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Bib Data Sheet

CONFIRMATION NO. 3728

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/755,723	01/05/2001 RULE	~~711~~ 707	~~2185~~ 2175	017002022500

APPLICANTS

Ron Goodman, Santa Cruz, CA;
Howard N. Egan, Capitola, CA;

** CONTINUING DATA ************************ NONE

** FOREIGN APPLICATIONS ******************* NONE

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 02/20/2001

Foreign Priority claimed / 35 USC 119 (a-d) conditions met / Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☒ no; 35 USC 119 (a-d) conditions met ☐ yes ☒ no ☐ Met after Allowance; Verified and Acknowledged — Examiner's Signature, Initials	CA	6	~~10~~ 13	~~5~~ 1

ADDRESS
20350

TITLE
Automatic hierarchical categorization of music by metadata

FILING FEE RECEIVED		
1000	FEES: Authority has been given in Paper No. _________ to charge/credit DEPOSIT ACCOUNT No. _________ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ____________ ☐ Credit

CL 000042

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CONFIRMATION NO. 3728

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/755,723	01/05/2001 RULE	707	2164	017002022500

APPLICANTS

Ron Goodman, Santa Cruz, CA;
Howard N. Egan, Capitola, CA;
DAVID BRISTOW, BAINBRIDGE, WA;

** CONTINUING DATA ************************* NONE

** FOREIGN APPLICATIONS ******************** NONE

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 02/20/2001

Foreign Priority claimed / 35 USC 119 (a-d) conditions met / Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☑ no 35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance Verified and Acknowledged ______ Examiner's Signature ______ Initials	CA	6	~~10~~ 13	~~5~~ 1

ADDRESS

40032

TITLE

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

FILING FEE RECEIVED		
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PATENT APPLICATION SERIAL NO. ____________________

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

01/10/2001 EEKUBAY1 00000001 201430 09755723

01 FC:101 710.00 CH
02 FC:102 160.00 CH

PTO-1556
(5/87)

*U.S. GPO: 1999-459-082/19144

CL 000044

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01/08/01

PTO/SB/05 (11-00)
Approved for use through 10/31/2002. OMB 0651-0032
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	17002-022500
First Inventor	Ron Goodman
Title	Automatic Hierarchical Cateogrization of Music by Metadata
Express Mail Label No.	EL769991701US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning design patent application contents.

ADDRESS TO Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. ☒ Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. ☐ Applicant claims small entity status. See 37 CFR 1.27.
3. ☒ Specification [Total Pages 14]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 7]
5. Oath or Declaration [Total Pages]
   a. ☐ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63 (d)) *(for a continuation/divisional with Box 18 completed)*
      i. ☐ DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☐ Application Data Sheet. See 37 CFR 1.76
7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATIONS PARTS

9. ☐ Assignment Papers (cover sheet & document(s))
10. ☐ 37 C.F.R. §3.73(b) Statement *(when there is an assignee)* ☐ Power of Attorney
11. ☐ English Translation Document *(if applicable)*
12. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
13. ☐ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. ☐ Request and Certification under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. ☒ Other: Unsigned Declaration/Power of Attorney, Fee Transmittal Sheet

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____ / _____

Prior application information: *Examiner* _____ *Group / Art Unit:* _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

☒ *Customer Number or Bar Code Label* 20350 *(Insert Customer No. or Attach bar code label here)* or ☒ *Correspondence address below*

Name	Townsend and Townsend and Crew LLP				
Address	Two Embarcadero enter				
	Eighth Floor				
City	San Francisco	State	CA	Zip Code	94111-3834
Country	USA	Telephone	(415) 576-0200	Fax	(415) 576-0300

Name (Print/Type)	~~Charles E. Krueger~~	Registration No. (Attorney/Agent)	30,077
Signature	*[signature]*	Date	1/5/01

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JC950 U.S. PTO 01/05/01

JC931 U.S. PTO 09/755723 01/05/01

CL 000045

FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision.

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	RON GOODMAN
Examiner Name	
Group Art Unit	
Attorney Docket No.	17002-022500

10841 U.S. PTO
09/755723
01/05/01

TOTAL AMOUNT OF PAYMENT | ($) 870

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 20-1430

Deposit Account Name: Townsend and Townsend and Crew LLP

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☐ Payment Enclosed:

☐ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	710
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($)710

2. EXTRA CLAIM FEES

				Extra Claims		Fee from below		Fee Paid
Total Claims		-**	=		X		=	
Independent Claims	5	-**	=	2	X	80	=	160
Multiple Dependent					X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 160

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive – unavoidable	
141	1,240	241	620	Petition to revive – unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Charles E. Krueger	Registration No. Attorney/Agent)	30,077	Telephone	415-576-0200
Signature	Charles E. Krueger			Date	1/5/01

CL 000046

DO NOT DESTROY

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

PATENT APPLICATION

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

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CL 000047

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

ABSTRACT OF THE DISCLOSURE

A method, performed by software executing on the processor of a portable music playback device, that automatically files tracks according to hierarchical structure of categories to organize tracks in a logical order. A user interface is utilized to change the hierarchy, view track names, and select tracks for playback or other operations.

SF 1174925 v2

DO NOT DESTROY

PATENT
Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

CROSS-REFERENCES TO RELATED APPLICATIONS

INSA1

~~This application is related to~~ Application No. ~~__/___,__, entitled "System for Selecting and Playing Songs in a Playback Device~~ with a Limited ~~User Interface," (Atty. Docket No. 17002-020800)~~; and Application No. __/___,___, entitled "~~Audioplayback Device with Power Savings Storage Access Mode," (Atty. Docket No. 17002-022400), all filed January 5, 2001, the disclosures~~ of which are ~~incorporated~~ herein by reference.

BACKGROUND OF THE INVENTION

Today, portable consumer electronic devices are more powerful than ever. For example, small, portable music playback devices can store hundreds, even thousands, of compressed songs and can play back the songs at high quality. With the capacity for so many songs, a playback device can store many songs from different albums, artists, styles of music, etc.

Music jukeboxes implemented in software executed by a digital computer and portable MP3 and CD players both provide facilities for forming playlists. For example, the OOZIC player, distributed by the assignee of the present application, runs on a host PC and has a playlist feature that allows selection of tracks from the PC's hard disk to be included in the playlist.

As storage capacity increases and songs are compressed to shorter file lengths the number of songs that can be stored increases rapidly. Major problems facing the consumer are organizing and accessing the tracks.

Typically, portable devices have a user interface including a small screen and buttons. Using such a compact user interface to navigate and select among hundreds of songs is inefficient and often frustrating. The display screen can only show a few song titles at one time, and the limited controls make it difficult for a user to arbitrarily select, or move among, the songs.

The creation of playlists is one technique to organize the playing of songs. A set of songs can be included in a playlist which is given a name and stored. When the playlist is accessed, the set of songs can be played utilizing various formats such as sequential play or shuffle.

However, the creation of playlists itself becomes problematic as the number of songs increases, since the user often arbitrarily selects songs from a large number of tracks to form a playlist. This selection mechanism: can be fairly tedious; does not necessarily produce playlists that are of interest to the user over the course of time; may not remain up-to-date if new songs are added that logically fit into a previously created playlist (e.g. "Favorites by Band X" might become out of date if a new favorite by Band X is added after the playlist was created); and leads to "lost" songs that are not members of any playlist.

Accordingly, improved techniques for organizing and grouping tracks useful in a portable music player are needed.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, a technique is provided for organizing tracks on a portable music player by automatically filing tracks in a hierarchical order based on attributes of the tracks.

According to another aspect of the invention, metadata is associated with each track that is used to automatically define the track's appropriate place in the hierarchy.

According to another aspect of the invention, the hierarchy is displayed on the portable music player so that a user can traverse the organizational hierarchy to find individual tracks or find playlists composed of logical groups of tracks.

According to another aspect of the invention, the hierarchy is derived by using metadata associated with the audio content that was obtained through any source of metadata (e.g. CDDB metadata, id3v2 metadata, other obtainable metadata) and subsequently stored with or alongside the file that stores the track.

According to another aspect of the invention, a file is formatted so that an unaltered track is stored as file data and information about the track is stored in file attribute files.

Other features and advantages of the invention will be apparent in view of the following detailed description and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a tree structure for hierarchical filing of tracks;

Fig. 2 is a definition file that specifies the hierarchy depicted in Fig. 1;

Fig. 3 is a user's view of the hierarchy;

Fig. 4 is a schematic diagram of a user interface displaying the hierarchical category structure;

Fig. 5 is a diagram of a file format for storing filed data and file attributes;

Fig. 6 is a flow chart depicting steps for filing tracks according to the hierarchical tree structure;

Fig. 7 depicts a tree resulting from searching the tracks; and

Fig. 8 depicts a format for a user interface.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the invention will now be described in the context of a portable personal player that plays audio files stored in memory. The files may be in MP3, wav. or other digital formats.

In the presently described embodiment, users are able to see the tracks on their player in some organized fashion other than as a single list of tracks. As will be described in more detail below, in one embodiment tracks are sorted utilizing a tree structure having branches labeled according to types of metadata associated with the tracks

For example, a track recorded as "Golden Slumbers" by the Beatles that appears on their album "Hey Jude" might appear as a track under the album "Abbey Road" as well as a track under the list of tracks by the Beatles. It might appear as a track under the genre "Pop Rock" as well as "Songs from the 60's." Furthermore, the organization can have more complex hierarchies. For example, the category of "Pop Rock" might contain subcategories "British Musicians," "American Musicians" and "Other Musicians". In all cases, the track is automatically filed into all appropriate locations without requiring user interaction.

In the currently defined embodiment, a tree structure is defined by a file having the following structure.

The first line of a TreeDef.inf file contains a version number:

V1.0

Each subsequent line (at least in v1.0) contains lines of the following format:

CATEGORY_NAME|TRACK_TYPE_MASK|CATEGORY_STRUCTURE

CATEGORY_NAMEs are the top-level names of the branch under which tracks are sorted. They include things like "Album," "Artist," "Voice Tracks," "All Tracks," etc.

TRACK_TYPE_MASKs tell which types of tracks are to be filed under this particular branch. The actual value is a hexadecimal numerical value (in '0x' format, e.g. 0x01) generated by ORing the following flags together as appropriate:

```
enum tTrackType
{
        kTTNothing=0x00,
        kTTSong=0x01,
        kTTVoice=0x02,
        kTTBook=0x04,
        kTTMacro=0x08,
        kTTPlaylist=0x10
};
```

So, for example, the "Album" branch has a TRACK_TYPE_MASK of kTTSong, because only songs are filed under that branch, but the "All Tracks" branch has a TRACK_TYPE_MASK of (kTTSong | kTTVoice | kTTBook).

Other elements might be added to tTrackType (e.g. kTTVideo) as appropriate.

CATEGORY_STRUCTUREs tell how to file the songs based on their metadata information. The CATEGORY_STRUCTURE is a string of characters that tell, from left to right, the order of hierarchy. The characters come from the following enum constants:

```
enum tFileTag
{
        kFTNone='@',
        kFTTrackType='T',
        kFTTitle='N',
        kFTAudioFile='F',
        kFTArtist='M',
        kFTAlbum='L',
```

```
kFTGenre='G',
kFTSource='S',
kFTYear='Y',
kFTArtistCountry='C'
};
```

Thus, a CATEGORY_STRUCTURE of LN tells to create a subcategory that is a list of Albums, each of which contains a list of Tracks.

In total, a line like:

Album|0x01|LN

Says to create a branch called "Album" which contains tracks of type kTTSong organized first by album name, and then by track name.

The following is an example of a tree definition file similar (though not identical) to the hierarchy presented in the Nomad Jukebox product (the 'B' before each FileTag was used to identify that these are basic tags so that we wouldn't run out of letters in the alphabet as we included more complex metadata – thus each group of two letters represents a level in the hierarchy):

```
V1.0
Album|0x01|BLBN
Artist|0x01|BMBN
Genre|0x01|BGBN
Voice Tracks|0x02|BSBGBN
Playlists|0x10|BN
Macros|0x08|BN
All Tracks|0x07|BN
```

Fig. 1 depicts a hypothetical organization hierarchy. The tree shows how tracks might be listed (as leaves in the tree) after having been organized. Example values for nodes in the tree are shown as well. The same track may appear more than once as a leaf in the tree, as described above, if it fits into multiple categories (e.g. a song that appears on the Abbey Road branch would also appear in the Beatles branch). In the example shown, the first branch contains tracks organized by album. As shown in the example, this music collection contains three tracks from "Abbey Road" and three tracks from "Hits from the

60's". The second branch contains tracks organized by artist, and sub organized by where the artist is from. Thus, a user browsing would first select the "Artists" branch and then choose between "British Artists" and "American Artists". Finally, they would select the particular artist. In the third branch, all tracks are shown.

The tree definition file that would specify the hierarchy shown in Figure 1 is shown in Figure 2.

The first line identifies the version of the tree definition file.

The second line defines the "Albums" branch. The first part of the line, "Albums" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BLBN," defines that the branch lists first the names of all albums (BL) and then tracks on those albums (BN).

The third line defines the "Artists" branch. The first part of the line "Artists" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BCBMBN," defines that the branch lists first the names of all countries where artists in this collection come from (BC) and under those items, the artists' names (BM), and then tracks by those artists (BN).

Fig. 3 shows what a user's view of this hierarchy might be if he/she were shown a fully expanded view of the 6-song tree. Notice that each song appears three times, once in each branch.

In consumer products the tree define file is not edited directly but through a user interface, one example of which is depicted in Fig. 4. An example of a user interface for viewing songs by category and editing the tree structure is depicted in Fig. 4.

An embodiment of the invention is utilized in the Nomad® Jukebox, manufactured by the assignee of the present invention, and described more fully in the copending application, filed on the same date as the present application, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," (Attny. Docket No. 17002-020800).

In a preferred embodiment, metadata is associated with each track and includes such information as title, genre, artist name, type, etc. In the preferred embodiment, software stored in a portable player and executed by the onboard processor automatically files each track in the correct category utilizing the associated metadata and the tree define file. The program code can be stored in any computer readable medium including magnetic storage, CD ROM, optical media, or digital data encoded on an electromagnetic signal.

Thus, the user is automatically provided with a powerful and flexible tool for organizing and categorizing the tracks stored on the portable player.

If the tracks are formatted in MP3 format the metadata can be stored in ID3 tags included in the MP3 file. In one embodiment of the invention, the tracks are stored in alternate file format including file data and file attributes. The file data is the music track itself and the file attributes part of the file includes fields of arbitrary size which are used to store metadata characterizing the track stored as the file data. Again this metadata includes information about the track such as title, genre, artist name, type, etc.

There are several advantages to using the alternate file format. Metadata of types not easily included in an ID3 tag can be utilized. Further, the original track format is not changed, so that error correction data such as checksums are valid. Finally, any file format can be used (e.g. WAV, WMA, etc.) because the metadata is stored separately, and thus audio formats that have limited support for metadata can still be stored on the portable player in native format without transcoding. The formatted files are formed by software stored in the portable music player and executed by an on-board processor.

The metadata for each track is utilized to file each track, using the categories defined in the hierarchical structure as described above, without any input from the user.

Fig. 5 is a schematic diagram of the alternative file format including file data in the form of an MP3 track, and metadata fields for holding data indicating the name of the album the track is from, the name of the song, the genre of the song, and the type of track.

A particular embodiment of a file format will now be described. All tracks are created with some set of attributes as shown below:

Definition of TrackInfo Data Field

Field	Offset	Size	Description
Attribute Count	0	2	The number of attribute follow for the track
Attr 1 type	2	2	Binary = 0, ASCII = 1
Attr 1 name len	4	2	Length of attribute name string
Attr1 data len	6	4	Length of attribute data
Attr1 Name	10	N	Attribute name string
Attr 1 Data	10+N	M	Attribute data

....			
....			
Attr N type			
Attr 1 name len			
Attr1 data len			
Attr1 Name			
Attr 1 Data			

Required Attributes

Attribute Name	Value(s)	Remarks
TITLE	ASCII string	Required By Jukebox
CODEC	"MP3", "WMA", "WAV"	Required By Jukebox
TRACK ID	DWORD	Set By Jukebox
ALBUM	ASCII string	Optional
ARTIST	ASCII string	Optional
GENRE	ASCII string	Optional
LENGTH	In seconds	Optional
TRACK SIZE	In bytes	Optional
TRACK NUM	1-n (track within album)	Optional

These attributes can be subsequently changeable via a host application, running on a personal computer connected to the portable music player.

Fig. 6 shows a flow chart of an embodiment the process used to build the hierarchical database of tracks. It starts by iterating through each track, and, for each track, iterating through each branch to find if the track belongs on the branch, and, if so, where. In this case, the term track could refer to any content, e.g. a music track, a spoken word track, or even a video track.

Also, the hierarchical catalog of tracks can be used to form playlists in a structured manner. For example, if a user wants to hear Jazz and Blues the entire sub-categories can be selected to form one playlist.

An alternative hierarchical catalog generation technique will now be described. In this alternative embodiment, at system startup and as tracks are added or changed, the hierarchy is generated as an in-memory tree structure. Each track is added to the tree using the categories ALBUM, ARTIST and GENRE.

The following example shows the algorithm for adding a track. For clarity, only the attributes used by the tree are shown.

TITLE	"Free Falling"
ALBUM	"Full Moon Fever"
ARTIST	"Tom Petty"
GENRE	"Rock"
TRACK NUM	1

The following function is executed to build the in-memory memory tree.

```
Build Tree ()
For each track,
        Add Track To Category(Album, Track)
        Add Track To Category(Artist, Track)
        Add Track To Category(Genre,Track)
End of Build Tree
```

Fig. 7 depicts a tree which could result from implementing Build Tree() function. Note that "Stardust" does not have any entries for Album or Artist. The host software running on a computer connected to the portable music player could be utilized to add missing attributes to the "Stardust" track and, optionally, edit the title attribute. The Build Tree() function would then reinsert this track in the correct location in the tree.

Fig. 8 is an embodiment of a user interface according to another embodiment of the invention. In this example the root node is labeled "My Configuration" and the Playlist category has been selected and the Playlist subcategory "Meddle" has been selected.

Note that the types of Metadata, in this example, Track Name, Artist, Album, Tempo and Dance, are listed across the top of the screen, and the attribute values for each track are listed in a row across the screen. Various control buttons are displayed to the right of configuration window that facilitate quickly invoking selected processing on a selected track.

The invention has now been described with reference to the preferred embodiments. Alternatives and substitutions will now be apparent to persons of skill in the art.

WHAT IS CLAIMED IS:

Sub B17

1. A method, performed by a processor in a portable digital music player, for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track, said method comprising the acts of:

reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata;

for each track, iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track.

2. The method of claim 1, where said act of searching further comprises the acts of:

utilizing track type information to file only tracks of a specified type under a particular branch.

3. The method of claim 1 further comprising the acts of:

for each branch, utilizing category structure information to file tracks in a specified attribute order.

4. The method of claim 1, where said portable digital music player includes a display screen and a user interface for interacting with the display, further comprising the acts of:

displaying the categories and subcategories on the display in a hierarchical order;

displaying all names of tracks associated with a category or sub-category when a user utilizes the interface to select a category or sub-category;

utilizing the pointer to access and play a track when a user selects a track name through the user interface. and

utilizing the pointer to access and play a collection of tracks within a category or subcategory when a user selects a category or subcategory through the user interface.

5. A method, implemented by a processor in a portable digital music player, for associating metadata with audio tracks comprising the acts of:

opening a formatted file for each track comprising a file data portion and a file attributes portion, with the file attributes portion including a plurality of fields corresponding to category types and file types;

storing an unmodified audio track in the file data portion of the formatted file; and

storing category type and file type information about the unmodified track in corresponding fields.

SUB B27

6. A method, performed by a processor in a portable digital music player, for filing audio tracks, stored on a computer readable media, under categories in an in-memory tree structure, with each audio track having metadata associated therewith including category name data for naming, said method comprising the acts of:

upon startup or when a track is added or changed, searching the metadata of each track; and

for each track, automatically filing the track by category name under each selected category to form a hierarchical track filing scheme.

7. The method of claim 6 further comprising the act of:

selecting the categories to be the Album including the track, the title of the track, and the name of the artist that recorded the track.

8. The method of claim 6, where said portable digital music player includes a display screen and a user interface for interacting with the display, further comprising the acts of:

displaying the categories on the display in a hierarchical order;

displaying all names of tracks associated with a category when a user utilizes the interface to select a category ;

accessing and playing a track when a user selects a track name through the user interface. and

accessing and playing a collection of tracks within a category when a user selects a category through the user interface.

9. A computer program product comprising:

a computer readable medium having program code embodied therein for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track, said program code comprising:

program code, executed by a processor, for reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata;

program code, executed by a processor, for each track, for iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track.

10. A computer program product comprising:

a computer readable medium for having program code embodied therein for filing audio tracks, stored on a computer readable media, under categories in an in-memory tree structure, with each audio track having metadata associated therewith including category name data for naming, said program code comprising:

program code, executed by a processor, upon startup or when a track is added or changed, for searching the metadata of each track; and

program code, executed by a processor, for each track, for automatically filing the track by category name under each selected category to form a hierarchical track filing scheme.

Add C17

ADD D17

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA** the specification of which ____ is attached hereto or ____ was filed on ____________ as Application No. ______________ and was amended on ______________ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56. I claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

I claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Date of Filing	Status
unknown	January 5, 2001	pending
unknown	January 5, 2001	pending

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Charles E. Krueger, Reg. No. 30,077
Paul C. Haughey, Reg. No. 31,836
Charles J. Kulas, Reg. No. 35,809
Daniel D. Tagliaferri, Reg. No. 43,178

Send Correspondence to:	Direct Telephone Calls to:
Charles E. Krueger	(Name, Reg. No., Telephone No.)
TOWNSEND and TOWNSEND and CREW LLP	Name: Charles E. Krueger
Two Embarcadero Center, 8th Floor	Reg. No.: 30,077
San Francisco, California 94111-3834	Telephone: 415-576-0200

Full Name of Inventor 1:	Last Name: **GOODMAN**	First Name: **RON**	Middle Name or Initial:	
Residence & Citizenship:	City: **Santa Cruz**	State/Foreign Country: **California**	Country of Citizenship: **United States**	
Post Office Address:	Post Office Address: **226 Jeter Street**	City: **Santa Cruz**	State/Country: **California**	Postal Code: **95060**

CL 000063

Full Name of Inventor 2:	Last Name: **EGAN**	First Name: **HOWARD**	Middle Name or Initial: **N.**	
Residence & Citizenship:	City: **Capitola**	State/Foreign Country: **California**	Country of Citizenship: **United States**	
Post Office Address:	Post Office Address: **219 Elinor Street**	City: **Capitola**	State/Country: **California**	Postal Code: **95010**

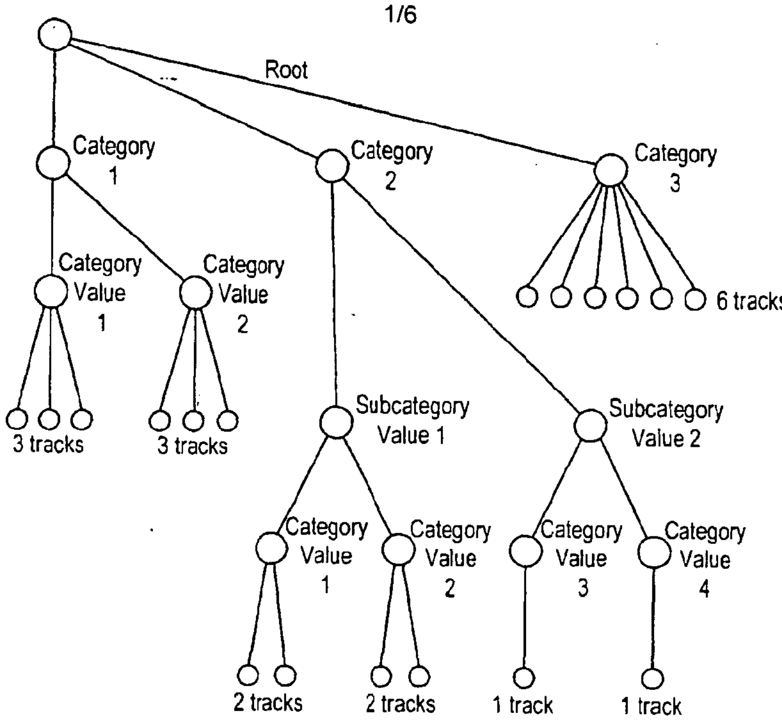
I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 1 RON GOODMAN	Signature of Inventor 2 HOWARD N. EGAN
Date	Date

SF 1175410 v1

PRINT OF DRAWINGS
AS ORIGINALLY FILED

#3



For example:

Category 1 = Album Name
Category Value 1 = Abbey Road
Category Value 2 = Hits from the 60's

Category 2 = Artist Name
Subcategory Value 1 = British Artists
Subcategory Value 2 = American Artists
Category Value 1 = The Beatles
Category Value 2 = Petula Clark
Category Value 3 = Mamas and the Papas
Category Value 4 = Nick Drake

Category 3 = All tracks

FIG. 1.

V1.0
Albums|0x01|BLBN
Artists|0x01|BCBMBN
All Tracks|0x01|BN

FIG. 2.

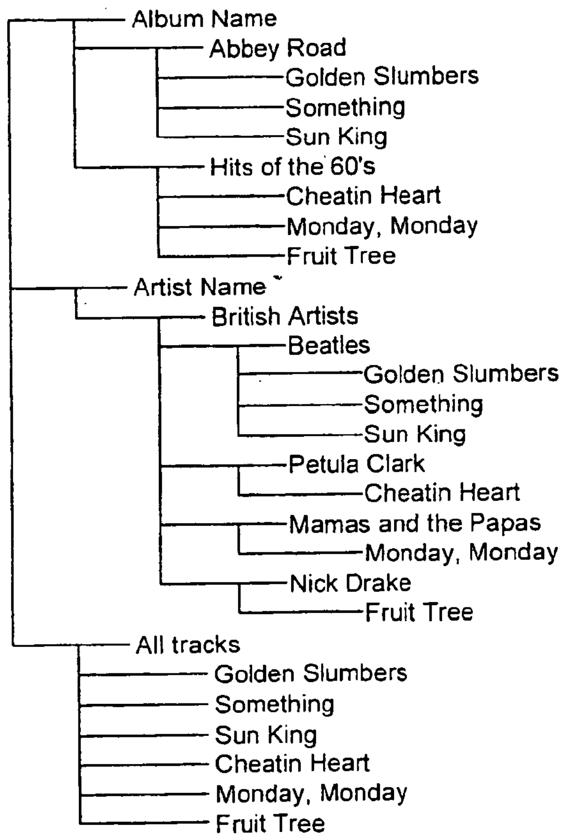


FIG. 3.

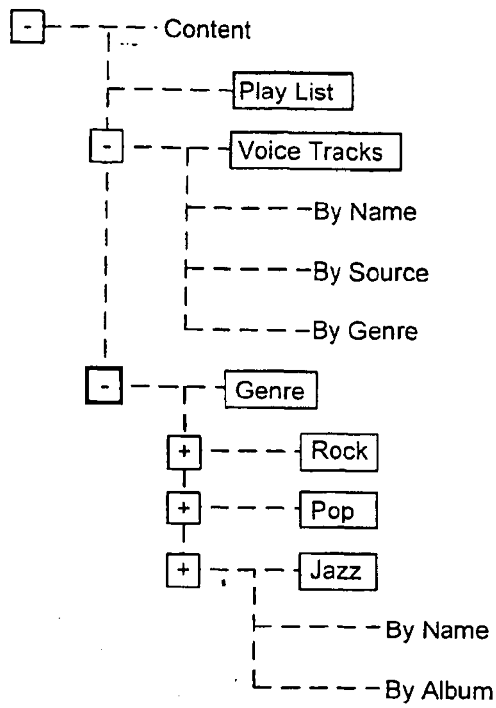


FIG. 4.

file data	album	name	genre	type

FIG. 5.

PRINT OF DRAWINGS
AS ORIGINALLY [illegible] D

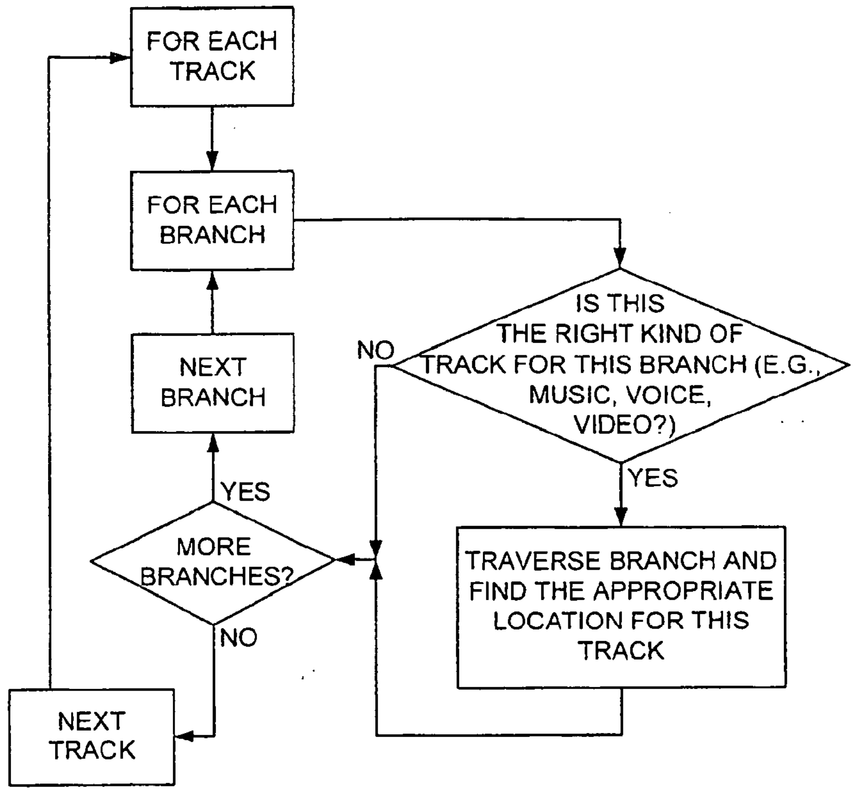


FIG. 6.

CL 000068

Albums	Full Moon Fever	Free Falling	
		I Won't Back Down	
		Love Is A Long Road	
	Graceland	The Boy In The Bubble	
		Graceland	
	Hotel California	Hotel California	
		New Kid In Town	
	Unknown (Created for items without Album attribute)	Track 1	
		Stardust	
Artist	Tom Petty	Full Moon Fever	Free Falling
			I Won't Back Down
			Love Is A Long Road
	Eagles	Hotel California	Hotel California
			New Kid In Town
	Paul Simon	Graceland	The Boy In The Bubble
			Graceland
Genre	Rock	Full Moon Fever	Free Falling
			I Won't Back Down
			Love Is A Long Road
		Hotel California	Hotel California
			New Kid In Town
		Graceland	The Boy In The Bubble
			Graceland

FIG. 7.

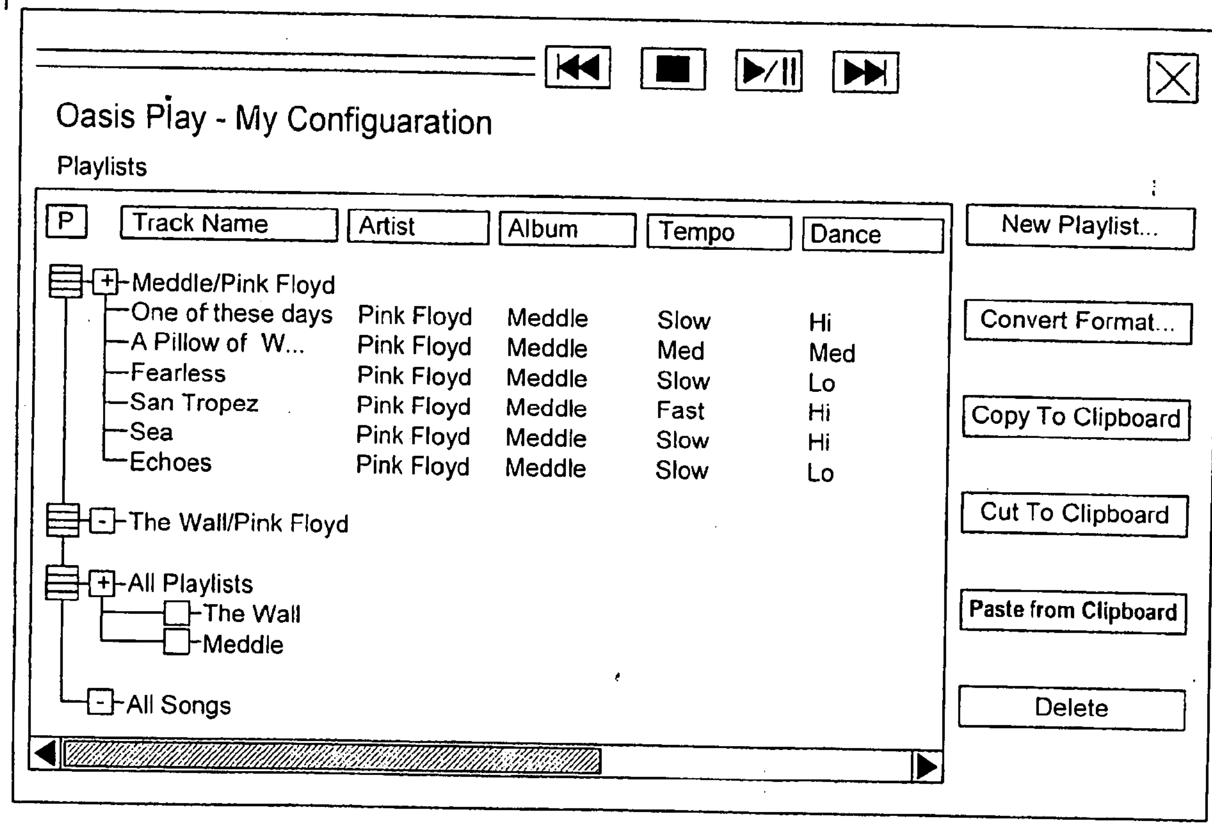


FIG. 8.

PRINT OF DRAWINGS AS ORIGINALLY FILED

UNITED STATES PATENT AND TRADEMARK OFFICE

#2

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/755,723	01/05/2001	Ron Goodman	17002-022500

CONFIRMATION NO. 3728
FORMALITIES LETTER
OC000000005783175

20350
TOWNSEND AND TOWNSEND AND CREW
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

Date Mailed: 02/21/2001

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given TWO MONTHS from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is unsigned.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

- **The balance due by applicant is $ 130.**

The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Substitute drawings in compliance with 37 CFR 1.84 because:
  - drawing sheets do not have the appropriate margin(s) (see 37 CFR 1.84(g)). Each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm. (5/8 inch), and a bottom margin of at least 1.0 cm. (3/8 inch);

A copy of this notice MUST be returned with the reply.

CL 000071

Ffkiete Geronew
Customer Service Center
Initial Patent Examination Division (703) 308-1202

PART 3 - OFFICE COPY

CL 000072

APR 23 2001

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/755,723	01/05/2001	Ron Goodman	17002-022500

CONFIRMATION NO. 3728

20350
TOWNSEND AND TOWNSEND AND CREW
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

FORMALITIES LETTER

OC000000005783175

Date Mailed: 02/21/2001

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RECEIVED FEB 26 2001

09755723

A copy of this notice MUST be returned with the reply.

CL 000073

Frirke Geromew
Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 1 - ATTORNEY/APPLICANT COPY

OIPE JC53 APR 23 2001 PATENT & TRADEMARK OFFICE

Please type a plus sign (+) inside this box → [+]

PTO/SB/21 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

#3

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	GOODMAN, RON, et. al.
Group Art Unit	2185
Examiner Name	
Total Number of Pages in This Submission	
Attorney Docket Number	017002022500

ENCLOSURES *(check all that apply)*

- [X] Fee Transmittal Form
  - [ ] Fee Attached
- [X] Amendment / Response
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [X] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [X] Assignment Papers *(for an Application)*
- [X] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition Routing Slip (PTO/SB/69) and Accompanying Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s)
- [ ] After Allowance Communication to Group
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to Group *(Appeal Notice, Brief, Reply Brief)*
- [ ] Proprietary Information
- [ ] Status Letter
- [X] Other Enclosure(s) *(please identify below)*:

Copy of PTO Notice, Recordation Cover Sheet, ADS

Remarks: The Commissioner is authorized to charge any additional fees to Deposit Account 20-1430.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm and Individual name	Townsend and Townsend and Crew LLP Charles E. Krueger Reg No. 30,077
Signature	[signature]
Date	4/17/01

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 4-18-01

Typed or printed name	D. Bullock		
Signature	[signature]	Date	4-18-01

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be send to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.
SF 1210973 v1

CL 000075

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OIPE APR 13 2001 JC53 PATENT & TRADEMARK OFFICE

FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 170

Complete If Known	
Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	GOODMAN, RON, et. al.
Examiner Name	
Group Art Unit	2185
Attorney Docket No.	017002022500

METHOD OF PAYMENT

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 20-1430

Deposit Account Name: Townsend and Townsend and Crew LLP

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☐ Payment Enclosed:

☐ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X		=	
Independent Claims		-3** =		X		=	
Multiple Dependent				X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	130
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive – unavoidable	
141	1,240	241	620	Petition to revive – unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) assignment recordation fee: 40

The Commissioner is authorized to charge any additional fees to the above noted Deposit Account.

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)170

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Charles E. Krueger	Registration No. (Attorney/Agent)	30,077	Telephone	415-576-0200
Signature	[signature]			Date	4/17/01

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231. SF 1210958 v1

CL 000076

X

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

DECLARATION AND POWER OF ATTORNEY

As a below named ~~inventor~~, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA** the specification of which ____ is attached hereto or ____ was filed on ____________ as Application No. ____________ and was amended on ____________ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56. I claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

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Application No.	Date of Filing	Status
unknown	January 5, 2001	pending
unknown	January 5, 2001	pending

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Charles E. Krueger, Reg. No. 30,077
Paul C. Haughey, Reg. No. 31,836
Charles J. Kulas, Reg. No. 35,809
Daniel D. Tagliaferri, Reg. No. 43,178

Send Correspondence to:	Direct Telephone Calls to: (Name, Reg. No., Telephone No.)
Charles E. Krueger **TOWNSEND and TOWNSEND and CREW LLP** **Two Embarcadero Center, 8th Floor** **San Francisco, California 94111-3834**	Name: Charles E. Krueger Reg. No.: 30,077 Telephone: 415-576-0200

Full Name of Inventor 1:	Last Name: **GOODMAN**	First Name: **RON**	Middle Name or Initial:	
Residence & Citizenship:	City: **Santa Cruz**	State/Foreign Country: **California**	Country of Citizenship: **United States**	
Post Office Address:	Post Office Address: **226 Jeter Street**	City: **Santa Cruz**	State/Country: **California**	Postal Code: **95060**

CL 000077

Full Name of Inventor 2:	Last Name: EGAN	First Name: HOWARD	Middle Name or Initial: N.	
Residence & Citizenship:	City: Capitola	State/Foreign Country: California	Country of Citizenship: United States	
Post Office Address:	Post Office Address: 219 Elinor Street	City: Capitola	State/Country: California	Postal Code: 95010

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 1	Signature of Inventor 2
RON GOODMAN	HOWARD N. EGAN
Date 3/14/2001	Date 3-22-2001

SF 1175410 v1

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

ASSIGNMENT OF PATENT APPLICATION

WHEREAS, RON GOODMAN, of 226 Jeter Street, Santa Cruz, CA 95060; HOWARD N. EGAN, of 219 Elinor Street, Capitola, CA 95010; hereinafter referred to as "Assignors," are the inventors of the invention described and set forth in the below-identified application for United States Letters Patent:

Title of Invention:	AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA
Date(s) of Execution:	
Filing Date:	January 5, 2001
Application No.:	09/755,723; and

WHEREAS, CREATIVE TECHNOLOGY LTD., located at 31 International Business Park, Creative Resource, Singapore, 609921, hereinafter referred to as "ASSIGNEE," is desirous of acquiring ASSIGNORS' interest in the said invention and application and in any U.S. Letters Patent which may be granted on the same;

NOW, THEREFORE, TO ALL WHOM IT MAY CONCERN: Be it known that, for good and valuable consideration, receipt of which is hereby acknowledged by Assignors, Assignors have sold, assigned and transferred, and by these presents do sell, assign and transfer unto the said Assignees, and Assignees' successors and assigns, all their right, title and interest in and to the said invention and application, and in and to any Letters Patent which may hereafter be granted on the same in the United States, the said interest to be held and enjoyed by said Assignees as fully and exclusively as it would have been held and enjoyed by said Assignors had this Assignment and transfer not been made, to the full end and term of any Letters Patent which may be granted thereon, or of any division, renewal, continuation in whole or in part, substitution, conversion, reissue, prolongation or extension thereof.

Assignors further agree that they will, without charge to Assignee, but at Assignee's expense, cooperate with Assignee in the prosecution of said application and/or applications, execute, verify, acknowledge and deliver all such further papers, including applications for Letters Patent and for the reissue thereof, and instruments of assignment and transfer thereof, and will perform such other acts as Assignee lawfully may request, to obtain or maintain Letters Patent for said invention and improvement, and to vest title thereto in Assignee, or Assignee's successors and assigns.

Assignors hereby authorize and request Townsend and Townsend and Crew LLP, Two Embarcadero Center, 8th Floor, San Francisco, CA 94111-3834, to insert herein above the application number and filing date of said application when known.

IN TESTIMONY WHEREOF, Assignors have signed their names on the dates indicated.

CL 000079

Dated: 3/14/2001

RON GOODMAN

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On March 14, 2001, before me, Jacqueline W. Bazzano, personally appeared RON GOODMAN, personally known to me ~~(or proved to me on the basis of satisfactory evidence)~~ to be the person whose name is subscribed to the within instrument, and acknowledged to me that he/~~she~~ executed the same in his/~~her~~ authorized capacity, and that by his/~~her~~ signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

JACQUELINE W. BAZZANO
Commission # 1132234
Notary Public — California
Santa Cruz County
My Comm. Expires Apr 2, 2001

NOTARY PUBLIC

My Commission Expires: 4/2/2001

Dated: 3-22-2001

HOWARD N. EGAN

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On March 22, 2001, before me, Jacqueline W Bazzano (Notary Public) personally appeared HOWARD N. EGAN, personally known to me (~~or proved to me on the basis of satisfactory evidence~~) to be the person whose name is subscribed to the within instrument, and acknowledged to me that he/~~she~~ executed the same in his/~~her~~ authorized capacity, and that by his/~~her~~ signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

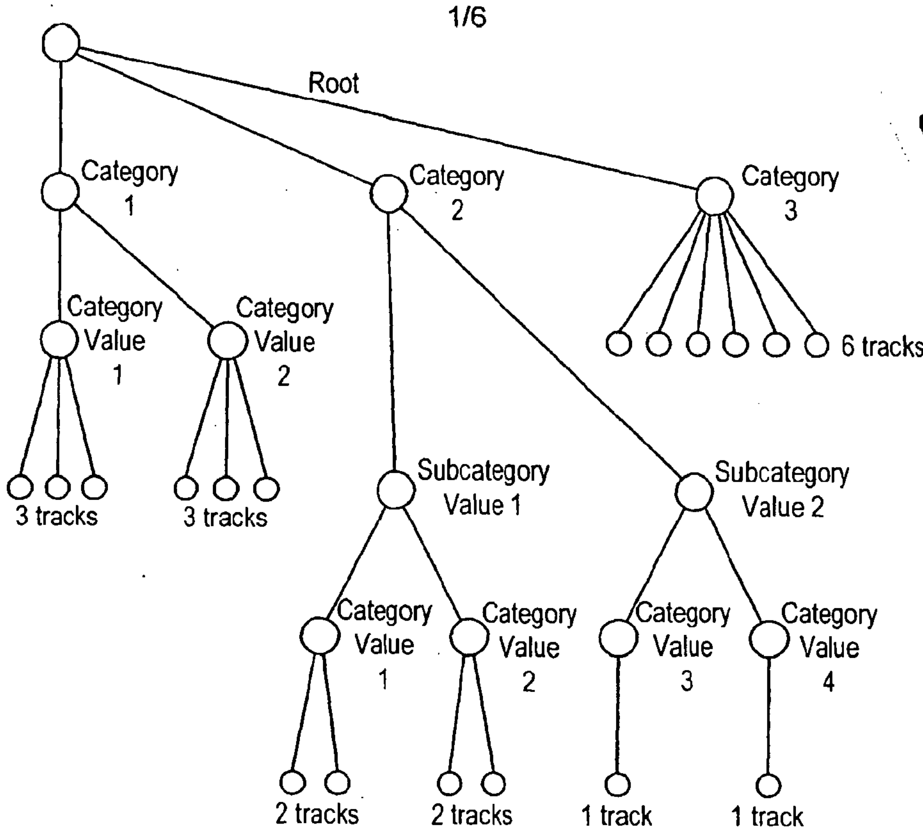
JACQUELINE W. BAZZANO
Commission # 1132234
Notary Public — California
Santa Cruz County
My Comm. Expires Apr 2, 2001

NOTARY PUBLIC

My Commission Expires: 4/2/2001

#3

6928433



For example:

Category 1 = Album Name
- Category Value 1 = Abbey Road
- Category Value 2 = Hits from the 60's

Category 2 = Artist Name
- Subcategory Value 1 = British Artists
- Subcategory Value 2 = American Artists
- Category Value 1 = The Beatles
- Category Value 2 = Petula Clark
- Category Value 3 = Mamas and the Papas
- Category Value 4 = Nick Drake

Category 3 = All tracks

FIG. 1.

V1.0
Albums|0x01|BLBN
Artists|0x01|BCBMBN
All Tracks|0x01|BN

FIG. 2.

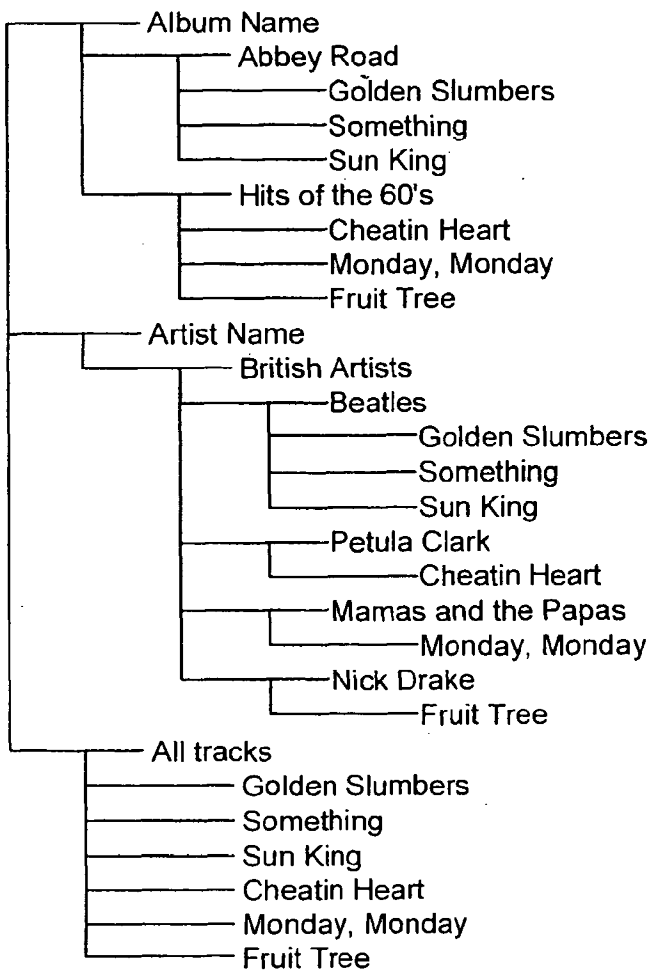


FIG. 3.

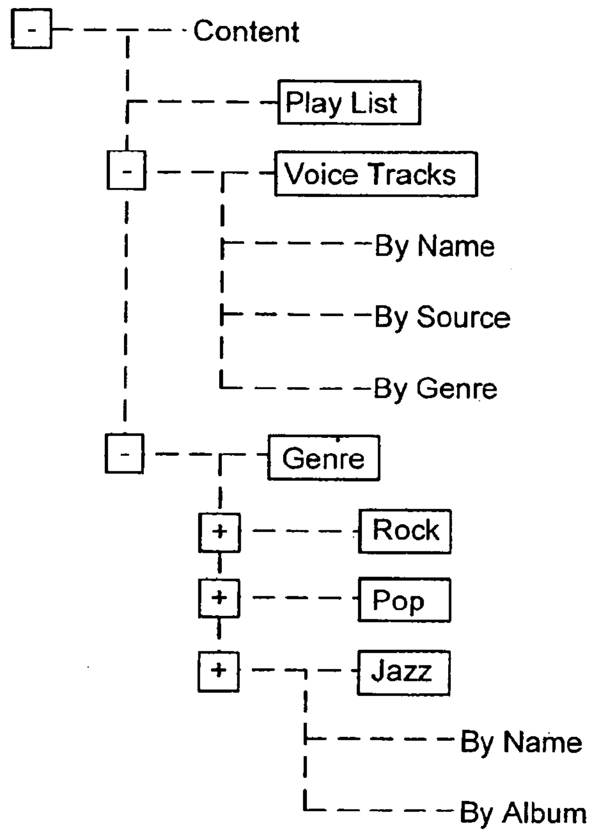


FIG. 4.

file data	album	name	genre	type

FIG. 5.

CL 000083

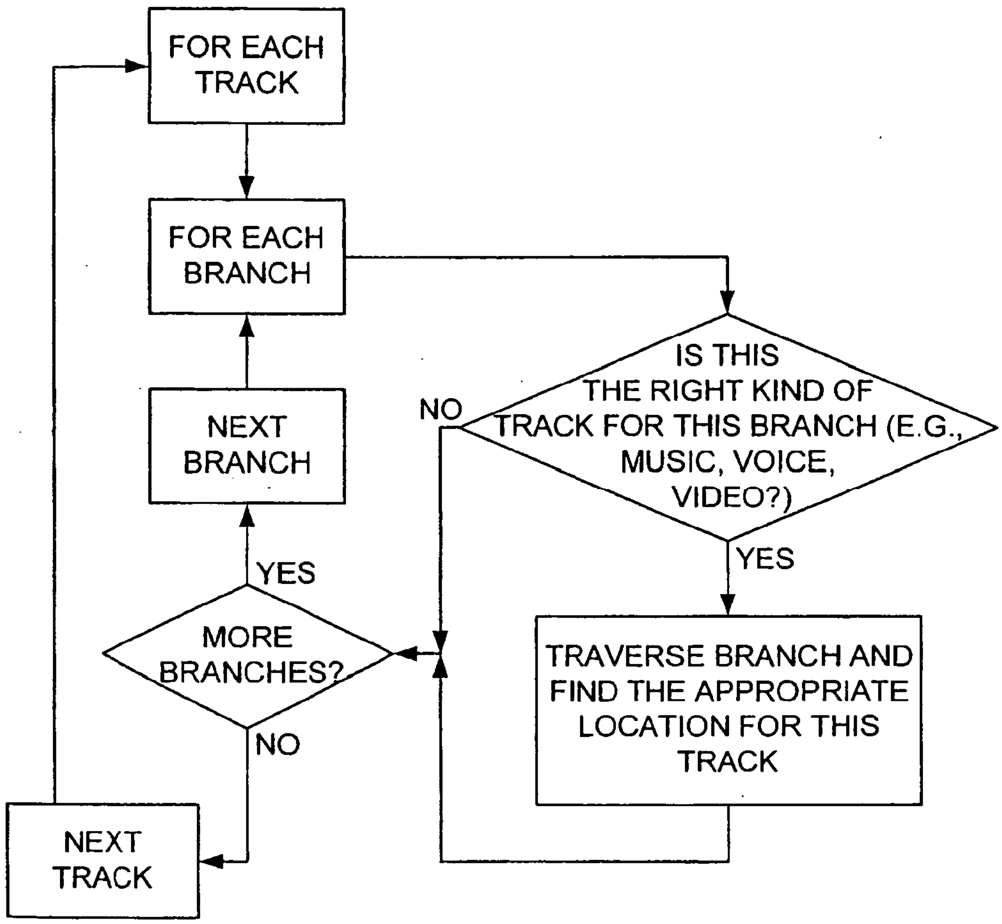

FOR EACH TRACK
FOR EACH BRANCH
IS THIS THE RIGHT KIND OF TRACK FOR THIS BRANCH (E.G., MUSIC, VOICE, VIDEO?)
NO
YES
TRAVERSE BRANCH AND FIND THE APPROPRIATE LOCATION FOR THIS TRACK
NEXT BRANCH
YES
MORE BRANCHES?
NO
NEXT TRACK

FIG. 6.

Albums	Full Moon Fever	Free Falling	
		I Won't Back Down	
		Love Is A Long Road	
	Graceland	The Boy In The Bubble	
		Graceland	
	Hotel California	Hotel California	
		New Kid In Town	
	Unknown (Created for items without Album attribute)	Track 1	
		Stardust	
Artist	Tom Petty	Full Moon Fever	Free Falling
			I Won't Back Down
			Love Is A Long Road
	Eagles	Hotel California	Hotel California
			New Kid In Town
	Paul Simon	Graceland	The Boy In The Bubble
			Graceland
Genre	Rock	Full Moon Fever	Free Falling
			I Won't Back Down
			Love Is A Long Road
		Hotel California	Hotel California
			New Kid In Town
		Graceland	The Boy In The Bubble
			Graceland

FIG. 7.

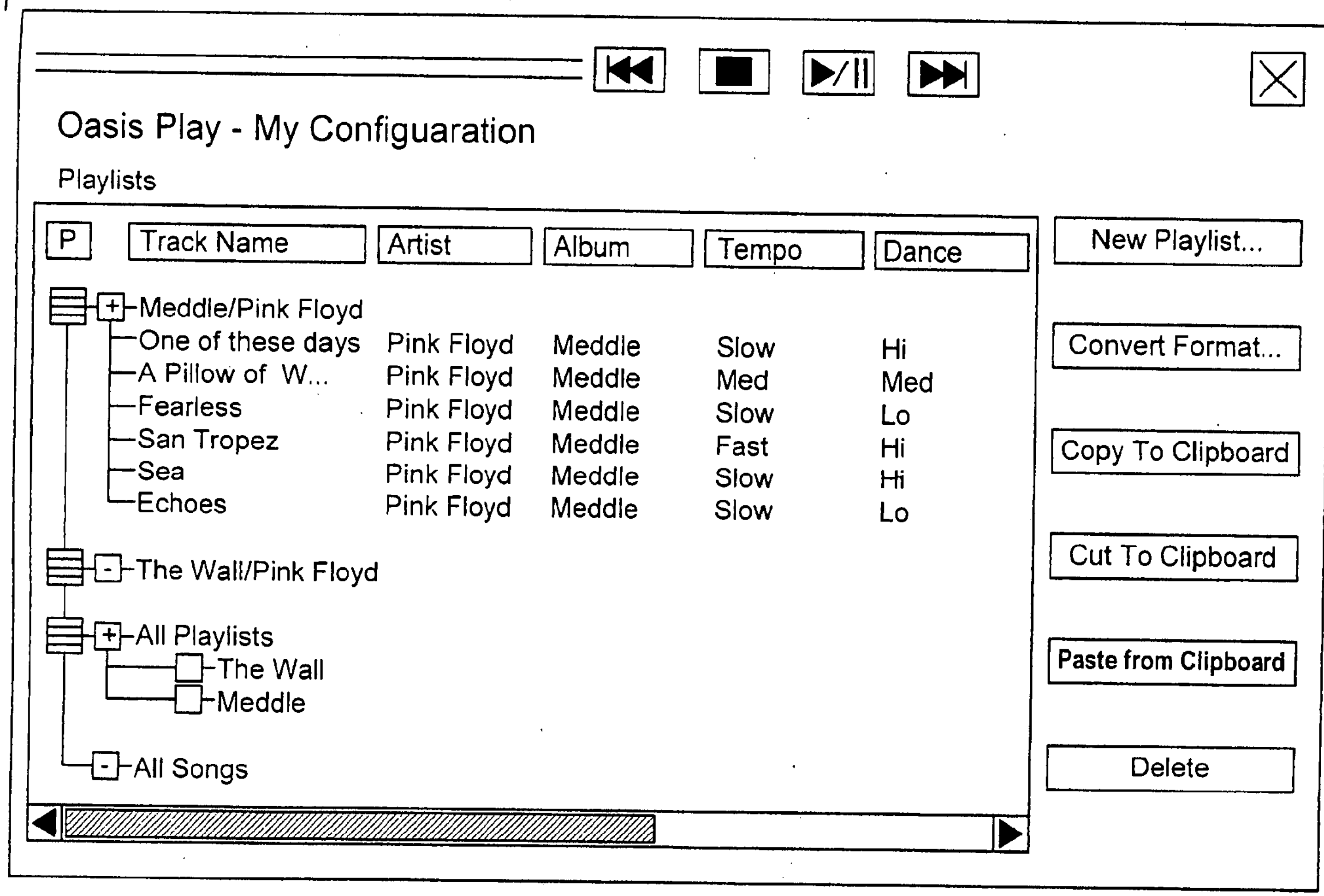

Oasis Play - My Configuaration
Playlists
P
Track Name
Artist
Album
Tempo
Dance
Meddle/Pink Floyd
One of these days
Pink Floyd
Meddle
Slow
Hi
A Pillow of W...
Pink Floyd
Meddle
Med
Med
Fearless
Pink Floyd
Meddle
Slow
Lo
San Tropez
Pink Floyd
Meddle
Fast
Hi
Sea
Pink Floyd
Meddle
Slow
Hi
Echoes
Pink Floyd
Meddle
Slow
Lo
The Wall/Pink Floyd
All Playlists
The Wall
Meddle
All Songs
New Playlist...
Convert Format...
Copy To Clipboard
Cut To Clipboard
Paste from Clipboard
Delete

FIG. 8.

#4

Please type a plus sign (+) inside this box: → [+]

PTO/SB/81 (10-00)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Group Art Unit	2185
Examiner Name	
Attorney Docket Number	017002-022500US

I hereby appoint:

☒ Practitioners at Customer Number 20350 → Place Customer Number Bar Code Label here

OR

☐ Practitioner(s) named below:

Name	Registration Number

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the Patent and Trademark Office connected therewith.

Please change the correspondence address for the above-identified application to:

☒ The above-mentioned Customer Number.

OR

☐ Firm or Individual Name			
Address			
Address			
City		State	Zip
Country			
Telephone		Fax	

I am the:

☐ Applicant/Inventor.

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Certificate under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

SIGNATURE of Applicant or Assignee of Record

Name	Ng Keh Long
Signature	Ng Keh Long
Date	April 10, 2001

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

Burden Hour Statement: This form is estimated to take 3 minutes to complete. Time will vary depending upon the needs of the individual case. Any Comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

SF 1197815 v1

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Creative Technology LTD.

Application No./Patent No.: 09/755,723 Filed/Issue Date: January 5, 2001

Entitled: Automatic Hierarchical Categorization of Music by Metadata

Creative Technology LTD., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☒ the assignee of the entire right, title, and interest; or
2. ☐ an assignee of an undivided part interest

in the patent application/patent identified above by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

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Technology Center 2100

3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

☐ Copies of assignments or other documents in the chain of title are attached.
[NOTE: A separate copy (i.e., the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the USPTO. See MPEP 302.8]

The undersigned (whose title is supplied below) is empowered to sign this statement on behalf of the assignee.

April 10, 2001
Date

[signature]
Signature

Ng Keh Long
Typed or printed name

Chief Financial Officer
Title

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

SF 1197824 v1

2185

PTO/SB/21 (08-00)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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OIPE MAY 18 2001 PATENT & TRADEMARK OFFICE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	GOODMAN, RON, et. al.
Group Art Unit	2185
Examiner Name	
Attorney Docket Number	017002022500

Total Number of Pages in This Submission: 4

ENCLOSURES *(check all that apply)*

- [ ] Fee Transmittal Form
  - [ ] Fee Attached
- [ ] Amendment / Response
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Assignment Papers *(for an Application)*
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition Routing Slip (PTO/SB/69) and Accompanying Petition
- [ ] Petition to Convert to a Provisional Application
- [x] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s)
- [ ] After Allowance Communication to Group
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to Group *(Appeal Notice, Brief, Reply Brief)*
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) *(please identify below)*:

Rule 3.73(b) Statement, copy of assignment

Remarks: The Commissioner is authorized to charge any additional fees to Deposit Account 20-1430.

RECEIVED MAY 22 2001 Technology Center 2100

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm and Individual name	Townsend and Townsend and Crew LLP Charles E. Krueger Reg No. 30,077
Signature	Charles E. Krueger
Date	5/10/01

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 5-14-01

Typed or printed name	D. Bullock		
Signature	D. Bullock	Date	5-14-01

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CL 000089

#5

10324055 . 042301

Inventor Information

Inventor One Given Name::	RON
Family Name::	GOODMAN
Name Suffix::	
Postal Address Line One::	226 Jeter Street
City::	Santa Cruz
State or Province::	CA
Postal or Zip Code::	95060
Citizenship Country::	US
Inventor Two Given Name::	HOWARD
Family Name::	EGAN
Name Suffix::	
Postal Address Line One::	219 Elinor Street
City::	Capitola
State or Province::	CA
Postal or Zip Code::	95010
Citizenship Country::	US

Correspondence Information

Correspondence Customer Number::	20350

Application Information

Title Line One::	AUTOMATIC HIERARCHICAL
Title Line Two::	CATEGORIZATION OF
Title Line Three::	MUSIC BY METADATA
Total Drawing Sheets::	6
Formal Drawings?::	Yes
Application Type::	Utility
Docket Number::	017002022500
Secrecy Order in Patent Appl.?::	No

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to:

Assistant Commissioner for Patents
Washington, D.C. 20231

On 4-18-01

TOWNSEND and TOWNSEND and CREW LLP

By: [signature]

PATENT #6
Attorney Docket No.: 017002-022500US
Client Reference No.: CT-1139

12-2
M.L.

OIPE JC83 APR 23 2001 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

GOODMAN et al.

Application No.: 09/755,723

Filed: January 5, 2001

For: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Art Unit: 2185

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-referenced application, please enter the following amendments and remarks.

IN THE SPECIFICATION:

Please substitute the following for the paragraph apearing on page 1 under the CROSS-REFERENCES TO RELATED APPLICATIONS heading. A marked up version of the paragraph is appended to this amendment.

CAL 6-8-04

A1

--This application is related to ~~Application~~ ~~U.S. Patent~~ No. ~~09/755,629~~, ~~6,6__,__0~~ now abandoned entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," ~~(Atty. Docket No. 17002-020800)~~; and ~~Application No.~~ U.S. Patent No. ~~09/755,367~~ 6,590,730, entitled "Audioplayback Device with Power Savings Storage Access Mode," ~~(Atty. Docket No. 17002-022400)~~, both filed January 5, 2001, the disclosures of which are incorporated herein by reference.--

AL 6-8-04 5

CL 000091

PATENT

REMARKS

By this amendment information regarding related applications that was not available at the time of filing has been added. Entrance of the amendment is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,

Charles E. Krueger
Reg. No. 30,077

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: (415) 576-0200
Fax: (415) 576-0300
CEK:deb
SF 1210990 v1

Marked Up Version of Amended Paragraph 09/755,723

This application is related to Application No. [__/___,___] 09/755,629, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," (Atty. Docket No. 17002-020800); and Application No. [__/___,___] 09/755,367, entitled "Audioplayback Device with Power Savings Storage Access Mode," (Atty. Docket No. 17002-022400), **[all]** **both** filed January 5, 2001, the disclosures of which are incorporated herein by reference.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Washington, D.C. 20231
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

P

20350 7590 01/15/2003

TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER	
PUNIT, PRAKASH C	
ART UNIT	PAPER NUMBER
2175	7

DATE MAILED: 01/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/755,723	GOODMAN ET AL.
	Examiner	Art Unit
	Prakash C Punit	2175

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-10 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-10 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

DOV POPOVICI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

Attachment(s)

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4)☐ Interview Summary (PTO-413) Paper No(s). _____.
5)☐ Notice of Informal Patent Applic
6)☐ Other:

CL 000095

DETAILED ACTION

1. This action is in response to application dated 01/05/2001. Claims 1-10 are pending in this office action.

Claim Objections

2. Claims 1-4 and 9 are objected to because of the following informalities:

In claim 1, line 9: the claim recitation "base" should be --based--. Appropriate correction is required.

OP 1/13/03 Claims 2-4 are ~~objects~~ objected to because claims 2-4 are dependent from objected independent claim 1.

In claim 9, line 12: the claim recitation "base" should be --based--. Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-10 are rejected under 35 U.S.C. 102(b) as being anticipated by <u>Grewe et al</u>. (U. S. Patent No.5,670,730.)

As to claim 1, Grewe et al. teaches a method, performed by a processor in a portable digital music player, for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track (see Abstract, see Fig. 3, and see column 1, lines 6-21), said method comprising the acts of:

reading a definition file that defines an ordered hierarchical tree structure (see Fig. 2, see column 1, lines 47-49), with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata (see column 1, lines 49-67);

for each track, iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track (see Abstract, see Fig. 3, also see column 3, lines 45-49.)

As to claim 2, Grewe et al. teaches a method, where said act of searching further comprises the acts of:

utilizing track type information to file only tracks of a specified type under a particular branch (see Abstract, see column 3, lines 47-53.)

As to claim 3, Grewe et al. teaches a method further comprising the acts of:

for each branch, utilizing category structure information to file tracks in a specified attribute order (see column 4, lines 19-35.)

As to claim 4, Grewe et al. teaches a method, where said portable digital music player includes a display screen and a user interface for interacting with the display (see column 1, lines 13-21), further comprising the acts of:

displaying the categories and subcategories on the display in a hierarchical order (see column 2, lines 49-51, also see column 3, lines 38-44);

displaying all names of tracks associated with a category or sub-category when a user utilizes the interface to select a category or sub-category (see column 1 line 65 through column 2, line 3, also see column 3, lines 49-53);

utilizing the pointer to access and play a track when a user selects a track name through the user interface (see column 3, lines 53-57, also see column 3, lines 17-19) and

utilizing the pointer to access and play a collection of tracks within a category or subcategory when a user selects a category or subcategory through the user interface (see column 3, lines 55-57.)

As to claim 5, Grewe et al. teaches a method, implemented by a processor in a portable digital music player, for associating metadata with audio tracks (see Abstract) comprising the acts of:

opening a formatted file for each track comprising a file data portion and a file attributes portion, with the file attributes portion including a plurality of fields corresponding to category types and file types (see column 3, lines 45-49);

storing an unmodified audio track in the file data portion of the formatted file (see column 4, lines 19-21);

and

storing category type and file type information about the unmodified track in corresponding fields (see column 2, line 37 through column 3, line 28.)

As to claim 6, Grewe et al. teaches a method, performed by a processor in a portable digital music player, for filing audio tracks, stored on a computer readable media, under categories in an in memory tree structure, with each audio track having metadata associated therewith including category name data for naming (see Abstract, see column 1, lines 46-56), said method comprising the acts of:

upon startup or when a track is added or changed, searching the metadata of each track (see column 1, lines 58-65); and

for each track, automatically filing the track by category name under each selected category to form a hierarchical track filing scheme (see column 5, lines 34-54.)

As to claim 7, Grewe et al. teaches a method further comprising the act of:

selecting the categories to be the Album including the track, the title of the track, and the name of the artist that recorded the track (see column 3, lines 45-53.)

As to claim 8, Grewe et al. teaches a method, where said portable digital music player includes a display screen and a user interface for interacting with the display (see column 2, lines 49-51), further comprising the acts of:

displaying the categories on the display in a hierarchical order see column 2, lines 49-51, also see column 3, lines 38-44);

displaying all names of tracks associated with a category when a user utilizes the interface to select a category (see column 3, lines 49-53) ;

accessing and playing a track when a user selects a track name through the user interface (see column 3, lines 53-57, also see column 3, lines 17-19); and

accessing and playing a collection of tracks within a category when a user selects a category through the user interface ((see column 1 line 65 through column 2, line 3, also see column 3, lines 49-53.)

As to claim 9, Grewe et al. teaches a computer program product comprising:

a computer readable medium having program code embodied therein for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track (see Abstract), said program code comprising:

program code, executed by a processor, for reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata (see Abstract, see summary);

program code, executed by a processor, for each track, for iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track (see Fig. 3, see column 3, lines 45-49, also see column 4, lines 10-14.)

As to claim 10, Grewe et al. teaches a computer program product comprising:

a computer readable medium for having program code embodied therein for filing audio tracks, stored on a computer readable media, under categories in an in-memory tree structure,

with each audio track having metadata associated therewith including category name data for naming (see Abstract, see column 1, lines 46-56), said program code comprising:

program code, executed by a processor, upon startup or when a track is added or changed, for searching the metadata of each track (see column 1, lines 58-65); and

program code, executed by a processor, for each track, for automatically filing the track by category name under each selected category to form a hierarchical track filing scheme (see column 5, lines 34-54.)

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of art with respect to method of organizing music in general:

U.S. Patent No. 5,670,730 to Grewe et al.

U.S. Patent No. 5,616,876 to Cluts.

U.S. Patent No. 5,918,303 to Yamaura et al.

U.S. Patent No. 5,969,283 to Looney et al.

U.S. Patent No. 5,062,868 to Toriumi.

U.S. Patent No. 5,248,946 to Dwek.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Prakash Punit whose telephone number is (703) 305-5914. The examiner can normally be reached on Mondays – Fridays from 9:45 am to 6:15 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dov Popovici, can be reached on (703) 305-3830. The fax numbers of the group is (703) 746-7239.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-9600.

Prakash Punit
Patent Examiner
Art Unit 2175

DOV POPOVICI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

January 10, 2003

Notice of References Cited	Application/Control No. 09/755,723	Applicant(s)/Patent Under Reexamination GOODMAN ET AL.	
	Examiner Prakash C Punit	Art Unit 2175	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,670,730	09-1997	Grewe et al.	84/609
	B	US-5,616,876	04-1997	Cluts, Jonathan C.	84/609
	C	US-5,918,303	06-1999	Yamaura et al.	84/609
	D	US-5,969,283	10-1999	Looney et al.	84/609
	E	US-6,062,868	05-2000	Toriumi, Hiroshi	434/307A
	F	US-6,248,946	06-2001	Dwek, Norman Scott	84/609
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

CL 000103

OIPE
MAY 2 0 2003
PATENT & TRADEMARK OFFICE

#8
5/27/03
AW

Docket No.: 6407P212

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: RON GOODMAN, ET AL.	Art Group: 2175
Application No.: 09/755,723	Examiner: Punit, Prakash C
Filed: January 5, 2001	
For: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**	

RECEIVED
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Technology Center 2100

PETITION FOR EXTENSION OF TIME PURSUANT TO 37 C.F.R. § 1.136(a)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with 37 C.F. R. § 1.136(a), Applicants for the above-identified application respectfully Petition the Commissioner for a one (1) month extension of time, extending the period for response to May 15, 2003, from the Office Action dated January 15, 2003. The petition filing fee of $110.00 and a Response to Office Action are attached.

If it should be determined that a longer extension of time is required to prevent this application from being abandoned, please charge any additional fees to Deposit Account No. 02-2666. A copy of the Fee Transmittal is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 5/15/03

Mark R. Vatuone

Mark R. Vatuone, Reg. No. 53,719

12400 Wilshire Blvd., 7th Floor
Los Angeles, California 90025
Telephone: (408) 947-8200

05/21/2003 NMOHAMM1 00000022 09755723
01 FC:1251 110.00 OP

CERTIFICATE OF MAILING/TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop Non-Fee Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Sarah M. Montgomery 5/16/03

Sarah M. Montgomery *Date*

CL 000104

#9B
5/27/03
A.W.

Attorney's Docket No. 6407P212 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re of Application of:

Ron Goodman et al.

Application No.: 09/755,723

Filing Date: January 5, 2001

For: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Examiner: Punit, Prakash C.

Art Group: 2175

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

on May 15, 2003
Date of Deposit

Sarah M. Montgomery
Name of Person Mailing Correspondence

Signature Date 5/15/03

Commissioner for Patents
Washington, D.C. 20231

AMENDMENT AND RESPONSE TO THE OFFICE ACTION

Sir:

In response to the Office Action of January 15, 2003 please enter the following amendments and consider the following remarks.

AMENDMENT

1. IN THE CLAIMS

Please cancel claim 5,without prejudice.

Please amend the claims as follows:

Sub C1

1. (Currently Amended) A method, performed by a processor in a ~~portable~~ digital ~~music~~ media player, for filing ~~audio~~ media tracks stored on a computer readable media, with each ~~audio~~ media track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track, said method comprising the acts of:

reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata;

for each track, ~~iteratively~~ determining, ~~base~~ based on metadata describing the track if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track.

B1

2. (Original) The method of claim 1, where said act of searching further comprises the acts of:

utilizing track type information to file only tracks of a specified type under a particular branch.

3. (Original) The method of claim 1 further comprising the acts of:

for each branch, utilizing category structure information to file tracks in a specified attribute order.

4. (Currently Amended) The method of claim 1, where said ~~portable~~ digital ~~music~~ media player includes a display ~~screen~~ and a user interface for interacting with the display, further comprising the acts of:

displaying the categories and subcategories on the display in a hierarchical order;

displaying all names of tracks associated with a category or sub-category when a user utilizes the interface to select a category or sub-category;

utilizing the pointer to access and play a track when a user selects a track name through the user interface; and

utilizing the pointer to access and play a collection of tracks within a category or subcategory when a user selects a category or subcategory through the user interface.

---

5. (Canceled)

---

6. (Currently Amended) A method, performed by a processor in a ~~portable~~ digital ~~music~~ media player, for filing ~~audio~~ media tracks, stored on a computer readable media, under categories in an in memory tree structure, with each ~~audio~~ media track having metadata associated therewith including category name data for naming, said method comprising the acts of:

upon startup or when a track is added or changed, searching the metadata of each track; and

for each track, automatically filing the track by category name under each selected category to form a hierarchical track filing scheme.

7. (Original) The method of claim 6 further comprising ~~the act of~~:

selecting the categories to be the Album including the track, the title of the track, and the name of the artist that recorded the track.

8. (Currently Amended) The method of claim 6, where said ~~portable~~ digital ~~music~~ media player includes a display ~~screen~~ and a user interface for interacting with the display, further comprising the acts of:

displaying the categories on the display in a hierarchical order;

displaying all names of tracks associated with a category when a user utilizes the interface to select a category ;

accessing and playing a track when a user selects a track name through the user interface; and

accessing and playing a collection of tracks within a category when a user selects a category through the user interface.

9. (Currently Amended) A computer program product comprising:

a computer readable medium having program code embodied therein for filing ~~audio~~ media tracks stored on a computer readable media, with each ~~audio~~ media track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track, said program code comprising:

program code, executed by a processor, for reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata;

program code, executed by a processor, for each track, for ~~iteratively~~ determining, ~~base~~ based on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track.

10. (Currently Amended) A computer program product comprising:

a computer readable medium ~~for~~ having program code embodied therein for filing ~~audio~~ media tracks, stored on a computer readable media, under categories in an in-memory tree structure, with each ~~audio~~ media track having metadata associated therewith including category name data for naming, said program code comprising:

program code, ~~execute~~ executed by a processor, upon startup or when a track is added or changed, for searching the metadata of each track; and

12 program code, executed by a processor, for each track, for automatically filing the track by category name under each selected category to form a hierarchical track filing scheme.

REMARKS

Reconsideration of this application, as amended, is earnestly requested.

Claims 1, 4, 6 and 8 – 10 have been amended as shown above. Claim 5 has been cancelled without prejudice.

Claims 1-4 and 9 were objected to because of certain informalities. These informalities have been corrected as shown above, and it is submitted that the objections to these claims have been overcome.

Claims 1 - 10 stand rejected under 35 U.S.C. 102(b) as being anticipated by Grewe et al., U.S. Patent 5,670,730 (hereinafter referred to as "Grewe"). This rejection is respectfully traversed.

Grewe teaches a system in which music files are provided with individual headers 36 that include category, artist, and track address information (Fig. 3, col. 3 from ln. 45). The track address information is used to identify the start and/or end location of the file, so that the music player can locate and play the file.

A global header 22 and a table of contents 34 are maintained separate from the individual music files. The global header 22 includes general information about the selections on the chip and how they were encoded, for example the distributor of the music and the bit rate at which the tracks have been encoded. <u>Track selections are listed as part of the table of contents by individual headers 36.</u> (Col. 3 ln. 23, Fig. 3). That is, as can be seen from the description and in particular Figs. 3 and 4, the "table of contents" is nothing more than a sequential list of the individual headers, appended one after another to the table of contents. The table of contents does not appear to be hierarchical[1] at all.

---

[1] Based on Applicants' understanding, Grewe's use of the term "hierarchical" appears to refer only to the predefined format of the individual headers and/or the global header.

Although it is not clearly stated how this is accomplished, it is a goal of Grewe to permit selection of tracks by category or artist. From the description of Grewe's "table of contents", it appears that such selections can only be made by searching serially through the sequential list of headers in the "table of contents" to identify the individual tracks meeting the criteria. While this may be an acceptable solution for small numbers of tracks, this method is going to be cumbersome when large numbers of tracks are involved or when the database is updated frequently.

Unlike Grewe, the current invention provides a hierarchical definition file that has a tree structure, including category names that name the branch under which tracks are listed. For each track, each branch in which the track belongs is determined, and the track is filed in the appropriate location in the branch. These limitations, found in claims 1 and 10, are not taught or suggested by Grewe.

Similarly, Grewe does not teach or suggest the method of claim 4. While Grewe does mention that music can be selected using the information in the headers (col. 3 lns. 50 – 57), there is little disclosure as to how this is accomplished. Similarly, while Grewe does mention that information can be presented on a display, there is no mention of displaying categories, subcategories and tracks in an hierarchical order for selection as defined in claim 4. Grewe does not even appear to contemplate subcategories at all. In particular, Grewe does not teach or disclose any of the specific displaying or utilizing steps in claim 4.

Similarly, Grewe does not teach the limitations of claims 6 and 9. The filing system of Grewe merely appends each individual header to the last individual header in the "table of contents," which thus is merely an elementary list of track headers (See Figs. 3 and 4). Grewe does not teach automatically filing a track by category name under each selected category, to form a hierarchical track filing scheme, as claimed in claims 6 and 9.

As set forth in MPEP 2131, to anticipate a claim the reference must teach every element of the claim. Since, as discussed above, every element of independent claims 1, 6, 9 and 10 is not taught by Grewe, Applicants submit that these claims are not anticipated by Grewe and are thus allowable.

Further, it is submitted that claims 2 -4, 7 and 8 are allowable as being dependent on allowable base claims.

From at least the foregoing reasons, it is respectfully submitted that claims 1 - 4 and 6 -10 are allowable and allowance of the application is earnestly requested.

If there are any additional fees associated with this communication, please charge our Deposit Account No. 02-2666.

Respectfully submitted

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

Date: May 15, 2003

Mark R. Vatuone

Mark R. Vatuone
Reg. No. 53,719

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(408) 947-8200

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application No.	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Group Art Unit	2175
Examiner Name	Punit, Prakash C
Attorney Docket Number	6407P212

Total Number of Pages in This Submission: 11

ENCLOSURES *(check all that apply)*

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [x] Amendment / Response
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [x] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
  - [ ] PTO/SB/08
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [ ] Basic Filing Fee
  - [ ] Declaration/POA
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s)
- [ ] After Allowance Communication to Group
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to Group *(Appeal Notice, Brief, Reply Brief)*
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) *(please identify below)*:

Postcard.

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Mark R. Vatuone, Reg. No. 53,719 BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Signature	Mark R. Vatuone
Date	5/15/2003

CERTIFICATE OF MAILING/TRANSMISSION

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Typed or printed name	Sarah M. Montgomery		
Signature	Sarah M. Montgomery	Date	5/15/03

Based on PTO/SB/21 (05-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 05/02/2003.
SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

OIPE JC67 MAY 2 0 2003 PATENT & TRADEMARK OFFICE

FEE TRANSMITTAL for FY 2003

Effective 01/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT ($) 110.00

Complete if Known	
Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Examiner Name	Punit, Prakash C
Group/Art Unit	2175
Attorney Docket No.	6407P212

RECEIVED MAY 2 2 2003 Technology Center 2100

METHOD OF PAYMENT (check one)

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None
☐ Deposit Account

Deposit Account Number: 02-2666

Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

The Commissioner is authorized to: (*check all that apply*)

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) required under 37 CFR §§ 1.16, 1.17, 1.18 and 1.20.

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	750	2001	375	Utility filing fee	
1002	330	2002	165	Design filing fee	
1003	520	2003	260	Plant filing fee	
1004	750	2004	375	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims		- 20** =		X		=	
Independent Claims		- 3** =		X		=	
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	84	2201	42	Independent claims in excess of 3
1203	280	2203	140	Multiple Dependent claim, if not paid
1204	84	2204	42	**Reissue independent claims over original patent
1205	18	2205	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater, For Reissues, see below

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
2053	130	2053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	110.00
1252	410	2252	205	Extension for reply within second month	
1253	930	2253	465	Extension for reply within third month	
1254	1,450	2254	725	Extension for reply within fourth month	
1255	1,970	2255	985	Extension for reply within fifth month	
1404	320	2401	160	Notice of Appeal	
1402	320	2402	160	Filing a brief in support of an appeal	
1403	280	2403	140	Request for oral hearing	
1451	1,510	2451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,300	2453	650	Petition to revive - unintentional	
1501	1,300	2501	650	Utility issue fee (or reissue)	
1502	470	2502	235	Design issue fee	
1503	630	2503	315	Plant issue fee	
1460	130	2460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	750	1809	375	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	750	2810	375	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	750	2801	375	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify)

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 110.00

SUBMITTED BY

Complete (if applicable)

Name (Print/Type)	Mark R. Vatuone	Registration No. (Attorney/Agent)	53,719	Telephone	(408) 947-8200
Signature	Mark R. Vatuone			Date	5/15/03

Based on PTO/SB/17 (01-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 05/02/2003.
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CL 000114

pp4

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

20350 7590 07/29/2003

TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER	
RONES, CHARLES	
ART UNIT	**PAPER NUMBER**
2175	10

DATE MAILED: 07/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

CL 000115

PRC

Office Action Summary	Application No.	Applicant(s)	
	09/755,723	GOODMAN ET AL.	
	Examiner	Art Unit	
	Charles L. Rones	2175	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 May 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

The amendment timely filed May 20, 2003. Claims 1-10 are pending in this office action.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Grewe et al. (U. S. Patent No. 5,670,730.)

As to claim 1, Grewe et al. teaches a method, performed by a processor in a portable digital music player, for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track (see Abstract, see Fig. 3, and see column 1, lines 6-21), said method comprising the acts of:

reading a definition file that defines an ordered hierarchical tree structure (see Fig. 2, see column 1, lines 47-49), with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata (see column 1, lines 49-67);

for each track, iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track (see Abstract, see Fig. 3, also see column 3, lines 45-49.)

As to claim 2, Grewe et al. teaches a method, where said act of searching further comprises the acts of:

utilizing track type information to file only tracks of a specified type under a particular branch (see Abstract, see column 3, lines 47-53.)

As to claim 3, Grewe et al. teaches a method further comprising the acts of:

for each branch, utilizing category structure information to file tracks in a specified attribute order (see column 4, lines 19-35.)

As to claim 4, Grewe et al. teaches a method, where said portable digital music player includes a display screen and a user interface for interacting with the display (see column 1, lines 13-21), further comprising the acts of:

displaying the categories and subcategories on the display in a hierarchical order (see column 2, lines 49-51, also see column 3, lines 38-44);

displaying all names of tracks associated with a category or sub-category when a user utilizes the interface to select a category or sub-category (see column 1 line 65 through column 2, line 3, also see column 3, lines 49-53);

utilizing the pointer to access and play a track when a user selects a track name through the user interface (see column 3, lines 53-57, also see column 3, lines 17-19) and

utilizing the pointer to access and play a collection of tracks within a category or subcategory when a user selects a category or subcategory through the user interface (see column 3, lines 55-57.)

As to claim 5, Grewe et al. teaches a method, implemented by a processor in a portable digital music player, for associating metadata with audio tracks (see Abstract) comprising the acts of:

opening a formatted file for each track comprising a file data portion and a file attributes portion, with the file attributes portion including a plurality of fields corresponding to category types and file types (see column 3, lines 45-49);

storing an unmodified audio track in the file data portion of the formatted file (see column 4, lines 19-21);

and

storing category type and file type information about the unmodified track in corresponding fields (see column 2, line 37 through column 3, line 28.)

As to claim 6, Grewe et al. teaches a method, performed by a processor in a portable digital music player, for filing audio tracks, stored on a computer readable media, under categories in an in memory tree structure, with each audio track having metadata associated therewith including category name data for naming (see Abstract, see column 1, lines 46-56), said method comprising the acts of:

upon startup or when a track is added or changed, searching the metadata of each track (see column 1, lines 58-65); and

for each track, automatically filing the track by category name under each selected category to form a hierarchical track filing scheme (see column 5, lines 34-54.)

As to claim 7, Grewe et al. teaches a method further comprising the act of:

selecting the categories to be the Album including the track, the title of the track, and the name of the artist that recorded the track (see column 3, lines 45-53.)

As to claim 8, Grewe et al. teaches a method, where said portable digital music player includes a display screen and a user interface for interacting with the display (see column 2, lines 49-51), further comprising the acts of:

displaying the categories on the display in a hierarchical order see column 2, lines 49-51, also see column 3, lines 38-44);

displaying all names of tracks associated with a category when a user utilizes the interface to select a category (see column 3, lines 49-53) ;

accessing and playing a track when a user selects a track name through the user interface (see column 3, lines 53-57, also see column 3, lines 17-19); and accessing and playing a collection of tracks within a category when a user selects a category through the user interface ((see column 1 line 65 through column 2, line 3, also see column 3, lines 49-53.)

As to claim 9, Grewe et al. teaches a computer program product comprising:

a computer readable medium having program code embodied therein for filing audio tracks stored on a computer readable media, with each audio track having metadata associated therewith including category value data for naming attributes of the track and type data indicating the type of track (see Abstract), said program code comprising:

program code, executed by a processor, for reading a definition file that defines an ordered hierarchical tree structure, with the file including category names for naming the branch under which tracks are sorted, track type information specifying which type of tracks are to be sorted under the branch, and structure information defining how to file tracks based on associated metadata (see Abstract, see summary);

program code, executed by a processor, for each track, for iteratively determining, base on metadata describing the track, if the track belongs in the branch, and, for each branch in which the track belongs, traversing the branch to determine the appropriate location to file the track (see Fig. 3, see column 3, lines 45-49, also see column 4, lines 10-14.)

As to claim 10, Grewe et al. teaches a computer program product comprising:

a computer readable medium for having program code embodied therein for filing audio tracks, stored on a computer readable media, under categories in an in-memory tree structure,

with each audio track having metadata associated therewith including category name data for naming (see Abstract, see column 1, lines 46-56), said program code comprising:

program code, executed by a processor, upon startup or when a track is added or changed, for searching the metadata of each track (see column 1, lines 58-65); and

program code, executed by a processor, for each track, for automatically filing the track by category name under each selected category to form a hierarchical track filing scheme (see column 5, lines 34-54.)

Response to Arguments

Applicant's arguments filed May 20, 2003 have been fully considered but they are not persuasive.

Firstly, Applicant argues that Grewe does not disclose using a hierarchical definition file as stated in the claim.

In response, Examiner maintains that Grewe discloses such as stated above in the rejection of the claim wherein the hierarchical arrangement of headers and the table of contents are deemed to be hierarchical.

Secondly, Applicant argues that Grewe does not disclose display categories or subcategories and tracks in an hierarchical order for selection.

In response, Examiner maintains that Grewe discloses such wherein Grewe discloses that the information is displayable. See 2:36-54.

Lastly, Applicant argues that Grewe does not disclose automatically filing a track by category name under a selected category to form a hierarchical track filing scheme.

In response, Examiner maintains that Grewe discloses such wherein Grewe discloses that the headers are arranged hierarchically and that the headers contains a music filed to which the track of music belongs, such as jazz, classical, country, etc. which are deemed to be categories of music arranged hierarchically.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles L. Rones whose telephone number is (703-306-3030. The examiner can normally be reached on Mondays – Fridays from Monday-Thursday 8am-4pm pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dov Popovici, can be reached on (703-305-3830. The fax numbers of the group is (703) 746-7239.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-9600.

Charles Rones
Charles L. Rones
Primary Examiner
Art Unit 2175

Notice of References Cited	Application/Control No. 09/755,723	Applicant(s)/Patent Under Reexamination GOODMAN ET AL.	
	Examiner Charles L. Rones	Art Unit 2175	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-2003/0016940 A1	01-2003	Robbins, Gerald V.	386/46
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

05/13/03 16:10 FAX 010 2175

OIPE JC138 MAY 2 0 2003 PATENT & TRADEMARK OFFICE

#11 8/1/03 A.W.

PTO/SB/82 (10-00)
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REVOCATION OF POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application No.	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Group Art Unit	2175
Examiner Name	Punit, Prakash C
Attorney Docket Number	6407P212

I hereby revoke all previous powers of attorney or authorizations of agent given in the above-identified application:

☒ A Power of Attorney or Authorization of Agent is submitted herewith.

AND

☒ Please change the correspondence address for the above-identified application to:

☒ Customer Number 08791 → *08791*

OR

☐ Firm or Individual Name	BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP				
Address	12400 Wilshire Boulevard, Seventh Floor				
Address					
City	Los Angeles	*State*	California	*Zip Code*	90025
Country	U.S.A.	*Telephone*	(408) 947-8200	*Fax*	(408) 947-8280

I am the:

☐ Applicant.

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under of 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

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SIGNATURE of Applicant or Assignee of Record

Name	C. Hock Leow
Signature	[signature]
Date	5/13/03

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of ______ forms are submitted.

Docket No.: 6407P212

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:

RON GOODMAN, ET AL.

Application No.: 09/755,723

Filed: January 5, 2001

For: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**

Art Group: 2175

Examiner: Punit, Prakash C

POWER OF ATTORNEY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant of the above-identified Application, hereby appoints the persons listed on Appendix A attached hereto (which is incorporated by reference and a part of this document), with full power of substitution and revocation, to prosecute this Application and to transact all business in the Patent and Trademark Office connected herewith.

Please direct all future communications concerning this Application to:

André L. Marais, Reg. No. 48,095
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Boulevard, Seventh Floor
Los Angeles, CA 90025
(714) 557-3800

Creative Technology Ltd.

Date: 5/8/03

CL 000127

Appendix A

I hereby appoint with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith, BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP, a firm including: Ramin Aghevli, Reg. No. 43,462; William E. Alford, Reg. No. 37,764; Farzad E. Amini, Reg. No. 42,261; W. Thomas Babbitt, Reg. No. 39,591; Jordan M. Becker, Reg. No. 39,602; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; R. Alan Burnett, Reg. No. 46,149; Gregory D. Caldwell, Reg. No. 39,926; Cory G. Claassen, Reg. No. 50,296; Thomas M. Coester, Reg. No. 39,637; Mimi D. Dao, Reg. No. 45,628; Stephen M. De Klerk, Reg. No. 46,503; Daniel M. De Vos, Reg. No. 37,813; Sanjeet Dutta, Reg. No. 46,145; Tarek N. Fahmi, Reg. No. 41,402; Thomas S. Ferrill, Reg. No. 42,532; George L. Fountain, Reg. No. 36,374; Adam Furst, Reg. No. 51,710; Angelo J. Gaz, Reg. No. 45,907; Andre M. Gibbs, Reg. No. 47,593; James Y. Go, Reg. No. 40,621; Jeffery S. Heileson, Reg. No. 46,765; James A. Henry, Reg. No. 41,064; William E. Hickman, Reg. No. 46,771; Willmore F. Holbrow III, Reg. No. 41,845; Sheryl Sue Holloway, Reg. No. 37,850; George W Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Aslam A. Jaffery, Reg. No. 51,841; Walter T. Kim, Reg. No. 42,731; Eric T. King, Reg. No. 44,188; Steven Laut, Reg. No. 47,736; Suk S. Lee, Reg. No. 47,745; Gordon R. Lindeen III, Reg. No. 33,192; Jan C. Little, Reg. No. 41,181; Joseph Lutz, Reg. No. 43,765; Lawrence E. Lycke, Reg. No. 38,540; Michael J. Mallie, Reg. No. 36,591; Andre L. Marais, Reg. No. 48,095; Raul D. Martinez, Reg. No. 46,904; Paul A. Mendonsa, Reg. No. 42,879; Jonathan S. Miller, Reg. No. 48,534; Heather M. Molleur, Reg. No. 50,432; Richard A. Nakashima, Reg. No. 42,023; Thinh V. Nguyen, Reg. No. 42,034; Robert B. O'Rourke, Reg. No. 46,972; Daniel E. Ovanezian, Reg. No. 41,236; Philip A. Pedigo, Reg. No. 52,107; Marina G. Portnova, Reg. No. 45,750; Joseph A. Pugh, Reg. No. 52,137; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Saina S. Shamilov, Reg. No. 48,266; Kevin G. Shao, Reg. No. 45,095; Stanley W. Sokoloff, Reg. No. 25,128; Judith A. Szepesi, Reg. No. 39,393; Edwin H. Taylor, Reg. No. 25,129; Lisa Tom, Reg. No. 52,291; John F. Travis, Reg. No. 43,203; Kerry D. Tweet, Reg. No. 45,959; Mark C. Van Ness, Reg. No. 39,865; Thomas A. Van Zandt, Reg. No. 43,219; Mark R. Vatuone, Reg. No. 53,719; Lester J. Vincent, Reg. No. 31,460; John P. Ward, Reg. No. 40,216; Mark L. Watson, Reg. No. 46,322; Thomas C. Webster, Reg. No. 46,154; Chui-Kiu Teresa Wong, Reg. No. 48,042; and Norman Zafman, Reg. No. 26,250, my patent attorneys, and Brent Vecchia, Reg. No. 48,011 and Lehua Wang, Reg. No. 48,023, my patent agents, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800; and James R. Thein, Reg. No. 31,710, my patent attorneyI also appoint P. Francois de Villiers, Reg. No. 48,200 of Creative Labs Inc., a corporation having principal offices at 1901 McCarthy Boulevard, Milpitas, California 95035; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith. with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

OIPE MAY 2 0 2003 PATENT & TRADEMARK OFFICE

Docket No. 6407P212

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Creative Technology Ltd

Application No./Patent No.: 09/755,723 Filing/Issue Date: 1/5/2001

Entitled: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Creative Technology Ltd, a Limited Liability Corporation,
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

of Singapore,

states that it is:

1. ☒ the assignee of the entire right, title and interest; or
2. ☐ an assignee of an undivided part interest

in the patent application/patent identified above by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the Patent and Trademark Office at Reel 011788, Frame 0174, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From: ______ To: ______
   The document was recorded in the Patent and Trademark Office at Reel 011788, Frame 0174, or for which a copy thereof is attached.
2. From: ______ To: ______
   The document was recorded in the Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.
3. From: ______ To: ______
   The document was recorded in the Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.
4. From: ______ To: ______
   The document was recorded in the Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

☐ Copies of assignments or other documents in the chain of title are attached.
[NOTE: A separate copy (*i.e.*, the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the PTO. See MPEP 302-302.8]

The undersigned (whose title is supplied below) is empowered to sign this statement on behalf of assignee.

05/09/03
Date

Signature

André L. Marais, Reg. No. 48,095
Typed or printed name

Title

OIPE JC182
NOV 03 2003
PATENT & TRADEMARK OFFICE

#12
11/13/03
AW.

NOTICE OF APPEAL FROM THE EXAMINER TO THE BOARD OF PATENT APPEALS AND INTERFERENCES		Docket Number (Optional) 6407P212
I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450. 10/29/03 Signature Dawn Shaw Typed or printed name Dawn Shaw	In re Application of Ron Goodman, et al.	
	Application Number 09/755,723	Filed 01/05/2001
	For AUTOMATIC HIERARCHICAL CATEGORIZATION	
	Art Unit 2175	Examiner Charles Rones

Applicant hereby appeals to the Board of Patent Appeals and Interferences from the last decision of the examiner.

The fee for this Notice of Appeal is (37 CFR 1.17(b)) $330.00

☐ Applicant claims small entity status under 37 CFR 1.27. Therefore, the fee shown above is reduced by half, and the resulting fee is: ______

☒ A check in the amount of the fee is enclosed.

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☐ Payment by credit card. Form PTO-2038 is attached.

☒ The Director has already been authorized to charge fees in this application to a Deposit Account. I have enclosed a duplicate copy of the fee transmittal.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 02-2666. I have enclosed a duplicate copy of the fee transmittal.

☐ A petition for an extension of time under 37 CFR 1.136(a) (PTO/SB/22) is enclosed.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2039.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

☒ attorney or agent of record.

☐ attorney or agent acting under 37 CFR 1.34(a). Registration number if acting under 37 CFR 1.34(a) ______.

Signature

André L. Marais, Reg. No. 48,095
Typed or printed name

10/29/03
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of ______ forms are submitted.

Based on PTO/SB/31 (08-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wr) 09/11/2003. 11/05/2003 BABRAHA1 00000124 09755723
SEND TO: Mail Stop Appeal, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

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CL 000130

O.I.P.E. JC162
NOV 03 2003
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~~2175~~
2700

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application No.	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Art Unit	2175
Examiner Name	Charles Rones
Attorney Docket Number	6407P212
Total Number of Pages in This Submission	4

ENCLOSURES ***(check all that apply)***

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment / Response
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
  - [ ] PTO/SB/08
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [ ] Basic Filing Fee
  - [ ] Declaration/POA
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s)
- [ ] After Allowance Communication to Group
- [ ] Appeal Communication to Board of Appeals and Interferences
- [x] Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) *(please identify below)*:

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Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	André L. Marais, Reg. No. 48,095 BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Signature	[signature]
Date	10/29/03

CERTIFICATE OF MAILING/TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Typed or printed name	Dawn Shaw		
Signature	Dawn Shaw	Date	10/29/03

Based on PTO/SB/21 (08-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 09/11/2003.
SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

CL 000131

OIPE
NOV 03 2003

FEE TRANSMITTAL for FY 2003

Effective 01/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT ($) 330.00

Complete if Known	
Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Examiner Name	Charles Rones
Group/Art Unit	2175
Attorney Docket No.	6407P212

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METHOD OF PAYMENT (check all that apply)

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☐ Deposit Account

Deposit Account Number: 02-2666

Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

The Commissioner is authorized to: *(check all that apply)*

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) required under 37 CFR §§ 1.16, 1.17, 1.18 and 1.20.

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims		- 20** =	0	x	18.00	=	$0.00
Independent Claims		- 3** =	0	x	86.00	=	$0.00
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple Dependent claim, if not paid
1204	86	2204	43	**Reissue independent claims over original patent
1205	18	2205	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

**or number previously paid, if greater. For Reissues, see below

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
2053	130	2053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	1,210	2255	605	Extension for reply within fifth month	
1404	330	2401	165	Notice of Appeal	330.00
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	2451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	2460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	1809	385	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 330.00

SUBMITTED BY

Complete (if applicable)

Name (Print/Type)	André L. Marais	Registration No. (Attorney/Agent)	48,095	Telephone	(408) 947-8200
Signature	[signature]			Date	10/29/03

Based on PTO/SB/17 (08-03) as modified by ~~Blakely, Sokoloff~~, Taylor & Zafman (wlr) 08/11/2003.
SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

CL 000132

12/2

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/755,723	01/05/2001	Ron Goodman	017002022500

CONFIRMATION NO. 3728

OC000000010623703

08791
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

Date Mailed: 08/01/2003

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 05/20/2003.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

A. White

ANGELA S WHITE
2100 (703) 308-8264

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/755,723	01/05/2001	Ron Goodman	017002022500

CONFIRMATION NO. 3728

OC000000010623641

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

Date Mailed: 08/01/2003

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 05/20/2003.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

A. White

ANGELA S WHITE
2100 (703) 308-8264

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CL 000134

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

8791 7590 11/17/2003

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER	
RONES, CHARLES	
ART UNIT	PAPER NUMBER
2175	13

DATE MAILED: 11/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

CL 000135

Advisory Action	Application No.	Applicant(s)
	09/755,723	GOODMAN ET AL.
	Examiner	Art Unit
	Charles L. Rones	2175

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE. Therefore, further action by the applicant is required to avoid abandonment of this application. A proper reply to a final rejection under 37 CFR 1.113 may only be either: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114.

PERIOD FOR REPLY [check either a) or b)]

a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.

b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection. ONLY CHECK THIS BOX WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

1.☒ A Notice of Appeal was filed on *03 November 2003*. Appellant's Brief must be filed within the period set forth in 37 CFR 1.192(a), or any extension thereof (37 CFR 1.191(d)), to avoid dismissal of the appeal.

2.☐ The proposed amendment(s) will not be entered because:

(a) ☐ they raise new issues that would require further consideration and/or search (see NOTE below);

(b) ☐ they raise the issue of new matter (see Note below);

(c) ☐ they are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or

(d) ☐ they present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: _____.

3.☐ Applicant's reply has overcome the following rejection(s): _____.

4.☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).

5.☐ The a)☐ affidavit, b)☐ exhibit, or c)☐ request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.

6.☐ The affidavit or exhibit will NOT be considered because it is not directed SOLELY to issues which were newly raised by the Examiner in the final rejection.

7.☐ For purposes of Appeal, the proposed amendment(s) a)☐ will not be entered or b)☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

The status of the claim(s) is (or will be) as follows:

Claim(s) allowed: _____.

Claim(s) objected to: _____.

Claim(s) rejected: _____.

Claim(s) withdrawn from consideration: _____.

8.☐ The drawing correction filed on _____ is a)☐ approved or b)☐ disapproved by the Examiner

9.☐ Note the attached Information Disclosure Statement(s)(PTO-1449) Paper No(s). _____.

CL 000136

10.☐ Other: _____

Charles Rones

Charles L. Rones
Primary Examiner
Art Unit: 2175

FEB 0 3 2004

O I P E JC64

PATENT & TRADEMARK OFFICE

Docket No.: 6407P212 SC

#14

2/10/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: RON GOODMAN, ET AL.	Art Group: 2175
Application No.: 09/755,723	Examiner: Rones, Charles
Filed: January 5, 2001	
For: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**	

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FEB 0 5 2004

Technology Center 2100

PETITION FOR EXTENSION OF TIME PURSUANT TO 37 C.F.R. § 1.136(a)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with 37 C.F. R. § 1.136(a), Applicants for the above-identified application respectfully Petition the Commissioner for a one (1) month extension of time, extending the period for response to February 03, 2004, from the Advisory Action dated November 17, 2003. The petition filing fee of $110.00 and a Request for Continued Examination are attached.

If it should be determined that a longer extension of time is required to prevent this application from being abandoned, please charge any additional fees to Deposit Account No. 02-2666. A copy of the Fee Transmittal is enclosed for deposit account charging purposes.

Respectfully submitted,

Blakely, Sokoloff, Taylor & Zafman LLP

Date: 1/29/04

Mark R. Vatuone

Mark R. Vatuone, Reg. No. 53,719

12400 Wilshire Boulevard, 7th Floor
Los Angeles, CA 90025
Telephone: (408) 947-8200

CERTIFICATE OF MAILING/TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dawn Shaw 1/29/04

Dawn Shaw *Date*

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OIPE JC64
FEB 0 3 2004
PATENT & TRADEMARK OFFICE

2700
RCE 5C
4/15
2/4/04

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL

Address to:
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Alexandria, VA 22313-1450

Application No.	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Art Unit	2175
Examiner Name	Rones, Charles
Attorney Docket Number	6407P212

This is a Request for Continued Examination (RCE) under 37 C.F.R. § 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR § 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

RECEIVED
FEB 0 5 2004
Technology Center 2100

1. Submission required under 37 C.F.R. § 1.114
   a. ☐ Previously submitted
      i. ☐ Consider the amendment(s)/reply under 37 C.F.R. § 1.116 previously filed on
         (Any unentered amendment(s) referred to above will be entered).
      ii. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on
      iii. ☐ Other ______
   b. ☒ Enclosed
      i. ☒ Amendment/Reply
      ii. ☐ Affidavit(s)/Declaration(s)
      iii. ☐ Information Disclosure Statement (IDS)
      iv. ☐ Other ______
2. Miscellaneous
   a. ☐ Suspension of action on the above-identified application is requested under 37 C.F.R. § 1.103(c) for a period of months. (Period of suspension shall not exceed 3 months; Fee under 37 C.F.R. § 1.17(i) required)
   b. ☐ Other ______
3. Fees The RCE fee under 37 C.F.R. § 1.17(e) is required by 37 C.F.R. § 1.114 when the RCE is filed.
   a. ☐ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No. 02-2666.
      i. ☒ RCE fee required under 37 C.F.R. § 1.17(e) and any additional claims fee(s)
      ii. ☒ Extension of time fee (37 C.F.R. § 1.136 and 1.17)
      iii. ☐ Other: ($.00)
   b. ☒ Check in the amount of $880.00 enclosed
   c. ☐ Payment by credit card (Form PTO-2038 enclosd)

   WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Name *(Print/Type)*	Mark R. Vatuone	*Registration No. (Attorney/Agent)*	53,719
Signature	Mark Vatuone	Date	1/29/04

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Name *(Print/Type)*	Dawn Shaw		
Signature	Dawn Shaw	Date	1/29/04

Based on PTO/SB/30 (06-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wr) 08/11/2003.
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02/04/2004 EFLORES 00000157 09755723
01 FC:1801 770.00 OP

CL 000138

SC
#16C
2/10/04

Attorney's Docket No. 6407P212 Patent

Response Under 37 CFR 1.116 — Expedited Procedure
Examining Group 2175

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Technology Center 2100

In re Application of:

Ron Goodman et al.

Application No.: 09/755,723

Filed: January 5, 2001

For: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Examiner: Rones, Charles

Art Group: 2175

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

on 1/29/04
Date of Deposit

Dawn R. Shaw
Name of Person Mailing Correspondence

Dawn R. Shaw 1/29/04
Signature Date

Mail Stop RCE
Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT ACCOMPANYING REQUEST FOR CONTINUING EXAMINATION

Sir:

Further to the Notice of Appeal of November 3, 2003 and to the Final Office Action mailed July 29, 2003, Applicants respectfully request the Examiner to enter the following amendment and reconsider the present application in view of the submission below.

Amendments to the Claims are reflected in the listing of claims which begin on page 2 of this paper.

Remarks/Arguments begin on page 8 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of the claims in the application:

Listing of Claims:

1. (Currently Amended) A method, performed by a processor in a digital media player, for filing media tracks stored on a computer~~-~~readable ~~media~~medium, with each media track having ~~metadata associated therewith including category value~~attribute data for ~~naming~~ identifying attributes of the track ~~and type data indicating the type of track~~, said method comprising ~~the acts of~~:

C1

reading a definition file that defines an ordered hierarchical tree structure having a plurality of branches, with the hierarchical tree structure ~~file~~ including category names for naming ~~the branch~~ branches under which tracks are sorted, subcategory names for defining subcategories within the branches~~, track type information specifying which type of tracks are to be sorted under the branch~~, and structure information defining ~~how to file tracks based on associated metadata~~ the hierarchy of branch names and subcategory names; and

for each track, determining, based on ~~metadata describing~~ the attribute data associated with the track if the track belongs in ~~the branch~~one or more of the branches, and, for each branch in which the track belongs, filing the track under one or more subcategories ~~traversing the branch to determine the appropriate location to file the track~~.

2. (Currently Amended) The method of claim 1, ~~where said act of searching further comprises the acts of~~comprising:

utilizing track type information to file only tracks of a specified type under a particular branch.

3. (Currently Amended) The method of claim 1, ~~further~~ comprising ~~the acts of~~:

for each branch, utilizing category structure information to file tracks in a specified attribute order.

4. (Currently Amended) The method of claim 1, where said digital media player includes a display screen and a user interface for interacting with the display screen, ~~further~~ the method comprising ~~the acts of~~:

displaying the categories and subcategories on the display screen in a hierarchical order;

displaying ~~all~~ names of at least some tracks associated with a category or sub-category when a user utilizes the interface to select a category or sub-category;

monitoring selection of a track name by the user and, in response to the selection, playing the track ~~utilizing the pointer to access and play a track when a user selects a track name through the user interface~~; and

monitoring selection of a category or subcategory by the user and, in response to the selection, playing ~~utilizing the pointer to access and play~~ a collection of tracks within ~~a~~ the selected category or subcategory ~~when a user selects a category or subcategory through the user interface~~.

C1

5. (Canceled)

6. (Currently Amended) A method, performed by a processor in a digital media player, for filing media tracks, stored on a computer-readable ~~media~~medium, under categories in ~~an in memory~~ a tree structure, with each media track having ~~metadata~~ attribute data identifying attributes of the track associated therewith, the attribute data including category name data ~~for naming~~, said method comprising ~~the acts of~~:

upon startup or when a track is added or changed, searching the ~~metadata~~ attributes of each track; and

for each track, automatically filing the track by category name under each selected category associated with the attributes to form ~~a~~ an hierarchical track filing scheme.

7. (Currently Amended) The method of claim 6, ~~further~~ comprising ~~the act of~~:

selecting the categories to be the album ~~Album~~ including the track, the title of the track, and the name of the artist that recorded the track.

8. (Currently Amended) The method of claim 6, where said digital media player includes a display screen and a user interface for interacting with the display screen, ~~further~~ the method comprising ~~the acts of~~:

displaying the categories on the display screen in a hierarchical order;

displaying all names of tracks associated with a category when a user utilizes the user interface to select a category ;

accessing and playing a track when a user selects a track name through the user interface; and

accessing and playing a collection of tracks within a category when a user selects a category through the user interface.

C1

9. (Currently Amended) A computer program product comprising:

a computer readable medium having program code embodied therein for filing media tracks stored on a computer readable ~~media~~medium, with each media track having ~~metadata associated therewith including category value~~ attribute data for ~~naming~~ identifying attributes of the track ~~and type data indicating the type of track~~, said program code comprising:

program code, executed by a processor, for reading a definition file that defines an ordered hierarchical tree structure having a plurality of branches, with the hierarchical tree structure~~file~~ including category names for naming ~~the branch~~ branches under which tracks are sorted, subcategory names for defining subcategories within the branches ~~track type information specifying which type of tracks are to be sorted under the branch~~, and structure information defining ~~how to file tracks based on associated metadata~~ the hierarchy of branch names and subcategory names ~~within the branches~~;

program code, executed by a processor, for each track, for determining, based on ~~metadata describing~~ the attribute data associated with the track, if the track belongs in one or more of the ~~branch~~branches, and, for each branch in which the track belongs, filing the track under one or more subcategories ~~traversing the branch to determine the appropriate location to file the track~~.

10. (Currently Amended) A computer program product comprising:

a computer readable medium for having program code embodied therein for filing media tracks, stored on a computer~~-~~readable ~~media~~medium, under categories in ~~an in memory~~a tree structure, with each media track having ~~metadata~~ attribute data identifying attributes of the track associated therewith, the attribute data including category name data ~~for naming~~, said program code comprising:

program code, execute by a processor, upon startup or when a track is added or changed, for searching the ~~metadata~~ attributes of each track; and

program code, executed by a processor, for each track, for automatically filing the track by category name under each selected category to form ~~a~~ an hierarchical track filing scheme.

11. (New) A method of arranging media information relating to media tracks stored on a computer-readable medium, the method comprising:

reading a media definition file that includes a plurality of categories, wherein each category groups tracks having corresponding attributes associated with the media tracks; and

for each track,

identifying a plurality of attributes associated with the track;

identifying a category associated with each attribute; and

grouping the track within each category that has been identified.

12. (New) The method of claim 11, wherein each track is grouped within at least two categories of the media definition file and each category includes a list of tracks having corresponding attributes.

13. (New) The method of claim 11, wherein a plurality of track identifiers are provided in each category, each track identifier being to identify a track associated with the category.

14. (New) The method of claim 11, wherein the plurality of categories relates to music and the categories comprise one of an album name category, an artist name category, and a genre category.

15. (New) The method of claim 11, wherein the at least one category comprises a plurality of subcategories associated with further attributes of the media tracks, the categories and the subcategories being arranged in a hierarchical tree structure.

16. (New) The method of claim 15, wherein the category comprises an artist name category that includes at least one subcategory identifying a group with which the artist is associated.

17. (New) The method of claim 15, wherein the category comprises a genre category that includes at least one subcategory identifying a group or artist associated with the genre category.

18. (New) The method of claim 11, wherein at least one category of the plurality of categories comprises a list of all tracks associated with the media definition file irrespective of their associated attributes

19. (New) The method of claim 1, wherein a link to the same media track is provided in more than one category.

20. (New) The method of claim 1, wherein said grouping the track within each category comprises providing an identifier within each category that has been identified, the identifier identifying the track associated with the category.

21. (New) A method of displaying media information on a display screen, the media information relating to media tracks stored on a computer-readable medium, the method comprising:

retrieving display data for display on the display screen from a media definition file that includes a plurality of categories, each category corresponding to an attribute associated with the media tracks, the display screen layout being based on the plurality of categories; and

for each track, displaying the track under each category with which it is associated.

22. (New) The method of claim 21, wherein the categories comprise at least one of an artist name category, an album name category and a genre category, the display screen layout identifying the at least one category.

23. (New) A method of arranging media information relating to media tracks stored on a computer-readable medium, the method comprising:

identifying a plurality of attributes associated with a media track;

identifying at least two categories, each identified category corresponding to an attribute; and

providing a link to the track in each of the categories identified to provide a plurality of links in each category that identify a plurality of tracks associated with the category.

REMARKS

1. Summary of the Office Action

Claims 1-4 and 6-10 stand rejected under 35 U.S.C.§ 102(b) as allegedly being anticipated by U.S. patent no. 5,670,730 (hereinafter "Grewe et al.").

2. Response to § 102 Rejections

Applicants respectfully traverse this rejection for the reasons set out below, and ask the Examiner for reconsideration.

To anticipate a claim, the reference must teach every element of the claim. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

Grewe teaches a system in which music files are arranged track-by-track. Each file is provided with individual headers 36 that include category, artist, and track address information (Figures 2-4 and col. 3 from ln. 29 onwards) associated with the particular track. The track address information is used to identify the start and/or end location of the file, so that the music player can locate and play the file. Clearly, the tracks are **arranged in a track-by-track fashion** and not based on the individual header 36. As can be seen from the description and in particular Figs. 3 and 4, the table of contents 34 is nothing more than a sequential list of the individual headers, ordered track-by-track, one after the other. The category information (see category field 40) and the artist information (see artist field 42) are thus **dispersed**. Thus, it is not readily apparent which set of tracks is in which genre or which set of tracks is performed by one particular artist.

Claim 1, as amended, reads as follows:

"1. A method, performed by a processor in a digital media player, for filing media tracks stored on a computer-readable medium, with each media track having attribute data for identifying attributes of the track, said method comprising:

reading a definition file that defines an ordered hierarchical tree structure having a plurality of branches, with **the hierarchical tree structure including category names for naming branches** <u>**under which tracks are sorted**</u>, subcategory names for defining subcategories within the branches, and structure information defining the hierarchy of branch names and subcategory names; and

for each track, **determining**, based on the attribute data associated with the track **if the track belongs in one or more of the branches**, and, for each branch in which the track belongs, **filing the track under one or more subcategories**"

Claim 1 includes the limitation of a "**hierarchical tree structure including category names for naming branches** <u>**under which tracks are sorted**</u>"

Firstly, Grewe does not teach or suggest "**reading a definition file** that defines an ordered hierarchical tree structure having a plurality of branches, with **the hierarchical tree structure including category names for naming branches** <u>**under which tracks are sorted**</u>, subcategory names for defining **subcategories** within the branches, and structure information defining the hierarchy of branch names and subcategory names." In Grewe, the tracks are not sorted according to category names that are provided in a branch but rather in sequential blocks of memory locations. There is no <u>hierarchical relationship</u> between the category field 40 or the artist field 42 with a particular track and any hierarchy in Grewe.

Secondly, as the tracks in Grewe are filed sequentially in memory according to track number, the limitation of claim 1 of "for each track, **determining**, based on the attribute data associated with the track **if the track belongs in one or more of the branches**, and, for each branch in which the track belongs, **filing the track under one or more subcategories**" is also not described or even suggested in Grewe.

In view of the above, it is submitted that Grewe does not describe or even suggest all the limitations of claim 1. Accordingly, claim 1 is allowable and, as claims 1-4 are dependent upon claim 1, they are also allowable.

Claim 9, as amended, also includes the limitation of "reading a definition file that defines an ordered hierarchical tree structure having a plurality of branches, with **the hierarchical tree structure including category names for naming branches <u>under which tracks are sorted</u>.**" Claim 9 also includes the limitation wherein, for each track, "**determining**, based on the attribute data associated with the track, **if the track belongs in one or more of the branches**, and, for each branch in which the track belongs, **filing the track under one or more subcategories**."

Accordingly, in view of the remarks above, it is submitted that claim 9 is also allowable.

Claim 6, as amended, reads as follows:

"6. A method, performed by a processor in a digital media player, for filing media tracks, stored on a computer-readable medium, under categories in a tree structure, with each media track having attribute data identifying attributes of the track associated therewith, the attribute data including category name data, said method comprising:

upon startup or when a track is added or changed, searching the attributes of each track; and

for each track, automatically **filing the track by category name** under each selected category associated with the attributes to form an hierarchical track filing scheme."

Claim 6 includes the limitation of "for each track, automatically **filing the track by category name** under each selected category associated with the attributes to form an hierarchical track filing scheme." This limitation is also not described or even suggested in Grewe that files tracks sequentially track-by-track. The filing system of Grewe merely appends each individual header 36 to the last individual header 36 in the table of contents 34 so that tracks having a common category field 40 or a common artist field 42 are **dispersed** (see

Figures 3 and 4). Grewe does not describe, or even suggest, "for each track, **filing the track by category name under each selected category**" as claimed in claim 6.

In view of the above it is submitted that claim 6 is allowable and, as claims 7 and 8 are dependent upon claim 6, they are also allowable.

Claim 10, as amended, also includes the limitation of, for each track, "**automatically filing the track by category name under each selected category to form an hierarchical track filing scheme.**" Accordingly, in view of the remarks above, it is submitted that claim 10 is also allowable.

Claim 11 reads as follows:

"11. A method of arranging media information relating to media tracks stored on a computer-readable medium, the method comprising:

reading a media definition file that includes a plurality of categories, wherein **each category groups tracks having corresponding attributes** associated with the media tracks; and

for each track,

identifying a plurality of attributes associated with the track;

identifying a category associated with each attribute; and

<u>grouping</u> the track within each category that has been identified."

Claim 11 includes the limitation of "reading a media definition file that includes a plurality of categories, wherein **each category groups tracks having corresponding attributes** associated with the media tracks." This limitation is also not disclosed in Grewe that merely arranges tracks in a sequential order resulting category fields 40 and artist fields 42 that are **dispersed** and not grouped as claimed in claim 11.

The above limitation in claim 11 must also be read in conjunction with the grouping operation performed for each track. In particular, claim 11 includes the limitation of, for each track, "**<u>grouping</u> the track within each category that has been identified.**" Grewe does not group tracks within a category but merely identifies a category associated with the track. Further, the category field 40 and artist field 42 are dispersed in Grewe.

In view of the above it is submitted that claim 11 is allowable. As claims 12-20 are dependent upon claim 11, they are also allowable.

Claim 21 reads as follows:

"21. A method of displaying media information on a display screen, the media information relating to media tracks stored on a computer-readable medium, the method comprising:

retrieving display data for display on the display screen from a media definition file that includes a plurality of categories, each category corresponding to an attribute associated with the media tracks, the **display screen layout being based on the plurality of categories**; and

for each track, **displaying the track under each category with which it is associated.**"

Grewe does not even mention that information can be displayed on a display screen. Accordingly, Grewe does not describe or even suggest the limitations of a "**display screen layout being based on the plurality of categories**; and for each track, **displaying the track under each category with which it is associated.**"

In view of the above it is submitted that claim 21 is allowable and, as claim 22 is dependent upon claim 21, it is also allowable.

Claim 23 reads as follows:

"23. A method of arranging media information relating to media tracks stored on a computer-readable medium, the method comprising:

identifying a plurality of attributes associated with a media track;

identifying at least two categories, each identify category corresponding to an attribute; and

providing a link to the track in each of the categories identified to provide a plurality of links in each category that identifies a plurality of tracks associated with the category."

The limitation of "**providing a link to the track in each of the categories identified to provide a plurality of links in each category that identify a plurality of tracks associated with the category**" is not described or even suggested in Grewe. Accordingly, claim 22 is also allowable.

In light of the above, Applicants respectfully submit that the rejection under 35 U.S.C. § 102 has been also been overcome, and withdrawal of this rejection is therefore respectfully requested.

3. <u>Conclusion</u>

Having tendered the above remarks and amended the claims as indicated herein, Applicants respectfully submit that all rejections have been addressed and that the claims are now in a condition for allowance, which is earnestly solicited.

If there are any additional charges, please charge Deposit Account No. 02-2666. If a telephone interview would in any way expedite the prosecution of the present application, the Examiner is invited to contact Garth Vivier at (408) 947-8200 ext. 245.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: 1/29, 2004

Mark R. Vatuone

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OIPE JCGA
FEB 03 2004
PATENT & TRADEMARK OFFICE

FEE TRANSMITTAL for FY 2003

Effective 01/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT	($)	880.00

Complete if Known	
Application Number	09/755,723
Filing Date	January 5, 2001
First Named Inventor	Ron Goodman
Examiner Name	Rones, Charles
Group/Art Unit	2175
Attorney Docket No.	6407P212

RECEIVED
FEB 05 2004
Technology Center 2100

METHOD OF PAYMENT (check all that apply)

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None
☐ Deposit Account

Deposit Account Number: 02-2666

Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

The Commissioner is authorized to: (check all that apply)

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) required under 37 CFR §§ 1.16, 1.17, 1.18 and 1.20.

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	
				SUBTOTAL (1)	($)

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	9	- 20** =	0	X	18.00	=	$0.00
Independent Claims	4	- 5** =	0	X	86.00	=	$0.00
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple Dependent claim, if not paid
1204	86	2204	43	**Reissue independent claims over original patent
1205	18	2205	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

**or number previously paid, if greater, For Reissues, see below

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
2053	130	2053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	110.00
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	1,210	2255	605	Extension for reply within fifth month	
1404	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	2451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	2460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	1809	385	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	770.00
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 880.00

SUBMITTED BY

Complete (if applicable)

Name (Print/Type)	Mark R. Vatuone	Registration No. (Attorney/Agent)	53,719	Telephone	(408) 947-8200
Signature	[signature]			Date	1/29/04

Based on PTO/SB/17 (08-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wr) 08/11/2003.
SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

CL 000152

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

8791 7590 03/30/2004

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER	
RONES, CHARLES	
ART UNIT	**PAPER NUMBER**
2175	17

DATE MAILED: 03/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

CL 000153

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/755,723	GOODMAN ET AL.	
	Examiner	Art Unit	
	Charles L. Rones	2175	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 03 February 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-4 and 6-23 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) 21 and 22 are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

CL 000154

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☒ Other: Restriction/Election.

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claim1-4,6-20, and 23, drawn to a method/computer program for filing media tracks, classified in class 707, subclass 7.

II. Claims 21-22, drawn to a method of displaying on a display screen, classified in class 707, subclass 526.

The inventions are distinct, each from the other because of the following reasons:

Inventions in Group I and Group II are related as combination and subcombination. Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because a method of filing media tracks and a method of displaying are distinct and does not require the particulars of the other. The subcombination has separate utility such as method of filing and a displaying.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Conclusion

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles L. Rones whose telephone number is 703-306-3030. The examiner can normally be reached on Monday-Thursday 8am-4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dov Popovici can be reached on 703-305-3830. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Charles Rones
Charles L. Rones
Primary Examiner
Art Unit 2175

March 29, 2004

#18D
6/3/04
A.W.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

In re application of: Goodman, et al

Application No.: 09/755,723

Filed: January 5, 2001

Title: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**

Attorney Docket No.: 6407P212

Examiner: Rones, Charles L.

Group: 2175

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail to: Commissioner for Patents, Alexandria, VA 22313 on April 30, 2004.

Signed: Karen Howe-Behrooz
Karen Howe-Behrooz

Amendment and Response to Restriction Requirement

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The enclosed remarks and amendments are submitted in response to the to the Office Action mailed on March 30, 2004 wherein a restriction requirement was imposed. Applicants respectfully request reconsideration of the captioned application in view of the following remarks and amendments. A listing of the claims commences on page 2. Remarks begin on page 6 of this paper.

Listing of Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (withdrawn) A method, performed by a processor in a digital media player, for filing media tracks stored on a computer-readable medium, with each media track having attribute data for identifying attributes of the track, said method comprising:

reading a definition file that defines an ordered hierarchical tree structure having a plurality of branches, with the hierarchical tree structure including category names for naming-branches under which tracks are sorted, subcategory names for defining subcategories within the branches, and structure information defining the hierarchy of branch names and subcategory names; and

for each track, determining, based on the attribute data associated with the track if the track belongs in one or more of the branches, and, for each branch in which the track belongs, filing the track under one or more subcategories.

2-23. (cancelled)

Sub E1

1

24. (new) A method of selecting at least one track from a plurality of tracks stored in a computer-readable medium of a portable media player configured to present sequentially a first, second, and third display screen on the display of the media player, the plurality of tracks organized according to a file hierarchy, the file hierarchy having a plurality of categories, subcategories, and items respectively in a first, second, and third level of the hierarchy, the method comprising:

selecting a category in the first display screen of the portable media player;

displaying the subcategories belonging to the selected category in a listing presented in the second display screen;

selecting a subcategory in the second display screen;

displaying the items belonging to the selected subcategory in a listing presented in the third display screen; and

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D

accessing at least one track based on a selection made in one of the display screens.

~~25~~ 2. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting a subcategory in the second display screen and playing a plurality of tracks associated with the selected subcategory.

~~26~~ 3. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting a subcategory and adding the tracks associated with the selected subcategory to a playlist.

~~27~~ 4. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting an item in the third display screen and playing at least one track associated with the selected item.

~~28~~ 5. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting an item in the third display screen and adding at least one track associated with the selected item to a playlist.

~~29~~ 6. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises one of playing or adding to a playlist at least one track associated with a selected one of the category, subcategory, and item.

~~30~~ 7. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track is made after the presentation of the third display screen by reverting back to one of the second and first display screens, the second display screen presented sequentially after the third display screen.

~~31~~ 8. (new) The method of selecting a track as recited in claim ~~24~~ 1 further comprising selecting one of the items displayed in the third display screen and presenting

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a listing of items associated with the selected item in a fourth sequentially presented display screen.

9 ~~32~~. (new) The method of selecting a track as recited in claim 1 ~~24~~ wherein the category genre is selected in the first display screen from available categories that include at least artist, album, and genre; and the subcategories listed in the second display screen comprise a listing of at least one genre type and one of the at least one genre type is selected.

10 ~~33~~. (new) The method of selecting a track as recited in claim 9 ~~32~~ further comprising displaying in the third display screen at least one album associated with the selected genre type and selecting one of the at least one albums displayed in the third display screen and presenting a listing of tracks associated with the selected album in a fourth sequentially presented display screen.

11 ~~34~~. (new) The method of selecting a track as recited in claim 1 ~~24~~ wherein the category artist is selected in the first display screen from available categories that include at least artist, album, and genre; the subcategories listed in the second display screen comprise a listing of names of artists and a first artist name is selected; and the items displayed in the third display screen comprises at least one album associated with the first artist name.

12 ~~35~~. (new) The method of selecting a track as recited in claim 1 ~~24~~ wherein the track is a music track, the item accessed in the third display screen is a track title, and the track is played in response to the access.

13 ~~36~~. (new) The method of selecting a track as recited in claim 1 ~~24~~ wherein receipt of the selection in the first display screen results in an automatic transition of the first display screen into the second display screen and receipt of the selection in the second display screen results in an automatic transition of the second display screen into the third display screen.

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Amendments to the Specification:

The changes to the specification are included in the attached substitute specification, submitted pursuant to 37 CFR 1.125. Both a marked up version and a clean version are attached. The substitute specification does not include the currently pending claims, which are listed directly in a listing of claims in this paper.

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Amendments to the Drawings:

New Drawings for Figures 9-14 are added. These are attached and correspond to drawings from patent application serial number 09/755.629, "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface", said application disclosure having been incorporated by reference in the original specification.

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REMARKS

Claims 1-4 and 6-23 are pending in the application. The examiner had required restriction to one of the Group I and Group II inventions under 35 U.S.C. 121. In particular, the Examiner had indicated that the Group I inventions included claims 1-4, 6-20,and 23, drawn to a method/computer program for filing media tracks. The Examiner had further indicated that the Group II invention included claims 21-22, drawn to a method of displaying on a display screen.

Applicants hereby elect without traverse the claims of Group II, claims 21-22. The claims to the Group I invention have been either cancelled or withdrawn. In particular, claim 1 has been withdrawn and the remainder of the claims identified by the examiner to be associated with Group I, i.e., claims 2-4, 6-20, and 23 have been cancelled. Applicants reserve the right to submit the nonelected claims in a continuation or divisional application.

Further, Group II claims 21-22 have been cancelled. New claims 24-39 have been added, consistent with applicants' election of Group II. No new matter has been added. Applicants respectfully submit that new claims 24-36 fall within the classification of the elected Group II. Support for the new claims may be found throughout the original specification, including the matter incorporated by reference.

Applicants have further amended the specification to directly include matter from patent application serial number 09/755.629, "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface", said application disclosure having been incorporated by reference in the original specification. This matter is added via a substitute specification. The substitute specification adds no new matter. Clean and marked up copies are attached to this amendment. Applicants respectfully request that the substitute specification be entered pursuant to the provisions of 37 CFR 1.125.

Applicants have also submitted replacement drawings, FIGS. 9-14, attached hereto. Applicants respectfully request entry of the replacement drawings (new drawings). These drawings correspond to drawings which were a part of patent application serial number 09/755.629, "System for Selecting and Playing Songs in a

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Playback Device with a Limited User Interface", said application disclosure having been incorporated by reference in the original specification.

Applicants respectfully request entry of the amendments to the claims. The new claims correspond to the election to the invention of Group II in response to the restriction required by the Examiner in the office action of March 30, 2004. Support for the amendments may be found in the previous versions of the claims and the new drawings submitted including Figures 9 and 10 as well as the accompanying text, for example in pages 13-15 of the description. Applicants submit that the amended claims, including independent claim 24 and dependant claims 25-36, are patentable over the art of record for at least the reason that Grewe doesn't teach or suggest displaying categories or subcategories in a display screen.

Conclusion

Accordingly, it is submitted that all issues in the Office Action have been addressed. Applicants believe that this application is in condition for allowance, and respectfully request a prompt passage to issuance. If the Examiner believes that a telephone conference would expedite the prosecution of this application, he is invited to contact the Applicants' undersigned attorney at the telephone number set out below.

Respectfully submitted,

Russell N. Swerdon
Registration No. 36,943

Creative Labs, Inc.
1901 McCarthy Boulevard
Milpitas, CA 95035
(408) 428-6600

CL 000165

SUBSTITUTE SPECIFICATION- MARKED UP VERSION

OK to Enter Substitute Specification CR 12-9-04

OIPE JC48 MAY 0 4 2004 PATENT & TRADEMARK OFFICE

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

PATENT APPLICATION

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Inventor:

RON GOODMAN, a citizen of the United States,
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Santa Cruz, CA 95060

HOWARD N. EGAN, a citizen of the United States,
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Assignee:

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Creative Resource
Singapore 609921
Republic of Singapore

Entity: Large

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SUBSTITUTE SPECIFICATION- CLEAN VERSION

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

PATENT APPLICATION

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Inventor:

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Assignee:

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31 International Business Park
Creative Resource
Singapore 609921
Republic of Singapore

Entity: Large

PATENT
Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to Application No. 09/755,629, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," now abandoned (Atty. Docket No. 17002-020800); and Application No. 09/755,367, entitled "Audioplayback Device with Power Savings Storage Access Mode," issued as U.S. Patent No. 6,590,730 (Atty. Docket No. 17002-022400), all filed January 5, 2001, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Today, portable consumer electronic devices are more powerful than ever. For example, small, portable music playback devices can store hundreds, even thousands, of compressed songs and can play back the songs at high quality. With the capacity for so many songs, a playback device can store many songs from different albums, artists, styles of music, etc.

Music jukeboxes implemented in software executed by a digital computer and portable MP3 and CD players both provide facilities for forming playlists. For example, the OOZIC player, distributed by the assignee of the present application, runs on a host PC and has a playlist feature that allows selection of tracks from the PC's hard disk to be included in the playlist.

As storage capacity increases and songs are compressed to shorter file lengths the number of songs that can be stored increases rapidly. Major problems facing the consumer are organizing and accessing the tracks.

Typically, portable devices have a user interface including a small screen and buttons. Such a display screen might be, e.g., 1" x 2". This small display size is necessary because of the physical size of the device which is typically carried in the hand. The small size

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also limits the number, size, shape, and types of user input controls that can be mounted on the device. For example, a few pushbuttons are usually provided to perform all of the device's control functions. Using such a compact user interface to navigate and select among hundreds of songs is inefficient and often frustrating. The display screen can only show a few song titles at one time, and the limited controls make it difficult for a user to arbitrarily select, or move among, the songs.

The creation of playlists is one technique to organize the playing of songs. A set of songs can be included in a playlist which is given a name and stored. When the playlist is accessed, the set of songs can be played utilizing various formats such as sequential play or shuffle.

However, the creation of playlists itself becomes problematic as the number of songs increases, since the user often arbitrarily selects songs from a large number of tracks to form a playlist. This selection mechanism: can be fairly tedious; does not necessarily produce playlists that are of interest to the user over the course of time; may not remain up-to-date if new songs are added that logically fit into a previously created playlist (e.g. "Favorites by Band X" might become out of date if a new favorite by Band X is added after the playlist was created); and leads to "lost" songs that are not members of any playlist.

Accordingly, improved techniques for organizing and grouping tracks useful in a portable music player are needed. Further, it is desirable to provide a user interface suitable for a small device. The user interface should allow a user to efficiently navigate among, and select from, many items stored in the device.

SUMMARY OF THE INVENTION

The present invention provides an efficient user interface for a small portable music player. The invention is suitable for use with a limited display area and small number of controls to allow a user to efficiently and intuitively navigate among, and select, songs to be played. By using the invention, very large numbers of songs can be easily accessed and played.

One aspect of the invention includes an overlapping hierarchy of categories. Categories include items that can also be included in other categories so that the categories "overlap" with each other. Thus, a song title can be accessed in multiple different ways by starting with different categories. For example, a preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Similarly, the Artists category includes names of artists which are, in turn, associated with their albums and songs. The Genre category includes types of categories of music such as "Rock", "Hip Hop", "Rap", "Easy Listening", etc. Within these sub-categories are found associated songs. Finally, the "Play Lists" category includes collections of albums and/or songs which are typically defined by the user.

Advantageous use is made of the overlapping hierarchy to allow the user to quickly designate a song for playback. The device uses three "soft" pushbuttons that have assignable functions. The interface maintains consistent button functionality whenever possible and uses uniform command names and operations on different types of items so that the interface is more intuitive. For example, the user can open and queue both albums and songs with predictable results.

The interface also provides for multiple functions for a single control. For example, a "Play" button can act, in a first function, to play a currently-selected song. The Play button can act, in a second function, to cycle through different playback modes. The modes can be, e.g., (1) playback of songs from a hard disk; (2) playback of music from a radio receiver built into the device; and (3) playback of voice messages. The first function for the Play button can be activated by momentarily depressing the Play button for a short period of time. The second function is invoked by depressing the Play button for a longer period of time whereupon the device cycles through the different modes. Other ways of invoking the functions are possible such as where the second function is automatically entered from a powered-down state.

In one embodiment, the invention provides a method for selecting songs to be played in an electronic audio device, wherein the device includes a display and one or more user input controls, wherein songs are organized into categories, albums, wherein songs and albums are associated with artist names. The method includes steps of displaying categories on the display; accepting signals from a user input control to select a category; displaying one or more songs in the selected category on the display; accepting signals from a user input control to select a displayed song; and entering selected songs into a playlist queue, wherein the device plays back songs in the playlist queue.

According to one aspect of the present invention, a technique is provided for organizing tracks on a portable music player by automatically filing tracks in a hierarchical order based on attributes of the tracks.

According to another aspect of the invention, metadata is associated with each track that is used to automatically define the track's appropriate place in the hierarchy.

According to another aspect of the invention, the hierarchy is displayed on the portable music player so that a user can traverse the organizational hierarchy to find individual tracks or find playlists composed of logical groups of tracks.

According to another aspect of the invention, the hierarchy is derived by using metadata associated with the audio content that was obtained through any source of metadata (e.g. CDDB metadata, id3v2 metadata, other obtainable metadata) and subsequently stored with or alongside the file that stores the track.

According to another aspect of the invention, a file is formatted so that an unaltered track is stored as file data and information about the track is stored in file attribute files.

Other features and advantages of the invention will be apparent in view of the following detailed description and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a tree structure for hierarchical filing of tracks;

Fig. 2 is a definition file that specifies the hierarchy depicted in Fig. 1;

Fig. 3 is a user's view of the hierarchy;

Fig. 4 is a schematic diagram of a user interface displaying the hierarchical category structure;

Fig. 5 is a diagram of a file format for storing filed data and file attributes;

Fig. 6 is a flow chart depicting steps for filing tracks according to the hierarchical tree structure;

Fig. 7 depicts a tree resulting from searching the tracks;

Fig. 8 depicts a format for a user interface;

Fig. 9 illustrates the NOMAD Jukebox and its user interface controls;

Fig. 10 illustrates a sequence of display screens describing how to navigate to lower levels;

Fig. 11 illustrates associations among items;

Fig. 12 shows display screens used to search for a song or other item;

Fig. 13 illustrates details of different items; and

Fig. 14 illustrates a playback device coupled to a host computer system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the invention will now be described in the context of a portable personal player that plays audio files stored in memory. The files may be in MP3, wav. or other digital formats.

In the presently described embodiment, users are able to see the tracks on their player in some organized fashion other than as a single list of tracks. As will be described in more detail below, in one embodiment tracks are sorted utilizing a tree structure having branches labeled according to types of metadata associated with the tracks

For example, a track recorded as "Golden Slumbers" by the Beatles that appears on their album "Hey Jude" might appear as a track under the album "Abbey Road" as well as a track under the list of tracks by the Beatles. It might appear as a track under the genre "Pop Rock" as well as "Songs from the 60's." Furthermore, the organization can have more complex hierarchies. For example, the category of "Pop Rock" might contain subcategories "British Musicians," "American Musicians" and "Other Musicians". In all cases, the track is automatically filed into all appropriate locations without requiring user interaction.

In the currently defined embodiment, a tree structure is defined by a file having the following structure.

The first line of a TreeDef.inf file contains a version number:

V1.0

Each subsequent line (at least in v1.0) contains lines of the following format:

CATEGORY_NAME|TRACK_TYPE_MASK|CATEGORY_STRUCTURE

CATEGORY_NAMEs are the top-level names of the branch under which tracks are sorted. They include things like "Album," "Artist," "Voice Tracks," "All Tracks," etc.

TRACK_TYPE_MASKs tell which types of tracks are to be filed under this particular branch. The actual value is a hexadecimal numerical value (in '0x' format, e.g. 0x01) generated by ORing the following flags together as appropriate:

```
enum tTrackType
{
```

```
        kTTNothing=0x00,
        kTTSong=0x01,
        kTTVoice=0x02,
        kTTBook=0x04,
        kTTMacro=0x08,
        kTTPlaylist=0x10
};
```

So, for example, the "Album" branch has a TRACK_TYPE_MASK of kTTSong, because only songs are filed under that branch, but the "All Tracks" branch has a TRACK_TYPE_MASK of (kTTSong | kTTVoice | kTTBook).

Other elements might be added to tTrackType (e.g. kTTVideo) as appropriate.

CATEGORY_STRUCTUREs tell how to file the songs based on their metadata information. The CATEGORY_STRUCTURE is a string of characters that tell, from left to right, the order of hierarchy. The characters come from the following enum constants:

```
enum tFileTag
{
        kFTNone='@',
        kFTTrackType='T',
        kFTTitle='N',
        kFTAudioFile='F',
        kFTArtist='M',
        kFTAlbum='L',
        kFTGenre='G',
        kFTSource='S',
        kFTYear='Y',
        kFTArtistCountry='C'
};
```

Thus, a CATEGORY_STRUCTURE of LN tells to create a subcategory that is a list of Albums, each of which contains a list of Tracks.

In total, a line like:

Album|0x01|LN

Says to create a branch called "Album" which contains tracks of type kTTSong organized first by album name, and then by track name.

The following is an example of a tree definition file similar (though not identical) to the hierarchy presented in the Nomad Jukebox product (the 'B' before each FileTag was used to identify that these are basic tags so that we wouldn't run out of letters in the alphabet as we included more complex metadata – thus each group of two letters represents a level in the hierarchy):

V1.0

Album|0x01|BLBN

Artist|0x01|BMBN

Genre|0x01|BGBN

Voice Tracks|0x02|BSBGBN

Playlists|0x10|BN

Macros|0x08|BN

All Tracks|0x07|BN

Fig. 1 depicts a hypothetical organization hierarchy. The tree shows how tracks might be listed (as leaves in the tree) after having been organized. Example values for nodes in the tree are shown as well. The same track may appear more than once as a leaf in the tree, as described above, if it fits into multiple categories (e.g. a song that appears on the Abbey Road branch would also appear in the Beatles branch). In the example shown, the first branch contains tracks organized by album. As shown in the example, this music collection contains three tracks from "Abbey Road" and three tracks from "Hits from the 60's". The second branch contains tracks organized by artist, and sub organized by where the artist is from. Thus, a user browsing would first select the "Artists" branch and then choose between "British Artists" and "American Artists". Finally, they would select the particular artist. In the third branch, all tracks are shown.

The tree definition file that would specify the hierarchy shown in Figure 1 is shown in Figure 2.

The first line identifies the version of the tree definition file.

The second line defines the "Albums" branch. The first part of the line, "Albums" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BLBN," defines that the branch lists first the names of all albums (BL) and then tracks on those albums (BN).

The third line defines the "Artists" branch. The first part of the line "Artists" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BCBMBN," defines that the branch lists first the names of all countries where artists in this collection come from (BC) and under those items, the artists' names (BM), and then tracks by those artists (BN).

Fig. 3 shows what a user's view of this hierarchy might be if he/she were shown a fully expanded view of the 6-song tree. Notice that each song appears three times, once in each branch.

In consumer products the tree define file is not edited directly but through a user interface, one example of which is depicted in Fig. 4. An example of a user interface for viewing songs by category and editing the tree structure is depicted in Fig. 4.

An embodiment of the invention is utilized in the Nomad® Jukebox, manufactured by the assignee of the present invention, and described more fully in the copending application, filed on the same date as the present application, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," (Attny. Docket No. 17002-020800).

In a preferred embodiment, metadata is associated with each track and includes such information as title, genre, artist name, type, etc. In the preferred embodiment, software stored in a portable player and executed by the onboard processor automatically files each track in the correct category utilizing the associated metadata and the tree define file. The program code can be stored in any computer readable medium including magnetic storage, CD ROM, optical media, or digital data encoded on an electromagnetic signal.

Thus, the user is automatically provided with a powerful and flexible tool for organizing and categorizing the tracks stored on the portable player.

If the tracks are formatted in MP3 format the metadata can be stored in ID3 tags included in the MP3 file. In one embodiment of the invention, the tracks are stored in alternate file format including file data and file attributes. The file data is the music track itself and the file attributes part of the file includes fields of arbitrary size which are used to store metadata characterizing the track stored as the file data. Again this metadata includes information about the track such as title, genre, artist name, type, etc.

There are several advantages to using the alternate file format. Metadata of types not easily included in an ID3 tag can be utilized. Further, the original track format is not changed, so that error correction data such as checksums are valid. Finally, any file format can be used (e.g. WAV, WMA, etc.) because the metadata is stored separately, and thus audio formats that have limited support for metadata can still be stored on the portable player in native format without transcoding. The formatted files are formed by software stored in the portable music player and executed by an on-board processor.

The metadata for each track is utilized to file each track, using the categories defined in the hierarchical structure as described above, without any input from the user.

Fig. 5 is a schematic diagram of the alternative file format including file data in the form of an MP3 track, and metadata fields for holding data indicating the name of the album the track is from, the name of the song, the genre of the song, and the type of track.

A particular embodiment of a file format will now be described. All tracks are created with some set of attributes as shown below:

Definition of TrackInfo Data Field

Field	Offset	Size	Description
Attribute Count	0	2	The number of attribute follow for the track
Attr 1 type	2	2	Binary = 0, ASCII = 1
Attr 1 name len	4	2	Length of attribute name string
Attr1 data len	6	4	Length of attribute data
Attr1 Name	10	N	Attribute name string
Attr 1 Data	10+N	M	Attribute data

....			
....			
Attr N type			
Attr 1 name len			
Attr1 data len			
Attr1 Name			
Attr 1 Data			

Required Attributes

Attribute Name	Value(s)	Remarks
TITLE	ASCII string	Required By Jukebox
CODEC	"MP3", "WMA", "WAV"	Required By Jukebox
TRACK ID	DWORD	Set By Jukebox
ALBUM	ASCII string	Optional
ARTIST	ASCII string	Optional
GENRE	ASCII string	Optional
LENGTH	In seconds	Optional
TRACK SIZE	In bytes	Optional
TRACK NUM	1-n (track within album)	Optional

These attributes can be subsequently changeable via a host application, running on a personal computer connected to the portable music player.

Fig. 6 shows a flow chart of an embodiment the process used to build the hierarchical database of tracks. It starts by iterating through each track, and, for each track, iterating through each branch to find if the track belongs on the branch, and, if so, where. In this case, the term track could refer to any content, e.g. a music track, a spoken word track, or even a video track.

Also, the hierarchical catalog of tracks can be used to form playlists in a structured manner. For example, if a user wants to hear Jazz and Blues the entire sub-categories can be selected to form one playlist.

An alternative hierarchical catalog generation technique will now be described. In this alternative embodiment, at system startup and as tracks are added or changed, the hierarchy is generated as an in-memory tree structure. Each track is added to the tree using the categories ALBUM, ARTIST and GENRE.

The following example shows the algorithm for adding a track. For clarity, only the attributes used by the tree are shown.

TITLE	"Free Falling"
ALBUM	"Full Moon Fever"
ARTIST	"Tom Petty"
GENRE	"Rock"
TRACK NUM	1

The following function is executed to build the in-memory memory tree.

```
Build Tree ()
For each track,
        Add Track To Category(Album, Track)
        Add Track To Category(Artist, Track)
        Add Track To Category(Genre,Track)
End of Build Tree
```

Fig. 7 depicts a tree which could result from implementing Build Tree() function. Note that "Stardust" does not have any entries for Album or Artist. The host software running on a computer connected to the portable music player could be utilized to add missing attributes to the "Stardust" track and, optionally, edit the title attribute. The Build Tree() function would then reinsert this track in the correct location in the tree.

Fig. 8 is an embodiment of a user interface according to another embodiment of the invention. In this example the root node is labeled "My Configuration" and the Playlist category has been selected and the Playlist subcategory "Meddle" has been selected. Note that the types of Metadata, in this example, Track Name, Artist, Album, Tempo and Dance, are listed across the top of the screen, and the attribute values for each track are listed in a row across the screen. Various control buttons are displayed to the right of configuration window that facilitate quickly invoking selected processing on a selected track.

As noted above, a preferred embodiment of the present invention is incorporated into a product manufactured and distributed by Creative Technology, Ltd. The product is called the "NOMAD Jukebox." The following description describes further details of the display screens and interface controls.

Fig. 9 illustrates the NOMAD Jukebox and its user interface controls.

In Fig. 9, electronic audio device 100 measures about 5.5" wide by 5.5" tall by 1" thick. Display screen 102 is about 2" wide by 1" tall. Display screen 102 includes different regions such as main region 104 and soft button function description region 106.

Three soft buttons are located at 108; including buttons 110, 112 and 114. The specific command, or function, that any of the soft buttons perform when depressed is indicated by the label in soft button function description region 106. Thus, the function of soft button 112 (as shown in Fig. 9) is "open," the function of soft button 114 is "search" while soft button 110 is currently not assigned a function.

The other eight buttons on device 100 perform essentially the same functions at all times. In other words, they are not subject to function changes according to soft button function description area 106. These buttons include Library button 116, EAX and System button 118, Skip Backward button 120, Play button 122, Stop button 124, Skip Forward button 126, Scroll Up button 128 and Scroll Down button 130. However, as discussed below, these buttons (or any type of controls used with the device) can include alternate functionality that is invoked in different ways.

The device uses visual cues, or indicators, in the display. When an item is highlighted it indicates that the item is the "current" item, or currently-selected item, which is susceptible to be operated on by a subsequent user action – such as playback, or expansion of the item. In Fig. 1, screen 102 shows that the item, "ALBUMS," is highlighted. The highlighted item can be acted upon by using the soft buttons, or another button, as discussed below. The current item can be changed by using Scroll Up button 128 and Scroll Down button 130 to move the highlight up or down, respectively, throughout a list of displayed items.

Icons are used to provide additional visual cues for an item. In Fig. 1, each of the categories has a category icon to the left of it. The category icon, which may not be distinctly visible in the Figure, illustrates a first box connected by lines to additional boxes below the first box. The icon depicts a hierarchy and illustrates the property of categories, i.e., that categories can contain additional categories, songs or other items.

Fig. 10 illustrates a sequence of display screens describing how to navigate to lower levels.

In Fig. 10, library category screen 150 shows the display as it appears when the user depresses library button 116 of Fig. 9. A preferred embodiment of the device uses 4 first-level categories. These are "Albums", "Artists," "Styles" and "Play Lists". Each of these categories can "contain," or be associated with, other categories, songs, or items.

Note that in library category screen 150 ALBUMS is currently highlighted. By depressing soft button 112 of Fig. 9, the "open" command is performed on the highlighted category, as indicated by the labeling of soft button 112 and soft button function description area 152 of Fig. 10.

Lists screen 154 is displayed as a result of a user opening the Albums category of library category screen 150. Lists screen 154 shows items within the Albums category such as commercial albums of multiple songs from a record label, pre-made lists or collections created by a user, or other predefined lists or collections of songs or recordings.

In Fig. 10, lists screen 154 shows each item as a list of songs. This is shown visually by the icon to the left of each item which depicts a miniature list. Possible soft button commands are "Close", "Open" and "Queue". These commands correspond to soft buttons 110, 112 and 114, respectively. If the user selects the Close command, the display reverts to library category screen 150. If the user selects the Open command, the display shows tracks screen 156.

Alternatively, the user can select the Queue command to instruct the device to place all the songs from the selected (i.e., highlighted) list into the play list for eventual playback. Yet another option allows the user to press play button 122 of Fig. 9 to cause any currently-selected songs or a list of songs (e.g., an album) to immediately be played.

Returning to Fig. 10, tracks screen 156 shows that a single song called "JukeBox Demo" is in the list. The list is also called JukeBox Demo as shown in lists screen 154. Tracks screen 156 shows possible soft commands assigned to buttons, namely "Close", "Details" and "Queue." The Close button performs the same function as before -- it returns the user to the previous screen which, in this case, is lists screen 154. The user can also select the Details command to cause details of the song JukeBox Demo to be displayed in details screen 158 as shown in Fig. 10. The user can select the Queue command by soft button 114 to enter the selected song into the play list queue. As before, the user can also depress play button 122 of Fig. 9 to cause immediate playback of the selected song.

Details screen 158 shows information about the selected song including the name of the song, album (or list) name containing the song; the track number, if applicable, and track duration. Note that other information can be included. The user can preview the song, close the Details screen to return to the Tracks screen or queue the song on the play list queue.

The device provides the ability to "preview" audio files even while a current song, or playlist, is being played. When a user chooses to preview an audio file, the audio file is played for about 10 seconds while any currently-played file or playlist is suspended. After previewing is complete, the suspended file or playlist resumes playback. In other embodiment, the preview duration can vary, or be stopped by user selection.

Fig. 11 illustrates associations among items.

In Fig. 11, song 168 is one of many songs stored in the device. Categories such as albums 160, artists 162, play lists 164 and genres 166 each include sub-categories. For example, albums 160 includes the names of various albums. Songs are associated with albums, genres and playlists. Such association can be by using pointers, a data structure including items to be associated, etc. "Association" as used herein, includes a first item associated with a second item; and the second item associated with the first item. In other words, albums can be associated with one or more songs in the database of the device so that an automated search to find all songs associated with an album is easier. The direction of arrow pointers in Fig. 11 is not intended to limit the manner of associations among items in the present invention.

Similar to albums, the category of artists 162 includes names of artists, or performers, of songs. Each artist name is associated with one or more songs in the database. Playlists 164 includes names of playlists. These are collections of songs that can be defined by the user, the device manufacturer, or others. Each playlist can be associated with one or more songs. Genres 166 includes various styles of music which are associated with one or more songs in the database. Note that items can exist without being associated with a song. Also, items can be associated with other items as where an artist name is associated with the albums containing the songs that the artist has created.

Although not shown in Fig. 11, items can have additional information, such as properties, details, etc., associated with the item. For example, a song can have information such as play time, artist name, artist album, copyright owner, etc., associated with the song.

Fig. 12 illustrates display screens used to search for a song or other item.

In Fig. 12, screen 180 is the initial library screen, as discussed above. If the user invokes the Search command (via the appropriate soft button) with Albums selected then screen 182 is displayed. Note that the search function can be applied to any of the categories. The user can depress the Plus or Minus soft buttons to cycle through the alphabet and change the character in the current location as indicated by the cursor. The cursor position is changed by using the scroll up/scroll down buttons 128 and 130, respectively, of Fig. 9. As each letter is entered the letters are compared and the nearest match of the stored albums' names is displayed as shown in screen 184. When the desired match is displayed the user selects the Go! command.

Screen 186 shows the result of selecting the Go! command. A list of albums is displayed with the matched album centered and selected. The user can close, open or queue the album as discussed above.

Fig. 13 illustrates details of different items.

In Fig. 13, screen 200 illustrates details displayed as a result of selecting the "Details" command from soft button 1A track is selected. Screen 200 shows that details of the track "Jukebox Demo" shows the name of the album that the track resides on, the creator, or copyright owner, of the track, and the playing time of the track.

Screen 202 illustrates details of an item on the active queue list. Items are placed onto the active queue list by selecting the "Queue" command when an album, song, track, or other item is selected, as discussed above. For example, screen 204 shows the active queuelist where the track "Jukebox Demo" is selected. By invoking the "Details" command screen 202 is brought up to show details of the Jukebox Demo track.

As shown in screen 202, the Detail screen shows what track number the selected track is, which album the track is from; the creator, or copyright owner, of the track, and the title of the track. Additionally, the details for an item on the queue list also show playback settings. These are shown by two-letter abbreviations at the bottom of the screen. The settings are as show in Table I, below.

EA	Environmental Preset
EQ	Parametric EQ
HS	Headphone Spatialization
TS	Time Scaling
4S	Four Channel Speaker Sound (only if speakers are connected)

TABLE I

These settings have their common meanings, as is known in the art. Note that the setting 4S is not shown in screen 202 as it is not currently active.

Fig. 14 illustrates the Nomad Jukebox coupled to a host computer system.

In Fig. 14, device 300 (e.g., the Nomad Jukebox) is coupled to host system 302. In a preferred embodiment host system 302 is a personal computer, such as an IBM-PC compatible computer. Host system 302 includes a user interface having display 304 and user input devices such as keyboard 306 and mouse 308. In other embodiments the host system need not be a full computer system. Any type of processing system having a user interface is possible. For example, it is possible to couple the device to a laptop computer, game console, web-enabled television, or any consumer electronic device or digital platform, in general. The host user interface need not provide a display and can be much more minimal than the keyboard and mouse shown in Fig. 14. A preferred embodiment of the invention uses a Universal Synchronous Bus (USB) connection but any type of connection such as IEEE 1394 (FireWire), Ethernet, Serial Port, etc. can be used. A wireless (i.e., optical or radio frequency) connection can be used.

Once device 300 is coupled to host system 302, a user of host system 302 can launch a bridge interface to allow for the transfer of files between device 300 and host system 302. In a preferred embodiment, once the bridge interface is launched, the controls of device 300 are inoperable. The user interface of host system 302 is used to operate the bridge interface to transfer files.

The invention has now been described with reference to the preferred embodiments. Alternatives and substitutions will now be apparent to persons of skill in the art.

WHAT IS CLAIMED IS:

PATENT
Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

ABSTRACT OF THE DISCLOSURE

A method, performed by software executing on the processor of a portable music playback device, that automatically files tracks according to hierarchical structure of categories to organize tracks in a logical order. A user interface is utilized to change the hierarchy, view track names, and select tracks for playback or other operations. The user interface uses an overlapping hierarchy of categories. A song title can be accessed in multiple different ways by starting with different categories. A preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Navigation is performed by presenting a sequence of display screens for each level of the hierarchy.

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PATENT
Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

Do not Enter Drawings will Filed Formally separately.

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to Application No. 09/755,629, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," now abandoned ~~(Atty. Docket No. 17002-020800)~~; and Application No. 09/755,367, entitled "Audioplayback Device with Power Savings Storage Access Mode," issued as U.S. Patent No. 6,590,730 ~~(Atty. Docket No. 17002-022400)~~, all filed January 5, 2001, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Today, portable consumer electronic devices are more powerful than ever. For example, small, portable music playback devices can store hundreds, even thousands, of compressed songs and can play back the songs at high quality. With the capacity for so many songs, a playback device can store many songs from different albums, artists, styles of music, etc.

Music jukeboxes implemented in software executed by a digital computer and portable MP3 and CD players both provide facilities for forming playlists. For example, the **OOZIC** player, distributed by the assignee of the present application, runs on a host PC and has a playlist feature that allows selection of tracks from the PC's hard disk to be included in the playlist.

As storage capacity increases and songs are compressed to shorter file lengths the number of songs that can be stored increases rapidly. Major problems facing the consumer are organizing and accessing the tracks.

Typically, portable devices have a user interface including a small screen and buttons. Such a display screen might be, e.g., 1" x 2". This small display size is necessary because of the physical size of the device which is typically carried in the hand. The small size also limits the number, size, shape, and types of user input controls that can be mounted on the

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device. For example, a few pushbuttons are usually provided to perform all of the device's control functions. Using such a compact user interface to navigate and select among hundreds of songs is inefficient and often frustrating. The display screen can only show a few song titles at one time, and the limited controls make it difficult for a user to arbitrarily select, or move among, the songs.

The creation of playlists is one technique to organize the playing of songs. A set of songs can be included in a playlist which is given a name and stored. When the playlist is accessed, the set of songs can be played utilizing various formats such as sequential play or shuffle.

However, the creation of playlists itself becomes problematic as the number of songs increases, since the user often arbitrarily selects songs from a large number of tracks to form a playlist. This selection mechanism: can be fairly tedious; does not necessarily produce playlists that are of interest to the user over the course of time; may not remain up-to-date if new songs are added that logically fit into a previously created playlist (e.g. "Favorites by Band X" might become out of date if a new favorite by Band X is added after the playlist was created); and leads to "lost" songs that are not members of any playlist.

Accordingly, improved techniques for organizing and grouping tracks useful in a portable music player are needed. Further, it is desirable to provide a user interface suitable for a small device. The user interface should allow a user to efficiently navigate among, and select from, many items stored in the device.

SUMMARY OF THE INVENTION

The present invention provides an efficient user interface for a small portable music player. The invention is suitable for use with a limited display area and small number of controls to allow a user to efficiently and intuitively navigate among, and select, songs to be played. By using the invention, very large numbers of songs can be easily accessed and played.

One aspect of the invention includes an overlapping hierarchy of categories. Categories include items that can also be included in other categories so that the categories "overlap" with each other. Thus, a song title can be accessed in multiple different ways by starting with different categories. For example, a preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Similarly, the Artists category includes names of artists which are, in turn, associated with their albums and songs. The Genre category includes types of categories of music such as "Rock", "Hip Hop", "Rap", "Easy Listening", etc. Within these sub-categories are found associated songs. Finally, the "Play Lists" category includes collections of albums and/or songs which are typically defined by the user.

Advantageous use is made of the overlapping hierarchy to allow the user to quickly designate a song for playback. The device uses three "soft" pushbuttons that have assignable functions. The interface maintains consistent button functionality whenever possible and uses uniform command names and operations on different types of items so that the interface is more intuitive. For example, the user can open and queue both albums and songs with predictable results.

The interface also provides for multiple functions for a single control. For example, a "Play" button can act, in a first function, to play a currently-selected song. The Play button can act, in a second function, to cycle through different playback modes. The modes can be, e.g., (1) playback of songs from a hard disk; (2) playback of music from a radio receiver built into the device; and (3) playback of voice messages. The first function for the Play button can be activated by momentarily depressing the Play button for a short period of time. The second function is invoked by depressing the Play button for a longer period of time whereupon the device cycles through the different modes. Other ways of invoking the functions are possible such as where the second function is automatically entered from a powered-down state.

In one embodiment, the invention provides a method for selecting songs to be played in an electronic audio device, wherein the device includes a display and one or more user input controls, wherein songs are organized into categories, albums, wherein songs and albums are associated with artist names. The method includes steps of displaying categories on the display; accepting signals from a user input control to select a category; displaying one or more songs in the selected category on the display; accepting signals from a user input control to select a displayed song; and entering selected songs into a playlist queue, wherein the device plays back songs in the playlist queue.

According to one aspect of the present invention, a technique is provided for organizing tracks on a portable music player by automatically filing tracks in a hierarchical order based on attributes of the tracks.

According to another aspect of the invention, metadata is associated with each track that is used to automatically define the track's appropriate place in the hierarchy.

According to another aspect of the invention, the hierarchy is displayed on the portable music player so that a user can traverse the organizational hierarchy to find individual tracks or find playlists composed of logical groups of tracks.

According to another aspect of the invention, the hierarchy is derived by using metadata associated with the audio content that was obtained through any source of metadata (e.g. CDDB metadata, id3v2 metadata, other obtainable metadata) and subsequently stored with or alongside the file that stores the track.

According to another aspect of the invention, a file is formatted so that an unaltered track is stored as file data and information about the track is stored in file attribute files.

Other features and advantages of the invention will be apparent in view of the following detailed description and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a tree structure for hierarchical filing of tracks;

Fig. 2 is a definition file that specifies the hierarchy depicted in Fig. 1;

Fig. 3 is a user's view of the hierarchy;

Fig. 4 is a schematic diagram of a user interface displaying the hierarchical category structure;

Fig. 5 is a diagram of a file format for storing filed data and file attributes;

Fig. 6 is a flow chart depicting steps for filing tracks according to the hierarchical tree structure;

Fig. 7 depicts a tree resulting from searching the tracks; ~~and~~

Fig. 8 depicts a format for a user interface[[.]];

<u>Fig. 9 illustrates the NOMAD Jukebox and its user interface controls;</u>

Fig. 10 illustrates a sequence of display screens describing how to navigate to lower levels;

Fig. 11 illustrates associations among items;

Fig. 12 shows display screens used to search for a song or other item;

Fig. 13 illustrates details of different items; and

Fig. 14 illustrates a playback device coupled to a host computer system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the invention will now be described in the context of a portable personal player that plays audio files stored in memory. The files may be in MP3, wav. or other digital formats.

In the presently described embodiment, users are able to see the tracks on their player in some organized fashion other than as a single list of tracks. As will be described in more detail below, in one embodiment tracks are sorted utilizing a tree structure having branches labeled according to types of metadata associated with the tracks

For example, a track recorded as "Golden Slumbers" by the Beatles that appears on their album "Hey Jude" might appear as a track under the album "Abbey Road" as well as a track under the list of tracks by the Beatles. It might appear as a track under the genre "Pop Rock" as well as "Songs from the 60's." Furthermore, the organization can have more complex hierarchies. For example, the category of "Pop Rock" might contain subcategories "British Musicians," "American Musicians" and "Other Musicians". In all cases, the track is automatically filed into all appropriate locations without requiring user interaction.

In the currently defined embodiment, a tree structure is defined by a file having the following structure.

The first line of a TreeDef.inf file contains a version number:

V1.0

Each subsequent line (at least in v1.0) contains lines of the following format:

CATEGORY_NAME|TRACK_TYPE_MASK|CATEGORY_STRUCTURE

CATEGORY_NAMEs are the top-level names of the branch under which tracks are sorted. They include things like "Album," "Artist," "Voice Tracks," "All Tracks," etc.

TRACK_TYPE_MASKs tell which types of tracks are to be filed under this particular branch. The actual value is a hexadecimal numerical value (in '0x' format, e.g. 0x01) generated by ORing the following flags together as appropriate:

```
enum tTrackType
{
      kTTNothing=0x00,
```

```
kTTSong=0x01,
kTTVoice=0x02,
kTTBook=0x04,
kTTMacro=0x08,
kTTPlaylist=0x10
};
```

So, for example, the "Album" branch has a TRACK_TYPE_MASK of kTTSong, because only songs are filed under that branch, but the "All Tracks" branch has a TRACK_TYPE_MASK of (kTTSong | kTTVoice | kTTBook).

Other elements might be added to tTrackType (e.g. kTTVideo) as appropriate.

CATEGORY_STRUCTUREs tell how to file the songs based on their metadata information. The CATEGORY_STRUCTURE is a string of characters that tell, from left to right, the order of hierarchy. The characters come from the following enum constants:

```
enum tFileTag
{
    kFTNone='@',
    kFTTrackType='T',
    kFTTitle='N',
    kFTAudioFile='F',
    kFTArtist='M',
    kFTAlbum='L',
    kFTGenre='G',
    kFTSource='S',
    kFTYear='Y',
    kFTArtistCountry='C'
};
```

Thus, a CATEGORY_STRUCTURE of LN tells to create a subcategory that is a list of Albums, each of which contains a list of Tracks.

In total, a line like:

Album|0x01|LN

Says to create a branch called "Album" which contains tracks of type kTTSong organized first by album name, and then by track name.

The following is an example of a tree definition file similar (though not identical) to the hierarchy presented in the Nomad Jukebox product (the 'B' before each FileTag was used to identify that these are basic tags so that we wouldn't run out of letters in the alphabet as we included more complex metadata – thus each group of two letters represents a level in the hierarchy):

V1.0
Album|0x01|BLBN
Artist|0x01|BMBN
Genre|0x01|BGBN
Voice Tracks|0x02|BSBGBN
Playlists|0x10|BN
Macros|0x08|BN
All Tracks|0x07|BN

Fig. 1 depicts a hypothetical organization hierarchy. The tree shows how tracks might be listed (as leaves in the tree) after having been organized. Example values for nodes in the tree are shown as well. The same track may appear more than once as a leaf in the tree, as described above, if it fits into multiple categories (e.g. a song that appears on the Abbey Road branch would also appear in the Beatles branch). In the example shown, the first branch contains tracks organized by album. As shown in the example, this music collection contains three tracks from "Abbey Road" and three tracks from "Hits from the 60's". The second branch contains tracks organized by artist, and sub organized by where the artist is from. Thus, a user browsing would first select the "Artists" branch and then choose between "British Artists" and "American Artists". Finally, they would select the particular artist. In the third branch, all tracks are shown.

The tree definition file that would specify the hierarchy shown in Figure 1 is shown in Figure 2.

The first line identifies the version of the tree definition file.

The second line defines the "Albums" branch. The first part of the line, "Albums" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BLBN," defines that the branch lists first the names of all albums (BL) and then tracks on those albums (BN).

The third line defines the "Artists" branch. The first part of the line "Artists" defines the name of the branch. The second part, "0x01," defines that all musical tracks should be categorized on this branch. The third part, "BCBMBN," defines that the branch lists first the names of all countries where artists in this collection come from (BC) and under those items, the artists' names (BM), and then tracks by those artists (BN).

Fig. 3 shows what a user's view of this hierarchy might be if he/she were shown a fully expanded view of the 6-song tree. Notice that each song appears three times, once in each branch.

In consumer products the tree define file is not edited directly but through a user interface, one example of which is depicted in Fig. 4. An example of a user interface for viewing songs by category and editing the tree structure is depicted in Fig. 4.

An embodiment of the invention is utilized in the Nomad® Jukebox, manufactured by the assignee of the present invention, and described more fully in the copending application, filed on the same date as the present application, entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," (Attny. Docket No. 17002-020800).

In a preferred embodiment, metadata is associated with each track and includes such information as title, genre, artist name, type, etc. In the preferred embodiment, software stored in a portable player and executed by the onboard processor automatically files each track in the correct category utilizing the associated metadata and the tree define file. The program code can be stored in any computer readable medium including magnetic storage, CD ROM, optical media, or digital data encoded on an electromagnetic signal.

Thus, the user is automatically provided with a powerful and flexible tool for organizing and categorizing the tracks stored on the portable player.

If the tracks are formatted in MP3 format the metadata can be stored in ID3 tags included in the MP3 file. In one embodiment of the invention, the tracks are stored in alternate file format including file data and file attributes. The file data is the music track itself and the file attributes part of the file includes fields of arbitrary size which are used to store metadata characterizing the track stored as the file data. Again this metadata includes information about the track such as title, genre, artist name, type, etc.

There are several advantages to using the alternate file format. Metadata of types not easily included in an ID3 tag can be utilized. Further, the original track format is not changed, so that error correction data such as checksums are valid. Finally, any file format can be used (e.g. WAV, WMA, etc.) because the metadata is stored separately, and thus audio formats that have limited support for metadata can still be stored on the portable player in native format without transcoding. The formatted files are formed by software stored in the portable music player and executed by an on-board processor.

The metadata for each track is utilized to file each track, using the categories defined in the hierarchical structure as described above, without any input from the user.

Fig. 5 is a schematic diagram of the alternative file format including file data in the form of an MP3 track, and metadata fields for holding data indicating the name of the album the track is from, the name of the song, the genre of the song, and the type of track.

A particular embodiment of a file format will now be described. All tracks are created with some set of attributes as shown below:

Definition of TrackInfo Data Field

Field	Offset	Size	Description
Attribute Count	0	2	The number of attribute follow for the track
Attr 1 type	2	2	Binary = 0, ASCII = 1
Attr 1 name len	4	2	Length of attribute name string
Attr1 data len	6	4	Length of attribute data
Attr1 Name	10	N	Attribute name string
Attr 1 Data	10+N	M	Attribute data
....			

....			
Attr N type			
Attr 1 name len			
Attr1 data len			
Attr1 Name			
Attr 1 Data			

Required Attributes

Attribute Name	Value(s)	Remarks
TITLE	ASCII string	Required By Jukebox
CODEC	"MP3", "WMA", "WAV"	Required By Jukebox
TRACK ID	DWORD	Set By Jukebox
ALBUM	ASCII string	Optional
ARTIST	ASCII string	Optional
GENRE	ASCII string	Optional
LENGTH	In seconds	Optional
TRACK SIZE	In bytes	Optional
TRACK NUM	1-n (track within album)	Optional

These attributes can be subsequently changeable via a host application, running on a personal computer connected to the portable music player.

Fig. 6 shows a flow chart of an embodiment the process used to build the hierarchical database of tracks. It starts by iterating through each track, and, for each track, iterating through each branch to find if the track belongs on the branch, and, if so, where. In this case, the term track could refer to any content, e.g. a music track, a spoken word track, or even a video track.

Also, the hierarchical catalog of tracks can be used to form playlists in a structured manner. For example, if a user wants to hear Jazz and Blues the entire sub-categories can be selected to form one playlist.

An alternative hierarchical catalog generation technique will now be described. In this alternative embodiment, at system startup and as tracks are added or changed, the hierarchy is generated as an in-memory tree structure. Each track is added to the tree using the categories ALBUM, ARTIST and GENRE.

The following example shows the algorithm for adding a track. For clarity, only the attributes used by the tree are shown.

TITLE	"Free Falling"
ALBUM	"Full Moon Fever"
ARTIST	"Tom Petty"
GENRE	"Rock"
TRACK NUM	1

The following function is executed to build the in-memory memory tree.

```
Build Tree ()
For each track,
        Add Track To Category(Album, Track)
        Add Track To Category(Artist, Track)
        Add Track To Category(Genre,Track)
End of Build Tree
```

Fig. 7 depicts a tree which could result from implementing Build Tree() function. Note that "Stardust" does not have any entries for Album or Artist. The host software running on a computer connected to the portable music player could be utilized to add missing attributes to the "Stardust" track and, optionally, edit the title attribute. The Build Tree() function would then reinsert this track in the correct location in the tree.

Fig. 8 is an embodiment of a user interface according to another embodiment of the invention. In this example the root node is labeled "My Configuration" and the Playlist category has been selected and the Playlist subcategory "Meddle" has been selected. Note that the types of Metadata, in this example, Track Name, Artist, Album, Tempo and Dance, are listed across the top of the screen, and the attribute values for each track are listed in a row across the screen. Various control buttons are displayed to the right of configuration window that facilitate quickly invoking selected processing on a selected track.

As noted above, a preferred embodiment of the present invention is incorporated into a product manufactured and distributed by Creative Technology, Ltd. The product is called the "NOMAD Jukebox." The following description describes further details of the display screens and interface controls.

Fig. 9 illustrates the NOMAD Jukebox and its user interface controls.

In Fig. 9, electronic audio device 100 measures about 5.5" wide by 5.5" tall by 1" thick. Display screen 102 is about 2" wide by 1" tall. Display screen 102 includes different regions such as main region 104 and soft button function description region 106.

Three soft buttons are located at 108; including buttons 110, 112 and 114. The specific command, or function, that any of the soft buttons perform when depressed is indicated by the label in soft button function description region 106. Thus, the function of soft button 112 (as shown in Fig. 9) is "open," the function of soft button 114 is "search" while soft button 110 is currently not assigned a function.

The other eight buttons on device 100 perform essentially the same functions at all times. In other words, they are not subject to function changes according to soft button function description area 106. These buttons include Library button 116, EAX and System button 118, Skip Backward button 120, Play button 122, Stop button 124, Skip Forward button 126, Scroll Up button 128 and Scroll Down button 130. However, as discussed below, these buttons (or any type of controls used with the device) can include alternate functionality that is invoked in different ways.

The device uses visual cues, or indicators, in the display. When an item is highlighted it indicates that the item is the "current" item, or currently-selected item, which is susceptible to be operated on by a subsequent user action – such as playback, or expansion of the item. In Fig. 1, screen 102 shows that the item, "ALBUMS," is highlighted. The highlighted item can be acted upon by using the soft buttons, or another button, as discussed below. The current item can be changed by using Scroll Up button 128 and Scroll Down button 130 to move the highlight up or down, respectively, throughout a list of displayed items.

Icons are used to provide additional visual cues for an item. In Fig. 1, each of the categories has a category icon to the left of it. The category icon, which may not be distinctly visible in the Figure, illustrates a first box connected by lines to additional boxes below the first box. The icon depicts a hierarchy and illustrates the property of categories, i.e., that categories can contain additional categories, songs or other items.

Fig. 10 illustrates a sequence of display screens describing how to navigate to lower levels.

In Fig. 10, library category screen 150 shows the display as it appears when the user depresses library button 116 of Fig. 9. A preferred embodiment of the device uses 4 first-level categories. These are "Albums", "Artists," "Styles" and "Play Lists". Each of these categories can "contain," or be associated with, other categories, songs, or items.

Note that in library category screen 150 ALBUMS is currently highlighted. By depressing soft button 112 of Fig. 9, the "open" command is performed on the highlighted category, as indicated by the labeling of soft button 112 and soft button function description area 152 of Fig. 10.

Lists screen 154 is displayed as a result of a user opening the Albums category of library category screen 150. Lists screen 154 shows items within the Albums category such as commercial albums of multiple songs from a record label, pre-made lists or collections created by a user, or other predefined lists or collections of songs or recordings.

In Fig. 10, lists screen 154 shows each item as a list of songs. This is shown visually by the icon to the left of each item which depicts a miniature list. Possible soft button commands are "Close", "Open" and "Queue". These commands correspond to soft buttons 110, 112 and 114, respectively. If the user selects the Close command, the display reverts to library category screen 150. If the user selects the Open command, the display shows tracks screen 156. Alternatively, the user can select the Queue command to instruct the device to place all the songs from the selected (i.e., highlighted) list into the play list for eventual playback. Yet another option allows the user to press play button 122 of Fig. 9 to cause any currently-selected songs or a list of songs (e.g., an album) to immediately be played.

Returning to Fig. 10, tracks screen 156 shows that a single song called "JukeBox Demo" is in the list. The list is also called JukeBox Demo as shown in lists screen 154. Tracks screen 156 shows possible soft commands assigned to buttons, namely "Close", "Details" and "Queue." The Close button performs the same function as before -- it returns the user to the previous screen which, in this case, is lists screen 154. The user can also select the Details command to cause details of the song JukeBox Demo to be displayed in details screen 158 as shown in Fig. 10. The user can select the Queue command by soft button 114 to enter the selected song into the play list queue. As before, the user can also depress play button 122 of Fig. 9 to cause immediate playback of the selected song.

Details screen 158 shows information about the selected song including the name of the song, album (or list) name containing the song; the track number, if applicable, and track duration. Note that other information can be included. The user can preview the song, close the Details screen to return to the Tracks screen or queue the song on the play list queue.

The device provides the ability to "preview" audio files even while a current song, or playlist, is being played. When a user chooses to preview an audio file, the audio file is played for about 10 seconds while any currently-played file or playlist is suspended. After previewing is complete, the suspended file or playlist resumes playback. In other embodiment, the preview duration can vary, or be stopped by user selection.

Fig. 11 illustrates associations among items.

In Fig. 11, song 168 is one of many songs stored in the device. Categories such as albums 160, artists 162, play lists 164 and genres 166 each include sub-categories. For example, albums 160 includes the names of various albums. Songs are associated with albums, genres and playlists. Such association can be by using pointers, a data structure including items to be associated, etc. "Association" as used herein, includes a first item associated with a second item; and the second item associated with the first item. In other words, albums can be associated with one or more songs in the database of the device so that an automated search to find all songs associated with an album is easier. The direction of arrow pointers in Fig. 11 is not intended to limit the manner of associations among items in the present invention.

Similar to albums, the category of artists 162 includes names of artists, or performers, of songs. Each artist name is associated with one or more songs in the database. Playlists 164 includes names of playlists. These are collections of songs that can be defined by the user, the device manufacturer, or others. Each playlist can be associated with one or more songs. Genres 166 includes various styles of music which are associated with one or more songs in the database. Note that items can exist without being associated with a song. Also, items can be associated with other items as where an artist name is associated with the albums containing the songs that the artist has created.

Although not shown in Fig. 11, items can have additional information, such as properties, details, etc., associated with the item. For example, a song can have information such as play time, artist name, artist album, copyright owner, etc., associated with the song.

Fig. 12 illustrates display screens used to search for a song or other item.

In Fig. 12, screen 180 is the initial library screen, as discussed above. If the user invokes the Search command (via the appropriate soft button) with Albums selected then screen 182 is displayed. Note that the search function can be applied to any of the categories. The user can depress the Plus or Minus soft buttons to cycle through the alphabet and change the character in the current location as indicated by the cursor. The cursor position is changed by using the scroll up/scroll down buttons 128 and 130, respectively, of Fig. 9. As each letter is entered the letters are compared and the nearest match of the stored albums' names is displayed as shown in screen 184. When the desired match is displayed the user selects the Go! command.

Screen 186 shows the result of selecting the Go! command. A list of albums is displayed with the matched album centered and selected. The user can close, open or queue the album as discussed above.

Fig. 13 illustrates details of different items.

In Fig. 13, screen 200 illustrates details displayed as a result of selecting the "Details" command from soft button 1A track is selected. Screen 200 shows that details of the track "Jukebox Demo" shows the name of the album that the track resides on, the creator, or copyright owner, of the track, and the playing time of the track.

Screen 202 illustrates details of an item on the active queue list. Items are placed onto the active queue list by selecting the "Queue" command when an album, song, track, or other item is selected, as discussed above. For example, screen 204 shows the active queuelist where the track "Jukebox Demo" is selected. By invoking the "Details" command screen 202 is brought up to show details of the Jukebox Demo track.

As shown in screen 202, the Detail screen shows what track number the selected track is, which album the track is from; the creator, or copyright owner, of the track, and the title of the track. Additionally, the details for an item on the queue list also show playback settings. These are shown by two-letter abbreviations at the bottom of the screen. The settings are as show in Table I, below.

EA	Environmental Preset
EQ	Parametric EQ
HS	Headphone Spatialization
TS	Time Scaling
4S	Four Channel Speaker Sound (only if speakers are connected)

TABLE I

These settings have their common meanings, as is known in the art. Note that the setting 4S is not shown in screen 202 as it is not currently active.

Fig. 14 illustrates the Nomad Jukebox coupled to a host computer system.

In Fig. 14, device 300 (e.g., the Nomad Jukebox) is coupled to host system 302. In a preferred embodiment host system 302 is a personal computer, such as an IBM-PC compatible computer. Host system 302 includes a user interface having display 304 and user input devices such as keyboard 306 and mouse 308. In other embodiments the host system need not be a full computer system. Any type of processing system having a user interface is possible. For example, it is possible to couple the device to a laptop computer, game console, web-enabled television, or any consumer electronic device or digital platform, in general. The host user interface need not provide a display and can be much more minimal than the keyboard and mouse shown in Fig. 14. A preferred embodiment of the invention uses a Universal Synchronous Bus (USB) connection but any type of connection such as IEEE 1394 (FireWire), Ethernet, Serial Port, etc. can be used. A wireless (i.e., optical or radio frequency) connection can be used.

Once device 300 is coupled to host system 302, a user of host system 302 can launch a bridge interface to allow for the transfer of files between device 300 and host system 302. In a preferred embodiment, once the bridge interface is launched, the controls of device 300 are inoperable. The user interface of host system 302 is used to operate the bridge interface to transfer files.

The invention has now been described with reference to the preferred embodiments. Alternatives and substitutions will now be apparent to persons of skill in the art.

WHAT IS CLAIMED IS:

PATENT
Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

ABSTRACT OF THE DISCLOSURE

A method, performed by software executing on the processor of a portable music playback device, that automatically files tracks according to hierarchical structure of categories to organize tracks in a logical order. A user interface is utilized to change the hierarchy, view track names, and select tracks for playback or other operations. The user interface uses an overlapping hierarchy of categories. A song title can be accessed in multiple different ways by starting with different categories. A preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Navigation is performed by presenting a sequence of display screens for each level of the hierarchy.

SF 1174925 v2

REPLACEMENT SHEET

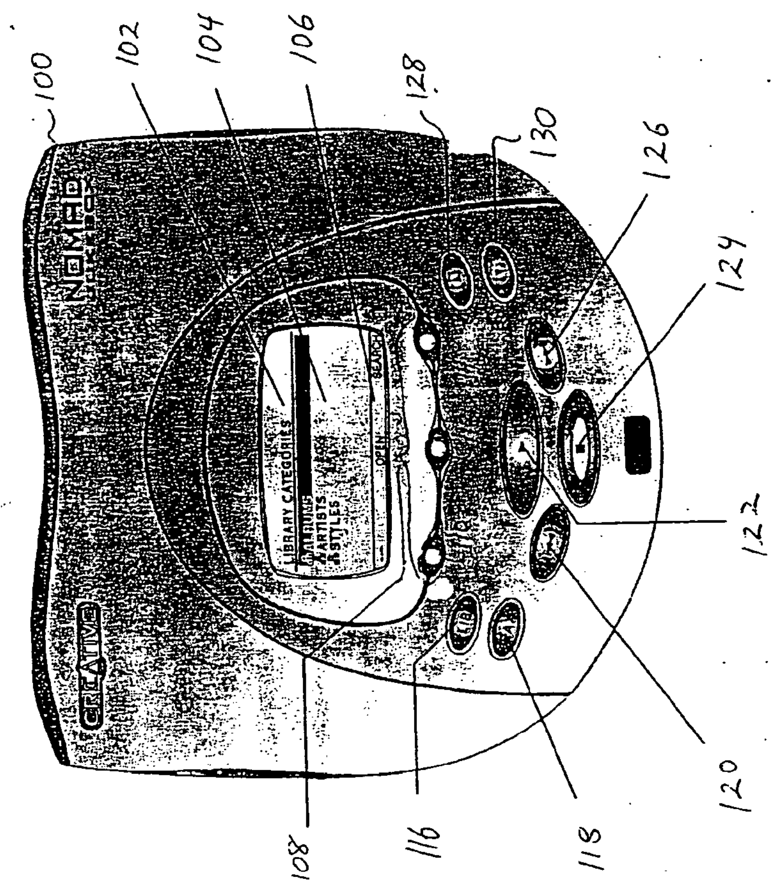
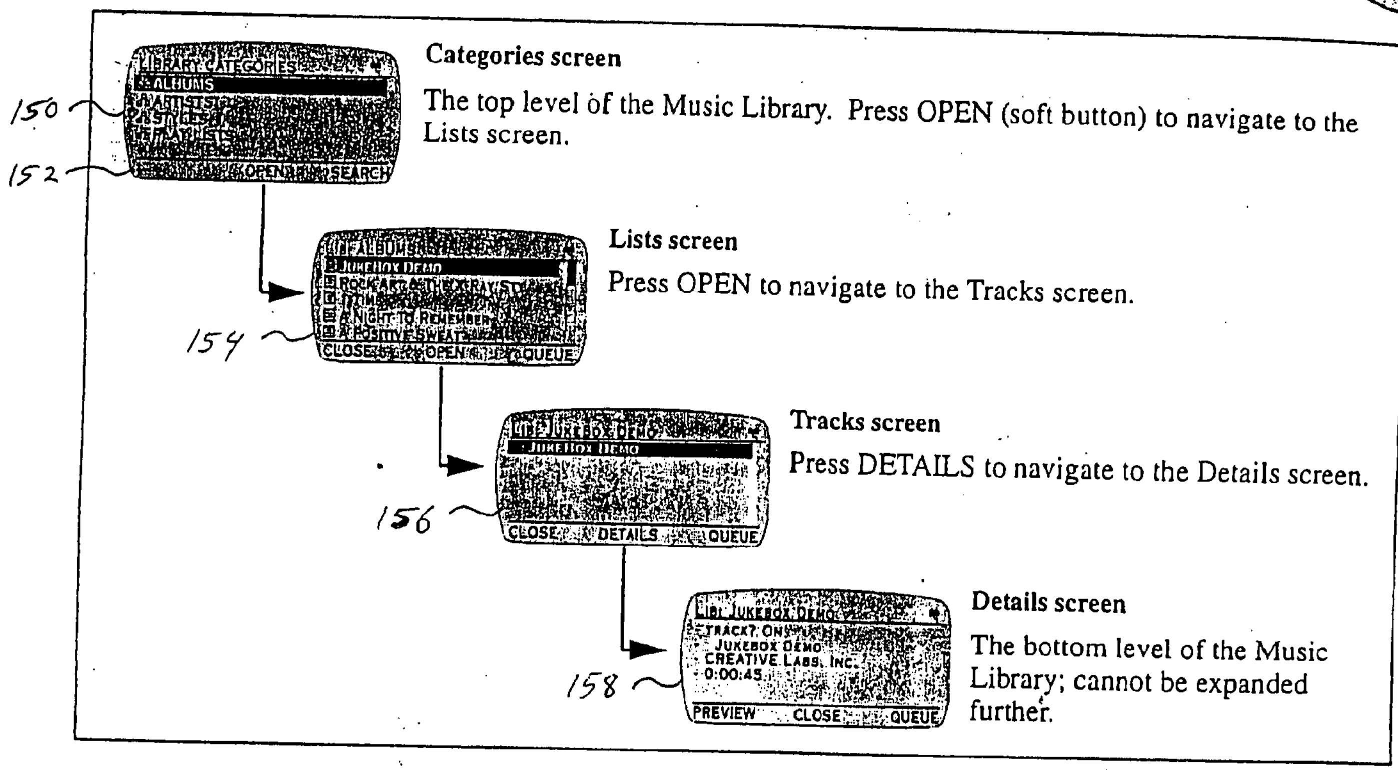


Fig. 9

CL 000208



REPLACEMENT SHEET

Fig. 10

REPLACEMENT SHEET

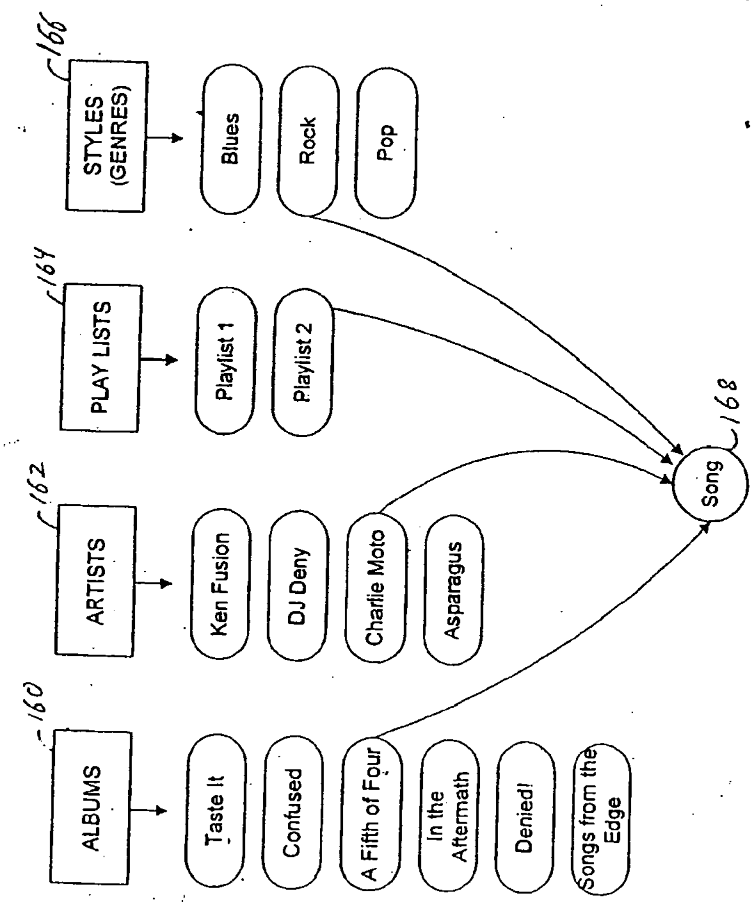


Fig. 11

CL 000210

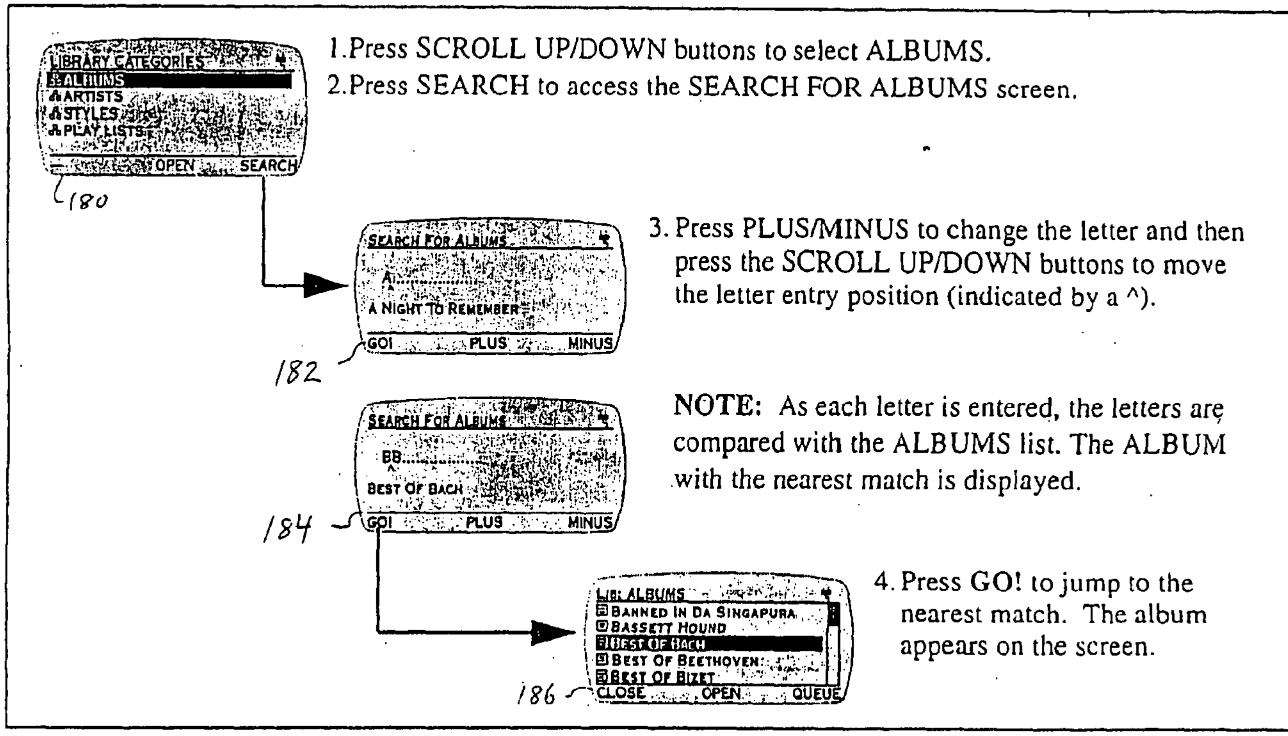
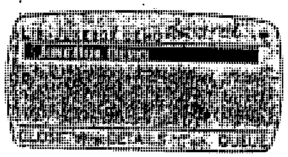


Fig. 12

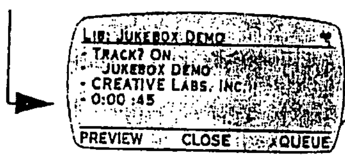
REPLACEMENT SHEET

CL 000211

View DETAILS accessed from the TRACKS screen:



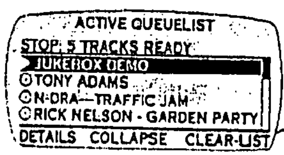
1. Press DETAILS. The DETAILS screen displays the Track Order, Album, Artist, and duration of the track.



200

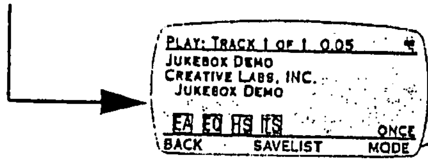
2. Press CLOSE to return to the TRACKS screen.

Viewing DETAILS accessed from the ACTIVE QUEUE LIST screen:



204

1. Press DETAILS. The DETAILS screen displays the Track Title, Artist, and Album together with Audio Playback settings (see note below) and Play Mode (see "Setting Play Mode" on page 16).



202

2. Press BACK to return to the ACTIVE QUEUE LIST screen.

Fig. 13

REPLACEMENT SHEET

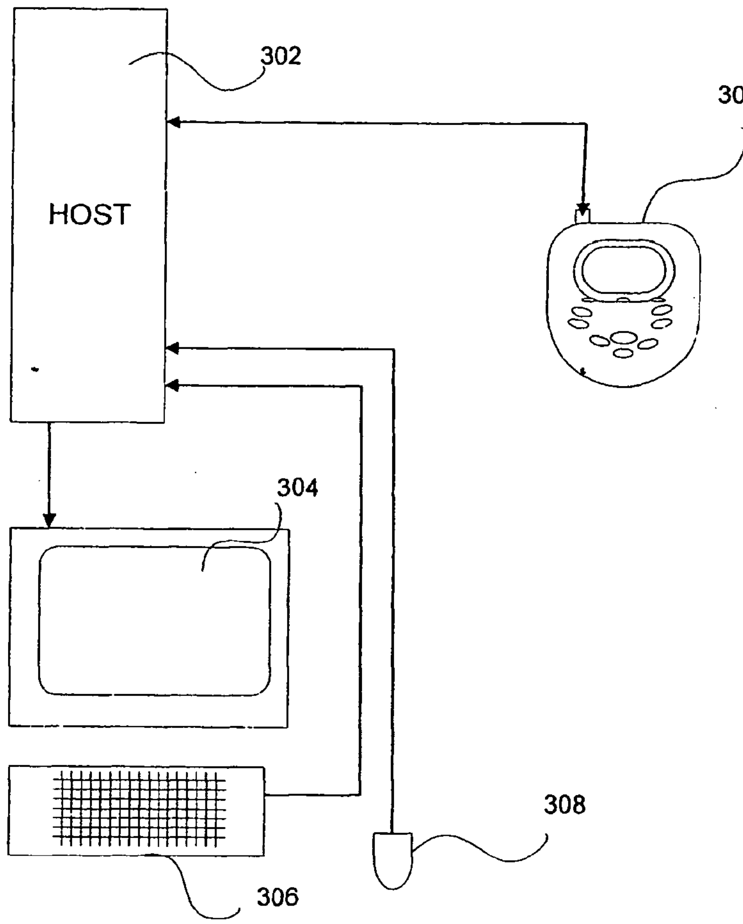


Fig. 14

2178

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TRANSMITTAL FORM

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Application Number	09/755,723
Filing Date	01/05/2001
First Named Inventor	GOODMAN, Ron
Art Unit	2175
Examiner Name	RONES, Charles L.
Attorney Docket Number	6407P212

Total Number of Pages in This Submission: 62

ENCLOSURES (*Check all that apply*)

- [x] Fee Transmittal Form
  - [ ] Fee Attached
- [x] Amendment/Reply
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  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
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Remarks

Items also enclosed:

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Firm or Individual	Russell N. Swerdon Reg. No. 36,943
Signature	Russell N. Swerdon
Date	April 30, 2004

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Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 0

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Application Number	09/755,723
Filing Date	01/05/2001
First Named Inventor	GOODMAN, Ron
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1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

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2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

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Independent Claims		- 3** =	0	x 86	= 0
Multiple Dependent					=

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1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

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FEE CALCULATION (continued)

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1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ______

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Name (Print/Type)	RUSSELL N. SWERDON	Registration No. (Attorney/Agent)	36,943	Telephone	(408)428-6600
Signature	*[signature]*			Date	4-30-2004

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Examiner: RONES, Charles L.
GOODMAN, et al	Art Unit: 2175
Application No.: 09/755,723	
Filed: January 5, 2001	
For: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**	

Commissioner for Patents
PO Box 1450
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Respectfully submitted,

Russell N. Swerdon
Reg. No. 36,943

Date: 4-30-04

Creative Labs, Inc.
1901 McCarthy Blvd.
Milpitas, CA 95035
(408) 428-6600

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Sheet 1 of 2

Complete If Known	
Application Number	09/755,723
Filing Date	01/05/2001
First Named Inventor:	GOODMAN, Ron
Art Unit	2175
Examiner Name	RONES, Charles L.
Attorney Docket Number	6407P212

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
CR	1	US-	6,377,530-B1	04-23-2002	BURROWS	
		US-				
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Complete If Known	
Application Number	09/755,723
Filing Date	01/05/2001
First Named Inventor:	GOODMAN, Ron
Art Unit	2175
Examiner Name	RONES, Charles L.
Attorney Docket Number	6407P212

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
CR	1	Web page, MENTA, RICHARD, "1200 Song MP3 Portable is a Milestone Player," MP3 newswire.net, 01/11/00, 5 pages, http://pjbox.com/newswire/	
CR	2	Web page on "MusicMatch Jukebox 4.0: Screen Shot 1," PC Magazine, June 17, 1999, 2 pages, http://web.archive.org/web/20000226113655/www.zdnet.com/products/stories/reviews/0,4161,2277814,00.html	
CR	3	Web page, NORTON, PATRICK, "MusicMatch Jukebox 4.1, the Ultimate MP3 Utility," techtv, 9/17/1999, 2 pages, http://www.techtv.com/freshgear/print/0,23102,2324631,00.html	
CR	4	Web page on "Can you carry your CD collection in your pocket? Yes, you can." Compaq web site, 3 pages, http://research.compaq.com/SRC/pjb/, printed on April 30, 2004.	
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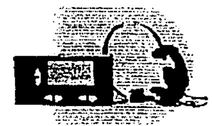
MP3newswire.net

1

1200 Song MP3 Portable is a Milestone Player

By Richard Menta- *01/11/00*



Remote Solutions Personal Jukebox holds 1200 songs in its 4.8G hard drive

Remote Solutions Personal Jukebox is a milestone product. By that we mean any product whose breakthrough innovations are so significant, they influence the future course of its industry. The iMac, which presently has PC manufacturers scrambling to breakout of the beige box routine, is a recent example of a milestone product.

Personal Jukebox raises the bar in several areas and there is no doubt the leaders, in MP3 portables are re-evaluating their future product releases. The most obvious element is Personal Jukebox's huge storage ability.

Up until now, all MP3 portables came with either 32MB or 64MB of memory, capable of holding anywhere of 9 to 20 song files at the standard 128k compression. This is the most limiting factor of MP3 players (many manufacturers advertise player capacity using songs compressed at a lower quality 56k setting. This stretches the limit of 64MB units to two hours), but promises of 300MB units using expensive flash memory or IBM's pricey, but tiny, micro drive litter manufacturer press releases.

The Personal Jukebox uses a 4.8G laptop hard drive, larger than the IBM's but far cheaper per MB of storage. This translates to a whopping 81 hours of music or 1200 songs and that is measured using the the higher 128k compression.

Think about this for a second. Right now, the largest capacity flash memory on the market is a 224MB CompactFlash card which Delkin started shipping Dec 99. The only player using that particular card to date is the RCA Lyra. The cost of the 224MB card is a very steep $800. Add to that the $200 cost of the Lyra costs and your up to $1,000. The Personal Jukebox offers more that

CL 000220

20 times that capacity and does it for $799.

And that is another area where the Personal Jukebox will affect the industry - price. Think about S3's (formerly Diamond's) Rio. The next generation of players is to include a unit using IBM's 300+MB micro drive. While this drive obviously has a size and weight advantage over the Jukebox's, how much can they actually sell it for now that its MP3 capacity, in a span of a few months, has gone from huge to modest. The player hasn't even come out yet! Indeed, these new Rio's may possibly be scrapped because market forces might not allow them to sell at prices that would cover the costs of those expensive micro drives.

The good news for consumers is that Remote Solution has provided shoppers with a choice. A choice that puts pressure on the companies supplying the storage cards and micro drives to drop prices, less they watch the MP3 portable industry shift to laptop drives - a seasoned, and far more competitive, arena.

The Hardware

The Personal Jukebox is a large an heavy unit for an MP3 player, closer in size and weight to a portable CD player. That's still a pretty reasonable size, especially since you can tote far more music along. It may not be the first choice of joggers for whom the smaller the better, but everywhere else it was a blessing

Real Jukebox uses a rechargeable Lithium Ion battery which give the unit a very long life considering the power needs of the hard drive, about 10 hours. This battery is another feature that makes this unit a candidate for milestone kudos. The battery charges inside the unit which comes with a power adapter.

The unit, which comes with both a cassette and cigarette lighter adapter, was ideally suited for the car. We didn't even bother to use the lighter adapter, we just attached the cassette adapter, popped it in the cassette bay of our radio, closed the player in the glove compartment, and ran tunes the whole day on just the battery. No CD changer in the trunk, no miles of speaker wire to lay.

We also hooked our player up to the stereo system. At this point we had a dozen CD's worth of music and if the Personal Jukebox seems big when compared to other MP3 portables, it is sleek and petite when compared to the bulky 100 CD carousels that equals it's music capacity.

Getting started: A

The unit includes Jukebox Manager, an intuitive drag-and-drop interface that easily allowed us to rip and download files to the player. We had no problem loading the software to our PC. A key (and another milestone) feature is the user has the ability to rip and encode MP3 files directly to the players hard drive, bypassing the need to load these files on your computers hard drive first. This is a major convenience in both time and system space.

The player connects to your PC through a USB cable, the only way to go when you have the power to download hundreds of megs of MP3 files in a shot. Downloads were quick and simple.

Controls: A

Big and easy. The unit doesn't have some of the nice features in other units, like the ability to scan within a song, but it did the job well and that is what's most important. The controls were precise and effective.

The Display: A

Excellent. The display on the Personal Jukebox is twice the size of the nearest competitor and they put it to good use. The unit shows no less than six categories of information simultaneously, avoiding the need to navigate through various sub-menus to display the info you need. This includes CD and folder titles (the player can separate music by genre or album title) track name, tone and bass settings, battery consumption, volume, bit rate of the music, a counter, and more.

While the unit does not come with a backlight, the letters were big and clear and were very readable in all but the lowest light conditions.

Sound: A

Again, excellent.

The Personal Jukebox comes with a fine set of Koss headphones. Some may choose to go with low profile earbuds - the Sennheiser MX-4 earbuds are our recommendation - but there was no need to upgrade for the sound quality, the Koss's did the job well

Conclusion

The reason MP3 player's will eventually send the cassette the way of the 8 track is convenience and the ability to store large amounts of music without taking up physical space. The biggest complaint of 32MB and 64MB portables is that they simply are not there yet, requiring you to constantly run back to your PC to swap music. The Personal Jukebox IS there right now as Jukebox owners can hold most (if not their entire) CD library, leveraging the advantages of the format today.

The industry seemed ready to bring larger capacity units by 64MB increments, thereby using capacity as a continual upgrading point, similar to how PC's use chip speed to get you to upgrade your system every few years. Personal Jukebox jumped over all that malarchy and now stands alone as the pre-eminent machine. The $799 pricetag should cause ripples in an industry that would have today priced this much capacity in the thousands.

The unit is not a perfect instrument. It's a tad heavy for the exercise minded, you can feel the hard drive mildly vibrate when it changes tunes, it doesn't have some useful scan and backlight features. So what? We'll take four-and-a-half gigs of extra space over a backlight anyday. In other words, the advantages this portable offers far outbalances the couple of minor niceties it may be missing. This unit is more expensive than the $150-$200 portables on the market, but it offers far more bang to the buck.

BUT - and this is important - this does NOT mean that every other portable on the market is ready for the dustbin. The reason is the memory expansion slots most have, the saving grace of the industry. Right now a 32MB flash card sells for about $100, quite a bit of money. Those prices will go down!

As mentioned above, what makes the Personal Jukebox so significant to the industry is that it pressures memory manufacturers to drop those prices quicker. In a couple of years, 32MB cards will sell for around five bucks and 300 MB cards will sell for about $50. At those prices, these flash cards will essentially become the new cassettes. Heck, we might be able to buy them pre-programmed with music from the record store like any other album (the Rio people saw this early and added sleeves to the carrying case of the Rio 500 that holds 8 flash cards).

When that happens, users will get that bang for the buck, even on units that already been on the market for a year. They also get the size and weight advantages not offered by the large Remote Solutions machine.

Bottom line, not everyone has $800 to spend right now for the Personal Jukebox. For a fraction of that cost, the better of the 64MB players like the Rio 500 and the RaveMP can do just fine till memory card prices drop. Hopefully that will be sooner rather than later.

Final Score: A+ (a Milestone Player)

Order The New Rio PMP 500 from Amazon for $289.

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MP3 newswire
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MP3 MUSIC
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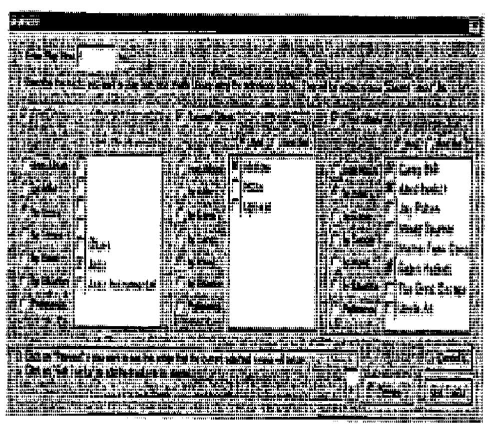
PC MAGAZINE

MusicMatch Jukebox 4.0: Screen Shot 1

From PC Magazine
June 17, 1999



Jukebox's AutoDJ function lets you select songs by general categories to fill large blocks of listening time easily.

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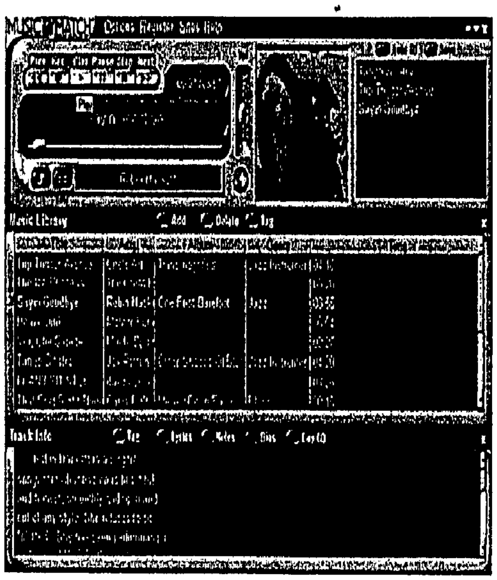
MusicMatch Jukebox 4.0: Screen Shot 2

From PC Magazine

June 17, 1999



Via support for ID3v2, Jukebox lets you add graphics or text to your encoded music and view the information included on MP3 files downloaded from the Internet.

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techtv [redacted]

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MusicMatch Jukebox 4.1, the Ultimate MP3 Utility

★★★★★

By Patrick Norton

Before RealJukebox jumped into the MP3 scene this summer, MusicMatch's Jukebox was the first such product. The latest version of MusicMatch Jukebox, 4.1 delivers nifty database and playlist tweaks, a graphic equalizer, and settings to help record from analog sources. As far as we're concerned, MusicMatch Jukebox (free to download, $29.99 for high bit encoding), is the best MP3 tool out there for managing, playing, and creating MP3 audio files.

MusicMatch divvies the Jukebox interface across four windows: one each for the player, library, recorder, and track information such as title or cover information from the CDDB database. The latter info automatically gets downloaded if your system has a connection to the Net. All we did was drop in a CD, check the songs we wanted to encode, and hit the start button. MusicMatch then plays and records the songs in real time. Unfortunately, this product doesn't offer RealJukebox's speedy "read-ahead" encoding.

Both MusicMatch Jukebox and RealJukebox use our favorite encoder: Xing Technologies. In blind testing, we couldn't tell the difference between MP3s encoded (or played back) over either app. Both sounded as good as MP3 gets. Jukebox's AutoDJ, which maps types of music to a specific program time gives it a lead over RealJukebox. We also found its interface more intuitive.

Summary, Pros, Cons

Summary: MusicMatch Jukebox 4.1 delivers the best MP3 utility for encoding, organizing, and playing back, at least for our dollar.

Pros: Solid interface, Xing encoder delivers great audio quality; nifty AutoDJ settings.

Cons: $29.99 upgrade if you want the best encoding; doesn't offer RealJukebox's speed in encoding.

Company: MusicMatch Inc.
Phone: 619.385.8360
Price: Free; $22.99 for high quality encoding
Available: Now
Category: MP3, Audio
Platform: Windows 95, 98, NT 4.0
Specs: NA
Requirements: Pentium/166 or better PC; 16MB RAM (32MB for Windows NT); 30MB hard disk space; sound card; speakers

Originally posted September 17, 1999

Return to Regular View

(4)

Can you carry your CD collection in your pocket? Yes, you can.

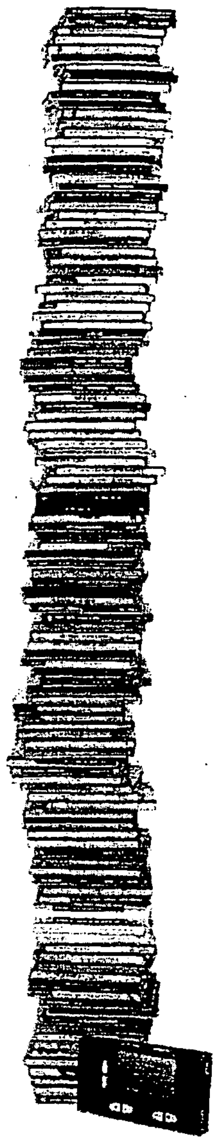
The **Personal Jukebox**, or PJB, was created as a prototype personal audio appliance by Compaq's Systems Research Center (SRC) and Palo Alto Advanced Development group (PAAD). The PJB project started in May 1998, and the PJB-100 product shipped in November 1999.

The PJB is a portable music player built around a small disk drive. A 30 GByte PJB will hold 550 hours of CD-quality audio. The battery lasts 10 to 11 hours on a single charge. The player weighs 9.5 ounces and can fit your jacket pocket. The audio quality is generally regarded as excellent, and the user interface is remarkably easy to learn and use. A 20 GByte PJB currently sells for around $550; the 6 GByte version is under $500.

Stereo Review's *Sound & Vision* magazine said:

> *In my 20 years of covering audio and video equipment, I can count on the fingers of one hand those products that gave me a spine-tingling "this changes everything" feeling. Now I can add the PJB-100 to the list.*

The PJB is being shipped as a product by our partner, HanGo Electronics (dba Remote Solutions). You can see their product specifications on their web site. You can also read several product reviews.



You can try out our Java emulation of the PJB User Interface. Or, of course, you could just buy a real one: try Hammacher-Schlemmer (U.S. mail and web order catalog), MP3FactoryDirect (U.S. distributor), or Uhu (European distributor).

For a slightly more detailed description of the PJB, see our PowerPoint presentation about it.

For information about the research project that created the PJB, please contact Andrew Birrell, Dave Redell, or Ted Wobber.

Opening up the covers, you'll find that the PJB is a fairly powerful special-purpose computer. It contains a Motorola 56309 digital signal processor (DSP), a 6.5 GByte hard disk, 12 MB of memory, 1 MB of flash memory, a USB port, a high quality digital-to-analog converter, and a small LCD display. We currently use MPEG-2 layer-3 encoding technology (MP3) from Fraunhofer IIS to store compressed CD-quality digital audio on the hard disk. This results in a 11:1 size reduction over raw digital audio with little noticeable difference in sound quality (even when you play it over your home stereo). Because the PJB uses flash ROM and a general-purpose DSP, it's quite easy to upgrade it to use other compression algorithms, or even to use different algorithms for different tracks.

You download music into a PJB using a PC program called the Jukebox Manager. This program communicates with the PJB using a proprietary RPC protocol over the USB. It reads digital audio from a CD in a local CD-ROM drive, compresses the bit stream, and stores the result on the PJB hard disk.

The Jukebox manager can also copy MP3 files from your PC into your PJB. The Jukebox Manager creates and manages a hierarchical table-of-contents (TOC), stored on the PJB, that makes it easy to find material in the PJB. The manager makes use of the Internet CDDB database to attach names to sets (categories), disks and tracks. Using the Jukebox Manager, it's easy to create personal playlists, to adjust the set/disk/track names to suit your personal tastes, and to move or copy items around within a TOC.

COMPAQ

Notice of Allowability	Application No.	Applicant(s)
	09/755,723	GOODMAN ET AL.
	Examiner	Art Unit
	Charles L. Rones	2175

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendment filed May 4, 2004.
2. ☒ The allowed claim(s) is/are 24-36.
3. ☒ The drawings filed on 05 January 2001 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____.
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 19
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Charles Rones

Charles L. Rones
Primary Exam'
Art Unit: 2175

CL 000234

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

08791 7590 06/09/2004

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER	
RONES, CHARLES	
ART UNIT	PAPER NUMBER
2175	10

DATE MAILED: 06/09/2004

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

TITLE OF INVENTION: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	09/09/2004

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status is changed, pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above and notify the United States Patent and Trademark Office of the change in status, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

☐ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

CL 000235

PTOL-85 (Rev. 11/03) Approved for use through 04/30/2004.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail — Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

or Fax (703) 746-4000

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

08791 7590 06/09/2004

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12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

TITLE OF INVENTION: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	09/09/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
RONES, CHARLES	2175	707-104100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1________________

2________________

3________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ individual ☐ corporation or other private group entity ☐ government

4a. The following fee(s) are enclosed:

- ☐ Issue Fee
- ☐ Publication Fee
- ☐ Advance Order - # of Copies __________

4b. Payment of Fee(s):

- ☐ A check in the amount of the fee(s) is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number __________ (enclose an extra copy of this form).

Director for Patents is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.

(Authorized Signature) (Date)

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Alexandria, Virginia 22313-1450.

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CL 000236

TRANSMIT THIS FORM WITH FEE(S)

PTOL-85 (Rev. 11/03) Approved for use through 04/30/2004. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

03791 7590 06/09/2004

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER	
RONES, CHARLES	
ART UNIT	**PAPER NUMBER**
2175	

DATE MAILED: 06/09/2004

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 303 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 303 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) system (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

B/93 2175 RH
#21
8-16-04
TC

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JUL 12 2004
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PTO/SB/82 (09-03)
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REVOCATION OF POWER OF ATTORNEY WITH NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	09/755,723
Filing Date	1/5/2001
First Named Inventor	GOODMAN et al.
Art Unit	2175
Examiner Name	Rones, Charles
Attorney Docket Number	6407P212

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint the practitioners associated with the Customer Number: 40032

☒ Please change the correspondence address for the above-identified application to:

☒ The address associated with Customer Number: 40032

OR

☐ Firm *or* Individual Name					
Address					
Address					
City		State		Zip	
Country					
Telephone		Fax			

I am the:

☐ Applicant/Inventor.

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Name	Chon Hock Leow		
Signature	[signature]		
Date	7/6/04	Telephone	(408) 428-6600

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

CL 000238

JUL 1 2 2004 PATENT & TRADEMARK OFFICE

PTO/SB/96 (08-03)
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: CREATIVE TECHNOLOGY LTD.

Application No./Patent No.: 09/755,723 Filed/Issue Date: 1/5/2001

Entitled: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

CREATIVE TECHNOLOGY LTD., a CORPORATION

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. [X] the assignee of the entire right, title, and interest; or

2. [ ] an assignee of less than the entire right, title and interest.
The extent (by, percentage) of its ownership interest is ________ %

in the patent application/patent identified above by virtue of either:

A. [X] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel/Frame 011788/0174, or for which a copy thereof is attached.

OR

B. [ ] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From:________________ To:________________
The document was recorded in the United States Patent and Trademark Office at
Reel ____________, Frame ____________, or for which a copy thereof is attached.

2. From:________________ To:________________
The document was recorded in the United States Patent and Trademark Office at
Reel ____________, Frame ____________, or for which a copy thereof is attached.

3. From:________________ To:________________
The document was recorded in the United States Patent and Trademark Office at
Reel ____________, Frame ____________, or for which a copy thereof is attached.

[ ] Additional documents in the chain of title are listed on a supplemental sheet.

[ ] Copies of assignments or other documents in the chain of title are attached.
[NOTE: A separate copy (*i.e.*, the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

7/6/04
Date

CHON HOCK LEOW
Typed or printed name

(408) 428-6600
Telephone number

[signature]
Signature

CHIEF TECHNOLOGY OFFICER
Title

CL 000239

8/16/04

OIPE
AUG 12 2004

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

08791 7590 06/09/2004

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12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission CED EXPRESS

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for ~~first class~~ mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

Cynthia K. Dawn (Depositor's name)
Cynthia K. Dawn (Signature)
August 12, 2004 (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

TITLE OF INVENTION: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	09/09/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
RONES, CHARLES	2175	707-104100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☒ Change of correspondence address (or Change of Correspondence Address form PTO/SB/~~122~~ 82) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Russell N. Swerdon
2 Creative Technology LTD
3 ______

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Creative Technology LTD

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Singapore

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ individual ☒ corporation or other private group entity ☐ government

4a. The following fee(s) are enclosed:

☒ Issue Fee
☒ Publication Fee
☐ Advance Order - # of Copies ______

4b. Payment of Fee(s):

☒ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number ______ (enclose an extra copy of this form).

Director for Patents is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.

(Authorized Signature) Russell N. Swerdon (Date) Aug. 12, 2004

Russell N. Swerdon, Reg. No. 36,943

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

08/16/2004 SDIRETAE 00000032 09755723

01 FC:1501 1330.00 OP
02 FC:1504 300.00 OP

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

CL 000240

TRANSMIT THIS FORM WITH FEE(S)

I hereby certify that the form Part B – Fee(s) Transmittal PTOL-85 and the check in the amount of the fee is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service under 37 CFR § 1.10 on the date indicated below and is addressed to:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

By: Cynthia K. Dawn

Typed Name: Cynthia K. Dawn

Express Mail Label No.: EV347886201US

Date of Deposit: August 12, 2004

CL 000241

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/755,723	01/05/2001	Ron Goodman	017002022500

CONFIRMATION NO. 3728

OC000000013550953

#22

08791
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

Date Mailed: 08/16/2004

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/12/2004.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Timothy Caldwell
for ALLEN M WILLIS
OPPD ()-

OFFICE COPY

CL 000242

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/755,723	01/05/2001	Ron Goodman	017002022500

CONFIRMATION NO. 3728

OC000000013550969

40032
CREATIVE LABS, INC.
LEGAL DEPARTMENT
1901 MCCARTHY BLVD
MILPITAS, CA 95035

#22

Date Mailed: 08/16/2004

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/12/2004.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Timothy Caldwell
for ALLEN M WILLIS
OPPD 0-

OFFICE COPY

CL 000243

07-12-04

2175 B 93

#23 9/10/04 AU

JUL 0 9 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail No. ER886552274US with sufficient postage in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

on July 9, 2004
Date of Deposit

Cynthia K. Dawn
Name of Person Mailing Correspondence

Cynthia K. Dawn

Application No.: 09/755,723

Title: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Applicant: Ron Goodman

Filed: January 5, 2001
TC/A.U. 2175
Examiner: Rones, Charles

Docket No.: 6407P212
Customer No.: 40032

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Match and Return

AMENDMENT AND PETITION UNDER 37 C.F.R. § 1.48(c)
TO CORRECT INVENTORSHIP

Dear Sir:

The undersigned hereby respectfully requests and petitions that the above-referenced application be amended under 37 C.F.R. § 1.48(c) to correct inventorship of the application.

The application was filed on January 5, 2001 naming the following persons as inventors of the present patent application:

07/14/2004 SKINHSS1 00000056 09755723
01 FC:1460 130.00 DP

(1) Ron Goodman, a citizen of the United States, residing at 226 Jeter Street, Santa Cruz, CA 95060; and

(2) Howard N. Egan, a citizen of the United States, residing at 219 Elinor Street, Capitola, CA 95010.

Please correct and amend the present patent application so that David Bristow, a citizen of the United Kingdom, residing at 5988 NE Tolo Road, Bainbridge Island, WA 98110 is additionally named as a joint inventor of the present patent application.

It is respectfully submitted that the amendment is necessitated by amendment of the claims and that the error in inventorship of the present patent application was made without any deceptive intent by anyone, including the actual inventors.

Enclosed with this Amendment and Petition are the following documents:

(1) a verified Statement of Facts by David Bristow stating that the addition in inventorship of the present patent application is necessitated by amendment of the claims and that the inventorship error occurred without any deceptive intent on his part;

(2) an executed Declaration/Power of Attorney indicating all inventors; and

(3) an Assent of Assignee for Correction of Inventorship with a copy of the previously recorded Notice of Recordation of Assignment document.

The Assignment by the additional inventor, David Bristow, to be recorded in accordance with 37 C.F.R. § 1.33(1), and a check in the amount of $40.00 to cover the recordation fee required by 37 C.F.R. § 1.21(h), are being forwarded separately to the Assignment Division.

Enclosed herewith is a check in the amount of $130.00 in payment of the fee under 37 C.F.R. § 1.17(i) for correction of inventorship.

Respectfully submitted,

Dated: July 9, 2004

Russell N. Swerdon
Reg. No. 36,943

Creative Labs, Inc.
1901 McCarthy Boulevard
Milpitas, CA 95035
(408) 428-6600

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail ~~first class mail~~ with sufficient postage in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

ER8865522...

on July 9, 2004
Date of Deposit

Cynthia K. Dawn
Name of Person Mailing Correspondence

Cynthia K Dawn July 9, 2004
Signature Date

Application No.: 09/755,723

Title: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Applicant:	Ron Goodman
Filed:	January 5, 2001
TC/A.U.	2175
Examiner:	Rones, Charles
Docket No.:	6407P212
Customer No.:	40032

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

STATEMENT OF FACTS BY DAVID BRISTOW
UNDER 37 C.F.R. § 1.48(c)

Dear Sir:

I hereby declare:

1. I am making this Statement of Facts under 37 C.F.R. § 1.48(c) in connection with U.S. Patent Application Serial No.09/755,723 filed January 5, 2001 (hereinafter referred to as "the present patent application").

2. My current residence and country of citizenship is as follows:

David Bristow, a citizen of the United Kingdom, residing at 5988 NE Tolo Road, Bainbridge Island, WA 98110.

3. The amendment in inventorship is made as necessitated by amendment of the claims. An inventorship error was made by naming only Ron Goodman and Howard N. Egan as joint inventors, rather than naming Ron Goodman, Howard N. Egan and David Bristow as joint inventors.

4. The inventorship error was made without any deceptive intent whatsoever on my part.

5. It is now requested that the additional inventor David Bristow be added to the present patent application.

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: July 7th, 2004

David Bristow

JUL 0 9 2004

PATENT APPLICATION

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	ATTORNEY DOCKET NO. 6407P212

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

the specification of which is attached hereto unless the following box is checked:

(X) was filed on January 5, 2001 as US Application Serial No. or PCT International Application Number 09/755,723 and was amended on 4/30/2004 (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES:____ NO:___
			YES:____ NO:___

Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE

U.S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS(patented/pending/abandoned)

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the practitioners associated with Customer No. 40032 as my patent attorneys, with full power of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Send Correspondence to:	Direct Telephone Calls To:
P. Francois de Villiers Customer No. 40032 Creative Labs, Inc. 1901 McCarthy Boulevard Milpitas, CA 95035	Russell N. Swerdon (408) 428-6600

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Ron GOODMAN Citizenship: UNITED STATES

Residence: 226 Jeter Street, Santa Cruz, CA USA 95060

Post Office Address: Same

Ron Goodman

Inventor's Signature

July 7, 2004

Date

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION (continued)

ATTORNEY DOCKET NO. 6407P212

Full Name of Inventor: Howard N. EGAN
Citizenship: UNITED STATES
Residence: 219 Elinor Street, Capitola, CA 95010 USA
Post Office Address: Same

Inventor's Signature ____________ Date: July , 2004

Full Name of Inventor: David BRISTOW
Citizenship: UNITED KINGDOM
Residence: 5988 NE Tolo Road, Bainbridge Island, WA 98110
Post Office Address: Same

Inventor's Signature ____________ Date: July , 2004

Full Name of Inventor: ____________ Citizenship: ____________
Residence: ____________
Post Office Address: ____________

Inventor's Signature ____________ Date ____________

Full Name of Inventor: ____________ Citizenship: ____________
Residence: ____________
Post Office Address: ____________

Inventor's Signature ____________ Date ____________

Full Name of Inventor: ____________ Citizenship: ____________
Residence: ____________
Post Office Address: ____________

Inventor's Signature ____________ Date ____________

Full Name of Inventor: ____________ Citizenship: ____________
Residence: ____________
Post Office Address: ____________

Inventor's Signature ____________ Date ____________

PATENT APPLICATION

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	ATTORNEY DOCKET NO. 6407P212

As a below named inventor, I hereby declare that:
My residence/post office address and citizenship are as stated below next to my name;
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA
the specification of which is attached hereto unless the following box is checked:
(X) was filed on January 5, 2001 as US Application Serial No. or PCT International Application Number 09/755,723 and was amended on 4/30/2004 (if applicable).
I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority
I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES:____ NO:____
			YES:____ NO:____

Provisional Application
I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE

U.S. Priority Claim
I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS(patented/pending/abandoned)

POWER OF ATTORNEY:
As a named inventor, I hereby appoint the practitioners associated with Customer No. 40032 as my patent attorneys, with full power of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Send Correspondence to:	Direct Telephone Calls To:
P. Francois de Villiers Customer No. 40032 Creative Labs, Inc. 1901 McCarthy Boulevard Milpitas, CA 95035	Russell N. Swerdon (408) 428-6600

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Ron GOODMAN Citizenship: UNITED STATES

Residence: 226 Jeter Street, Santa Cruz, CA USA 95060

Post Office Address: Same

Inventor's Signature ____________ July , 2004
Date

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION (continued) ATTORNEY DOCKET NO. 6407P212

Full Name of Inventor: Howard N. EGAN Citizenship: UNITED STATES

Residence: 219 Rilner Street, Capitola, CA 95010 USA

Post Office Address: Same

Inventor's Signature

July 7, 2004
Date

Full Name of Inventor: David BRISTOW Citizenship: UNITED KINGDOM

Residence: 5988 NE Toln Road, Bainbridge Island, WA 98110

Post Office Address: Same

Inventor's Signature

July , 2004
Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

JUL 0 9 2004

PATENT APPLICATION

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	ATTORNEY DOCKET NO. 6407P212

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

the specification of which is attached hereto unless the following box is checked:

(X) was filed on January 5, 2001 as US Application Serial No. or PCT International Application Number 09/755,723 and was amended on 4/30/2004 (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES:____ NO:___
			YES:____ NO:___

Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE

U.S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS(patented pending abandoned)

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the practitioners associated with Customer No. 40032 as my patent attorneys, with full power of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Send Correspondence to:	Direct Telephone Calls To:
P. Francois de Villiers Customer No. 40032 Creative Labs, Inc. 1901 McCarthy Boulevard Milpitas, CA 95035	Russell N. Swerdon (408) 428-6400

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Ron GOODMAN

Citizenship: UNITED STATES

Residence: 216 Jeter Street, Santa Cruz, CA USA 95060

Post Office Address: Same

____
Inventor's Signature

July ____, 2004
Date

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION (continued)	ATTORNEY DOCKET NO. 64117P212

Full Name of Inventor: Howard N. EGAN Citizenship: UNITED STATES
Residence: 219 Elinor Street, Capitola, CA 95010 USA
Post Office Address: Same

Inventor's Signature July , 2004
Date

Full Name of Inventor: David BRISTOW Citizenship: UNITED KINGDOM
Residence: 5088 NE Tolo Road, Bainbridge Island, WA 98110
Post Office Address: Same

Inventor's Signature July 7, 2004
Date

Full Name of Inventor: Citizenship:
Residence:
Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:
Residence:
Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:
Residence:
Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:
Residence:
Post Office Address:

Inventor's Signature Date

OIPE JUL 0 9 2004 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail No. ER866522274US with sufficient postage in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

on July 9, 2004
Date of Deposit

Cynthia K. Dawn
Name of Person Mailing Correspondence

Cynthia K. Dawn

Application No.: 09/755,723

Title: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Applicant: Ron Goodman

Filed: January 5, 2001
TC/A.U. 2175
Examiner: Rones, Charles

Docket No.: 6407P212
Customer No.: 40032

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ASSENT OF ASSIGNEE UNDER 37 C.F.R. § 3.73(b)
FOR CORRECTION OF INVENTORSHIP

Dear Sir:

Attached please find a copy of the Recordation of Assignment document that is currently on file with the U.S. Patent and Trademark Office concerning the above noted application. The Assignment document is being submitted to provide evidence of chain of title for this application.

07/14/2004 SMINASS1 00000096 09755723
01 FC:1460 130.00 OP

Match and Return

CL 000254

Assignee, CREATIVE TECHNOLOGY LTD., a Singapore corporation having a place of business at 31 International Business Park, Creative Resource, Singapore 609921, Republic of Singapore, does hereby assent to the correction of inventorship, the petition for which is filed herewith, which seeks to add David Bristow as an additional inventor in the above-referenced application. The undersigned of Creative Technology Ltd. does hereby declare, under penalty of perjury, that he is authorized by Creative Technology Ltd. to make this Assent of Assignee for Correction of Inventorship.

Respectfully submitted,

Dated: 7/6/, 2004

Chon Hock Leow
Chief Technology Officer

U.S. PATENT & TRADEMARK OFFICE JUL 0 9 2004

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

JULY 30, 2001

PTAS

TOWNSEND AND TOWNSEND AND CREW LLP
CHARLES E. KRUEGER
TWO EMBARCADERO CENTER, EIGHTH FLOOR
SAN FRANCISCO, CALIFORNIA 94111

GE Stanton
017002-022500US

101717181A

UNITED STATES PATENT AND TRADEMARK OFFICE
NOTICE OF RECORDATION OF ASSIGNMENT DOCUMENT

THE ENCLOSED DOCUMENT HAS BEEN RECORDED BY THE ASSIGNMENT DIVISION OF THE U.S. PATENT AND TRADEMARK OFFICE. A COMPLETE MICROFILM COPY IS AVAILABLE AT THE ASSIGNMENT SEARCH ROOM ON THE REEL AND FRAME NUMBER REFERENCED BELOW.

PLEASE REVIEW ALL INFORMATION CONTAINED ON THIS NOTICE. THE INFORMATION CONTAINED ON THIS RECORDATION NOTICE REFLECTS THE DATA PRESENT IN THE PATENT AND TRADEMARK ASSIGNMENT SYSTEM. IF YOU SHOULD FIND ANY ERRORS OR HAVE QUESTIONS CONCERNING THIS NOTICE, YOU MAY CONTACT THE EMPLOYEE WHOSE NAME APPEARS ON THIS NOTICE AT 703-308-9723. PLEASE SEND REQUEST FOR CORRECTION TO: U.S. PATENT AND TRADEMARK OFFICE, ASSIGNMENT DIVISION, BOX ASSIGNMENTS, CG-4, 1213 JEFFERSON DAVIS HWY, SUITE 320, WASHINGTON, D.C. 20231.

RECORDATION DATE: 04/23/2001 | REEL/FRAME: 011788/0174
NUMBER OF PAGES: 4

BRIEF: ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS).

ASSIGNOR:
GOODMAN, RON | DOC DATE: 03/14/2001

ASSIGNOR:
EGAN, HOWARD N. | DOC DATE: 03/22/2001

ASSIGNEE:
CREATIVE TECHNOLOGY LTD., A CORP. OF THE REPUBLIC OF SINGAPORE
31 INTERNATIONAL BUSINESS PARK
CREATIVE RESOURCE
SINGAPORE, SINGAPORE 609921

SERIAL NUMBER: 09755723 | FILING DATE: 01/05/2001
PATENT NUMBER: | ISSUE DATE:

CL 000256

011788/0174 PAGE 2

ALLYSON PURNELL, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS

CL 000257

Attorney Docket No.: 17002-022500US
Client Reference No.: CT-1139

ASSIGNMENT OF PATENT APPLICATION

WHEREAS, RON GOODMAN, of 226 Jeter Street, Santa Cruz, CA 95060; HOWARD N. EGAN, of 219 Elinor Street, Capitola, CA 95010; hereinafter referred to as "Assignors," are the inventors of the invention described and set forth in the below-identified application for United States Letters Patent:

Title of Invention:	AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA
Date(s) of Execution:	-
Filing Date:	January 5, 2001
Application No.:	09/755,723; and

WHEREAS, CREATIVE TECHNOLOGY LTD., located at 31 International Business Park, Creative Resource, Singapore, 609921, hereinafter referred to as "ASSIGNEE," is desirous of acquiring ASSIGNORS' interest in the said invention and application and in any U.S. Letters Patent which may be granted on the same;

NOW, THEREFORE, TO ALL WHOM IT MAY CONCERN: Be it known that, for good and valuable consideration, receipt of which is hereby acknowledged by Assignors, Assignors have sold, assigned and transferred, and by these presents do sell, assign and transfer unto the said Assignees, and Assignees' successors and assigns, all their right, title and interest in and to the said invention and application, and in and to any Letters Patent which may hereafter be granted on the same in the United States, the said interest to be held and enjoyed by said Assignees as fully and exclusively as it would have been held and enjoyed by said Assignors had this Assignment and transfer not been made, to the full end and term of any Letters Patent which may be granted thereon, or of any division, renewal, continuation in whole or in part, substitution, conversion, reissue, prolongation or extension thereof.

Assignors further agree that they will, without charge to Assignee, but at Assignee's expense, cooperate with Assignee in the prosecution of said application and/or applications, execute, verify, acknowledge and deliver all such further papers, including applications for Letters Patent and for the reissue thereof, and instruments of assignment and transfer thereof, and will perform such other acts as Assignee lawfully may request, to obtain or maintain Letters Patent for said invention and improvement, and to vest title thereto in Assignee, or Assignee's successors and assigns.

Assignors hereby authorize and request Townsend and Townsend and Crew LLP, Two Embarcadero Center, 8th Floor, San Francisco, CA 94111-3834, to insert herein above the application number and filing date of said application when known.

IN TESTIMONY WHEREOF, Assignors have signed their names on the dates indicated.

CL 000258

Assignment
Attorney Docket No.: 17002-022500US
Page 2

Dated: 3/14/2001

RON GOODMAN

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On March 14, 2001, before me, Jacqueline W. Bazzano, personally appeared RON GOODMAN, personally known to me ~~(or proved to me on the basis of satisfactory evidence)~~ to be the person whose name is subscribed to the within instrument, and acknowledged to me that he/~~she~~ executed the same in his/~~her~~ authorized capacity, and that by his/~~her~~ signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

JACQUELINE W. BAZZANO
Commission # 1132234
Notary Public — California
Santa Cruz County
My Comm. Expires Apr 2, 2001

NOTARY PUBLIC

My Commission Expires: 4/2/2001

Dated: 3-22-2001

HOWARD N. EGAN

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On March 22, 2001, before me, Jacqueline W Bazzano (Notary Public) personally appeared HOWARD N. EGAN, personally known to me ~~(or proved to me on the basis of satisfactory evidence)~~ to be the person whose name is subscribed to the within instrument, and acknowledged to me that he/~~she~~ executed the same in his/~~her~~ authorized capacity, and that by his/~~her~~ signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

JACQUELINE W. BAZZANO
Commission # 1132234
Notary Public — California
Santa Cruz County
My Comm. Expires Apr 2, 2001

NOTARY PUBLIC

My Commission Expires: 4/2/2001

CL 000259

#24E
9/10/04
A.U.

CR
OK to Enter 11-16-04
except do not enter drawings will be filed separately

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

In re application of: Goodman, et al

Application No.: 09/755,723

Filed: January 5, 2001

Title: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

Attorney Docket No.: 6407P212

Examiner: Rones, Charles L.

Group: 2175

RECEIVED
CENTRAL FAX CENTER
JUL 27 2004
OFFICIAL

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office (FAX No. (703) 872-9306 on July 27, 2004.

Signed: Cynthia K. Dawn
Cynthia K. Dawn

Amendment After Notice of Allowance, pursuant to 37 CFR 1.312

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The enclosed remarks and amendments are submitted under the provisions of 37 CFR 1.312. This amendment is filed on or before the date the issue fee is paid. Applicants respectfully request reconsideration of the captioned application in view of the following remarks and amendments. A listing of the claims commences on page 2. Remarks begin on page 6 of this paper. Formal drawings are also attached to replace several informal drawings in the drawing package previously submitted.

Listing of Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

1-23. (cancelled)

1

~~24~~. (currently amended) A method of selecting at least one track from a plurality of tracks stored in a computer-readable medium of a portable media player configured to present sequentially a first, second, and third display screen on the display of the media player, the plurality of tracks accessed ~~organized~~ according to a ~~file~~ hierarchy, the ~~file~~ hierarchy having a plurality of categories, subcategories, and items respectively in a first, second, and third level of the hierarchy, the method comprising:

selecting a category in the first display screen of the portable media player;

displaying the subcategories belonging to the selected category in a listing presented in the second display screen;

E1

selecting a subcategory in the second display screen;

displaying the items belonging to the selected subcategory in a listing presented in the third display screen; and

accessing at least one track based on a selection made in one of the display screens.

2

~~25~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting a subcategory in the second display screen and playing a plurality of tracks associated with the selected subcategory.

3

~~26~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting a subcategory and adding the tracks associated with the selected subcategory to a playlist.

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4
~~27~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting an item in the third display screen and playing at least one track associated with the selected item.

5
~~28~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises selecting an item in the third display screen and adding at least one track associated with the selected item to a playlist.

6
~~29~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track comprises one of playing or adding to a playlist at least one track associated with a selected one of the category, subcategory, and item.

7
~~30~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the accessing at least one track is made after the presentation of the third display screen by reverting back to one of the second and first display screens, the second display screen presented sequentially after the third display screen.

E1

8
~~31~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 further comprising selecting one of the items displayed in the third display screen and presenting a listing of items associated with the selected item in a fourth sequentially presented display screen.

9
~~32~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the category genre is selected in the first display screen from available categories that include at least artist, album, and genre; and the subcategories listed in the second display screen comprise a listing of at least one genre type and one of the at least one genre type is selected.

10
~~33~~. (previously presented) The method of selecting a track as recited in claim ~~32~~ 9 further comprising displaying in the third display screen at least one album associated with the selected genre type and selecting one of the at least one albums displayed in the

BEST AVAILABLE COPY

third display screen and presenting a listing of tracks associated with the selected album in a fourth sequentially presented display screen.

11 ~~34~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein the category artist is selected in the first display screen from available categories that include at least artist, album, and genre; the subcategories listed in the second display screen comprise a listing of names of artists and a first artist name is selected; and the items displayed in the third display screen comprises at least one album associated with the first artist name.

12 ~~35~~. (currently amended) The method of selecting a track as recited in claim ~~24~~ 1 wherein the track is a music track, accessing at least one track comprises accessing a track title ~~the item accessed~~ in the third display screen ~~is a track title~~, and the track is played in response to the access.

E1

13 ~~36~~. (previously presented) The method of selecting a track as recited in claim ~~24~~ 1 wherein receipt of the selection in the first display screen results in an automatic transition of the first display screen into the second display screen and receipt of the selection in the second display screen results in an automatic transition of the second display screen into the third display screen.

14 ~~37~~. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the category selected in the first display screen is from a top level of the hierarchy.

15 ~~38~~. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the category selected in the first display screen is a category from a level at least one level below the top level of the hierarchy.

16 ~~39~~. (new) The method of selecting a track as recited in claim ~~24~~ 1 wherein the plurality of categories comprise a list of artist names, the plurality of subcategories comprise a list of album names and the plurality of items comprise a list of track names.

Amendments to the Drawings:

Five sheets of Replacement Drawings for Figures 9-13 are attached. These are formal drawings submitted to replace the informal drawings submitted and entered with the April 30 amendment. Inasmuch as the previously submitted informal drawings include handwritten reference numbers and grayscale sectioning that may be unsuitable for publication, applicants request entry of the formal drawings attached.

ATTACHMENT: 5 sheets of formal drawings

REMARKS

The examiner had indicated the allowability of claims 24-36 in a notice of allowance mailed on June 9, 2004. As a result of the amendment filed on or about April 30, only claims 1 and 24-36 had been pending.

Applicants herewith have amended the claims to cancel claim 1. Claim 1 had previously been merely withdrawn, hence the cancellation deals with mere informalities. Independent claim 24 has been amended to identify in the preamble that the plurality of tracks are accessed according to a hierarchy instead of organized according to a file hierarchy. Applicants believe that this amendment should be entered for at least the reason that it helps clarify the invention and that the amended claim with the change in only two words is allowable for the same reasons as the previously presented claim was found to be allowable by the Examiner. Further, the claim is patentable over the art of record for at least the reason that Grewe doesn't teach or suggest displaying categories or subcategories in a display screen.

Dependent claim 35 has been amended to overcome any problems as to explicit antecedent basis for the phrase "the item accessed" and hence largely deals with informalities. Dependent claims 37, 38, and 39 are new claims, all of which are dependent from independent claim 24. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers (35 USC 112.) These claims add a further limitation to independent claim 24 and thus help clarify applicant's invention. Since the added claims are dependant claims, applicants submit that this reason alone strongly supports their entry. In particular, MPEP section 714.16 notes in pertinent part as follows:

> "Where claims added by amendment under 37 CFR 1.312 are all of the form of dependant claims, some of the usual reasons for nonentry are less likely to apply."

The dependent claims depend from an allowed independent claim (claim 24) and are therefore patentable for at least the same reason as the independent claim 24. Support for the amendments may be found in the drawings, FIGS. 1,3, 7, 10-11, their associated descriptions, and throughout the specification, in particular the abstract and page 8. They add no new matter. The amendments to claim 35 had not been submitted previously because the lack of proper antecedent basis for the terms used had not been noticed previously. Allowed claims 24-36 had first been presented in the amendment recently filed on April 30, 2004 (in response to a restriction requirement) and thus had not been previously involved in any discussions or communications between the examiner and applicants. Applicants submit that the amendments to add dependent claims 37-39 are proper to help clarify and disclose applicant's invention.

Conclusion

Applicants believe that entry of the amendment is proper and respectfully request that the application not be withdrawn from issue. Applicants respectfully request that the primary examiner recommend entry of the amendment as provided by the guidelines set forth in MPEP Section 714.16(a), including the claim amendments discussed above and the entry of replacement formal drawings, FIGS. 9-13, as discussed in the drawings amendment section. Applicants believe that consideration of the matters presented herein will not require any substantial amount of additional work on the part of the Office and are needed for proper disclosure of the invention. If the Examiner believes that a telephone conference would expedite the prosecution of this application, he is invited to contact the Applicants' undersigned attorney at the telephone number set out below.

Respectfully submitted,

Russell N. Swerdon
Registration No. 36,943

Creative Labs, Inc.
1901 McCarthy Boulevard
Milpitas, CA 95035
(408) 428-6600

09/755,723

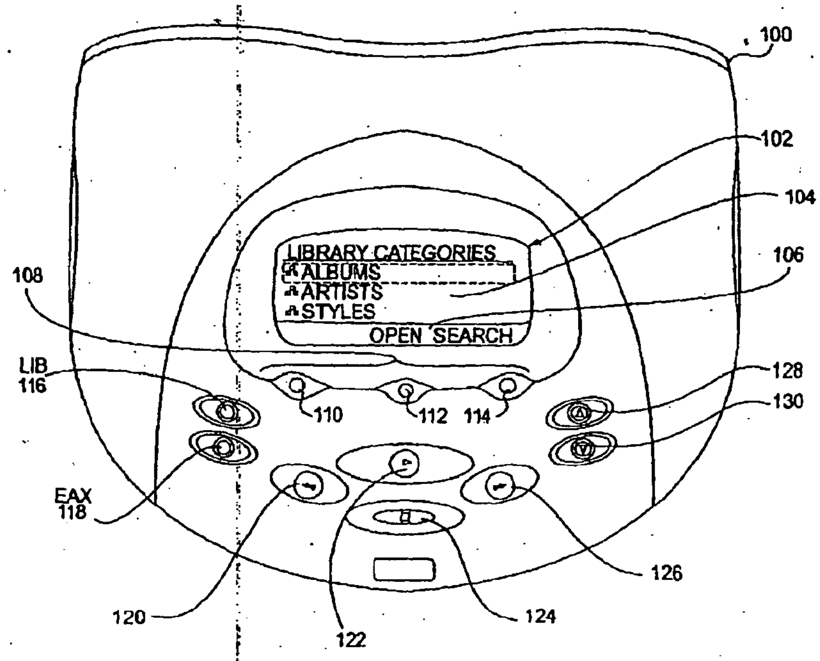


FIG. 9

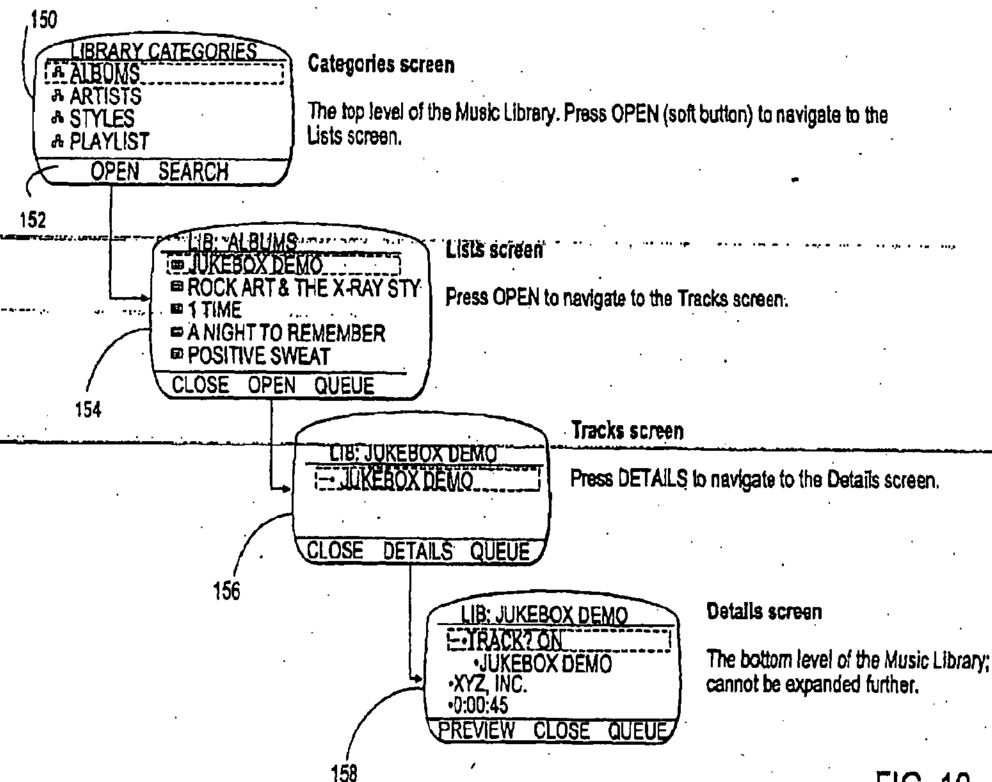

150
LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
PLAYLIST
OPEN SEARCH
152
Categories screen
The top level of the Music Library. Press OPEN (soft button) to navigate to the Lists screen.
LIB: ALBUMS
JUKEBOX DEMO
ROCK ART & THE X-RAY STY
1 TIME
A NIGHT TO REMEMBER
POSITIVE SWEAT
CLOSE OPEN QUEUE
154
Lists screen
Press OPEN to navigate to the Tracks screen.
LIB: JUKEBOX DEMO
JUKEBOX DEMO
CLOSE DETAILS QUEUE
156
Tracks screen
Press DETAILS to navigate to the Details screen.
LIB: JUKEBOX DEMO
TRACK? ON
•JUKEBOX DEMO
•XYZ, INC.
•0:00:45
PREVIEW CLOSE QUEUE
158
Details screen
The bottom level of the Music Library; cannot be expanded further.

FIG. 10

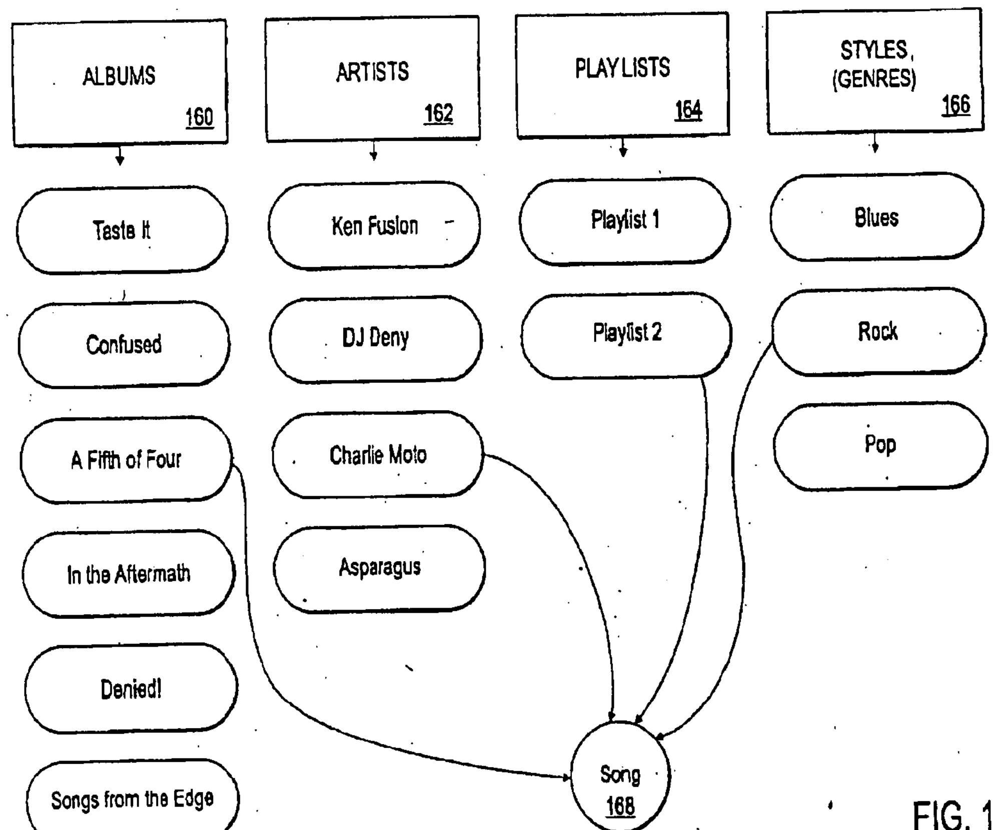

ALBUMS
160
ARTISTS
162
PLAYLISTS
164
STYLES, (GENRES)
166
Taste It
Confused
A Fifth of Four
In the Aftermath
Denied!
Songs from the Edge
Ken Fusion
DJ Deny
Charlie Moto
Asparagus
Playlist 1
Playlist 2
Blues
Rock
Pop
Song
168

FIG. 11

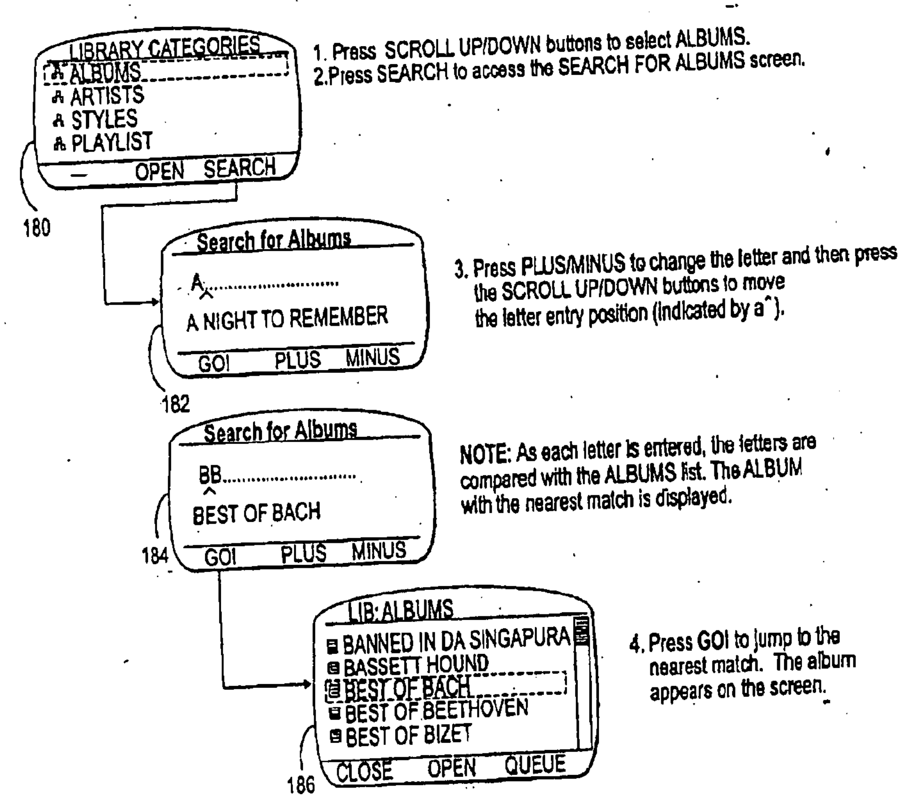

LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
PLAYLIST
— OPEN SEARCH
180
1. Press SCROLL UP/DOWN buttons to select ALBUMS.
2.Press SEARCH to access the SEARCH FOR ALBUMS screen.
Search for Albums
A
A NIGHT TO REMEMBER
GOI PLUS MINUS
182
3. Press PLUS/MINUS to change the letter and then press the SCROLL UP/DOWN buttons to move the letter entry position (indicated by a ^).
Search for Albums
BB
BEST OF BACH
GOI PLUS MINUS
184
NOTE: As each letter is entered, the letters are compared with the ALBUMS list. The ALBUM with the nearest match is displayed.
LIB: ALBUMS
BANNED IN DA SINGAPURA
BASSETT HOUND
BEST OF BACH
BEST OF BEETHOVEN
BEST OF BIZET
CLOSE OPEN QUEUE
186
4. Press GOI to jump to the nearest match. The album appears on the screen.

FIG. 12

View DETAILS accessed from the TRACKS screen:

1. Press DETAILS. The DETAILS screen displays the Track Order, Album, Artist, and duration of the track.

2. Press CLOSE to return to the TRACKS screen.

Viewing DETAILS accessed from the ACTIVE QUEUE LIST screen:

1. Press DETAILS. The DETAILS screen displays the Track Title, Artist, Album together with Audio Playback settings (see note below) and Play Mode (see "Setting Play Mode" on page 16).

2. Press BACK to return to the ACTIVE QUEUE LIST screen.

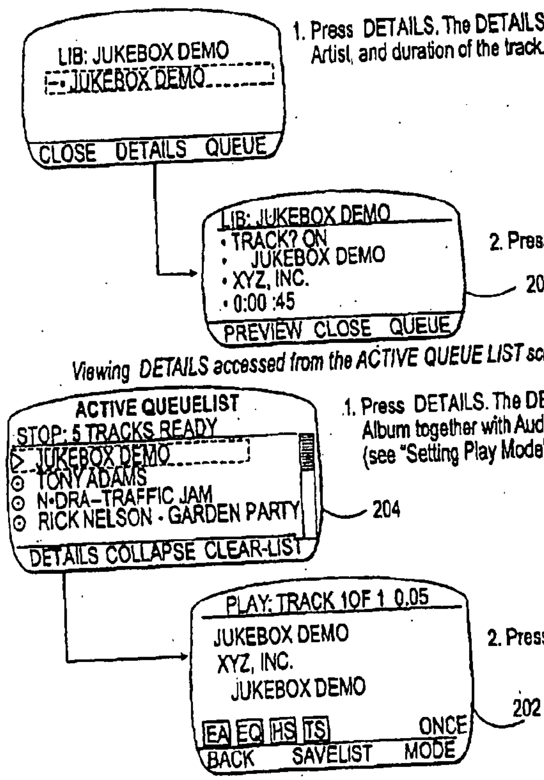


FIG. 13

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

40032 7590 02/08/2005

CREATIVE LABS, INC.
LEGAL DEPARTMENT
1901 MCCARTHY BLVD
MILPITAS, CA 95035

EXAMINER	
RONES, CHARLES	
ART UNIT	**PAPER NUMBER**
2164	25

DATE MAILED: 02/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

CL 000272

Response to Rule 312 Communication	Application No.	Applicant(s)	
	09/755,723	GOODMAN ET AL.	
	Examiner	**Art Unit**	
	Charles Rones	2164	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☒ The amendment filed on *July 27, 2004* under 37 CFR 1.312 has been considered, and has been:

a) ☐ entered.

b) ☒ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

C. Rones

Charles Rones
Primary Examir
Art Unit: 2164

CL 000273

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,723	01/05/2001	Ron Goodman	017002022500	3728

40032 7590 03/03/2005

CREATIVE LABS, INC.
LEGAL DEPARTMENT
1901 MCCARTHY BLVD
MILPITAS, CA 95035

EXAMINER	
RONES, CHARLES	
ART UNIT	PAPER NUMBER
2164	#26

DATE MAILED: 03/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Supp. **Notice of Allowability**	**Application No.** 09/755,723	**Applicant(s)** GOODMAN ET AL.
	Examiner Charles Rones	**Art Unit** 2164

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to drawing replacement sheets filed 11-16-04, 11-19-04 and 7-27-04.

2. ☒ The allowed claim(s) is/are 24-39.

3. ☒ The drawings filed on 11-16-04, 11-19-04 and 7-27-04 are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____.
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)
1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

C. Rones
Charles Rones
Primary Examiner
Art Unit: 2164

CL 000275

OIPE JC25 NOV 1 6 2004 PATENT & TRADEMARK OFFICE

94

RCS

#27

4-25-05

TO

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

In re application of: Goodman, et al

Application No.: 09/755,723

Filed: January 5, 2001

Title: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**

Attorney Docket No.: 6407P212

Examiner: Rones, Charles L.

Group: 2175

Declaration from Practitioner re Amendatory Material

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Russell N. Swerdon, declare as follows:

1. I am the an attorney employed by Creative Labs, Inc. and am one of the attorneys of record for assignee Creative Technology Ltd. with respect to the above entitled patent application. I have reviewed the file in this matter including the application filed on or about Jan. 5, 2001, and the application entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," also filed on Jan. 5, 2001, and assigned application serial number 09/755,629. Based on my review of the records I can make the following statements either based on personal knowledge or upon information and belief.

2. The currently pending application, application serial number 09/755,723, incorporated by reference the application entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," also filed on Jan. 5, 2001, and assigned application serial number 09/755629.

3. On or about April 30, 2004 a substitute specification was submitted in an amendment filed with the PTO. The amendment also included new drawings, FIGS. 9-14 which were submitted rather than relying upon their previous incorporation by reference. The amendatory material as provided in the substitute specification, included FIGS. 9-14, constitutes the same material incorporated by reference in the referencing application.

4. I hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 11-16-04 Signature: [signature]

Russell N. Swerdon

Respectfully submitted,

[signature]

Russell N. Swerdon
Registration No. 36,943

Creative Labs, Inc.
1901 McCarthy Blvd.
Milpitas, CA 95035
(408) 428-6600

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): GOODMAN, et al Application No.: 09/755,723 Filed: 1/5/2001 Title: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA Attorney Docket No.: 6407P212	Approved 3-1-05 CR Art Unit: 2175 Examiner: Charles L. RONES

OIPE JC25 NOV 16 2004 PATENT & TRADEMARK OFFICE

28

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FORMAL DRAWING TRANSMITTAL LETTER

Dear Sir:

Enclosed herewith please find five sheets of formal drawings (Figs 9-13) in substitution for the identically numbered formal drawings previously submitted by fax. Applicants were informally notified that several of the formal drawings previously submitted by fax were of poor quality. Please substitute these formal drawings for the corresponding poor quality drawings previously filed.

Entry of these drawings is respectfully requested.

Dated: 11-15-04

Russell N. Swerdon
Reg. No. 36943

1901 McCarthy Boulevard
Milpitas, CA 95035
Tel. (408) 546-6104
Fax (408) 428-6699

CL 000278

09755723 RZS

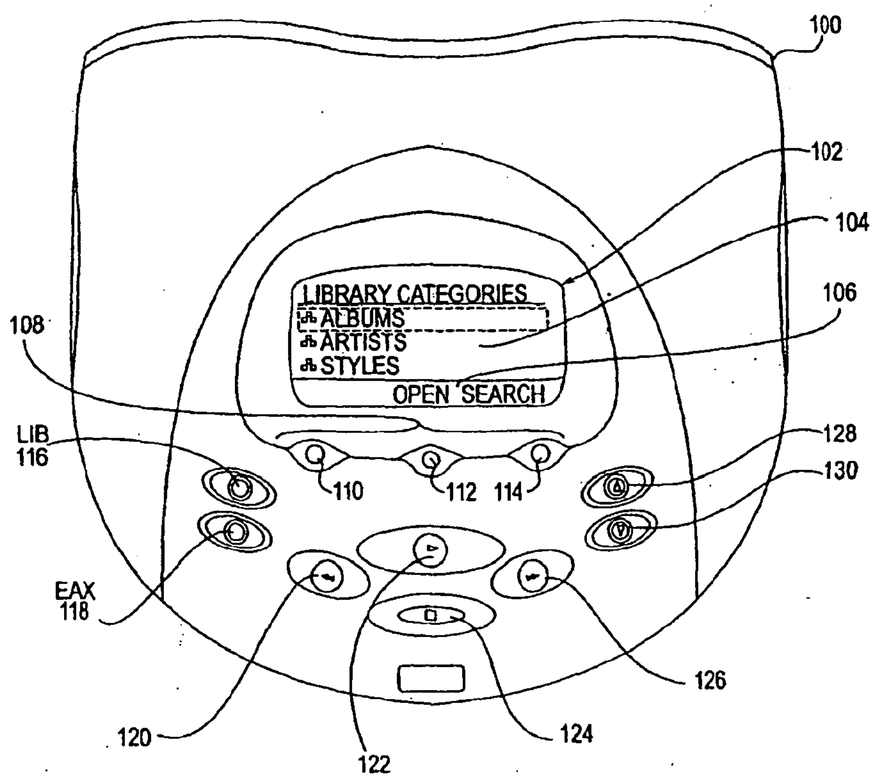


FIG. 9

CL 000279

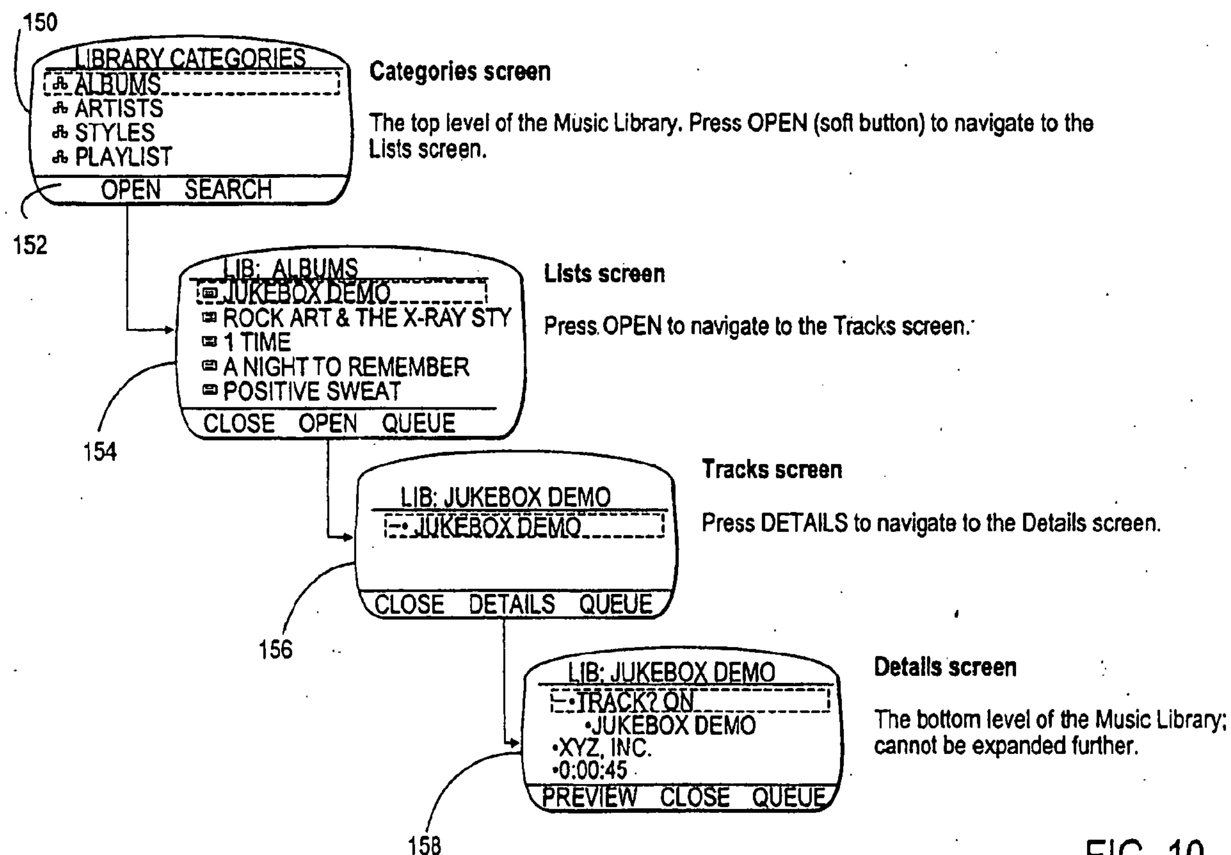


FIG. 10

CL 000280

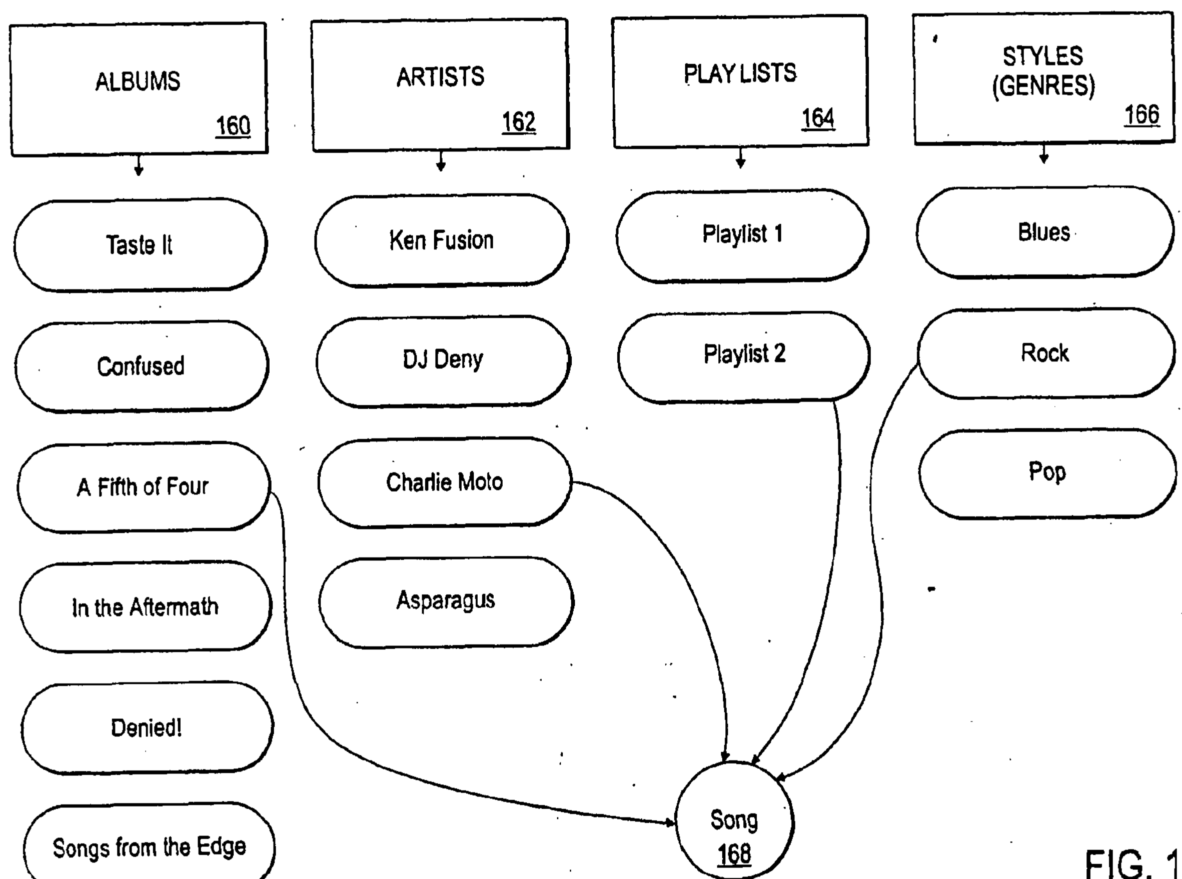


FIG. 11

CL 000281

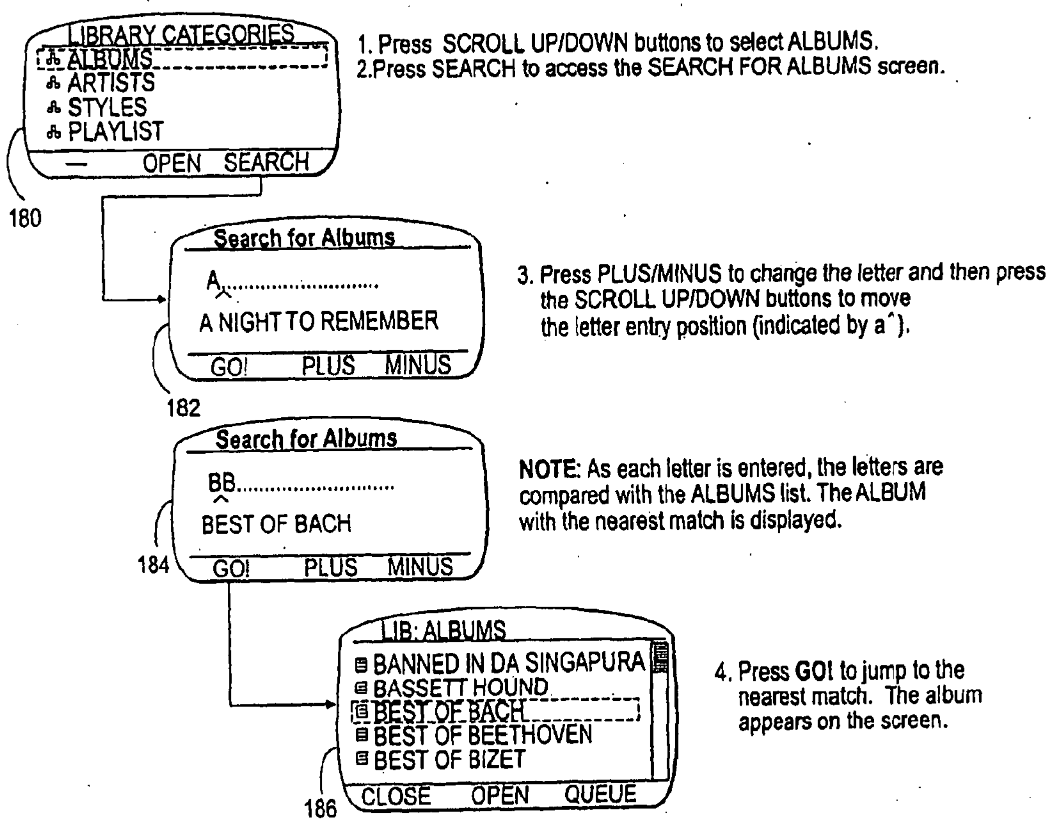
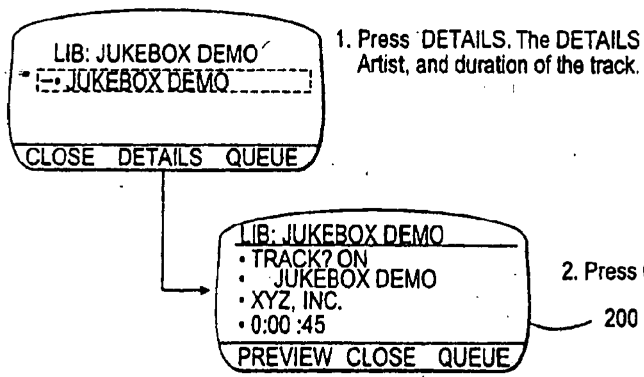

LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
PLAYLIST
— OPEN SEARCH
180
1. Press SCROLL UP/DOWN buttons to select ALBUMS.
2.Press SEARCH to access the SEARCH FOR ALBUMS screen.
Search for Albums
A............................
A NIGHT TO REMEMBER
GO! PLUS MINUS
182
3. Press PLUS/MINUS to change the letter and then press the SCROLL UP/DOWN buttons to move the letter entry position (indicated by a ˆ).
Search for Albums
BB............................
BEST OF BACH
GO! PLUS MINUS
184
NOTE: As each letter is entered, the letters are compared with the ALBUMS list. The ALBUM with the nearest match is displayed.
LIB: ALBUMS
BANNED IN DA SINGAPURA
BASSETT HOUND
BEST OF BACH
BEST OF BEETHOVEN
BEST OF BIZET
CLOSE OPEN QUEUE
186
4. Press GO! to jump to the nearest match. The album appears on the screen.

FIG. 12

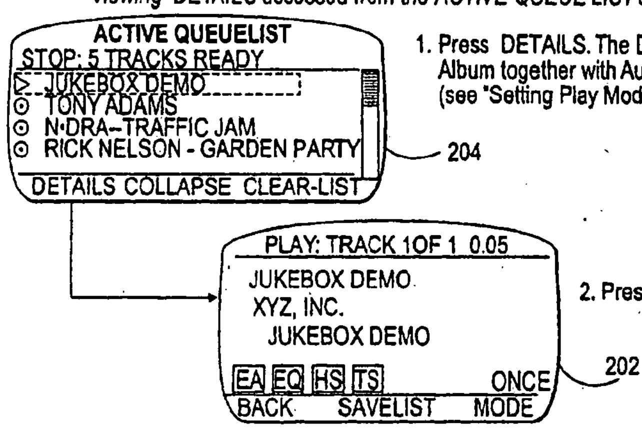
View DETAILS accessed from the TRACKS screen:



1. Press DETAILS. The DETAILS screen displays the Track Order, Album, Artist, and duration of the track.

2. Press CLOSE to return to the TRACKS screen.

Viewing DETAILS accessed from the ACTIVE QUEUE LIST screen:



1. Press DETAILS. The DETAILS screen displays the Track Title, Artist, Album together with Audio Playback settings (see note below) and Play Mode (see "Setting Play Mode" on page 16).

2. Press BACK to return to the ACTIVE QUEUE LIST screen.

FIG. 13

Approved 3-1-05 CR

11-22-04

941 2175

#29

OIPE NOV 1 9 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

In re application of: Goodman, et al

Application No.: 09/755,723

Filed: January 5, 2001

Title: **AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA**

Attorney Docket No.: 6407P212

Examiner: Rones, Charles L.

Group: 2175

Mail-Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FORMAL DRAWING TRANSMITTAL LETTER

Sir:

Enclosed herewith please find 1 sheet of formal drawing(s) including FIG. 14. Please substitute this formal drawing for the informal FIG. 14 drawing, originally filed with the amendment (including substitute specification) mailed on or about April 30, 2004.

Please add this sheet to the formal drawing sheets corresponding to FIGS. 1-8 (previously approved) and the recently filed (November 16, 2004) formal drawing sheets pertaining to FIGS. 9-13.

Applicants respectfully request that the Examiner approve entry of this formal drawing. If any others of the formal drawings in the group of Figures 1-14 are not currently approved, then applicants further request that the Examiner approve entry of those drawings.

Respectfully submitted,

Russell N. Swerdon
Registration No. 36,943

Creative Labs, Inc.
1901 McCarthy Boulevard
Milpitas, CA 95035
(408) 428-6600

CERTIFICATE OF EXPRESS MAIL (37 C.F.R. § 1.10)

Express Mail No.: EV 413 048 674 US Date: 11/19/2004

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as "Express Mail Post Office to Addressee" in an envelope addressed to Mail Stop Issue Fee, Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Lissa Oros

Date of Deposit: 11/19/04

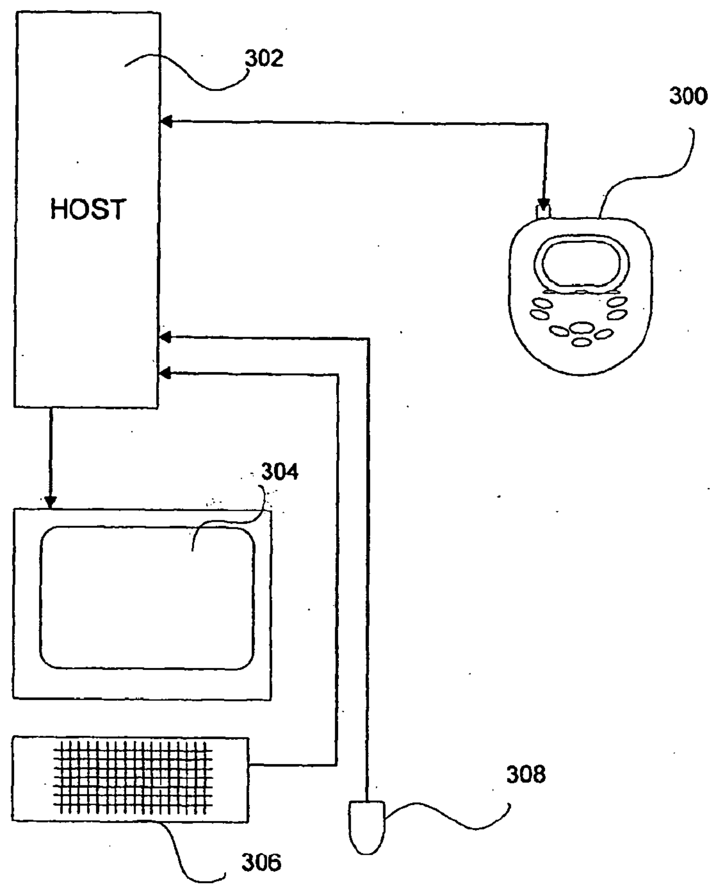


FIG. 14

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number
09755723

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY TYPE ☐ RATE	FEE	OR	OTHER THAN SMALL ENTITY RATE	FEE
TOTAL CLAIMS	10						
FOR	NUMBER FILED	NUMBER EXTRA	BASIC FEE	355.00	OR	BASIC FEE	710.00
TOTAL CHARGEABLE CLAIMS	10 minus 20=	* 0	X$ 9=		OR	X$18=	
INDEPENDENT CLAIMS	5 minus 3 =	* 2	X40=		OR	X80=	160.00
MULTIPLE DEPENDENT CLAIM PRESENT ☐			+135=		OR	+270=	
			TOTAL		OR	TOTAL	870.00

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
Total	*	Minus	**	=	X$ 9=		OR	X$18=	
Independent	*	Minus	***	=	X40=		OR	X80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+135=		OR	+270=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
Total	*	Minus	**	=	X$ 9=		OR	X$18=	
Independent	*	Minus	***	=	X40=		OR	X80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+135=		OR	+270=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
Total	*	Minus	**	=	X$ 9=		OR	X$18=	
Independent	*	Minus	***	=	X40=		OR	X80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+135=		OR	+270=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 8/00)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

CL 000286

CLAIMS ONLY

SERIAL NO.	FILING DATE
09755723	
APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT			*		*		*	
	IND.	DEP.	IND.	DEP.	IND.	DEP.		IND.	DEP.	IND.	DEP.	IND.	DEP.
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TOTAL DEP.	5						TOTAL DEP.						
TOTAL CLAIMS	10						TOTAL CLAIMS						

*MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS

FORM PTO-2022 (1-98)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

*U.S. GPO: 1998-443-593

CL 000287

Approved 3-1-5
C.R.

Amendments to the Drawings:

Five sheets of Replacement Drawings for Figures 9-13 are attached. These are formal drawings submitted to replace the informal drawings submitted and entered with the April 30 amendment. Inasmuch as the previously submitted informal drawings include handwritten reference numbers and grayscale sectioning that may be unsuitable for publication, applicants request entry of the formal drawings attached.

ATTACHMENT: 5 sheets of formal drawings

ISSUE SLIP STAPLE AREA (for additional cross references)

POSITION	INITIALS	ID NO.	DATE
FEE DETERMINATION			
O.I.P.E. CLASSIFIER	[illegible]	[illegible]	2/2
FORMALITY REVIEW	[illegible]	1027	02/28/01
RESPONSE FORMALITY REVIEW	[illegible]	901	6-5-01

INDEX OF CLAIMS

✓ .... Rejected
= .... Allowed
— (Through numeral)... Canceled
÷ .... Restricted
N .... Non-elected
I .... Interference
A .... Appeal
O .... Objected

Claim Final	Claim Original	Date 01/16/03	7-24-03	3-29-04	5-8-0?	11-16-0?
	1	✓	✓	+		
	2	✓	✓	+		
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If more than 150 claims or 10 actions staple additional sheet here

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CL 000289

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02/20/01

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SEARCHED

Class	Sub.	Date	Exmr.
84	609 601 602 611-614	01/08/03	[illegible]
707	104.1 3 4 102		
386	46	7-24-03	CZR
707 386	3 4 102 46	6-8-04	CZR

SEARCH NOTES
(INCLUDING SEARCH STRATEGY)

	Date	Exmr.
SEARCHED EAST (USPAT; US-PG PUB EPO; JPO; DERWENT; IBM TDB) SEARCH NOTES ATTACHED	01/08/03	[illegible]
East	7-24-03	CZR
East	6-8-04	CZR

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
707 386	3 4 102 46	6-8-04	CZR

CL 000290

(RIGHT OUTSIDE)

ATTACH
DISK/FICHE/CD-ROM
ENVELOPE
HERE

(RIGHT INSIDE)

CL 000291

CLASSIFICATION NOTES

Examiner/ Classifier	Class	Date	Initials

ATTACH
DISK/FICHE/CD-ROM
ENVELOPE
HERE

(RIGHT INSIDE)

CL 000293

PATENT APPLICATION

09755723

JC841 U.S. PTO
09/755723
01/05/01

FEB 02 0194

INITIALS ______

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EXHIBIT
R

Gadgets : Mac

Inside Look at Birth of the IPod

Leander Kahney 07.21.04

Tony Fadell sold Apple on the idea of an MP3 player linked to an online music store, according to Ben Knauss, who worked with Fadell to bring the iPod to life. "This is the project that's going to remold Apple and 10 years from now, it's going to be a music business, not a computer business," Fadell predicted in early 2001.

The iPod's development is shrouded in secrecy and rumor; but for the first time, an insider has agreed to tell the story of the device's development.

Ben Knauss is a former senior manager at PortalPlayer, the company Apple Computer approached to help develop an MP3 player that would eventually become the wildly popular iPod.

Knauss shared his firsthand knowledge of the device's development, the glitches that almost killed it, and the extraordinary steps Apple took to keep the iPod a secret.

Knauss, who acted as the primary liaison between Apple and PortalPlayer, quit the company in 2001. According to Knauss, the iPod originated with a business idea dreamed up by Tony Fadell, an independent contractor and hardware expert who'd helped develop handheld devices at General Magic and Philips.

"Tony's idea was to take an MP3 player, build a Napster music sale service to complement it, and build a company around it," Knauss said. "Tony had the business idea."

Knauss said Fadell left Philips and set himself up as an independent contractor to shop the idea around. Knauss said Fadell approached several companies and was turned away by all of them, except for Apple.

Apple hired Fadell in early 2001 and assigned him a team of about 30 people -- "a typical industrial design team," Knauss said, including designers, programmers and hardware engineers. He's currently the senior director of iPod & Special Projects Group at Apple.

Knauss said at one of the first meetings with PortalPlayer, Fadell said, "This is the project that's going to remold Apple and 10 years from now, it's going to be a music business, not a computer business."

"Tony had an idea for a business process and Apple is transforming itself on his whim and an idea he had a few years ago," Knauss added.

Knauss said Fadell was familiar with PortalPlayer's reference designs for a couple of MP3 players, including one about the size of a cigarette packet. And though the design was unfinished, several prototypes had been built. "It was fairly ugly," he said. "It looked like an FM radio with a bunch of buttons." The interface, Knauss said, "was typical of an interface done by hardware guys."

But Knauss said Fadell recognized the design's potential. "Tony figured the product was there."

"(PortalPlayer) was attractive to Apple because we had an operating system," said Knauss. "That was a real selling point for Apple. We had the software and the hardware already done, and Apple was on a tight schedule."

Knauss said the reference design was about 80 percent complete when Apple came calling. For example, the prototype wouldn't support playlists longer than 10 songs. "Most of the time building the iPod was spent finishing our product," Knauss said.

At the time, PortalPlayer had 12 customers designing MP3 players based on the company's reference design. Most were Asian hardware manufacturers, Knauss said, but also included Teac and IBM.

Big Blue planned a small, black MP3 player, based on the company's own mini hard drives, which featured a unique circular screen and wireless Bluetooth headphones. "The design for IBM was a lot sexier," Knauss said.

But PortalPlayer went exclusively with Apple. "When Apple came to the table, we dropped all our other customers," Knauss said. For the next eight months, the company's 200 employees in the United States and 80 engineers in India worked exclusively on the iPod, Knauss said.

Apple had a list of features it wanted added to the reference design: Apple's preferred music format, AAC, as well as Audible's audio book format, and a five-band equalizer.

Apple also wanted a new interface, which it designed in-house in about three months, Knauss said.

And while Fadell may have had the business plan, Apple CEO Steve Jobs molded the device's shape, feel and design.

"The interesting thing about the iPod, is that since it started, it had 100 percent of Steve Jobs' time," said Knauss. "Not many projects get that. He was heavily involved in every single aspect of the project."

At the beginning of the project, Jobs held meetings about the iPod every two to three weeks, but when the first iPod prototypes were built, Jobs became involved daily.

"They'd have meetings and Steve would be horribly offended he couldn't get to the song he wanted in less than three pushes of a button," Knauss said. "We'd get orders: 'Steve doesn't think it's loud enough, the sharps aren't sharp enough, or the menu's not coming up fast enough.' Every day there were comments from Steve saying where it needed to be."

Knauss said Jobs' influence was sometimes idiosyncratic. For example, the iPod is louder than most MP3 players because Jobs is partly deaf, he said. "They drove the sound up so he could hear it," Knauss said.

Knauss noted that there were no demands to add FairPlay, Apple's copy-protection technology, which was appended to the second-generation iPod to coincide with the introduction of the iTunes music store.

"There was no discussion of (digital rights management)," Knauss said. "Their belief was DRM would hurt sales when they rolled out the music store. They specifically wanted no DRM in the original iPod."

Knauss said all the iPod prototypes -- and there were several -- were sealed tight inside a reinforced plastic box about the size of a shoebox.

"They put the buttons and the screen in creative locations all over the box so people couldn't tell what product was inside it and how small it was," Knauss said. "They always put the controls in different places -- the scroll wheel on the side, the screen on the top -- to make sure it wasn't predictable what the end design was. The only thing accessible was the jacks."

Knauss said the iPod project was nearly killed just as it drew to completion. Tests showed the iPod drained its batteries even when powered down. "It would have run three hours before going dead, and that was when it was turned off," Knauss said.

"The production lines had already been set up," Knauss said. "That was a tense part of the project: For eight weeks they thought they had a three-hour MP3 player."

Knauss said the problem was eventually fixed and shortly after, Apple bought a majority stake in the company.

Knauss stayed on until near the end of the iPod's development, but quit shortly before it was released because he had no confidence it would be a success.

"It was probably a mistake, but then you have to go with what you think at the time," he said.

Knauss, 33, is now contracting for Microsoft.

Apple, IBM and PortalPlayer did not respond to requests for comment, though PortalPlayer confirmed Knauss had been employed as a senior manager.

1. New Yorker's Remnick Says He Won't Censor to Make Apple Happy
2. Student Sues School for Damages in Sexting Case
3. When It Comes to PR, Facebook Does Know What a Real 'Friend' Is
4. Shadow is the Likely Successor to Motorola Droid
5. Darpa's Super Sniper Scopes in Shooters' Hands by 2011
6. House GOP Launches a Republican Reddit
7. CIA Mulled Saddam Gay Sex Vid, Made Osama Tape Instead
8. Video: The Butterfly Effect on the Sun's Surface
9. LimeWire Begs Music Industry for Second Chance
10. Spyware Installed on Student Laptops Has More Security Problems

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Posted by: wired200905271901 127 days ago 1 Point

A shorter version is that some people saw what Kane Kramer had done in the 1970s with his IXI digital player. Then the Koreans at Eiger Labs brought out the flash-based MP3Man in the mid-90s and everyone copied them. Then in 1999 Compaq brought out t...

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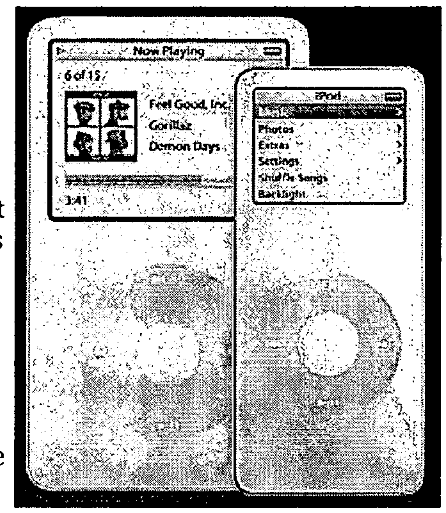
EXHIBIT
S

The Apple Core

iPod UI: Love it or hate it?

By Jason D. O'Grady | June 9, 2006, 7:05am PDT



I struck a nerve earlier this week with a comment I made about the iPod user interface being tired. The problem I have is that while the hardware has evolved, the iPod's UI hasn't changed much in five years.

One of the reasons that the iPod is so successful, it can be argued, is because **the interface is drop dead simple**. So simple in fact that young children and seniors alike can pick it up with ease. This is a point that I'm willing to concede, but if the iPod is going to continue its ascension to the heights of consumer electronics legend, new features need to be added.

For starters, the interface itself is mostly black and white, with the exception of the My Rating stars, the battery icon, progress bar and the album artwork. It would be great to have a couple of Apple designed skins to choose from with different themes. It would be even better if Apple provided an SDK so that people could design their own themes.

It would be great if it were easier to create and edit playlists on the iPod and I'd love to be able to delete a song or playlist on the fly. Scrolling through long lists of artists and songs can be arduous on a full iPod. A search function or type-ahead using a virtual keyboard and intelligent auto-complete would be a great way to easily find a needle in the haystack.

The iPod's "now playing" interface needs an overhaul too. I'd like to be able to customize it to show whatever ID3 tags that I want (BPM, for example). And now that all iPods (save the shuffle) have color displays they should be able to show full-screen album artwork. I know that it could be a battery issue but displaying iTunes visualizers on the iPod would be great too. What about scrolling lyrics?

Meta data is king and I'm a huge proponent of using ID3 tags to organize my music but there's no way to edit this data on the iPod itself - short of changing the rating. I'd like a virtual keyboard that pops up allowing me to edit any of the ID3 tags at any time. Currently I'm forced to change the rating of a song to remind me to correct the ID3 tags later.

I was optimistic back in February when Apple filed a patent for a touch-screen iPod interface. Apple's application shows a landscape-mode iPod running a mini version of iTunes which would be the ideal replacement for the drill-down interface that the iPod currently uses.

What would you change about the iPod UI? Or is it perfect as it is?

Jason D. O'Grady is the editor of PowerPage.org, which has been publishing daily mobile technology news since December 1995.

Disclosure

Jason O'Grady is the creator and editor of O'Grady's PowerPage, which has been publishing mobile technology news since 1995. Mr. O'Grady maintains an advertising relationship with the following legacy advertisers on the PowerPage:

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All other advertising on the PowerPage is brokered by a third-party agency (BackBeat Media) and Mr. O'Grady recuses himself from these negotiations.

Biography

Jason D. O'Grady is the editor of PowerPage.org, which has been publishing daily mobile technology news since December 1995. Jason has contributed to MacWEEK, Macworld, MacAddict, MacPower (Japan), and written chapters for The Macintosh Bible, Eighth Edition and The Macintosh Bible, Panther Edition (Peachpit Press). He also co-founded the first dedicated PowerBook User Group (PPUG) in the United States.

EXHIBIT
T

August 30, 2007
Nokia to Introduce Digital Music Service
By ERIC PFANNER

LONDON, Aug. 29 ‹ In the same converted 19th-century fish market where Apple announced the European introduction of its iTunes music store three years ago, Nokia said on Wednesday that it would soon introduce its own digital music service, along with an easier-to-use Apple-style mobile interface and an Apple-style touchscreen handset.

The Nokia Music Store, to open this year, will let users download songs from the Internet to their computers or directly to mobile phones over wireless networks, which Apple¹s recently released iPhone cannot do.

Analysts said the move heightened the rivalry between Nokia and Apple at the high end of the mobile phone business. ³It was obviously going straight at Apple,² said Seamus McAteer, senior analyst at M:Metrics, a research firm.

While Nokia executives chose suits and ties rather than the black mock turtlenecks and blue jeans favored by Steven P. Jobs, Apple¹s chief executive, they acknowledged that Nokia was not above imitating its rival.

³I don¹t know what is copying and what is original but if there is something good in the world, we copy it with pride,² said Anssi Vanjoki, head of the Nokia multimedia division, which makes the company¹s high-end handsets, when asked about similarities between the iPhone, iTunes and the new devices and services announced by Nokia.

In offering direct downloads, the Nokia Music Store goes beyond iTunes, which requires users to download songs to their personal computers before transferring them to an iPod music player or an iPhone.

The Nokia store, which the company said would be made available first in important European markets, could put pressure on Apple to develop a similar service, analysts said.

The music store also potentially puts Nokia into conflict with operators of mobile networks, which in many cases have developed music services of their own.

But analysts say that outside of Asia, mobile phone services like music have been relatively slow to take off, despite the tens of billions of dollars that network operators have poured into the technology to enable them.

³Now Nokia is saying, ŒYou guys had your chance to run music stores, or whatever, and it didn¹t work, so now we¹re going to give consumers what they

want,' ' said Paul Jackson, an analyst at Forrester Research.

In addition to the music store, Nokia said it would revive a game platform called N-Gage, with a number of video game publishers agreeing to supply games to download. The company said it would make all of its mobile content and Internet services available under the brand Ovi, which means door in Finnish.

Nokia, which is based in Finland, showed pictures and video clips of the interface that will allow users to navigate through the various Ovi services. Analysts said it appeared to resemble the interfaces for the iPod, iPhone and iTunes, whose simplicity has been seen as a chief selling point.

But analysts said they were frustrated by a lack of detail about the Ovi offerings.

'It's a bit of an empty shell for now,' said Mark Newman, chief research officer at Informa Telecoms and Media.

Nokia also introduced several phone models on Wednesday with increased storage capacity for music and other media content and said it would introduce its touchscreen phone next year.

While Nokia clearly has one eye on Apple, analysts said network operators might more directly feel its move into services, and that could affect relationships with device manufacturers.

Orange, which is part of France Télécom, for example, has a partnership with the phone maker Sony Ericsson, under which its Walkman-branded phones send users to the Orange music store at the touch of a button. Apple, meanwhile, has signed an exclusive iPhone distribution agreement with AT&T in the United States and is reportedly pursuing similar arrangements for the pending introduction of the phone in Europe.

Analysts said mobile operators who agreed to carry certain Nokia multimedia phones might try to demand that the company disable features that overlap with the carriers' own services.

Yet Nokia has a strong negotiating position, analysts added, because it sells about 400 million phones a year ‹ more than one-third of the global market ‹ so the network operators might not be able to drop a popular handset from their lineups.

Despite all the jockeying for position, the appeal of mobile download services remains uncertain. Even in the leading European market for mobile music, Britain, fewer than 3 percent of cellular subscribers downloaded songs wirelessly in January, according to M:Metrics. About 12 percent of subscribers, meanwhile, listened to music that had been transferred to their phones from personal computers.

[3]How to get them to switch over to something like the Nokia music store remains unclear,[2] said Martin Garner, an analyst at Ovum.

Nokia said it would price music downloads at 1 euro for each song, or 10 euros for each album, in the same price range as many existing mobile music services. In addition, customers would have to pay for the use of phone networks for the download, though many operators are starting to offer monthly flat-fee packages.

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Audio navigation for your iPod


By Staska on 04 May 06

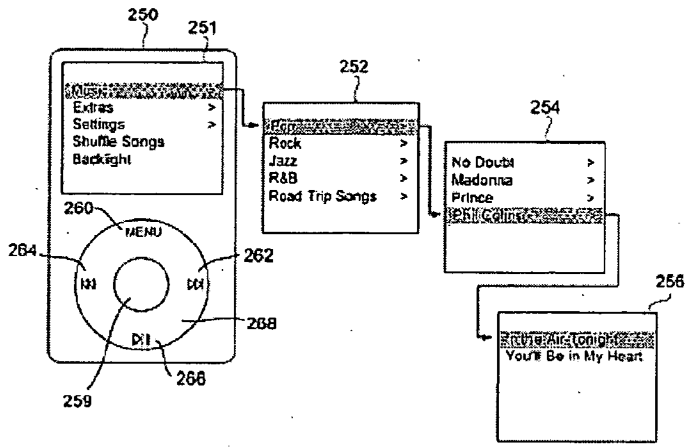
One of the key factors in Apple's iPod success was it's convenient user interface for navigating through the huge music libraries stored inside the player. And this user interface might get even better soon â€“ it seems that Apple plans to add audio navigation to the iPods.

One of the problems when searching for a particular song or changing playlists is that you have to look at the tiny screen when navigating to the right place. This is particularly troublesome if you forgot your glasses or can not shift your eyes from other things you are doing. Like crossing the street, jogging or driving and watching the road ahead.

Now Apple may have found solution for this problem – Audio navigation interface. In patent application made public today Apple describes such a system for automatic generation of audio navigation tags for your iPod.

The tags are generated from the metadata of your music or video files – the text information like author, song name and duration, film director or lead actor name, etc;- which comes with a song or video that you download from iTunes store. This text information is then converted using text-to-speech software into a small audio files – audio navigation tags. The iPod computing capabilities are too small to do a good text-to speech translation, so this operation is carried out on your Mac or PC.

Audio navigation tags then are attached to the songs or videos themselves and transferred to you iPod. When getting there, audio navigation tags can be stored with the songs themselves or transferred to a separate database and then synchronized with the navigation menu. The same audio information can be generated for user playlists and every song in the playlist.



So for example when an iPod user wants to play “In the air tonight” by Phil Collins he navigates to the song using his preferred path: “Menu”->”Music”->”Pop”->”Phil Collins”->”In the air tonight”->”Play”. However instead of having to look at the screen, all along the way he hears audio prompts advising him on the next navigation steps.

Now, audio navigation menus are used in various business applications for a long time and there’s not much to patent here. However the clever thing with this particular Apple’s patent seems to be the way they solved the dynamic synchronization problem for constantly changing metafiles of huge music collections stored on the iPod.

By dynamically generating audio tags in iTunes on your computer when song is downloaded or playlist is created and then synchronizing it with the iPod, Apple is able to make audio navigation as easy to use and update as current text navigation system.

And since no hardware and navigation control changes are necessary, audio navigation can be added to current iPods through simple software update.

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- Quick thoughts on Yahoo deal. Nokia gives-up on OVI Mail and Chat development. Great news!
- Chat with Julien Fourgeaud about Symbian, Symbian^3, Nokia N8 and other stuff
- Interview with Eldar Murtazin, part 2. Nokia's reaction to N8 leak, security issues at Nokia, and a bit about

Eseries.

- Interview with Eldar Murtazin, part 1. Nokia N8 leak, market prospects and Symbian^3
- Some thoughts on Nokia N8 and Nokia's device strategy

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CREATIVE ZEN MICRO PHOTO WINS "BEST OF CES" AWARD

ZEN Micro Photo -- MP3 Player/Photo Viewer Steals the Show to Win Creative's Third Consecutive "Best of CES" Award

SINGAPORE - January 10, 2005 - Creative (NASDAQ: CREAF), a worldwide leader in digital entertainment products, today announced that its MP3 player/photo viewer - the ZEN Micro Photo, won the "Best of CES" 2005 award in the "Audio to Go" category. This is the third consecutive year that Creative has won a "Best of CES" award.
Featuring a stunning, high-intensity 262,144-color 1.5" OLED screen, the Creative ZEN Micro Photo can hold up to 7,500 JPEG images or 3,000 songs on a 6GB model. Users can watch slide shows of their favorite digital images while they listen to MP3 or WMA music. The ZEN Micro Photo also includes all the features of the award-winning Zen Micro MP3 player.

The micro-sized ultra-cool looking ZEN Micro with its ten electrifying colors took the market by storm after its launch during the holiday season, selling out in major retailers and online sites. Creative accelerated the excitement and momentum with the introduction of the new ZEN Micro Photo at CES.

"The success of the original ZEN Micro has been so great that it was tough to deliver an encore in such a short period of time. Yet we blew everyone away when we unveiled the ZEN Micro Photo and won the 'Best of CES' award for the third time in a row," said Sim Wong Hoo, chairman and CEO of Creative. "Huge crowds have been swarming around our exhibit and everyone is talking about the ZEN Micro. We raised the excitement level even higher when we introduced the ZEN Micro Photo, which features an OLED screen for amazing image quality. The judges for 'Best of CES' had never seen anything like it."

Slated to ship in the second quarter of this year, the ZEN Micro Photo will be available in ten electrifying colors in 5GB and 6GB models, in the same micro-sized, ultra-cool looking form factor as the original ZEN Micro. The ZEN Micro Photo in a 5GB model will be priced at US$299, and the ZEN Micro Photo in 6GB will be priced at US$349. More information about the Creative ZEN Micro Photo will be available in coming months at www.creative.com.

About Creative
Creative (NASDAQ: CREAF) is a worldwide leader in digital entertainment products for PC users. Famous for its Sound Blaster® sound cards and for launching the multimedia revolution, Creative is now driving digital entertainment on the PC platform with products like its highly acclaimed MuVo® and ZEN portable audio players. Creative's innovative hardware, proprietary technology, applications and services leverage the Internet, enabling consumers to experience high-quality digital entertainment -- anytime, anywhere.

###

This announcement relates to products launched in the Asia Pacific. The product names, prices and availability are subject to change without notice and may differ elsewhere in the world according to local factors and requirements. MuVo and Sound Blaster are registered trademarks of Creative Technology Ltd. in the United States and other countries. All other brand names are trademarks of their respective owners.

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CREATIVE ZEN VISION:M WINS "BEST OF CES" AWARD IN MP3 AND PORTABLE VIDEO CATEGORY AND ALSO WINS OVERALL "BEST IN SHOW" AWARD

Creative Wins "Best of CES" for the Fourth Consecutive Year

Singapore - January 9, 2006 - Creative (NASDAQ: CREAF), a worldwide leader in digital entertainment products, today announced that the ZEN Vision:M portable media player won the "Best of CES" 2006 award in the MP3 and Portable Video category and that it also won the overall "Best in Show" award. This is the fourth consecutive year that Creative has won a "Best of CES" award.
Selected by CNET's unbiased, expert editors, winners were recognized as the hottest products in their respective technology categories for their unmatched innovation and creativity, and their ability to excite consumers and make their way into everyday life. CNET's editors received and reviewed hundreds of entries, and combed the CES show floor for products to consider for the prestigious award.

"The Consumer Electronics Show (CES) is the largest trade show in the United States, and the Creative ZEN Vision:M beat thousands of other companies and all the big names in consumer electronics from all over the world to win not only the 'Best of CES' award for the MP3 and portable video category, but also the overall 'Best in Show' award as the best product at the entire CES 2006," said Sim Wong Hoo, chairman and CEO of Creative. "This is the most powerful endorsement one can have in our industry and it is a reaffirmation of our strategy to provide the coolest-looking, most feature-rich portable media players. The Zen Vision:M outclasses all the competition by providing more features, cooler design, 262,144 vivid colors, longer battery life and supporting numerous subscription and download music sites. It can carry up to 15,000 songs, 120 hours of video or tens of thousands of digital photos, and it comes in five gorgeous high-gloss colors. And now with this prestigious overall 'Best of CES' award, the Zen Vision:M can become the coolest MP3 and media player in the world."

"By winning a CNET Best of CES Award, the Creative ZEN Vision:M sets a standard within its sector for others to follow," said Brian Cooley, editor at large at CNET.com. "Each year at CES, CNET scours the show floor to bring extensive coverage to our passionate community of consumers, who look to our editors for the best new products at the show, and the Creative Zen Vision:M is without doubt one of the hottest products at CES 2006."

The ZEN Vision:M supports music subscription services including Yahoo! Music Unlimited, Napster To Go and Rhapsody To Go. The Zen Vision:M also supports downloads from online music stores including Yahoo! Music, Soundbuzz, Napster, MSN Music and AOL Music Now. The rechargeable battery provides up to 14 hours of music playback. The Zen Vision:M delivers up to four hours of video playback and provides extensive video format support, including MPEG-2, MPEG-4 Simple Profile formats such as Xvid, WMV, and MJPEG. The Zen Vision:M also supports TiVoToGo for free viewing of TV shows recorded on a TiVo personal video recorder, digitized home movies transferred from the PC, and video blogs from ZenCast.com and companies such as RocketBoom.

About Creative
Creative (NASDAQ: CREAF) is a worldwide leader in digital entertainment products for PC users. Famous for its Sound Blaster® sound cards and for launching the multimedia revolution, Creative is now driving digital entertainment on the PC platform with products like its highly acclaimed Zen™ and MuVo® MP3 players. Creative's innovative hardware, proprietary technology, applications and services leverage the Internet, enabling consumers to experience high-quality digital entertainment -- anytime, anywhere.

This announcement relates to products launched in the United States. The product names, prices and availability are subject to change without notice and may differ elsewhere in the world according to local factors and requirements. ZEN, MuVo and Sound Blaster are trademarks or registered trademarks of Creative Technology Ltd. in the United States and other countries. All other brand names are trademarks of their respective owners.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent No.:	6,928,433	Reexam Control No.:	95/001,274
Original Issue Date:	August 9, 2005	Examiner:	STEELMAN, MARY J.
Original Serial No.:	09/755,723	Group Art Unit:	3992
Original Filing Date:	January 5, 2001	Confirmation No.:	6990
By:	Ron Goodman, Howard N. Egan, David Bristow		
For:	AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA		

INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §§ 1.98 AND 1.555

Mail Stop *Inter Partes* Reexam
ATTN: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Patent Owner submits herewith patents, publications or other information listed on the accompanying Substitute Form PTO-1449 that may be material to the reexamination of the above-captioned patent, and in respect of which there may be a duty of disclosure as set forth in 37 CFR § 1.555, for consideration and to be made of record in the above-captioned reexamination by the U.S. Patent and Trademark Office.

I. Applications and Patents Related to U.S. Patent No. 6,928,433

U.S. Patent No. 6,928,433 ("the '433 patent") was filed on January 5, 2001, and issued on August 9, 2005, from U.S. Patent Application No. 09/755,723.

The '433 patent is related to other U.S. applications and patents. These include: U.S. Patent Application Serial No. 09/755,629 (the "'629 Application), entitled "System for Selecting and Playing Songs in a Playback Device with a Limited User Interface," now abandoned; U.S. Patent No. 6,590,730 (the "'730 Patent"), entitled "Audioplayback Device with Power Savings Storage Access Mode"; and U.S. Patent Application Serial No. 11/033,465 (the "'465 Application"), which is a pending continuation of the '433 patent. Relevant data concerning the '629 Application, the '730 Patent, and the '465 Application is presented in the tables below:

Serial No.	09/755,629
Filed	January 5, 2001
Status	abandoned

Serial No.	09/755,367
Filed	January 5, 2001
Status	patented
Patent No.	6,590,730
Issue Date	July 8, 2003
Publication No.	US 2002/0089774 A1
Publication Date	July 11, 2002

Serial No.	11/033,465
Filed	January 10, 2005
Status	pending
Publication No.	US 2005/0187976 A1
Publication Date	August 25, 2005
Priority Data	U.S. Application No. 09/755,723

The '629 Application, the '730 Patent, and the '465 Application are hereinafter referred to as the "related patents and applications."

A. Information From Related Patents and Applications

Cite Nos. A1-A8 and **B1** on the accompanying Substitute Form PTO-1449 are publications of the above identified related patents and applications.

Information made of record during the prosecution of the related patents and applications that is not already of record in the captioned patent or instant reexamination is being cited herein. Specifically, **Cite Nos. A1-A8** correspond to U.S. patents and published applications disclosed in one or more of the related patents or applications; **Cite No. B1** corresponds to a non-patent document disclosed in one or more of the related patents or applications.

B. Office Actions and Responses From Related Patents and Applications

Consistent with the holdings in *Larson Mfg Co. v. Aluminart Products, Ltd*, 90 USPQ2d 1257 (Fed. Cir. 2009), *McKesson Information Solutions v. Bridge Medical, Inc.*, 82 USPQ2d 1865 (Fed. Cir. 2007), and *Therasense, Inc. v. Becton, Dickinson & Co.*, 93 USPQ2d 1489 (Fed. Cir. 2010), copies of office actions, responses thereto, and certain other miscellaneous papers in each of the related patents and applications are listed on the attached Substitute Form PTO-1449 under the Cite Nos. referenced below:

Related Patent or Application	Cite Nos.
U.S. Patent Application Serial No. 09/755,629	C1-C5
U.S. Patent Application Serial No. 11/033,465	D1-D10

II. United States Litigations Involving U.S. Patent No. 6,928,433

A. *Creative Technology Ltd. v. Apple Computer, Inc.*, Case No. 4:06-cv-03218-SBA

On May 15, 2006, Creative Technology Ltd., the instant patent owner, filed suit in the Northern District of California against defendant Apple Computer, Inc., alleging infringement of the above-captioned '433 patent. On May 17, 2006, defendant answered the complaint, pleading various defenses. On August 29, 2006, plaintiff and defendant stipulated to dismissal with prejudice of all claims asserted.

The Complaint for Patent Infringement; Apple Computer, Inc's Answer to Creative Technology Ltd.'s Complaint; and Stipulated Dismissal, filed and/or served by the parties in compliance with the Federal Rules, are listed on the accompanying Substitute Form PTO-149 under **Cite Nos. E1-E3**.

B. *In the Matter of Certain Portable Digital Media Players*, ITC Inv. No. 337-TA-573

On May 15, 2006, Creative Labs, Inc. and Creative Technology Ltd. requested that the U.S. International Trade Commission ("ITC") institute an investigation pursuant to Section 337 of the Tariff Act of 1930, as Amended, based upon the importation and sale of Apple Computer, Inc. products allegedly infringing the above-captioned '433 patent. On July 6, 2006, Apple Computer, Inc. responded to the complaint, pleading various defenses. On August 29, 2006, Complainants and Respondent filed a joint motion to terminate the Investigation.

The Complaint Under Section 337 of the Tariff Act of 1930, as Amended; Response of Apple Computer, Inc. to the Complaint of Creative Labs, Inc. and Creative Technology Ltd.; and Joint Motion to Terminate the Investigation based on a Binding Term Sheet filed and/or served by the parties are listed on the accompanying Substitute Form PTO-1449 under **Cite Nos. F1-F3**.

III. References that Have Come to the Attention of the Patent Owner

Patent Owner also hereby identifies references that have come to its attention, and wishes to have made of record. **Cite Nos. G1-G8** listed on the accompanying Substitute Form PTO-1449 correspond to U.S. Patents that have come to the Patent Owner's attention. **Cite Nos. H1-H2** correspond to foreign patent documents that have come to the Patent Owner's attention. **Cite No. I1** corresponds to a non-patent document that has come to the Patent Owner's attention.

Although Document **Cite No. I1** is marked with a date, it is unknown to what this date refers or relates, and when, or if, this document was ever distributed or available to the public. Accordingly, the Patent Owner does not make any representations or admissions concerning the date indicated for **Cite No. I1** on the accompanying Substitute Form PTO-1449.

IV. General

1) ☒ In accordance with 37 CFR § 1.98, accompanying this Information Disclosure Statement are:

   1a. ☒ ***with the exceptions noted above***, copies of: (i) each foreign patent listed on the attached Substitute Form PTO-1449; (ii) each publication listed on the attached Substitute Form PTO-1449, or that portion which caused it to be listed, *other than* U.S. patents and U.S. patent application publications; (iii) for each pending unpublished U.S. application, a copy of the application specification including the claims, and any drawing of the application, or that portion of the application which caused it to be listed including any claims directed to that portion; and (iv) other information, or that portion which caused it to be listed herein or on the attached Substitute Form PTO-1449 (37 CFR § 1.98(a)(2)); and/or

   1b. ☒ a concise explanation of relevancy, or an English language translation, of non-English language publications listed on the attached Substitute Form PTO-1449 (37 CFR § 1.98(a)(3)(i) & (ii)).

2) ☒ This Information Disclosure Statement is filed under 37 CFR § 1.555(a):

   3a. ☐ within two months from the date of the order for reexamination;

3b. ☐ as soon as possible after two months from the date of the order for reexamination, and before a first office action on the merits.

The filing of this Information Disclosure Statement shall not be construed as a representation that a search has been made. The filing of this Information Disclosure Statement shall not be construed as a representation that no other material information as defined in 37 CFR § 1.555(a) exists. The filing of this Information Disclosure Statement shall not be construed to be an admission that any information cited herein is, or is considered to be, material to patentability as defined in 37 CFR § 1.555(b).

Moreover, although certain of the patents, publications and/or other information disclosed in this Information Disclosure Statement may be deemed to be "material" pursuant to 37 CFR § 1.555, the Disclosure is not intended to constitute an admission that any patents, publications and/or other information included or referred to herein is "prior art" to the captioned application unless specifically designated as such.

It is respectfully submitted that, as required by 37 CFR § 1.555, this Information Disclosure Statement is in compliance with 37 CFR § 1.98 and MPEP § 609. Accordingly, consideration of the foregoing and prompt return of a copy of the enclosed Substitute Form PTO-1449 with the Examiner's initials in the left column in accordance with MPEP § 609 are respectfully requested.

No fees are believed due in connection with this Information Disclosure Statement. However, the Director is authorized to charge any required fees, or credit any overpayment, to Dechert LLP Deposit Account No. 50-2778 (Order No. 380786-108980).

Respectfully submitted,

Date: June 1, 2010

Justin F. Boyce
Registration No. 40,920

DECHERT LLP
Customer No. 37509
Tel: 650.813.4800
Fax: 650.813.4848

A1

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

United States Patent [19]

Nigam

[11] **Patent Number: 4,984,103**

[45] **Date of Patent: Jan. 8, 1991**

[54] **METHOD FOR READING/WRITING FOR A FLOPPY DISC DRIVE WITH BUFFER MEMORY**

[75] Inventor: **Anil K. Nigam**, Cupertino, Calif.

[73] Assignee: **Fujitsu America, Inc.**, San Jose, Calif.

[21] Appl. No.: **332,023**

[22] Filed: **Mar. 30, 1989**

Related U.S. Application Data

[62] Division of Ser. No. 130,104, Dec. 7, 1987, Pat. No. 4,933,795.

[51] **Int. Cl.**[5] **G11B 19/20**; G11B 5/09

[52] **U.S. Cl.** **360/074.100**; 360/66; 360/69; 360/121; 360/75

[58] **Field of Search** 360/69, 71-72.2, 360/73.03, 74.1, 74.4, 75, 77.02, 78.01, 78.04, 86, 97.01, 98.01, 99.01, 48, 51, 57, 66

[56] **References Cited**

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FOREIGN PATENT DOCUMENTS

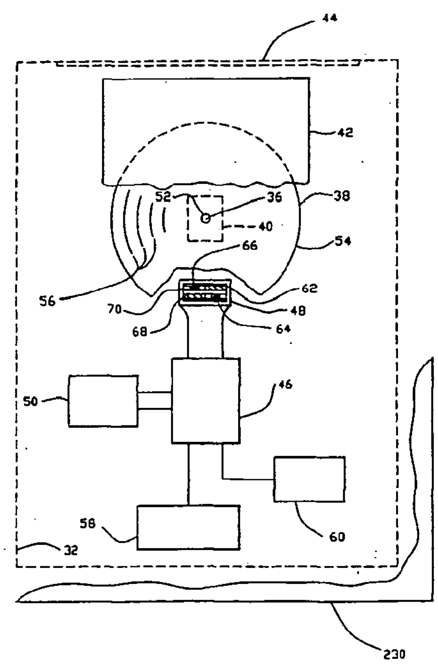
54-131833	10/1979	Japan	360/97.01
55-4731	1/1980	Japan	360/69

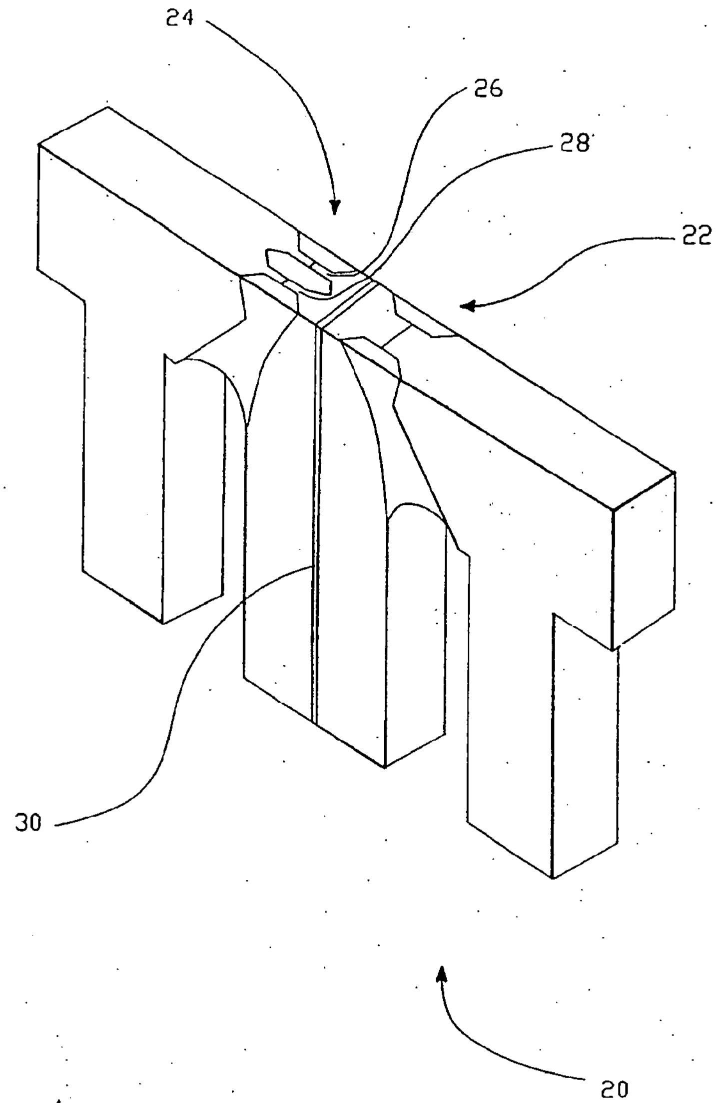
Primary Examiner—Aristolelis M. Psitos
Assistant Examiner—Steven R. Garland
Attorney, Agent, or Firm—Staas & Halsey

[57] **ABSTRACT**

A method for writing and reading for a floppy disc drive using a read/write head having a high density read/write gap and a low density read/write gap and a memory buffer. The method includes reading requested data and data ahead of the requested data from the disc and then storing the read data ahead of the requested data in a look-ahead memory buffer. Data stored in the look-ahead memory buffer is then read, instead of from the disc, when the next requested data is the same as the data stored in the memory buffer. There is no movement of the disc until reading of the data stored in the memory buffer is completed or until other data is requested that is needed directly from the disc. The above method reduces power consumption and provided an improved higher rate of read/write operation for a floppy disc drive that is particularly useful in a portable computer.

6 Claims, 14 Drawing Sheets





(PRIOR ART)

FIG.-1

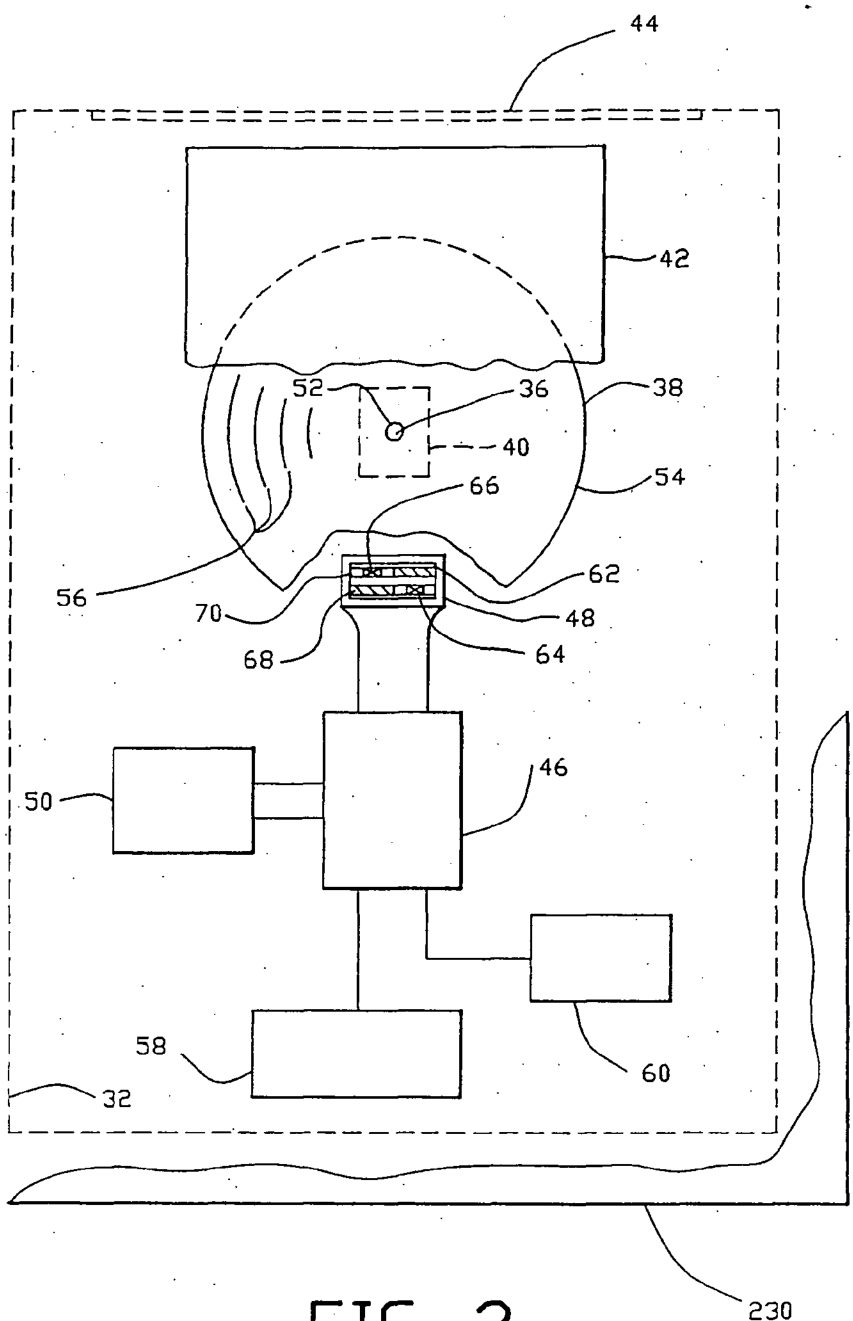
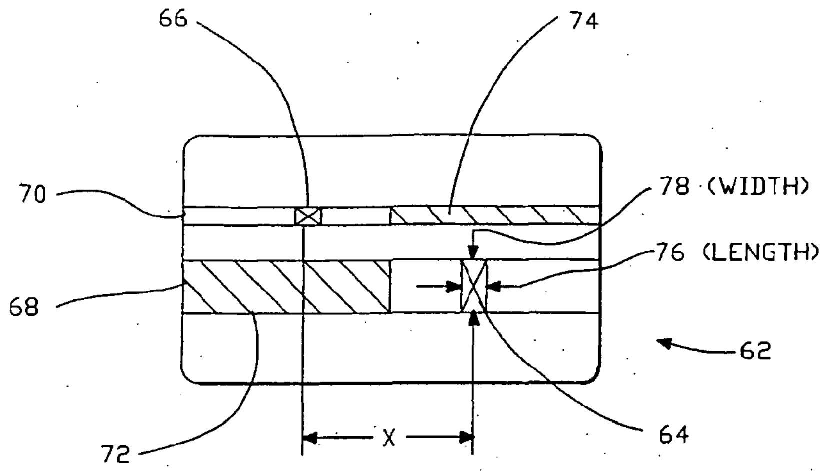
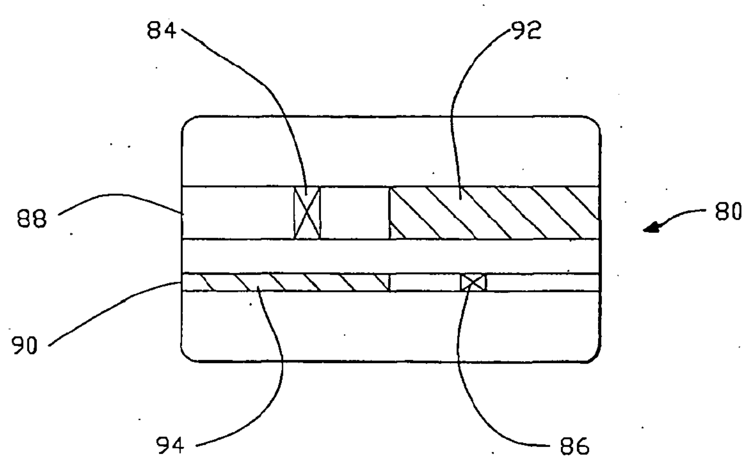


FIG.-2



LOWER GAPS

FIG.-3



UPPER GAPS

FIG.-4

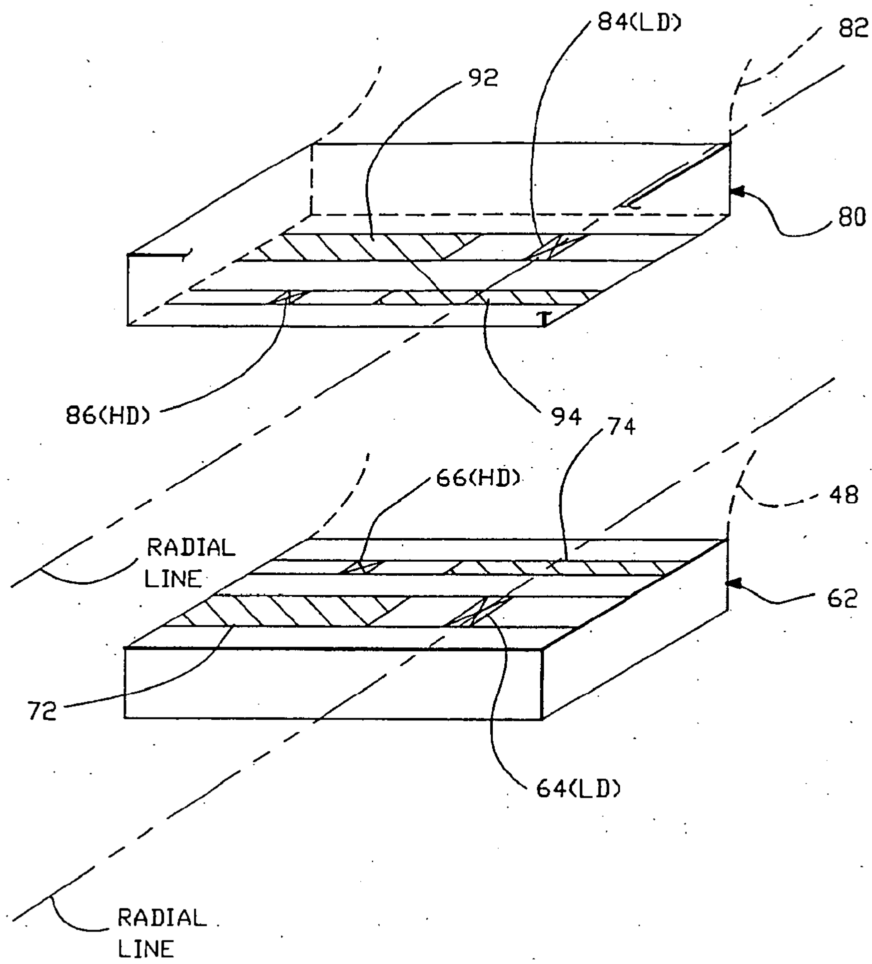

84(LD)
82
92
80
86(HD)
94
74
66(HD)
48
RADIAL
LINE
62
72
64(LD)
RADIAL
LINE

FIG.-5

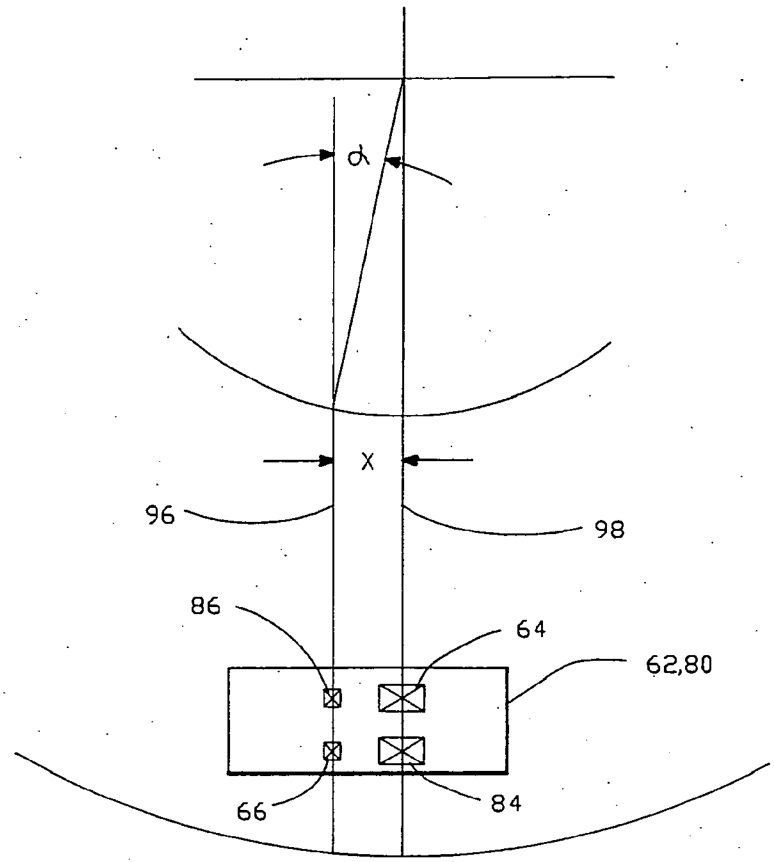


FIG.-6

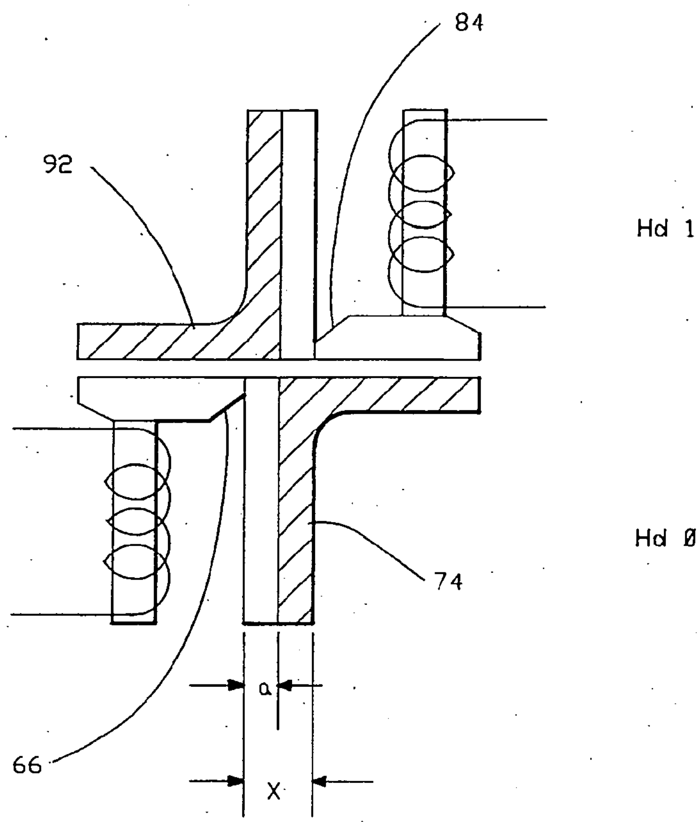


FIG.-7

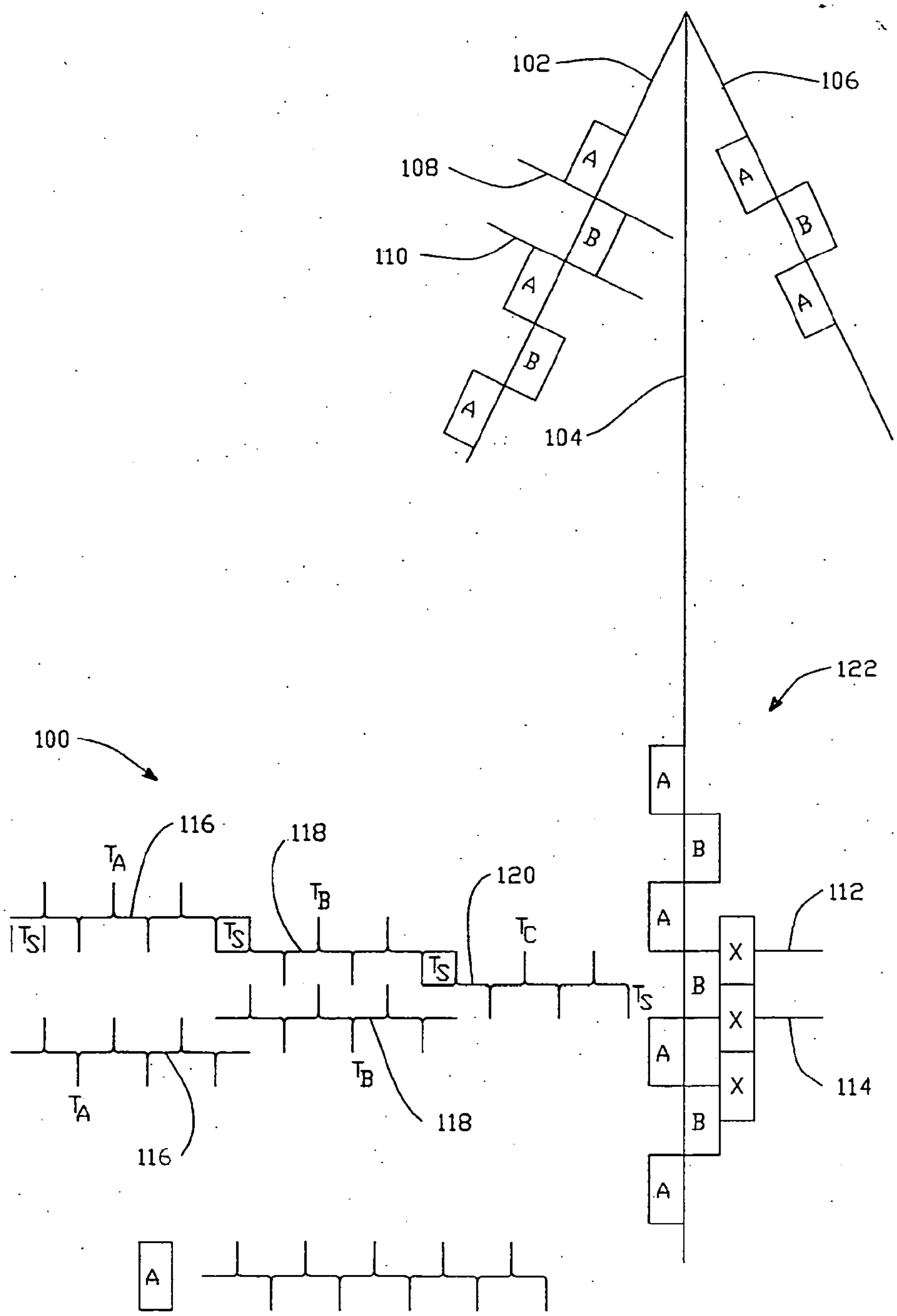


FIG.-8

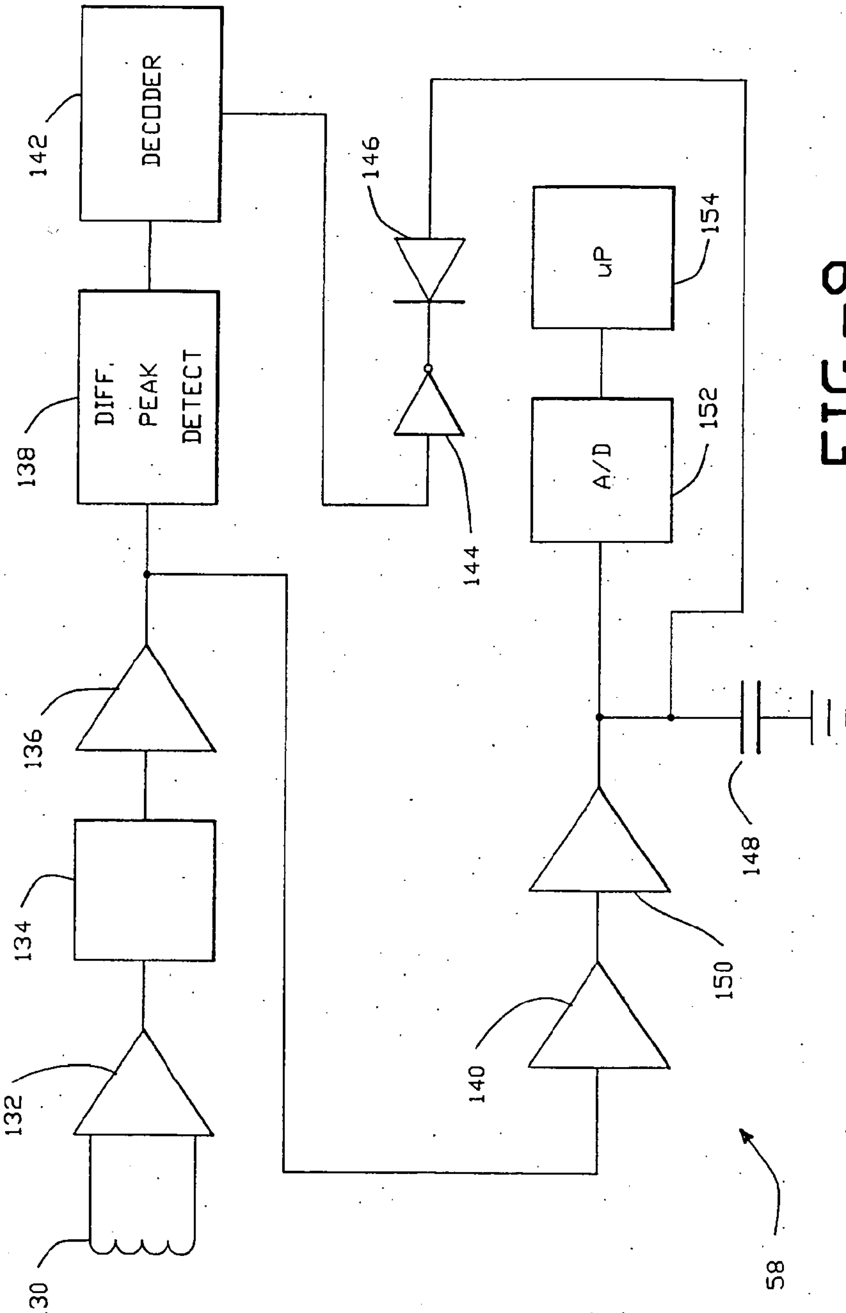

DECODER
142
146
uP
154
DIFF. PEAK DETECT
138
A/D
152
144
136
148
134
150
140
132
130
58

FIG.-9

SERVO FORMAT DETECTOR CIRCUIT FLOWCHART

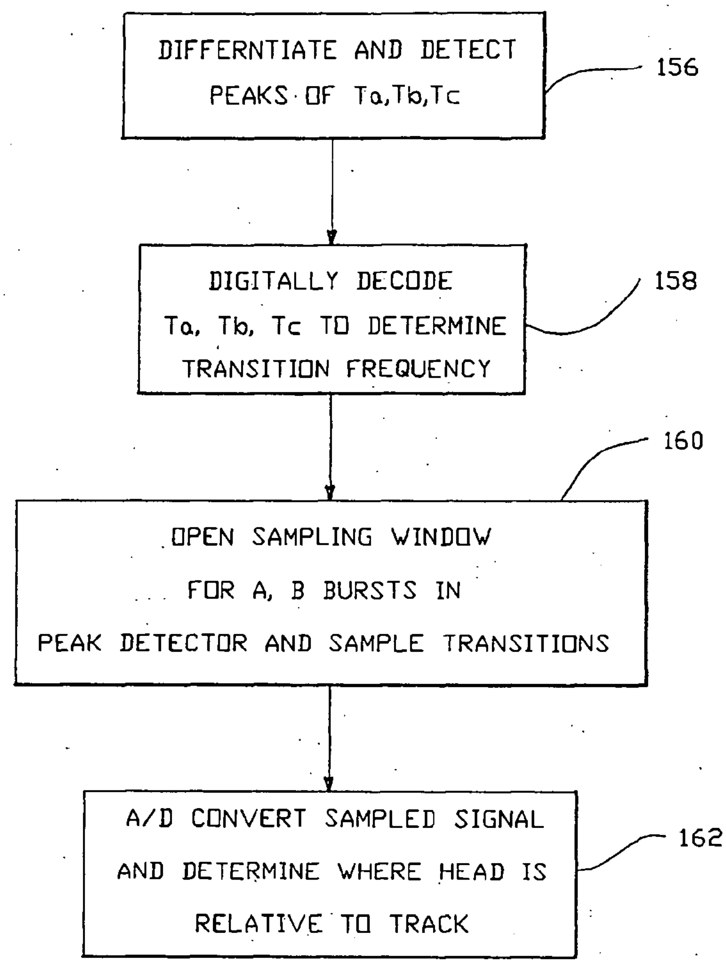


FIG.-10

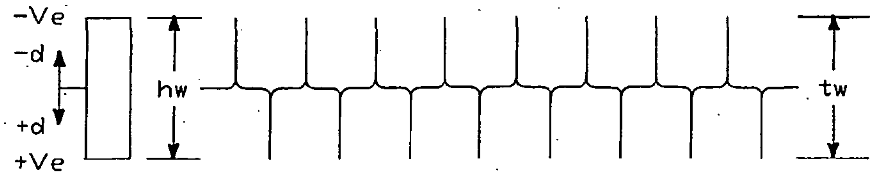

-Ve
-d
+d
+Ve
hw
tw

FIG.-11

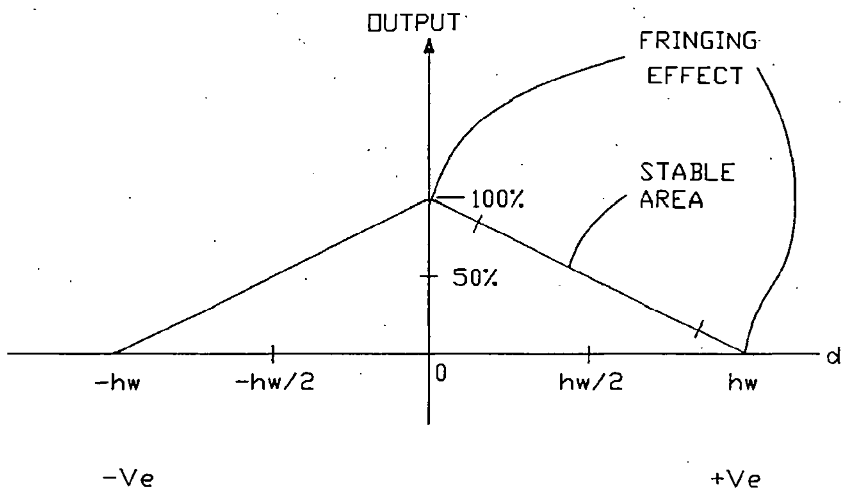

OUTPUT
FRINGING EFFECT
STABLE AREA
100%
50%
d
-hw
-hw/2
0
hw/2
hw
-Ve
+Ve

FIG.-12

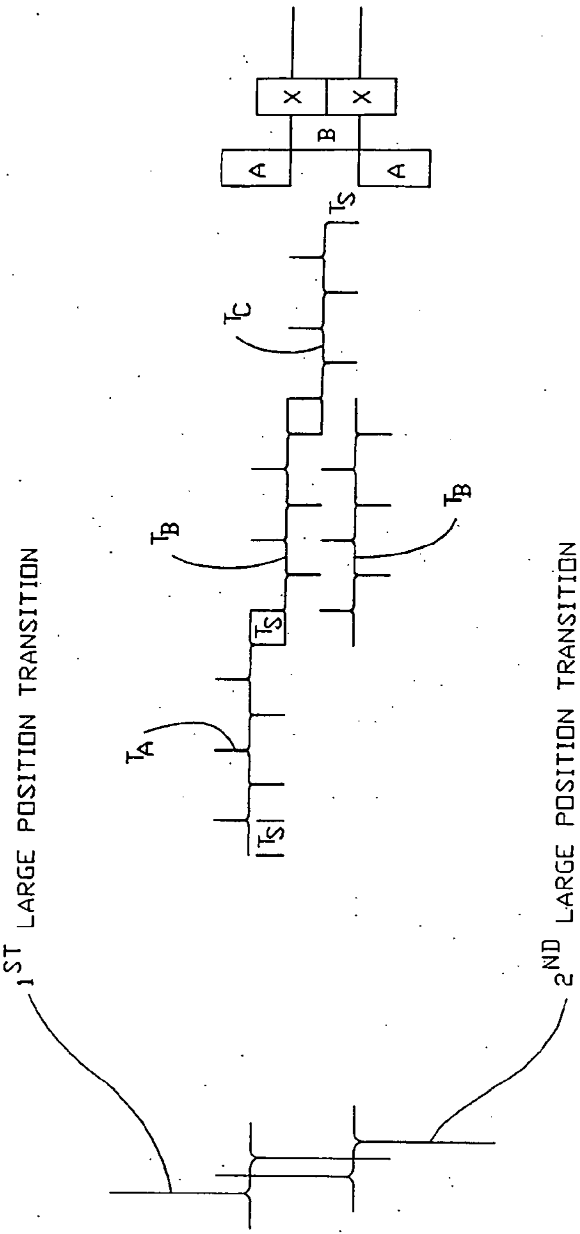

1ST LARGE POSITION TRANSITION
2ND LARGE POSITION TRANSITION
TA
TB
TB
TC
TS
TS
TS
A
B
A
X
X

FIG.-13

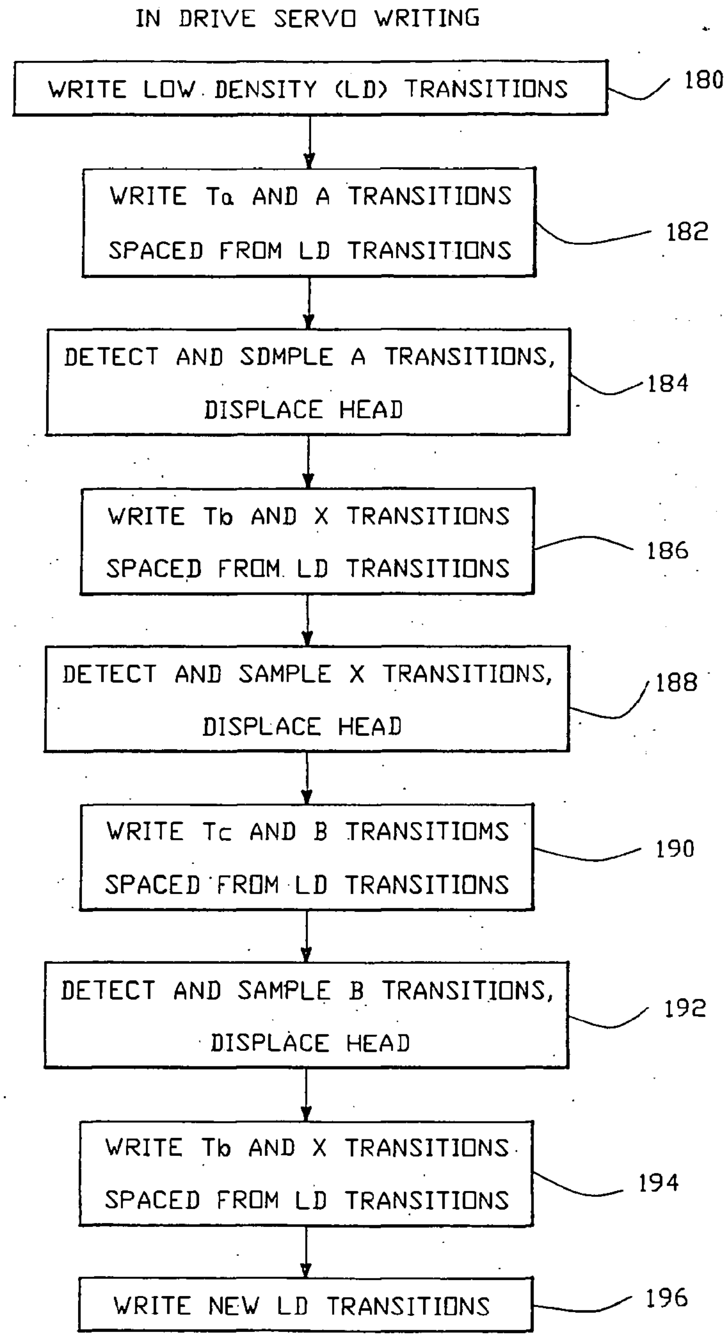

IN DRIVE SERVO WRITING
WRITE LOW DENSITY (LD) TRANSITIONS
180
WRITE Ta AND A TRANSITIONS SPACED FROM LD TRANSITIONS
182
DETECT AND SDMPLE A TRANSITIONS, DISPLACE HEAD
184
WRITE Tb AND X TRANSITIONS SPACED FROM LD TRANSITIONS
186
DETECT AND SAMPLE X TRANSITIONS, DISPLACE HEAD
188
WRITE Tc AND B TRANSITIOMS SPACED FROM LD TRANSITIONS
190
DETECT AND SAMPLE B TRANSITIONS, DISPLACE HEAD
192
WRITE Tb AND X TRANSITIONS SPACED FROM LD TRANSITIONS
194
WRITE NEW LD TRANSITIONS
196

FIG.-14

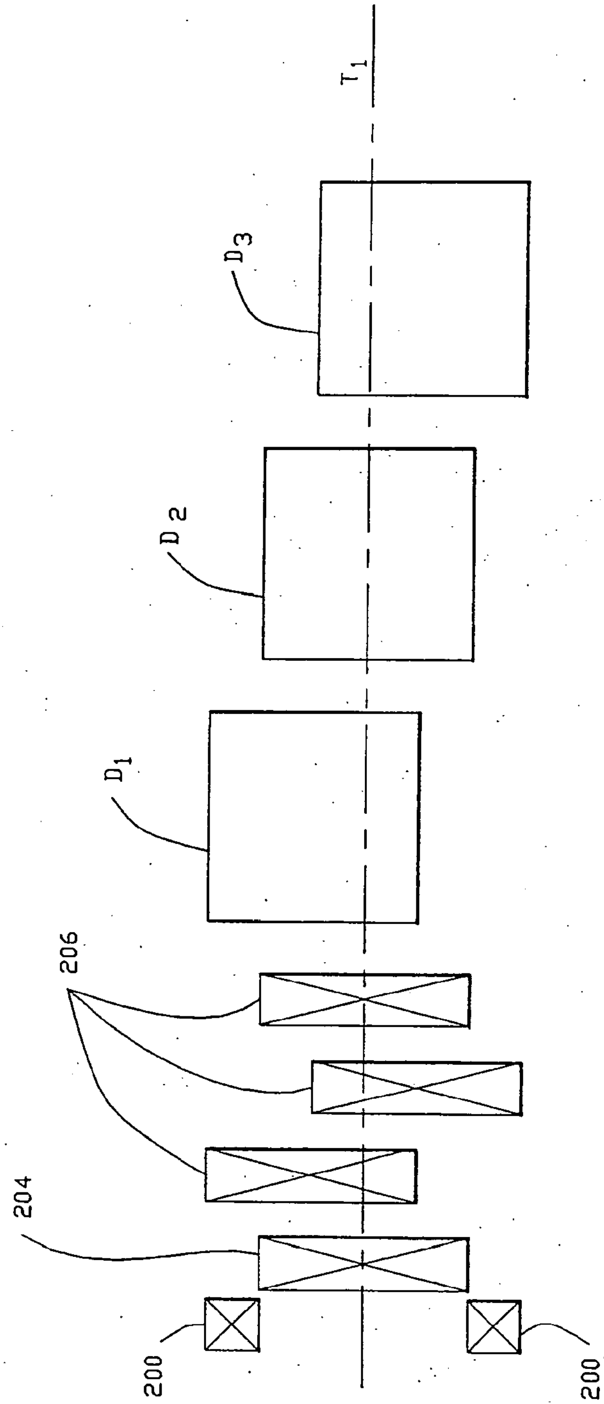


FIG.-15

METHOD OF UPDATING ONE OR MULTIPLE SETS OF RECORDS ON STANDARD LOW DENSITY MEDIA

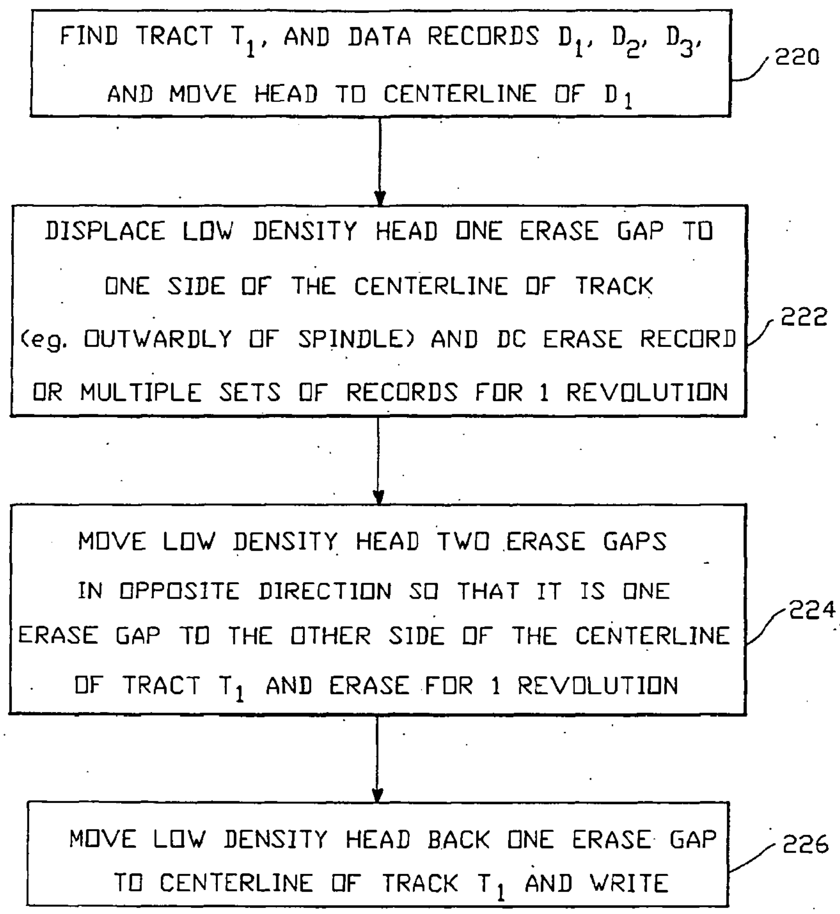


FIG.-16

METHOD FOR READING/WRITING FOR A FLOPPY DISC DRIVE WITH BUFFER MEMORY

This is a division of Ser. No. 07/130,104, filed Dec. 7, 1987, now U.S. Pat. No. 4,933,795.

FIELD OF THE INVENTION

The present invention is related to floppy disc drives.

BACKGROUND ART

The current state of the art is to provide an open loop servo controlled floppy disc drive using standard formatted floppy diskette media which is interchangable among drives. Such disc drives are generally characterized as low density or capacity in order to accommodate the mechanical positioning errors inherent in such open loop system and still be able to read and write data.

High capacity floppy disc drives as well as hard disc drives rely on developing high areal densities through increased track density (tracks per inch, TPI) and increased bit density (bits per inch, BPI). However both of these approaches to achieve a higher capacity floppy disc drive would require increased positioning accuracies which can only be achieved through a closed loop servo system. The error feedback required for such a closed loop servo system can be developed by prerecording or servo writing information on the magnetic disc media at a manufacturing facility. The net result of this procedure is that a servo writer must be developed and that the media requires costly and time consuming handling in order to be preformatted specifically to cater to the servo system of the disk drive.

Further such high density systems with closed loop servo mechanisms are generally incompatible with the aforementioned open loop servo controlled, low density disc drives using standard formatted media. Thus the high density floppy disc drives are not able to write to the standard formatted disc media.

SUMMARY OF THE INVENTION

The present invention is directed to improving upon the disadvantages of the prior art.

The present invention is directed towards a high density floppy media disc drive having a closed loop servo system with a capability of read/write updating data recorded using a standard low density open loop disc drive.

It is an object of the present invention to provide a floppy disc drive having a read/write head incorporating a read/write slider which has a read/write high density gap and a read/write low density gap so that read and write operations can be accomplished for data in a high density format and also for data in a low density format.

The advantage of the above object is that the floppy disc drive of the invention can not only read and write new data in a high density mode but can also write update data which has been previously written on standard media using a low capacity disc drive. Furthermore, the drive can also generate low density media to maintain compatability with an installed base of low density drives.

It is another object of the present invention to provide for a servo format which can be field written onto the floppy media using the disc drive itself without the requirement that a specially designed servo writer in a factory environment be used to servo format the blank diskette media.

The advantage of the above object is that the cost requirement for first designing and developing a factory servo writer and then individually servo writing each diskette before it is shipped to a customer is eliminated. The servo writing is accomplished by the disc drive itself for each new diskette at the time the diskette is first put in service by the customer.

Another object of the present invention is to provide for a unique detection circuit for the servo signals which uses a single circuit instead of multiple parallel circuits in order to eliminate DC offset error. This detection circuit is also used to accomplish the appropriate servo writing.

Yet another object of the present invention is to provide for the read/write update of data recorded in a low density manner without the use of a standard erase gap which is found on low density open loop servo controlled floppy disc drives.

Accordingly, the present invention provides for a magnetic read/write head for a disc drive capable of both high density read/write operations as measured in tracks per inch and low density read/write operations as measured in tracks per inch, which head comprises a first slider, and a first magnetic high density read/write gap positioned on the first slider. The head further includes a first magnetic low density read/write gap positioned on the slider. A non-magnetic spacer separates the first magnetic high density read/write gap and the first magnetic low density read/write gap in order to prevent interference between the two gaps. No erase gap is incorporated in the slider of the present invention.

The present invention further includes a method for servo formatting disc media comprising the steps of establishing a first alignment pattern of transitions and a second alignment pattern of transitions. The method further includes establishing a data track having a centerline defined where a comparison determines the amplitude of the first pattern of transitions equals approximately the amplitude of the second pattern of transitions. The method further includes establishing a first timing decode pattern of transitions which preceeds the first alignment pattern of transitions, that has a centerline that is substantially colinear with the centerline of the first alignment pattern, and which first timing decode pattern is different from the first and second alignment patterns of transitions. The method further includes establishing a second timing decode pattern of transitions which preceeds the data track, which has a centerline which is substantially colinear with the centerline of the data track and which second timing decode pattern is different from the first and second alignment patterns of transitions and the first timing decode pattern of transitions. The method further includes establishing a third timing decode pattern of transitions which preceeds the second alignment pattern of transitions, and which has a centerline that is substantially colinear with the centerline of the second alignment pattern of transitions, and which third timing decode pattern is different from the first and second alignment patterns of transitions and from the first and second timing decode patterns of transitions.

The invention further includes an electronic circuit for detecting a servo format on a disc and for locating a data track wherein the servo format includes pluralities of patterns of alignment transitions for defining data tracks and pluralities of different patterns of time decode transitions. The electronic circuit includes a first detector and decoder for detecting and decoding the peaks of transitions of the pluralities of time decode transitions. The device further includes a second detector and sampler for detecting and sampling the peaks of transitions of the pluralities of patterns of alignment transitions in order to locate the data tracks. The electronic circuit further includes a third device for using the output of the first detector and decoder for determining when the second detector and sampler is to detect and sample the peaks of transitions of the pluralities of patterns of alignment transitions.

The invention additionally includes a method of field servo writing a disc in a disc drive using the read/write head of the drive including the steps of writing a first time decode pattern of transitions followed by a first alignment pattern of transitions. Then sampling the first alignment pattern and offsetting the read/write head radially a prescribed amount determined by the sampled amplitude of the first alignment pattern. Then writing a second timing decode pattern of transitions followed by an intermediate alignment pattern of transitions and sampling the intermediate pattern and offsetting the read/write head radially a prescribed amount determined by the sampled amplitude of the intermediate alignment pattern. Finally writing a third timing decode pattern of transitions followed by a second alignment pattern of transitions.

The invention further includes a method for write updating data provided on a disc by an open loop servo controlled disc drive with a head having a low density read/write gap and an erase gap, using a closed loop servo controlled disc drive having a read/write head with a low density read/write gap and a high density read/write gap including the step of moving the closed loop servo controlled low density gap to the centerline of a track containing the data to be updated. The method also includes the step of moving the servo controlled low density gap radially to one side of the track by the width of one erase gap and erasing the desired data. The method further includes the steps of moving this closed loop servo controlled low density gap radially by the width of two erase gaps toward the opposite side of the track and erasing the desired data. The method further includes a step of moving the closed loop servo controlled low density gap radially back one erase gap width to the centerline of the track and using the servo controlled low density gap to write update the data.

The invention also includes the method of reducing power consumption of a floppy disc drive in a portable computer including the steps of providing a read/write head capable of reading data on a disk and providing a look ahead memory buffer in the disc drive. The method further includes storing data in the look ahead memory buffer that is positioned ahead of the last requested data on the magnetic media read by the disc drive, and then ceasing movement of the disc until the data stored in the buffer memory is used or until other data is requested.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a perspective view of a prior art slider for a low density read/write head depicting both a read/write gap and an erase gap.

FIG. 2 is a view of an embodiment of a disc drive of the invention.

FIG. 3 is a view depicting a lower read/write slider of the invention having a high density gap and a low density gap.

FIG. 4 is a view depicting an upper read/write slider of the invention having a high density gap and a low density gap.

FIG. 5 is a perspective view of upper and lower sliders of the disc drive of the invention showing the orientation and positioning of the high and low density gaps with respect to each other.

FIG. 6 is a depiction of the orientation of the high and low density gaps of the slider of the invention relative to a radial line of disc media.

FIG. 7 is a side view of the gap of an upper slider with respect to a gap of a lower slider.

FIG. 8 is a schematical representation of the servo format of the invention.

FIG. 9 is a schematic of the servo detector circuit of the invention.

FIG. 10 is a flow chart representing the method for servo detection.

FIG. 11 shows a pattern of alignment transition.

FIG. 12 depicts a graphical representation of the output of the detector circuit after having sampled the transitions of FIG. 11.

FIG. 13 depicts the use of low density transitions to servo format disc media.

FIG. 14 depicts a flow chart representing the method for in-drive field servo formatting disc media.

FIG. 15 depicts a representation of write updating of low density data using the drive of the invention.

FIG. 16 depicts a flow chart representing the method of write updating standard open loop formatted data using the disc drive of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 depicts prior art floppy disc read/write head cores of the type used in low density floppy disc drives. These head cores are identified by the numeral 20. These head cores fit into head sliders which are used as part of a total head assembly. As can be seen in FIG. 1, a read/write gap 22 for low density reading and writing is depicted. Also depicted in FIG. 1 adjacent to the read/write gap 22 is an erase head 24 which has two erase gaps 26, 28. Separating the read/write gap 22 from the erase gaps 26, 28 is a non-metallic material 30. Even with the separation of the erase gaps 26, 28 from the read/write gap 22 by the non-metallic material 30, there is still magnetic interference between these gaps due to the large surface area with which one gap element core can see the other gap element core.

It is also to be understood that magnetic interference can occur between upper and lower heads. Thus in prior art floppy disc drives which include upper and lower head assemblies with upper and lower sliders having both erase gaps and read/write gaps, the read/write and erase gaps of the upper and lower heads are displaced laterally from each other in order to prevent magnetic interference of one core with another which is writing or reading data.

Head Design With High And Low Density Read/Write Gaps

An embodiment of the present floppy disc drive of the invention is shown in FIG. 2 and identified by the numeral 32. This disc drive 32 is positioned in a portable computer 230. The floppy disc drive 32 includes a housing 34 which includes a spindle 36 upon which a floppy disc 38 can be mounted. Spindle motor 40 rotates spindle 36 and disc 38. The disc 38 is itself housed in a cartridge or housing 42 which can be removably inserted into the housing 34 of the floppy disc drive 32 through door 44 so that the disc 38 may be positioned on the spindle 36.

The floppy disc drive 32 further includes a carriage 46 to which is mounted a lower head assembly 48. The carriage is controlled by the motor 50 which causes the carriage 46 and the lower head assembly 48 to move radially inwardly toward the inner diameter 52 located adjacent spindle 36 and outwardly toward the outer diameter 54. In doing so the head assembly 46 traverses radially tracks 56 which are magnetically laid down on the disc 38. These tracks 56 have recorded thereon both servo information and the data formats.

The floppy disc drive 32 further includes servo format detector circuitry 58 which will be described more fully hereinbelow and semiconductor look-ahead buffer memory 60. The lower head assembly 46 includes a lower slider 62. The lower slider 62 includes both a low density read/write gap 64 and a high density read/write gap 66 which is shown in greater detail in FIG. 3.

As can be seen in FIG. 3, the low density gap 64 is placed on a first track 68 of the slider 62 while the high density gap 66 is placed on a second track 70 of the slider 62. The low density head 64 occupies about half of the first track 68 with the other half comprised of non-magnetic material 72. Similarly non-magnetic material 74 occupies approximately half of the second track 70. In FIGS. 2 and 3 it can be seen that tracks 68 and 70 are spaced radially from each other and that gaps 64 and 66 are spaced laterally or tangentially from each other in order to prevent magnetic interference between the two gaps. The designation of the gap length is shown at number 76 with the designation of the gap width is shown at number 78. It is to be understood that in this embodiment, that the gap length of both the high density and the low density gaps is the same and thus both can read and write the same number of bits per inch (BPI) circumferentially on each track 56 of the disc shown in FIG. 2. In other embodiments the gap lengths may be different. In a preferred embodiment, the gap width of the high density gap is approximately 0.036 millimeters while the gap width of the low density gap is approximately 0.126 millimeters. It is also to be understood that other combinations, orientations and numbers of high and low density gaps can be provided on each slider and fall within the scope of the invention.

FIG. 4 depicts an upper slider 80 which would be included in an upper head assembly such as assembly 82 in FIG. 5. The upper slider 80 includes a low density read/write gap 84 and a high density read/write gap 86 which are located on third and fourth tracks 88 and 90 respectively. As with the lower slider 62, approximately half of each of these tracks 88 and 90 are comprised of non-metallic material 92 and 94 respectively for all the reasons given herein above with respect to the avoidance of interference between read/write gaps.

FIGS. 5 and 6 show the upper and lower sliders 62, 80 and the associated high and low density gap disposed with respect to each other. As can be seen in FIG. 5, the lower density gap 84 of the upper slider 80 is positioned above the non-metallic material 74 of the lower slider 62 with the high density gap 66 of the lower slider 62 positioned below the non-metallic material 92 of the upper slider 80. Similarly the high density gap 86 of the upper slider 80 is positioned above the non-metallic material 72 of the lower slider 62 with the low density gap 64 of the lower slider 62 positioned below the non-metallic material 94 of the upper slider 80.

Additionally as can be seen in FIGS. 5 and 6, the low density gaps 64 and 84 are provided along a radial line 96 of the disc 38. The high density gaps, 66, 86, are provided along a line 98 which is parallel to the radial line 96, but skewed from radial line 98 by the angle alpha. Due to the fact that the low density gaps require a tighter azimuth control than the high density gaps, due to the large gap width of the low density gaps, it is highly advantageous in a preferred embodiment to have the low density gaps aligned along radial line 96 with the high density gaps displaced by an angle alpha therefrom. This displacement is, as indicated above, approximately a distance "x" which is specified so that the cores which define the read/write gaps do not overlap. Due to the smaller gap width of the high density gaps, azimuth alignment is not as important and thus positioning of such gaps displaced from a radial line 96 can be tolerated.

Tight azimuth angle control is essential for a low density gap when used with interchangable cartridges. On such cartridges, it is important that the bits be written consistently in a perpendicular manner. If the bits are written in an angled or skewed manner, the bits tend to erase each other or have other adverse effects.

As can be seen in FIG. 7, a gap such as gap 84 of an upper slider is shown positioned adjacent a gap such as gap 66 of a lower slider. This distance "x" which is defined to ensure that there is no overlapping of the gap core is defined as twice the distance "a" which is the thickness of the legs of each core. The non-metallic material 92, 74 is also depicted in FIG. 7. In a preferred embodiment, the distance "a" is approximately 0.4 millimeters with the distance "x" being approximately 0.8 millimeters.

It is to be understood that in a preferred embodiment, with a low density gap there can be approximately 80 tracks on a 3½ inch floppy diskette. For the high density gap there can be approximately 318 tracks on a 3½ inch floppy diskette. The low density gap is capable of recording 1 to 2 megabites of data in the recordable data area defined by the 80 tracks while the high density gap is capable of recording approximately 10 megabytes of data in the 318 tracks defining the recordable data area.

Servo Format

The servo format 100 (FIG. 8) of the invention consists of a series of unique transitions (recorded bits) spaced in such a fashion so as to allow a sampling window 160 (FIG. 10) to open so that alignment patterns of transitions can be sampled in order to determine the centerline of a track onto which data is to be written to or read from. As can be seen in FIG. 8, the alignment patterns of transitions are identified by the A and B transition bursts which in a preferred embodiment include a transition burst of 18 equally spaced single frequency transitions all of the same amplitude. In a preferred embodiment, the A and B bursts are offset in time and alternate, first A, then B, then A again about a radial line such as radial lines 102, 104 and 106. Tracks such as tracks 108, 110, 112 and 114 are defined between the A and B bursts as indicated in FIG. 8. In prior art devices, a peak detector and sampling circuit would detect, sample and sum the A bursts and the B bursts as a read/write head traverses across the A and B bursts. If the sums are equal, the disc drive head is in the center of the track, such as track 108. If the sums are unequal, the head is not on the center of the track and must be repositioned.

In the preferred embodiment of the invention, additional transitions which include timing decode patterns of transitions are recorded ahead of the A and B alignment transitions. As can be seen in FIG. 8, a first timing decode pattern of transitions is recorded ahead of the A burst and has a datum or centerline which is colinear with the datum or centerline of the A burst. This first timing decode pattern of transitions is identified by the number 116 and the designation Ta. In a preferred embodiment, this pattern includes six timing decode transitions having a first frequency. A second timing decode pattern of transitions numbered 118, identified by Tb, follows the Ta pattern and has a centerline which is colinear with the centerline of track 112. The Ta and Tb transition patterns are spaced apart by time interval Ts. A similar time interval Ts preceeds the Ta timing decode pattern.

A third timing decode pattern 120, also identified by Tc, has a centerline which is colinear with the centerline of burst B, is spaced from the Tb pattern by time interval Ts, and is additionally spaced from the A burst by the same time interval Ts. In a preferred embodiment, it is to be understood that each of these timing decode patterns Ta, Tb, and Tc are comprised of six full transitions, each pattern having a different frequency, with the frequency of the Ta pattern being higher than the frequency of the Tb pattern which is in turn higher than the frequency of the Tc pattern. It is to be understood that in a preferred embodiment there are 18 servo sectors such as servo sector 122 which is associated with radial line 104 equally spaced circumferentially about the disc. Further it is to be understood that there is a Ta pattern associated with each A burst, a Tc pattern associated with each B burst and Tb pattern associated with the track defined between an A and a B burst. Thus the timing decode patterns of transitions Ta, Tb, Tc, as well as the alignment patterns of transitions extend in each servo sector radially from the outermost track adjacent the outer diameter of the disc, which can accept valid data, to the innermost track adjacent the spindle which can accept valid data.

By detecting the frequency or timing of the Ta, Tb or Tc pattern the detector circuitry can determine how long it will be before a sampling window 160, FIG. 10, should be opened in order to sample the amplitudes of the A or the B bursts which samples are then used to accurately locate the head relative to the desired track.

The servo format detector circuitry 58 is more fully depicted in FIG. 9. In this circuitry 58, a head core and its associated read/write coil such as the read/write coil on head core 130 is associated with a preamplifier 132 and a filter 134. The output from the filter 134 is provided to an amplifier 136 and therefrom to a differentiator and peak detector 138 and to another amplifier 140. The output of the differentiator and peak detector 138 is provided to a digital decoder 142 and therefrom through an open collector driver 144 and a diode 146 to discharge a capacitor 148 which is associated with an amplifier of peak detector 150. The signal from the amplifier 140 is provided to peak detector 150. The output of peak detector 150 as sampled on the capacitor 148 is provided to an A to D converter 152 and therefrom to a microprocessor 154.

The servo format detector circuit 58 of FIG. 9 basically consists of digital logic which decodes the timing decode transitions Ta, Tb, Tc, 156, FIG. 10, and opens a window 160, FIG. 10, after a specified time interval, which interval is unique depending on whether the frequencies of the Ta pattern or the Tb pattern or the Tc pattern were detected. This information is decoded by digital decoder 142 (158, FIG. 10) in order to determine when the capacitor 148 can be discharged in order that the appropriate timing window for sampling can begin. When capacitor 148 is discharged, the peak detector 150 in conjunction with capacitor 148 can sample either an A burst or a B burst depending on which timing decode pattern was detected. Stated alternatively, the digital decoder 142 senses whether there is a Ta, Tb, or Tc pattern and discharges the capacitor 148 of the signal peak detector 150 after a preset time interval depending on which of the Ta, Tb, or Tc patterns are detected. The capacitor 148 is set up to charge again after the read/write head is in the first of the A or B burst region. The microprocessor 154 (162, FIG. 10) then reads the output of the A to D converter 152 after a prescribed time which allows for the output of the peak detector 150 to stabilize. The capacitor 148 is then again discharged in time, in order to set capacitor 148 up to sample the second alignment burst which is the other of the A or B burst. Then the microprocessor 158 uses the difference in amplitude from the A and B bursts to determine the position error and reposition the head on the centerline of the track.

It is to be understood that in the present embodiment that a single circuit is used to detect both the A and B bursts and thus all DC offsets characteristic of prior art devices in the servo circuit are eliminated. In prior art devices, separate parallel circuits, including an amplifier and peak detector, are used to detect the A bursts and the B bursts. Information detected is then compared to determine where the head is relative to the track. As each circuit may have a different DC offset, the offsets do not necessarily cancel each other and thus there is the possibility of an error in the determination of the location of the track as defined by the A and B bursts. This DC offset error is eliminated by using the single circuit of the present invention.

Field Servo Writing

Normally writing servo information on a blank disc media is accomplished in a factory environment through the use of a very precise and expensive servo writer. Existing servo writers use lasers to exactly position the heads of the servo writer so that servo information can be accurately recorded on disc. Such an operation is not only costly but also time consuming. The cost of the operation greatly increases the cost of the media which is sold for use with a disc drive.

In order to reduce the cost of in-factory servo writing, attempts have been made to provide for in-the-field in-drive servo writing by the customer. One attempt uses an index pulse to write a servo pattern. The index pulse in such devices triggers the writing of only a single servo pattern at a prescribed interval from the index pulse.

As indicated previously, the present invention provides for a multiplicity of servo patterns disposed circumferentially about the disc and radially from the outermost track which can receive data to the innermost track which can receive data.

As indicated above the servo writing method of the invention is done closed loop in the drive for the entire disc. The servo writing method uses the track profile of a head. That is to say that this method uses the continuous alignment patterns of transitions, bursts A and B, and a substantially identical intermediate alignment pattern of transitions, burst pattern X, which is later overwritten with a data format in order to provide in-drive servo writing.

FIG. 11 depicts an enlarged version of a alignment pattern of transitions, which is burst A, showing both track width (t_w) and head width (h_w). Also depicted is the head displacement (d) and the transition voltage value (v_t). Normally the head width is approximately equal to the track width except for fringing effects where the track width is slightly larger than a head width.

FIG. 12 depicts the output of a peak detector which is the peak detector shown in FIG. 9 and how this output varies according to the displacement d from the centerline of the burst A. This output is essentially stable in a mid-range which does not include the fringing end effects. Thus the stable portion of this output can be used to guide the positioning of the read/write head for in-drive servo writing.

For in-drive servo writing, the read/write head, and in particular to the high density read/write gap, first writes a Ta pattern followed by a A burst. The head is then displaced a prescribed amount, which in a preferred embodiment is a distance of one half of a track, as determined by the amplitude of the A burst. The head then writes the Tb pattern followed by an intermediate alignment pattern, X burst, which intermediate pattern will eventually be overwritten to provide for a data format. The intermediate alignment pattern, the X burst, is then detected and sampled in order to reposition the head another half track and to write the Tc timing decode pattern of transitions and a B burst alignment pattern of transitions. This procedure is continued until all the servo information is written circumferentially along each track of the disc from the outermost track to the innermost track.

To solve the problem of the precise positioning of the servo format circumferentially around each track, the low density read/write gap is used. There are two approaches to using this low density read/write gap for the precise positioning of the pulses. It is to be understood that for both approaches, all the information written by the low density gap is subsequently erased as the high density gap continues to write the servo patterns. Further it is to be understood that the low density gap, being larger in width, allows for good peak detection of the signals before falling below the required threshold. When this occurs, another large positioning transition written by the low density read/write gap is written displaced from the first large positioning transition so that additional servo formats can be written on the disc.

The first method includes, in a preferred embodiment, writing eighteen large position transitions with the low density gap about the first track (180, FIG. 18). These transitions are substantially equally spaced; however, any variation in spacing is accounted for by the microprocessors so that all the servo information written using the large positioning transitions as a guide will be essentially equally spaced about the track. The next step (182, 184, 186, 188, 190, 192, 194, FIG. 14) is to write the timing decode transitions in the order of Ta, Tb, Tc and Tb, with the corresponding alignment transitions A, X, B, X. After the second X intermediate alignment transitions are written, the X alignment transitions are used to position the low density gap so as to write another series of large positioning transitions circumferentially about a track, which in a preferred embodiment would be spaced about one and one half track widths from the centerline of the first series of large transitions. This above procedure is repeated until all of the servo information has been written. In other embodiment the spacing can be greater or less than one and one half tracks depending on the width of the large positioning transitions.

Alternatively, a second method is to write the second series of large transitions using the first series of large transitions as a reference for positioning the second series of large positioning transitions.

Method For Write Updating Low Density Standard Media

There is presently a large installed base of low density floppy disc drives which can read and write on the order of one to two megabites of information on a standard 3½ inch, 80 track floppy diskette. The heads used to read/write and erase such a floppy diskette have sliders which are similar to the prior art slider shown in FIG. 1. That is to say that the slider includes a read/write gap and two side-by-side erase gaps. As is well known in the industry, the reason for this slider configuration is that prior art disc drives have open loop servoing which means that different data records written at different times and perhaps using different floppy disc drives on a single track may not all be exactly aligned along the centerline of the track. For example in FIG. 15, three data records, D1, D2 and D3 were written along track one, T_1, by three different prior art low density disc drives. As can be seen, each data record is slightly displaced from the centerline of the track T_1. In order to write update this track T_1 and these three data records, the two spaced apart erase gaps 200, 202 are used to erase the upper and lower fringe areas of the data records, where the data records extend more than half a track's width from the centerline of the track T_1. The low density head is then used to write update track T_1 by writing over the existing data.

The present invention provides for using the low density head of the invention for performing the write update function in the following manner. First the track and data to be updated is located (220, FIG. 16). Then the low density head 206 of the disk drive of the invention is displaced by the width of one erase gap, of a prior art disc drive, to one side of the centerline of track T_1 and low density head 206 is used to then erase the portions of the selected data records that can be erased with the low density head so positioned (222, FIG. 16). Once this is accomplished, the low density head is repositioned by two erase gap widths in an opposite direction so that now it is one erase gap width to the opposite side of the centerline of the T_1 track and an erase operation is performed (224, FIG. 16). Next the erase gap is moved back one erase gap width so that it is now centered on the T_1 track and the data records are now updated with new data (226, FIG. 16). Thus in three revolutions, the present invention can write update standard media using its low density head 206. The updated information can then be read by the low density head 206 with just one revolution.

It is to be understood that a semiconductor buffer memory such as memory 60 in FIG. 2 can be associated with this procedure so that this buffer memory can be used to temporarily store information received at high speed from a microprocessor, in order to write update low density tracks, until the low density head can accomplish the three passes required to write update the information.

It is to be understood that for the high density gap that the buffer memory would in most cases not be used as this gap can write information on a high density floppy diskette at speeds appropriate to match that of the information coming from the microprocessor, or could be used to speed information transfer as a cache memory or as a look-ahead buffer memory to achieve even faster access timer realizing that semiconductor memories have much faster access times than disc drive devices.

Portable Floppy Diskette Drive With Buffer Memory

Although rigid disk drive devices are ideal for holding large amounts of information and affording rapid access time, their large power consumption requirement put them at a significant disadvantage for use in portable computer such as portable **230** in FIG. 2. Floppy diskette drives are used, even though they store less information and are slower because the discs therein spin intermittently as information is read from or written to the disc, and thus less power is required.

The present invention provides for a high density floppy disc drive with a look-ahead buffer memory such as memory **60** in FIG. 2. In this configuration, the data requested from the disc drive is provided to the portable microprocessor. Data located ahead of the requested data is then stored in the buffer memory in anticipation of that data next being required by the microprocessor. The floppy disc drive then shuts down conserving power. When additional data is needed, that data can be read from the buffer memory. Thus the combination of the high density floppy diskette with the buffer memory provides for rapid communication of data to and from the microprocessor and makes the high density floppy disc drive appear to be more like a hard disk drive than a standard formatted low density low disk drive in that it provides data at a much higher rate. However, advantageously, the disc drive of the invention consumes power at the lower rate of a standard floppy diskette.

Other advantages and objects of the invention can be obtained from a review of the appended claims and the figures.

It is to be understood that other embodiments of the invention can be provided and fall within the breadth and scope of appended claims.

I claim:

1. A method for a floppy disc drive in a computer for reducing power consumption and/or speeding data transfer, the method comprising the steps of:

(a) providing a read/write head capable of reading data on a floppy disc;

(b) providing a look-ahead memory buffer in the disc drive;

(c) reading requested data and data ahead of the requested data from the disc by the read/write head;

(d) storing the read data ahead of the requested data in the look-ahead memory buffer;

(e) reading the stored data from the look-ahead memory buffer instead of the disc when a next requested data is the same as the data stored in the memory buffer; and

(f) ceasing movement of the disc until reading of the data stored in the memory buffer is completed or until other data is requested that is needed directly from the disc.

2. A method for reducing power consumption and speeding data transfer of a floppy disc drive which includes a read/write head with a high density read/write gap and a low density read/write gap, the method comprising the steps of:

(a) providing a look-ahead memory buffer in the disc drive;

(b) reading requested data and data ahead of the requested data from the disc by the high density read/write gap of the read/write head;

(c) storing, when using the high density read/write gap of the read/write head, the read data ahead of the requested data in the look-ahead memory buffer;

(d) reading, when using the high density read/write gap of the read/write head, the stored data from the look-ahead memory buffer instead of the disc when a next requested data is the same as the data stored in the memory buffer;

(e) ceasing, when using the high density read/write gap of the read/write head, movement of the disc until reading of the data stored in the memory buffer is completed or until other data is requested that is needed directly from the disc; and

(f) storing, when using the low density read/write gap of the read/write head, additional data in the memory buffer preparatory to the data being written on the disc by the low density read/write gap of the read/write head.

3. The method of claim 2, further comprising, after step (f) the steps, of:

(g) erasing portion of a selected data record on both sides of a track of the disc by the low density read/write gap of the read/write head; and

(h) writing data to a selected data record of the disc from the look-ahead memory buffer by the low density read/write gap of the read/write head.

4. The method of claim 3, wherein the erasing step (g) includes the steps of:

displacing the read/write head so far as the width of one erase gap of a side-by-side erase gap to one side of the centerline of a track of the disc;

erasing a portion of a selected data record on the disc by the low density read/write gap of the read/write head;

displacing the read/write head so far as the width of one erase gap of the side-by-side erase gap to the other side of the centerline of the track on the disc; and

erasing a portion of the selected data record on the disc by the low density read/write gap of the read/write head.

5. The method of claim 3, further comprising, before writing step (h), the step of positioning the read/write head to a centerline of the track of the selected data record before writing.

6. The method of claim 2, further comprising, after step (f), the steps of:

displacing the read/write head so far as the width of one erase gap of a side-by-side erase gap to one side of a centerline of a track of the disc;

erasing a portion of a selected data record on the disc by the low density read/write gap of the read/write head for 1 revolution of the disc;

displacing the read/write head so far as the width of one erase gap of the side-by-side erase gap to the other side of the centerline of the track on the disc;

erasing a portion of the selected data record by the low density read/write gap of the read/write head for 1 revolution of the disc;

positioning the read/write head to the centerline of the track; and

writing data to the selected data record on the disc from the look-ahead memory buffer by the low density read/write gap of the read/write head.

* * * * *

Substitute for form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Patent No.	6,928,433
(Use as many sheets as necessary)	Reexam Control No.	95/001,274
	Original Serial No.	09/755,723
	First Named Inventor	Ron GOODMAN
	Group Art Unit	3992
	Examiner Name	Mary J. STEELMAN
	Confirmation No.	6990
Sheet 1 of 5	Attorney Docket No.	380786-108980

U.S. PATENT DOCUMENTS DISCLOSED IN RELATED PATENTS AND APPLICATIONS

Examiner Initials*	Cite No.[1]	U.S. Publication Document Number	Kind Code (if known)	Name of Patentee or Applicant of Cited Document	Date of Issue/ Publication of Cited Document MM-DD-YYYY
	A1	US-4,984,103		Nigam	01-08-1991
	A2	US-5,739,451		Winksy et al.	04-14-1998
	A3	US-5,787,292		Ottesen et al.	07-28-1998
	A4	US-6,310,848	B1	Ueki	10-30-2001
	A5	US-6,760,721	B1	Chasen et al.	07-06-2004
	A6	US-6,976,229	B1	Balabanovic et al.	12-13-2005
	A7	US-2001/0008471	A1	Naohara et al.	07-19-2001
	A8	US-2002/0045960	A1	Phillips et al.	04-18-2002

NON-PATENT LITERATURE DOCUMENTS DISCLOSED IN RELATED PATENTS AND APPLICATIONS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and-or country where published.	Translation
	B1	"MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT Disk Drives Product Manual," (C141-E088-02EN), pp. 1-227, Fujitsu Limited, 1999.	

OFFICIAL CORRESPONDENCE AND RESPONSES IN RELATED U.S. PATENT APPLICATION SERIAL NO. 09/755,629

Examiner Initials*	Cite No.[1]	Description of Item
	CI	Original Application, dated January 5, 2001, for Application No. 09/755,629.

Examiner Signature		Date Considered	

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Substitute for form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Patent No.	6,928,433
(Use as many sheets as necessary)	Reexam Control No.	95/001,274
	Original Serial No.	09/755,723
	First Named Inventor	Ron GOODMAN
	Group Art Unit	3992
	Examiner Name	Mary J. STEELMAN
	Confirmation No.	6990
Sheet 2 of 5	Attorney Docket No.	380786-108980

OFFICIAL CORRESPONDENCE AND RESPONSES IN RELATED U.S. PATENT APPLICATION SERIAL NO. 09/755,629		
Examiner Initials*	**Cite No.[1]**	**Description of Item**
	C2	Non-Final Office Action, dated September 24, 2001, for Application No. 09/755,629.
	C3	Amendment, dated December 26, 2001, for Application No. 09/755,629.
	C4	Non-Final Office Action, dated February 19, 2002, for Application No. 09/755,629.
	C5	Notice of Abandonment, dated September 19, 2002, for Application No. 09/755,629.

OFFICIAL CORRESPONDENCE AND RESPONSES IN RELATED U.S. PATENT APPLICATION SERIAL NO. 11/033,465		
Examiner Initials*	**Cite No.[1]**	**Description of Item**
	D1	Original Application, dated January 10, 2005, for Application No. 11/033,465.
	D2	Non-Final Office Action, dated August 6, 2008, for Application No. 11/033,465.
	D3	Amendment and Response to Non-Final Office Action, dated February 6, 2009, for Application No. 11/033,465.
	D4	Final Office Action, dated April 15, 2009, for Application No. 11/033,465.
	D5	Request for Continued Examination (RCE) Transmittal, dated October 15, 2009, for Application No. 11/033,465.
	D6	Amendment (Submitted with an RCE herewith), dated Oct. 15, 2009, for Application No. 11/033,465.
	D7	Non-Final Office Action, dated November 24, 2009, for Application No. 11/033,465.
	D8	Information Disclosure Statement by Applicant, dated May 5, 2010, for Application No. 11/033,465.

Examiner Signature		Date Considered	

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	Original Serial No.	09/755,723
	First Named Inventor	Ron GOODMAN
	Group Art Unit	3992
	Examiner Name	Mary J. STEELMAN
	Confirmation No.	6990
Sheet 3 of 5	**Attorney Docket No.**	380786-108980

OFFICIAL CORRESPONDENCE AND RESPONSES IN RELATED U.S. PATENT APPLICATION SERIAL NO. 11/033,465

Examiner Initials*	Cite No.[1]	Description of Item
	D9	Applicant Initiated Interview Request Form, dated May 18, 2010, for Application No. 11/033,465.
	D10	Response, dated May 24, 2010, for Application No. 11/033,465.

PLEADINGS FROM *CREATIVE TECHNOLOGY LTD. V. APPLE COMPUTER, INC.*, CASE NO. 4:06-CV-03218-SBA (N.D. Cal. May 15, 2006)

Examiner Initials*	Cite No.[1]	Description of Item
	E1	Complaint for Patent Infringement, with Exhibits 1-2, filed by Creative Technology Ltd. on May 15, 2006.
	E2	Apple Computer, Inc.'s Answer to Creative Technology Ltd.'s Complaint, filed by Apple Computer, Inc. on May 17, 2006.
	E3	Stipulated Dismissal, filed by Creative Technology Ltd. and Apple Computer, Inc. on August 29, 2006.

PLEADINGS FROM *IN THE MATTER OF CERTAIN PORTABLE DIGITAL MEDIA PLAYERS*, INTERNATIONAL TRADE COMMISSION INVESTIGATION NO. 337-TA-573 (MAY 15, 2006)

Examiner Initials*	Cite No.[1]	Description of Item
	F1	Complaint Under Section 337 of the Tariff Act of 1930, as Amended, with Exhibits 1-17 and Appendices A-B, filed by Creative Labs, Inc. and Creative Technology Ltd. on May 15, 2006.
	F2	Response of Apple Computer, Inc. to the Complaint of Creative Labs, Inc. and Creative Technology Ltd., with Exhibits 1-5, filed by Apple Computer, Inc. on July 6, 2006.
	F3	Joint Motion to Terminate the Investigation Based on a Binding Term Sheet, filed by Creative Technology Ltd., Creative Labs, Inc., and Apple Computer, Inc. on August 29, 2006.

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	First Named Inventor	Ron GOODMAN
	Group Art Unit	3992
	Examiner Name	Mary J. STEELMAN
	Confirmation No.	6990
Sheet 4 of 5	Attorney Docket No.	380786-108980

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Examiner Initials*	Cite No.[1]	U.S. Publication Document Number	Kind Code *(if known)*	Name of Patentee or Applicant of Cited Document	Date of Issue/ Publication of Cited Document MM-DD-YYYY
	G1	US-5,355,302		Martin et al.	10-11-1994
	G2	US-5,481,509		Knowles	01-02-1996
	G3	US-5,530,235		Stefik et al.	06-25-1996
	G4	US-5,864,868		Contois	01-26-1999
	G5	US-5,870,710		Ozawa et al.	02-09-1999
	G6	US-5,914,941		Janky	06-22-1999
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	G8	US-6,182,126	B1	Nathan et al.	01-30-2001

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Examiner Initials*	Cite No.[1]	Foreign Patent Document Office	Number	Kind Code *(if known)*	Issue-Date of Publication of Cited Document MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Translation[2]
	H1	JP	H4-11288		01-16-1992	Brother Industries, Ltd.	X
	H2	WIPO	WO 00/51128	A1	08-31-2000	Havin Co., Ltd.	

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Substitute for form 1449/PTO	Complete if Known	
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(Use as many sheets as necessary)	Reexam Control No.	95/001,274
	Original Serial No.	09/755,723
	First Named Inventor	Ron GOODMAN
	Group Art Unit	3992
	Examiner Name	Mary J. STEELMAN
	Confirmation No.	6990
Sheet 5 of 5	Attorney Docket No.	380786-108980

NON-PATENT LITERATURE DOCUMENTS THAT HAVE COME TO THE ATTENTION OF THE PATENT OWNER

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and-or country where published.	Translation
	I1	"Personal Jukebox User Manual," pp. 1-32, HanGo Electronics Co., Ltd., 1999.	

Examiner Signature		Date Considered	

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A2

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

US005739451A

United States Patent [19]

Winksy et al.

[11] **Patent Number: 5,739,451**

[45] **Date of Patent: Apr. 14, 1998**

[54] **HAND HELD ELECTRONIC MUSIC ENCYCLOPEDIA WITH TEXT AND NOTE STRUCTURE SEARCH**

[75] Inventors: **Gregory J. Winksy**, Medford; **Michael Woolf**, Cinnaminson; **Jules Egyud**, Voorhees, all of N.J.

[73] Assignee: **Franklin Electronic Publishers, Incorporated**, Burlington, N.J.

[21] Appl. No.: **775,015**

[22] Filed: **Dec. 27, 1996**

[51] **Int. Cl.**^{6} **A63H 5/00**; G04B 13/00; G10H 7/00

[52] **U.S. Cl.** **84/609**

[58] **Field of Search** 84/600, 609, 634, 84/615

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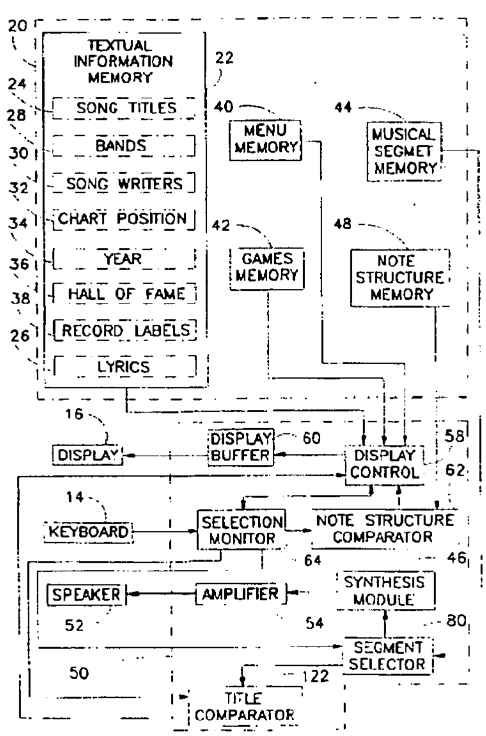
Bultman, Mary, et al., This is The Ultimate Fake Book it Contains Over 1200 Songs. 1981, vol. 1, 1 pg.

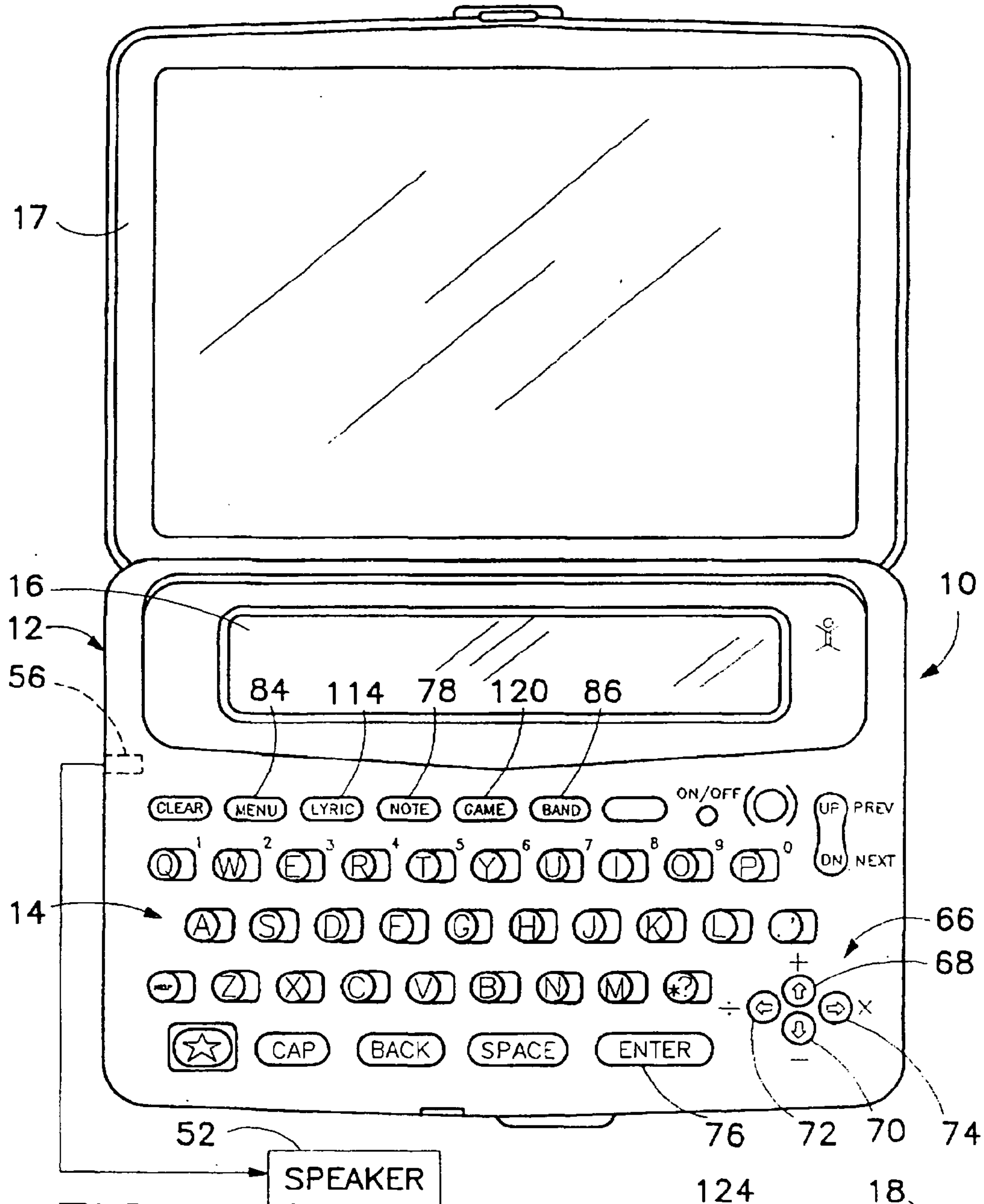
Primary Examiner—William M. Shoop, Jr.
Assistant Examiner—Jeffrey W. Donels
Attorney, Agent, or Firm—McAulay Fisher Nissen Goldberg & Kiel, LLP

[57] **ABSTRACT**

A hand held electronic music reference machine includes a platform having a keyboard and a display for displaying text. A database removably or permanently mounted to the platform has a first memory portion storing, for each of a multiplicity of songs, selected lyrics and identification information including a title. The database has a second memory portion storing a segment from each of the songs. A user actuated selection component is operatively connected to the first memory portion of the database and to the display for permitting operator selection of a song from a list of song titles shown on the display and inducing display of the lyrics stored in the first memory portion for the selected song. In addition, a user actuated audio production element provided on the platform is operatively coupled to selection component and the database for enabling an audible reproduction of the segment stored in the second memory portion for the selected song. Search filters are provided for enabling a user to determine a song title from bits of ancillary information, including a series of relative note or pitch values, i.e., a melody line which is rising, falling or remaining the same in pitch value.

12 Claims, 4 Drawing Sheets

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BAND
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CAP
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SPACE
ENTER
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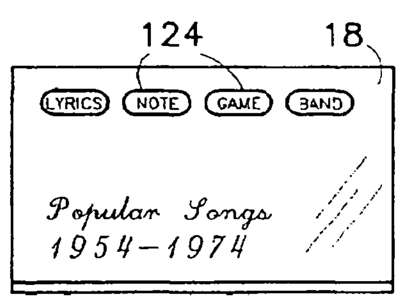
72
70
74
52
SPEAKER

FIG. 1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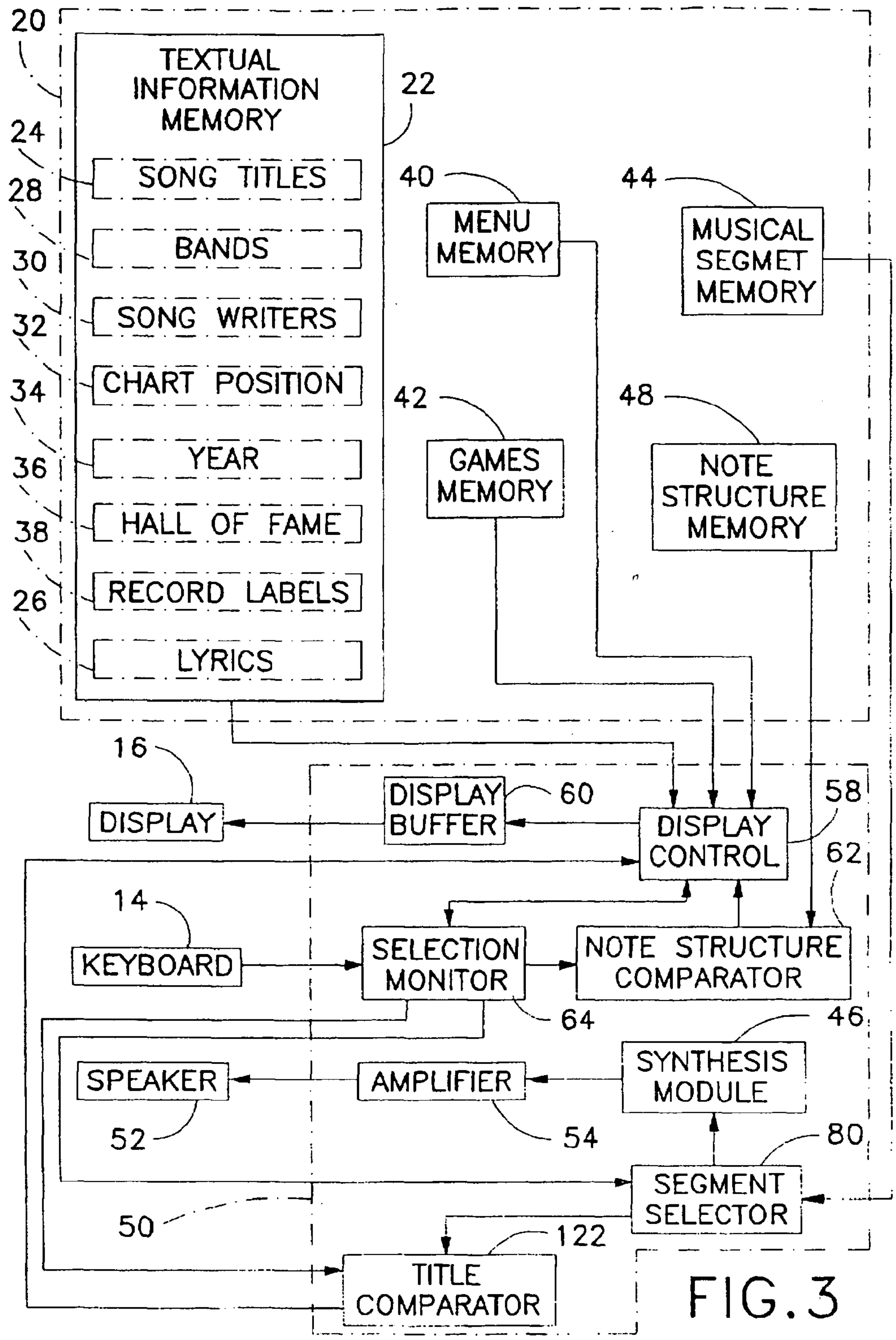
BAND
Popular Songs
1954–1974

FIG. 2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SONG WRITERS
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CHART POSITION
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YEAR
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38
RECORD LABELS
26
LYRICS
40
MENU MEMORY
44
MUSICAL SEGMET MEMORY
42
GAMES MEMORY
48
NOTE STRUCTURE MEMORY
16
DISPLAY
DISPLAY BUFFER
60
DISPLAY CONTROL
58
62
14
KEYBOARD
SELECTION MONITOR
NOTE STRUCTURE COMPARATOR
64
46
SPEAKER
AMPLIFIER
SYNTHESIS MODULE
52
54
80
SEGMENT SELECTOR
50
122
TITLE COMPARATOR

FIG. 3

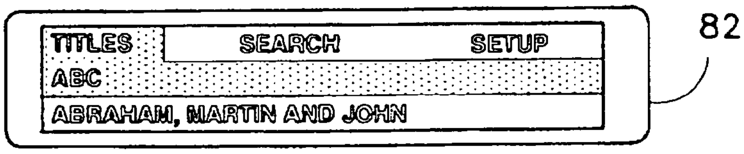

FIG.4

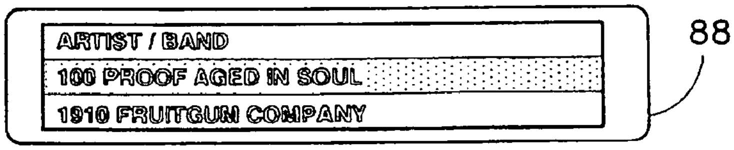

FIG.5A

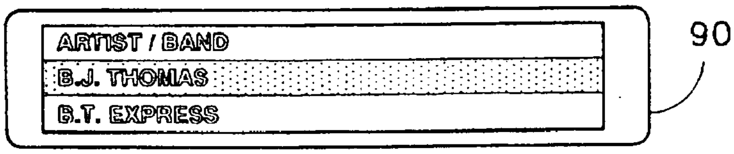

FIG.5B

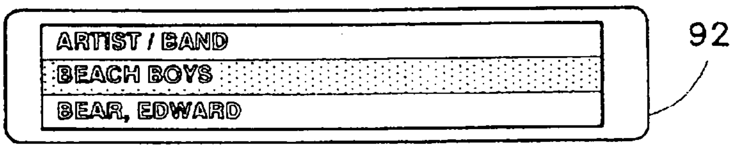

FIG.5C

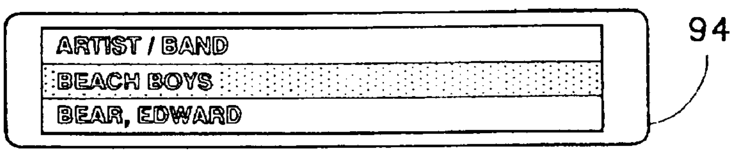

FIG.5D

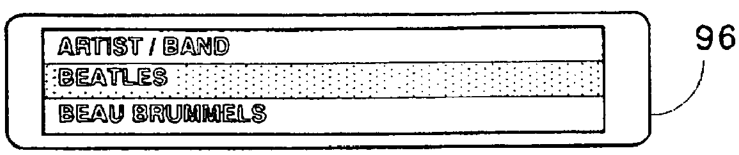

FIG.5E

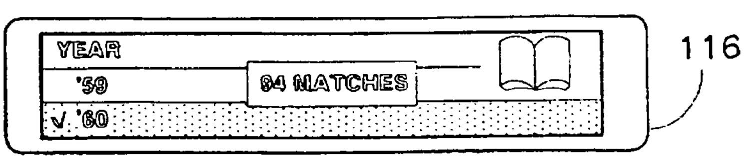

FIG.7A

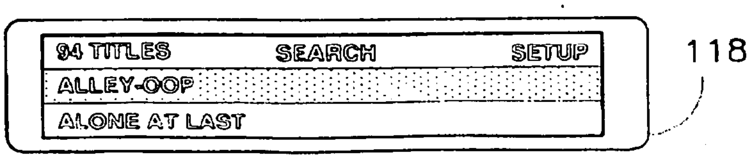

FIG.7B

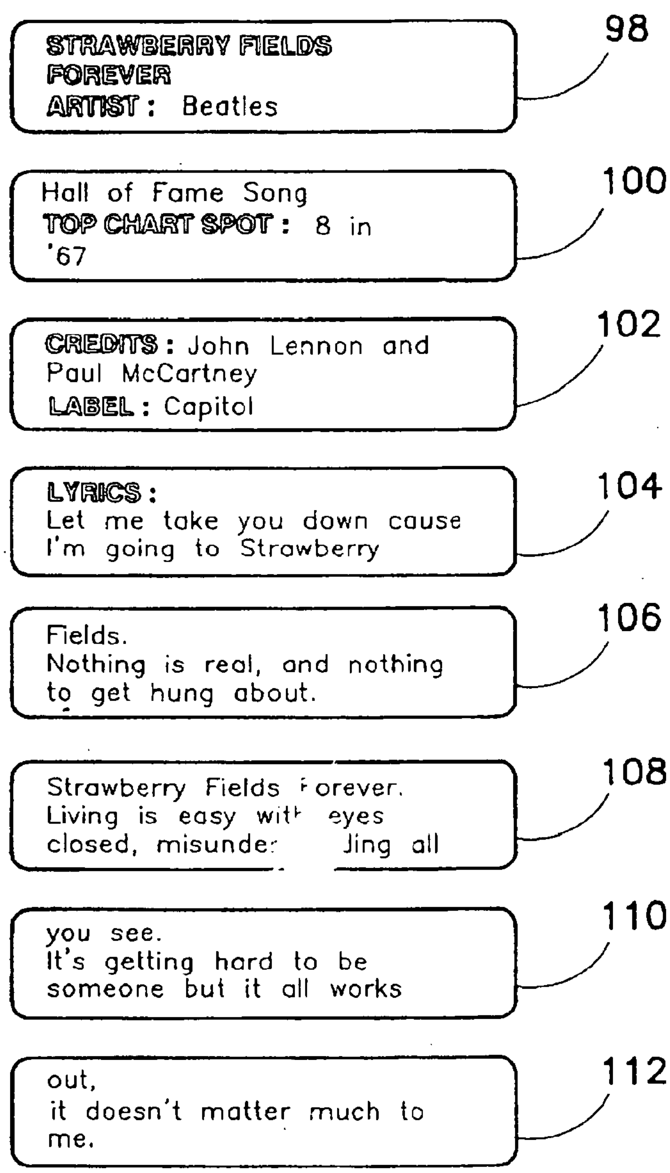

FIG.6A

FIG.6B

FIG.6C

FIG.6D

FIG.6E

FIG.6F

FIG.6G

FIG.6H

HAND HELD ELECTRONIC MUSIC ENCYCLOPEDIA WITH TEXT AND NOTE STRUCTURE SEARCH

BACKGROUND OF THE INVENTION

This invention relates to a hand held electronic reference machine and to an associated method for operating the machine. More particularly, this invention relates to such a machine and associated method for use in researching information about songs.

Many people experience memory lapses or mental gaps with respect to music they have heard. Even musicians and song writers occasionally remember only a musical phrase or a fragment of lyrics of a song, or ancillary information relating to the song, such as the name of the songwriter or the year in which the song hit the charts, without being able to recall other lyrics or even the name of the song. In such a situation, the individual has little recourse but to consult other people's memories to fill in the missing information. Clearly, it would be beneficial to have a reference work which would facilitate the identification of the song, as well as supply ancillary information pertaining to the song.

One technique exists which enables one to determine a song title by manually searching a paper reference work for an up-down-repeat note structure, i.e., a sequence of directions of changes in pitch values for a melody segment of the song. In performing such a search, the first note of the tune is designated as the reference point and therefore has no change direction in and of itself. Following notes are designated as "D," "U" or "R" if the pitch value goes down, up or remains the same relative to the immediately preceding note.

This note structure search technique can sometimes result in a small list of possible song titles. However, it is not uncommon for many songs to have the same note structure although their melodies are widely different. In these cases, the note structure search is not especially helpful.

OBJECTS OF THE INVENTION

Accordingly, it is an object of this invention to provide an electronic reference device and/or an associated method which will enable a user to identify a song from only pieces of available information about the song.

A more particular object of the invention is to provide such a device and/or method which will enable a user to identify a song from available identification information, such as some lyrics, and/or from a segment of its melody line.

Another, related object of the invention is to provide an electronic reference device and/or method which will provide a user with at least some lyrics and an audio reproduction of at least a portion of the song.

It is an associated purpose of this invention to reach the above objects in a device that exhibits minimum complexity and is easy to use.

A further related purpose is to provide a device which has reasonable cost so that it can be made available to a wide variety of users.

BRIEF DESCRIPTION

In brief, one embodiment of a hand held electronic music reference machine in accordance with the present invention includes a platform having a keyboard and a display for displaying text. The machine includes a database removably or permanently mounted to the platform. The database or memory has a first memory portion for storing preselected ancillary textual identification information for each of a plurality of musical works, the identification information including an identifier (e.g., a song title or a bridging piece of music) for each of the musical works. The database or memory further has a second memory portion storing a predetermined reproducible segment (e.g., arrangement) for each of the musical works. A note structure determination component is disposed on the platform for providing a reference sequential note structure for each of the musical works. By "note structure" is meant a sequence of directional changes in successive pitch values (up, down, same) for a melody segment of the song. A user actuated note structure input on the platform of the electronic reference machine provides an input search sequential note structure, while the keyboard enables user input of a textual search term (e.g., a word or words). A functional search module disposed on the platform is operatively connected to the keyboard, the user actuated note structure input, the memory and the note structure determination component for searching the identification information in the first memory portion in response to the search term and for cooperating with the note structure determination component to search the reference sequential note structures in response to the input search sequential note structure, to provide a set of proposed identifiers on the display. The set of proposed identifiers is determined by the search module in accordance with dual match criteria comprising (a) a first match criterion between the search term and the identification information and (b) a second match criterion between the input search sequential note structure and the sequential note structures of the musical works. A user actuated selector on the keyboard enables a user to select one of the proposed identifiers on the display and a melody production component disposed on the platform and connected to the memory generates an audio reproduction of one of the predetermined reproducible musical segments in the second memory portion corresponding to the selected one of the proposed identifiers.

Generally, it is contemplated that the musical works are songs and the identification information includes lyrics.

Preferably, the note structure determination component includes a third memory portion of the database or memory. This third memory portion stores the sequential note structure for each of the musical works. Alternatively, the note structure determination component may include means for deriving a sequence of pitch value change directions from the reproducible musical segments in the second memory portion.

Pursuant to a particular feature of the present invention, the machine further comprises user-activated game implementation componentry operatively connected to the memory for automatically and essentially randomly selecting a reproducible segment from the second memory portion. The game implementation componentry is operatively connected to the melody production means for generating an audible reproduction of the randomly selected reproducible segment. In addition, the machine includes elements for indicating to a user that an identifier selected by the user in response to the reproduction of the randomly selected reproducible segment corresponds to the randomly selected reproducible segment.

The ability to perform a search based on both written information (lyrics, band, etc.) and melody information dramatically enhances the research value of the machine. Moreover, the portability and ease of use of a hand held device is especially advantageous.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of a platform with a keyboard and a display, for a hand held electronic music reference machine in accordance with the present invention.

FIG. 2 is a plan view of a database connectable to the platform of FIG. 1, the database electronically storing song titles, lyrics, and ancillary identifying information for display.

FIG. 3 is a block diagram showing programmed functional elements of an electronic music reference machine in accordance with the present invention.

FIG. 4 shows a main menu display screen and the beginning of a master list of song titles in an electronic music reference machine in accordance with the present invention.

FIGS. 5A–5E illustrate successive display screens produced by an electronic music reference machine and an associated method in searching for songs by a particular band or recording artist in accordance with the present invention.

FIGS. 6A–6H illustrate successive display screens listing identification information and lyrics of a selected song, produced by an electronic music reference machine and an associated method in accordance with the present invention.

FIGS. 7A and 7B illustrate successive display screens produced by an electronic music reference machine and an associated method in searching for songs which were popular in a particular year (1960) in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, an electronic music reference machine 10 according to this invention includes a platform, frame member or casing 12 which can be held by hand and which carries a keyboard 14 and a display screen 16. The platform 12 has an optional hinged cover 17 and is provided with a slot (not shown) for receiving a card 18 (FIG. 2) which carries a database 20 (FIG. 3). Alternatively, database 20 may be permanently incorporated into platform 12.

As illustrated in FIG. 3, database 20 has a first memory portion 22 storing textual or alphanumeric information which can be shown on display 16. Memory portion 22 includes an area 24 storing song titles and another memory area 26 storing at least some lyrics for each song whose title exists in memory area 24. Memory portion 22 further includes areas 28, 30, 32, 34, 36 and 38 respectively storing band or artist names, songwriter names, highest chart positions attained by the various songs, the years in which the highest chart positions were attained, Hall of Fame listings and recording labels.

Database 20 includes an additional memory portion 40 storing a main menu, as well as other programming for ancillary functions of the music reference machine 10. Such ancillary functions include generic search functions, automatic shut-off, screen clearing, a tutorial, and page up and page down functions. Another memory portion 42 of database 20 stores programming for game functions of the music reference machine 10.

Database 20 further includes a memory portion 44 which stores, for each song, a segment of the song's musical arrangement. The stored reproducible musical segments are preferably the most memorable and well known portions of the songs. The reproducible segments are preferably stored as compressed MIDI (Musical Instrument Digital Interface) files, capable of conversion to an analog signal by a decompression and music synthesis module 46. Alternatively, the reproducible musical segments can be stored in digitized form, convertible by a digital-to-analog converter (not shown). In another alternative construction (not illustrated), the MIDI files are transmittable directly to an ancillary device that is capable of processing the MIDI format, such as certain electronic keyboards.

Yet another portion 48 of database 20 stores note structure information, i.e., information pertaining the directions of change of pitch values of melody segments. The term "note structure" is defined herein to mean a series of directions of change of note values. A note structure specifies the directions which successive notes take, each relative to the immediately preceding note. If a given note in a melody has a higher pitch than the preceding note, the sequence goes up at the given note. Conversely, if the given note has a lower pitch than the preceding note, the sequence goes down at the given note. If the given note and the preceding note have the same pitch value, the note structure remains the same. Of course, this characterization of a melody extracts only part of the information which defines the melody. Absolute pitch values, durations and intervals are left out. However, for purposes of identifying a song, the note structure information in memory portion 48 of database 20 can be effective in narrowing a search to a small number of song titles.

Database 20, as contained in card 18, is removably mounted to platform 12 for enabling the use of platform 12 with different databases storing song identification and melody information for different periods or different types of music. For example, a first card can carry music information for songs appearing between 1954 and 1974, while a second card can hold information pertaining to the years between 1974 and 1994. One card might be limited to popular songs, while another card carries jazz or country western songs.

Platform 12 carries a microprocessor 50 which accesses database 20 to obtain textual type information from memory portion 22 for display on screen 16 and to obtain digitized reproducible musical segments from memory portion 44 for audible reproduction via a headphone speaker or other electroacoustic transducer 52 (FIGS. 1 and 3). Headphone speaker 52 is connected to microprocessor 50 and database 20 and, more particularly, to an amplifier 54, via a jack 56 disposed on platform 12. Amplifier 54 is disposed downstream of synthesis module 46. Amplifier 54 and synthesis module 46 may be implemented by circuits of microprocessor 50 or by other, dedicated circuit components (not shown) in platform 12.

Microprocessor 50 includes a display control module 58 which extracts or selects information from database 20 for reproduction in visually sensible form on display screen 16. The information to be displayed is temporarily stored in a buffer 60 operatively connected at an input side to display control module 58 and on an output side to display screen 16. Display control module 58 obtains a menu and submenus from memory portion 40, song identification information from memory portion 22 and games programming from memory portion 42.

Display control module 58 is also connected at a data input to a note structure comparator 62. Comparator 62 is connected at an input to keyboard 14 for receiving therefrom note structure data input by a user for purposes of researching and ultimately identifying a song.

The note structure data input by the user via keyboard 14 is detected and decoded by a selection monitor component 64 of microprocessor 50. Selection monitor 64 forwards the input note structure data to comparator 62 for comparison with the note structure information stored in memory portion 48. Upon identifying one or more songs having a note structure matching the input sequence, comparator 62 signals display control 58 to access memory portion 22 and to display a list of the identified song titles on display 16.

The note structure data is input via directional keys 66. More particularly, "up" and "down" directional keys 68 and 70 are used to respectively indicate a rise or fall in pitch of a given note over a preceding note, while left and/or right directional key 72, 74 is used to indicate that the given note has the same pitch as the preceding note.

Selection monitor 64 is also coupled to display module 58 for directing the operation thereof, i.e., the selection of information for display on screen 16. In general, selection monitor 64 scans an Enter function key 76 and directional keys 66 to determine which entry in a displayed menu is highlighted and scans other keys to determine whether a function is selected and, if so, which function. Upon such a selection of an entry by a user, selection monitor 64 signals display control 58 to show different information on display screen 16, e.g., identification information and lyrics for a selected song or a submenu such as a list of search options. Alternatively, a submenu may be selected by actuating a left or right directional key 72 or 74 included in directional group 66.

Selection monitor 64 also determines whether the user desires to have a particular melody reproduced via speaker or transducer 52. To that end, upon the highlighting of a song title as described above, the user actuates a specialized function key 78 labeled "NOTE" in FIG. 1, to induce the transmission of a reproducible musical segment from memory portion 44 to a segment selector module 80. Selector module 80 functions as an addressing unit controlled by selection monitor 64 for extracting the reproducible musical segment for a selected song from memory portion 44. The extracted segment is fed to speaker 52 via synthesis module 46 and amplification stage 54.

FIG. 4 shows a main menu screen 82 brought to display 16 upon initialization of the device, or upon pressing of a specialized key 84 (FIG. 1) labeled "Menu." The main menu includes a "Titles" selection, a "Search" selection and a "Setup" selection. A selection is made by actuating Enter function key 76 when the desired selection is highlighted. The highlighting can be shifted among the different selections by using left and right directional keys 72 and 74 (FIG. 1). FIG. 4 shows the beginning of an alphabetical master list of song titles ("ABC" and "Abraham, Martin and John") which appears upon selection of "Titles" from the main menu. When "Search" is selected from the main menu, display 16 shows a list of nine search parameters or filters including song titles, bands, song writers, song position, chart position, year, hall of fame status, record labels, lyrics, and melody line. Any search filter may be selected by actuating Enter function key 76 upon highlighting the desired search filter. In executing the first eight search filters, display control 58 accesses the respective areas of memory portion 22. In executing a melody line search, note structure comparator 62 accesses memory portion 48 in accordance with a note structure input via directional keys 66.

Selection of "Setup" from the main menu induces display of a submenu including the following entries: "Tutorial," "Copyright," "Set Type Size," "Set Shutoff," "Set Contrast," and "View Demo." These operating functions are ancillary features not germane to the invention and are not discussed herein.

The names of bands and other recording artists are searched via menu selection, as described above. Alternatively, a specialized function key 86 may be pressed at any time to display an alphabetical list of recording artists, shown as a display screen 88 in FIG. 5A. The list of recording artists is searched by display control 58 in response to successive keystrokes as detected by selection monitor 64. FIG. 5B shows a display screen 90 shown on display 16 after typing in the letter "B." FIGS. 5C–5E show similar display screens 92, 94 and 96 brought to display 16 after entry of the letters "E," "A," and "T," respectively. This mode of searching is called an "alphasearch." Microprocessor 60 does not wait for an actuation of Enter function key 76 in order to commence a search. Instead, the search is updated every time an alphanumeric key of keyboard 14 is pressed.

During a search of the band list, highlighting of the entries may be shifted from artist to artist by using up and down directional keys 68 and 70. If selection monitor 64 detects the actuation of Enter function key 76, a list of song titles appears for the highlighted recording artist. As in every case where a list of song titles is shown on display 16, actuation of special function key 78, which is detected by selection monitor 64, causes selector module 80 to retrieve the stored reproducible musical segment for a highlighted song from memory portion 44 and to feed the retrieved segment to synthesis module 46 for playback via speaker 52.

Whenever a song title is highlighted on display 16 and selection monitor 64 detects the actuation of Enter function key 76, display control 58 accesses memory portion 22 to obtain identification information and lyrics for the highlighted song. FIGS. 6A–6H illustrate a sequence of successive screens 98, 100, 102, 104, 106, 108, 110, and 112 in which the identification information and lyrics are displayed for the user. Screen 98 lists the song title and the recording artist, that information being obtained from memory areas 24 and 28, respectively. The next screen 100 identifies the song, "Strawberry Fields Forever," as a Hall of Fame song (memory area 36) with a top chart spot of 8 (memory area 36) in the year 1967 (memory area 36). The remaining screens 104, 106, 108, 110, and 112 show lyrics of the selected song. The lyrics corresponding to a highlighted song title may be selected immediately for viewing on display 16 by pressing a special function key 114 labeled "LYRIC" in FIG. 1.

A list of song titles shown in display 16 for a specified recording artist may be narrowed down by performing a further search. A desired search parameter or filter is selected via the menu function. As discussed above, a user can search for a label under which the song was recorded, the highest chart position attained by the song, the year in which the song attained that chart position, Hall of Fame status, and the name of the songwriter. Microprocessor 50 respectively accesses memory areas 38, 32, 34, 36 and 30, respectively, during those searches.

FIG. 7A shows a display screen 116 indicating that 94 songs were found in a search of the year 1960. The year search may have been implemented, for example, following another search such as a band search. As shown in FIG. 7B, another screen 118 lists the 94 titles uncovered in the year search. The main menu appears at the top of the screen and may be used to undertake an additional search in an attempt to decrease the number of titles on the list. Such an additional search may be, for example, a word search of the lyrics stored in memory area 26 (FIG. 2). Upon a selection of "Lyrics" from the search submenu, microprocessor 50 awaits the entry of alphanumeric characters alphanumeric characters via keyboard 14 and the actuation of Enter function key 76. As in other searches, the songs incorporating the inputted alphanumeric characters have their titles listed on display 16.

As discussed above, another search function is performed by note structure comparator 62 in response to a note structure entered via directional keys 66. Again, the term "note structure" refers to a series of relative note or pitch values, i.e., a melody line which is rising, falling or remaining the same in pitch value. An illustrative note structure is FFSRFF where the second and third notes of a melody fall in pitch, the fourth note remains the same as the third, the fifth note rises in tone, and the sixth and seventh notes fall. The first note of the sequence is the starting value and is not specified. In response to this note structure search request, comparator 62 advises display control 58 as to which songs have the inputted note structure FFSRFF.

Generally, the reproducible musical segments in memory portion 44 and the note structures in memory portion 48 are taken from the most commonly recognizable parts of the respective songs. Preferably, the reproducible segments stored in memory portion 44 are musical arrangements. The arrangements are frequently of chorus sections and occasionally correspond to the words of the title, where the title appears in the lyrics of a song. The reproducible segments stored in memory portion 44 may be converted into sound during display of lyrics (FIGS. 6D–6H).

Microprocessor 50 accesses memory portion 42 of database 20 for purposes of carrying out any of several music trivia games. Upon detecting the actuation of a special function key 120 labeled "GAME," selection monitor 64 induces display control module 58 to extract a game menu from memory portion 40. Several of the games available in machine 10 utilize a selection function according to which selector module 80 automatically and randomly selects a reproducible musical segment from memory portion 44. The randomly selected musical segment, or a part thereof, is played over speaker 52. In response to the audio presentation, the user attempts to identify the song's title by typing the title on keyboard 16 or by selecting from a list of titles shown on display 16 by display control 58. Selection monitor 64 relays the song title to a comparison module 122 which checks whether the inputted song title is correct. To that end, comparison module 122 is connected to selector module 80 for receiving address information therefrom. In response to an address from selector module 80, comparison module 122 accesses memory area 24 of memory portion 22 to obtain the title of the song acoustically reproduced via speaker 52. Upon determining that the user has correctly identified a song title, comparison module 122 forwards a signal to display control 58 for providing a visual signal to the user via display 16.

In one game, the complete stored segment of the randomly selected song is played and the user is presented, on the display 16, at the end of the audio reproduction, with a list of titles from which to choose. In another game, the user can interrupt the playing of the reproducible musical segment by pressing Enter function key 76. Display control 58 then brings a list of song titles to display 16 and the user selects the desired song title by using the alphasearch technique described above. In a related game, a part of the randomly selected song is played several times, with the length of the reproduced portion increasing each time, until the user actuates Enter function key 76. At that time, the user "alphasearches" a list of song titles on display 16.

In yet another game, the user inputs a note structure via directional keys 66 in response to the playing of a randomly selected song segment via speaker 52. In this game, selection monitor 64 automatically and randomly selects a song in response to an instruction from keyboard 14. An address specifying the song is transmitted at that time from selection monitor 64 to selector module 80, which accesses memory portion 44 for the reproducible musical segment of the randomly selected song. The same address is transmitted from selection monitor 64 to note structure comparator 62, which obtains the corresponding note structure from memory 48. Upon a subsequent input of a note structure via directional keys 66, as described hereinabove, and the feeding of the input note structure to comparator 62, that component of microprocessor 50 compares the user-input note structure with the note structure of the randomly selected song, obtained from memory portion 48. Upon detecting a correct note structure match, comparator 62 alerts display control 58 which in turn communicates the correctness of the inputted note structure to the user via display 16.

Another game, selected from the game menu called to display 1 by pressing special function key 120, is a music trivia game wherein microprocessor 50 randomly accesses memory portion 22 for a song title and then prompts the user for ancillary information such as band or artist names, songwriter names, highest chart positions attained by the various songs, the years in which the highest chart positions were attained, Hall of Fame listings, and recording labels. Alternatively, identifying information such as selected lyrics may be shown on display 16. The user then guesses the song title corresponding to the displayed information.

It is understood that display control module 58, note structure comparator 62, selection monitor module 64, selector module 80, title comparator 122 and other functional circuit components of microprocessor 50 are implemented by generic microprocessor circuits as modified by programming. The programming for those functional circuit components of microprocessor 50 are permanently stored in database 20 and transferred to RAM in microprocessor 50 for purposes of implementing the language learning functions therein. Alternatively, microprocessor 50 directly accesses ROM on card 18 and follows the programming therein without intermediate transfer to a RAM on platform 12. In any event, the programming in database 20 largely and perhaps most significantly determines the programmed structure of microprocessor 50 and the operation thereof. Exchanging a card 18 on platform 12 for another card carrying different programming relating, for example, to different songs essentially generates a new machine.

As illustrated in FIG. 2, a card 18 is provided with printed key representations 124. Representations 124 are color coded to match respective colored keys on keyboard 14, thereby enabling a reassignment of function in accordance with a particular card 18.

The search filters described hereinabove are implemented in the music reference machine 10 pursuant to the techniques described in U.S. Pat. No. 5,321,609, the disclosure of which is hereby incorporated by reference. After the display of a master list of titles (FIG. 4), the use of search filters reduces the number of titles listed. Generally, the greater the number of filters used, the smaller the resulting list of titles.

The above-described alphasearch technique is utilizable with the titles listing, as well as the search filters pertaining to recording artist (band), year of song ascendance, recording label, and songwriter. A word search technique, also alluded to above, is limited to title searching and lyrics searching, i.e., to memory areas 24 and 26 (FIG. 3).

Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of the claimed invention. For example, the note structure information, instead of being stored separately in memory portion **48**, may be derived from the reproducible musical segments (arrangements or melodies) in memory portion **44**, as in the case where those reproducible segments are stored in a MIDI (Musical Instrument Digital Interface) file. Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

What is claimed is:

1. A hand held electronic music reference machine having a platform, a keyboard, and a display for displaying text, comprising:

a memory mounted to said platform, said memory having a first memory portion for storing preselected ancillary textual identification information for each of a plurality of musical works, said identification information including an identifier for each of said musical works, said memory further having a second memory portion storing a predetermined reproducible segment of each of said musical works;

note structure determination means disposed on said platform for providing a reference sequential note structure for each of said musical works;

user actuated note structure input means on said platform for providing an input search sequential note structure, said keyboard enabling user input of a textual search term;

search means disposed on said platform and operatively connected to said keyboard, said user actuated note structure input means, said memory and said note structure determination means for searching the identification information in said first memory portion in response to said search term and for cooperating with said note structure determination means to search said reference sequential note structures in response to said input search sequential note structure, to provide a set of proposed identifiers on said display, said set of proposed identifiers being determined by said search means in accordance with dual match criteria comprising (a) a first match criterion between said textual search term and said identification information and (b) a second match criterion between said input search sequential note structure and said reference sequential note structures;

user actuated selection means on said keyboard for selecting one of said proposed identifiers on said display; and

melody production means disposed on said platform and connected to said memory for enabling generation of an audio reproduction of one of said predetermined reproducible segments in said second memory portion corresponding to the selected one of said proposed identifiers.

2. The machine defined in claim **1** wherein said identifiers include titles of said musical works.

3. The machine defined in claim **1** wherein said musical works are songs and said identification information includes lyrics.

4. The machine defined in claim **1** wherein said note structures each comprise directions of change of note values.

5. The machine defined in claim **1** wherein said note structure determination means includes a third memory portion of said memory, said third memory portion storing the sequential note structure for each of said musical works.

6. The machine defined in claim **1** wherein said identification information includes band data pertaining to recording artists.

7. The machine defined in claim **1**, further comprising user-activated random selection means operatively connected to said memory for automatically and essentially randomly selecting a reproducible segment from said second memory portion, said random selection means being operatively connected to said melody production means for generating an audible reproduction of the randomly selected reproducible segment, also comprising means for indicating to a user that an identifier selected by the user in response to the reproduction of the randomly selected reproducible segment corresponds to said randomly selected reproducible segment.

8. The machine defined in claim **1** wherein the stored reproducible segments are musical arrangements.

9. The machine defined in claim **1** wherein the stored reproducible segments include melodies.

10. A hand-held electronic music encyclopedia having a platform, a keyboard, a display for displaying text, and a speaker for providing audible information comprising:

a memory within said platform,

a first portion of said memory storing text identification information for each of a plurality of musical works,

a second portion of said memory storing a reference sequential note structure for each of said musical works,

a third portion of said memory storing a reproducible audible musical segment for each of said musical works,

said memory including an identifier for each of said works,

first user actuated means on said keyboard for inputting a text search element,

second user actuated means on said keyboard for inputting a sequential note structure search element,

a search program in said platform,

said search program being responsive to said text search element to provide on said display said identifier for each of said musical works having text in memory that meet a first match criteria with said text search element,

said search program being responsive to said sequential note structure search element to provide on said display said identifier for each of said musical works having a sequential note structure in memory that meets a second match criteria with said sequential note structure search element,

third user actuated means on said keyboard to select one of said identifiers when on said display, and

music production means responsive to a user selection of one of said identifiers to provide said audible musical segment for the one of said musical works identified by the selected one of said identifiers for generation through said speaker.

11. The hand-held music reference encyclopedia of claim **10** wherein:

when either of said search elements is input as a first search element, the other of said search elements when entered as a second search element will search only from the set of musical works identified by the search responsive to said first search element.

12. The hand-held electronic music reference encyclopedia of claim **10** wherein:

said third user actuated means is operable whenever at least one of said identifiers is provided on said display.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,739,451

DATED : April 14, 1998

INVENTOR(S) : Gregory J. Winsky
Michael Woolf
Jules Egyud

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, under item [19] and item [75], "Winksy" should read --Winsky--.

Signed and Sealed this

Ninth Day of June, 1998

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer *Commissioner of Patents and Trademarks*

A3

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

US005787292A

United States Patent [19]

Ottesen et al.

[11] Patent Number: 5,787,292

[45] Date of Patent: Jul. 28, 1998

[54] **POWER SAVING METHOD AND APPARATUS FOR USE IN MULTIPLE FREQUENCY ZONE DRIVES**

[75] Inventors: **Hal Hijalmar Ottesen; Gordon J. Smith**, both of Rochester, Minn.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **625,334**

[22] Filed: **Apr. 1, 1996**

[51] **Int. Cl.**^{6} **G06F 11/00**

[52] **U.S. Cl.** **395/750.01**; 395/441; 395/488; 395/470; 360/75.01; 360/71

[58] **Field of Search** 395/750, 441, 395/488, 182.03, 470, 851; 360/73.03, 71, 31, 75, 48; 369/75.1, 32; 318/66

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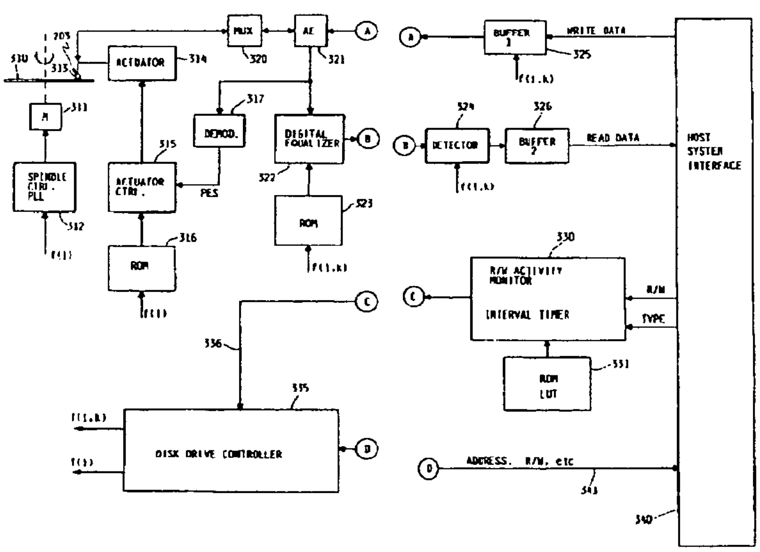
Primary Examiner—Ayaz R. Sheikh
Assistant Examiner—Eric S. Thlang
Attorney, Agent, or Firm—William D. Miller; Mark A. Hollingsworth; Min Xu

[57] **ABSTRACT**

A multiple frequency zoned disk storage device in which data is read from and/or written to the disk at two or more discrete disk velocities is disclosed. The disk storage device includes a low power mode where information is read/written from/to the disk while the disk velocity is reduced to conserve power. The allocation track locations into zones on the drive reduces the number of zone bit frequencies the storage device must handle.

21 Claims, 12 Drawing Sheets



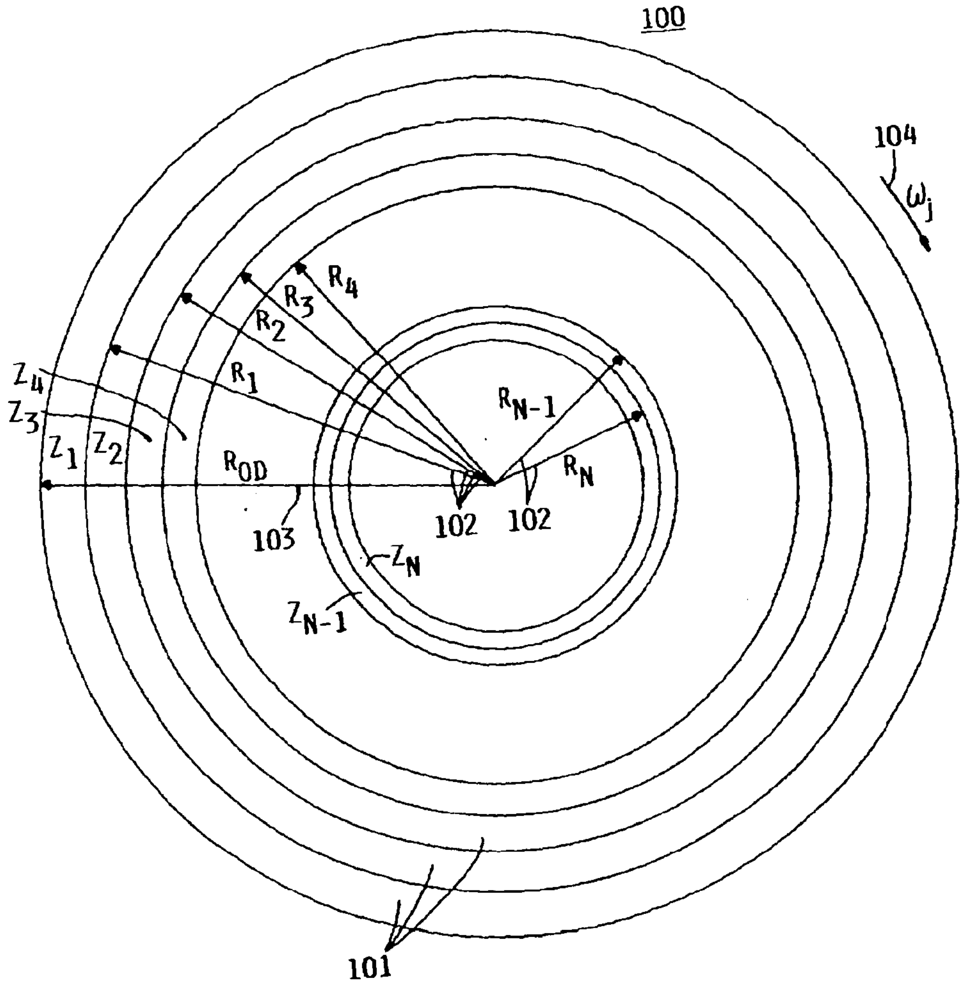

100
104
ω_j
R_4
R_3
R_2
R_1
Z_4
Z_3
Z_1
Z_2
R_{OD}
R_{N-1}
R_N
102
102
103
Z_N
Z_{N-1}
101

FIG. 1

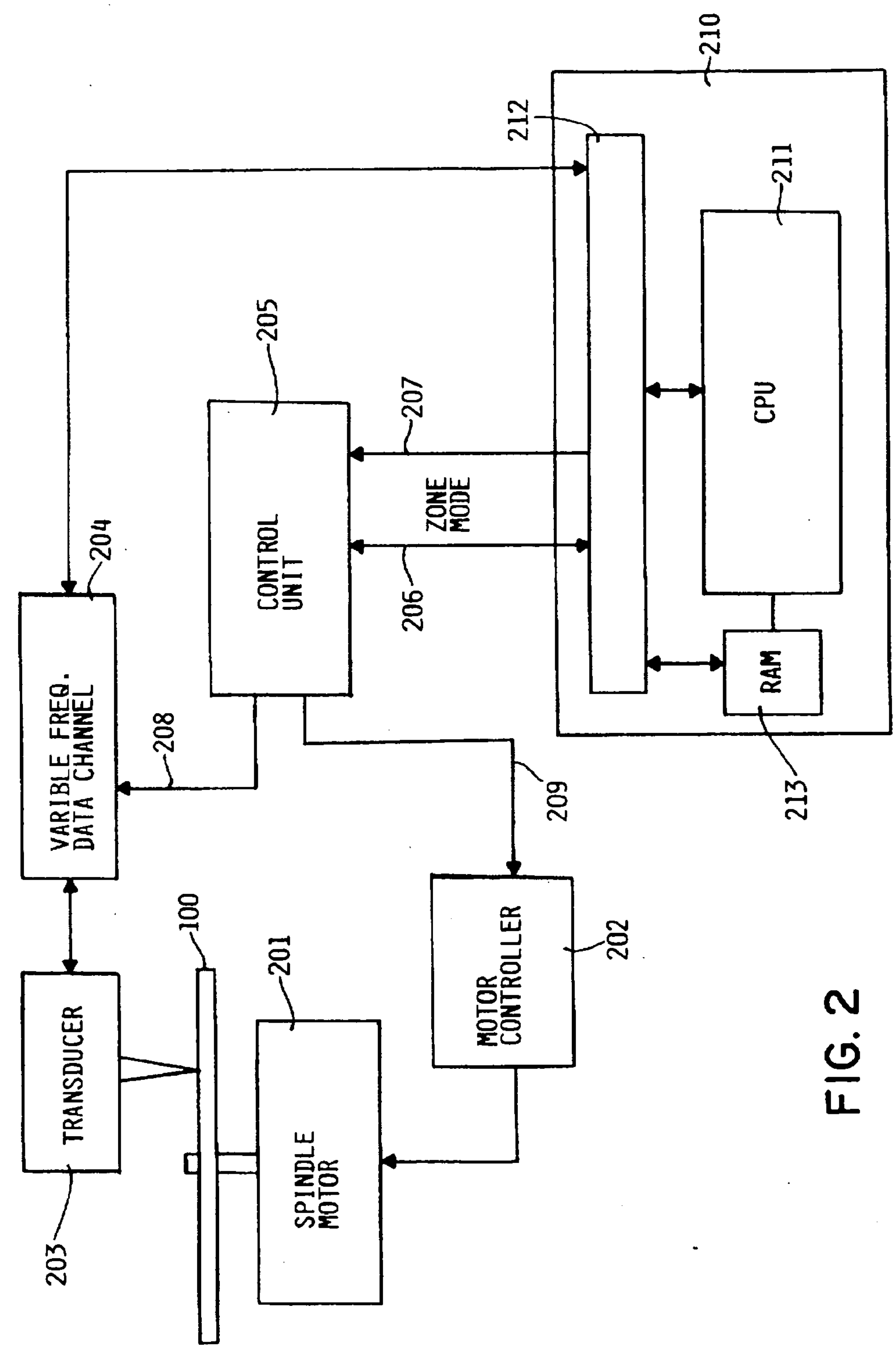

210
212
211
205
207
CONTROL UNIT
ZONE MODE
CPU
204
206
VARIBLE FREQ. DATA CHANNEL
208
RAM
213
209
100
201
MOTOR CONTROLLER
202
TRANSDUCER
SPINDLE MOTOR
203

FIG. 2

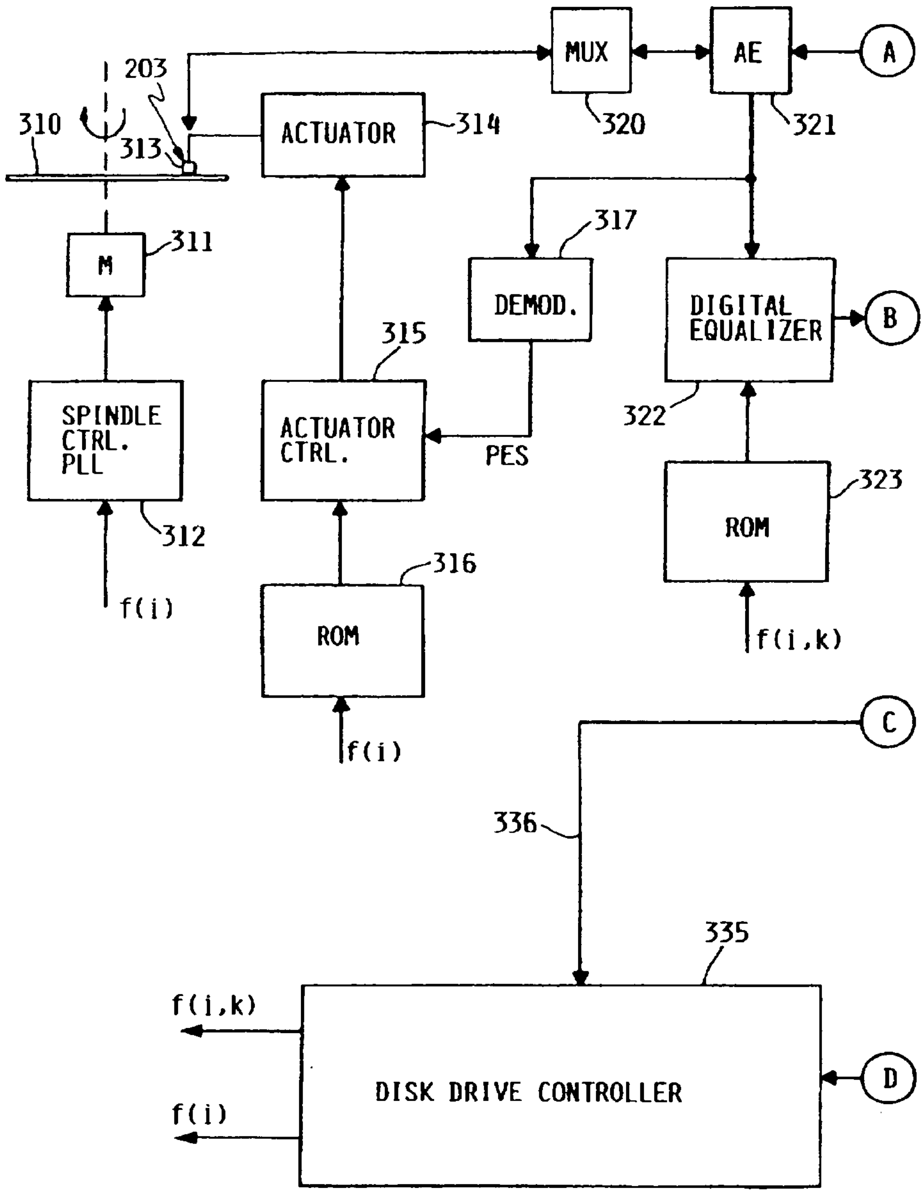

MUX
AE
A
203
310
313
ACTUATOR
314
320
321
317
311
M
DEMOD.
DIGITAL EQUALIZER
B
315
SPINDLE CTRL. PLL
ACTUATOR CTRL.
322
PES
323
ROM
312
316
f(i)
ROM
f(i,k)
f(i)
C
336
335
f(i,k)
DISK DRIVE CONTROLLER
D
f(i)

FIG. 3A

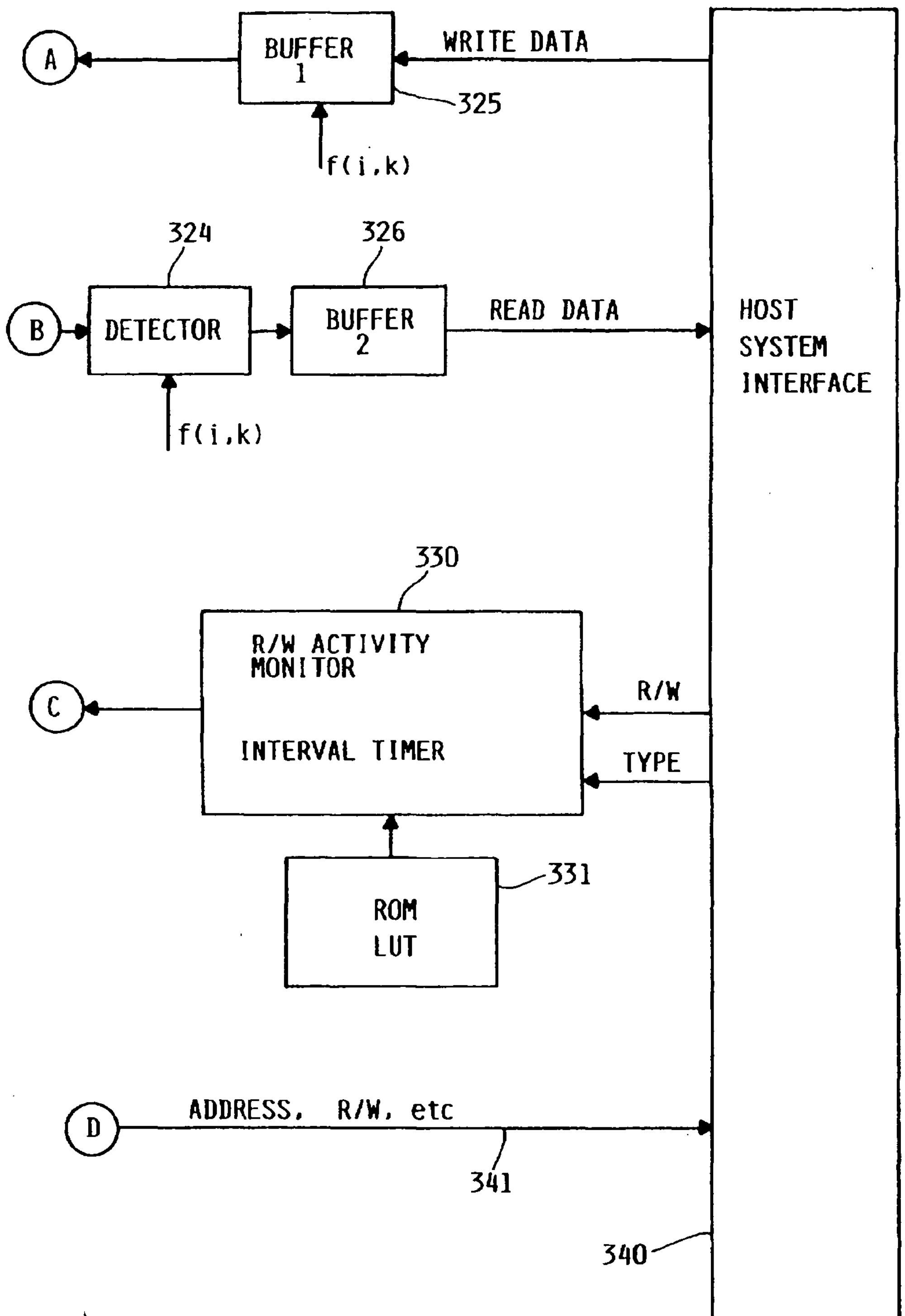

BUFFER 1
WRITE DATA
325
A
f(i,k)
324
326
B
DETECTOR
BUFFER 2
READ DATA
HOST SYSTEM INTERFACE
f(i,k)
330
R/W ACTIVITY MONITOR
INTERVAL TIMER
C
R/W
TYPE
331
ROM LUT
D
ADDRESS, R/W, etc
341
340

FIG. 3B

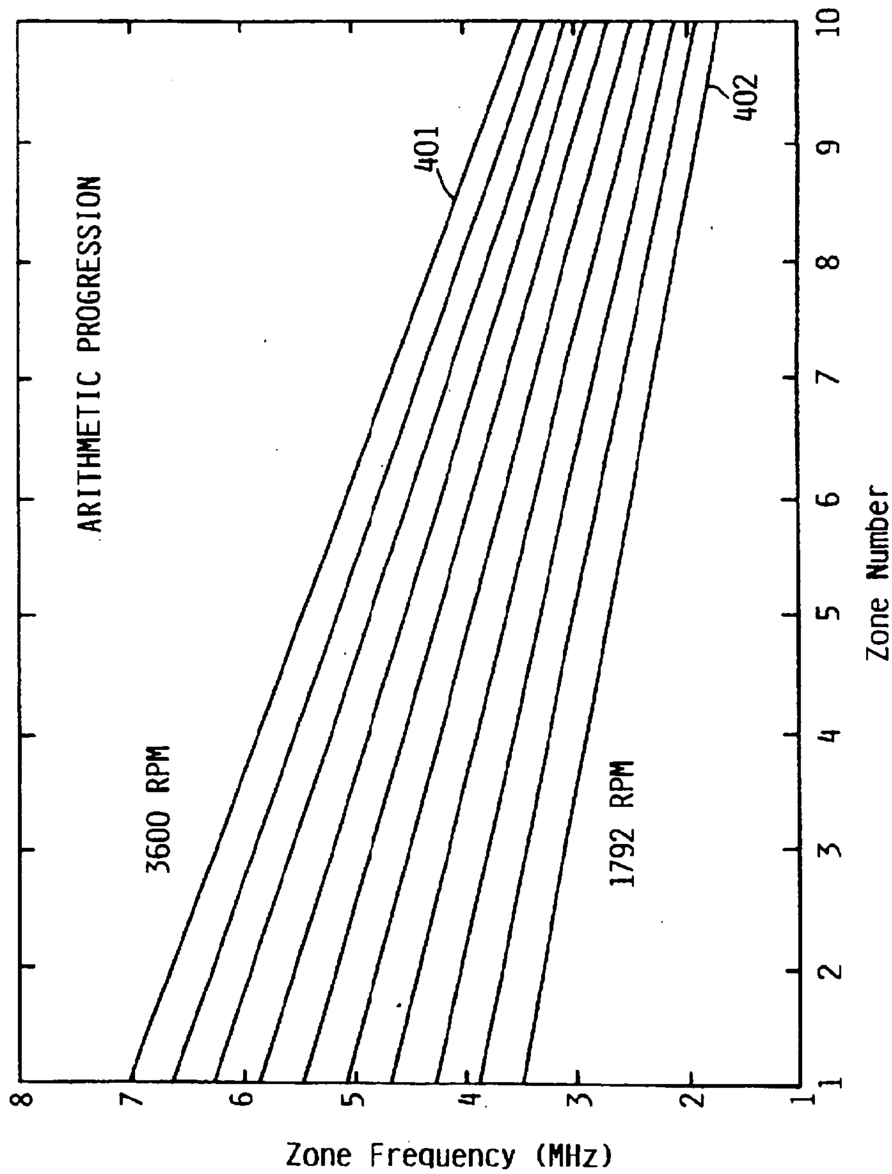

ARITHMETIC PROGRESSION
3600 RPM
1792 RPM
401
402
Zone Number
Zone Frequency (MHz)
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8

FIG. 4

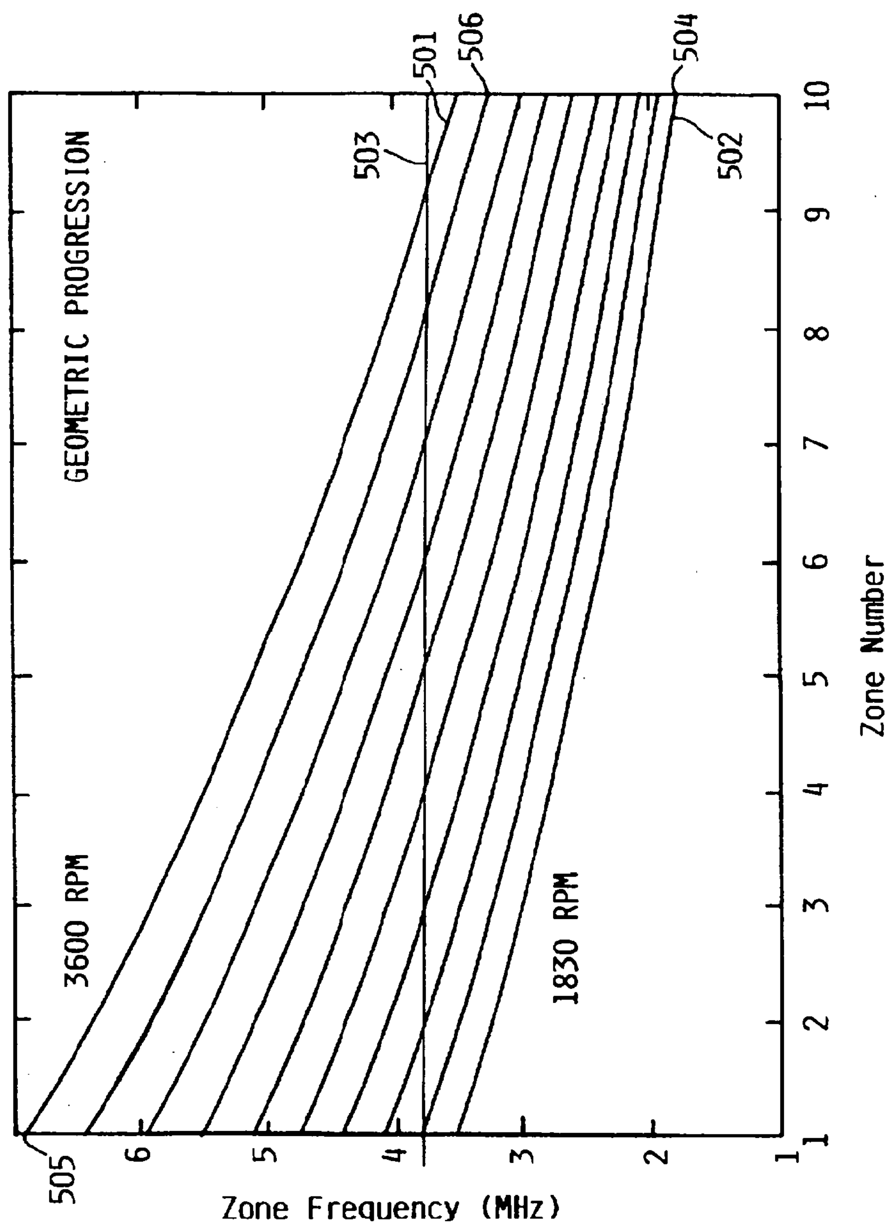

GEOMETRIC PROGRESSION
3600 RPM
1830 RPM
501
502
503
504
505
506
Zone Frequency (MHz)
1
2
3
4
5
6
Zone Number
1
2
3
4
5
6
7
8
9
10

FIG. 5

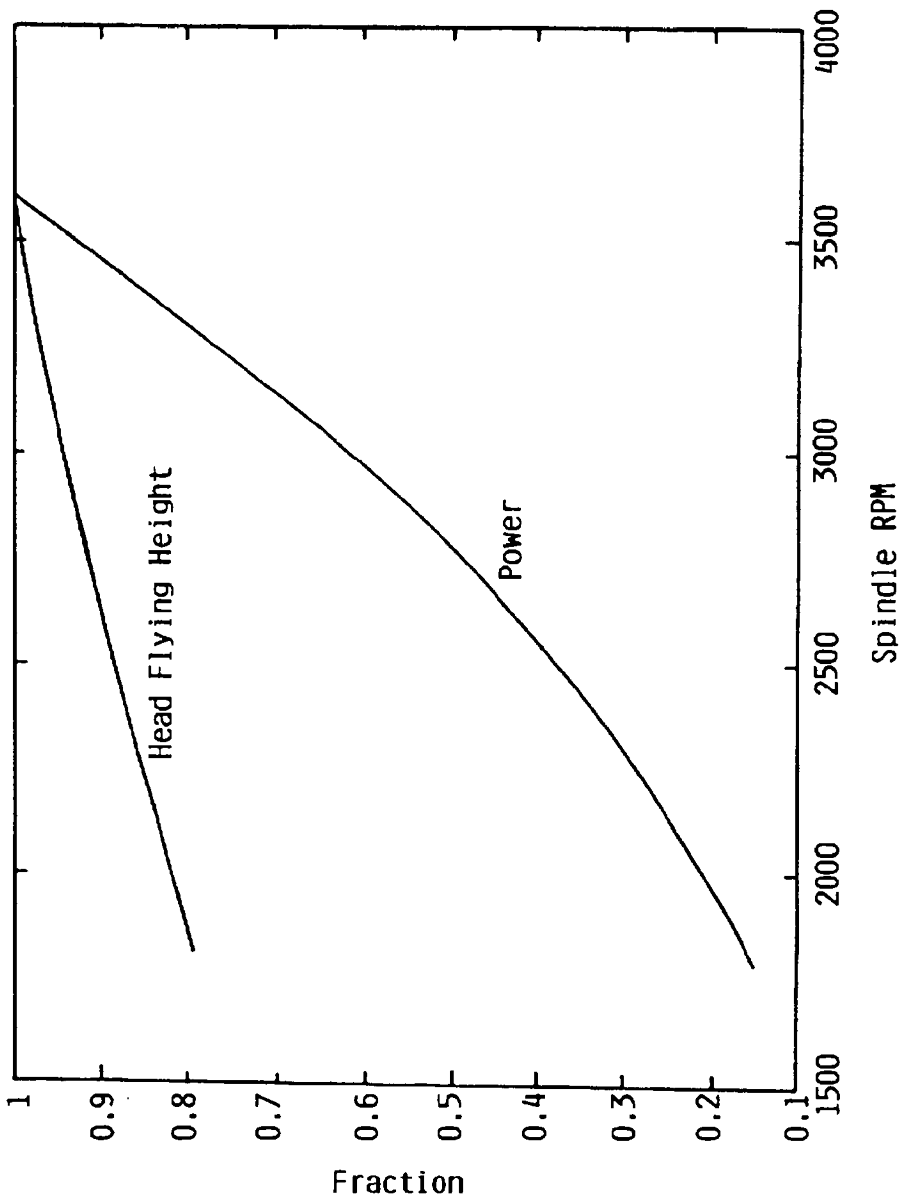

Head Flying Height
Power
Spindle RPM
1500
2000
2500
3000
3500
4000
Fraction
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

FIG. 6

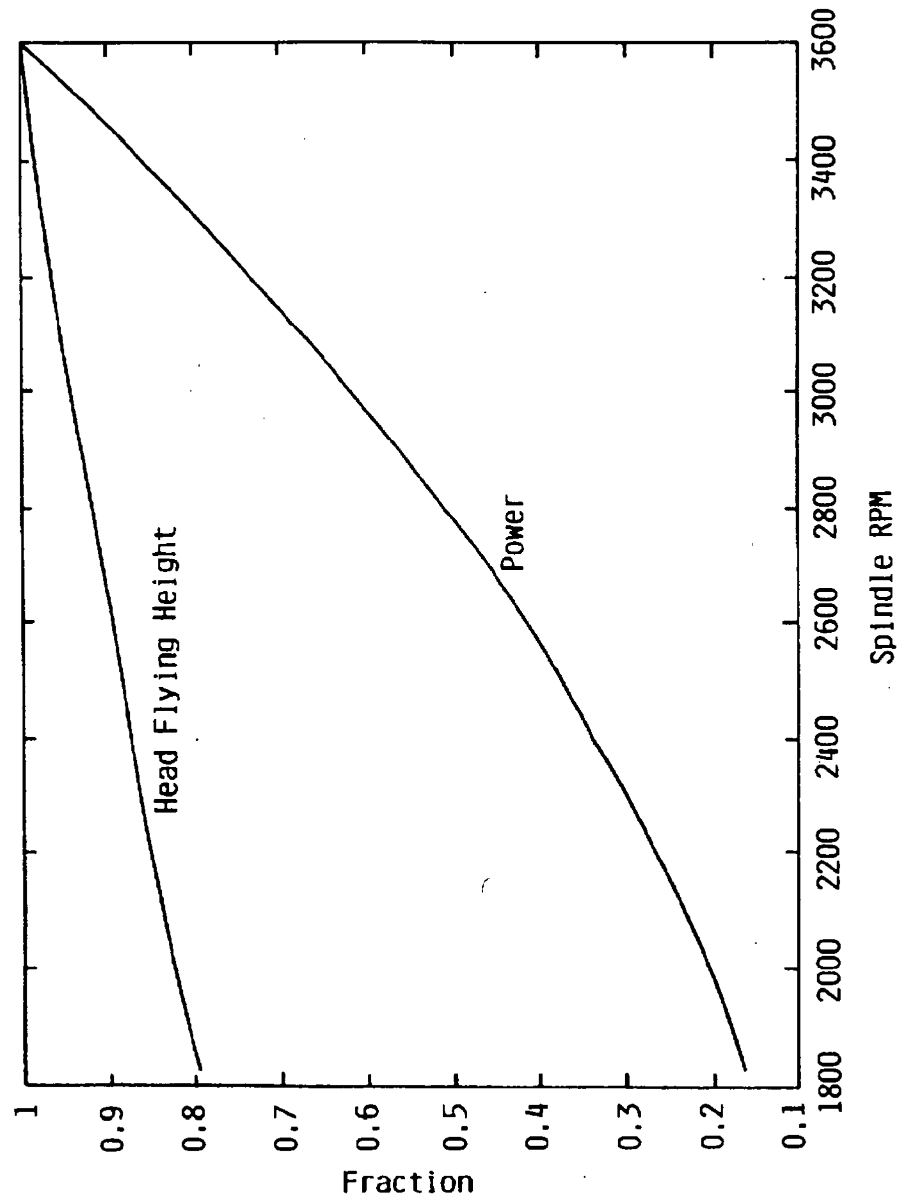

Head Flying Height
Power
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Fraction
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
Spindle RPM

FIG. 7

ZONE	Radii (mm)										
	RPM	3600	3339	3097	2873	2665	2472	2293	2127	1972	1830
	FH	1.0000	0.9755	0.9516	0.9282	0.9005	0.8833	0.8616	0.8405	0.8199	0.7998
	POWER	1.0000	0.8175	0.6682	0.5462	0.4465	0.3650	0.2984	0.2439	0.1994	0.1630
1	27.55	6.8998	6.3999	5.9363	5.5062	5.1072	4.7372	4.3940	4.0757	3.7804	3.5065
2	25.55	6.3999	5.9363	5.5062	5.1072	4.7372	4.3940	4.0757	3.7804	3.5065	3.2524
3	23.70	5.9363	5.5062	5.1072	4.7372	4.3940	4.0757	3.7804	3.5065	3.2524	3.0168
4	21.98	5.5062	5.1072	4.7372	4.3940	4.0757	3.7804	3.5065	3.2524	3.0168	2.7982
5	20.39	5.1072	4.7372	4.3940	4.0757	3.7804	3.5065	3.2524	3.0168	2.7982	2.5955
6	18.91	4.7372	4.3940	4.0757	3.7804	3.5065	3.2524	3.0168	2.7982	2.5955	2.4075
7	17.54	4.3940	4.0757	3.7804	3.5065	3.2524	3.0168	2.7982	2.5955	2.4075	2.2330
8	16.27	4.0757	3.7804	3.5065	3.2524	3.0168	2.7982	2.5955	2.4075	2.2330	2.0713
9	15.09	3.7804	3.5065	3.2524	3.0168	2.7982	2.5955	2.4075	2.2330	2.0713	1.9212
10	14.00	3.5065	3.2524	3.0168	2.7982	2.5955	2.4075	2.2330	2.0713	1.9212	1.7820

GEOMETRIC PROGRESSION

FIG. 8A

ZONE											
	RPM	3600	3399	3198	2997	2796	2595	2395	2194	1993	1792
	FH	1.0000	0.9812	0.9617	0.9413	0.9200	0.8976	0.8741	0.8492	0.8227	0.7943
	POWER	1.0000	0.8573	0.7282	0.6120	0.5081	0.4161	0.3353	0.2651	0.2049	0.1541
ZONE	Radii (mm)										
1	28.13	7.0455	6.6523	6.2591	5.8659	5.4726	5.0794	4.6862	4.2929	3.8997	3.5065
2	26.56	6.6523	6.2810	5.9098	5.5385	5.1672	4.7959	4.4246	4.0533	3.6821	3.3108
3	24.99	6.2591	5.9098	5.5604	5.2111	4.8618	4.5124	4.1631	3.8137	3.4644	3.1151
4	23.42	5.8659	5.5385	5.2111	4.8837	4.5563	4.2289	3.9015	3.5741	3.2468	2.9194
5	21.85	5.4726	5.1672	4.8618	4.5563	4.2509	3.9454	3.6400	3.3346	3.0291	2.7237
6	20.28	5.0794	4.7959	4.5124	4.2289	3.9454	3.6619	3.3784	3.0950	2.8115	2.5280
7	18.71	4.6862	4.4246	4.1631	3.9015	3.6400	3.3784	3.1169	2.8554	2.5938	2.3323
8	17.14	4.2929	4.0533	3.8137	3.5741	3.3346	3.0950	2.8554	2.6158	2.3762	2.1366
9	15.57	3.8997	3.6821	3.4644	3.2468	3.0291	2.8115	2.5938	2.3762	2.1585	1.9408
10	14.00	3.5065	3.3108	3.1151	2.9194	2.7237	2.5280	2.3323	2.1366	1.9408	1.7451

ARITHMETIC PROGRESSION

FIG. 8B

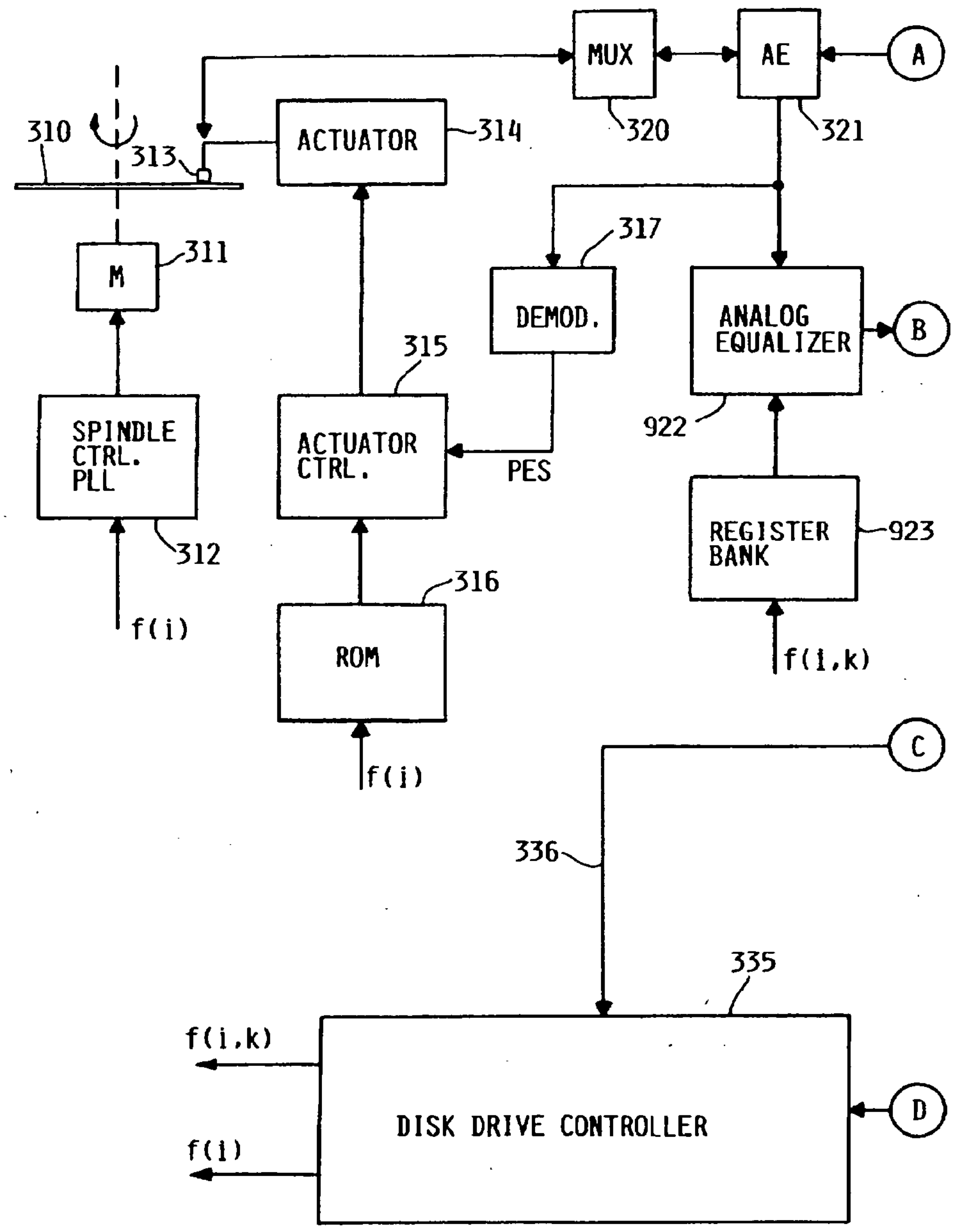

MUX
AE
A
310
313
ACTUATOR
314
320
321
317
311
M
DEMOD.
ANALOG EQUALIZER
B
315
922
SPINDLE CTRL. PLL
ACTUATOR CTRL.
PES
REGISTER BANK
923
312
316
f(i)
ROM
f(i,k)
f(i)
C
336
335
f(i,k)
DISK DRIVE CONTROLLER
D
f(i)

FIG. 9A

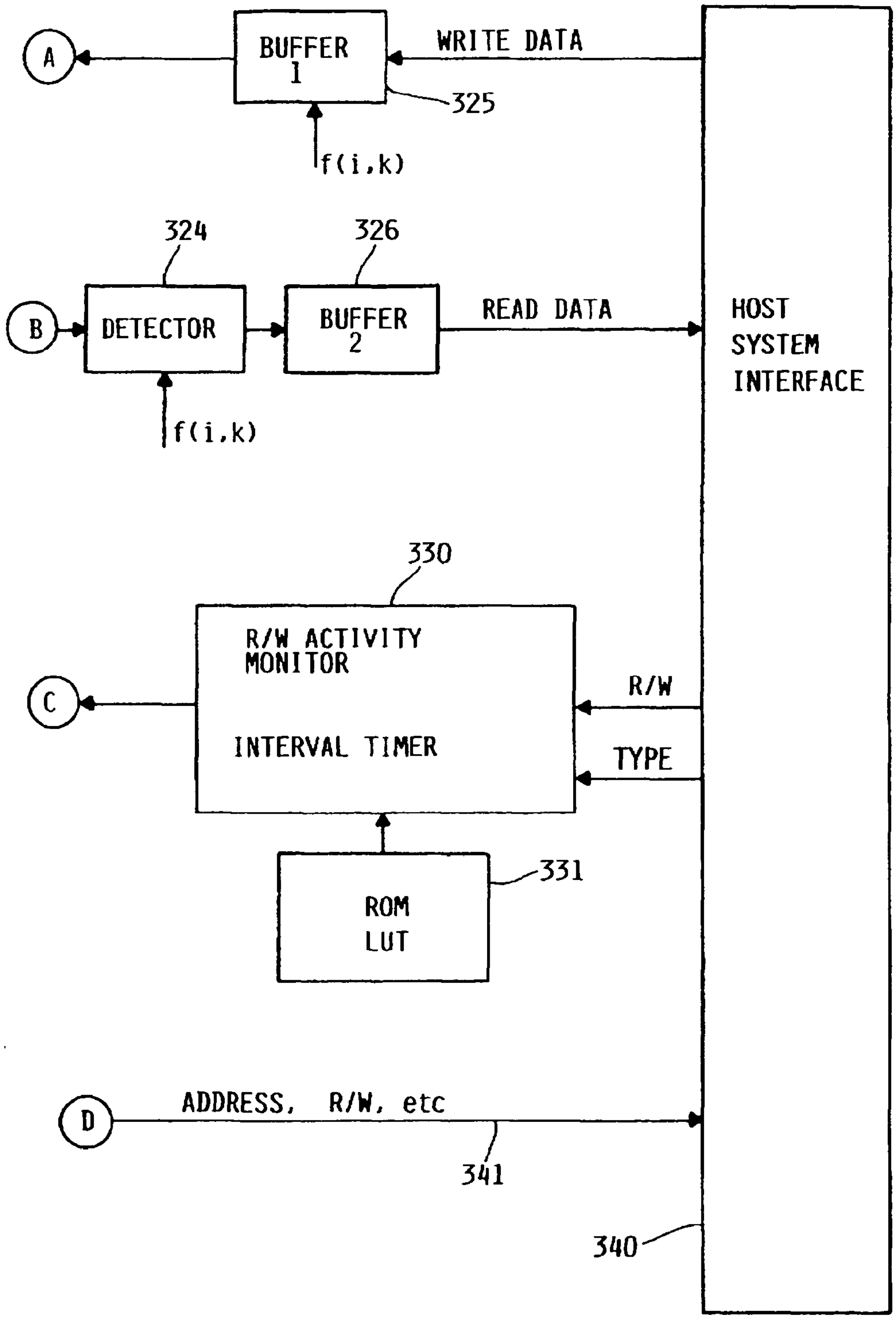

A
BUFFER 1
WRITE DATA
325
f(i,k)
324
326
B
DETECTOR
BUFFER 2
READ DATA
HOST SYSTEM INTERFACE
f(i,k)
330
R/W ACTIVITY MONITOR
INTERVAL TIMER
C
R/W
TYPE
ROM LUT
331
D
ADDRESS, R/W, etc
341
340

FIG. 9B

POWER SAVING METHOD AND APPARATUS FOR USE IN MULTIPLE FREQUENCY ZONE DRIVES

BACKGROUND OF THE INVENTION

The present invention is directed to a method and apparatus for saving power in zone bit recording (ZBR) drives, and in particular to a method and apparatus for carrying out operations in multiple zones at different spindle velocities.

One of the key components of some electrical devices is a place to store and read data. For example, compact disk players read data, such as music, from a plastic disk. Another example is a VCR which reads data from a tape. Computer systems also store and read large amounts of data. Typically computer systems employ a number of storage means to store data. One of the places where a computer can store data is in a disk drive which is also called a direct access storage device.

Although this invention is not limited to a direct access storage device one will be described by way of example. A disk drive or direct access storage device includes several disks which look similar to records used on a record player or compact disks which are used in a CD player. The disks are stacked on a spindle, much like several records awaiting to be played. In a disk drive, however, the disks are mounted to the spindle and spaced apart so that the separate disks do not touch each other.

The surface of each disk is uniform in appearance. However, in actuality, each of the surfaces is divided into portions where data is stored. There are a number of tracks situated in concentric circles like rings on a tree. Each track in a disk drive is further subdivided into a number of sectors which is essentially just one section of the circumferential track.

Storage of data on a magnetic disk entails magnetizing portions of the disk in a pattern which represents the data. To store data on a disk the disk is magnetized. In order to magnetize the magnetic layer, a small ceramic block which contains a magnetic transducer known as a write element is passed over the surface of the disk. More specifically, the write element is flown at a height of approximately six millionths of an inch from the surface of the disk and is flown over the track as the write element is energized to various states causing the track below to be magnetized to represent the data to be stored. In some applications, the write element is the same as the read element. Other applications use a separate write element and a separate read element.

To retrieve data stored on a magnetic disk, a read element located, in close proximity to the write element, is flown over the disk. The magnetized portions of the disk provide a signal from the read element. By looking at output from the read element, the data can be reconstructed and then used by the computer system.

Like a record, both sides of a disk are generally used to store data or other information necessary for the operation of the disk drive. Since the disks are held in a stack and are spaced apart from one another, both the top and the bottom surface of each disk in the stack of disks has its own read element and write element. This would be comparable to having a stereo that could play both sides of a record at once. Each side would have a stylus which played the particular side of the record.

Disk drives also have something that compares to the tone arm of a stereo record player. There are two types of disk drives, rotary and linear. Rotary disk drives have a tone arm that rotates much like a record player. The tone arm of a rotary disk drive, termed an actuator arm, holds all the transducers or read/write elements, one head for each surface of each disk supported in a structure that looks like a comb. Sometimes the structure is called an E-block. Like a tone arm, the actuator arms rotate so that the read element and write element attached to the actuator arm can be moved to locations over various tracks on the disk. In this way, the write element can be used to magnetize the surface of the disk in a pattern representing the data at one of several track locations. The read element is used to detect the magnetized pattern on one of the tracks of a disk. For example, the needed data may be stored on two different tracks on one particular disk, so to read the magnetic representations of data, the actuator arm is rotated from one track to another track.

It should be noted that this invention is not limited to use in disk drives using magnetic media but is useful in any device having rotating media. In this particular application, where magnetic media is described as an example it should be recognized that the invention would be useful in other storage devices which have different types of media or read and write elements.

The use of direct access storage devices (DASD), such as magnetic disk drives, in portable computers has increased significantly over the past several years. Such computers typically have a portable battery pack which provides power to the various components of the computer when the computer is used away from a power outlet. It is important that the battery pack used to supply power to the portable computer be compact and light weight. However, as the portable computers are increasingly used in locations where an external power source is unavailable, for example, traveling on an airplane, it is also increasingly important that the portable computers operate for significant periods of time between recharging of the battery pack.

The desire to achieve a compact and light weight design often competes with a desire for longer usage time of the computer between charging the battery pack. In order to increase operating time at the portable computer, various steps have been taken to reduce the power consumption of components used in the computer. Moreover, increased efforts have also been made to reduce power consumption of desk-top computers in order to more generally conserve energy resources. The Environmental Protection Agency now provides for power saving status to be granted to computers meeting certain standards. Thus, efforts to reduce power consumption of the various components of a computer have been increasingly employed. For example, the central processing unit (CPU), often includes some from of power management function to reduce clock frequency of the CPU when the computer is in a power savings mode. In general, a power saving mode may be invoked to reduce use of power by a component of the computer when the component is not being used.

In the case of memory storage devices various power savings techniques have been employed. For example, in disk drives, the spindle motor uses a large percentage of the total power. In order to conserve power, it has been proposed that the spindle speed of the disk drive be reduced or stopped when the disk drive is not being used by the portable computer. In a typical approach, a normal operating spindle velocity is used by the disk drive during read and write operations to the disk. When the power saving mode is initiated, for example, when the disk drive is not accessed over a predetermined period of time, the spindle velocity of the disk is reduced or stopped to conserve power. When an access operation to the disk drive is initiated, the spindle speed is increased until the disk is rotated at the normal operating velocity prior to beginning the read or write operation. In other words, the power saving mode is disengaged prior to the commencement of read and write operations.

Another increasingly important requirement of storage devices, including those used in portable computers, is that the devices have a high storage capacity. In order to conserve power and provide a light weight compact design, it is also desirable that the disks used in the drives be as small as possible. By using smaller disks, power is saved by reducing the size of the disk which the spindle motor must rotate. The increasing demand for high storage capacity while using smaller disks present competing interests to the disk drive developer.

One technique used to increase the storage capacity of a rotating disk is zone bit recording (ZBR). The principle behind ZBR is that at a constant spindle velocity, the linear speed of the disk as it moves past the transducer varies from the inner diameter to the outer diameter of the disk. In particular, the linear speed of the disk moving past a transducer positioned at the outer diameter of the disk is higher than when the transducer is positioned at the inner diameter. ZBR takes advantage of this higher linear velocity by increasing the frequency at which data is recorded to the disk at the outer diameter in order to increase the linear density of the recorded data to the maximum linear density limit for the particular DASD.

Ideally, to achieve maximum storage capacity, the write frequency could be selected as a function of the radial position of the head such that the maximum linear density of transitions used (e.g., data) at the outer diameter of the disk is the same as the density at the inner diameter of the disk. In such a system, the linear density of the data recorded on the disk is constant and equal to the maximum linear density limit regardless of the radial position on the disk at which the data is recorded. In practice, to achieve near optimum storage capacity, it is not necessary to change the density for each track location. Rather, the disk may be divided into a number of concentric zones made up of a band of adjacent track locations. Each zone has an associated frequency at which data is written to and read from the disk. The zone frequency is typically selected for each zone such that the linear density of data at the innermost track of each zone is constant and equal to the maximum linear density limit. In this manner, the overall storage capacity of the disk can be significantly increased.

SUMMARY OF THE INVENTION

Generally, the present invention provides an improved low power direct access storage device and method. In one particular embodiment, the present invention is implemented in the form of a memory storage device which includes a disk having N concentric zones, N being an integer greater than 1, provided around a surface of the disk. Data is stored in each zone such that a linear density of data at an inner track location of each zone is substantially constant. A variable speed motor may be connected to the disk to selectively rotate the disk at a plurality of discrete disk velocities and a transducer may be used to perform write and/or read operations to and from each of the zones at each of the plurality of discrete disk velocities.

In accordance with an aspect of the invention a storage device may be operated by rotating a disk at a first disk velocity, performing access operations to the plurality of concentric zones while rotating the disk at the first disk velocity, rotating the disk at a second disk velocity and performing access operations to the plurality of concentric zones while rotating the disk at the second disk velocity.

The invention may be advantageously implemented in a portable computer. The disk drive provides added value to the portable computer because it provides decreased power consumption.

The above summary of the present invention is not intended to present each embodiment or every aspect of the present invention. Rather, the invention will be understood by reference to the figures and the associated description which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. 1 illustrates a disk surface having a number of recording zones;

FIG. 2 depicts a block diagram which exemplifies an embodiment of the present invention;

FIG. 3 depicts a more detailed block diagram exemplifying an embodiment of the present invention;

FIG. 4 illustrates a relationship between zone frequency and spindle motor velocity for tracks partitioned into zones according to an arithmetic progression;

FIG. 5 illustrates a relationship between zone frequency and spindle motor velocity for tracks partitioned into zones according to a geometric progression;

FIG. 6 illustrates a relationship between fractional power and head flying height at different spindle motor velocities for tracks partitioned into zones according to an arithmetic progression;

FIG. 7 illustrates a relationship between fractional power and head flying height at different spindle motor velocities for tracks partitioned into zones according to a geometric progression;

FIGS. 8A and 8B, respectively, are tables depicting the geometrically and arithmetically located zone radii, flying height, power requirements and frequency as a function of varying spindle speed for a 2.5' disk drive; and

FIG. 9 illustrates another embodiment of the invention.

While the invention is amenable to various modifications and alterative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

The present invention provides an improved power saving mode for use in a storage device which is well suited for use in a multiple frequency zone (i.e., ZBR) drives. More particularly, the present invention provides an improved power savings mode of operation for a memory storage device, by allowing the storage device to be accessed while in the power savings mode. As described more fully below, when conservation of power is more critical to a user than the access speed to the data on the drive or when access operations to the storage device are relatively infrequent, the storage device may be operated in power savings mode to reduce power consumption. While the invention relates in general to direct access storage devices such as magnetic and optical disk drives, CD ROMs and the like, the exemplary embodiments provided below describe a disk drive for purposes of illustration. The implementation of the described features in other types of storage devices will be apparent from the description.

In FIGS. 1–3, various components of a disk drive are shown for the purpose of illustrating various features of the present invention. A diagram illustrating a disk surface using multiple frequency recording zones (i.e., ZBR) is illustrated in FIG. 1. In FIG. 1, a disk **100** has N zones **101** each made up of a band of tracks or track locations (not shown). The zones **101** progress from zone Z_1 at the outer diameter of the disk to zone Z_N at the inner diameter of the disk. The zones **101** may be defined by the inner radii **102** of the zones. The radius R_i corresponds to the inner radius of zone Z_i. The radius **103** of the disk defines an outer diameter R_{OD} of the disk.

The disk **100** is rotated by a spindle motor at a velocity ω_j in the direction of arrow **104**. As described more fully below, the disk may be rotated at two or more discrete velocities ω_j. The particular velocity ω_j used can be determined on the basis of the operating mode in which the disk drive is being used.

As described more fully below, data may be written to the each of the zones at different write frequencies while the disk is rotated at a constant velocity, as is conventionally know in ZBR drives, such that all write operations are carried out at the same spindle velocity with a write frequency selected according to the zone. Alternatively, data may be written to the disks at different spindle speeds. When different spindle speeds are used for write operations the write frequency for a particular zone is selected such that the linear density for data written to the inner track of each zone is substantially constant and substantially equal to the maximum linear density limit for the particular DASD.

Data may also be read from the disk at two or more spindle velocities. Thus, the linear data rate as the disk is read, (i.e., the rate at which data is presented to the read head) also varies as the speed of the spindle motor is changed. In other words, the rate at which data bits, represented by transitions in the signal, are presented to the transducer for a given zone varies as the spindle motor speed changes. Hereinafter, the rate at which data is presented to a transducer at a given spindle velocity will be referred to as the "zone bit frequency". Thus, as used herein, the term "zone bit frequency" is to represent the rate at which bits of data are presented to (or written by) the transducer. The zone bit frequency is a function of both the linear density of the data in the zone and the rotational speed of the disk (i.e., the spindle velocity).

The components of a disk drive used to control the spindle velocity and operating frequency of a data channel are illustrated in FIG. 2 in block diagram form. In FIG. 2, the disk **100** is rotated by a spindle motor **201**. The rotational velocity of the spindle motor **201** is controlled by a motor controller **202**. The motor controller **202** is provided to rotate the spindle motor **201** and hence the disk **100**, at a number of known, discrete velocities. A transducer **203** is positioned adjacent the disk **100** to read and/or write information to and from the surface of the disk **100**.

The transducer **203** may be mounted to, for example, a rotary actuator (not shown) to position the transducer over a

desired track location. The radial position of the transducer **203** relative the disk determines which zone of the disk **100** is being accessed. The transducer **203** is connected to a variable frequency data channel **204** which may be used to read and write signals from and to the disk at an appropriate zone bit frequency for a selected zone and disk speed. In a read operation, for example, the transducer **203** provides a raw signal of information read from the disk to the data channel **204** which extracts data from the signal at the appropriate frequency for the given zone and spindle speed. The data read from the disk **100** is supplied from the variable frequency data channel **204** to a processing interface **212** which processes the signal for use by the CPU **211** of a computer using the disk drive.

A control unit **205** is connected to the variable frequency data channel **204** and the motor controller **202**. The control unit **205** receives a zone control signal **206** and a mode control signal **207** from the processing interface **212**. The zone control signal **206** indicates the zone at which the transducer **203** is performing an access operation. This information can be obtained by any of the conventionally known methods for determining head position. For example, zone information may be obtained from the transducer as it reads servo information (e.g., Gray code information) from the surface of the disk.

The mode control signal **207** informs the control unit **205** of an operating mode of the disk storage device. For example, if the disk storage device is operating in a power savings mode, this information is provided to the control unit **205** as the mode control signal **207**.

On the basis of the mode control signal **207**, the control unit supplies a motor speed control signal **209** to the motor controller to cause the spindle motor **201** to rotate the disk at the appropriate velocity. The control unit also determines, on the basis of the zone control signal **206** and the mode control signal **207**, the appropriate zone bit frequency for accessing the disk zones **101**. The data rate (zone bit frequency) is determined on the basis of both the mode control signal **207**, which reflects the spindle motor **201** velocity and the zone control signal **206** which reflects the relative rate at which the data is written to the disk at the particular zone. The appropriate zone bit frequency is communicated to the variable data channel **204** on line **208** from the control unit **205**.

The processing interface **212** processes information and provides an interface to the main CPU **211** of the computer **210** using the disk storage device. The operation of this circuitry may be understood from the detailed example provided below.

A number of different mechanisms may be used by the system to determine the appropriate mode of operation. A power savings mode may be entered, for example, in response to user input which specifies a desire to operate in a low power mode. For example, the user may be using the computer on a long airplane flight where low battery power consumption is more important than access speed to the disk drive. Alternatively, a power savings mode may be automatically entered when activity in the disk drive falls below a particular threshold or if the battery power level is below a threshold. It is noted that monitoring activity level of the disk drive can be accomplished using the techniques generally known in the art. However, in conventional power saving disk drive devices, data is not written to or read from the disk while the speed of the spindle motor is reduced. Thus, in addition to determining when a power savings mode should be initiated the system must also know when to exit the power savings mode. In contrast to the conventional power savings approach which automatically exits the power savings mode when any access is made to the disk drive, in accordance with an aspect of the invention a more sophisticated mechanism is employed to determine when the power savings mode should be initiated and terminated.

In certain environments, it may be desirable to operate the disk drive in a low power mode only for read operations and resume full speed when a disk write operation is initiated. Such an approach may be used where it is desired to write data only at the higher spindle speed. For example, as the spindle speed is slowed, the time between servo sectors is increased, thereby decreasing the sampling rate of servo information. A lower sampling rate may result in lower servo stability increasing track mis-registration (TMR). Typically, a higher TMR is acceptable for read operations than for write operations. Thus, for certain configurations, it may be desirable to increase the speed for write operations in order to decrease TMR. Reduced power consumption may still be realized since in a typical use of a disk drive there are 5–10 read operations for every write operation.

If write operations are to be carried out only at the higher spindle speeds, it is necessary to resume full speed prior to initiating a write operation to the disk. If write access operations to the disk are minimal, a simple process of resuming full speed on the initiation of a write operation may produce significant power savings. Alternatively, information to be written to the disk may be saved in a temporary memory such as a random access memory 213 (RAM) used by the computer, upon initiation of a write operation. The data in the RAM 213 may then be transferred to the disk at a later point in time, when the normal operating speed of the spindle motor is resumed. Some form of data hierarchy, such as that used by cache memory schemes, may be used to determine whether the data on the disk or in the RAM should be used for read operations.

The above described temporary storage of data to be written to the disk may be advantageous in a system where a user manually selects a power saving mode and where write operations are not to be carried out at slower spindle speeds. In this mode, the spindle motor may be generally operated at a lower spindle velocity. Periodically, the spindle motor velocity could then be increased to the normal operating speed, at which time the data is transferred from the RAM 213 to the disk. After the data is written to the disk the reduced spindle speed may be resumed. It is noted that instead of the RAM 213, any other type of temporary storage may be used. For example, a temporary memory may incorporated directly into the disk storage device to serve this function.

In another alternative embodiment, the power savings mode may be invoked and maintained when the average number of disk access operations, including read and/or write operations, occurring during a predetermined time period fall below a set threshold. A give spindle speed may be selected which corresponds to a particular activity level.

A more detailed circuit diagram exemplifying various components which may be used to implement a low-power disk storage device is illustrated in FIG. 3. In FIG. 3, a recording head 313 is positioned to read and write information from and to the surface of disk 310. It is noted that while only a single disk is illustrated in FIG. 3, multiple disks and heads may be used. An actuator assembly 314, including a voice coil motor (VCM), is provided to move the head 313 relative to the rotating disk 310. A spindle motor 311 is provided to rotate the disk 310. The spindle motor 311 is controlled by a spindle controller 312. The spindle controller 312 may be implemented with a phase locked loop (PLL) such that the speed of the spindle motor 311 may be controlled by applying a frequency control signal f(i) to the spindle controller 312. It is noted that the various control elements illustrated in FIG. 3, while shown as discrete blocks may be implemented on a microprocessor using microcode. Moreover, a number of different microprocessors may be used, each implementing one or more of the described functions. The present description describes the functional operation of the various elements whether implemented as microcode or as discrete circuits.

An adaptive actuator controller 315 is provided to control the actuator 314. The actuator controller 315 uses a set of coefficients stored in a read-only memory (ROM) 316. The ROM 316 stores one set of coefficients for each discrete rotational velocity of the disk 310. It should be noted that the various coefficients used in a storage device will typically be tuned for the particular storage device at final test stages of the manufacturing process. The disk velocity is changed under control of the frequency control signal f(i) from one discrete velocity to another. As the disk velocity is changed, the actuator controller 315 loads a new set of a coefficients corresponding to the new disk velocity. The different coefficients are required because of the change in sampling rate of servo information formed by transducer 313 and servo patterns written on equispaced and radial sectors on the disk and decoded by demodulator 317 to produce a position error signal (PES). The coefficients are used to adjust the dynamic operation of the adaptive actuator controller 315 thereby optimizing actuator access and tracking performance. The position error signal is used for servo control to keep the head 313 aligned over the correct track location. If the disk 310 is slowed down, for example, the sampling of the position error signals will be slower than when the disk 310 is rotated at the faster nominal speed. The adaptive actuator controller 315 must be dynamically reconfigured to work with the proper sampling rate of the position error signal.

Information read from or written to the disk 310 passes through a multiplexer 320. The multiplexer 320 selects a head from various heads respectively corresponding to multiple disk surfaces (only one head 313 is shown in FIG. 3). The multiplexer 320 is coupled to the arm electronics (AE) module 321. The arm electronics module 321 is coupled to buffer 325 to receive data to be written the disk during a write operation. Buffer 325 is coupled to a host system interface 340 which in turn is coupled to the host system such as the processing unit of a portable computer. Data is typically passed from the host system interface 340 to the buffer 325 at a fixed rate (i.e., at a fixed number of bytes-per-second). The data is then stored in buffer 325. The data is clocked from the buffer 325 to the disk via the arm electronics module 321 and the multiplexer 320 at a rate (or frequency) which depends on the disk velocity and the zone in which the data is to be written. Thus, the buffer is provided with a control signal f(i,k) which is dependent upon the disk velocity denoted by "i" and the zone denoted by the letter "k". In other words, write data enters the buffer at constant speed and is output at a variable speed dependent upon disk velocity and zone information.

In a read operation, using head 313, for example, data is read and passed to the multiplexer 320, amplified by the AE module 321 and then provided to a digital equalizer 322. The adaptive digital equalizer (filter) 322 compensates for amplitude variation in bit frequency arising, for example, in the head 313 and/or the arm electronics module 321. The digital equalizer 322 amplifies all frequencies of the recorded signals such that the overall amplification of each frequency is of the same amplitude. The digital equalizer 322 is coupled to a ROM 323 to receive a set of coefficients corresponding to the spindle speed (disk velocity) and the zone from which the data is read in response to the control signal f(i,k). The coefficients are precalculated values to be used to optimize the operation of the digital equalizer 322.

The output of the digital equalizer 322 is provided to the detector 324. The detector 324 is also provided with the control signal f(i,k) to optimize the clocking and detection operation of the detector on the basis of the spindle speed and the particular zone from which the data was read. The detector 324 detects data bits in the signal read using the head 313. Once the data bits now have been detected, error correction for soft errors may be further carried out in the detector 324. The data may then be passed into the buffer 326 and subsequently read from the buffer 326 to the host system interface 340 at a frequency which is accepted by the interface. This frequency, for example, may be the same as the frequency at which write data is received by buffer 325 from the host system interface 340.

A demodulator 317 is also shown receiving the output from the arm electronics module 321. The demodulator 317 extracts servo information from a signal read by the head 313 from equispaced and radial servo patterns written on the disk surface. From the servo information the position error signal (PES) is derived and is provided to the actuator controller 315 to control the positioning of the head as described above. A detailed analysis of the above operation is provided in U.S. Pat. Nos. 5,285,327 entitled "Application for Controlling Reading and Writing in a Disk Drive", issued Feb. 8, 1994; 5,440,474 entitled "Magnetic Recording disk with Equally Spaced Servo Sectors Extending Across Multiple Data Bands", issued Aug. 8, 1995; and 5,210,660 entitled Sectored Servo Independent of Data Architecture, issued May 11, 1993.

The control signals f(i) and f(i,k) are generated by a disk drive controller 335. The disk drive controller 335 is coupled to communicate with the host system interface 340 as indicated by line 341. The host system interface 340 provides addressing information, read/write commands designating the type of operation to be performed, and the like, to the disk drive controller 335. The address information may include, for example, a head number, a cylinder number or track number as well as a data sector number. The disk drive controller 335 may also communicate information to the host system interface 340. For example, the disk drive controller 335 may communicate status information to the host system interface along line 341. When the disk drive is initially powered up, the controller may perform operations independent of the host. While performing such operations the disk drive controller 335 may inform the host system interface 340 that the disk drive is busy and will further notify the host system interface when the drive is ready to perform access operations.

The disk drive controller 335 also receives a control mode signal 336 indicative of a desired operating frequency for the drive. This control mode signal 336 will indicate, for example, whether the disk drive should be operated at a lower spindle speed to conserve power. The control mode signal 336 may be used to control, for example, a variable frequency oscillator in the disk drive controller 335. The frequency of this oscillator may then be used as a master frequency to control other elements in the disk drive. For example, the frequency of the oscillator may be provided to the phase locked loop (PLL) of the spindle controller 312 to control the spindle speed. The control mode signal 336 is determined on the basis of a mode of operation which in which the disk drive is to be operated.

By way of example, the internal variable frequency oscillator may be controlled to a desired frequency on the basis of the type of the operations that are being called for by the host or the activity level of such operations. If, for example, there is high activity in the disk drive, the activity monitor 330 may instruct the disk drive controller 335 via control mode signal 336 to operate at full speed. Certain types of operations, such as interactive operations, may also be recognized by the activity monitor as needing to operate at full speed. Further, a manual power savings mode selection entered by the user into the host system may be passed to the activity monitor. In response to the power savings mode selection the control mode signal 336 may be set to lower the spindle speed of the disk drive regardless of the activity level.

The activity monitor 330 may include an interval timer used to monitor activity levels within a set interval. The activity monitor 330 may also monitor for read, write or other types of operations from the host system. The system may determine that based on the absence of the monitored operations for a given period of time that the spindle speed should be slowed down. Depending on then the length of time incurred without the specified activity the control mode signal 336 may preferably instruct the disk drive controller 335 to slow the spindle speed over a number of increments or steps. It should be appreciated that the spindle speed can not be instantaneously changed. Moreover, while changing the speed of the spindle from one value to another read and write operations cannot be carried out. Thus, if the disk drive is in the process of changing spindle motor speed, the disk drive controller provides a short "busy" signal along line 341 to the host system interface to place the system in a wait state until the desired spindle velocity is achieved.

In order to eliminate or reduce the waiting time while changing spindle speed, the host system may provide an indication to the disk drive controller when high disk drive activity is anticipated for future operations. In response to such an indication, the spindle speed may be increased prior to initiation of the high activity disk drive access operations. Information used by the activity monitor 330 is stored in the ROM 331 which may include a look-up table (LUT). The look-up table can be referred to determine whether a particular type of activity typically requires very high, high, medium high, average, etc. disk drive activity. For example, operations such as search operations of large databases, operations heavily using graphic images, video games, and the like, typically all require high disk drive activity. Initiation of interactive operations, for example, a "spell check" operations may also indicate a high activity level. The look-up table may also include a desired operating frequency associated with a particular level of activity. The activity monitor 330 may also include some form of alterable memory which can have values representing levels of activity set by a user, providing additional flexibility for initiating a power savings mode.

The activity monitor 330 also receives a signal from the host system interface 340 indicating the type of information being read from or written to the disk. For example, certain types of information such video information or interactive types of information, may require faster response times for access operations. This type indicator may be used to ensure that a satisfactory spindle speed is used for the type of information being read.

The activity monitor 330 may also be provided with a signal indicating battery power level from the host system interface **340** where the host system is operating on battery power. When the battery power level is below a predetermined set value, the system may be placed into a low power mode until adequate power levels are resumed by for example, hooking up to a power an AC power source or changing the battery.

As described above, as the spindle speed changes the read frequency changes for the various zones. This increases the overall complexity of the system. For example, in the circuit described above, for each discrete spindle velocity the digital equalizer (filter) **322** must be loaded with filter configuration data for each zone from ROM **323**. The configuration data is unique for each different zone bit frequency. Thus, as the number of zones and discrete spindle velocities used by the storage device increase, the number of different zone bit frequencies also increases. An increase in the number of different zone bit frequencies is even more problematic when an analog or hybrid digital/analog data channel is used. As described more fully below, such a channel must include separate analog front end components such as resistors and capacitors for each different zone bit frequency used, increasing significantly the cost and size of the read channel. Moreover, in certain smaller form factor disk drives the needed space may not be available.

In view of the above considerations, it is desired that the number of different zone bit frequencies used by a storage device performing access operations at different spindle speeds be minimized. As described more fully below, it has been discovered in connection with the present invention that by special partitioning of the tracks into zones the complexity of the system may be decreased.

Referring to FIG. 1, an operating frequency f_i, in hertz (Hz), for zone i may determined by the relationship

$$f_i=d_i\,(2\pi r_i\omega_j/60)$$

where d_i is the linear density at r_i in zone z_i, r_i is the inner radius of zone z_i, and ω_j is the discrete j-th disk annular velocity in revolutions per minute (RPM). This equation may be reduced to

$$f_i=0.1047 d_i r_i \omega_j,$$

and assuming that the maximum linear density for each zone is constant (i.e., $d_i=d_0$) for zones of equal width, the equation becomes

$$f_i=0.1047 d_* r_i \omega_j.$$

In accordance with one embodiment of the invention, a specific allocation of tracks into zones, by selecting the radii for the inner track for each zone is used to minimize the complexity and cost associated with a read channel. While the reduced spindle velocity is described for the purposes of saving power in battery based applications, the specific partitioning of tracks may be advantageously used in other applications as well. For example, high performance drives may use different spindle velocities for different applications. A "lazy tape backup" of a drive may also be carried out at reduced velocity in businesses where the system is actively used for only part of the day (e.g, 12 hours).

In accordance with an embodiment of the invention, the inner track radii defining each zone are selected as a geometric progression which is a function of radius. As described more fully below, this method of banding tracks into zones provides for a high degree of overlap in zone bit frequencies between zones as the spindle velocity is reduced. In general, the inner radius r_i, defining each zone, is determined according to a geometric progression which maintains a substantially constant ratio of radii between adjacent bands or zones. In other words, r_i/r_{i+1} is substantially equal to K, where K equals a constant.

The advantages obtained using such an allocation will be apparent from the examples provided below. Using this method, a drive having N zones and operating at M different discrete spindle (disk) speeds will have a total number of different required zone bit frequencies equal to N+M−1. For example, a drive having 10 recording zones and operating at 10 discrete spindle speeds will require channel capable of handling 19 (i.e., 10+10−1=19) different zone bit frequencies.

In contrast, the number of different zone bit frequencies required for a disk banded according to a simple arithmetic progression is determined according to the relationship N+(((M*M)−N)/2). In the above example, the number of zone bit frequencies which the channel must handle equals 55 (i.e., 10+(((10*10)−10)/2)=55). Thus, partitioning the tracks into zones in accordance with a geometric progression offers significant advantages in terms of reduced channel complexity and cost.

The advantages obtained by partitioning the tracks into zones according to a geometric progression in comparison with an arithmetic progression will better understood by the following discussion in connection with FIGS. **4**–**8**.

Consider a disk having the inner band radii r_i, of each zone, follow a geometric progression. This may be expressed as

$$r_i=r_{OD}^{\,1-i\rho},\ \text{for } i=1,2,\ldots,N,$$

where ρ is a coefficient for the progression.

The ratio between two adjacent zone radii r_i and r_{i+1}, is constant providing the relationship:

$$r_i/r_{i+1}=r_{OD}^{\,\rho},$$

for $i=1,2,\ldots N-1$.

For a disk having an inner radius r_{ID}, the coefficient, ρ, for a given number of data bands can be determined as follows:

$$\ln(r_{ID})=(1-N\rho)\ \ln(r_{OD}),$$

which may be rewritten as:

$$\rho=1/N(1-\ln(r_{ID})/\ln(r_{OD})).$$

By way of example, consider a 2.5 inch disk divided into 10 zones (N=10) and having an inner radius r_{ID} of 14 mm, an outer radius r_{OD} of 29.7 mm. The value of ρ for a disk having these dimensions can be calculated as follows:

$$\rho=1/10(1-\ln(14)/\ln(29.7))=0.022178.$$

Using this value for ρ the inner radius of each of the 10 zones will be determined as the geometric progression:

$$r_i=r_{OD}^{\,(1-0.022178i)}.$$

By way of contrast, the inner radii of each zone may be determined as an arithmetic progression. Here the difference between two adjacent inner zone radii r_i and r_{i-1} is a constant b providing the relationship:

$$r_i-r_{i+1}=b,$$

In this case, the radii r_i can be expressed as

$$r_i=r_{i-1}-b,$$

which yields the following radii

$$\begin{aligned} r_1 &= r_0 - b; \\ r_2 &= r_1 - b = r_0 - 2b; \\ r_3 &= r_2 - b = r_0 - 3b; \\ &\cdots \\ r_i &= r_{i-1} - b = r_0 - kb. \end{aligned}$$

Recalling the expression $f_i=0.1047d_o r_i \omega_j$ and by substitution, the following equation for f_i may be written:

$$f_i = 0.1047 d_o (r_o - ib)\omega_j.$$

This equation can also be written as $f_i=f_{0j}-i\Delta f_{0j}$ where $f_{0j}=0.1047d_0r_0\omega_j$ and $\Delta f_{0j}=0.1047\ d_0b\omega_j$. Thus, a general equation for the zone bit frequency can be expressed as

$$f_{ij}=(k_0-i\Delta k)\omega_j$$

where $k_0=0.1047d_0r_0$, and $\Delta k=0.1047d_0b$.

When the disk is rotated at full speed (i.e., when $\omega=\omega_1$ and $j=1$), the following relationship can be derived:

$$\begin{aligned} f_{11} &= (k_0 - \Delta k)\omega_1; \\ f_{21} &= (k_0 - 2\Delta k)\omega_1; \\ f_{31} &= (k_0 - 3\Delta k)\omega_1; \\ &\cdots \\ f_{i1} &= (k_0 - i\Delta k)\omega_1. \end{aligned}$$

At a lower speed, when $\omega=\omega_2$ and $j=2$, the frequencies can be calculated as:

$$\begin{aligned} f_{12} &= (k_0 - \Delta k)\omega_2; \\ f_{22} &= (k_0 - 2\Delta k)\omega_2; \\ f_{32} &= (k_0 - 3\Delta k)\omega_2; \\ &\cdots \\ f_{i2} &= (k_0 - i\Delta k)\omega_2 \end{aligned}$$

In order to reduce complexity of the read channel, it is desirable to have $f_{12}=f_{21}$ so that all but one of the frequencies at ω_1 are reusable at the lower speed ω_2. For this to occur, $(k_0-\Delta k)\omega_2$ must equal $(k_0\ \_2\Delta k)\omega_1$. It is also desired that $f_{22}=f_{31}$, which means that $(k_0-2\Delta k)\omega_2=(k_0\_3\Delta k)\omega_1$.

For zone i, we need $f_{i2}=f_{(i+1)1}$ which means that $(k_0-1\Delta k)\omega_2=(k_0-(i+1)\Delta k)\omega_1$. The above constraints can be written as $\omega_2=[(k_0-(i+1)\Delta k)/(k_0-i\Delta k)]\ \omega_1$, and for the j^{th} speed ω_j, the relationship may be expressed as $\omega_j=[(k_0-(j+1)\Delta k)/(k_0-\Delta k)]\ \omega_0$.

The power savings associated with lowering the spindle speed can be determined by examining the spindle power requirement as a function of the speed. This value may empirically be expressed as:

$$P_j=(\omega/\omega_0)^{2.68}P_0.$$

where P_0 is the power dissipated in the spindle at speed ω_0 and P_j is the power required to spin the spindle at speed ω_j.

If we substitute the relationship for ω_j into this equation, the power savings may be expressed as:

$$P_j=[(k_0-(j+1)\Delta k)/(k_0-\Delta k)]^{2.68}P_0.$$

Consider the example described above using a 2.5" disk having the dimensions $r_{ID}=14$ mm and $r_{OD}=29.7$ mm with 10 zones divided into equal sized bands of approximately 1.57 mm (i.e., $b=(29.7-14)/10$). Assuming a linear density of data on the inner radius of each zone of 135 kilobits-per-inch (i.e., $d_0=5315$ bits per mm), the value of $k_0=0.1047\ d_0\ r_0=16527.47$ and $\Delta k=873.67$. In this case, some of the spindle velocities, using the arithmetic progression for the inner band radii, may be determined as:

$$\omega_1=[(k_0-2\Delta k)/(k_0-\Delta k)]\omega_0=0.9442\ \omega_0$$

$$\omega_2=[(k_0-3\Delta k)/(k_0-\Delta k)]\omega_0=0.8884\ \omega_0$$

$$\omega_3=[(k_0-4\Delta k)/(k_0-\Delta k)]\omega_0=0.8326\ \omega_0$$

$$\omega_4=[(k_0-5\Delta k)/(k_0-\Delta k)]\omega_0=0.7768\ \omega_0$$

$$\omega_5=[(k_0-6\Delta k)/(k_0-\Delta k)]\omega_0=0.7209\ \omega_0$$

$$\omega_6=[(k_0-7\Delta k)/(k_0-\Delta k)]\omega_0=0.6651\ \omega_0.$$

Using the above relations, the following comparisons can be made between the geometric and arithmetic progression methods of selecting the inner band radii of the various zones. It is noted, that the storage capacity of a disk using the above-described geometric progression is substantially the same as that of a disk using the arithmetic progression.

In FIG. 4 and 5, zone data rate frequencies versus the zone index position are graphed as a function of varying spindle motor speeds for zones banded using the arithmetic progression and the geometric progression, respectively. The spindle motor speed is varied over ten discrete drive speeds between a nominal speed of 3600 revolutions per minute (RPM), represented by lines **401** and **501** to 1792 RPM, represented by line **402** in the case of the arithmetic progression (FIG. 4) and 1830 RPM, represented by line **502** in the case of the geometric progression (FIG. 5).

A comparison of FIGS. 4 and 5 illustrates various advantages obtained by using a geometric progression to allocated tracks to zones. When the graph in FIG. 5 is viewed horizontally, it is noted that the zone bit frequencies line up along a horizontal line. For example, the zone bit frequency of 3.78 megahertz (MHz) extending along line **503** is used by each of zones **1-9** at different discrete spindle motor speeds. Moreover, all but two zone bit frequencies indicated at points **504** and **505** (corresponding to frequencies 1.78 MHz and 6.90 MHz) are used by more than one zone. It is further noted that the frequencies also align vertically. This indicates that as the drive speed is reduced, the zone bit frequencies are shifted toward the outer diameter (OD) of the disk.

Referring to FIG. 8A, the following example illustrates an advantage obtained by using the geometric progression to allocate track locations to zones. In zone number **2**, when the disk is rotated at a nominal speed of 3600 RPM, the zone bit frequency is 6.3999 megabits/sec (MB/sec) (i.e., 6.399 MHz). If the drive speed is reduced to the next discrete speed of 3339 RPM, represented by line **506**, the correct zone bit frequency for zone **2** is 5.9363 MB/sec. As illustrated in the graph, this frequency was used by zone **3** when the spindle speed was 3600 RPM. Similarly, the zone data rate used by zone **2** at 3600 RPM is now used in zone **1**. In this matter, the zone data rates shift toward the outer diameter of the disk. At the innermost zone, zone **10** in the illustrated example, a new zone bit frequency is needed by the data channel for each reduction in spindle motor speed. It should now be appreciated that for drives having N zones and M spindle speeds, the number G of data rate frequencies required may be described by the relation G=N+M−1.

As illustrated in FIGS. 4 and 8B, when the rotational speed is reduced using a disk having zones banded using an arithmetic progression, the number of zone bit frequencies which may be reused by other zones is significantly less than a disk having zones allocated using the geometric progression. Thus, the complexity and cost of the data channel can be significantly reduced by using the geometric progression.

In addition to handling varying data rates, other factors must be considered when operating a disk drive at multiple spindle velocities. For example, the flying heights of the heads in a drive will decrease as the drive speed is reduced. In conventional power saving techniques, the heads are moved to a safe zone prior to slowing the disk velocity. In the present technique, however, the heads must retain a fly-height within acceptable read and write operation parameters.

The flying height H, forming an air bearing between the recording head and the disk surface of a disk rotating at a velocity V may empirically be approximated as:

$$H=(V/V_o)^{0.33}H_0$$

Where V_0 is the nominal disk speed, and H_0 is the nominal flying height at V_0. Referring to the drive spindle speeds illustrated in FIG. 5, and assuming that the fly-height is 50 nanometers (nm) at the nominal speed V_0, the fly-height at the reduced speeds are 49 nm for 3,339 RPM, 48 nm for 3,097 RPM, and 46 nm for 2,873 RPM. In this example, at a spindle velocity at 2,873 RPM, the power consumed by the spindle motor is reduced to 55% of that at 3,600 RPM. However, the flying height reduction is only 4 nm. Such a slight decrease in flying height is within the tolerances allowed in many disk drives.

The fractional power and head flying heights for the arithmetic and geometric radii progressions are illustrated in FIG. 6 and 7, respectively. FIGS. 8A and 8B are tables depicting the zone radii (for the inner radii for each zone in millimeters) and frequency in Megahertz for the geometric and arithmetic radii progressions, respectively, as a function of varying spindle speed (RPM). The tables also list the fractional flying height (FH) and fractional power (POWER) for the different spindle speeds. In FIG. 8A, representing the geometric progression, the zone frequencies are identical along the diagonals of the table. The diagonal relationship of the frequencies illustrates the abovenoted advantageous characteristics of the geometric progression in tabular form.

FIG. 9 is similar to FIG. 3 with like parts having like reference numerals. In FIG. 9, a tunable analog equalizer **922** is incorporated into the read channel of the disk drive. The tunable analog equalizer **922** may consist of operational amplifiers with tunable RC networks having capacitors and banks of selectable resistor **923** which are used to change the coefficients of the analog equalizer **922**. The resistor bank **923** includes a number of resistors that can be switched in parallel or series to make up different resistor values used by the analog equalizer **922**. The different resistor values correspond to the coefficients needed by the analog equalizer **922** as the spindle speed is changed. Thus, different resistor values are used depending upon the spindle velocity and zone information provided to the resistor bank by the control signal f(i,k).

The embodiment depicted in FIG. 9 is useful when very high operating frequencies are used in the disk drive. Current disk drives may operate at recording signal frequencies of over 200 megahertz (MHz). At such rates, analog-to-digital conversion circuitry becomes quite expensive. In order to reduce cost, the read channel may be implemented using more analog components. For example, detection can be simplified by using analog circuitry thereby reducing costs. Further, power dissipation may be reduced using analog components. As the operating speed of the disk drive is further increased the need to use analog devices in the read channel becomes even more important.

One potential drawback to using analog components in a disk drive changing spindle speed to conserve power is that discrete components must be made available for each zone bit frequency used. As can be appreciated, using the above described geometric progression for partitioning zones provides for significant cost savings by reducing the number of different zone bit frequencies the drive must handle thereby reducing the number of discrete analog components needed.

While the invention has been described above in connection with various embodiments, it will be apparent from the above disclosure that the implementation may be used with various other systems and embodiments. Thus, the various embodiments described above are provided by way of illustration only and should not be construed to limit the invention. Those skilled in the art will readily recognize various modifications and changes which may be made to the present invention without strictly following the exemplary embodiments and applications illustrated and described herein, and without departing from the true spirit and scope of the present invention which is set forth in the following claims.

What is claimed is:

1. A memory storage device comprising:

a disk having N concentric zones, N being an integer greater than 1, provided around a surface of the disk, data being stored in each zone such that a linear density of data at an inner track location of each zone is substantially constant;

a motor connected to the disk to selectively rotate the disk at a plurality of discrete disk velocities; and

a transducer provided to perform at least one of a write and a read operation to and from at least two of said zones on the disk at each of the plurality of discrete disk velocities.

2. A device as recited in claim 1, wherein said plurality of discrete disk velocities include a normal operating disk velocity and at least one low power disk velocity, the at least one low power disk velocity being lower than the normal operating disk velocity, the at least one low power disk velocity being used to conserve power.

3. A device as recited in claim 2, wherein:

the transducer writes data to a selected zone on the disk at a storing frequency corresponding to the selected zone while the disk is rotated at the normal operating disk velocity;

the data written to the selected zone is read at the storing frequency corresponding to the selected zone when the disk is rotated at the normal operating disk velocity; and

the data written to the selected zone is read from the disk when the disk is rotated at the low power disk velocity at a storing frequency used to write data to a different zone when the disk is rotated at the normal operating disk velocity.

4. A device as recited in claim 1, wherein the N concentric zones are defined by N inner zone radius r_i, for i=1 to N, and wherein an inner zone radius r_{i-1} of a zone Z_{i-1} is determined as asgeometric progression from an inner zone radius r_i of an adjacent zone z_i.

5. A device as recited in claim 1, wherein the N concentric zones are defined by N inner zone radius r_i, for i=1 to N, determined according to a geometric progression which maintains a substantially constant ratio of radii between adjacent zones.

6. A device as recited in claim 4, wherein in the geometric progression determines the inner radius r_i for zone Z_i according to the relationship

$$r_i = r_{OD}^{1-i\rho},$$

where r_{OD} is an outer diameter radius of the disk and ρ is a substantially fixed geometric progression coefficient.

7. A device as recited in claim 1, wherein each of the N concentric zones is defined by a corresponding inner zone radius r_i, for $i=1$ to N, and wherein the density of data stored on the disk at each of inner zone radius r_i is substantially constant.

8. A method of accessing a memory storage device having a disk for storing data in a plurality of concentric zones, data being stored at an innermost track location for each of the plurality of concentric zones at a substantially constant linear density, the method comprising the steps of:

(a) rotating the disk at a first disk velocity;

(b) performing access operations to the plurality of concentric zones while rotating the disk at the first disk velocity;

(c) rotating the disk at a second disk velocity; and

(d) performing access operations to the plurality of concentric zones while rotating the disk at the second disk velocity.

9. A method as recited in claim 8, wherein the rotating step (c) comprises the steps of:

i. detecting a low power mode condition; and

ii. initiating a reduction in disk velocity to the second disk velocity in response to the low power mode condition.

10. A method as recited in claim 8, wherein the access operations comprise at least one of data read operations and data write operations.

11. A method as recited in claim 8, wherein the access operations comprise data read operations.

12. A method as recited in claim 11, further comprising the steps of:

(e) resuming the first disk velocity; and

(f) writing data to the plurality of concentric zones while rotating the disk at the first disk velocity.

13. A method as recited in claim 11, further comprising the steps of:

(e) initiating a write operation to write data to the disk;

(f) if the disk is rotating at the first velocity, writing the data to the disk at a frequency corresponding to a zone in which the data is written in response to the initiating step (e); and

(g) if the disk is rotating at the second velocity,

i. writing the data in a temporary memory,

ii. changing the velocity of the disk to the first disk velocity, and

iii. copying the data from the temporary memory to the disk at the frequency corresponding to the zone in which the data to be written while the disk is rotated at the first disk velocity.

14. A method as recited in claim 8, further comprising the steps of:

performing an access operation to a first zone of the plurality of zones while the disk is rotating at the first disk velocity at a first data bit frequency; and

performing an access operation to a second zone of the plurality of zones while the disk is rotating at the second disk velocity at the first data bit frequency.

15. A method as recited in claim 14, wherein the first zone is radially adjacent to the second zone.

16. A method as recited in claim 15, further comprising the steps of:

rotating the disk at a third disk velocity; and

performing an access operation to a third zone of the plurality of zones while rotating the disk at the third disk velocity at the first data bit frequency.

17. A computer, including a disk storage device having a disk formed with a plurality of concentric zones of banded track locations for storing data for use by the computer, an innermost track location of each of said zones having data stored thereon at a substantially constant linear density, the computer comprising:

rotating means coupled to the storage disk for rotating the storage disk at a desired disk velocity;

control means, for determining a current operational mode of the disk drive and for controlling the rotating means to rotate the disk at a disk velocity corresponding to the current operational mode; and

access means for performing access operations to the plurality of concentric zones at zone bit frequencies corresponding to the plurality of concentric zones for the disk velocity corresponding to the current operational mode, wherein in the access operations comprise data read operations and data write operations.

18. A computer, including a disk storage device having a disk formed with a plurality of concentric zones of banded track locations for storing data for use by the computer, an innermost track location of each of said zones having data stored thereon at a substantially constant linear density, the computer comprising:

rotating means coupled to the storage disk for rotating the storage disk at a desired disk velocity;

control means, for determining a current operational mode of the disk drive and for controlling the rotating means to rotate the disk at a disk velocity corresponding to the current operational mode; and

access means for performing access operations to the plurality of concentric zones at zone bit frequencies corresponding to the plurality of concentric zones for the disk velocity corresponding to the current operational mode, wherein the computer operates in a plurality of operational modes include a normal operational mode and a low power operational mode and wherein a disk velocity corresponding to the low power operational mode is less than a disk velocity corresponding to the normal operational mode.

19. A computer as recited in claim 18, wherein the control means comprises:

input means for inputting a user selected low power mode; and

means for controlling the rotating means to rotate the disk at the disk velocity corresponding to the low power operational mode in response to the user selected the low power mode.

20. A computer as recited in claim 18, wherein the control means comprises:

monitoring means for monitoring access operations to the disk storage device; and

initiation means for automatically initiating the low power operational mode when a number of access operations to the disk storage device is below a predefined threshold.

21. A computer as recited in claim 18, further comprising:

a temporary holding memory; and

a write control means for controlling write operations to said disk storage device,

wherein, when a write operation of data to the disk storage device is initiated while the computer is operating in the low power operational mode, the write control means writes the data in the temporary holding memory until the velocity of the disk is increased to a disk velocity corresponding the normal operational mode, and copies the data from the temporary holding memory to the disk while the disk is rotating at the disk velocity corresponding to the normal operational mode.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CO CTION

PATENT NO. : 5,787,292

DATED : July 28, 1998

INVENTOR(S) : H H Ottesen, et al

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On title page, item

[75] Inventors: "Hijalmar" should be --Hjalmar--.

Col. 16, Line 61, "asgeometric" should be --a geometric--.

Signed and Sealed this

Sixth Day of October, 1998

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer *Commissioner of Patents and Trademarks*

A4

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

US006310848B1

(12) **United States Patent**
Ueki

(10) **Patent No.: US 6,310,848 B1**
(45) **Date of Patent: Oct. 30, 2001**

(54) **POWER SAVING SYSTEM FOR OPTICAL DISC RECORDING/REPRODUCING APPARATUS**

(75) Inventor: **Yasuhiro Ueki**, Sagamihara (JP)

(73) Assignee: **Victor Company of Japan, Ltd.**, Yokohama (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/290,393**

(22) Filed: **Apr. 13, 1999**

(30) **Foreign Application Priority Data**

Feb. 10, 1998	(JP)	10-44681
Apr. 21, 1998	(JP)	10-126906
Apr. 27, 1998	(JP)	10-116319
Jul. 29, 1998	(JP)	10-228592
Jul. 29, 1998	(JP)	10-228593

(51) **Int. Cl.**^{7} **G11B 7/00**
(52) **U.S. Cl.** **369/53.37**; 369/47.33
(58) **Field of Search** 369/53.37, 47.3, 369/47.33, 47.42

(56) **References Cited**

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08-273276	10/1996	(JP) .	
8-273304	10/1996	(JP) .	
8-336103	12/1996	(JP) .	
8-336104	12/1996	(JP) .	
8-339637	12/1996	(JP) .	
8-339663	12/1996	(JP) .	
9-17161	1/1997	(JP) .	

* cited by examiner

Primary Examiner—Nabil Hindi
(74) *Attorney, Agent, or Firm*—Connolly Bove Lodge & Hutz

(57) **ABSTRACT**

A power saving system of an optical recording/reproducing apparatus is provided. The optical recording/reproducing apparatus includes a temporal memory which stores reproduced data or recording data in a cyclic data storage stage and from which the stored data is read out for reproduction or recording in a cyclic data readout stage following the data storage stage. The power saving system saves part of power consumed in the apparatus in the data storage stage in a record mode of operation and in the data readout stage in a reproduce mode of operation.

8 Claims, 20 Drawing Sheets

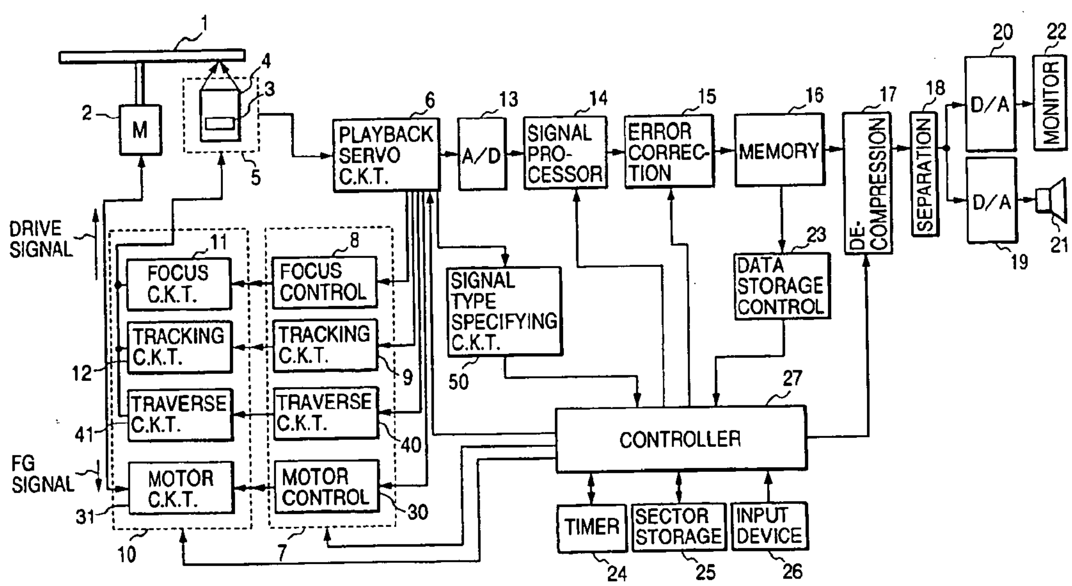
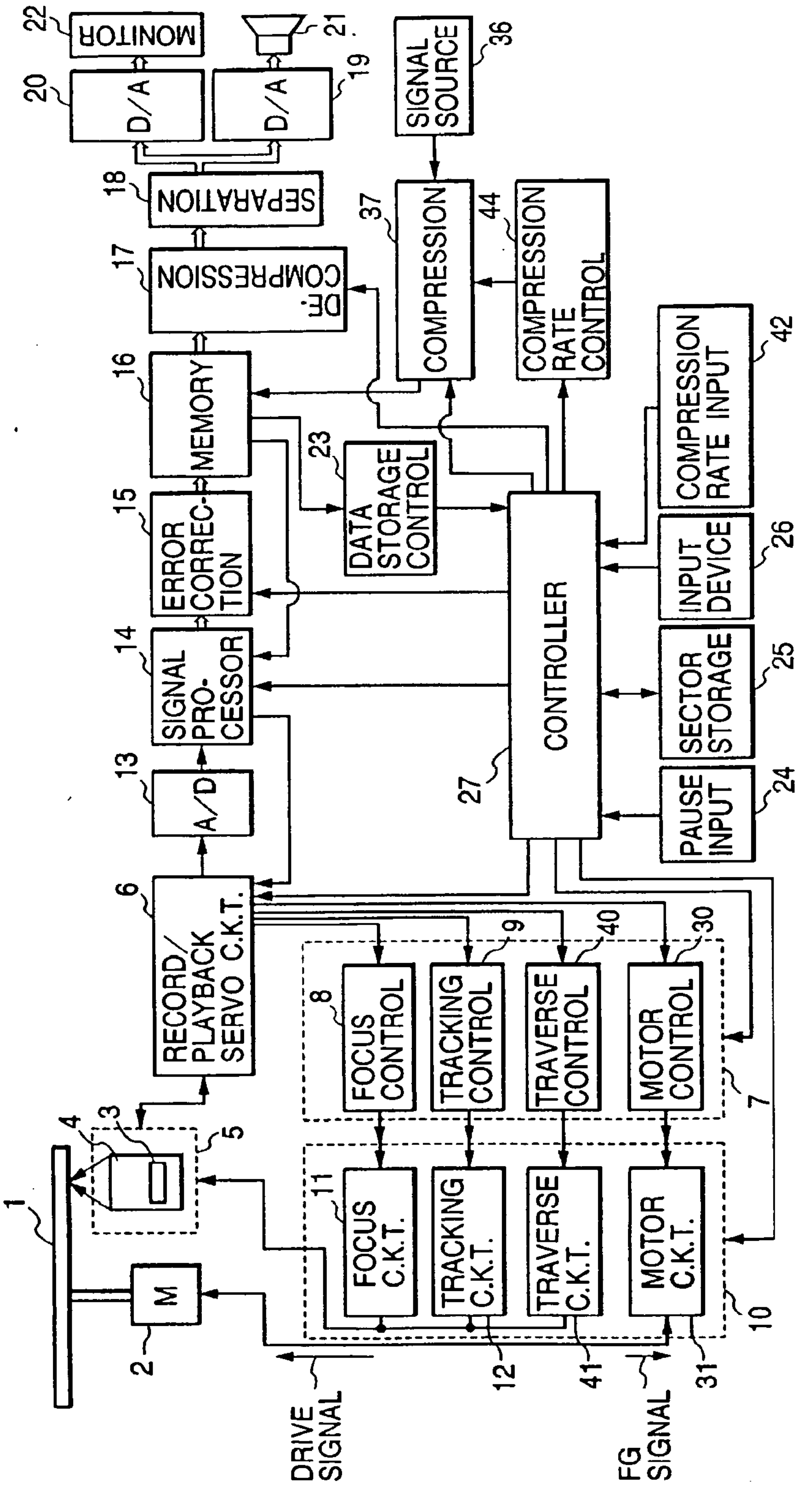


FIG. 1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SEPARATION
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DE-COMPRESSION
17
MEMORY
16
ERROR CORREC-TION
15
SIGNAL PRO-CESSOR
14
A/D
13
RECORD/PLAYBACK SERVO C.K.T.
6
SIGNAL SOURCE
36
COMPRESSION
37
COMPRESSION RATE CONTROL
44
DATA STORAGE CONTROL
23
CONTROLLER
27
COMPRESSION RATE INPUT
42
INPUT DEVICE
26
SECTOR STORAGE
25
PAUSE INPUT
24
FOCUS CONTROL
8
TRACKING CONTROL
9
TRAVERSE CONTROL
40
MOTOR CONTROL
30
7
FOCUS C.K.T.
11
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
10
M
1
2
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12
41
31
DRIVE SIGNAL
FG SIGNAL

FIG. 2

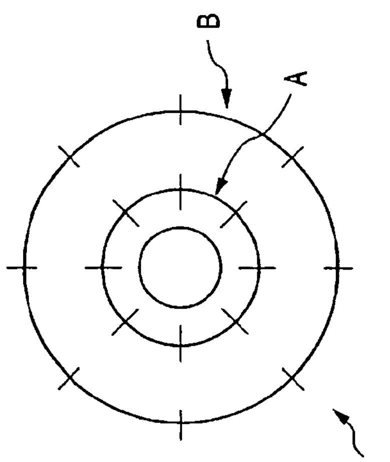

B
A
1

FIG. 3

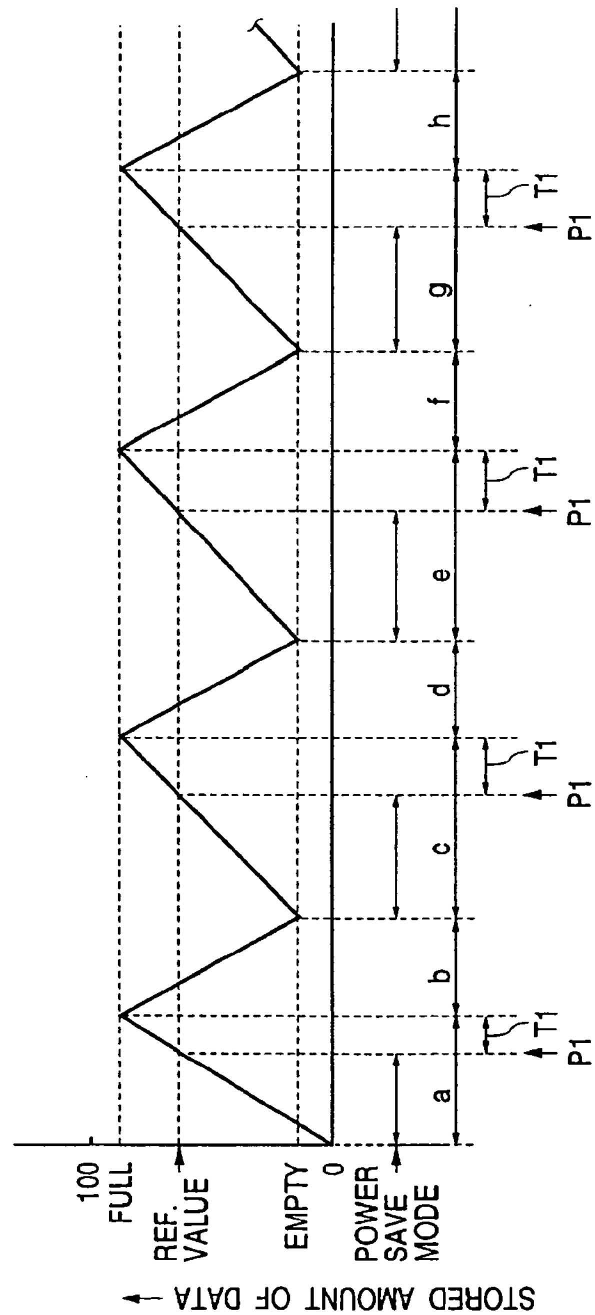

STORED AMOUNT OF DATA
100
FULL
REF. VALUE
EMPTY
0
POWER SAVE MODE
a
b
c
d
e
f
g
h
T1
P1

FIG. 4(a)

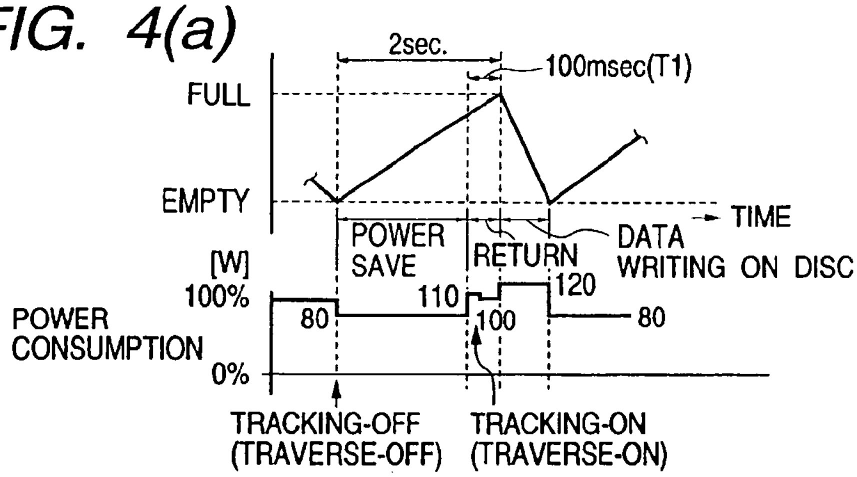


FIG. 4(b)

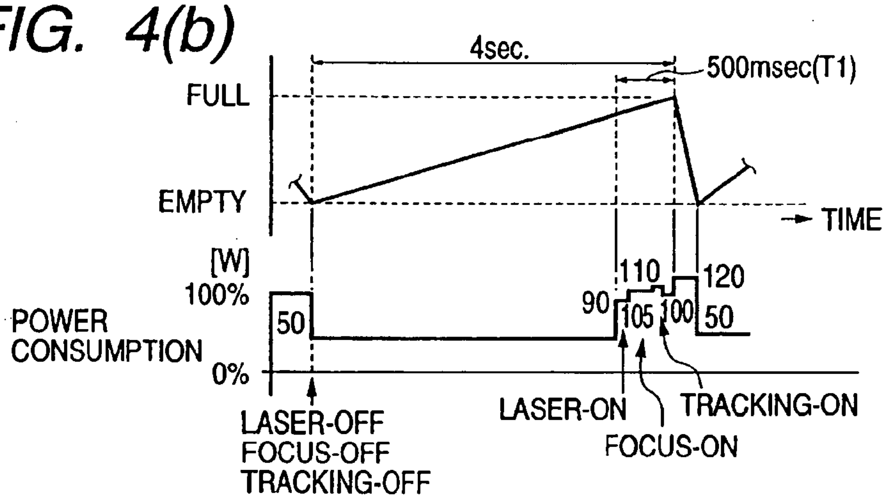


FIG. 4(c)

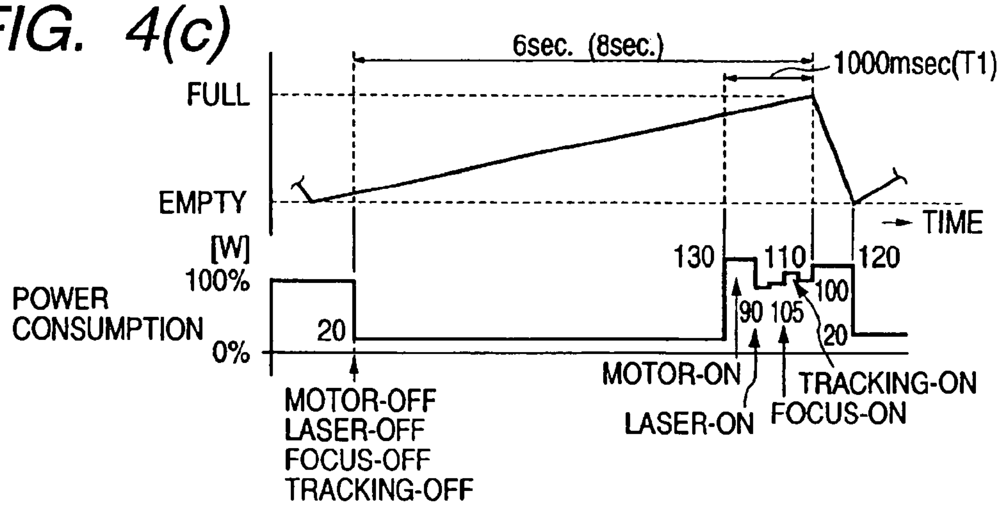


FIG. 5

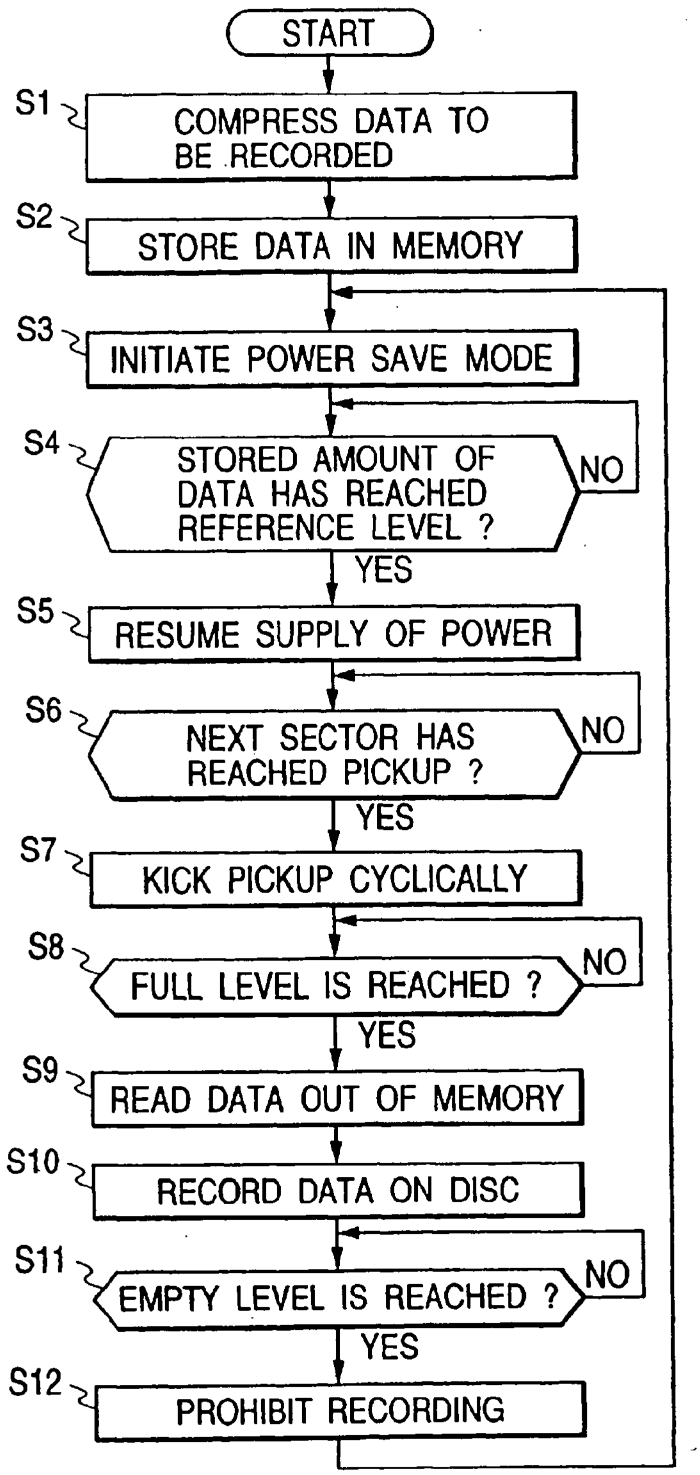
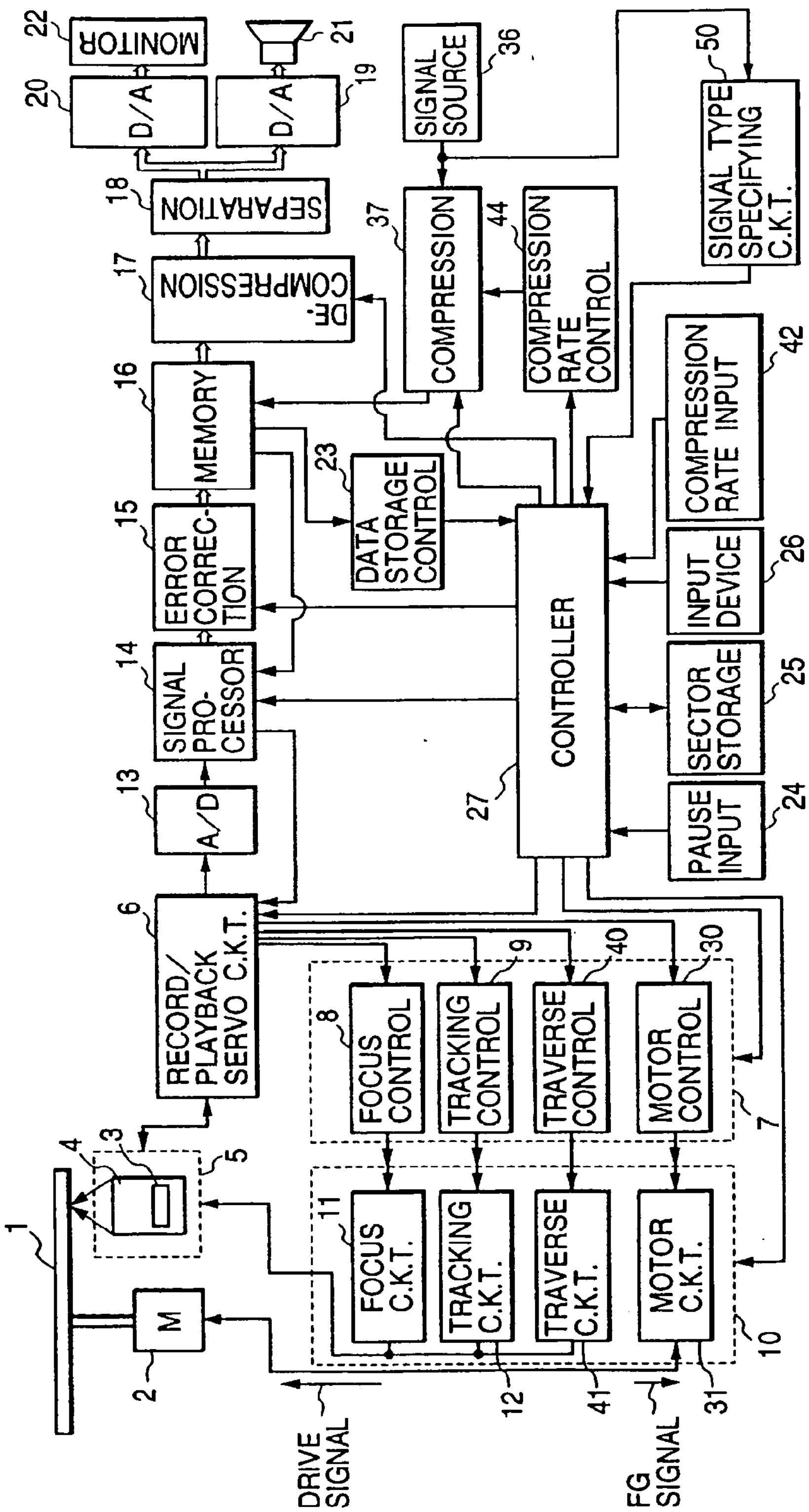

START
S1
COMPRESS DATA TO BE RECORDED
S2
STORE DATA IN MEMORY
S3
INITIATE POWER SAVE MODE
S4
STORED AMOUNT OF DATA HAS REACHED REFERENCE LEVEL ?
NO
YES
S5
RESUME SUPPLY OF POWER
S6
NEXT SECTOR HAS REACHED PICKUP ?
NO
YES
S7
KICK PICKUP CYCLICALLY
S8
FULL LEVEL IS REACHED ?
NO
YES
S9
READ DATA OUT OF MEMORY
S10
RECORD DATA ON DISC
S11
EMPTY LEVEL IS REACHED ?
NO
YES
S12
PROHIBIT RECORDING

FIG. 6



MONITOR
22
D/A
20
D/A
19
21
SEPARATION
18
DE-COMPRESSION
17
MEMORY
16
ERROR CORREC-TION
15
SIGNAL PRO-CESSOR
14
A/D
13
RECORD/ PLAYBACK SERVO C.K.T.
6
DATA STORAGE CONTROL
23
SIGNAL SOURCE
36
COMPRESSION
37
COMPRESSION RATE CONTROL
44
SIGNAL TYPE SPECIFYING C.K.T.
50
COMPRESSION RATE INPUT
42
CONTROLLER
27
INPUT DEVICE
26
SECTOR STORAGE
25
PAUSE INPUT
24
FOCUS CONTROL
8
TRACKING CONTROL
9
TRAVERSE CONTROL
40
MOTOR CONTROL
30
7
FOCUS C.K.T.
11
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
10
12
41
31
M
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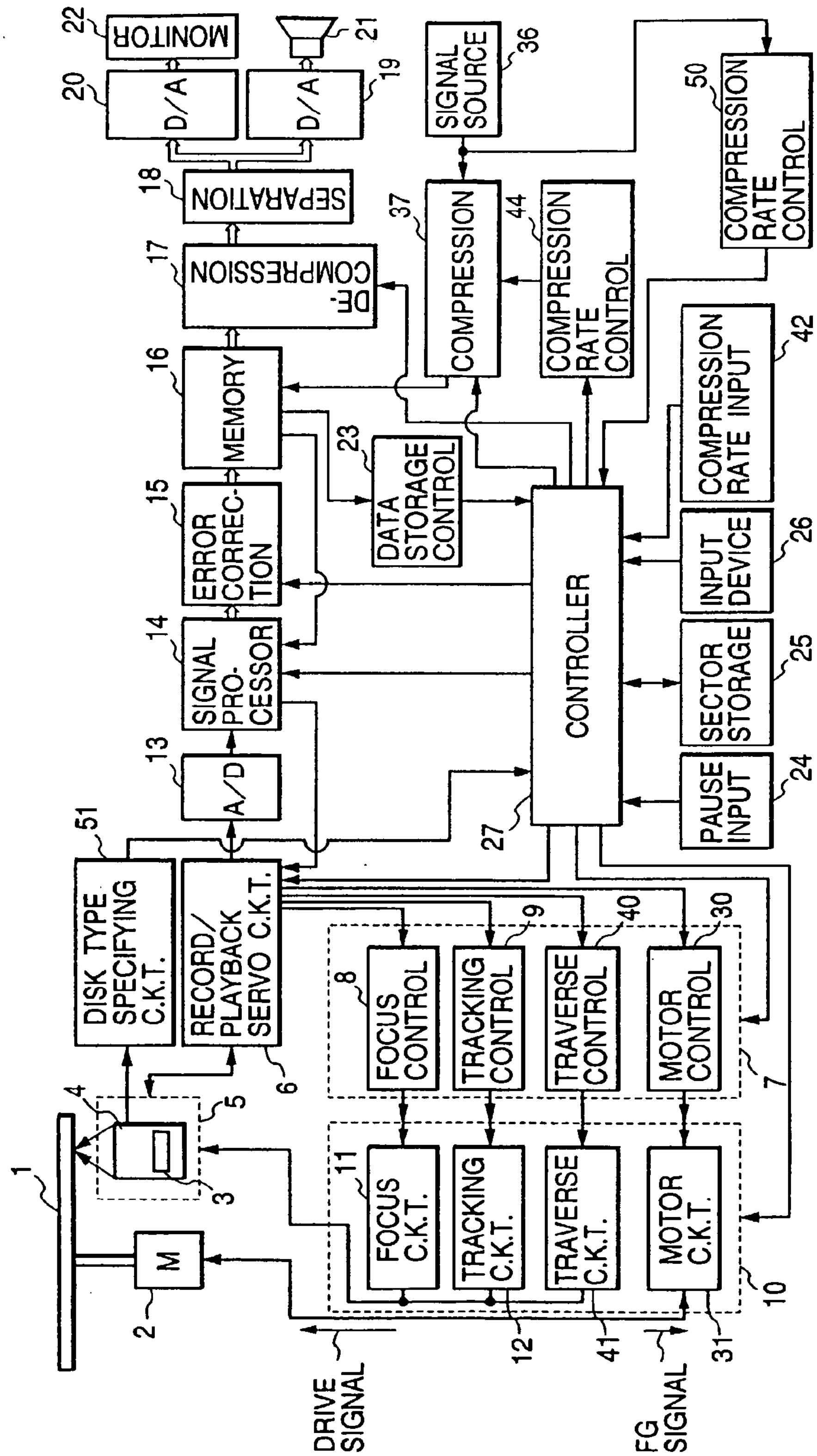
DRIVE SIGNAL
FG SIGNAL

FIG. 7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DE-COMPRESSION
MEMORY
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
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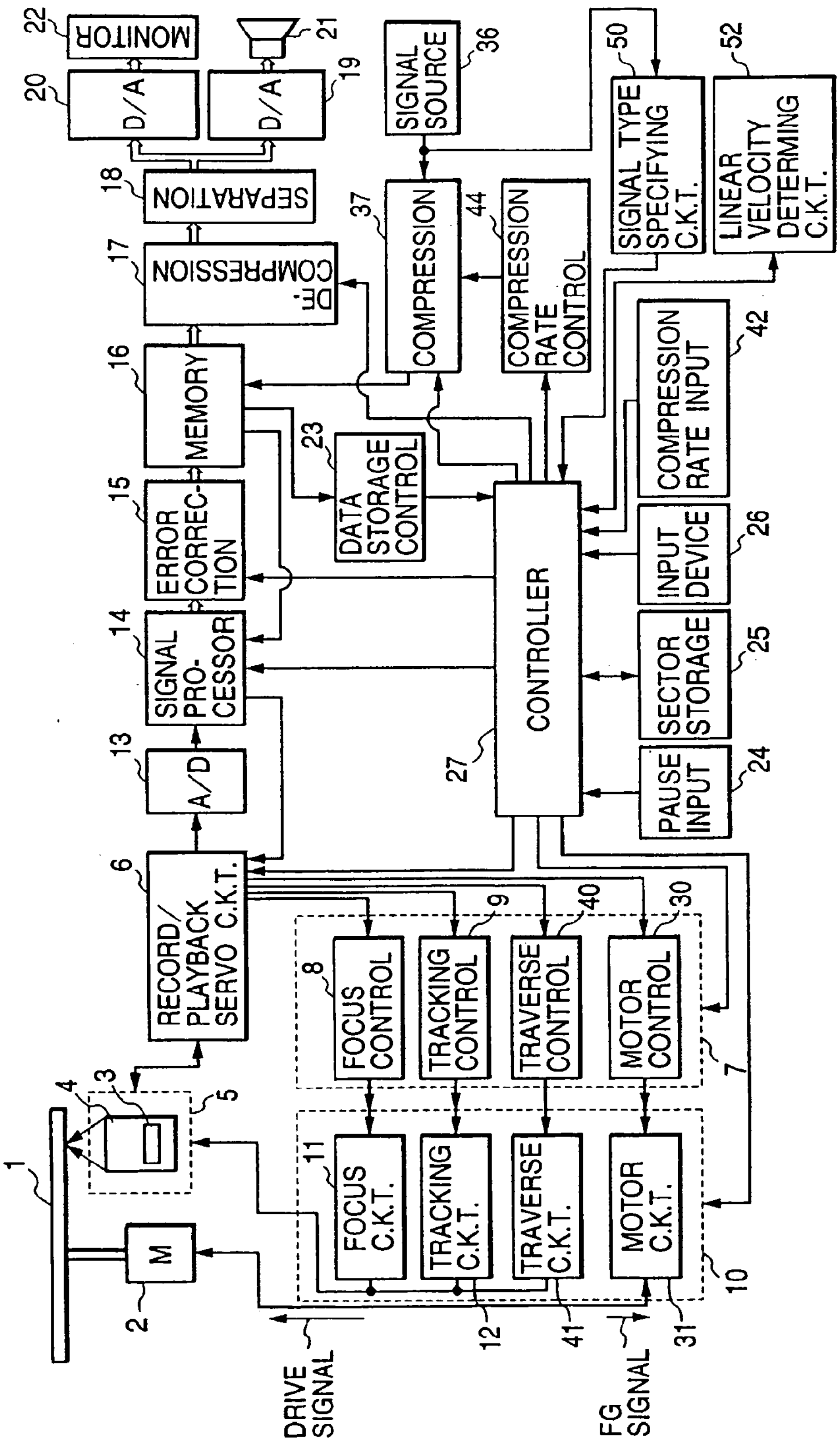
RECORD/PLAYBACK SERVO C.K.T.
SIGNAL SOURCE
COMPRESSION
COMPRESSION RATE CONTROL
DATA STORAGE CONTROL
CONTROLLER
COMPRESSION RATE INPUT
INPUT DEVICE
SECTOR STORAGE
PAUSE INPUT
FOCUS CONTROL
TRACKING CONTROL
TRAVERSE CONTROL
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
M
DRIVE SIGNAL
FG SIGNAL

FIG. 8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D/A
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MEMORY
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
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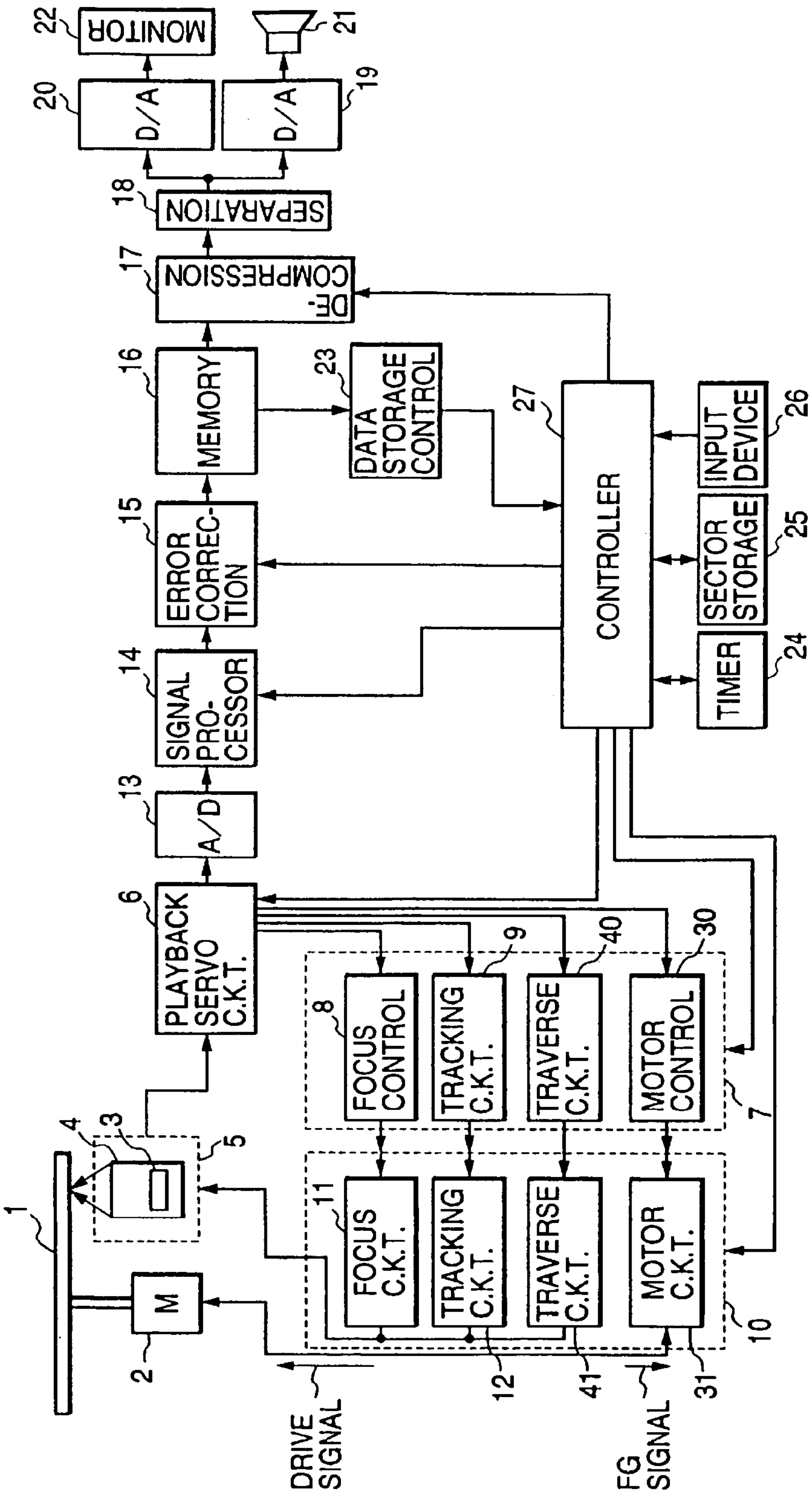
SIGNAL SOURCE
COMPRESSION
COMPRESSION RATE CONTROL
SIGNAL TYPE SPECIFYING C.K.T.
LINEAR VELOCITY DETERMING C.K.T.
COMPRESSION RATE INPUT
DATA STORAGE CONTROL
CONTROLLER
INPUT DEVICE
SECTOR STORAGE
PAUSE INPUT
FOCUS CONTROL
TRACKING CONTROL
TRAVERSE CONTROL
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
M
DRIVE SIGNAL
FG SIGNAL

FIG. 9



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D/A
SEPARATION
DE-COMPRESSION
MEMORY
DATA STORAGE CONTROL
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
PLAYBACK SERVO C.K.T.
CONTROLLER
INPUT DEVICE
SECTOR STORAGE
TIMER
FOCUS CONTROL
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
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DRIVE SIGNAL
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FIG. 10

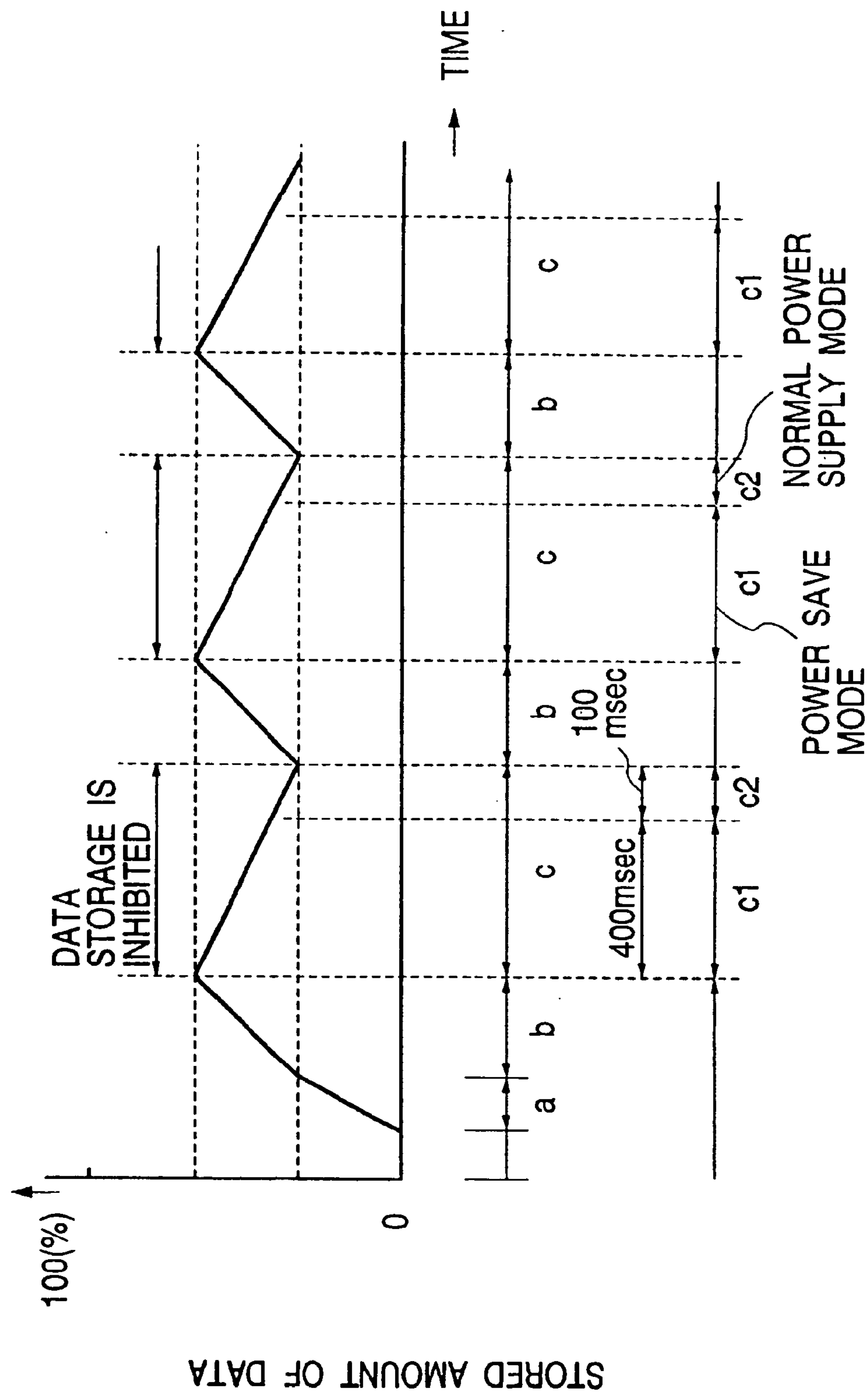

STORED AMOUNT OF DATA
100(%)
0
TIME
DATA STORAGE IS INHIBITED
a
b
c
400msec
100 msec
c1
c2
POWER SAVE MODE
NORMAL POWER SUPPLY MODE

FIG. 11

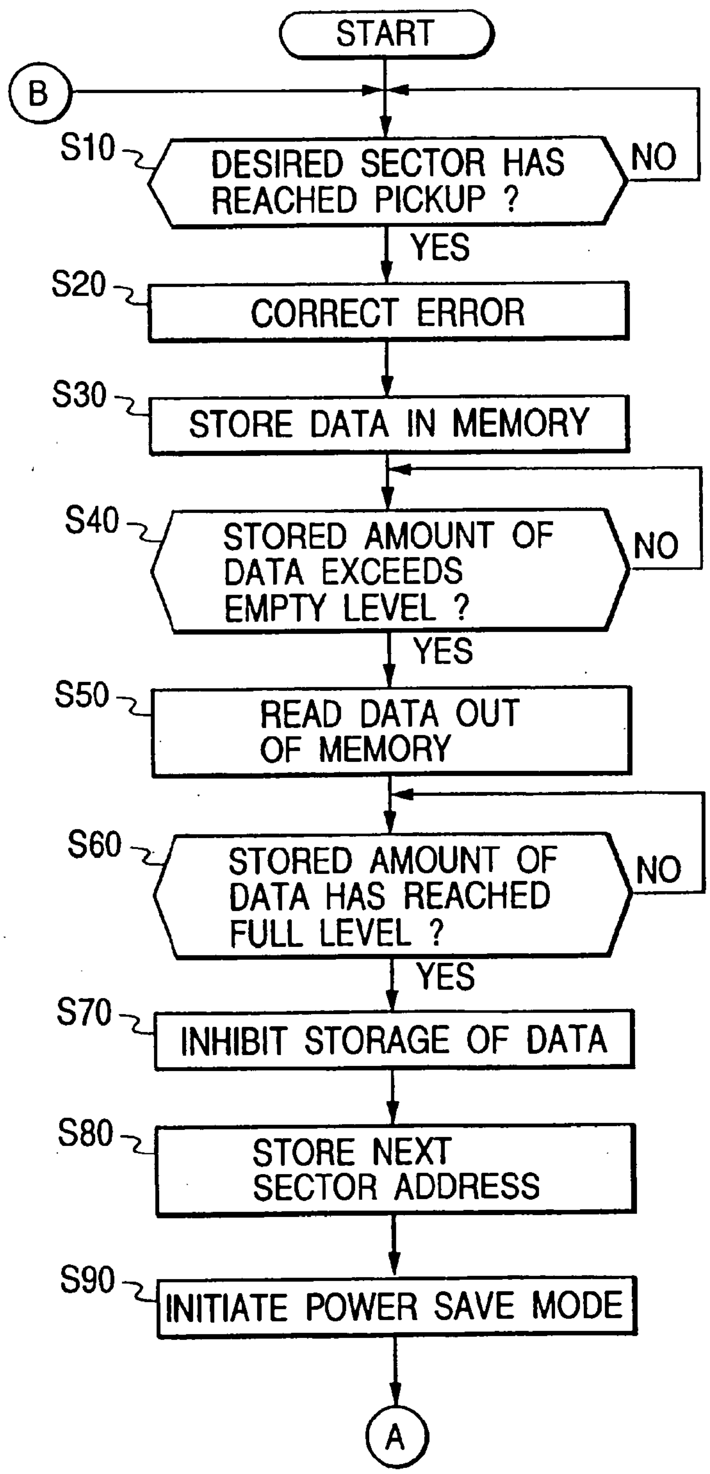

START
B
S10
DESIRED SECTOR HAS REACHED PICKUP ?
NO
YES
S20
CORRECT ERROR
S30
STORE DATA IN MEMORY
S40
STORED AMOUNT OF DATA EXCEEDS EMPTY LEVEL ?
NO
YES
S50
READ DATA OUT OF MEMORY
S60
STORED AMOUNT OF DATA HAS REACHED FULL LEVEL ?
NO
YES
S70
INHIBIT STORAGE OF DATA
S80
STORE NEXT SECTOR ADDRESS
S90
INITIATE POWER SAVE MODE
A

FIG. 12

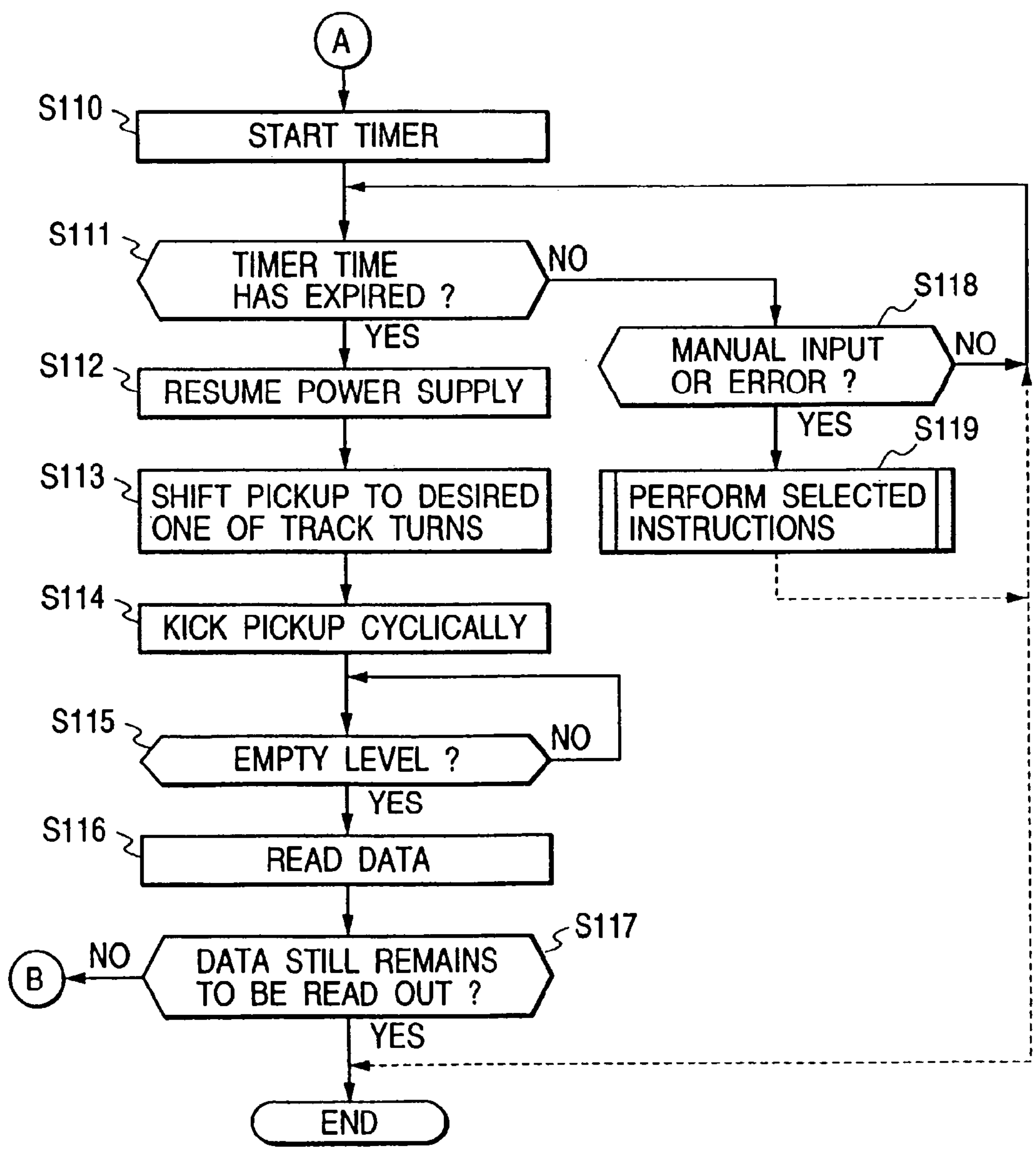
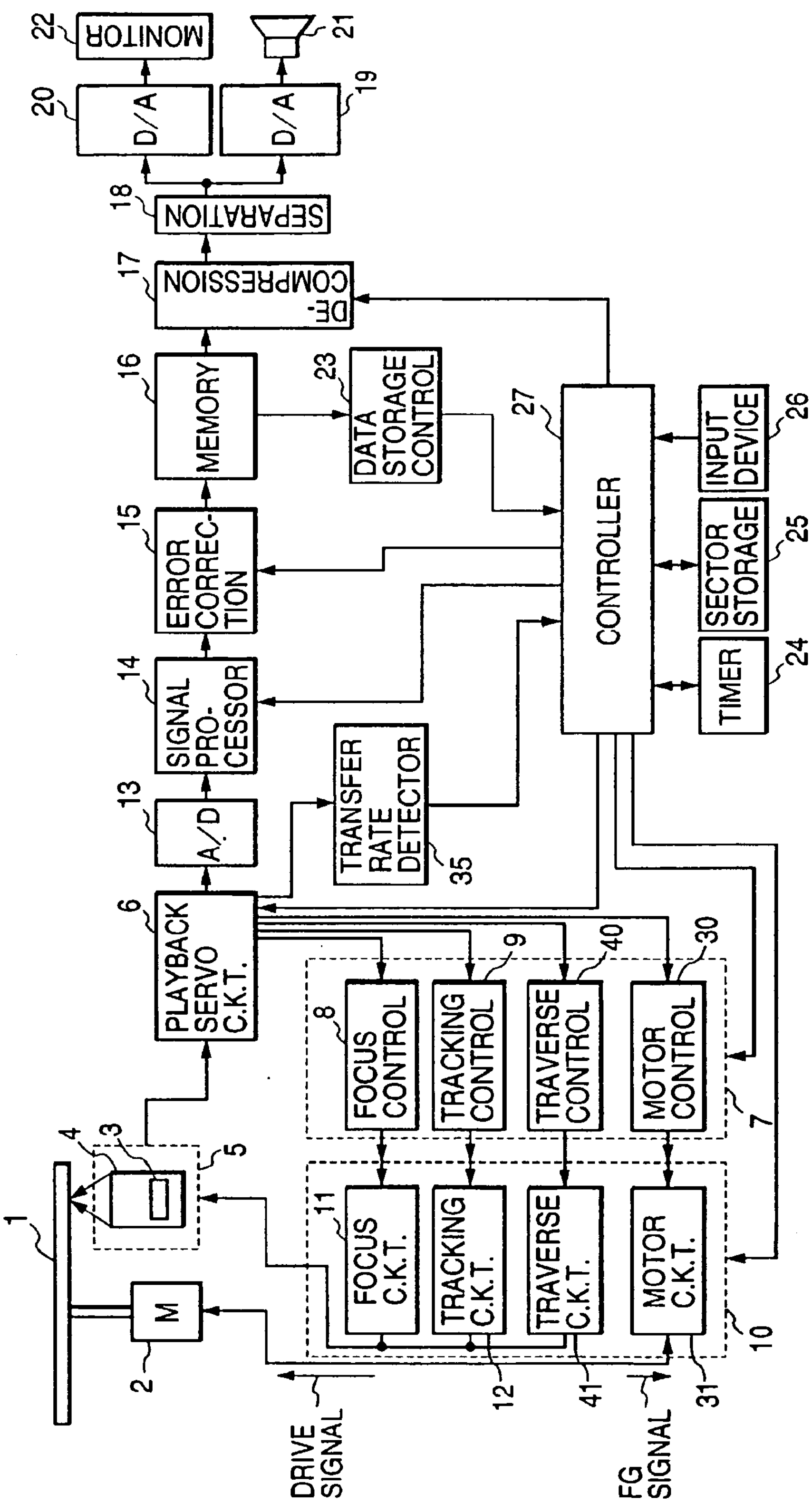

A
S110
START TIMER
S111
TIMER TIME HAS EXPIRED ?
NO
YES
S112
RESUME POWER SUPPLY
S113
SHIFT PICKUP TO DESIRED ONE OF TRACK TURNS
S114
KICK PICKUP CYCLICALLY
S115
EMPTY LEVEL ?
NO
YES
S116
READ DATA
S117
DATA STILL REMAINS TO BE READ OUT ?
NO
B
YES
END
S118
MANUAL INPUT OR ERROR ?
NO
YES
S119
PERFORM SELECTED INSTRUCTIONS

FIG. 13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D/A
D/A
SEPARATION
DE-COMPRESSION
MEMORY
DATA STORAGE CONTROL
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
TRANSFER RATE DETECTOR
CONTROLLER
INPUT DEVICE
SECTOR STORAGE
TIMER
PLAYBACK SERVO C.K.T.
FOCUS CONTROL
TRACKING CONTROL
TRAVERSE CONTROL
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
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DRIVE SIGNAL
FG SIGNAL
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FIG. 14(a)

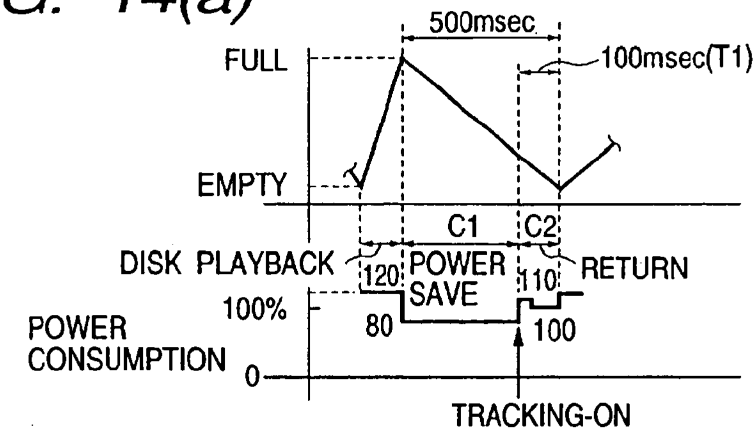


FIG. 14(b)

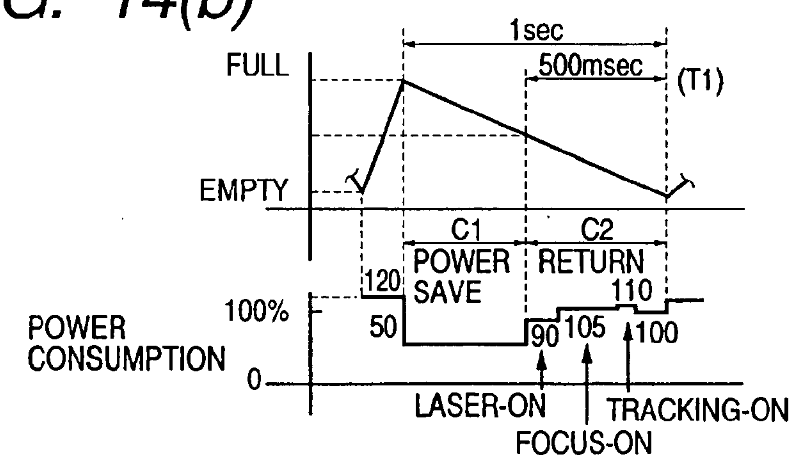


FIG. 14(c)

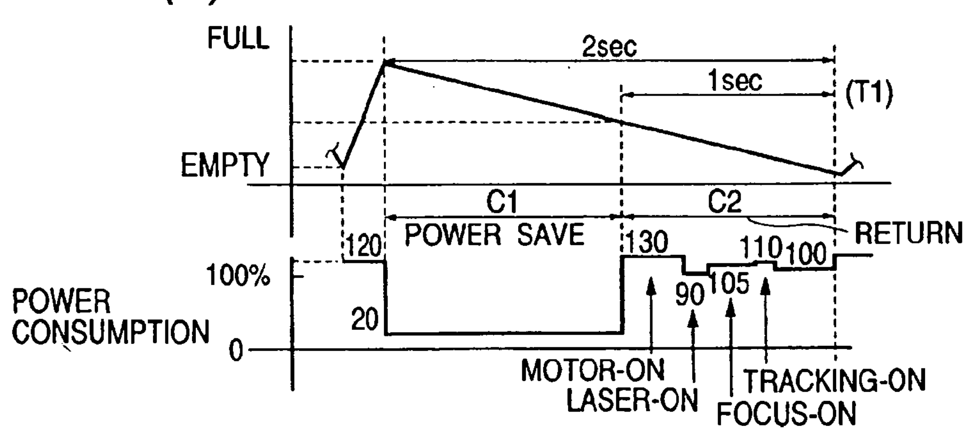
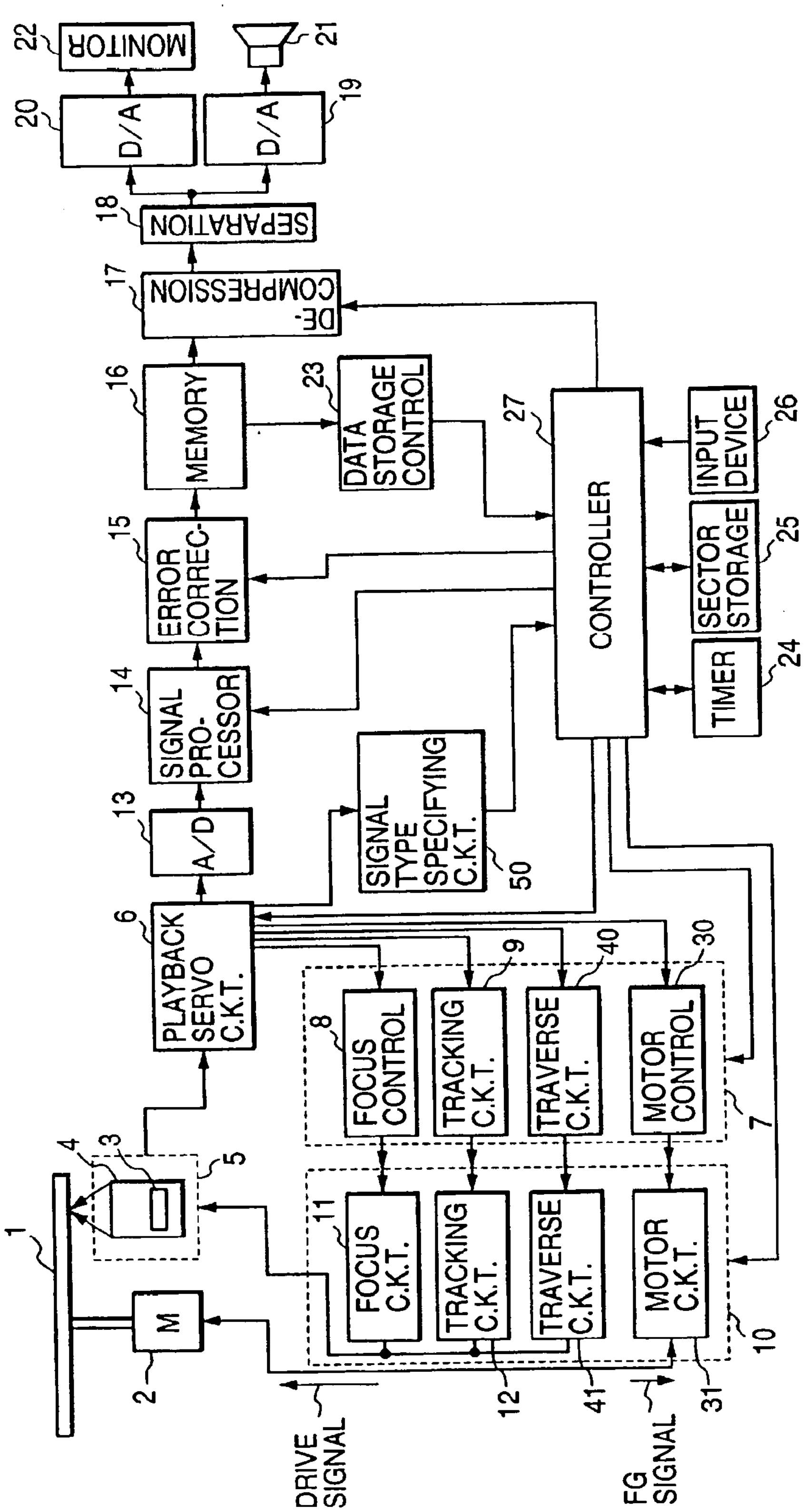


FIG. 15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A/D
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SIGNAL TYPE SPECIFYING C.K.T.
CONTROLLER
INPUT DEVICE
SECTOR STORAGE
TIMER
FOCUS CONTROL
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
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DRIVE SIGNAL
FG SIGNAL
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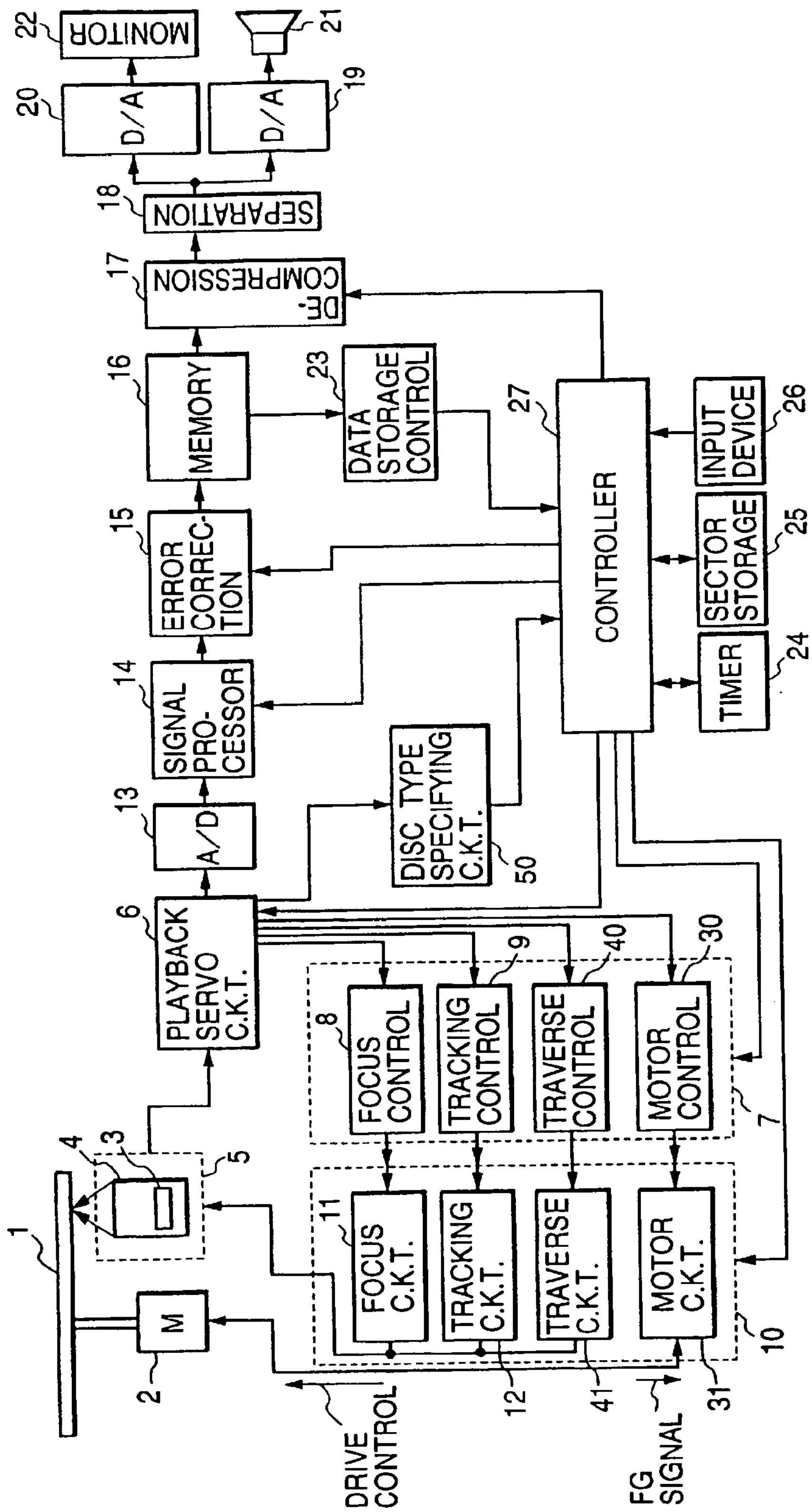
FIG. 16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D/A
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DE-COMPRESSION
MEMORY
DATA STORAGE CONTROL
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
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INPUT DEVICE
SECTOR STORAGE
TIMER
PLAYBACK SERVO C.K.T.
FOCUS CONTROL
TRACKING CONTROL
TRAVERSE CONTROL
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
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FG SIGNAL
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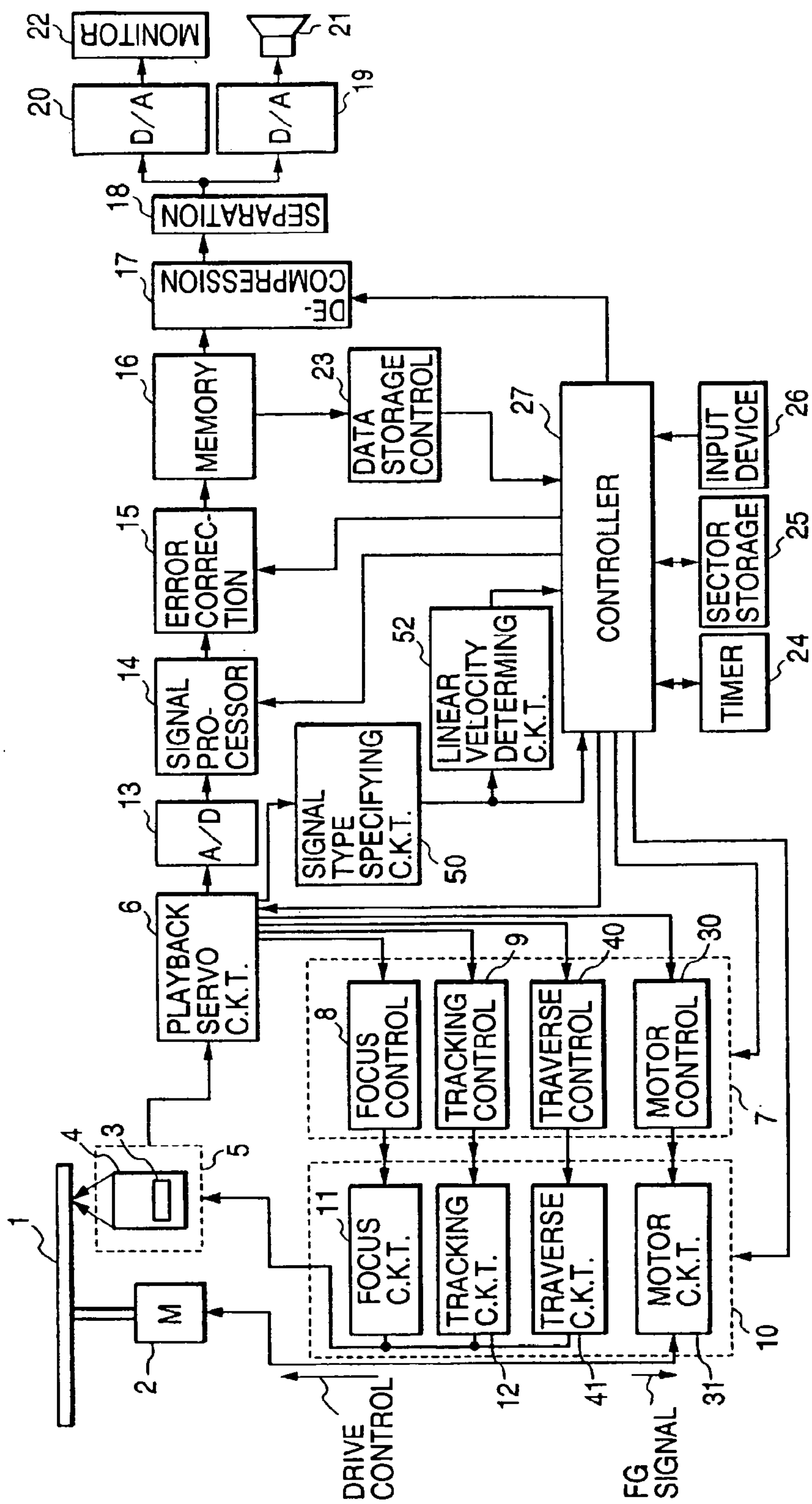
FIG. 17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DATA STORAGE CONTROL
ERROR CORREC-TION
SIGNAL PRO-CESSOR
A/D
PLAYBACK SERVO C.K.T.
SIGNAL TYPE SPECIFYING C.K.T.
LINEAR VELOCITY DETERMING C.K.T.
CONTROLLER
INPUT DEVICE
SECTOR STORAGE
TIMER
FOCUS CONTROL
TRACKING CONTROL
TRAVERSE CONTROL
MOTOR CONTROL
FOCUS C.K.T.
TRACKING C.K.T.
TRAVERSE C.K.T.
MOTOR C.K.T.
M
DRIVE CONTROL
FG SIGNAL

FIG. 18

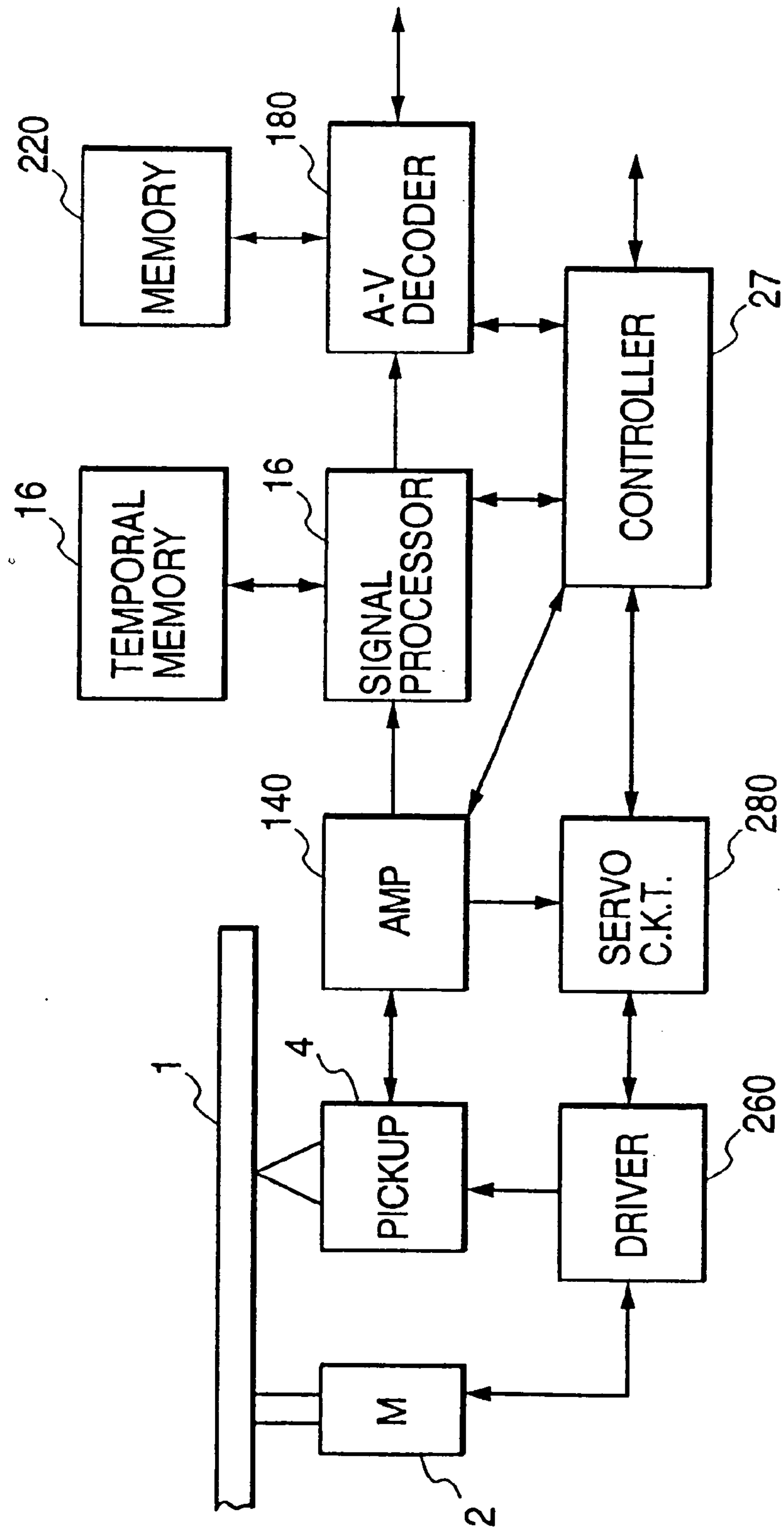

220
MEMORY
180
A-V DECODER
16
TEMPORAL MEMORY
16
SIGNAL PROCESSOR
CONTROLLER
27
140
AMP
SERVO C.K.T.
280
1
4
PICKUP
DRIVER
260
M
2

FIG. 19

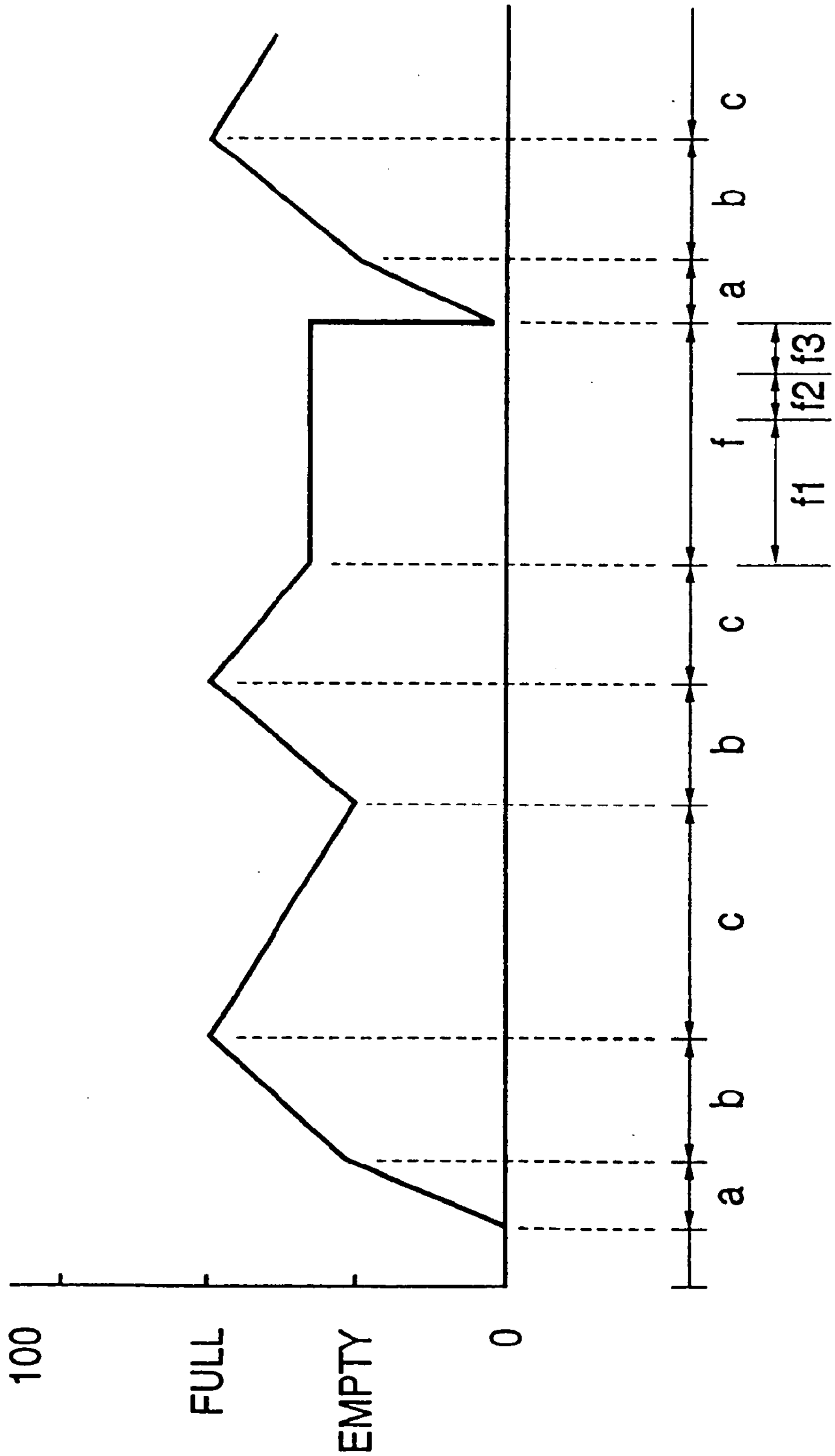


FIG. 20

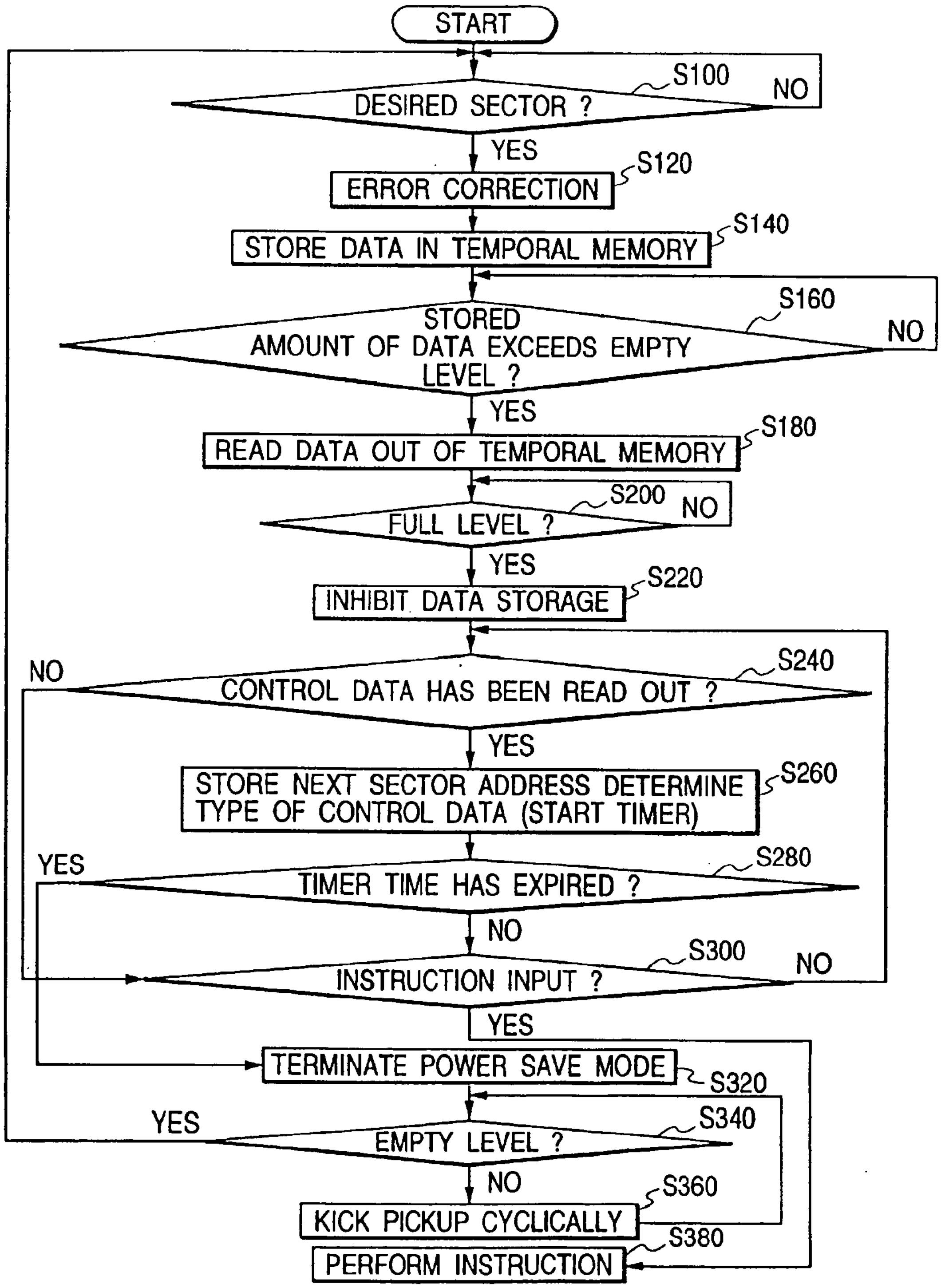
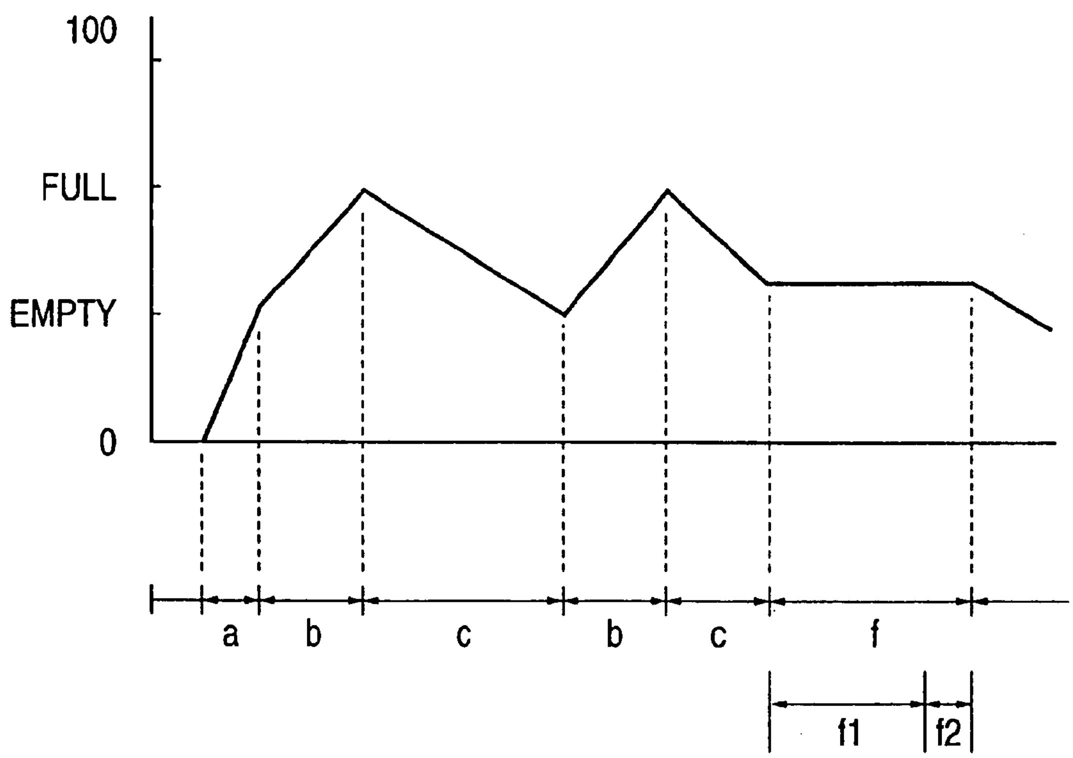

START
DESIRED SECTOR ?
S100
NO
YES
ERROR CORRECTION
S120
STORE DATA IN TEMPORAL MEMORY
S140
STORED AMOUNT OF DATA EXCEEDS EMPTY LEVEL ?
S160
NO
YES
READ DATA OUT OF TEMPORAL MEMORY
S180
FULL LEVEL ?
S200
NO
YES
INHIBIT DATA STORAGE
S220
CONTROL DATA HAS BEEN READ OUT ?
S240
NO
YES
STORE NEXT SECTOR ADDRESS DETERMINE TYPE OF CONTROL DATA (START TIMER)
S260
TIMER TIME HAS EXPIRED ?
S280
YES
NO
INSTRUCTION INPUT ?
S300
NO
YES
TERMINATE POWER SAVE MODE
S320
EMPTY LEVEL ?
S340
YES
NO
KICK PICKUP CYCLICALLY
S360
PERFORM INSTRUCTION
S380

FIG. 21



POWER SAVING SYSTEM FOR OPTICAL DISC RECORDING/REPRODUCING APPARATUS

BACKGROUND OF THE INVENTION

1. Technical Field of the Invention

The present invention relates generally to a power saving system for a recording/reproducing apparatus designed to record or reproduce information on or from optical discs such as MDs (Mini Discs), MD2s, video CDs (Compact Discs), high-quality CDs, CD-Rs, CD-RWs, DVDs (Digital Versatile Discs), DVD-ROMs, DVD-Rs, DVD-RAMs, DVD-RWs, DVD+RWs, and MO (Magneto-Optical) discs, and more particularly to a power saving system for an optical disc recording/reproducing apparatus having a temporary memory for storing the data for data compression or decompression or shock-proofing.

2. Background Art

Recently, various types of portable recording/reproducing apparatus using an optical disc such as a CD, a DVD, or a MD appear on the market.

Usually, such portable recording/reproducing apparatuses have a shock-proof memory. For instance, MD portable players have a shock-proof memory of a capacity of about 4 Mbit and, in the playback mode of operation, holds the information content equivalent to a playback time of about 10 sec. in the memory temporarily, while kicking a pickup cyclically between adjacent track turns until one of sectors on which information is to be recorded next. In a record mode, after audio signals are compressed and stored in the shock-proof memory, they are read out of the memory and recorded on a MD for a preselected period of time. A sequence of these operations is carried out cyclically to record all audio signals on the MD. During a time interval between cyclic recordings of the audio signals on the MD, the pickup is kept kicked to track one of track turns for waiting one of sectors on which audio signals are to be recorded next.

Such portable players are required to record or reproduce data for an increased period of time. To this end, it is necessary to prolong the service lift of a battery, or to save as much of power consumed in the player as possible.

SUMMARY OF THE INVENTION

It is therefore a principal object of the present invention to avoid the disadvantages of the prior art.

It is another object of the present invention to provide a recording/reproducing apparatus having a power saving system for prolonging the record or playback time.

According to one aspect of the invention, there is provided an optical recording apparatus. The optical recording apparatus comprises: (a) a temporal memory which stores therein a signal to be recorded on an optical disc which is compressed at a given compression rate; (b) a data storage monitoring circuit which monitors the amount of the compressed signal stored in the temporal memory and provides a signal indicative thereof; (c) a pickup which emits light onto the optical disc to record the compressed signal read out of the temporal memory and receives a return of the light from the optical disc to output a signal; (d) a first servo circuit which produces servo error signals based on the signal outputted from the pickup; (e) a second servo circuit which is responsive to the servo error signals from the first servo circuit to subject the pickup to focus, tracking, and traverse control; and (f a power saving circuit which is responsive to the signal from the data storage monitoring circuit to save power supplied to a preselected circuit component of at least one of the first and second servo circuit during a time interval in which the amount of the compressed signal stored in the temporal increases from a first level to a second level.

In the preferred mode of the invention, a compression rate determining circuit is further provided which determines the compression rate of the signal to be recorded on the optical disc. The power saving circuit determines the second level based on the compression rate.

The power saving circuit resumes the supply of power to the preselected circuit component after the amount of the compressed signal stored in the temporal reaches the second level.

A signal type specifying circuit may be provided which specifies a type of the signal to be recorded on the optical disc. The power saving circuit performs a power saving operation based on the type of the signal specified by the signal type specifying circuit and determines a timing with which the supply of power to the preselected circuit component is resumed based on the type of the signal.

A disc type specifying circuit may be provided which specifies a type of the optical disc. The power saving circuit performs the power saving operation based on the type of the signal specified by the signal type specifying circuit and the type of the optical disc specified by the disc type specifying circuit and determines the timing with which the supply of power to the preselected circuit component is resumed based on the type of the signal and the type of the optical disc.

A linear velocity determining circuit may also be provided which determines a linear velocity of the optical disc based on the type of the signal. The power saving circuit performs the power saving operation and determines the timing with which the supply of power to the preselected circuit component is resumed based on the type of the signal and the linear velocity of the optical disc.

According to the second aspect of the invention, there is provided an optical reproducing apparatus. The optical reproducing apparatus comprises: (a) an error correcting circuit which subjects data reproduced from an optical disc to error correction; (b) a temporal memory which stores the data corrected in error by the error correcting circuit in a data storage stage; (c) a data storage monitoring circuit which monitors the amount of the data stored in the temporal memory and provides a signal indicative thereof; (d) a reproducing circuit which reads the data out of the temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and (e) a power saving circuit which is responsive to the signal from the data storage monitoring circuit to save power supplied to at least the error correcting circuit during a time interval in which the amount of the data stored in the temporal decreases from a first level to a second level in the data readout stage.

In the preferred mode of the invention, the apparatus further comprises a pickup which optically picks up the data from the optical disc, a driver which drives the pickup under servo control, a playback/servo circuit which produces a data signal and a servo error signal from the data picked up by the pickup, provides the servo error signal to the driver for use in the servo control of the pickup, and holds the data signal in the temporal memory, and a tracking circuit which subjects the pickup to tracking control. The reproducing circuit reads the data signal out of the temporal memory and decompresses the data signal. The power saving circuit saves the power supplied to at least the error correcting circuit and the tracking circuit during the time interval in which the amount of the data stored in the temporal decreases from the first level to the second level in the data readout stage.

According to the third aspect of the invention, there is provided an optical reproducing apparatus. The optical reproducing apparatus comprises: (a) a first control circuit which controls rotation of an optical disc in a first servo control mode based on a speed control signal derived from a drive circuit rotating the optical disc; (b) a second control circuit which controls rotation of the optical disc in a second servo control mode based on a speed control signal derived from data reproduced from the optical disc; (c) a driver circuit which drives a pickup reading the data out of the optical disc; (d) a playback/servo circuit which produces a data signal for playback and a servo error signal from on the data picked up by the pickup; (e) a focus control circuit which subjects the pickup to focus control; (f a tracking control circuit which subjects the pickup to tracking control; (g) an error correcting circuit which subjects the data read out by the pickup to error correction; (h) a temporal memory which stores the data corrected in error by the error correcting circuit in a data storage stage; (i) a data storage monitoring circuit which monitors the amount of the data stored in the temporal memory and provides a signal indicative thereof; (j) a reproducing circuit which reads the data out of the temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and (k) a controlling circuit which is responsive to the signal from the data storage monitoring circuit to save power supplied to at least the error correcting circuit during a time interval in which the amount of the data stored in the temporal decreases from a first level to a second level in the data readout stage. The controlling circuit switches control of the rotation of the optical disc from the second servo control mode to the first servo control mode.

According to the fourth aspect of the invention, there is provided an optical reproducing apparatus. The optical reproducing apparatus comprises: (a) a driver circuit which drives a pickup reading data out of the optical disc; (b) a playback/servo circuit which produces a data signal for playback and a servo error signal from on the data picked up by the pickup; (c) a servo circuit which provides a servo signal to the driver circuit based on the servo error signal from the playback/servo circuit; (d) an error correcting circuit which subjects the data read out by the pickup to error correction; (e) a temporal memory which stores the data corrected in error by the error correcting circuit in a data storage stage; (f) a data storage monitoring circuit which monitors the amount of the data stored in the temporal memory and provides a signal indicative thereof; (g) a reproducing circuit which reads the data out of the temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and (h) a power saving circuit which is responsive to the signal from the data storage monitoring circuit to save power supplied to at least one of the drive circuit, the playback/servo circuit, and the error correcting circuit during a time interval in which the amount of the data stored in the temporal decreases from a first level to a second level in the data readout stage.

In the preferred mode of the invention, a transfer rate detector is further provided which detecting a transfer rate of the data picked up from the optical disc. The power saving circuit performs a power saving operation based on the transfer rate of the data detected by the transfer rate detector and determines a timing with which supply of power is resumed based on the transfer rate.

A signal type specifying circuit may be provided which specifies a type of the data signal reproduced from the optical disc. The power saving circuit performs a power saving operation based on the type of the data signal specified by the signal type specifying circuit and determines a timing with which the supply of power is resumed based on the type of the signal.

A disc type specifying circuit may be provided which specifies a type of the optical disc. The power saving circuit performs a power saving operation based on the type of the optical disc specified by the disc type specifying circuit and determines a timing with which supply of the power is resumed based on the type of the optical disc.

A linear velocity determining circuit may also be provided which determines a linear velocity of the optical disc based on the type of the signal. The power saving circuit performs the power saving operation and determines the timing with which the supply of power is resumed based on the type of the signal and the linear velocity of the optical disc.

According to the fifth aspect of the invention, there is provided an optical reproducing apparatus. The optical reproducing apparatus comprises: (a) a pickup reading data out of an optical disc optically; (b) a signal producing circuit producing a reproduction signal containing control data and a servo circuit from the data read out by the pickup; (c) a servo circuit responsive to the servo signal to control readout of the data through the pickup; (d) a temporal memory storing therein the reproduction signal containing the control data; (e) a reproducing circuit reproducing the reproduction signal based on the control data; and (f) a power saving circuit saving a portion of power consumed in the apparatus during a reproduce mode of operation of the reproducing circuit.

According to the sixth aspect of the invention, there is provided an optical reproducing apparatus. The optical reproducing apparatus comprises: (a) a pickup reading data out of an optical disc optically; (b) a signal producing circuit producing a reproduction signal containing control data and a servo circuit from the data read out by the pickup; (c) a servo circuit responsive to the servo signal to control readout of the data through the pickup; (d) a temporal memory storing therein the reproduction signal containing the control data; (e) a reproducing circuit reproducing the reproduction signal based on the control data; (f) a first control circuit which controls rotation of an optical disc in a first servo control mode based on a speed control signal derived from a motor rotating the optical disc; (g) a second control circuit which controls rotation of the optical disc in a second servo control mode based on a speed control signal derived from the data reproduced from the optical disc; and (h) a power saving circuit saving a portion of power consumed in the apparatus during a reproduce mode of operation of the reproducing circuit, the power saving circuit switching control of the rotation of the optical disc from the second servo control mode to the first servo control mode.

In the preferred mode of the invention, the power saving circuit selects one of a plurality of power save operation modes based on a controlled content of the control data.

The power saving circuit may determine a power save duration based on a controlled content of the control data.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinbelow and from the accompanying drawings of the preferred embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments but are for the purpose of explanation and understanding only.

In the drawings:

FIG. 1 is a block diagram which shows an optical recording/reproducing apparatus having a power save function according to the first embodiment of the invention;

FIG. 2 is an illustration which shows an optical disc on which track turns consisting of sectors are formed;

FIG. 3 is a time chart which shows a variation in amount of data stored in a temporal memory;

FIG. 4(*a*) shows a power save duration in the first power save mode;

FIG. 4(*b*) shows a power save duration in the second power save mode;

FIG. 4(*c*) shows a power save duration in the third power save mode;

FIG. 5 is a flowchart of a power saving program in the first embodiment;

FIG. 6 is a block diagram which shows an optical recording/reproducing apparatus having a power save function according to the second embodiment of the invention;

FIG. 7 is a block diagram which shows an optical recording/reproducing apparatus having a power save function according to the third embodiment of the invention;

FIG. 8 is a block diagram which shows an optical recording/reproducing apparatus having a power save function according to the fourth embodiment of the invention;

FIG. 9 is a block diagram which shows an optical reproducing apparatus having a power save function according to the fifth embodiment of the invention;

FIG. 10 is a time chart which shows a variation in amount of data stored in a temporal memory in the fifth embodiment;

FIGS. 11 and 12 show a flowchart of a power saving program in the fifth embodiment;

FIG. 13 is a block diagram which shows an optical reproducing apparatus having a power save function according to the sixth embodiment of the invention;

FIG. 14(*a*) shows a power save duration in the fourth power save mode;

FIG. 14(*b*) shows a power save duration in the fifth power save mode;

FIG. 14(*c*) shows a power save duration in the sixth power save mode;

FIG. 15 is a block diagram which shows an optical reproducing apparatus having a power save function according to the seventh embodiment of the invention;

FIG. 16 is a block diagram which shows an optical reproducing apparatus having a power save function according to the eighth embodiment of the invention;

FIG. 17 is a block diagram which shows an optical reproducing apparatus having a power save function according to the ninth embodiment of the invention;

FIG. 18 is a block diagram which shows a DVD player having a power save function according to the tenth embodiment of the invention;

FIG. 19 is a time chart which shows a variation in amount of data stored in a temporal memory in the tenth embodiment;

FIG. 20 is a flowchart of a power saving program in the tenth embodiment; and

FIG. 21 is a time chart which shows a variation in amount of data stored in a temporal memory in a modification of the tenth embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like numbers refer to like parts in several views, particularly to FIG. 1, there is shown a recording/reproducing apparatus for optical discs which has a power saving system used in a record mode of operation.

The optical disc 1 has concentric tracks or a spiral track formed on a surface thereof. FIG. 2 shows, as one example, two track tuns A and B formed on the optical disc 1 which have different diameters. It is assumed that the optical disc 1 is controlled to be rotated at a CLV (Constant Linear Velocity), the inner track turn A has four sectors, and the outer track turn B has eight sectors. The time for a complete turn of the disc 1 is 40 msec. when a pickup, as will be described later, lies on the inner track turn A and 80 msec. when the pickup lies on the outer track turn B.

Referring back to FIG. 1, the recording/reproducing apparatus generally includes a spindle motor **2**, a laser **3**, a pickup **4**, a record/playback servo circuit **6**, a second servo circuit **7**, and a driver **10**.

The spindle motor **2** is driven under the servo control to spin the optical disc **1**. The laser **3** emits a laser beam for recording or reproducing information on or from the optical disc **1**. The pickup **4** picks up a laser return from the optical disc **1**. The pickup **4** has the laser **3** installed therein and is moved in unison by a moving mechanism **5** in a radius direction of the optical disc **1**. The record/playback servo circuit **6** receives outputs from the pickup **4** and outputs a signal reproduced from the optical disc **1**, servo signals, and a speed control signal for the CLV control. The record/playback servo circuit **6** includes a focus error signal generator, a tracking error signal generator, a reproduced signal generator, an equalizer, a PLL, a speed control signal generator, and a laser power controller such as an automatic power controller (APC). The second servo circuit **7** includes a focus controller **8**, a tracking controller **9**, a traverse controller **40**, and a spindle motor controller **30**. The driver **10** operates the pickup **4** and the spindle motor **2** and includes a focus circuit **11**, a tracking circuit **12**, a traversing circuit **41**, and a spindle motor circuit **31**.

The recording/reproducing apparatus also includes an A/D converter **13**, a signal processor **14**, an error correction circuit **15**, a temporal memory **16**, a decompressing circuit **17**, a separation circuit **18**, a D/A converters **19** and **20**, a speaker **21**, and a monitor **22**.

The A/D converter **13** converts a reproduced signal in a digital form inputted from the record/playback servo circuit **6** into an analog signal. The signal processor **14** decodes the reproduced signal, e.g., an EFM(Eight to Fourteen Modulation)+signal, into NRZ data. The error correction circuit **15** corrects errors contained in the decoded signal outputted from the signal processor **14**. The error-corrected decoded signal is a signal compressed at a variable transfer rate. The temporal memory **16** is, for example, a DRAM with a capacity of about 16Mb and stores therein the compressed data outputted from the error correction circuit **15** to absorb a variation in transfer rate. In the record mode of operation, the temporal memory **16** also serves to hold compressed data to be recorded on the optical disc **1**. The decompressing circuit **17** consists of, for example, an A-V (audio-video) decoder which decompresses the data read out of the temporal memory **16**. The separation circuit **18** separates the decompressed data into audio and video signals, for example, and supplies them to the D/A converters **19** and **20**, respectively. The D/A converter **19** converts the video signal in a digital form into an analog video signal and supplies it to the monitor 22. The D/A converter 20 converts the audio signal in a digital form into an analog audio signal and supplies it to the speaker 21.

The recording/reproducing apparatus also includes a data storage control circuit 23, a controller 27, a pause input device 24, a sector storage 25, and an input device 26.

The data storage control circuit 23 controls the quantity of data held in the temporal memory 16 and provides a data quantity control signal indicative of a controlled quantity of the data to the controller 27. The pause input device 24 may consist of an external device or a key for inputting a pause signal to stop a playback operation of the apparatus. The sector storage 25 holds therein a sector number or address of one of sectors of the optical disc 1 from or on which data is to be reproduced or recorded next. The input device 26 is used by an operator to input desired instructions into the controller 27. The controller 27 is made up of a microcomputer which controls the whole operation of the apparatus. Signal flows only during the playback mode of operation are indicated by white thick arrows.

A recording system of the recording/reproducing apparatus generally includes a recording signal source 36, a compressing circuit 37, a compression rate input circuit 42, and a compression rate control circuit 44.

The recording signal source 36 outputs recording signals in a digital form to be recorded on the optical disc 1 and may be implemented with a microphone, a video recorder which inputs audio and video signals to the apparatus, or other similar devices. The compressing circuit 37 codes the recording signals inputted from the recording signal source 36, for example, in the MPEG-2 format. The compressed signals outputted from the compressing circuit 37 are stored in the temporal memory 16 and then supplied to the signal processor 14. The signal processor 14 adds codes such as addresses and sync signals to the compressed signals read out of the temporal memory 16 and supplies them as recording data to the record/playback servo circuit 6. The record/playback servo circuit 6 outputs the recording data intermittently to the pickup 4 and modulates, for example, laser beams emitted from the laser 3 to write the recording data on the optical disc 1.

The compression rate input circuit 42 is designed to manually input a record mode switch instruction to select the recording time in the record mode of operation among, for example, two hours, four hours, and six hours and to determine the compression rate as a function of the recording time.

The compression rate control circuit 44 controls the compressing circuit 37 to compress the recording signals from the recording signal source 36 at a rate selected by the compression rate input circuit 42.

In the playback mode of operation, a signal reproduced from the optical disc 1 by the pickup 4 is inputted to the record/playback servo circuit 6. The record/playback servo circuit 6 produces servo signals, and a speed control signal. The servo signals are inputted to the second servo circuit 7. The focus controller 8 is responsive to the servo signal to produce a focus drive signal. The tracking controller 9 is responsive to the servo signal to produce a tracking drive signal. Similarly the traverse controller 40 is responsive to the servo signal to produce a traverse drive signal. The spindle motor controller 30 is responsive to the speed control signal to produce a drive signal. The focus drive signal, the tracking drive signal, the traverse drive signal, and the drive signal are inputted to the driver 10 to perform the so-called focus, tracking, and traversing control of the pickup 4 through the focus circuit 11, the tracking circuit 12, and the traversing circuit 41.

In practice, the speed control signal is produced by a PLL built in the record/playback servo circuit 6 and sent to the spindle motor controller 30 of the second servo circuit 7 to produce the drive signal. The drive signal is supplied to the spindle motor circuit 31. The spindle motor circuit 31 produces a drive control signal to regulate the speed of the spindle motor 2 under the CLV control. The spindle motor 2 produces an angular position signal through a Hall element (not shown) which is fed back to the second servo circuit 7 to produce a speed control signal which is used as needed in the FG (Frequency Generator) control to maintain the speed of the spindle motor 2 constant.

The reproduced signal outputted from the pickup 4 is optimized in frequency characteristics by an equalizer installed in the record/playback servo circuit 6 and inputted to the PLL. The reproduces signal is converted by the A/D converter 13 into a digital signal and then inputted to the signal processor 14. The signal processor 14 subjects the digital signal to the synchronous detection so as to decode the EFM+signal recorded on the optical disc 1 to produce the NRZ data. The NRZ data is inputted to the error correction circuit 15. The error correction circuit 15 has the NRZ data undergo the error correction and derives an address signal for a sector and a data signal. The data signal is a signal compressed at a variable transfer rate and thus held in the temporal memory 16 for absorbing a variation in transfer rate.

The signal read out of the temporal memory 16 is decompressed by the decompressing circuit 17 which consists of the A-V decoder and then split by the separation circuit 18 into audio and video signals. The audio signal is supplied to the speaker 21 through the D/A converter 19. The video signal is supplied to the motor 22 through the D/A converter 20.

In the record mode of operation, if audio and video signals produced from the recording signal source 36 are digital signals, they are inputted directly to the compressing circuit 37. Alternatively, if analog signals, they are first converted by an A/D converter (not shown) into digital signals and then inputted to the compressing circuit 37. The compressing circuit 37 codes and compresses the input signals which are, in turn, stored in the temporal memory 16, as indicated by "a" in a time chart of FIG. 3. For instance, if the input signals to the compressing circuit 37 are video signals, they are decoded into NTSC signals and compressed in the MPEG-2 format. Alternatively, if audio signals, they are compressed by an A-V encoder in the AC-3 format. The amount of data stored in the temporal memory 16 are always monitored by the data storage control circuit 23. When a stored amount of data in the temporal memory 16 reaches a full level, the data are read out of the temporal memory 16, as indicated by "b" in FIG. 3, and supplied to the signal processor 14. The signal processor 14 adds error correction codes, address codes, and sync signals to the input data which are, in turn, written in the optical disc 1 through the pickup 4. During the readout of data from the temporal memory 16, following recording signals compressed by the compressing circuit 37 are stored in the temporal memory 16. Note that the data readout speed is higher than the data write speed.

When the temporal memory 16 becomes empty, typical systems prohibit the data from being read out of the temporal memory 16 and written in the optical disc 1, kick the pickup 4 cyclically to trace one of track turns on which the data is to be recorded next in a standby mode, however, the controller 27 of this embodiment. as will be described later in detail, prohibits the readout of the data from the temporal memory 16 until a stored amount of data in the temporal memory 16 reaches a given level. During the prohibition of the readout of data, compressed data from the compressing circuit 37 continues, as indicated by "c" in FIG. 3, to be stored in the temporal memory 16. When the temporal memory 16 becomes full again, the data, as indicated by "d", begins to be read out of the temporal memory 16 and written in the optical disc 1 until a stored amount of data in the temporal memory 16 reaches the empty level. Subsequently, the same steps are repeated to write data on the optical disc 1 cyclically.

Within each of the data storage stages "a", "c","e", and "g" where the amount of data stored in the temporal memory 16 is increased, the recording/reproducing apparatus is in a power save mode to minimize the power consumption until the stored amount of data reaches a reference level slightly lower than the full level. During the power save mode, the supply of power to at least part of either or both of the record/playback servo circuit 6 and the second servo circuit 7 is cut to reduce the total power consumption of the apparatus. For instance, the supply of power to the tracking control is cut while keeping the supply of power to the focus control. Alternatively, the supply of power to the record/playback servo circuit 6, the laser 3, and the second servo circuit 7 is cut while rotating the optical disc 1.

When the amount of data stored in the temporal memory 16 reaches the reference level at p1 in FIG. 3, the controller 27 switches the power save mode to a normal power supply mode. The controller 27 moves the pickup 4 to a subsequent track and enters the standby mode. When the stored amount of data in the temporal memory 16 reaches the full level, the controller 27 activates the pickup 4 to start writing data on the optical disc 1. When the temporal memory 16 becomes empty, the controller 27 prohibits the writing of data on the optical disc 1 and at the same time, enters the power save mode again.

The time T1 required for the amount of data stored in the temporal memory 16 to reach the full level from P1 is determined, allowing for the time required for a system to which the supply of power is cut in the power save mode to return to the normal operation mode. In this embodiment, the time T1 is approximately 100 msec. The time T1, will be discussed later in detail, depends upon the compression rate of data in the record mode of operation and the duration of the power save mode.

The switching of the compression rate of data used in the compressing circuit 37 is achieved by manually selecting one of data recording modes through the compression rate input circuit 42 to send a compression rate switching signal to the compressing circuit 37 through the compression rate control circuit 44 or may alternatively be achieved by automatically selecting one of the compression rates in the controller 27 according to the type of signals outputted from the recording signal source 36.

The data recording modes are of, for example, three types: two-hour mode, four-hour mode, and six-hour mode. In the two-hour mode, a total recording time is approximately two hours to ensure a high quality of images. In the four-hour mode, a total recording time is approximately four hours to keep a normal quality of images. In the six-hour mode, a total recording time is approximately six hours, but resulting in a deterioration in quality of images. Further, the compression rate input circuit 42 may have manual keys used to change the data recording mode through an internal switch when it is required to change the definition of images, when a high speed scene such as a car race is recorded, or when it is required to select the recording time rather than the quality of images or have a control circuit receiving control data inputted from an external device to change the data recording mode. When a desired one of the data recording modes is selected, the duty of the pickup 4, that is, a ratio of a data write period during which the pickup 4 writes data on the optical disc 1 to a rest period during which the pickup 4 waits for next recording, in other words, a transfer rate ratio of data to be recorded on the optical disc 1 to data compressed by the compressing circuit 37 is determined. The power save mode may, thus, be determined as a function of the duty of the pickup 4 or the compression rate of data to be recorded, as will be described later.

Further, the power save mode may be determined by an operator through a manual switch according to the degree of priority to increase in service life of a battery over protection of data against vibration or shock, or vice versa.

The timing with which the controller 27 terminates the power saving operation is determined in the following manner.

The temporal memory 16 has, as described above, a capacity of 16 Mb. Thus, for instance, when it is required to record image data at 8 Mbps in the two-hour mode, it allows the temporal memory 16 to hold the image data for 2 sec. If 100 msec. is required for the apparatus to return to the normal operation mode following the termination of the power save mode, then the amount of image data stored in the temporal memory 16 in 100 msec. is calculated in the following manner. If the empty level is defined as zero (0) Mb, and the full level is defined as 16 Mb, a ratio of the time required for the apparatus to return to the normal operation mode following the termination of the power save mode to the time required for the temporal memory 16 to reach the full level from the empty level is 100 msec./2 sec.=0.05. The amount of image data stored in the temporal memory 16 in 100 msec. is, thus, 16 Mb×0.05=0.8 Mb. Therefore, the controller 27 may terminates the power saving operation when the amount of image data stored in the temporal memory 16 becomes at least 15.2 Mb (=16 Mb−0.8 Mb).

Note that the full level and the empty level of the amount of data stored in the temporal memory 16, as referred to this disclosure, do not indicate data stored amounts of 100% and 0%, respectively, but values to which preselected margins are added. The time required for the apparatus to return to the normal operation mode following the termination of the power save mode depends upon the type of power save mode, as will be discussed later in detail, and is preferably determined as function of the position of a current track turn on the optical disc 1. This is because the time required for the apparatus to return to the normal power save mode should include the waiting time of the pickup 4 until one of sectors on the optical disc 1 on which data is to be recorded next reaches the pickup 4, and the waiting time becomes short when the pickup 4 is tracing an inner one of the track turns, while it becomes long when the pickup 4 is tracing an outer one of the track turns.

The power save mode used in this embodiment is classified into three types below.

When it is required to record data on the optical disc 1 in the tow-hour mode, the controller 27 selects the first power save mode to turn off the tracking and traverse controls while keeping the focus control on. The sector storage 25 stores a sector address of one of sectors of the optical disc

1 on which data is to be recorded next. When the tracking control is in the off-state, a complete servo signal is not obtained. A component of an RF signal outputted intermittently from the pickup 4 is, thus, extracted and used in the CLV control of the spindle motor 2 to perform the rough servo control, providing the speed control signal to the spindle motor controller 30.

The power save is achieved by cutting the supply of power to, for example, a tracking error signal generator of the record/playback servo circuit 6, the tracking controller 9 of the second servo circuit 7, and the tracking circuit 12 of the driver 10.

After a lapse of a preselected period of time, as will be described later, the supply of power is resumed to activate the tracking control. The tracking control has the pickup 4 seek one of track turns of the optical disc 1 having a sector whose address is stored in the sector storage 25 and kicks the pickup 4 cyclically until that sector reaches the pickup 4.

When it is required to record data on the optical disc 1 in the four-hour mode, the controller 27 selects the second power save mode to turn off the focus and tracking controls and the laser 3. The laser 3 may alternatively be kept on. The sector storage 25 stores a sector address of one of sectors of the optical disc 1 on which data is to be recorded next. When the focus and tracking controls are in the off-state, a complete servo signal is not obtained. It is, thus, impossible to operate the spindle motor 2 under the CLV control, and the above described FG control is initiated. Specifically, the controller 27 determines the speed of the FG corresponding to the current one of sectors to keep the FG rotated at the determined speed.

The power saving is achieved by cutting the supply of power to all components of the record/playback servo circuit 6: the focus error signal generator, the tracking error signal generator, the reproduced signal generator, the equalizer, the PLL, the speed control signal generator, and the laser power controller, all components of the second servo circuit 7: the focus controller 8, the tracking controller 9, the traverse controller 40, and the spindle motor controller 30, part of the driver 10: the focus circuit 11, the tracking circuit 12, and the traversing circuit 41, and the laser 3. This allows the power consumption to be lowered greatly as compared with the first power save mode.

After a lapse of a preselected period of time, as will be described later, the supply of power is resumed to turn on the focus control, and the tracking control in that sequence. The tracking control has the pickup 4 seek one of track turns of the optical disc 1 having a sector whose address is stored in the sector storage 25 and kicks the pickup 4 cyclically until that sector reaches the pickup 4.

The reason that the spindle motor 2 is not turned off is because it takes approximately two seconds to resume rotating the spindle motor 2 at a desired speed, which exceeds a 500 msec memory holding time of the temporal memory 16. In order to reduce a more power consumption, it is advisable that the speed of the spindle motor 2 under the FG control be decreased to ½ or ¼ times a normal speed.

When it is required to record data on the optical disc 1 in the six-hour mode, the controller 27 selects the third power save mode to turn off the focus and tracking controls, the laser 3, and the spindle motor control. The sector storage 25 stores a sector address of one of sectors of the optical disc 1 on which data is to be recorded next.

Since the focus and tracking controls, the laser 3, and the spindle motor control are all turned off, the power consumption is reduce greatly. It, however, takes approximately one second to return the apparatus to the normal operation mode, and a great quantity of power is consumed in starting the spindle motor 2. Thus, if the third power save mode is not kept for more than six seconds, for example, it will cause the power consumption to be increased undesirably.

The power saving is achieved by cutting the supply of power to all components of the record/playback servo circuit 6: the focus error signal generator, the tracking error signal generator, the reproduced signal generator, the equalizer, the PLL, the speed control signal generator, and the laser power controller, all components of the second servo circuit 7: the focus controller 8, the tracking controller 9, the traverse controller 40, and the spindle motor controller 30, all components of the driver 10: the focus circuit 11, the tracking circuit 12, the traversing circuit 41, and the spindle motor circuit 31, and the laser 3. This results in a greater decrease in power consumption than in the first and second power save modes.

After a lapse of a preselected period of time, as will be described later, the supply of power is resumed to turn on the laser 3, the spindle motor control, the focus control, and the tracking control in that sequence. The tracking control has the pickup 4 seek one of track turns of the optical disc 1 having a sector whose address is stored in the sector storage 25 and kicks the pickup 4 cyclically until that sector reaches the pickup 4.

FIGS. 4(A), 4(B), and 4(C) show changes in power consumption in the first, second, and third power save modes, respectively.

FIG. 4(A) illustrates for the case where image data is recorded in the two-hour mode in which a total recording time is approximately two hours, and the first power save mode is selected as a function of the compression rate of the image data. A high quality of images is, thus, ensured, but the transfer rate is high. The time required for the temporal memory 16 to reach the full level from the empty level (i.e., "c", "e", "g" in FIG. 3) is very short, about two seconds. The off-duration of the tracking and traversing controls is also short. The time T1 required for the apparatus to return to the normal operation mode from the first power save mode is, thus, short, about 100 msec. The power consumption of the apparatus during the first power save mode is about 80% of that in the normal standby mode of operation. During a period of time between turning on of the tracking control and a time when a given track turn has been sought after resumption of the normal power supply mode, a great power consumption of 110% is required instantaneously if the power consumption in the normal playback mode is defined as 100%. The amounts of power consumption in the standby mode and the record mode of operation are 100% and 120%, respectively.

FIG. 4(B) illustrates for the case where image data is recorded in the four-hour mode in which a total recording time is approximately four hours, and the second power save mode is selected as a function of the compression rate of the image data. The quality of images and the transfer rate are both common levels. The time required for the temporal memory 16 to reach the full level from the empty level is about four seconds which is slightly longer than that in the first power save mode. This will cause the time T1 required for the apparatus to return to the normal operation mode from the second power save mode to be increased to about 500 msec. The off-duration of the tracking and traversing controls and the laser 3 is, thus, set longer than that in the first power save mode, about 3.5 sec. The power consumption of the apparatus during the second power save mode is about 50% of that in the standby mode of operation, which is lower than that in the first power save mode. When the normal power supply mode is resumed, the laser 3, the focus control, and the tracking control are turned on in sequence, so that the power consumption is increased gradually.

FIG. 4(C) illustrates for the case where image data is recorded in the six-hour mode in which a total recording time is approximately six hours, and the third power save mode is selected as a function of the compression rate of the image data. The quality of images is, thus, low, but the transfer rate is slow. The time required for the temporal memory 16 to reach the full level from the empty level is about six seconds which is longer than that in the second power save mode. This will cause the time T1 required for the apparatus to return to the normal operation mode from the third power save mode to be increased to about 1000 msec. The off-duration of the focus control, the tracking control, the laser 3, and the spindle motor control in the third power save mode is, thus, set longer than that in the second power save mode, about 5 sec. The power consumption of the apparatus during the third power save mode is about 20% of that in the standby mode of operation, which is lower than that in the second power save mode. When the normal power supply mode is resumed, the spindle motor control, the laser 3, the focus control, and the tracking control are turned on in sequence, so that the power consumption is increased gradually.

FIG. 5 shows a program or sequence of logical steps performed by the recording/reproducing apparatus of this embodiment.

Upon initiation of the record mode of operation, the routine proceeds to step 1 wherein the compressing circuit 37 compresses input data from the recording signal source 36. The routine proceeds to step 2 wherein the compressed data is stored in the temporal memory 16 (i.e., the data storage stage a in FIG. 3). The routine proceeds to step 3 wherein the controller 27 selects one of the first to third power save modes to cut the supply of power to the above described circuit components. The routine proceeds to step 4 wherein it is determined whether a stored amount of data in the temporal memory 16 monitored by the data storage control circuit 23 is increased up to the reference level or not. If a YES answer is obtained, then the routine proceeds to step 5 wherein the apparatus is switched in operation from the power save mode to the normal power supply mode to resume the supply of power to the circuit components undergoing the power cut, and the pickup 4 seeks one of track turns on the optical disc 1 which has one of sectors on which data is recorded next. The routine proceeds to step 6 wherein it is determined whether the one of sectors of the optical disc 1 has reached the pickup 4 or not. If a YES answer is obtained, then the routine proceeds to step 7 wherein the pickup 4 is kicked toward a previous track turn cyclically so as to trace the sought one of the track turns. The routine proceeds to step 8 wherein it is determined whether a stored amount of data in the temporal memory 16 monitored by the data storage control circuit 23 has reached the full level or not. If a YES answer is obtained, then the routine proceeds to step 9 wherein the signal processor 14 reads the compressed data out of the temporal memory 16 and adds an error correction code, an address code, a synchronous signal, etc. thereto. The routine proceeds to step 10 wherein the laser 3 is activated to record the data on the optical disc 1 (i.e., the data readout stage b in FIG. 3).

The routine proceeds to step 11 wherein it is determined whether a stored amount of data in the temporal memory 16 has reached the empty level or not. If a YES answer is obtained, then the routine proceeds to step 12 wherein the controller 27 prohibits the signal processor 14 from reading the data out of the temporal memory 16 and the pickup 4 from recording the data on the optical disc 1. Subsequently, the routine returns back to step 3 and repeats steps 3 to 12 until all data is recorded on the optical disc 1.

If any signal or instruction to terminate the power saving operation immediately is inputted through the input device 26 or if a recording error occurs during the power saving operation, requiring data to be stored in the temporal memory 16 again, the controller 27 may detect that event to resume the supply of power immediately even during the power save mode.

In this embodiment, one of the first, second, and third power save modes is selected as a function of the compression rate of signals to be recorded on the optical disc 1, but may alternatively be selected as a function of type of the recording signals, which will be discussed below.

FIG. 6 shows a recording/reproducing apparatus according to the second embodiment of the invention which is different from the first embodiment, as shown in FIG. 1, in that a signal type specifying circuit 50 is installed between the recording signal source 36 and the controller 27 for selecting one of the first to third power save modes based on the type of signal to be record on the optical disc 1. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The signal type specifying circuit 50 specifies the type of signal outputted from the recording signal source 36 and provides a signal indicative thereof to the controller 27. The signal type specifying circuit 50 may alternatively be built in the input device 26 to design the input device 26 so that an operator may input the type of a recording signal manually into the controller 27.

Here, it is assumed that the signal type specifying circuit 50 discriminates between two types of signals: one consisting of both video and audio signals to be recorded on a DVD and the second consisting of only audio signal to be recorded on the DVD.

When an output from the recording signal source 36 consists of a combination of audio and video signals, the signal type specifying circuit 50 provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the signal from the signal type specifying circuit 50 to determine that the video signal should be recorded with a high image quality in the two-hour mode, for example, sets the transfer rate of the signals to 8 Mpbs, and selects the first power save mode.

When an output from the recording signal source 36 consists of only an audio signal, the signal type specifying circuit 50 provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the signal from the signal type specifying circuit 50 to determine that the audio signal should be recorded with a high tone quality in the eight-hour mode, for example, in which a total recording time is approximately eight hours, sets the transfer rate of the signals to 2 Mpbs, and selects the third power save mode. In this case, the time required for the amount of the audio signal stored in the temporal memory 16 to reach the full level from the empty level is, as shown in FIG. 4(c), about eight seconds.

The controller 27 may alternatively determine the data recording time or the transfer rate based on a manual input through the compression rate input circuit 42.

The time T1 required for the apparatus to return to the normal operation mode is, like the first embodiment, different between the first and third power save modes. The controller 27 determines the time when the apparatus should return to the normal power supply mode as a function of a stored amount of data in the temporal memory 16 corresponding to the time T1 in each of the first and third power save modes in the manner as described above.

FIG. 7 shows a recording/reproducing apparatus according to the third embodiment of the invention which is different from the second embodiment, as shown in FIG. 6, in that a disc type specifying circuit 51 is installed between the pickup 4 and the controller 27 for selecting one of the first to third power save modes according to the type of the optical disc 1 in addition to the type of signals to be recorded. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The disc type specifying circuit 51 specifies the type of the optical disc 1 when loaded into the apparatus. There have been proposed in the art several manners to specify the type of a disc. For example, the type of the optical disc 1 may be specified by measuring the quantity of light reflected from the optical disc 1 based on the fact that the quantity of light reflected from an optical disc is different between the types of disc.

Here, it is assumed that the optical disc 1 is either of a DVD and a CD-RW, and a video signal outputted from the recording signal source 36 is either of a high-quality MPEG-2 signal and a normal quality MPEG-1 signal.

The disc type specifying circuit 51 determines whether the optical disc 1 is a DVD or a CD-RW disc. The signal type specifying circuit 50 determines whether an output from the recording signal source 36 is the high-quality MPEG-2 signal or the normal quality MPEG-1 signal. If the optical disc 1 is the DVD, and the MPEG-2 signal is outputted from the recording signal source 36, the controller 27 determines that the MPEG-2 signal should be recorded, for example, in the two-hour mode, sets the transfer rate of the signal to 8 Mbps, and selects the first power save mode. In this case, the temporal memory 16 with a capacity of 16 Mb becomes full, like the first embodiment, in two seconds, as shown in FIG. 4(A).

If the optical disc 1 is the CD-RW, and the MPEG-1 signal is outputted from the recording signal source 36, the controller 27 determines that the MPEG-1 signal should be recorded, for example, in a one-hour mode in which a total recording time is one hour, sets the transfer rate of the signal to 2 Mbps, and selects the third power save mode. In this case, the temporal memory 16 becomes full, like the second embodiment, in eight seconds, as shown in FIG. 4(C).

The time T1 required for the apparatus to return to the normal operation mode is, like the above embodiments, different between the first and third power save modes. In this embodiment, the time Ti in the first power save mode is, as shown in FIG. 4(A), 100 msec. The time T1 in the third power save mode is, as shown in FIG. 4(C), 1000 msec. The controller 27 determines the time when the apparatus should return to the normal power supply mode as a function of a stored amount of data in the temporal memory 16 corresponding to the time T1 in each of the first and third power save modes in the manner as described above.

FIG. 8 shows a recording/reproducing apparatus according to the fourth embodiment of the invention which is different from the second embodiment, as shown in FIG. 6, in that a linear velocity determining circuit 52 is installed between the signal type specifying circuit 50 and the controller 27 for selecting one of the first to third power save modes as a function of the linear velocity of the optical disc 1 and the type of signal to be recorded. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The linear velocity determining circuit 52 determines a target linear velocity of the optical disc 1, that is, the speed of the spindle motor 2 to be controlled based on the transfer rate of signals outputted from the recording signals source 36 and provides a signal indicative thereof to the controller 27. The transfer rate of signals to be recorded on the optical disc 1 is, as described above, determined by the controller 27 automatically according to the type of signal to be recorded specified by the signal type determining circuit 50 or a manual input through the compression rate input circuit 42.

As an example, two cases where audio signals are recorded on a DVD at a higher transfer rate and at a lower transfer rate will be referred to below.

For instance, when it is required to record linear PCM six-channel signals at a transfer rate of 8 Mbps in the two-hour mode, the controller 27 selects the first power save mode.

When it is required to record MPEG-2 two-channel signals at a transfer rate of 2 Mbps in the eight-hour mode, the controller 27 selects the second power save mode.

As apparent from the above discussion, the controller 27 selects one of the first and second power save modes based on outputs from the signal type specifying circuit 50 and the linear velocity determining circuit 52. Specifically, when the transfer rate of signals to be recorded is low, the linear velocity determining circuit 52 decreases a target linear velocity of the optical disc 1, and the controller 27 decreases the speed of the spindle motor 2. For example, when MPEG-1 signals are recorded on the optical disc 1, the linear velocity of the optical disc 1 is lowered to half that when linear PCM signals are recorded.

The reason that when data is recorded at a transfer rate of 2 Mb in the second embodiment, the third power save mode is selected, while when the MPEG-2 two-channel signals are recorded at the same transfer rate of 2 Mb, the second power save mode is selected is because if a total time period required for a stored amount of data in the temporal memory 16 to be increased from the empty level to the full level and then decreased to the empty level (i.e., c+T1+d in FIG. 3) is constant, a decrease in speed of the optical disc 1 by half will cause the time required to record data on the optical disc 1 (i.e., the duration of the data readout stage b, d, f, . . . in FIG. 3) to be doubled, thus resulting in a decrease in time (i.e., the duration of the data storage stage c, e, g, . . .) during which the power can be saved, therefore, if the third power save mode is selected in which the spindle motor 2 is turned off, it will cause the power consumption to be increased undesirably unless the third power save mode is kept for more than six seconds, for example, because it takes approximately one second to return the apparatus to the normal operation mode, and a great quantity of power is consumed in starting the spindle motor 2.

When the speed of the optical disc 1 is reduced, it will cause the time required for the optical disc 1 to reach a target speed to be increased. It is, thus, advisable that the controller 27 change the set time when the apparatus should be returned to the normal power supply mode as a function of a change in speed of the optical disc 1.

FIG. 9 shows a reproducing apparatus according to the fifth embodiment of the invention which is designed to save the power consumed in the playback mode of operation. The same reference numbers as employed in the first embodiment shown in FIG. 1 refer to the same parts, but they perform only the function of playback.

The reproducing apparatus includes a timer 240 which measures the elapsed time from prohibition of storage of data in the temporal memory 16 and provides a signal to the controller 27 when the elapsed time has reached a preselected period of time (e.g., 400 msec.).

The temporal memory 16 in this embodiment has a capacity of 4 Mb. If the optical disc 1 is a DVD, and data is reproduced therefrom at a transfer rate of 8 Mbps, then the temporal memory 16 is allowed to store the amount of data corresponding to 500 msec. For instance, if it takes 80 msec. for the optical disc 1 to make a complete turn of a track, the temporal memory 16 can hold the amount of data corresponding to about six turns of the track.

FIG. 10 shows a variation in amount of data stored in the temporal memory 16 in the playback mode of operation. The full level and the empty level in the drawing do not indicate stored amounts of 100% and 0%, respectively, but values to which preselected margins are added. The stored amount of data in the temporal memory 16 is monitored by the data storage control circuit 23.

After passing through the playback servo circuit 6, the A/D converter 13, the signal processor 14, and the error correction circuit 15, signals reproduced through the pickup 4 from a selected one of sectors of the optical disc 1 are stored in the temporal memory 16 (a data storage stage a in FIG. 10). When a stored amount of data in the temporal memory 16 reaches the empty level, the data is read out of the temporal memory 16 and supplied to the decompressing circuit 17 (a data storage/readout stage b). The speed at which data is reproduced from the optical disc 1 is faster than that at which data is read out of the temporal memory 16.

When the stored amount of data in the temporal memory 16 reaches the full level, the controller 27 inhibits data from being stored in the temporal memory 16 (storage inhibit stages c1 and c2). The pickup 4 starts to be kicked and is kept kicked at regular intervals until the stored amount of data in the temporal memory 16 reaches the empty level (in practice, until a given period of time expires). The sector storage 25 stores an address of one of the sectors of the optical disc 1 from which data is to be reproduced next.

During a given period of time after the stored amount of data in the temporal memory 16 reaches the full level, the controller 27 of this embodiment cuts the supply of power to some circuit components which need not be operated in that period of time. For instance, the controller 27 cuts the supply of power to the circuit components until 400 msec. which is slightly shorter than the time (e.g., 500 msec.) required for the stored amount of data in the temporal memory 16 to reach the empty level from the full level expires after the stored amount of data in the temporal memory 16 reaches the full level. A time interval of 400 msec. is, as described above, measured by the timer 240.

The power save mode in the storage inhibit stage c1 is classified into three types below.

During the storage inhibit stage c1, the data stored in the temporal memory 16 continues to be read out therefrom. The supply of power, thus, must be cut without blocking the servo control and the readout of data from the temporal memory 16. Therefore, in the first power save mode, the controller 27 cuts the supply of power to the signal processor 14 and the error correction circuit 15 to inhibit synchronous detection, decoding, and error correction and inhibits control of writing of data in the temporal memory 16.

In operation of the servo system, the pickup 4 is kept kicked in the first power save mode for 400 msec. after the stored amount of data in the temporal memory 16 reaches the full level. After a lapse of 400 msec., the pickup 4 continues to be kicked in the normal operation mode of the apparatus.

In the second power save mode, the controller 27 turns off the tracking control while keeping the focus control on in addition to the operation in the power save mode. The sector storage 25 stores a sector address of one of sectors of the optical disc 1 on which data is to be reproduced next. When the tracking control is in the off-state, a complete servo signal is not obtained. A component of an RF signal outputted intermittently from the pickup 4 is, thus, extracted and used in the CLV control mode of the spindle motor 2 to perform the rough servo control, producing the speed control signal.

The power saving is achieved through the controller 27 by cutting the supply of power to, for example, the tracking error signal generator of the playback servo circuit 6, the tracking controller 9 of the second servo circuit 7, and the tracking circuit 12 of the driver 10.

After a lapse of 400 msec. the controller 27 resumes the supply of power to turn on the tracking control to kick the pickup 4 at regular intervals until one of the sectors of the optical disc 1 whose address is stored in the sector storage 25 is reached.

In the third power save mode, the controller 27 turns off the focus control and the tracking control in addition to the operation in the first power save mode. The sector storage 25 stores a sector address of one of sectors of the optical disc 1 on which data is to be reproduced next. When the focus control and the tracking control are in the off-state, a complete servo signal is not obtained. It is, thus, impossible to operate the spindle motor 2 under the CLV control, and the above described FG control is initiated. Specifically, the controller 27 determines the speed of the FG corresponding to the current one of sectors to keep the FG rotated at the determined speed.

The power saving is achieved through the controller 27 by cutting the supply of power to all components of the playback servo circuit 6, all components of the second servo circuit 7, and part of the driver 10, for example, the focus circuit 11 and the tracking circuit 12. This allows the power consumption to be reduced greatly as compared with the second power save mode.

The duration of the storage inhibit stage c1 which is measured by the timer 240 is set to 300 msec. which is shorter than that in the first and second power save modes, allowing the time required for the focus and tracking controls to return to the steady state. Thus, 300 msec. after the stored amount of data in the temporal memory 16 reaches the full level, the third power save mode is switched to the normal power supply mode to resume the supply of power to the focus control and the tracking control in sequence to kick the pickup 4 at regular intervals until one of the sectors of the optical disc 1 whose address is stored in the sector storage 25 is reached.

In each of the first to third power save modes, upon input of any signal through the input device 26, the power supply may be resumed immediately. For instance, in a case where the reproducing apparatus of this embodiment is a portable video player, the power supply may be resumed upon manual input of a signal for searching a desired portion or the leader of a moving picture or occurrence of an error in reproducing audio or image signals, requiring reproduction of desired data from the optical disc 1 again. The input of the signal and the occurrence of the error may be monitored automatically in the controller 27.

FIGS. 11 and 12 show a program or sequence of logical steps performed by the recording/reproducing apparatus of the fifth embodiment.

Upon initiation of the playback mode of operation, the routine proceeds to step 10 wherein it is determined whether one of sectors from which reproduction of data is to be started has reached the pickup 4 or not. If a YES answer is obtained, then the reproduction of data is started, and the routine proceeds to step 20 wherein the reproduced data is subjected to error correction through the error correction circuit 15. The routine proceeds to step 30 wherein the error-corrected data is stored in the temporal memory 16. The routine proceeds to step 40 wherein it is determined whether a stored amount of data in the temporal memory 16 monitored by the data storage control circuit 23 exceeds the empty level or not. If a YES answer is obtained, then the routine proceeds to step 50 wherein the controller 27 activates the decompressing circuit 17 to start to read the data out of the temporal memory 16 and to decompress it. The routine proceeds to step 60 wherein it is determined whether a stored amount of data in the temporal memory 16 has reached the full level or not. If a YES answer is obtained, then the routine proceeds to step 70 wherein the controller 27 inhibits data from being stored in the temporal memory 16. The routine proceeds to step 80 wherein the sector storage 25 stores a sector address of one of sectors of the optical disc 1 from which data is to be reproduced next. The routine proceeds to step 90 wherein a preselected one of the first to third power save mode is entered.

The routine proceeds to step 110 in FIG. 5 wherein the timer 240 is activated. The routine proceeds to step 111 wherein the timer 240 determines whether a preselected period of time, e.g., 400msec. has passed or not. If a YES answer is obtained, then the routine proceeds to step 112 wherein the power save mode is terminated to resume the normal power supply mode. The routine proceeds to step 113 wherein the controller 27 reads out the sector address stored in the sector storage 25 in step 80 and has the pickup 4 seek one of the track turns of the optical disc 1 which has the sector specified by the sector address read out of the sector storage 25. The routine proceeds to step 114 wherein the pickup 4 is kicked at regular intervals to trace the one of the track turns. The routine proceeds to step 115 wherein it is determined whether a stored amount of data in the temporal memory 16 has reached the empty level or not. If a YES answer is obtained, then the routine proceeds to step 116 wherein the pickup 4 start to read data out of one of the sectors specified by the sector address read out of the sector storage 25. The routine proceeds to step 117 wherein it is determined whether the one of the sectors holds available data or not, that is, whether data still remains to be read out of the optical disc 1 or not. If a NO answer is obtained meaning that reproduction of all data has been completed, the routine terminates. Alternatively, if a YES answer is obtained, then the routine returns back to step 10 in FIG. 11.

If a NO answer is obtained in step 111, then the routine proceeds to step 118 wherein it is determined whether the above described manual input has been provided through the input device 26 or not and whether the error in reproducing audio or image signals has occurred or not. If a NO answer is obtained, then the routine returns back to step 111. Alternatively, if a YES answer is obtained, then the routine proceeds to step 119 wherein the controller 27 terminates the power save mode before 400 msec. expires, and performs instructions programmed therein to cure the error or given by the manual input. The routine returns back to step 111 or terminates according to the instructions performed in step 119.

FIG. 13 shows a reproducing apparatus according to the sixth embodiment of the invention which is different from the fifth embodiment in that a transfer rate detector 35 is provided to detect the transfer rate of reproduced signals for saving the power consumed in the playback mode of operation as a function thereof.

The transfer rate detector 35 reads a control signal out of signals reproduced from the optical disc 1 to find the data recording mode (e.g., the two-hour mode, the four-hour mode, or the six-hour mode, as described above) of the reproduced signals for determining the transfer rate thereof and outputs a signal indicative thereof to the controller 27. The controller 27 selects one of the fourth, fifth, and sixth power save modes, as will be described below, as a function of the transfer rate of the reproduced signals.

In the fourth power save mode, the controller 27 turns off only the tracking control while keeping the focus control on. The sector storage 25 stores a sector address of one of sectors of the optical disc 1 on which data is to be reproduced next. When the tracking control is in the off-state, a complete servo signal is not obtained. A component of an RF signal outputted intermittently from the pickup 4 is, thus, extracted and used in the CLV control mode of the spindle motor 2 to perform the rough servo control, providing the speed control signal to the spindle motor controller 30.

The power saving is achieved through the controller 27 by cutting the supply of power to, for example, the tracking error signal generator of the playback servo circuit 6, the tracking controller 9 of the second servo circuit 7, and the tracking circuit 12 of the driver 10.

After a lapse of 400 msec., as will be discussed later, the controller 27 resumes the supply of power.to turn on the tracking control to kick the pickup 4 at regular intervals until one of sectors whose address is stored in the sector storage 25 is reached.

In the fifth power save mode, the controller 27 turns off the focus control, the tracking control, and the laser 3. The sector storage 25 stores a sector address of one of the sectors of the optical disc 1 on which data is to be reproduced next. When the focus control and the tracking control are in the off-state, a complete servo signal is not obtained. It is, thus, impossible to operate the spindle motor 2 under the CLV control, and the above described FG control is initiated. Specifically, the controller 27 determines the speed of the FG corresponding to the current one of sectors to keep the FG rotated at the determined speed.

The power saving is achieved through the controller 27 by cutting the supply of power to all components of the playback servo circuit 6, all components of the second servo circuit 7, and part of the driver 10: the focus circuit 11 and the tracking circuit 12. This allows the power consumption to be reduced greatly as compared with the second power save mode.

After a lapse of 500 msec., as will be discussed later, the controller 27 resumes the supply of power to turn on the laser 3, the focus control, and the tracking control in that sequence to kick the pickup 4 at regular intervals and waits for one of the sectors whose address is stored in the sector storage 25 to reach the pickup 4. The reason that the spindle motor 2 is not turned off is because it takes approximately two seconds to resume rotating the spindle motor 2 at a desired speed, which exceeds a 500 msec memory holding time of the temporal memory 16. In order to reduce a more power consumption, it is advisable that the speed of the spindle motor 2 under the FG control be decreased to ½ or ¼ times a normal speed.

In the sixth power save mode, the controller **27** turns off the focus and tracking controls, the laser **3**, and the spindle motor control. The sector storage **25** stores a sector address of one of sectors of the optical disc **1** on which data is to be recorded next.

Since the focus and tracking controls, the laser **3**, and the spindle motor control are all turned off, the power consumption is reduce greatly. It, however, takes approximately one second to return the apparatus to the normal mode of operation, and a great quantity of power is consumed in starting the spindle motor **2**. Thus, if the sixth power save mode is not kept for more than six seconds, for example, it will cause the power consumption to be increased undesirably.

The power saving is achieved through the controller **27** by cutting the supply of power to all components of the playback servo circuit **6**, all components of the second servo circuit **7**, all components of the driver **10**, and the laser **3**. This results in a greater decrease in power consumption than in the fourth and fifth power save modes.

After a lapse of 1000 msec., as will be described later, the controller **27** resumes the supply of power to turn on the laser **3**, the spindle motor control, the focus control, and the tracking control in that sequence to kick the pickup **4** at regular intervals and waits for one of sectors whose address is stored in the sector storage **25** to reach the pickup **4**.

FIGS. **14**(A), **14**(B), and **14**(C) show changes in power consumption in the fourth, fifth, and sixth power save modes, respectively.

FIG. **14**(A) illustrates for the case where image data is reproduced from the optical disc **1** in the two-hour mode in which a total playback time is approximately two hours, and the fourth power save mode is selected. A high quality of images is, thus, ensured, but the transfer rate is high. The time required for the temporal memory **16** to reach the empty level from the full level (i.e., the storage inhibit stages c1 and c2 in FIG. **10**) is very short, about 500 msec. The time T1 required for the apparatus to return to the normal operation mode from the fourth power save mode T1 (i.e., the duration of the storage inhibit stage C2)is short, about 100 msec. The off-duration of the tracking control in the fourth power save mode (i.e., the storage inhibit stage C1) is, thus, set short, about 400 msec. The power consumption of the apparatus during the fourth power save mode is about 80% of that in the normal standby mode of operation. During a period of time between turning on of the tracking control and a time when a given track turn has been sought upon resumption of the normal operation mode, a great power consumption of 110% is required instantaneously if the power consumption in the normal playback mode is defined as 100%. The amounts of power consumption in the standby mode and the playback mode of operation are 100% and 120%, respectively.

FIG. **14**(B) illustrates for the case where image data is recorded in the four-hour mode in which a total playback time is approximately four hours, and the fifth power save mode is selected. The quality of images and the transfer rate are both common levels. The time required for the temporal memory **16** to reach the empty level from the full level is about 1 sec. which is slightly longer than that in the fourth power save mode. This will cause the time T1 required for the apparatus to return to the normal operation mode from the fifth power save mode (i.e., the duration of the storage inhibit stage C2) to be increased to about 500 msec. The off-duration of the focus and tracking controls and the laser **3** in the fifth power save mode (i.e., the duration of the storage inhibit stage C1) is, thus, set longer than that in the first power save mode, about 500 sec. The power consumption of the apparatus during the firth power save mode is about 50% of that in the standby mode of operation, which is lower than that in the fourth power save mode. Upon resumption of the normal power supply mode, the laser **3**, the focus control, and the tracking control are turned on in sequence, so that the power consumption is increased gradually.

FIG. **14**(C) illustrates for the case where image data is recorded in the six-hour mode in which a total playback time is approximately six hours, and the sixth power save mode is selected. Thus, the quality of images is low, but the transfer rate is slow. The time required for the temporal memory **16** to reach the empty level from the full level is about 2 sec. which is longer than that in the fifth power save mode. This will cause the time T1 required for the apparatus to return to the normal operation mode from the sixth power save mode to be increased to about 1 sec. The off-duration of the focus control, the tracking control, the laser **3**, and the spindle motor control (i.e., the duration of the storage inhibit stage C1), thus, become longer than that in the fifth power save mode, about 1 sec. The power consumption of the apparatus during the sixth power save mode is about 20% of that in the normal standby mode of operation, which is lower than that in the fifth power save mode. Upon resumption of the normal power supply mode, the spindle motor control, the laser **3**, the focus control, and the tracking control are turned on in sequence, so that the power consumption is increased gradually.

Total amounts of power consumption in FIGS. **14**(A) to **14**(C) are approximately 84%, 75%, and 60% of that in the normal power supply mode, respectively. The use of the fourth to sixth power save modes allows the power economy to be assured without sacrificing the playback operation.

The timing with which the controller **27** terminates the power saving operation is determined in the following manner.

The temporal memory **16** has, as described above, a capacity of 4 Mb. Thus, for instance, when image data is reproduced at 8 Mbps in the two-hour mode, it allows the temporal memory **16** to hold the image data for 0.5 sec. When the controller **27** is responsive to an output from the transfer rate detector **35** indicating that the image data is being reproduced at 8 Mbps to select the fourth power save mode, the amount of image data read out of the temporal memory **16** during the storage inhibit stage c2, that is, a period of time required for the apparatus to return to the normal operation mode following the termination of the fourth power save mode may be calculated in the following manner. If the empty level is defined as zero (0) Mb, and the full level is defined as 4 Mb, then a ratio of the time T1 to the time required for the temporal memory **16** to reach the empty level from the full level is 100 msec./500 msec.=0.2. The amount of image data read out of the temporal memory **16** during the storage inhibit stage c2, that is, the time T1 is, thus, 4 Mb×0.2=0.8 Mb. Therefore, the controller **27** may terminates the power saving operation when the amount of image data remaining in the temporal memory **16** becomes at least 0.8 Mb.

FIG. **15** shows a reproducing apparatus according to the seventh embodiment of the invention which is different from the fifth embodiment, as shown in FIG. **9**, in that a signal type specifying circuit **50** is installed between the playback servo circuit **6** and the controller **27** for selecting one of the fourth to sixth power save modes based on the type of signal reproduced from the optical disc 1. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The signal type specifying circuit 50 specifies the type of signal inputted to the playback servo circuit 6 and provides a signal indicative thereof to the controller 27. The signal type specifying circuit 50 may alternatively be built in the input device 26 so that an operator can input the type of a reproduced signal manually into the controller 27.

Here, it is assumed that the signal type specifying circuit 50 discriminates between two types of signals: one consisting of both video and audio signals reproduced from a DVD and the second consisting of only an audio signal reproduced from the DVD.

In a case where a combination of audio and video signals is reproduced from the optical disc 1, the signal type specifying circuit 36 monitors an input to the playback servo circuit 6 to determine that data is being reproduced at 8 Mbps in the two-hour mode, for example, and provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the input from the signal type specifying circuit 26 to select the fourth power save mode.

In a case where only an audio signal is reproduced from the optical disc 1, the signal type specifying circuit 36 monitors an input to the playback servo circuit 6 to determine that data is being reproduced at 2 Mbps in the eighth-hour mode, for example, and provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the input from the signal type specifying circuit 26 to select the sixth power save mode.

FIG. 16 shows a reproducing apparatus according to the eighth embodiment of the invention which is different from the seventh embodiment, as shown in FIG. 15, in that a disc type specifying circuit 51 is installed between the playback servo circuit 6 and the controller 27 for selecting one of the fourth to sixth power save modes according to the type of the optical disc 1. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The disc type specifying circuit 51 has substantially the same structure as the one used in the third embodiment of FIG. 7 which specifies the type of the optical disc 1 when loaded into the apparatus.

Here, it is assumed that the optical disc 1 is either of a DVD and a CD-RW, and a video signal reproduced from the optical disc 1 is either of a high-quality MPEG-2 signal and a normal quality MPEG-1 signal.

The disc type specifying circuit 51 determines whether the optical disc 1 is a DVD or a CD-RW disc. If the optical disc 1 is the DVD from which the high-quality MPEG-2 signal is being reproduced at 8 Mbps in the two-hour mode, for example, the disc type specifying circuit 51 provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the signal from the disc type specifying circuit 51 to select the fourth power save mode. Alternatively, if the optical disc 1 is the CD-RW disc from which the normal quality MPEG-1 signal is being reproduced at 2 Mbps in the one-hour mode, for example, the disc type specifying circuit 51 provides a signal indicative thereof to the controller 27. The controller 27 is responsive to the signal from the disc type specifying circuit 51 to select the sixth power save mode.

FIG. 17 shows a reproducing apparatus according to the ninth embodiment of the invention which is different from the seventh embodiment, as shown in FIG. 15, in that a linear velocity determining circuit 52 is further installed between the signal type specifying circuit 50 and the controller 27 for selecting one of the fourth to sixth power save modes as a function of the linear velocity of the optical disc 1 and the type of signal reproduced from the optical disc 1. Other arrangements are identical, and explanation thereof in detail will be omitted here.

The linear velocity determining circuit 52 determines a target linear velocity of the optical disc 1, that is, the speed of the spindle motor 2 to be controlled based on the transfer rate of signals reproduced from the optical disc 1 and provides a signal indicative thereof to the controller 27.

As an example, two cases where audio signals are reproduced from a DVD at a higher transfer rate and at a lower transfer rate will be referred to below.

For instance, when linear PCM six-channel signals are being reproduced at a transfer rate of 8 Mbps in the two-hour mode, the linear velocity determining circuit 52 determines a target linear velocity of the optical disc 1 based on the transfer rate of the reproduced signals and provides a signal indicative thereof to the controller 27. The controller 27 is responsive to outputs from the signal type specifying circuit 50 and the linear velocity determining circuit 52 to select the fourth power save mode.

When MPEG-2 two-channel signals are being reproduced at a transfer rate of 2 Mbps in the eight-hour mode, for example, the controller 27 selects the fifth power save mode.

As apparent from the above discussion, the controller 27 selects one of the fourth and fifth power save modes based on outputs from the signal type specifying circuit 50 and the linear velocity determining circuit 52. When the transfer rate of signals being reproduced is low, the controller 27 decreases the speed of the spindle motor 2, or the linear velocity of the optical disc 1 to agree with a target linear velocity determined by the linear velocity determining circuit 52. For example, when MPEG-1 signals are being reproduced from the optical disc 1, the velocity of the optical disc 1 is lowered to half that when linear PCM signals are being reproduced.

The reason that when data is reproduced at a transfer rate of 2 Mb in the seventh embodiment, the sixth power save mode is selected, while when the MPEG-2 two-channel signals are recorded at the same transfer rate of 2 Mb, the fifth power save mode is selected is the same as described in the fourth embodiment shown in FIG. 8.

FIG. 18 shows a DVD player according to the tenth embodiment of the invention.

The DVD player includes generally the spindle motor 2, the pickup 4, the amplifier 140, the signal processor 14, the servo circuit 280, the driver 260, the temporal memory 16, a 16 Mb memory 220, the A-V decoder 180, and the controller 27. The temporal memory 16 consist of a DRAM with a capacity of 4 Mb. The A-V decoder 180 is connected to components such as the separator 18, the D/A converters 19 and 20, the monitor 22, and the speaker 21, as shown in FIG. 1. The controller 27 is also connected to a post-circuit (not shown).

In operation, the pickup 4 reads data out of the optical disc 1 and outputs it to the amplifier 140 to provide an audio/video signal and a control signal. The audio/video signal is optimized in frequency characteristic by an equalizer built in the amplifier 140 and supplied to the signal processor 14 after passing through a PLL in the amplifier 140. The signal processor 14 converts the audio/video signal in a digital form into an analog signal. For example, the signal processor 14 subjects an EFM(Eight to Fourteen Modulation)+ signal read out of the optical disc 1 to synchronous detection and decodes it into NRZ data. The NRZ data is subjected to error correction and split into a data signal and a sector address signal. The data signal is a signal compressed in a variable transfer rate and stored in the temporal memory **16** to absorb a variation in transfer rate. The data signal read out of the temporal memory **16** by the signal processor **14** is supplied to the A-V decoder **180** and decompressed using the memory **220** to produce an audio and a video signal which are, in turn, converted by D/A converters into an analog audio signal and an analog video signal, respectively.

The control signal produced by the amplifier **140** is supplied to the servo circuit **280** to produce servo signals for focus and tracking control of the pickup **4**. The servo signals are inputted to the driver **260**. The driver **260** operates an actuator to drive the pickup **4** under the servo control. The amplifier **140** also produces a speed control signal through the PLL and sends it to the driver **260**. The driver **260** is responsive to the speed control signal to spin the optical disc **1** under the CLV control through the spindle motor **2**. The spindle motor **2** produces an angular position signal through a Hall element (not shown) which is fed back to the servo circuit **280** to produce a speed control signal which is used as needed in the FG (Frequency Generator) control to maintain the speed of the spindle motor **2** constant.

The temporal memory **16** in this embodiment has a capacity of 4 Mb. In a case of a DVD, the temporal memory **16** is allowed to store the amount of data corresponding to about 500 msec. For instance, if it takes 80 msec. for the optical disc **1** to make a complete turn of a track, the temporal memory **16** can hold the amount of data corresponding to about six turns of the track.

FIG. **19** shows a variation in amount of data stored in the temporal memory **16** when a highlight command is handled in the playback mode of operation. The full level and the empty level in the drawing do not indicate stored amounts of 100% and 0%, respectively, but values to which preselected margins are added.

Usually, when the highlight command is handled, reproduction of data read out of a given sector of the optical disc **1** terminates in the course of a stage c where the pickup **4** is kicked cyclically, waiting for reproduction of data from the next sector. In a stage f, the controller **27** displays a highlighted image on the monitor in responsive to the highlight command recorded on the optical disc 1 and at the same time, inhibits data from being read out of the temporal memory **16**. The controller **27** cuts the supply of power to preselected circuit components until a viewer chooses one of options listed on the highlighted image.

The stages a, b, and c are identical in system operation with the ones shown in FIG. **10**.

FIG. **20** shows a program or sequence of logical steps performed by the controller **27**.

Upon initiation of the playback mode of operation, the routine proceeds to step **100** wherein it is determined whether one of sectors from which reproduction of data is to be started has reached the pickup **4** or not. If a YES answer is obtained, then the reproduction of data is started, and the routine proceeds to step **120** wherein the reproduced data is subjected to error correction. The routine proceeds to step **140** wherein the error-corrected data is stored in the temporal memory **16**. The routine proceeds to step **160** wherein it is determined whether a stored amount of data in the temporal memory **16** exceeds the empty level or not. If a YES answer is obtained, then the routine proceeds to step **180** wherein the controller **27** activates the A-V decoder **180** to start to read the data out of the temporal memory **16** and to decompress it. The routine proceeds to step **200** wherein it is determined whether a stored amount of data in the temporal memory **16** has reached the full level or not. If a YES answer is obtained, then the routine proceeds to step **220** wherein the controller **27** inhibits data from being stored in the temporal memory **16**.

The routine proceeds to step **240** wherein it is determined whether given control data has been read out of the optical disc **1** or not. If a NO answer is obtained, then the routine proceeds to step **300** wherein it is determined whether a given instruction is inputted or not. If a YES answer is obtained, then the routine proceeds directly to step **380** wherein the given instruction is performed. For instance, the given instruction is to search another title in response to a manual input of the viewer using a key or to cure a failure in operation of the servo system caused by unwanted input of vibration or shock.

If a YES answer is obtained in step **240**, then the routine proceeds to step **260** wherein the controller **27** stores an address of one of the sectors of the optical disc **1** from which data is to be read out next and determines the type of the control data. If the control data indicates, for example, a slide show command to display a still image for 20 seconds, the controller **27** sets a count value of a timer to 20 seconds minus 1 second, i.e., 19 seconds, starts the timer (only in the first program cycle), and performs the power save mode, as will be described later in detail.

The routine proceeds to step **280** wherein it is determined whether the count value of the timer has been reached or not. If a NO answer is obtained, then the routine proceeds to step **300**. Alternatively, if a YES answer is obtained, then the routine proceeds to step **320** wherein the power save mode is terminated to resume the normal power supply mode.

The routine proceeds to step **340** wherein a stored amount of data in the temporal memory **16** has reached the empty level or not. If a YES answer is obtained, then the routine returns back to step **100**. Alternatively, if a NO answer is obtained, then the routine proceeds to step **360** wherein the controller **27** kicks the pickup **4** cyclically to trace one of the track turns of the optical disc **1** which has the sector specified by the sector address stored in step **260**.

If it is determined in step **260** that the control data is a highlight command, the controller **27** displays a highlighted image on the monitor in responsive to the highlight command without starting the timer. Subsequently, the controller **27** determines in step **280** whether a viewer has chosen one of options listed on the highlighted image or not.

In the power save mode, the controller **27** must save the power without blocking the servo control and the readout of data from the temporal memory **16**. In this embodiment, therefore, the controller **27** cut the supply of power to the signal processor **14** to deactivate the synchronous detection, the EFM+signal-to-NRZ data conversion, the error correction, and the control of data storage in the temporal memory **16** and to the A-V decoder **180** to deactivate the decompression of data. If the control data is the highlight command, it is difficult to estimate the timing with which the viewer will choose one of options listed on the highlighted image. It is, thus, necessary to resume the normal power mode to activate the signal processor **14** and the A-V decoder **180** immediately after the viewer chooses one of the options. Accordingly, the controller **27** keeps the pickup **4** kicked to trace one of track turns having the next sector in the power save mode (i.e., **f1** in FIG. **19**).

When the viewer chooses one of the options, the controller **27** resumes the supply of power (**f2** in FIG. **19**)to the signal processor **14** and the A-V decoder **180**. The time required to resume the supply of power to activate the signal processor **14** and the A-V decoder **180** is, for example, 1msec. The pickup **4** seeks one of the track turns of the optical disc **1** from which data is to be reproduced next (f3 in FIG. **19**) and starts to read data out of the optical disc **1** (a following f3 in FIG. **19**). Image data associated with the other options not chosen by the viewer is read out of the temporal memory **16** so that a stored amount of data is decreased to zero instantaneously (at the end of f3). Subsequently, data associated with the option chosen by the viewer is stored in the temporal memory **16** so that a stored amount of data is increased.

In the power save mode, the controller **27** may also turn off the tracking control while keeping the focus control on. When the tracking control is in the off-state, a beam spot on the optical disc **1** produced by the pickup **4** moves across track turns, so that a complete RF signal is not obtained. A component of the RF signal is, thus, extracted intermittently and used in the CLV control mode of the spindle motor **2** to perform the rough servo control, producing the speed control signal.

The power saving is achieved by cutting the supply of power to a tracking error signal generator in the amplifier **140**, a circuit component of the servo circuit **28** which produces a control signal using a tracking error signal, and a tracking circuit of the driver **260**.

Upon resumption of the supply of power, the controller **27** turns on the tracking control, reads out the address of one of the sectors of the optical disc **1** from which data is to be reproduced next, and kicks the pickup **4** at regular intervals until the one of the sectors is reached. The time required for the DVD player to return to the normal operation mode completely is about 50 msec.

FIG. **21** shows a variation in amount of data stored in the temporal memory **16** in a case where a slide show command is handled in the playback mode of operation.

It is assumed that reproduction of data read out of a given sector of the optical disc **1** terminates in the course of a stage c while the pickup **4** is kicked cyclically, waiting for the next sector, after which a still image such as a slide picture is displayed in response to the slide show command. In this case, only audio data is reproduced or read out of the temporal memory **16**, while image data is stopped from being read out of the temporal memory **16**. The speed at which the data is outputted from the temporal memory **16** is decreased greatly (f in FIG. **21**). Assuming that the control data has instructions to display the still image for 20 sec. and to switch the still image to another one in sequence, the supply of power to circuit components which need not operate during reproduction of the still image is cut for 20 sec. minus, for example, 50 msec. required for the DVD layer to return to the normal operation mode completely, i.e., 19.95 sec. The servo control is substantially the same as described above.

In the above case where the slide show command is handled, it is possible to estimate the timing with which the controller **27** should take subsequent action, that is, switch the still image being displayed to another one. The supply of power to the servo system taking much time to return to the normal operation mode may, thus, also be cut. If this recovery time is 50 msec., it is advisable that the supply of power be resumed in f2 at least 50 msec. before the reproduction of one still image terminates.

In the power save mode, the controller **27** may further turn off the focus control, the tracking control, and a laser built in the pickup **4**. When the focus and tracking controls are in the off-state, a complete servo signal is not obtained. It is, thus, impossible to operate the spindle motor **2** under the CLV control, and the above described FG control is initiated. Specifically, the controller **27** determines the speed of the FG corresponding to the current one of sectors to keep the FG rotated at the determined speed.

The spindle motor **2** may alternatively be stopped in this power save mode, however, it takes much time to accelerate the spindle motor **2** to a normal speed. It is, thus, preferable that the speed of the spindle motor **2** be kept under the FG control. Under the FG control, the spindle motor **2** may be decreased in speed to half a normal speed or less in order to save more power.

In each power save mode as described above, upon input of any signal to the controller **27**, the power supply may be resumed immediately. For instance, the power supply may be resumed upon manual input of a signal for searching a desired portion or the leader of a moving picture or occurrence of an error in reproducing audio or image signals, requiring reproduction of desired data from the optical disc **1** again. The input of the signal and the occurrence of the error may be monitored automatically in the controller **27**.

The above described tenth embodiment has referred to the DVD player, however, it may be used with any other optical disc players in which the time required for data to be stored in a buffer or temporal memory up to a full level is relatively long, thus allowing much power save time to be taken such as players which handle control data whose content hardly change for a relatively long period of time such as the highlight command or the slide show command or which reproduce data at lower transfer rates.

While the present invention has been disclosed in terms of the preferred embodiments in order to facilitate better understanding thereof, it should be appreciated that the invention can be embodied in various ways without departing from the principle of the invention. Therefore, the invention should be understood to include all possible embodiments and modifications to the shown embodiments which can be embodied without departing from the principle of the invention as set forth in the appended claims.

What is claimed is:

1. An optical reproducing apparatus comprising:

an error correcting circuit which subjects data reproduced from an optical disc to error correction;

a temporal memory which stores the data corrected in error by said error correcting circuit in a data storage stage;

a data storage monitoring circuit which monitors the amount of the data stored in said temporal memory and provides a signal indicative thereof;

a reproducing circuit which reads the data out of said temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and

a power saving circuit which is responsive to the signal from said data storage monitoring circuit to save power supplied to at least said error correcting circuit during a time interval in which the amount of the data stored in said temporal decreases from a first level to a second level in the data readout stage.

2. An optical reproducing apparatus as set forth in claim 1, further comprising a pickup which optically picks up the data from the optical disc, a driver which drives said pickup under servo control, a playback/servo circuit which produces a data signal and a servo error signal from the data picked up by said pickup, provides the servo error signal to

said driver for use in the servo control of said pickup, and holds the data signal in said temporal memory, and a tracking circuit which subjects said pickup to tracking control, and wherein said reproducing circuit reads the data signal out of said temporal memory and decompresses the data signal, and wherein said power saving circuit saves the power supplied to at least said error correcting circuit and said tracking circuit during the time interval in which the amount of the data stored in said temporal decreases from the first level to the second level in the data readout stage.

3. An optical reproducing apparatus comprising:

a first control circuit which controls rotation of an optical disc in a first servo control mode based on a speed control signal derived from a drive circuit rotating the optical disc;

a second control circuit which controls rotation of the optical disc in a second servo control mode based on a speed control signal derived from data reproduced from the optical disc;

a driver circuit which drives a pickup reading the data out of the optical disc;

a playback/servo circuit which produces a data signal for playback and a servo error signal from on the data picked up by the pickup;

a focus control circuit which subjects the pickup to focus control;

a tracking control circuit which subjects the pickup to tracking control;

an error correcting circuit which subjects the data read out by the pickup to error correction;

a temporal memory which stores the data corrected in error by said error correcting circuit in a data storage stage;

a data storage monitoring circuit which monitors the amount of the data stored in said temporal memory and provides a signal indicative thereof;

a reproducing circuit which reads the data out of said temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and

a controlling circuit which is responsive to the signal from said data storage monitoring circuit to save power supplied to at least said error correcting circuit during a time interval in which the amount of the data stored in said temporal decreases from a first level to a second level in the data readout stage, said controlling circuit switching control of the rotation of the optical disc from the second servo control mode to the first servo control mode.

4. An optical reproducing apparatus comprising:

a driver circuit which drives a pickup reading data out of the optical disc;

a playback/servo circuit which produces a data signal for playback and a servo error signal from on the data picked up by the pickup;

a servo circuit which provides a servo signal to said driver circuit based on the servo error signal from said playback/servo circuit;

an error correcting circuit which subjects the data read out by the pickup to error correction;

a temporal memory which stores the data corrected in error by said error correcting circuit in a data storage stage;

a data storage monitoring circuit which monitors the amount of the data stored in said temporal memory and provides a signal indicative thereof;

a reproducing circuit which reads the data out of said temporal memory in a data readout stage following the data storage stage and outputs the data for reproduction; and

a power saving circuit which is responsive to the signal from said data storage monitoring circuit to save power supplied to at least one of said drive circuit, said playback/servo circuit, and said error correcting circuit during a time interval in which the amount of the data stored in said temporal decreases from a first level to a second level in the data readout stage.

5. An optical reproducing apparatus as set forth in claim 4, further comprising a transfer rate detector which detecting a transfer rate of the data picked up from the optical disc, and wherein said power saving circuit performs a power saving operation based on the transfer rate of the data detected by said transfer rate detector and determines a timing with which supply of power is resumed based on the transfer rate.

6. An optical reproducing apparatus as set forth in claim 4, further comprising a signal type specifying circuit which specifies a type of the data signal reproduced from the optical disc, and wherein said power saving circuit performs a power saving operation based on the type of the data signal specified by said signal type specifying circuit and determines a timing with which supply of power is resumed based on the type of the signal.

7. An optical reproducing apparatus as set forth in claim 4, further comprising a disc type specifying circuit which specifies a type of the optical disc, and wherein said power saving circuit performs a power saving operation based on the type of the optical disc specified by said disc type specifying circuit and determines a timing with which supply of power is resumed based on the type of the optical disc.

8. An optical reproducing apparatus as set forth in claim 6, further comprising a linear velocity determining circuit which determines a linear velocity of the optical disc based on the type of the signal, and wherein said power saving circuit performs the power saving operation and determines the timing with which the supply of power is resumed based on the type of the signal and the linear velocity of the optical disc.

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By: Ron Goodman, Howard N. Egan, David Bristow

For: AUTOMATIC HIERARCHICAL CATEGORIZATION OF MUSIC BY METADATA

NOTIFICATION OF PRIOR OR CONCURRENT PROCEEDINGS UNDER 37 CFR § 1.985(a)

Mail Stop *Inter Partes* Reexam
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Sir:

Pursuant to 37 CFR § 1.985(a), the patent owner of the above-captioned patent undergoing *inter partes* reexamination hereby submits this Notification of Prior or Concurrent Proceedings. On information and belief, the patent owner is aware of the following prior or concurrent proceedings involving the patent, and the results of such proceedings:

Prior/Current Proceeding No. 1:

Case Style:	Creative Technology Ltd. v. Apple Computer, Inc.
Court:	U.S. District Court for the Northern District of California
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Date Case Filed:	May 15, 2006
District Judge:	Hon. Saundra Brown Armstrong
Results of Case:	On May 15, 2006, plaintiff filed suit alleging infringement of U.S. Patent No. 6,928,433. On May 17, 2006, defendant answered pleading various defenses. On August 29, 2006, plaintiff and defendant stipulated to dismissal with prejudice of all claims asserted.

Prior/Current Proceeding No. 2:

Case Style:	In the Matter of Certain Portable Digital Media Players
Court:	International Trade Commission
Docket No.:	Investigation No. 337-TA-573
Date Case Filed:	May 15, 2006
Judge:	Administrative Law Judge Paul J. Luckern
Results of Case:	On May 15, 2006, Creative Labs, Inc. and Creative Technology Ltd. requested that the International Trade Commission ("ITC") institute an investigation pursuant to Section 337 of the Tariff Act of 1930, as Amended, based upon the importation and sale of Apple Computer, Inc. products allegedly infringing U.S. Patent No. 6,928,433. On July 6, 2006, Apple Computer, inc. responded to the complaint, pleading various defenses. On August 29, 2006, Complainants and Respondent filed a joint motion to terminate the Investigation.

The patent owner reserves the right to supplement this Notice in light of new information that may come to its attention. A copy of the certificate of service by which a copy of this Notification was served on the third party requester is submitted herewith, as required under 37 CFR § 1.903.

No fees are believed due in connection with this Notification of Prior or Concurrent Proceedings. However, the Director is authorized to charge any additional required fees, or credit any overpayment, to Dechert LLP Deposit Account No. 50-2778 (Order No. 380786-108980).

Respectfully submitted,

Date: June 1, 2010

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Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

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Chasen et al.

(10) Patent No.: US 6,760,721 B1
(45) Date of Patent: Jul. 6, 2004

(54) **SYSTEM AND METHOD OF MANAGING METADATA DATA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(52) **U.S. Cl.** .... **707/3**; 707/5; 707/103 R; 707/104.1; 709/219; 345/804

(58) **Field of Search** .... 707/5, 10, 102, 707/104.1, 501, 513, 200, 103 R; 709/219, 200, 201, 202; 345/854, 428, 804

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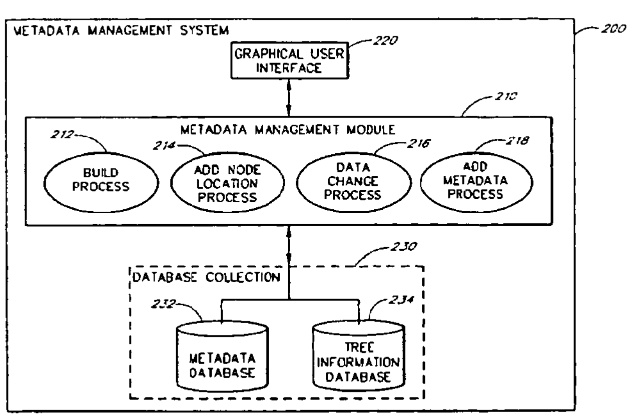
(57) **ABSTRACT**

A system and method of the present invention allow users to access, manage, and edit information about content data, often referred to as metadata. Metadata is collected from various sources, added, and maintained in a metadata database. In addition, metadata is dynamically read from the metadata database and dynamically displayed in a graphical user interface in an organized manner, such as a hierarchical tree. In the graphical user interface, a user may add, delete, and/or modify the metadata. As the user changes the metadata, the metadata database is updated and the user's changes are propagated throughout the graphical user interface such that the hierarchical tree is displays the changed metadata.

38 Claims, 7 Drawing Sheets



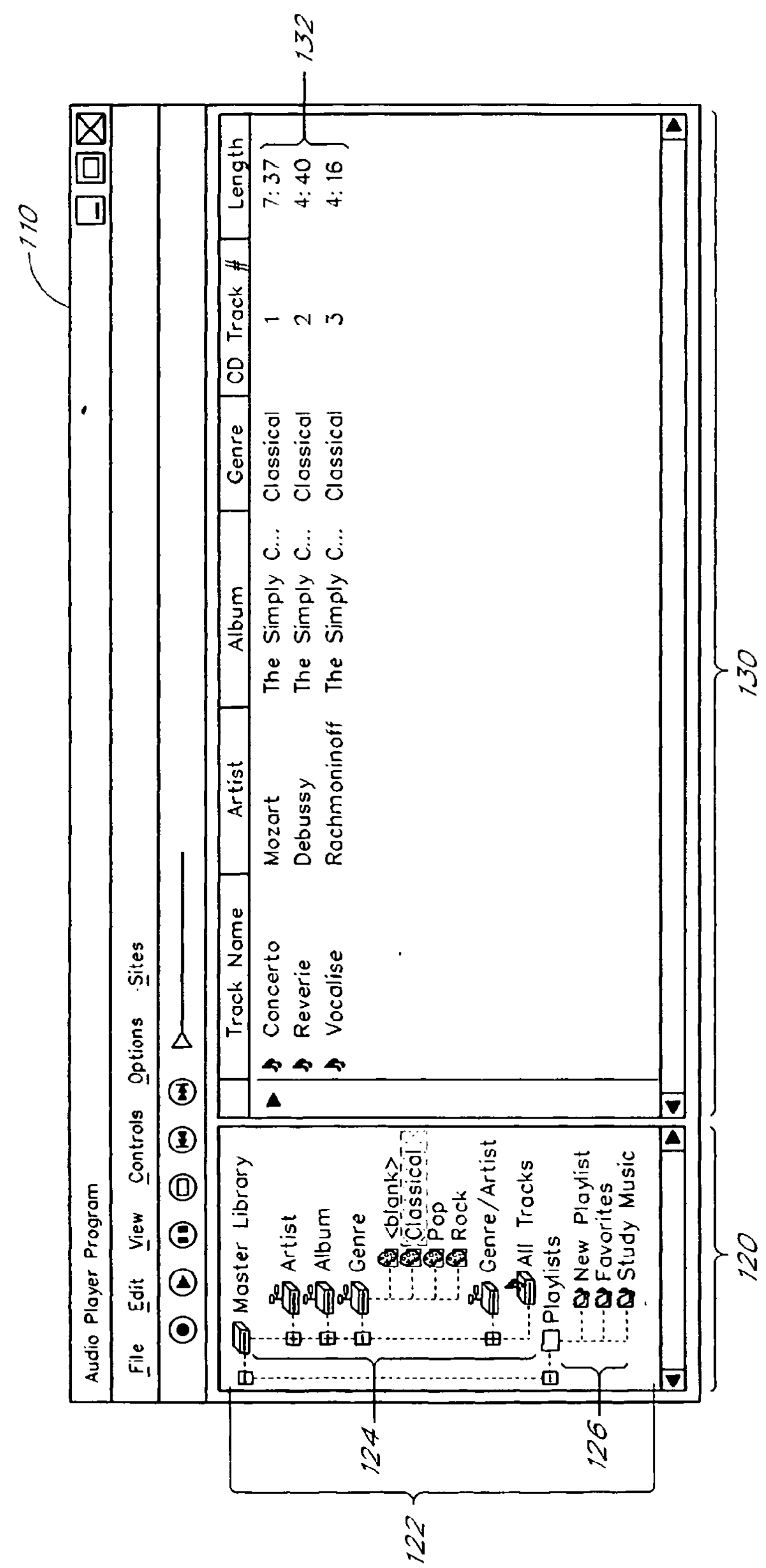

110
Audio Player Program
File Edit View Controls Options Sites
Master Library
Artist
Album
Genre
<blank>
Classical
Pop
Rock
Genre/Artist
All Tracks
Playlists
New Playlist
Favorites
Study Music
Track Name
Artist
Album
Genre
CD
Track #
Length
Concerto Mozart The Simply C... Classical 1 7:37
Reverie Debussy The Simply C... Classical 2 4:40
Vocalise Rachmoninoff The Simply C... Classical 3 4:16
132
130
120
124
126
122

FIG. 1

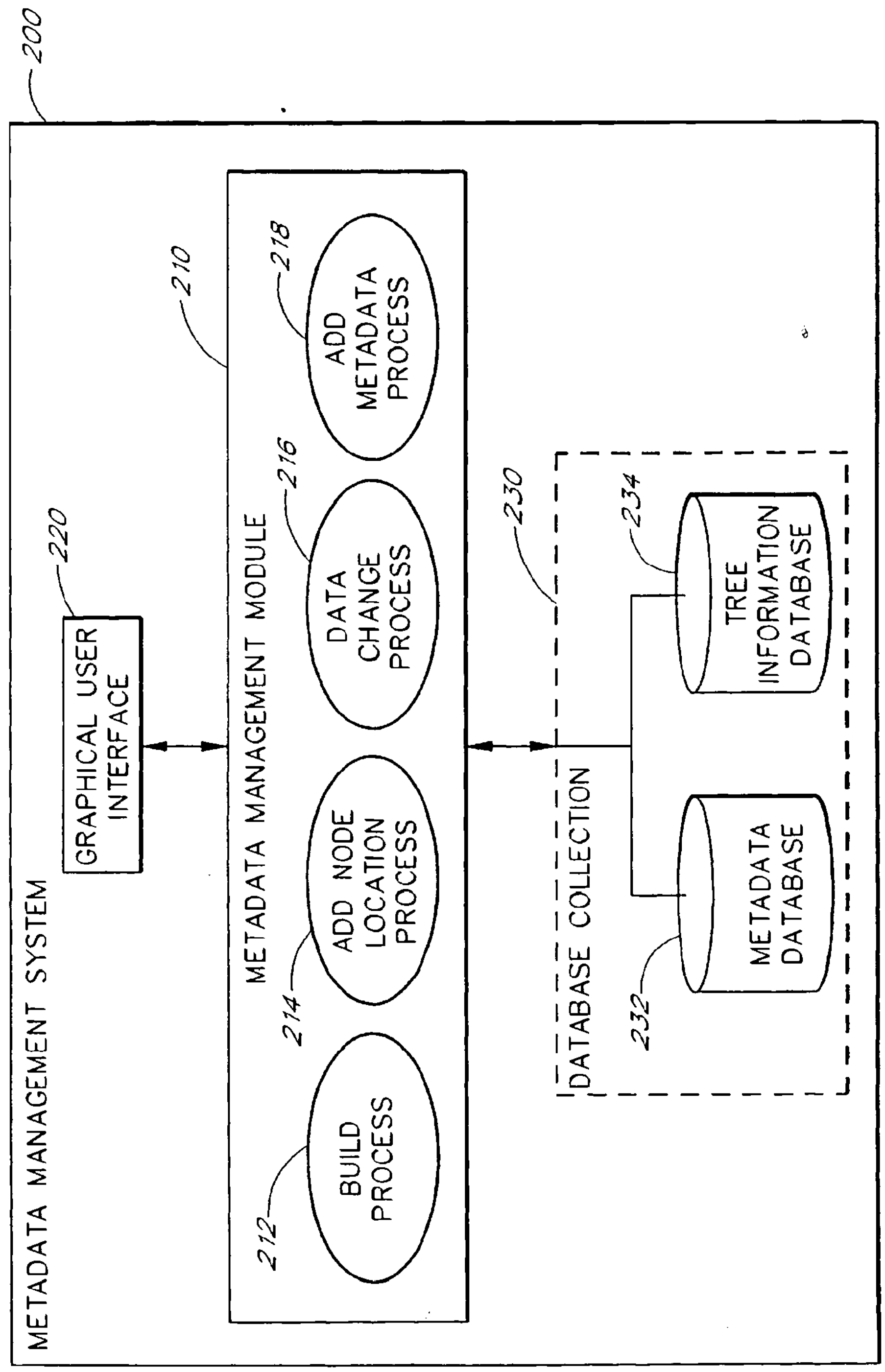

200
METADATA MANAGEMENT SYSTEM
220
GRAPHICAL USER INTERFACE
210
METADATA MANAGEMENT MODULE
212
BUILD PROCESS
214
ADD NODE LOCATION PROCESS
216
DATA CHANGE PROCESS
218
ADD METADATA PROCESS
230
DATABASE COLLECTION
232
METADATA DATABASE
234
TREE INFORMATION DATABASE

FIG. 2

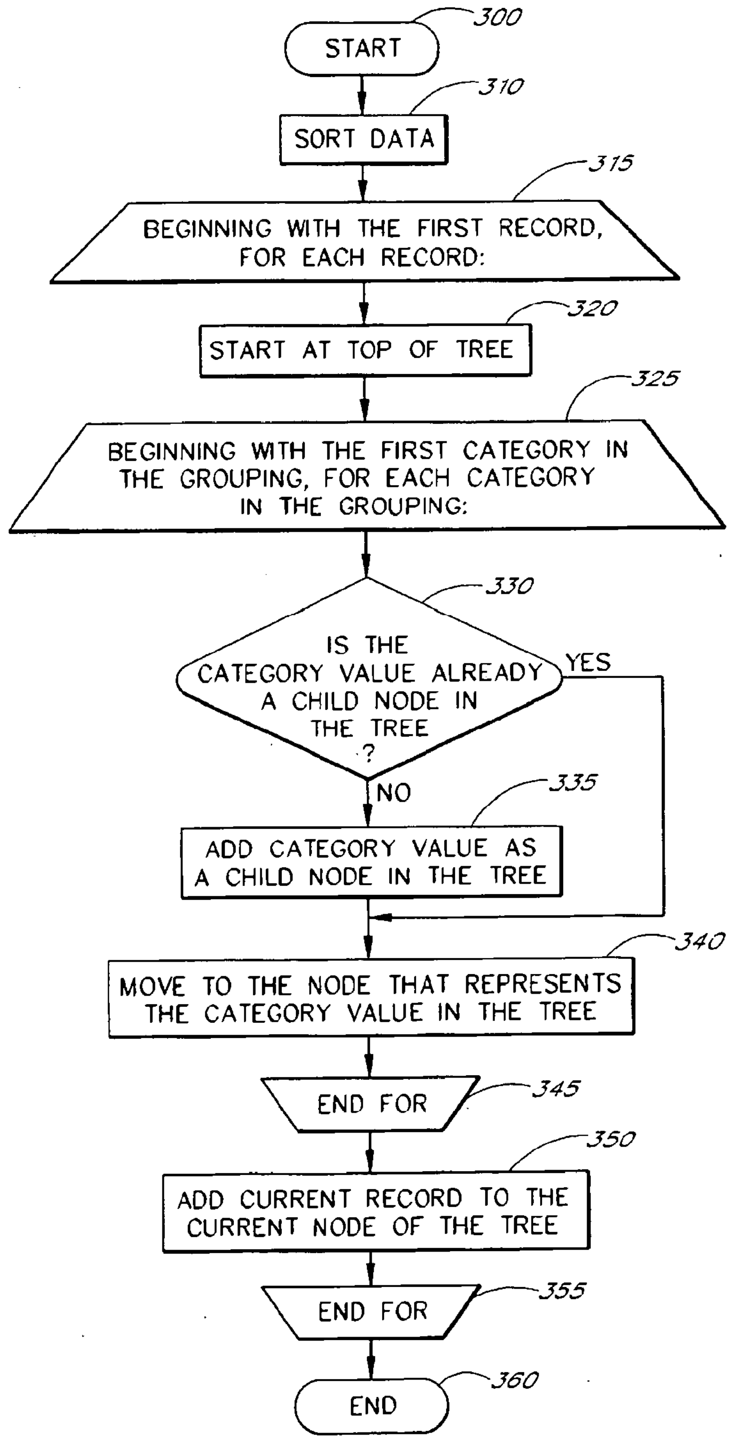

300
START
310
SORT DATA
315
BEGINNING WITH THE FIRST RECORD, FOR EACH RECORD:
320
START AT TOP OF TREE
325
BEGINNING WITH THE FIRST CATEGORY IN THE GROUPING, FOR EACH CATEGORY IN THE GROUPING:
330
IS THE CATEGORY VALUE ALREADY A CHILD NODE IN THE TREE ?
YES
NO
335
ADD CATEGORY VALUE AS A CHILD NODE IN THE TREE
340
MOVE TO THE NODE THAT REPRESENTS THE CATEGORY VALUE IN THE TREE
345
END FOR
350
ADD CURRENT RECORD TO THE CURRENT NODE OF THE TREE
355
END FOR
360
END

FIG. 3

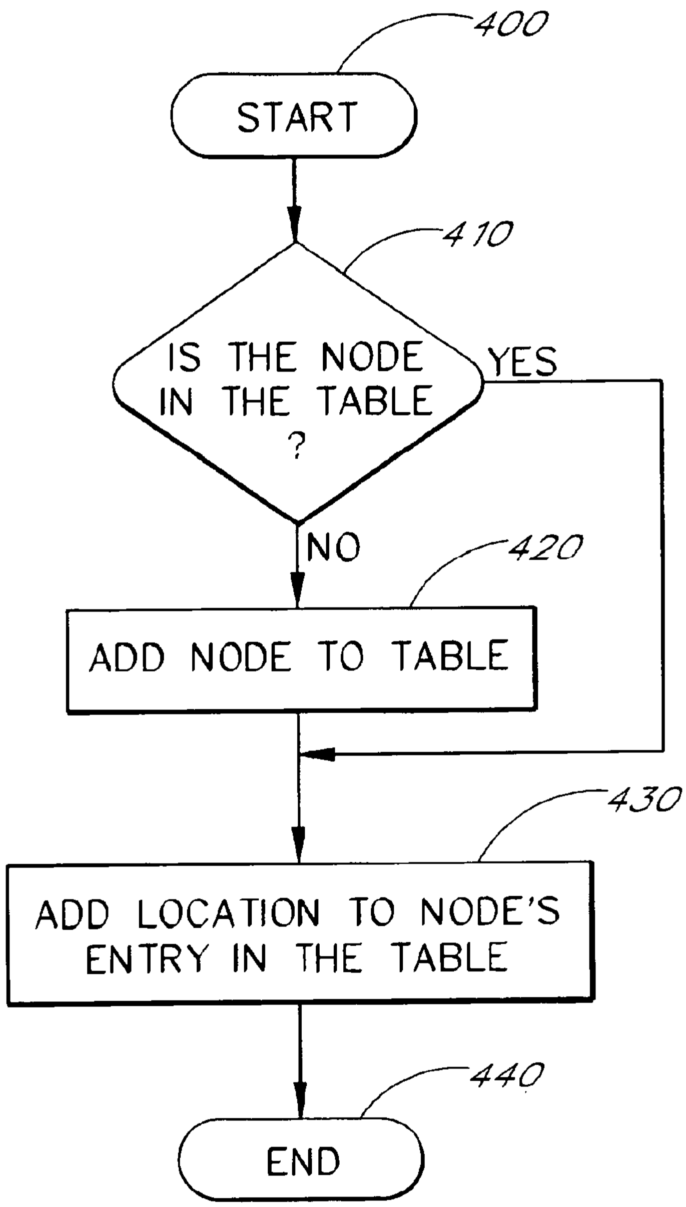

400
START
410
IS THE NODE IN THE TABLE ?
YES
NO
420
ADD NODE TO TABLE
430
ADD LOCATION TO NODE'S ENTRY IN THE TABLE
440
END

FIG. 4

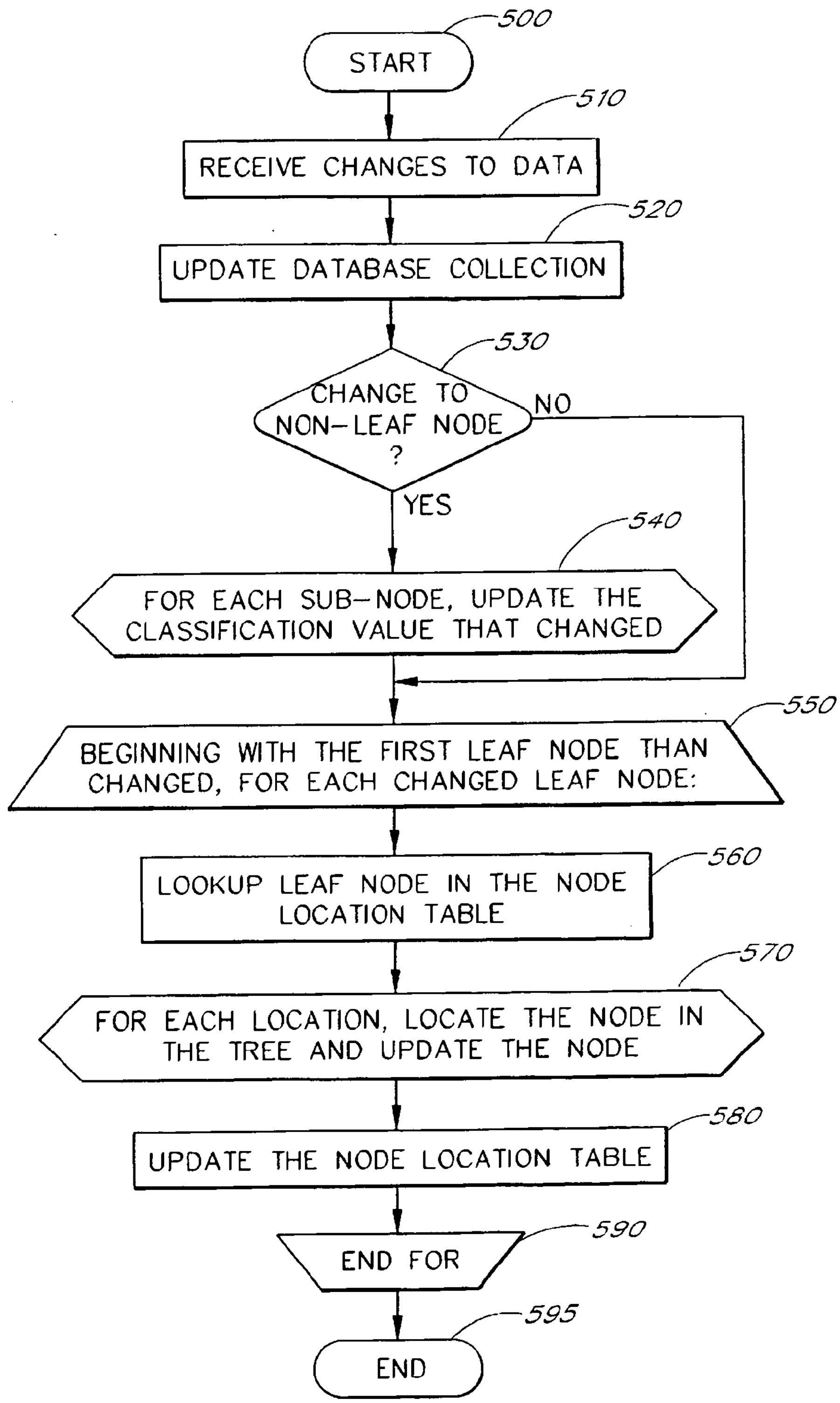

500
START
510
RECEIVE CHANGES TO DATA
520
UPDATE DATABASE COLLECTION
530
CHANGE TO NON-LEAF NODE ?
NO
YES
540
FOR EACH SUB-NODE, UPDATE THE CLASSIFICATION VALUE THAT CHANGED
550
BEGINNING WITH THE FIRST LEAF NODE THAN CHANGED, FOR EACH CHANGED LEAF NODE:
560
LOOKUP LEAF NODE IN THE NODE LOCATION TABLE
570
FOR EACH LOCATION, LOCATE THE NODE IN THE TREE AND UPDATE THE NODE
580
UPDATE THE NODE LOCATION TABLE
590
END FOR
595
END

FIG. 5

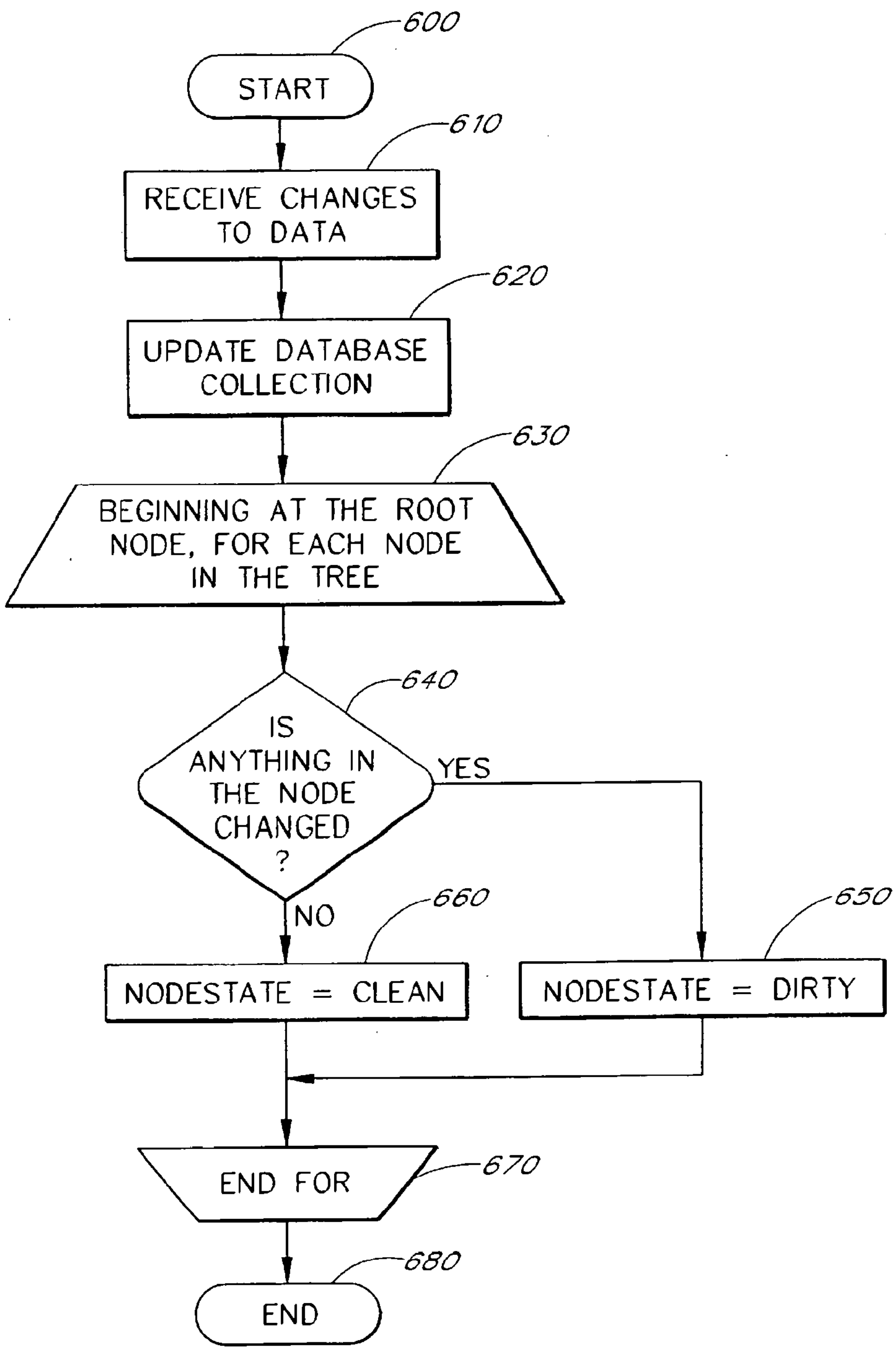

600
START
610
RECEIVE CHANGES TO DATA
620
UPDATE DATABASE COLLECTION
630
BEGINNING AT THE ROOT NODE, FOR EACH NODE IN THE TREE
640
IS ANYTHING IN THE NODE CHANGED ?
YES
NO
660
NODESTATE = CLEAN
650
NODESTATE = DIRTY
670
END FOR
680
END

FIG. 6

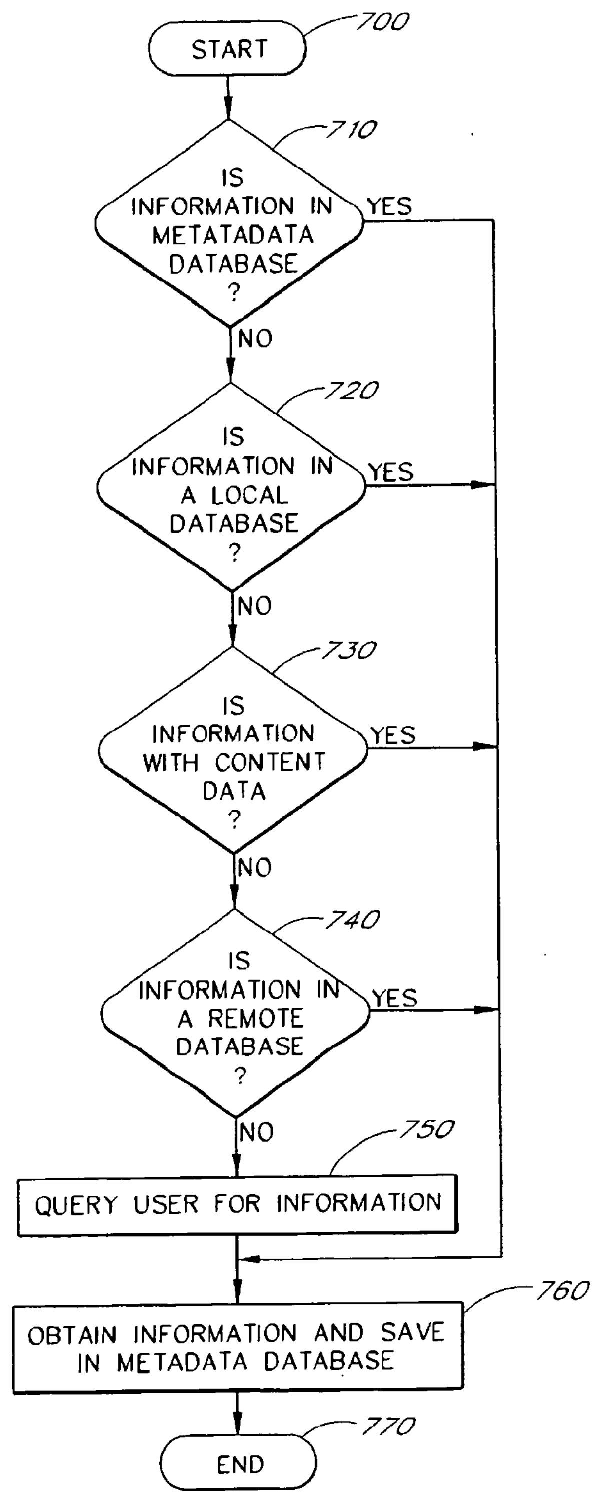

700
START
710
IS INFORMATION IN METATADATA DATABASE ?
YES
NO
720
IS INFORMATION IN A LOCAL DATABASE ?
YES
NO
730
IS INFORMATION WITH CONTENT DATA ?
YES
NO
740
IS INFORMATION IN A REMOTE DATABASE ?
YES
NO
750
QUERY USER FOR INFORMATION
760
OBTAIN INFORMATION AND SAVE IN METADATA DATABASE
770
END

FIG. 7

SYSTEM AND METHOD OF MANAGING METADATA DATA

FIELD OF THE INVENTION

The system and method of the present invention relate generally to the field of managing metadata.

BACKGROUND

The increased reliance on digital data has led to a need for detailed information about the digital data as well as techniques for managing and controlling this detailed information. This detailed information is known as "metadata." For example, there is a high demand for audio data, and accordingly, there is a high demand for metadata about the audio data such as, for example, the artist or speaker name, album name, genre, number of songs, and so forth.

While access to metadata provides the public with a vast amount of information, it is often difficult to manage the metadata. For example, keeping track of various audio files as well as the immense amount of metadata for each audio file can be a difficult task.

One common problem is that conventional approaches do not allow the user to easily view and access the metadata. For example, it is typical for a user to have hundreds or even thousands of audio files making it difficult for the user to sift through each file of metadata. A user may have to look through hundreds or through thousands of files to find the desired file.

Another common problem is that conventional approaches fail to provide users with control over the metadata such as the ability to make changes to a piece of metadata or a set of metadata. For example, a user may want to alter the genre of an audio file by changing the genre from Jazz to New Age.

SUMMARY OF THE INVENTION

In one embodiment, the present invention is a method for dynamically organizing metadata located in a database of metadata for presentation to a user in a display. The method comprises receiving a plurality of categories of metadata wherein the plurality of categories of metadata represent a hierarchical representation of the metadata; querying a database of metadata to produce a set of metadata query results; arranging the metadata query results in a hierarchical representation of metadata based at least upon a subset of the plurality of categories; and presenting the hierarchical representation of metadata to a user in a graphical display.

Another embodiment of the present invention is a method of dynamically updating a display of metadata to a user. The method comprises storing metadata in a database; displaying a hierarchical representation of a subset of the metadata to a user; receiving a change to at least a portion of the subset of metadata displayed to the user; processing the change to update the corresponding portion of the subset of metadata in the metadata database; determining which portions of the hierarchical representation are affected by the change; updating the portions of the hierarchical representations affected by the change; and displaying the updated hierarchical representation to the user.

Another embodiment of the present invention is a metadata management system used to access, manage, and edit information about content data. The metadata management system comprises a metadata database that includes information about content data; a metadata management module used to access the information about content data in the metadata database; and a graphical user interface configured to communicate with the metadata management module, to dynamically access the information about content data in the metadata database, and to dynamically present an organized grouping of at least a portion of the information about content data for display to a user.

Another embodiment of the present invention is a method for presenting metadata in a database. The method comprises obtaining a hierarchy of category nodes; querying the database for a set of metadata; dynamically arranging the set of metadata in the hierarchy of category nodes; and presenting the set of metadata in the hierarchy of category nodes to a user.

Another embodiment of the present invention is a method for presenting metadata in a database. The method comprises displaying a set of metadata from a metadata database in a hierarchy of category nodes; receiving a change to a portion of the set of metadata; and dynamically updating the display of the set of metadata and the hierarchy of category nodes to reflect the change.

Another embodiment of the present invention is a method for dynamically presenting metadata in a hierarchical form. The method comprises executing a search on a database, to obtain a set of search results, wherein the database stores metadata; receiving a set of user preferences for viewing the search results wherein the user preferences are based on properties of the metadata; dynamically generating a tree structure based on the search results and the set of user preferences; dynamically determining a layout of the tree structure; dynamically mapping the search results onto the tree structure based on the layout; and dynamically displaying the tree structure.

Another embodiment of the present invention is a method of obtaining information about content data wherein information about content data is stored in a database and displayed in a graphical user interface using a standard data structure. The method comprises obtaining an identifier related to a set of content data; creating a request for information about the set of content data using the identifier; processing the request for information; receiving a set of request information in response to the request for information; and storing the set of request information a database.

For purposes of summarizing the invention, certain aspects, advantages, and novel features of the invention are described herein. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for example, those skilled in the art will recognize that the invention may be embodied or carried out in a manner that achieves one advantage or group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates an example display from one embodiment of the present invention.

FIG. 2 illustrates a high-level block diagram of one embodiment of the present invention.

FIG. 3 illustrates a flowchart of one embodiment of building a tree grouping.

FIG. 4 illustrates a flowchart of one embodiment of adding an entry to the node location table.

FIG. 5 illustrates a flowchart of one embodiment of processing a data change.

FIG. 6 illustrates a flowchart of one embodiment of processing a data change.

FIG. 7 illustrates a flowchart of one embodiment of adding metadata.

DETAILED DESCRIPTION

A system and method which represent one embodiment and example application of the invention will now be described with reference to the drawings. Variations to the system and method which represent other embodiments will also be described. In one disclosed embodiment, the system and method are used to dynamically represent audio metadata using a master tree and a node table. It will be recognized, however, that other embodiments may use only one of these two types of data structures and/or different types of data structures to help users organize and access data. In addition, other types of data may also be used.

For purposes of illustration, one embodiment will be described in the context of a master tree and node table for organizing and accessing audio metadata and audio data within an audio playing device such as, for example, RealJukebox™. While the inventors contemplate that the present invention is not limited by the type of content data and/or metadata to be managed and that the types of data may include video, audio, audio-visual, slideshow, image and text, and so forth, the figures and descriptions relate to an embodiment of the invention using audio metadata and audio content data. Furthermore, the details of the master tree, node table, and of specific implementations are set forth in order to illustrate, and not to limit, the invention. The scope of the invention is defined by the appended claims.

These and other features will now be described with reference to the drawings summarized above. The drawings and the associated descriptions are provided to illustrate embodiments of the invention, and not to limit the scope of the invention. Throughout the drawings, reference numbers are re-used to indicate correspondence between referenced elements. In addition, the first digit of each reference number indicates the figure in which the element first appears.

I. Overview

Audio metadata, such as track name, artist, album, genre, track number, length, and so forth, is collected from various sources, added, and maintained in a metadata database. A metadata management module dynamically reads metadata from the metadata database, organizes the metadata into groupings using a groupings tree, combines the groupings tree with other trees to form a master tree, combines metadata relating to the selected grouping into a node table, and presents the master tree and the node table in a graphical user interface. In the graphical user interface, a user may add, delete, and/or modify the metadata in the master tree and/or the node table. As the user changes the metadata, the metadata database is updated and the user's changes are propagated throughout the graphical user interface. The user may also use the master tree and the node table to begin playing an audio file and/or a set of audio files.

The top node of the master tree represents a root node. The next level of the master tree represents root nodes of subtrees such as the groupings tree and the playlist tree. The lowest-level nodes of the master tree represent audio metadata of individual audio tracks, while the other nodes represent groupings (or sub-groupings) of audio tracks. This relationship structure allows the master tree to include various types of trees. For example, the groupings tree provides ways to group and categorize audio metadata, such as, for example, by Album, Artist, Genre, and so forth as well as by nested groupings such as, for example, Artist/Album, Genre/Artist, Genre/Artist/Album, and so forth. The groupings may be based upon fields of the metadata database as well as other groupings, categories, and/or preferences created by the user, hard-coded into the system, and so forth. The playlist tree provides ways to create or provide ordered lists of audio tracks.

The master tree and the node table are dynamically populated and displayed to the user. In addition, when a user makes any changes to the master tree and/or the metadata in the node table, both the master tree and the node table may be dynamically updated. In one embodiment, the master tree and the node table are dynamically updated without having to rebuild the entire master tree and the entire node table. Instead, the changes may be propagated throughout the master tree and node table through the use of a node location table that tracks the locations of the node within the master tree.

One benefit of this embodiment is that the metadata management system can read metadata from the metadata database and dynamically organize the metadata for display in the graphical user interface. Thus the metadata can be stored in a basic format and still presented to the user in an accessible format without requiring extensive or time consuming processing of the metadata.

Another benefit of this embodiment is that the user is given access to the metadata to make additions, changes, and/or deletions through an easy to use graphical user interface. Using the graphical user interface, the user has access to the data through interface tools such as, for example, menus, windows, pointing devices, drag and drop features, and so forth. For example, rather than having to manually edit each piece of the metadata, the user can use the interface tools to add data, move data into new categories and/or groupings, and so forth.

An additional benefit of this embodiment is that the metadata information may be displayed in the graphical user interface using organizational techniques. Rather than having to traverse vast amounts of metadata to find a particular record, the user is instead presented with an organized view of the metadata. This embodiment allows the metadata to be presented in a variety of categories using a variety of subtrees. The user may create custom categories as well as custom subtrees affording much flexibility and user control. For example, one user may create groupings for the Genres Rock and Jazz, while another user may create groupings for the Artists Styx and Abba. In addition, one user may group data into categories that are often used such as Artist/Genre/Album, while another user may create customized playlists.

A further benefit of this embodiment is the ability to dynamically update the data in the database collection as well as the data displayed in the graphical user interface. Thus, when users make changes to the metadata and/or the groupings or categories, the changes are made in the database and propagated throughout the graphical user interface such that the user is seeing an accurate representation of the metadata database. The user can view changed data without having to reread all of the data and regenerate the entire display. Instead, this embodiment provides fast, dynamic updating of the view of the data within the graphical user interface without causing much delay and/or inconvenience to the user.

Another benefit of this embodiment is that the user can update multiple sets of metadata with simple changes in the graphical user interface. For example, if a user has one thousand files with the genre value as Pop and the user wants to change the genre to Rock, the user can rename the genre grouping from Pop to Rock and all of the nodes within that genre grouping may be updated to reflect the genre value change. This feature saves the user from having to manually edit each of the metadata files one-by-one.

An additional benefit of this embodiment is that the user may update the metadata located in the individual content data files with the current metadata in the metadata database. For example, a user may select a command wherein the data within the metadata database is then copied to the appropriate MP3 header file that includes the metadata. For example, if a user changes the Genre of an audiofile from Rock to Pop in the graphical user interface and then executes an update MP3 file command, then the user's MP3 file will also automatically be updated such that the Genre is changed from Rock to Pop in the MP3 file.

II. Sample Display

FIG. 1 illustrates an example program display of a graphical user interface. In FIG. 1, an audio player program display **110** includes two windows, a tree window **120** that includes a master tree **122**, with an example groupings tree **124** and an example playlist tree **126**, and a table window **130** that includes a node table **132** with an example set of audio metadata.

The tree window **120** displays the master tree **122**. In the exemplary master tree **122**, there are two subtrees, Master Library **124** and Playlists **126**. The Master Library subtree **124** represents a groupings tree and illustrates ways to group or categorize the audio metadata in the metadata database. The Master Library subtree's **124** grouping includes five groupings, Artist, Album, Genre, Genre/Artist, and All Tracks. Furthermore, the Genre grouping includes four sub-groupings, <blank>, Classical, Pop, and Rock. The Playlists subtree **126** provides ways to group or categorize the audio metadata into custom playlists, (i.e., lists of tracks that the user wants played in a specific order). Users can create custom playlists indicating the order in which the user would like to listen to the audio files. The Playlists subtree **126** includes three playlists, New Playlist, Favorites, and Study Music.

The table window **130** displays a node table **132** that includes information about the node that is selected in the tree window **120**. This information includes details about the audio tracks that fall within the selected node. A user may display a node table **132** by selecting a grouping such as, for example, by using a mouse to click on the desired node in the tree window **120**. Other methods of selecting a grouping are discussed below.

In FIG. 1, the Master Library→Genre→Classical grouping was selected, and thus, the metadata for audio tracks that have the value "Classical" in the Genre field in the database are displayed as audio track records in the node table **132** within the table window **130**. In the exemplary table window **130**, three audio track records are shown: Concerto by Mozart, Reverie by Debussy, and Vocalise by Rachmaninoff. In one embodiment, the user may begin playing the audio file of a track record by selecting an audio track for playback such as, for example, by using a mouse to double click on any field of the audio track record in the node table **132**. Other methods of selecting an audio track record for playback are discussed below. In another example, the user may select a higher level node, such as the Genre node located under the Master Library→Genre grouping. The node table **132** may then display the sub-groupings of the Genre node such as, for example, <blank>, Classical, Pop, and Rock, as well as collective information about the tracks within the sub-groupings such as, for example, the total number of tracks, total length, and total size.

III. The Metadata Management System

FIG. 2 represents an overview of one embodiment of a metadata management system **200**. In one embodiment, the metadata management system **200** manages descriptive data, herein after referred to as metadata, about content data. For example, if the content data is a set of audio files, the corresponding metadata may include information about the audio files such as, for example, the album, artist or speaker, genre, the unique identifying characteristic of a track, and so forth. In another embodiment, the content data may be a set of video files, and the corresponding metadata may include information about the video files such as, for example, the genre, video length, leading actors, parent advisory rating, and so forth. It is recognized that in other embodiments, the metadata management system **200** may manage other types of content data and/or metadata.

In FIG. 2, the metadata management system **200** includes a metadata management module **210** that communicates with a graphical user interface **220** and a database collection **230**. The metadata management module **210** includes a build process **212**, an add node location process **214**, a data change process **216**, and an add metadata process **218**. Furthermore, the database collection **230** includes a metadata database **232** as well as a tree information database **234**.

As used herein, the word module, whether in upper or lower case letters, refers to logic embodied in hardware or firmware, or to a collection of software instructions, possibly having entry and exit points, written in a programming language, such as, for example, C++. A software module may be compiled and linked into an executable program, or installed in a dynamic link library, or may be written in an interpretive language such as BASIC. It will be appreciated that software modules may be callable from other modules or from themselves, and/or may be invoked in response to detected events or interrupts. Software instructions may be embedded in firmware, such as an EPROM. It will be further appreciated that hardware modules may be comprised of connected logic units, such as gates and flip-flops, and/or may be comprised of programmable units, such as programmable gate arrays or processors. The modules described herein are preferably implemented as software modules, but may be represented in hardware or firmware.

In one embodiment, the metadata management system **200** is implemented on a user computer (not shown). The user computer is a device which allows a user to access the content data and/or the metadata. While the term user computer is used, it is recognized that in other embodiments, the metadata management system **200** may be implemented on other systems such as, for example, a portable computing device, a portable audio player, a portable video player, a server, a computer workstation, a local area network of individual computers, an interactive television, an interactive kiosk, a personal digital assistant, an interactive wireless communications device, a handheld computer, a telephone, a router, a satellite, a smart card, an embedded computing device, or the like.

In one embodiment, the user computer is a conventional, general purpose computer using one or more microprocessors, such as, for example, a Pentium processor, a Pentium II processor, a Pentium Pro processor, an xx86 processor, an 8051 processor, a MIPS processor, a Power PC processor, or an Alpha processor. In one embodiment, the user computer runs an appropriate operating system, such as, for example, Microsoft® Windows® 3.X, Microsoft® Windows 98, Microsoft® Windows® NT, Microsoft® Windows® CE, Palm Pilot OS, Apple® MacOS®, Disk Operating System (DOS), UNIX, Linux®, or IBM® OS/2® operating systems.

In one embodiment, the metadata management system 200 includes or is connected to a player module (not shown). For example, the metadata management system 200 may include an audio player, a video player, and so forth such that a user may access the content data as well as the metadata using the graphical user interface 220.

A. Metadata Management Module

In one embodiment, the metadata management system 200 includes a metadata management module 210. As indicated above, the metadata management module 210 communicates with the graphical user interface 220 and the database collection 230.

The metadata management module 210 works in concert with the graphical user interface 220 to build the master tree 122 displayed in the tree window 120 and the node table 132 displayed in the table window 130. The metadata management module 210 may be requested to build the master tree 122 and the node table 132 upon the occurrence of several events such as, for example, upon user request (e.g., selecting the "refresh" button or via a menu option), upon an automatic request when the audio player program is opened, and so forth. In other embodiments, the metadata management module 210 may generate a portion of or the entire master tree 122 and/or the node table 132 off-line.

As indicated above, in one embodiment, the metadata management module 210 may generate several types of trees (sometimes referred to as subtrees) and combine the trees into a master tree 122 for display in the tree window 120. The metadata management module 210 may combine the trees by creating a root node and attaching the various trees as children of the root node. It is recognized that the various trees may be combined in other manners that are well known to those skilled in the art. Furthermore, in other embodiments, the audio data tree may represent a combination of several types of trees and/or a single type of tree.

In one embodiment, the metadata management module 210 may also generate the node table 132 for display in the table window 130. As discussed above, the node table 132 displays additional information about the selected grouping. In one embodiment, a default selected grouping may be stored in the tree information database 234 wherein the default selected grouping may be based on one or more factors such as, for example, the last grouping that the user selected, the most popular grouping that has been selected, a pre-selected grouping, and so forth. To build the node table 132, the metadata management module 210, queries the metadata database 232 for records that fall within the selected grouping. In one embodiment, if the selected node is a leaf node, the node table 132 may display metadata pertaining to the audio tracks that fall within the selected grouping. If the selected node is a non-leaf node, the node table 132 may display collective information about the tracks within the sub-groupings of the selected grouping. For more information on the node table 132, see the section below entitled Graphical User Interface—Node Table.

The metadata management module 210 illustrated in FIG. 2 includes a build process 212, an add node location process 214, a data change process 216, and an add metadata process 218. For more information on these process, see the section below entitled Metadata Management Module Processes.

The metadata management module 210 may include other processes (not shown) such as, for example, a process for combining one or more grouping trees into a groupings tree 124, combining one or more trees (e.g., groupings tree 124, playlist tree 126, etc.) into a master tree 122, and so forth.

B. Graphical User Interface

In one embodiment, the metadata management system 200 includes a graphical user interface 220 ("GUI"). The GUI 220 in FIG. 2 presents information to the user such as the content data and metadata. The GUI 220 may also allow the user to view the data, change the view of the data, access data (e.g., for playback), modify data, delete data, and/or add new data to the database collection 230.

The GUI 220 may be implemented as a module that uses text, graphics, audio, video, and other media to present data and to allow interaction with the data. The GUI 220 may be implemented as a combination of an all points addressable display such as a cathode-ray tube (CRT), a liquid crystal display (LCD), a plasma display, or other types and/or combinations of displays; input devices such as, for examples, a mouse, trackball, touch screen, pen, keyboard, voice recognition module, and so forth; and software with the appropriate interfaces which allow a user to access data through the use of stylized screen elements such as, for example, menus, windows, dialog boxes, toolbars, controls (e.g., radio buttons, check boxes, sliding scales, etc.), and so forth.

As illustrated in FIG. 1, in one embodiment, the GUI 220 may display a master tree 122 in the tree window 120 and a node table 132 in the table window 130.

1. Master Tree

As indicated above, the master tree 122 provides various ways to group and categorize audio data. In one embodiment, the master tree 122 displays nodes that have at least one child (non-leaf nodes) such that the leaf nodes are not displayed in the master tree 122, but are instead displayed in a table format in the node table 132. It is recognized that in other embodiments, the leaf nodes as well as the non-leaf nodes may be displayed in the master tree 122. In addition, the GUI 220 allows the user to expand a subtree of the master tree 122 in order to view the subtrees children.

The master tree 122 is preferably in the form of a directed acyclic graph (a tree that allows a child node to have multiple parents). While this embodiment uses an acyclic graph representation, it is recognized that in other embodiments, other types of graphs or trees may be used such as, for example, B* trees, optical trees, binary trees, n-way trees, balanced trees, min-max trees, Huffinan trees, splay trees, AVL trees, and so forth. Furthermore, other data structures, such as, for example, files, lists, arrays, records, tables, and so forth, or a combination of data structures may be used.

2. Node Table

As indicated above, the node table 132 displays additional information about the node that is selected in the master tree 122. In one embodiment, if the selected node is a leaf node, the node table 132 may display metadata pertaining to the audio tracks that fall within the grouping as audio track records. The node table 132 in FIG. 1 includes the fields Track Name, Artist, Album, Genre, CD Track #, and Length and is arranged in a standard table format wherein the rows represent audio track records and the columns represent categories or attributes of data within the metadata database 232. If the selected node is a non-leaf node, the node table 132 may display collective information about the tracks within the sub-groupings of the selected node such as, for example, the total number of tracks, total length, and total size. For example, if the selected node is Artist under the grouping Master Library→Artist, the node table 132 may then display the sub-groupings of the Artist node such as, for example, Debussy, Mozart, and Rachmaninoff, as well as the total number of tracks, total length, and total size of audio files data for each artist.

It is recognized that in other embodiments different categories, attributes, and/or collective information may be used that include fewer fields of the metadata database 232, additional fields of the metadata database 232, user customized categories, as well as other categories. In addition, some or all of the exemplary categories or attributes may be omitted from the node table 132.

The node table 132 is preferably in the form of a standard table wherein data is arranged in rows and columns such that multiple audio track records are visible in the table window 130. It is recognized that other formats may be used. For example, the table window 130 may display individual records, a tree of records, a linked list of records, and so forth. It is recognized that in other embodiments, other types of data structures such as, for example, trees, files, lists, arrays, records, and so forth, or a combination of data structures may be used.

C. Database Collection

In one embodiment, the metadata management system 200 includes a database collection 230. The database collection 230 in FIG. 2 includes a metadata database 232 and a tree information database 234.

1. Metadata Database

The metadata database 232 includes metadata about the audio content data. The metadata may include information such as track name, artist, album, genre, CD track number, length, format, quality, comments, date and/or time last played, date and/or time the track was created, file size, file location, protection flag, as well as other types of information related to the audio file. The metadata may include fields that are used in standards such as, for example, ID3v1, ID3v2, ID3v2.3.0, and so forth, as well as other fields that are created by other parties, by users, by content providers, and so forth. As indicated above, it is also recognized that in other embodiments, the metadata database 232 may manage other types of content data and/or metadata.

In one embodiment, the metadata database 232 includes the metadata as well as the content data. For example, the metadata database 232 may include the audio files as well as the metadata that corresponds to the audio files. In another embodiment, the content data may be stored in a different database and/or only a subset of the content data may be stored in the metadata database 232. It is recognized that the metadata database 232 may be implemented as several separate databases.

2. Tree Information Database

The tree information database 234 includes data about the trees within the master tree 122. This information may include tree types, groupings, node names, node locations, and so forth. For example, the tree information database may include grouping tables that include data about the grouping tree structure wherein the grouping tables include information such as, for example, the names of the nodes, the relationship between nodes, whether the node is a standard node or customized node, and so forth. In addition, the tree information database 234 may include playlist tables that define the various playlists and include information about the playlists such as, for example, data/time created, name of the creator, and so forth. The tree information database 234 may also include node location tables that define the location of nodes in the subtrees and/or the master tree 122.

It is recognized that the tree information database 234 may include other types of information as well. In addition, in other embodiments, the tree information database 234 may be implemented as several separate databases.

3. Additional Embodiments

The database collection 230 may also include other databases (not shown) for performing various management tasks. For example, the database collection 230 may include a user preferences database that includes information on the types of audio content and metadata that the user prefers and/or the user's favorite web sites for downloading audio content and metadata.

In connection with the database collection 230, in one embodiment, there may be several processes (not shown) such as ID generators, number generators, statistic generators, session generators, and temp storage units that work with the database collection 230.

In one embodiment, the database collection 230 is implemented using CodeBase, a semi-relational database offered by Sequiter. CodeBase is a high-speed xBase-compatible database engine that works with C/C++, Visual Basic, Delphi and Java under standalone and client/server environments. It is recognized that the database collection 230 may be implemented using a different type of relational database, such as Sybase, Oracle, Microsoft® SQL Server, and so forth as well as other types of databases such as, for example, a flat file database, an entity-relationship database, and object-oriented database, a record-based database, and so forth.

Moreover, while the database collection 230 depicted in FIG. 2 is comprised of several separate databases, it is recognized that in other embodiments, the database collection 230 may contain other databases or some of the databases may be omitted and/or combined. In addition, the database collection 230 may be implemented as a single database with separate tables or as other data structures that are well know in the art such as linked lists, binary trees, and so forth.

In one embodiment, the database collection 230 may be connected to a backend component (not shown) that receives database requests via servlets, small programs that run on servers, and sends a corresponding request to the database collection 230. It is recognized that in other embodiments data access may be performed differently, for example, a different type of backend component may be used, or the database collection 230 may be accessed directly.

IV. Metadata Management Module Processes

The metadata management module 210 illustrated in FIG. 2 includes a build process 212, an add node location process 214, a data change process 216, and an add metadata process 218.

A. Build Process

The build process 212 is used to dynamically build a grouping tree that represents a grouping wherein the grouping is a category or a set of categories by which the data may be grouped. For example, one grouping may be Artist while another grouping may be Genre/Artist, and yet another grouping may be Genre/Artist/Album.

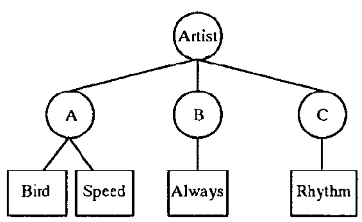
For example, Table 1 represents a sample set of audio metadata.

TABLE 1

Track Name	Artist	Album	Genre	Length
Always	B	XXX	Funk	2:34:35
Bird	A	YYY	Pop	1:56:22
Rhythm	C	YYY	Pop	3:21:48
Speed	A	ZZZ	Rock	2:15:03

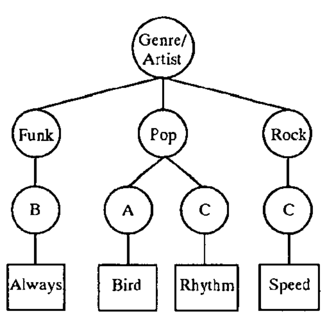
The field names are located in the first row and represent categories, and the metadata information, also referred to as a category value, is shown in the subsequent rows. For example, the category Track Name has four different category values: Always, Bird, Rhythm, and Speed; and the category Artist has three different category values: A, B, and C.

A tree based on the grouping "Artist" for the data in Table 1 may look like the following, wherein the grouping is "Artist" that includes one category, Artist:



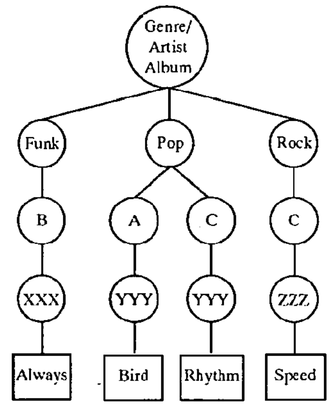
The circles represent categories from the groupings and the squares represent the audio track records which are the leaf nodes of the tree. The top node (or root note of this grouping) represents the grouping name. The next level of nodes represents the category values for the category Artist category. The leaf nodes represent the audio track records (and/or a reference to the records).

To further illustrate, a tree based on the grouping "Genre/Artist" for the data in Table 1 may look like the following, wherein the grouping is "Genre/Artist" that includes two categories, first Genre and second Artist:



The root node represents the grouping name. The next level of nodes under the root node represent the category values for the Genre category and the next level of nodes represent the category values for the Artist category. The leaf nodes represent the audio track records (and/or a reference to the records).

In the next example, a tree based on the grouping "Genre/Artist/Album" for the data in Table 1 may look like the following, wherein the grouping is "Genre/Artist/Album" that includes three categories, first Genre, second Artist, and third Album:



The root node represents the grouping name. The next level of nodes under the root node represent the category values for the Genre category; the next level of nodes represent the category values for the Artist category; the third level of nodes represent the category values for the Album category. The leaf nodes represent the audio track records (and/or a reference to the records).

One embodiment of a build process 212 will now be described with reference to FIG. 3, though it is recognized that a variety of methods may be used to implement the build tree process.

The build process 212 begins at a start state 300 and then proceeds to a state 310. In state 310, the build process 212 sorts the data by the first category in the grouping, then by the second category in the grouping, and so forth for each category in the grouping and then proceeds to a state 315. In state 315, beginning with the first record of the sorted data, and continuing until all of the records have been traversed (states 315 and 355), the build process 212 proceeds to a state 320. In state 320, the build process 212 creates a grouping name node as the top of the tree and moves the current location to the top of the tree. Proceeding to a state 325, beginning with the first category in the grouping, and continuing until all of the categories in the grouping have been traversed (states 325 and 345), the build process 212 proceeds to a state 330. In state 330, the build process 212 determines if the category value is already a child node in the tree. If the category value for the current record is not already a child node in the current location of the tree, the build process 212 proceeds to a state 335 and adds the category value as a child node in the current location of the tree and proceeds to a state 340. If the category is already a child node in the current location of the tree, the build process 212 proceeds to state 340. In state 340, the build process 212 moves the current location to the node that represents the category value and proceeds to a state 345. In state 345, the build process 212 returns to state 325 if there are any more categories in the grouping. Once all of the categories in the grouping have been traversed (states 325 and 345), the build process 212 proceeds to a state 350. In state 350, the build process 212 adds the current record to the current node of the tree and proceeds to a state 355. In state 355, the build process 212 returns to state 315 if there are any more records that have not been traversed. Once all of the records have been traversed, the build process 212 proceeds to an end state 360.

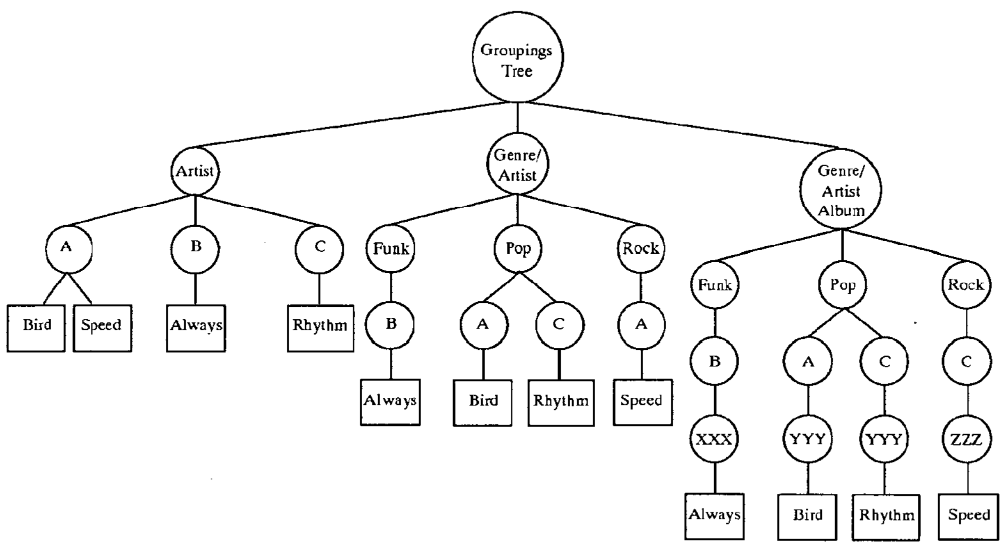
As indicated above, it is recognized that other methods of building a grouping tree may also be used. In addition, various methods for improving efficiency may also be used using tools such as recursion and other data management tools that are well-known to those skilled in the art. For example, the build process **212** may build the entire tree first without leaf nodes before adding any of the records. In addition, the build process **212** may recursively add nodes down one path of a tree and then add all records that fall within that path before moving onto the next path of the tree.

It is recognized that the various grouping trees may be combined to form a groupings tree **124**, such as, for example, by creating a root node and attaching each of the grouping trees to the root node as a child node. A sample groupings tree **124** that corresponds to the data in Table 1 includes the grouping tree "Artist," the grouping tree "Genre/Artist," and the grouping tree "Genre/Artist/Album" may look like the following:

TABLE 2

Node	Location 1	Location 2	Location 3
Always	Artist-B	Genre/Artist-Funk-B	Genre/Artist/Album-Funk-B-XXX
Bird	Artist-A	Genre/Artist-Pop-A	Genre/Artist/Album-Pop-A-YYY
Rhythm	Artist-C	Genre/Artist-Pop-C	Genre/Artist/Album-Pop-C-YYY
Speed	Artist-A	Genre/Artist-Rock-C	Genre/Artist/Album-Rock-C-ZZZ

While Table 2 includes only three locations, it is recognized that in other embodiments, the node location table may include N locations where N is a positive integer. In addition, some nodes may have more locations than others.



B. Add Node Location Process

The add node location process **214** is used to track the various locations of nodes in the master tree **122**. In one embodiment, as the leaf-nodes are being added to any of the trees to be displayed in the tree window **120**, the metadata management module **210** tracks the various locations in which the node is located and stores the data in the tree information database **234**. As indicated above, the master tree **122** is preferably an acyclic graph that allows nodes to have multiple parent nodes. Thus, each time a node is added to a tree, the metadata management module **210** tracks and stores the node's location information in a data structure, such as a node location table, though it is recognized that a variety of data structures may be used such as, for example, a list, a tree, an array, a database, and so forth. The node location table may then be stored in the tree information database **234**.

Table 2 illustrates a sample node location table that corresponds to the node locations of the example nodes used in the Build Process section above based upon the sample data of Table 1.

For example, if the node Speed is in two of the user's playlists and Always is not in the user's playlists, then Speed may have two more locations than Always.

One embodiment of an add node location process **214** will now be described with reference to FIG. **4**, though it is recognized that a variety of methods may be used to implement an add node location process **214**. In one embodiment, the add node location process **214** is executed each time a node is added to any of the trees in the master tree **122**.

The add node location process **214** begins at a start state **400** and then proceeds to a state **410**. In state **410**, the add node location process **214** determines whether the node exists in the node location table. If the node does not exist in the node location table, the add node location process **214** adds the node to the node location table in state **420** and proceeds to a state **430**. If the node already exists in the node location table, then the node location process proceeds to state **430**. In state **430**, the add node location process **214** adds the current location of the node to the node's first empty location field in the node location table and proceeds to an end state **440**.

C. Data Change Process

The data change process **216** is used to dynamically integrate changes into the database collection **230** as well as the master tree 122 and/or the node table 132. As indicated above, the user has access to add, change, or delete data in the tree window 120 and/or the table window 130 and the metadata management module 210 dynamically updates the master tree 122 and the node table 132 to reflect the user's additions, changes, and/or deletions. One embodiment of a data change process 216 is illustrated in FIG. 5.

Beginning at a start state 500, the data change process 216 proceeds to a state 510. In state 510, the data change process 216 receives a user's changes to data. For example, a user may reclassify a song from the genre Jazz to the genre New Age by using a mouse to drag the song from the Jazz node to the New Age node. In another example, a user may change the value of a grouping (e.g., rename a grouping) by selecting the grouping and typing in a new value. The user may also create a new playlist by selecting one or more audio tracks and copying them into a playlist node. The user may make the changes using various actions such as, for example, typing and changing any of the fields of information, dragging and dropping one of the nodes into a different grouping, adding a new grouping using the menu system, and so forth. When a user drags, one node to a different grouping, the node will then inherit the characteristics of the new grouping (i.e., be reclassified), and the metadata database 232 will be updated accordingly. For example, if the audio track entitled "Always" was located under the Genre/Artist grouping Funk→B and the user moved it to Pop→A, the Genre value of the "Always" track may be updated to Pop and the Artist value may be updated to B.

The data change process 216 then proceeds to a state 520. In state 520, the data change process 216 updates the database collection 230 (e.g., the metadata database 232 and/or the tree information database 234) with the changes and proceeds to a state 530. In state 530, the data change process 216 determines whether the change was made to a leaf node or a non-leaf node. If the change was made to a non-leaf node, then the data change process 216 proceeds to state 540 wherein for each sub-node (e.g. children, grandchildren, and so forth) of the non-leaf node, the data change process 216 updates the classification or field value that changed and proceeds to a state 550. If the change was made to a leaf node, then the data change process 216 proceeds to state 550. In state 550, beginning with the first leaf node that was changed, and continuing until all of the leaf nodes that were changed (states 550 and 590) are processed, the data change process 216 proceeds to a state 560. In state 560, the data change process 216 looks up the leaf node in the node location table and proceeds to a state 570. In state 570, for each location in the node location table entry, the data change process 216 locates the node in the master tree 122, updates the node and proceeds to a state 580. In state 580, the data change process 216 updates the node location table to reflect any location changes and proceeds to a state 590. In state 590, the data change process 216 returns to state 550 if there are more changed leaf nodes that have not been updated. Once all of the changed leaf nodes have been updated, the data change process 216 proceeds to an end state 595.

It is recognized that in other embodiments, the data change process 216 may be implemented in a different manner. For example, the node location table may be limited to include only those nodes that are displayed in the graphical user interface 220 such that the data change process 216 updates only those nodes that are being displayed in the graphical user interface 220. In other embodiments, the data change process 216 may be implemented without using a node location table.

An additional embodiment of the data change process 216 is illustrated in FIG. 6. Beginning at a start state 600 the data change process 216 proceeds to a state 610. In state 610, the data change process 216 receives a user's changes to data and proceeds to a state 620. In state 620, the data change process 216 updates the database collection 230 (e.g., the metadata database 232 and/or the tree information database 234) with the changes and proceeds to a state 630. In state 630, beginning with the root node, and continuing until all of the nodes in the tree (states 630 and 670) are traversed, the data change process 216 proceeds to a state 640. In state 640, the data change process determines whether anything in the node has been changed. If anything in the node has been changed, the data change process proceeds to a state 650 wherein a Node State is set to DIRTY, and proceeds to a state 670. If the node has not been changed, the data change process proceeds to a state 660 wherein the Node State is set to CLEAN, and proceeds to state 670. In state 670, the data change process 216 returns to state 630 if there are nodes that have not been traversed. Once all of the nodes have been traversed, the data change process 216 proceeds to an end state 680.

Thus, at then end of the process, each node in the tree has been marked as DIRTY or CLEAN. The next time the node is accessed, (e.g., selected by the user), then the node is regenerated to reflect the changes, and the changes are recursively propagated to any of the accessed node's sub-nodes.

It is recognized that in other embodiments, the data change process 216 may be implemented in a different manner. For example, additional, fewer, and/or different states may be used to track the changes to the nodes; a non-recursive process may be implemented; each node in the tree may be regenerated before the node is accessed; and so forth.

It is also recognized that the leaf-nodes may contain references to leaf node data such that when the leaf node data is changed, the changes may be automatically propagated to the other locations in which the leaf node resides.

D. Add Metadata Process

The add metadata process 218 is used to find and add metadata to the metadata database 232. In one embodiment, the add metadata process 218 is triggered if there is no information in the metadata database 232 for an audio track. In other embodiments, the add metadata process 218 may be triggered if there is information in the metadata database 232 for an audio track, but certain portions of the information is missing. In such embodiments, when new data is found that includes data that conflicts with the existing data, the add metadata process 218 may default to overwriting the old data, keeping the old data, keeping the old data only if the user had edited the data, or use other defaults.

One embodiment of an add metadata process 218 is illustrated in FIG. 7. The embodiment depicted in FIG. 7 looks for data if there is no information in the metadata database 232 for a track and thus, there are no conflicts. As previously indicated, it is recognized that an add metadata process 218 may be implemented using other defaults.

Beginning at a start state 700, the add metadata process 218 proceeds to a state 710. In state 710, the add metadata process 218 determines whether there is information for the designated track in the metadata database 232. The track may be designated using a variety of methods such as, for example, by placing a CD in the CD-ROM drive, by having the user select a group of tracks, by preselecting a group of tracks, and so forth. If there is already information for the designated track in the metadata database 232, the add metadata process 218 proceeds to an end state 770. If the information is not already in the metadata database 232, the add metadata process 218 proceeds to a state 720. In state 720, the add metadata process 218 determines whether the information is located in a local database. The local database may be, for example the CDPlayer.ini file as well as any other database or file of metadata that may be stored on or accessed by the add metadata process 218. If the information is in a local database, the add metadata process 218 proceeds to a state 760 wherein the add metadata process 218 obtains a copy of the information and saves the information in the metadata database 232 and proceeds to the end state 770. If the information is not in the local database, the add metadata process 218 proceeds to a state 730. In state 730, the add metadata process 218 determines whether the information is located with the content data. For example, if the content data is stored on a CD-ROM, then CD-ROM is checked for metadata information. If the content data is stored in an encoded data file such as, for example an MP3 file, the encoded data file is checked for metadata information. If the information is with the content data, the add metadata process 218 proceeds to a state 760 wherein the add metadata process 218 obtains a copy of the information and saves the information in the metadata database 232 and proceeds to the end state 770. If the information is not with the content data, the add metadata process 218 proceeds to a state 740. In state 740, the add metadata process 218 determines whether the information is located in a remote database. For example, the adding data process may contact a remote database of audio metadata and perform a lookup of the designated track(s) to look for and retrieve the corresponding metadata. The corresponding metadata may then be sent to the add metadata process 218. The contact with the remote database may be through a variety of mediums such as, for example, a direct network connection, a dial-up connection, an internet connection, and so forth. If the information is in the remote database, the add metadata process 218 proceeds to a state 760 wherein the add metadata process 218 obtains a copy of the information and saves the information in the metadata database 232 and proceeds to the end state 770. If the information is not in the remote database, the add metadata process 218 proceeds to a state 750. In state 750, the add metadata process 218 queries the user for the information and the add metadata process 218 proceeds to a state 760 wherein the add metadata process 218 obtains a copy of the entered information, saves the information in the metadata database 232, and proceeds to the end state 770.

In one embodiment, the graphical user interface 220 may also be updated each time the metadata database 232 is updated. In addition, it is recognized that a subset of the various checks for data described above may be used. For example, in one embodiment, the add metadata process 218 may only look in a local database and a remote database.

In another embodiment, metadata information may also be added by user-initiated actions. For example, a user may drag and drop a set of metadata information the user received in an e-mail or on a disk into the graphical user interface 220. Furthermore, the user may also initiate the add metadata process 218 wherein the user requests to be queried for information about the metadata. In other embodiments, metadata information may also be added by other processes. For example, if a user downloads a file, the download process may automatically import metadata information into the metadata database 232. In another example, when the user updates the audio playing program, audio playing program may automatically trigger a lookup of any missing metadata information.

V. Conclusion

While certain embodiments of the invention have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present invention. Accordingly, the breadth and scope of the present invention should be defined in accordance with the following claims and their equivalents.

What is claimed is:

1. In a user computer, a method comprising:

generating a graphical representation of a plurality of metadata database entries corresponding to, audio/video content to be played by a media player application, each metadata entry stored locally at the user computer in the metadata database and characterized in accordance with a plurality of attributes that are associated with the audio/video content and shared between one or more of the plurality of metadata database entries;

receiving user input to manually modify one of the shared attributes;

recharacterizing in the metadata database, those of the plurality of metadata database entries characterized by the modified one of the shared attributes; and

dynamically updating the graphical representation of the one or more of the plurality of metadata database entries based upon the user input.

2. The method of claim 1, wherein the audio/video content is played by the media player application in response to a metadata entry being selected by the user.

3. The method of claim 1, wherein the user may manually perform at least one of a metadata addition, metadata deletion, and a metadata modification via the graphical representation.

4. The method of claim 1, wherein the audio/video content comprises an MP3 file.

5. The method of claim 1, wherein the metadata database is stored separate from the audio/video content.

6. The method of claim 1, wherein the graphical representation further comprises a plurality of content grouping trees, each representing one or more of the plurality of metadata database entries and characterized in accordance with at least a first of the one or more attributes.

7. The method of 6, wherein the graphical representation further comprises a table including metadata entries corresponding to nodes of a selected one of the plurality of content grouping trees.

8. The method of 7, wherein the table includes metadata entries corresponding to leaf nodes of the selected one of the plurality of content grouping trees.

9. The method of 6, wherein the plurality of content grouping trees comprises a hierarchical folder structure.

10. The method of 9, wherein the plurality of content grouping trees comprises a hierarchical folder structure wherein the hierarchical folder structure is selectively expandable based upon user input.

11. The method of claim 1, wherein the graphical representation further comprises a table including metadata entries characterized in accordance with at least a subset of the plurality of attributes associated with the audio/video content.

12. The method of claim 1, wherein the metadata database is a hierarchically arranged database containing the plurality of metadata database entries corresponding to a plurality of audio/video content.

13. The method of claim 1, wherein the attributes associated with the audio/video content comprise a selected one of a title, artist, genre, and track name.

14. In a user computer, a method comprising:

generating a graphical representation of a plurality of metadata entries characterizing audio/video content to be played by a media player application, wherein the metadata is stored locally at the user computer in a metadata database and characterized in accordance with one or more attributes associated with the audio/video content, the graphical representation including

a plurality of content grouping trees, with each content grouping tree representing one or more metadata entries characterized in accordance with a first of the one or more attributes; and

a table including metadata entries corresponding to nodes of a selected one of the plurality of content grouping trees;

receiving user input to manually modify at least one of the attributes associated with the audio/video content; and

dynamically updating the graphical representation of the metadata and the metadata database to reflect the user input.

15. The method of claim 14, wherein a user may recharacterize a metadata entry by graphically associating the metadata entry displayed in the table with a second content grouping tree corresponding to a second of the one or more attributes.

16. The method of claim 15, wherein the metadata entry inherits characteristics associated with the second content grouping tree.

17. The method of claim 14, wherein the table comprises a plurality of attribute field names including at least one of track name, artist, album, genre and track length.

18. The method of claim 14, wherein the audio/video content is played by the media player application in response to a metadata entry being selected by the user.

19. The method of claim 14, wherein the user may manually perform at least one of a metadata addition, metadata deletion, and a metadata modification via the graphical representation.

20. The method of claim 14, wherein the audio/video content comprises an MP3 file.

21. The method of claim 14, wherein the table includes metadata entries corresponding to leaf nodes of a selected one of the plurality of content grouping trees.

22. An apparatus comprising:

a storage medium having a plurality of programming instructions stored therein, the programming instructions designed to

generate a graphical representation of a plurality of metadata database entries corresponding to, audio/video content to be played by a media player application, each metadata entry stored locally in the metadata database and characterized in accordance with a plurality of attributes that are associated with the audio/video content and shared between one or more of the plurality of metadata database entries,

receive user input to manually modify one of the shared attributes,

recharacterize in the metadata database, those of the plurality of metadata database entries characterized by the modified one of the shared attributes, and

dynamically update the graphical representation of the one or more of the plurality of metadata database entries based upon the user input; and

at least one processor coupled with the storage medium to execute the programming instructions.

23. The apparatus of claim 22, wherein the programming instructions are further designed to play the audio/video content in response to a metadata entry being selected by the user.

24. The apparatus of claim 22, wherein the programming instructions are further designed to facilitate at least one of a metadata addition, metadata deletion, and a metadata modification by a user via the graphical representation.

25. The apparatus of claim 22, wherein the graphical representation further comprises a plurality of content grouping trees, each representing one or more of the plurality of metadata database entries and characterized in accordance with at least a first of the one or more attributes.

26. The apparatus of 25, wherein the graphical representation further comprises a table including metadata entries corresponding to nodes of a selected one of the plurality of content grouping trees.

27. The apparatus of 26, wherein the table includes metadata entries corresponding to leaf nodes of the selected one of the plurality of content grouping trees.

28. The apparatus of 25, wherein the plurality of content grouping trees comprises a hierarchical folder structure.

29. The apparatus of 28, wherein the plurality of content grouping trees comprises a hierarchical folder structure wherein the hierarchical folder structure is selectively expandable based upon user input.

30. The apparatus of claim 22, wherein the graphical representation further comprises a table including metadata entries characterized in accordance with at least a subset of the plurality of attributes associated with the audio/video content.

31. The apparatus of claim 22, wherein the metadata database is a hierarchically arranged database containing the plurality of metadata database entries corresponding to a plurality of audio/video content.

32. The apparatus of claim 22, wherein the attributes associated with the audio/video content comprise a selected one of a title, artist, genre, and track name.

33. An apparatus comprising:

a storage medium having a plurality of programming instructions stored therein, the programming instructions designed to

generate a graphical representation of a plurality of metadata entries, characterizing audio/video content to be played, wherein the metadata is stored locally in a metadata database and characterized in accordance with one or more attributes associated with the audio/video content, the graphical representation including a plurality of content grouping trees, with each content grouping tree representing one or more metadata entries

characterized in accordance with a first of the one or more attributes, and a table including metadata entries corresponding to nodes of a selected one of the plurality of content grouping trees,

receive user input to manually modify at least one of the attributes associated with the content, and

dynamically update the graphical representation of the metadata and the metadata database to reflect the user input; and

at least one processor coupled with the storage medium to execute the programming instructions.

34. The apparatus of claim 33, wherein the programming instructions are further designed to facilitate a user in recharacterizing a metadata entry by graphically associating the metadata entry displayed in the table with a second content grouping tree corresponding to a second of the one or more attributes.

35. The apparatus of claim 33, wherein the table comprises a plurality of attribute field names including at least one of track name, artist, album, genre and track length.

36. The apparatus of claim 33, wherein the audio/video content comprises an MP3 file.

37. The apparatus of claim 33, wherein the programming instructions are further designed to play the audio/video content in response to a metadata entry being selected by the user.

38. The apparatus of claim 33, wherein the programming instructions are further designed to facilitate at least one of a metadata addition, metadata deletion, and a metadata modification by a user via the graphical representation.

* * * * *

A6

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Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

US006976229B1

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Balabanovic et al.

(10) **Patent No.:** **US 6,976,229 B1**
(45) **Date of Patent:** **Dec. 13, 2005**

(54) **METHOD AND APPARATUS FOR STORYTELLING WITH DIGITAL PHOTOGRAPHS**

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(52) **U.S. Cl.** **715/838**; 715/719; 715/737; 715/738; 715/780; 715/723

(58) **Field of Search** 345/835, 730, 345/838, 731, 732, 719, 724, 723, 716, 717; 707/500.1; 716/500.1, 512; 715/719, 737, 715/738, 780, 723, 835, 730, 838, 731, 732, 715/724, 716; 382/305; 358/442

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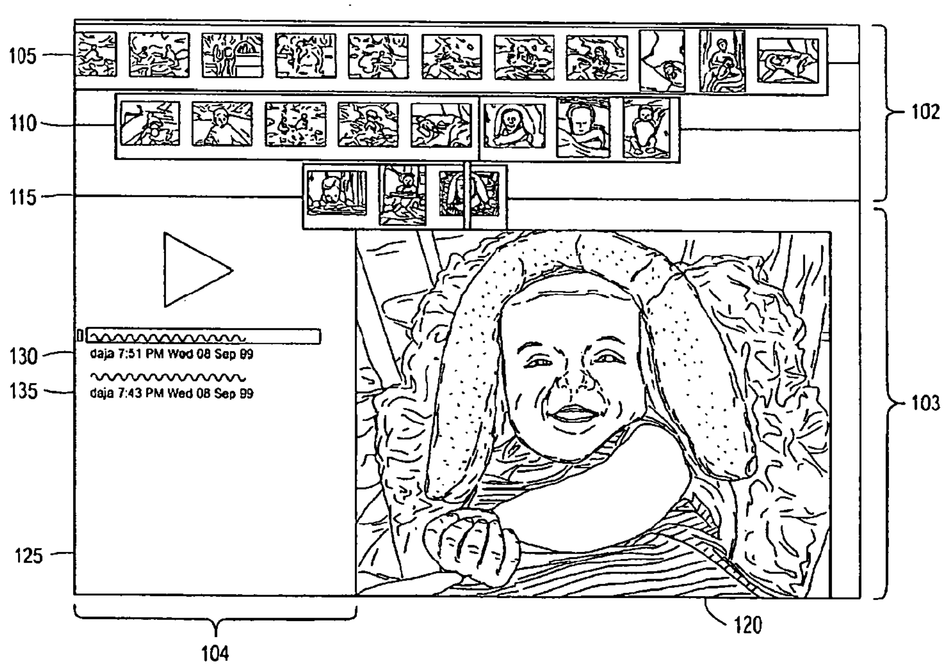
Assistant Examiner—Mylinh Tran
(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

(57) **ABSTRACT**

A display showing an imported story track, an authored story track, and a story-in-progress track. Each story contains one or more objects. The display also shows a large photo corresponding to a selected object in a story. Furthermore, the display also provides visual forms showing audio clips associated with the large photo displayed. The photo may have more than one associated audio clips. Control buttons are available to navigate among the three tracks and among the objects on each track. Other control buttons allow a user to record audio clips and to author new stories.

49 Claims, 7 Drawing Sheets



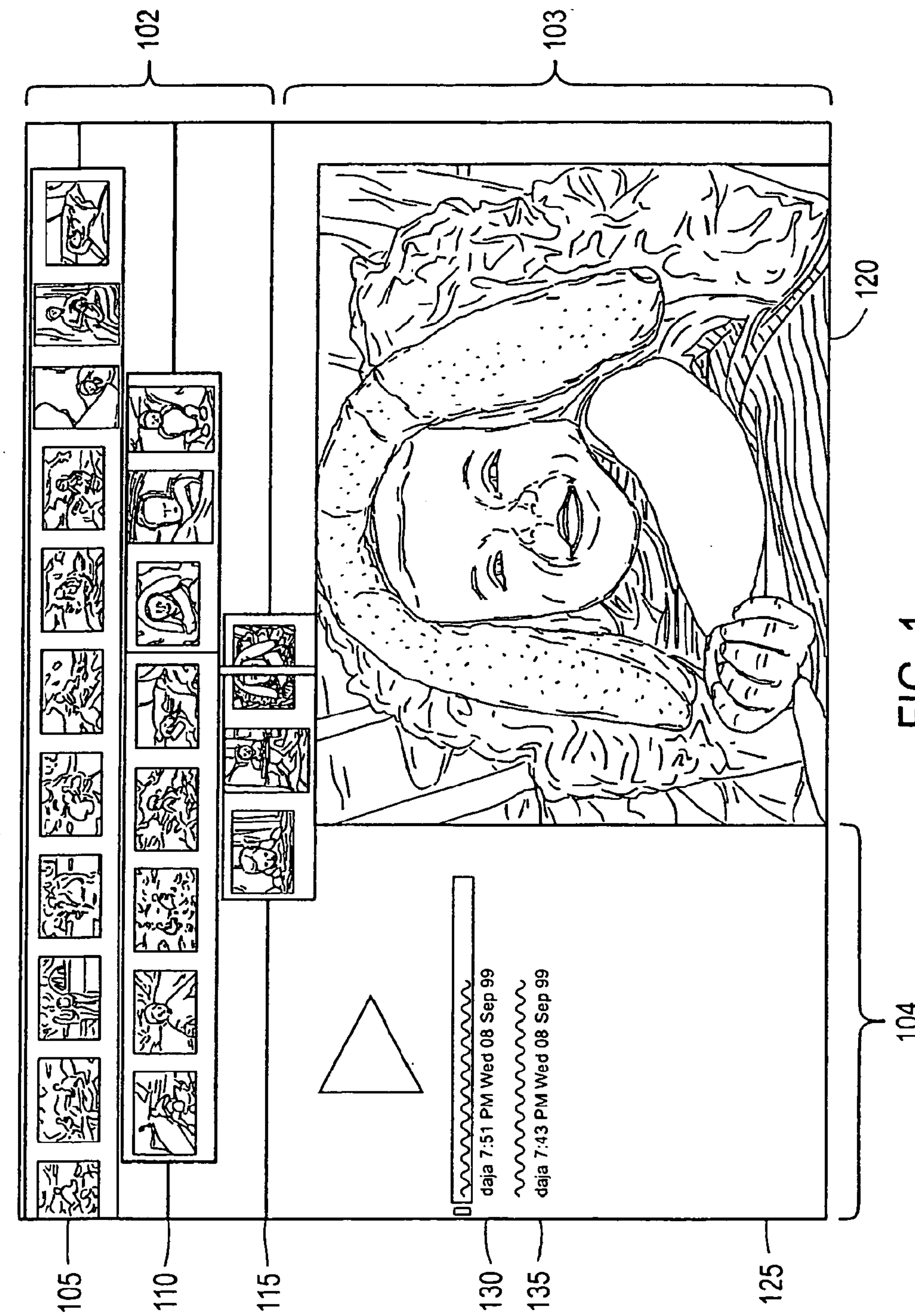

102
103
120
104
105
110
115
130
135
125
daja 7:51 PM Wed 08 Sep 99
daja 7:43 PM Wed 08 Sep 99

FIG. 1

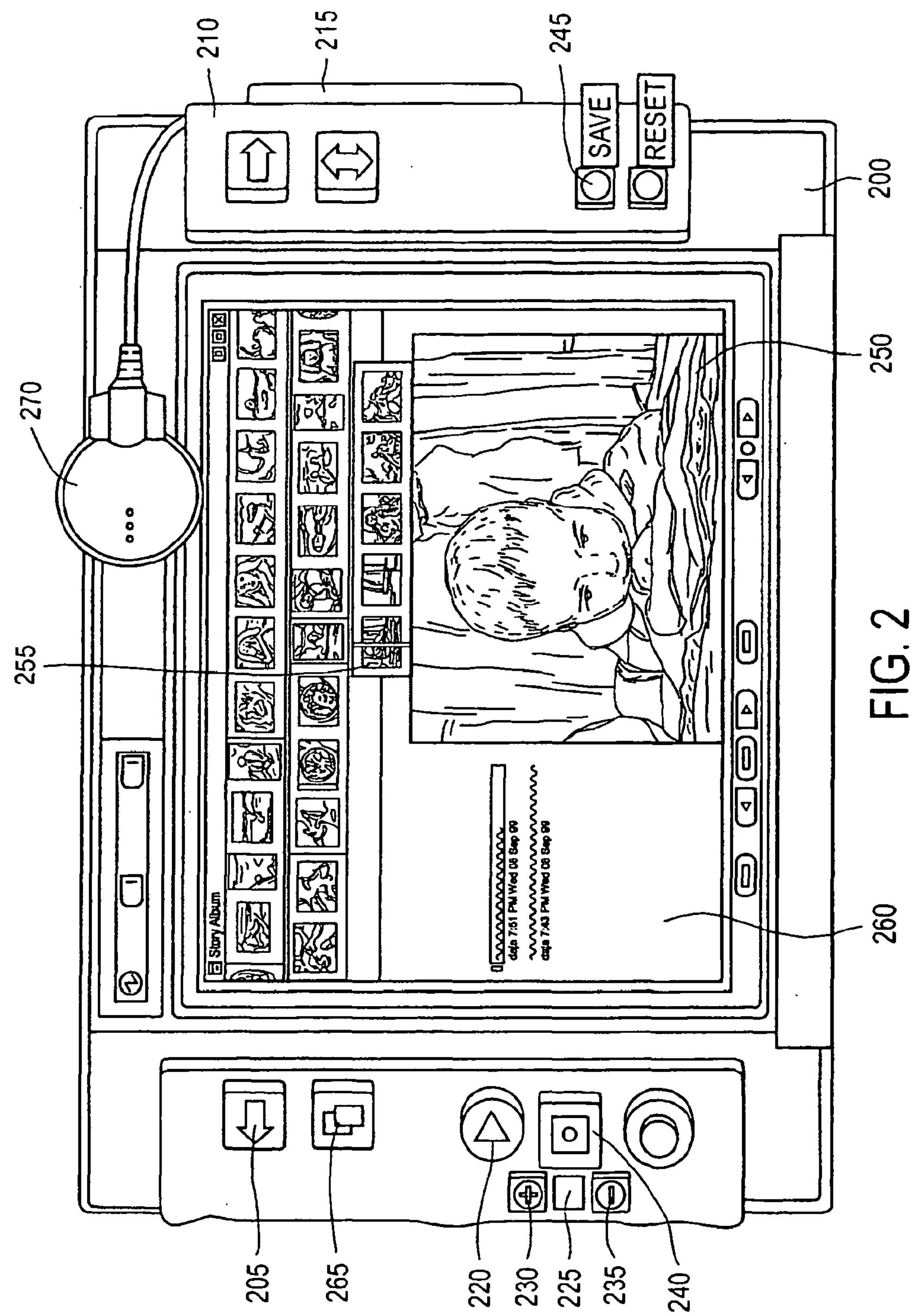

210
215
245
SAVE
RESET
200
270
250
255
Story Album
260
205
265
220
230
225
235
240

FIG. 2

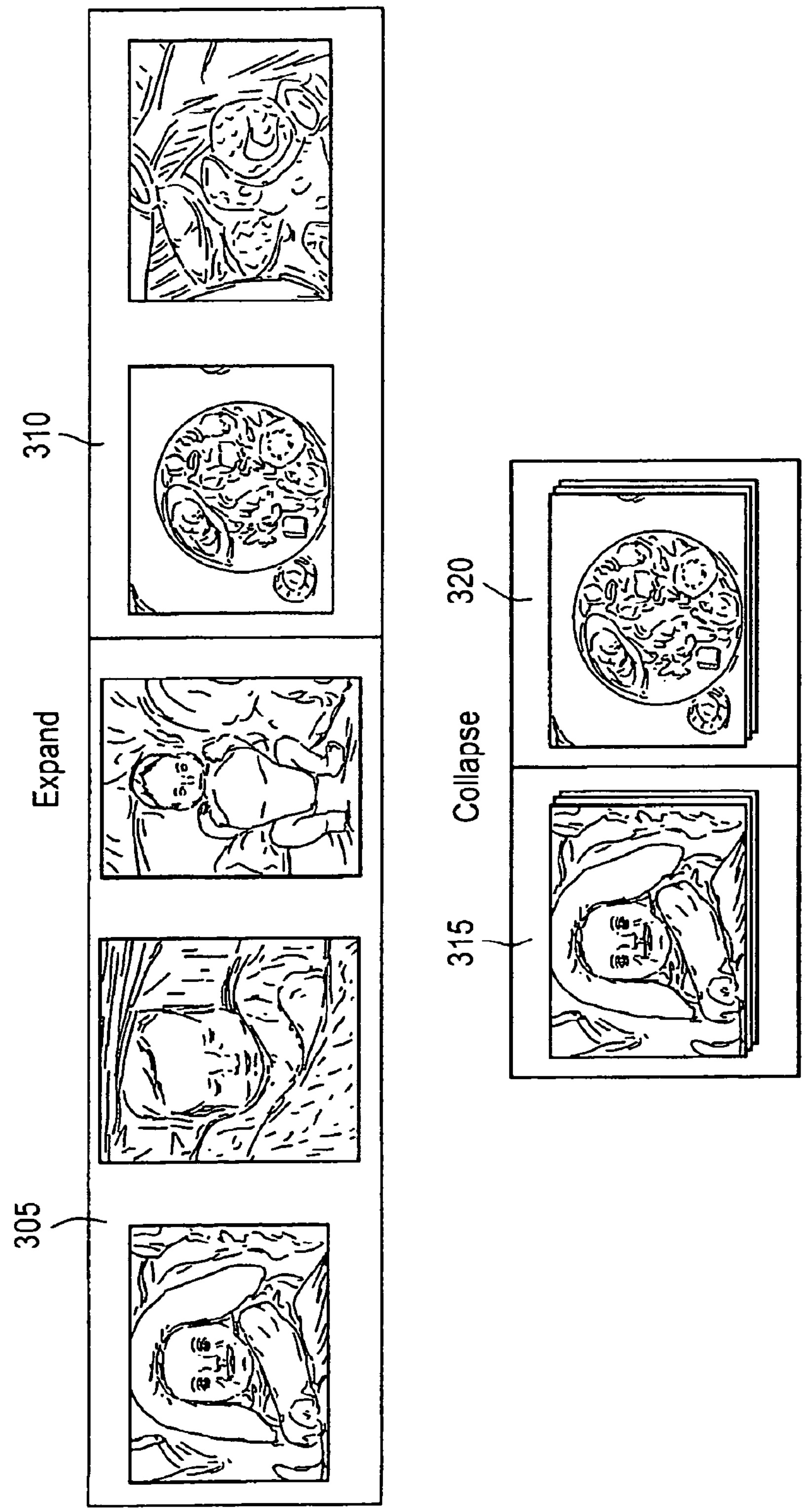


FIG. 3

400

405

```
<?xml version="1.0" ?>
<families>
  <family id="balabanovic">
    <everything-track id="http://Server10/meta6.xml" />
    <stories-track id="http://Server11/meta7.xml" />
    <current-track id="EMPTY" />
    <users>
      <user id="marko" />
      <user id="janet" />
      . . .
    </users>
  </family>
  . . .
</families>
```

FIG. 4

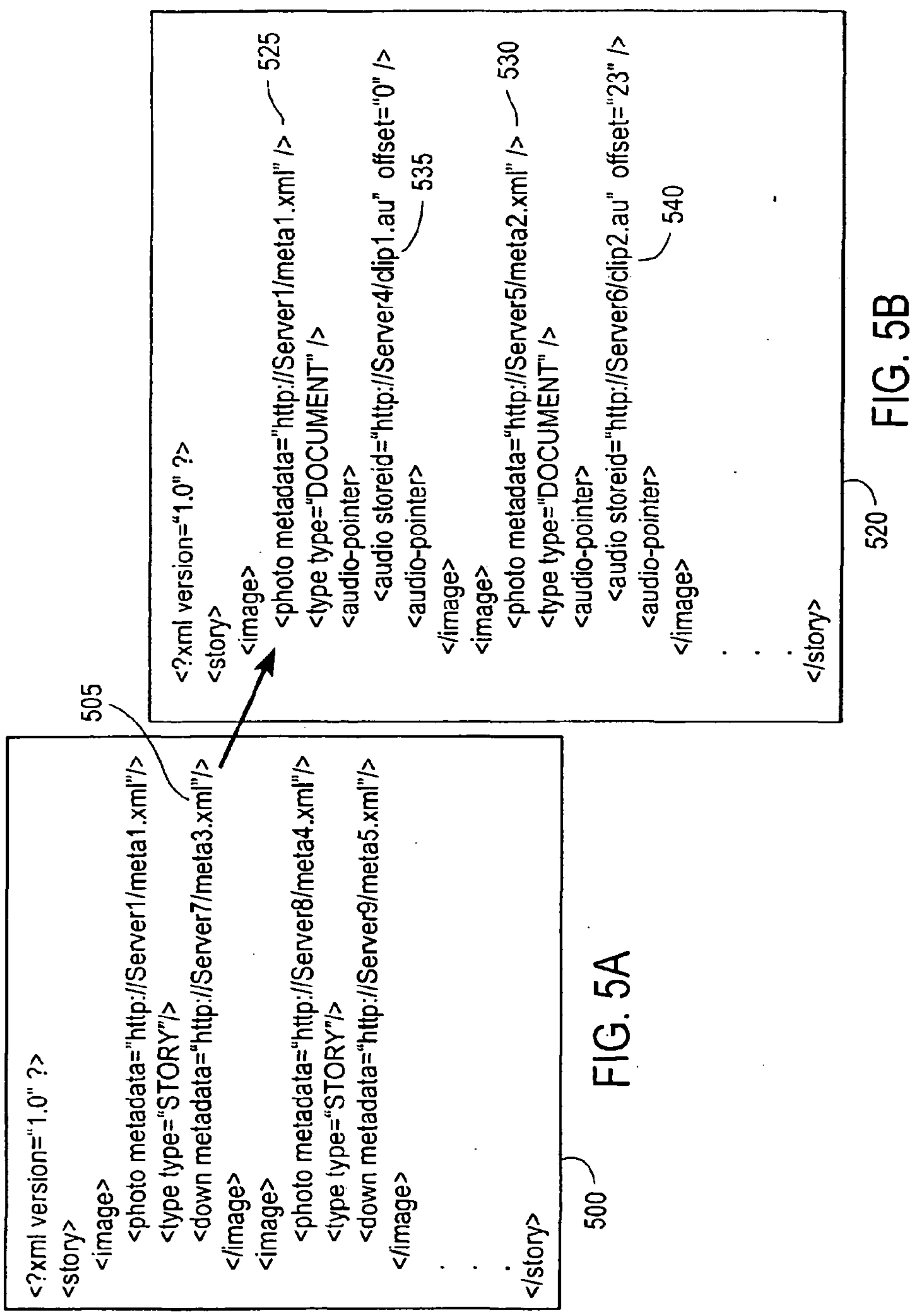
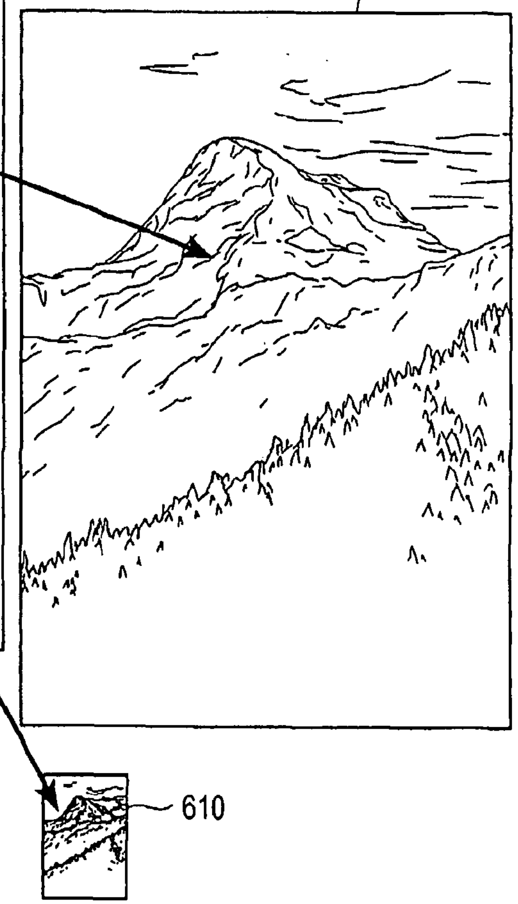

<?xml version="1.0" ?>
<story>
<image>
<photo metadata="http://Server1/meta1.xml"/>
<type type="STORY"/>
<down metadata="http://Server7/meta3.xml"/>
</image>
<image>
<photo metadata="http://Server8/meta4.xml"/>
<type type="STORY"/>
<down metadata="http://Server9/meta5.xml"/>
</image>
. . .
</story>
505
500
<?xml version="1.0" ?>
<story>
<image>
<photo metadata="http://Server1/meta1.xml" />
525
<type type="DOCUMENT" />
<audio-pointer>
<audio storeid="http://Server4/clip1.au" offset="0" />
535
<audio-pointer>
</image>
<image>
<photo metadata="http://Server5/meta2.xml" />
530
<type type="DOCUMENT" />
<audio-pointer>
<audio storeid="http://Server6/clip2.au" offset="23" />
540
<audio-pointer>
</image>
. . .
</story>
520

FIG. 5A

FIG. 5B




```
<?xml version="1.0" ?>
   <full-image id="http://Server2/img1.jpg" />
   <thumb-image id="http://Server3/img2.jpg" />
   <timestamp time="1999-08-13 07:07:42 PDT />
   <full-dimension h="360" w="253" />
   <thumb-dimension h="60" w=42 />
   <reduced-dimension h="10" w="7" />
   <thumb-colors colors="-5392700 -46688979 -4076846 -3682604 -

3551018 -3682603 -4011565 -4471347 -3747882 -3156261 -2827298 -
2761248 -2761504 -3024420 -3484971 -3024420 -2893348 -1776413 -
1118487 -1512984 -1841949 -3419178 -3551019 -3025190 -1645086 -
1645343 -1579551 -2829613 -4932669 -4735288 -4472118 -4801082 -
4670268 -4934212 -9738130 -5393732 -5656390 -5722183 -5722183 -
8289396 -11975093 -12568001 -12568001 -6380369 -7959917 -11053733
-12962245 -12962502 -12108742 -9277574 -11251883--12831175
13094347 -13291213 -13225677 -13160656 -12635083 -12831175
13029327 -13160656 -13226192 -13160656 -13226964 -12832205
12701134 -12832720 -13029586 -13029586 -13029843 -12306890
</photo>                                              -13030101" />
```


600

FIG. 6

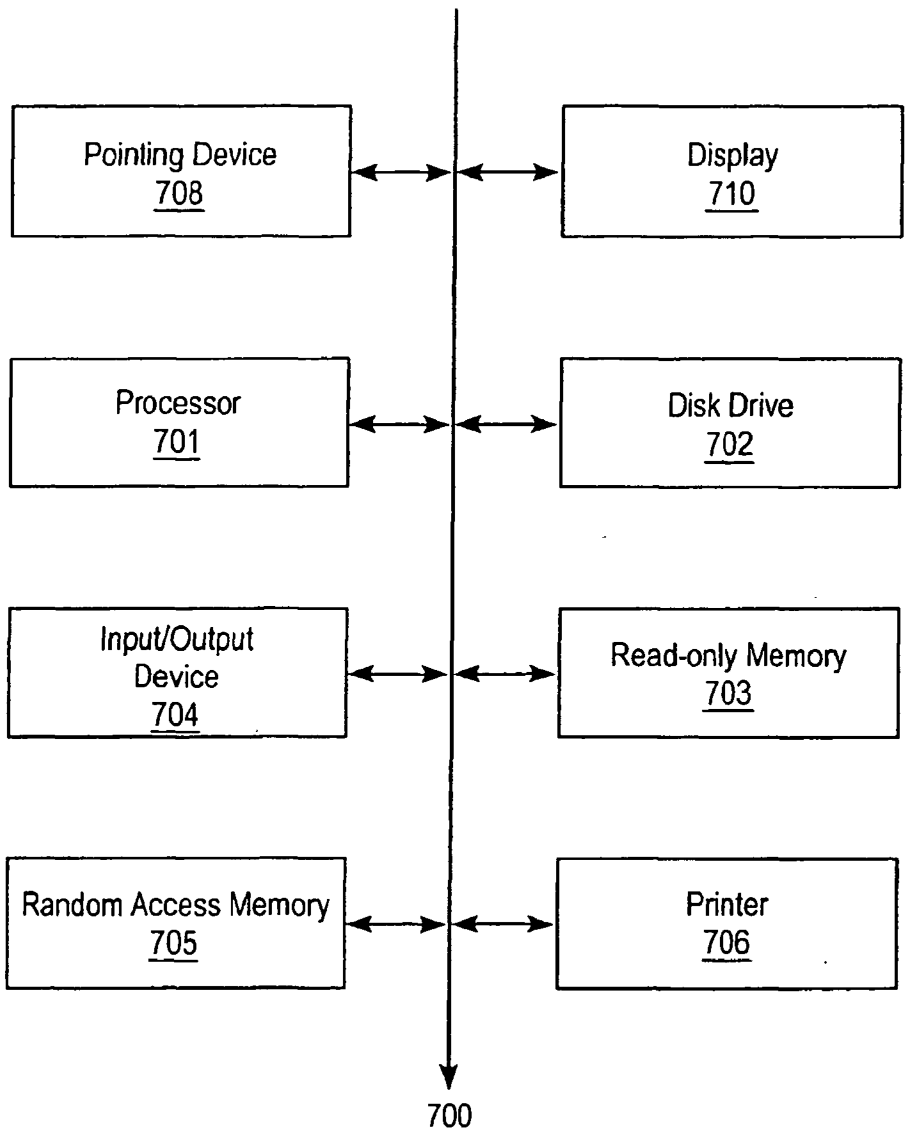

Pointing Device
708
Display
710
Processor
701
Disk Drive
702
Input/Output
Device
704
Read-only Memory
703
Random Access Memory
705
Printer
706
700

FIG. 7

METHOD AND APPARATUS FOR STORYTELLING WITH DIGITAL PHOTOGRAPHS

FIELD OF THE INVENTION

The present invention relates generally to field of image retrieval and organization. More specifically, the present invention is directed to multimedia creation using digital objects (e.g., images).

BACKGROUND

Photographs play a central role in many types of informal storytelling. One of the most common and enjoyable uses for photographs is to share stories about experiences, travels, friends and family. Almost everyone has experience with this form of storytelling, which ranges from the exchange of personal reminiscences to family and cultural histories. The World Wide Web can facilitate the sharing of such stories in digital form and has inspired a movement towards "digital storytelling." Stories in digital form are referred to herein as digital stories. Digital photographs have an advantage over print photographs in that users can search for and retrieve them both by their content (e.g., features such as color and texture) and by their metadata (e.g., user-supplied text annotations). Today, most digital stories are created by people with computer skills using special-purpose software for editing images and authoring Web pages. Furthermore, these digital stories are created on systems relying on graphical interfaces dependent on windows, or tables, and some type of pointing or cursor control device. Such systems are typically not portable and are complex to use. These features make these systems difficult to share. These systems also require significant training and are inadequate for mass consumer use.

SUMMARY OF THE INVENTION

A method and system that combines capabilities for storing, authoring, and viewing various forms of digital media are described. In one embodiment, a visual interface having three areas is provided. The first area displays three tracks of images. One track displays images that are stored on the device. A second track displays images of authored stories. The third track displays one or more images associated with a story currently being authored on the device. Control buttons are available to navigate among the three tracks and among the images on each track.

The second area of the visual interface displays a larger version of an image corresponding to a thumbnail image selected in any of the three tracks in the first area.

The third area of the visual interface displays a representation of one or more audio clips and other information associated with the image being displayed in the second area of the visual interface.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example in the following drawings in which like references indicate similar elements. The following drawings disclose various embodiments of the present invention for purposes of illustration only and are not intended to limit the scope of the invention.

FIG. 1 illustrates an exemplary embodiment of the display screen of one embodiment of a digital story-telling system.

FIG. 2 illustrates an exemplary embodiment of control buttons of the digital story-telling system.

FIG. 3 illustrates an exemplary expand/collapse view of a story.

FIG. 4 illustrates an exemplary XML metadata file that the system reads upon initialization of the system.

FIG. 5A illustrates an exemplary XML metadata for a story.

FIG. 5B illustrates another exemplary XML metadata file for a story.

FIG. 6 illustrates an exemplary XML metadata file for a single photograph.

DETAILED DESCRIPTION

A multimedia story creation and playback system is disclosed. The following detailed description sets forth numerous specific details to provide a thorough understanding of the invention. However, those of ordinary skill in the art will appreciate that the invention may be practiced without these specific details. In other instances, well-known methods, procedures, protocols, components, algorithms, and circuits have not been described in detail so as not to obscure the invention.

Some portions of the detailed descriptions that follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

The present invention also relates to apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general-purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

Overview

A multimedia storytelling system that provides a user capabilities to share digital photographs and stories. In one embodiment, the system allows the user to seamlessly switch between browsing, viewing, authoring, and playing back the photographs and/or stories. In one embodiment, a multimedia storytelling system includes three components: a storage component, a display component, and an interaction component. The storage component stores digital media objects which are displayed by the display component. The system provides the interaction component (e.g., control buttons) that allow a user to navigate the digital media objects and create stories, or playlists. For purposes herein, a story, or a "playlist", is an ordered collection of digital media objects, such as, for example, images or video clips, with one or more narration tracks. Imported stories on the top track may be merely a single photograph with or without a narration track. Photographs may be imported in batches, similar to that of a roll of film. Similarly, a collection may comprise the images of multiple pages in a single document. Thus, although these may not be a narration track, the imported collection of photographs or single photograph may represent a story for purposes herein.

In one embodiment, the digital media stored in the system includes photographs, images, audio and video clips. The digital media may include raw objects, such as, for example individual photographs, as well as authored objects that combine multiple forms of media into integrated stories. An example of an authored object is a sequence of photographs with an audio, or narration, clip associated with or accompanying the photographs. In one embodiment, the time of capture for an object is known and is stored along with the object in the system.

New objects may be input into the system automatically without requiring any action from the user. New objects are input into the system using one or more sources, such as, for example, on flash memory cards containing digital photographs, video capture camera, reading digital photographs or video clips from floppy or CD-ROM drives, network (e.g., Web) downloads, etc. In one embodiment, the user inserts a flash memory card into a slot in the system and the photographs from the flash memory card are automatically copied and stored in the system. In another embodiment, the system is able to receive email messages with attached photographs and stories. The photographs and/or stories are then automatically accessible. It would be apparent to one skilled in the art the various ways multimedia objects may be input into the system.

A narration may take a variety of forms, such as, for example, recorded audio, digital ink, or typed notes. In one embodiment, a narration track may apply to a single object or to a number of objects (e.g., a narration track for a sequence of images). There may be multiple narration tracks for a single object. That is, the same digital object (photograph) may have several associated narrations.

The display component of the system provides multiple tracks displaying digital media objects to the user. One track displays digital media objects that are stored in the system. A second track displays digital media objects that have been integrated into authored stories. The third track displays one or more digital media objects associated with a story currently being authored using the system.

The display component of the system also allows the user to navigate through the objects in storage. This may include being able to browse through raw objects (e.g., objects without narrations associated or attached thereto), browse through stories, and play back previously created stories. In one embodiment, playing back a story involves showing the user a slideshow of images along with any accompanying narrations.

The interaction component of the system allows the user to create new stories. In one embodiment, the user may create new stories using one or more of several approaches. For example, a user may author a story by starting with an empty or blank story, selecting objects to add to the story, and adding narrations to individual objects or a range of objects. The selection of objects and the addition of narrations may be performed in any order. A user may author a new story by performing edit or delete operations on an existing story.

In one embodiment, the system has a modeless interface, giving the users an interface of a small number of buttons and no pointing device or touchscreen. In another embodiment, the system may be implemented on a typical desktop computer or on a standalone appliance. The user controls for such a system may utilize standard input devices, such as, for example, a mouse, a keyboard, a touchscreen, a touch pad, or a physical control environment of buttons and/or sliders designed specifically for the interaction described herein.

FIG. 1 illustrates one embodiment of a display screen and interface of a system. Media objects may be loaded onto the system from various sources, such as, for example, digital cameras, digital video capture, microphones, scanners, or may be created on the system itself. These objects are then stored in the system on a storage medium (e.g., random access memory, a hard drive, flash memory).

As illustrated in FIG. 1, the system provides a visual interface **100** which splits the screen into three general areas. In one embodiment, the first area **102** at the top of the screen, the second, or central, area **103** at the bottom right side of the screen, and the third area **104** at the bottom left side of the screen.

The first area **102** provides a graphical representation for browsing and navigating through media objects (e.g., photographs, etc.). In one embodiment, there are three horizontal tracks of thumbnail images, tracks **105**, **110** and **115**, each of which can be navigated by scrolling.

In one embodiment, the top track **105** shows images of existing photographs ordered by time of creation (or other such features). The time of creation may be indicated by time stamps. These may be grouped into "rolls of film" or other natural clusters. In the case of scanned prints, imported stories may correspond to literal rolls of film. In the case of digital photographs, the photographs may correspond to a set of photographs downloaded from the camera in one session. The top track **105** may also display all or many existing photographs currently stored in the system. That is, any image stored on the system may be displayed. The photographs displayed in the top track **105** may be stories. For example, one or more of the photographs in the top track **105** may be an imported story.

In one embodiment, the imported stories may be generated automatically as a result of a database query. For example, a database query for "all images stored on a device containing blue" returns images having the "blue" identifier. The resulting images are then imported into the system. Note that there is no requirement that the first track **105** include any stories at all. That is, the first track **105** may contain zero or more stories, each of which having one or more images.

Within an imported story, the photographs are ordered chronologically. Photographs from digital cameras may be ordered according to when they were taken, while images scanned from print photographs are ordered by scanning time. In one embodiment, in order to distinguish separate stories, the system uses alternating background colors with each color corresponding to different story.

The middle, or second, track **110** contains authored stories, each including a sequence of one or more photographs selected by an individual. Each story appears as a sequence of thumbnail images. In one embodiment, the imported and authored stories are ordered according to their time of creation with separate stories being visually distinguished using different colored backgrounds. In another embodiment, stories in a track may be separated by spaces in the display. The size of the spaces may depend on the length of time between the story creation times. For example, in one embodiment, photographs taken on the same day are closer together on the second track **110** than those separated by a day or a weekend. The space may be a function of a time duration, but not necessarily linear. For example, there might be set increments for "day", "weekend", "week" and "more than a week".

The bottom, or third, track **115** represents a story being authored. That is, the bottom track **115** includes a working set of thumbnail images that have been selected and manipulated by the user. The set of images may only appear in the bottom track **115** for the current session with the system. If the user wishes to further author a story after a session has ended, the user selects the authored story for inclusion into the bottom track **115**.

In one embodiment, a thumbnail image appears in the bottom track **115** if it has been added to the working set by pressing one or more control buttons (e.g., either of the + (add) or record buttons, as detailed below). At any time, the story being authored has a pending status. When the story is completed and saved by the user, it joins the set of authored stories in the middle track **110**. In one embodiment, the middle track **110** and the bottom track **115** need not be visually distinguished, nor for that matter, any of the tracks.

The display of the three tracks **105**, **110**, and **115** enables an essentially modeless interface where a user can simultaneously view authored stories, view/navigate through photographs and view/create new stories. The display also provides helpful context for viewing the current image. For example, when the user selects a thumbnail and views an image from one story, adds it to the current story, then adds annotation, the context of that image with the surrounding thumbnails in both the original and current story remains visible and helpful for annotation.

In one embodiment, each thumbnail image appears exactly once in the top track **105**. It may appear in any number of stories in the middle track **110** and appears in the bottom track **115** only if it has been explicitly added to or annotated as part of the story currently being authored.

In a typical interaction, the user comes across a thumbnail image and adds it to the working set (bottom track **115**). The users may also record a related voice narration to accompany the selected thumbnail image. At the end of the session, all the thumbnail images in the bottom track **115** are grouped into a single story, and the story is then appended or added to the middle track **110**.

The central area **103** of the screen display shows a large image **120**. The large image **120** corresponds to a thumbnail image of a story or photograph currently being selected in the tracks in the first area **102**. This allows the user to view photographs at a size that is comfortable and enjoyable (as opposed to the smaller thumbnail versions in tracks **105**, **110** and **115**). In another embodiment, other objects may require other display characteristics.

The third area **104** of the screen display shows the available audio narrations of the photograph currently displayed in the central area **103**. In another embodiment, other information, such as, for example, creation date may also be displayed in the third area **104**. As shown in FIG. **1**, there are two narrations **130** and **135** available for the photograph **120** in the central area **103** indicated by the depiction of the wave signal. In one embodiment, each narration has a visual display corresponding to the length of time of the narration (e.g., the longer the signal wave the longer the narration), together with related recording information, such as, for example, time and date recorded, and the name of recording user.

FIG. **2** illustrates an exemplary embodiment of the control buttons and the display of a system for creating and/or viewing multimedia stories. In one embodiment, the control buttons are integrated into and positioned at the sides of the body of the system to enable the user manipulate the controls while holding the system in two hands. This further removes the need for a keyboard, mouse, or other device that forces the user to let go of the system.

As illustrated in FIG. **2**, the control buttons in this embodiment include navigation buttons such as a scroll left button **205** to scroll the images in a selected track to the left, a scroll right button **210** to scroll the images in a selected track to the right, and a track selection button **215** to select the track to scroll. In one embodiment, a jog shuttle is used to control scrolling.

In one embodiment, a colored (e.g., yellow) vertical line **255** indicates the selected track and the selected thumbnail image of this track. The vertical line **255** is shown in the first thumbnail image of the bottom track. The selected thumbnail image corresponds to the large image displayed in the central area **250**. The track selection button **215** moves the vertical line **255** between the three different tracks.

When either of the scroll buttons **205** or **210** is pressed, the new selected thumbnail image on the current track either to the left or to the right side of the previously selected thumbnail image is selected and displayed in the central area **250**. As a different thumbnail image moves under the vertical line **255**, the corresponding image is displayed in the central area **250**. Note that any type of indicator or indication may be used on the screen to select an image. It should also be noted that while in one embodiment, the scroll button **205** or **210** causes the images in the track with the vertical line **255** to move to the left or right while leaving the vertical line **255** in place, the system could keep the images in place while moving the vertical line **255** to select an image. In one embodiment, the navigation between the images may be controlled by an external joystick communicating with the system through a joy stick interface.

In one embodiment, the user may quickly traverse the thumbnail images on a track by using variable-speed scrolling. At standard speed, the display appears as shown in FIG. 2. In one embodiment, standard speed refers to pressing one time on the left scroll button **205** or the right scroll button **210**. This moves the track by exactly one thumbnail image. Faster scrolling speeds may be enabled by rendering low resolution versions of the thumbnail images that are quickly accessible from a separate index in the system and by not rendering the image in the central area **250** or the narrations in the audio area **260**. In one embodiment, such images may be cached in memory to increase access speed. To increase scrolling speed, the user may need to hold down a scroll buttons **205** or **210** for a longer period of time. When this occurs, the images appear to be scrolling faster by the vertical line indicator **255**.

In one embodiment, an expand/collapse button **265** controls the view or the number of photographs displayed for each story on one of the three tracks. In the expanded view, every thumbnail image in a story is shown. In one embodiment, the expanded view is the default view. In the collapsed view, each story is represented by a predetermined number of thumbnail images (e.g., one thumbnail image). In one embodiment, a first thumbnail image of the story is used to represent the story. The collapsed view allows for faster navigation. FIG. **3** illustrates an exemplary expand/collapse view of a story. Referring to FIG. **3**, the two stories **305** and **310**, with thumbnail images belonging to one story having the same colored background, are shown in expanded form. The same two stories are illustrated in collapsed form in thumbnails **315** and **320**, with the first thumbnail image of each story **305** and **310** being used as the thumbnail image in the corresponding collapsed form.

Referring back to FIG. **2**, the cluster of buttons at the bottom left of the system **200** provides the user with additional controls for authoring, browsing and playing back of stories. A play button **220** is used to enter a play mode to allow an individual to view existing stories. During the play mode, the system starts playback from the currently selected thumbnail image. In one embodiment, although not necessary, each thumbnail image has an audio clip associated with it as part of a story in which it resides. Furthermore, each thumbnail image may be part of more than one story, and thus may have more than one audio clip associated with it, one audio clip for each story. However, an audio clip may or may not contain any recorded narration. If a narration exists, it is played through a built-in loudspeaker in the system (not shown). If there is no recorded narration, there will be a pause of a certain length of time, for example one second. After the narration is played or after the pause (due to not having the narration), the selected track automatically scrolls forward to a next thumbnail image in the story. In one embodiment, the next thumbnail image is determined based on a default viewing and storytelling direction of left-to-right. If the user navigates to a new thumbnail image while the system is playing, for example scrolling left or right, changing to a different track, playback of the currently playing audio clip is stopped. If the user takes no further action for a brief length of time (e.g., one second), the system plays the audio clip associated with the newly selected thumbnail image and continues with that story from that point on.

As discussed above, the selected thumbnail image may have more than one associated audio clip and corresponding narrations. Whenever a thumbnail image is selected, all of the audio narrations associated with that thumbnail image are displayed in the audio area **260**. In one embodiment, if the selected thumbnail image has more than one associated audio clip, and when the system is playing an audio clip, pressing the play button **220** causes the system to advance to a next audio clip.

Referring to FIG. **1**, there are two available narrations for the selected thumbnail image, narration **120** and narration **125**. Each narration is marked with the time of recording and the name of the recording user. The length of the wavy lines is proportional to the duration of the audio. The narration associated with the selected story is listed first, as in narration **120**. Referring to FIG. **2**, the narration associated with the selected story is played by default when the play button **220** is pressed. Pressing the play button **220** multiple times in quick succession selects one of the alternate audio clips and playback "jumps" to the corresponding story, providing a method of automatic hyperlinking between stories.

The system remains in the play mode until the stop button **225** is pressed or until the end of story is reached. When this occurs, the system enters into stop mode. While in the stop mode, no audio clip is played by the system.

In one embodiment, while the system is in the play mode, the remove (–) button **235** has no effect on the play mode of the system. However, pressing the add (+) button **230** adds the currently displayed image to the working set. Thus, the system appends the currently displayed image to the working set, but it does not stop the play mode. Furthermore, if the user presses the save button **245** while the system is in the play mode, the system stops playing the audio clip and performs a save operation. Furthermore, if the user presses the record button **240** while the system is in the play mode, the audio clip is stopped.

In one embodiment, while in the authoring mode (not the play mode) a story may be created by pressing the + (add) button **230** when the vertical line **255** is positioned over a particular thumbnail image to append a copy of that currently selected thumbnail image onto the working set or the bottom track **115**. The – (remove) button **235**, conversely, removes the selected thumbnail image (i.e., the image over which the vertical line **255** is positioned) from the working set on the bottom track **115**.

While in authoring mode, pressing the record button **240** starts the recording function. While the recording function is active, the audio recorded by the microphone is stored and associated with the currently displayed thumbnail image in the working track. In one embodiment, this is done by making a link in the underlying XML file. If the thumbnail image is not already in the working set, it is appended before the recording begins, as though the + button **230** was pushed first. If the selected thumbnail image is already on the working track, the new recording overwrites any previous recording associated with the thumbnail image in the story being authored. While recording, if the user selects a new thumbnail image, such as, for example by scrolling left or right, by changing to a different track, or by pressing the expand/collapse button, the recording continues for the audio clip associated with the new thumbnail image. In addition, the new thumbnail image is appended to the working track, if it is viewed for more than a short time, (e.g. 1 second). However, if the user scrolls left or backward, but still remains on the working track, recording is automatically stopped. This prevents accidental erasures. In other embodiments, the new thumbnail image is inserted at a point before or after the thumbnail image last selected on the working track (e.g., the center image of track **3**). In this situation, recording continues starting with the audio clip associated with the new inserted thumbnail image. Furthermore, pressing the play button **220** also stops the recording mode and put the system in the play mode. This makes recording a story as similar to viewing a story as possible.

In another embodiment, the system may include a touch-screen or a pointing device (e.g., cursor control device). In this case, while in the recording mode, the user's pointing gestures would be captured. During playback, areas that had been pointed to are highlighted at appropriate times. One way to perform highlighting is to darken the rest of the image. Alternatively, a semi-transparent overlay can be used (e.g., a yellow circle).

When the system is in the stop mode, the user may drag thumbnail images from one track to another, or the user may drag thumbnail images to different points within a story. Alternatively, a dragging operation can be used in place of scroll left/right to move all or multiple images in a track at the same time.

Pointing to a particular thumbnail selects the thumbnail image, selects the track the thumbnail image is on, and displays the corresponding large image in the central area **250**. In another embodiment, touching the screen may highlight an image in a track but not select it.

In one embodiment, the recording operation supports both "select then narrate" and "select while narrating" strategies. In "select then narrate" strategy, the users may compose a story by first selecting a working set of thumbnail images using the + button **230** or the – button **235** and then annotating each thumbnail images in order. Alternatively, in the "select while narrating" strategy, the users may continuously record narrations while navigating and selecting photos. When recording is active, each new photograph that a user views for longer than a short time interval is automatically added to the working set along with any recorded input. This supports the "select while narrating" strategy. For sound recording, in one embodiment, a microphone **270** is attached to or integrated into the external body of the system. In another embodiment, the device is equipped with a speech recognition software to translate audio narration into text.

The group of buttons at the bottom right of FIG. **2** controls story operations. The save button **245** "saves" the current working story that is displayed on the bottom track by moving it to the end of the middle track. Note that the current state of the system is also saved to the system storage device at that time. The XML files (or equivalent representations) along with audio clips may be stored in memory (e.g., RAM) and written out to a hard disk when saved. (They may also be written out at other times.) In another embodiment, the user would also have the option of electronically sending a completed story to another user for viewing on a similar system or on a regular PC via a media player application or standard Web browser. In another embodiment, a "print" button allows the user to print a selected image on a locally connected, via wire or wireless technology, printer or a remote device.

In one embodiment, the system has an attached image creation/capturing device (e.g., a video camera). The video camera can point inward at the holder of the system or it can point outward. A take-picture button on the system allows the user to take a still image from the camera, time-stamp, and add the image to the top track. In another embodiment, an image of the narrator is automatically grabbed by the camera at the beginning of every recording session, or at pre-set intervals, or every time the video input changes by more than some predetermined threshold. Using the video camera, the images captured by the video camera may be added to the first track **105** and available for inclusion in authored stories like all other objects in the system.

In one embodiment, stories and metadata about photographs are stored on the storage device in Extensible Markup Language (XML). FIG. **4** illustrates an exemplary XML metadata file that the system reads during initialization. The initializing metadata file **400** is stored in a predetermined known location on the storage device. In one embodiment, the initializing metadata file is named "families.xml" and the location of the file is determined using a local Uniform Resource Locator (URL) corresponding to the file on the storage device of the system. For each possible group (e.g., family) using the system, the initializing metadata file contains pointers to the stories corresponding to the three tracks. For example, the metadata file of FIG. **4** points to a story file **405** "meta6.xml". In one embodiment, the initializing metadata file also maintains further administrative functions, such as, for example, user ids and passwords to prevent unauthorized viewing of personal stories. In one embodiment, the initialization file contains user specific information. In another embodiment, the system assumes a single user.

FIG. **5A** illustrates an exemplary XML metadata for a story. The XML metadata file for story **500** points to two other stories, "meta3.xml" **505** and "meta5.xml" **510**. Note that each metadata file has an associated "type" attribute having a value of either "story" or "document" indicates single object. FIG. **5B** illustrates another exemplary XML metadata file for a story. Metadata file **520** represents the story "meta3.xml" **505** pointed to by the metadata file **500**. Metadata file **520** has a list of photographs shown as "meta1.xml" **525** and "meta2.xml" **530**. Note that the photograph references are in the form of the URL of the corresponding metadata XML file. Each photograph may also have an associated audio clip shown as "clip1.au" **535** and "clip2.au" **540**. In one embodiment, the offset attribute of the audio tags associated with audio clip **535** or audio clip **540** specifies a starting location of the referenced audio narration (such as when, for example, one audio file contains more than one user-supplied audio narration) within the audio file and is measured in milliseconds.

FIG. **6** illustrates an exemplary XML metadata file for a single photograph. Metafile **600** represents the image "meta1.xml" pointed to by the metafile illustrated in FIG. **5B**. Metafile **600** includes URLs that point to two image files, a full size image **605** that may be used in area **103** of the display and a thumbnail image **610** that may be used in the tracks **105**, **110**, and **115**. In addition, the metafile **600** includes color data for a reduced representation. The reduced representation of the image may be rendered either as a thumbnail image or as a full size.

In one embodiment, using XML allows for easy translation to other formats such as Hypertext Markup Language (HTML) or Synchronized Multimedia Integration Language (SMIL). This enables stories to be shared with others and viewed on different devices. The SMIL format is especially appropriate as it allows the synchronization of audio with a series of images to match the structure of the stories. Using any of these formats, a story including the associated photos and audio clips can be saved in a file. The file may then be uploaded to a web server and assigned a unique URL. The URL may then be sent on the web to specified recipient or list of recipients by email using the standard email protocols, for example SMTP. In one embodiment, to send the electronic mail (email), the system provides a network interface, for example Ethernet, modem, or wireless. Alternatively, the file may be sent to the recipient(s) as an email attachment using a standard attachment encoding technique, for example Multipurpose Internet Mail Extensions (MIME).

In one embodiment, the email address of the recipients may be specified using the scroll left/right and the add (+)/remove (–) buttons. These buttons are used to navigate among letters and punctuation symbols displayed on the top track **105**. An email address may be constructed on the bottom track **115**. The middle track may be used to display previously saved email addresses. Email addresses of people who send stories to the users may automatically be added to the second track. Furthermore, the system may accept input email addresses through a "contact" file or vCard file (a Personal Data Interchange (PDI) technology developed by the Versit Consortium) beamed by IR from a PDA (e.g., a Palm Pilot). To generate a new email address, the user may use a stylus to type on an on-screen keyboard. Using the stylus, handwriting recognition software, for example Graffiti by Palm Computing, may be used to recognize the user's handwriting. Alternatively, the user may use an external keyboard plugged into a keyboard interface provided by the system. Besides sending stories to email recipients, the system may also automatically check for new stories, for example, in the form of email messages or a predetermined web page listing new stories sent to the device/owner, at set intervals or at set times of day. The system may also automatically download any new stories or messages.

In one embodiment, the system includes a cradle or docking station that includes power and network interface. In one embodiment, all communication (sending/receiving messages) is queued for execution when the system is docked. The communication then occurs automatically when docked. In one embodiment, while the system is in the cradle or otherwise unused for a set period of time, an auto play screen saver feature is activated causing the screen to cycle through all the stories in the system.

In one embodiment, the system may create a movie file using the images and the associated audio clips in synchronization with each other, just as they are shown on the system when the user presses the play button. The movie file may then be stored in a standard format, such as, for example MPEG, AVI, or QuickTime, and may then be sent to the recipient(s) as an email attachment. In another embodiment, the author of a story may choose to send his or her own photograph to be associated with a story when the story is sent to a recipient. A link to this photograph is included and associated with the email. When the recipient views the email, the photograph of the author is displayed in an image slot. Alternatively, the photograph associated with the author might also be displayed as the first photograph in a story, or somehow combined with the first photograph especially for the collapsed view.

As discussed above, the system may accept as input media objects from various sources. In one embodiment, other media objects, for example video clips, presentation slides, pages of documents, web pages, and audio clips may also be loaded onto the system. With the video clips as input, an incoming video stream can be captured through a standard analog video capture board, or via a "firewire" (IEEE 1394) interface, or by direct connection to an already-digitized video file, for example a MPEG file, or a QuickTime file. The stream can then be segmented into clips using standard scene-change detection algorithms. Each clip can then be treated as a photograph. Furthermore, each clip may already have an associated audio segment from the original video source. In this embodiment, pressing the play button enables the system to play both the audio segment and the video clip synchronized with each other. The system then moves on to a next clip of the story. A first frame of the video clip may be used as a thumbnail image representing the video clip.

With presentation slides as input, the system creates an image for each presentation slide. The presentation slides may have been generated by presentation software (e.g., Powerpoint) or other document or graphics editing tools. The story is then viewed on the system as a sequence of slides, similar to a presentation. With the pages of document as input, a story in the top track corresponds to the pages of an original document, in order. A story in the middle track is a collection of reorganized pages with added audio commentary, for example a summary. Documents can easily be imported from existing formats, both page-based, for example Postscript, or PDF, and linear, for example HTML, or plain text. In the latter case a pagination operation would be required.

With Web pages as input, the top track **115** may contain a user's chronological browsing history. This may be captured by monitoring a Web browser or by acting as a proxy server intercepting and serving all of a user's HTTP requests. Each story corresponds to a length of time (e.g., one day or one browsing session, etc.). The second track allows the user to compose and sequence groups of Web pages for easy access and later retrieval. In the second track, a story might correspond to a bookmark folder, a series of pages found in the course of one search, or any other structure as is useful to the user.

With the audio clips as input, the top track may represent "albums" or audio CDs that the user has scanned into the system via a CD-ROM drive, or downloaded from the Web directly as a series of audio files, for example MP3 files from MP3.com, Windows Media Audio files from Microsoft, Liquid Audio files from LiquidAudio.com, RealJukebox files from Real Networks, etc. Each "album" is an ordered set of "songs". The second track represents the user's "playlists" (e.g., the user's own sequences of songs to be played). In this case, there is a default visual representation for each song, or the user chooses relevant icons, or a Web service provides icons to match artist names, song titles or album titles.

FIG. **7** illustrates an embodiment of an exemplary computer system that comprises the storage, display and interaction components of the digital story creation and play back system. The various components shown in FIG. **7** are provided by way of example. Certain components of the computer in FIG. **7** can be deleted from the system for a particular implementation of the invention. In other systems, additional components may be added without affecting the scope of the present invention. In other systems, additional components may be added without affecting the scope of the present invention.

FIG. **7** illustrates a system bus **700** to which various components are coupled. A processor **701** performs processing tasks required by the computer. Processor **701** may be any type of processing device capable of implementing the steps necessary to perform the storage, displaying, and interaction capabilities described herein. An input/output (I/O) device **704** is coupled to bus **700** for communicating with other devices coupled to the computer. A read-only memory (ROM) **703** and a random access memory (RAM) **705** are coupled to bus **700** to provide storage for various data and information used by the computer. Although ROM **703** and RAM **705** are shown coupled to bus **700**, in alternate embodiments, ROM **703** and RAM **705** are coupled directly to processor **701** or coupled to a dedicated memory bus (not shown).

A video display **710** is coupled to bus **700** and displays various information and data to the user of the computer. A disk drive **702** is coupled to bus **700** to provide long-term mass storage of information. In one embodiment, a pointing device **708** is coupled to bus **700** for entering information and commands to the computer system. In another embodiment two displays may be used, one low resolution display for the 3 tracks and a high-resolution display for the main viewing area. The main viewing area may not be needed for audio and other media.

From the above description and drawings, it will be understood by those of ordinary skill in the art that the particular embodiments shown and described are for purposes of illustration only and are not intended to limit the scope of the invention. Those of ordinary skill in the art will recognize that the invention may be embodied in other specific forms without departing from its spirit or essential characteristics. References to details of particular embodiments are not intended to limit the scope of the claims.

What is claimed is:

1. A system comprising:

means for displaying a first list of reduced visual representations in a first track of a first display area, the first list of reduced visual representations including a plurality of media objects ordered automatically in chronological order and grouped by media objects relating to one another;

means for recording an audio narration to be associated with at least one of the reduced visual representations, the recorded audio narration being displayed within a second display area different from the first display area;

means for displaying within the second display area an icon representing the recorded audio narration comprising a non-numeric, visual representation corresponding to a length of the audio narration;

means for displaying in a second track different from the first track within the first display area a second list of reduced visual representations of the plurality of media objects selected from the first list of reduced visual representation displayed in the first track of the first display area, the second list including one or more authored stories and each story having an audio narration associated with at least one of the reduced visual representations; and

means for displaying in a third track different from the first and second tracks within the first display area a third list of reduced visual representations selected from the first track, the third list of reduced visual representations representing a story being authored including associating one or more audio narrations with one or more reduced visual representations displayed within the third track.

2. The system of claim **1** wherein the first list comprises imported stories, and the second list comprises authored stories.

3. The system of claim **1** wherein the display means displays imported stories, the authored stories, and/or a representation for each associated audio clip or a selected object in the imported stories or the authored stories.

4. The system of claim **3** further comprising means for displaying in a third display area different from the first and second display areas one of the reduced visual representations of the third track of the first display area, wherein the displayed visual representation is displayed in the third display area having a resolution larger than the corresponding reduced visual representation displayed in the third track of the first display area, and wherein the displayed visual representation in the third display area indicates a current visual representation being authored using at least one of the audio narrations displayed in the second display area.

5. The system of claim **1** further comprising:

means for moving the authored story from the second track to the third track such that a user can edit the authored story; and

means for moving the authored story from the third track back to the second track once the user completes authoring.

6. The system of claim **1** wherein means for displaying a first list of reduced visual representations of a plurality of media objects comprises means for displaying a series of audio files.

7. The system defined in claim **6** wherein the audio files are from a group comprising MP3 files, Liquid Audio files, and RealJukebox files, WAV files, or other compressed or uncompressed audio file formats.

8. The system of claim **1** wherein means for displaying a first list of reduced visual representations of a plurality of media objects comprises means for displaying a plurality of video clips.

9. The system defined in claim **8** wherein the video clips are from a group comprising MPEG files, QuickTime files, AVI files, and RealVideo files.

10. A method comprising:

displaying a first list of reduced visual representations in a first track of a first display area, the first list of reduced visual representations including a plurality of media objects ordered automatically in chronological order and grouped by media objects relating to one another;

recording an audio narration to be associated with at least one of the reduced visual representations, the recorded audio narration being displayed within a second display area different from the first display area;

displaying within the second display area an icon representing the recorded audio narration comprising a non-numeric, visual representation corresponding to a length of the audio narration;

displaying in a second track different from the first track within the first display area a second list of reduced visual representations of the plurality of media objects selected from the first list of reduced visual representation displayed in the first track of the first display area, the second list including one or more authored stories and each story having the audio narration associated with at least one of the reduced visual representations; and

displaying in a third track different from the first and second tracks within the first display area a third list of reduced visual representations selected from the first track, the third list of reduced visual representations representing a story being authored including associating one or more audio narrations with one or more reduced visual representations displayed within the third track.

11. The method of claim **10** wherein the first list comprises imported stories, and the second list comprises authored stories.

12. The method of claim **10** wherein displaying the plurality of media objects comprises displaying imported stories, the authored stories, and/or a representation for each associated audio clip for a selected object in the imported stories or the authored stories.

13. The method of claim **12** further comprising displaying in a third display area different from the first and second display areas one of the reduced visual representations of the third track of the first display area, wherein the displayed visual representation is displayed in the third display area

having a resolution larger than the corresponding reduced visual representation displayed in the third track of the first display area, and wherein the displayed visual representation in the third display area indicates a current visual representation being authored using at least one of the audio narrations displayed in the second display area.

14. The method of claim 10 further comprising:

moving the authored story from the second track to the third track such that a user can edit the authored story; and

moving the authored story from the third track back to the second track once the user completes authoring.

15. The method of claim 10 wherein displaying a first list of reduced visual representations of a plurality of media objects comprises displaying a series of audio files.

16. The method defined in claim 15 wherein the audio files are from a group comprising MP3 files, Liquid Audio files, and RealJukebox files, WAV files, or other compressed or uncompressed audio file formats.

17. The method of claim 10 wherein displaying a first list of reduced visual representations of a plurality of media objects comprises displaying a plurality of video clips.

18. The method defined in claim 17 wherein the video clips are from a group comprising MPEG files, QuickTime files, AVI files, and RealVideo files.

19. A system comprising:

a storage device having a plurality of stories, each story comprising a plurality of objects; and

a processor in communication with the storage device, the processor to

display a first story track within a first display area a plurality of imported stories which have objects automatically ordered in chronological order,

record an audio narration to be associated with at least one of the reduced visual representations;

display within a second display area different from the first display area an icon representing the recorded audio narration comprising a non-numeric, visual representation corresponding to a length of the audio narration;

display a second story track of the first display area different from the first story track for a plurality of authored stories including the recorded audio narration,

display a full size image of a selected object in the story in a third display area, the full size image representing the selected object being authored using at least one of the audio narrations displayed in the second display area,

process navigation input from a user, the navigation input comprising moving a track selection from one story track to another story track, moving an object selection from one object to another object, and

process operational input from the user, the operation input comprising playing the story, stopping recording or the playing, and saving the story.

20. The system of claim 19 wherein process operational input from the user further comprises recording a narration for the selected object.

21. The system of claim 19 wherein the processor is further operable to display a third story track for a story being constructed, and wherein the navigation input further comprises adding an object to the third track, and removing an object from the third track.

22. The system of claim 19 wherein the processor is further operable to display a plurality of narrations associated with the selected object.

23. The system of claim 19 further comprising an object input device to input new objects, the new objects comprising imported stories, digital photographs, video clips, pages of documents, presentation slides, audio clips, and web pages.

24. The system of claim 19 further comprising a docking cradle for communication and an output device to send a story to a recipient's email address in the form of email attachment.

25. The system of claim 24 further comprising sending the story to a web server, assigning unique URL to the story, and sending the URL to the recipient by email.

26. The system of claim 19 further comprising a recording device to record a narration for the audio clip, the recording device being one of a group comprising voice activated recording and microphone recording.

27. The system of claim 19 wherein the selected object is in one or more stories and has one or more associated audio clips, each audio clip is associated with one story, and each audio clip has zero or one narration.

28. The system of claim 19 wherein displaying an audio clip comprises displaying all audio clips associated with the selected object, and wherein the audio clip associated with the story is displayed as a current audio clip, the current audio clip is played before all other audio clips.

29. The system of claim 19 wherein the story under construction in the third story track is placed at the end of the second story track when the construction is completed and wherein the story is saved in the storage device.

30. The system of claim 29 further comprising grouping objects in the third story track and recording a narration for each object, and wherein saving the story comprises saving the objects and the associated audio clips.

31. The system of claim 29 wherein the story and the associated objects are saved as files in the storage device using a markup language format.

32. The system of claim 31 wherein the markup language format comprises HTML, SMIL, or XML.

33. The system of claim 19 wherein playing the story comprises

selecting a story from the first track, from the second track, or from the third track using the navigation input, activating a play operation, and

viewing the full size image corresponding to each of the plurality of objects in the selected story.

34. The system of claim 33 wherein viewing the image comprises

selecting the objects in the story in a sequence, wherein the sequence is from beginning of the story to end of the story, and

playing the audio clip corresponding to the selected object.

35. The system of claim 19 further comprising a pointing device configured to enable the user to perform track selection, object selection, and moving of the selected object from one track to another track, the pointing device being one from a group comprising a mouse, an external joy stick, a voice activated control device, a touch screen, a track pad, and a cursor control device.

36. The system of claim 19 further comprising an attached video camera, the video camera used to add new objects to the first track.

37. The system of claim 19 wherein the objects in the first track, the second track and the third track are displayed as thumbnail images or in reduced representation of the corresponding objects.

38. The system of claim 37 wherein a first thumbnail image for each story is used to represent the corresponding story when the tracks are configured to display in collapsed form.

39. The system of claim 19 wherein moving the object selection from one object to another object comprises displaying the thumbnail images in high resolution if the movement is in standard speed and displaying the thumbnail images in low resolution if the movement is in high speed.

40. The system of claim 39 further comprising not displaying the thumbnail image and the associated audio clips when the movement is in high speed.

41. A computer readable storage medium having executable code to cause a machine to perform a method, the method comprising:

displaying a first list of reduced visual representations in a first track of a first display area, the first list of reduced visual representations including a plurality of media objects ordered automatically in chronological order and grouped by media objects relating to one another;

recording an audio narration to be associated with at least one of the reduced visual representations, the recorded audio narration being displayed within a second display area different from the first display area;

displaying within the second display area an icon representing the recorded audio narration comprising a non-numeric, visual representation corresponding to a length of the audio narration;

displaying in a second track different from the first track within the first display area a second list of reduced visual representations of the plurality of media objects selected from the first list of reduced visual representation displayed in the first track of the first display area, the second list including one or more authored stories and each story having the audio narration associated with at least one of the reduced visual representations; and

displaying in a third track different from the first and second tracks within the first display area a third list of reduced visual representations selected from the first track, the third list of reduced visual representations representing a story being authored including associating one or more audio narrations with one or more reduced visual representations displayed within the third track.

42. The computer readable storage medium of claim 41 wherein the first list comprises imported stories, and the second list comprises authored stories.

43. The computer readable storage medium of claim 41 wherein displaying the plurality of media objects comprises displaying imported stories, the authored stories, and/or a representation for each associated audio clip for a selected object in the imported stories or the authored stories.

44. The computer readable storage medium of claim 43 wherein the method further comprises displaying in a third display area different from the first and second display areas one of the reduced visual representations of the third track of the first display area, wherein the displayed visual representation is displayed in the third display area having a resolution larger than the corresponding reduced visual representation displayed in the third track of the first display area, and wherein the displayed visual representation in the third display area indicates a current visual representation being authored using at least one of the audio narrations displayed in the second display area.

45. The computer readable storage medium of claim 41 wherein the method further comprises:

moving the authored story from the second track to the third track such that a user can edit the authored story; and

moving the authored story from the third track back to the second track once the user completes authoring.

46. The computer readable storage medium of claim 41 wherein displaying a first list of reduced visual representations of a plurality of media objects comprises displaying a series of audio files.

47. The computer readable storage medium of claim 46 wherein the audio files are from a group comprising MP3 files, Liquid Audio files, and RealJukebox files, WAV files, or other compressed or uncompressed audio file formats.

48. The computer readable storage medium of claim 41 wherein displaying a first list of reduced visual representations of a plurality of media objects comprises displaying a plurality of video clips.

49. The computer readable storage medium of claim 48 wherein the video clips are from a group comprising MPEG files, QuickTime files, AVI files, and RealVideo files.

* * * * *

A7

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

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Naohara et al. (43) Pub. Date: Jul. 19, 2001

(54) RECORDING/REPRODUCING APPARATUS

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(52) U.S. Cl. 360/15; 369/47.12; 360/60

(57) ABSTRACT

Partial information such as the beginning data of each of chapters is read from a CD and written in a HDD **10** at a higher speed than that in a normal reproduction while the normal reproduction is carried out using a buffer memory **8**. After the chapters relative to all CDs have been written in the HDD **10**, reproduction is carried out in switching between the information remaining in the HDD **10** and the information included in the CD. This configuration makes it unnecessary to record the information beforehand, and permits an unreproducible blank in reproduction to be filled with audio information during track search or CD change while the reproduction is carried out normally.

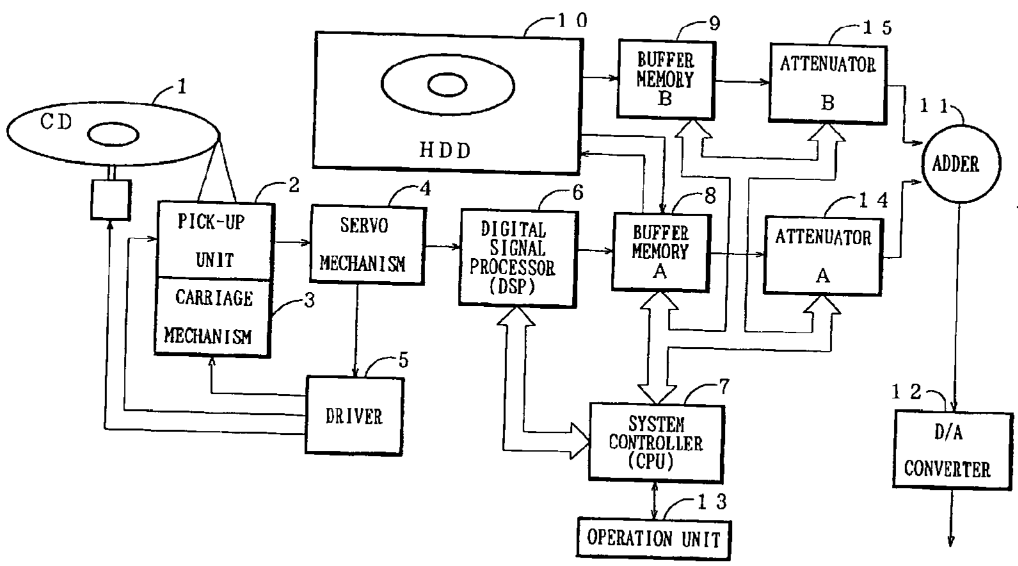


FIG. 1

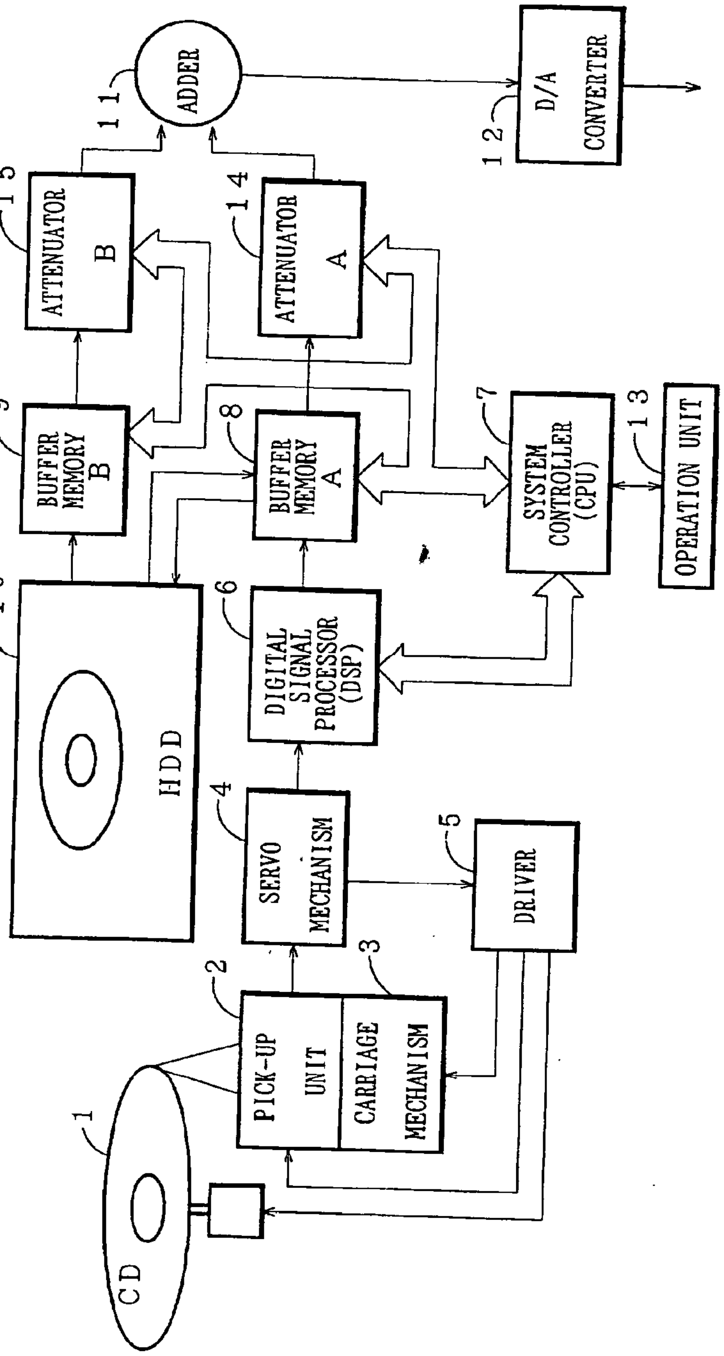

CD
1
PICK-UP UNIT
2
CARRIAGE MECHANISM
3
SERVO MECHANISM
4
DRIVER
5
DIGITAL SIGNAL PROCESSOR (DSP)
6
SYSTEM CONTROLLER (CPU)
7
BUFFER MEMORY A
8
BUFFER MEMORY B
9
HDD
10
ADDER
11
D/A CONVERTER
12
OPERATION UNIT
13
ATTENUATOR A
14
ATTENUATOR B
15

FIG. 2

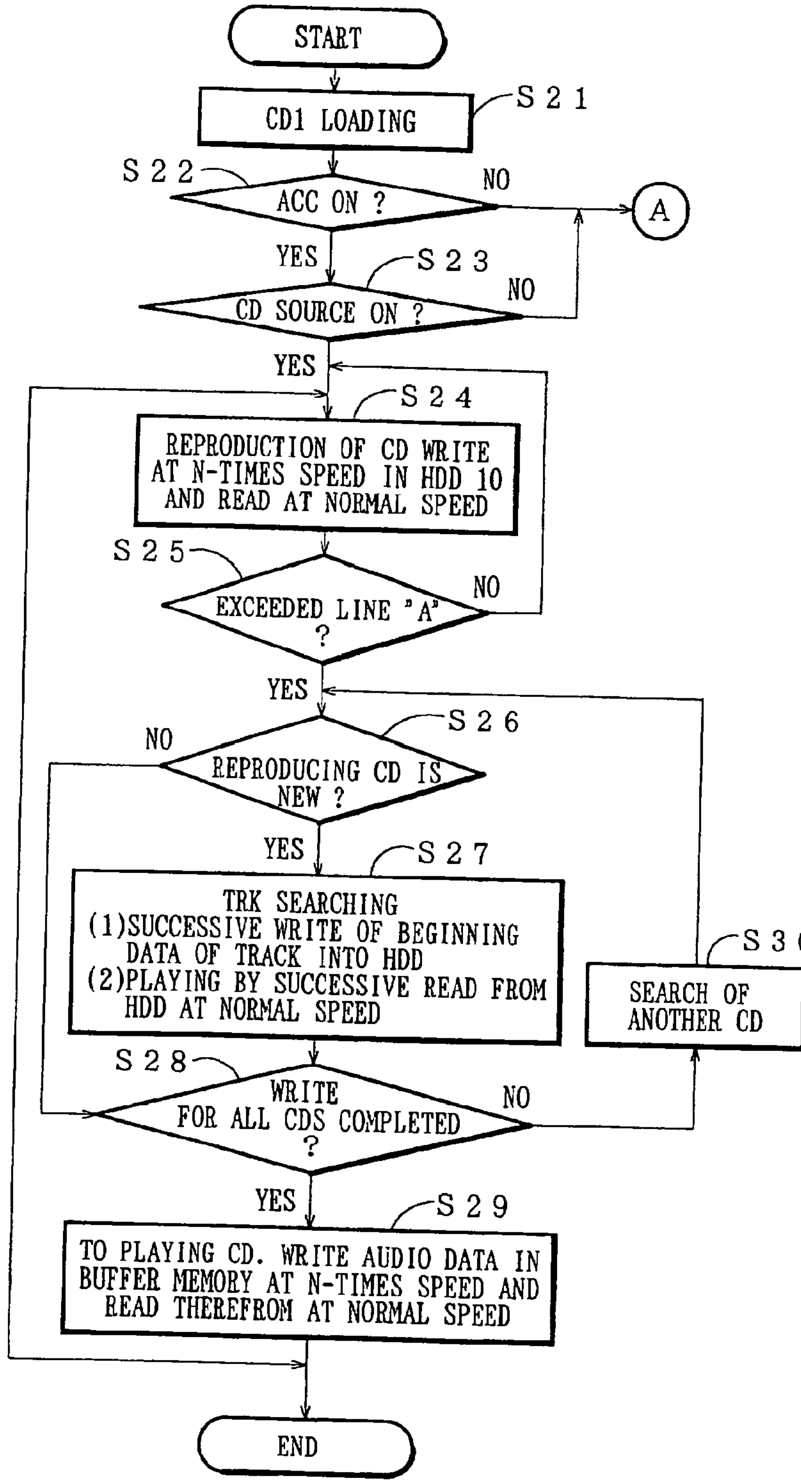

START
CD1 LOADING
S21
S22
ACC ON ?
NO
A
YES
S23
CD SOURCE ON ?
NO
YES
S24
REPRODUCTION OF CD WRITE AT N-TIMES SPEED IN HDD 10 AND READ AT NORMAL SPEED
S25
EXCEEDED LINE "A" ?
NO
YES
S26
NO
REPRODUCING CD IS NEW ?
YES
S27
TRK SEARCHING
(1)SUCCESSIVE WRITE OF BEGINNING DATA OF TRACK INTO HDD
(2)PLAYING BY SUCCESSIVE READ FROM HDD AT NORMAL SPEED
S30
SEARCH OF ANOTHER CD
S28
WRITE FOR ALL CDS COMPLETED ?
NO
YES
S29
TO PLAYING CD. WRITE AUDIO DATA IN BUFFER MEMORY AT N-TIMES SPEED AND READ THEREFROM AT NORMAL SPEED
END

FIG. 3

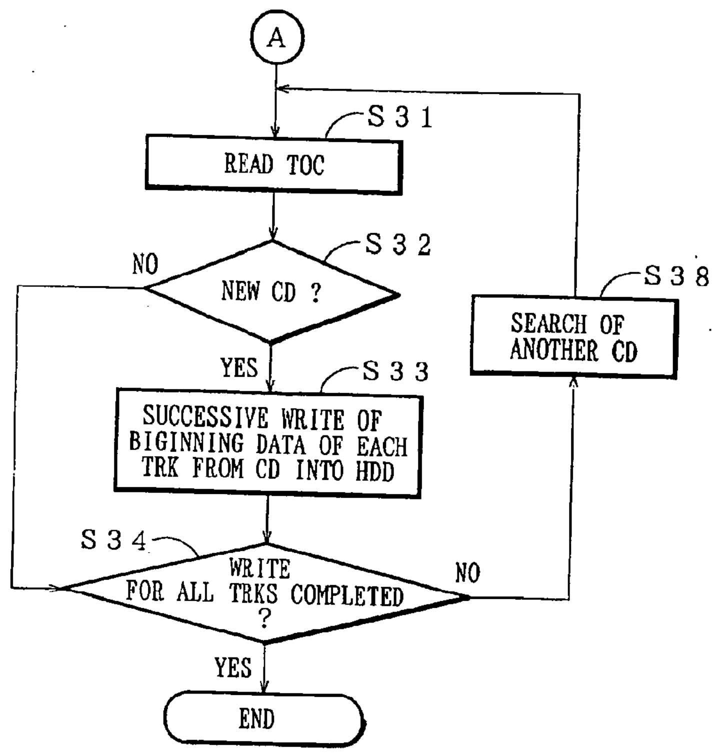
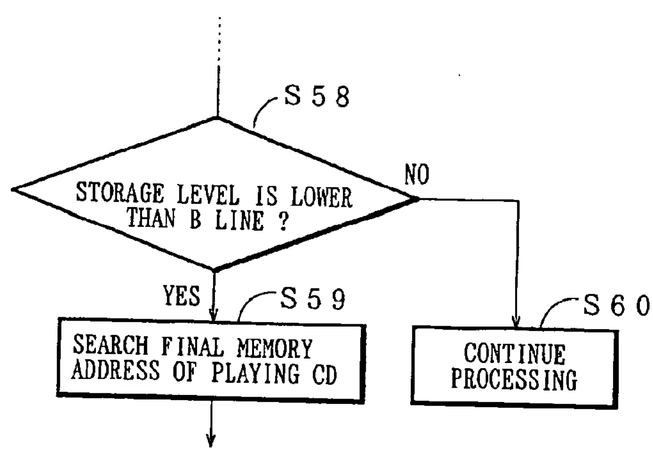

A
S31
READ TOC
S32
NEW CD ?
NO
YES
S33
SUCCESSIVE WRITE OF BIGINNING DATA OF EACH TRK FROM CD INTO HDD
S34
WRITE FOR ALL TRKS COMPLETED ?
NO
YES
END
S38
SEARCH OF ANOTHER CD

FIG. 7


S58
STORAGE LEVEL IS LOWER THAN B LINE ?
NO
YES
S59
SEARCH FINAL MEMORY ADDRESS OF PLAYING CD
S60
CONTINUE PROCESSING

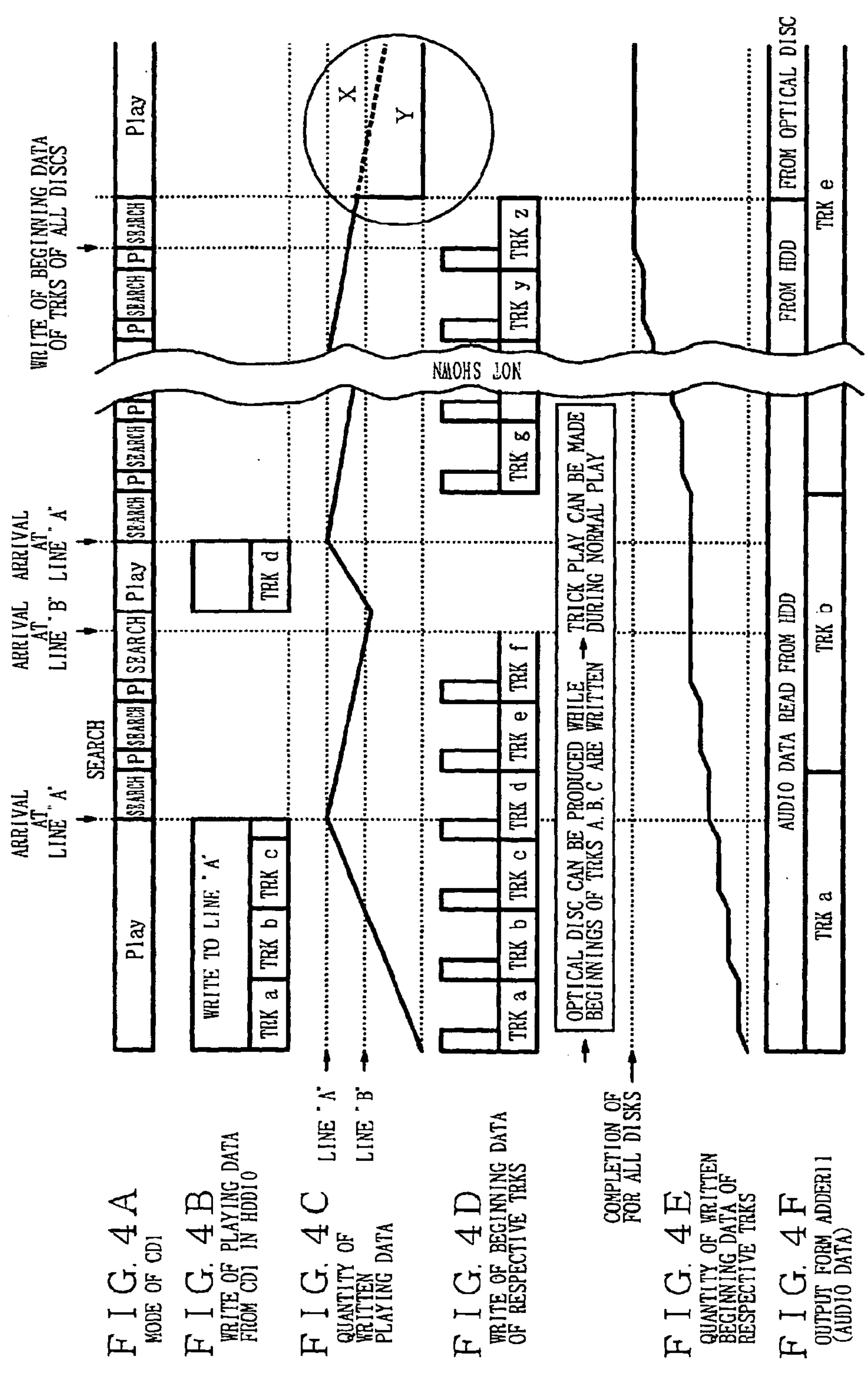


FIG. 4A MODE OF CD1
FIG. 4B WRITE OF PLAYING DATA FROM CD1 IN HDD10
FIG. 4C QUANTITY OF WRITTEN PLAYING DATA
FIG. 4D WRITE OF BEGINNING DATA OF RESPECTIVE TRKS
FIG. 4E QUANTITY OF WRITTEN BEGINNING DATA OF RESPECTIVE TRKS
FIG. 4F OUTPUT FORM ADDER11 (AUDIO DATA)
ARRIVAL AT LINE 'A'
SEARCH
ARRIVAL AT LINE 'B'
ARRIVAL AT LINE 'A'
WRITE OF BEGINNING DATA OF TRKS OF ALL DISCS
Play
SEARCH
P
Play
WRITE TO LINE 'A'
TRK a
TRK b
TRK c
TRK d
LINE 'A'
LINE 'B'
X
Y
NOT SHOWN
TRK e
TRK f
TRK g
TRK y
TRK z
OPTICAL DISC CAN BE PRODUCED WHILE BEGINNINGS OF TRKS A, B, C ARE WRITTEN
TRICK PLAY CAN BE MADE DURING NORMAL PLAY
COMPLETION OF FOR ALL DISKS
AUDIO DATA READ FROM HDD
FROM HDD
FROM OPTICAL DISC

FIG. 5

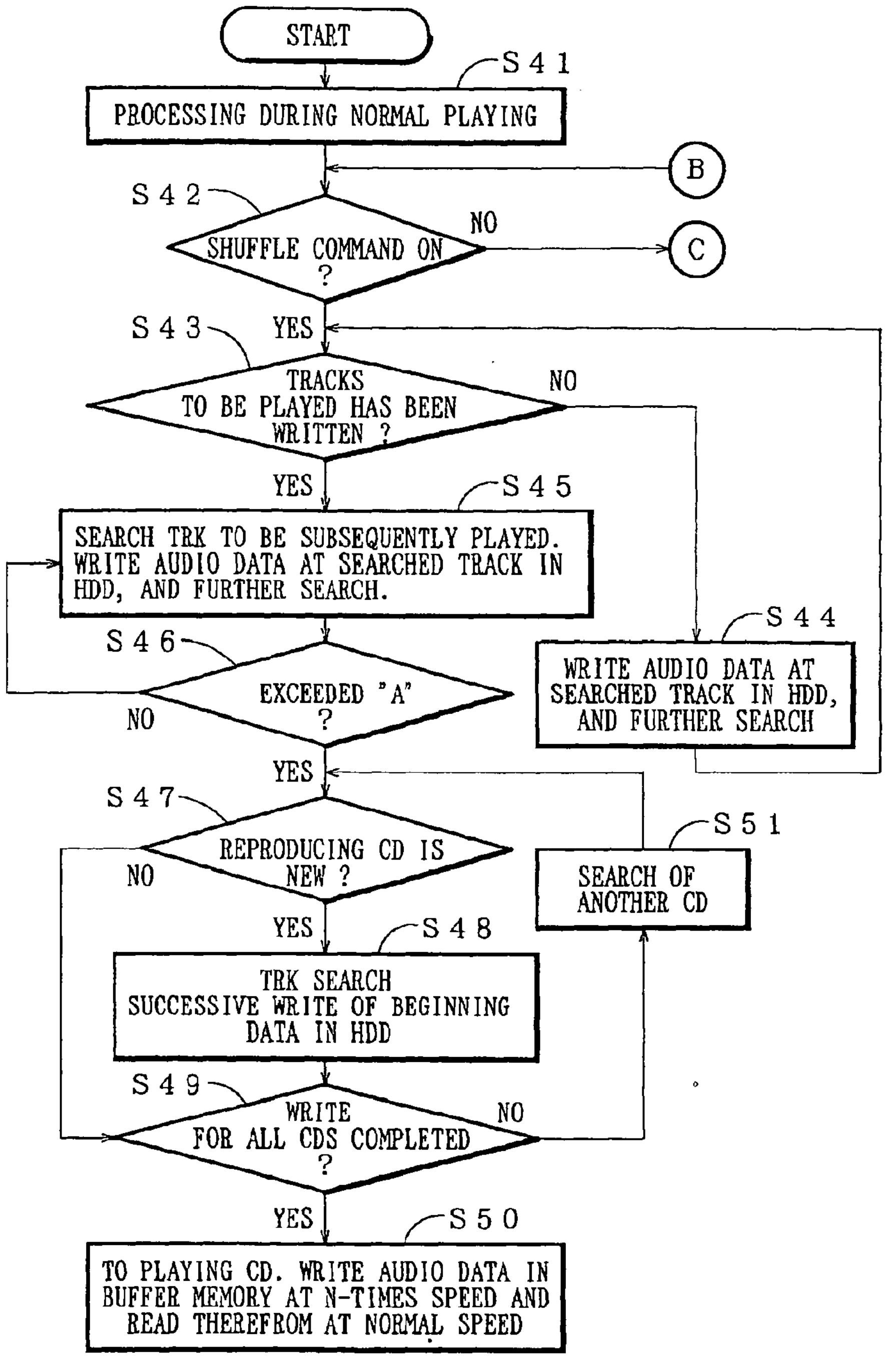
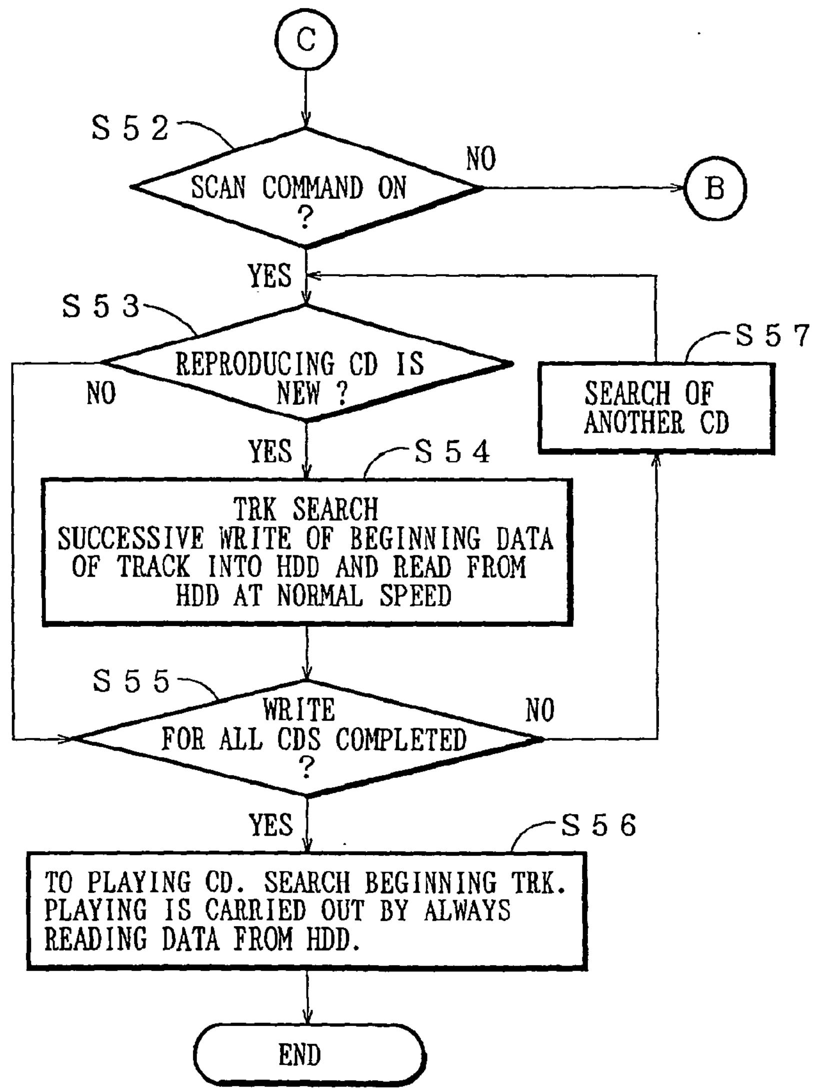

START
S41
PROCESSING DURING NORMAL PLAYING
B
S42
SHUFFLE COMMAND ON ?
NO
C
YES
S43
TRACKS TO BE PLAYED HAS BEEN WRITTEN ?
NO
YES
S45
SEARCH TRK TO BE SUBSEQUENTLY PLAYED. WRITE AUDIO DATA AT SEARCHED TRACK IN HDD, AND FURTHER SEARCH.
S44
WRITE AUDIO DATA AT SEARCHED TRACK IN HDD, AND FURTHER SEARCH
S46
EXCEEDED "A" ?
NO
YES
S47
REPRODUCING CD IS NEW ?
NO
S51
SEARCH OF ANOTHER CD
YES
S48
TRK SEARCH SUCCESSIVE WRITE OF BEGINNING DATA IN HDD
S49
WRITE FOR ALL CDS COMPLETED ?
NO
YES
S50
TO PLAYING CD. WRITE AUDIO DATA IN BUFFER MEMORY AT N-TIMES SPEED AND READ THEREFROM AT NORMAL SPEED

FIG. 6


C
S52
SCAN COMMAND ON ?
NO
B
YES
S53
REPRODUCING CD IS NEW ?
NO
S57
SEARCH OF ANOTHER CD
YES
S54
TRK SEARCH
SUCCESSIVE WRITE OF BEGINNING DATA OF TRACK INTO HDD AND READ FROM HDD AT NORMAL SPEED
S55
WRITE FOR ALL CDS COMPLETED ?
NO
YES
S56
TO PLAYING CD. SEARCH BEGINNING TRK.
PLAYING IS CARRIED OUT BY ALWAYS
READING DATA FROM HDD.
END

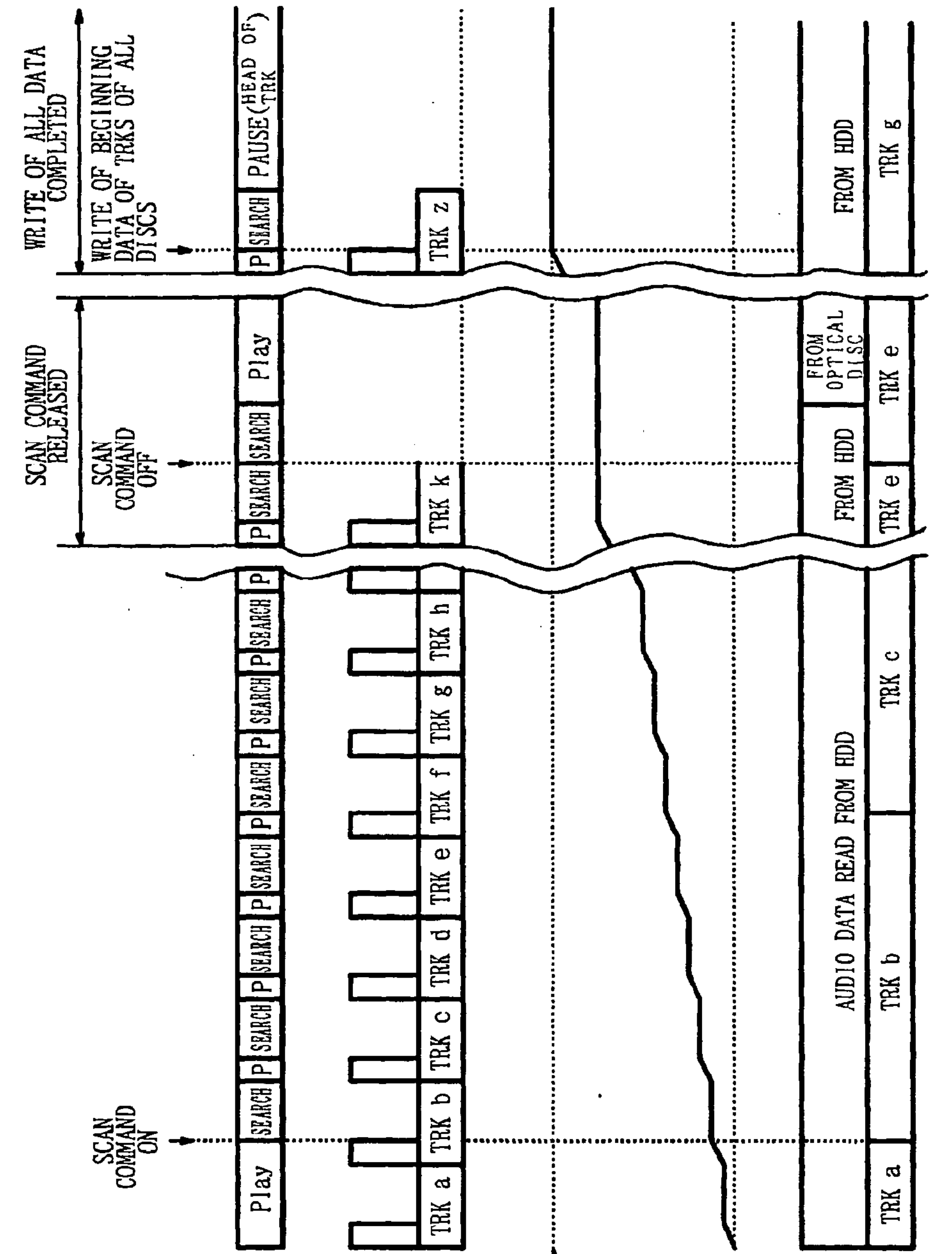


FIG. 8A MODE OF CD1

FIG. 8B WRITE OF BEGINNING DATA OF RESPECTIVE TRACKS

FIG. 8C QUANTITY OF WRITTEN BEGINNING DATA OF RESPECTIVE TRACKS

FIG. 8D OUTPUT FROM ADDER (AUDIO DATA)

FIG. 9

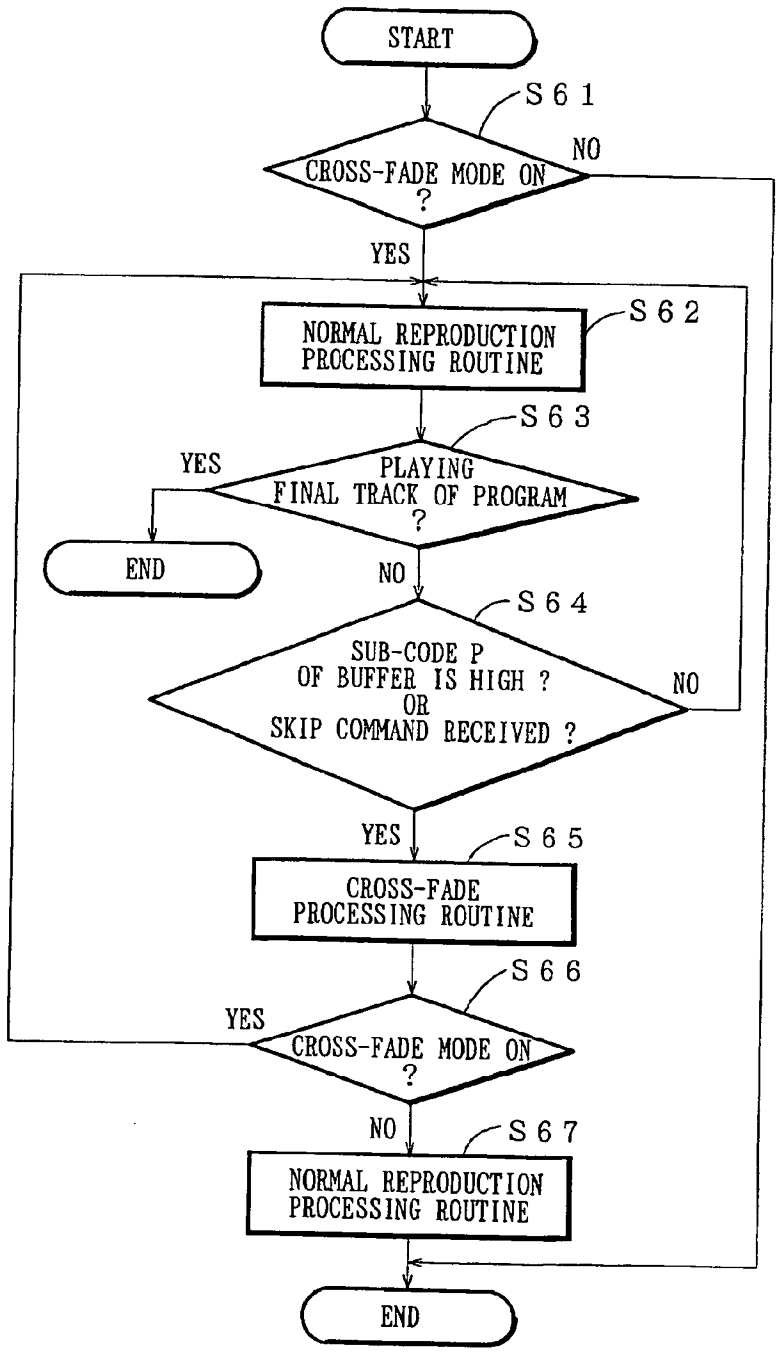
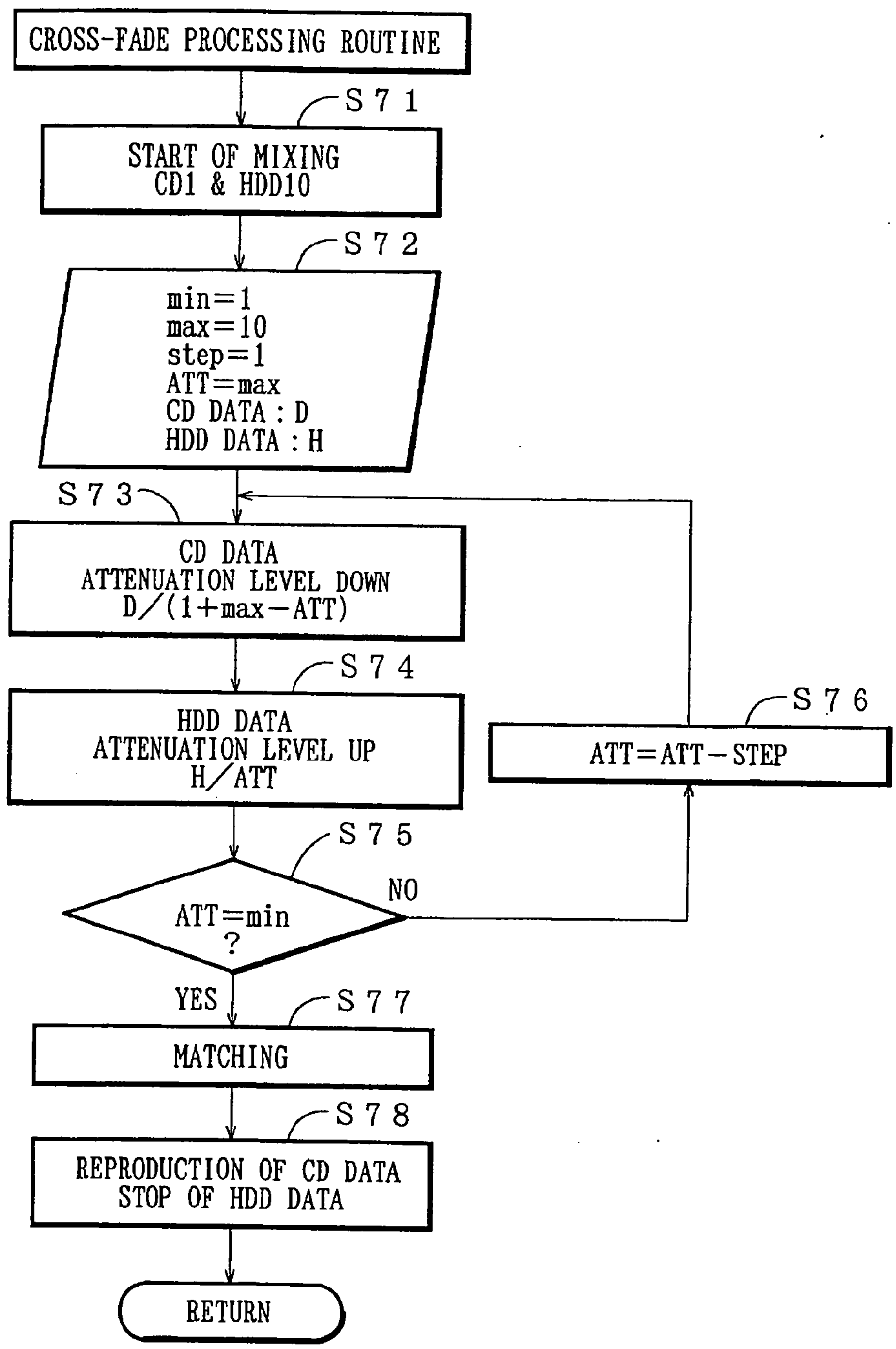

START
S61
CROSS-FADE MODE ON ?
NO
YES
S62
NORMAL REPRODUCTION PROCESSING ROUTINE
S63
PLAYING FINAL TRACK OF PROGRAM ?
YES
END
NO
S64
SUB-CODE P OF BUFFER IS HIGH ? OR SKIP COMMAND RECEIVED ?
NO
YES
S65
CROSS-FADE PROCESSING ROUTINE
S66
CROSS-FADE MODE ON ?
YES
NO
S67
NORMAL REPRODUCTION PROCESSING ROUTINE
END

FIG. 10


CROSS-FADE PROCESSING ROUTINE
S71
START OF MIXING
CD1 & HDD10
S72
min=1
max=10
step=1
ATT=max
CD DATA : D
HDD DATA : H
S73
CD DATA
ATTENUATION LEVEL DOWN
D/(1+max−ATT)
S74
HDD DATA
ATTENUATION LEVEL UP
H/ATT
S76
ATT=ATT−STEP
S75
ATT=min
?
NO
YES
S77
MATCHING
S78
REPRODUCTION OF CD DATA
STOP OF HDD DATA
RETURN

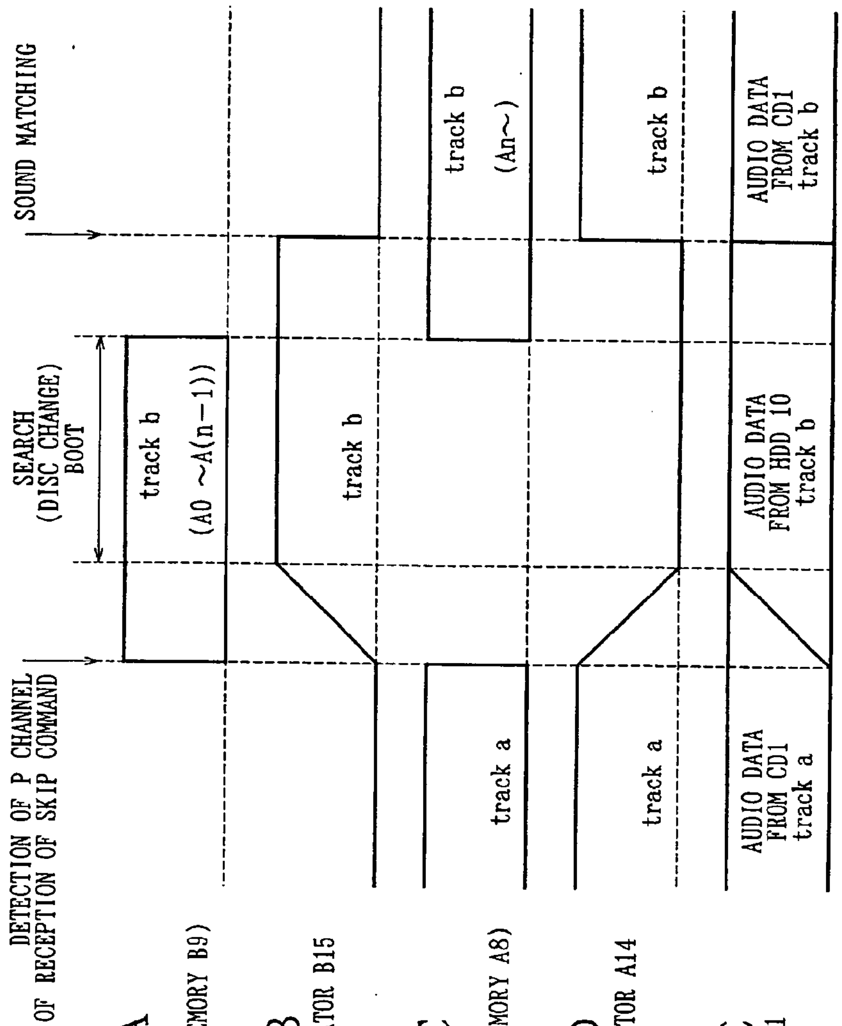


FIG. 11A READ FROM HDD (WRITE IN BUFFER MEMORY B9)

FIG. 11B OUTPUT FROM ATTENUATOR B15

FIG. 11C READ FROM CD1 (WRITE IN BUFFER MEMORY A8)

FIG. 11D OUTPUT FROM ATTENUATOR A14

FIG. 11E OUTPUT FROM ADDER 11 (AUDIO DATA)

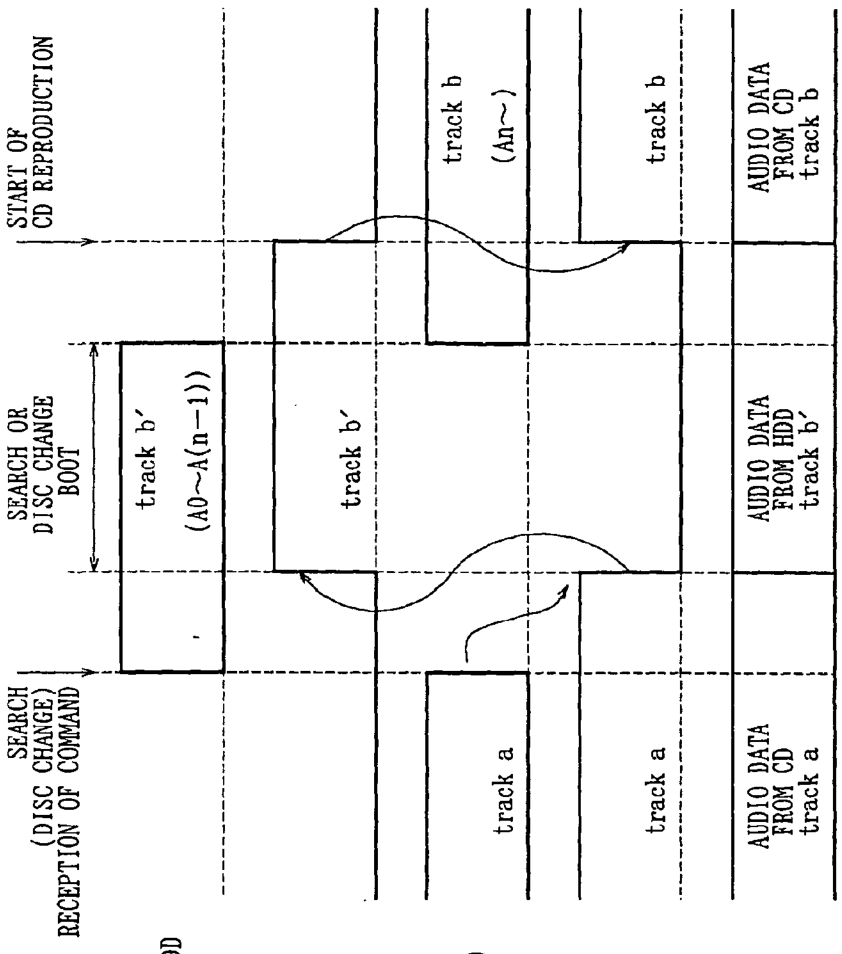


FIG. 12A READ OF AUDIO DATA FROM HDD (RECORDED BEGINNING DATA)

FIG. 12B OUTPUT OF BUFFER MEMORY (FOR HDD)

FIG. 12C READ OF AUDIO DATA FROM CD (SUCCEEDED BY BEGINNING DATA b´)

FIG. 12D OUTPUT OF BUFFER MEMORY (FOR CD)

FIG. 12E AUDIO DATA

RECORDING/REPRODUCING APPARATUS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a recording/reproducing apparatus which can record/reproduce the beginning of a recording medium such as a CD or the beginning of each track into/from a magnetic storage medium such as a hard disk drive (HDD).

[0003] 2. Description of the Related Art

[0004] In recent years, with development of the high density and low-price of a hard disk (HDD), the hard disk has been not only used as an external storage device of a personal computer but also used to store a large amount of sound contents. Many acoustic products have become available in the market.

[0005] For example, there is a music editing apparatus in which all the audio data written in a recording medium such as a compact disk (CD) loaded in a changer are previously written in a HDD in the digital form, and the written audio data are/read reproduced from the HDD. Although such an apparatus becomes large in size, it can reproduce the audio data from the HDD and hence does not require for the CD to be changed, thereby realizing comfortable continuous playback of music.

[0006] In order that music playback is not stopped during the track search or CD change in an ordinary CD changer, a reproducing apparatus in which the beginning audio data of a CD written previously in the HDD are read for playback and replaced by the audio data of the CD after track search or CD change has been completed. Such a reproducing apparatus is disclosed in JP-A-134586.

[0007] The control in the above conventional reproducing device is shown in a timing chart of **FIG. 12**. Now it is assumed that the beginning data of each of tracks (A_0-$A_{(n-1)}$) is previously written in a HDD and searching is performed from a certain track (track a) to another track (track b).

[0008] First, while the audio data on the track a of a certain CD is reproduced, it is read by a pick-up unit **2** and written in a buffer memory (**FIGS. 12C**). The audio data is read from the buffer memory and played back through a speaker (**FIGS. 12D and 12E**).

[0009] At this time, when a track search (or disk change) command is received, the audio data at the beginning (track b') of the track b of the CD to be reproduced subsequently is read (**FIG. 12A**), and the audio data thus read is written in the buffer memory. The read of the audio data from the buffer memory is started and the audio data sequentially read from the buffer memory is produced as the reproduced sound at the beginning of the track to be subsequently reproduced (**FIG. 12B**). Meanwhile, the booting for track search or disk change is performed.

[0010] Upon completion of the booting, the read of the audio data by the pickup unit is started from the track b (**FIG. 12C**), and the audio data thus read is written in the buffer memory. The write of the audio data is made from the data at the address successive to the data at a pertinent address of the track, for example the data from an address A10 if the pertinent address is A9 at ten second relative to the track b (n=10). Thereafter, the audio data is read sequentially from the buffer memory by the normal playback (**FIG. 12D**).

[0011] As a result, as seen from (**FIG. 12E**), without stopping the playing during the track search or CD change, the playback can be performed in the sequence of the audio data (track a) from the CD, the audio data from the HDD (track b') and audio data (track b) from the CD.

[0012] In order to perform the playback continuously without stopping the playing during the track search or CD change, the above conventional recording/reproducing apparatus requires an operation of previously recording the information relative to the beginnings in the recording medium in an HDD.

SUMMARY OF THE INVENTION

[0013] An object of the present invention is to provide a recording/reproducing apparatus capable of effectively recording the information relative to beginnings in a recording medium such as a CD.

[0014] In order to attain the above object, there is provided a recording/reproducing apparatus comprising:

> [0015] storage means for storing information read from a recording medium on which the information is written in a prescribed number of groups;
>
> [0016] means for reading the information on said recording medium; and
>
> [0017] control means for controlling the write in said storage means of at least a prescribed time of information corresponding to a beginning address of each of said groups.

[0018] Preferably, said means for reading reads the information on said recording medium at a speed of N-times as high as a normal speed.

[0019] Preferably, said control means controls the write of the information read from said recording tedium while it controls reproduction of the information written in said storage means at any time.

[0020] Preferably, said control means causes a prescribed time of information of the information written in said storage means to be held therein and the other information to be discarded after reproduction.

[0021] Preferably, said control means correlatively manages said prescribed time of information written in said storage means and the recording medium in which it has been written.

[0022] Preferably, the recording/reproducing apparatus comprises: means for detecting identification information for identifying said recording medium, and where said prescribed time of information contained in the recording medium identified by said identifying means has been already written in said storage means, said control means inhibits write of the information into said storage means.

[0023] Preferably, the recording/reproducing apparatus further comprises: a holding member for holding a plurality of recording media, and said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding member.

[0024] Preferably, after said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding member, it continues reproduction using the information remaining in said storage means.

[0025] Preferably, after said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding portion, it continues reproduction using the information recording in said recording media.

[0026] Preferably, said recording means is a compact disk and said storage means is a hard disk drive.

[0027] In accordance with the configuration of the present invention; partial information such as the beginning data of each of chapters is read from a recording medium and written in storage medium at a higher speed than that in a normal reproduction while the normal reproduction is carried out using a buffer memory. This configuration makes it unnecessary to record the information beforehand, and permits a unreproduciable blank in reproduction to be filled with audio information during track search or CD change while the reproduction is carried out normally. After the chapters relative to all CDs have been written in the HDD, reproduction is carried out using the information remaining in the HDD. This reproduction is more resistant to external disturbance than the case of reproduction using an optical pick-up. Otherwise, after the chapters relative to all CDs have been written in the HDD, reproduction is carried out using the information written in the CDs. This reproduction does not require the read/write of the information for the HDD, and hence realizes power saving. The present invention can be applied to not only the normal reproduction but also to the trick play such as shuffle, scan, etc. Therefore, continuous reproduction can be realized without stopping the playing during track/disk searching or disk changing.

[0028] The above and other objects and features of the invention will be more apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] **FIG. 1** is a block diagram showing the basic arrangement of a recording/reproducing apparatus according to the invention;

[0030] **FIGS. 2 and 3** are flowcharts each for explaining the operation of normal reproduction in an embodiment of the invention;

[0031] FIGS. 4A-4F are timing charts for explaining the operation of normal reproduction in an embodiment of the invention;

[0032] **FIGS. 5 and 6** are flowcharts each for explaining the operation of trick reproduction in an embodiment of the invention;

[0033] **FIG. 7** is a flowchart for explaining the operation of normal reproduction and trick playback in an embodiment of the invention;

[0034] FIGS. 8A-8D are timing charts for explaining the operation of trick playback in an embodiment of the invention;

[0035] **FIG. 9** is a flowchart for explaining the operation in another embodiment of the invention;

[0036] **FIG. 10** is a flowchart for explaining the operation of cross fade processing in another embodiment;

[0037] FIGS. 11A-11E are timing charts for explaining the operation of another embodiment of the invention; and

[0038] FIGS. 12A-12E is a timing chart for explaining the operation of a conventional recording/reproducing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] Now referring to the drawings, an explanation will be given of various embodiments of the invention.

[0040] **FIG. 1** is a block diagram of an recording/reproducing apparatus according to an embodiment of the invention.

[0041] In this embodiment, an optical disk **1** (CD: compact disk) on which audio data are written is adopted as a recording medium. In operation, when CD **1** is loaded on a disk table, it is rotated at a constant speed by a spindle motor during playback. The data written in a bit form in the CD are read by a pickup unit and supplied to a RF amplifier (not shown). The pickup unit **2** is loaded on a carriage mechanism **3** and driven by a driver **5** which is controlled by a servo mechanism **4**. The pickup unit **2** further incorporates an optical system composed of a laser diode, a polarizing beam splitter and an objective lens, a detector for detecting reflected light, etc. An output from the RF amplifier is supplied to a digital signal processor (DSP) incorporating a decoder.

[0042] The servo mechanism **4** creates various kinds of servo drive signals of focus, tracking and spindle on the basis of a focus error signal and tracking error signal from the RF amplifier and a spindle error signal from the decoder, and controls the driver **5** to perform various servo operations. The reproduced RF signal produced from the RF amplifier is supplied to the decoder incorporated in the DSP **6**. The decoder performs EFM (Eight to Fourteen Modulation) demodulation, CIRC (Cross interleave Readsolomon Code) decoding, etc. to decode the information read from the CD1 into the format of digital audio data. The digital audio data produced from the decoder is once written into a buffer memory (A) **8**. The audio data read from the buffer memory (A) **8** is supplied to a D/A converter **12** via an attenuator (A) **14** and an adder **11** under the control by a system controller (CPU) **7**. The analog audio data from the D/A converter **12** is supplied to predetermined audio output components, e.g. a speaker or headphone output terminal through a volume adjusting circuit and an amplifier.

[0043] The audio data read from the buffer memory (A) **8** is also supplied to a HDD (hard disk drive) **11** under the control by the system controller **7**. Thus, the audio data is written on the HDD **10**. The audio data read from the HDD **10** is supplied to the buffer memory (A) **8** or buffer memory (B) **9** under the control by the controller **7**. The audio data is supplied to the D/A converter **12** via the adder **11** through the attenuator (A) 14 or attenuator (B) 15 which will be described later. The analog audio data from the D/A converter 12 is supplied to predetermined audio output components, e.g. a speaker or headphone output terminal through a volume adjusting circuit and an amplifier.

[0044] The data transfer between the HDD 10 and the buffer memory (B) 9, the data transfer between the DSP 6 and buffer memory (A) 8 and the reproduction of the CD 1 are controlled by the system controller 7. The system controller 7, which has a CPU serving as a center of control, includes a program memory, a data memory and an input/output port. The system controller 7 performs the data transfer between the HDD 10 and the buffer memory (B) 9 and the data transfer between the DSP 6 and buffer memory (A) 8 according to the program written in a program memory. The system controller 7 implements the start or end of reproduction, track access, fast-forward playback, fast-backward playback, program playback, etc. by controlling the DSP 6 or pick-up unit 2.

[0045] The system controller 7 also determines the attenuating amount or amplifying amount in the attenuator (A) 14 and the attenuator (B) 15 to which the outputs from the buffer memory (A) 8 and the buffer memory (B) 9 are supplied. The details thereof will be described later.

[0046] An operation unit 13 includes an LCD display and an operation key. The operation unit 13 has keys allotted to various operations, e.g. a playback key, track access key, stop key, etc. The operation unit 13 has also a key for selecting one to be reproduced from a plurality of CDs, a key for program playback and a key for random playback. The LCD display displays various items of information to be processed by the system controller in interlock with these keys. Namely, the operation unit 13 serves to realize a man-machine interface.

[0047] Method of Recording Biggining Data

[0048] (1). Method of Recording the Beginning Data During Normal Playback

[0049] FIGS. 2 to 4 and FIG. 7 are views for explaining the operation of an embodiment of the invention shown in FIG. 1. Now assuming that the recording/reproducing apparatus embodying the invention is a magazine type CD changer, the processing procedure will be explained.

[0050] The flowcharts shown in FIGS. 2, 3 and 7 are written in the program memory incorporated in the system controller 7 shown in FIG. 1.

[0051] First, a CD 1 is loaded to a clamping position for preparation of normal playback (step S21).

[0052] Next, the system controller 7 decides whether or not an accessory power supply (ACC) "ON" and an CD source "ON" (steps S22, S23). When it is verified that they are "ON", the system controller 7 starts the playback operation of the CD 1. Now it is assumed that audio data of the CD 1 is written in the HDD 10 while the CD 1 is reproduced. Specifically, the audio data on the CD 1 is read at a speed of N-times (N>1), and the audio data thus read is written in the HDD 10 via the buffer memory (A) 8. Thereafter, the audio data written on the HDD 10 is supplied to the buffer memory (A) 8 again at the speed of N-times. The audio data is read from the buffer memory (A) 8 at a normal or standard speed to effect the playback operation (step S24). Incidentally, the data written in the HDD 10 is composed of the audio data and the corresponding address data. The audio data reproduced from the pick-up unit 2 and the corresponding address data will be written successively in the HDD 10. All these data may be left or held in the HDD. As regards the audio data read from the buffer memory (A) 8 at the normal speed, only its beginning data (beginning audio data and the corresponding address data) may be left. In short, any recording format can be adopted as long as at least the beginning data remains held in the HDD 10.

[0053] It is decided whether or not a prescribed or more quantity (quantity) of the audio data has been written in the HDD 10 (step S25). Since only the prescribed quantity of the audio data can be written in the HDD 10, "A-line check" is made (which will be described later referring to the timing chart of FIG. 4). When it is verified that the prescribed or more quantity of audio data has been written, the read of the audio data from the CD 1 at the speed of N times is temporarily stopped.

[0054] When the read of the audio data is temporarily stopped, it is determined whether or not the CD 1 which is now being reproduced is a new CD (step S26). The new CD refers to a CD loaded first in the magazine. If the CD at issue is a CD loaded previously in the magazine and having the beginning data already written in the HDD 1, the answer instep S26 is NO. Incidentally, this determination is made, for example by checking the flag for the absolute time (total time) of the CD or checking the individual ID appended to each CD. The checking of the CD is carried out to omit the write of the beginning data already written in the HDD 10 when the new CD is loaded again.

[0055] If the CD at issue is a new CD, a track subsequent to track written in the HDD is searched so that the beginning prescribed time of data (hereinafter referred to as beginning data) of the respective tracks are sequentially written into the HDD 10. Meanwhile, the playback will be continued by reading the data at the normal speed from the HDD 10. The timings of the playback and write will be described later (step S27). The data written into the HDD 10 is composed of ID of the CD, absolute time of the CD, beginning data for each track and the corresponding address data. As regards the old CD with the beginning data written in the HDD 10 (for example, the absolute time has been written as a flag in the HDD 10) the write of the beginning data can be omitted when the old CD is loaded again.

[0056] In step S28, whether or not the record has been completed for all the CDs is determined since it is assumed that the CD changer is used. According to the result of the determination, if YES, the processing proceeds to normal CD playback (step S29) whereas if NO, the processing proceeds to searching of another CD (step S30). In this case, it is not required the normal playback processing is performed at the speed of N-times.

[0057] On the other hand, if the ACC is not "ON", or CD is not "ON" (namely, the engine is not operating, or the other source (tuner, tape, etc.) than the CD has been selected and the CD has been already loaded), the CD 1 is not reproduced but only its beginning data are written). To this end, TOC (Table of Contents) of the loaded CD 1 is read (step S31). Whether or not the CD is an new CD is determined (step S32). If YES in step S32, the beginning data of the tracks of the CD 1 are successively written in the HDD 10 (step S38).

Whether or not the write has been completed for the tracks of all the CDs is determined (step S34). If YES, the processing of writing the beginning data into HDD 10 is ended. If NO, another CD is searched (step S38). Thus, also when the ACC is off or the other source than the CD is activated, the beginning data in the magazine will be automatically written into the HDD 10.

[0058] On the way of steps S26 to S28, checking of B line is performed as shown in the flowchart of FIG. 7 (the details will be explained with reference to the timing chart of FIG. 4). Specifically, first, whether or not the quantity of written data in the memory is not more than a prescribed value (B line) (step S58). If YES (not more than the B lines), the final memory address of the CD 1 is searched and the processing of step S24 et seq. is repeated. If NO, the processing of writing only the beginning data of each track into the HDD 10 during the normal playback is continued (step S60).

[0059] In the flowchart of FIG. 2, although disk discrimination (NEW or OLD) is made after the prescribed quantity of written data has been written in the HDD 10, it may be made during the processing in step S24.

[0060] FIGS. 4A to 4F are timing charts showing the method of recording beginning data of the respective tracks during normal playback of the CD.

[0061] Specifically, FIG. 4A shows the operation mode of the CD (playback/search). FIG. 4B shows the data (data for normal playing (playing data x) written from the CD1 into the HDD10. FIG. 4C shows the quantity of written data (of the playing data x) in the HDD 10. FIG. 4D shows the beginning data of each track (data y) written from the CD1 into the HDD 10. FIG. 4E shows the quantity of written data relative to the beginning data. FIG. 4F shows the output (audio data) from the adder 11.

[0062] Incidentally, symbol x and symbol y represent whether the all the audio data or only the beginning data of the respective tracks are written from the CD1 into the HDD 10.

[0063] FIGS. 4A to 4F illustrate that the playback mode (P) and the search mode are alternately repeated so that the CD 1 is played back while the beginning data of the respective tracks (a-z) are successively written. Lines for checking the quantities of written data are formed because the HDD 10 can record only a prescribed quantity of data.

[0064] First, the reproduction of the CD 1 is carried out at the speed of N-times successively from the first track (track a) Specifically, the audio data of track a (TRK a), track b (TRK b) and track c (TRK c) are successively written at the speed of N-times into the HDD 10. As a result, the mount of data within the HDD 10 is gradually increased (FIG. 4C). Simultaneously, the audio data on the track a is read from the HDD 10 at the speed of N-times, and supplied to the buffer memory (A) 8. The audio data is read from the buffer memory (A) 8 and reproduced at the normal speed through the attenuator (A) 14 and adder 11.

[0065] On the way of the above operation, when the quantity of written data of the HDD 10 reaches a prescribed quantity (A line) the read from the pick-up unit 2 is temporarily stopped. Since the normal playback is continued, the quantity of the written audio data decreases gradually (FIG. 4C). In this example, when the audio data of the fourth track (track d) is being written in the HDD 10, the quantity of written audio data of the HDD 10 reaches the A line. At this point, the read from the pick-up unit 2 is temporarily stopped. In this state, the first track is played back normally and the beginning data have been written until the fourth track.

[0066] With a progression of the normal playback, the quantity of written data in the HDD 10 decreases. Therefore, for the time being, the operation of acquiring only the beginning data of the subsequent track (TRK e) et seq. is started. Specifically, since the audio data of the three tracks have been actually acquired, it is not necessary to acquire the audio data further so that only the beginning data will be acquired precedently. Therefore, the fifth track (track e) is searched and only its beginning data is written. Subsequently, the sixth track (track f) is searched and only its beginning data is written. When the quantity of written data in the HDD 10 reaches B line, the operation of acquiring the audio data of the fourth track is started again. From now on, the above operation will be repeated.

[0067] Incidentally, as regards the audio data for playing after the beginning data of all the tracks have been written in the HDD 10, there are two cases where playing is continued using the audio data remaining in the HDD 10 as indicated by symbol X and where the audio data from the pick-up unit 2 is used instead of that in the HDD 10 as indicated by symbol Y. The former is resistant to external disturbance whereas the latter is useful to save power since the CD 1 is used.

[0068] In this way, the beginning data of the respective tracks can be written in the HDD 10 while the normal playback is carried out at the speed of N-times. As seen from FIG. 4E, the beginning data of the respective tracks are accumulated gradually.

[0069] (2) Method of Recording Beginning Data During Trick Playback

[0070] FIGS. 5 to 7 are flowcharts showing the processing procedure of the system controller 7 during the trick playback of shuffle, scan command, etc. FIGS. 8A to 8D are timing charts of this processing procedure. Specifically, FIG. 8A shows the operation mode of the CD. FIG. 8B shows the beginning data written from the CD1 into the HDD 10. FIG. 8C shows the quantity of written audio data (relative to the beginning data of the respective tracks). FIG. 4F shows the output (audio data) from the adder 11. Timings in the shuffle playback which are substantially the same as in the normal playback are not illustrated, but only the scan operation is illustrated.

[0071] Now referring to FIGS. 5-8, an explanation will be given of the operation during the trick playback for the recording/reproducing apparatus shown in FIG. 1. The "shuffle" refers to the programming playback and random playback, and the "scan" refers to continuous playback of only the beginning of each CD.

[0072] In FIG. 5, during the processing of normal playback (FIGS. 2 and 3) (step S41), it is decided whether or not the shuffle operation such as the programming playback and random playback has been instructed by a user (step S42). If YES, it is determined whether or not all the playing tracks which are now being played back have been written in the HDD 10 (step S43). If NO, the playing track(s) is read from the CD 1 and the audio data thus read is written into the HDD 10. Thereafter, the audio data written in the HDD 10 is supplied to the buffer memory (A) 8 again at the speed of N-times. The audio data is read from the buffer memory (A) 8 at a normal speed to effect the playback of the playing track (step S44). In step S43, if YES, a playing track designated by shuffle is searched and the corresponding audio data is written into the HDD 10. Further, the track to be played subsequently is searched (step S45). The beginning data written in the HDD 10 is composed of the audio data and the corresponding address data.

[0073] It is decided whether or not a prescribed or higher quantity the audio data has been written in the HDD 10 (step S46). Since only the prescribed amount of the audio data can be written in the HDD 10, "A-line check" is made. When it is verified that the prescribed or higher quantity of the audio data has been written, it is determined whether or not the CD 1 which is now being reproduced is a new CD (step S47). If the CD at issue is a new CD, the beginning data are successively written into the HDD 10 after track searching (step S48). Incidentally, the data written into the HDD 10 is composed of ID of the CD, absolute time of the CD, beginning audio data for each track and the corresponding address data. In the case of shuffle, only the programmed track is read at the speed of N-times and the beginning data is written. As regards the old CD with the beginning data written in the HDD 10 (for example, the absolute time has been written as a flag in the HDD 10) the write of the beginning data can be omitted when the old CD is loaded again.

[0074] Now since it is assumed that the CD changer is used, whether or not the write has been completed for all the CDs is determined (step S49). According to the result of the determination, if YES, the processing proceeds to the CD reproduction processing (step S50), whereas if NO, the processing proceeds to searching of another CD (step S51). In this case, the playing CD is written in the buffer memory (A) 8 at the speed of N-times not via the HDD 10, and read at the normal speed from the buffer memory (A) 8.

[0075] On the other hand, in step S42, if NO (the shuffle command is not ON), the processing proceeds to step S52 (FIG. 6). In step S52, whether or not the scan command is ON is determined. If YES, it is decided whether or not the CD 1 which is being reproduced is a new CD (step S53). If YES, track search is carried out and the beginning audio data are successively written into the HDD 10 at the speed of N-times and read from the buffer memory (A) 8 at the normal speed. Incidentally, the data written in the HDD 10 is composed of the same audio data reproduced from the pick-up unit 2 and the corresponding address data. It is determined whether or not the write has been carried out for all the CDs (step S55). According to the result of the determination, if YES, the processing proceeds to the CD reproduction processing (step S56), whereas if NO, the processing proceeds to searching of another CD (step S57). In the reproduction of the CD, the beginning of the playing track is searched and the playback is performed in such a manner that the audio data is read from the HDD 10 and reproduced via the buffer memory (B) 9.

[0076] As seen from the timing chart of FIG. 8, if a scan releasing command is issued while the scan command is being processed, the playing track is reproduced again from its beginning on the basis of the data read from the HDD 10 through the buffer memory (B) 9. In the mean time, the playing track to be reproduced subsequently in the CD 1 is searched.

[0077] On the way of steps S47 to S49, it is determined whether or not the quantity of written data in the HDD 10 is not higher than a prescribed quantity (B line). If YES (not higher than B line), the final memory address of the playing CD is searched. If NO, the write of the beginning data into the HDD 10 during the trick playing is continued.

[0078] In this way, in accordance with the present invention, the beginning audio data of the respective tracks of the CD are written during the normal playback or the trick playback.

[0079] In this embodiment, although the beginning audio data of each of the tracks of the CD was written, only the beginning audio data of each of the CDs may be written. This technique can be applied to the other recording medium such as MD and DVD.

[0080] The other data such as video data or textual data than the audio data may be used for the same purpose. In this case, the beginning data may be written for each group, chapter and title.

[0081] In this embodiment, in order to write the beginning data, the HDD 10 was provided in the reproducing apparatus. However, another inner storage means may be used as long as it can record the beginning data.

[0082] Cross Fade Processing

[0083] An explanation will be given of the processing of special playback (cross fade processing) using the beginning data.

[0084] FIGS. 9 to 11 are views for explaining the special reproduction effectively using the beginning data written in the HDD 1. This special playback includes a cross-fade main processing and cross-fade subroutine processing during normal playback or skip selection.

[0085] Referring to FIGS. 9 and 10, an explanation will be given of the special playback in the arrangement of the recording/reproducing apparatus according to the invention shown in FIG. 1 for two cases where the beginning data have been already written and where the special playback is performed while the beginning data are written in the HDD.

[0086] (1) The Case Where the Beginning Data Have Been Written in the HDD

[0087] The system controller 7 determines whether or not the cross fade mode has been set by a user (step S61). If YES, the processing enters the normal playback(step S62). Further, whether or not the track at issue is the last track of a playing program is determined (step S63). If YES, the normal playback will be ended.

[0088] If NO, for the purpose of actuating the function of fade-out and fade-in, in order to detect the end of the track being reproduced, the beginning of a next-programmed track or the pause between therebetween, the system controller 7 monitors the audio data supplied to the DSP 6, e.g. the state of the P channel within the sub-code information contained in the audio data (step S64). The sub-code P indicates the pause between the tracks as "HIGH" and the middle of the track as "LOW". Therefore, by monitoring the sub-code P, the pause between the tracks can be detected.

[0089] If the sub-code P is "LOW", it means that the track is being reproduced. Therefore, the normal playback processing (step S62) is continued to detect the pause between the tracks.

[0090] If the sub-code is "HIGH", the cross-fade sub-routine as shown in **FIG. 10** is started (step S65). As described below, on the basis of the checking result of the P-channel, the control of the attenuators A and B (14, 15) is started to determine the timing of the cross-fade.

[0091] Next, whether or not the cross-fade mode has been set by the user is checked again (step S66). This is performed to deal with the case where the cross-fade mode is released halfway. If YES, the processing is returned to step S62 to repeat the normal playback described above. If NO, since the cross-fade processing has been released halfway, the normal playback is performed (step S67).

[0092] Additionally, in step S64, not only when the pause is detected, but also when a skip command (search command) is executed, the system controller **7** receives this command to start the cross-fade processing routine described below.

[0093] As described above, in the case of the CD, the P channel of the sub-code is used to detect the pause between the tracks. In the case of the other recording media, any information capable of detecting the pause may be adopted. Further, any information capable of detecting the start or end of the track can be adopted. For example, the data indicative of the absolute starting time of each track can be used.

[0094] An explanation will be given of the cross-fade subroutine shown in **FIG. 10**.

[0095] When the cross-fade sub-routine is started, the mixing of the CD 1 and HDD **10** is made by the adder **11** (step S71). Specifically, the audio data which is being reproduced is supplied to the adder **11** through the buffer memory (A) **8** and the attenuator **14**. The audio data of the next-programmed track is also supplied to the adder **11** through the buffer memory (B) **9** and attenuator **15**. These data are mixed in the adder 11. In this case, in order to determine the attenuating or amplifying quantity for the attenuators (A) and (B) **14** and **15**, ten quantity values of variable ATT from 1 (min) to 10 (max) are set and looped with a step of +1. Now, assuming that the attenuation quantity of the CD 1 is D and that of the HDD **10** is "H", the variable ATT is set at the maximum of 10 (step S72). The attenuation quantity of the CD **1** is stepped down by calculating "1+max−ATT" (step S73).

[0096] The attenuation quantity of the HDD 1 is stepped up by setting it at the max of "10". Then, until the variable ATT becomes the min of "1", the calculation of "variable ATT−step amount" is repeated (step S75) so that the respective attenuation quantities D and H of the CD1 and HDD 1 are gradually stepped up or down.

[0097] Thus, the end portion of the track being reproduced and the starting portion of the next-programmed track are caused to cross-fade and produced as sound from the speaker through the D/A converter **12**.

[0098] Since only the beginning audio data of the next-programmed track has been written in the HDD **10**, the addresses of the portion of the audio data in the HDD **10** and that of the CD **1** to be reproduced subsequently thereto are matched to make sound continuous (sound matching) (step S77). The addresses are changed so that the data reproduction is shifted from the HDD **10** to the CD 1 (step **S78**).

[0099] **FIGS. 11A** to **11D** are timing charts for explaining the operation of the cross-fade processing. Specifically, **FIG. 11A** shows the data read from the HDD **10** (written into the buffer memory (B) **9**). **FIG. 11B** shows the data produced from the attenuator (B) **15**. **FIG. 11C** shows the data from the CD **1** (written into the buffer memory (A) **8**). **FIG. 11D** shows the data produced from the attenuator (A) **14**. **FIG. 11E** shows the data (audio data) produced from the adder **11**.

[0100] In operation, while the track a of the CD **1** is reproduced (**FIG. 11C**), when the P channel is detected or the skip command is executed, the cross-fade processing is started. As regards the output from the adder **11** (**FIG. 11E**), the P channel which is time information is detected before the audio data of the CD **1** is completed. This is because when the audio data is supplied to the DSP **6** capable of detecting the P channel, the audio data produced from the adder **11** is the audio data immediately before completion of the track at issue. On the basis of such a prescribed time lag, the cross-fade processing between the audio data immediately before its completion and that of the next-programmed track can be realized.

[0101] When the cross-fade processing is started, the beginning audio data of the next-programmed track (track b) is read from the HDD **10** (**FIG. 11A**). Simultaneously, the fade-out of the output from the attenuator (A) **14** is started (**FIG. 11D**), whereas the fade-in of the output from the attenuator (B) **15** is started (**FIG. 11B**). The outputs from both attenuators (A) an (B) **14** and **15** are mixed by the adder **11** (**FIG. 11E**).

[0102] In this way, the cross-fade processing produces the data when the beginning of the track b which is the next audio data written in the HDD **10** is superimposed on the ending portion of the track a which is the audio data of the CD while the CD 1 is being reproduced. In this case, the respective audio data are subjected to fade-out or fade-in so that the audio data is continuously reproduced in the cross-fade manner. Accordingly, the successive tracks can be continuously coupled with no gap.

[0103] Further, the beginning audio data of the track of the next-programmed track and the beginning audio data of the track successive thereto are bound. Specifically, while the audio data at the beginning of the track b is reproduced, the pick-up unit **2** executes the searching for the track b to read the data at the address An et seq. Since the beginning audio data are located at the addresses A0-A(n−1), the matching of the audio data on the track b is made by the adder 11. The attenuating degree of the attenuator (A) **14** is returned to the initial value.

[0104] Thus, as seen from **FIG. 1E**, the audio data on the track a and that on the track b are subjected to the cross-fade processing, and the audio data on the track b is subjected to the matching processing.

[0105] (2) Case Where the Beginning Data Have Not Been Written

[0106] In this case, the method of recording the beginning data during the normal reproduction may be applied to the normal playback processing routine in step S62 in the flowchart of **FIG. 9**.

[0107] In the normal playback processing routine in step S62, the read from the CD may be executed at the speed of N-times, and the date thus read may be successively written/held in the HDD **10**. In the course of this process, when the P channel is detected, the cross-fade routine is started.

[0108] As described above, since the cross-fade control is executed using the information obtained from the recording medium such as a CD and a part of the beginning information written in prescribed groups in the internal storage means such as a HDD, the information written in the recording media can be continuously reproduced also when the searching for the recording medium and medium exchange is made. Therefore, the information written in the internal storage means can be effectively used.

[0109] When the track search command or CD change command is issued, by detecting the end of the group being reproduced such as the pause between tracks or the beginning of a group successive to the group being reproduced, the fade-out is started using the output from the one attenuator whereas the fade-in is started using the output from the other attenuator. The outputs from both attenuators are mixed by the adder so that the beginning of the next-programmed audio data written in the HDD is superimposed on the end of the audio data being reproduced. Thus, the audio data can be continuously reproduced in the cross-fade manner (fade-out and fade-in). Otherwise, using the P-channel of the sub-code in the CD format and PTT in the DVD format, the cross-fade processing can be started. In this case, the timing of starting the cross-fade processing can be easily determined using the existing information.

[0110] The continuous reproduction of the audio data using the cross-fade processing also provides the effect of the sense of play of binding the tracks with no stop.

[0111] Although the embodiment of the present invention was explained in connection with a CD changer, the present invention can be applied to an MD changer. The present invention can be also applied to an ordinary player for the recording medium. Further, the present invention can be also applied to the recording/reproducing the video data as well as the audio data.

What is claimed is:

1. A recording/reproducing apparatus comprising:

storage means for storing information read from a recording medium on which the information is written in a prescribed number of groups;

means for reading the information on said recording medium; and

control means for controlling the write in said storage means of at least a prescribed time of information corresponding to a beginning address of each of said groups.

2. A recording/reproducing apparatus according to claim 1, wherein said means for reading reads the information on said recording medium at a speed of N-times as high as a normal speed.

3. A recording/reproducing apparatus according to claim 1, wherein said control means controls the write of the information read from said recording medium while it controls reproduction of the information written in said storage means at any time.

4. A recording/reproducing apparatus according to claim 3, wherein said control means causes a prescribed time of information of the information written in said storage means to be held therein and the other information to be discarded after reproduction.

5. A recording/reproducing apparatus according to claim 1, wherein said control means correlatively manages said prescribed time of information written in said storage means and the recording medium in which it has been written.

6. A recording/reproducing apparatus according to claim 5, further comprising:

means for detecting identification information for identifying said recording medium, wherein where said prescribed time of information contained in the recording medium identified by said identifying means has been already written in said storage means, said control means inhibits storage of the information into said storage means.

7. A recording/reproducing apparatus according to claim 1, further comprising:

a holding member for holding a plurality of recording media, wherein

said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding member.

8. A recording/reproducing apparatus according to claim 7, wherein after said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding member, it continues reproduction using the information remaining in said storage means.

9. A recording/reproducing apparatus according to claim 7, wherein after said control means causes said storage means to store said prescribed time of information relative to all said recording media held in said holding portion, it continues reproduction using the information recording in said recording media.

10. A recording/reproducing apparatus according to claim 1, wherein said recording means is a compact disk and said storage means is a hard disk drive.

* * * * *

A8

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Reexam Control No. 95/001,274

US 20020045960A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2002/0045960 A1
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(54) SYSTEM AND METHOD FOR MUSICAL PLAYLIST SELECTION IN A PORTABLE AUDIO DEVICE

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(21) Appl. No.: 09/975,748

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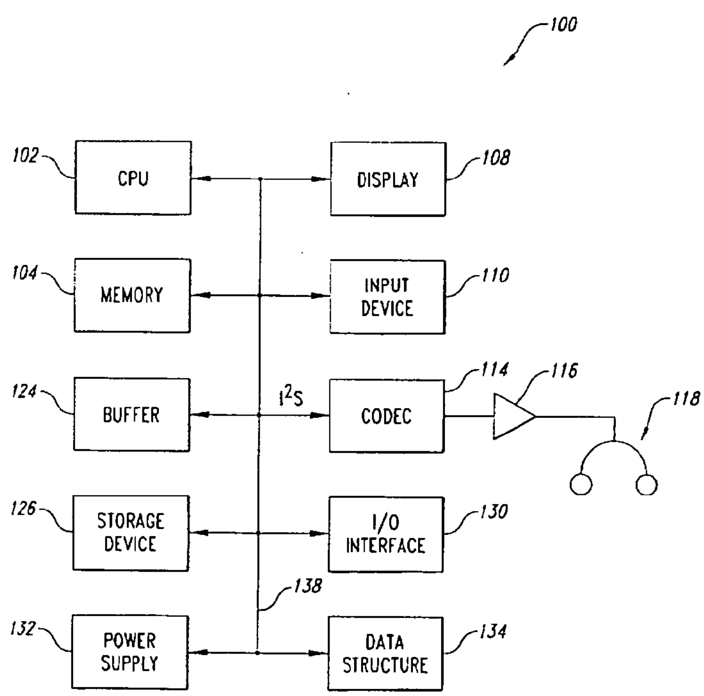
(52) U.S. Cl. 700/94; 381/61; 704/270

(57) ABSTRACT

A portable audio playing device implements a jukebox manager function to permit the simple generation of musical playlists and the alteration or editing of existing playlists. Data, such as MPEG-3 data or other conventional audio format data, may be readily downloaded into the system for storage in a solid state memory or in a spinning media device. The audio tracks are associated with one or more metatags that are used to describe the content of each track. The metatags and associated audio tracks are stored in a data structure that may be implemented as a database or other convenient data structure that readily permits searching by user-specified search terms. The user generates a new playlist by selecting one or more metatags corresponding to the desired musical tracks. The system queries the data structure using the user-specified metatags and automatically generates a playlist containing one or more audio tracks whose metatags correspond to the user-specified metatags. Alternatively, the system may perform the same query and simply generate a results list that will allow the user to manually specify which of the audio tracks identified by the search process will be added to the newly created playlist. The system also permits the simple editing of existing playlists. New audio tracks may be added in the manner described above using metatags for searching or maybe manually added from the list of stored audio tracks. The system readily supports different audio formats and different playlist types.



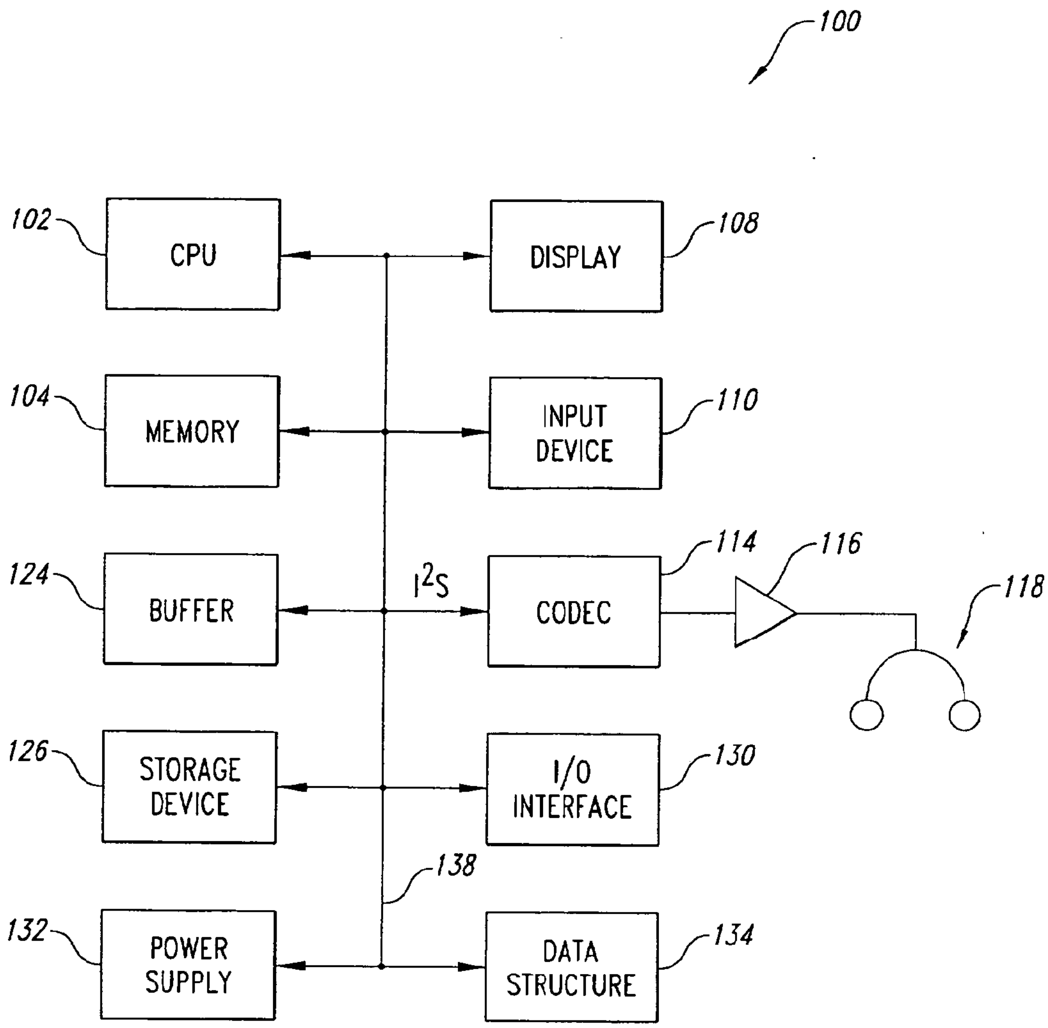

100
102
CPU
104
MEMORY
124
BUFFER
126
STORAGE DEVICE
132
POWER SUPPLY
108
DISPLAY
110
INPUT DEVICE
114
116
118
I^2S
CODEC
130
I/O INTERFACE
138
134
DATA STRUCTURE

Fig. 1

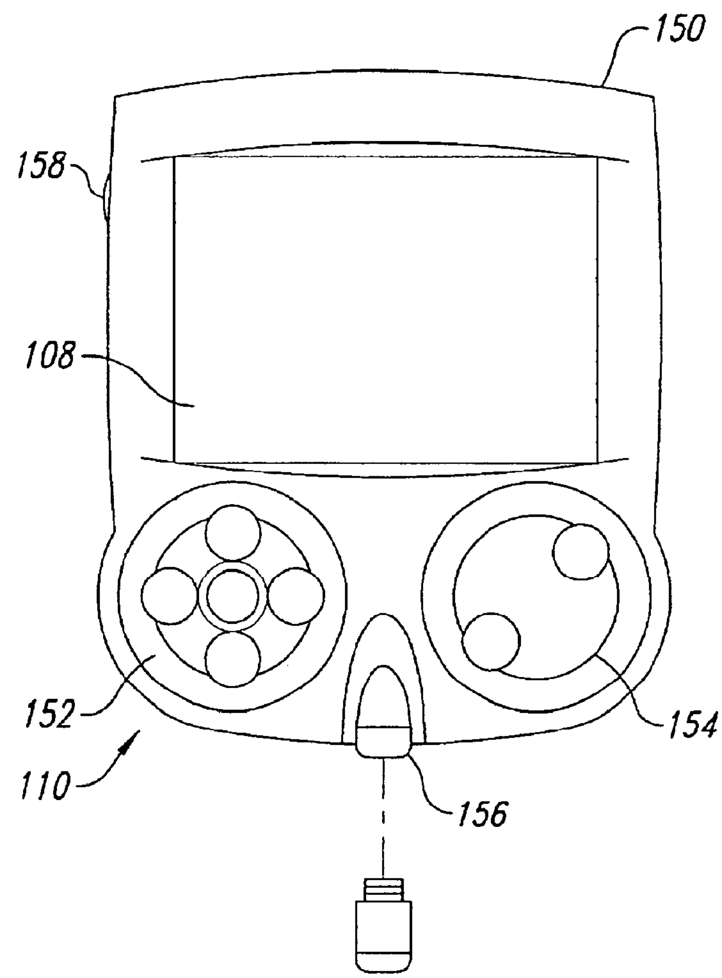


Fig. 2

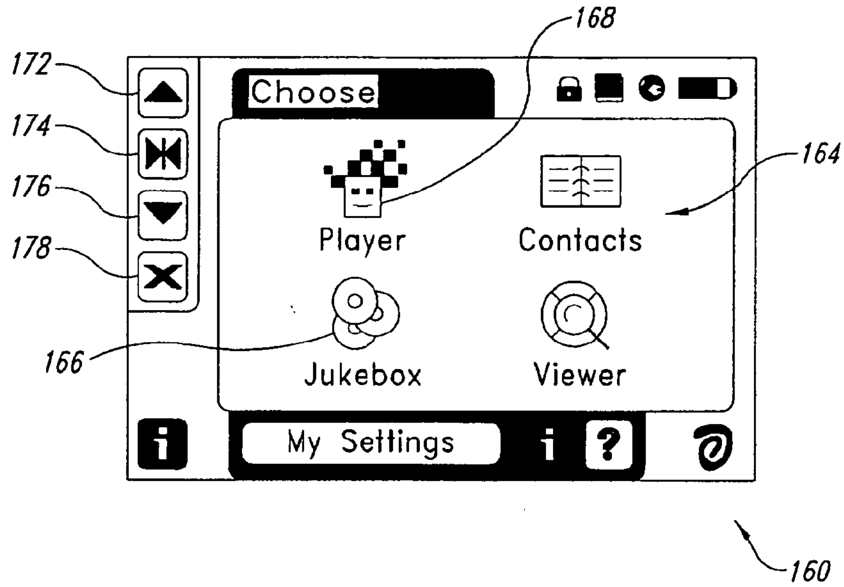

168
172
174
176
178
164
166
Choose
Player
Contacts
Jukebox
Viewer
My Settings
160

Fig. 3

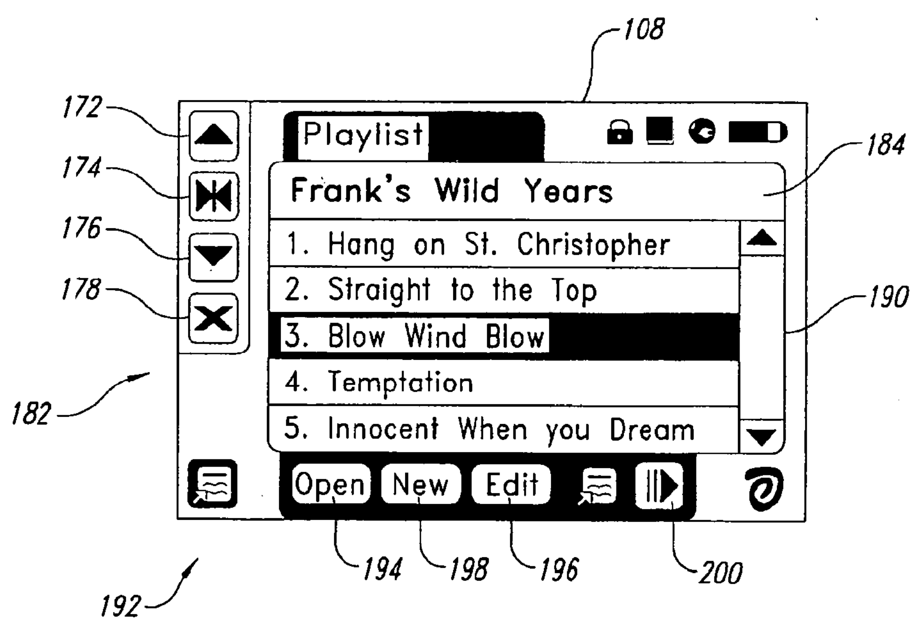

108
172
174
176
178
184
190
182
192
Playlist
Frank's Wild Years
1. Hang on St. Christopher
2. Straight to the Top
3. Blow Wind Blow
4. Temptation
5. Innocent When you Dream
Open
New
Edit
194
198
196
200

Fig. 4

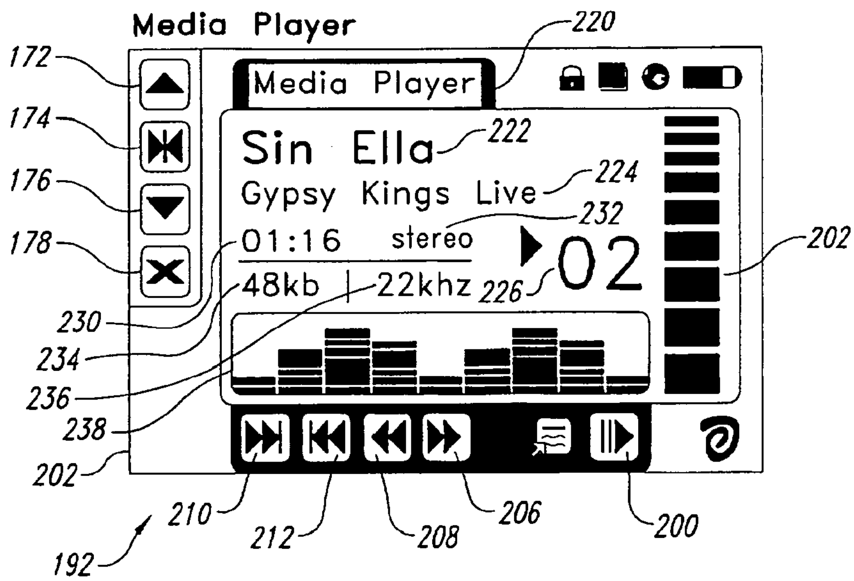

Media Player
Media Player
Sin Ella
Gypsy Kings Live
01:16 stereo
02
48kb | 22khz
172
174
176
178
220
222
224
232
202
226
230
234
236
238
202
210
212
208
206
200
192

Fig. 5

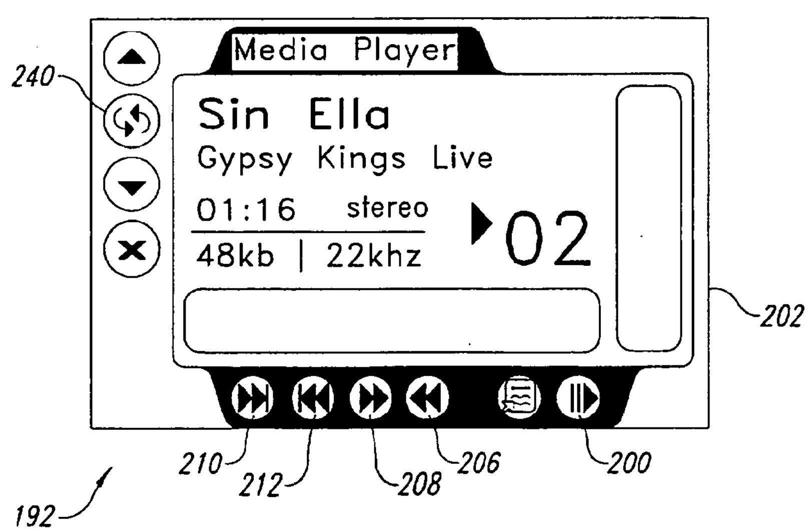

Media Player
Sin Ella
Gypsy Kings Live
01:16 stereo
02
48kb | 22khz
240
202
210
212
208
206
200
192

Fig. 6

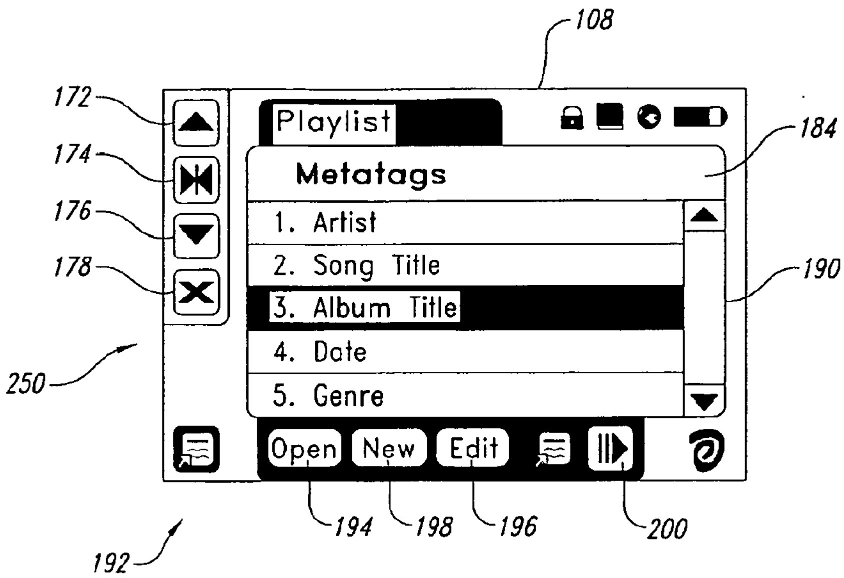

108
172
174
176
178
250
184
190
192
194
198
196
200
Playlist
Metatags
1. Artist
2. Song Title
3. Album Title
4. Date
5. Genre
Open
New
Edit

Fig. 7

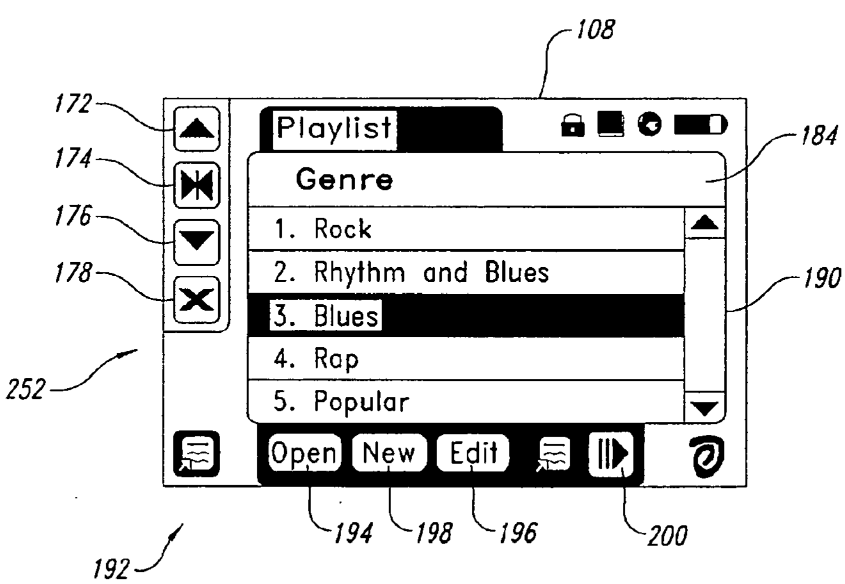

108
172
174
176
178
252
184
190
192
194
198
196
200
Playlist
Genre
1. Rock
2. Rhythm and Blues
3. Blues
4. Rap
5. Popular
Open
New
Edit

Fig. 8

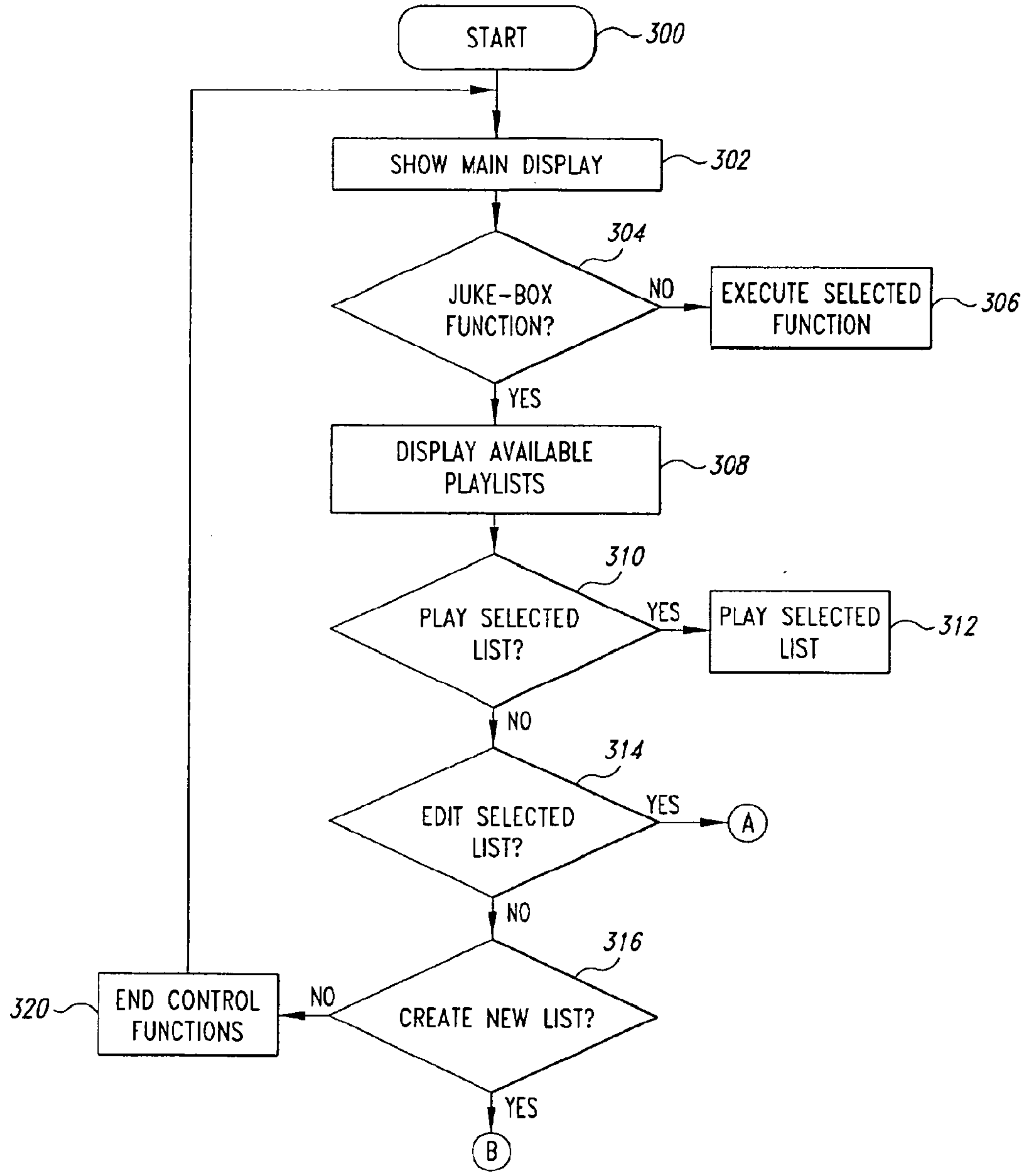
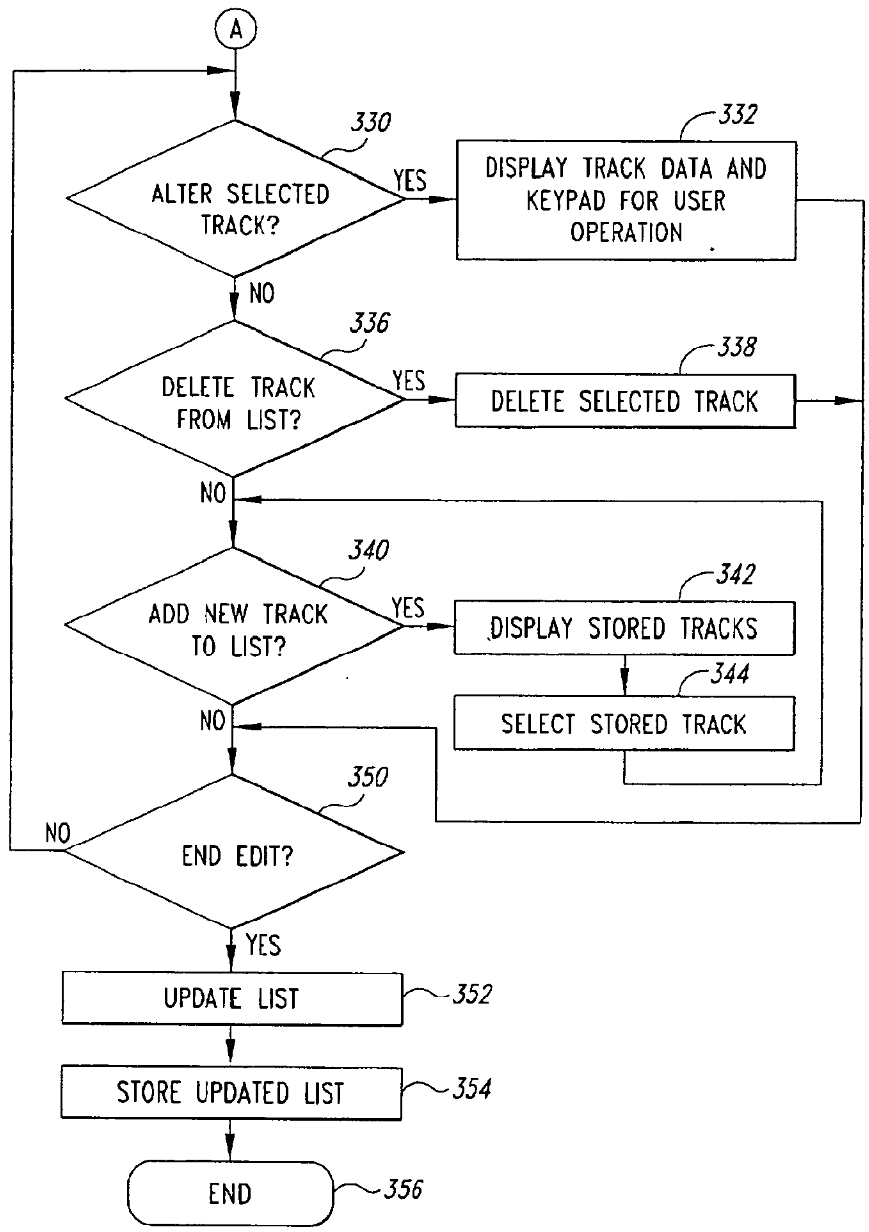

START
300
SHOW MAIN DISPLAY
302
304
JUKE-BOX FUNCTION?
NO
EXECUTE SELECTED FUNCTION
306
YES
DISPLAY AVAILABLE PLAYLISTS
308
310
PLAY SELECTED LIST?
YES
PLAY SELECTED LIST
312
NO
314
EDIT SELECTED LIST?
YES
A
NO
316
CREATE NEW LIST?
NO
END CONTROL FUNCTIONS
320
YES
B

Fig. 9



A
330
ALTER SELECTED TRACK?
YES
332
DISPLAY TRACK DATA AND KEYPAD FOR USER OPERATION
NO
336
DELETE TRACK FROM LIST?
YES
338
DELETE SELECTED TRACK
NO
340
ADD NEW TRACK TO LIST?
YES
342
DISPLAY STORED TRACKS
344
SELECT STORED TRACK
NO
350
NO
END EDIT?
YES
UPDATE LIST
352
STORE UPDATED LIST
354
END
356

Fig. 10

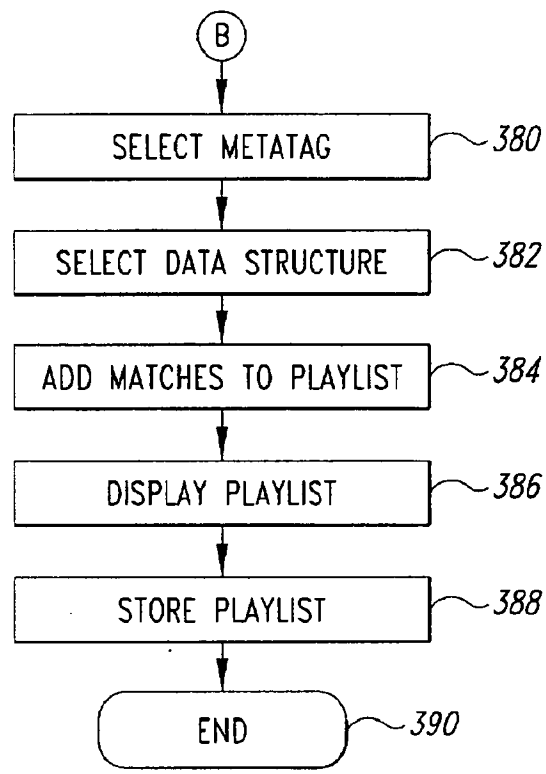

B
SELECT METATAG
380
SELECT DATA STRUCTURE
382
ADD MATCHES TO PLAYLIST
384
DISPLAY PLAYLIST
386
STORE PLAYLIST
388
END
390

Fig. 11

SYSTEM AND METHOD FOR MUSICAL PLAYLIST SELECTION IN A PORTABLE AUDIO DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/240,766 filed Oct. 13, 2000, where this provisional application is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention is related generally to portable audio devices and, more particularly, to a system and method for cataloging and creating playlists of audio data files.

BACKGROUND OF THE INVENTION

[0003] Portable audio devices have evolved from large cumbersome analog tape players to highly miniaturized digital storage devices. Early portable audio devices were typically in the form of analog tape players that sequentially played musical selections (or other audio presentations). For example, a prerecorded audio tape could be purchased by the user and sequentially played in a portable tape player. However, the user had no control over the sequence of play other than to stop the playing and manually fast forward or rewind to skip over one or more selections.

[0004] With the advent of portable digital devices in the form of compact disk (CD) players, the user has additional flexibility in the selections of songs from a CD. For example, some CD players permit the user to manually enter the sequence of musical tracks that will be played rather than play the musical tracks in a predetermined sequence from start to finish. Alternatively, some CD players also include a "random" mode in which musical tracks are randomly selected. However, the CD players described above are still limited to the selection of musical tracks on a single CD. Digital musical devices have been designed to eliminate all moving parts. These devices incorporate solid state memory storage technology and utilize digital processing capabilities, such as data compression, to minimize data storage requirements. A popular musical format, known as Motion Pictures Expert Group layer 3 (MPEG-2 layer 3) defines a digital musical format that plays "near-CD quality" music from a relatively small digital file as compared with the original digital file stored on a CD. Using known data compression techniques, the data structure defined by MPEG-2 layer 3, sometimes abbreviated as MP3, is approximately one tenth the size of a comparable data file on a CD.

[0005] With the introduction of large storage capacity MP3 players, the user may record and store a large number of musical data files. However, track selection and organization of such data files cannot be readily accomplished with conventional techniques. Therefore, it can be appreciated that there is a significant need for a system and method that will allow easy organization of data files in a portable digital audio device. The present invention provides this, and other advantages, as will be apparent from the following detailed description and accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] **FIG. 1** is a functional block diagram of an exemplary embodiment of the present invention.

[0007] **FIG. 2** is a top plan view of one embodiment of the present invention.

[0008] FIGS. **3-8** are various screen displays illustrating the operation of the present invention in various data entry and editing modes.

[0009] FIGS. **9-11** together form a flow chart illustrating the operation of the system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The present invention is directed to techniques that permit the user to implement a form of "jukebox" on a portable audio device. A jukebox manager allows the user to create, edit, and utilize a playlist comprising one or more data files. In a typical implementation, each data file is a separate musical track. The jukebox manager provides the user with a quick, flexible tool to organize music into playlists. As will be discussed in greater detail below, the system supports different play file formats and allows the user to generate or edit a playlist regardless of the format of the data file.

[0011] The present invention is embodied in a system **100**, illustrated in the functional block diagram of **FIG. 1**. The system **100** includes a central processing unit (CPU) **102** and a memory **104**. The CPU **102** may be implemented using a device, such as the ARM **7209** from Cirrus Logic or other processor designed for operation as an MP3 player. However, those skilled in the art will appreciate that the CPU **102** may be implemented using any convenient processor, such as a microprocessor, embedded controller, digital signal processor (DSP) or the like. The present invention is not limited by the specific form of the CPU **102**. The memory **104** may typically include both random access memory (RAM) and readonly memory (ROM). In one embodiment, the ROM portion of the memory **104** may be implemented using a flash program memory or a NAND flash memory. In addition, the memory **104** includes a basic input output system (BIOS), which contains instructions that allow the CPU **102** to communicate with various peripheral devices.

[0012] In addition, the system **100** includes a display **108**. In an exemplary embodiment, the display **108** is implemented as a liquid crystal display (LCD) to reduce overall power consumption. In one example, the display **108** may be a 240 by 160 pixel LCD subsystem, such as may be commercially purchased from a number of vendors. The display **108** may conveniently provide instructions to the user as well as programmable functions that may be context-sensitive. For example, when playing a music signal, the display **108** may provide commands associated with music playing, song information, and the like. For example, the display **108** may show the data sampling rate and number of kilobytes (Kb) in a particular data file. The display **108** may also include other information, such as power status, startup information, and the like.

[0013] The system **100** also includes an input device **110**. The input device **110** may be implemented as a series of electromechanical switches using conventional techniques. Alternatively, the input device **110** may be implemented in conjunction with the display **108** to provide a touch-sensitive display. A touch-sensitive display advantageously minimizes the need for electromechanical switches and further provides labels on the display that may be readily altered to accommodate variations in the implementation of the system 100. Alternatively, the input device 110 may comprise both electromechanical switches and a touch-sensitive display. Electromechanical switches and touch-sensitive displays are known in the art and need not be described in further detail herein. However, the present invention is not limited by the specific form of the input device 110.

[0014] As those skilled in the art can appreciate, the data representing the audio signal is in the form of digital samples. The digital data must be converted to analog form to produce a useful signal for the user. The system 100 includes a coder/decoder (CODEC) 114. The CODEC 114 is also sometimes referred to as a "compressor/decompressor" because the digital data samples are usually stored in a compressed form and are decompressed for playback. The CODEC 114 accepts a digital data stream and converts it to a representative analog signal. Different commercial CODECs are available for audio applications. Some CODECs, such as a code excited linear prediction (CELP) CODEC is designed for operations at relatively low frequencies and thus is particularly useful as a speech CODEC. Other forms of speech CODECs include adaptive delta modulation (ADM), pulse code modulation (PCM) and adaptive differential pulse code modulation (ADPCM).

[0015] Other forms of CODECs are designed for operation at higher data sampling rates and are thus useful for music applications. These music CODECs include MPEG or MP3 CODECs, G2 format, developed by Real Networks, Enhanced Perception Audio Decoder (ePAC), developed by Lucent, AC3 algorithm, which is a modified version of PCM, and Windows Media Audio (WMA), developed by the Microsoft Corporation. Some formats, such as the G2 format, may be used for both music and voice. Although the examples illustrated herein are directed to MP3 music format, those skilled in the art will recognize that the CODEC 114 illustrated in FIG. 1 may be satisfactorily implemented using any of the known CODEC technologies for either speech applications, music applications, or both. Thus, the present invention is not limited by the specific implementation of the CODEC 114.

[0016] In a typical embodiment, the system 100 may include multiple CODECs to process different file types. For example, an MP3 CODEC may be included to process music files encoded in accordance with an MP3 format. Other data files, such as audio books, may be processed using a different CODEC, such as the CELP CODEC. The playlists generated by the present invention may include data files of different types, such as an MP3 data file. The data file types may typically be identified by the file extension. For example, an MP3 file is followed by an extension ".m3u" while other data files may have a different file extension, such as ".1st." For the sake of convenience in operation, the system 100 of the present invention may display the names of data files without file extensions since multiple CODECs are available to process different file types. From the perspective of the end user, the file type and format is irrelevant so long as the user knows that the system can process the data file(s) selected by the user. Therefore, the playlist need not contain any file extensions. Alternatively, the system can display file extensions simply to provide the user with additional information concerning the various file types.

[0017] In an MP3 environment, the digital data is provided to the CODEC 114 using an I^2S bus. The I^2S bus is a high speed serial bus that is well known to those of ordinary skill in the art. As such, implementation details of the I^2S bus need not be provided herein. The CODEC 114 receives the data on the I^2S bus and converts it from digital data form to analog data. An analog amplifier 116 has an input terminal coupled to the output of the CODEC and receives the analog signal thereon. The amplifier 116 provides the necessary amplification and drive capability to power an audio output device 118, such as a pair of headphones. It should be noted that in a typical implementation, the output of the amplifier 116 is coupled to a standard ⅛ inch phone jack (not shown). The headphones 118 plus into the phone jack.

[0018] The system 100 also includes a buffer 124 that receives and temporarily stores digital data and provides the digital data to the CODEC 114. As will be discussed below, the buffer 124 receives data from a storage device 126. The buffer 124 may be a stand-alone device, or may be a portion of the memory 104. The use of the buffer 124 in optimizing the response of the storage device 126 will be discussed below.

[0019] The storage device 126 is typically implemented as a spinning media device, such as a micro-drive, click drive, or the like. The storage device 126 has a controllable motor (not shown) that is only enabled when the system 100 requires a data transfer to or from the storage media. The optimization of the storage device 126 includes a determination of when to start the motor on the storage device to allow it to come up to full speed, and how long to maintain power to the motor so as to transfer the desired amount of data from the storage media to the buffer 124.

[0020] Those skilled in the art will recognize that the storage device 126 is an optional component and may be eliminated without adversely affecting the operation of the present invention. A number of portable audio devices contain no storage device 126, but rely solely on the memory 104 to store the musical tracks. For the sake of completeness, the buffer 124 and storage device 126 are described herein. The buffer 124 is implemented in the system to optimize data transfer from the storage device 126. Although it is beyond the scope of the present invention, the buffer 124 may be allocated into a large number of buffer portions with one of the buffer portions being actively used to transfer data to the CODEC 114 while the remaining buffer portions are available for data transfer from the storage device 126. If the system 100 is implemented without the storage device 126, the buffer 124 may also be eliminated without adversely affecting the operation of the system. In this implementation, the musical track data is transferred directly from the memory 104 to the CODEC 114. Because the memory 114 is a solid state memory, data transfer rates are sufficiently high to accommodate satisfactory data transfer to the CODEC so as not to cause interruptions in the generation of output data.

[0021] The system 100 also may include an optional input/output (I/O) interface 130. The system 100 may include any conventional form of I/O interface and may typically include a serial interface and/or a universal serial bus (USB) interface. The operation of a serial interface and USB interface are well-known in the art and need not be described in greater detail herein. Although illustrated as a single I/O interface 130, those skilled in the art will recognize that the I/O interface 130 is intended to illustrate the function of one or more conventional interfaces.

[0022] A power supply 132 provides power to all of the components of the system 100. In an exemplary embodiment, the power supply 132 comprises two or more AAA batteries. A voltage regulator (not shown) in the power supply 132 provides a regulated voltage of approximately 3.1 VDC. The power supply 132 may also include provisions, such as an external power supply jack 170 (see FIG. 2), to permit the introduction of power from an external source, such as a cigarette lighter in an automobile, or the like.

[0023] The system also includes a data structure 134 to store data related to user-generated playlists and associated data. In one embodiment, the data structure 134 may be implemented as a database. However, those skilled in the art will recognize that any convenient form of known data structure will operate satisfactorily with system 100. Furthermore, the data structure 134 may be a portion of the memory 104 or a stand-alone data storage element. The present invention is not limited by the specific form in which the data structure 134 is implemented.

[0024] The various components of the system 100 are coupled together by a bus system 138. The bus system 138 may include a data bus, control bus, the I^2S bus, a memory bus, and the like. However, for the sake of simplicity, these various buses are illustrated in FIG. 1 as the bus system 138.

[0025] The system 100 is intended for portable operation. The various components described above are typically implemented as one or more integrated circuits on a printed circuit (PC) board (not shown). The PC board power supply 132, display 108, input device 110, and other components of the system 100 are enclosed in a case or housing 150, as illustrated in FIG. 2. As further illustrated in FIG. 2, the input device 110 comprises a four-button key pad assembly 152, a two-button key pad assembly 154, and an optional joystick 156. The four-button key pad 152 may be conveniently configured to function in a manner similar to well-known hand-held electronic games. Alternatively, the four-button key pad 152 can be replaced with a membrane (not shown) to permit the operation of four hardware buttons in a manner similar to a top hat switch on a joystick wherein one or two of the buttons may be activated to provide eight unique switch settings. In yet another alternative, the four-button key pad 152 or the two-button key pad 154 could be replaced with a position-sensing membrane, such as a touch pad commonly used in laptop computers. Those skilled in the art will recognize that other configurations may also be used for the input device 110. As will be described in greater detail below, the display 108 may conveniently comprise touch-sensitive display technology that will allow readily alterable configurations for control buttons that will correspond with the particular data shown on the display 108. A power switch 158 may be conveniently installed in the side of the housing 150 to allow the user to turn the system on and off.

[0026] When power is first applied to the system 100, the display 108 may be configured to illustrate a main menu, such as illustrated in the screen display 160 of FIG. 3. The screen display 160 may include a series of icons 164, such as a jukebox icon 166, a player icon 168, and the like. In addition to icons 164, the screen display 160 may include touch-sensitive programmable controls, such as a "Scroll Up" control button 172, a "Selection" control button 174, a "Scroll Down" control button 176 and an "Exit" control button 178. The operation of a touch-sensitive screen to implement these buttons are well known and need not to be described in any greater detail herein. Furthermore, the operation of the buttons, such as the Scroll Up button 172 and the Scroll Down button 176 are well known in the art and need not be described in detail. Activating the Scroll Up button 172 or the Scroll Down button 176 will cause the display to highlight a different one of the icons 164. When the desired icon is highlighted, such as by reverse video or other conventional technique, the user may activate the selection button 174 to activate the selected function.

[0027] FIG. 4 illustrates a sample screen display 182 shown by the system in response to the activation of the jukebox icon 166 and the selection of one playlist. As previously noted, the system 100 supports a plurality of different playlists. The screen display 182 comprises a playlist title portion for a playlist title display 184 to permit the user to readily identify the selected playlist. The user may simply activate the playlist to play musical tracks in the predetermined sequence shown in the playlist by pressing the Selection control button 174. When a display list is first shown on the display 108, the first entry in the playlist may be automatically selected and indicated using, by way of example, reverse video. The user may also scroll through the selected playlist using a scroll bar 190 in a well-known fashion or, alternatively, simply by touching the touch-sensitive display 108 at a point corresponding to the desired musical track. The system 100 may also be configured to allow the user to scroll through the selected playlist using the Scroll Up button 172, a Scroll Down button 176, and the Selection control button 174 in the manner described above to select a musical track out of the sequence illustrated in the playlist.

[0028] The user may also control the operation of the system 100 to open or edit playlists, or create new playlists using additional programmable control buttons 192 on a predetermined portion of the touch-sensitive display 108. The Programmable control buttons 192 may comprise buttons such as a "Open" control button 194, an "Edit" control button 196 and a "New" control button 198. The Open control button 194 may be used to display a number of different playlists and permit the user to select from one of the displayed playlists in the manner described above. That is, the user may activate the scroll bar 190 or the Scroll Up button 172, the Scroll Down button 174, and the like, to navigate through the displayed playlists. As the displayed playlists scroll up or down the display 108, a selected display list is shown in a highlighted fashion, such as reverse video. The user opens the selected playlist using the Selection control button 174 or another one of the convenient Programmable control buttons 192. The user may edit a selected playlist by selecting the Edit control button 196.

[0029] The user may edit an existing playlist by activating the Edit control button 196. Activation of the Edit control button 196 will cause the system 100 to display the names of already established playlists. The user may manipulate through the lists of playlists using, by way of example, the scroll bar 190 to select the desired playlist. When the desired playlist has been selected, the display 108 will indicate the musical tracks already selected in the playlist, as illustrated in **FIG. 4**. In an exemplary embodiment, the first musical track in the playlist is highlighted using, by way of example, reverse video. The user selects a particular musical track in the manner described above. The user can edit a selected musical track, to correct misspellings or other information, delete an existing musical track from the current playlist, or add additional musical tracks to the selected playlist using conventional editing techniques. The user exits the edit mode by activating the Exit control button **178**.

[0030] In addition to editing an existing playlist, the user may elect to create a new playlist by activating the New control button **198**. When the user activates the New control button **198**, the display **108** may be configured to show all musical tracks currently stored in the memory **104**. The user may scroll through the list of musical tracks using conventional controls, such as the scroll bar **190**. As the user scrolls through the list of musical tracks, a selected musical track may be highlighted using, by way of example, reverse video. Other conventional techniques, such as bold video, underlined text, an asterisk or other indicator, may also be used to indicate the selected musical track. To enter a selected musical track into the new playlist, the user may activate the Selection control button **174**. The user may scroll through the displayed list of stored musical tracks and select other musical tracks in the manner described above to thereby enter them into the playlist. When the playlist is completed, the user may exit the data entry mode by selecting the Exit control button **178**. Thus, the system **100** has provided the user with a simple technique for creating music playlists.

[0031] When a playlist or individual musical track has been selected, that selection may be played by activating the Selection control button **174** or a special control button, such as a "Play/Pause" button **200**. When a selected musical track begins to play, the touch-sensitive display **108** may be reprogrammed to show a screen display **202**, illustrated in **FIG. 5**. The touch-sensitive display **108** has also been changed such that the control buttons perform different functions relevant to a media player. For example, the Scroll Up control button **172** and Scroll Down control button **174** may now be used to control the volume. A graphical representation **204** may provide visual cues to the user as to the volume level. The programmable control buttons **192** may now comprise a Fast Forward button **206** and Rewind button **208** to advance or rewind within the selected musical track. A Skip Forward button **210** may be used to automatically advance to the next musical track in the playlist while a Skip Rewind button **212** may be activated to rewind to the beginning of the current musical track if activated once and rewound to the beginning of the previous musical track in the playlist if activated twice within a short period of time. In addition, the Play/Pause control button **200** may be used in the manner previously described.

[0032] In addition to control buttons, the display screen **202** can provide user information, such as the currently selected function **220**, a title **222**, an artist name **224**, and a track selection **226**. Other information, such as an elapsed time **230**, stereo indicator **232**, sample rate indicator **234**, and bandwidth indicator **236** may also be provided on the display screen **202**. In addition, an exemplary embodiment of the system **100** may include a graphical equalization display **238** to indicate the relative power of signals at different frequency bands. Those skilled in the art will recognize that numerous variations are possible with the present invention. For example, the graphical equalization display **238** can be eliminated and replaced with other information, such as metatags indicating categories or other identifier tags that correspond to the selected musical track.

[0033] One convenient aspect of on-screen programming using the display **108** is that many configurations are possible. An alternative configuration of the media player is illustrated in **FIG. 6** where the programmable controls **192** have a different appearance, but perform the same functions as previously described with respect to **FIG. 5**. In addition, the Scroll Up control button **172**, Scroll Down control button **176** and Exit button **178** have a different appearance in the display screen **202** of **FIG. 6**, but perform identical functions to those described above with respect to the corresponding buttons in **FIG. 5**. In **FIG. 6**, the selection control button **174** has been replaced with a Repeat control button **240** to permit the user to repeat a selected musical track or selected musical playlist. Other programmable features, such as random selection of musical tracks within a playlist, and the like may also be readily provided using the touch-sensitive display **108**.

[0034] Although the operation of the system **100** has been described with respect to buttons on the touch-sensitive display **108**, similar control of the system may be accomplished using, by way of example, the four-button key pad **152** (see **FIG. 2**) and the two-button key pad **154**. Essentially, the buttons of the four-button key pad **152** and two-button key pad **154** are mapped into the functions described above with respect to the Programmable control buttons **192** and the control buttons **172-178**. The operation of the four-button key pad **152** and two-button key pad **154** is within the scope of knowledge of one of ordinary skill in the art and thus, need not be described in greater detail herein.

[0035] The operation of the system **100** to open, edit, or create playlists has been previously described. In addition to selection of musical tracks by title, the system **100** advantageously allows the selection of musical tracks using metatags. In an exemplary embodiment, the system **100** creates the data structure **134** (see **FIG. 1**) to store metatags corresponding to musical tracks stored in the memory **104** (see **FIG. 1**). The data structure or database **134** may be part of the memory **104** (see **FIG. 1**) or a separate data storage element. Those skilled in the art will recognize that any one of a number of well-known data structures may be satisfactorily used to implement the data structure described herein. For the sake of convenience, the data structure **134** will be subsequently described as a database. However, the present invention is not limited by the specific implementation of a data structure to store metatags.

[0036] A number of different data elements may be used as metatags. For example, the artist's name, song title, album title, date, copyright, or any other information associated with a musical track can be potentially used as a metatag. In an exemplary implementation, the user may elect to create a new playlist by activating the New control button **198** (see **FIG. 4**) using metatags to describe the desired musical tracks. In this example, illustrated in **FIG. 7**, the display **108** shows a screen display **250** that lists a series of possible metatags for selection by the user. In an exemplary embodiment, the first metatag in the list of metatags is automatically selected. The user may scroll through the list using, by way of example, the scroll bar 190 to select a desired metatag, as illustrated in FIG. 7. As noted above, the system 100 can automatically generate a playlist based on the user-selected metatag or provide a list of musical tracks that match the selected metatag for display and subsequent manual selection by the user. For example, if the user selected the metatag "Artist," the system 100 would permit the user to enter the name of a desired artist or, alternatively, will display the artist name for all musical tracks stored in the memory 104 (see FIG. 1). When the user selects a desired artist, the system may automatically generate the playlist and include all songs stored in the memory 104 that have a metatag corresponding to the user-selected artist name. Alternatively, the system 100 can display all musical tracks whose metatag corresponds to the user-selected artist name and thereby permit the user to manually select which musical tracks will be added to the playlist.

[0037] In addition to the metatags discussed above, other metatags, such as musical genre may be used as a metatag. For example, songs may be classified as "Rock,""Blues, ""Rap," and the like. If the user selects a particular metatag, the system 100 accesses the database to determine which musical tracks stored in the memory 104 (see FIG. 1) correspond to the selected metatag. If the user selects genre as the desired metatag, the system 100 may generate a screen display 252 on the display 108, as illustrated in FIG. 8, to list the various musical genre for musical tracks stored in the memory 104. As noted above, the first item in the list may be automatically selected and the user may alter the selection using, by way of example, the scroll bar 190. In the example illustrated in FIG. 8, the user-selected musical genre is "Blues." The user may activate the selection using the Selection control button 174. Once a particular genre, such as Blues, has been selected, the system 100 may search the data structure 134 (see FIG. 1) and automatically generate a playlist containing the musical tracks stored in the memory 104 whose metatags match the selected musical genre (i.e., Blues). Alternatively, the system 100 may search the data structure 134 and create a list of all musical titles stored in the memory 104 whose metatag matches the selected musical genre. The list may be shown on the display 108 to permit subsequent manual selection by the user.

[0038] It should be noted that each musical track may have a number of different metatags to easily enable the user to search the data structure and automatically generate playlists. The association of musical tracks with multiple metatags makes it easier for the user to search for desired musical tracks. In certain cases, a musical track may appear in more than one category. For example, certain musical tracks may be considered to belong to multiple genre, such as "Rock" and "Popular."

[0039] In an alternative embodiment, the system 100 permits searching by multiple metatags. For example, the user may wish to search the data structure 134 for musical tracks that match metatags for both artist name and a particular date. In another example, the user may wish to select a particular musical genre, such as "Rock" and date to automatically generate a musical playlist of rock songs prior to a user-selected date.

[0040] The operation of the invention is illustrated in the flowchart of FIGS. 9-11. At a start 300, illustrated in FIG. 9, it is assumed that the system is under power or has just been turned on by the user. In step 302, the system 100 shows the main display, such as illustrated in FIG. 3. In decision 304, the system determined whether the user has selected the jukebox function. If the user has not selected the jukebox function, the result of decision 304 is NO. In that event, the system moves to step 306 and executes the selected function, such as displaying a contact list of user-entered names, addresses and telephone numbers. These additional functions are beyond the scope of the present invention and will not be discussed in greater detail herein.

[0041] If the user has selected the jukebox function, the result of decision 304 is YES. In that event, the system 100 queries the data structure 134 and extracts the titles of all existing playlists and, in step 308, the existing playlists are shown on the display 108 (see FIG. 1). In decision 310, the system 100 determines whether the user has activated one or more buttons to select a playlist. If the user has selected a playlist for play, the result of decision 310 is YES and, in step 312, the system plays the selected playlist by transferring data from the buffer 124 (or the memory 104) to the CODEC 114 in a conventional fashion. As previously noted, the musical tracks of the selected playlist may be played sequentially in the sequence originally specified by the user when creating the playlist, in a new sequence specified by the user at the present time, or in some other fashion, such as random selection.

[0042] If the user has not selected a playlist to play, the result of decision 310 is NO. In that event, in decision 314, the system 100 determines whether the user has selected a playlist for editing. If the user has selected a playlist for editing, the result of decision 314 is YES and the system enters an edit mode, described in the flowchart of FIG. 10. If the user has not selected a playlist for editing, the result of decision 314 is NO. In that event, the system determines, in decision 316, whether the user has activated one or more buttons to create a new playlist. If the user has activated one or more buttons on the system 100 to create a new playlist, the result of decision 316 is YES and, the system enters a data entry mode illustrated in FIG. 11. If the user has not elected to create a new playlist, the result of decision 316 is NO and, in step 320, the system ends the control function operation and, in one example, may return to display the main menu in step 302. Those skilled in the art will recognize that a number of different possible flowcharts may be implemented by the present system. For example, the system 100 may return to decision 310 until the user selects an operation. In addition, the activation of other buttons, such as a main menu button (not shown) may be used to exit the control function process and return to the main display in step 302. The flowchart of FIGS. 9-11 are intended simply as an illustration of possible control flow to create, edit, and play selected playlists. The present invention is not limited to the specific processing sequence illustrated in the flowcharts of FIGS. 9-11.

[0043] As previously stated, the user may activate one or more of the buttons on the system 100 to edit a selected playlist. If the user has elected to edit a selected playlist, the result of decision 314 in FIG. 9 is YES. In that event, the system 100 moves to decision 330, illustrated in FIG. 10, to determine whether the user has elected to alter a selected track. If the user has elected to alter a selected track, the result of decision 330 is YES. In step 332, the system displays stored data about the selected track and may further display a keypad (not shown) for user operation to change selected data. For example, the user may wish to edit the title of a musical track to correct a typographical error from a previous entry. The user can highlight the selected data element (e.g., the title) and activate the edit control button **196** (see **FIG. 4**). The user can operate the touch-sensitive display **108** to enter a new title. The altered data will be displayed and stored in subsequent steps described below.

[0044] If the user has not elected to alter a selected track, the result of decision **330** is NO. In that event, the system **100** moves to decision **336** to determine whether the user has activated one or more keys to delete a selected track from the playlist. If the user has elected to delete a track from the playlist, the result of decision **336** is YES. In that event, in step **338**, the system **100** deletes the selected track and the newly edited playlist is updated and stored in steps described below. The system **100** also checks to see if the user wishes to perform more edits, as will be described in greater detail below. If the user has not activated one or more buttons on the system **100** to delete a musical track from the playlist, the result of decision **336** is NO.

[0045] In decision **340**, the system **100** determines whether the user has activated one or more buttons on the system **100** to add a new musical track to an existing playlist. If the user has elected to add a new musical track to the playlist, the result of decision **340** is YES. In that event, in step **342**, the system **100** displays a list of all musical tracks that may be stored in the memory **104** (or the optional storage device **126**). In step **344**, the user selects the desired musical track to the selected playlist in the manner described above. In an exemplary embodiment, a musical track that may be stored on the optional storage device **126** may be relocated to the memory **104**. Following the selection of the stored musical track in step **344**, the system **100** returns to decision **340** to determine whether additional new tracks will be added to the selected playlist.

[0046] If no additional musical tracks are to be added to the existing playlist, the result of decision **340** is NO and the edit operation. Following the completion of the selected edit operation, such as altering the selected track in step **332**, deleting a selected track in step **338**, or adding selected tracks in steps **342-344**, the system **100** moves to decision **350** to determine if the user wishes to perform additional edit operations on the selected existing playlist. If the user does not wish to end the current editing session, the result of decision **350** is NO and the system may return to decision **330** to permit additional editing of one or more tracks in the existing playlist.

[0047] If the user wishes to end the editing session by activating, by way of example, the Exit control button **178** (see **FIG. 4**), the result of decision **350** is YES. In that event, in step **352**, the system **100** updates the existing playlist to include all edits performed by the user and, in step **354**, the system stores the newly edited playlist. As previously discussed, the edited playlists may be conveniently stored as part of the data structure **134**. The edit operation ends at **356**.

[0048] Returning momentarily to the flow chart of **FIG. 9**, if the user wishes to create a new playlist, the result of decision **316** is YES. In that event, the system executes processes illustrated in the flowchart of **FIG. 11** to create a new playlist. As previously discussed, the system **100** may simply display the titles of all musical tracks stored in the memory **104** and allow the user to manually select ones of the displayed musical tracks to add to the newly created playlist. **FIG. 11** illustrates the operation of the system **100** to generate a playlist using metatags. In step **380**, the user selects a desired metatag from the list shown, by way of example, in the screen display **250**, illustrated in **FIG. 7**. The user may select a metatag, such as genre, which causes the system **100** to display the display screen **252** listing the various genre metatags corresponding to the various musical tracks stored in the memory **104** (or in the storage device **126**). In addition, as noted above, the user may select more than one metatag to further refine the selection of musical tracks. Thus, step **380** may represent multi-step processes in which one or more screen displays are provided to the user to guide the user through the metatag selection process.

[0049] After one or more metatags have been selected in step **380**, the system **100** searches the data structure **134** (see **FIG. 1**) in step **382**. In one example implementation, the data structure **134** may be a conventional database in which search terms, such as the selected metatags, are provided as inputs to the database and results are produced by the database in the form of one or more musical tracks whose metatags correspond to the user-selected metatags.

[0050] In step **384**, the system automatically adds to the playlist musical tracks whose metatags match the user-selected metatags. The automatically selected playlist is displayed for the user in step **386**. The user may manually edit one or more of the musical tracks on the newly generated playlist in the manner described above with respect to the flowchart of **FIG. 10**. Alternatively, the system **100** may simply display the resultant matches and permit the user to manually select which musical tracks will be added to the newly created playlist. In step **388**, the completed playlist is stored in the memory **104** or, alternatively, in the data structure **134**. The process ends at **390**.

[0051] Thus, the system **100** provides a powerful but simple interface that allows the user to quickly generate playlists from stored musical tracks using one or more user-selected metatags. The system further provides simple editing processes that allow the user to readily alter existing playlists.

[0052] From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. For example, the operation of the system **100** has been described using the example of musical tracks as the audio data files that are selected by a user and placed in playlists. However, the system **100** is applicable to any type of audio data file, such as audio books, as well as musical data files. Accordingly, the invention is not limited except as by the appended claims.

What is claimed is:

1. A system for the display and control of music selection in a hand-held portable multi-media device, the system comprising:

a housing sized to be held by a user;

a circuit board within the housing;

a battery power supply to provide electrical power to electrical circuitry on the circuit board;

a data structure to store a plurality of music data files, each music selection data file having identification data associated therewith;

a display to display data comprising a playlist indicating music data files to be played;

an input device operable by the user to select identification data associated with desired music data files for the playlist;

a processor responsive to the input device to select the music data files for the playlist based on the user selected identification data;

a CODEC to receive the selected music data files and convert the selected music data files to audio data; and

an audio output driver coupled to the CODEC to receive the audio data therefrom, the audio output driver further having an output and providing analog signals to the output for connection to an audio output device.

2. The system of claim 1 wherein the data structure contains music data files having different data format types.

3. The system of claim 1 wherein the data associated with the stored music data files comprises song names and the display displays the song names, the user manually generating the playlist by operating the user input device to select song names and the processor generating the playlist based on the selected song names.

4. The system of claim 1 wherein the data associated with the stored music data files comprises metatags and the display displays the metatags, the user generating the playlist by operating the user input device to select metatags and the processor generating the playlist based on the selected metatags.

5. The system of claim 1, further comprising an associated data structure wherein the associated data comprises a plurality of data types, the processor analyzing the music data file to determine one or more associated data types and storing each of the data types for each music data file in the associated data structure in association with the music data file.

6. The system of claim 5 wherein the processor selects the music data files for the playlist by generating an indicator to indicate a storage location in the associated data structure for an associated data type for each of the selected music data files.

7. The system of claim 1 wherein the associated data comprises a plurality of data types and the user selects a desired data type using the user input device, the display displaying the user-selected data type associated with each of the plurality of music data files.

8. The system of claim 1 wherein the associated data comprises a plurality of data types and the display displays all associated data types for a user-selected one of the music data files.

9. The system of claim 1, further comprising a selection data structure wherein the playlist is stored for subsequent use.

10. The system of claim 1 wherein the processor alters the stored playlist and wherein the altered playlist is stored for subsequent use.

11. The system of claim 1 wherein the processor is responsive to the input device to select music data files based on user-selection of a plurality of identification data associated with the music data files.

12. A method for the automatic control of music selection in a hand-held portable multi-media device, the method comprising:

storing a plurality of music data files, each music selection data file having identification data associated therewith;

sensing user operation of an input device to select identification data associated with desired music data files for the playlist;

selecting a portion of the music data files to generate the playlist based on the user selected identification data;

processing the selected music data files with a CODEC to convert the selected music data files to audio data; and

providing the audio data to an output for connection to an audio output device.

13. The method of claim 12 wherein the music data files have different data format types.

14. The method of claim 12 wherein the data associated with the stored music data files comprises song names, the method further comprising displaying the song names and sensing user-operation of the input device to manually generate the playlist by operating the user input device to select song names wherein selecting comprises generating the playlist based on the selected song names.

15. The method of claim 12 wherein the data associated with the stored music data files comprises metatags, the method further comprising displaying the metatags and sensing user-operation of the input device to select metatags wherein selecting comprises generating the playlist based on the selected metatags.

16. The method of claim 12 wherein the associated identification data comprises a plurality of data types, the method further comprising analyzing the music data file to determine one or more associated data types and storing each of the data types for each music data file in association with the music data file.

17. The method of claim 12, further comprising sensing user input to select a plurality of identification data wherein selecting music data files is based on the user-selected plurality of identification data associated with the music data files.

18. A computer-readable media that causes a processor to control of music selection in a hand-held portable multi-media device by performing the steps of:

storing a plurality of music data files, each music selection data file having identification data associated therewith;

sensing user operation of an input device to select identification data associated with desired music data files for the playlist;

selecting a portion of the music data files to generate the playlist based on the user selected identification data;

processing the selected music data files with a CODEC to convert the selected music data files to audio data; and

providing the audio data to an output for connection to an audio output device.

19. The computer-readable media of claim 18 wherein the data associated with the stored music data files comprises metatags, the computer-readable media causing the processor to perform the steps of displaying the metatags and sensing user-operation of the input device to select metatags wherein selecting comprises generating the playlist based on the selected metatags.

20. The computer-readable media of claim 18, further causing the processor to sense user input to select a plurality of identification data and select music data files based on the user-selected plurality of identification data associated with the music data files.

* * * * *

B1

Reference cited in Substitute PTO Form 1449
Attorney Docket No. 380786-108980
Reexam Control No. 95/001,274

C141-E088-01EN

MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT

DISK DRIVES

PRODUCT MANUAL

FUJITSU

FOR SAFE OPERATION

Handling of This Manual

This manual contains important information for using this product. Read thoroughly before using the product. Use this product only after thoroughly reading and understanding especially the section "Important Alert Items" in this manual. Keep this manual handy, and keep it carefully.

FUJITSU makes every effort to prevent users and bystanders from being injured or from suffering damage to their property. Use the product according to this manual.

IMPORTANT NOTE TO USERS

READ THE ENTIRE MANUAL CAREFULLY BEFORE USING THIS PRODUCT. INCORRECT USE OF THE PRODUCT MAY RESULT IN INJURY OR DAMAGE TO USERS, BYSTANDERS OR PROPERTY.

While FUJITSU has sought to ensure the accuracy of all information in this manual, FUJITSU assumes no liability to any party for any damage caused by any error or omission contained in this manual, its updates or supplements, whether such errors or omissions result from negligence, accident, or any other cause. In addition, FUJITSU assumes no liability with respect to the application or use of any product or system in accordance with the descriptions or instructions contained herein; including any liability for incidental or consequential damages arising therefrom. FUJITSU DISCLAIMS ALL WARRANTIES REGARDING THE INFORMATION CONTAINED HEREIN, WHETHER EXPRESSED, IMPLIED, OR STATUTORY.

FUJITSU reserves the right to make changes to any products described herein without further notice and without obligation.

The contents of this manual may be revised without prior notice.

C141-E088-01EN

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Revision History

(1/1)

Edition	Date	Revised section (*1) (Added/Deleted/Altered)	Details
01	1999-07-20	—	—

*1 Section(s) with asterisk (*) refer to the previous edition when those were deleted.

C141-E088-01EN

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Preface

This manual describes the MHJ Series and MHK Series, 2.5-inch hard disk drives. These drives have a built-in controller that is compatible with the ATA interface.

This manual describes the specifications and functions of the drives and explains in detail how to incorporate the drives into user systems. This manual assumes that the reader has a basic knowledge of hard disk drives and their implementations in computer systems.

This manual consists of seven chapters and sections explaining the special terminology and abbreviations used in this manual:

Overview of Manual

CHAPTER 1 Device Overview

This chapter gives an overview of the MHJ Series and MHK Series and describes their features.

CHAPTER 2 Device Configuration

This chapter describes the internal configurations of the MHJ Series and MHK Series and the configuration of the systems in which they operate.

CHAPTER 3 Installation Conditions

This chapter describes the external dimensions, installation conditions, and switch settings of the MHJ Series and MHK Series.

CHAPTER 4 Theory of Device Operation

This chapter describes the operation theory of the MHJ Series and MHK Series.

CHAPTER 5 Interface

This chapter describes the interface specifications of the MHJ Series and MHK Series.

CHAPTER 6 Operations

This chapter describes the operations of the MHJ Series and MHK Series.

Terminology

This section explains the special terminology used in this manual.

Abbreviation

This section gives the meanings of the definitions used in this manual.

Conventions for Alert Messages

This manual uses the following conventions to show the alert messages. An alert message consists of an alert signal and alert statements. The alert signal consists of an alert symbol and a signal word or just a signal word.

The following are the alert signals and their meanings:

⚠CAUTION	This indicates a hazarous situation *could* result in *minor* or *moderate personal injury* if the user does not perform the procedure correctly. This alert signal also indicates that damages to the product or other property, *may* occur if the user does not perform the procedure correctly.
IMPORTANT	This indicates information that could help the user use the product more efficiently.

In the text, the alert signal is centered, followed below by the indented message. A wider line space precedes and follows the alert message to show where the alert message begins and ends. The following is an example:

(Example)

⚠CAUTION

Data corruption: Avoid mounting the disk drive near strong magnetic sources such as loud speakers. Ensure that the disk drive is not affected by external magnetic fields.

The main alert messages in the text are also listed in the "Important Alert Items."

Operating Environment

This product is designed to be used in offices or computer rooms.

For details regarding the operating environment of use, refer to the ________ ________________________________ (Cnnn-Xnnn) and the ________ ________________________________ (Cnnn-Xnnn).

Attention

Please forward any comments you may have regarding this manual.

To make this manual easier for users to understand, opinions from readers are needed. Please write your opinions or requests on the Comment at the back of this manual and forward it to the address described in the sheet.

Liability Exception

"Disk drive defects" refers to defects that involve adjustment, repair, or replacement.

Fujitsu is not liable for any other disk drive defects, such as those caused by user misoperation or mishandling, inappropriate operating environments, defects in the power supply or cable, problems of the host system, or other causes outside the disk drive.

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Important Alert Items

Important Alert Messages

The important alert messages in this manual are as follows:

CAUTION

A hazardous situation *could* result in *minor* or *moderate personal injury* if the user does not perform the procedure correctly. Also, damage to the predate or other property, *may* occur if the user does not perform the procedure correctly.

Task	Alert message	Page
Normal Operation	**Data corruption:** Avoid mounting the disk near strong magnetic soures such as loud speakers. Ensure that the disk drive is not affected by extrnal magnetic fields. **Stastic:** When handling the device, disconnect the body ground (500 kΩ or greater). Do not touch the printed circuit board, but hold it by the edges.	3-8

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Manual Organization

MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT DISK DRIVES PRODUCT MANUAL (C141-E088) <This manual>	• Device Overview • Device Configuration • Installation Conditions • Theory of Device Operation • Interface • Operations
MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT DISK DRIVES MAINTENANCE MANUAL (C141-F038)	• Maintenance and Diagnosis • Removal and Replacement Procedure

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Contents

Illustrations

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CHAPTER 1 Device Overview

Overview and features are described in this chapter, and specifications and power requirement are described.

The MHJ Series and MHK Series are 2.5-inch hard disk drives with built-in disk controllers. These disk drives use the AT-bus hard disk interface protocol and are compact and reliable.

1.1 Features

1.1.1 Functions and performance

The fillowing features of the MHJ Series and MHK Series are described.

(1) Compact

The MHJ2181AT has 3 disks, and its height is 12.5 mm (0.492 inch). The MHK2120AT, MHK2090AT and MHK2060AT have 1 disk or 2 disks of 65 mm (2.5 inches) diameter, and its height is 9.5 mm (0.374 inch).

(2) Large capacity

The disk drive can record up to 6.0 GB (formatted) on one disk using the 16/17 MTR recording method and 15 recording zone technology. The MHJ Series and MHK Series have a formatted capacity of 18.1 GB (MHJ2181AT), 12.0 GB (MHK2120AT), 9.0 GB (MHK2090AT) and 6.0 GB (MHK2060AT) respectively.

(3) High-speed Transfer rate

The disk drives (the MHJ Series and MHK Series) have an internal data rate up to 22.3 MB/s. The disk drive supports an external data rate up to 66.6 MB/s (U-DMA mode 4).

(4) Average positioning time

Use of a rotary voice coil motor in the head positioning mechanism greatly increases the positioning speed. The average positioning time is 13 ms (at read).

1.1.2 Adaptability

(1) Power save mode

The power save mode feature for idle operation, stand by and sleep modes makes The disk drives (the MHJ Series and MHK Series) ideal for applications where power consumption is a factor.

(2) Wide temperature range

The disk drives (the MHJ Series and MHK Series) can be used over a wide temperature range (5°C to 55°C).

(3) Low noise and vibration

In Ready status, the noise of the disk drives (the MHJ Series and MHK Series) is only about 30 dBA (measured at 1 m apart from the drive under the idle mode).

1.1.3 Interface

(1) Connection to interface

With the built-in ATA interface controller, the disk drives (the MHJ Series and MHK Series) can be connected to an ATA interface of a personal computer.

(2) 512-KB data buffer

The disk drives (the MHJ Series and MHK Series) uses a 512-KB data buffer to transfer data between the host and the disk media.

In combination with the read-ahead cache system described in item (3) and the write cache described in item (7), the buffer contributes to efficient I/O processing.

(3) Read-ahead cache system

After the execution of a disk read command, the disk drive automatically reads the subsequent data block and writes it to the data buffer (read ahead operation). This cache system enables fast data access. The next disk read command would normally cause another disk access. But, if the read ahead data corresponds to the data requested by the next read command, the data in the buffer can be transferred instead.

(4) Master/slave

The disk drives (the MHJ Series and MHK Series) can be connected to ATA interface as daisy chain configuration. Drive 0 is a master device, drive 1 is a slave device.

(5) Error correction and retry by ECC

If a recoverable error occurs, the disk drives (the MHJ Series and MHK Series) themselves attempt error recovery. The ECC has improved buffer error correction for correctable data errors.

(6) Self-diagnosis

The disk drives (the MHJ Series and MHK Series) have a diagnostic function to check operation of the controller and disk drives. Executing the diagnostic command invokes self-diagnosis.

(7) Write cache

When the disk drives (the MHJ Series and MHK Series) receive a write command, the disk drives post the command completion at completion of transferring data to the data buffer completion of writing to the disk media. This feature reduces the access time at writing.

1.2 Device Specifications

1.2.1 Specifications summary

Table 1.1 shows the specfications of the disk drives (MHJ Series and MHK Series).

Table 1.1 Specifications (1/2)

	MHJ2181AT	MHK2120AT	MHK2090AT	MHK2060AT
Format Capacity (*1)	18.1 GB	12.0 GB	9.0 GB	6.0 GB
Number of Heads	6	4	3	2
Number of Cylinders (User)	14,784			
Bytes per Sector	512			
Recording Method	16/17 MTR			
Track Density	24,300 TPI			
Bit Density	383 Kbpi			
Rotational Speed	4,200 rpm ± 1%			
Average Latency	7.14 ms			
Positioning time (read and seek) • Minimum (Track to Track) • Average • Maximum (Full)	 1.5 ms (typ.) Read: 13 ms (typ.) 23 ms (typ.)			
Start/Stop time • Start (0 rpm to Drive Read) • Stop (at Power Down)	 Typ.: 5 sec Typ.: 5 sec			
Interface	ATA-5 (Max. Cable length: 0.46 m)			
Data Transfer Rate • To/From Media	12.5 to 22.3 MB/s			
• To/From Host	66.6 MB/s Max. (U-DMA mode 4)			
Data Buffer Size	512 KB			
Physical Dimensions (Height × Width × Depth)	12.5 mm × 100.0 mm × 70.0 mm	9.5 mm × 100.0 mm ×70.0 mm		
Weight	145 g	98 g		

*1: Capacity under the LBA mode.

Under the CHS mode (normal BIOS specification), formatted capacity, number of cylinders, number of heads, and number of sectors are as follows.

Table 1.1 Specifications (2/2)

Model	Formatted Capacity	No. of Cylinder	No. of Heads	No. of Sectors
MHJ2181AT	8,455.20 MB	16,383	16	63
MHK2120AT	8,455.20 MB	16,383	16	63
MHK2090AT	8,455.20 MB	16,383	16	63
MHK2060AT	6,007.35 MB	12,416	15	63

1.2.2 Model and product number

Table 1.2 lists the model names and product numbers of the MHJ Series and MHK Series.

Table 1.2 Model names and product numbers

Model Name	Capacity (user area)	Mounting screw	Order No.
MHJ2181AT	18.1 GB	M3, depth 3	CA05365-B060
MHK2120AT	12.0 GB	M3, depth 3	CA05366-B040
MHK2090AT	9.0 GB	M3, depth 3	CA05366-B030
MHK2060AT	6.0 GB	M3, depth 3	CA05366-B020

1.3 Power Requirements

(1) Input Voltage

- +5 V ±5 %

(2) Ripple

	+5 V
Maximum	100 mV (peak to peak)
Frequency	DC to 1 MHz

(3) Current Requirements and Power Dissipation

Table 1.3 lists the current and power dissipation.

Table 1.3 Current and power dissipation

	Typical RMS Current		Typical Power (*3)	
	MHJ Series	MHK Series	MHJ Series	MHK Series
Spin up (*1)	0.9 A	0.9 A	4.5 W	4.5 W
Idle	170 mA	170 mA	0.85 W	0.85 W
R/W (on track) (*2)	460 mA	460 mA	2.3 W	2.3 W
Seek (*5)	460 mA	460 mA	2.3 W	2.3 W
Standby	56 mA	56 mA	0.28 W	0.28 W
Sleep	20 mA	20 mA	0.1 W	0.1 W
Energy Consumption Efficiency (*4)	—	—	0.047 W/GB	0.071 W/GB

*1 Current at starting spindle motor.

*2 At 30% disk accessing.

*3 Power requirements reflect nominal values for +5V power.

*4 Energy Consumption Efficiency =
Idle power dissipation / Total record capacity (GB)

*5 The seek average current is specified based on three operations per 100 msec.

(4) Current fluctuation (Typ.) at +5V when power is turned on

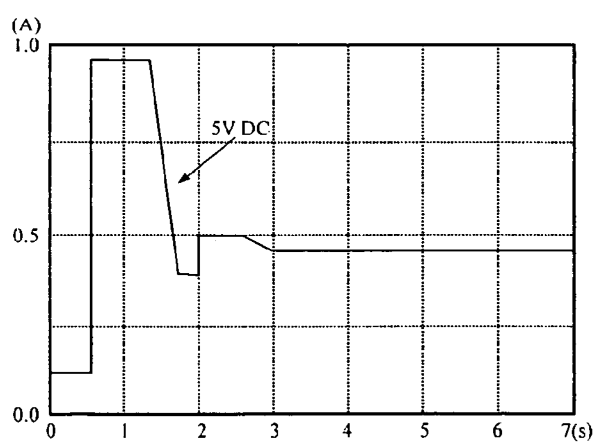


Figure 1.1 Current fluctuation (Typ.) at +5V when power is turned on

(5) Power on/off sequence

The voltage detector circuits (the MHJ Series and MHK Series) monitor +5 V. The circuits do not allow a write signal if either voltage is abnormal. These prevent data from being destroyed and eliminates the need to be concerned with the power on/off sequence.

1.4 Environmental Specifications

Table 1.4 lists the environmental specifications.

Table 1.4 Environmental specifications

Item	Specification
Temperature	
• Operating	5°C to 55°C (ambient)
	5°C to 60°C (disk enclosure surface)
• Non-operating	–40°C to 65°C
• Thermal Gradient	20°C/h or less
Humidity	
• Operating	8% to 90% RH (Non-condensing)
• Non-operating	5% to 95% RH (Non-condensing)
• Maximum Wet Bulb	29°C (Operating) 40°C (Non-operating)
Altitude (relative to sea level)	
• Operating	–300 to 3,000 m
• Non-operating	–300 to 12,000 m

1.5 Acoustic Noise

Table 1.5 lists the acoustic noise specification.

Table 1.5 Acoustic noise specification

Item	Specification
Sound Pressure • Idle mode (DRIVE READY)	 30 dBA typical at 1 m

Note:

Measure the noise from the cover top surface.

1.6 Shock and Vibration

Table 1.6 lists the shock and vibration specification.

Table 1.6 Shock and vibration specification

Item	Specification
Vibration (swept sine, one octave per minute) • Operating • Non-operating	 5 to 500 Hz, 1.0G 0-peak (MHJ series) 5 to 400 Hz, 1.0G 0-peak (MHK series) (without non-recovered errors) (9.8 m/s^2 0-peak) 5 to 500 Hz, 5G 0-peak (MHJ series) 5 to 400 Hz, 5G 0-peak (MHK series) (no damage) (49 m/s^2 0-peak)
Shock (half-sine pulse) • Operating • Non-operating	 150G 0-peak (1,470 m/s^2 0-peak) 2 ms duration (without non-recovered errors) 700G 0-peak (6,860 m/s^2 0-peak) 1 ms duration (no damage) 120G 0-peak (1,176 m/s^2 0-peak) 11 ms duration (no damage)

1.7 Reliability

(1) Mean time between failures (MTBF)

Conditions of 300,000 h	Power-on time	250H/month or less 3000H/years or less
	Operating time	20% or less of power-on time
	CSS operations	50/day or less Total 50,000 or less
	Power on/off	1/day or more needed.
	Environment	5 to 55°C/8 to 90% But humidity bulb temperature 29°C or less

MTBF is defined as follows:

$$\text{MTBF} = \frac{\text{Total operation time in all fields}}{\text{number of device failure in all fields (*1)}} \text{ (H)}$$

*1 "Disk drive defects" refers to defects that involve repair, readjustment, or replacement. Disk drive defects do not include failures caused by external factors, such as damage caused by handling, inappropriate operating environments, defects in the power supply host system, or interface cable.

(2) Mean time to repair (MTTR)

The mean time to repair (MTTR) is 30 minutes or less, if repaired by a specialist maintenance staff member.

(3) Service life

In situations where management and handling are correct, the disk drive requires no overhaul for five years when the DE surface temperature is less than 48°C. When the DE surface temperature exceeds 48°C, the disk drives requires no overhaul for five years or 20,000 hours of operation, whichever occurs first. Refer to item (3) in Subsection 3.2 for the measurement point of the DE surface temperature. Also the operating conditions except the environment temperature are based on the MTBF conditions.

(4) Data assurance in the event of power failure

Except for the data block being written to, the data on the disk media is assured in the event of any power supply abnormalities. This does not include power supply abnormalities during disk media initialization (formatting) or processing of defects (alternative block assignment).

1.8 Error Rate

Known defects, for which alternative blocks can be assigned, are not included in the error rate count below. It is assumed that the data blocks to be accessed are evenly distributed on the disk media.

(1) Unrecoverable read error

Read errors that cannot be recovered by maximum read retries of drive without user's retry and ECC corrections shall occur no more than 10 times when reading data of 10^{14} bits. Read retries are executed according to the disk drive's error recovery procedure, and include read retries accompanying head offset operations.

(2) Positioning error

Positioning (seek) errors that can be recovered by one retry shall occur no more than 10 times in 10^7 seek operations.

1.9 Media Defects

Defective sectors are replaced with alternates when the disk (the MHJ Series and MHK Series) are formatted prior to shipment from the factory (low level format). Thus, the hosts see a defect-free devices.

Alternate sectors are automatically accessed by the disk drive. The user need not be concerned with access to alternate sectors.

CHAPTER 2 Device Configuration

This chapter describes the internal configurations of the hard disk drives and the configuration of the systems in which they operate.

2.1 Device Configuration

Figure 2.1 shows the disk drive. The disk drive consists of a disk enclosure (DE), read/write preamplifier, and controller PCA. The disk enclosure contains the disk media, heads, spindle motors, actuators, and a circulating air filter.

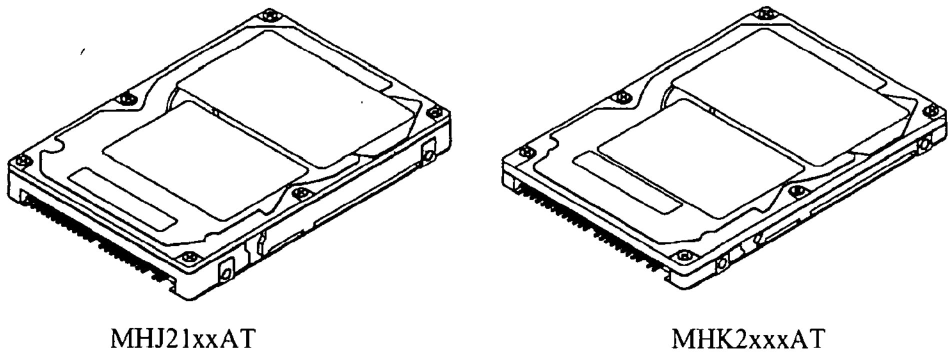


Figure 2.1 Disk drive outerview (the MHJ Series and MHK Series)

(1) Disk

The outer diameter of the disk is 65 mm. The inner diameter is 20 mm. The number of disks used varies with the model, as described below. The disks are rated at over 50,000 start/stop operations.

MHJ2181AT: 3 disks

MHK2120AT: 2 disks MHK2090AT: 2 disks MHK2060AT: 1 disk

(2) Head

The heads are of the contact start/stop (CSS) type. The head touches the disk surface while the disk is not rotating and automatically lifts when the disk starts.

Figure 2.2 illustrates the configuration of the disks and heads of each model. In the disk surface, servo information necessary for controlling positioning and read/write and user data are written. Numerals 0 to 5 indicate read/write heads.

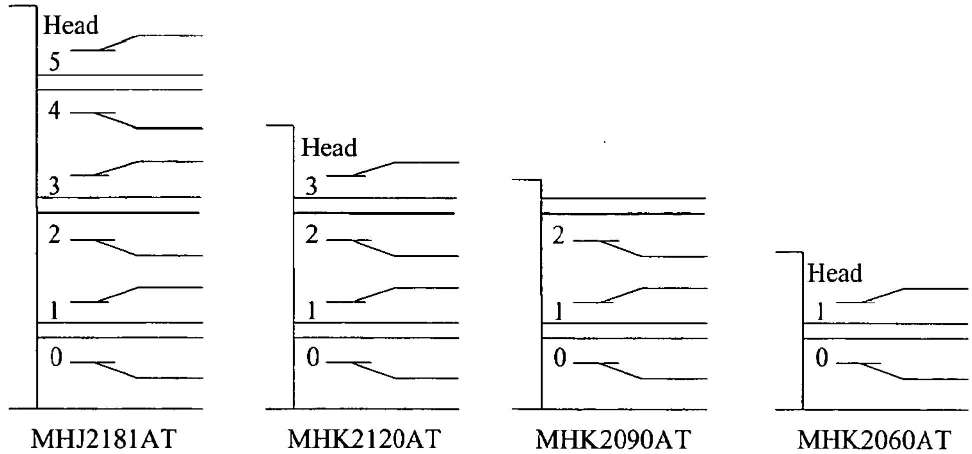


Figure 2.2 Configuration of disk media heads

(3) Spindle motor

The disks are rotated by a direct drive Hall-less DC motor.

(4) Actuator

The actuator uses a revolving voice coil motor (VCM) structure which consumes low power and generates very little heat. The head assembly at the edge of the actuator arm is controlled and positioned by feedback of the servo information read by the read/write head. If the power is not on or if the spindle motor is stopped, the head assembly stays in the specific CSS zone on the disk and is fixed by a mechanical lock.

(5) Air circulation system

The disk enclosure (DE) is sealed to prevent dust and dirt from entering. The disk enclosure features a closed loop air circulation system that relies on the blower effect of the rotating disk. This system continuously circulates the air through the circulation filter to maintain the cleanliness of the air within the disk enclosure.

(6) Read/write circuit

The read/write circuit uses a LSI chip for the read/write preamplifier. It improves data reliability by preventing errors caused by external noise.

(7) Controller circuit

The controller circuit consists of an LSI chip to improve reliability. The high-speed microprocessor unit (MPU) achieves a high-performance AT controller.

2.2 System Configuration

2.2.1 ATA interface

Figures 2.3 and 2.4 show the ATA interface system configuration. The drive has a 44-pin PC AT interface connector and supports the PIO transfer at 16.6 MB/s (ATA-3, Mode 4), the DMA transfer at 16.6 MB/s (ATA-3, Multiword Mode 2) and also the U-DMA at 66.6 MB/s (ATA-3, Mode 4).

2.2.2 1 drive connection

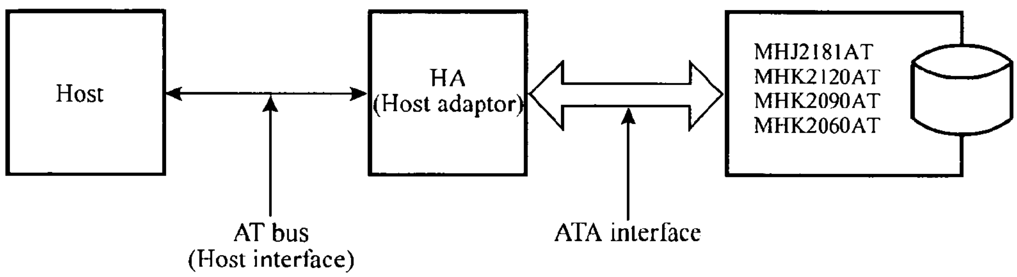
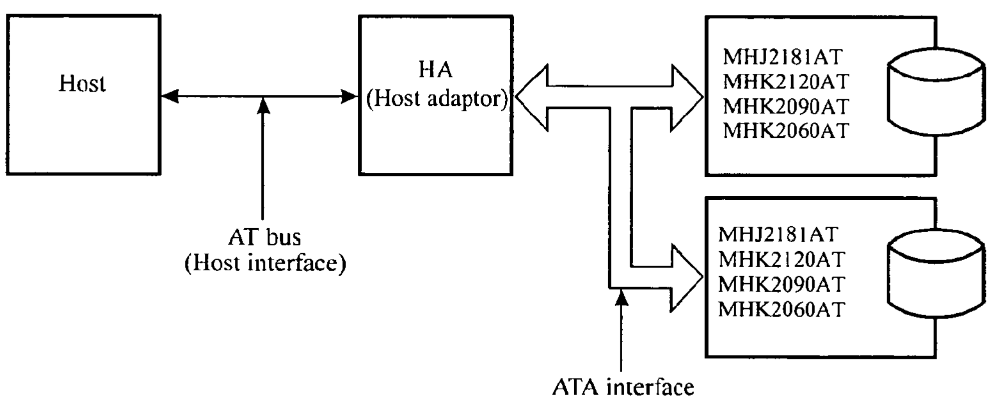


Figure 2.3 1 drive system configuration

2.2.3 2 drives connection



Note:

When the drive that is not conformed to ATA is connected to the disk drive above configuration, the operation is not guaranteed.

Figure 2.4 2 drives configuration

IMPORTANT

HA (host adaptor) consists of address decoder, driver, and receiver. ATA is an abbreviation of "AT attachment". The disk drive is conformed to the ATA-4 interface.

At high speed data transfer (PIO mode 3, mode 4, or DMA mode 2 U-DMA mode 4), occurence of ringing or crosstalk of the signal lines (AT bus) between the HA and the disk drive may be a great cause of the obstruction of system reliability. Thus, it is necessary that the capacitance of the signal lines including the HA and cable does not exceed the ATA-5 standard, and the cable length between the HA and the disk drive should be as short as possible.

No need to push the top cover of the disk drive. If the over-power worked, the cover could be contacted with the spindle motor. Thus, that could be made it the cause of failure.

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CHAPTER 3 Installation Conditions

This chapter gives the external dimensions, installation conditions, surface temperature conditions, cable connections, and switch settings of the hard disk drives.

3.1 Dimensions

Figure 3.1 illustrates the dimensions of the disk drive and positions of the mounting screw holes. All dimensions are in mm.

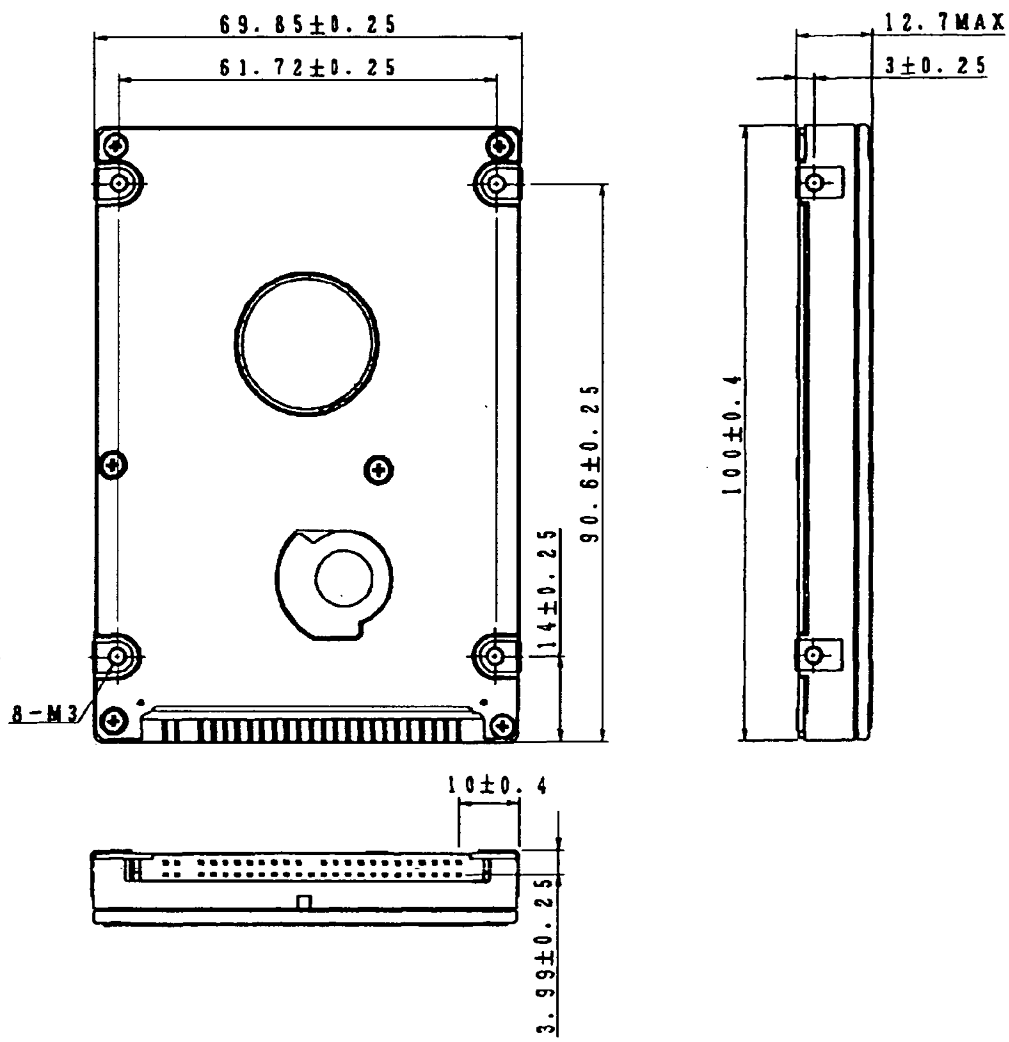


Figure 3.1 Dimensions (MHJ series) (1/2)

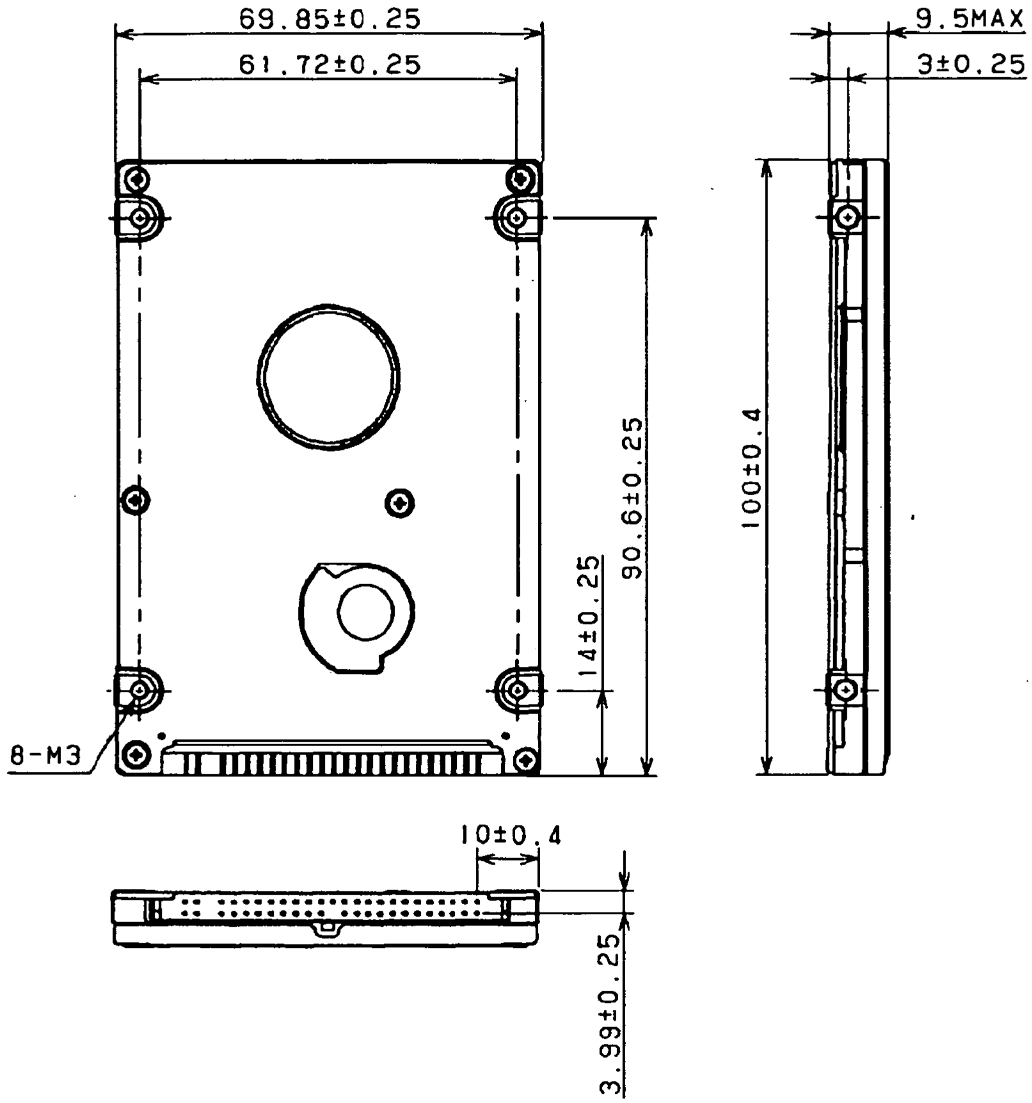
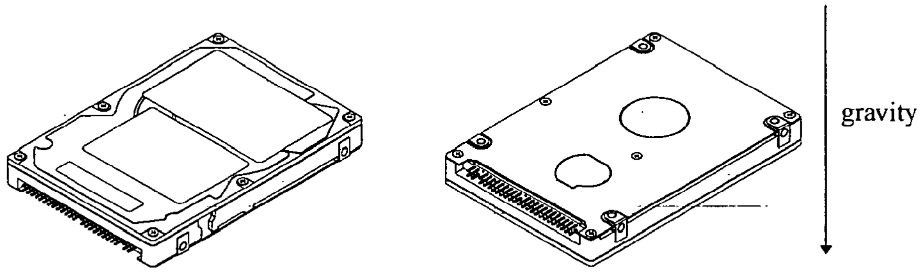


Figure 3.1 Dimensions (MHK series) (2/2)

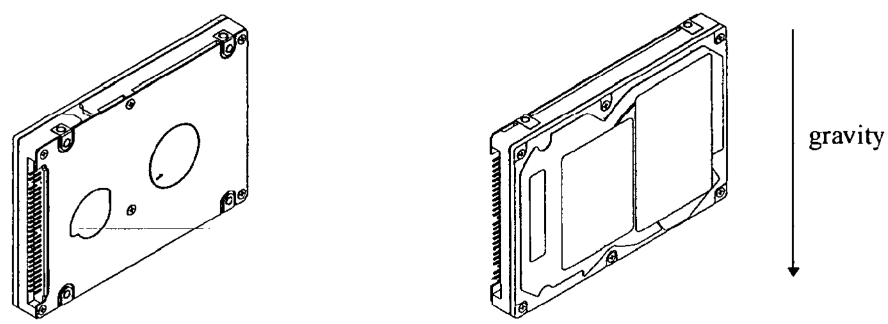
3.2 Mounting

(1) Orientation

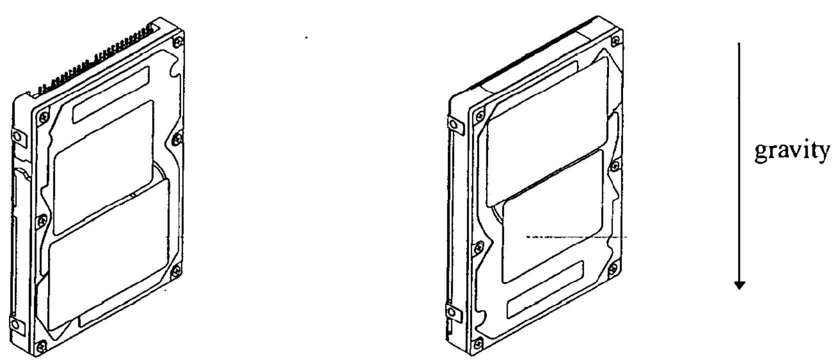
Figure 3.2 illustrates the allowable orientations for the disk drive.



(a) Horizontal –1 (b) Horizontal –1



(c) Vertical –1 (d) Vertical –2



(e) Vertical –3 (f) Vertical –4

Figure 3.2 Orientation (Sample: MHJ2181AT)

(2) Frame

The MR head bias of the HDD disk enclosure (DE) is zero. The mounting frame is connected to SG.

IMPORTANT

Use M3 screw for the mounting screw and the screw length should satisfy the specification in Figure 3.3.
The tightening torque must be 5 kgcm.
When attaching the HDD to the system frame, do not allow the system frame to touch parts (cover and base) other than parts to which the HDD is attached.

(3) Limitation of mounting

Do not use the center hole. For screw length, see Figure 3.3.

Note) These dimensions are recommended values; if it is not possible to satisfy them, contact us.

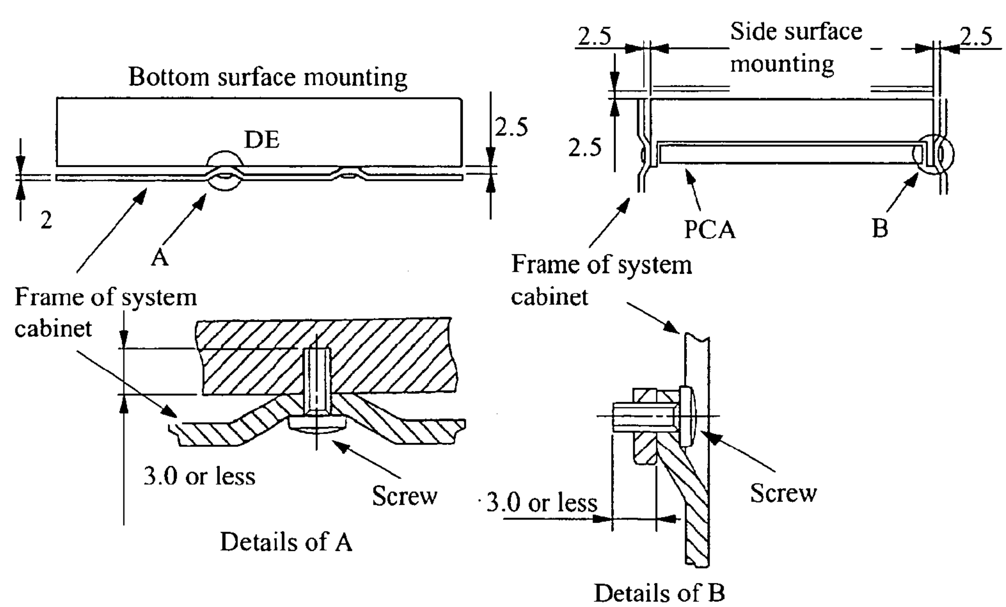


Figure 3.3 Mounting frame structure

IMPORTANT

Because of breather hole mounted to the HDD, do not allow this to close during mounting.

Locating of breather hole is shown as Figure 3.4 in both MHJ series and MHK series.

For breather hole of Figure 3.4, at least, do not allow its around $\phi 3$ to block.

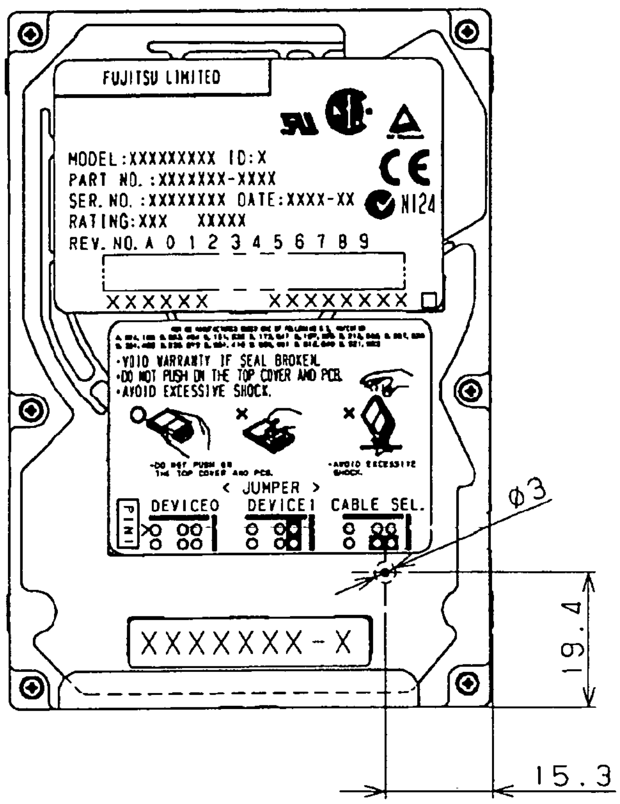


Figure 3.4 Location of breather

(4) Ambient temperature

The temperature conditions for a disk drive mounted in a cabinet refer to the ambient temperature at a point 3 cm from the disk drive. The ambient temperature must satisfy the temperature conditions described in Section 1.4, and the airflow must be considered to prevent the DE surface temperature from exceeding 60°C.

Provide air circulation in the cabinet such that the PCA side, in particular, receives sufficient cooling. To check the cooling efficiency, measure the surface temperatures of the DE. Regardless of the ambient temperature, this surface temperature must meet the standards listed in Table 3.1. Figure 3.5 shows the temperature measurement point.

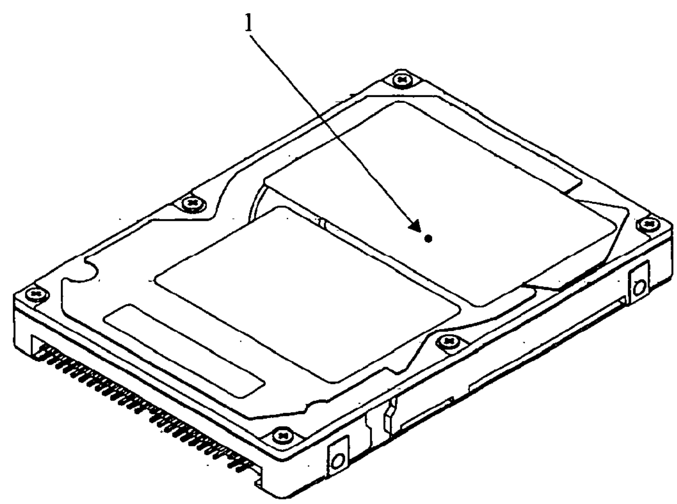


Figure 3.5 Surface temperature measurement points (Sample: MHJ2181AT)

Table 3.1 Surface temperature measurement points and standard values

No.	Measurement point	Temperature
1	DE cover	60°C max

(5) Service area

Figure 3.6 shows how the drive must be accessed (service areas) during and after installation.

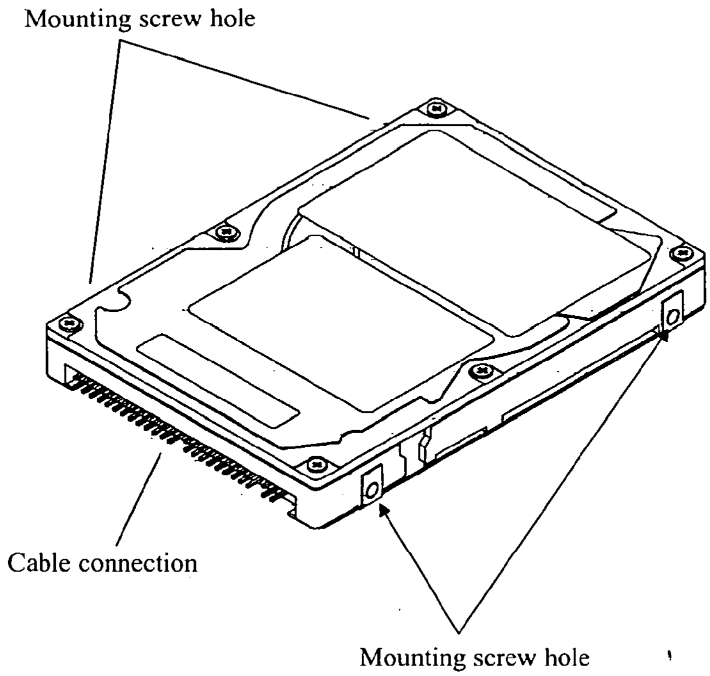


Figure 3.6 Service area (Sample: MHJ2181AT)

⚠CAUTION

Data corruption: Avoid mounting the disk drive near strong magnetic sources such as loud speakers. Ensure that the disk drive is not affected by external magnetic fields.
Also, do not press the cover of the disk drive. Pressing it too much, the cover and the spindle motor contacts and it is fear of causes of the trouble being.

Stastic: When handling the device, disconnect the body ground (500 kΩ or greater). Do not touch the printed circuit board, but hold it by the edges.

3.3 Cable Connections

3.3.1 Device connector

The disk drive has the connectors and terminals listed below for connecting external devices. Figure 3.7 shows the locations of these connectors and terminals.

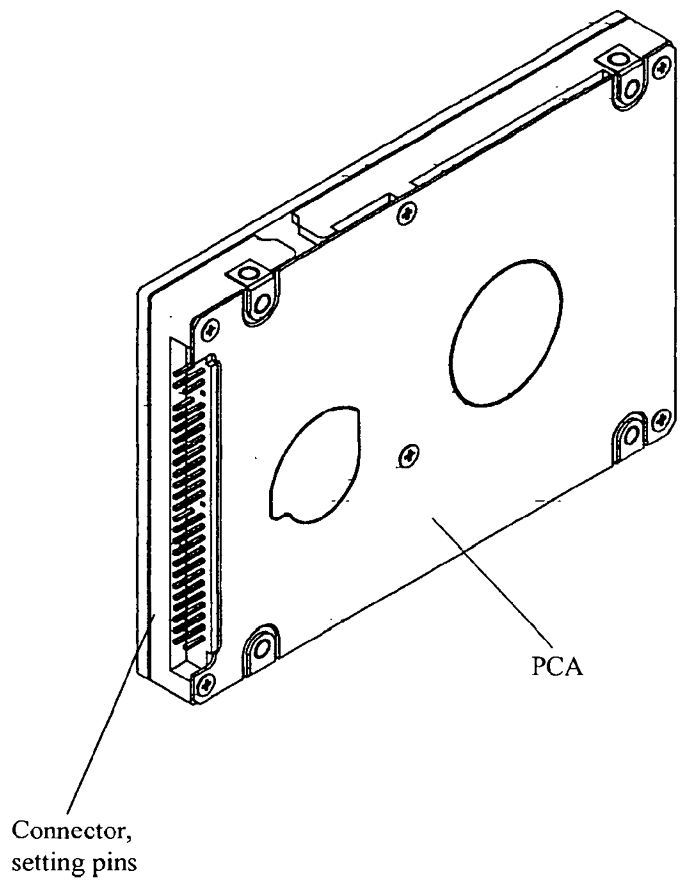


Figure 3.7 Connector locations (Sample: MHJ2181AT)

3.3.2 Cable connector specifications

Table 3.2 lists the recommended specifications for the cable connectors.

Table 3.2 Cable connector specifications

	Name	Model	Manufacturer
ATA interface and power supply cable (44-pin type)	Cable socket (44-pin type)	89361-144	BERG

IMPORTANT

For the host interface cable, use a ribbon cable. A twisted cable or a cable with wires that have become separated from the ribbon may cause crosstalk between signal lines. This is because the interface is designed for ribbon cables and not for cables carrying differential signals.

3.3.3 Device connection

Figure 3.8 shows how to connect the devices.

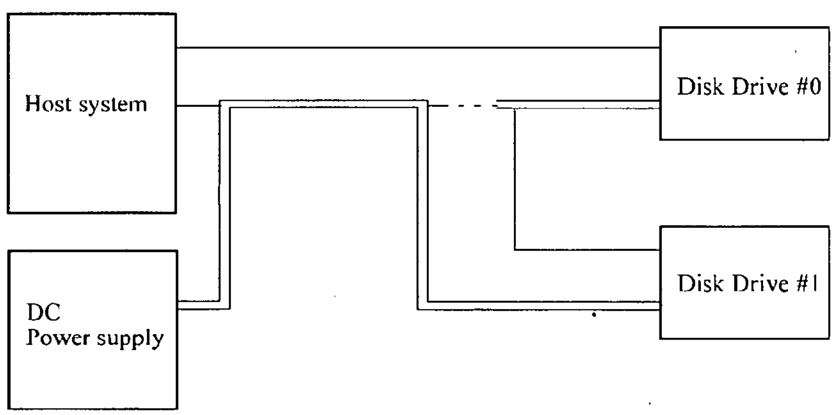


Figure 3.8 Cable connections

3.3.4 Power supply connector (CN1)

Figure 3.9 shows the pin assignment of the power supply connector (CN1).

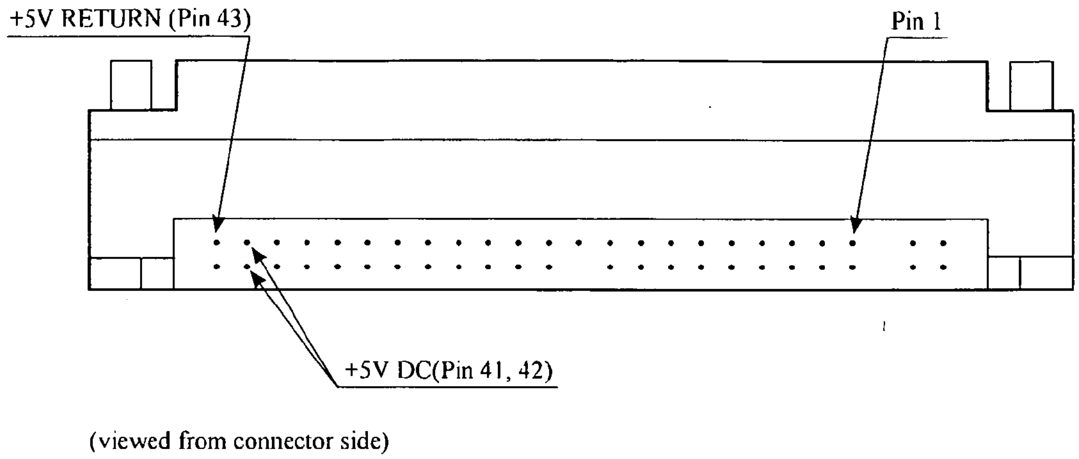


Figure 3.9 Power supply connector pins (CN1)

3.4 Jumper Settings

3.4.1 Location of setting jumpers

Figure 3.10 shows the location of the jumpers to select drive configuration and functions.

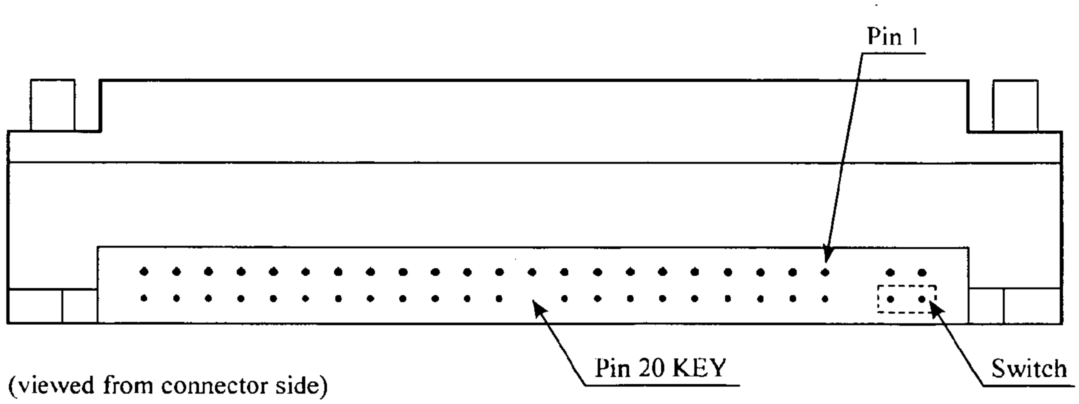


Figure 3.10 Jumper location

3.4.2 Factory default setting

Figure 3.11 shows the default setting position at the factory.

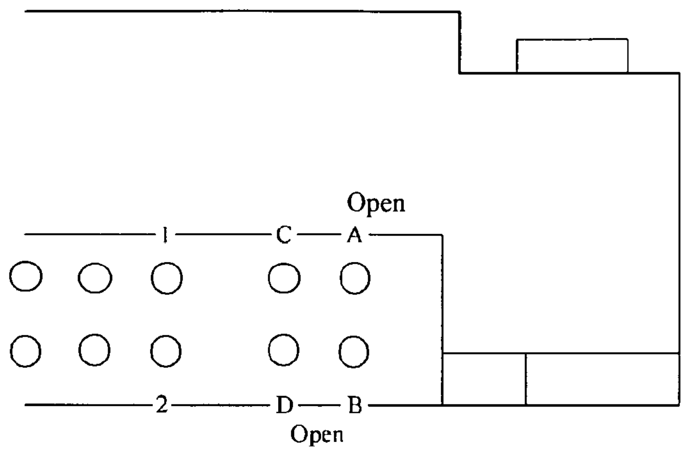


Figure 3.11 Factory default setting

3.4.3 Master drive-slave drive setting

Master device (device #0) or slave device (device #1) is selected.

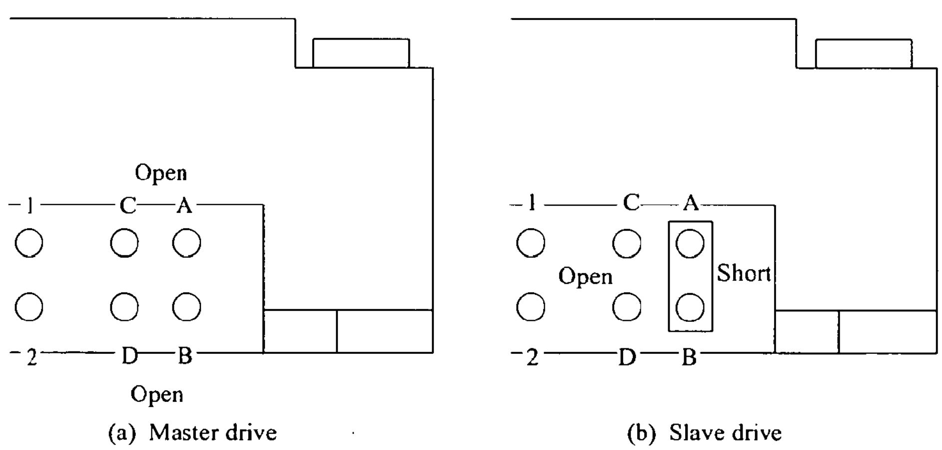


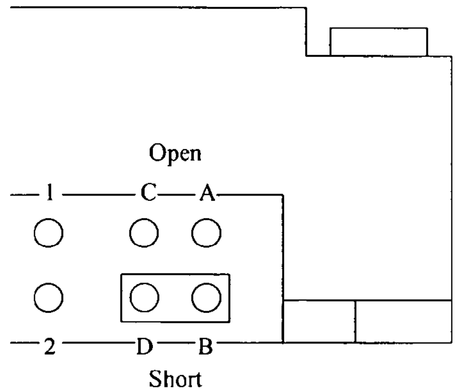
Figure 3.12 Jumper setting of master or slave device

Note:

Pins A and C should be open.

3.4.4 CSEL setting

Figure 3.13 shows the cable select (CSEL) setting.



Note:

The CSEL setting is not depended on setting between pins Band D.

Figure 3.13 CSEL setting

Figure 3.14 and 3.15 show examples of cable selection using unique interface cables.

By connecting the CSEL of the master device to the CSEL Line (conducer) of the cable and connecting it to ground further, the CSEL is set to low level. The device is identified as a master device. At this time, the CSEL of the slave device does not have a conductor. Thus, since the slave device is not connected to the CSEL conductor, the CSEL is set to high level. The device is identified as a slave device.

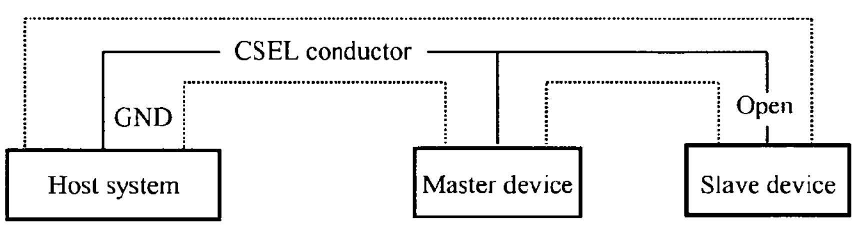


Figure 3.14 Example (1) of Cable Select

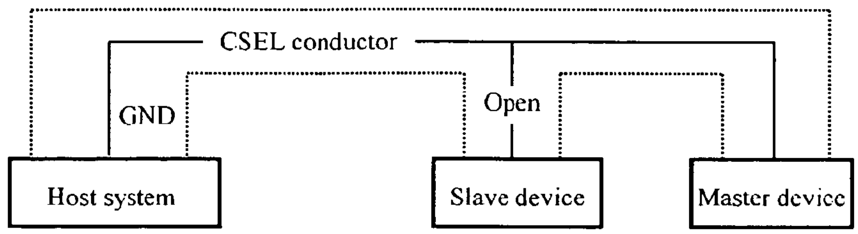


Figure 3.15 Example (2) of Cable Select

CHAPTER 4 Theory of Device Operation

This chapter explains basic design concepts of the disk drive. Also, this chapter explains subassemblies of the disk drive, each sequence, servo control, and electrical circuit blocks.

4.1 Outline

This chapter consists of two parts. First part (Section 4.2) explains mechanical assemblies of the disk drive. Second part (Sections 4.3 through 4.7) explains a servo information recorded in the disk drive and drive control method.

4.2 Subassemblies

The disk drive consists of a disk enclosure (DE) and printed circuit assembly (PCA).

The DE contains all movable parts in the disk drive, including the disk, spindle, actuator, read/write head, and air filter. For details, see Subsections 4.2.1 to 4.2.5.

The PCA contains the control circuits for the disk drive. The disk drive has one PCA. For details, see Sections 4.3.

4.2.1 Disk

The DE contains disks with an outer diameter of 65 mm and an inner diameter of 20 mm. The MHJ2181AT have three disks and MHK2120AT and MHK2090AT have two disks and MHK2060AT have one disk.

The head contacts the disk each time the disk rotation stops; the life of the disk is 50,000 contacts or more. Servo data is recorded on top disk.

Servo data is recorded on each cylinder (total 66). Servo data written at factory is read out by the read/write head. For servo data, see Section 4.7.

4.2.2 Head

Figure 4.1 shows the read/write head structures. MHJ2181AT has 6 read/write heads and MHK2120AT has 4 read/write heads and MHK2090AT has 3 read/write heads and MHK2060AT has 2 read/write head. These heads are raised from the disk surface as the spindle motor the rated rotation speed.

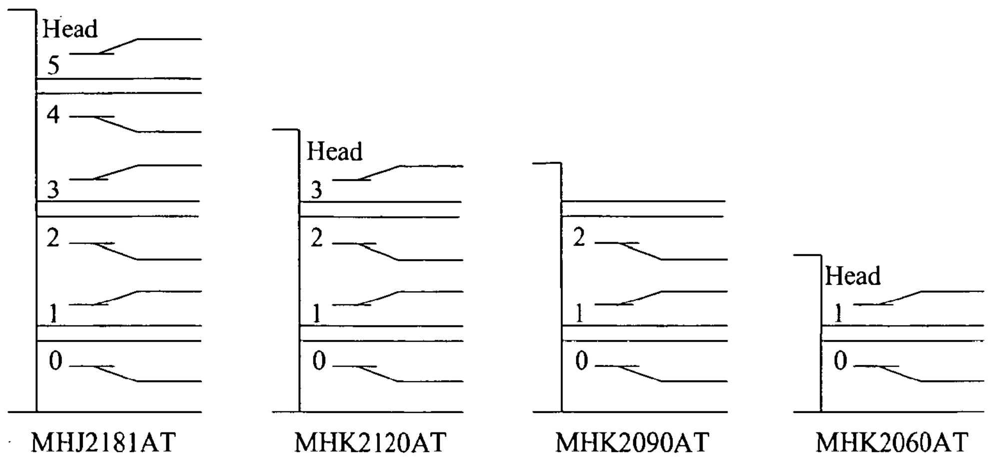


Figure 4.1 Head structure

4.2.3 Spindle

The spindle consists of a disk stack assembly and spindle motor. The disk stack assembly is activated by the direct drive sensor-less DC spindle motor, which has a speed of 4,200 rpm ±1%. The spindle is controlled with detecting a PHASE signal generated by counter electromotive voltage of the spindle motor at starting.

4.2.4 Actuator

The actuator consists of a voice coil motor (VCM) and a head carriage. The VCM moves the head carriage along the inner or outer edge of the disk. The head carriage position is controlled by feeding back the difference of the target position that is detected and reproduced from the servo information read by the read/write head.

4.2.5 Air filter

There are two types of air filters: a breather filter and a circulation filter.

The breather filter makes an air in and out of the DE to prevent unnecessary pressure around the spindle when the disk starts or stops rotating. When disk drives are transported under conditions where the air pressure changes a lot, filtered air is circulated in the DE.

The circulation filter cleans out dust and dirt from inside the DE. The disk drive cycles air continuously through the circulation filter through an enclosed loop air cycle system operated by a blower on the rotating disk.

4.3 Circuit Configuration

Figure 4.2 shows the disk drive circuit configuration.

(1) Read/write circuit

The read/write circuit consists of two LSIs; read/write preamplifier (PreAMP) and read channel (RDC).

The PreAMP consists of the write current switch circuit, that flows the write current to the head coil, and the voltage amplifier circuit, that amplitudes the read output from the head.

The RDC is the read demodulation circuit using the Modified Extended Partial Response (MEEPR), and contains the Viterbi detector, programmable filter, adaptable transversal filter, times base generator, and data separator circuits. The RDC also contains the 16/17 group coded recording (GCR) encoder and decoder and servo demodulation circuit.

(2) Servo circuit

The position and speed of the voice coil motor are controlled by 2 closed-loop servo using the servo information recorded on the data surface. The servo information is an analog signal converted to digital for processeing by a MPU and then reconverted to an analog signal for control of the voice coil motor.

The MPU precisely sets each head on the track according on the servo information on the media surface.

(3) Spindle motor driver circuit

The circuit measures the interval of a PHASE signal generated by counter-electromotive voltage of a motor at the MPU and controls the motor speed comparing target speed.

(4) Controller circuit

Major functions are listed below.

- Data buffer (512 KB) management
- ATA interface control and data transfer control
- Sector format control
- Defect management
- ECC control
- Error recovery and self-diagnosis

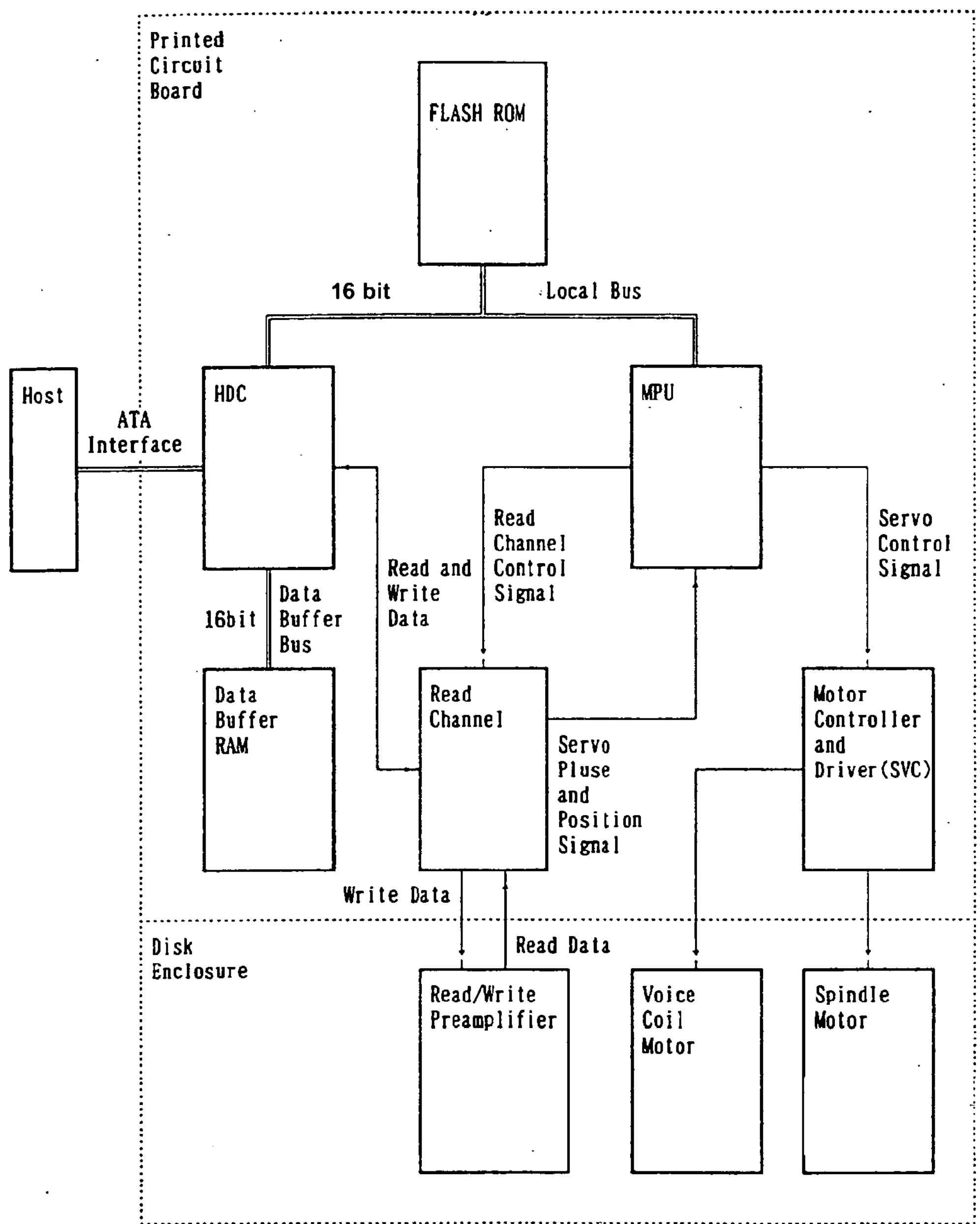


Figure 4.2 Circuit Configuration

4.4 Power-on Sequence

Figure 4.3 describes the operation sequence of the disk drive at power-on. The outline is described below.

a) After the power is turned on, the disk drive executes the MPU bus test, internal register read/write test, and work RAM read/write test. When the self-diagnosis terminates successfully, the disk drive starts the spindle motor.

b) The disk drive executes self-diagnosis (data buffer read/write test) after enabling response to the ATA bus.

c) After confirming that the spindle motor has reached rated speed, the disk drive releases the heads from the actuator magnet lock mechanism by applying current to the VCM. This unlocks the heads which are parked at the inner circumference of the disks.

d) The disk drive positions the heads onto the SA area and reads out the system information.

e) The disk drive executes self-seek-calibration. This collects data for VCM tarque and mechanical external forces applied to the actuator, and updates the calibrating value.

f) The drive becomes ready. The host can issue commands.

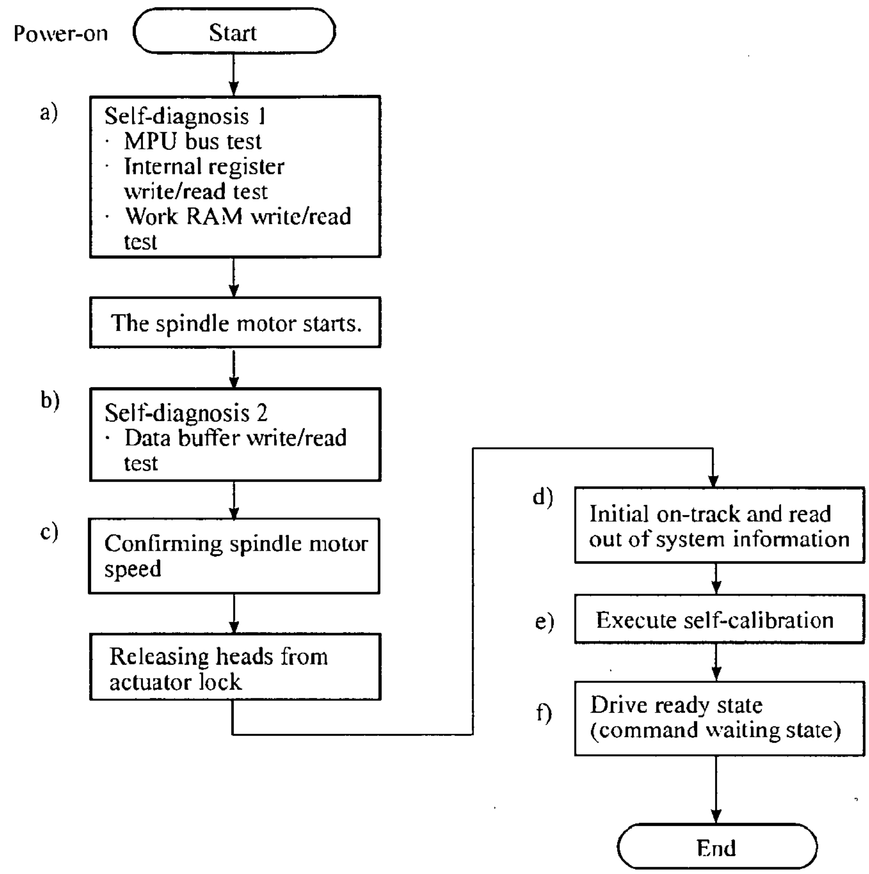


Figure 4.3 Power-on operation sequence

4.5 Self-calibration

The disk drive occasionally performs self-calibration in order to sense and calibrate mechanical external forces on the actuator, and VCM tarque. This enables precise seek and read/write operations.

4.5.1 Self-calibration contents

(1) Sensing and compensating for external forces

The actuator suffers from torque due to the FPC forces and winds accompanying disk revolution. The torque vary with the disk drive and the cylinder where the head is positioned. To execute stable fast seek operations, external forces are occasionally sensed.

The firmware of the drive measures and stores the force (value of the actuator motor drive current) that balances the torque for stopping head stably. This includes the current offset in the power amplifier circuit and DAC system.

The forces are compensated by adding the measured value to the specified current value to the power amplifier. This makes the stable servo control.

To compensate torque varing by the cylinder, the disk is divided into 23 areas from the innermost to the outermost circumference and the compensating value is measured at the measuring cylinder on each area at factory calibration. The measured values are stored in the SA cylinder. In the self-calibration, the compensating value is updated using the value in the SA cylinder.

(2) Compensating open loop gain

Torque constant value of the VCM has a dispersion for each drive, and varies depending on the cylinder that the head is positioned. To realize the high speed seek operation, the value that compensates torque constant value change and loop gain change of the.whole servo system due to temperature change is measured and stored.

For sensing, the firmware mixes the disturbance signal to the position signal at the state that the head is positioned to any cylinder. The firmware calculates the loop gain from the position signal and stores the compensation value against to the target gain as ratio.

For compensating, the direction current value to the power amplifier is multiplied by the compensation value. By this compensation, loop gain becomes constant value and the stable servo control is realized.

To compensate torque constant value change depending on cylinder, whole cylinders from most inner to most outer cylinder are divided into 16 partitions at calibration in the factory, and the compensation data is measured for representive cylinder of each partition. This measured value is stored in the SA area. The compensation value at self-calibration is calculated using the value in the SA area.

4.5.2 Execution timing of self-calibration

Self-calibration is executed when:

- The power is turned on.
- The disk drive receives the RECALIBRATE command from the host.
- The self-calibration execution timechart of the disk drive specifies self-calibration.

The disk drive performs self-calibration according to the timechart based on the time elapsed from power-on. The timechart is shown in Table 4.1. After power-on, self-calibration is performed about every five or ten or fifteen minutes for the first 60 minutes or six RECALIBRATE command executions, and about every 30 minutes after that.

Table 4.1 Self-calibration execution timechart

	Time elapsed	Time elapsed (accumulated)
1	At power-on	Initial calibration
2	About 5 minutes	About 5 minutes
3	About 5 minutes	About 10 minutes
4	About 10 minutes	About 20 minutes
5	About 10 minutes	About 30 minutes
6	About 15 minutes	About 45 minutes
7	About 15 minutes	About 60 minutes
8	Every about 30 minutes	

4.5.3 Command processing during self-calibration

If the disk drive receives a command execution request from the host while executing self-calibration according to the timechart, the disk drive terminates self-calibration and starts executing the command precedingly. In other words, if a disk read or write service is necessary, the disk drive positions the head to the track requested by the host, reads or writes data, and restarts calibration.

This enables the host to execute the command without waiting for a long time, even when the disk drive is performing self-calibration. The command execution wait time is about maximum 100 ms.

4.6 Read/write Circuit

The read/write circuit consists of the read/write preamplifier (PreAMP), the write circuit, the read circuit, and the time base generator in the read channel (RDC). Figure 4.4 is a block diagram of the read/write circuit.

4.6.1 Read/write preamplifier (PreAMP)

One PreAMP is mounted on the FPC. The PreAMP consists of an read preamplifier and a write current switch and senses a write error. Each channel is connected to each data head. The head IC switches the heads by the chip select signals (*CS) and the head select signals. The IC generates a write error sense signal (WUS) when a write error occurs due to head short-circuit or head disconnection.

The Pre AMP sets the write current and bias current which flows through MR devices.

4.6.2 Write circuit

The write data is output from the hard disk controller (HDC) with the NRZ data format, and sent to the encoder circuit in the RDC. The NRZ write data is converted from 16-bit data to 17-bit data by the encoder circuit then sent to the PreAMP, and the data is written onto the media.

(1) 16/17 MTR MEEPRML

This device converts data using the 16/17 (Maximum Transitions Run) algorithm.

This code is converted so that a maximum of three 1's are placed continuously and so that there are two or fewer 1's in a 17-bit border.

(2) Write precompensation

Write precompensation compensates, during a write process, for write non-leneartiry generated at reading. Table 4.2 shows the write precompensation algorithm.

Table 4.2 Write precompensation algorithm

Bits	Compensation
111001	–7
111010	–6
:	
111111	–1
000000	±0
000001	+1
:	
010000	+16
:	
100000	+32

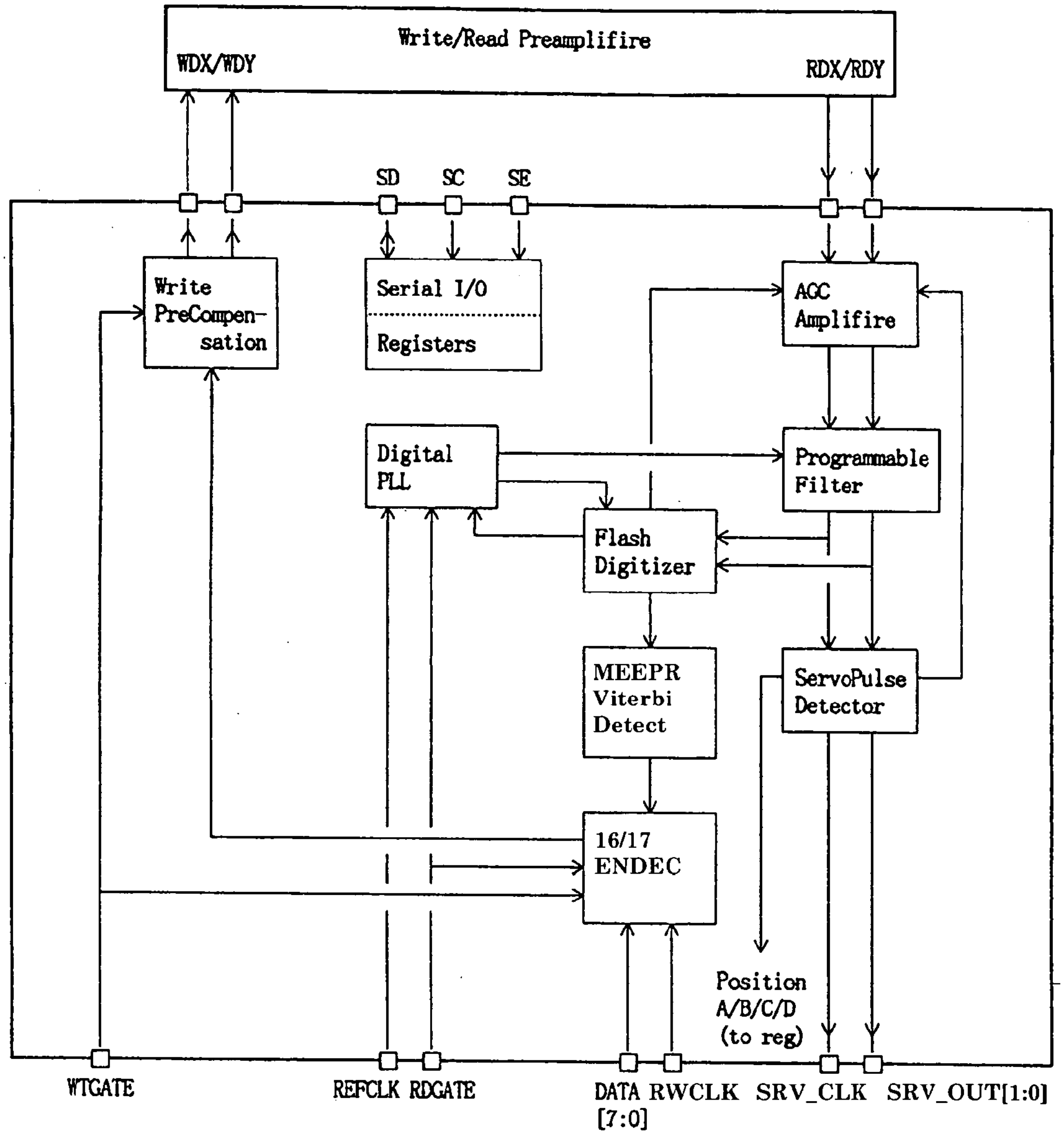


Figure 4.4 Read/write circuit block diagram

4.6.3 Read circuit

The head read signal from the PreAMP is regulated by the automatic gain control (AGC) circuit. Then the output is converted into the sampled read data pulse by the programmable filter circuit and the flash digitizer circuit. This clock signal is converted into the NRZ data by the 16/17 GCR decoder circuit based on the read data maximum-likelihood-detected by the Viterbi detection circuit, then is sent to the HDC.

(1) AGC circuit

The AGC circuit automatically regulates the output amplitude to a constant value even when the input amplitude level fluctuates. The AGC amplifier output is maintained at a constant level even when the head output fluctuates due to the head characteristics or outer/inner head positions.

(2) Programmable filter circuit

The programmable filter circuit has a low-pass filter function that eliminates unnecessary high frequency noise component and a high frequency boost-up function that equalizes the waveform of the read signal.

Cut-off frequency of the low-pass filter and boost-up gain are controlled from the register in read channel by an instruction of the serial data signal from MPU (M5). The MPU optimizes the cut-off frequency and boost-up gain according to the transfer frequency of each zone.

Figure 4.5 shows the frequency characteristic sample of the programmalbe filter.

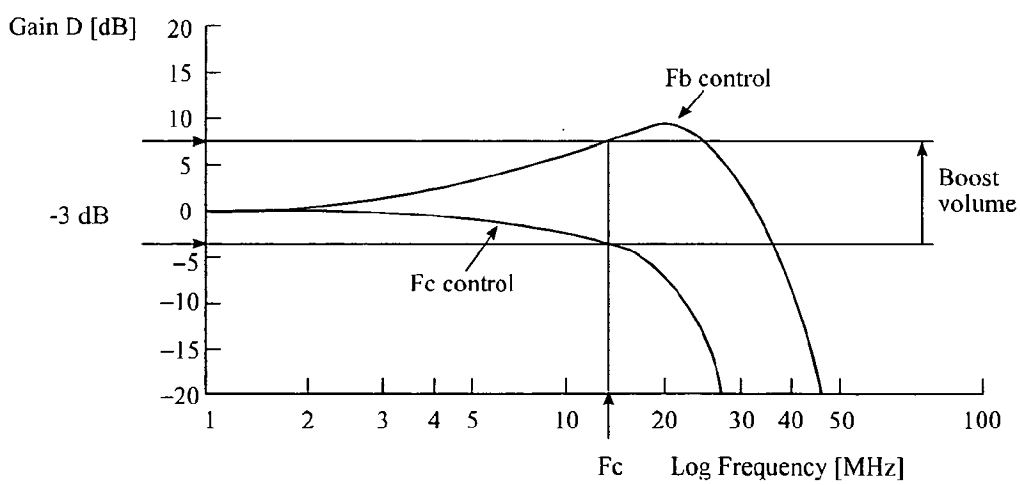


Figure 4.5 Frequency characteristic of programmable filter

(3) Flash digitizer circuit

This circuit is 10-tap sampled analog transversal filter circuit that cosine-equalizes the head read signal to the Modified Extended Partial Response (MEEPR) waveform.

(4) Viterbi detection circuit

The sample hold waveform output from the flash digitizer circuit is sent to the Viterbi detection circuit. The Viterbi detection circuit demodulates data according to the survivor path sequence.

(5) 16/17 MTR MEEPRM

This circuit converts the 17-bit read data into the 16-bit NRZ data.

4.6.4 Digital PLL circuit

The drive uses constant density recording to increase total capacity. This is different from the conventional method of recording data with a fixed data transfer rate at all data area. In the constant density recording method, data area is divided into zones by radius and the data transfer rate is set so that the recording density of the inner cylinder of each zone is nearly constant. The drive divides data area into 14 zones to set the data transfer rate.

The MPU transfers the data transfer rate setup data (SD/SC) to the RDC that includes the Digital PLL circuit to change the data transfer rate.

4.7 Servo Control

The actuator motor and the spindle motor are submitted to servo control. The actuator motor is controlled for moving and positioning the head to the track containing the desired data. To turn the disk at a constant velocity, the actuator motor is controlled according to the servo data that is written on the data side beforehand.

4.7.1 Servo control circuit

Figure 4.6 is the block diagram of the servo control circuit. The following describes the functions of the blocks:

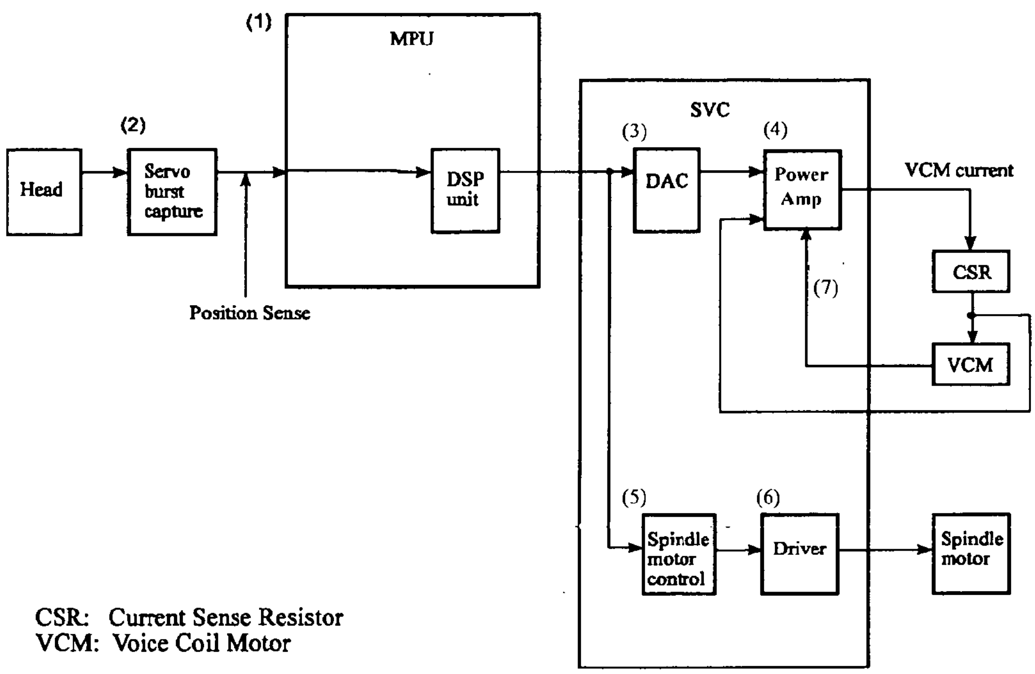


Figure 4.6 Block diagram of servo control circuit

(1) Microprocessor unit (MPU)

The MPU includes the DSP unit, and the MPU starts the spindle motor, moves the heads to the reference cylinders, seeks the specified cylinder, and executes calibration according to the internal operations of the MPU. Main internal operation of the MPU are shown below.

The major internal operations are listed below.

a. Spindle motor start

   Starts the spindle motor and accelerates it to normal speed when power is applied.

b. Move head to reference cylinder

   Drives the VCM to position the head at the any cylinder in the data area. The logical initial cylinder is at the outermost circumference (cylinder 0).

c. Seek to specified cylinder

   Drives the VCM to position the head to the specified cylinder.

d. Calibration

   Senses and stores the thermal offset between heads and the mechanical forces on the actuator, and stores the calibration value.

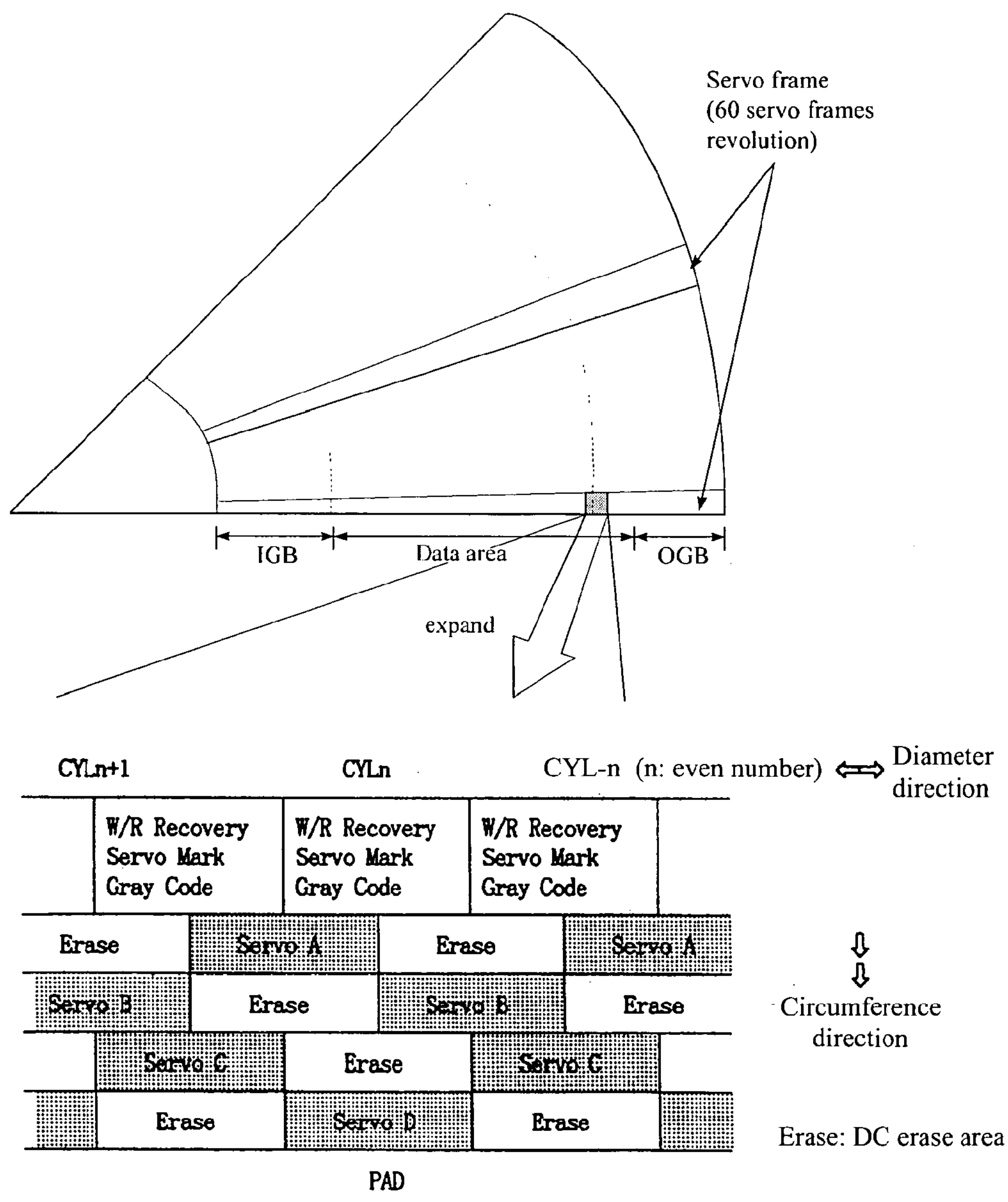


Figure 4.7 Physical sector servo configuration on disk surface

(2) Servo burst capture circuit

The servo burst capture circuit reproduces signals (position signals) that indicate the head position from the servo data on the data surface. SERVO A, SERVO B, SERVO C and SERVO D burst signals shown in Figure 4.8 followed the servo mark, cylinder gray and index information are output from the servo area on the data surface via the data head. The servo signals do A/D-convert by Fourier-demodulator in the servo burst capture circuit. At that time the AGC circuit is in hold mode. The A/D converted data is recognized by the MPU as position information with A-B and C-D processed.

(3) D/A converter (DAC)

The D/A converter (DAC) converts the VCM drive current value (digital value) calculated by the DSP unit into analog values and transfers them to the power amplifier.

(4) Power amplifier

The power amplifier feeds currents, corresponding to the DAC output signal voltage to the VCM.

(5) Spindle motor control circuit

The spindle motor control circuit controls the sensor-less spindle motor. This circuit detects number of revolution of the motor by the interrupt generated periodically, compares with the target revolution speed, then flows the current into the motor coil according to the differentation (abberration).

(6) Driver circuit

The driver circuit is a power amplitude circuit that receives signals from the spindle motor control circuit and feeds currents to the spindle motor.

(7) VCM current sense resistor (CSR)

This resistor controls current at the power amplifier by converting the VCM current into voltage and feeding back.

4.7.2 Data-surface servo format

Figure 4.7 describes the physical layout of the servo frame. The three areas indicated by (1) to (3) in Figure 4.7 are described below.

(1) Inner guard band

The head is in contact with the disk in this space when the spindle starts turning or stops, and the rotational speed of the spindle can be controlled on this cylinder area for head moving.

(2) Data area

This area is used as the user data area SA area.

(3) Outer guard band

This area is located at outer position of the user data area, and the rotational speed of the spindle can be controlled on this cylinder area for head moving.

4.7.3 Servo frame format

As the servo information, the IDD uses the two-phase servo generated from the gray code and servo A to D. This servo information is used for positioning operation of radius direction and position detection of circumstance direction.

The servo frame consists of 6 blocks; write/read recovery, servo mark, gray code, servo A to D, and PAD. Figure 4.8 shows the servo frame format.

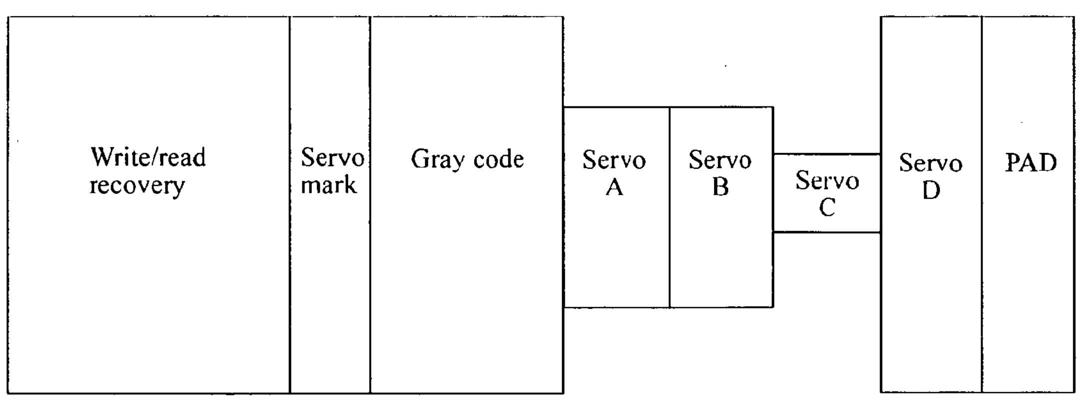


Figure 4.8 Servo frame format

(1) Write/read recovery

This area is used to absorb the write/read transient and to stabilize the AGC.

(2) Servo mark

This area gererates a timing for demodulating the gray code and position-demodulating the servo A to D by detecting the servo mark.

(3) Gray code (including index bit)

This area is used as cylinder address. The data in this area is converted into the binary data by the gray code demodulation circuit

(4) Servo A, servo B, servo C, servo D

This area is used as position signals between tracks, and the IDD control at on-track so that servo A level equals to servo B level.

(5) PAD

This area is used as a gap between servo and data.

4.7.4 Actuator motor control

The voice coil motor (VCM) is controlled by feeding back the servo data recorded on the data surface. The MPU fetches the position sense data on the servo frame at a constant interval of sampling time, executes calculation, and updates the VCM drive current.

The servo control of the actuator includes the operation to move the head to the reference cylinder, the seek operation to move the head to the target cylinder to read or write data, and the track-following operation to position the head onto the target track.

(1) Operation to move the head to the reference cylinder

The MPU moves the head to the reference cylinder when the power is turned. The reference cylinder is in the data area.

When power is applied the heads are moved from the inner circumference shunt zone to the normal servo data zone in the following sequence:

a) Micro current is fed to the VCM to press the head against the inner circumference.

b) Micro current is fed to the VCM to move the head toward the outer circumference.

c) When the servo mark is detected the head is moved slowly toward the outer circumference at a constant speed.

d) If the head is stopped at the reference cylinder from there. Track following control starts.

(2) Seek operation

Upon a data read/write request from the host, the MPU confirms the necessity of access to the disk. If a read/write instruction is issued, the MPU seeks the desired track.

The MPU feeds the VCM current via the D/A converter and power amplifier to move the head. The MPU calculates the difference (speed error) between the specified target position and the current position for each sampling timing during head moving. The MPU then feeds the VCM drive current by setting the calculated result into the D/A converter. The calculation is digitally executed by the firmware. When the head arrives at the target cylinder, the track is followed.

(3) Track following operation

Except during head movement to the reference cylinder and seek operation under the spindle rotates in steady speed, the MPU does track following control. To position the head at the center of a track, the DSP drives the VCM by feeding micro current. For each sampling time, the VCM drive current is determined by filtering the position difference between the target position and the position clarified by the detected position sense data. The filtering includes servo compensation. These are digitally controlled by the firmware.

4.7.5 Spindle motor control

Hall-less three-phase twelve-pole motor is used for the spindle motor, and the 3-phase full/half-wave analog current control circuit is used as the spindle motor driver (called SVC hereafter). The firmware operates on the MPU manufactured by Fujitsu. The spindle motor is controlled by sending several signals from the MPU to the SVC. There are three modes for the spindle control; start mode, acceleration mode, and stable rotation mode.

(1) Start mode

When power is supplied, the spindle motor is started in the following sequence:

a) After the power is turned on, the MPU sends a signal to the SVC to charge the charge pump capacitor of the SVC. The charged amount defines the current that flows in the spindle motor.

b) When the charge pump capacitor is charged enough, the MPU sets the SVC to the motor start mode. Then, a current (approx. 0.7 A) flows into the spindle motor.

c) The SVC generates a phase switching signal by itself, and changes the phase of the current flowed in the motor in the order of (V-phase to U-phase), (W-phase to U-phase), (W-phase to V-phase), (U-phase to V-phase), (U-phase to W-phase), and (V-phase to W-phase) (after that, repeating this order).

d) During phase switching, the spindle motor starts rotating in low speed, and generates a counter electromotive force. The SVC detects this counter electromotive force and reports to the MPU using a PHASE signal for speed detection.

e) The MPU is waiting for a PHASE signal. When no phase signal is sent for a sepcific period, the MPU resets the SVC and starts from the beginning. When a PHASE signal is sent, the SVC enters the acceleration mode.

(2) Acceleration mode

In this mode, the MPU stops to send the phase switching signal to the SVC. The SVC starts a phase switching by itself based on the counter electromotive force. Then, rotation of the spindle motor accelerates. The MPU calcurates a rotational speed of the spindle motor based on the PHASE signal from the SVC, and waites till the rotational speed reaches 4,200 rpm. When the rotational speed reaches 4,200 rpm, the SVC enters the stable rotation mode.

(3) Stable rotation mode

The SVC calcurates a time for one revolution of the spindle motor based on the PHASE signal. The MPU takes a difference between the current time and a time for one revolution at 4,200 rpm that the MPU already recognized. Then, the MPU keeps the rotational speed to 4,200 rpm by charging or discharging the charge pump for the different time. For example, when the actual rotational speed is 4,000 rpm, the time for one revolution is 15.000 ms. And, the time for one revolution at 4,200 rpm is 14.286 ms. Therefore, the MPU charges the charge pump for 0.714 ms × k (k: constant value). This makes the flowed current into the motor higher and the rotational speed up. When the actual rotational speed is faster than 4,200 rpm, the MPU discharges the pump the other way. This control (charging/discharging) is performed every 1 revolution.

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CHAPTER 5 Interface

This chapter gives details about the interface, and the interface commands and timings.

5.1 Physical Interface

5.1.1 Interface signals

Figure 5.1 shows the interface signals.

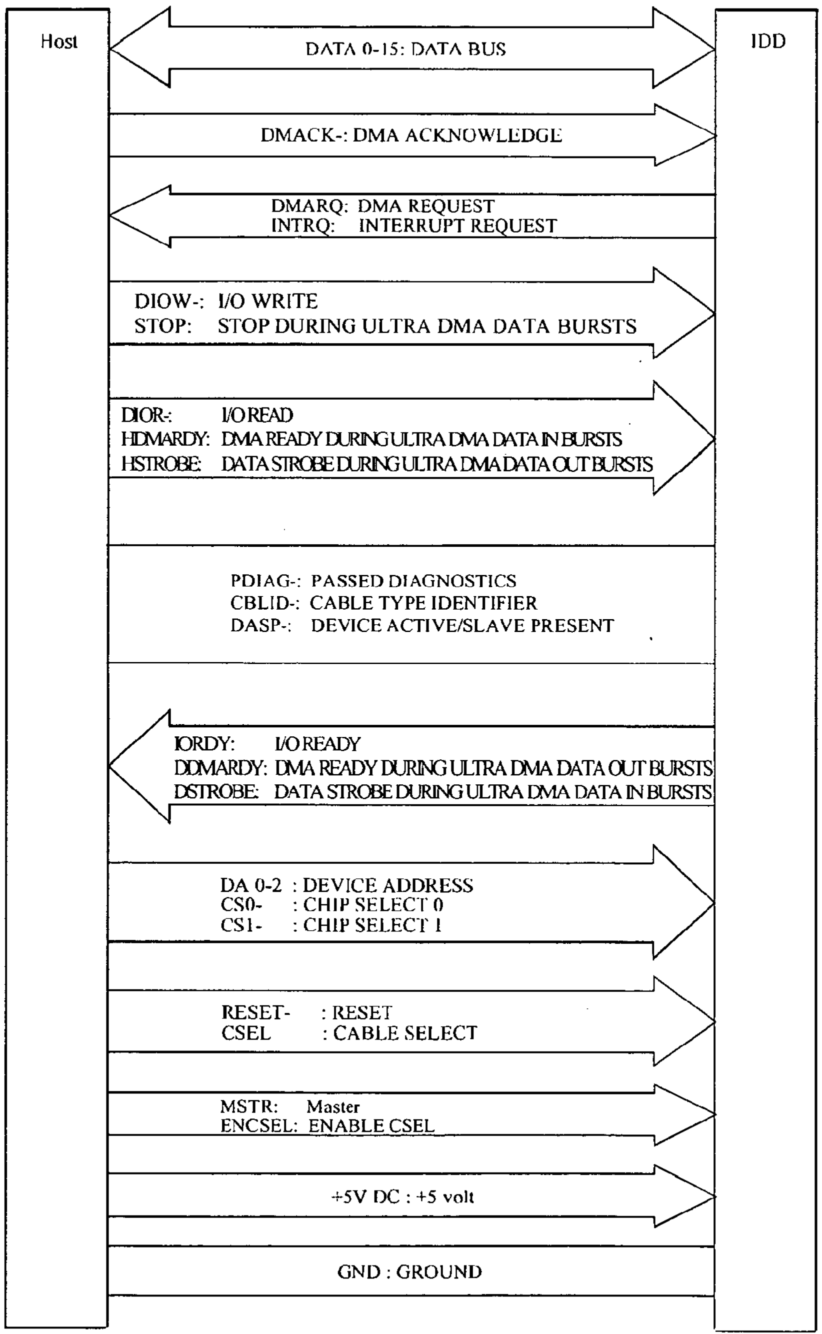


Figure 5.1 Interface signals

5.1.2 Signal assignment on the connector

Table 5.1 shows the signal assignment on the interface connector.

Table 5.1 Signal assignment on the interface connector

Pin No.	Signal	Pin No.	Signal
A	MSTR	B	MSTR/ENCSEL
C	unused	D	ENCSEL
E	(KEY)	F	(KEY)
1	RESET–	2	GND
3	DATA7	4	DATA8
5	DATA6	6	DATA9
7	DATA5	8	DATA10
9	DATA4	10	DATA11
11	DATA3	12	DATA12
13	DATA2	14	DATA13
15	DATA1	16	DATA14
17	DATA0	18	DATA15
19	GND	20	(KEY)
21	DMARQ	22	GND
23	DIOW-, STOP	24	GND
25	DIOR-, HDMRDY, HSTROBE	26	GND
27	IORDY, DDMARDY, DSTROBE	28	CSEL
29	DMACK–	30	GND
31	INTRQ	32	reserved
33	DA1	34	PDIAG–, CBLID–
35	DA0	36	DA2
37	CS0–	38	CS1–
39	DASP–	40	GND
41	+5 VDC	42	+5 VDC
43	GND	44	unused

[signal]	[I/O]	[Description]
ENCSEL	I	This signal is used to set master/slave using the CSEL signal (pin 28). Pins B and D Open: Sets master/slave using the CSEL signal is disabled. Short: Sets master/slave using the CSEL signal is enabled.
MSTR-	I	MSTR, I, Master/slave setting Pin A, B, C, D open: Master setting Pin A, B Short: Slave setting
RESET-	I	Reset signal from the host. This signal is low active and is asserted for a minimum of 25 μs during power on.
DATA 0-15	I/O	Sixteen-bit bi-directional data bus between the host and the device. These signals are used for data transfer
DIOW-	I	Signal asserted by the host to write to the device register or data port.
STOP	I	DIOW- must be negated by the host before starting the Ultra DMA transfer. The STOP signal must be negated by the host before data is transferred during the Ultra DMA transfer. During data transfer in Ultra DMA mode, the assertion of the STOP signal asserted by the host later indicates that the transfer has been suspended.
DIOR-	I	Read strobe signal from the host to read the device register or data port
HDMARDY-	I	Flow control signal for Ultra DMA data In transfer (READ DMA command). This signal is asserted by the host to inform the device that the host is ready to receive the Ultra DMA data In transfer. The host can negate the HDMARDY- signal to suspend the Ultra DMA data In transfer.
HSTROBE	I	Data Out Strobe signal from the host during Ultra DMA data Out transfer (WRITE DMA command). Both the rising and falling edges of the HSTROBE signal latch data from Data 15-0 into the device. The host can suspend the inversion of the HSTROBE signal to suspend the Ultra DMA data Out transfer.
INTRQ	O	Interrupt signal to the host. This signal is negated in the following cases: - assertion of RESET- signal - Reset by SRST of the Device Control register - Write to the command register by the host - Read of the status register by the host - Completion of sector data transfer (without reading the Status register) The signal output line has a high impedance when no devices are selected or interruption is disabled.

[signal]	[I/O]	[Description]
CS0-	I	Chip select signal decoded from the host address bus. This signal is used by the host to select the command block registers.
CS1-	I	Chip select signal decoded from the host address bus. This signal is used by the host to select the control block registers.
DA 0-2	I	Binary decoded address signals asserted by the host to access task file registers.
KEY	-	Key pin for prevention of erroneous connector insertion
PDIAG-	I/O	This signal is an input mode for the master device and an output mode for the slave device in a daisy chain configuration. This signal indicates that the slave device has been completed self diagnostics. This signal is pulled up to +5 V through 10 kΩ resistor at each device.
CBLID-	I/O	This signal is used to detect the type of cable installed in the system. This signal is pulled up to +5 V through 10 kΩ resistor at each device.
DASP-	I/O	This is a time-multiplexed signal that indicates that the device is active and a slave device is present. This signal is pulled up to +5 V through 10 kΩ resistor at each device.
IORDY	O	This signal requests the host system to delay the transfer cycle when the device is not ready to respond to a data transfer request from the host system.
DDMARDY -	O	Flow control signal for Ultra DMA data Out transfer (WRITE DMA command). This signal is asserted by the device to inform the host that the device is ready to receive the Ultra DMA data Out transfer. The device can negate the DDMARDY- signal to suspend the Ultra DMA data Out transfer.
DSTROBE	O	Data In Strobe signal from the device during Ultra DMA data In transfer. Both the rising and falling edges of the DSTROBE signal latch data from Data 15-0 into the host. The device can suspend the inversion of the DSTROBE signal to suspend the Ultra DMA data In transfer.
CSEL	I	This signal to configure the device as a master or a slave device. - When CSEL signal is grounded,, the IDD is a master device. - When CSEL signal is open,, the IDD is a slave device. This signal is pulled up with 240 kΩ resistor at each device.
DMACK-	I	The host system asserts this signal as a response that the host system receive data or to indicate that data is valid.

[signal]	[I/O]	[Description]
DMARQ	O	This signal is used for DMA transfer between the host system and the device. The device asserts this signal when the device completes the preparation of DMA data transfer to the host system (at reading) or from the host system (at writing). The direction of data transfer is controlled by the DIOR and DIOW signals. This signal hand shakes with the DMACK-signal. In other words, the device negates the DMARQ signal after the host system asserts the DMACK signal. When there is other data to be transferred, the device asserts the DMARQ signal again. When the DMA data transfer is performed, IOCS16-, CS0- and CS1- signals are not asserted. The DMA data transfer is a 16-bit data transfer.
+5 VDC	I	+5 VDC power supplying to the device.
GND	-	Grounded signal at each signal wire.

Note:

"I" indicates input signal from the host to the device.

"O" indicates output signal from the device to the host.

"I/O" indicates common output or bi-directional signal between the host and the device.

5.2 Logical Interface

The device can operate for command execution in either address-specified mode; cylinder-head-sector (CHS) or Logical block address (LBA) mode. The IDENTIFY DEVICE information indicates whether the device supports the LBA mode. When the host system specifies the LBA mode by setting bit 6 in the Device/Head register to 1, HS3 to HS0 bits of the Device/Head register indicates the head No. under the LBA mode, and all bits of the Cylinder High, Cylinder Low, and Sector Number registers are LBA bits.

The sector No. under the LBA mode proceeds in the ascending order with the start point of LBA0 (defined as follows).

LBA0 = [Cylinder 0, Head 0, Sector 1]

Even if the host system changes the assignment of the CHS mode by the INITIALIZE DEVICE PARAMETER command, the sector LBA address is not changed.

LBA = [((Cylinder No.) × (Number of head) + (Head No.)) × (Number of sector/track)] + (Sector No.) − 1

5.2.1 I/O registers

Communication between the host system and the device is done through input-output (I/O) registers of the device.

These I/O registers can be selected by the coded signals, CS0-, CS1-, and DA0 to DA2 from the host system. Table 5.2. shows the coding address and the function of I/O registers.

Table 5.2 I/O registers

CS0–	CS1–	DA2	DA1	DA0	I/O registers		Host I/O address
					Read operation	Write operation	
Command block registers							
L	H	L	L	L	Data	Data	X'1F0'
L	H	L	L	H	Error Register	Features	X'1F1'
L	H	L	H	L	Sector Count	Sector Count	X'1F2'
L	H	L	H	H	Sector Number	Sector Number	X'1F3'
L	H	H	L	L	Cylinder Low	Cylinder Low	X'1F4'
L	H	H	L	H	Cylinder High	Cylinder High	X'1F5'
L	H	H	H	L	Device/Head	Device/Head	X'1F6'
L	H	H	H	H	Status	Command	X'1F7'
L	L	X	X	X	(Invalid)	(Invalid)	—
Control block registers							
H	L	H	H	L	Alternate Status	Device Control	X'3F6'
H	L	H	H	H	—	—	X'3F7'

Notes:

1. The Data register for read or write operation can be accessed by 16 bit data bus (DATA0 to DATA15).
2. The registers for read or write operation other than the Data registers can be accessed by 8 bit data bus (DATA0 to DATA7).
3. When reading the Drive Address register, bit 7 is high-impedance state.
4. H indicates signal level High and L indicates signal level Low.

   And the LBA mode is specified, the Device/Head, Cylinder High, Cylinder Low, and Sector Number registers indicate LBA bits 27 to 24, 23 to 16, 15 to 8, and 7 to 0.

5.2.2 Command block registers

(1) Data register (X'1F0')

The Data register is a 16-bit register for data block transfer between the device and the host system. Data transfer mode is PIO or DMA mode.

(2) Error register (X'1F1')

The Error register indicates the status of the command executed by the device. The contents of this register are valid when the ERR bit of the Status register is 1.

This register contains a diagnostic code after power is turned on, a reset , or the EXECUTIVE DEVICE DIAGNOSTIC command is executed.

[Status at the completion of command execution other than diagnostic command]

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ICRC	UNC	X	IDNF	X	ABRT	TK0NF	AMNF

X: Unused

- Bit 7: Interface CRC Error (ICRC). This bit indicates that a CRC error occurred during Ultra DMA transfer.
- Bit 6: Uncorrectable Data Error (UNC). This bit indicates that an uncorrectable data error has been encountered.
- Bit 5: Unused
- Bit 4: ID Not Found (IDNF). This bit indicates an error except for bad sector, uncorrectable error and SB not found.
- Bit 3: Unused
- Bit 2: Aborted Command (ABRT). This bit indicates that the requested command was aborted due to a device status error (e.g. Not Ready, Write Fault) or the command code was invalid.
- Bit 1: Track 0 Not Found (TK0NF). This bit indicates that track 0 was not found during RECALIBRATE command execution.
- Bit 0: Address Mark Not Found (AMNF). This bit indicates that the SB Not Found error occurred.

[Diagnostic code]

X'01': No Error Detected.

X'02': HDC Register Compare Error

X'03': Data Buffer Compare Error.

X'05': ROM Sum Check Error.

X'80': Device 1 (slave device) Failed.

Error register of the master device is valid under two devices (master and slave) configuration. If the slave device fails, the master device posts X'80' OR (the diagnostic code) with its own status (X'01' to X'05').

However, when the host system selects the slave device, the diagnostic code of the slave device is posted.

(3) Features register (X'1F1')

The Features register provides specific feature to a command. For instance, it is used with SET FEATURES command to enable or disable caching.

(4) Sector Count register (X'1F2')

The Sector Count register indicates the number of sectors of data to be transferred in a read or write operation between the host system and the device. When the value in this register is X'00', the sector count is 256.

When this register indicates X'00' at the completion of the command execution, this indicates that the command is completed succefully. If the command is not completed scuccessfully, this register indicates the number of sectors to be transferred to complete the request from the host system. That is, this register indicates the number of remaining sectors that the data has not been transferred due to the error.

The contents of this register has other definition for the following commands; INITIALIZE DEVICE PARAMETERS, SET FEATURES, IDLE, STANDBY and SET MULTIPLE MODE.

(5) Sector Number register (X'1F3')

The contents of this register indicates the starting sector number for the subsequent command. The sector number should be between X'01' and [the number of sectors per track defined by INITIALIZE DEVICE PARAMETERS command.

Under the LBA mode, this register indicates LBA bits 7 to 0.

(6) Cylinder Low register (X'1F4')

The contents of this register indicates low-order 8 bits of the starting cylinder address for any disk-access.

At the end of a command, the contents of this register are updated to the current cylinder number.

Under the LBA mode, this register indcates LBA bits 15 to 8.

(7) Cylinder High register (X'1F5')

The contents of this register indicates high-order 8 bits of the disk-access start cylinder address.

At the end of a command, the contents of this register are updated to the current cylinder number. The high-order 8 bits of the cylinder address are set to the Cylinder High register.

Under the LBA mode, this register indicates LBA bits 23 to 16.

(8) Device/Head register (X'1F6')

The contents of this register indicate the device and the head number.

When executing INITIALIZE DEVICE PARAMETERS command, the contents of this register defines "the number of heads minus 1" (a maximum head No.).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	L	X	DEV	HS3	HS2	HS1	HS0

- Bit 7: Unused
- Bit 6: L. 0 for CHS mode and 1 for LBA mode.
- Bit 5: Unused
- Bit 4: DEV bit. 0 for the master device and 1 for the slave device.
- Bit 3: HS3 CHS mode head address 3 (2^3). LBA bit 27.
- Bit 2: HS2 CHS mode head address 2 (2^2). LBA bit 26.
- Bit 1: HS1 CHS mode head address 1 (2^1). LBA bit 25.
- Bit 0: HS0 CHS mode head address 0 (2^0). LBA bit 24.

(9) Status register (X'1F7')

The contents of this register indicate the status of the device. The contents of this register are updated at the completion of each command. When the BSY bit is cleared, other bits in this register should be validated within 400 ns. When the BSY bit is 1, other bits of this register are invalid. When the host system reads this register while an interrupt is pending, it is considered to be the Interrupt Acknowledge (the host system acknowledges the interrupt). Any pending interrupt is cleared (negating INTRQ signal) whenever this register is read.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BSY	DRDY	DF	DSC	DRQ	0	0	ERR

- Bit 7: Busy (BSY) bit. This bit is set whenever the Command register is accessed. Then this bit is cleared when the command is completed. However, even if a command is being executed, this bit is 0 while data transfer is being requested (DRQ bit = 1).When BSY bit is 1, the host system should not write the command block registers. If the host system reads any command block register when BSY bit is 1, the contents of the Status register are posted. This bit is set by the device under following conditions:

  (a) Within 400 ns after RESET- is negated or SRST is set in the Device Control register, the BSY bit is set. the BSY bit is cleared, when the reset process is completed.

  The BSY bit is set for no longer than 15 seconds after the IDD accepts reset.

  (b) Within 400 ns from the host system starts writing to the Command register.

  (c) Within 5 μs following transfer of 512 bytes data during execution of the READ SECTOR(S), WRITE SECTOR(S), or WRITE BUFFER command.

  Within 5 μs following transfer of 512 bytes of data and the appropriate number of ECC bytes during execution of READ LONG or WRITE LONG command.

- Bit 6: Device Ready (DRDY) bit. This bit indicates that the device is capable to respond to a command.

  The IDD checks its status when it receives a command. If an error is detected (not ready state), the IDD clears this bit to 0. This is cleared to 0 at power-on and it is cleared until the rotational speed of the spindle motor reaches the steady speed.

- Bit 5: The Device Write Fault (DF) bit. This bit indicates that a device fault (write fault) condition has been detected.

  If a write fault is detected during command execution, this bit is latched and retained until the device accepts the next command or reset.

- Bit 4: Device Seek Complete (DSC) bit. This bit indicates that the device heads are positioned over a track.

  In the IDD, this bit is always set to 1 after the spin-up control is completed.

- Bit 3: Data Request (DRQ) bit. This bit indicates that the device is ready to transfer data of word unit or byte unit between the host system and the device.

- Bit 2: Always 0.

- Bit 1: Always 0.

- Bit 0: Error (ERR) bit. This bit indicates that an error was detected while the previous command was being executed. The Error register indicates the additional information of the cause for the error.

(10) Command register (X'1F7')

The Command register contains a command code being sent to the device. After this register is written, the command execution starts immediately.

Table 5.3 lists the executable commands and their command codes. This table also lists the neccesary parameters for each command which are written to certain registers before the Command register is written.

5.2.3 Control block registers

(1) Alternate Status register (X'3F6')

The Alternate Status register contains the same information as the Status register of the command block register.

The only difference from the Status register is that a read of this register does not imply Interrupt Acknowledge and INTRQ signal is not reset.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BSY	DRDY	DF	DSC	DRQ	0	0	ERR

(2) Device Control register (X'3F6')

The Device Control register contains device interrupt and software reset.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	SRST	nIEN	0

- Bit 2: SRST is the host software reset bit. When this bit is set, the device is held reset state. When two device are daisy chained on the interface, setting this bit resets both device simultaneously.

  The slave device is not required to execute the DASP- handshake.

- Bit 1: nIEN bit enables an interrupt (INTRQ signal) from the device to the host. When this bit is 0 and the device is selected, an interruption (INTRQ signal) can be enabled through a tri-state buffer. When this bit is 1 or the device is not selected, the INTRQ signal is in the high-impedance state.

5.3 Host Commands

The host system issues a command to the device by writing necessary parameters in related registers in the command block and writing a command code in the Command register.

The device can accept the command when the BSY bit is 0 (the device is not in the busy status).

The host system can halt the uncompleted command execution only at execution of hardware or software reset.

When the BSY bit is 1 or the DRQ bit is 1 (the device is requesting the data transfer) and the host system writes to the command register, the correct device operation is not guaranteed.

5.3.1 Command code and parameters

Table 5.3 lists the supported commands, command code and the registers that needed parameters are written.

Table 5.3 Command code and parameters (1 of 2)

Command name	Command code (Bit)								Parameters used				
	7	6	5	4	3	2	1	0	FR	SC	SN	CY	DH
READ SECTOR(S)	0	0	1	0	0	0	0	R	N	Y	Y	Y	Y
READ MULTIPLE	1	1	0	0	0	1	0	0	N	Y	Y	Y	Y
READ DMA	1	1	0	0	1	0	0	R	N	Y	Y	Y	Y
READ VERIFY SECTOR(S)	0	1	0	0	0	0	0	R	N	Y	Y	Y	Y
WRITE MULTIPLE	1	1	0	0	0	1	0	1	N	Y	Y	Y	Y
WRITE DMA	1	1	0	0	1	0	1	R	N	Y	Y	Y	Y
WRITE VERIFY	0	0	1	1	1	1	0	0	N	Y	Y	Y	Y
WRITE SECTOR(S)	0	0	1	1	0	0	0	R	N	Y	Y	Y	Y
RECALIBRATE	0	0	0	1	X	X	X	X	N	N	N	N	D
SEEK	0	1	1	1	X	X	X	X	N	N	Y	Y	Y
INITIALIZE DEVICE PARAMETERS	1	0	0	1	0	0	0	1	N	Y	N	N	Y
IDENTIFY DEVICE	1	1	1	0	1	1	0	0	N	N	N	N	D
IDENTIFY DEVICE DMA	1	1	1	0	1	1	0	0	N	N	N	N	D
SET FEATURES	1	1	1	0	1	1	1	1	Y	N*	N	N	D
SET MULTIPLE MODE	1	1	0	0	0	1	1	0	N	Y	N	N	D
SET MAX ADDRESS	1	1	1	1	1	0	0	1	N	Y	Y	Y	Y
READ NATIVE MAX ADDRESS	1	1	1	1	1	0	0	0	N	N	N	N	D
EXECUTE DEVICE DIAGNOSTIC	1	0	0	1	0	0	0	0	N	N	N	N	D*
READ LONG	0	0	1	0	0	0	1	R	N	Y	Y	Y	Y
WRITE LONG	0	0	1	1	0	0	1	R	N	Y	Y	Y	Y
READ BUFFER	1	1	1	0	0	1	0	0	N	N	N	N	D
WRITE BUFFER	1	1	1	0	1	0	0	0	N	N	N	N	D
IDLE	1 1	0 1	0 1	1 0	0 0	1 0	1 1	1 1	N	Y	N	N	D

Table 5.3 Command code and parameters (2 of 2)

Command name	Command code (Bit)								Parameters used				
	7	6	5	4	3	2	1	0	FR	SC	SN	CY	DH
IDLE IMMEDIATE	1 1	0 1	0 1	1 0	0 0	1 0	0 0	1 1	N	N	N	N	D
STANDBY	1 1	0 1	0 1	1 0	0 0	1 0	1 1	0 0	N	Y	N	N	D
STANDBY IMMEDIATE	1 1	0 1	0 1	1 0	0 0	1 0	0 0	0 0	N	N	N	N	D
SLEEP	1 1	0 1	0 1	1 0	1 0	0 1	0 1	1 0	N	N	N	N	D
CHECK POWER MODE	1 1	0 1	0 1	1 0	1 0	0 1	0 0	0 1	N	N	N	N	D
SMART	1	0	1	1	0	0	0	0	Y	Y	Y	Y	D
SECURITY DISABLE PASSWORD	1	1	1	1	0	1	1	0	N	N	N	N	D
SECURITY ERASE PREPARE	1	1	1	1	0	0	1	1	N	N	N	N	D
SECURITY ERASE UNIT	1	1	1	1	0	1	0	0	N	N	N	N	D
SECURITY FREEZE LOCK	1	1	1	1	0	1	0	1	N	N	N	N	D
SECURITY SET PASSWORD	1	1	1	1	0	0	0	1	N	N	N	N	D
SECURITY UNLOCK	1	1	1	1	0	0	1	0	N	N	N	N	D
FLUSH CACHE	1	1	1	0	0	1	1	1	N	N	N	N	D

Notes:

FR: Features Register

CY: Cylinder Registers

SC: Sector Count Register

DH: Drive/Head Register

SN: Sector Number Register

R: Retry at error

1 = Without retry

0 = With retry

Y: Necessary to set parameters

Y*: Necessary to set parameters under the LBA mode.

N: Not necessary to set parameters (The parameter is ignored if it is set.)

N*: May set parameters

D: The device parameter is valid, and the head parameter is ignored.

D*: The command is addressed to the master device, but both the master device and the slave device execute it.

X: Do not care

5.3.2 Command descriptions

The contents of the I/O registers to be necessary for issuing a command and the example indication of the I/O registers at command conpletion are shown as following in this subsection.

Example: READ SECTOR(S)

At command issuance (I/O registers setting contents)								
Bit	7	6	5	4	3	2	1	0
$1F7_H$(CM)	0	0	1	0	0	0	0	0
$1F6_H$(DH)	×	L	×	DV	Head No. / LBA [MSB]			
$1F5_H$(CH)	Start cylinder address [MSB] / LBA							
$1F4_H$(CL)	Start cylinder address [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)								
Bit	7	6	5	4	3	2	1	0
$1F7_H$(ST)	Status information							
$1F6_H$(DH)	×	L	×	DV	Head No. / LBA [MSB]			
$1F5_H$(CH)	End cylinder address [MSB] / LBA							
$1F4_H$(CL)	End cylinder address [LSB] / LBA							
$1F3_H$(SN)	End sector No. / LBA [LSB]							
$1F2_H$(SC)	X'00'							
$1F1_H$(ER)	Error information							

CM: Command register	FR: Features register
DH: Device/Head register	ST: Status register
CH: Cylinder High register	ER: Error register
CL: Cylinder Low register	L: LBA (logical block address) setting bit
SN: Sector Number register	DV: Device address. bit
SC: Sector Count register	x, xx: Do not care (no necessary to set)

Note:

1. When the L bit is specified to 1, the lower 4 bits of the DH register and all bits of the CH, CL and SN registers indicate the LBA bits (bits of the DH register are the MSB (most significant bit) and bits of the SN register are the LSB (least significant bit).

2. At error occurrance, the SC register indicates the remaining sector count of data transfer.

3. In the table indicating I/O registers contents in this subsection, bit indication is omitted.

(1) READ SECTOR(S) (X'20' or X'21')

This command reads data of sectors specified in the Sector Count register from the address specified in the Device/Head, Cylinder High, Cylinder Low and Sector Number registers. Number of sectors can be specified to 256 sectors in maximum. To specify 256 sectors reading, '00' is specified. For the DRQ, INTRQ, and BSY protocols related to data transfer, see Subsection 5.4.1.

If the head is not on the track specified by the host, the device performs a implied seek. After the head reaches to the specified track, the device reads the target sector.

If an error occurs, retry reads are attempted to read the target sector before reporting an error, irrespective of the R bit setting.

The DRQ bit of the Status register is always set prior to the data transfer regardless of an error condition.

Upon the completion of the command execution, command block registers contain the cylinder, head, and sector addresses (in the CHS mode) or logical block address (in the LBA mode) of the last sector read.

If an unrecoverable error occurs in a sector, the read operation is terminated at the sector where the error occured.

Command block registers contain the cylinder, the head, and the sector addresses of the sector (in the CHS mode) or the logical block address (in the LBA mode) where the error occurred, and remaining number of sectors of which data was not transferred.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	0	1	0	0	0	0	R
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

(R: Retry)

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(2) READ MULTIPLE (X'C4')

This command operates similarly to the READ SECTOR(S) command. The device does not generate an interrupt (assertion of the INTRQ signal) on each every sector. An interrupt is generateed after the transfer of a block of sectors for which the number is specified by the SET MULTIPLE MODE command.

The implementation of the READ MULTIPLE command is identical to that of the READ SECTOR(S) command except that the number of sectors is specified by the SET MULTIPLE MODE command are transferred without intervening interrupts. In the READ MULTIPLE command operation, the DRQ bit of the Status register is set only at the start of the data block, and is not set on each sector.

The number of sectors (block count) to be transferred without interruption is specifed by the SET MULTIPLE MODE command. The SET MULTIPLE MODE command should be executed prior to the READ MULTIPLE command.

When the READ MULTIPLE command is issued, the Sector Count register contains the number of sectors requested (not a number of the block count or a number of sectors in a block).

Upon receipt of this command, the device executes this command even if the value of the Sector Count register is less than the defined block count (the value of the Sector Count should not be 0).

If the number of requested sectors is not divided evenly (having the same number of sectors [block count]), as many full blocks as possible are transferred, then a final partial block is transferred. The number of sectors in the partial block to be transferred is n where n = remainder of ("number of sectors"/"block count").

If the READ MULTIPLE command is issued before the SET MULTIPLE MODE command is executed or when the READ MULTIPLE command is disabled, the device rejects the READ MULTIPLE command with an ABORTED COMMAND error.

If an unrecoverable error occurs, reading sector is stopped at the sector where the error occurred. Command block registers contain the cylinder, the head, the sector addresses (in the CHS mode) or the logical block address (in the LBA mode) of the sector where the error occurred, and remaining number of sectors that had not transferred after the sector where the error occurred.

An interrupt is generated when the DRQ bit is set at the beginning of each block or a partial block.

Figure 5.2 shows an example of the execution of the READ MULTIPLE command.

- Block count specified by SET MULTIPLE MODE command = 4 (number of sectors in a block)
- READ MULTIPLE command specifies;

Number of requested sectors = 9 (Sector Count register = 9)

↓

Number of sectors in incomplete block = remainder of 9/4 =1

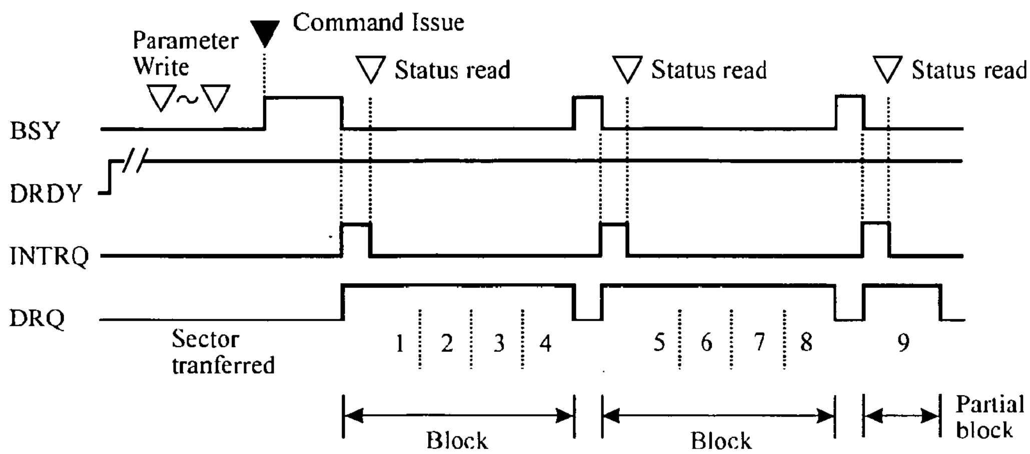


Figure 5.2 Execution example of READ MULTIPLE command

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	0	0	0	1	0	0
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00(*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors for which data was not transferred is set in this register.

(3) READ DMA (X'C8' or X'C9')

This command operates similarly to the READ SECTOR(S) command except for following events.

- The data transfer starts at the timing of DMARQ signal assertion.
- The device controls the assertion or negation timing of the DMARQ signal.
- The device posts a status as the result of command execution only once at completion of the data transfer.

When an error, such as an unrecoverable medium error, that the command execution cannot be continued is detected, the data transfer is stopped without transferring data of sectors after the erred sector. The device generates an interrupt using the INTRQ signal and posts a status to the host system. The format of the error information is the same as the READ SECTOR(S) command.

In LBA mode

The logical block address is specified using the start head No., start cylinder No., and first sector No. fields. At command completion, the logical block address of the last sector and remaining number of sectors of which data was not transferred, like in the CHS mode, are set.

The host system can select the DMA transfer mode by using the SET FEATURES command.

- Multiword DMA transfer mode 0 to 2
- Ultra DMA transfer mode 0 to 4

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	0	0	1	0	0	R
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(4) READ VERIFY SECTOR(S) (X'40' or X'41')

This command operates similarly to the READ SECTOR(S) command except that the data is not transferred to the host system.

After all requested sectors are verified, the device clears the BSY bit of the Status register and generates an interrupt. Upon the completion of the command execution, the command block registers contain the cylinder, head, and sector number of the last sector verified.

If an unrecoverable error occurs, the verify operation is terminated at the sector where the error occurred. The command block registers contain the cylinder, the head, and the sector addresses (in the CHS mode) or the logical block address (in the LBA mode) of the sector where the error occurred. The Sector Count register indicates the number of sectors that have not been verified.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	1	0	0	0	0	0	R
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(5) WRITE SECTOR(S) (X'30' or X'31')

This command writes data of sectors from the address specified in the Device/Head, Cylinder High, Cylinder Low, and Sector Number registers to the address specified in the Sector Count register. Number of sectors can be specified to 256 sectors in maximum. Data transfer begins at the sector specified in the Sector Number register. For the DRQ, INTRQ, and BSY protocols related to data transfer, see Subsection 5.4.2.

If the head is not on the track specified by the host, the device performs a implied seek. After the head reaches to the the specified track, the device writes the target sector.

If an error occurs when writing to the target sector, retries are attempted irrespectively of the R bit setting.

The data stored in the buffer, and CRC code and ECC bytes are written to the data field of the corresponding sector(s). Upon the completion of the command execution, the command block registers contain the cylinder, head, and sector addresses of the last sector written.

If an error occurs during multiple sector write operation, the write operation is terminated at the sector where the error occured. Command block registers contain the cylinder, the head, the sector addresses (in the CHS mode) or the logical block address (in the LBA mode) of the sector where the error occurred. Then the host can read the command block registers to determine what error has occurred and on which sector the error has occurred.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	0	1	1	0	0	0	R
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(6) WRITE MULTIPLE (X'C5')

This command is similar to the WRITE SECTOR(S) command. The device does not generate interrupts (assertion of the INTRQ) signal) on each sector but on the transfer of a block which contains the number of sectors for which the number is defined by the SET MULTIPLE MODE command.

The implementation of the WRITE MULTIPLE command is identical to that of the WRITE SECTOR(S) command except that the number of sectors is specified by the SET MULTIPLE MODE command are transferred without intervening interrupts. In the WRITE MULTIPLE command operation, the DRQ bit of the Status register is required to set only at the start of the data block, not on each sector.

The number of sectors (block count) to be transferred without interruption is specifed by the SET MULTIPLE MODE command. The SET MULTIPLE MODE command should be executed prior to the WRITE MULTIPLE command.

When the WRITE MULTIPLE command is issued, the Sector Count register contains the number of sectors requested (not a number of the block count or a number of sectors in a block).

Upon receipt of this command, the device executes this command even if the value of the Sector Count register is less than the defined block count the value of the Sector Count should not be 0).

If the number of requested sectors is not divided evenly (having the same number of sectors [block count]), as many full blocks as possible are transferred, then a final partial block is transferred. The number of sectors in the partial block to be transferred is n where n = remainder of ("number of sectors"/"block count").

If the WRITE MULTIPLE command is issued before the SET MULTIPLE MODE command is executed or when WRITE MULTIPLE command is disabled, the device rejects the WRITE MULTIPLE command with an ABORTED COMMAND error.

Disk errors encountered during execution of the WRITE MULTIPLE command are posted after attempting to write the block or the partial block that was transferred. Write operation ends at the sector where the error was encountered even if the sector is in the middle of a block. If an error occurs, the subsequent block shall not be transferred. Interrupts are generated when the DRQ bit of the Status register is set at the beginning of each block or partial block.

The contents of the command block registers related to addresses after the transfer of a data block containing an erred sector are undefined. To obtain a valid error information, the host should retry data transfer as an individual request.

At command issuance (I/O registers setting contents)								
1F7$_H$(CM)	1	1	0	0	0	1	0	1
1F6$_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
1F5$_H$(CH)	Start cylinder No. [MSB] / LBA							
1F4$_H$(CL)	Start cylinder No. [LSB] / LBA							
1F3$_H$(SN)	Start sector No. / LBA [LSB]							
1F2$_H$(SC)	Transfer sector count							
1F1$_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
1F7$_H$(ST)	Status information				
1F6$_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
1F5$_H$(CH)	End cylinder No. [MSB] / LBA				
1F4$_H$(CL)	End cylinder No. [LSB] / LBA				
1F3$_H$(SN)	End sector No. / LBA [LSB]				
1F2$_H$(SC)	00				
1F1$_H$(ER)	Error information				

(7) WRITE DMA (X'CA' or X'CB')

This command operates similarly to the WRITE SECTOR(S) command except for following events.

- The data transfer starts at the timing of DMARQ signal assertion.
- The device controls the assertion or negation timing of the DMARQ signal.
- The device posts a status as the result of command execution only once at completion of the data transfer or completion of processing in the device.
- The device posts a status as the result of command execution only once at completion of the data transfer.

When an error, such as an unrecoverable medium error, that the command execution cannot be continued is detected, the data transfer is stopped without transferring data of sectors after the erred sector. The device generates an interrupt using the INTRQ signal and posts a status to the host system. The format of the error information is the same as the WRITE SECTOR(S) command.

A host system can select the following transfer mode using the SET FEATURES command.

- Multiword DMA transfer mode 0 to 2
- Ultra DMA transfer mode 0 to 4

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	0	0	1	0	1	R
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(8) WRITE VERIFY (X'3C')

This command operates similarly to the WRITE SECTOR(S) command except that the device verifies each sector immediately after being written. The verify operation is a read and check for data errors without data transfer. Any error that is detected during the verify operation is posted.

After all sectors are verified, the last interruption (INTRQ for command termination) is generated.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	0	1	1	1	1	0	0
$1F6_H$(DH)	×	L	×	DV	Start head No. /LBA [MSB]			
$1F5_H$(CH)	Start cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Start cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Start sector No. / LBA [LSB]							
$1F2_H$(SC)	Transfer sector count							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	End head No. /LBA [MSB]
$1F5_H$(CH)	End cylinder No. [MSB] / LBA				
$1F4_H$(CL)	End cylinder No. [LSB] / LBA				
$1F3_H$(SN)	End sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, the remaining number of sectors of which data was not transferred is set in this register.

(9) RECALIBRATE (X'1x', x: X'0' to X'F')

This command performs the calibration. Upon receipt of this command, the device sets BSY bit of the Status register and performs a calibration. When the device completes the calibration, the device updates the Status register, clears the BSY bit, and generates an interrupt.

This command can be issued in the LBA mode.

At command issuance (I/O registers setting contents)								
1F7$_H$(CM)	0	0	0	1	x	x	x	x
1F6$_H$(DH)	×	×	×	DV	xx			
1F5$_H$(CH)	xx							
1F4$_H$(CL)	xx							
1F3$_H$(SN)	xx							
1F2$_H$(SC)	xx							
1F1$_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
1F7$_H$(ST)	Status information				
1F6$_H$(DH)	×	×	×	DV	xx
1F5$_H$(CH)	xx				
1F4$_H$(CL)	xx				
1F3$_H$(SN)	xx				
1F2$_H$(SC)	xx				
1F1$_H$(ER)	Error information				

Note:

Also executable in LBA mode.

(10) SEEK (X'7x', x : X'0' to X'F')

This command performs a seek operation to the track and selects the head specified in the command block registers. After completing the seek operation, the device clears the BSY bit in the Status register and generates an interrupt.

The IDD always sets the DSC bit (Drive Seek Complete status) of the Status register to 1.

In the LBA mode, this command performs the seek operation to the cylinder and head position in which the sector is specified with the logical block address.

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	0 1 1 1 x x x x				
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]
$1F5_H$(CH)	Cylinder No. [MSB] / LBA				
$1F4_H$(CL)	Cylinder No. [LSB] / LBA				
$1F3_H$(SN)	Sector No. / LBA [LSB]				
$1F2_H$(SC)	xx				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]
$1F5_H$(CH)	Cylinder No. [MSB] / LBA				
$1F4_H$(CL)	Cylinder No. [LSB] / LBA				
$1F3_H$(SN)	Sector No. / LBA [LSB]				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(11) INITIALIZE DEVICE PARAMETERS (X'91')

The host system can set the number of sectors per track and the maximum head number (maximum head number is "number of heads minus 1") per cylinder with this command. Upon receipt of this command, the device sets the BSY bit of Status register and saves the parameters. Then the device clears the BSY bit and generates an interrupt.

When the SC register is specified to X'00', an ABORTED COMMAND error is posted. Other than X'00' is specified, this command terminates normally.

The parameters set by this command are retained even after reset or power save operation regardless of the setting of disabling the reverting to default setting.

In LBA mode

The device ignores the L bit specification and operates with the CHS mode specification. An accessible area of this command within head moving in the LBA mode is always within a default area. It is recommended that the host system refers the addressable user sectors (total number of sectors) in word 60 to 61 of the parameter information by the IDENTIFY DEVICE command.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	0	0	1	0	0	0	1
$1F6_H$(DH)	×	×	×	DV	Max. head No.			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	Number of sectors/track							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	Max. head No.
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	Number of sectors/track				
$1F1_H$(ER)	Error infomation				

(12) IDENTIFY DEVICE (X'EC')

The host system issues the IDENTIFY DEVICE command to read parameter information (512 bytes) from the device. Upon receipt of this command, the drive sets the BSY bit of Status register and sets required parameter information in the sector buffer. The device then sets the DRQ bit of the Status register, and generates an interrupt. After that, the host system reads the information out of the sector buffer. Table 5.4 shows the arrangements and values of the parameter words and the meaning in the buffer.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	1	0	1	1	0	0
$1F6_H$(DH)	×	×	×	DV	xx			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	xx							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

Table 5.4 Information to be read by IDENTIFY DEVICE command (1 of 8)

Word	Value	Description
0	X'045A'	General Configuration *1
1	*2	Number of cylinders *2
2	X'C837'	Detailed Configuration
3	*2	Number of Heads *2
4-5	X'0000'	Undefined
6	*2	Number of sectors per track *2
7-9	X'0000'	Undefined
10-19	Set by a device	Serial number (ASCII code, 20 characters, right)
20	X'0000'	Undefined
21	X'0400'	Buffer Size (1 LSB: 512 Byte)
22	X'0004'	Number of ECC bytes transferred at READ LONG or WRITE LONG command

Table 5.4 Information to be read by IDENTIFY DEVICE command (2 of 8)

Word	Value	Description
23-26	–	Firmware revision (ASCII code, 8 characters, left)
27-46	Set by a device	Model name (ASCII code, 40 characters, left)
47	X'8010'	Maximum number of sectors per interrupt on READ/WRITE MULTIPLE command
48	X'0000'	Reserved
49	X'0B00'	Capabilities *3
50	X'0000'	Reserved
51	X'0200'	PIO data transfer mode *4
52	X'0000'	Reserved
53	X'0007'	Enable/disable setting of words 54-58 and 64-70, 88 *5
54	(Variable)	Number of current Cylinders
55	(Variable)	Number of current Head
56	(Variable)	Number of current sectors per track
57-58	(Variable)	Total number of current sectors
59	*6	Transfer sector count currently set by READ/WRITE MULTIPLE command *6
60-61	*2	Total number of user addressable sectors (LBA mode only) *2
62	X'0000'	Reserved
63	X'xx07'	Multiword DMA transfer mode *7
64	X'0003'	Advance PIO transfer mode support status *8
65	X'0078'	Minimum multiword DMA transfer cycle time per word : 120 [ns]
66	X'0078'	Manufacturer's recommended DMA transfer cycle time : 120 [ns]
67	X'00F0'	Minimum PIO transfer cycle time without IORDY flow control : 240 [ns]
68	X'0078'	Minimum PIO transfer cycle time with IORDY flow control : 120 [ns]
69-79	X'0000'	Reserved
80	X'003C'	Major version number *9
81	X'0000'	Minor version number (not reported)
82	X'346B'	Support of command sets *10
83	X'4008'	Support of command sets *11
84	X'4000'	Support of command sets/function

Table 5.4 Information to be read by IDENTIFY DEVICE command (3 of 8)

Word	Value	Description
85	*12	Valid of command sets/function *12
86	*13	Valid of command sets/function *13
87	X'4000'	Default of command sets/function
88	X'xx1F'	Ultra DMA transfer mode *14
89	Set by a device	Security Erase Unit execution time (Unit: 2 min.)
90	X'0000'	Enhanced Security Erase Unit execution time (Unit: 2 min.)
91	(Variable)	Advance power management level
92	(Variable)	Master password revision
93	*15	Hardware configuration
94-127	X'0000'	Reserved
128	(Variable)	Security status *16
129-159	X'0000'	Undefined
160-254	X'0000'	Reserved
255	X'xxA5'	Check sum (The 2 complement of the lower order byte resulting from summing bits 7 to 0 of word 0 to 254 and word 255, in byte units.)

*1 Word 0: General configuration

Bit 15: ATA device = 0, ATAPI device = 1

Bit 14-8: Undefined

Bit 7: Removable disk drive = 1

Bit 6: Fixed drive = 1

Bit 5-3: Undefined

Bit 2: IDENTIFY DEVICE Valid = 0

Bit 1-0: Reserved

*2 Word 1, 3, 6, 60-61

	MHJ2181AT	MHK2120AT	MHK2090AT	MHK2060AT
Word 01	X'3FFF'	X'3FFF'	X'3FFF'	X'3080'
Word 03	X'10'	X'10'	X'10'	X'0F'
Word 06	X'3F'	X'3F'	X'3F'	X'3F'
Word 60-61	X'21CAB00'	X'167CA00'	X'10D7900'	X'B30880'

*3 Word 49: Capabilities

Bit 15-14: Reserved

Table 5.4 Information to be read by IDENTIFY DEVICE command (4 of 8)

Bit 13: Standby timer value. Factory default is 0.

Bit 12: Reserved

Bit 11: IORDY support 1=Supported

Bit 10: IORDY inhibition 0=Disable inhibition

Bit 9-0: Undefined

Bit 9, 8: Always 1

*4 Word 51: PIO data transfer mode

Bit 15-8: PIO data transfer mode X'02'=PIO mode 2

Bit 7-0: Undefined

*5 Word 53: Enable/disable setting of word 54-58 and 64-70

Bit 15-3: Reserved

Bit 2: Enable/disable setting of word 88 1=Enable

Bit 1: Enable/disable setting of word 64-70 1=Enable

Bit 0: Enable/disable setting of word 54-58 1=Enable

*6 Word 59: Transfer sector count currently set by READ/WRITE MULTIPLE command

Bit 15-9: Reserved

Bit 8: Multiple sector transfer 1=Enable

Bit 7-0: Transfer sector count currently set by READ/WRITE MULTIPLE command without interrupt supports 2, 4, 8 and 16 sectors.

*7 Word 63: Multiword DMA transfer mode

Bit 15-8: Currently used multiword DMA transfer mode

Bit 7-0: Supportable multiword DMA transfer mode

Bit 2=1 Mode 2

Bit 1=1 Mode 1

Bit 0=1 Mode 0

*8 Word 64: Advance PIO transfer mode support status

Bit 15-8: Reserved

Bit 7-0: Advance PIO transfer mode

Bit 1 = 1 Mode 4

Table 5.4 Information to be read by IDENTIFY DEVICE command (5 of 8)

Bit 0 = 1 Mode 3

*9 WORD 80

Bit 15-6: Reserved

Bit 5: ATA/ATAPI-5 supported = 1

Bit 4: ATA/ATAPI-4 supported = 1

Bit 3: ATA-3 supported = 1

Bit 2: ATA-2 supported = 1

Bit 1-0: Undefined

*10 WORD 82

Bit 15: Undefined

Bit 14: '1' = Supports the NOP command.

Bit 13: '1' = Supports the READ BUFFER command.

Bit 12: '1' = Supports the WRITE BUFFER command.

Bit 11: Undefined

Bit 10: '1' = Supports the Host Protected Area feature set.

Bit 9: '1' = Supports the DEVICE RESET command.

Bit 8: '1' = Supports the SERVICE interrupt.

Bit 7: '1' = Supports the release interrupt.

Bit 6: '1' = Supports the read cache function.

Bit 5: '1' = Supports the write cache function.

Bit 4: '1' = Supports the PACKET command feature set.

Bit 3: '1' = Supports the power management feature set.

Bit 2: '1' = Supports the Removable Media feature set.

Bit 1: '1' = Supports the Security Mode feature set.

Bit 0: '1' = Supports the SMART feature set.

*11 WORD 83

Bits 15-7: Undefined

Bit 6: '1' = When the power is turned on, spin is started by the SET FEATURES sub-command.

Table 5.4 Information to be read by IDENTIFY DEVICE command (6 of 8)

Bit 5: '1' = Supports the Power-Up In Standby set.

Bit 4: '1' = Supports the Removable Media Status Notification feature set.

Bit 3: '1' = Supports the Advanced Power Management feature set.

Bit 2: '1' = Supports the CFA (Compact Flash Association) feature set.

Bit 1: '1' = Supports the READ/WRITE DMA QUEUED command.

Bit 0: '1' = Supports the DOWNLOAD MICROCODE command.

*12 WORD 85

Bits 15-9 : Same definition as WORD 82.

Bit 8 : '1' = Enables the SERVICE interrupt.

Bit 7: '1' = Enables the release interrupt.

Bit 6: '1' = Enables the read cache function.

Bit 5: '1' = Enables the write cache function.

Bits 4-2: '1' = Same definition as WORD 82.

Bit 1: '1' = Enables the Security Mode function.

Bit 0: '1' = Enables the SMART function.

*13 WORD 86

Bits 15-7: '1' = Reserved

Bit 6: Same definition as WORD 83.

Bit 5 Enables the Power-Up In Standby function.

Bit 4: '1' = Enables the Removable Media Status Notification function.

Bit 3: '1' = Enables the Advanced Power Management function.

Bits 2-0: Same definition as WORD 83.

*14 WORD 88

Bit 15-8: Currently used Ultra DMA transfer mode

Bit 7-0: Supportable Ultra DMA transfer mode

Bit 4 = '1': Mode 4

Bit 3 = '1': Mode 3

Bit 2 = '1': Mode 2

Table 5.4 Information to be read by IDENTIFY DEVICE command (7 of 8)

Bit 1 = '1': Mode 1

Bit 0 = '1': Mode 0

*15 WORD 93

Bits 15-14: Reserved

Bit 13: '1' = CBLID- is a level higher than V_{IH}.

'0' = CBLID- is a level lower than V_{IL}.

Bits 12-8: In the case of Device 1 (slave drive), a valid value is set.

Bit 12: Reserved

Bit 11: '1' = Device asserts PDIAG-.

Bit 10, 9: Method for deciding the device No. of Device 1.

'00' = Reserved

'01' = Using a jumper.

'10' = Using the CSEL signal.

'11' = Other method.

Bit 8: Reserved

Bits 7-0: In the case of Device 0 (master drive), a valid value is set.

Bit 7: Reserved

Bit 6: '1' = Device 1 is selected, Device 0 responds.

Bit 5: '1' = Device 0, assertion of DASP- was detected.

Bit 4: '1' = Device 0, assertion of PDIAG- was detected.

Bit 3: '1' = Device 0, an error was not detected in the self-diagnosis.

Bit 2, 1: Method for deciding the device No. of Device 0.

'00' = Reserved

'01' = Using a jumper.

'10' = Using the CSEL signal.

'11' = Other method.

Bit 0: Reserved

*16 WORD 128

Table 5.4 Information to be read by IDENTIFY DEVICE command (8 of 8)

Bit 15-9: Reserved

Bit 8: Security level. 0: High, 1: Maximum

Bit 7-6: Reserved

Bit 5: 1: Enhanced security erase supported

Bit 4: 1: Security counter expired

Bit 3: 1: Security frozen

Bit 2: 1: Security locked

Bit 1: 1: Security enabled

Bit 0: 1: Security supported

(13) IDENTIFY DEVICE DMA (X'EE')

When this command is not used to transfer data to the host in DMA mode, this command functions in the same way as the Identify Device command.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	1	0	1	1	1	0
$1F6_H$(DH)	×	×	×	DV	xx			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	xx							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(14) SET FEATURES (X'EF')

The host system issues the SET FEATURES command to set parameters in the Features register for the purpose of changing the device features to be executed. For the transfer mode (Feature register = 03), detail setting can be done using the Sector Count register.

Upon receipt of this command, the device sets the BSY bit of the Status register and saves the parameters in the Features register. Then, the device clears the BSY bit, and generates an interrupt.

If the value in the Features register is not supported or it is invalid, the device posts an ABORTED COMMAND error.

Table 5.5 lists the available values and operational modes that may be set in the Features register.

Table 5.5 Features register values and settable modes

Features Register	Drive operation mode
X'02'	Enables the write cache function.
X'03'	Transfer mode depends on the contents of the Sector Count register. (Details are given later.)
X'05'	Enables the advanced power management function.
X'55'	Disables read cache function.
X'66'	Disables the reverting to power-on default settings after software reset.
X'82'	Disables the write cache function.
X'85'	Disables the advanced power management function.
X'AA'	Enables the read cache function.
X'BB'	Specifies the transfer of 4-byte ECC for READ LONG and WRITE LONG commands.
X'CC'	Enables the reverting to power-on default settings after software reset.

At power-on or after hardware reset, the default mode is the same as that is set with a value greater than X'85' (except for write cache). If X'66' is specified, it allows the seting value greater than X'AA' which may have been modified to a new value since power-on, to remain the same even after software reset.

At command issuance (I/O registers setting contents)								
1F7H(CM)	1	1	1	0	1	1	1	1
1F6H(DH)	×	×	×	DV	xx			
1F5H(CH)	xx							
1F4H(CL)	xx							
1F3H(SN)	xx							
1F2H(SC)	xx or transfer mode							
1F1H(FR)	[See Table 5.5]							

At command completion (I/O registers contents to be read)					
1F7H(ST)	Status information				
1F6H(DH)	×	×	×	DV	xx
1F5H(CH)	xx				
1F4H(CL)	xx				
1F3H(SN)	xx				
1F2H(SC)	xx				
1F1H(ER)	Error information				

The host sets X'03' to the Features register. By issuing this command with setting a value to the Sector Count register, the transfer mode can be selected. Upper 5 bits of the Sector Count register defines the transfer type and lower 3 bits specifies the binary mode value.

The IDD supports following values in the Sector Count register value. If other value than below is specified, an ABORTED COMMAND error is posted.

PIO default transfer mode	00000 000 (X'00')
PIO flow control transfer mode X	00001 000 (X'08': Mode 0)
	00001 001 (X'09': Mode 1)
	00001 010 (X'0A': Mode 2)
	00001 011 (X'0B': Mode 3)
	00001 100 (X'0C': Mode 4)

Multiword DMA transfer mode X	00100 000 (X'20': Mode 0)
	00100 001 (X'21': Mode 1)
	00100 010 (X'22': Mode 2)
Ultra DMA transfer mode X	01000 000 (X'40': Mode 0)
	01000 001 (X'41': Mode 1)
	01000 010 (X'42': Mode 2)
	01000 011 (X'43': Mode 3)
	01000 100 (X'44': Mode 4)

The host writes the Sector Count register with the desired power management level and executes this command with the Features register X'05', and then Advanced Power Management is enabled.

Level	Sector Count register
Power management without standby	80h-FEh
Power management with standby	01h-7Fh
Reserved	FFh, 00h

(15) SET MULTIPLE MODE (X'C6')

This command enables the device to perform the READ MULTIPLE and WRITE MULTIPLE commands. The block count (number of sectors in a block) for these commands are also specified by the SET MULTIPLE MODE command.

The number of sectors per block is written into the Sector Count register. The IDD supprots 2, 4, 8, 16 and 32 (sectors) as the block counts.

Upon receipt of this command, the device sets the BSY bit of the Status register and chccks the contents of the Sector Count register. If the contents of the Sector Count register is valid and is a supported block count, the value is stored for all subsequent READ MULTIPLE and WRITE MULTIPLE commands. Execution of these commands is then enabled. If the value of the Sector Count register is not a supported block count, an ABORTED COMMAND error is posted and the READ MULTIPLE and WRITE MULTIPLE commands are disabled.

If the contents of the Sector Count register is 0, 1 when the SET MULTIPLE MODE command is issued, the READ MULTIPLE and WRITE MULTIPLE commands are disabled.

When the SET MULTIPLE MODE command operation is completed, the device clears the BSY bit and generates an interrupt.

At command issuance (I/O registers setting contents)								
1F7H(CM)	1	1	0	0	0	1	1	0
1F6H(DH)	×	×	×	DV	xx			
1F5H(CH)	xx							
1F4H(CL)	xx							
1F3H(SN)	xx							
1F2H(SC)	Sector count/block							
1F1H(FR)	xx							

At command completion (I/O registers contents to be read)					
1F7H(ST)	Status information				
1F6H(DH)	×	×	×	DV	xx
1F5H(CH)	xx				
1F4H(CL)	xx				
1F3H(SN)	xx				
1F2H(SC)	Sector count/block				
1F1H(ER)	Error information				

After power-on or after hardware reset, the READ MULTIPLE and WRITE MULTIPLE command operation are disabled as the default mode.

The mode established before software reset is retained if disable default (Features Reg. = 66h setting) has been defined by the SET FEATURES command. If disable default has not been defined after the software is the READ MULTIPLE and WRITE MULTIPLE commands are disabled.

The parameters for the multiple commands which are posted to the host system when the IDENTIFY DEVICE command is issued are listed below. See Subsection 5.32 for the IDENTIFY DEVICE command.

Word 47

Bit 7-0 = 10:	Maximum number of sectors that can be transferred per interrupt by the READ MULTIPLE and WRITE MULTIPLE commands.
Word 59 = 0000:	The READ MULTIPLE and WRITE MULTIPLE commands are disabled.
= 01xx:	The READ MULTIPLE and WRITE MULTIPLE commands are enabled. "xx" indicates the current setting for number of sectors that can be transferred per interrupt by the READ MULTIPLE and WRITE MULTIPLE commands. e.g. 0110 = Block count of 16 has been set by the SET MULTIPLE MODE command.

(16) SET MAX ADDRESS (F9)

This command allows the maximum address accessible by the user to be set in LBA or CHS mode. Upon receipt of the command, the device sets the BSY bit and saves the maximum address specified in the DH, CH, CL and SN registers. Then, it clears BSY and generates an interrupt.

The new address information set by this command is reflected in Words 1, 54, 57, 58, 60 and 61 of IDENTIFY DEVICE information. If an attempt is made to perform a read or write operation for an address beyond the new address space, an ID Not Found error will result.

When SC register bit 0, VV (Value Volatile), is 1, the value set by this command is held even after power on and the occurrence of a hard reset. When the VV bit is 0, the value set by this command becomes invalid when the power is turned on or a hard reset occurs, and the maximum address returns to the value (default value if not set) most lately set when VV bit = 1.

After power on and the occurrence of a hard reset, the host can issue this command only once when VV bit = 1. If this command with VV bit = 1 is issued twice or more, any command following the first time will result in an Aborted Command error.

At command issuance (I/O registers setting contents)								
1F7$_H$(CM)	1	1	1	1	1	0	0	1
1F6$_H$(DH)	×	L	×	DV	Max head/LBA [MSB]			
1F5$_H$(CH)	Max. cylinder [MSB]/Max. LBA							
1F4$_H$(CL)	Max. cylinder [LSB]/Max. LBA							
1F3$_H$(SN)	Max. sector/Max. LBA [LSB]							
1F2$_H$(SC)	xx							VV
1F1$_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
1F7$_H$(ST)	Status information				
1F6$_H$(DH)	×	×	×	DV	Max head/LBA [MSB]
1F5$_H$(CH)	Max. cylinder [MSB]/Max. LBA				
1F4$_H$(CL)	Max. cylinder [LSB]/Max. LBA				
1F3$_H$(SN)	Max. sector/Max. LBA [LSB]				
1F2$_H$(SC)	xx				
1F1$_H$(ER)	Error information				

(17) READ NATIVE MAX ADDRESS (F8)

This command posts the maximum address intrinsic to the device, which can be set by the SET MAX ADDRESS command. Upon receipt of this command, the device sets the BSY bit and indicates the maximum address in the DH, CH, CL and SN registers. Then, it clears BSY and generates an interrupt.

At command issuance (I/O registers setting contents)								
1F7$_H$(CM)	1	1	1	1	1	0	0	0
1F6$_H$(DH)	×	L	×	DV	xx			
1F5$_H$(CH)	xx							
1F4$_H$(CL)	xx							
1F3$_H$(SN)	xx							
1F2$_H$(SC)	xx							
1F1$_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	Max head/LBA [MSB]
$1F5_H$(CH)	Max. cylinder [MSB]/Max. LBA				
$1F4_H$(CL)	Max. cylinder [LSB]/Max. LBA				
$1F3_H$(SN)	Max. sector/Max. LBA [LSB]				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(18) EXECUTE DEVICE DIAGNOSTIC (X'90')

This command performs an internal diagnostic test (self-diagnosis) of the device. This command usually sets the DRV bit of the Drive/Head register is to 0 (however, the DV bit is not checked). If two devices are present, both devices execute self-diagnosis.

If device 1 is present:

- Both devices shall execute self-diagnosis.
- The device 0 waits for up to 5 seconds until device 1 asserts the PDIAG- signal.
- If the device 1 does not assert the PDIAG- signal but indicates an error, the device 0 shall append X'80' to its own diagnostic status.
- The device 0 clears the BSY bit of the Status register and generates an interrupt. (The device 1 does not generate an interrupt.)
- A diagnostic status of the device 0 is read by the host system. When a diagnostic failure of the device 1 is detected, the host system can read a status of the device 1 by setting the DV bit (selecting the device 1).

When device 1 is not present:

- The device 0 posts only the results of its own self-diagnosis.
- The device 0 clears the BSY bit of the Status register, and generates an interrupt.

Table 5.6 lists the diagnostic code written in the Error register which is 8-bit code.

If the device 1 fails the self-diagnosis, the device 0 "ORs" X'80' with its own status and sets that code to the Error register.

Table 5.6 Diagnostic code

Code	Result of diagnostic
X'01'	No error detected.
X'03'	Data buffer compare error
X'05'	ROM sum check error
X'8x'	Failure of device 1

attention: The device responds normally to this command without excuting internal diagnostic test.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	0	0	1	0	0	0	0
$1F6_H$(DH)	×	×	×	DV	Head No. /LBA [MSB]			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	xx							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	Head No. /LBA [MSB]
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	01_H (*1)				
$1F2_H$(SC)	01_H				
$1F1_H$(ER)	Diagnostic code				

*1 This register indicates X'00' in the LBA mode.

(19) READ LONG (X'22' or X'23')

This command operates similarly to the READ SECTOR(S) command except that the device transfers the data in the requested sector and the ECC bytes to the host system. The ECC error correction is not performed for this command. This command is used for checking ECC function by combining with the WRITE LONG command.

Number of ECC bytes to be transferred is fixed to 4 bytes and cannot be changed by the SET FEATURES command.

The READ LONG command supports only single sector operation.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	0	1	0	0	0	1	R
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]			
$1F5_H$(CH)	Cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Sector No. / LBA [LSB]							
$1F2_H$(SC)	01							
$1F1_H$(FR)	xx							

(R: Retry)

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]
$1F5_H$(CH)	Cylinder No. [MSB] / LBA				
$1F4_H$(CL)	Cylinder No. [LSB] / LBA				
$1F3_H$(SN)	Sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, this register indicates 01.

(20) WRITE LONG (X'32' or X'33')

This command operates similarly to the READ SECTOR(S) command except that the device writes the data and the ECC bytes transferred from the host system to the disk medium. The device does not generate ECC bytes by itself. The WRITE LONG command supports only single sector operation.

The number of ECC bytes to be transferred is fixed to 4 bytes and can not be changed by the SET FEATURES command.

This command is operated under the following conditions:

- READ LONG issued → WRITE LONG (Same address) issues sequence (After READ LONG is issued, WRITE LONG can be issued consecutively.)

If above condition is not satisfied, the command operation is not guaranteed.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	0	0	1	1	0	0	1	R
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]			
$1F5_H$(CH)	Cylinder No. [MSB] / LBA							
$1F4_H$(CL)	Cylinder No. [LSB] / LBA							
$1F3_H$(SN)	Sector No. / LBA [LSB]							
$1F2_H$(SC)	01							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	L	×	DV	Head No. /LBA [MSB]
$1F5_H$(CH)	Cylinder No. [MSB] / LBA				
$1F4_H$(CL)	Cylinder No. [LSB] / LBA				
$1F3_H$(SN)	Sector No. / LBA [LSB]				
$1F2_H$(SC)	00 (*1)				
$1F1_H$(ER)	Error information				

*1 If the command is terminated due to an error, this register indicates 01.

(21) READ BUFFER (X'E4')

The host system can read the current contents of the sector buffer of the device by issuing this command. Upon receipt of this command, the device sets the BSY bit of Status register and sets up the sector buffer for a read operation. Then the device sets the DRQ bit of Status register, clears the BSY bit, and generates an interrupt. After that, the host system can read up to 512 bytes of data from the buffer.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	1	1	0	1	0	0
$1F6_H$(DH)	×	×	×	DV	xx			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	xx							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(22) WRITE BUFFER (X'E8')

The host system can overwrite the contents of the sector buffer of the device with a desired data pattern by issuing this command. Upon receipt of this command, the device sets the BSY bit of the Status register. Then the device sets the DRQ bit of Status register and clears the BSY bit when the device is ready to receive the data. After that, 512 bytes of data is transferred from the host and the device writes the data to the sector buffer, then generates an interrupt.

At command issuance (I/O registers setting contents)								
$1F7_H$(CM)	1	1	1	1	1	0	0	0
$1F6_H$(DH)	×	×	×	DV	xx			
$1F5_H$(CH)	xx							
$1F4_H$(CL)	xx							
$1F3_H$(SN)	xx							
$1F2_H$(SC)	xx							
$1F1_H$(FR)	xx							

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(23) IDLE (X'97' or X'E3')

Upon receipt of this command, the device sets the BSY bit of the Status register, and enters the idle mode. Then, the device clears the BSY bit, and generates an interrupt. The device generates an interrupt even if the device has not fully entered the idle mode. If the spindle of the device is already rotating, the spin-up sequence shall not be implemented.

By using this command, the automatic power-down function is enabled and the timer immediately starts the countdown. When the timer reaches the specified value, the device enters standby mode.

Enabling the automatic power-down function means that the device automatically enters the standby mode after a certain period of time. When the device enters the idle mode, the timer starts countdown. If any command is not issued while the timer is counting down, the device automatically enters the standby mode. If any command is issued while the timer is counting down, the timer is initialized and the command is executed. The timer restarts countdown after completion of the command execution.

The period of timer count is set depending on the value of the Sector Count register as shown below.

Sector Count register value		Point of timer
0	[X'00']	30 minutes
1 to 3	[X'01' to X'03']	15 seconds
4 to 240	[X'04' to X'F0']	(Value ×5) seconds
241 to 251	[X'F1' to X'FB']	30 minutes
252	[X'FC']	21 minutes
253	[X'FD']	30 minutes
254 to 255	[X'FE' to X'FF']	21 minutes 15 seconds

attention: The automatic power-down is excuted if no command is coming for 30 min.

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	X'97' or X'E3'				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	Period of timer				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(24) IDLE IMMEDIATE (X'95' or X'E1')

Upon receipt of this command, the device sets the BSY bit of the Status register, and enters the idle mode. Then, the device clears the BSY bit, and generates an interrupt. This command does not support the automatic power-down function.

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	X'95' or X'E1'				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(25) STANDBY (X'96' or X'E2')

Upon receipt of this command, the device sets the BSY bit of the Status register and enters the standby mode. The device then clears the BSY bit and generates an interrupt. The device generates an interrupt even if the device has not fully entered the standby mode. If the device has already spun down, the spin-down sequence is not implemented.

By using this command, the automatic power-down function is enabled and the timer starts the countdown when the device returns to idle mode.

When the timer value reaches 0 (a specified time has padded), the device enters standby mode.

Under the standby mode, the spindle motor is stopped. Thus, when the command involving a seek such as the READ SECTOR(s) command is received, the device processes the command after driving the spindle motor.

attention: The automatic power-down is excuted if no command is coming for 30 min.

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	X'96' or X'E2'				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	Period of timer				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(26) STANDBY IMMEDIATE (X'94' or X'E0')

Upon receipt of this command, the device sets the BSY bit of the Status register and enters the standby mode. The device then clears the BSY bit and generates an interrupt. This command does not support the automatic power-down sequence.

At command issuance (I/O registers setting contents)					
1F7$_H$(CM)	X'94' or X'E0'				
1F6$_H$(DH)	×	×	×	DV	xx
1F5$_H$(CH)	xx				
1F4$_H$(CL)	xx				
1F3$_H$(SN)	xx				
1F2$_H$(SC)	xx				
1F1$_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
1F7$_H$(ST)	Status information				
1F6$_H$(DH)	×	×	×	DV	xx
1F5$_H$(CH)	xx				
1F4$_H$(CL)	xx				
1F3$_H$(SN)	xx				
1F2$_H$(SC)	xx				
1F1$_H$(ER)	Error information				

(27) SLEEP (X'99' or X'E6')

This command is the only way to make the device enter the sleep mode.

Upon receipt of this command, the device sets the BSY bit of the Status register and enters the sleep mode. The device then clears the BSY bit and generates an interrupt. The device generates an interrupt even if the device has not fully entered the sleep mode.

In the sleep mode, the spindle motor is stopped and the ATA interface section is inactive. All I/O register outputs are in high-impedance state.

The only way to release the device from sleep mode is to execute a software or hardware reset.

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	X'99' or X'E6'				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

(28) CHECK POWER MODE (X'98' or X'E5')

The host checks the power mode of the device with this command.

The host system can confirm the power save mode of the device by analyzing the contents of the Sector Count and Sector registers.

The device sets the BSY bit and sets the following register value. After that, the device clears the BSY bit and generates an interrupt.

Power save mode	Sector Count register
• During moving to standby mode • Standby mode • During returning from the standby mode	X'00'
• Idle mode	X'FF'
• Active mode	X'FF'

At command issuance (I/O registers setting contents)					
$1F7_H$(CM)	X'98' or X'E5'				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(FR)	xx				

At command completion (I/O registers contents to be read)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	xx				
$1F4_H$(CL)	xx				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	X'00' ,X'80' or X'FF'				
$1F1_H$(ER)	Error information				

(29) SMART (X'B0)

This command performs operations for device failure predictions according to a subcommand specified in the FR register. If the value specified in the FR register is supported, the Aborted Command error is posted.

It is necessary for the host to set the keys (CL = 4Fh and CH = C2h) in the CL and CH registers prior to issuing this command. If the keys are set incorrectly, the Aborted Command error is posted.

In the default setting, the failure prediction feature is enabled.

The device collects or updates several items to forecast failures. In the following sections, the values of items collected or updated by the device to forecast failures are referred to as attribute values.

Table 5.7 Features Register values (subcommands) and functions (1 of 3)

Features Resister	Function
X'D0'	SMART Read Attribute Values: A device that received this subcommand asserts the BSY bit and saves all the updated attribute values. The device then clears the BSY bit and transfers 512-byte attribute value information to the host. * For infomation about the format of the attribute value information, see Table 5.8.
X'D1'	SMART Read Attribute Thresholds: This subcommand is used to transfer 512-byte insurance failure threshold value data to the host. * For infomation about the format of the insurance failure threshold value data, see Table 5.9.
X'D2'	SMART Enable-Disable Attribute AutoSave: This subcommand is used to enable (SC register ≠ 00h) or disable (SC register = 00h) the setting of the automatic saving feature for the device attribute data. The setting is maintained every time the device is turned off and then on. When the automatic saving feature is enabled, the attribute values are saved before the device enters the power saving mode. However, if the failure prediction feature is disabled, the attribute values are not automatically saved. When the device receives this subcommand, it asserts the BSY bit, enables or disables the automatic saving feature, then clears the BSY bit.
X'D3'	SMART Save Attribute Values: When the device receives this subcommand, it asserts the BSY bit, saves device attribute value data, then clears the BSY bit.
X'D4'	SMART Executive Off-line Immediate: A device which receives this command asserts the BSY bit, then starts collecting the off-line data specified in the SN register, or stops. In the off-line mode, after BSY is cleared, off-line data are collected. In the captive mode, it collects off-line data with the BSY assertion as is, then clears the BSY when collection of data is completed. SN Off-line data collection mode 00h: Off-line diagnosis (off-line mode) 01h: Simple self test (off-line mode) 02h: Comprehensive self test (off-line mode) 7Fh: Self test stop 81h: Simple self test (captive mode) 82h: Comprehensive self test (captive mode)

Table 5.7 Features Register values (subcommands) and functions (2 of 3)

Features Resister	Function
X'D5'	SMART Read Log Sector: A device which receives this sub-command asserts the BSY bit, then reads the log sector specified in the SN register. Next, it clears the BSY bit and transmits the log sector to the host computer. 01h should be specified in the SC register. SN: Log sector 01h: SMART error log 06h: SMART self test log 80h-9Fh: Host vendor log * See Table 5.10 concerning the SMART error log data format. See Table 5.11 concerning the SMART self test log data format.
X'D6'	SMART Write Log Sector: A device which receives this sub-command asserts the BSY bit and when it has prepared to receive data from the host computer, it sets DRQ and clears the BSY bit. Next, it receives 512 bytes of data from the host computer and writes the specified log sector in the SN register. 01h should be specified in the SC register. SN: Log sector 80h-9Fh: Host vendor log * The host can write any desired data in the host vendor log.
X'D8'	SMART Enable Operations: This subcommand enables the failure prediction feature. The setting is maintained even when the device is turned off and then on. When the device receives this subcommand, it asserts the BSY bit, enables the failure prediction feature, then clears the BSY bit.
X'D9'	SMART Disable Operations: This subcommand disables the failure prediction feature. The setting is maintained even when the device is turned off and then on. When the device receives this subcommand, it asserts the BSY bit, disables the failure prediction feature, then clears the BSY bit.

Table 5.7 Features Register values (subcommands) and functions (3 of 3)

Features Resister	Function
X'DA'	SMART Return Status: When the device receives this subcommand, it asserts the BSY bit and saves the current device attribute values. Then the device compares the device attribute values with insurance failure threshold values. If there is an attribute value exceeding the threshold, F4h and 2Ch are loaded into the CL and CH registers. If there are no attribute values exceeding the thresholds, 4Fh and C2h are loaded into the CL and CH registers. After the settings for the CL and CH registers have been determined, the device clears the BSY bit
X'DB'	SMART Enable/Disable Auto Off-line: This sets automatic off-line data collection in the enabled (when the SC register specification ≠ 00h) or disabled (when the SC register specification = 00) state. This setting is preserved whether the drive's power is switched on or off. If four hours have passed since the power was switched on, or since the last time that off-line data were collected, off-line data collection is performed without relation to any command from the host computer.

The host must regularly issue the SMART Read Attribute Values subcommand (FR register = D0h), SMART Save Attribute Values subcommand (FR register = D3h), or SMART Return Status subcommand (FR register = DAh) to save the device attribute value data on a medium.

Alternative, the device must issue the SMART Enable-Disable Attribute AutoSave subcommand (FR register = D2h) to use a feature which regularly save the device attribute value data to a medium.

The host can predict failures in the device by periodically issuing the SMART Return Status subcommand (FR register = DAh) to reference the CL and CH registers.

If an attribute valuc is below the insurance failure threshold value, the device is about to fail or the device is nearing the end of its life . In this case, the host recommends that the user quickly backs up the data.

<table>
<tr><th colspan="9">At command issuance (I-O registers setting contents)</th></tr>
<tr><td>$1F7_H$(CM)</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>$1F6_H$(DH)</td><td>×</td><td>×</td><td>×</td><td>DV</td><td colspan="4">xx</td></tr>
<tr><td>$1F5_H$(CH)</td><td colspan="8">Key (C2h)</td></tr>
<tr><td>$1F4_H$(CL)</td><td colspan="8">Key (4Fh)</td></tr>
<tr><td>$1F3_H$(SN)</td><td colspan="8">xx</td></tr>
<tr><td>$1F2_H$(SC)</td><td colspan="8">xx</td></tr>
<tr><td>$1F1_H$(FR)</td><td colspan="8">Subcommand</td></tr>
</table>

At command completion (I-O registers setting contents)					
$1F7_H$(ST)	Status information				
$1F6_H$(DH)	×	×	×	DV	xx
$1F5_H$(CH)	Key-failure prediction status (C2h-2Ch)				
$1F4_H$(CL)	Key-failure prediction status (4Fh-F4h)				
$1F3_H$(SN)	xx				
$1F2_H$(SC)	xx				
$1F1_H$(ER)	Error information				

The attribute value information is 512-byte data; the format of this data is shown below. The host can access this data using the SMART Read Attribute Values subcommand (FR register = D0h). The insurance failure threshold value data is 512-byte data; the format of this data is shown below. The host can access this data using the SMART Read Attribute Thresholds subcommand (FR register = D1h).

Table 5.8 Format of device attribute value data

Byte	Item	
00 01	Data format version number	
02	Attribute 1	Attribute ID
03 04		Status flag
05		Current attribute value
06		Attribute value for worst case so far
07 to 0C		Raw attribute value
0D		Reserved
0E to 169	Attribute 2 to attribute 30	(The format of each attribute value is the same as that of bytes 02 to 0D.)
16A	Off-line data collection status	
16B	Self test execution status	
16C, 16D	Off-line data collection execution time [sec.]	
16E	Reserved	
16F	Off-line data collection capability	
170, 171	Trouble prediction capability flag	
172	Error logging capability	
173	Vendor unique	
174	Simple self test execution time [min.]	
175	Comprehensive self test execution time [min.]	
176 to 181	Reserved	
182 to 1FE	Vendor unique	
1FF	Check sum	

Table 5.9 Format of insurance failure threshold value data

Byte	Item	
00 01	Data format version number	
02	Threshold 1	Attribute ID
03		Insurance failure threshold
04 to 0D		Reserved
0E to 169	Threshold 2 to Threshold 30	(The format of each threshold value is the same as that of bytes 02 to 0D.)
16A to 17B	Reserved	
17C to 1FE	Vendor unique	
1FF	Check sum	

- Data format version number

  The data format version number indicates the version number of the data format of the device attribute values or insurance failure thresholds. The data format version numbers of the device attribute values and insurance failure thresholds are the same. When a data format is changed, the data format version numbers are updated.

- Attribute ID

  The attribute ID is defined as follows:

Attribute ID	Attribute name
0	(Indicates unused attribute data.)
1	Read error rate
2	Throughput performance
3	Spin up time
4	Start/stop count
5	Re-allocated sector count
7	Seek error rate
8	Seek time performance
9	Power-on time
10	Number of retries made to activate the spindle motor
12	Number of power-on-power-off times
13 to 198	(Reserved)
199	Ultra ATA CRC error rate
200	Write error rate
201 to 255	(Unique to vendor)

- Status Flag

Bit	Meaning
0	If this bit 1, it indicates that if the attribute exceeds the threshold, it is the attribute covered by the drive warranty.
1	If this bit is 1 (0), it indicates the attribute only updated by an on-line test (off-line test).
2	If this bit 1, it indicates the attribute that represents performance.
3	If this bit 1, it indicates the attribute that represents an error rate.
4	If this bit 1, it indicates the attribute that represents the number of occurrences.
5	If this bit 1, it indicates the attribute that can be collected/saved even if the drive fault prediction function is disabled.
6 to 15	Reserve bit

- Current attribute value

  The current attribute value is the normalized raw attribute data. The value varies between 01h and 64h. The closer the value gets to 01h, the higher the possibility of a failure. The device compares the attribute values with thresholds. When the attribute values are larger than the thresholds, the device is operating normally.

- Attribute value for the worst case so far

  This is the worst attribute value among the attribute values collected to date. This value indicates the state nearest to a failure so far.

- Raw attribute value

  Raw attributes data is retained.

- Off-line data collection status

  Bits 0 to 6: Indicates the situation of off-line data collection according to the table below.

  Bit 7: If this bit is 1, it indicates that the automatic off-line data collection function is enabled.

Status Byte	Meaning
0	Off-line data collection is not started.
2	Off-line data collection has been completed normally.
4	Off-line data collection has been suspended by a command interrupt.
5	Off-line data collection has been aborted by a command interrupt.
6	Off-line data collection has been aborted by a fatal error.

- Self test execution status

  Bits 0 to 3: Indicates the rest of self-test in 0 to 9 (corresponding 0 to 90%).

  Bits 4 to 7: Indicates the self-test execution status at the following table.

Self-test execution status	Meaning
0	Self-test has been completed normally or has not been executed.
1	Self-test has been stopped by the host computer.
2	Self-test has been suspended by hard or soft reset.
3	Self-test has been aborted by a fatal error.
4	Self-test has been completed abnormally by an unknown meaning.
5	Self-test has been completed abnormally by write test.
6	Self-test has been completed abnormally by serbo test.
7	Self-test has been completed abnormally by read test.
8 to 14	Reserved
15	Self-test is in progress.

- Off-line data collection capability

  Indicates the method of off-line data collection carried out by the drive. If the off-line data collection capability is 0, it indicates that off-line data collection is not supported.

Bit	Meaning
0	Indicates that Execute Off-Line Immediate is supported.
1	Vendor unique
2	Indicates that off-line data collection being executed is aborted when a new command is received.
3	Indicates that supports off-line read scan function.
4	Indicates that supports self-test function.

- Failure prediction capability flag

  Bit 0: The attribute value data is saved to a media before the device enters power saving mode.

  Bit 1: The device automatically saves the attribute value data to a media after the previously set operation.

  Bits 2 to 15: Reserved bits

- Error logging capability

  Bit 0: Indicates that error logging function.

  Bits 1 to 7: Reserved bits

- Check sum

  Two's complement of the lower byte, obtained by adding 511-byte data one byte at a time from the beginning.

- Insurance failure threshold

  The limit of a varying attribute value. The host compares the attribute values with the thresholds to identify a failure.

If an unrecoverable error is detected during execution of a command received by the device from the host computer, the device saves the SMART error log on the disk medium.

The host computer can issue the SMART Read Log Sector sub-command (FR register = D5h, SN register = 01h) and read the SMART error log.

Table 5.10 SMART error log data format (1/2)

Byte	Item		
00	Error log version number		
01	Error log index		
02	Error log 1	Command Data 1	Device Control register
03			Features register
04			Sector Count register
05			Sector Number register
06			Cylinder Low register
07			Cylinder High register
08			Device/Head register
09			Command register
0A to 0D			Elapsed time [ms] from the point when the power is turned on until command reception
0E to 3D		Command Data 2 to 5	(The format of each type of command data is the same as that of byte 02 to 0D.)
3E		Error data	Reserved
3F			Error register
40			Sector Count register
41			Sector Number register
42			Cylinder Low register
43			Cylinder High register

Table 5.10 SMART error log data format (2/2)

Byte	Item		
44	Error log 1	Error data	Device/Head register
45			Status register
46 to 58			Vendor unique
59			Status
5A, 5B			Total power on time [hour]
5C to 1C3	Error log 2 to Error log 5	(The format of each error log is the same as Byte 02 to 5B.)	
1C4, 1C5	Number of unrecoverable errors that have occurred.		
1C6 to 1FE	Reserved		
1FF	Check sum		

- Error log index

  Indicates the latest error log number. If an error has not occurred, 00 is displayed.

- Error log 1 to 5

  When an error occurs, the error log index value is incremented and information at the time the error occurred is recorded in the error log area specified by this value. When the error log index exceeds 05, it returns to 01.

- Command data 1 to 5

  Indicates five commands data in order received by the device until the error occurs. Commands for which an error occurred are included in Command Data 5.

- Error data

  Indicates the I/O register values when the error is reported.

- Status

  Bits 0 to 3: Indicates the drive status when received error commands according to the following table.

  Bits 4 to 7: Vendor unique

Status	Meaning
0	Unclear status
1	Sleep status
2	Standby status
3	Active status or idle status (BSY bit = 0)
4	Off-line data collection being executed
5 to F	Reserved

The host computer can issue the SMART Execute Off-line Immediate sub-command (FR Register = D4h) and cause the device to execute a self test. When the self test is completed, the device saves the SMART self test log to the disk medium.

The host computer can issue the SMART Read Log Sector sub-command (FR Register = D5h, SN Register = 06h) and can read the SMART self test log.

Table 5.11 SMART self test log data format

Byte	Item	
00, 01	Self test log data format version number	
02	Self test log 1	Self test mode (SN Register Value)
03		Self test execution status
04, 05		Total power on time until the self test is completed. [hours]
06		Self test error No.
07 to 0A		Error LBA
0B to 19		Vendor unique
1A to 1F9	Self test log 2 to 21	(Each log data format is the same as that in byte 02 to 19.)
1FA, 1FB	Vendor unique	
1FC	Self test index	
1FD, 1FE	Reserved	
1FF	Check sum	

- Self test log 1 to 21

  When executes self test, the self test index value is incremented and the self test execution result is recorded in the self log test area specified by this value. When the self test index exceeds 21, it returns to 01.

- Self test index

  Indicates the latest self test log number. If the self test has not been executed, 00h is displayed.

(30) SECURITY DISABLE PASSWORD (F6h)

This command invalidates the user password already set and releases the lock function.

The host transfers the 512-byte data shown in Table 5.12 to the device. The device compares the user password or master password in the transferred data with the user password or master password already set, and releases the lock function if the passwords are the same.

Although this command invalidates the user password, the master password is retained. To recover the master password, issue the SECURITY SET PASSWORD command and reset the user password.

If the user password or master password transferred from the host does not match, the Aborted Command error is returned.

Issuing this command while in LOCKED MODE or FROZEN MODE returns the Aborted Command error.

(The section about the SECURITY FREEZE LOCK command describes LOCKED MODE and FROZEN MODE.)

Table 5.12 Contents of security password

Word	Contents
0	Control word Bit 0: Identifier 0 = Compares the user passwords. 1 = Compares the master passwords. Bits 1 to 15: Reserved
1 to 16	Password (32 bytes)
17 to 255	Reserved

At command issuance (I-O register contents))								
$1F7_h$(CM)	1	1	1	1	0	1	1	0
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(31) SECURITY ERASE PREPARE (F3h)

The SECURITY ERASE UNIT command feature is enabled by issuing the SECURITY ERASE PREPARE command and then the SECURITY ERASE UNIT command. The SECURITY ERASE PREPARE command prevents data from being erased unnecessarily by the SECURITY ERASE UNIT command.

Issuing this command during FROZEN MODE returns the Aborted Command error.

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	1	0	0	1	1
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(32) SECURITY ERASE UNIT (F4h)

This command erases all user data. This command also invalidates the user password and releases the lock function.

The host transfers the 512-byte data shown in Table 5.10 to the device. The device compares the user password or master password in the transferred data with the user password or master password already set. The device erases user data, invalidates the user password, and releases the lock function if the passwords are the same.

Although this command invalidates the user password, the master password is retained. To recover the master password, issue the SECURITY SET PASSWORD command and reset the user password.

If the SECURITY ERASE PREPARE command is not issued immediately before this command is issued, the Aborted Command error is returned.

Issuing this command while in FROZEN MODE returns the Aborted Command error.

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	1	0	1	0	0
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(33) SECURITY FREEZE LOCK (F5h)

This command puts the device into FROZEN MODE. The following commands used to change the lock function return the Aborted Command error if the device is in FROZEN MODE.

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE UNIT

FROZEN MODE is canceled when the power is turned off. If this command is reissued in FROZEN MODE, the command is completed and FROZEN MODE remains unchanged.

Issuing this command during LOCKED MODE returns the Aborted Command error.

The following medium access commands return the Aborted Command error when the device is in LOCKED MODE:

- READ DMA
- READ LONG
- READ MULTIPLE
- READ SECTORS
- WRITE DMA
- WRITE LONG
- WRITE MULTIPLE
- WRITE SECTORS
- WRITE VERIFY
- SECURITY DISABLE PASSWORD
- SECURITY FREEZE LOCK
- SECURITY SET PASSWORD

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	1	0	1	0	1
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(34) SECURITY SET PASSWORD (F1h)

This command enables a user password or master password to be set.

The host transfers the 512-byte data shown in Table 5.13 to the device. The device determines the operation of the lock function according to the specifications of the Identifier bit and Security level bit in the transferred data. (Table 5.14)

Issuing this command in LOCKED MODE or FROZEN MODE returns the Aborted Command error.

Table 5.13 Contents of SECURITY SET PASSWORD data

Word	Contents
0	Control word Bit 0 Identifier 0 = Sets a user password. 1 = Sets a master password. Bits 1 to 7 Reserved Bit 8 Security level 0 = High 1 = Maximum Bits 9 to 15 Reserved
1 to 16	Password (32 bytes)
17 to 18	Master password version number
19 to 255	Reserved

Table 5.14 Relationship between combination of Identifier and Security level, and operation of the lock function

Indentifier	Level	Description
User	High	The specified password is saved as a new user password. The lock function is enabled after the device is turned off and then on. LOCKED MODE can be canceled using the user password or the master password already set.
Master	High	The specified password is saved as a new master password. The lock function is not enabled.
User	Maximum	The specified password is saved as a new user password. The lock function is enabled after the device is turned off and then on. LOCKED MODE can be canceled using the user password only. The master password already set cannot cancel LOCKED MODE.
Master	Maximum	The specified password is saved as a new master password. The lock function is not enabled.

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	1	0	0	0	1
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(35) SECURITY UNLOCK

This command cancels LOCKED MODE.

The host transfers the 512-byte data shown in Table 5.12 to the device. Operation of the device varies as follows depending on whether the host specifies the master password.

- When the master password is selected

  When the security level is LOCKED MODE is high, the password is compared with the master password already set. If the passwords are the same, LOCKED MODE is conceled. Otherwise, the Aborted Command error is returned. If the security level in LOCKED MODE is set to the highest level, the Aborted Command error is always returned.

- When the user password is selected

  The password is compared with the user password already set. If the passwords are the same, LOCKED MODE is conceled. Otherwise, the Aborted Command error is returned.

If the password comparison fails, the device decrements the UNLOCK counter. The UNLOCK counter initially has a value of five. When the value of the UNLOCK counter reaches zero, this command or the SECURITY ERASE UNIT command causes the Aborted Command error until te device is turned off and then on, or until a hardware reset is executed. Issuing this command with

LOCKED MODE conceled (in UNLOCK MODE) has no affect on the UNLOCK counter.

Issuing this command in FROZEN MODE returns the Aborted Command error.

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	1	0	0	1	0
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

(36) FLUSH CACHE (E7)

This command is used to order to write every write cache data stored by the device into the medium. BSY bit is held at "1" until every data has been written normally or a error has occurred. The device performs every error recovery so that the data are read correctly.

When executing this command, the reading of the data may take several seconds if much data are to be read.

In case a non-recoverable error has occurred while the data is being read, the error generation address is put into the command block register before ending the command. This error sector is deleted from the write cache data, and the remaining cache data is written into the medium by the execution of the next Flush Cache command.

At command issuance (I-O register contents)								
$1F7_h$(CM)	1	1	1	0	0	1	1	1
$1F6_h$(DH)	×	×	×	DV	xx			
$1F5_h$(CH)	xx							
$1F4_h$(CL)	xx							
$1F3_h$(SN)	xx							
$1F2_h$(SC)	xx							
$1F1_h$(FR)	xx							

At command completion (I-O register contents to be read)					
$1F7_h$(ST)	Status information				
$1F6_h$(DH)	×	×	×	DV	xx
$1F5_h$(CH)	xx				
$1F4_h$(CL)	xx				
$1F3_h$(SN)	xx				
$1F2_h$(SC)	xx				
$1F1_h$(ER)	Error information				

5.3.3 Error posting

Table 5.15 lists the defined errors that are valid for each command.

Table 5.15 Command code and parameters (1 of 2)

Command name	Error register (X'1F1')					Status register (X'1F7')		
	ICRC	UNC	INDF	ABRT	TK0NF	DRDY	DWF	ERR
READ SECTOR(S)		V	V	V		V	V	V
WRITE SECTOR(S)			V	V		V	V	V
READ MULTIPLE		V	V	V		V	V	V
WRITE MULTIPLE			V	V		V	V	V
READ DMA	V	V	V	V		V	V	V
WRITE DMA	V		V	V		V	V	V
WRITE VERIFY		V	V	V		V	V	V
READ VERIFY SECTOR(S)		V	V	V		V	V	V

V: Valid on this command

*: See the command descriptions.

Table 5.15 Command code and parameters (2 of 2)

Command name	Error register (X'1F1')					Status register (X'1F7')		
	ICRC	UNC	INDF	ABRT	TKONF	DRDY	DWF	ERR
RECALIBRATE				V	V	V	V	V
SEEK			V	V		V	V	V
INITIALIZE DEVICE PARAMETERS				V		V	V	V
IDENTIFY DEVICE				V		V	V	V
IDENTIFY DEVICE DMA				V		V	V	V
SET FEATURES				V		V	V	V
SET MULTIPLE MODE				V		V	V	V
SET MAX ADDRESS			V	V		V	V	V
READ NATIVE MAX ADDRESS				V		V	V	V
EXECUTE DEVICE DIAGNOSTIC	*	*	*	*	*			V
READ LONG			V	V		V	V	V
WRITE LONG			V	V		V	V	V
READ BUFFER				V		V	V	V
WRITE BUFFER				V		V	V	V
IDLE				V		V	V	V
IDLE IMMEDIATE				V		V	V	V
STANDBY				V		V	V	V
STANDBY IMMEDIATE				V		V	V	V
SLEEP				V		V	V	V
CHECK POWER MODE				V		V	V	V
SMART			V	V		V	V	V
SECURITY DISABLE PASSWORD				V		V	V	V
SECURITY ERASE PREPARE				V		V	V	V
SECURITY ERASE UNIT				V		V	V	V
SECURITY FREEZE LOCK				V		V	V	V
SECURITY SET PASSWORD				V		V	V	V
SECURITY UNLOCK				V		V	V	V
FLUSH CACHE			V	V		V	V	V
Invalid command				V		V	V	V

V: Valid on this command

*: See the command descriptions.

5.4 Command Protocol

The host should confirm that the BSY bit of the Status register of the device is 0 prior to issue a command. If BSY bit is 1, the host should wait for issuing a command until BSY bit is cleared to 0.

Commands can be executed only when the DRDY bit of the Status register is 1. However, the following commands can be executed even if DRDY bit is 0.

- EXECUTE DEVICE DIAGNOSTIC
- INITIALIZE DEVICE PARAMETERS

5.4.1 Data transferring commands from device to host

The execution of the following commands involves data transfer from the device to the host.

- IDENTIFY DEVICE.
- IDENTIFY DEVICE DMA
- READ SECTOR(S)
- READ LONG
- READ BUFFER
- SMART

The execution of these commands includes the transfer one or more sectors of data from the device to the host. In the READ LONG command, 516 bytes are transferred. Following shows the protocol outline.

a) The host writes any required parameters to the Features, Sector Count, Sector Number, Cylinder, and Device/Head registers.

b) The host writes a command code to the Command register.

c) The device sets the BSY bit of the Status register and prepares for data transfer.

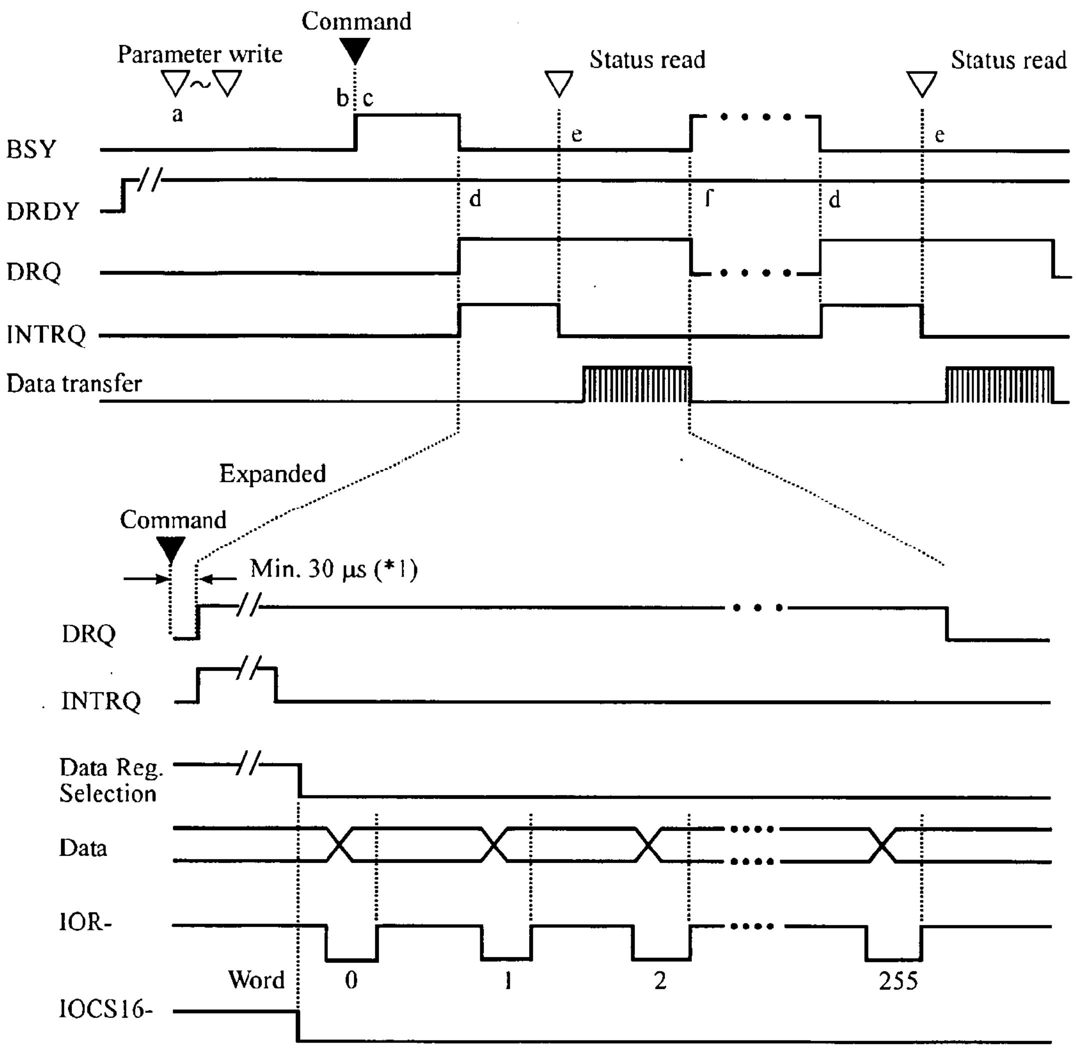
d) When one sector of data is available for transfer to the host, the device sets DRQ bit and clears BSY bit. The drive then asserts INTRQ signal.

e) After detecting the INTRQ signal assertion, the host reads the Status register. The host reads one sector of data via the Data register. In response to the Status register being read, the device negates the INTRQ signal.

f) The drive clears DRQ bit to 0. If transfer of another sector is requested, the device sets the BSY bit and steps d) and after are repeated.

Even if an error is encountered, the device prepares for data transfer by setting the DRQ bit. Whether or not to transfer the data is determined for each host. In other words, the host should receive the relevant sector of data (512 bytes of uninsured dummy data) or release the DRQ status by resetting.

Figure 5.3 shows an example of READ SECTOR(S) command protocol, and Figure 5.4 shows an example protocol for command abort.



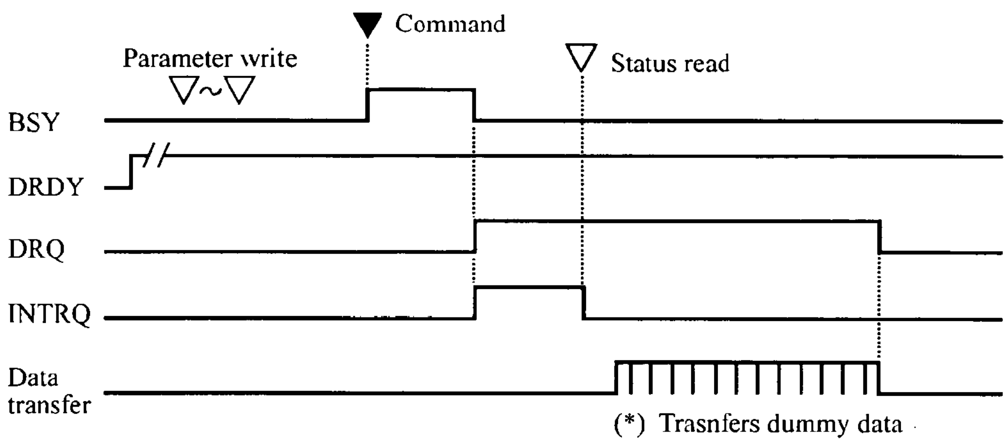
*1 When the IDD receives a command that hits the cache data during read-ahead, and transfers data from the buffer without reading from the disk medium.

Figure 5.3 Read Sector(s) command protocol

IMPORTANT

For transfer of a sector of data, the host needs to read Status register (X'1F7') in order to clear INTRQ (interrupt) signal. The Status register should be read within a period from the DRQ setting by the device to 50 ms after the completion of the sector data transfer. Note that the host does not need to read the Status register for the reading of a single sector or the last sector in multiple-sector reading. If the timing to read the Status register does not meet above condition, normal data transfer operation is not guaranteed.

When the host new command even if the device requests the data transfer (setting in DRQ bit), the correct device operation is not guaranteed.



*: The host should receive 512-byte dummy data or release the DRQ set state by resetting.

Figure 5.4 Protocol for command abort

5.4.2 Data transferring commands from host to device

The execution of the following commands involves Data transfer from the host to the drive.

- WRITE SECTOR(S)
- WRITE LONG
- WRITE BUFFER
- WRITE VERIFY
- SECURITY DISABLE PASSWORD
- SECURITY ERASE UNIT
- SECURITY SET PASSWORD
- SECURITY UNCLOK

The execution of these commands includes the transfer one or more sectors of data from the host to the device. In the WRITE LONG command, 516 bytes are transferred. Following shows the protocol outline.

a) The host writes any required parameters to the Features, Sector Count, Sector Number, Cylinder, and Device/Head registers.

b) The host writes a command code in the Command register. The drive sets the BSY bit of the Status register.

c) When the device is ready to receive the data of the first sector, the device sets DRQ bit and clears BSY bit.

d) The host writes one sector of data through the Data register.

e) The device clears the DRQ bit and sets the BSY bit.

f) When the drive completes transferring the data of the sector, the device clears BSY bit and asserts INTRQ signal. If transfer of another sector is requested, the drive sets the DRQ bit.

g) After detecting the INTRQ signal assertion, the host reads the Status register.

h) The device resets INTRQ (the interrupt signal).

I) If transfer of another sector is requested, steps d) and after are repeated.

Figure 5.5 shows an example of WRITE SECTOR(S) command protocol.

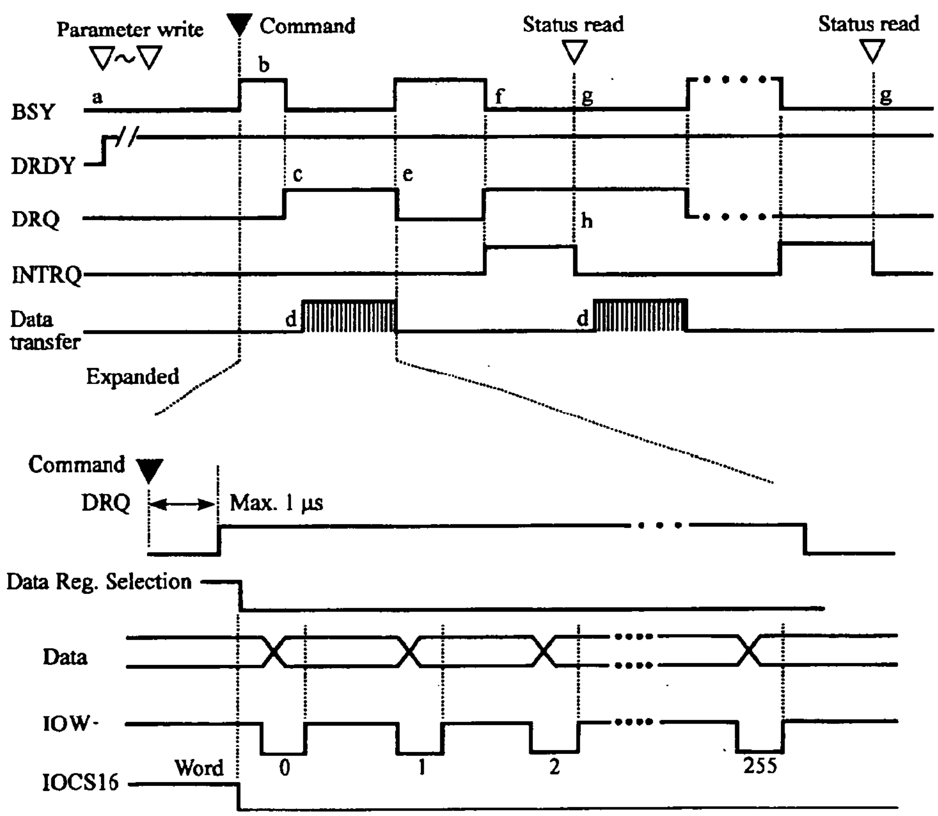


Figure 5.5 WRITE SECTOR(S) command protocol

IMPORTANT

For transfer of a sector of data, the host needs to read Status register (X'1F7') in order to clear INTRQ (interrupt) signal. The Status register should be read within a period from the DRQ setting by the device to 50 μs after the completion of the sector data transfer. Note that the host does not need to read the Status register for the first and the last sector to be transferred. If the timing to read the Status register does not meet above condition, normal data transfer operation is not assured guaranteed.

When the host issues the command even if the drive requests the data transfer (DRQ bit is set), or when the host executes resetting, the device correct operation is not guaranteed.

5.4.3 Commands without data transfer

Execution of the following commands does not involve data transfer between the host and the device.

- RECABLIBRATE
- SEEK
- READY VERIFY SECTOR(S)
- EXECUTE DEVICE DIAGNOSTIC
- INITIALIZE DEVICE PARAMETERS
- SET FEATURES
- SET MULTIPLE MODE
- SET MAX ADDRESS
- READ NATIVE MAX ADDRESS
- IDLE
- IDLE IMMEDIATE
- STANDBY
- STANDBY IMMEDIATE
- CHECK POWER MODE
- SECURITY ERASE PREPARE
- SECURITY FREEZE LOCK
- FLUSH CACHE

Figure 5.6 shows the protocol for the command execution without data transfer.

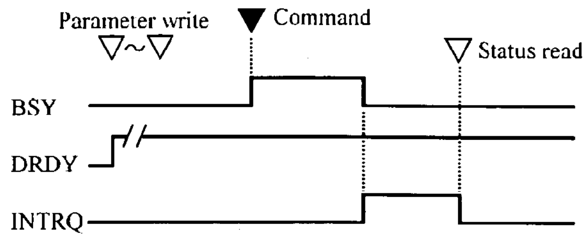


Figure 5.6 Protocol for the command execution without data transfer

5.4.4 Other commands

- READ MULTIPLE
- SLEEP
- WRITE MULTIPLE

See the description of each command.

5.4.5 DMA data transfer commands

- READ DMA
- WRITE DMA

Starting the DMA transfer command is the same as the READ SECTOR(S) or WRITE SECTOR(S) command except the point that the host initializes the DMA channel preceding the command issurance.

Interruption processing for DMA transfer does not issue interruptions in any intermediate sector when a multisector command is executed.

The following outlines the protocol:

The interrupt processing for the DMA transfer differs the following point.

- The interrupt processing for the DMA transfer differs the following point.

a) The host writes any parameters to the Features, Sector Count, Sector Number, Cylinder, and Device/Head register.

b) The host initializes the DMA channel

c) The host writes a command code in the Command register.

d) The device sets the BSY bit of the Status register.

e) The device asserts the DMARQ signal after completing the preparation of data transfer. The device asserts either the BSY bit or DRQ bit during DMA data transfer.

f) When the command execution is completed, the device clears both BSY and DRQ bits and asserts the INTRQ signal. Then, the host reads the Status register.

g) The host resets the DMA channel.

Figure 5.7 shows the correct DMA data transfer protocol.

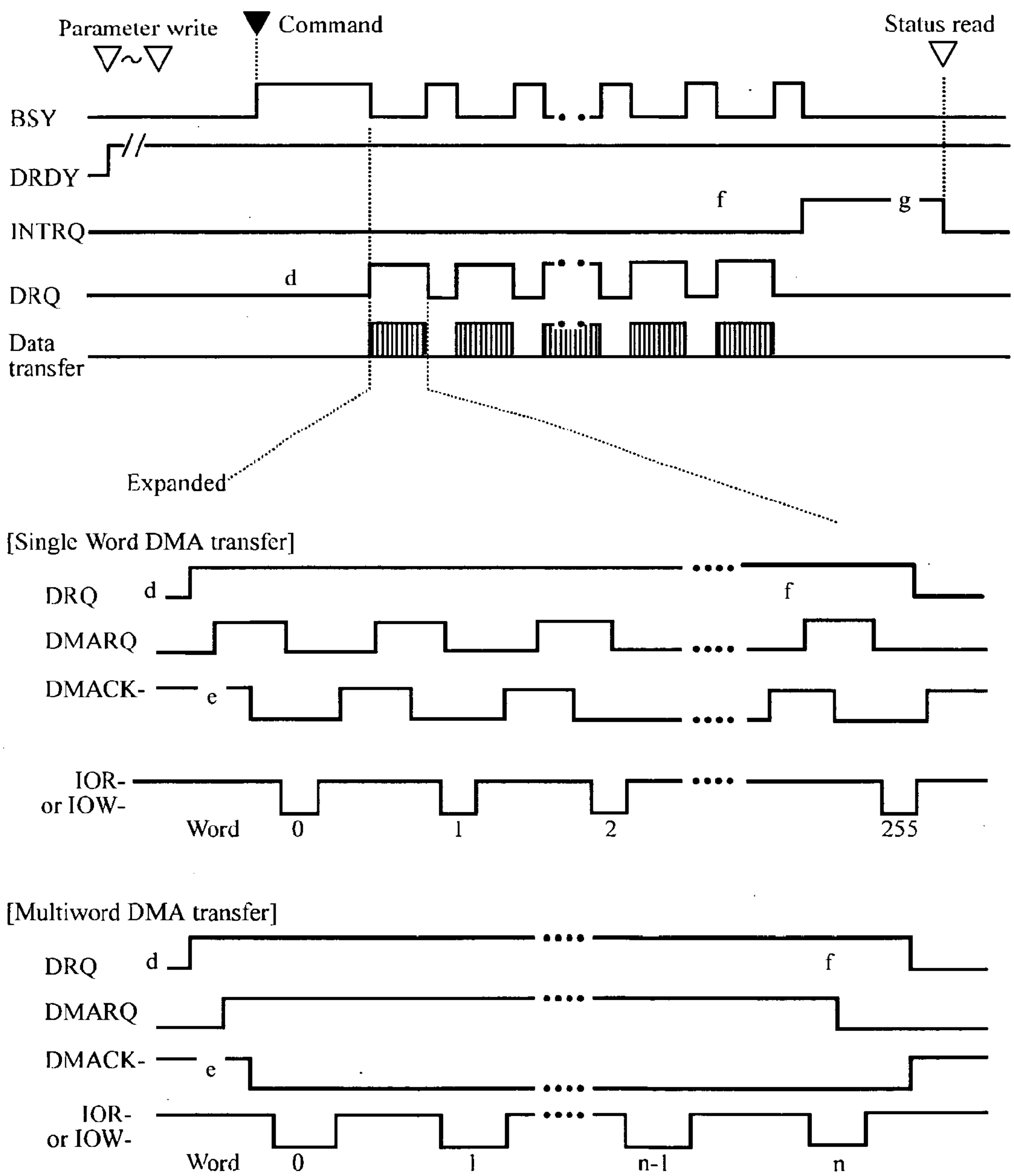


Figure 5.7 Normal DMA data transfer

5.5 Ultra DMA Feature Set

5.5.1 Overview

Ultra DMA is a data transfer protocol used with the READ DMA and WRITE DMA commands. When this protocol is enabled it shall be used instead of the Multiword DMA protocol when these commands are issued by the host. This protocol applies to the Ultra DMA data burst only. When this protocol is used there are no changes to other elements of the ATA protocol (e.g.: Command Block Register access).

Several signal lines are redefined to provide new functions during an Ultra DMA burst. These lines assume these definitions when 1) an Ultra DMA Mode is selected, and 2) a host issues a READ DMA or a WRITE DMA, command requiring data transfer, and 3) the host asserts DMACK-. These signal lines revert back to the definitions used for non-Ultra DMA transfers upon the negation of DMACK- by the host at the termination of an Ultra DMA burst. All of the control signals are unidirectional. DMARQ and DMACK- retain their standard definitions.

With the Ultra DMA protocol, the control signal (STROBE) that latches data from DD (15:0) is generated by the same agent (either host or device) that drives the data onto the bus. Ownership of DD (15:0) and this data strobe signal are given either to the device during an Ultra DMA data in burst or to the host for an Ultra DMA data out burst.

During an Ultra DMA burst a sender shall always drive data onto the bus, and after a sufficient time to allow for propagation delay, cable settling, and setup time, the sender shall generate a STROBE edge to latch the data. Both edges of STROBE are used for data transfers so that the frequency of STROBE is limited to the same frequency as the data. The highest fundamental frequency on the cable shall be 16.67 million transitions per second or 8.33 MHz (the same as the maximum frequency for PIO Mode 4 and DMA Mode 2).

Words in the IDENTIFY DEVICE data indicate support of the Ultra DMA feature and the Ultra DMA Modes the device is capable of supporting. The Set transfer mode subcommand in the SET FEATURES command shall be used by a host to select the Ultra DMA Mode at which the system operates. The Ultra DMA Mode selected by a host shall be less than or equal to the fastest mode of which the device is capable. Only the Ultra DMA Mode shall be selected at any given time. All timing requirements for a selected Ultra DMA Mode shall be satisfied. Devices supporting Ultra DMA Mode 2 shall also support Ultra DMA Modes 0 and 1. Devices supporting Ultra DMA Mode 1 shall also support Ultra DMA Mode 0.

An Ultra DMA capable device shall retain its previously selected Ultra DMA Mode after executing a Software reset sequence. An Ultra DMA capable device shall clear any previously selected Ultra DMA Mode and revert to its default non-Ultra DMA Modes after executing a Power on or hardware reset.

Both the host and device perform a CRC function during an Ultra DMA burst. At the end of an Ultra DMA burst the host sends the its CRC data to the device. The device compares its CRC data to the data sent from the host. If the two values do not match the device reports an error in the error register at the end of the command. If an error occurs during one or more Ultra DMA bursts for any one command, at the end of the command, the device shall report the first error that occurred.

5.5.2 Phases of operation

An Ultra DMA data transfer is accomplished through a series of Ultra DMA data in or data out bursts. Each Ultra DMA burst has three mandatory phases of operation: the initiation phase, the data transfer phase, and the Ultra DMA burst termination phase. In addition, an Ultra DMA burst may be paused during the data transfer phase (see 5.5.3 and 5.5.4 for the detailed protocol descriptions for each of these phases, 5.6.4 defines the specific timing requirements). In the following rules DMARDY- is used in cases that could apply to either DDMARDY- or HDMARDY-, and STROBE is used in cases that could apply to either DSTROBE or HSTROBE. The following are general Ultra DMA rules.

a) An Ultra DMA burst is defined as the period from an assertion of DMACK- by the host to the subsequent negation of DMACK-.

b) A recipient shall be prepared to receive at least two data words whenever it enters or resumes an Ultra DMA burst.

5.5.2.1 Ultra DMA burst initiation phase

a) The Ultra DMA burst initiation phase is started by the assertion of DMARQ signal by the device, and is ended when the transmitting side has inverted STROBE signal for transmitting the first data.

b) The Ultra DMA burst requires the assertion of DMARQ signal by the device.

c) The host asserts DMACK-signal when it is able to start the requested burst.

d) The host always asserts DMACK signal after detecting the first assertion of DMARQ signal.

e) Ultra DMA data in burst

   The device starts transmission of the data to DD (15 : 0) when;

   - DMACK-signal assertion has been detected,
   - STOP signal negation has been detected, or
   - HDMARDY-signal assertion has been detected.

f) Ultra DMA data out burst

   The device should not invert the state of this signal in the period from the moment of DMARQ signal assertion or DDMARDY-signal assertion to the moment of inversion of the first STROBE signal.

g) Ultra DMA data in burst

The device should not invert the state of this signal in the period from the moment of STOP signal negation or HDMARDY-signal assertion to the moment of inversion of the first STROBE signal.

5.5.2.2 Data transfer phase

a) The Data transfer phase is defined as the period from The Ultra DMA burst initiation phase to Ultra DMA burst termination phase.

b) The receiving side stops the Ultra DMA burst temporarily by negating DMARDY-signal, and then restarts the Ultra DMA burst by asserting again.

c) The transmitting side stops the Ultra DMA burst temporarily by not-performing inversion of STROBE signal, and then restarts the Ultra DMA burst by restarting the inversion.

d) When the transmitting side has stopped the inversion of STROBE signal, the receiving side should not output termination request signal immediately.

The receiving side should negate DMARDY signal when no termination request signal has been received from the transmission side, and then should output the termination request signal when a certain wait time has elapsed.

e) The transmitting side is allowed to send STROBE signal at a transfer speed that is lower than the one in the transferable fastest Ultra DMA mode, but is not allowed to send the STROBE signal at a higher speed than this.

The receiving side should be able to receive the data in the transferable fastest Ultra DMA mode.

5.5.2.3 Ultra DMA burst termination phase

a) The transmitting side or receiving side is allowed to end the Ultra DMA burst.

b) The Ultra DMA burst termination is not the end of the command execution. When the Ultra DMA burst termination has occurred before the ending of the command, the command should be ended by starting a new Ultra DMA burst, or the host should issue command abort by outputting hard reset or soft reset to the device.

c) The Ultra DMA burst should be stopped temporarily before the receiving side outputs the ending request.

d) The host outputs the ending request by asserting STOP signal, and then the device negates DMARQ signal to confirm it.

e) The device outputs the ending request by negating DMARQ signal, and then the host asserts STOP signal to confirm it.

f) Once the transmitting side has outputted the ending request, the output state of STROBE signal should not be changed unless the receiving side has confirmed it. Then, if the STROBE signal is not in asserted state, The transmitting side should assert the STROBE signal. However, the assertion of the STROBE signal should not cause the data transfer to occur.

g) The transmitting side should return the STROBE signal to its asserted state immediately after receiving the ending request from the receiving side.

   However, the returning of the STROBE signal to its asserted state should not cause the data transfer to occur and CRC to be perform.

h) Once the receiving side has outputted the ending request, the negated state of the DMARDY signal should not be changed for the remaining Ultra DMA burst to be performed.

i) The receiving side should neglect the inversion of the STROBE signal if DMARQ signal has been negated or STOP signal has been asserted.

5.5.3 Ultra DMA data in commands

5.5.3.1 Initiating an Ultra DMA data in burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.1 and 5.6.4.2 for specific timing requirements):

1) The host shall keep DMACK- in the negated state before an Ultra DMA burst is initiated.

2) The device shall assert DMARQ to initiate an Ultra DMA burst. After assertion of DMARQ the device shall not negate DMARQ until after the first negation of DSTROBE.

3) Steps (3), (4) and (5) may occur in any order or at the same time. The host shall assert STOP.

4) The host shall negate HDMARDY-.

5) The host shall negate CS0-, CS1-, DA2, DA1, and DA0. The host shall keep CS0-, CS1-, DA2, DA1, and DA0 negated until after negating DMACK- at the end of the burst.

6) Steps (3), (4) and (5) shall have occurred at least t_{ACK} before the host asserts DMACK-. The host shall keep DMACK- asserted until the end of an Ultra DMA burst.

7) The host shall release DD (15:0) within t_{AZ} after asserting DMACK-.

8) The device may assert DSTROBE t_{ZIORDY} after the host has asserted DMACK-. Once the device has driven DSTROBE the device shall not release DSTROBE until after the host has negated DMACK- at the end of an Ultra DMA burst.

9) The host shall negate STOP and assert HDMARDY- within t_{ENV} after asserting DMACK-. After negating STOP and asserting HDMARDY-, the host shall not change the state of either signal until after receiving the first transition of DSTROBE from the device (i.e., after the first data word has been received).

10) The device shall drive DD (15:0) no sooner than t_{ZAD} after the host has asserted DMACK-, negated STOP, and asserted HDMARDY-.

11) The device shall drive the first word of the data transfer onto DD (15:0). This step may occur when the device first drives DD (15:0) in step (10).

12) To transfer the first word of data the device shall negate DSTROBE within t_{FS} after the host has negated STOP and asserted HDMARDY-. The device shall negate DSTROBE no sooner than t_{DVS} after driving the first word of data onto DD (15:0).

5.5.3.2 The data in transfer

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.3 and 5.6.4.2):

1) The device shall drive a data word onto DD (15:0).

2) The device shall generate a DSTROBE edge to latch the new word no sooner than t_{DVS} after changing the state of DD (15:0). The device shall generate a DSTROBE edge no more frequently than t_{CYC} for the selected Ultra DMA Mode. The device shall not generate two rising or two falling DSTROBE edges more frequently than $2t_{CYC}$ for the selected Ultra DMA mode.

3) The device shall not change the state of DD (15:0) until at least t_{DVH} after generating a DSTROBE edge to latch the data.

4) The device shall repeat steps (1), (2) and (3) until the data transfer is complete or an Ultra DMA burst is paused, whichever occurs first.

5.5.3.3 Pausing an Ultra DMA data in burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.4 and 5.6.4.2 for specific timing requirements).

a) Device pausing an Ultra DMA data in burst

   1) The device shall not pause an Ultra DMA burst until at least one data word of an Ultra DMA burst has been transferred.

   2) The device shall pause an Ultra DMA burst by not generating DSTROBE edges.

   NOTE - The host shall not immediately assert STOP to initiate Ultra DMA burst termination when the device stops generating STROBE edges. If the device does not negate DMARQ, in order to initiate ULTRA DMA burst termination, the host shall negate HDMARDY- and wait t_{RP} before asserting STOP.

3) The device shall resume an Ultra DMA burst by generating a DSTROBE edge.

b) Host pausing an Ultra DMA data in burst

1) The host shall not pause an Ultra DMA burst until at least one data word of an Ultra DMA burst has been transferred.

2) The host shall pause an Ultra DMA burst by negating HDMARDY-.

3) The device shall stop generating DSTROBE edges within t_{RFS} of the host negating HDMARDY-.

4) If the host negates HDMARDY- within t_{SR} after the device has generated a DSTROBE edge, then the host shall be prepared to receive zero or one additional data words. If the host negates HDMARDY- greater than t_{SR} after the device has generated a DSTROBE edge, then the host shall be prepared to receive zero, one or two additional data words. The additional data words are a result of cable round trip delay and t_{RFS} timing for the device.

5) The host shall resume an Ultra DMA burst by asserting HDMARDY-.

5.5.3.4 Terminating an Ultra DMA data in burst

a) Device terminating an Ultra DMA data in burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.5 and 5.6.4.2 for specific timing requirements):

1) The device shall initiate termination of an Ultra DMA burst by not generating DSTROBE edges.

2) The device shall negate DMARQ no sooner than t_{SS} after generating the last DSTROBE edge. The device shall not assert DMARQ again until after the Ultra DMA burst is terminated.

3) The device shall release DD (15:0) no later than t_{AZ} after negating DMARQ.

4) The host shall assert STOP within t_{LI} after the device has negated DMARQ. The host shall not negate STOP again until after the Ultra DMA burst is terminated.

5) The host shall negate HDMARDY- within t_{LI} after the device has negated DMARQ. The host shall continue to negate HDMARDY- until the Ultra DMA burst is terminated. Steps (4) and (5) may occur at the same time.

6) The host shall drive DD (15:0) no sooner than t_{ZAH} after the device has negated DMARQ. For this step, the host may first drive DD (15:0) with the result of its CRC calculation (see 5.5.5):

7) If DSTROBE is negated, the device shall assert DSTROBE within t_{LI} after the host has asserted STOP. No data shall be transferred during this assertion. The host shall ignore this transition on DSTROBE. DSTROBE shall remain asserted until the Ultra DMA burst is terminated.

8) If the host has not placed the result of its CRC calculation on DD (15:0) since first driving DD (15:0) during (6), the host shall place the result of its CRC calculation on DD (15:0) (see 5.5.5).

9) The host shall negate DMACK- no sooner than t_{MLI} after the device has asserted DSTROBE and negated DMARQ and the host has asserted STOP and negated HDMARDY-, and no sooner than t_{DVS} after the host places the result of its CRC calculation on DD (15:0).

10) The device shall latch the host's CRC data from DD (15:0) on the negating edge of DMACK-.

11) The device shall compare the CRC data received from the host with the results of its own CRC calculation. If a miscompare error occurs during one or more Ultra DMA bursts for any one command, at the end of the command the device shall report the first error that occurred (see 5.5.5).

12) The device shall release DSTROBE within t_{IORDYZ} after the host negates DMACK-.

13) The host shall not negate STOP no assert HDMARDY- until at least t_{ACK} after negating DMACK-.

14) The host shall not assert DIOR-, CS0-, CS1-, DA2, DA1, or DA0 until at least t_{ACK} after negating DMACK.

b) Host terminating an Ultra DMA data in burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.6 and 5.6.4.2 for specific timing requirements):

1) The host shall not initiate Ultra DMA burst termination until at least one data word of an Ultra DMA burst has been transferred.

2) The host shall initiate Ultra DMA burst termination by negating HDMARDY-. The host shall continue to negate HDMARDY- until the Ultra DMA burst is terminated.

3) The device shall stop generating DSTROBE edges within t_{RFS} of the host negating HDMARDY-.

4) If the host negates HDMARDY- within t_{SR} after the device has generated a DSTROBE edge, then the host shall be prepared to receive zero or one additional data words. If the host negates HDMARDY- greater than t_{SR} after the device has generated a DSTROBE edge, then the host shall be prepared to receive zero, one or two additional data words. The additional data words are a result of cable round trip delay and t_{RFS} timing for the device.

5) The host shall assert STOP no sooner than t_{RP} after negating HDMARDY-. The host shall not negate STOP again until after the Ultra DMA burst is terminated.

6) The device shall negate DMARQ within t_{LI} after the host has asserted STOP. The device shall not assert DMARQ again until after the Ultra DMA burst is terminated.

7) If DSTROBE is negated, the device shall assert DSTROBE within t_{LI} after the host has asserted STOP. No data shall be transferred during this assertion. The host shall ignore this transition on DSTROBE. DSTROBE shall remain asserted until the Ultra DMA burst is terminated.

8) The device shall release DD (15:0) no later than t_{AZ} after negating DMARQ.

9) The host shall drive DD (15:0) no sooner than t_{ZAH} after the device has negated DMARQ. For this step, the host may first drive DD (15:0) with the result of its CRC calculation (see 5.5.5).

10) If the host has not placed the result of its CRC calculation on DD (15:0) since first driving DD (15:0) during (9), the host shall place the result of its CRC calculation on DD (15:0) (see 5.5.5).

11) The host shall negate DMACK- no sooner than t_{MLI} after the device has asserted DSTROBE and negated DMARQ and the host has asserted STOP and negated HDMARDY-, and no sooner than t_{DVS} after the host places the result of its CRC calculation on DD (15:0).

12) The device shall latch the host's CRC data from DD (15:0) on the negating edge of DMACK-.

13) The device shall compare the CRC data received from the host with the results of its own CRC calculation. If a miscompare error occurs during one or more Ultra DMA burst for any one command, at the end of the command, the device shall report the first error that occurred (see 5.5.5).

14) The device shall release DSTROBE within t_{IORDYZ} after the host negates DMACK-.

15) The host shall neither negate STOP nor assert HDMARDY- until at least t_{ACK} after the host has negated DMACK-.

16) The host shall not assert DIOR-, CS0-, CS1-, DA2, DA1, or DA0 until at least t_{ACK} after negating DMACK.

5.5.4 Ultra DMA data out commands

5.5.4.1 Initiating an Ultra DMA data out burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.7 and 5.6.4.2 for specific timing requirements):

1) The host shall keep DMACK- in the negated state before an Ultra DMA burst is initiated.

2) The device shall assert DMARQ to initiate an Ultra DMA burst.

3) Steps (3), (4), and (5) may occur in any order or at the same time. The host shall assert STOP.

4) The host shall assert HSTROBE.

5) The host shall negate CS0-, CS1-, DA2, DA1, and DA0. The host shall keep CS0-, CS1-, DA2, DA1, and DA0 negated until after negating DMACK- at the end of the burst.

6) Steps (3), (4), and (5) shall have occurred at least t_{ACK} before the host asserts DMACK-. The host shall keep DMACK- asserted until the end of an Ultra DMA burst.

7) The device may negate DDMARDY- t_{ZIORDY} after the host has asserted DMACK-. Once the device has negated DDMARDY-, the device shall not release DDMARDY- until after the host has negated DMACK- at the end of an Ultra DMA burst.

8) The host shall negate STOP within t_{ENV} after asserting DMACK-. The host shall not assert STOP until after the first negation of HSTROBE.

9) The device shall assert DDMARDY- within t_{LI} after the host has negated STOP. After asserting DMARQ and DDMARDY- the device shall not negate either signal until after the first negation of HSTROBE by the host.

10) The host shall drive the first word of the data transfer onto DD (15:0). This step may occur any time during Ultra DMA burst initiation.

11) To transfer the first word of data: the host shall negate HSTROBE no sooner than t_{LI} after the device has asserted DDMARDY-. The host shall negate HSTROBE no sooner than t_{DVS} after the driving the first word of data onto DD (15:0).

5.5.4.2 The data out transfer

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.8 and 5.6.4.2 for specific timing requirements):

1) The host shall drive a data word onto DD (15:0).

2) The host shall generate an HSTROBE edge to latch the new word no sooner than t_{DVS} after changing the state of DD (15:0). The host shall generate an

HSTROBE edge no more frequently than t_{CYC} for the selected Ultra DMA Mode. The host shall not generate two rising or falling HSTROBE edges more frequently than 2 t_{CYC} for the selected Ultra DMA mode.

3) The host shall not change the state of DD (15:0) until at least t_{DVH} after generating an HSTROBE edge to latch the data.

4) The host shall repeat steps (1), (2) and (3) until the data transfer is complete or an Ultra DMA burst is paused, whichever occurs first.

5.5.4.3 Pausing an Ultra DMA data out burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.9 and 5.6.4.2 for specific timing requirements).

a) Host pausing an Ultra DMA data out burst

   1) The host shall not pause an Ultra DMA burst until at least one data word of an Ultra DMA burst has been transferred.

   2) The host shall pause an Ultra DMA burst by not generating an HSTROBE edge.

      Note: The device shall not immediately negate DMARQ to initiate Ultra DMA burst termination when the host stops generating HSTROBE edges. If the host does not assert STOP, in order to initiate Ultra DMA burst termination, the device shall negate DDMARDY- and wait t_{RP} before negating DMARQ.

   3) The host shall resume an Ultra DMA burst by generating an HSTROBE edge.

b) Device pausing an Ultra DMA data out burst

   1) The device shall not pause an Ultra DMA burst until at least one data word of an Ultra DMA burst has been transferred.

   2) The device shall pause an Ultra DMA burst by negating DDMARDY-.

   3) The host shall stop generating HSTROBE edges within t_{RFS} of the device negating DDMARDY-.

   4) If the device negates DDMARDY- within t_{SR} after the host has generated an HSTROBE edge, then the device shall be prepared to receive zero or one additional data words. If the device negates DDMARDY- greater than t_{SR} after the host has generated an HSTROBE edge, then the device shall be prepared to receive zero, one or two additional data words. The additional data words are a result of cable round trip delay and t_{RFS} timing for the host.

   5) The device shall resume an Ultra DMA burst by asserting DDMARDY-.

5.5.4.4 Terminating an Ultra DMA data out burst

a) Host terminating an Ultra DMA data out burst

The following stops shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.10 and 5.6.4.2 for specific timing requirements):

1) The host shall initiate termination of an Ultra DMA burst by not generating HSTROBE edges.

2) The host shall assert STOP no sooner than t_{SS} after it last generated an HSTROBE edge. The host shall not negate STOP again until after the Ultra DMA burst is terminated.

3) The device shall negate DMARQ within t_{LI} after the host asserts STOP. The device shall not assert DMARQ again until after the Ultra DMA burst is terminated.

4) The device shall negate DDMARDY- with t_{LI} after the host has negated STOP. The device shall not assert DDMARDY- again until after the Ultra DMA burst termination is complete.

5) If HSTROBE is negated, the host shall assert HSTROBE with t_{LI} after the device has negated DMARQ. No data shall be transferred during this assertion. The device shall ignore this transition on HSTROBE. HSTROBE shall remain asserted until the Ultra DMA burst is terminated.

6) The host shall place the result of its CRC calculation on DD (15:0) (see 5.5.5)

7) The host shall negate DMACK- no sooner than t_{MLI} after the host has asserted HSTROBE and STOP and the device has negated DMARQ and DDMARDY-, and no sooner than t_{DVS} after placing the result of its CRC calculation on DD (15:0).

8) The device shall latch the host's CRC data from DD (15:0) on the negating edge of DMACK-.

9) The device shall compare the CRC data received from the host with the results of its own CRC calculation. If a miscompare error occurs during one or more Ultra DMA bursts for any one command, at the end of the command, the device shall report the first error that occurred (see 5.5.5).

10) The device shall release DDMARDY- within t_{IORDYZ} after the host has negated DMACK-.

11) The host shall neither negate STOP nor negate HSTROBE until at least t_{ACK} after negating DMACK-.

12) The host shall not assert DIOW-, CS0-, CS1-, DA2, DA1, or DA0 until at least t_{ACK} after negating DMACK.

b) Device terminating an Ultra DMA data out burst

The following steps shall occur in the order they are listed unless otherwise specifically allowed (see 5.6.4.11 and 5.6.4.2 for specific timing requirements):

1) The device shall not initiate Ultra DMA burst termination until at least one data word of an Ultra DMA burst has been transferred.

2) The device shall initiate Ultra DMA burst termination by negating DDMARDY-.

3) The host shall stop generating an HSTROBE edges within t_{RFS} of the device negating DDMARDY-.

4) If the device negates DDMARDY- within t_{SR} after the host has generated an HSTROBE edge, then the device shall be prepared to receive zero or one additional data words. If the device negates DDMARDY- greater than t_{SR} after the host has generated an HSTROBE edge, then the device shall be prepared to receive zero, one or two additional data words. The additional data words are a result of cable round trip delay and t_{RFS} timing for the host.

5) The device shall negate DMARQ no sooner than t_{RP} after negating DDMARDY-. The device shall not assert DMARQ again until after the Ultra DMA burst is terminated.

6) The host shall assert STOP with t_{LI} after the device has negated DMARQ. The host shall not negate STOP again until after the Ultra DMA burst is terminated.

7) If HSTROBE is negated, the host shall assert HSTROBE with t_{LI} after the device has negated DMARQ. No data shall be transferred during this assertion. The device shall ignore this transition of HSTROBE. HSTROBE shall remain asserted until the Ultra DMA burst is terminated.

8) The host shall place the result of its CRC calculation on DD (15:0) (see 5.5.5).

9) The host shall negate DMACK- no sooner than t_{MLI} after the host has asserted HSTROBE and STOP and the device has negated DMARQ and DDMARDY-, and no sooner than t_{DVS} after placing the result of its CRC calculation on DD (15:0).

10) The device shall latch the host's CRC data from DD (15:0) on the negating edge of DMACK-.

11) The device shall compare the CRC data received from the host with the results of its own CRC calculation. If a miscompare error occurs during one or more Ultra DMA bursts for any one command, at the end of the command, the device shall report the first error that occurred (see 5.5.5).

12) The device shall release DDMARDY- within t_{IORDYZ} after the host has negated DMACK-.

13) The host shall neither negate STOP nor HSTROBE until at least t_{ACK} after negating DMACK-.

14) The host shall not assert DIOW-, CS0-, CS1-, DA2, DA1, or DA0 until at least t_{ACK} after negating DMACK.

5.5.5 Ultra DMA CRC rules

The following is a list of rules for calculating CRC, determining if a CRC error has occurred during an Ultra DMA burst, and reporting any error that occurs at the end of a command.

a) Both the host and the device shall have a 16-bit CRC calculation function.

b) Both the host and the device shall calculate a CRC value for each Ultra DMA burst.

c) The CRC function in the host and the device shall be initialized with a seed of 4ABAh at the beginning of an Ultra DMA burst before any data is transferred.

d) For each STROBE transition used for data transfer, both the host and the device shall calculate a new CRC value by applying the CRC polynomial to the current value of their individual CRC functions and the word being transferred. CRC is not calculated for the return of STROBE to the asserted state after the Ultra DMA burst termination request has been acknowledged.

e) At the end of any Ultra DMA burst the host shall send the results of its CRC calculation function to the device on DD (15:0) with the negation of DMACK-.

f) The device shall then compare the CRC data from the host with the calculated value in its own CRC calculation function. If the two values do not match, the device shall save the error and report it at the end of the command. A subsequent Ultra DMA burst for the same command that does not have a CRC error shall not clear an error saved from a previous Ultra DMa burst in the same command. If a miscompare error occurs during one or more Ultra DMA bursts for any one command, at the end of the command, the device shall report the first error that occurred.

g) For READ DMA or WRITE DMA commands: When a CRC error is detected, it shall be reported by setting both ICRC and ABRT (bit 7 and bit 2 in the Error register) to one. ICRC is defined as the "Interface CRC Error" bit. The host shall respond to this error by re-issuing the command.

h) A host may send extra data words on the last Ultra DMA burst of a data out command. If a device determines that all data has been transferred for a command, the device shall terminate the burst. A device may have already received more data words than were required for the command. These extra words are used by both the host and the device to calculate the CRC, but, on an Ultra DMA data out burst, the extra words shall be discarded by the device.

i) The CRC generator polynomial is : $G(X) = X^{16} + X^{12} + X^5 + 1$.

Note: Since no bit clock is available, the recommended approach for calculating CRC is to use a word clock derived from the bus strobe. The combinational logic shall then be equivalent to shifting sixteen bits serially through the generator polynominal where DD0 is shifted in first and DD15 is shifted in last.

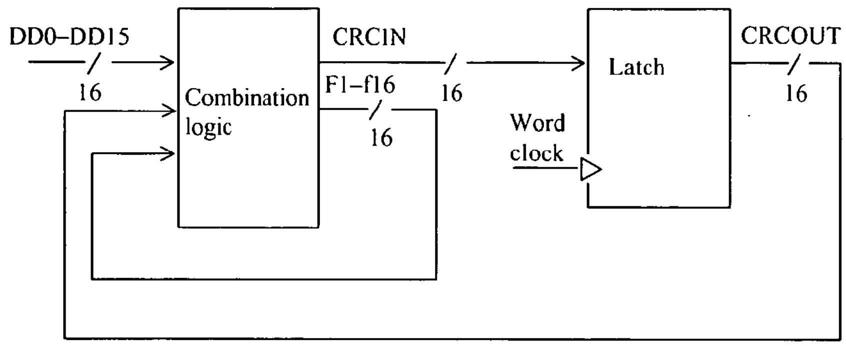


Figure 5.8 An example of generation of parallel CRC

Table 5.16 Parallel generation equation of CRC polynomial

CRCIN0=f_{16}	CRCIN8 = f_8 XOR f_{13}
CRCIN1=f_{15}	CRCIN9 = f_7 XOR f_{12}
CRCIN2=f_{14}	CRCIN10 = f_6 XOR f_{11}
CRCIN3=f_{13}	CRCIN11 = f_5 XOR f_{10}
CRCIN4=f_{12}	CRCIN12 = f_4 XOR f_9 XOR f_{16}
CRCIN5=f_{11} XOR f	CRCIN13 = f_3 XOR f_8 XOR f_{15}
CRCIN6=f_{10} XOR f_{15}	CRCIN14 = f_2 XOR f_7 XOR f_{14}
CRCIN7=f_9 XOR f_{14}	CRCIN15 = f_1 XOR f_6 XOR f_{13}

f_1 = DD0 XOR $CRCOUT_{15}$
f_2 = DD1 XOR $CRCOUT_{14}$
f_3 = DD2 XOR $CRCOUT_{13}$
f_4 = DD3 XOR $CRCOUT_{12}$
f_5 = DD4 XOR $CRCOUT_{11}$ XOR f_1
f_6 = DD5 XOR $CRCOUT_{10}$ XOR f_2
f_7 = DD6 XOR $CRCOUT_9$ XOR f_3
f_8 = DD7 XOR $CRCOUT_8$ XOR f_4
f_9 = DD8 XOR CRCOUT7 XOR f_5
f_{10} = DD9 XOR CRCOUT6 XOR f_6
f_{11} = DD10 XOR CRCOUT5 XOR f_7
f_{12} = DD11 XOR CRCOUT4 XOR f_1 XOR f_8
f_{13} = DD12 XOR CRCOUT3 XOR f_2 XOR f_9
f_{14} = DD13 XOR CRCOUT2 XOR f_3 XOR f_{10}
f_{15} = DD14 XOR CRCOUT1 XOR f_4 XOR f_{11}
f_{16} = DD15 XOR CRCOUT0 XOR f_5 XOR f_{12}

DD : Data from bust f : Feedback
CRCIN : Output of combination logic (the next CRC)
CROUT : Result of 16 bit latch (current CRC)

5.5.6 Series termination required for Ultra DMA

Series termination resistors are required at both the host and the device for operation in any of the Ultra DMA Modes. The following table describes recommended values for series termination at the host and the device.

Table 5.17 Recommended series termination for Ultra DMA

Signal	Host Termination	Device Termination
DIOR-:HDMARDY-:HSTROBE	33 Ω	82 Ω
DIOW-:STOP	33 Ω	82 Ω
CS0-, CS1-	33 Ω	82 Ω
DA0, DA1, DA2	33 Ω	82 Ω
DMACK-	33 Ω	82 Ω
DD15 through DD0	33 Ω	120 Ω (100 MHz)
DMARQ	82 Ω	33 Ω
INTRQ	82 Ω	33 Ω
IORDY:DDMARDY-:DSTROBE	82 Ω	22 Ω
Note: Only those signals requiring termination are listed in this table. If a signal is not listed, series termination is not required for operation in an Ultra DMA Mode. For signals also requiring a pull-up or pull-down resistor at the host see Figure 5.9.		

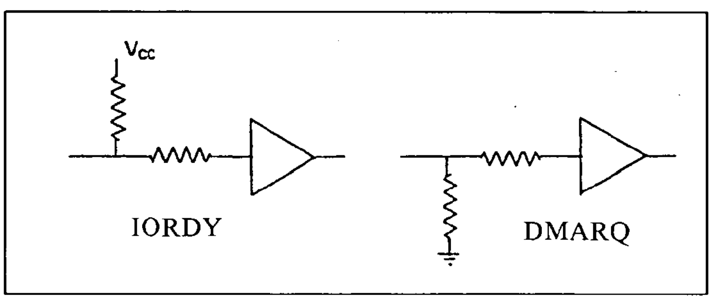


Figure 5.9 Ultra DMA termination with pull-up or pull-down

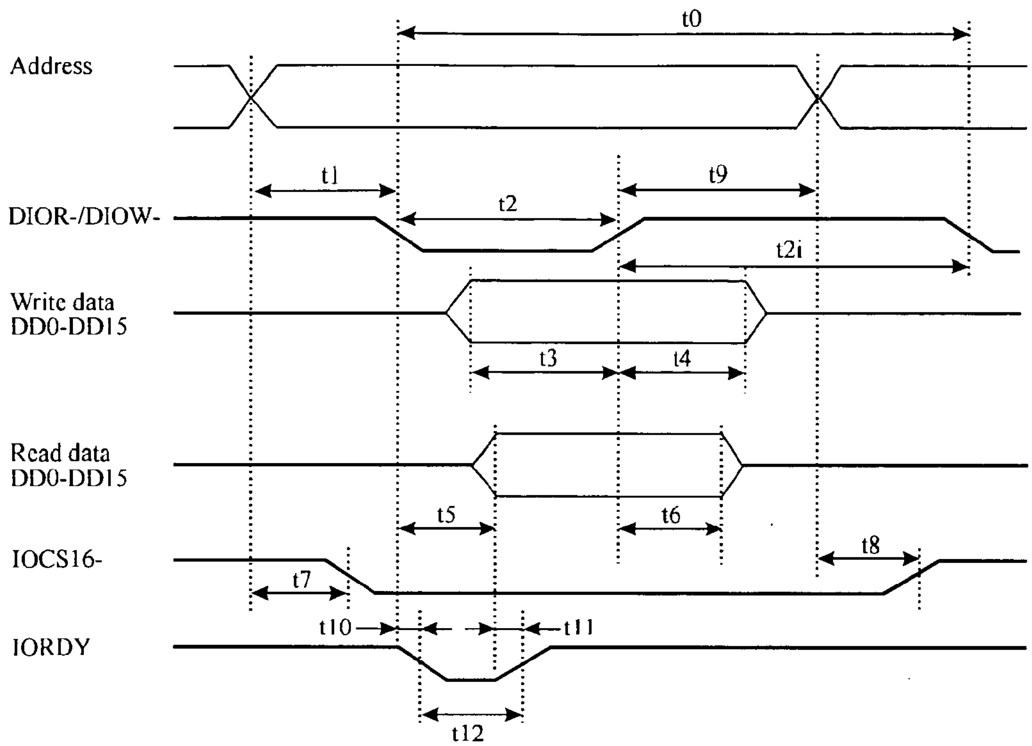
Configuration of cable

For the configuration of the cable (common use of primary port and secondary port), DMACK signal should not be used in common. It is not recommended to use DIOR-, DIOW- and IORDY signal in common.

5.6 Timing

5.6.1 PIO data transfer

Figure 5.10 shows of the data transfer timing between the device and the host system.

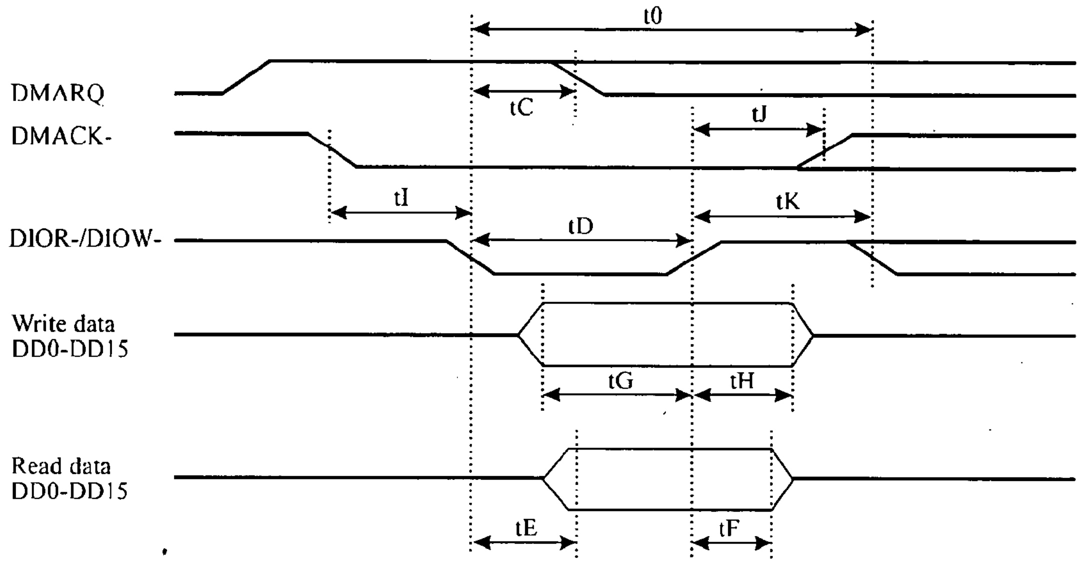


Symbol	Timing parameter	Min.	Max.	Unit
t0	Cycle time	120	—	ns
t1	Data register selection setup time for DIOR-/DIOW-	25	—	ns
t2	Pulse width of DIOR-/DIOW-	70	—	ns
t2i	Recovery time of DIOR-/DIOW-	25	—	ns
t3	Data setup time for DIOW-	20	—	ns
t4	Data hold time for DIOW-	10	—	ns
t5	Time from DIOR- assertion to read data available	—	20	ns
t6	Data hold time for DIOR-	5	—	ns
t7	Time from Data register selection to IOCS16- assertion	—	20	ns
t8	Time from Data register selection reset to IOCS16- negation	—	5	ns
t9	Data register selection hold time for DIOR-/DIOW-	10	—	ns
t10	Time from DIOR-/DIOW- assertion to IORDY "low" level	—	35	ns
t11	Time from validity of read data to IORDY "high" level	0	—	ns
t12	Pulse width of IORDY	—	1,250	ns

Figure 5.10 Data transfer timing

5.6.2 Multiword DMA data transfer

Figure 5.11 shows the multiword DMA data transfer timing between the device and the host system.



Symbol	Timing parameter	Min.	Max.	Unit
t0	Cycle time	120	—	ns
tC	Delay time from DIOR-/DIOW- assertion to DMARQ negation	—	35	ns
tD	Pulse width of DIOR-/DIOW-	70	—	ns
tE	Data setup time for DIOR-	—	30	ns
tF	Data hold time for DIOR-	5	—	ns
tG	Data setup time for DIOW-	20	—	ns
tH	Data hold time for DIOW-	10	—	ns
tI	DMACK setup time for DIOR-/DIOW-	0	—	ns
tJ	DMACK hold time for DIOR-/DIOW-	5	—	ns
tK	Continuous time of high level for DIOR-/DIOW-	25	—	ns

Figure 5.11 Multiword DMA data transfer timing (mode 2)

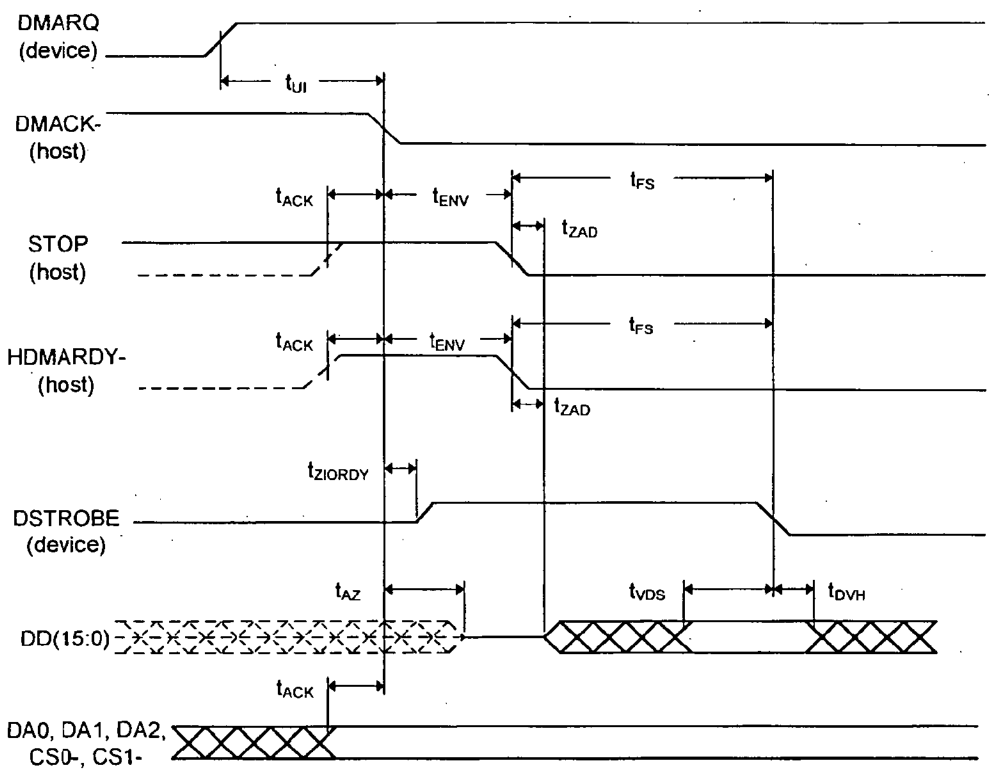
5.6.3 Transfer of Ultra DMA data

Figures 5.12 to 5.21 define the timings concerning every phase for the Ultra DMA Burst.

Table 5.18 includes the timing for each Ultra DMA mode.

5.6.3.1 Starting of Ultra DMA data In Burst

The timing for each Ultra DMA mode is included in 5.6.3.2.



Note : The definitions of STOP, HDMARDY- and DSTROBE signals are valid before the assertion of DMACK signal.

Figure 5.12 Starting of Ultra DMA data In Burst transfer

5.6.3.2 Ultra DMA data burst timing requirements

Table 5.18 Ultra DMA data burst timing requirements (1 of 2)

NAME	MODE 0 (in ns)		MODE 1 (in ns)		MODE 2 (in ns)		MODE 3 (in ns)		MODE 4 (in ns)		COMMENT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	(see Notes 1 and 2)
$t_{2CYCTYP}$	240		160		120		90		60		Typical sustained average two cycle time
t_{CYC}	112		73		54		39		25		Cycle time allowing for asymmetry and clock variations (from STROBE edge to STROBE edge)
t_{2CYC}	230		154		115		86		57		Two cycle time allowing for clock variations (from rising edge to next rising edge or from falling edge to next falling edge of STROBE)
t_{DS}	15		10		7		7		5		Data setup time (at recipient) (see Note 4)
t_{DH}	5		5		5		5		5		Data hold time (at recipient) (see Note 4)
t_{DVS}	70		48		30		20		6		Data valid setup time at sender (from data valid until STROBE edge) (see Note 5)
t_{DVH}	6		6		6		6		6		Data valid hold time at sender (from STROBE edge until data may become invalid) (see Note 5)
t_{FS}	0	230	0	200	0	170	0	130	0	120	First STROBE time (for device to first negate DSTROBE from STOP during a data in burst)
t_{LI}	0	150	0	150	0	150	0	100	0	100	Limited interlock time (see Note 3)
t_{MLI}	20		20		20		20		20		Interlock time with minimum (see Note 3)
t_{UI}	0		0		0		0		0		Unlimited interlock time (see Note 3)
t_{AZ}		10		10		10		10		10	Maximum time allowed for output drivers to release (from asserted or negated)
t_{ZAH}	20		20		20		20		20		Minimum delay time required for output
t_{ZAD}	0		0		0		0		0		Drivers to assert or negate (from released)
t_{ENV}	20	70	20	70	20	70	20	55	20	55	Envelope time (from DMACK- to STOP and HDMARDY- during data in burst initiation and from DMACK to STOP during data out burst initiation)
t_{SR}		50		30		20		NA		NA	STROBE-to-DMARDY-time (if DMARDY- is negated before this long after STROBE edge, the recipient shall receive no more than one additional data word)
t_{RFS}		75		70		60		60		60	Ready-to-final-STROBE time (no STROBE edges shall be sent this long after negation of DMARDY-)
t_{RP}	160		125		100		100		100		Ready-to-pause time (that recipient shall wait to pause after negating DMARDY-)
t_{IORDYZ}		20		20		20		20		20	Maximum time before releasing IORDY

Table 5.18 Ultra DMA data burst timing requirements (2 of 2)

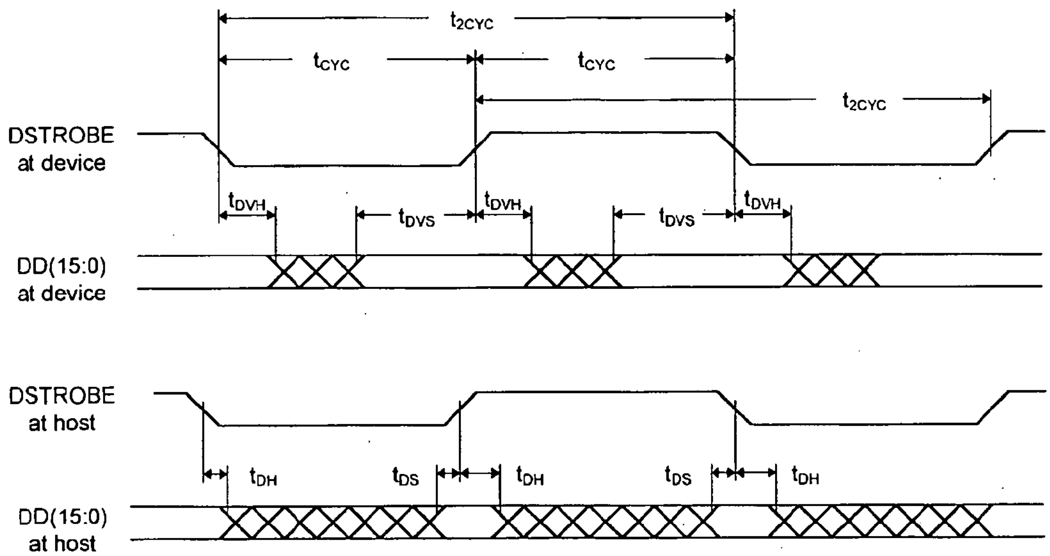
NAME	MODE 0 (in ns)		MODE 1 (in ns)		MODE 2 (in ns)		MODE 3 (in ns)		MODE 4 (in ns)		COMMENT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	(see Notes 1 and 2)
t_{ZIORDY}	0		0		0		0		0		Minimum time before driving IORDY
t_{ACK}	20		20		20		20		20		Setup and hold times for DMACK- (before assertion or negation)
t_{SS}	50		50		50		50		50		Time from STROBE edge to negation of DMARQ or assertion of STOP (when sender terminates a burst)

Notes:

1) Unless otherwise specified, timing parameters shall be measured at the connector of the sender or receiver to which the parameter applies (see Note 5 for exceptions). For example, the sender shall stop generating STROBE edges t_{RFS} after the negation of DMARDY-. Both STROBE and DMARDY- timing measurements are taken at the connector of the sender.
2) All timing measurement switching points (low to high and high to low) shall be taken at 1.5 V.
3) t_{UI}, t_{MLI} and t_{LI} indicate sender-to-recipient or recipient-to-sender interlocks, i.e., one agent (either sender or recipient) is waiting for the other agent to respond with a signal before proceeding. t_{UI} is an unlimited interlock that has no maximum time value. t_{MLI} is a limited time-out that has a defined minimum. t_{LI} is a limited time-out that has a defined maximum.
4) Special cabling shall be required in order to meet data setup (t_{DS}) and data hold (t_{DH}) times in modes 3 and 4.
5) Timing for t_{DVS} and t_{DVH} shall be met for all capacitive loads from 15 to 40 pf where all signals have the same capacitive load value.

5.6.3.3 Sustained Ultra DMA data in burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

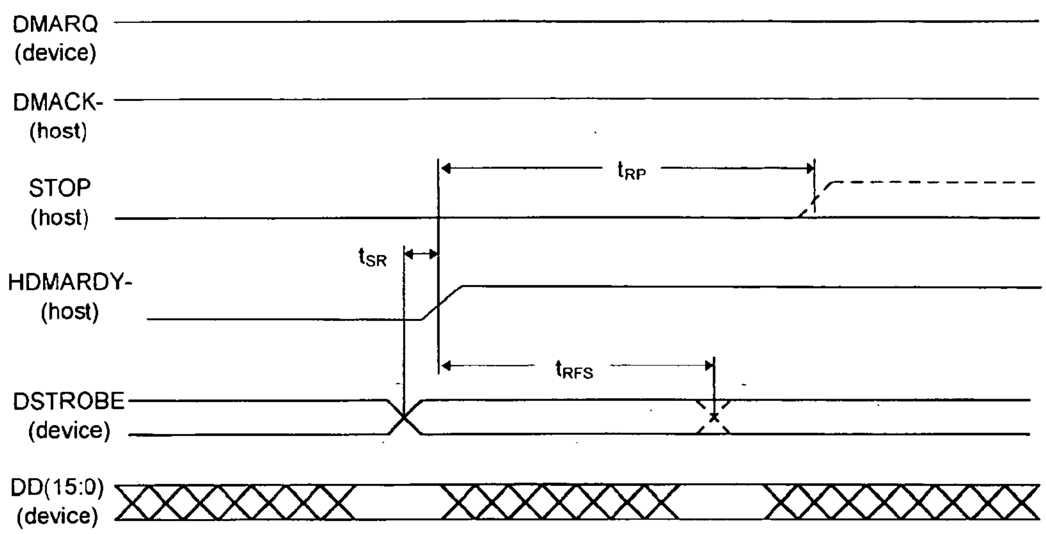


Note: DD (15:0) and DSTROBE are shown at both the host and the device to emphasize that cable setting time as well as cable propagation delay shall not allow the data signals to be considered stable at the host until some time after they are driven by the device.

Figure 5.13 Sustained Ultra DMA data in burst

5.6.3.4 Host pausing an Ultra DMA data in burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.



Notes:

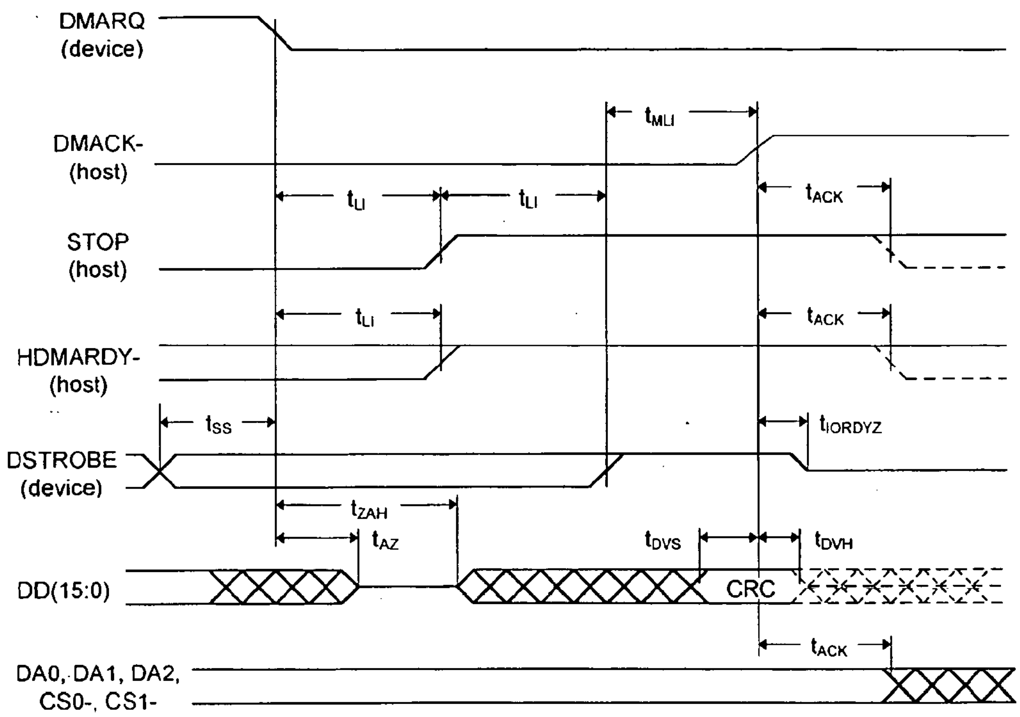
1) The host may assert STOP to request termination of the Ultra DMA burst no sooner than t_{RP} after HDMARDY- is negated.

2) If the t_{SR} timing is not satisfied, the host may receive zero, one or two more data words from the device.

Figure 5.14 Host pausing an Ultra DMA data in burst

5.6.3.5 Device terminating an Ultra DMA data in burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

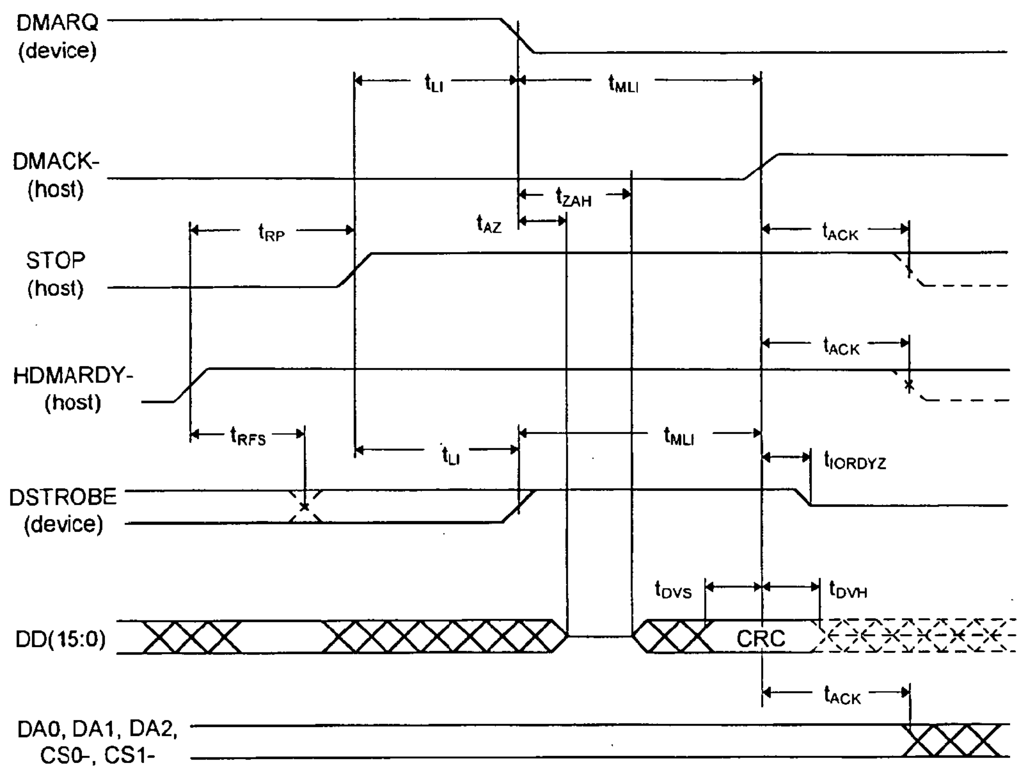


Note: The definitions for the STOP, HDMARDY- and DSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

Figure 5.15 Device terminating an Ultra DMA data in burst

5.6.3.6 Host terminating an Ultra DMA data in burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

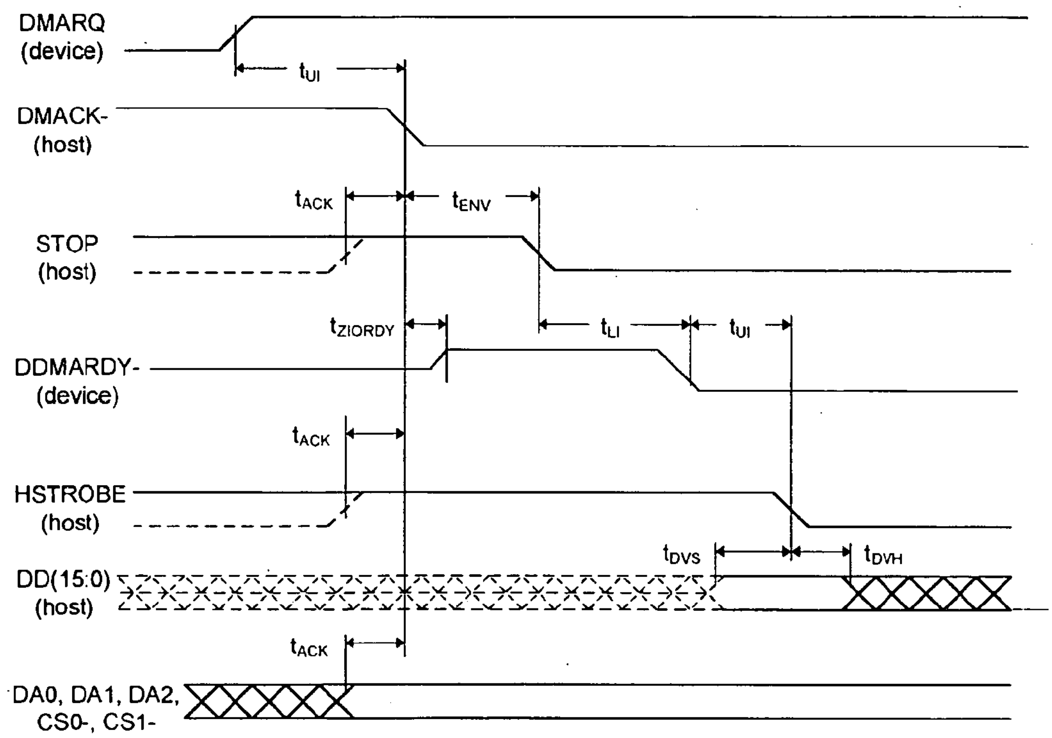


Note: The definitions for the STOP, HDMARDY- and DSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

Figure 5.16 Host terminating an Ultra DMA data in burst

5.6.3.7 Initiating an Ultra DMA data out burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

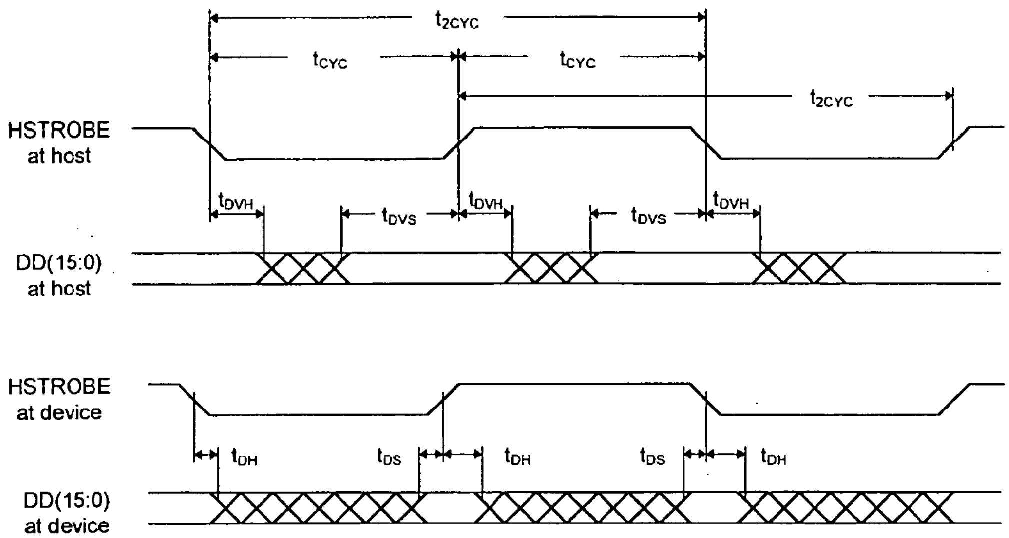


Note: The definitions for the STOP, DDMARDY- and HSTROBE signal lines are not in effect until DMARQ and DMACK are asserted.

Figure 5.17 Initiating an Ultra DMA data out burst

5.6.3.8 Sustained Ultra DMA data out burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

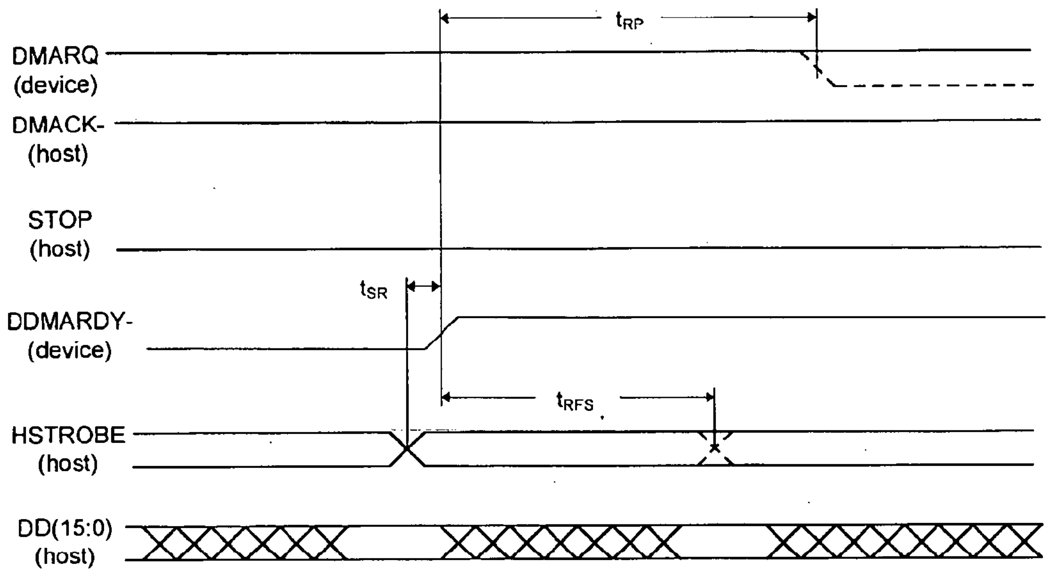


Note: DD (15:0) and HSTROBE signals are shown at both the device and the host to emphasize that cable setting time as well as cable propagation delay shall not allow the data signals to be considered stable at the device until some time after they are driven by the host.

Figure 5.18 Sustained Ultra DMA data out burst

5.6.3.9 Device pausing an Ultra DMA data out burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.



Notes:

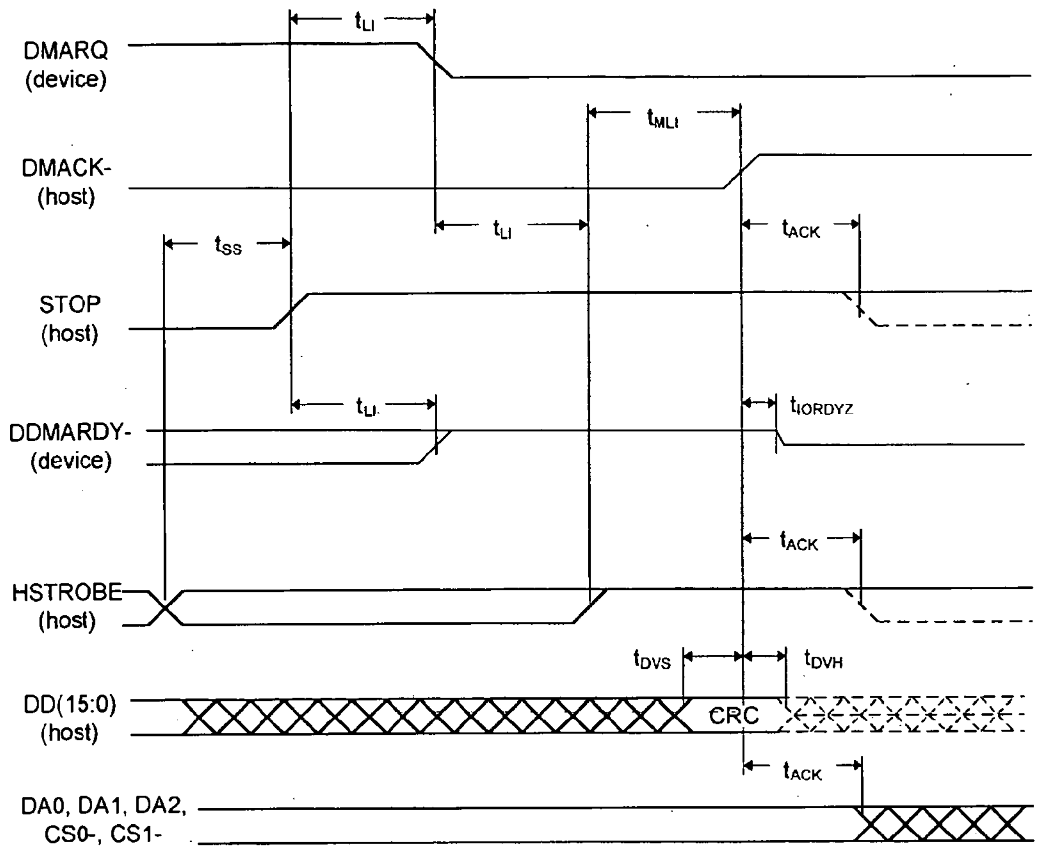
1) The device may negate DMARQ to request termination of the Ultra DMA burst no sooner than t_{RP} after DDMARDY- is negated.

2) If the t_{SR} timing is not satisfied, the device may receive zero, one or two more data words from the host.

Figure 5.19 Device pausing an Ultra DMA data out burst

5.6.3.10 Host terminating an Ultra DMA data out burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.

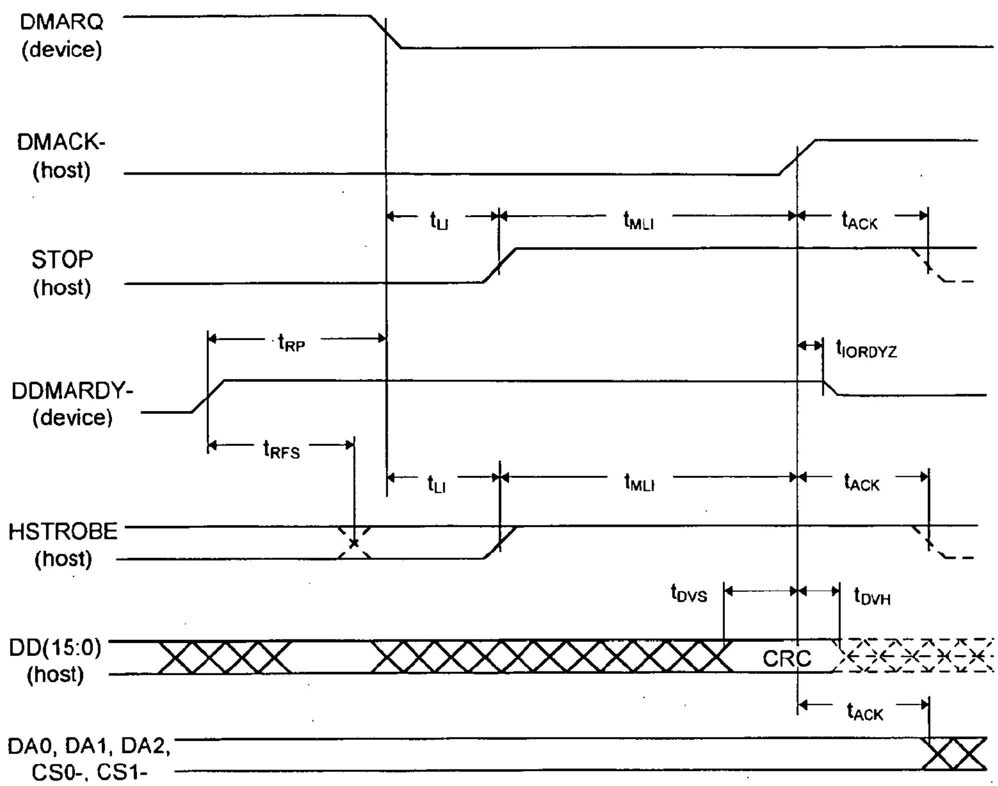


Note: The definitions for the STOP, DDMARDY- and HSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

Figure 5.20 Host terminating an Ultra DMA data out burst

5.6.3.11 Device terminating an Ultra DMA data in burst

5.6.3.2 contains the values for the timings for each of the Ultra DMA Modes.



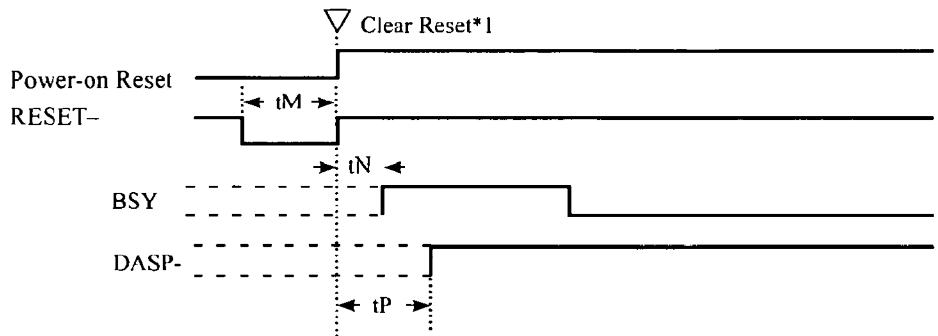
Note: The definitions for the STOP, DDMARDY- and HSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

Figure 5.21 Device terminating an Ultra DMA data out burst

5.6.4 Power-on and reset

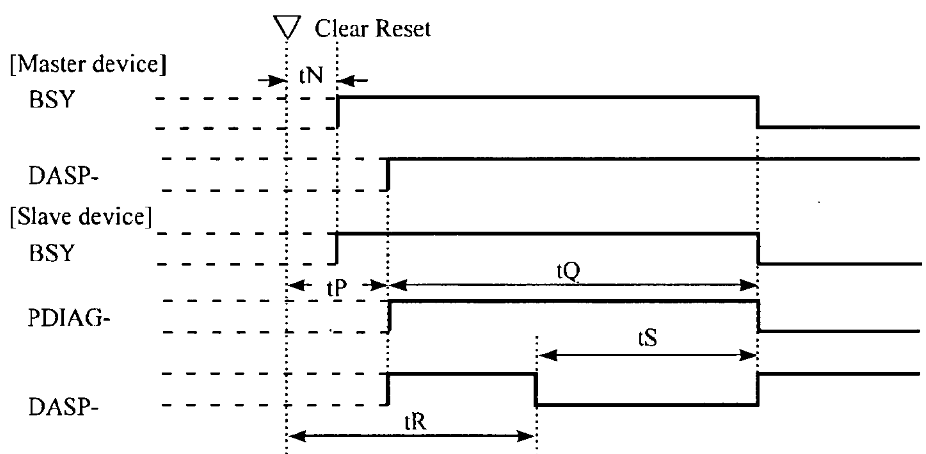
Figure 5.22 shows power-on and reset (hardware and software reset) timing.

(1) Only master device is present



*1: Reset means including Power-on-Reset, Hardware Reset (RESET-), and Software Reset.

(2) Master and slave devices are present (2-drives configulation)



Symbol	Timing parameter	Min.	Max.	Unit
tM	Pulse width of RESET-	25	—	μs
tN	Time from RESET- negation to BSY set	—	400	ns
tP	Time from RESET- negation to DASP- or PDIAG- negation	—	1	ms
tQ	Self-diagnostics execution time	—	15	s
tR	Time from RESET- negation to DASP- assertion (slave device)	—	400	ms
tS	Duration of DASP- assertion	—	31	s

Figure 5.22 Power on Reset Timing

CHAPTER 6 Operations

6.1 Device Response to the Reset

This section describes how the PDIAG- and DASP- signals responds when the power of the IDD is turned on or the IDD receives a reset or diagnostic command.

6.1.1 Response to power-on

After the master device (device 0) releases its own power-on reset state, the master device shall check a DASP- signal for up to 450 ms to confirm presence of a slave device (device 1). The master device recognizes presence of the slave device when it confirms assertion of the DASP- signal. Then, the master device checks a PDIAG- signal to see if the slave device has sucessfully completed the power-on diagnostics.

If the master device cannot confirm assertion of the DASP- signal within 450 ms, the master device recognizes that no slave device is connected.

After the slave device (device 1) releases its own power-on reset state, the slave device shall report its presence and the result of power-on diagnostics to the master device as described below:

DASP- signal: Asserted within 400 ms.

PDIAG- signal: Negated within 1 ms and asserted within 30 seconds.

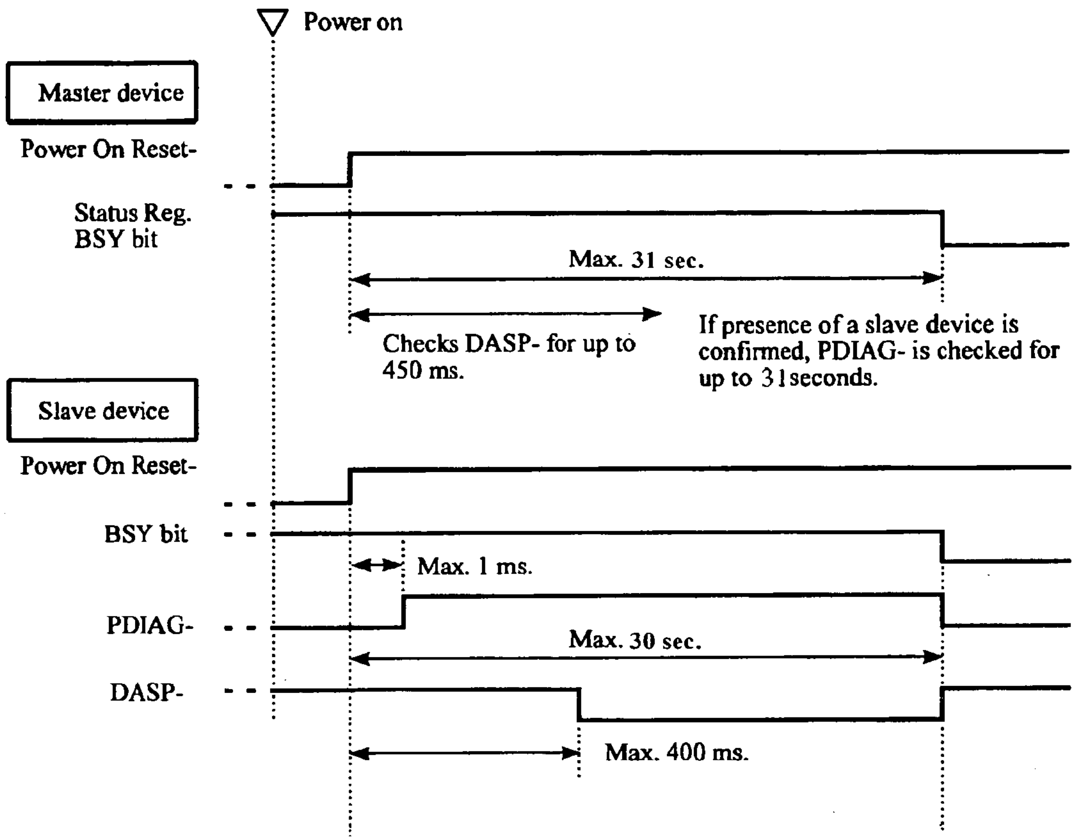


Figure 6.1 Response to power-on

6.1.2 Response to hardware reset

Response to RESET- (hardware reset through the interface) is similar to the power-on reset.

Upon receipt of hardware reset, the master device checks a DASP- signal for up to 450 ms to confirm presence of a slave device. The master device recognizes the presence of the slave device when it confirms assertion of the DASP- signal. Then the master device checks a PDIAG- signal to see if the slave device has successfully completed the self-diagnostics.

If the master device cannot confirm assertion of the DASP- signal within 450 ms, the master device recognizes that no slave device is connected.

After the slave device receives the hardware reset, the slave device shall report its presense and the result of the self-diagnostics to the master device as described below:

DASP- signal: Asserted within 400 ms.

PDIAG- signal: Negated within 1 ms and asserted within 30 seconds.

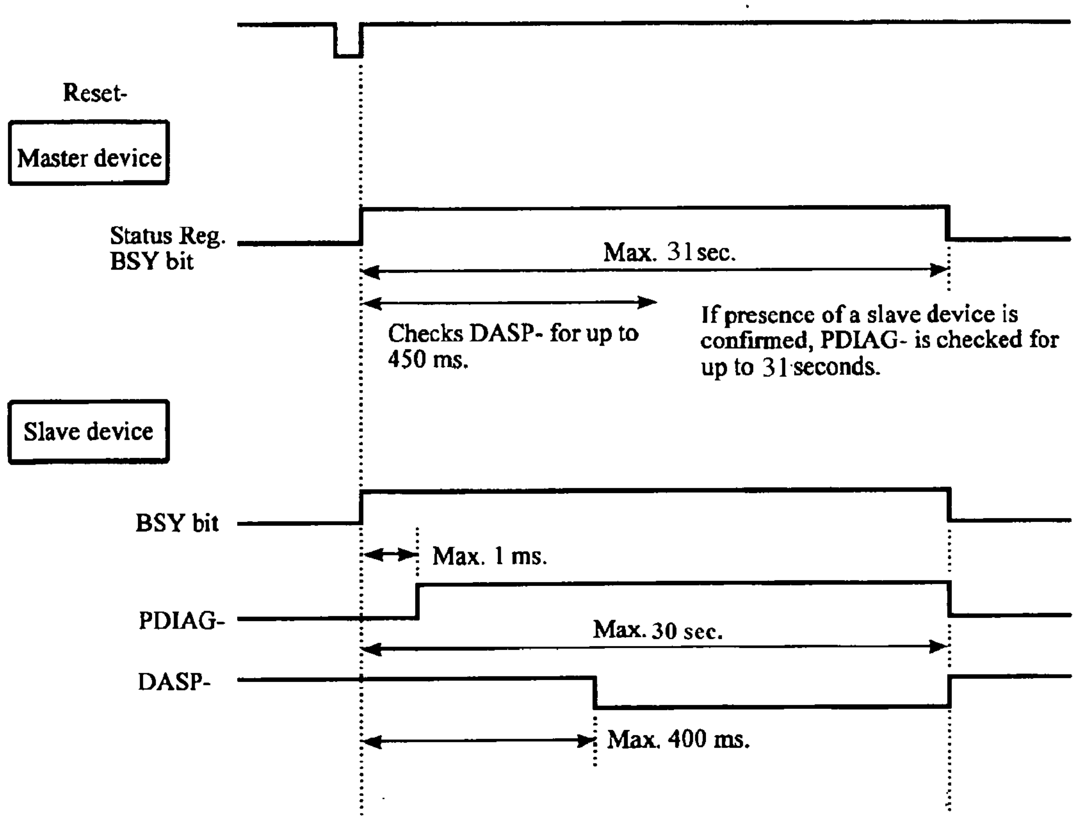


Figure 6.2 Response to hardware reset

6.1.3 Response to software reset

The master device does not check the DASP- signal for a software reset. If a slave device is present, the master device checks the PDIAG- signal for up to 15 seconds to see if the slave device has completed the self-diagnosis successfully.

After the slave device receives the software reset, the slave device shall report its presense and the result of the self-diagnostics to the master device as described below:

PDIAG- signal: negated within 1 ms and asserted within 30 seconds

When the IDD is set to a slave device, the IDD asserts the DASP- signal when negating the PDIAG- signal, and negates the DASP- signal when asserting the PDIAG- signal.

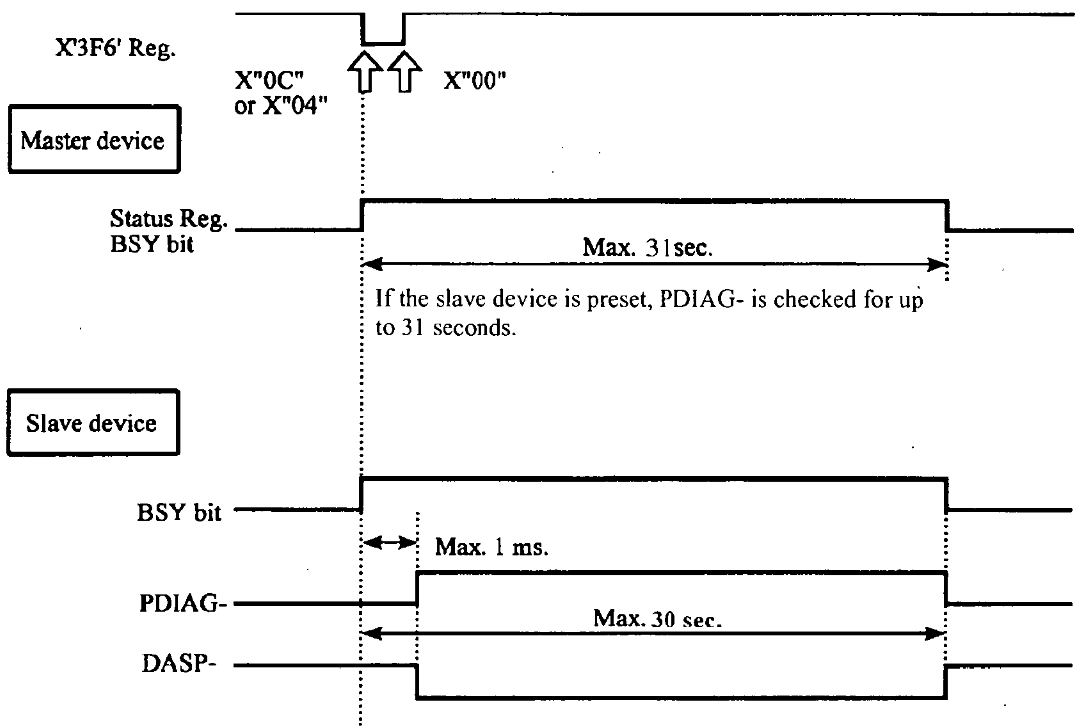


Figure 6.3 Response to software reset

6.1.4 Response to diagnostic command

When the master device receives an EXECUTE DEVICE DIAGNOSTIC command and the slave device is present, the master device checks the PDIAG- signal for up to 6 seconds to see if the slave device has completed the self-diagnosis successfully.

The master device does not check the DASP- signal.

After the slave device receives the EXECUTE DEVICE DIAGNOSTIC command, it shall report the result of the self-diagnostics to the master device as described below:

PDIAG- signal: negated within 1 ms and asserted within 5 seconds

When the IDD is set to a slave device, the IDD asserts the DASP- signal when negating the PDIAG- signal, and negates the DASP- signal when asserting the PDIAG- signal.

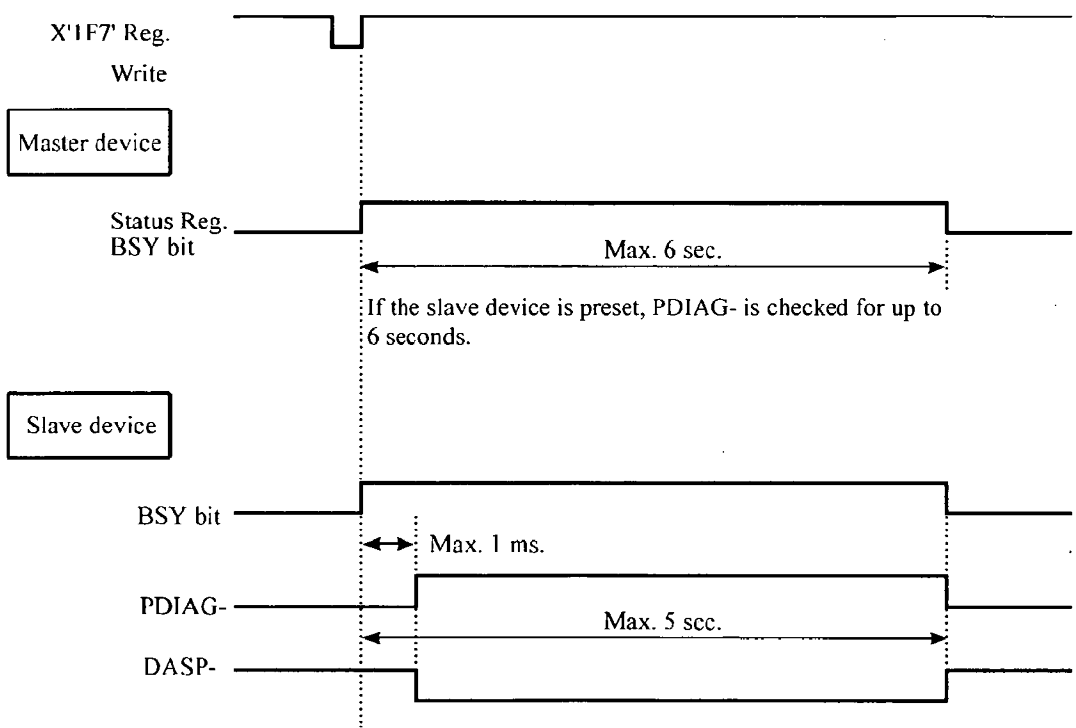


Figure 6.4 Response to diagnostic command

6.2 Address Translation

When the IDD receives any command which involves access to the disk medium, the IDD always implements the address translation from the logical address (a host-specified address) to the physical address (logical to physical address translation).

Following subsections explains the CHS translation mode.

6.2.1 Default parameters

In the logical to physical address translation, the logical cylinder, head, and sector addresses are translated to the physical cylinder, head, and sector addresses based on the number of heads and the number of sectors per track which are specified with an INITIALIZE DEVICE PARAMETERS command. This is called as the current translation mode.

If the number of heads and the number of sectors are not specified with an INITIALIZE DEVICE PARAMETERS command, the default values listed in Table 6.1 are used. This is called sa the default translation mode. The parameters in Table 6.1 are called BIOS specification.

Table 6.1 Default parameters

		MHJ2181AT	MHK2120AT	MHK2090AT	MHK2060AT
Parameters (logical)	Number of cylinders	16,383	16,383	16,383	12,416
	Number of heads	16	16	16	15
	Number of sectors/track	63	63	63	63
Formatted capacity (MB)		8,455.20	8,455.20	8,455.20	6,007.35

As long as the formatted capacity of the IDD does not exceed the value shown on Table 6.1, the host can freely specify the number of cylinders, heads, and sectors per track.

Generally, the device recognizes the number of heads and sectors per track with the INITIALIZE DEVICE PARAMETER command. However, it cannot recognizes the number of cylinders. In other words, there is no way for the device to recognize a host access area on logical cylinders. Thus the host should manage cylinder access to the device.

The host can specify a logical address freely within an area where an address can be specified (within the specified number of cylinders, heads, and sectors per track) in the current translation mode.

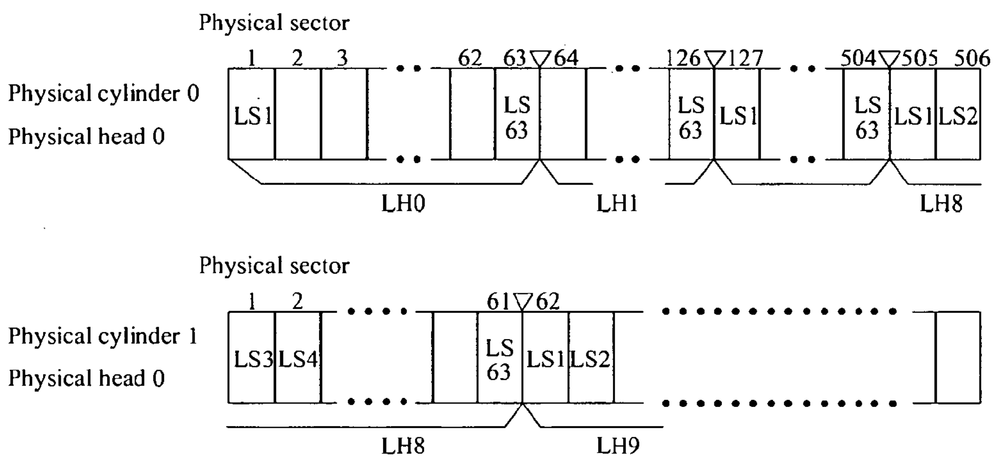
The host can read an addressable parameter information from the device by the IDENTIFY DEVICE command (Words 54 to 56).

6.2.2 Logical address

(1) CHS mode

Logical address assignment starts from physical cylinder (PC) 0, physical head (PH) 0, and physical sector (PS) 1 and is assigned by calculating the number of sectors per track that is specified by the INITIALIZE DEVICE PARAMETERS command. If the last sector of a physical track is used, the track is switched and the next logical sector is placed in the initial sector of the subsequent physical track.

Figure 6.5 shows an example of 6 heads configuration. (assuming there is no track skew).



ex: Zone 0 in 6-head device

Physical parameter
- Physical head: 0 to 5
- Physical sector: 1 to 506

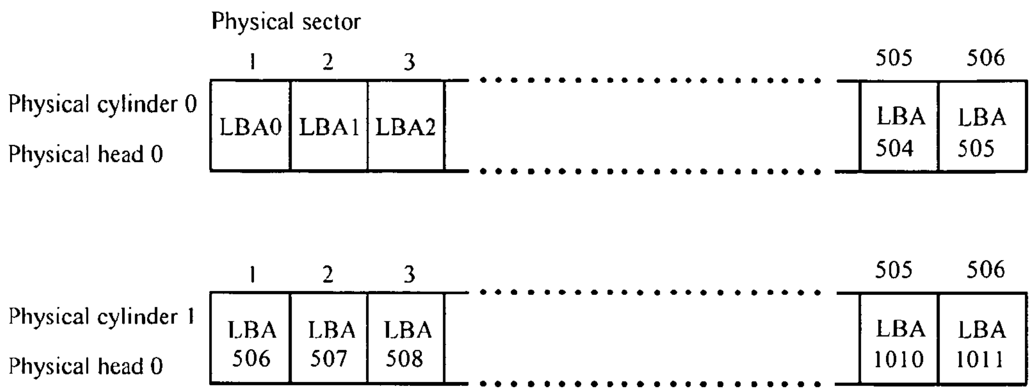
Specification of INITIALIZE DEVICE PARAMETERS command
- Logical head: 0 to 15
- Logical sector: 1 to 63

Figure 6.5 Address translation (example in CHS mode)

(2) LBA mode

Logical address assignment in the LBA mode starts from physical cylinder 0, physical head 0, and physical sector 1. If the last sector of a physical track is used, the track is switched and the next LBA is assigned to the initial sector of the subsequent physical track.

Figure 6.6 shows an example of 4 heads configuration (assuming there is no track skew).



ex: Zone 0 in 6-head device

Physical parameter
- Physical head : 0 to 5
- Physical sector : 1 to 506

Figure 6.6 Address translation (example in LBA mode)

6.3 Power Save

The host can change the power consumption state of the device by issuing a power command to the device.

6.3.1 Power save mode

There are four types of power consumption state of the device including active mode where all circuits are active.

In the power save mode, power supplying to the part of the circuit is turned off. There are three types of power save modes:

- Idle mode
- Standby mode
- Sleep mode

The drive moves from the Active mode to the idle mode by itself.

Regardless of whether the power down is enabled, the device enters the idle mode. The device also enters the idle mode in the same way after power-on sequence is completed.

And, the automatic power-down is executed if no command is coming for 30 min. (default)

(1) Active mode

In this mode, all the electric circuit in the device are active or the device is under seek, read or write operation.

A device enters the active mode under the following conditions:

- A command other than power commands is issued.
- A reset command is received.

(2) Idle mode

In this mode, circuits on the device is set to power save mode.

The device enters the Idle mode under the following conditions:

- After completion of power-on sequence.
- After completion of the command execution other than SLEEP and STANDBY commands.
- After completion of the reset sequence

(3) Standby mode

In this mode, the VCM circuit is turned off and the spindle motor is stopped.

The device can receive commands through the interface. However if a command with disk access is issued, response time to the command under the standby mode takes longer than the active or Idle mode because the access to the disk medium cannot be made immediately.

The drive enters the standby mode under the following conditions:

- A STANDBY or STANDBY IMMEDIATE command is issued in the active or idle mode.
- When automatic power down sequence is enabled, the timer has elapsed.
- A reset is issued in the sleep mode.

When one of following commands is issued, the command is executed normally and the device is still stayed in the standby mode.

- Reset (hardware or software)
- STANDBY command
- STANDBY IMMEDIATE command
- INITIALIZE DEVICE PARAMETERS command
- CHECK POWER MODE command

(4) Sleep mode

The power consumption of the drive is minimal in this mode. The drive enters only the standby mode from the sleep mode. The only method to return from the standby mode is to execute a software or hardware reset.

The drive enters the sleep mode under the following condition:

- A SLEEP command is issued.

Issued commands are invalid (ignored) in this mode.

6.3.2 Power commands

The following commands are available as power commands.

- IDLE
- IDLE IMMEDIATE
- STANDBY
- STANDBY IMMEDIATE
- SLEEP
- CHECK POWER MODE

6.4 Defect Management

Defective sectors of which the medium defect location is registered in the system space are replaced with spare sectors in the formatting at the factory shipment.

All the user space area are formatted at shipment from the factory based on the default parameters listed in Table 6.1.

6.4.1 Spare area

Following two types of spare area are provided for every physical head.

1) Spare cylinder for sector slip:

   used for alternating defective sectors at formatting in shipment (4 cylinders)

2) Spare cylinder for alternative assignment:

   used for automatic alternative assignment at read error occurrence.
   (4 cylinders)

6.4.2 Alternating defective sectors

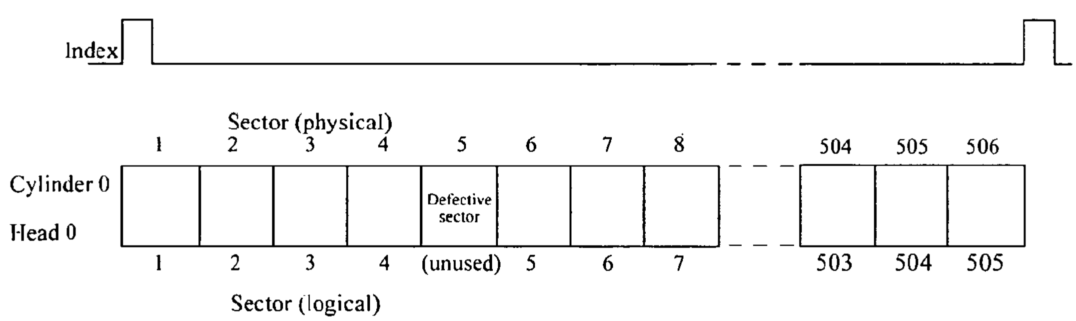
The two alternating methods described below are available:

(1) Sector slip processing

A defective sector is not used and is skipped and a logical sector address is assigned to the subsequent normal sector (physically adjacent sector to the defective sector).

When defective sector is present, the sector slip processing is performed in the formatting.

Figure 6.7 shows an example where (physical) sector 5 is defective on head 0 in cylinder 0.



Note: If an access request to physical sector 5 is specified, the device accesses physical sector 6 instead of sector 5.

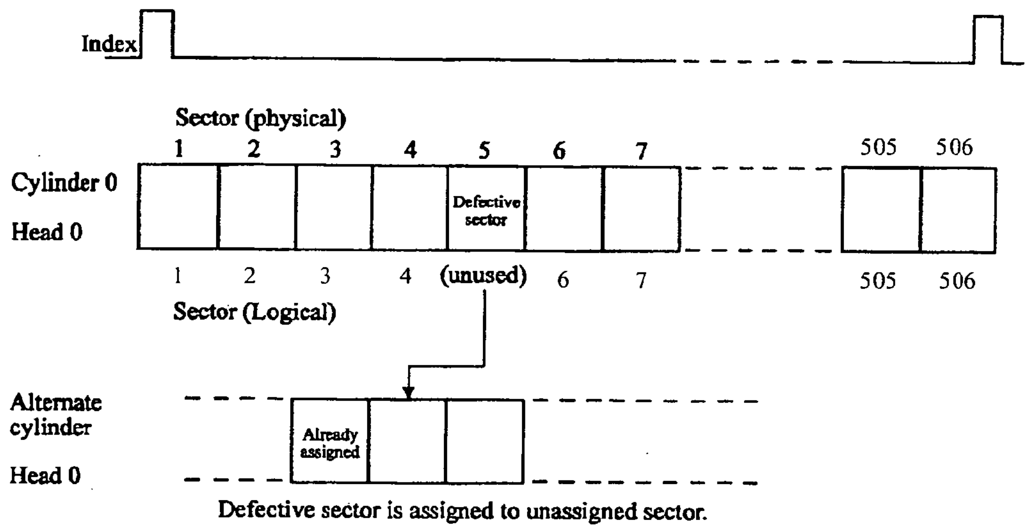
Figure 6.7 Sector slip processing

(2) Alternate cylinder assignment

A defective sector is assigned to the spare sector in the alternate cylinder.

This processing is performed when the alternate assignment is specified in the FORMAT TRACK command or when the automatic alternate processing is performed at read error occurrence.

Figure 6.8 shows an example where (physical) sector 5 is detective on head 0 in cylinder 0.



Notes:

1) 4 alternate cylinders are provided for each head in zone 14 (inner side).

2) When an access request to physical sector 5 is specified, the device accesses the alternated sector in the alternate cylinder instead of sector 5. When an access request to sectors next to sector 5 is specified, the device seeks to cylinder 0, head 0, and continues the processing.

Figure 6.8 Alternate cylinder assignment

(3) Automatic alternate assignment

The device performs the automatic alternate assignment when ECC correction performance is increased during read error retry, a read error is recovered. Before automatic alternate assignment, the device performs rewriting the corrected data to the erred sector and rereading. If no error occurs at rereading, the automatic alternate assignment is not performed.

An unrecoverable write error occurs during write error retry, automatic alternate assignment is performed.

6.5 Read-Ahead Cache

After read command which involes read data from the disk medium is completed, the read-ahead cache function reads the subsequent data blocks automatically and stores the data to the data buffer.

When the next command requests to read the read-ahead data, the data can be transferred from the data buffer without accessing the disk medium. The host can thus access data at higher speed.

6.5.1 Data buffer configuration

The drive has a 512-KB data buffer. The buffer is used by divided into three parts; for read commands, for write commands, and for MPU work (see Figure 6.9).

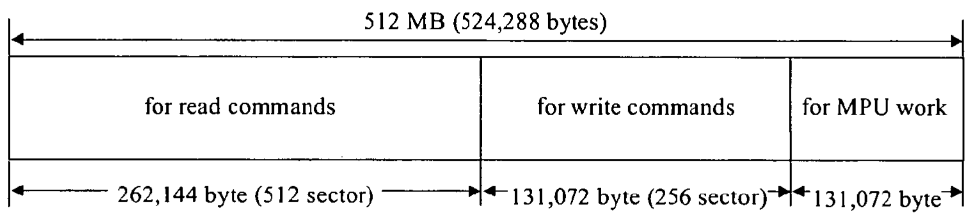


Figure 6.9 Data buffer configuration

The read-ahead operation is performed at execution of the READ SECTOR(S), READ MULTIPLE, or READ DMA command, and read-ahead data is stored in the buffer for read commands.

6.5.2 Caching operation

Caching operation is performed only at issurance of the following commands. The device transfers data from the data buffer to the host system at issurance of following command if following data exist in the data buffer.

- All sectors to be processed by the command
- A part of data including load sector to be processed by the command

When a part of data to be processed exist in the data buffer, remaining data are read from the medium and are transferred to the host system.

(1) Commands that are object of caching operation

Follow commands are object of caching operation.

- READ SECTOR (S)
- READ MULTIPLE
- READ DMA

When caching operation is disabled by the SET FEATURES command, no caching operation is performed.

(2) Data that are object of caching operation

Follow data are object of caching operation.

1) Read-ahead data read from the medium to the data buffer after completion of the command that are object of caching operation.

2) Data transferred to the host system once by requesting with the command that are object of caching operation (except for the cache invalid data by some reasons).

3) Remaining data in the data buffer (for write command) transferred from the host system by the command that writes data onto the disk medium, such as the WRITE SECTOR (S), WRITE DMA, WRITE MULTIPLE.

Followings are definition of in case that the write data is treated as a cache data. However, since the hit check at issurance of read command is performed to the data buffer for read command prioritily, caching write data is limited to the case that the hit check is missed at the data buffer for read command.

- When all data requested by the read command are stored in the data buffer for write command (hit all), the device transfers data from the data buffer for write command. At this time, the read-ahead operation to the data subsequent to the requested data is not performed.
- Even if a part of data requested by the read command are stored in the data buffer for write command (hit partially), all data are read from the disk medium without transferring from the data buffer for write command.

(3) Invalidating caching data

Caching data in the data buffer is invalidated in the following case.

1) Following command is issued to the same data block as caching data.

   - WRITE SECTOR(S)
   - WRITE DMA
   - WRITE MULTIPLE

2) Command other than following commands is issued (all caching data are invalidated)

   - READ SECTOR (S)
   - READ DMA

- READ MULTIPLE
- WRITE SECTOR(S)
- WRITE MULTIPLE
- WRITE VERIFY SECTOR(S)

3) Caching operation is inhibited by the SET FEATURES command.
4) Issued command is terminated with an error.
5) Soft reset or hard reset occurs, or power is turned off.
6) The device enters the sleep mode.
7) Under the state that the write data is kept in the data buffer for write command as a caching data, new write command is issued. (write data kept until now are invalidated)

6.5.3 Usage of read segment

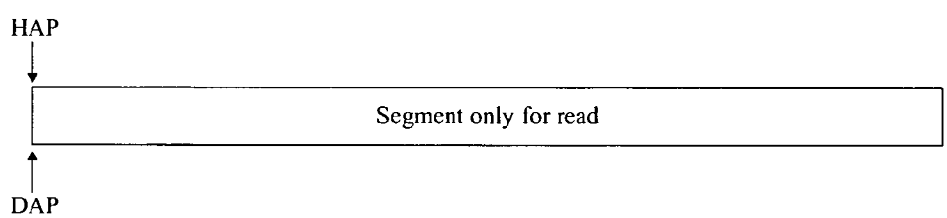
This subsection explains the usage of the read segment buffer at following cases.

6.5.3.1 Mis-hit (no hit)

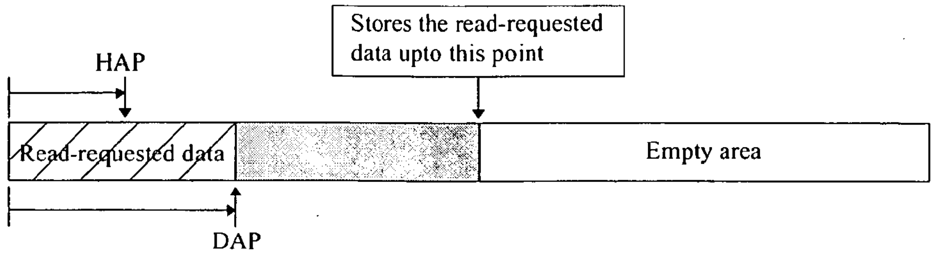
A lead block of the read-requested data is not stored in the data buffer. The requested data is read from the disk media.

The read-ahead operation is performed only when the last sector address of the previous read command and the lead sector address of this read command is sequential (see item (2)).

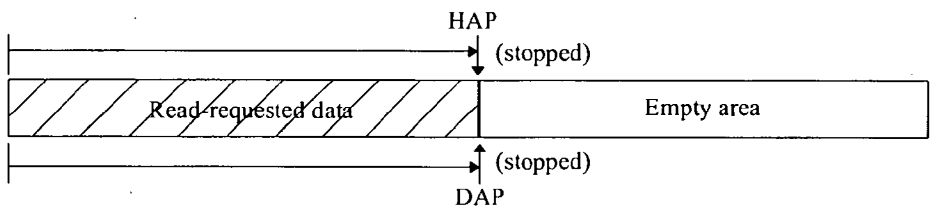
1) Sets the host address pointer (HAP) and the disk address pointer (DAP) to the lead of segment.



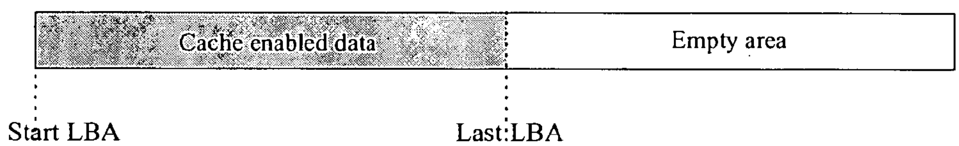
2) Transfers the requested data that already read to the host system with reading the requested data from the disk media.



3) After reading the requested data and transferring the requested data to the host system had been completed, the disk drive stops command execution without performing the read-ahead operation.



4) Following shows the cache enabled data for next read command.



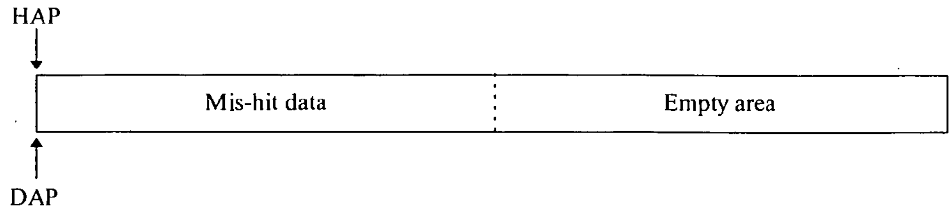
6.5.3.2 Sequential read

When the disk drive receives the read command that targets the sequential address to the previous read command, the disk drive starts the read-ahead operation.

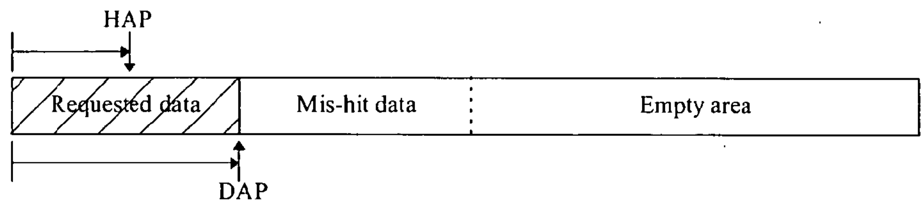
a. Sequential command just after non-sequential command

When the previously executed read command is an non-sequential command and the last sector address of the previous read command is sequential to the lead sector address of the received read command, the disk drive assumes the received command is a sequential command and performs the read-ahead operation after reading the requested data.

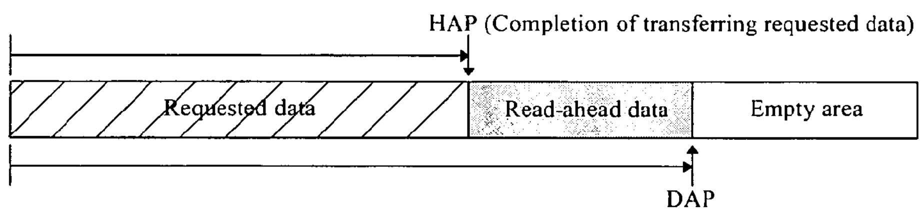
1) At receiving the sequential read command, the disk drive sets the DAP and HAP to the start address of the segment and reads the requested data from the load of the segment.



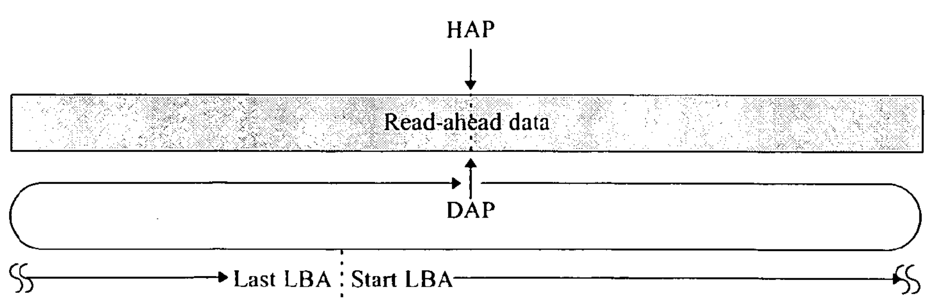
2) The disk drive transfers the requested data that is already read to the host system with reading the requested data.



3) After completion of the reading and transferring the requested data to the host system, the disk drive performs the read-ahead operation continuously.



4) The disk drive performs the read-ahead operation for all area of segment with overwriting the requested data. Finally, the cache data in the buffer is as follows.

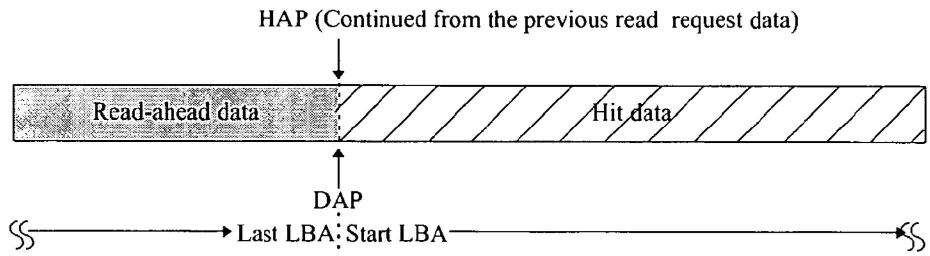


b. Sequential hit

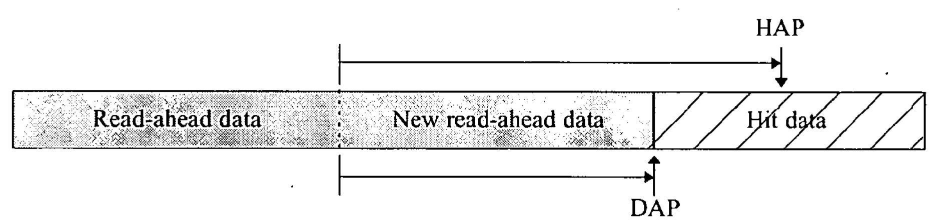
When the previously executed read command is the sequential command and the last sector address of the previous read command is sequential to the lead sector address of the received read command, the disk drive transfers the hit data in the buffer to the host system.

The disk drive performs the read-ahead operation of the new continuous data to the empty area that becomes vacant by data transfer at the same time as the disk drive starts transferring data to the host system.

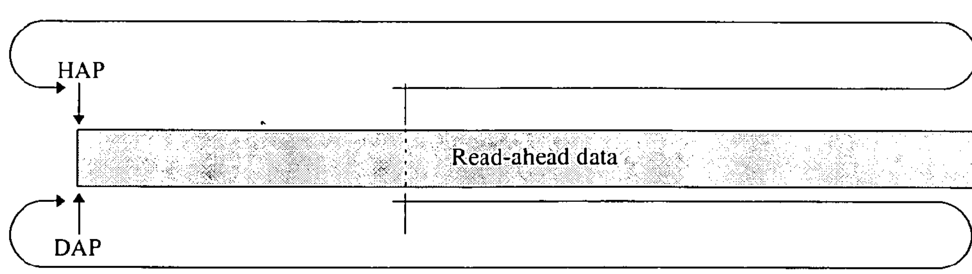
1) In the case that the contents of buffer is as follows at receiving a read command;



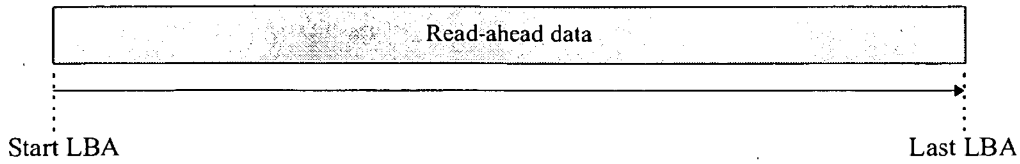
2) The disk drive starts the read-ahead operation to the empty area that becomes vacant by data transfer at the same time as the disk drive starts transferring hit data.



3) After completion of data transfer of hit data, the disk drive performs the read-ahead operation for the data area of which the disk drive transferred hit data.



4) Finally, the cache data in the buffer is as follows.



c. Non-sequential command immediately after sequential command

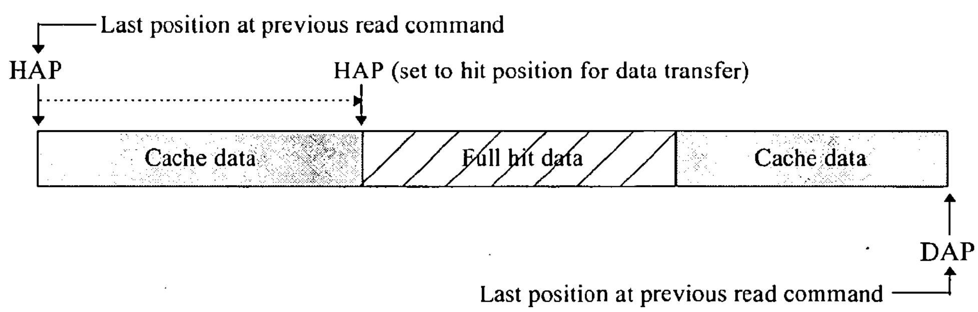
When a sequential read command (first read) has been executed, the first read operation should be stopped if a non-sequential read command has been received and then, ten or more of the non-sequential read commands have been received. (Refer to 6.5.3.1.)

The figure that describes the first read operation is the same as that shown in the sub-section a.

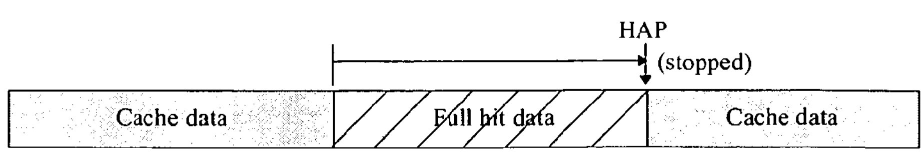
6.5.3.3 Full hit (hit all)

All requested data are stored in the data buffer. The disk drive starts transferring the requested data from the address of which the requested data is stored. After completion of command, a previously existed cache data before the full hit reading are still kept in the buffer, and the disk drive does not perform the read-ahead operation.

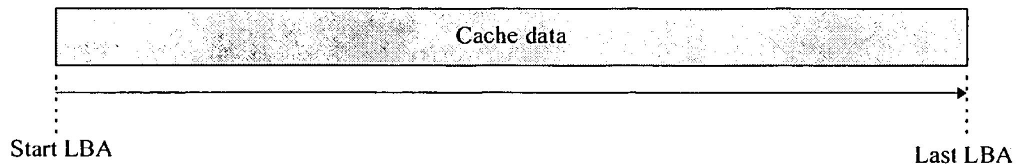
1) In the case that the contents of the data buffer is as follows for example and the previous command is a sequential read command, the disk drive sets the HAP to the address of which the hit data is stored.



2) The disk drive transfers the requested data but does not perform the read-ahead operation.



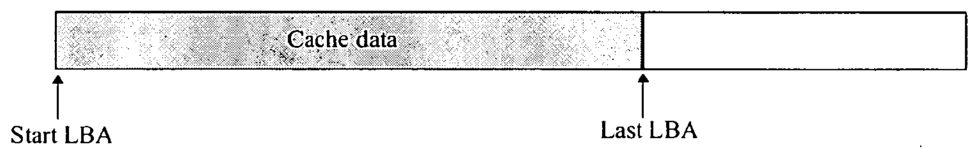
3) The cache data for next read command is as follows.



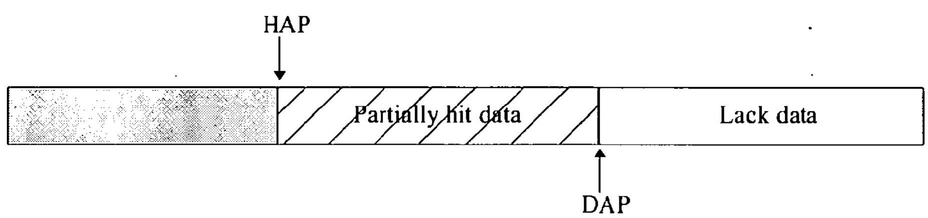
6.5.3.4 Partially hit

A part of requested data including a lead sector are stored in the data buffer. The disk drive starts the data transfer from the address of the hit data corresponding to the lead sector of the requested data, and reads remaining requested data from the disk media directly. The disk drive does not perform the read-ahead operation after data transfer.

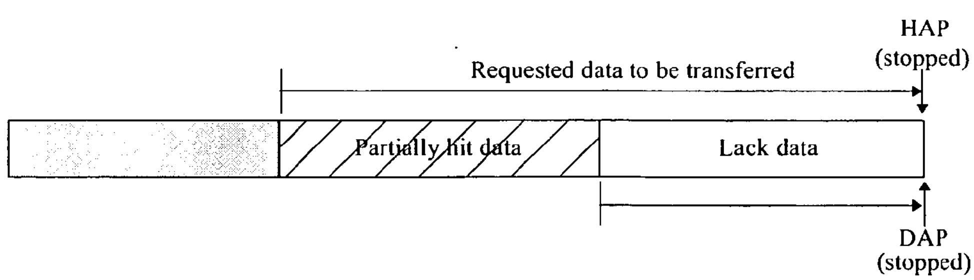
Following is an example of partially hit to the cache data.



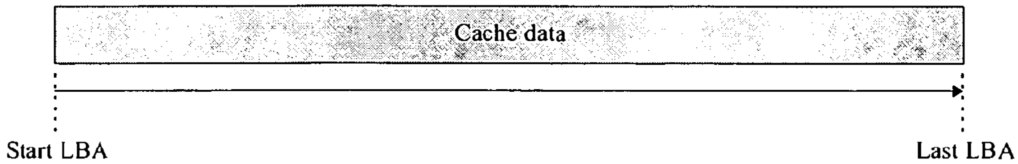
1) The disk drive sets the HAP to the address where the partially hit data is stored, and sets the DAP to the address just after the partially hit data.



2) The disk drive starts transferring partially hit data and reads lack data from the disk media at the same time. However, the disk drive does not perform the read-ahead operation newly.



3) The cache data for next read command is as follows.



6.6 Write Cache

The write cache function of the drive makes a high speed processing in the case that data to be written by a write command is physically sequent the data of previous command and random write operation is performed.

When the drive receives a write command, the drive starts transferring data of sectors requested by the host system and writing on the disk medium. After transferring data of sectors requested by the host system, the drive generates the interrupt of command complete. Also, the drive sets the normal end status in the Status register.

The drive continues writing data on the disk medium. When all data requested by the host are written on the disk medium, actual write operation is completed.

The drive receives the next command continuously. If the received command is a "sequential write" (data to be written by a command is physically sequent to data of previous command), the drive starts data transfer and receives data of sectors requested by the host system. At this time, if the write operation of the previous command is still been executed, the drive continuously executes the write operation of the next command from the sector next to the last sector of the previous write operation. Thus, the latency time for detecting a target sector of the next command is eliminated. This shortens the access time.

The drive generates an interrupt of command complete after completion of data transfer requested by the host system as same as at previous command.

When the write operation of the previous command had been completed, the latency time occurs to search the target sector.

If the received command is not a "sequential write", the drive receives data of sectors requested by the host system as same as "sequential write". The drive generates the interrupt of command complete after completion of data transfer requested by the host system. Received data is processed after completion of the write operation to the disk medium of the previous command.

Even if a hard reset or soft reset is received or the write cache function is disabled by the SET FEATURES command during unwritten data is kept, the instruction is not enabled until remaining unwritten data is written onto the disk medium.

The drive uses a cache data of the last write command as a read cache data. When a read command is issued to the same address after the write command (cache hit), the read operation to the disk medium is not performed.

If an error occurs during the write operation, the device retries the processing. If the error cannot be recovered by retry, automatic alternate assignment is performed. For details about automate alternate assignment, see item (3) of Section 6.4.2.

The write cache function is operated with the following command.

- WRITE SECTOR(S)
- WRITE MULTIPLE
- WRITE DMA

IMPORTANT

When Write Cache is permitted, the writing of the data transferred from the host by the abovementioned Write Cache permit command into the disk medium may not be completed at the moment a normal ending interrupt has occurred.

In case a non-recoverable error has occurred during receiving more than one write command, it is difficult for the host to identify a command that caused the error.

(However, the error is not reported to the hose if an error at writing has been processed normally.)

Therefore, note that it is difficult for the host to retry an operation that caused a non-recoverable error.

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Glossary

Actuator

Head positioning assembly. The actuator consists of a voice coil motor and head arm. If positions the read-write (R-W) head.

AT bus

A bus between the host CPU and adapter board

ATA (AT Attachment) standard

The ATA standard is for a PC AT interface regulated to establish compatibility between products manufactured by different vendors. Interfaces based on this standard are called ATA interfaces.

BIOS standard for drives

The BIOS standard collectively refers to the parameters defined by the host, which, for example, include the number of cylinders, the number of heads, and the number of sectors per track in the drive. The physical specifications of the drive do not always correspond to these parameters.

The BIOS of a PC AT cannot make full use of the physical specifications of these drivers. To make the best use of these drives, a BIOS that can handle the standard parameters of these drives is required.

Command

Commands are instructions to input data to and output data from a drive. Commands are written in command registers.

Data block

A data block is the unit used to transfer data. A data block normally indicates a single sector.

DE

Disk enclosure. The DE includes the disks, built-in spindle motor, actuator, heads, and air filter. The DE is sealed to protect these components from dust.

Master (Device 0)

The master is the first drive that can operate on the AT bus. The master is daisy-chained with the second drive which can operate in conformity with the ATA standard.

MTBF

Mean time between failures. The MTBF is calculated by dividing the total operation time (total power-on time) by the number of failures in the disk drive during operation.

MTTR

Mean time to repair. The MTTR is the average time required for a service person to diagnose and repair a faulty drive.

PIO (Programmed input-output)

Mode to transfer data under control of the host CPU

Positioning

Sum of the seek time and mean rotational delay

Power save mode

The power save modes are idle mode, standby mode, and sleep mode.

In idle mode, the drive is neither reading, writing, nor seeking data. In standby mode, the spindle motor is stopped and circuits other than the interface control circuit are sleeping. The drive enters sleep mode when the host issues the SLEEP command.

Reserved

Reserved bits, bytes, and fields are set to zero and unusable because they are reserved for future standards.

Rotational delay

Time delay due to disk rotation. The mean delay is the time required for half a disk rotation. The mean delay is the average time required for a head to reach a sector after the head is positioned on a track.

Seek time

The seek time is the time required for a head to move from the current track to another track. The seek time does not include the mean rotational delay.

Slave (Device 1)

The slave is a second drive that can operate on the AT bus. The slave is daisy-chained with the first drive operating in conformity with the ATA standard.

Status

The status is a piece of one-byte information posted from the drive to the host when command execution is ended. The status indicates the command termination state.

VCM

Voice coil motor. The voice coil motor is excited by one or more magnets. In this drive, the VCM is used to position the heads accurately and quickly.

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Acronyms and Abbreviations

A

ABRT Abored command
AIC Automatic idle control
AMNF Address mark not found
ATA AT attachment
AWG American wire gage

B

BBK Bad block detected
BIOS Basic input-output system

C

CORR Corrected data
CH Cylinder high register
CL Cylinder low register
CM Command register
CSR Current sense register
CSS Current start/stop
CY Cylinder register

D

dBA dB A-scale weighting
DE Disk enclosure
DH Device/head register
DRDY Drive ready
DRQ Ddata request bit
DSC Drive seek complete
DWF Drive write fault

E

ECC Error checking and correction
ER Error register
ERR Error

F

FR Feature register

H

HA Host adapter
HDD Hard disk drive

I

IDNF ID not found
IRQ14 Interrupt request 14

L

LED Light emitting diode

M

MB Mega-byte
MB/S Mega-byte per seconds
MPU Micro processor unit

P

PCA Printed circuit assembly
PIO Programed input-output

R

RLL Run-lrnght-limited

S

SA System area
SC Sector count register
SG Signal ground
SN Sector number register
ST Status register

T

TPI Track per inches
TRONF Track 0 not found
Typ Typical

U

UNC Uncorrectable ECC error

V

VCM Voice coil motor

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Index

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Comment Form

We would appreciate your comments and suggestions regarding this manual.

Manual code	C141-E088-01EN
Manual name	MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT DISK DRIVES PRODUCT MANUAL

Please mark each item: E(Excellent), G(Good), F(Fair), P(Poor).

General appearance	( )	Illustration	( )
Technical level	( )	Glossary	( )
Organization	( )	Acronyms & Abbreviations	( )
Clarity	( )	Index	( )
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Comments & Suggestions

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Page	Line	Contents

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C141-E088-01EN

MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT DISK DRIVES PRODUCT MANUAL

C141-E088-01EN

MHJ2181AT, MHK2120AT, MHK2090AT, MHK2060AT DISK DRIVES PRODUCT MANUAL

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A

NEW APPLICATION TRANSMITTAL

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Attorney Docket No. 17002-020800US

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ASSISTANT COMMISSIONER FOR PATENTS
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Sir:
Transmitted herewith for filing under 37 CFR 1.53(b) is the
[X] patent application of
[ ] continuation patent application of
[ ] divisional patent application of
[ ] continuation-in-part patent application of

Inventor(s)/Applicant Identifier: Ron Goodman, et al.

For: SYSTEM FOR SELECTING AND PLAYING SONGS IN A PLAYBACK DEVICE WITH A LIMITED USER INTERFACE

Enclosed are:
[X] 11 page(s) of specification
[X] 4 page(s) of claims
[X] 1 page of Abstract
[X] 11 sheet(s) of [ ] formal [X] informal drawing(s).
[ ] An assignment of the invention to ______
[ ] A [ ] signed [ ] unsigned Declaration & Power of Attorney
[X] A [ ] signed [X] unsigned Declaration.
[ ] A Power of Attorney.
[ ] A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27 [ ] is enclosed [ ] was filed in the prior application and small entity status is still proper and desired.
[ ] A certified copy of a ______ application.
[ ] Information Disclosure Statement under 37 CFR 1.97.
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In view of the Unsigned Declaration as filed with this application and pursuant to 37 CFR §1.53(f), Applicant requests deferral of the filing fee until submission of the Missing Parts of Application.

DO NOT CHARGE THE FILING FEE AT THIS TIME.

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SF 1175578 v1

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PATENT APPLICATION

SYSTEM FOR SELECTING AND PLAYING SONGS IN A PLAYBACK DEVICE WITH A LIMITED USER INTERFACE

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SYSTEM FOR SELECTING AND PLAYING SONGS IN A PLAYBACK DEVICE WITH A LIMITED USER INTERFACE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to the following co-pending applications: "System For Managing Power In A Portable Music Player" (Atty. Docket No. 17002-022400) and "Automatic Hierarchical Categorization Of Music By Metadata" (Atty. Docket No. 17002-022500) both filed January 5, 2001, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Today, portable consumer electronic devices are more powerful than ever. For example, small, portable music playback devices can store hundreds, even thousands, of compressed songs and can play back the songs at high quality. With the capacity for so many songs, a playback device can store many songs from different albums, artists, styles of music, etc.

However, a problem exists with such devices because the small size of the devices means that only a very limited user interface can be provided.

Typically, the user interface includes a small display screen. Such a display screen might be, e.g., 1" x 2". This small display size is necessary because of the physical size of the device which is typically carried in the hand. The small size also limits the number, size, shape, and types of user input controls that can be mounted on the device. For example, a few pushbuttons are usually provided to perform all of the device's control functions.

Using such a compact user interface to navigate and select among hundreds of songs is inefficient and often frustrating. The display screen can only show a few song titles at one time, and the limited controls make it difficult for a user to arbitrarily select, or move among, the songs.

Thus, it is desirable to provide a user interface suitable for a small device. The user interface should allow a user to efficiently navigate among, and select from, many items stored in the device.

SUMMARY OF THE INVENTION

The present invention provides an efficient user interface for a small portable music player. The invention is suitable for use with a limited display area and small number of controls to allow a user to efficiently and intuitively navigate among, and select, songs to be played. By using the invention, very large numbers of songs can be easily accessed and played.

One aspect of the invention includes an overlapping hierarchy of categories. Categories include items that can also be included in other categories so that the categories "overlap" with each other. Thus, a song title can be accessed in multiple different ways by starting with different categories. For example, a preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Similarly, the Artists category includes names of artists which are, in turn, associated with their albums and songs. The Genre category includes types of categories of music such as "Rock", "Hip Hop", "Rap", "Easy Listening", etc. Within these sub-categories are found associated songs. Finally, the "Play Lists" category includes collections of albums and/or songs which are typically defined by the user.

Advantageous use is made of the overlapping hierarchy to allow the user to quickly designate a song for playback. The device uses three "soft" pushbuttons that have assignable functions. The interface maintains consistent button functionality whenever possible and uses uniform command names and operations on different types of items so that the interface is more intuitive. For example, the user can open and queue both albums and songs with predictable results.

The interface also provides for multiple functions for a single control. For example, a "Play" button can act, in a first function, to play a currently-selected song. The Play button can act, in a second function, to cycle through different playback modes. The modes can be, e.g., (1) playback of songs from a hard disk; (2) playback of music from a radio receiver built into the device; and (3) playback of voice messages. The first function for the Play button can be activated by momentarily depressing the Play button for a short period of time. The second function is invoked by depressing the Play button for a longer period of time whereupon the device cycles through the different modes. Other ways of invoking the functions are possible such as where the second function is automatically entered from a powered-down state.

In one embodiment, the invention provides a method for selecting songs to be played in an electronic audio device, wherein the device includes a display and one or more user input controls, wherein songs are organized into categories, albums, wherein songs and albums are associated with artist names. The method includes steps of displaying categories on the display; accepting signals from a user input control to select a category; displaying one or more songs in the selected category on the display; accepting signals from a user input control to select a displayed song; and entering selected songs into a playlist queue, wherein the device plays back songs in the playlist queue.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates the NOMAD Jukebox and its user interface controls;

Fig. 2 illustrates a sequence of display screens describing how to navigate to lower levels;

Fig. 3 illustrates associations among items;

Fig. 4 shows display screens used to search for a song or other item;

Fig. 5 illustrates details of different items;

Fig. 6 shows menus that are available to the user to set different parameters;

Fig. 7A is a flowchart illustrating menu displays and sequencing for navigating through a playlist;

Fig. 7B is a flowchart illustrating menu displays and sequencing for playing files and managing playlists;

Fig. 7C is a flowchart illustrating menu displays and sequencing for deleting items;

Fig. 8 illustrates a playback device coupled to a host computer system; and

Fig. 9 is a screen display of a bridge interface.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

A preferred embodiment of the present invention is incorporated into a product manufactured and distributed by Creative Technology, Ltd. The product is called the "NOMAD Jukebox."

Fig. 1 illustrates the NOMAD Jukebox and its user interface controls.

In Fig. 1, electronic audio device 100 measures about 5.5" wide by 5.5" tall by 1" thick. Display screen 102 is about 2" wide by 1" tall. Display screen 102 includes different regions such as main region 104 and soft button function description region 106.

Three soft buttons are located at 108; including buttons 110, 112 and 114. The specific command, or function, that any of the soft buttons perform when depressed is indicated by the label in soft button function description region 106. Thus, the function of soft button 112 (as shown in Fig. 1) is "open," the function of soft button 114 is "search" while soft button 110 is currently not assigned a function.

The other eight buttons on device 100 perform essentially the same functions at all times. In other words, they are not subject to function changes according to soft button function description area 106. These buttons include Library button 116, EAX and System button 118, Skip Backward button 120, Play button 122, Stop button 124, Skip Forward button 126, Scroll Up button 128 and Scroll Down button 130. However, as discussed below, these buttons (or any type of controls used with the device) can include alternate functionality that is invoked in different ways.

The device uses visual cues, or indicators, in the display. When an item is highlighted it indicates that the item is the "current" item, or currently-selected item, which is susceptible to be operated on by a subsequent user action – such as playback, or expansion of the item. In Fig. 1, screen 102 shows that the item, "ALBUMS," is highlighted. The highlighted item can be acted upon by using the soft buttons, or another button, as discussed below. The current item can be changed by using Scroll Up button 128 and Scroll Down button 130 to move the highlight up or down, respectively, throughout a list of displayed items.

Icons are used to provide additional visual cues for an item. In Fig. 1, each of the categories has a category icon to the left of it. The category icon, which may not be distinctly visible in the Figure, illustrates a first box connected by lines to additional boxes below the first box. The icon depicts a hierarchy and illustrates the property of categories, i.e., that categories can contain additional categories, songs or other items.

Fig. 2 illustrates a sequence of display screens describing how to navigate to lower levels.

In Fig. 2, library category screen 150 shows the display as it appears when the user depresses library button 116 of Fig. 1. A preferred embodiment of the device uses 4 first-level categories. These are "Albums", "Artists," "Styles" and "Play Lists". Each of these categories can "contain," or be associated with, other categories, songs, or items.

Note that in library category screen 150 ALBUMS is currently highlighted. By depressing soft button 112 of Fig. 1, the "open" command is performed on the highlighted category, as indicated by the labeling of soft button 112 and soft button function description area 152 of Fig. 2.

Lists screen 154 is displayed as a result of a user opening the Albums category of library category screen 150. Lists screen 154 shows items within the Albums category such as commercial albums of multiple songs from a record label, pre-made lists or collections created by a user, or other predefined lists or collections of songs or recordings.

In Fig. 2, lists screen 154 shows each item as a list of songs. This is shown visually by the icon to the left of each item which depicts a miniature list. Possible soft button commands are "Close", "Open" and "Queue". These commands correspond to soft buttons 110, 112 and 114, respectively. If the user selects the Close command, the display reverts to library category screen 150. If the user selects the Open command, the display shows tracks screen 156. Alternatively, the user can select the Queue command to instruct the device to place all the songs from the selected (i.e., highlighted) list into the play list for eventual playback. Yet another option allows the user to press play button 122 of Fig. 1 to cause any currently-selected songs or a list of songs (e.g., an album) to immediately be played.

Returning to Fig. 2, tracks screen 156 shows that a single song called "JukeBox Demo" is in the list. The list is also called JukeBox Demo as shown in lists screen 154. Tracks screen 156 shows possible soft commands assigned to buttons, namely "Close", "Details" and "Queue." The Close button performs the same function as before -- it returns the user to the previous screen which, in this case, is lists screen 154. The user can also select the Details command to cause details of the song JukeBox Demo to be displayed in details screen 158 as shown in Fig. 2. The user can select the Queue command by soft button 114 to enter the selected song into the play list queue. As before, the user can also depress play button 122 of Fig. 1 to cause immediate playback of the selected song.

Details screen 158 shows information about the selected song including the name of the song, album (or list) name containing the song; the track number, if applicable, and track duration. Note that other information can be included. The user can preview the song, close the Details screen to return to the Tracks screen or queue the song on the play list queue.

The device provides the ability to "preview" audio files even while a current song, or playlist, is being played. When a user chooses to preview an audio file, the audio file is played for about 10 seconds while any currently-played file or playlist is suspended.

After previewing is complete, the suspended file or playlist resumes playback. In other embodiment, the preview duration can vary, or be stopped by user selection.

Fig. 3 illustrates associations among items.

In Fig. 3, song 168 is one of many songs stored in the device. Categories such as albums 160, artists 162, play lists 164 and genres 166 each include sub-categories. For example, albums 160 includes the names of various albums. Songs are associated with albums, genres and playlists. Such association can be by using pointers, a data structure including items to be associated, etc. "Association" as used herein, includes a first item associated with a second item; and the second item associated with the first item. In other words, albums can be associated with one or more songs in the database of the device so that an automated search to find all songs associated with an album is easier. The direction of arrow pointers in Fig. 3 is not intended to limit the manner of associations among items in the present invention.

Similar to albums, the category of artists 162 includes names of artists, or performers, of songs. Each artist name is associated with one or more songs in the database. Playlists 164 includes names of playlists. These are collections of songs that can be defined by the user, the device manufacturer, or others. Each playlist can be associated with one or more songs. Genres 166 includes various styles of music which are associated with one or more songs in the database. Note that items can exist without being associated with a song. Also, items can be associated with other items as where an artist name is associated with the albums containing the songs that the artist has created.

Although not shown in Fig. 3, items can have additional information, such as properties, details, etc., associated with the item. For example, a song can have information such as play time, artist name, artist album, copyright owner, etc., associated with the song.

Fig. 4 illustrates display screens used to search for a song or other item.

In Fig. 4, screen 180 is the initial library screen, as discussed above. If the user invokes the Search command (via the appropriate soft button) with Albums selected then screen 182 is displayed. Note that the search function can be applied to any of the categories. The user can depress the Plus or Minus soft buttons to cycle through the alphabet and change the character in the current location as indicated by the cursor. The cursor position is changed by using the scroll up/scroll down buttons 128 and 130, respectively, of Fig. 1. As each letter is entered the letters are compared and the nearest match of the stored albums' names is displayed as shown in screen 184. When the desired match is displayed the user selects the Go! command.

Screen 186 shows the result of selecting the Go! command. A list of albums is displayed with the matched album centered and selected. The user can close, open or queue the album as discussed above.

Fig. 5 illustrates details of different items.

In Fig. 5, screen 200 illustrates details displayed as a result of selecting the "Details" command from soft button 1A track is selected. Screen 200 shows that details of the track "Jukebox Demo" shows the name of the album that the track resides on, the creator, or copyright owner, of the track, and the playing time of the track.

Screen 202 illustrates details of an item on the active queue list. Items are placed onto the active queue list by selecting the "Queue" command when an album, song, track, or other item is selected, as discussed above. For example, screen 204 shows the active queuelist where the track "Jukebox Demo" is selected. By invoking the "Details" command screen 202 is brought up to show details of the Jukebox Demo track.

As shown in screen 202, the Detail screen shows what track number the selected track is, which album the track is from; the creator, or copyright owner, of the track, and the title of the track. Additionally, the details for an item on the queue list also show

playback settings. These are shown by two-letter abbreviations at the bottom of the screen. The settings are as show in Table I, below.

EA	Environmental Preset
EQ	Parametric EQ
HS	Headphone Spatialization
TS	Time Scaling
4S	Four Channel Speaker Sound (only if speakers are connected)

TABLE I

These settings have their common meanings, as is known in the art. Note that the setting 4S is not shown in screen 202 as it is not currently active.

Fig. 6 shows menus that are available to the user to set different parameters for some of the settings shown in Table I, and for additional properties of the device.

In screen 202, the word "ONCE" to the far right of the screen indicates the current playback setting for the play list, namely, that each track will played once. Other possible settings are SHUFFLE, RANDOM, or REPEAT.

Figs. 7A, 7B and 7C are flowcharts to illustrate menu displays and sequences for three different operations of, respectively, (1) navigating through a playlist, (2) playing files and managing playlists and (3) deleting files.

Fig. 8 illustrates the Nomad Jukebox coupled to a host computer system.

In Fig. 8, device 300 (e.g., the Nomad Jukebox) is coupled to host system 302. In a preferred embodiment host system 302 is a personal computer, such as an IBM-PC compatible computer. Host system 302 includes a user interface having display 304 and user input devices such as keyboard 306 and mouse 308. In other embodiments the host system need not be a full computer system. Any type of processing system having a user interface is possible. For example, it is possible to couple the device to a laptop computer, game console, web-enabled television, or any consumer electronic device or digital platform, in general. The host user interface need not provide a display and can be much more minimal than the keyboard and mouse shown in Fig. 8. A preferred embodiment of the invention uses a Universal Synchronous Bus (USB) connection but any type of connection such as IEEE 1394 (FireWire), Ethernet, Serial Port, etc. can be used. A wireless (i.e., optical or radio frequency) connection can be used.

Once device 300 is coupled to host system 302, a user of host system 302 can launch a bridge interface to allow for the transfer of files between device 300 and host system 302. In a preferred embodiment, once the bridge interface is launched, the controls of device 300 are inoperable. The user interface of host system 302 is used to operate the bridge interface to transfer files.

Fig. 9 is a screen display of the bridge interface.

In Fig. 9, the bridge display is shown having two separate areas. A first area at 350 corresponds to information and controls for the host system while a second area 352 corresponds to information and controls relating to the playback device, or Nomad Jukebox. The main windows in each of the areas show files residing on the respective system or device. Window 354 shows files residing on the host system. Window 356 shows files residing on the playback device. A highlighted file is transferred between the system and device by highlighting the file and depressing one of the two "Transfer" buttons between the windows.

In a preferred embodiment, only files in one window are actively highlighted. In Fig. 9, the file "Intrigue" in window 354 on the host system is actively highlighted. Although the file "Supernatural" in the playback device window 356 is also highlighted, this file is not "active" and the highlight for "Supernatural" is slightly less in intensity, or contrast. This difference may not be visible in the reprinted Figure. A file is made active simply by clicking on the file name. If a file is already highlighted in a window, clicking anywhere in the window makes any highlighted files in the window the active file or files.

When the active file is on the host system, only the lower transfer button is operable to send the file to the playback device. Likewise, when the active file is on the playback device, only the upper button is operable to send the file to the host system. The operable button is indicated by "brightening" the text of the button, as shown in Fig. 9 for the lower transfer button.

Both areas include controls for file manipulation such as changing directories, renaming and deleting files, etc.

Playback controls are shown in area 350. These are used to control playback of sound files on the host system. Standard controls for playing, pausing, stopping, skipping forward or backward, volume control, etc. are shown. In a preferred embodiment, once the bridge interface is launched, the physical controls on the playback device are not operable. Other embodiments can allow both the bridge interface and the playback device physical controls to operate. The bridge interface controls in area 350 of Fig. 9 can be used to control playback of audio files on the playback device. Controls on the playback device can be used to control playback of audio files on the host system.

In addition to the use of soft buttons as described, above, an embodiment of the invention provides for a single control, such as a button, to have multiple functions. For example, the Play button can perform a first function to play a currently-selected song. The Play button can also be used to perform a second function to put the device in an alternative playback mode. For example, an alternative embodiment of the device can include a radio receiver for playing signals from radio stations. A short depressing of the playback button acts to perform the first function and play back a currently-selected song. A long depressing of the playback button acts to perform the second function and to cycle through the different playback modes.

As an example, depressing the Play button for less than one-half second invokes the first function – that of playback of a selection. Depressing the Play button for more than one-half second causes playback of a selection for two second. After two seconds a test is made by the device to determine if the Play button is still being depressed. If not, the selected song continues to play and the device remains in the mode of playing back songs from a hard disk. If the Play button is still being depressed then playing of a currently selected (or last chosen) radio station begins for two seconds. Again, after the two-second interval if the button is no longer pressed the radio mode of the device is maintained and the radio signals are played. If the Play button is still pressed then a third mode of voice-recorded message playback is entered whereupon voice messages recorded by a user are played back.

Note that either function of the Play button can be invoked by other means. For example, the second function (mode changing) can be entered whenever the Play button is depressed when the device is in a powered-down state. Also, other modes can be used such as video playback, audio CD playback, etc. – assuming the device is so equipped.

Although the present invention has been discussed with respect to specific embodiments, these embodiments are merely illustrative, and not restrictive, of the invention. For example, although the bridge interface has been discussed only for purposes of transferring files, the bridge interface can also be used to operate any of the controls of the device to cause the device (e.g., the Nomad JukeBox) to start, pause and stop the playback of songs.

The scope of the invention is to be determined solely by the appended claims.

WHAT IS CLAIMED IS:

1. A method for presenting songs to be played in an electronic audio device, wherein the electronic audio device includes a display and at least one user input control, the method comprising

associating a song with two or more categories in the device;

displaying the categories;

accepting signals from a user input control to select a category;

displaying the songs in the selected category;

accepting signals from a user input control to select a song; and

playing the song.

2. The method of claim 1, wherein the categories include the category "album."

3. he method of claim 1, wherein the categories include the category "artist."

4. The method of claim 1, wherein the categories include the category "style."

5. A method for navigating among a plurality of song titles, the method using a device having a display and a user interface, the device including a plurality of songs associated with items and categories, the method comprising

displaying first, second and third categories on the display, wherein the first category is of albums of songs, wherein the second category is of artists and wherein the third category is of genres of recordings;

accepting signals from the user input control to select a category;

displaying items associated with the category;

accepting signals from the user interface to select one or more items and, if the selected items have additional associated items then displaying the additional associated items to progress down the hierarchy; and

displaying at least one song associated with one or more of the selected items.

6. A user interface for a device to play back songs, user interface comprising

a processor;

a display coupled to the processor;

at least one user input control coupled to the processor;

storage coupled to the processor, wherein the storage includes a song associated with two different categories;

a category display process for displaying the categories on the display;

a category selection mechanism for receiving signals from the user interface to select a category, wherein the category includes the song;

a song display mechanism for displaying the song in response to a signal from the category selection mechanism; and

a playback mechanism for playing the song.

accepting a new song for storage in the device;

associating the new song with two or more top-level categories in the hierarchy;

allowing the user to store a new song in the device; and

accepting signals from the user interface to associate the song in the overlapping hierarchy.

7. A method for selecting songs to be played in an electronic audio device, wherein the device includes a display and one or more user input controls, wherein songs are organized into categories, albums, wherein songs and albums are associated with artist names, the method comprising

displaying categories on the display;

accepting signals from a user input control to select a category;

displaying one or more songs in the selected category on the display;

accepting signals from a user input control to select a displayed song; and

entering selected songs into a playlist queue, wherein the device plays back songs in the playlist queue.

8. The method of claim 1, wherein the categories include the category "album."

9. The method of claim 1, wherein the categories include the category "artist."

10. The method of claim 1, wherein the categories include the category "style."

11. A method for presenting songs for selection on a display, the method comprising

organizing the songs into multiple overlapping categories; and

displaying the categories and songs on the display.

12. A method for selecting songs for playback in an electronic device, the device including a user interface coupled to a processor, the user interface including a display and user input controls, wherein a plurality of songs are stored in the device and are associated with an album name, the method comprising

displaying the album name on the display;

designating a first single-action user input control for signaling an "opening" command;

designating a second single-action user input control for signaling a "queuing" command;

if the "queuing" command is received then designating the plurality of songs for playback;

if the "opening" command is received then performing the following steps

displaying the plurality of songs;

accepting signals from a user input control to select a song;

if the "queuing" command is received then designating the selected song for playback; and

if the "opening" command is received then displaying information about the selected song.

13. A method for providing multiple functions for a Play button in an electronic device, wherein the electronic device includes a first playback mode for playing audio files from a local storage and a second playback mode for playing audio information from other than the local storage, the method comprising

determining whether the Play button is operated by a user in a first manner;

if the Play button is operated in the first manner then performing the step of playing back an audio file from the local storage else performing the step of playing back audio information from other than the local storage.

14. The method of claim 13, wherein the first manner is depressing the Play button for less than a predetermined time.

15. The method of claim 13, wherein the first manner is depressing the Play button for greater than a predetermined time.

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09755629.010501

SYSTEM FOR SELECTING AND PLAYING SONGS IN A PLAYBACK DEVICE WITH A LIMITED USER INTERFACE

ABSTRACT OF THE DISCLOSURE

An efficient user interface for a small portable music player. The user interface uses an overlapping hierarchy of categories. A song title can be accessed in multiple different ways by starting with different categories. A preferred embodiment of the invention uses the top-level categories "Albums", "Artists", "Genres" (or styles), and "Play Lists". Within the Albums category are names of different albums of songs stored in the device. Within each album are the album tracks, or songs, associated with that album. Similarly, the Artists category includes names of artists which are, in turn, associated with their albums and songs. The Genre category includes types of categories of music such as "Rock", "Hip Hop", "Rap", "Easy Listening", etc. Within these sub-categories are found associated songs. Finally, the "Play Lists" category includes collections of albums and/or songs which are typically defined by the user. The interface also provides for multiple functions for a single control. For example, a "Play" button can act, in a first function, to play a currently-selected song. The Play button can act, in a second function, to cycle through different playback modes. The modes can be, e.g., (1) playback of songs from a hard disk; (2) playback of music from a radio receiver built into the device; and (3) playback of voice messages.

SF 1154851 v1

10057552.010501

DECLARATION

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **SYSTEM FOR SELECTING AND PLAYING SONGS IN A PLAYBACK DEVICE WITH A LIMITED USER INTERFACE** the specification of which __X__ is attached hereto or ____ was filed on ______________ as Application No. ______________ and was amended on ______________ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56. I claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Country	Application No.	Date of Filing	Priority Claimed Under 35 USC 119

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

Application No.	Filing Date

I claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Date of Filing	Status
Unassigned	01/05/00	Pending
Unassigned	01/05/00	Pending

Full Name of Inventor 1:	Last Name: **GOODMAN**	First Name: **RON**	Middle Name or Initial:	
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Residence & Citizenship:	City:	State/Foreign Country:	Country of Citizenship: **Canada**	
Post Office Address:	Post Office Address:	City:	State/Country:	Postal Code:
Full Name of Inventor 4:	Last Name: **AYON**	First Name: **MARIA**	Middle Name or Initial:	
Residence & Citizenship:	City:	State/Foreign Country:	Country of Citizenship: ————	
Post Office Address:	Post Office Address:	City:	State/Country:	Postal Code:

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 1 Ron Goodman	Signature of Inventor 2 Howard N. Egan	Signature of Inventor 3 David Bristow
Date	Date	Date
Signature of Inventor 4 Maria Ayon		
Date		

84/609

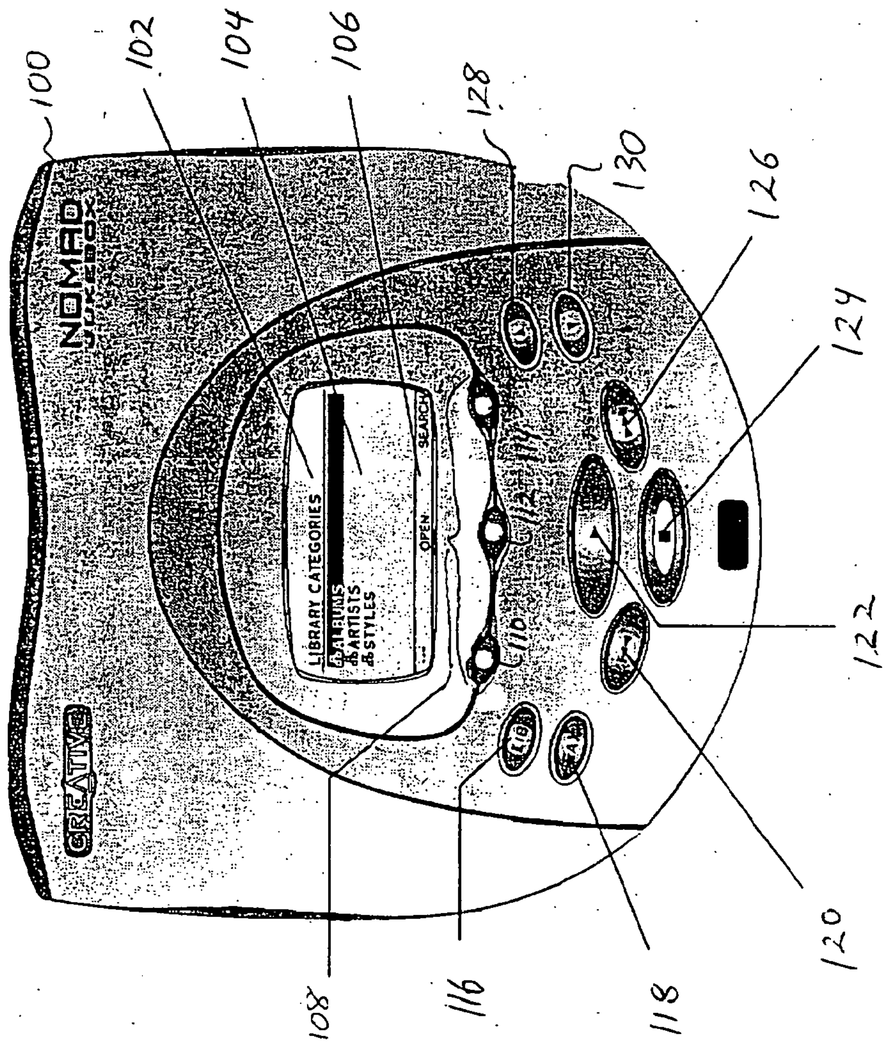

CREATIVE
NOMAD
JUKEBOX
LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
OPEN
SEARCH
100
102
104
106
108
110
112
114
116
118
120
122
124
126
128
130

Fig. 1

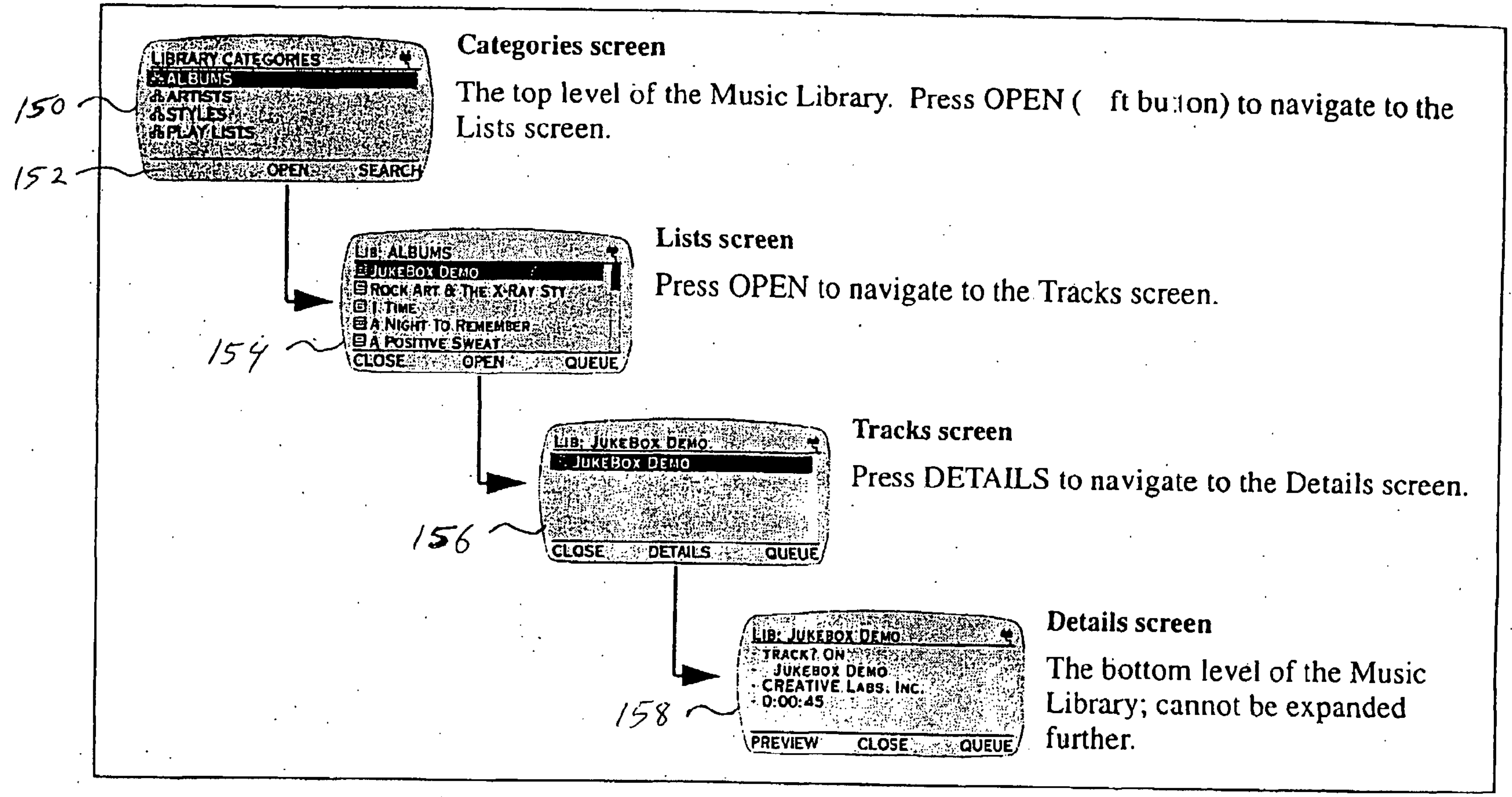

LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
PLAY LISTS
OPEN
SEARCH
150
152
Categories screen
The top level of the Music Library. Press OPEN (ft bu:ion) to navigate to the Lists screen.
LIB: ALBUMS
JUKEBOX DEMO
ROCK ART & THE X-RAY STY
I TIME
A NIGHT TO REMEMBER
A POSITIVE SWEAT
CLOSE
OPEN
QUEUE
154
Lists screen
Press OPEN to navigate to the Tracks screen.
LIB: JUKEBOX DEMO
JUKEBOX DEMO
CLOSE
DETAILS
QUEUE
156
Tracks screen
Press DETAILS to navigate to the Details screen.
LIB: JUKEBOX DEMO
TRACK? ON
JUKEBOX DEMO
CREATIVE LABS, INC.
0:00:45
PREVIEW
CLOSE
QUEUE
158
Details screen
The bottom level of the Music Library; cannot be expanded further.

Fig. 2

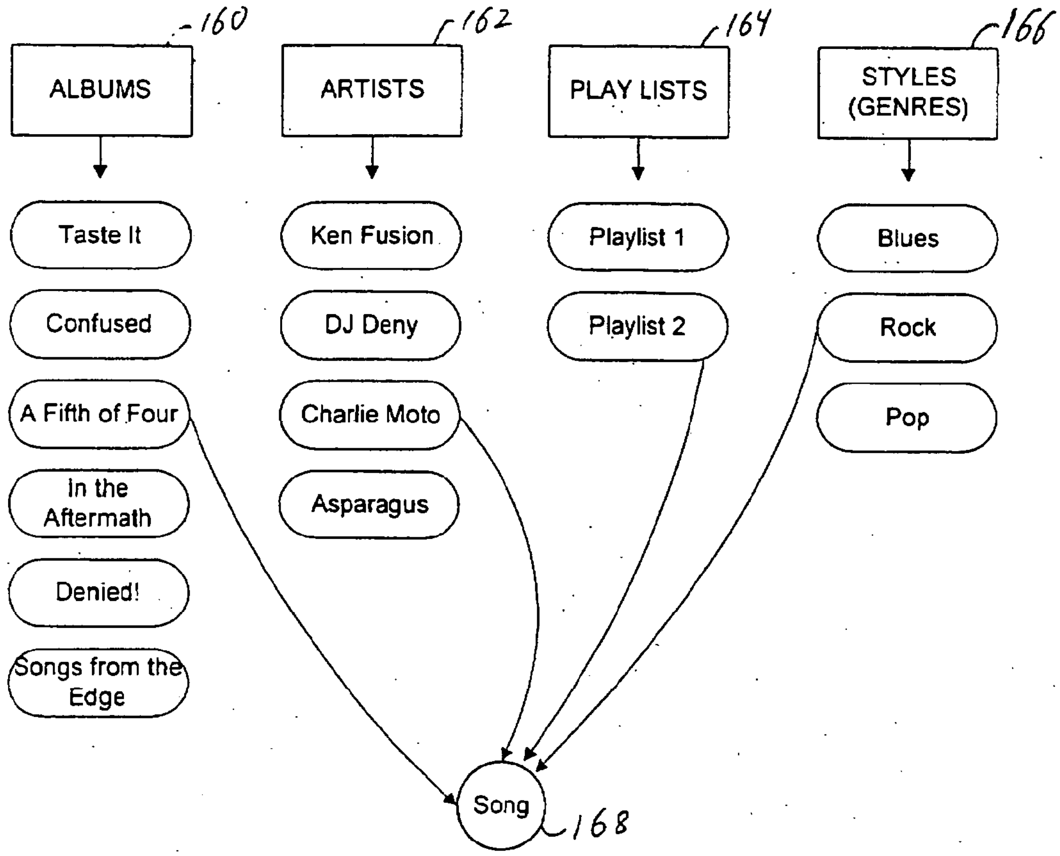

160
162
164
166
ALBUMS
ARTISTS
PLAY LISTS
STYLES (GENRES)
Taste It
Confused
A Fifth of Four
In the Aftermath
Denied!
Songs from the Edge
Ken Fusion
DJ Deny
Charlie Moto
Asparagus
Playlist 1
Playlist 2
Blues
Rock
Pop
Song
168

Fig. 3

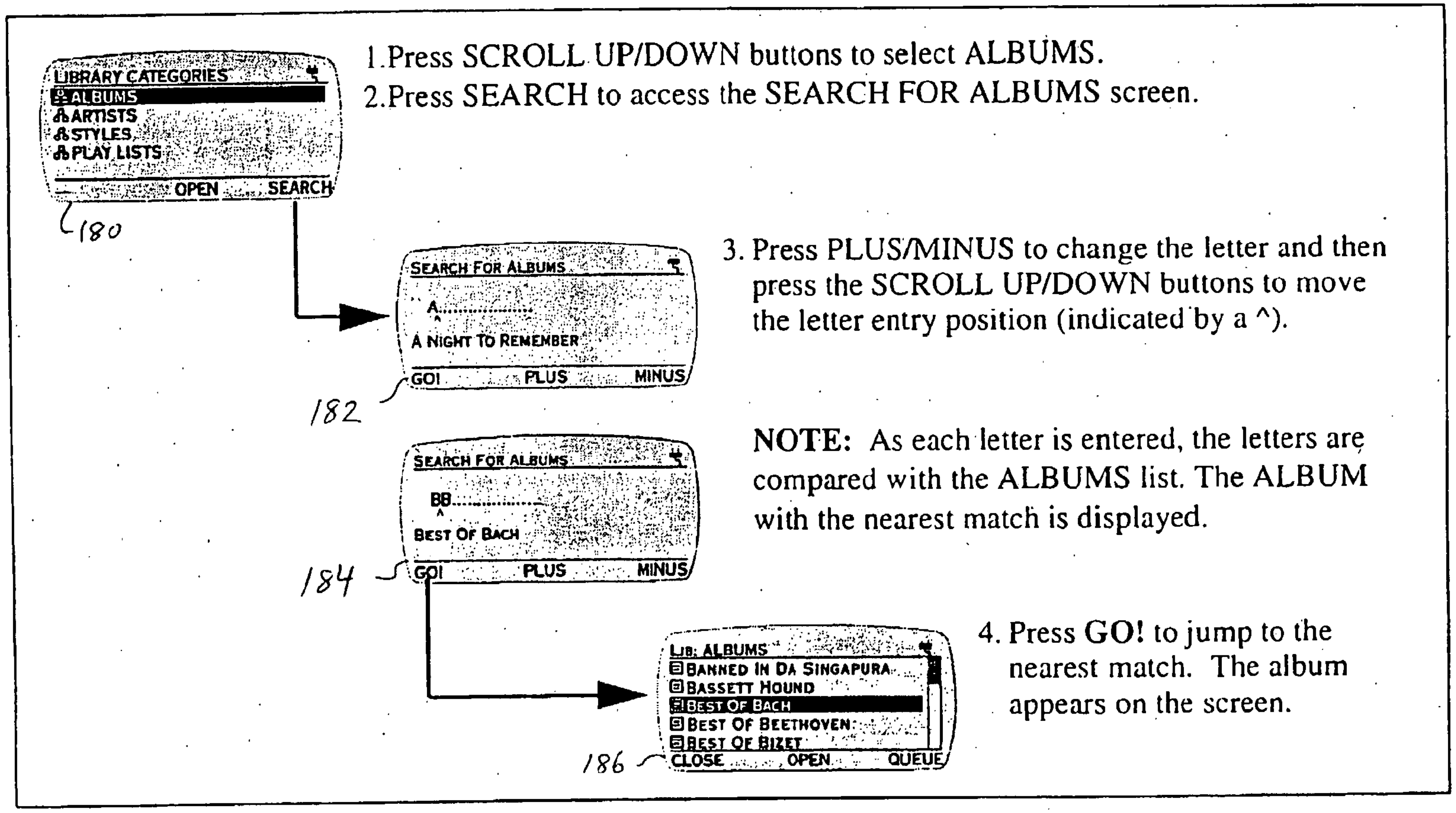
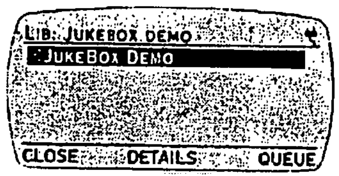
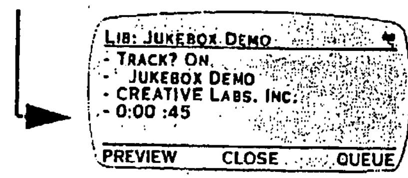

1.Press SCROLL UP/DOWN buttons to select ALBUMS.
2.Press SEARCH to access the SEARCH FOR ALBUMS screen.
LIBRARY CATEGORIES
ALBUMS
ARTISTS
STYLES
PLAY LISTS
OPEN
SEARCH
180
3. Press PLUS/MINUS to change the letter and then press the SCROLL UP/DOWN buttons to move the letter entry position (indicated by a ^).
SEARCH FOR ALBUMS
A
A NIGHT TO REMEMBER
GO!
PLUS
MINUS
182
NOTE: As each letter is entered, the letters are compared with the ALBUMS list. The ALBUM with the nearest match is displayed.
SEARCH FOR ALBUMS
BB
BEST OF BACH
GO!
PLUS
MINUS
184
4. Press GO! to jump to the nearest match. The album appears on the screen.
LIB: ALBUMS
BANNED IN DA SINGAPURA
BASSETT HOUND
BEST OF BACH
BEST OF BEETHOVEN
BEST OF BIZET
CLOSE
OPEN
QUEUE
186

Fig. 4

View DETAILS accessed from the TRACKS screen:



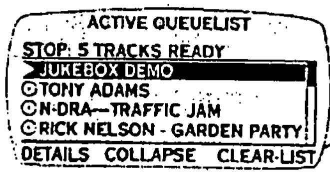
1. Press DETAILS. The DETAILS screen displays the Track Order, Album, Artist, and duration of the track.



200

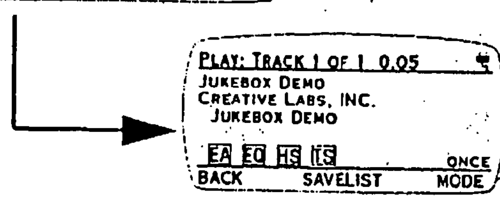
2. Press CLOSE to return to the TRACKS screen.

Viewing DETAILS accessed from the ACTIVE QUEUE LIST screen:.



204

1. Press DETAILS. The DETAILS screen displays the Track Title, Artist, and Album together with Audio Playback settings (see note below) and Play Mode (see "Setting Play Mode" on page 16).



202

2. Press BACK to return to the ACTIVE QUEUE LIST screen.

Fig. 5

PRINT OF DRAWINGS
AS ORIGINALLY FILED

EAX AND SYSTEM MENU
1. Parametric EQ
2. Spatialization
3. EAX presets
4. Playback Speed
5. System Preferences
6. System Information

Back Open ...

Parametric EQ (1)

EQ: on/off
Bass: +? dB
Mid: +? dB
Treble: +? dB
Middle Frequency: ??Hz

\- + More
Save Cancel More

Spatialization (2)

Headphone: ??
Rear Speaker ??
Save Changes: On/Off

Back - +

EAX presets (3)

Effect:
Amount:
Save Changes: On/Off

Back - +

Playback Speed (4) (NOTE 1)

Playback Speed:
Save Changes: On/Off

Back - +

System Preferences:(5) (NOTE 2,3,4,5)

Backlight:
Contrast:
Sleep Timer:
Idle Status/Detail Popup:
Save Changes: On/off

Back - +

System Information (6)

Firmware release date:
Power Status: (battery/external)
ID:
Total Disk Space
Free Disk Space:
Track Count:
Album Count

Back ... ...

EAX AND SYSTEM MENU Screen
System Options

LIB BUTTON Function:

LIB button rotates between current EAX submenu and Main Library screen

EAX BUTTON Function:

EAX button rotates between current EAX submenu and main Active Queue screen.

NOTE 1: When the playback speed is not 1x. The following should be displayed on screen.

Playback speed: ??
EAX effects disabled

Bottom line dissappear if speed returns to 1x.

NOTE 2: Backlight should have the following options when +/- pressed:
Always OFF/10 Seconds/30 Seconds/1 Minute/5 Minutes/Always ON

NOTE 3: Start up volume should retain volume when unit was last turned off as well as having the ability to change volume any time.

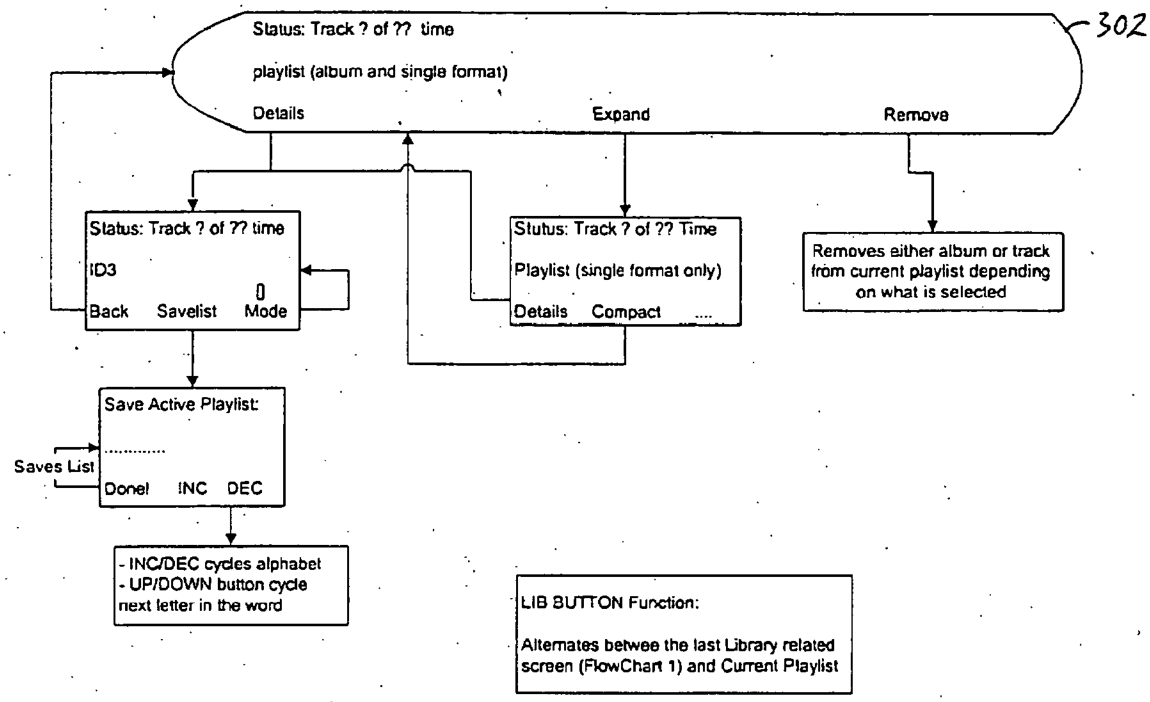
NOTE 4: Sleep Timer options:
Off/30 Seconds/1 Minute/3 Minutes/4 Minutes/5 Minutes/10 Minutes/15 Minutes

NOTE 5: Idle Status/Details Popup:
Always Off/30 Seconds/1 Minute/3 Minutes/4 Minutes/5 Minutes/10 Minutes/15 Minutes

SF 1123485 v1

Fig. 6

PRINT OF DRAWINGS
AS ORIGINALLY FILED



Navigating through current playlist.

SF 1123480 v1

Fig. 7A

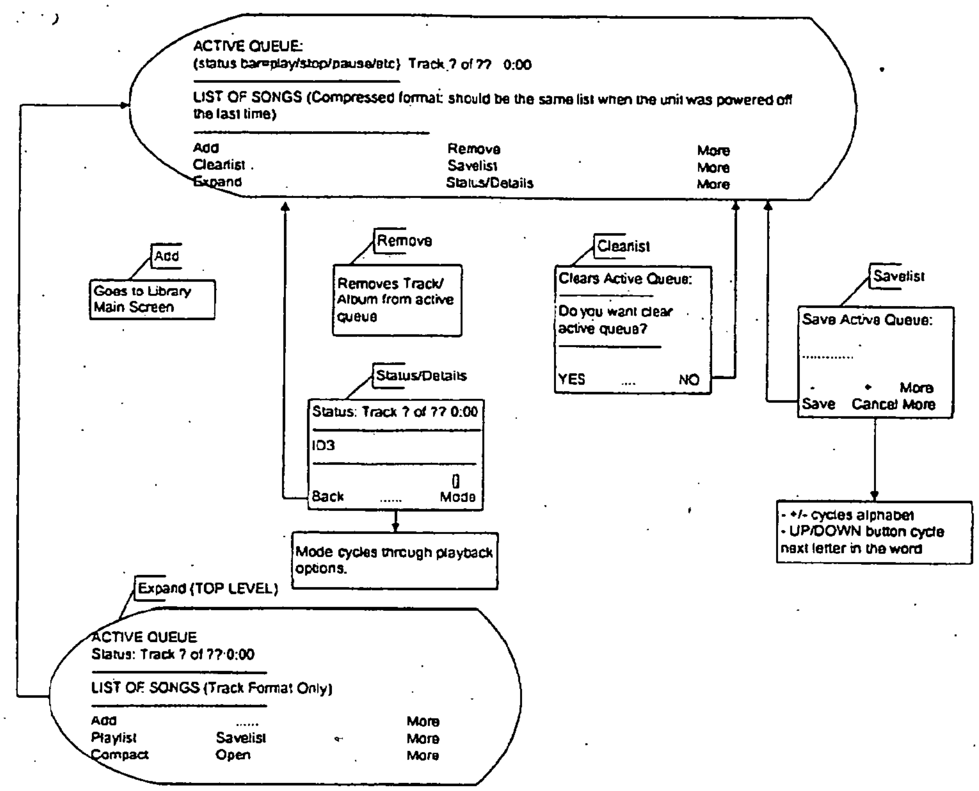


Fig. 7B

ACTIVE QUEUE Screen
Playing files and managing playlists

LIB BUTTON Function:

Alternates between the last Library related screen and last Active Queue related screen

EAX BUTTON Function:

Toggles ON/OFF EAX main screen.

NOTE: The Status/Details should pop up with select/playing track on playlist when the player is idle for certain period of time. Option in EAX should control idle on/off and time before idle screen pops up.

NOTE: Pause status be a popup box that disappear after a few seconds.

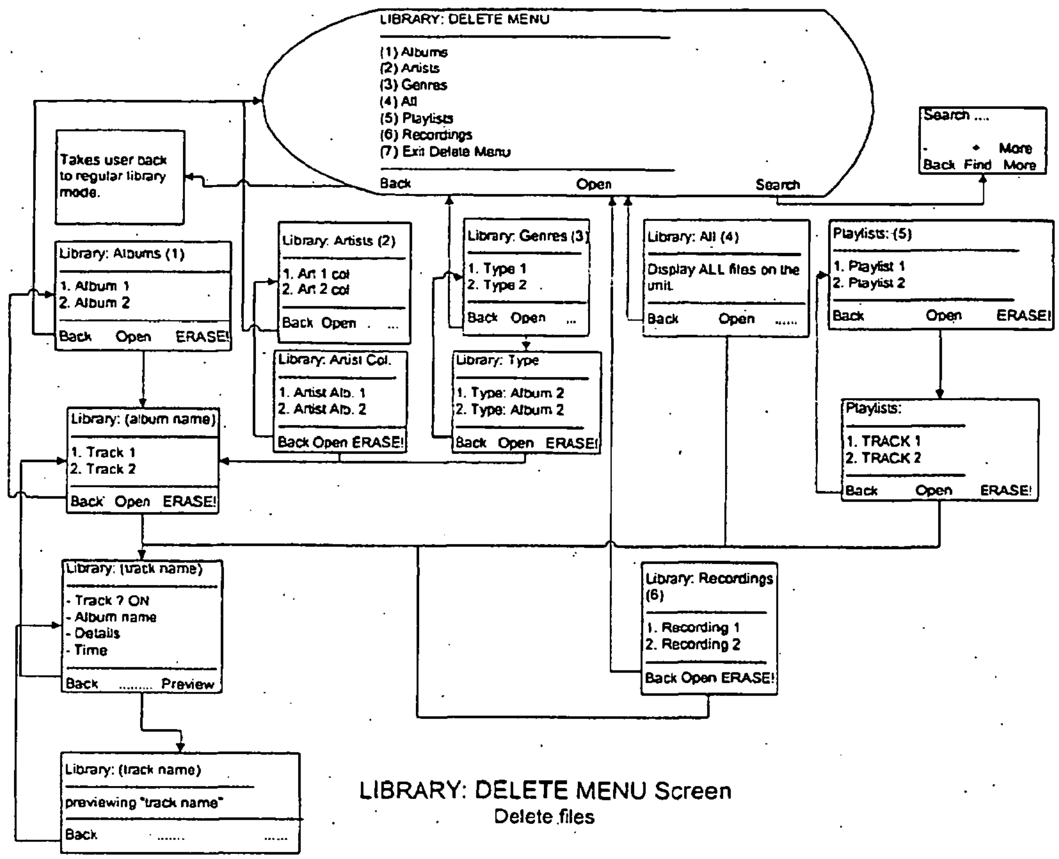
NOTE: All queued commands should display "Queued" text on top right hand corner for a second while staying at current screen.

NOTE: The More button assigns new function to soft keys

NOTE: "Open" at (library: track level) previews the track. If a song is already playing, error message should be (No Preview While Song Playing) instead of current error message (No auditioning while previewing). "Back" key should stop preview as well.

NOTE: "Back" saves previous screen.

SF 1123478 v1



LIBRARY: DELETE MENU Screen
Delete files

Fig. 7C

LIB BUTTON Function:

Returns to Main Library Menu and exits Delete Menus

NOTE: All song playing should be stopped while in delete mode.

NOTE: While in delete mode, top line of all screen should have the words "DELETE MODE!" appended.

NOTE: All ERASE! keypresses would give user a popup warning:

Are you sure? (pop up screen)

YES ...... NO

NOTE: "Open" at (library: track level) previews the track. "Back" key would stop preview.

SF 1123484 v1