US00RE43019E

(19) **United States**
(12) **Reissued Patent**
Chang et al.

(10) **Patent Number: US RE43,019 E**
(45) **Date of Reissued Patent: Dec. 13, 2011**

(54) **ENCODING RECORDING DATA ON OPTICAL DISKS**

(75) Inventors: **Wen-Jeng Chang**, Taipei Hsien (TW); **Kun-Long Lin**, Taipei Hsien (TW)

(73) Assignee: **Tian Holdings, LLC**, Wilmington, DE (US)

(21) Appl. No.: **12/098,361**

(22) Filed: **Apr. 4, 2008**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,023,784**
Issued: **Apr. 4, 2006**
Appl. No.: **10/400,574**
Filed: **Mar. 28, 2003**

(30) **Foreign Application Priority Data**

Mar. 29, 2002 (TW) ..... 91106426 A

(51) **Int. Cl.**
G11B 7/00 (2006.01)

(52) **U.S. Cl.** **369/59.25**

(58) **Field of Classification Search** 369/59.25, 369/59.11, 59.12, 53.33, 53.34, 53.35, 47.1, 369/47.28, 59.33, 59.34, 47.27, 47.23, 47.24
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,269,059 B1 * 7/2001 Kuroda et al. 369/47.28

FOREIGN PATENT DOCUMENTS

TW 244066 11/2005

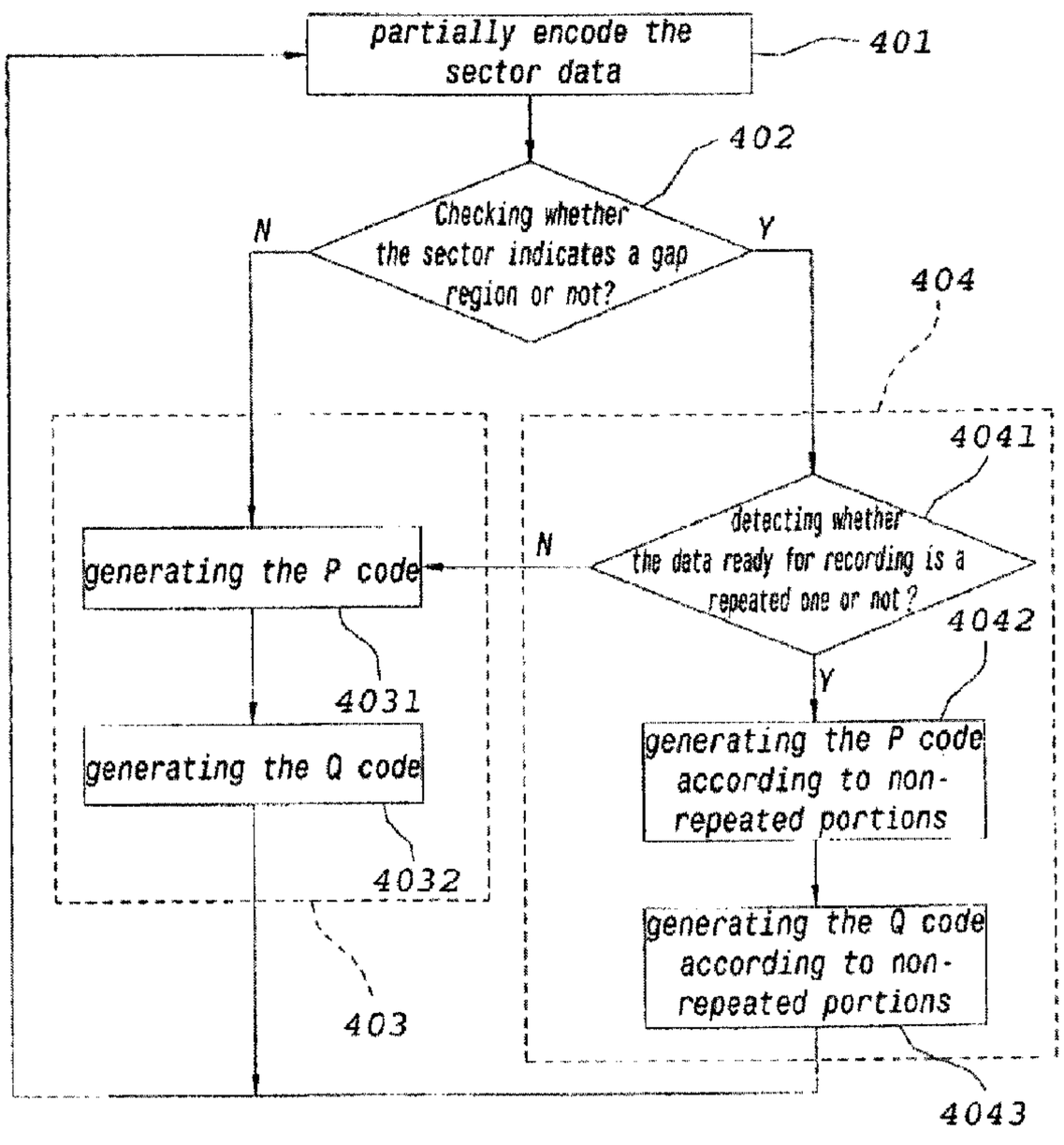
* cited by examiner

Primary Examiner — Nabil Z Hindi
(74) *Attorney, Agent, or Firm* — Perkins Coie LLP

(57) **ABSTRACT**

An encoding method for recording gap regions or sectors having repeated data is disclosed. At least one sector is entirely encoded and stored in a memory buffer of the optical recording system. If the currently encoded are gap regions or sector having repeated data embedded in the fields of user data, only those portions affected by the modified header will be encoded to derive associated P code and Q code. The error detection code is firstly generated in the mode 1 standard when a gap region is encoded. P code is then encoded for those regions affected by the sequentially modified header and error detection code, while associated Q code is then derived according the modified header, error detection code, and P code. In the mode 2 form 1 and mode form 2 standards, only those regions affected by the sequentially modified header should be re-encoded again. Since the remaining portions employ the same data as the last encoded one in the memory buffer so that the encoding performance would be significantly upgraded whatever encoding standards are employed.

31 Claims, 4 Drawing Sheets



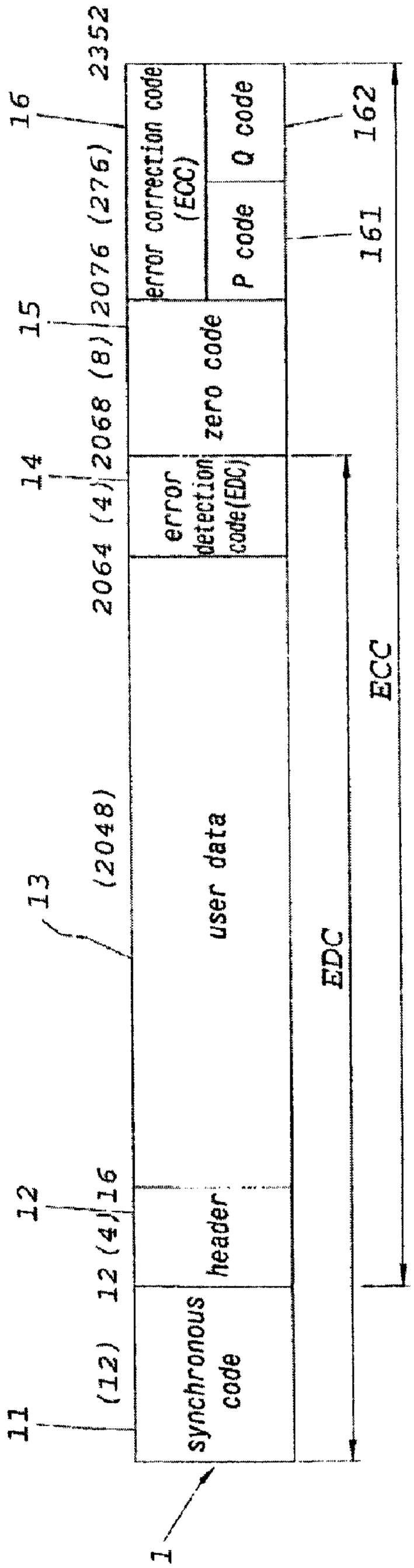


FIG 1
PRIOR ART

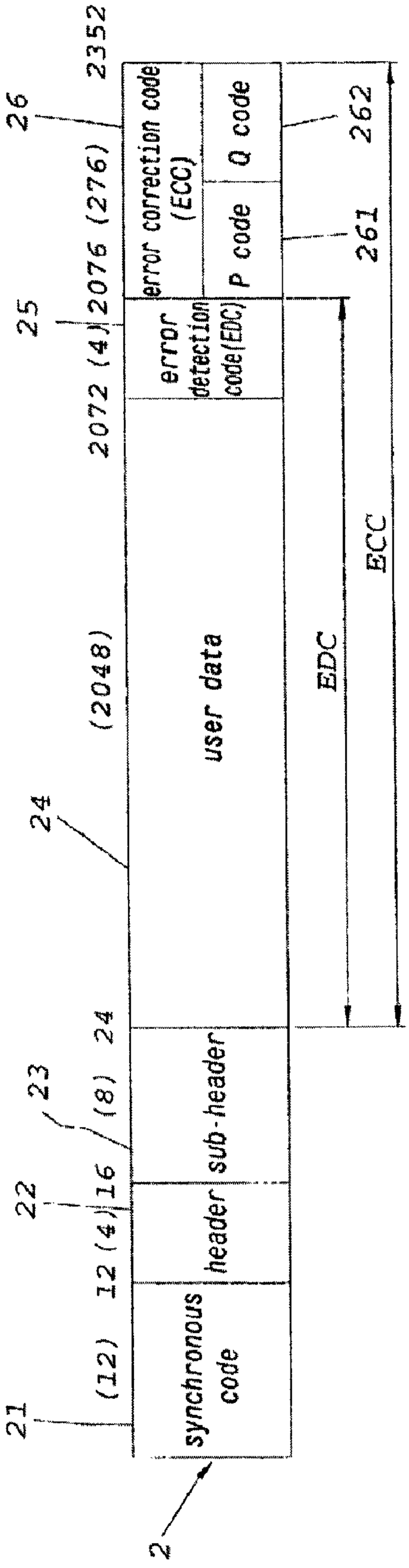


FIG 2
PRIOR ART

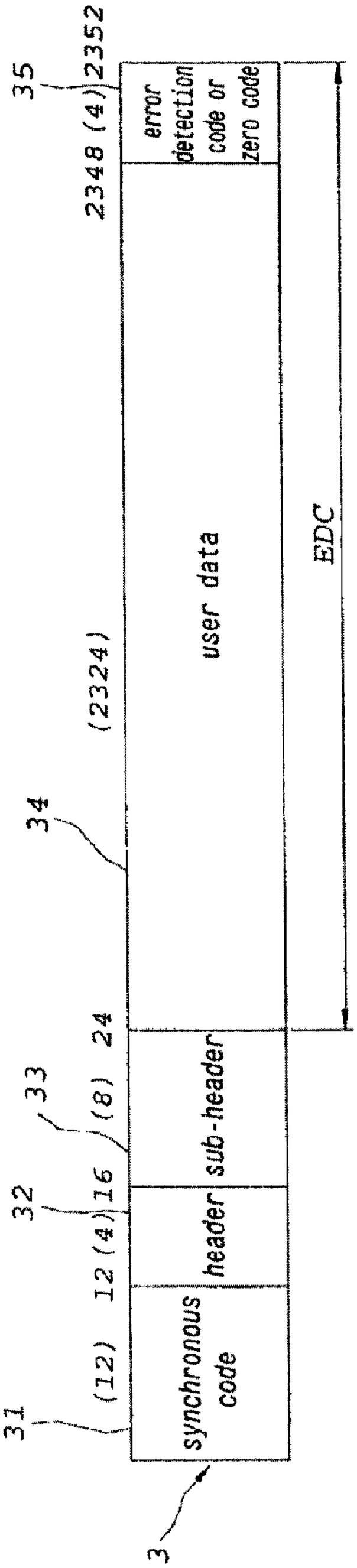


FIG 3
PRIOR ART

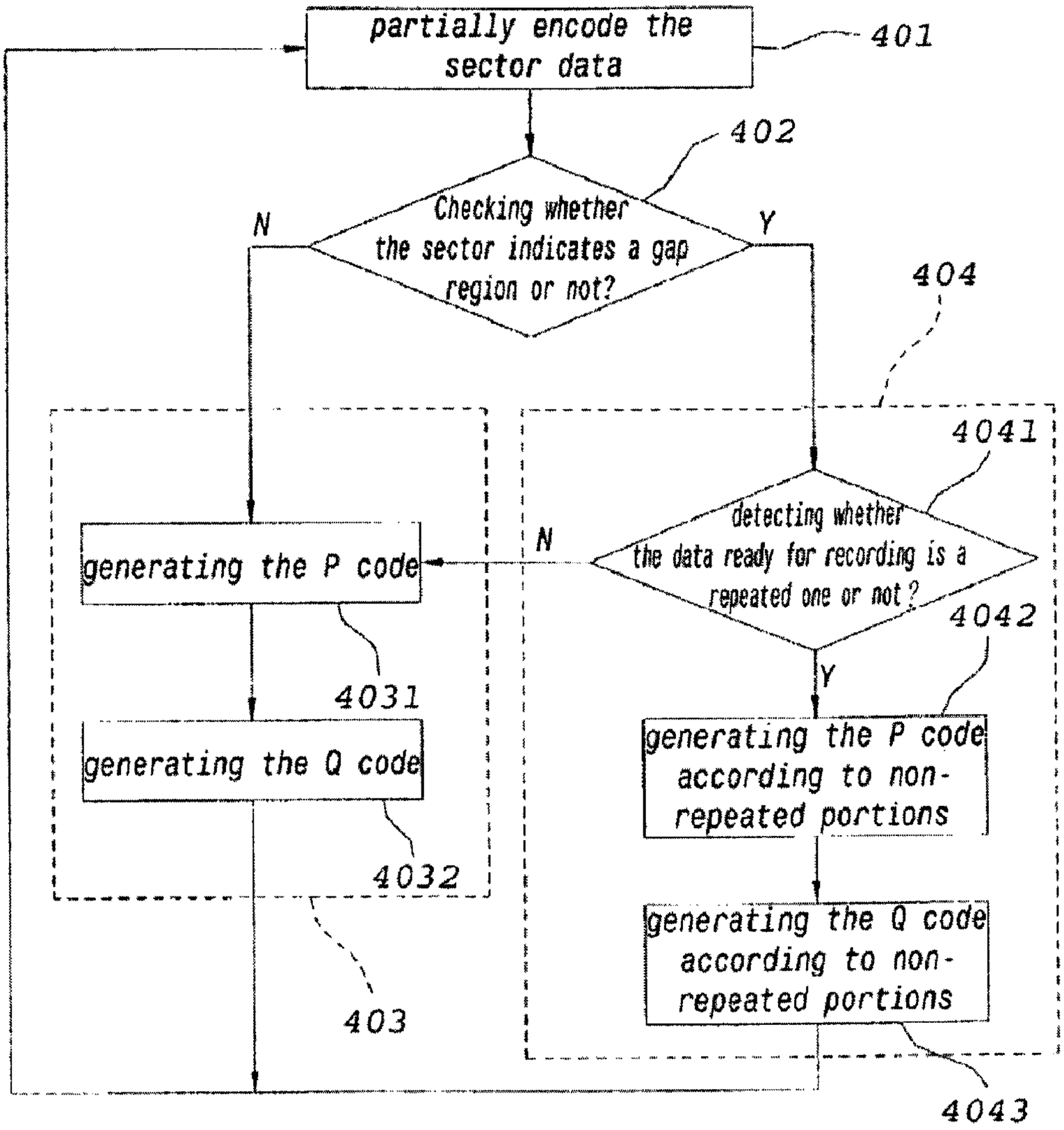

partially encode the sector data
401
402
Checking whether the sector indicates a gap region or not?
N
Y
404
4041
detecting whether the data ready for recording is a repeated one or not?
N
Y
4042
generating the P code
4031
generating the Q code
4032
403
generating the P code according to non-repeated portions
generating the Q code according to non-repeated portions
4043

FIG 4

ENCODING RECORDING DATA ON OPTICAL DISKS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CROSS-REFERENCE TO RELATED APPLICATION

This patent application is a reissue application for commonly assigned U.S. Pat. No. 7,023,784, issued Apr. 4, 2006 from U.S. patent application Ser. No. 10/400,574, filed on Mar. 28, 2003.

BACKGROUND

1. Field of the Invention

The present invention is related to an encoding method for recording data on a compact disk (CD), and more particularly, to an encoding method that can efficiently upgrade the data encoding performance when an optical recording system records gap regions or sectors including repeated data onto a compact disk.

2. Background of the Invention

[Recently, optical**]** *Optical* disks *have* become an important and popular storage media for holding a huge volume of data. Generally, the data that is ready to be recorded onto a compact disk is divided and encoded into a plurality of sectors by following standard formats such as the sector structures shown in FIGS. **1** to **3**. In these figures, the unit of data is byte, and there are 2352 bytes included in a sector. FIG. **1** is a schematic diagram of the first encoding form (e.g., mode 1 standard), which is adapted to encode data for application software. FIGS. **2** and **3** respectively show the second encoding form (e.g., mode 2 form 1 standard) and the third encoding form (e.g., mode 2 form 2 standard) that both of them are adapted for encoding video/audio data.

The conventional encoding method is described by making reference with FIG. **1**. A host such as a personal computer (PC) firstly transfers a user data **13** having 2048 bytes to an optical recording system, e.g. a compact disk-recordable (CD-R) drive or a compact disk-rewritable (CD-RW) drive. The optical recording system then generates a synchronous code **11** and a header **12** for the user data **13**, while an error detection code **14** (EDC) is generated according to the synchronous code **11**, header **12**, and the user data **13**. Sequentially, after a zero code **15** is attached (with 4-byte length), an error correction code **16** (ECC) is next generated according to the header **12**, user data **13**, EDC **14**, and the zero code **15**. The first encoding form (or the C3 encoding procedure) is completed when the above encoding procedure terminates, wherein the ECC **16** includes a P code **161** (P-parity check code) and a Q code **162** (Q-parity check code). Sequential encoding procedures, including C2 and C1 encoding procedures, are then performed to the complete encoded data under the mode 1 standard.

Sometimes the optical recording system will record so-called gap regions on the compact disk within the data recording procedures. For example, when an audio or music CD is recording, the optical recording system may record a lot of gap regions (e.g., 2 seconds, about 150 gap regions) adjacent to a just recorded song before recording another one. Besides, if the so-called buffer-under-run occurs during data recoding operations, the optical recording system will also record gap regions on the current compact disk and wait for the data stored in buffers reaches to a predetermined threshold again. In comparison with a normal sector, these gap regions usually contain repeated information (e.g., all bit **0**'s) stored therein, and contents of the gap regions will be repeated except the header **12**, **22** and **32**, the EDC **14**, **25** and **35**, and the ECC **16** and **22**.

As shown in FIG. **1**, when a sector is being encoded, the ECC **16** will be generated according the header **12**, user data **13**, EDC **14** and zero code **15**, while the ECC **26** will be derived according to the user data **24** and EDC **25** as shown in FIG. **2**. However, since the **[**the**]** user data **13**, **24** and **34** occupy most of the entire sector portions and they usually store repeated data as mentioned above, the conventional approach is **[**obvious**]** an inefficient way for encoding information due to a time-cost as well as resource-cost**[**approach is employed for the optical recording system**]**.

Accordingly, the aforementioned conventional encoding scheme obviously includes many disadvantages waiting for further improvements. The present invention therefore discloses a solution for overcoming these disadvantages of the prior art scheme.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide an encoding method for recording data on a compact disk so that the encoding efficiency can be significantly upgraded**[**than before**]**.

In the preferred embodiment, the disclosed method provides an encoding method adapted for recording gap regions or sectors having repeated data that these repeated data are not always entirely encoded so as to upgrade encoding efficiency.

In accordance with the present invention, the optical recording system will encode at least one gap region or sector having repeated data firstly. The non-repeated portions such as the headers of the following gap regions or sectors in memory buffer of the optical recording system are then modified. Encoding procedures are then actuated for those portions affected by the modified header, while those unaffected portions are not encoded again since the unaffected ones in the memory buffer are not changed during the encoding procedures. The current encoded sector or gap region is then delivered to actuate following encoding procedures before being recorded onto a compact disc

In the embodiment, when *a* header is modified in the memory buffer under the mode 1 standard when gap regions are encoded, the error detection code will be changed according to the modified **[**heard**]** *header* simultaneously. The optical recording system then only encodes those portions affected by the modified header and error detection code. In another embodiment, since only the header changes as different gap regions in the mode 2 form 1 standard and the mode 2 form 2 standard, only those portions affected by the modified headers will be encoded by the optical recording system. Total time-cost regarding the encoding procedures will be significantly reduced since the bus bandwidths for accessing data is significantly reduced.

Numerous additional features, benefits and details of the method of the present invention are described in the detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of the first encoding form;

FIG. **2** is a diagram of the second encoding form;

FIG. **3** is a diagram of the third encoding form; and

FIG. **4** is a flow chart of the preferred embodiment according to the present invention.

Table 1 is a coding table of the first encoding form 1.

Table 2 is a coding table of the Q code of the first encoding form 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Please refer to FIG. **1** and by making reference to Tables 1 and 2. Table 1 is the coding table of the mode 1 standard (the sync code **11** of the first encoding form is not included in Table 1), while Table 2 is the coding table of the Q code **162** of the mode 1 standard. The word addresses (a word is composed of two bytes) are respectively marked as **0~1169** in Table 1, and the contents of the first encoding form is mapped into Table 1 orderly. For example, the header **12** is stored in words **0~1**, the user data **13** employs **1024** words **2~1025** for storing purpose, the error detection code **14** is stored in words **1026~1027**, while the fields of words **1028~1031** is used to store zero code **15**. Furthermore, the P code **161** and the Q code of the error correction code **16** are respectively stored in words **1032~1117** and **1118~1169**.

Since all information of the gap regions is stored into *a* memory buffer of the optical recording system for encoding **[**purpose**]** *purposes*, the operating flows of the embodiment are described based on the memory buffer in the following paragraphs. The first embodiment demonstrates the operating flows when the optical recording system encodes data under the mode 1 standard. During the operation of recording data onto a compact disk, the optical recording system will encode whole portions of the first sector (or, at least one sector stored in the memory buffer currently). Thereafter, the optical recording system will generate a synchronous code **11** and a header **12** for the user data **13**, while an error detection code **14** (EDC) is then derived according to the synchronous code **11**, header **12**, and the user data **13** when the mode 1 standard is followed. If gap regions are currently encoded, only the header **12** of the first sector (which indicates the first gap region now) will be changed (in fact, the content of header **12** will plus an integer one to indicate the header of the next gap region), which will also affect the error detection code under the mode 1 standard. Accordingly, the optical recording system will partially encode the next gap region to those non-repeated **[**potions**]** *portions* (or affected portions), e.g. those portions affected by the modified header **12** (such column and rows including information regarding the modified header **12**, EDC **14** and P code **161** under the mode 1 standard). All gap regions are encoded by following the aforementioned steps so that encoding efficiency will be significantly upgraded since most of the entire sectors do not need to be repeatedly encoded except the first gap region. On the other hand, if the currently encoded sector **[**are**]** *is* not *a* gap region, error correction code (ECC) **16** including P code and Q code are then derived by the optical recording system based on header **12**, user data **13**, EDC **14**, and zero code **15**. Please note that the optical recording system may employ the disclosed method of the embodiments for encoding sectors having repeated data embedded in their user data **13** in order to decrease required time-cost regarding encoding procedures. Any ordinary person having skills in the art may modify the embodiment **[**as applications**]** but all similar rearrangements and modifications within the **[**spirits**]** *spirit* of the embodiment should included in the appended claims.

The first encoding operation when encoding sectors having non-repeated data (i.e., non-repeated data in their fields of user data **13**) is described as follows. Please refer to Table 1 firstly. The optical recording system will generate P code **161** according to the data stored in rows R**0~23**, while the derived P code is then stored into rows R**24~25** Taking column C**0** as an example (the other columns will be manipulated in the same way), the optical recording system will encode the data in addresses **0**, **43**, **86** . . . **989** to derive corresponding parity check codes before storing in addresses **1032** and **1075**.

Please now refer to Table 2. The optical recording system will generate Q code **162** according to the data in column C'**0**~C'**42** after P code **161** is derived, while the derived Q code **162** is then stored into column C'**43~44**. Taking column R'**0** as an example (the other rows will be encoded as the same manner), the optical recording system will encode the data in addresses **0**, **44**, **88** . . . **730** to generate corresponding parity check codes, while the derived parity check codes are then stored in addresses **1118** and **1144**.

On the other hand, the second encoding operation when encoding gap regions or sectors having repeated data is described as follows. The optical recording system will firstly detect whether the gap region or sector encompasses repeated information or not. Please note that the gap regions basically including repeated data stored therein, this detection will be a step for guarantee purpose. If the detected sector or gap region is not a repeated one, the first encoding operation will be performed, otherwise the optical recording system will perform the second encoding operation to generate the error correction code **16** for those portions unaffected by the modified header **12**.

Taking the first encoding form as an example. Since the header **12** in addresses **0~1**, the error detection code **14** in addresses **1026~1027** and their corresponding parity check codes in addresses **1032**, **1033**, **1069**, **1070**, **1075**, **1076**, **1112** and **1113** are changed in the memory buffer when recording gap regions under mode 1 standard, the optical recording system only have to encode those portions affected by the above addresses during the second encoding operation.

For the sake of clarity, the encoding procedures of those portions affected by the modified header **12** are described further in the following.

(a) Firstly, the optical recording system generates the P code **161**, according to the header **12** and the error detection code **14**. Referring to Table 1, since there are columns C**0**, C**1**, C**37** and C**38** include the information regarding modified header **12** and EDC **14**, the optical recording system generates the parity check codes for the data in columns C**0**, C**1**, C**37** and C**38** and then stores the derived parity check codes in addresses **1032**, **1033**, **1069**, **1070**, **1075**, **1076**, **1112** and **1113**. Taking column C**0** for example, the optical recording system will generate parity check codes according to the data in addresses **0**, **43**, **86** . . . **989**, while these parity check codes are then stored into the addresses **1032** and **1075**.

(b) The optical recording system generates the Q code **162** according to the header **12**, the error detection code **14** and the P code **161** since modifications to P code **161** will cause modifications to Q code **162** simultaneously. Referring to Table 2, the optical recording system generates the Q code **162** according to the data in eight rows R'**0**, R'**11**, R'**12**, R'**13**, R'**14**, R'**23**, R'**24** and R'**25** and then stores the generated parity check codes in addresses **1118**, **1129**, **1130**, **1131**, **1132**, **1141**, **1142**, **1143**, **1144**, **1155**, **1156**, **1157**, **1158**, **1167**, **1168** and **1169**, respectively. Taking row R'**0** for example, the optical recording system generates parity check codes for the data in addresses **0**, **44**, **88** . . . **730** and then stores these parity check codes into the addresses **1118** and **1144**. As known by an ordinary person having skills in the art, the modified header **12** will directly affect two rows by itself, and simultaneously affect two rows regarding the EDC **14** under the

mode 1 standard. Since the P code **161** and Q code **162** will be affected to vary their currently stored values by the modified header **12** and EDC **14**, eight additional rows are changed and need to be encoded in the embodiment. Finally, only aforementioned eight rows require to be encoded since some overlapped rows must be eliminated.

Please now refer to FIGS. **1** and **4** and by making reference to Tables 1 and 2, wherein FIG. **4** is a flow chart of the encoding method in accordance with the present invention. The encoding method of the present invention includes those steps as follows. Please note that the method described below is an embodiment of the present invention according to the mode 1 standard as shown in FIG. **1**. However, in practice, this method also can apply to mode 2 form 1 and the mode 2 form 2 standards respectively shown in FIGS. **2** and **3**, which may bring more encoding efficiency than that of the mode 1 standard. Detailed descriptions regarding the use of mode 2 form 1 and mode 2 form 2 standards are given later.

Step **401**: During data recording operations, the optical recording system will encode the ready-for-encoding sector in the memory buffer to derive EDC **14** firstly. Of course, at least one sector (whether a gap region or a normal sector) should be encoded by using whole sector data. For example, there may create memory buffer having enough spaces to store three sectors in practical implementations, and the optical recording system will perform encoding procedures to all these three sectors before the operating flow of FIG. **4** starts. Please note that only the headers **12** of the three gap regions are different since they are given by sequential numerals, e.g. 00000001h, 00000002h, 00000003h are given for these three gap regions. The optical recording system will modify the header 00000001h of the first gap region to be 00000004h for the purpose of indicating the fourth gap region after the first gap region has been delivered to arisen the following C2 and C1 encoding procedures. Similarly, the fifth and sixth gap regions may be encoded by respectively modifying the header 00000002h and 00000003h to be 00000005h, 00000006h after the second and third gap regions being delivered. An artisan having ordinary skills in the art may modify the embodiment as requirements and applications *dictate*.

Step **402**: The optical recording system then **[**check**]** *checks* whether the next sector ready for recording indicates a gap region (or a sector having repeated data) or not. This step will be one for achieving the guarantee purpose as above-mentioned when encoding gap regions. Based on decision result, the optical recording system performs the following Step **403** if the next sector data does not indicate a gap region, otherwise the following Step **404** will be performed if a gap region is going to be encoded.

Step **403**: A first encoding operation is performed, which also includes Steps **4031** and **4032** as follows.

Step **4031**: Referring to Table 1, the optical recording system will perform an encoding operation to derive the P code **161** according to related portions of the encoding format in Table 1. In other words, the data in columns C**0**~C**42** are sequentially encoded along the direction indicated by rows R**0**~R**23**, while the generated parity check codes are then stored in rows R**24**~**25** Taking column C**0** as an example (of course the other columns will be encoded as the same manner), the optical recording system will encode the data in addresses **0**, **43**, **86** . . . **989** and generate corresponding parity check codes that are stored in addresses **1032** and **1075** as mentioned above.

Step **4032**: Referring to Table 2, the optical recording system would generate the Q code **162**. Taking column R'**0** as an example, the optical recording system will encode the data mapped to addresses **0**, **44**, **88** . . . **730** and generate a corresponding parity check code stored in addresses **1118** and **1144**. The encoding procedure of the embodiment is complete after this step terminates, while the optical recording system returns to Step **401** for encoding the successive sectors or gap regions.

Step **404**: The optical recording system will execute the second encoding operation, which can be divided into separate Steps **4041**, **4042** and **4043** described as follows.

Step **4041**: By comparing with the former encoded data, the optical recording system will firstly detect whether the ready-for-encoding sector or gap region encompasses repeated data or not. This step may be eliminated or remained for confirmation purpose as applications since the optical recording system understands whether the currently encoding sector is a gap region (or a sector having repeated data stored in the filed of user data **13**) or not. The optical recording system will switch to Step **4031** to perform the first encoding operations if the current encoding sector or gap region does not include repeated data. Otherwise the optical recording system will go on the following Step **4042**.

Step **4042**: The optical recording system generates the parity check code, i.e., the P code **161**, according to those non-repeated portions (or "affected" portions) that are affected by the modified header **12** and EDC **14**. Please now refer to Table 1, the optical recording system generates the parity check code according to the data mapped to columns C**0**, C**1**, C**37** and C **38** and stores the generated parity check code in addresses **1032**, **1033**, **1069**, **1070**, **1075**, **1076**, **1112** and **1113**. Taking column C**0** for example, the optical recording system will generate a parity check code mapped to addresses **1032** and **1075** according to the data mapped to addresses **0**, **43**, **86** . . . **989**. Moreover, the optical recording system will generate the parity check code of the P code **161** corresponding to the repeated portions by copying that of the former encoding data.

Step **4043**: The optical recording system generates the Q code **162** according to the non-repeated portions affected by the modified header **12** and EDC **14**. Please note that only the header **12** mapped to addresses **0**~**1**, the EDC **14** mapped to addresses **1026**~**1027** and their corresponding parity check code (P code) mapped to addresses **1032**, **1033**, **1069**, **1070**, **1075**, **1076**, **1112** and **1113** are non-repeated portions here. Please refer to Table 2 now, the optical recording system will generate the Q code **162** according to the data mapped to rows R'**0**, R'**11**, R'**12**, R'**13**, R'**14**, R'**23**, R'**24** and R'**25** and then stores the generated parity check code in Addresses **1118**, **1129**, **1130**, **1131**, **1132**, **1141**, **1142**, **1143**, **1144**, **1155**, **1156**, **1157**, **1158**, **1167**, **1168** and **1169**. Taking row R'**0** for example, the optical recording system will generate a parity check code mapped to addresses **1118** and **1144** according to the data in addresses **0**, **44**, **88** . . . **730**. Moreover, the optical recording system does not need to generate Q code **162** for those repeated portions since the Q code **162** regarding the repeated portions has been calculated and stored in the memory buffer already when encoding the first gap region. The second encoding operation is complete when this step terminates and the current encoded gap region can be delivered for recording onto a compact disc. Finally the optical recording system returns to Step **401** for encoding the sequential gap regions.

Since the encoding method of the present invention only encodes the non-repeated portions of the gap region, time-cost for encoding the gap region will be effectively reduced so that the data encoding efficiency can be significantly upgraded due to the system resource being efficiently used. In another embodiment, there is no additional portion in the memory buffer affected by the modified headers **22** and **32**

under the mode 2 form 1 and mode 2 form 2 standards, respectively. In other words, the EDC **25** and ECC **26** in the mode 2 form 1 standard, and the EDC **35** in the mode 2 form 2 standard will remains the same as the former encoded results when only the header is modified. Therefore, only those portions related to the headers require to be encoded by the optical recording system, that is, only those rows and columns that include the modified header need to be encoded in these two embodiment. Totally encoding time will be significantly reduced since the bus bandwidths for accessing data will be significantly reduced whatever mode 1, mode 2 form 1, or mode 2 form 2 standards are employed.

Although the present invention has been described with reference to the preferred embodiment thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have been suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are embraced within the scope of the invention as defined in the appended claims.

TABLE 1

PRIOR ART

	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
R0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
R1	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
R2	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
R3	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
R4	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186
R5	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229
R6	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
R7	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
R8	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358
R9	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401
R10	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444
R11	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487
R12	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530
R13	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573
R14	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616
R15	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659
R16	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702
R17	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745
R18	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788
R19	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831
R20	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874
R21	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917
R22	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
R23	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003
R24	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046
R25	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089
R26	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132
R27	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158

	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
R0	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
R1	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
R2	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115
R3	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158
R4	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201
R5	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244
R6	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
R7	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
R8	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373
R9	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416
R10	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
R11	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502
R12	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545
R13	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588
R14	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631
R15	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674
R16	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717
R17	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
R18	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803
R19	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846
R20	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889
R21	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932
R22	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975
R23	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018
R24	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061
R25	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104
R26	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143				
R27	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169				

TABLE 1-continued

	PRIOR ART												
	C30	*C31*	*C32*	*C33*	*C34*	*C35*	*C36*	*C37*	*C38*	*C39*	*C40*	*C41*	*C42*
R0	30	31	32	33	34	35	36	37	38	39	40	41	42
R1	73	74	75	76	77	78	79	80	81	82	83	84	85
R2	116	117	118	119	120	121	122	123	124	125	126	127	128
R3	159	160	161	162	163	164	165	166	167	168	169	170	171
R4	202	203	204	205	206	207	208	209	210	211	212	213	214
R5	245	246	247	248	249	250	251	252	253	254	255	256	257
R6	288	289	290	291	292	293	294	295	296	297	298	299	300
R7	331	332	333	334	335	336	337	338	339	340	341	342	343
R8	374	375	376	377	378	379	380	381	382	383	384	385	386
R9	417	418	419	420	421	422	423	424	425	426	427	428	429
R10	460	461	462	463	464	465	466	467	468	469	470	471	472
R11	503	504	505	506	507	508	509	510	511	512	513	514	515
R12	546	547	548	549	550	551	552	553	554	555	556	557	558
R13	589	590	591	592	593	594	595	596	597	598	599	600	601
R14	632	633	634	635	636	637	638	639	640	641	642	643	644
R15	675	676	677	678	679	680	681	682	683	684	685	686	687
R16	718	719	720	721	722	723	724	725	726	727	728	729	730
R17	761	762	763	764	765	766	767	768	769	770	771	772	773
R18	804	805	806	807	808	809	810	811	812	813	814	815	816
R19	847	848	849	850	851	852	853	854	855	856	857	858	859
R20	890	891	892	893	894	895	896	897	898	899	900	901	902
R21	933	934	935	936	937	938	939	940	941	942	943	944	945
R22	976	977	978	979	980	981	982	983	984	985	986	987	988
R23	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031
R24	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074
R25	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117
R26													
R27													

TABLE 2

	PRIOR ART														
	C'0	*C'1*	*C'2*	*C'3*	*C'4*	*C'5*	*C'6*	*C'7*	*C'8*	*C'9*	*C'10*	*C'11*	*C'12*	*C'13*	*C'14*
R'0	0	44	88	132	176	220	264	308	352	396	440	484	528	572	616
R'1	43	87	131	175	219	263	307	351	395	439	483	527	571	615	659
R'2	86	130	174	218	262	306	350	394	438	482	526	570	614	658	702
R'3	129	173	217	261	305	349	393	437	481	525	569	613	657	701	745
R'4	172	216	260	304	348	392	436	480	524	568	612	656	700	744	788
R'5	215	259	303	347	391	435	479	523	567	611	655	699	743	787	831
R'6	258	302	346	390	434	478	522	566	610	654	698	742	786	830	874
R'7	301	345	389	433	477	521	565	609	653	697	741	784	829	873	917
R'8	344	388	432	476	520	564	608	652	696	740	784	828	872	916	960
R'9	387	431	475	519	563	607	651	695	739	783	827	871	915	959	1003
R'10	430	474	518	562	606	650	694	738	782	826	870	914	958	1002	1046
R'11	473	517	561	605	649	693	737	781	825	869	913	957	1001	1045	1089
R'12	516	560	604	648	692	736	780	824	868	912	956	1000	1044	1088	14
R'13	559	603	647	691	735	779	823	867	911	955	999	1043	1087	13	57
R'14	602	646	690	734	778	822	866	910	954	998	1042	1086	12	56	100
R'15	645	689	733	777	821	865	909	953	997	1041	1085	11	55	99	143
R'16	688	732	776	820	864	908	952	996	1040	1084	10	54	98	142	186
R'17	731	774	819	863	907	951	995	1039	1083	9	53	97	141	185	229
R'18	774	818	862	906	950	994	1038	1082	8	52	96	140	184	228	272
R'19	817	861	905	949	993	1037	1081	7	51	95	139	183	227	271	315
R'20	860	904	948	992	1036	1080	6	50	94	138	182	226	270	314	358
R'21	903	947	991	1035	1079	5	49	93	137	181	225	269	313	357	401
R'22	946	990	1034	1078	4	48	92	136	180	224	268	312	356	400	444
R'23	989	1033	1077	3	47	91	135	179	223	267	311	355	399	443	487
R'24	1032	1076	2	46	90	134	178	222	266	310	354	398	442	486	530
R'25	1075	1	45	89	133	177	221	265	309	353	397	441	485	529	573

	C'15	*C'16*	*C'17*	*C'18*	*C'19*	*C'20*	*C'21*	*C'22*	*C'23*	*C'24*	*C'25*	*C'26*	*C'27*	*C'28*	*C'29*
R'0	660	704	748	792	836	880	924	968	1012	1056	1100	26	70	114	158
R'1	703	747	791	835	879	923	967	1011	1055	1099	25	69	113	157	201
R'2	746	790	834	878	922	966	1010	1054	1098	24	68	112	156	200	244
R'3	789	833	877	921	965	1009	1053	1097	23	67	111	155	199	243	287
R'4	832	876	920	964	1008	1052	1096	22	66	110	154	198	242	286	330
R'5	875	919	963	1007	1051	1095	21	65	109	153	197	241	285	329	373
R'6	918	962	1006	1050	1094	20	64	108	152	196	240	284	328	372	416
R'7	961	1005	1049	1093	19	63	107	151	195	239	283	327	371	415	459
R'8	1004	1048	1092	18	62	106	150	194	238	282	326	370	414	458	502

TABLE 2-continued

PRIOR ART

R'9	*1047*	*1091*	*17*	*61*	*105*	*149*	*193*	*237*	*281*	*325*	*369*	*413*	*457*	*501*	*545*
R'10	*1090*	*16*	*60*	*104*	*148*	*192*	*236*	*280*	*324*	*368*	*412*	*456*	*500*	*544*	*588*
R'11	*15*	*59*	*103*	*147*	*191*	*235*	*279*	*323*	*367*	*411*	*455*	*499*	*543*	*587*	*631*
R'12	*58*	*102*	*146*	*190*	*234*	*278*	*322*	*366*	*410*	*454*	*498*	*542*	*586*	*630*	*674*
R'13	*101*	*145*	*189*	*233*	*277*	*321*	*365*	*409*	*453*	*497*	*541*	*585*	*629*	*673*	*717*
R'14	*144*	*188*	*232*	*276*	*320*	*364*	*408*	*452*	*496*	*540*	*584*	*628*	*672*	*716*	*760*
R'15	*187*	*231*	*275*	*319*	*363*	*407*	*451*	*495*	*539*	*583*	*627*	*671*	*715*	*759*	*803*
R'16	*230*	*274*	*318*	*362*	*406*	*450*	*494*	*538*	*582*	*626*	*670*	*714*	*758*	*802*	*846*
R'17	*273*	*317*	*361*	*405*	*449*	*493*	*537*	*581*	*625*	*669*	*713*	*757*	*801*	*845*	*889*
R'18	*316*	*360*	*404*	*448*	*492*	*536*	*580*	*624*	*668*	*712*	*756*	*800*	*844*	*888*	*932*
R'19	*359*	*403*	*447*	*491*	*535*	*579*	*623*	*667*	*711*	*755*	*799*	*843*	*887*	*931*	*975*
R'20	*402*	*446*	*490*	*534*	*578*	*622*	*666*	*710*	*754*	*798*	*842*	*886*	*930*	*974*	*1018*
R'21	*445*	*489*	*533*	*577*	*621*	*665*	*709*	*753*	*797*	*841*	*885*	*929*	*973*	*1017*	*1061*
R'22	*488*	*532*	*576*	*620*	*664*	*708*	*752*	*796*	*840*	*884*	*928*	*972*	*1016*	*1060*	*1104*
R'23	*531*	*575*	*619*	*663*	*707*	*751*	*795*	*839*	*883*	*927*	*971*	*1015*	*1059*	*1103*	*29*
R'24	*574*	*618*	*662*	*706*	*750*	*794*	*868*	*882*	*926*	*970*	*1014*	*1058*	*1102*	*28*	*72*
R'25	*617*	*661*	*705*	*749*	*793*	*837*	*881*	*925*	*969*	*1013*	*1057*	*1101*	*27*	*71*	*115*

	C'30	*C'31*	*C'32*	*C'33*	*C'34*	*C'35*	*C'36*	*C'37*	*C'38*	*C'39*	*C'40*	*C'41*	*C'42*	*C'43*	*C'44*
R'0	*202*	*246*	*290*	*334*	*378*	*422*	*466*	*510*	*554*	*598*	*642*	*686*	*730*	*1118*	*1144*
R'1	*245*	*289*	*333*	*377*	*421*	*465*	*509*	*553*	*597*	*641*	*685*	*729*	*773*	*1119*	*1145*
R'2	*288*	*332*	*376*	*420*	*464*	*508*	*552*	*596*	*640*	*684*	*728*	*772*	*816*	*1120*	*1146*
R'3	*331*	*375*	*419*	*463*	*507*	*551*	*595*	*639*	*683*	*727*	*771*	*815*	*859*	*1121*	*1147*
R'4	*374*	*418*	*462*	*506*	*550*	*594*	*638*	*682*	*726*	*770*	*814*	*858*	*902*	*1122*	*1148*
R'5	*417*	*461*	*505*	*549*	*593*	*637*	*681*	*725*	*769*	*813*	*857*	*901*	*945*	*1123*	*1149*
R'6	*460*	*504*	*548*	*592*	*636*	*680*	*724*	*768*	*812*	*856*	*900*	*944*	*988*	*1124*	*1150*
R'7	*503*	*547*	*591*	*635*	*679*	*723*	*767*	*811*	*855*	*899*	*943*	*987*	*1031*	*1125*	*1151*
R'8	*546*	*590*	*634*	*678*	*722*	*766*	*810*	*854*	*898*	*942*	*986*	*1030*	*1074*	*1126*	*1152*
R'9	*589*	*633*	*677*	*721*	*765*	*809*	*853*	*897*	*941*	*985*	*1029*	*1073*	*1117*	*1127*	*1153*
R'10	*632*	*676*	*720*	*764*	*808*	*852*	*896*	*940*	*984*	*1028*	*1072*	*1116*	*42*	*1128*	*1154*
R'11	*675*	*719*	*763*	*807*	*851*	*895*	*939*	*983*	*1027*	*1071*	*1115*	*41*	*85*	*1129*	*1155*
R'12	*718*	*762*	*806*	*850*	*894*	*938*	*982*	*1026*	*1070*	*1114*	*40*	*84*	*128*	*1130*	*1156*
R'13	*761*	*805*	*849*	*893*	*937*	*981*	*1025*	*1069*	*1113*	*39*	*83*	*127*	*171*	*1131*	*1157*
R'14	*804*	*848*	*892*	*936*	*980*	*1024*	*1068*	*1112*	*38*	*82*	*126*	*170*	*214*	*1132*	*1158*
R'15	*847*	*891*	*935*	*979*	*1023*	*1067*	*1111*	*37*	*81*	*125*	*169*	*213*	*257*	*1133*	*1159*
R'16	*890*	*934*	*978*	*1022*	*1066*	*1110*	*36*	*80*	*124*	*168*	*212*	*256*	*300*	*1134*	*1160*
R'17	*933*	*977*	*1021*	*1065*	*1109*	*35*	*79*	*123*	*167*	*211*	*255*	*299*	*343*	*1135*	*1161*
R'18	*976*	*1020*	*1064*	*1108*	*34*	*78*	*122*	*166*	*210*	*254*	*298*	*342*	*386*	*1136*	*1162*
R'19	*1019*	*1063*	*1107*	*33*	*77*	*121*	*165*	*209*	*253*	*297*	*341*	*385*	*429*	*1137*	*1163*
R'20	*1062*	*1106*	*32*	*76*	*120*	*164*	*208*	*252*	*296*	*340*	*384*	*428*	*472*	*1138*	*1164*
R'21	*1105*	*31*	*75*	*119*	*163*	*207*	*251*	*295*	*339*	*383*	*427*	*471*	*515*	*1139*	*1165*
R'22	*30*	*74*	*118*	*162*	*206*	*250*	*294*	*338*	*382*	*426*	*470*	*514*	*558*	*1140*	*1166*
R'23	*73*	*117*	*161*	*205*	*249*	*293*	*337*	*381*	*425*	*469*	*513*	*557*	*601*	*1141*	*1167*
R'24	*116*	*160*	*204*	*248*	*292*	*336*	*380*	*424*	*468*	*512*	*556*	*600*	*644*	*1142*	*1168*
R'25	*159*	*203*	*247*	*291*	*335*	*379*	*423*	*467*	*511*	*555*	*599*	*643*	*687*	*1143*	*1169*

What is claimed is:

1. A method for encoding data ready-for-recording on a compact disk, wherein said ready-for-recording data comprises a plurality of data sectors and each of said data **[**sector**]** *sectors* having a header and a user data, said method comprising:

encoding first sector of said plurality of data sectors;

modifying said header of a second data sector of said plurality of data sectors, said second data sector being succeeding to said first data sector;

partially encoding said second data sector by encoding an affected portion of said second data sector according to said modified header when said second sector having said user data identical to that of said first sector, wherein a portion of said second data sector that is not affected by said modified header is not varied when said affected portion is encoded; and

encoding said second sector by using entire data of said second sector when said second sector has user data non-identical to that of said first sector.

2. The encoding method as claimed in claim **1** wherein said affected portion is varied with said modified header.

3. The encoding method as claimed in claim **2** wherein an encoding form for recording said optical disk is the mode 1 standard.

4. The encoding method as claimed in claim **1** wherein said modified header modified according to a relationship between said first sector and said second sector.

5. The encoding method as claimed in claim **4** wherein said affected portion comprises a row including information being modified by said modified header and a column including information being modified by said modified header.

6. The encoding method as claimed in claim **4** wherein said affected portion comprises an error detection code being modified according to said modified header.

7. The encoding method as claimed in claim **4** wherein said affected portion comprises an error correction code being modified according to said modified header.

8. The encoding method as claimed in claim **1** wherein said ready-for-recording data indicates a gap region when all of said user data in said plurality of data sectors are identical.

9. The encoding method as claimed in claim **1** wherein portion of said second data sector that is not affected by said modified header remains the same in a memory buffer of an optical recording system when encoding said second data sector.

10. A method of encoding a plurality of data sectors having identical user data before an optical recording system records said sector onto a compact disk comprising:

encoding a first sector of said plurality of data sectors, wherein each one of said plurality of data sectors having a header;

modifying said header of a second data sector of said plurality of data sectors, said second data sector being succeeding to said first data sector; *and*

partially encoding said second data sector by encoding an affected portion of said second data sector according to said modified header, wherein a portion of said second data sector that is not affected by said modified header is not varied when said affected portion is encoded.

11. The encoding method as claimed in claim **10** wherein said affected portion is varied with said modified header.

12. The encoding method as claimed in claim **10** wherein an encoding form for recording said optical disk is the mode 1 standard.

13. The encoding method as claimed in claim **12** wherein said affected portion comprises a row including information being modified by said modified header and a column including information being modified by said modified header.

14. The encoding method as claimed in claim **12** wherein said affected portion comprises an error detection code being modified according to said modified header.

15. The encoding method as claimed in claim **14** wherein said affected portion comprises an error correction code being modified according to said modified header.

16. The encoding method as claimed in claim **15** wherein said currently encoded sector follows a standard adapted to encode application software.

17. The encoding method as claimed in claim **10** wherein said ready-for-recording data indicates a gap region when all of said user data in said plurality of data sectors are identical.

18. The encoding method as claimed in claim **10** wherein said portion of said second data sector that is not affected by said modified header remains the same in a memory buffer of an optical recording system when encoding said second data sector.

19. A method for encoding a gap region ready-for-recording onto a compact disk, wherein said gap region comprises a plurality of data sectors and each of said data sectors having a repeated user data identical to said other data sectors and a header that is non-identical to said other data sectors, said method comprising:

encoding a first sector of said plurality of data sectors according to said repeated user data and said non-repeated portion;

modifying said header of a second data sector of said plurality of data sector according to a relationship between said first sector and said second data sector, said second data sector being succeeding to said first data sector;

encoding an affected portion of said second data sector according to said modified header, wherein said affected portion is varied with said modified header; and

encoding said second data sector according to an encoding form said compact disk being employed.

20. The encoding method as claimed in claim **19** wherein said step of encoding said affected portion of said second data sector comprises a step of encoding an error detection code of said second data sector according to a synchronous code of said second data sector, said modified header, and said identical user data when said encoding form is the mode 1 standard.

21. The encoding method as claimed in claim **19** wherein a non-affected portion of said encoded result of said first sector remains the same when encoding said gap region.

22. The encoding method as claimed in claim **19** wherein said step of encoding said affected portion of said second data sector skipped when said encoding form is the mode 2 standard.

23. A method for encoding data ready-for-recording on a compact disk, wherein the ready-for-recording data comprises multiple data sectors and the individual data sectors have a header and a user data, the method comprising:

modifying the header of a second data sector of the multiple data sectors, the second data sector following a first data sector; and

at least partially encoding the second data sector by encoding an affected portion of the second data sector according to the modified header if the second sector has identical user data to that of the first data sector, wherein a portion of the second data sector that is not affected by the modified header is not varied if the affected portion is encoded.

24. The method of claim 23 further comprising encoding the first data sector before the modifying.

25. The method of claim 23 further comprising encoding the second data sector by using substantially all data of the second data sector if the second data sector has user data that is not identical to that of the first data sector.

26. The method of claim 23 further comprising:

encoding the first data sector before the modifying; and

encoding the second data sector by using substantially all data of the second data sector if the second data sector has user data that is not identical to that of the first data sector.

27. A computer-readable storage device storing computer-executable instructions that, when executed, perform a method for encoding data ready-for-recording on a compact disk, wherein the ready-for-recording data comprises multiple data sectors and individual data sectors have a header and a user data, the method comprising:

modifying the header of a second data sector of the multiple data sectors, the second data sector following a first data sector; and

at least partially encoding the second data sector by encoding an affected portion of the second data sector according to the modified header if the second sector has identical user data to that of the first data sector, wherein a portion of the second data sector that is not affected by the modified header is not varied if the affected portion is encoded.

28. The computer-readable storage device of claim 27 wherein the method further comprises:

encoding the first data sector before the modifying; and

encoding the second data sector by using substantially all data of the second data sector if the second data sector has user data that is not identical to that of the first data sector.

29. A system for encoding data ready-for-recording on a compact disk, wherein the ready-for-recording data comprises multiple data sectors and individual data sectors have a header and a user data, comprising:

a component configured to modify the header of a second data sector of the multiple data sectors, the second data sector following a first data sector; and

a component configured to encode the second data sector by encoding an affected portion of the second data sector according to the modified header if the second sector has identical user data to that of the first data sector, wherein

a portion of the second data sector that is not affected by the modified header is not varied if the affected portion is encoded.

30. A system for encoding data ready-for-recording on a compact disk, wherein the ready-for-recording data comprises multiple data sectors and individual data sectors have a header and a user data, comprising:

means for modifying the header of a second data sector of the multiple data sectors, the second data sector following a first data sector; and

means for at least partially encoding the second data sector by encoding an affected portion of the second data sector according to the modified header if the second sector has identical user data to that of the first data sector, wherein a portion of the second data sector that is not affected by the modified header is not varied if the affected portion is encoded.

31. The system of claim 30 further comprising:

means for encoding the first data sector before the modifying; and

means for encoding the second data sector by using substantially all data of the second data sector if the second data sector has user data that is not identical to that of the first data sector.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE43,019 E
APPLICATION NO. : 12/098361
DATED : December 13, 2011
INVENTOR(S) : Chang et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

The title page showing the illustrative figure should be deleted to be replaced with the attached title page.

On the Cover Page, item (57), under "ABSTRACT", in Column 2, Line 12, delete "according" and insert -- according to --, therefor.

On the Cover Page, item (57), under "ABSTRACT", in Column 2, Line 13, delete "mode form 2" and insert -- mode 2 form 2 --, therefor.

In the drawing sheets, consisting of Figs. 1-4, should be deleted to be replaced with the drawing sheets, consisting of Figs. 1-4, as shown on the attached pages.

In Column 2, Line 9, delete "according" and insert -- according to --, therefor.

In Column 2, Line 45, delete "disc" and insert -- disc. --, therefor.

In Column 5, Line 58, delete "R24~25" and insert -- R24~25. --, therefor.

In Column 6, Line 16, delete "filed" and insert -- field --, therefor.

In Column 12, Line 45, in Claim 4, delete "header" and insert -- header is --, therefor.

In Column 12, Line 63, in Claim 9, delete "wherein" and insert -- wherein said --, therefor.

Signed and Sealed this
Fourth Day of December, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

(19) **United States**
(12) **Reissued Patent**
Chang et al.

(10) **Patent Number: US RE43,019 E**
(45) **Date of Reissued Patent: Dec. 13, 2011**

(54) **ENCODING RECORDING DATA ON OPTICAL DISKS**

(75) Inventors: **Wen-Jeng Chang**, Taipei Hsien (TW); **Kun-Long Lin**, Taipei Hsien (TW)

(73) Assignee: **Tian Holdings, LLC**, Wilmington, DE (US)

(21) Appl. No.: **12/098,361**

(22) Filed: **Apr. 4, 2008**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,023,784**
Issued: **Apr. 4, 2006**
Appl. No.: **10/400,574**
Filed: **Mar. 28, 2003**

(30) **Foreign Application Priority Data**

Mar. 29, 2002 (TW) ..... 91106426 A

(51) **Int. Cl.**
G11B 7/00 (2006.01)

(52) **U.S. Cl.** **369/59.25**

(58) **Field of Classification Search** 369/59.25, 369/59.11, 59.12, 53.33, 53.34, 53.35, 47.1, 369/47.28, 59.33, 59.34, 47.27, 47.23, 47.24
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,269,059 B1 * 7/2001 Kuroda et al. 369/47.28

FOREIGN PATENT DOCUMENTS

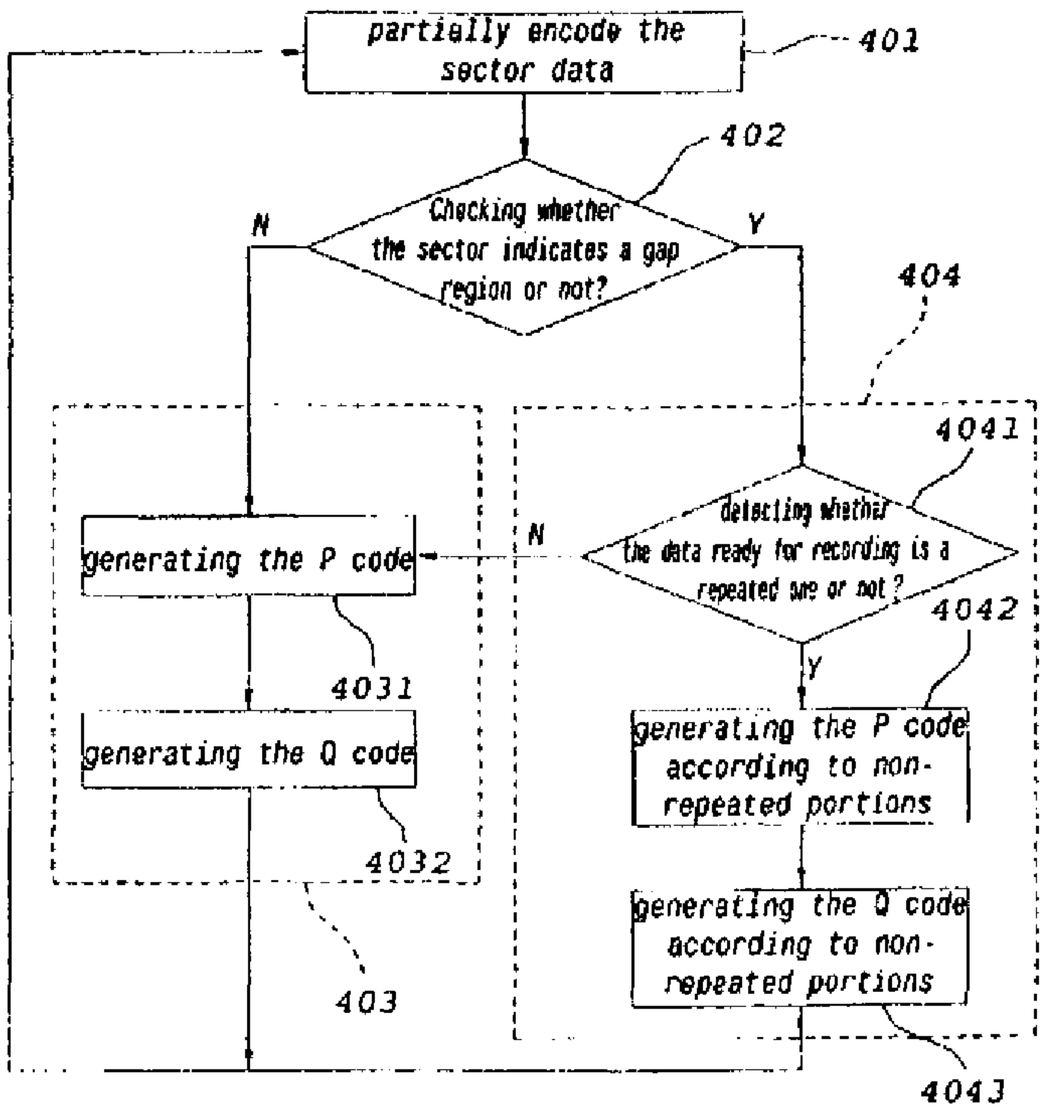
TW 244066 11/2005
* cited by examiner

Primary Examiner - Nabil Z Hindi
(74) *Attorney, Agent, or Firm* — Perkins Coie LLP

(57) **ABSTRACT**

An encoding method for recording gap regions or sectors having repeated data is disclosed. At least one sector is entirely encoded and stored in a memory buffer of the optical recording system. If the currently encoded are gap regions or sector having repeated data embedded in the fields of user data, only those portions affected by the modified header will be encoded to derive associated P code and Q code. The error detection code is firstly generated in the mode 1 standard when a gap region is encoded. P code is then encoded for those regions affected by the sequentially modified header and error detection code, while associated Q code is then derived according the modified header, error detection code, and P code. In the mode 2 form 1 and mode form 2 standards, only those regions affected by the sequentially modified header should be re-encoded again. Since the remaining portions employ the same data as the last encoded one in the memory buffer so that the encoding performance would be significantly upgraded whatever encoding standards are employed.

31 Claims, 4 Drawing Sheets



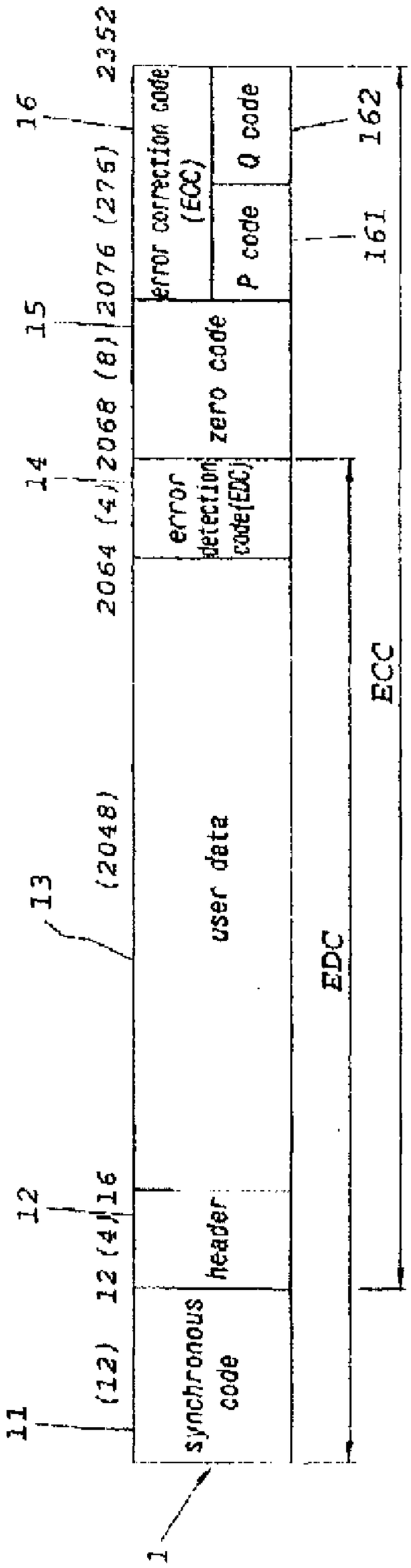


FIG. 1
PRIOR ART

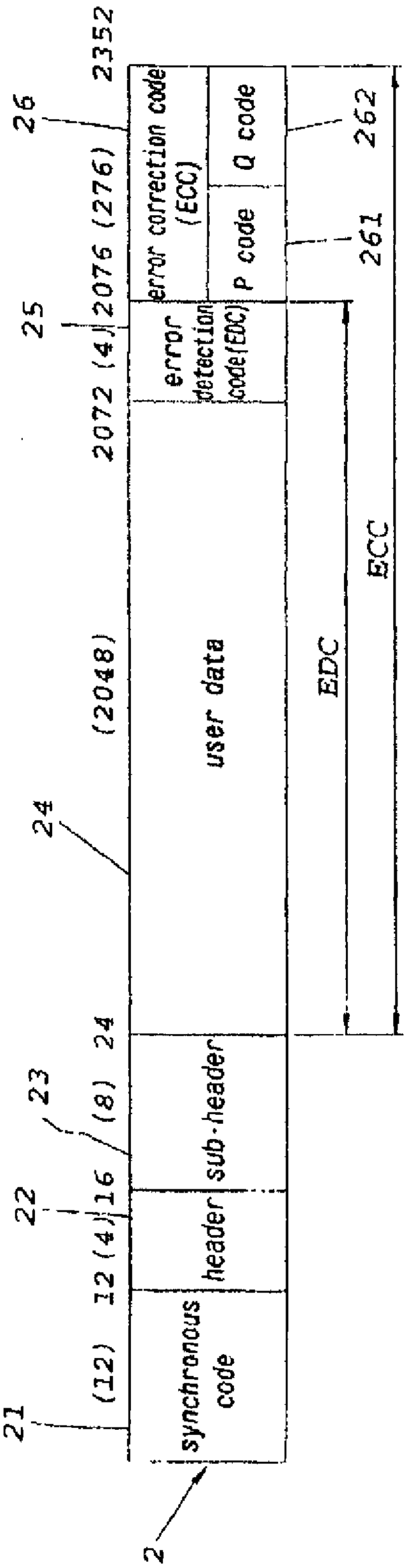


FIG. 2
PRIOR ART

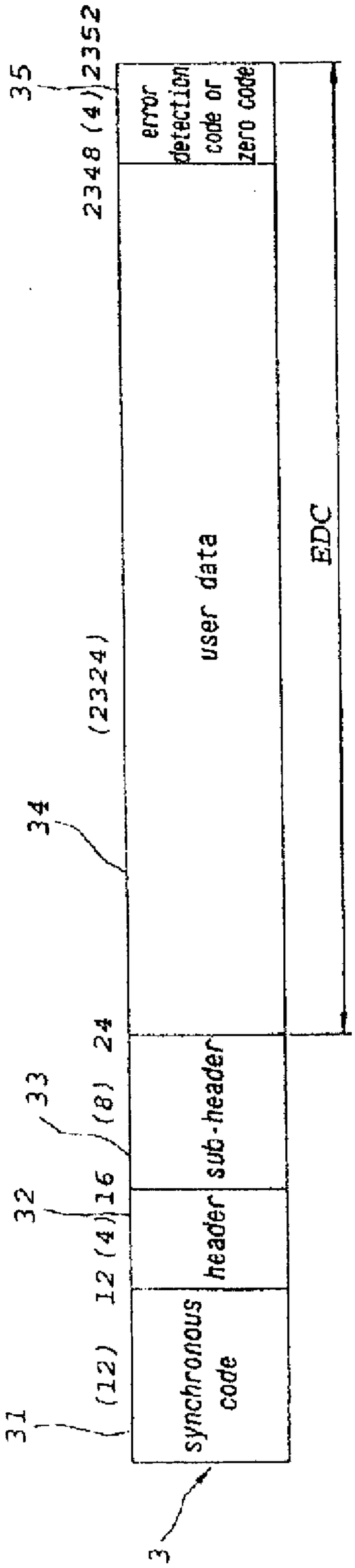


FIG. 3
PRIOR ART

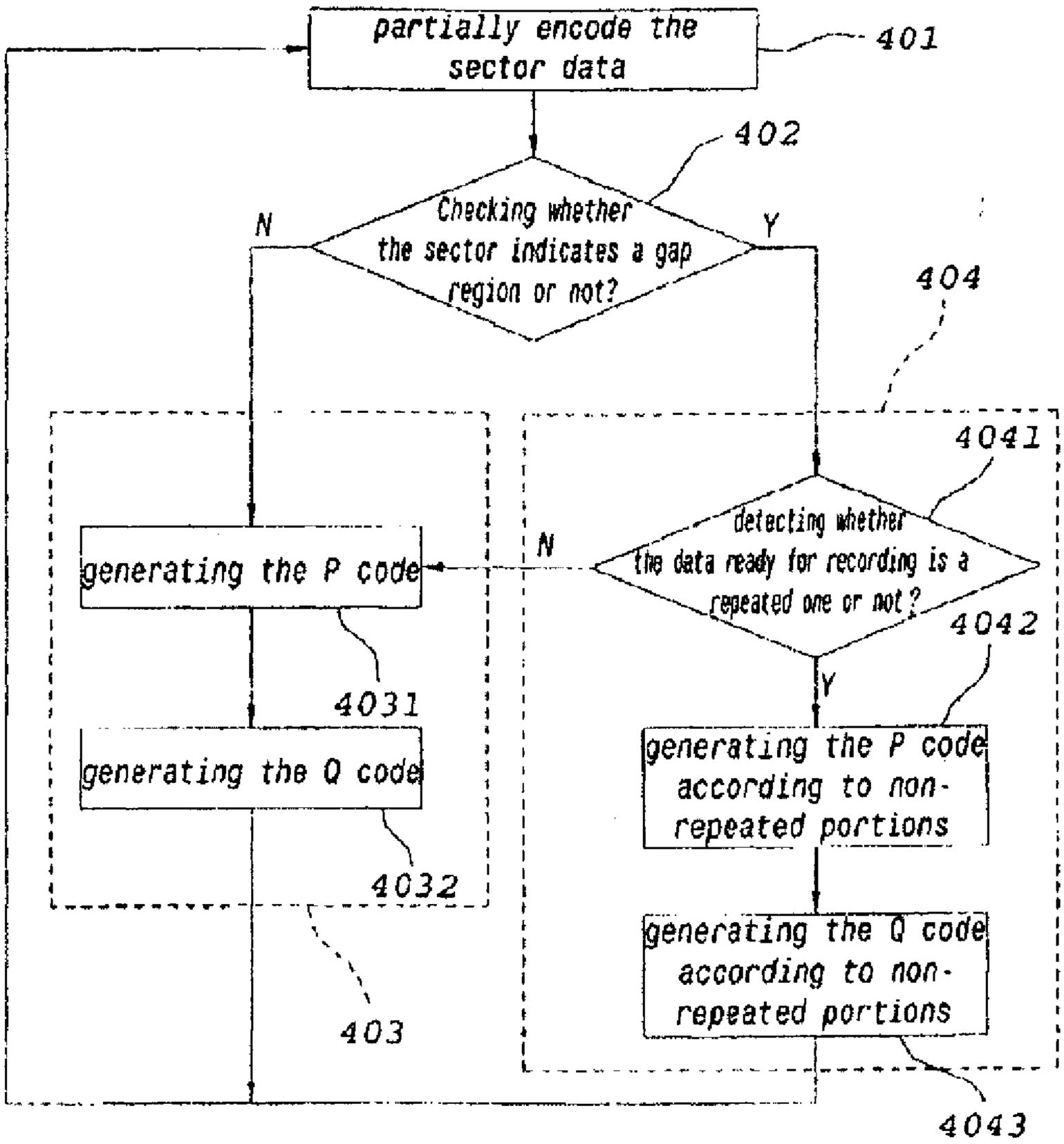

partially encode the sector data
401
402
Checking whether the sector indicates a gap region or not?
N
Y
404
4041
detecting whether the data ready for recording is a repeated one or not?
N
Y
4042
generating the P code
4031
generating the Q code
4032
403
generating the P code according to non-repeated portions
generating the Q code according to non-repeated portions
4043

FIG.4