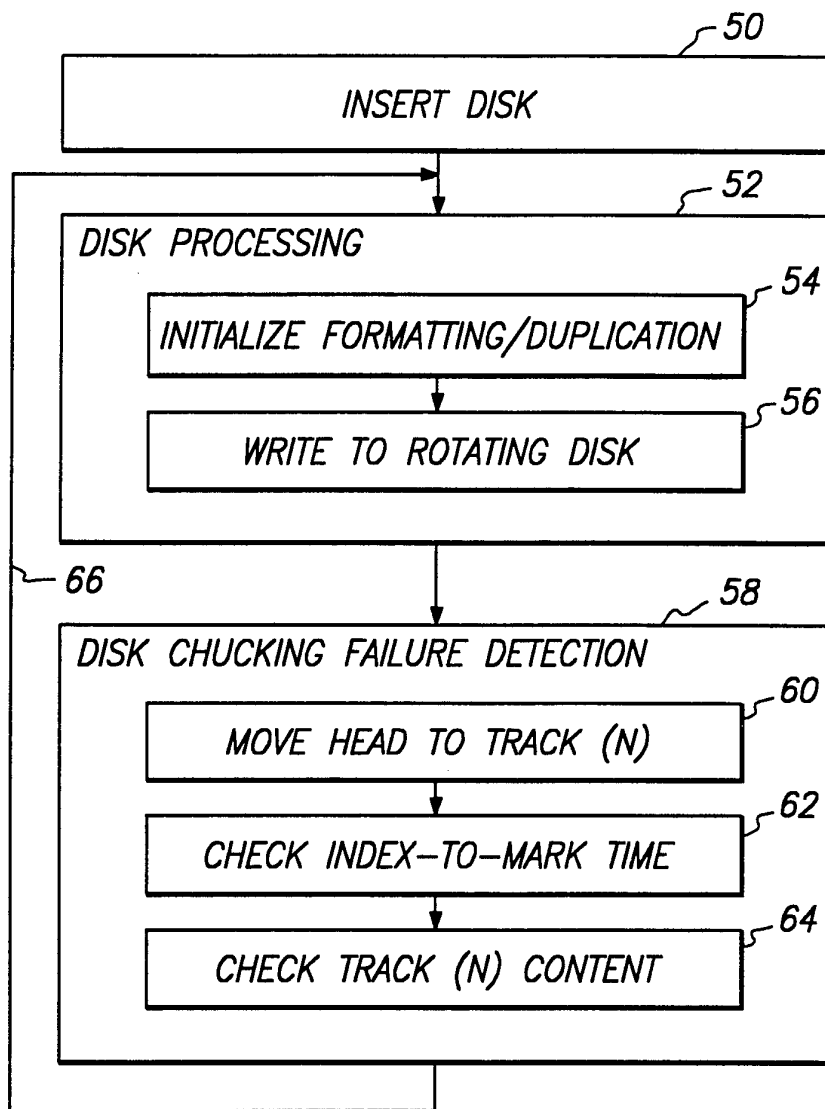


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/09260

A. CLASSIFICATION OF SUBJECT MATTER				
IPC(5) :G11B 5/596 US CL : 360/77.04, According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED				
Minimum documentation searched (classification system followed by classification symbols) U.S. : 360/77.04,				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched G11B 5/596,15/18,5/09,27/36,5/82, 360/77.04,69,77.11,31,53,135				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) APS				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
Y	U,S, A, 4,513,331 (BAKER ET AL.) 10 April 1979, see col. 1 lines 46-68	1-7, 9-10, 12		
Y	U.S, A, 4,149,199 (CHICK ET AL.) 10 April 1979, see col 1, lines 46-68	8, 11		
Y	U,S, A, 5,068,754 (GARDE) 26 November 1991, see col 1, lines 51-67	1-7, 9-10, 12		
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.				
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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (N/A)		Authorized officer <i>V. KAPADIA</i> Telephone No. (703) 308-1551		