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A method of recording realtime data and a realtime data recording apparatus

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(56) Related Art
JP 11-296999
JP 11-242858
JP 11-273265

ABSTRACT OF THE DISCLOSURE

Realtime data is recorded on a disc at a unit of cluster including successive sectors. When an error occurs in recording, the realtime data to be recorded in one

5 cluster is relocated at another cluster, wherein successive sectors in each cluster are physically nearly arranged, so that movement of head is reduced when an error occurs and realtime data is recorded without losing the realtime data and without waiting. The area recording medium may be

10 scanned to detect an error in recording during an idle interval. The idle interval is detected in accordance with the request interval of storing or reproducing and writing and reading execution time. A bit map table for storing used status and defect status may be recorded on the area

15 recording medium. Logical sector address in a sector may be converted into a physical sector address such that sectors indicated by the physical sector address converted from the logical sector address in a cluster are physically nearly located on the area recording medium.

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AUSTRALIA
Patents Act 1990

COMPLETE SPECIFICATION
STANDARD PATENT

Applicant(s):

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Invention Title:

A METHOD OF RECORDING REALTIME DATA AND A REALTIME
DATA RECORDING APPARATUS

The following statement is a full description of this
invention, including the best method of performing it known to
me/us:

TITLE OF THE INVENTION

A METHOD OF RECORDING REALTIME DATA AND
A REALTIME DATA RECORDING APPARATUS

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

This invention relates to a method of recording
realtime data and a realtime data recording apparatus.

2. Description of the Prior Art

A method of recording realtime data is known.

10 Moreover, a method of setting alternation sector is
disclosed in Japanese patent application provisional
publication No. 5-28646. Figs. 5A and 5B are illustrations
showing such a prior art operation. In this method, when a
defective sector 51 is detected in the disc device, the
15 defective sector 51 is skipped and the data is stored but
shifted in the sectors ahead and the spare sector except
defected sector.

SUMMARY OF THE INVENTION

At least some embodiments of the present invention may provide a
20 superior method of recording realtime data and a superior
realtime data recording apparatus.

According to a first aspect of the present invention there is provided
a method of recording realtime data on an area recording
medium, including the steps of: (a) recording the realtime
25 data on the recording medium to locate the realtime data at

unit of a cluster including successive sectors physically
nearly located each other on the recording medium; (b)
detecting errors in recording the realtime data; and (c)
in response to the errors, relocating the defective
5 clusters, where the errors are detected, to another new
clusters by recording.

In one embodiment of this method, assuming that the
error is detected at L^{th} sector at the one cluster, L being
a natural number, the method further includes the steps
10 of: temporally storing the real time data with a buffer
memory to record the real time data on the recording
medium. The successive realtime data from the buffer
memory is recorded on the area recording medium at the
another cluster from the L^{th} sector of the another cluster
15 in response to the error, and the recorded data is read at
the one cluster and recorded to the another cluster from
the first sector to $(L-1)^{\text{th}}$ sector. The successive sectors
in each of the clusters may have monotone increasing
physical sector numbers.

20 According to a second aspect of this invention, there
is provided a first realtime data recording apparatus
including: a storing circuit including an area recording
medium for storing realtime data at a unit of cluster
including successive sectors which are physically nearly
25 located; a bit map table for defect status and used status
of the



clusters; a link table for generating a link of the clusters in accordance with the bit map table to provide a file of the realtime data; a file access control circuit for operating the storing circuit to store the realtime
5 data in response to a recording request; and an error detecting circuit responsive to the area storing circuit for detecting an error in storing the realtime data, wherein the file access control circuit relocates the realtime data at a first cluster of the clusters to a
10 second cluster of the clusters which is physically near the first cluster in response to the error detecting circuit in accordance with the bit map table and the link table.

In the first realtime data recording apparatus, the bit map table may comprise a semiconductor memory.

15 In the first realtime data recording apparatus, the area recording medium may further store data of the bit map table.

In the first realtime data recording apparatus, the file access control circuit may operate the storing circuit to
20 store the realtime data with logical address of the cluster, the realtime data recording apparatus further including converting circuit for converting the logical address to physical address, the storing circuit storing the realtime data with the physical address of the cluster, the bit map
25 table controlling defect status and used status of the

clusters with the logical or physical address of the cluster;

5 In the realtime data recording apparatus, the successive sectors in each of the clusters may have monotone increasing physical sector numbers.

According to a third aspect of this invention, there is provided a second realtime data recording apparatus including: a storing circuit including an area recording medium for
10 recording and reading realtime data at a unit of cluster including successive sectors at writing and reading data transfer rates, the successive sectors being physically nearly located each other; a bit map table for storing defect conditions and used conditions of the clusters; a
15 link table for generating a file and a link of the clusters in accordance with the bit map table; a file access control circuit for operating the storing circuit to record or read the realtime data in response to a request; an idle interval detecting circuit for detecting
20 an idle interval in storing or reproducing the realtime data in accordance with the writing and reading data transfer rates and the request; and an error detecting circuit responsive to the idle interval detecting circuit for detecting an error in a cluster. The file access
25 control circuit relocates the realtime data at a first cluster of the clusters to a second cluster of the clusters which is physically near the



first cluster in response to the error detecting circuit in accordance with the bit map table and the link table.

In the second realtime data recording apparatus, the file access control circuit may compensate the link table
5 in response to the error detecting circuit in accordance with the bit map table to inhibit to use the cluster in which the error is detected.

The successive sectors in each of the clusters may have monotone increasing physical sector numbers.

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According to a fourth aspect of this invention, there is provided a third realtime data recording apparatus including: a disc drive unit including: a storing circuit including an area recording medium for storing realtime data at a unit of
15 cluster and data of a bit map; a converting circuit for converting between logical sector address and physical sector address such that sectors indicated by the physical sector address converted from the logical sector address in a cluster are physically nearly located on the area
20 recording medium; a bit map storing circuit for storing defect status and used status of the sectors with the physical address in the area recording medium as the bit map table; and an error detecting circuit responsive to the storing circuit for detecting an error in storing the
25 realtime data; a link table for generating a link of the

clusters in accordance with the bit map table via the
converting circuit to provide a file of the realtime data;
and a file access control circuit for operating the
storing circuit to store the realtime data with the
5 logical sector address in response to a recording request,
wherein the file access control circuit relocates said
realtime data at a first cluster of the clusters to a
second cluster of the clusters with the logical sector
address in response to the error detecting circuit in
10 accordance with the bit map table and the link table.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be
described, by way of example only, with reference to the
15 accompanying drawings, in which:

Figs. 1 A and 1 B are illustrations of an embodiment
of this invention showing an operation of skipping an
error occurring cluster on an area recording medium;

Fig. 2 is a block diagram of a realtime data
20 recording apparatus according to a first embodiment;

Fig. 3 is a block diagram of a realtime data
recording apparatus of a second embodiment;

Fig. 4 is a block diagram of a realtime data
recording apparatus according to a third embodiment; and

25 Figs. 5A and 5B are illustrations showing a prior



art operation.

The same or corresponding elements or parts are designated with like references throughout the drawings.

DETAILED DESCRIPTION OF THE INVENTION

5 Prior to describe embodiments of this invention, a concept of this invention will be described briefly.

Figs. 1A and 1B are illustrations of an embodiment of this invention showing an operation of skipping an error occurring cluster on an area recording medium.

10 In Figs. 1A and 1B, each cluster includes N sectors which are physically near each other on the area recording medium. N (cluster size) is a natural number more than one. The area recording medium may comprise a hard disc or an optical disc for example. If a hard disc or an optical
15 disc is used as the area recording medium, logical sectors are successively generated from the peripheral track of the area recording medium and are sectioned every N sectors to provide clusters. The cluster size N or the access size is determined to provide a data rate necessary for recording
20 and reproducing video and audio data with chained clusters (file). If the access size is large, a movement of the head is reduced, so that a high data transfer rate is provided. On the other hand, a small access size results in decrease in data throughput or the available recording
25 capacity. Accordingly, the cluster size N and the access

size is determined to provide the data transfer rate required to read and record the audio data and video data. The access size is an arbitrary number of clusters. More specifically, the access size is positive integer times the
5 cluster size N.

In Figs. 1A and 1B, K is a variable indicating relative sector number in a cluster.

<FIRST EMBODIMENT>

Fig. 2 is a block diagram of a realtime data
10 recording apparatus according to a first embodiment.

The realtime data recording apparatus of the first embodiment includes an audio and video data recording and reproducing control circuit 21, a file access control circuit 22, a drive control circuit 23, a disc drive unit
15 24, a cluster link table 25, and a cluster bit map 26 which comprises a semiconductor memory.

Audio and video data (AV data) is inputted to the audio and video data recording and reproducing control circuit 21 in a recording mode. The audio and video data
20 recording and reproducing control circuit 21 controls recording in response to a recording request and controls reproducing AV data in response to a reproducing request (a reproducing mode). In the reproducing mode, the audio and video data recording and reproducing control circuit 21
25 outputs AV data read from the disc drive unit 24.

In the recording mode, the file accessing control circuit 22 generates a file, that is, a chain of clusters in the cluster link table 25 with reference to the cluster bit map 26 to store the audio data and the video data, wherein the chain represents cluster number data of clusters used in the file and the order of the clusters used in the file. The file accessing control circuit 22 registers the chain (link) as a file in the cluster link table 25. The cluster bit map 26 stores using status and inhibit or defect status of clusters.

In response to a recording request, the file access control circuit 22 operates the drive control circuit 23 to record the AV data from the audio and video data recording and reproducing control circuit 21 into the disc drive unit 24. The disc drive unit 24 stores the AV data from the drive control circuit 23 on the area recording medium 11 in accordance with the cluster data from the file access control circuit 22.

During recording, the disc drive unit 24 detects an error in recording. When the disc drive unit 24 detects an error in recording, the disc drive unit 24 informs the file access control circuit 22 via the drive control circuit 23 of the error, that is, error data which includes error status and a logical address of the error sector.

In Fig. 1A, an error occurs at a sector of which

sector number is K. Then, the file access control circuit 22 stops writing the AV data from the buffer memory 22a and assigns one more cluster to the chain and stores a defect mark data in the cluster bit map table 26 to inhibit to use
5 the cluster in which the error occurs. The position on the area recording medium 11 of the added cluster in the chain (link) is determined at will. The file access control circuit 22 temporally stores the cluster number where the error occurs, a relative sector number where the error
10 occurs, and the relocated cluster number.

Next, the head is controlled to access the following cluster (L + 1). The file access control circuit 22 reads the buffer memory 22a, and records the realtime data from the sector K of the following cluster (L + 1), when the
15 head reaches the sector K of the following cluster (L + 1).

In an idle interval or after recording, the file access control circuit 22 copies the recorded data on the sector (K = 1) to the sector (K - 1) of the cluster L at the sector (K = 1) to the sector (K - 1) of the cluster (L
20 + 1), so that the realtime data at the cluster L is relocated at the cluster (L + 1). Next, the file access control circuit 22 stores defect mark data on the cluster bit map 26 and erases the cluster number, the relative sector number, and the relocated cluster number which were
25 temporally stored by the file access control circuit 22.

When any other error occurs during the copy of those sectors, mentioned cluster reallocating operation is executed recursively.

As mentioned, realtime data is recorded on the area
5 recording medium 11, at a unit of cluster including N
sectors of which physical sector addresses increase in a
monotone increasing function. When an error is detected
during recording, that is, a defected cluster is detected,
a spare cluster is prepared. The remaining realtime data
10 to be recorded at the cluster where the error occurs is
recorded at the corresponding sector at the following
cluster. The cluster where the error occurs is registered
as a defected cluster to inhibit to use it. During idle
interval, or after recording a series of the realtime data,
15 the realtime data recorded at the cluster where the error
occurs is copied at the former sectors at the following
cluster. This makes it possible to provide the cluster
size N or the access size required for a continuous data
transfer rate of the realtime data. When an error occurs
20 in recording, increase in sector accessing is suppressed
because the realtime data is recorded physically nearly
located sectors. That is, relocating the realtime data to
be recorded at one sector is performed at a large unit
(cluster) to reduce movement of the head, so that data
25 transfer rate necessary for recording and reproducing

realtime data is provided irrespective of the number of errors in recording.

<SECOND EMBODIMENT>

Fig. 3 is a block diagram of a realtime data recording apparatus of a second embodiment.

The realtime data recording apparatus of the second embodiment includes an audio and video data recording and reproducing control circuit 31, a file access control circuit 32, a drive control circuit 33, a disc drive unit 34, and a cluster link table 35. The disc drive unit 34 includes a logical-to-physical-address conversion circuit 36, a cluster bit map control circuit 37, an area recording medium 11, and an error detecting circuit 39. The area recording medium records data of a cluster bit map 38 in addition to the realtime data.

Audio and video data (AV data) is supplied to the audio and video data recording and reproducing control circuit 31 in a recording mode. The audio and video data recording and reproducing control circuit 31 controls recording in response to a recording request and controls reproducing AV data in response to a reproducing request (a reproducing mode). In the reproducing mode, the audio and video data recording and reproducing control circuit 31 outputs AV data read from the disc drive unit 34.

In the recording mode, the file accessing control

circuit 32 generates a file, that is, a chain (link) of clusters in the cluster link table 35 with reference to the cluster bit map 38, wherein the chain represents cluster number data of clusters used in the file and the order of the clusters used in the file. The file accessing control circuit 32 registers the chain (link) as a file in the cluster link table 35 with logical sector data. The cluster bit map 38 stores using status and defect status of clusters with physical sector address. The cluster bit map control circuit 37 controls the cluster bit map 38. That is, the cluster bit map control circuit 37 records data of the cluster bit map 38 with physical sector address on the area recording medium 11 to renew the data of the cluster bit map 38.

The logical-to-physical-address converting circuit 36 converts logical sector address from the file access control circuit 32 via the drive control circuit 33 into physical sector address, wherein the sectors converted from the logical sector address in a sector are physically nearly located on the area recording medium 11. The disc drive unit 34 records the realtime data with physical sector address converted from the logical sector address from the file access control circuit 32. The physical sector address from the cluster bit map 38 is also converted into the logical sector address which is sent to

the file access control circuit 32.

In response to recording request, the file access control circuit 32 operates the drive control circuit 33 to record the AV data from the audio and video data recording and reproducing control circuit 31 into the disc drive unit 34. The disc drive unit 34 stores the AV data from the drive control circuit 33 on the area recording medium 11 in accordance with the cluster data from the file access control circuit 32.

10 During recording, the disc drive unit 34 detects an error in recording with the error detection circuit 39. When the error detection circuit 39 detects an error in recording, the disc drive unit 34 informs the file access control circuit 32 via the drive control circuit 33 of the error, that is, error data which includes error status and
15 logical address of the error sector.

In Fig. 1A, it is assumed that an error occurs at a sector of which sector number is K. In response to the error detection, the file access control circuit 32 stops writing the AV data from the buffer memory 32a and assigns
20 one more cluster to the chain and stores a defect mark data in the cluster bit map table 38 to inhibit to use the cluster in which the error occurs. The position on the area recording medium 11 of the added cluster in the chain
25 (link) is determined at will. The file access control

circuit 32 temporally stores the cluster number, a relative sector number, and the relocated cluster number.

Next, the head is controlled to access the following cluster (L + 1). The file access control circuit 32 reads
5 the buffer memory 32a and records the realtime data from the sector K of the following cluster (L + 1), when the head reaches the sector K of the following cluster (L + 1).

In an idle interval or after recording, the file access control circuit 32 copies the recorded data on the
10 sector (K = 1) to the sector (K - 1) of the cluster L at the sector (K = 1) to the sector (K - 1) of the cluster (L + 1), so that the realtime data at the cluster L is relocated at the cluster (L + 1). Then, the file access control circuit 32 stores defect mark data on the cluster bit map 38 and
15 erases the cluster number, the relative sector number, and the relocated cluster number which were temporally stored by the file access control circuit 32.

When any other error occurs during the copy of those sectors, mentioned cluster reallocating operation is
20 executed recursively.

As mentioned, the cluster bit map control circuit 37 records data of the cluster bit map 38 on the area recording medium 11, so that a semiconductor-memory for storing the defect status and used status is not used
25 because the data of cluster bit map 38 is recorded on the

area recording medium 11.

<THIRD EMBODIMENT>

Fig. 4 is a block diagram of a realtime data recording apparatus according to a third embodiment.

5 The realtime data recording apparatus of the third embodiment includes an audio and video data recording and reproducing control circuit 41, a file access control circuit 42, a drive control circuit 43, a disc drive unit 44, a cluster link table 45, and a cluster bit map 46. The
10 realtime data recording apparatus of the third embodiment further includes an access monitoring circuit 47 and a scan control circuit 48.

Audio and video data (AV data) is supplied to the audio and video data recording and reproducing control
15 circuit 41 in a recording mode. The audio and video data recording and reproducing control circuit 41 controls recording in response to a recording request and controls reproducing AV data in response to a reproducing request (a reproducing mode). In the reproducing mode, the audio and
20 video data recording and reproducing control circuit 41 outputs the AV data read from the disc drive unit 44.

In the recording mode, the file accessing control circuit 42 generates a file, that is, a chain of clusters in the cluster link table 45 with reference to the cluster
25 bit map 46, wherein the chain represents cluster number

data of clusters used in the file and the order of the clusters used in the file. The file accessing control circuit 42 registers the chain (link) as a file in the cluster link table 45. The cluster bit map 46 stores using
5 status and inhibitive and defect status of clusters.

In response to a recording request, the file access control circuit 42 operates the drive control circuit 43 to write the AV data from the audio and video data recording and reproducing control circuit 41 into the disc drive unit
10 44. The disc drive unit 44 stores the AV data from the drive control circuit 43 on the area recording medium 11 therein in accordance with the cluster data from the file access control circuit 42.

During recording, the access monitoring circuit 47
15 detects an idle interval in accordance with the interval of the request inputted to the audio and video data recording and reproducing control circuit 41 and with command execution time of writing and reading the realtime data. When there is an idle interval during recording the
20 realtime data at one cluster (no recording or reproducing request or the data transfer rate for recording or reproducing is higher than data amount to be processed at that instance), the access monitoring circuit 47 operates the scan control circuit 48. The scan control circuit 48
25 successively scans the sectors of the cluster on the disc

drive unit 44 to read the recorded realtime data or verifies the recorded realtime data with the realtime data in the buffer or check error detection codes of the sectors by controlling the file access control circuit 42.

5 When there is an error at the sector K as shown in Fig. 1A, the file access control circuit 42 stops writing the AV data from the buffer memory 42a and assigns one more cluster to the chain and stores defect mark data in the cluster bit map 46 to inhibit to use the cluster in which
10 the error occurs. That is, the file access control circuit 42 compensates the link table in response to the error detecting circuit in accordance with the bit map 46 to inhibit to use the cluster in which the error is detected. The position in the disc drive unit 11 of the added cluster
15 in the chain (link) is determined at will. The file access control circuit 42 temporally stores the cluster number, a relative sector number, and the relocated cluster number.

Next, the head is controlled to access the following cluster (L + 1). The file access control circuit 42 reads
20 the buffer memory 42a, and starts recording the realtime data from the sector K of the following cluster (L + 1), when the head reaches the sector K of the following cluster (L + 1).

In an idle interval or after recording the file, the
25 file access control circuit 42 copies the recorded data on

the sector ($K = 1$) to the sector ($K - 1$) of the cluster L
at the sector ($K = 1$) to the sector ($K - 1$) of the cluster
($L + 1$), so that the realtime data at the cluster L is
relocated at the cluster ($L + 1$). Then, the file access
5 control circuit 42 stores defect mark data on the cluster
bit map 46 and erases the cluster number, the relative
sector number, and the relocated cluster number which were
temporally stored by the file access control circuit 42.

When any other error occurs during the copy of those
10 sectors, mentioned cluster reallocating operation is
executed recursively.

As mentioned, realtime data is recorded on a disc at
a unit of cluster including successive sectors. When an
error occurs in recording, the realtime data to be recorded
15 in one cluster is relocated at another cluster, wherein
successive sectors in each cluster are physically nearly
arranged, so that movement of head is reduced when an error
occurs and realtime data is recorded without losing the
realtime data. The area recording medium may be scanned to
20 detect an error in recording during an idle interval. The
idle interval is detected in accordance with the request
interval of storing and reproducing and with writing and
reading execution time. A bit map table for storing used
status and defect status may be recorded on the area
25 recording medium. Logical sector address in a sector may

be converted into a physical sector address such that sectors indicated by the physical sector address converted from the logical sector address in a cluster are physically nearly located on the area recording medium.

5 Accordingly, though an error occurs during recording the realtime data, the realtime data is continuously recorded on an area recording medium by relocating the realtime data to be recorded at the cluster at the following cluster.

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WHAT IS CLAIMED IS:

1. A method of recording realtime data on an area recording medium comprising the steps of:

5 (a) recording said realtime data on said recording medium to locate said realtime data at unit of a cluster including successive sectors physically nearly located each other on said recording medium;

(b) detecting an error in recording said realtime
10 data; and

(c) in response to said error, relocating said realtime data at one of said clusters, where said error is detected, on another cluster by recording.

15 2. A method as claimed in claim 1, wherein it is assumed that said error is detected at L^{th} sector at said one cluster, L being a natural number, said method further comprising the steps of:

temporally storing said real time data with a
20 buffer memory to record said real time data on said recording medium in step (a), wherein said realtime data from said buffer memory is recorded on said area recording medium at said another cluster from the L^{th} sector of said another cluster in response to said error and said
25 realtime data is read at said one cluster and recorded at said another



cluster from the first sector to the $(L-1)^{th}$ sector.

3. A method as claimed in claim 1, wherein said successive
sectors in each of said clusters have monotone increasing
5 physical sector numbers.

4. A realtime data recording apparatus comprising:

storing means including an area recording medium for
storing realtime data at a unit of cluster including

10 successive sectors which are physically nearly located;

a bit map table for defect status and used status in
said clusters;

a link table for generating a link of said clusters
in accordance with said bit map table to provide a file of
15 said realtime data;

file access control means for operating said storing
means to store said realtime data in response to a
recording request; and

error detecting means responsive to said area
20 storing means for detecting an error in storing said
realtime data, wherein said file access control means
relocates said realtime data at a first cluster of said
clusters on a second cluster of said clusters which is
physically near said first cluster in response to said
25 error detecting means in accordance with said bit map table

and said link table.

5. A realtime data recording apparatus as claimed in claim
4, wherein said bit map table comprises a semiconductor
5 memory.

6. A realtime data recording apparatus as claimed in claim
4, wherein said area recording medium further stores data
of said bit map table.

10

7. A realtime data recording apparatus as claimed in claim
4, wherein said file access control means operates said
storing means to store said realtime data with logical
address of said cluster, said realtime data recording
15 apparatus further including converting means for converting
said logical address to physical address, said storing
means storing said realtime data with said physical address
of said cluster, said bit map table controlling defect
status and used status of said clusters with said physical
20 address of said cluster;

8. A realtime data recording apparatus as claimed in claim
4, wherein said successive sectors in each of said clusters
have monotone increasing physical sector numbers.

25

9. A realtime data recording apparatus comprising:

storing means including an area recording medium
for recording and reading realtime data at a unit of
cluster including successive sectors at writing and

5 reading data transfer rates, said successive sectors being
physically nearly located each other;

a bit map table for storing defect conditions and
used conditions in said clusters;

a link table for generating a file and a link of
10 said clusters in accordance with said bit map table;

file access control means for operating said
storing means to record or read said realtime data in
response to a request;

idle interval detecting means for detecting an idle
15 interval in storing or reproducing said realtime data in
accordance with said writing and reading data transfer
rates and said request; and

error detecting means responsive to said idle
interval detecting means for detecting an error in a
20 cluster, wherein said file access control means relocates
said realtime data at a first cluster of said clusters to
a second cluster of said clusters which is physically near
said first cluster in response to said error detecting
means in accordance with said bit map table and said link
25 table.



10. A realtime data recording apparatus as claimed in
claim 9, wherein said file access control means, in
responsive to said error detecting means, compensates said
5 link table in accordance with said bit map table to inhibit
to use said cluster in which said error is detected.

11. A method as claimed in claim 9, wherein said
successive sectors in each of said clusters have monotone
10 increasing physical sector numbers.

12. A realtime data recording apparatus comprising:
a disc unit including:
storing means including an area recording medium
15 for storing realtime data at a unit of a cluster and data
of a bit map;
converting means for converting between logical
sector address and physical sector address such that
sectors indicated by said physical sector address converted
20 from said logical sector address in a cluster are
physically nearly located on said area recording medium;
bit map storing means for storing defect status
and used status of said sectors with said physical address
in said area recording medium as said bit map table; and
25 error detecting means responsive to said storing

means for detecting an error in storing said realtime data;

a link table for generating a link of said clusters in accordance with said bit map table via said converting

5 means to provide a file of said realtime data; and

file access control means for operating said storing means to store said realtime data with said logical sector address in response to a recording request, wherein said file access control means relocates said
10 realtime data at a first cluster of said clusters to a second cluster of said clusters with said logical sector address in response to said error detecting means in accordance with said bit map table and said link table.

15 13. A method of recording realtime data on an area recording medium substantially as herein described with reference to the accompanying drawings.

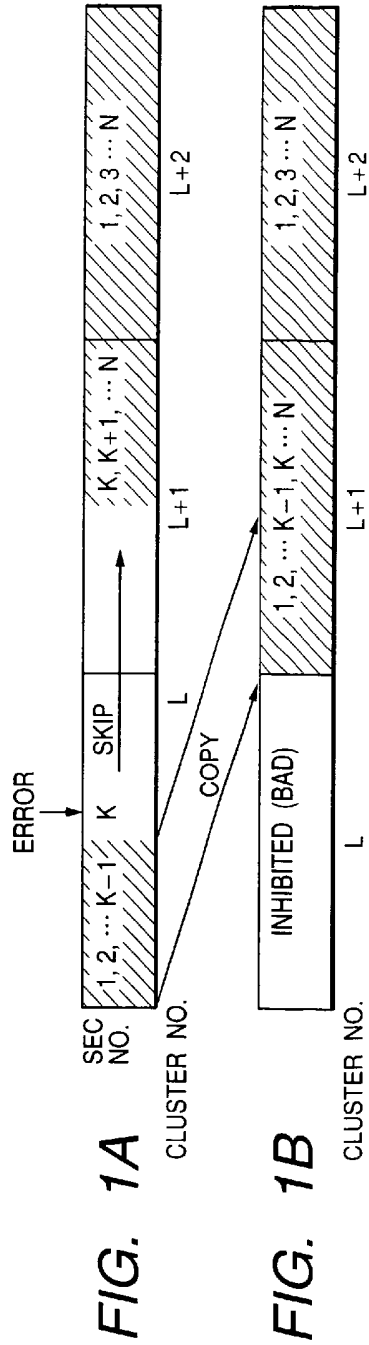
20 14. A realtime data recording apparatus substantially as herein described with reference to the accompanying drawings.

Dated this 17th day of April 2001

25 MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
By their Patent Attorneys
GRIFFITH HACK

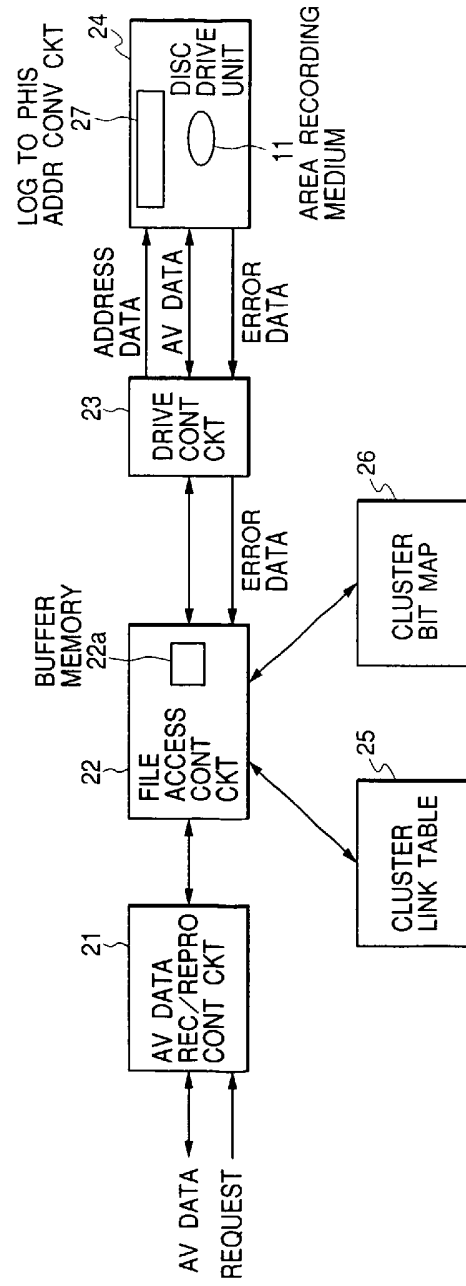


10 44 00 3703



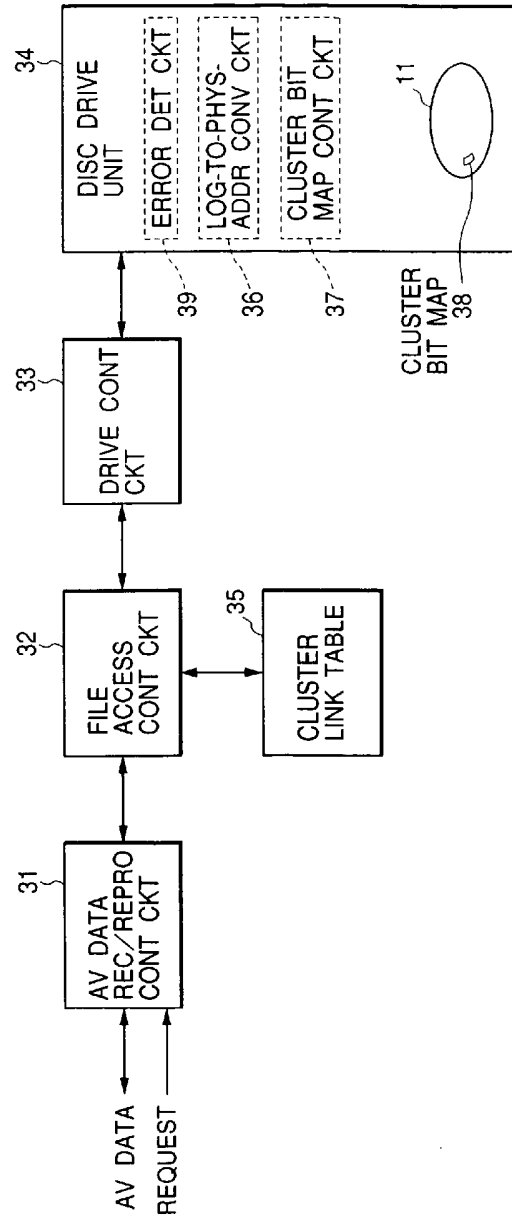
10 04 00 21033

FIG. 2



10 04 00 2103

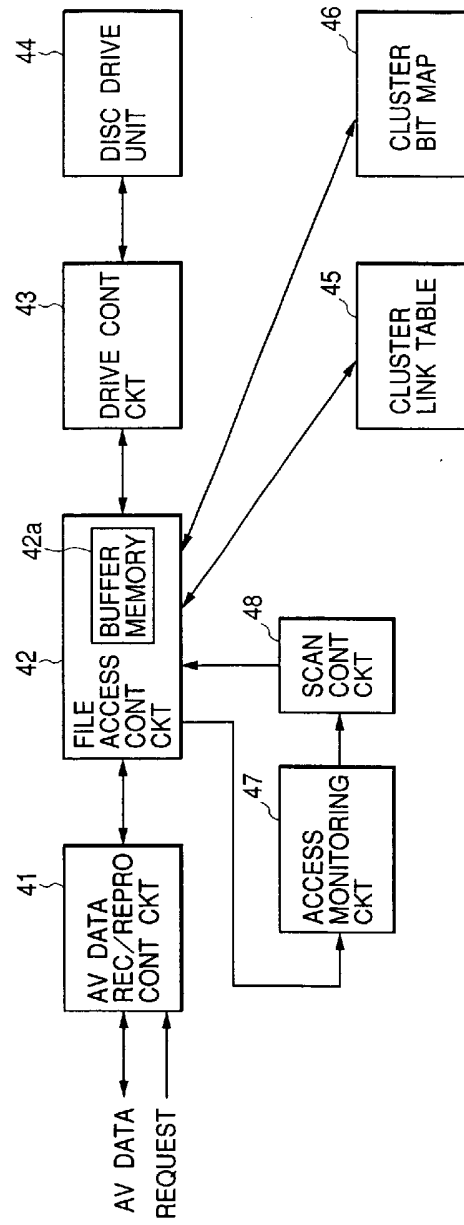
FIG. 3



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FIG. 4



10 04 00 2703

FIG. 5A PRIOR ART

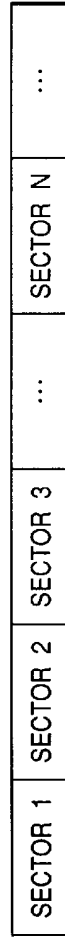


FIG. 5B PRIOR ART

