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(54) CONTENTS MANAGING METHOD AND CONTENTS MANAGING APPARATUS

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(22) Filed: **Dec. 21, 2004**

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(30) **Foreign Application Priority Data**

Apr. 30, 1999 (JP) 11-124182

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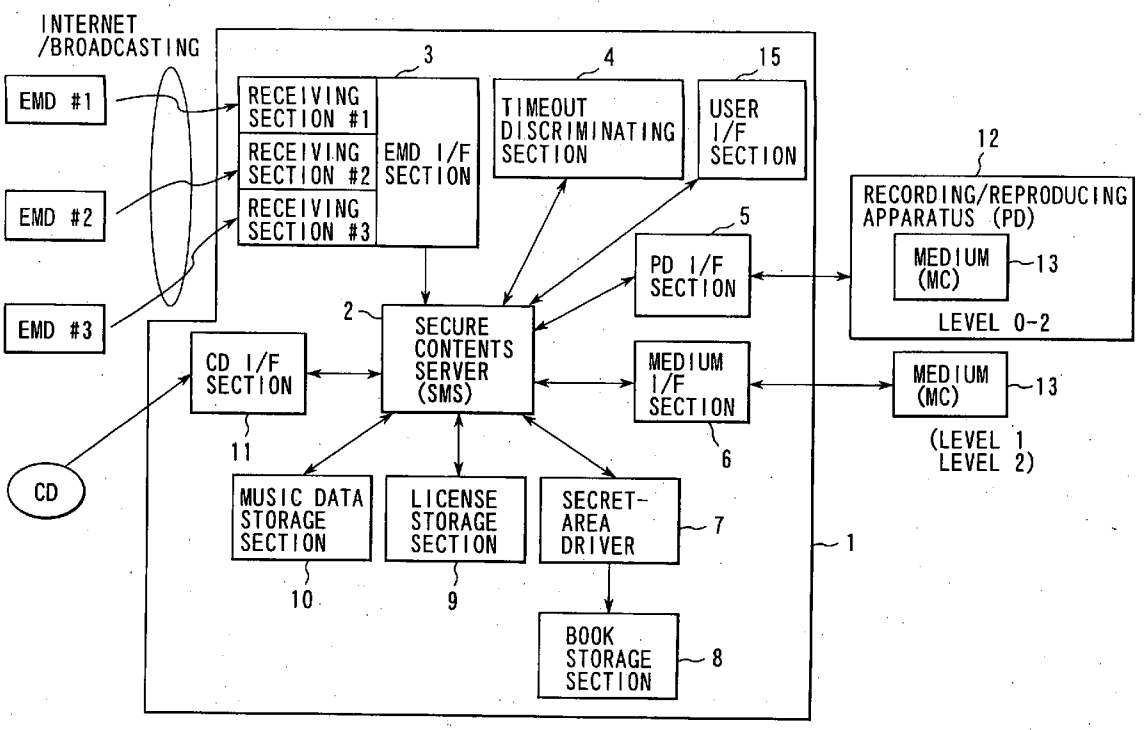
(52) **U.S. Cl.** **705/57**

(57) ABSTRACT

A contents managing method of regulating a number of copied contents storable on a storage medium includes giving a predetermined number of copyable contents for each content, recording the copied contents on the storage medium upon reception of an instruction for copy recording on the storage medium when there is a remainder in the number of copyable contents, decrementing the number of copyable contents by "1" every time one copied content is recorded on the storage medium at a time of recording, and incrementing the number of copyable contents by "1" every time one copied content is erased from the storage medium upon reception of an instruction to erase the copied contents from the storage medium.



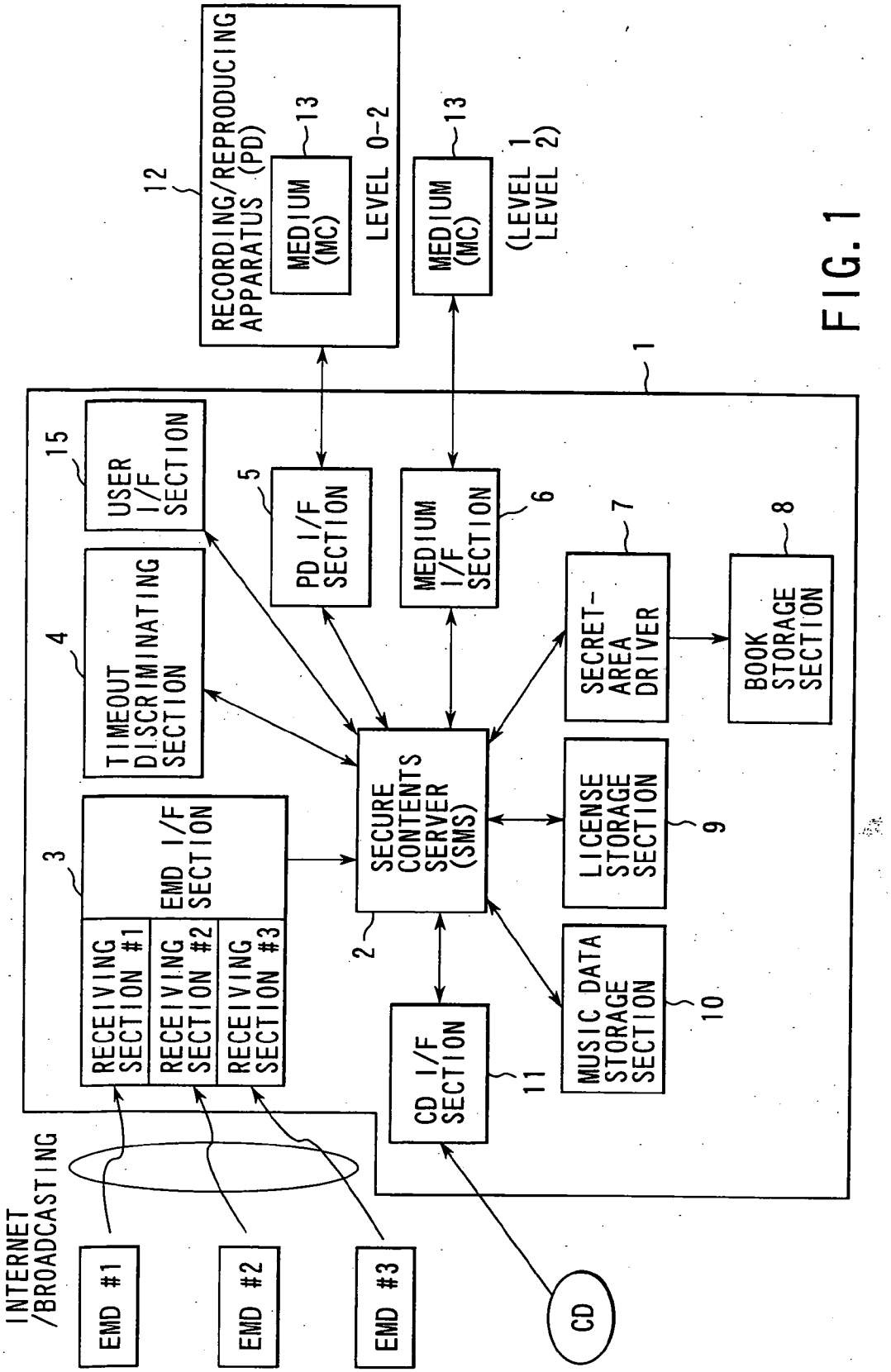

INTERNET /BROADCASTING
EMD #1
EMD #2
EMD #3
CD
RECEIVING SECTION #1
RECEIVING SECTION #2
RECEIVING SECTION #3
EMD I/F SECTION
3
TIMEOUT DISCRIMINATING SECTION
4
USER I/F SECTION
15
SECURE CONTENTS SERVER (SMS)
2
PD I/F SECTION
5
MEDIUM I/F SECTION
6
CD I/F SECTION
11
SECRET-AREA DRIVER
7
LICENSE STORAGE SECTION
9
MUSIC DATA STORAGE SECTION
10
BOOK STORAGE SECTION
8
1
RECORDING/REPRODUCING APPARATUS (PD)
12
MEDIUM (MC)
13
LEVEL 0-2
MEDIUM (MC)
13
(LEVEL 1 LEVEL 2)

FIG. 1

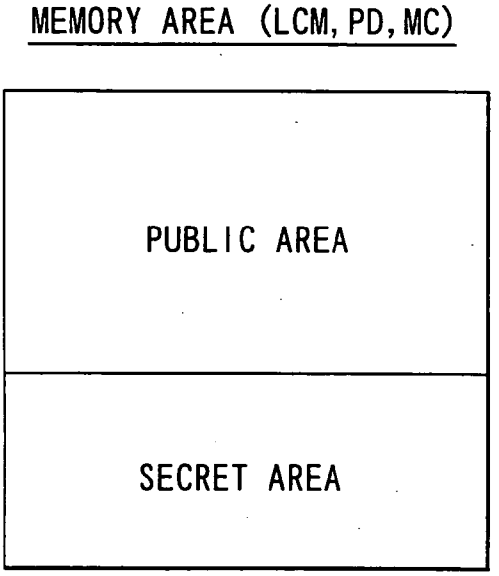

MEMORY AREA (LCM, PD, MC)
PUBLIC AREA
SECRET AREA

FIG. 2

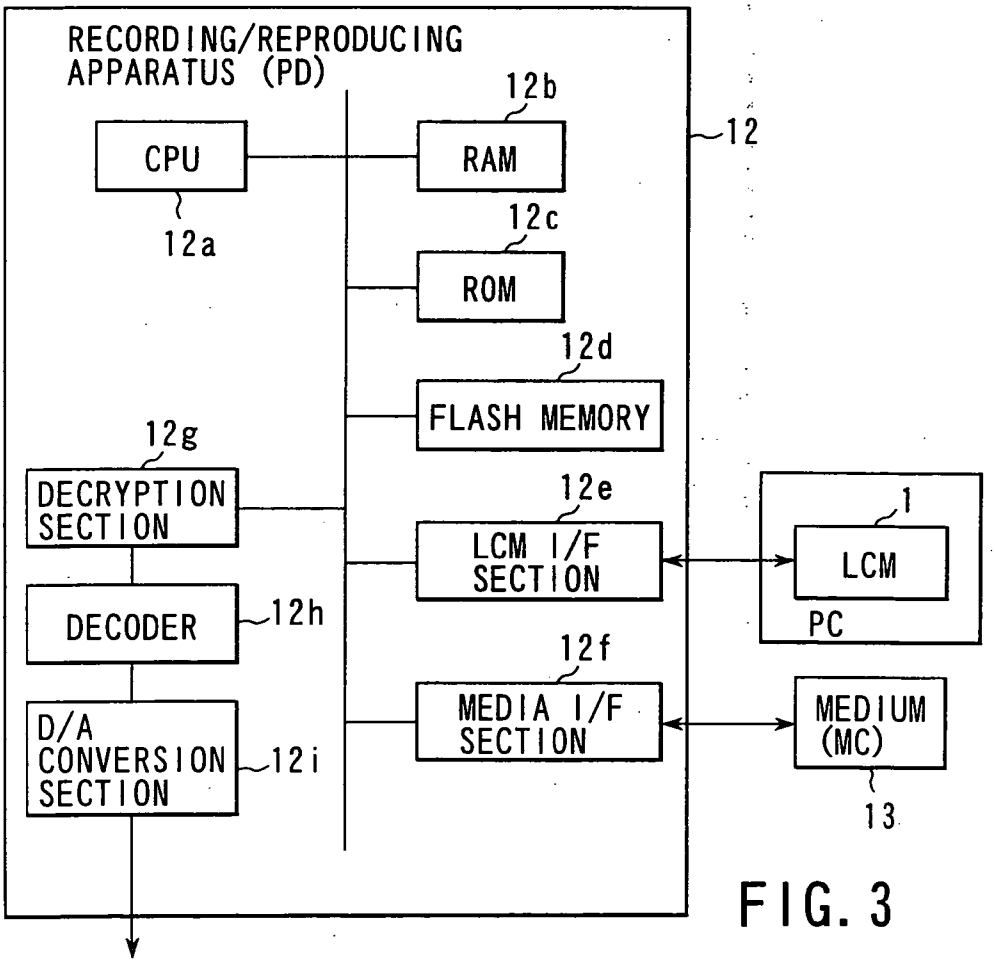

RECORDING/REPRODUCING APPARATUS (PD)
12
CPU
12a
12b
RAM
12c
ROM
12d
FLASH MEMORY
12e
LCM I/F SECTION
12f
MEDIA I/F SECTION
12g
DECRYPTION SECTION
DECODER
12h
D/A CONVERSION SECTION
12i
1
LCM
PC
MEDIUM (MC)
13

FIG. 3

FIG. 4A

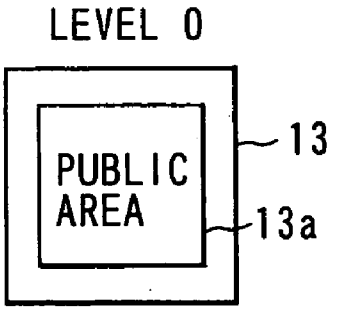


FIG. 4B

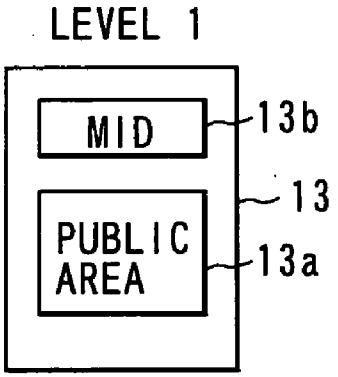
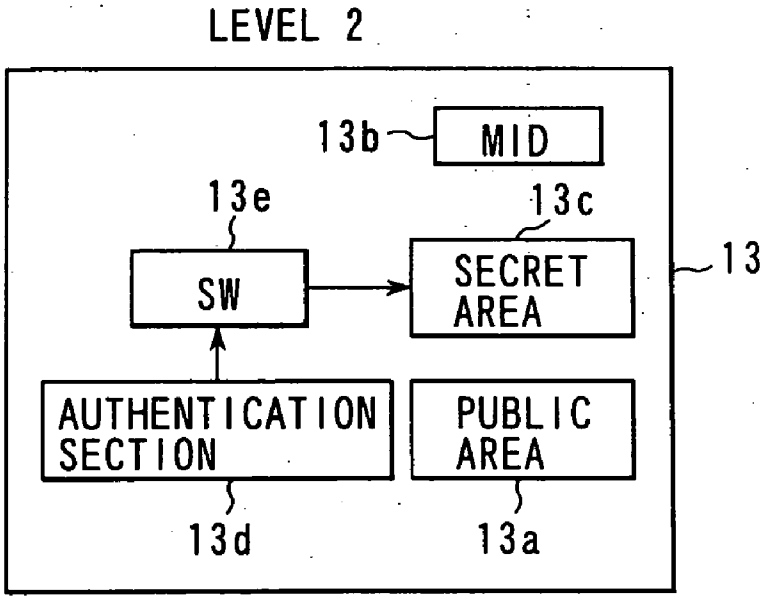


FIG. 4C



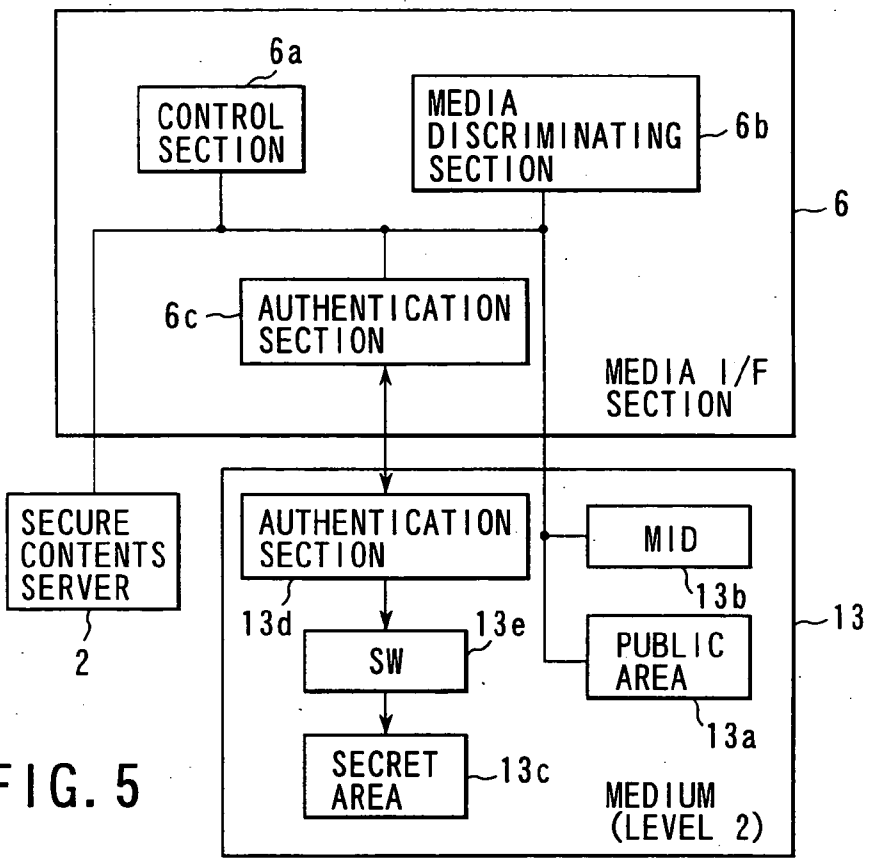

6a
CONTROL SECTION
MEDIA DISCRIMINATING SECTION
6b
6
6c
AUTHENTICATION SECTION
MEDIA I/F SECTION
SECURE CONTENTS SERVER
2
AUTHENTICATION SECTION
MID
13b
13d
13e
SW
PUBLIC AREA
13
13a
SECRET AREA
13c
MEDIUM (LEVEL 2)

FIG. 5

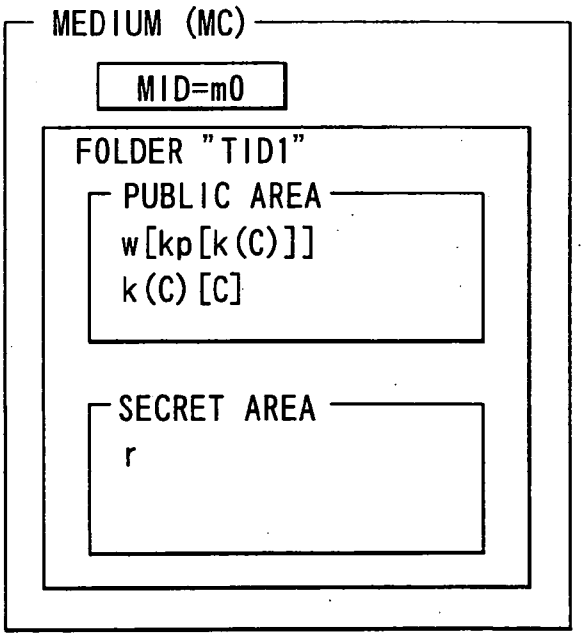

MEDIUM (MC)
MID=m0
FOLDER "TID1"
PUBLIC AREA
w[kp[k(C)]]
k(C)[C]
SECRET AREA
r

FIG. 6

FIG. 7A

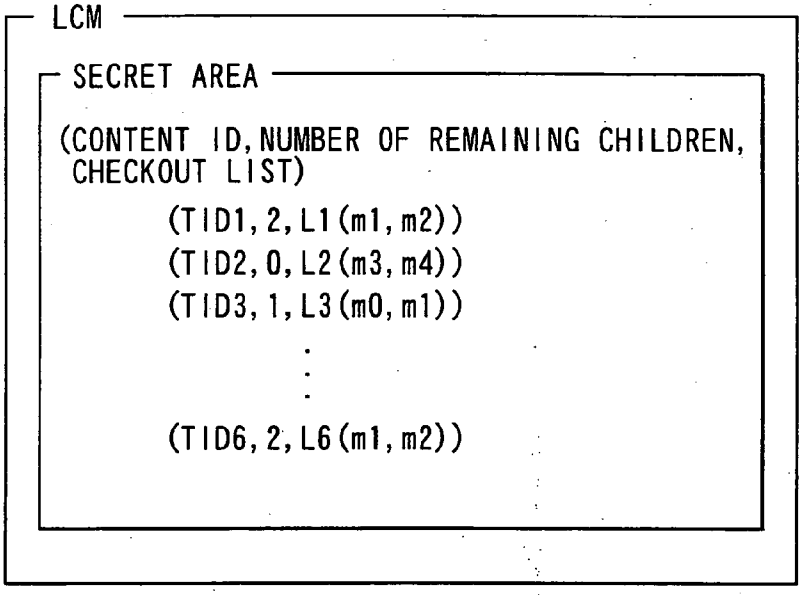


FIG. 7B

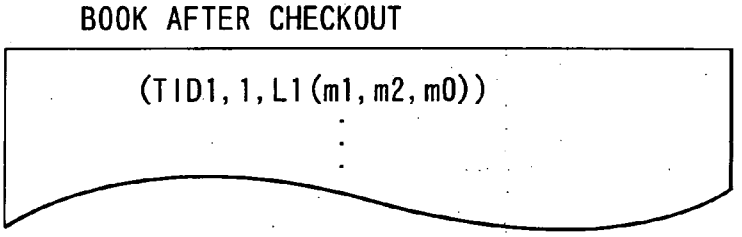


FIG. 7C

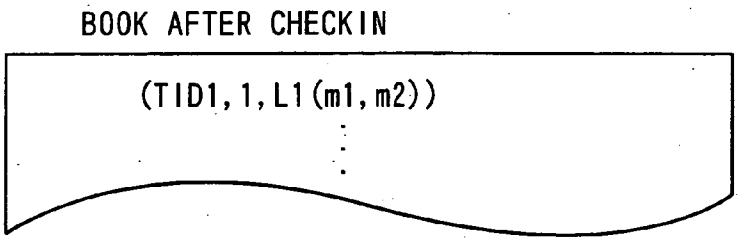


FIG. 8A

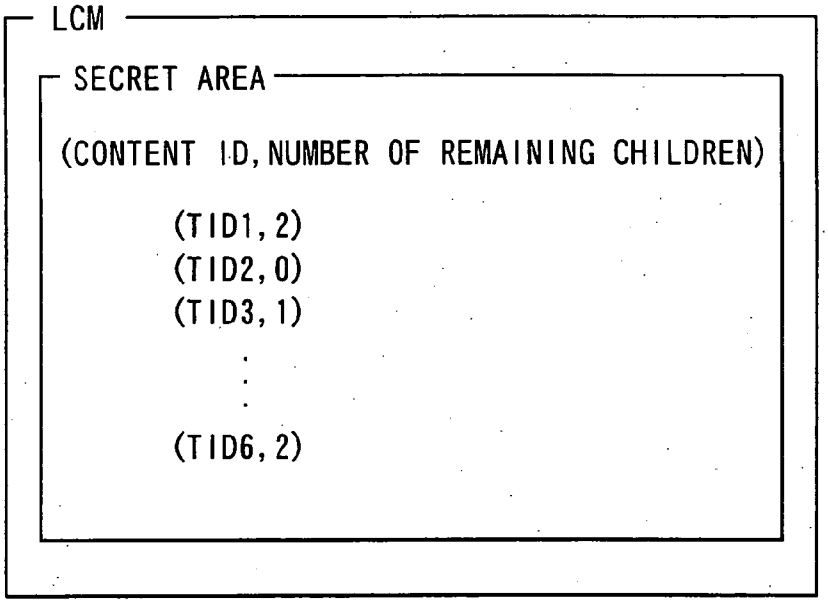
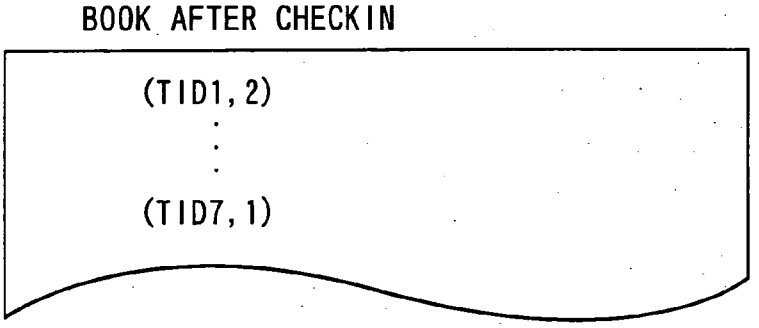

LCM
SECRET AREA
(CONTENT ID, NUMBER OF REMAINING CHILDREN)
(TID1, 2)
(TID2, 0)
(TID3, 1)
(TID6, 2)

FIG. 8B


BOOK AFTER CHECKIN
(TID1, 2)
(TID7, 1)

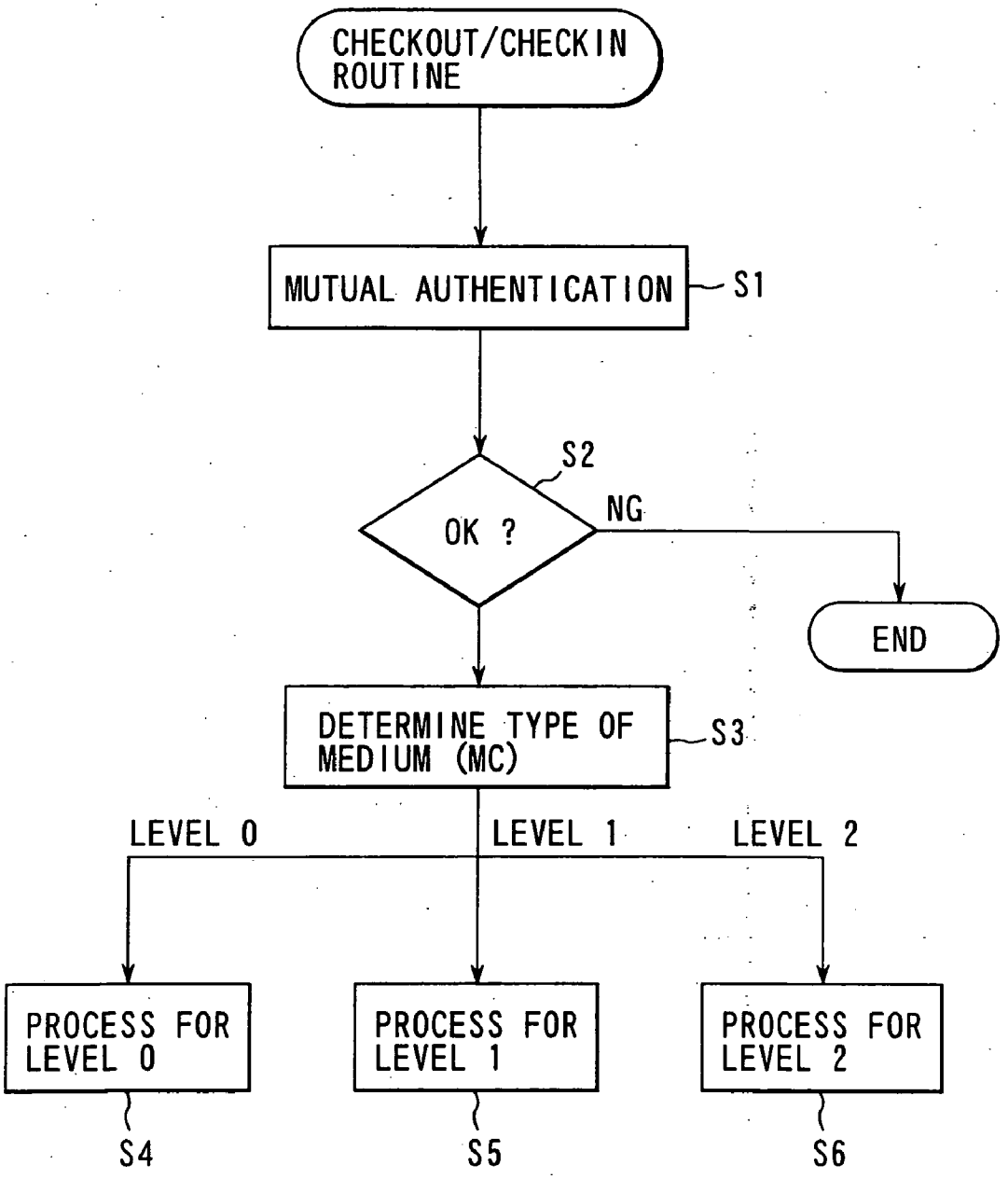

CHECKOUT/CHECKIN ROUTINE
MUTUAL AUTHENTICATION
S1
S2
OK ?
NG
END
DETERMINE TYPE OF MEDIUM (MC)
S3
LEVEL 0
LEVEL 1
LEVEL 2
PROCESS FOR LEVEL 0
PROCESS FOR LEVEL 1
PROCESS FOR LEVEL 2
S4
S5
S6

FIG. 9

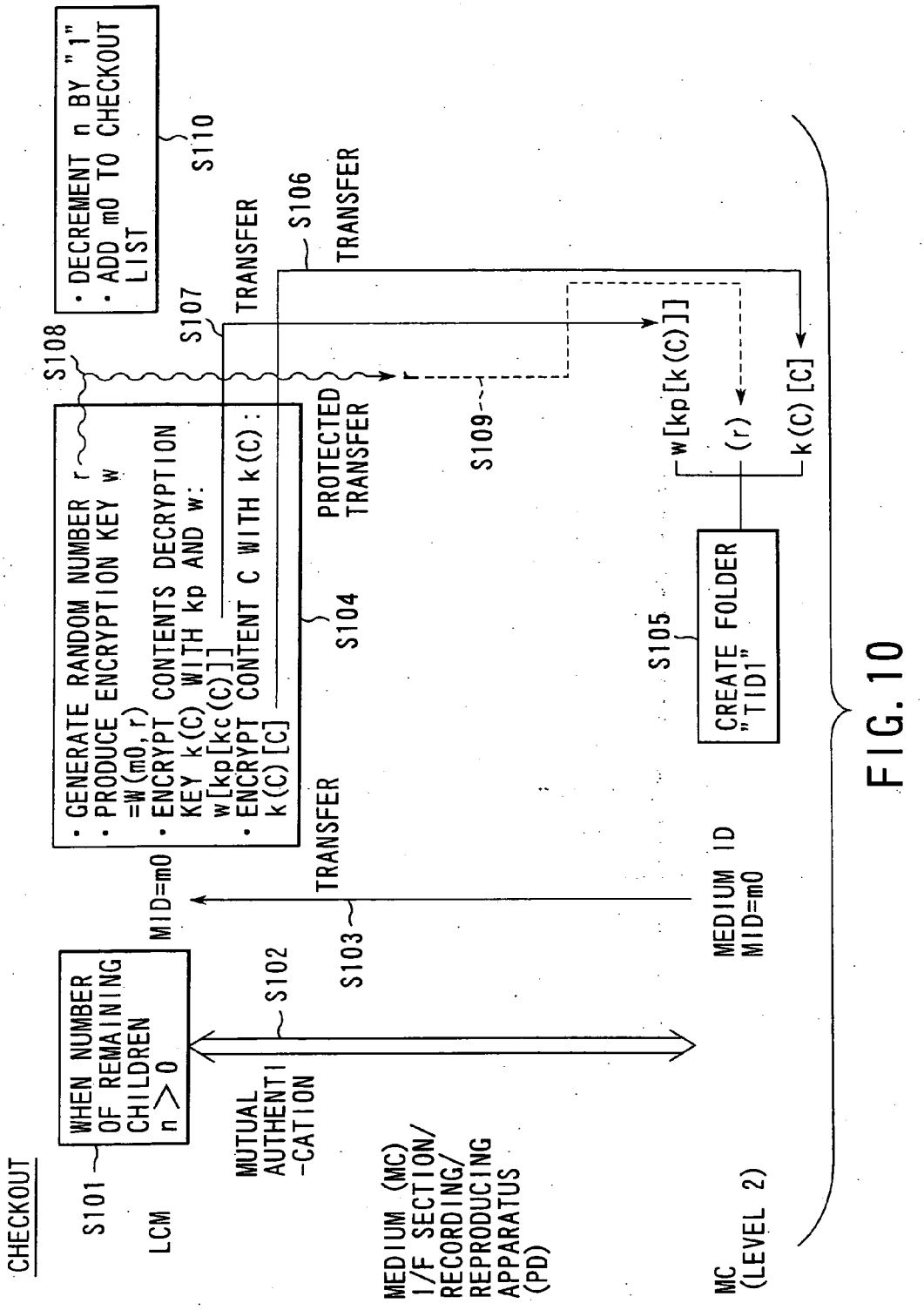

CHECKOUT
S101
WHEN NUMBER OF REMAINING CHILDREN n > 0
LCM
MUTUAL AUTHENTI -CATION
S102
S103
MID=m0
TRANSFER
• GENERATE RANDOM NUMBER r
• PRODUCE ENCRYPTION KEY w =W(m0,r)
• ENCRYPT CONTENTS DECRYPTION KEY k(C) WITH kp AND w: w[kp[kc(C)]]
• ENCRYPT CONTENT C WITH k(C): k(C)[C]
S104
PROTECTED TRANSFER
S107
TRANSFER
S108
• DECREMENT n BY "1"
• ADD m0 TO CHECKOUT LIST
S110
S106
TRANSFER
S109
r
w[kp[k(C)]]
(r)
k(C)[C]
S105
CREATE FOLDER "TID1"
MEDIUM ID MID=m0
MEDIUM (MC) I/F SECTION/ RECORDING/ REPRODUCING APPARATUS (PD)
MC (LEVEL 2)

FIG. 10

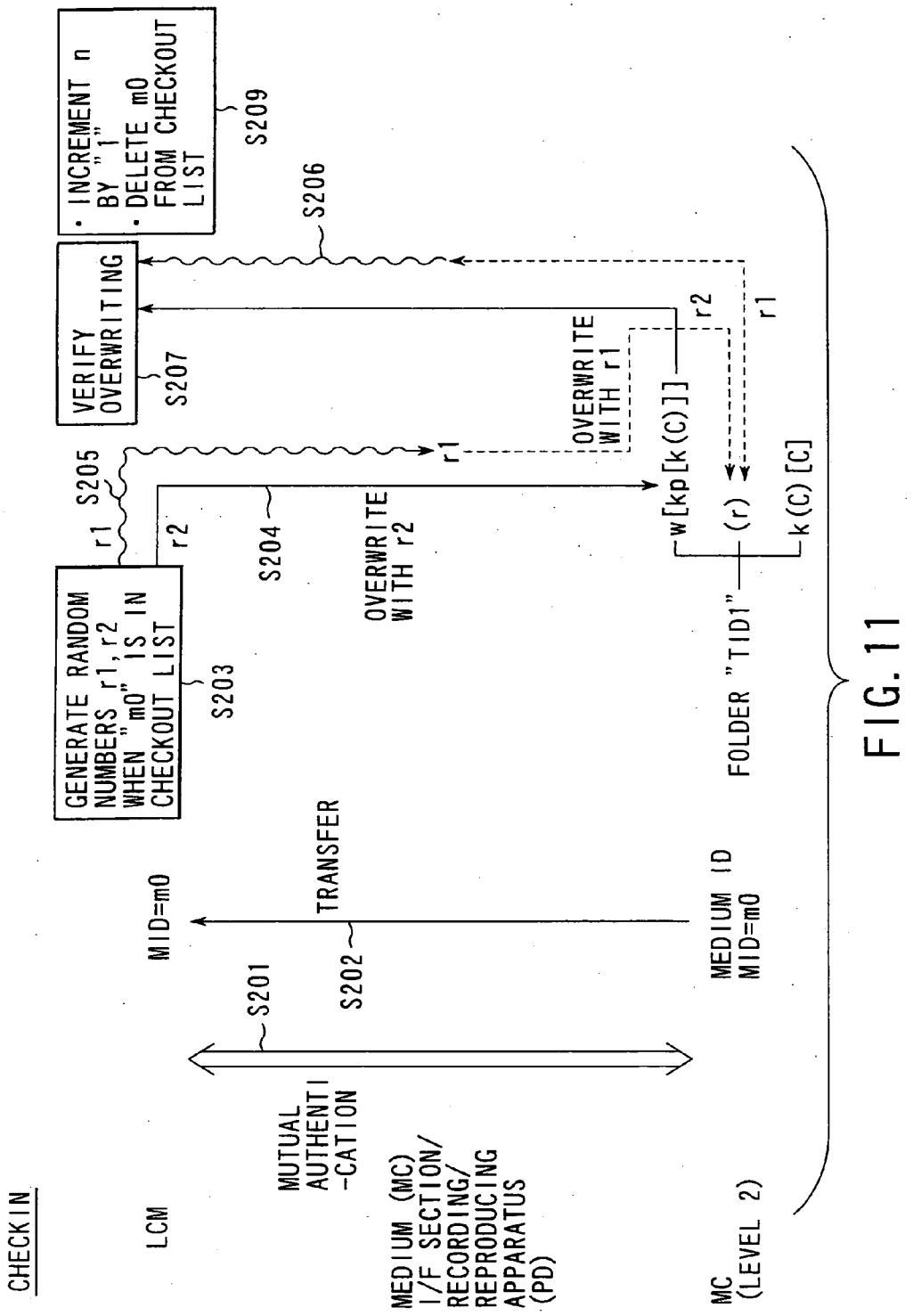

CHECK IN
LCM
MUTUAL AUTHENTI-CATION
MEDIUM (MC) I/F SECTION/ RECORDING/ REPRODUCING APPARATUS (PD)
MC (LEVEL 2)
MID=m0
TRANSFER
MEDIUM ID MID=m0
S201
S202
GENERATE RANDOM NUMBERS r1, r2 WHEN "m0" IS IN CHECKOUT LIST
S203
r1 S205
r2
S204
OVERWRITE WITH r2
FOLDER "TID1"
w[kp[k(C)]]
(r)
k(C) [C]
r1
OVERWRITE WITH r1
r2
r1
VERIFY OVERWRITING
S207
S206
• INCREMENT n BY "1"
• DELETE m0 FROM CHECKOUT LIST
S209

FIG. 11

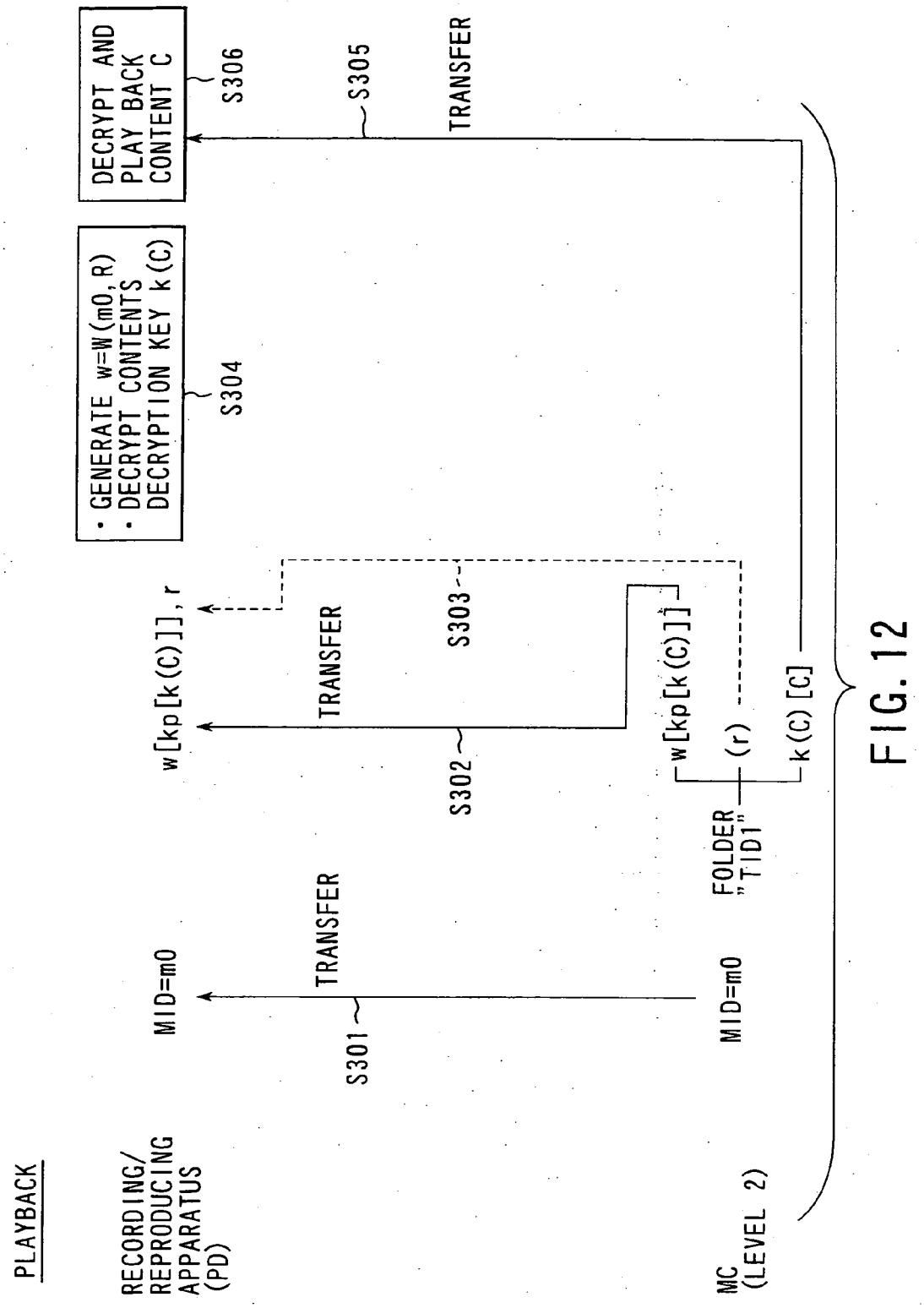

PLAYBACK
RECORDING/ REPRODUCING APPARATUS (PD)
MC (LEVEL 2)
MID=m0
TRANSFER
S301
w[kp[k(C)]],r
TRANSFER
S303
S302
w[kp[k(C)]]
(r)
k(C) [C]
FOLDER "TID1"
MID=m0
• GENERATE w=W(m0,R)
• DECRYPT CONTENTS DECRYPTION KEY k(C)
S304
S305
TRANSFER
DECRYPT AND PLAY BACK CONTENT C
S306

FIG. 12

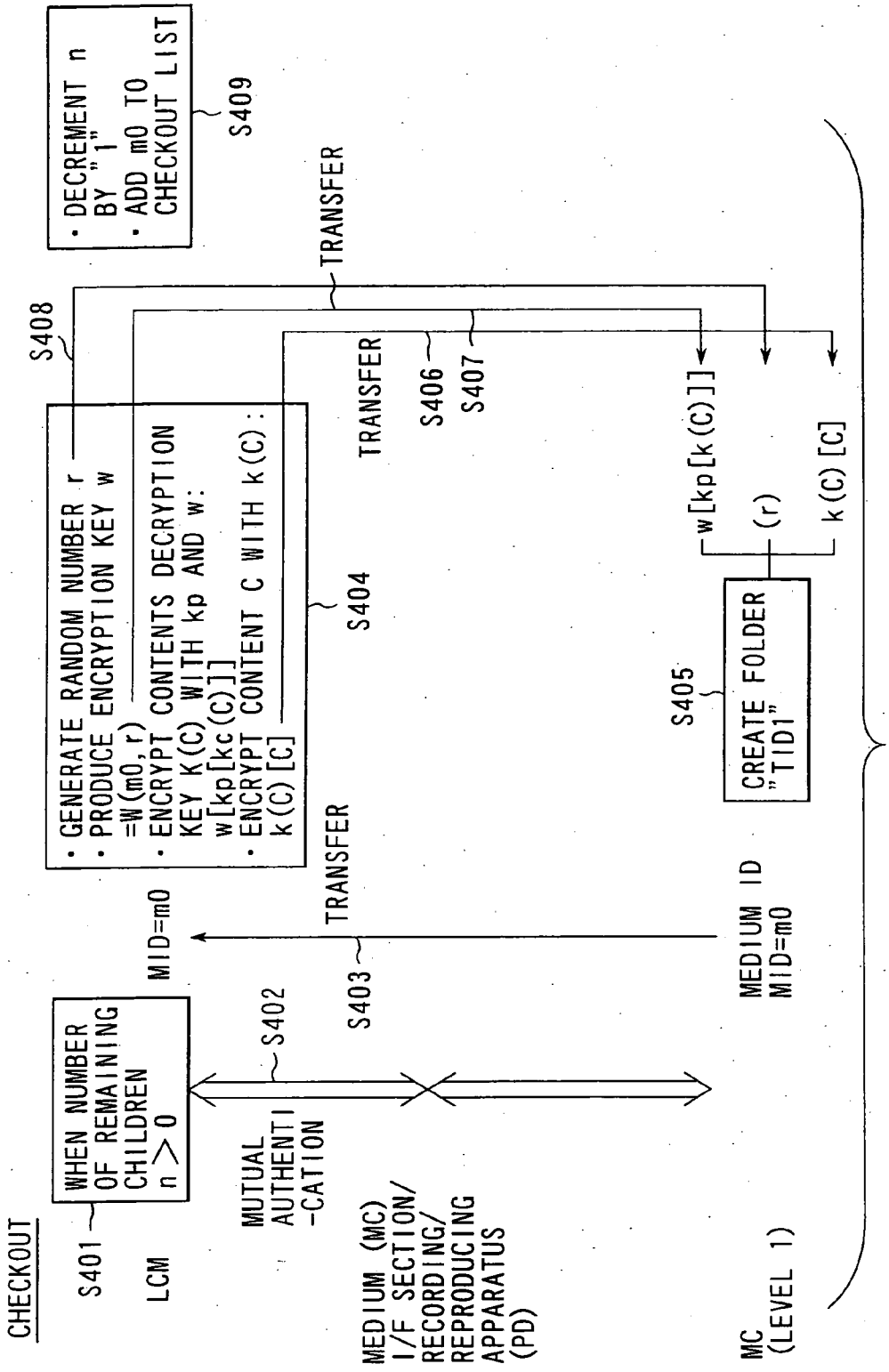

CHECKOUT
S401
WHEN NUMBER OF REMAINING CHILDREN n > 0
LCM
MID=m0
S402
MUTUAL AUTHENTI -CATION
S403
TRANSFER
• GENERATE RANDOM NUMBER r
• PRODUCE ENCRYPTION KEY w =W(m0, r)
• ENCRYPT CONTENTS DECRYPTION KEY K(C) WITH kp AND w: w[kp[kc(C)]]
• ENCRYPT CONTENT C WITH k(C): k(C)[C]
S404
TRANSFER
S405
CREATE FOLDER "TID1"
MEDIUM ID MID=m0
S406
TRANSFER
S407
w[kp[k(C)]]
(r)
k(C)[C]
S408
TRANSFER
• DECREMENT n BY "1"
• ADD m0 TO CHECKOUT LIST
S409
MEDIUM (MC) I/F SECTION/ RECORDING/ REPRODUCING APPARATUS (PD)
MC (LEVEL 1)

FIG. 13

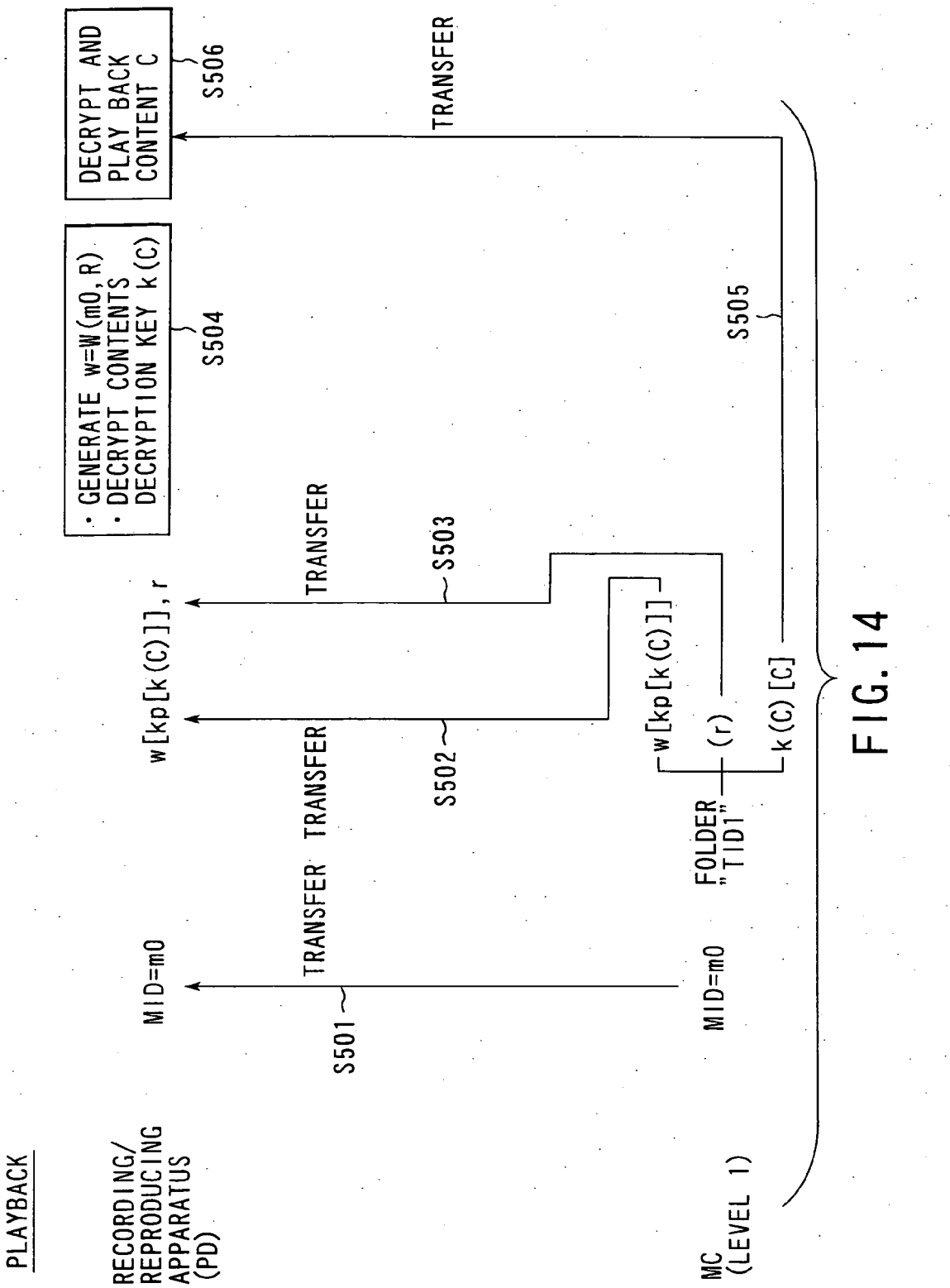

PLAYBACK
RECORDING/
REPRODUCING
APPARATUS
(PD)
MC
(LEVEL 1)
MID=m0
TRANSFER
S501
w[kp[k(C)]],r
TRANSFER
S502
· GENERATE w=W(m0,R)
· DECRYPT CONTENTS
DECRYPTION KEY k(C)
S504
TRANSFER
S503
MID=m0
FOLDER
"TID1"
w[kp[k(C)]]
(r)
k(C)[C]
S505
TRANSFER
DECRYPT AND
PLAY BACK
CONTENT C
S506

FIG. 14

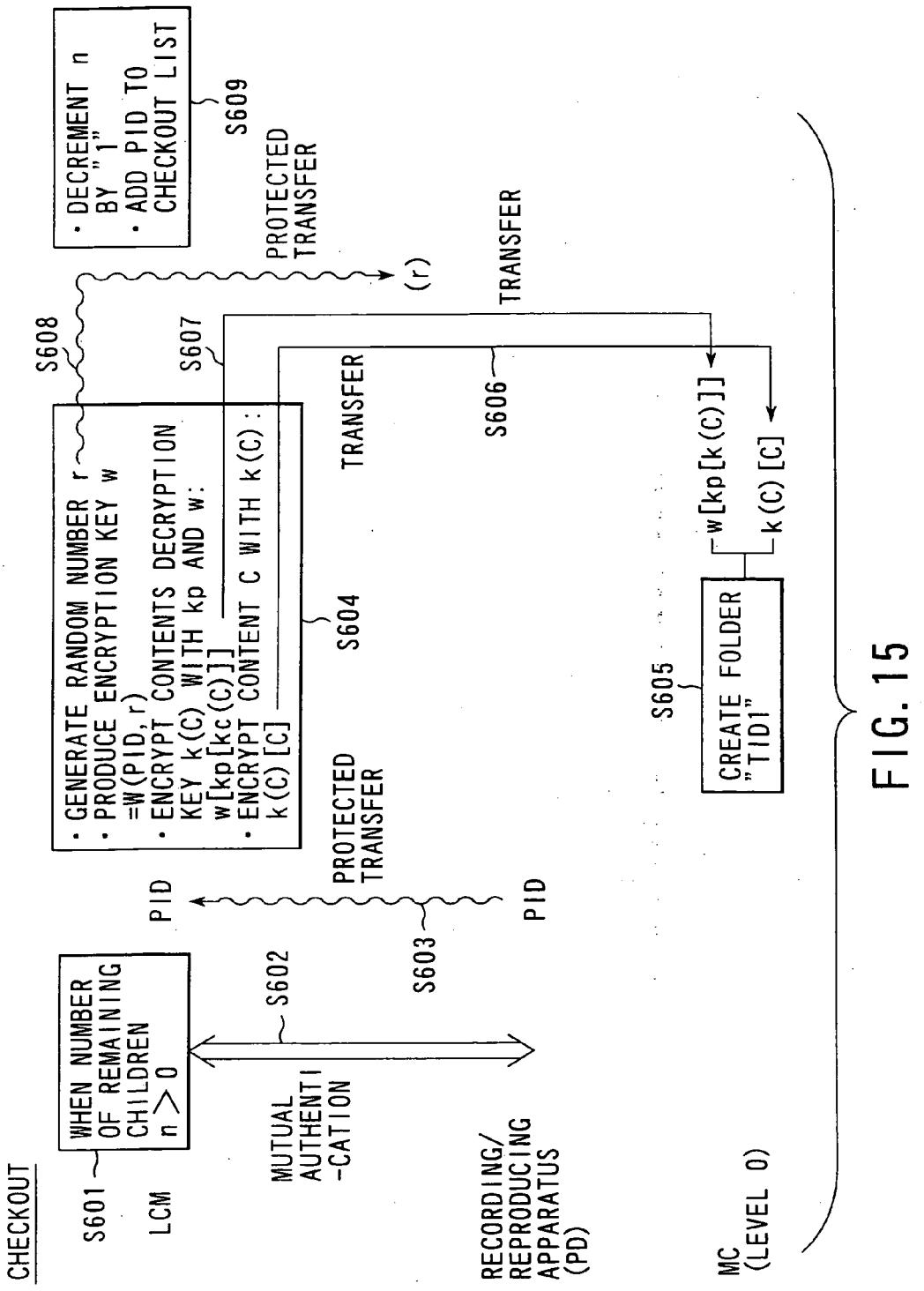

CHECKOUT
S601
WHEN NUMBER OF REMAINING CHILDREN n > 0
LCM
PID
S602
MUTUAL AUTHENTI -CATION
S603
PID
RECORDING/ REPRODUCING APPARATUS (PD)
• GENERATE RANDOM NUMBER r
• PRODUCE ENCRYPTION KEY w =W(PID,r)
• ENCRYPT CONTENTS DECRYPTION KEY k(C) WITH kp AND w: w[kp[kc(C)]]
• ENCRYPT CONTENT C WITH k(C): k(C)[C]
S604
PROTECTED TRANSFER
TRANSFER
S606
S605
CREATE FOLDER "TID"
w[kp[k(C)]]
k(C)[C]
TRANSFER
S607
S608
PROTECTED TRANSFER
(r)
• DECREMENT n BY "1"
• ADD PID TO CHECKOUT LIST
S609
MC (LEVEL 0)

FIG. 15

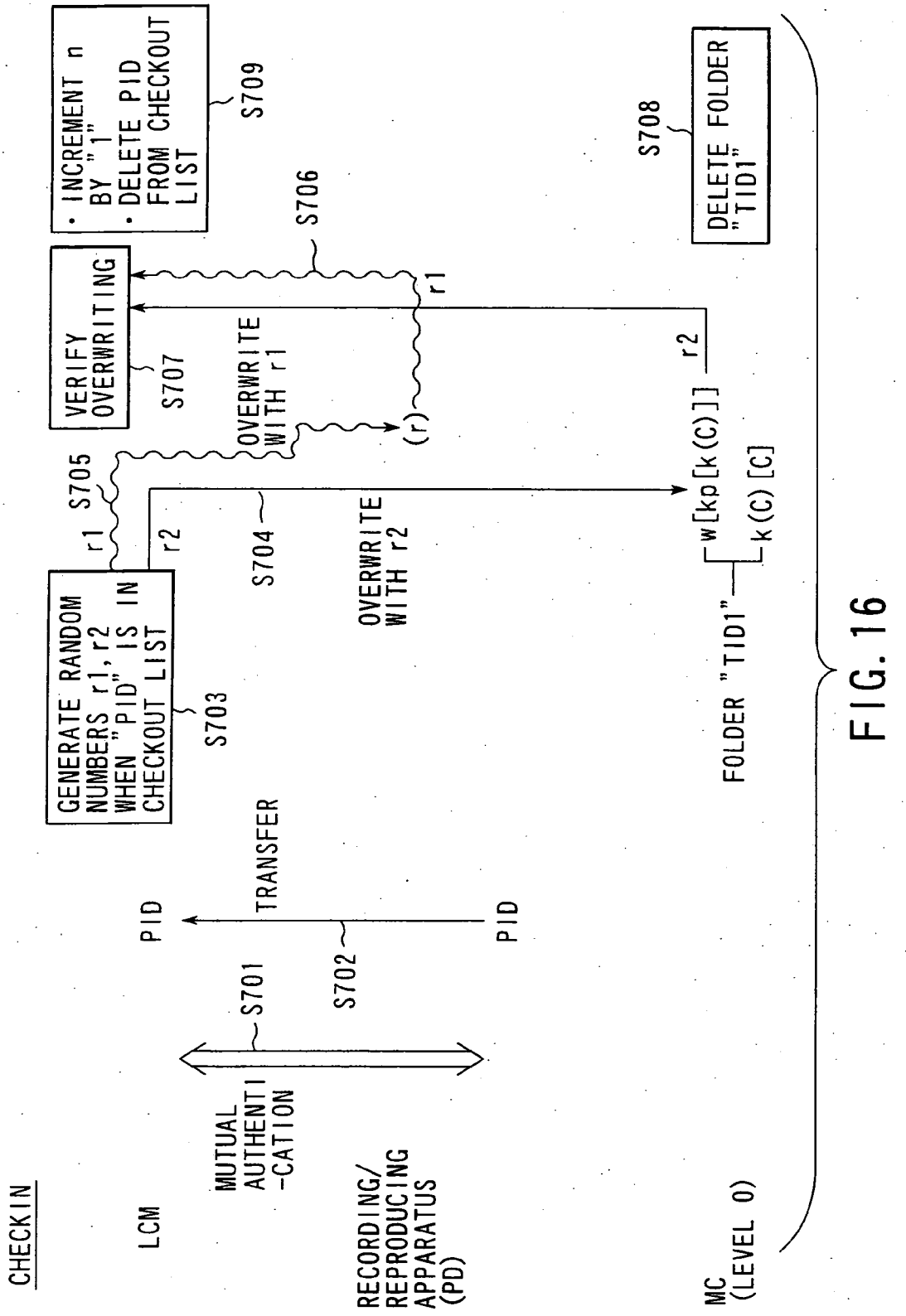

CHECKIN
LCM
RECORDING/
REPRODUCING
APPARATUS
(PD)
MC
(LEVEL 0)
MUTUAL
AUTHENTI
-CATION
S701
S702
PID
TRANSFER
PID
GENERATE RANDOM
NUMBERS r1, r2
WHEN "PID" IS IN
CHECKOUT LIST
S703
r1
r2
S705
S704
OVERWRITE
WITH r2
VERIFY
OVERWRITING
S707
OVERWRITE
WITH r1
(r)
S706
r1
r2
w[kp[k(C)]]
k(C) [C]
FOLDER "TID1"
• INCREMENT n
BY "1"
• DELETE PID
FROM CHECKOUT
LIST
S709
S708
DELETE FOLDER
"TID1"

FIG. 16

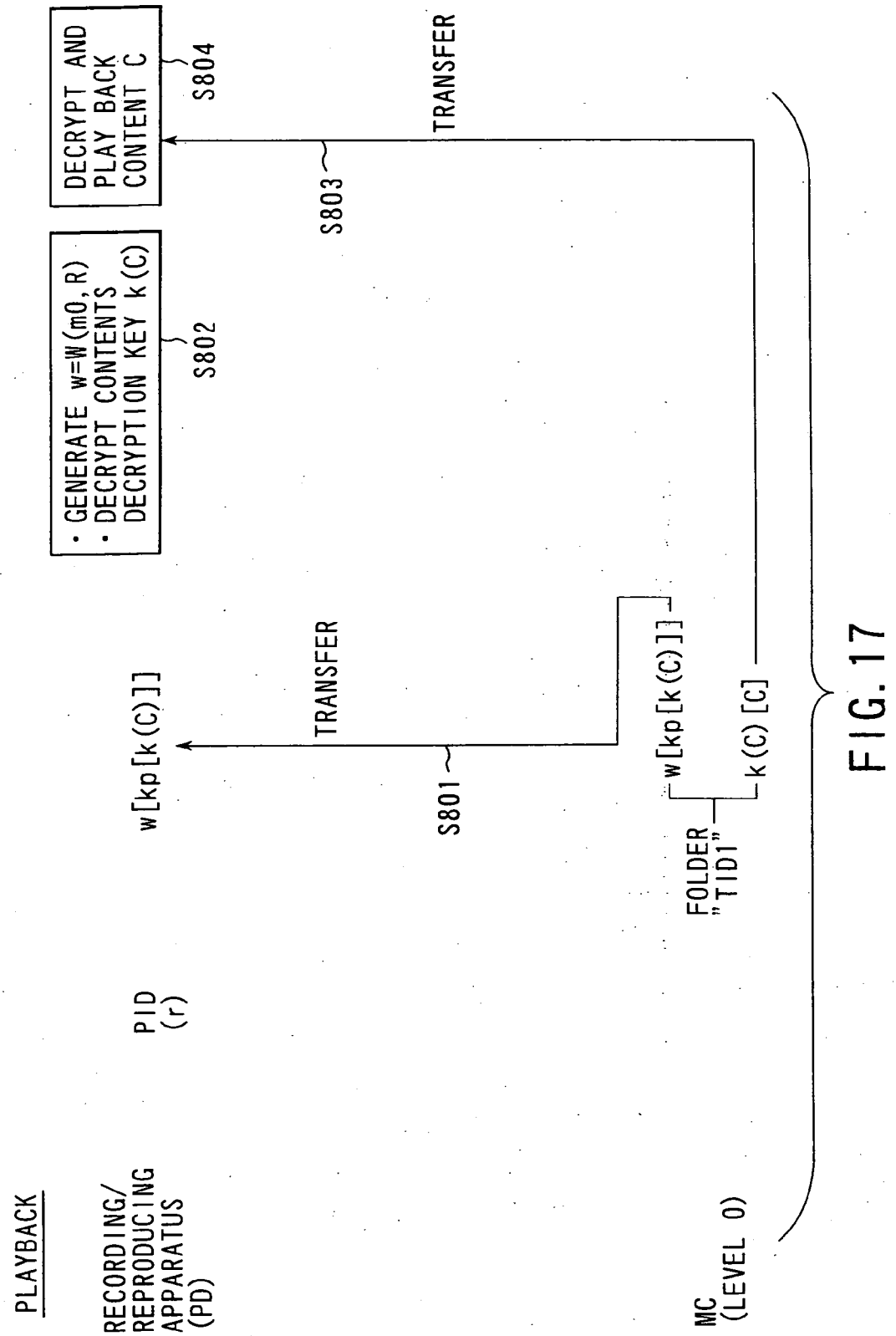

PLAYBACK
RECORDING/
REPRODUCING
APPARATUS
(PD)
PID
(r)
MC
(LEVEL 0)
FOLDER
"TID1"
w[kp[k(C)]]
k(C) [C]
w[kp[k(C)]]
TRANSFER
S801
TRANSFER
S803
• GENERATE w=W(m0, R)
• DECRYPT CONTENTS
DECRYPTION KEY k(C)
S802
DECRYPT AND
PLAY BACK
CONTENT C
S804

FIG. 17

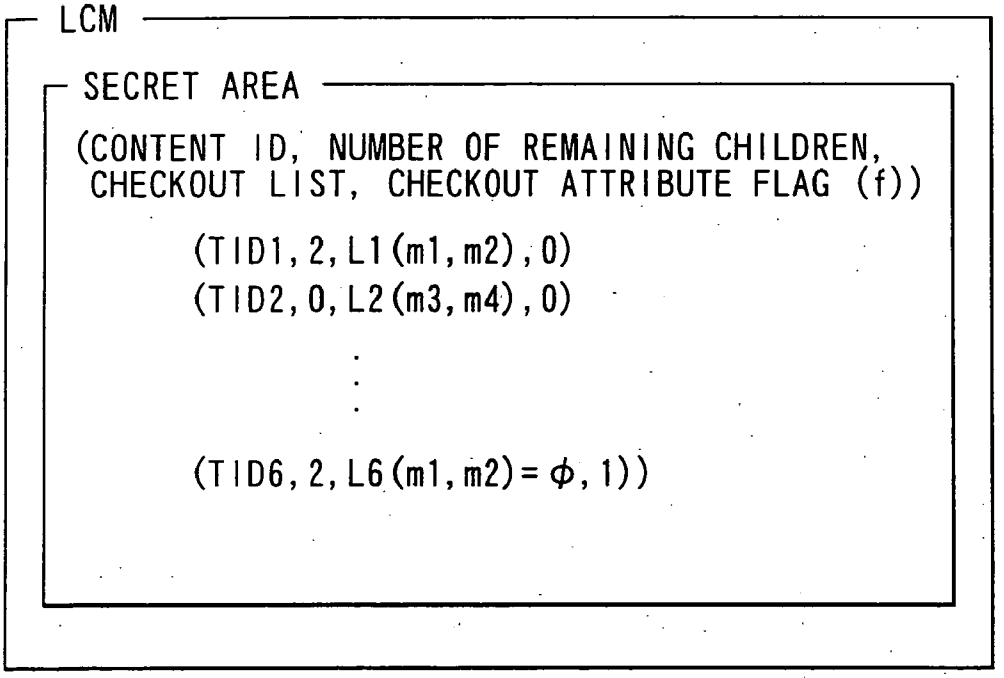


FIG. 18A

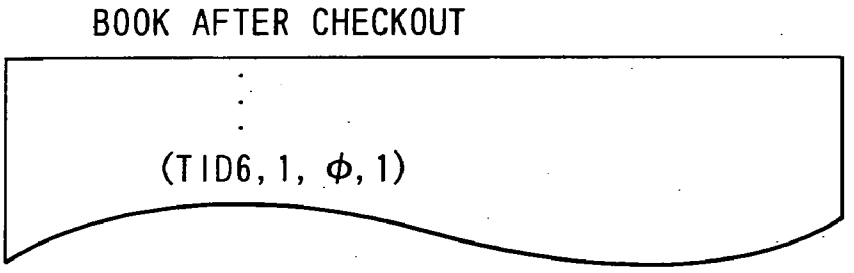


FIG. 18B

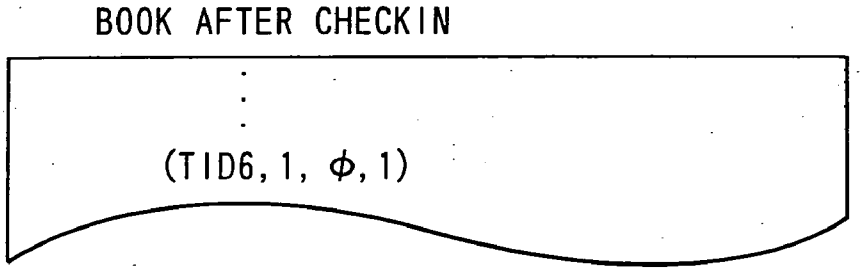


FIG. 18C

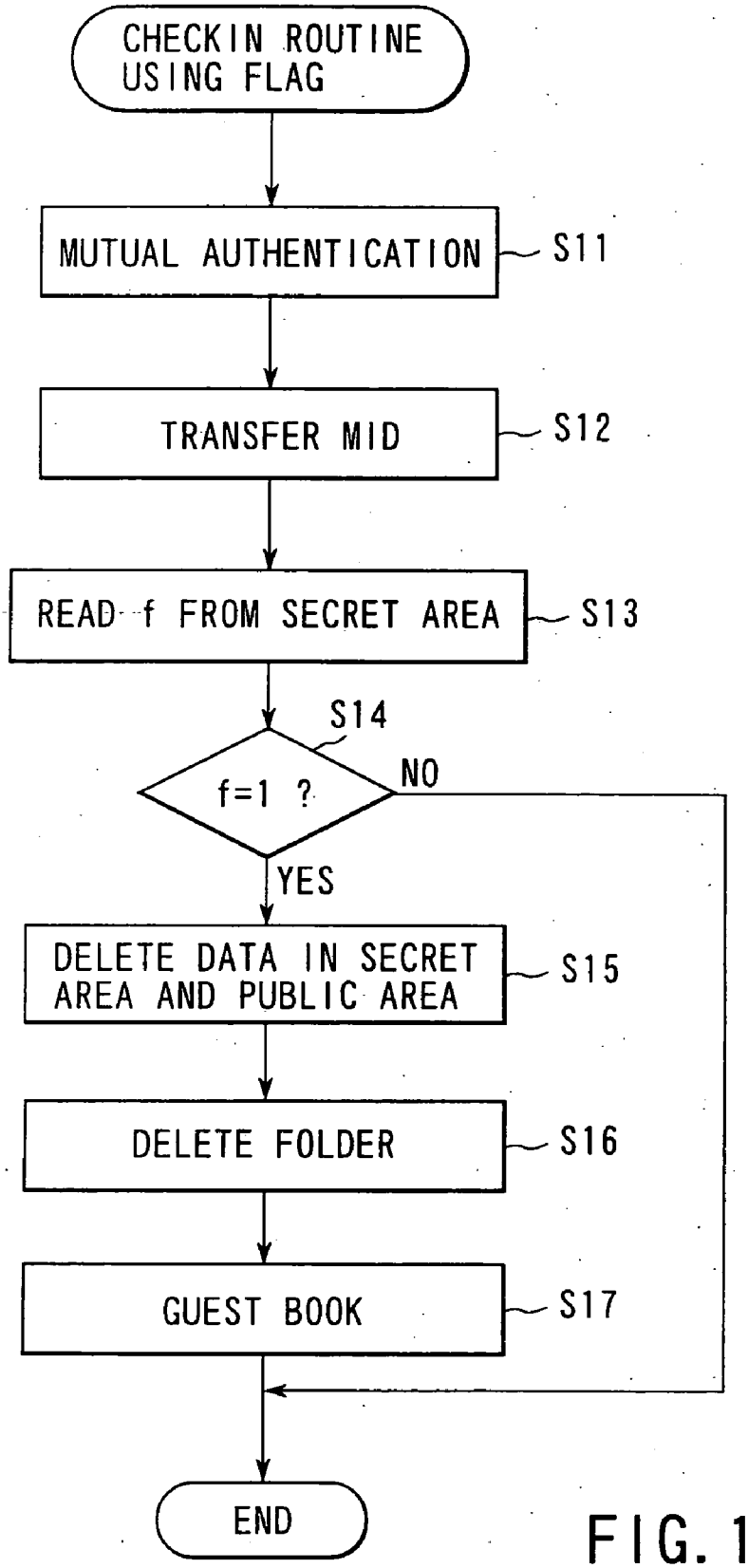

CHECKIN ROUTINE USING FLAG
MUTUAL AUTHENTICATION
S11
TRANSFER MID
S12
READ f FROM SECRET AREA
S13
S14
f=1 ?
NO
YES
DELETE DATA IN SECRET AREA AND PUBLIC AREA
S15
DELETE FOLDER
S16
GUEST BOOK
S17
END

FIG. 19

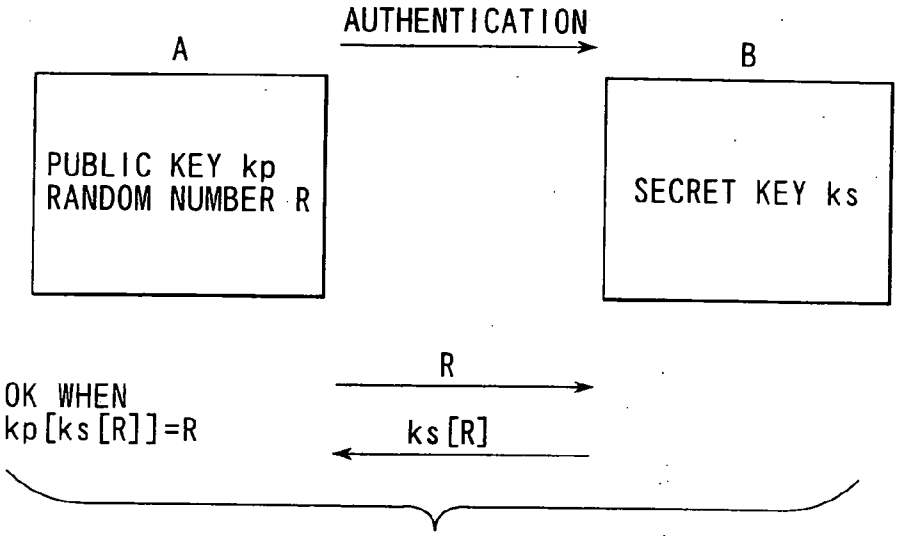

AUTHENTICATION
A
B
PUBLIC KEY kp
RANDOM NUMBER R
SECRET KEY ks
R
OK WHEN
kp[ks[R]]=R
ks[R]

FIG. 20

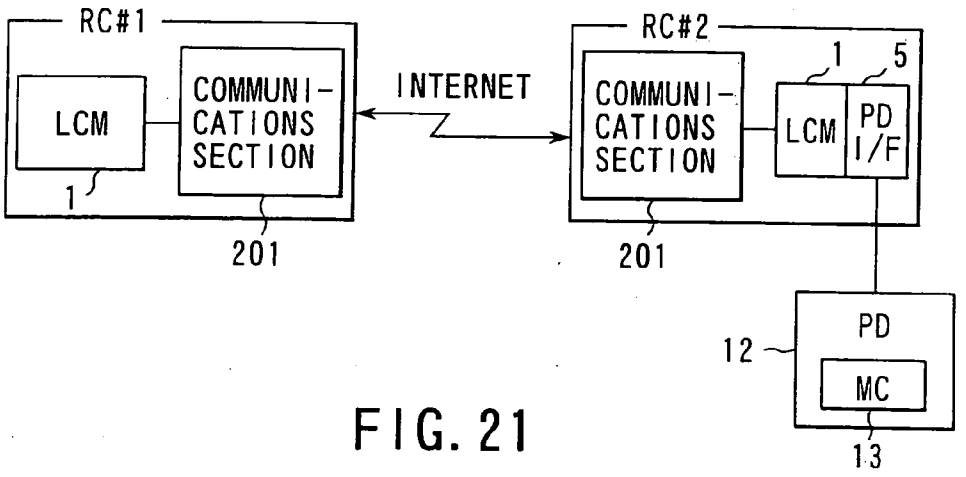

RC#1
LCM
1
COMMUNI-
CATIONS
SECTION
201
INTERNET
RC#2
COMMUNI-
CATIONS
SECTION
201
1
5
LCM
PD
I/F
PD
12
MC
13

FIG. 21

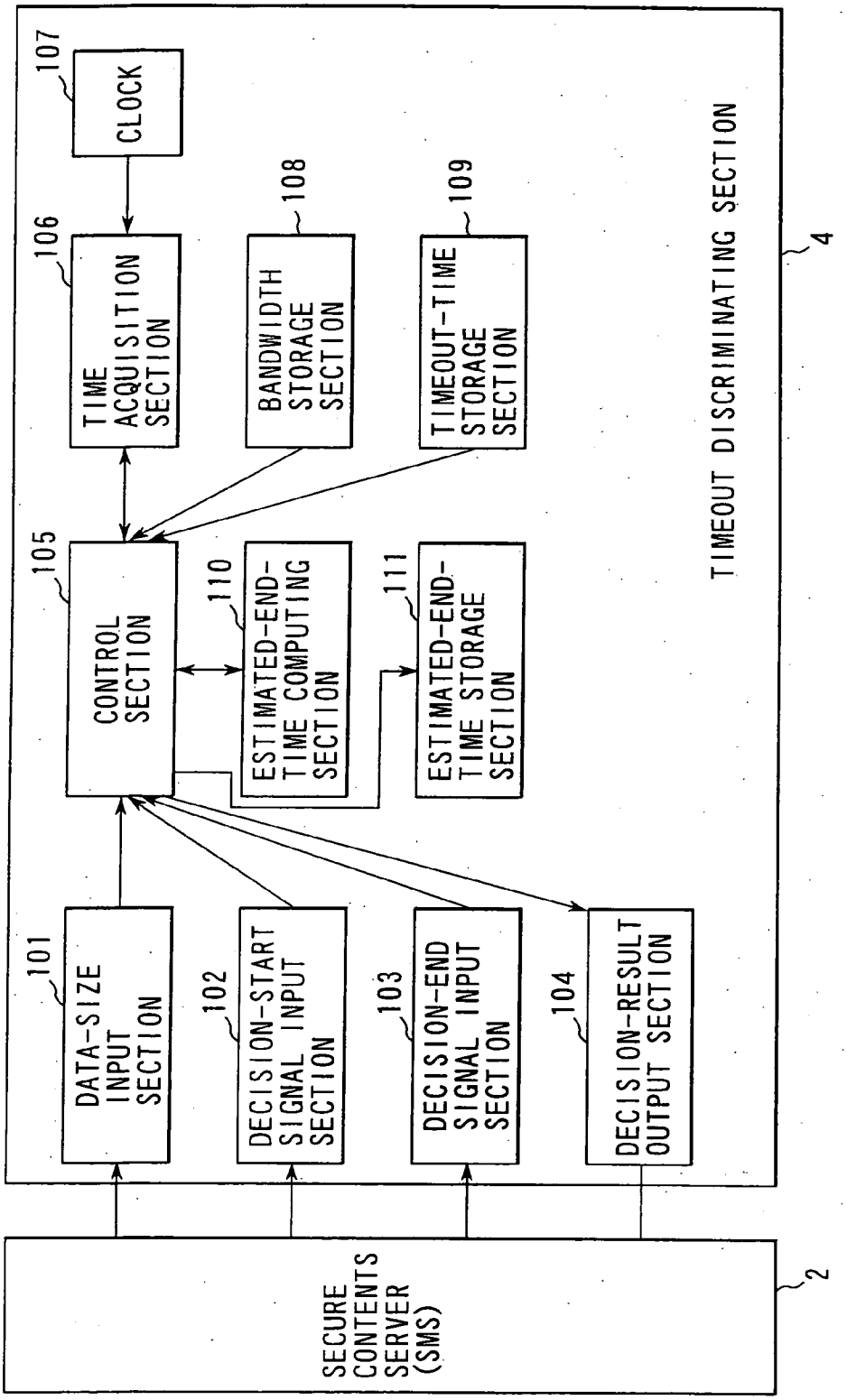

SECURE CONTENTS SERVER (SMS)
2
TIMEOUT DISCRIMINATING SECTION
4
DATA-SIZE INPUT SECTION
101
DECISION-START SIGNAL INPUT SECTION
102
DECISION-END SIGNAL INPUT SECTION
103
DECISION-RESULT OUTPUT SECTION
104
CONTROL SECTION
105
TIME ACQUISITION SECTION
106
CLOCK
107
BANDWIDTH STORAGE SECTION
108
TIMEOUT-TIME STORAGE SECTION
109
ESTIMATED-END-TIME COMPUTING SECTION
110
ESTIMATED-END-TIME STORAGE SECTION
111

FIG. 22

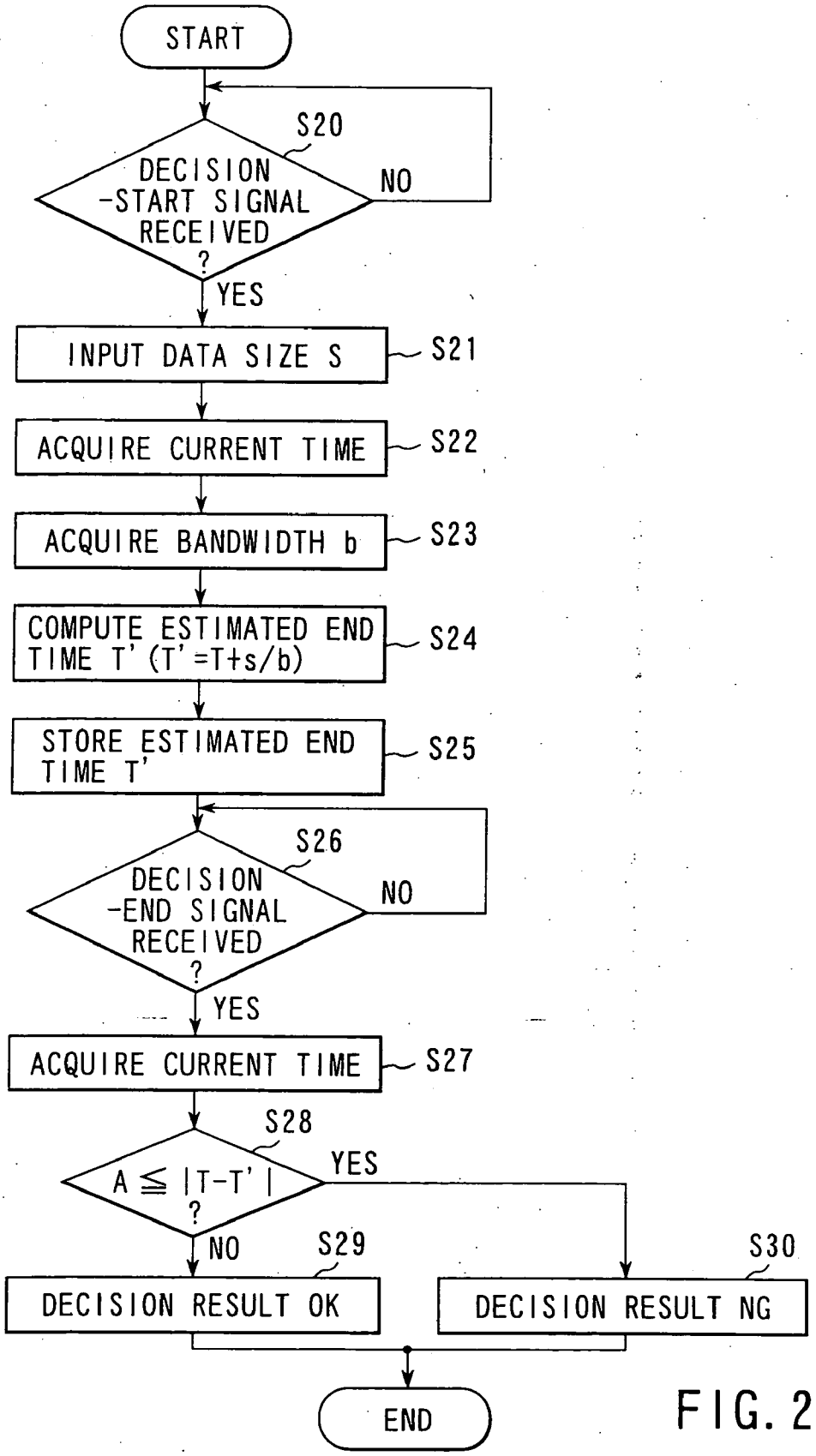

START
S20
DECISION -START SIGNAL RECEIVED ?
NO
YES
INPUT DATA SIZE S
S21
ACQUIRE CURRENT TIME
S22
ACQUIRE BANDWIDTH b
S23
COMPUTE ESTIMATED END TIME T' (T'=T+s/b)
S24
STORE ESTIMATED END TIME T'
S25
S26
DECISION -END SIGNAL RECEIVED ?
NO
YES
ACQUIRE CURRENT TIME
S27
S28
A ≦ |T-T'| ?
YES
NO
S29
S30
DECISION RESULT OK
DECISION RESULT NG
END

FIG. 23

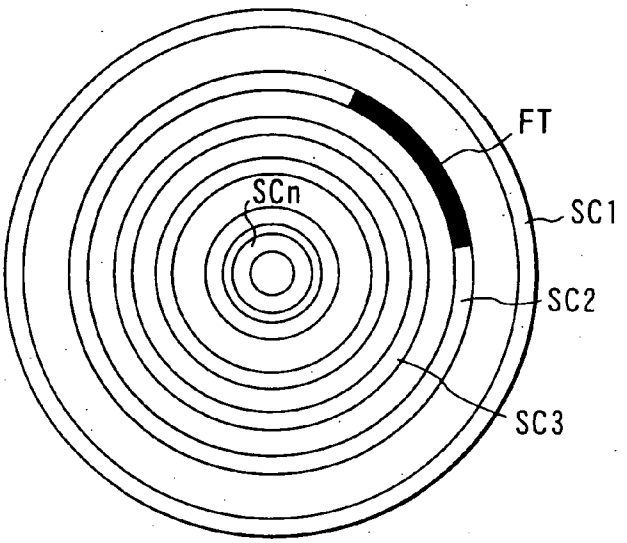

FT
SCn
SC1
SC2
SC3

FIG. 24

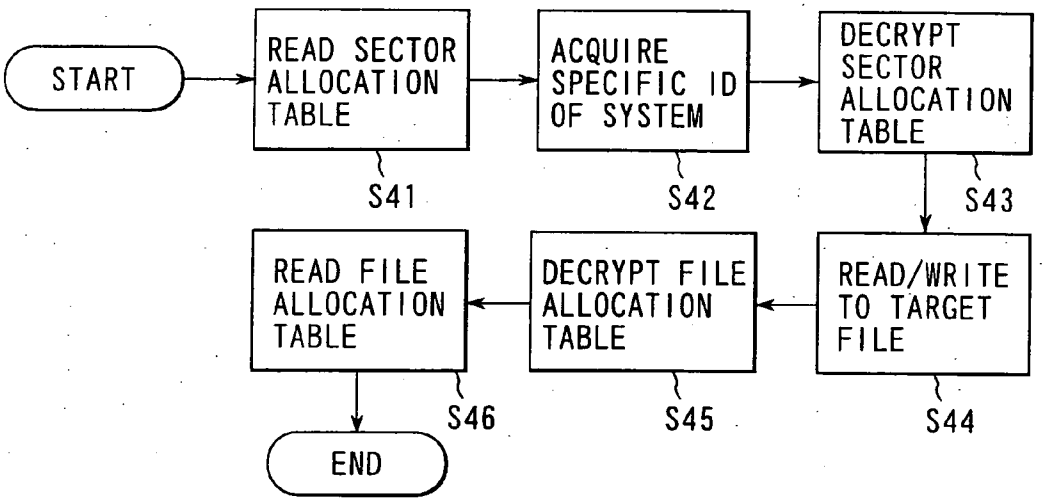

START
READ SECTOR ALLOCATION TABLE
S41
ACQUIRE SPECIFIC ID OF SYSTEM
S42
DECRYPT SECTOR ALLOCATION TABLE
S43
READ/WRITE TO TARGET FILE
S44
DECRYPT FILE ALLOCATION TABLE
S45
READ FILE ALLOCATION TABLE
S46
END

FIG. 25

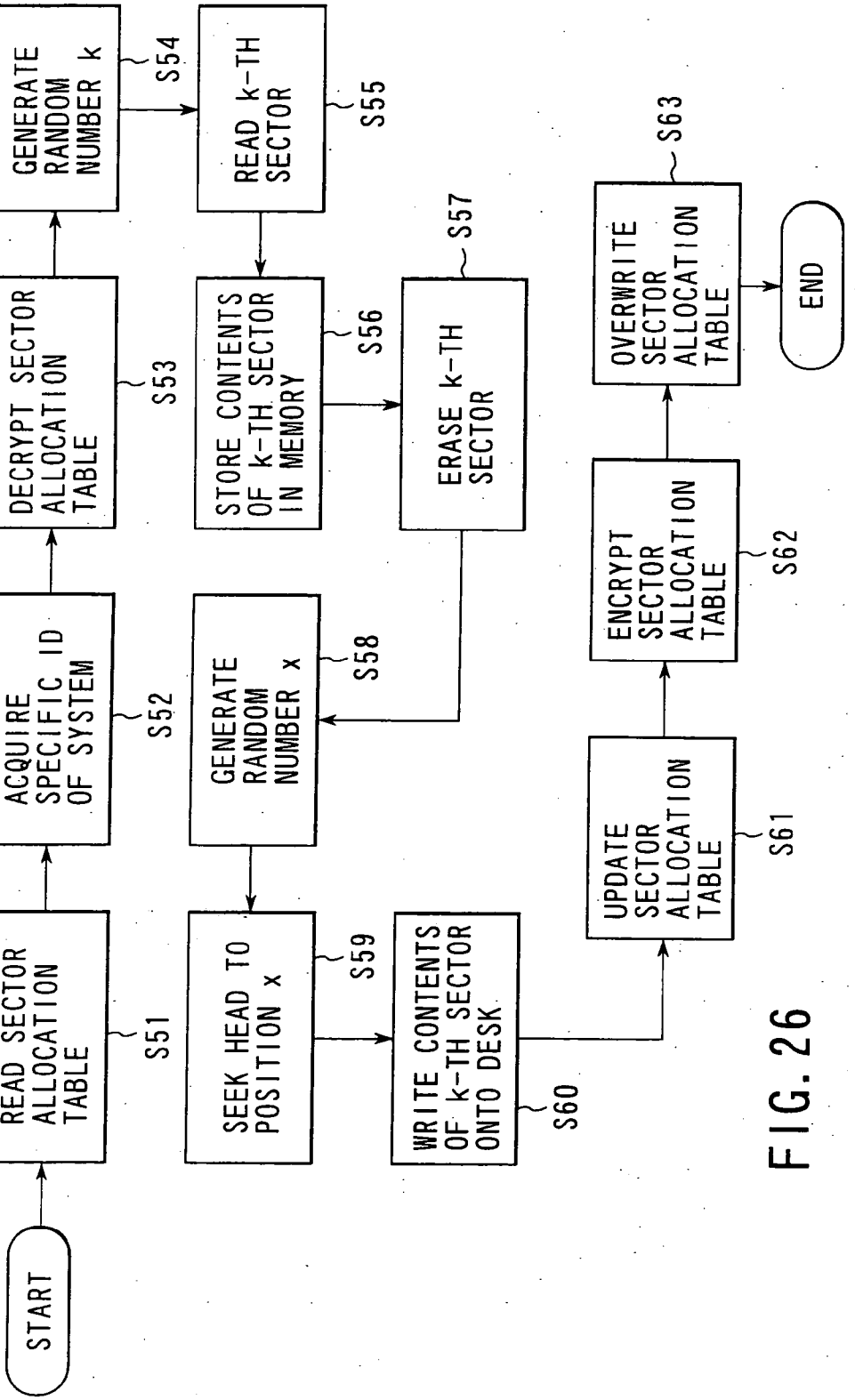

START
READ SECTOR ALLOCATION TABLE
S51
ACQUIRE SPECIFIC ID OF SYSTEM
S52
DECRYPT SECTOR ALLOCATION TABLE
S53
GENERATE RANDOM NUMBER k
S54
READ k-TH SECTOR
S55
STORE CONTENTS OF k-TH SECTOR IN MEMORY
S56
ERASE k-TH SECTOR
S57
GENERATE RANDOM NUMBER x
S58
SEEK HEAD TO POSITION x
S59
WRITE CONTENTS OF k-TH SECTOR ONTO DESK
S60
UPDATE SECTOR ALLOCATION TABLE
S61
ENCRYPT SECTOR ALLOCATION TABLE
S62
OVERWRITE SECTOR ALLOCATION TABLE
S63
END

FIG. 26

CONTENTS MANAGING METHOD AND CONTENTS MANAGING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 11-124182, filed Apr. 30, 1999, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a contents managing method for regulating the number of replicated contents, such as music pieces and movies, that can be stored on a storage medium, and a contents managing apparatus which uses this method.

[0003] Conventionally, copy management has been performed on contents (works or the like). The copyright protection and the users' convenience have been balanced by managing the copy generation and the number of copies.

[0004] The concept of "moving" has emerged as a replacement of the copy management. Copying does not erase the original data, whereas "moving" transfers data to a different location (medium) and erases the original data. The copy protection by "moving" has appeared to cope with the digitalization of contents and the popularity of networks or the like.

[0005] As it recently becomes possible to copy originals with high fidelity over a network or the like, the copy management alone cannot guarantee adequate copyright protection. Further, it is not possible to implement copyright control on unlimited moving of contents from one medium to another, e.g., distribution of data (by moving) for a business purpose.

BRIEF SUMMARY OF THE INVENTION

[0006] Accordingly, it is an object of the present invention to provide a contents managing method which can protect the copyright of contents by restricting the replication of contents by regulating the number of copied contents that can be stored on a storage medium, and a contents managing apparatus which uses this method.

[0007] According to one aspect of the present invention, there is provided a contents managing method for regulating a number of copied contents storable on a storage medium, the method comprising giving a predetermined number of copyable contents for each content; recording the copied contents on the storage medium upon reception of an instruction for copy recording on the storage medium when there is a remainder in the number of copyable contents; decrementing the number of copyable contents by "1" every time one copied content is recorded on the storage medium at the time of recording; and incrementing the number of copyable contents by "1" every time one copied content is erased from the storage medium upon reception of an instruction to erase the copied contents from the storage medium.

[0008] The method may further comprise recording information necessary to reproduce the copied contents in a secret area provided in a memory area on the storage medium and accessible by secret specific procedures.

[0009] The method may further comprise recording at least the number of copyable contents for each content in a secret memory area accessible by secret specific procedures.

[0010] The method may further comprise recording at least the number of copyable contents for each content and identification information of the storage medium having stored the copied contents in a secret memory area accessible by secret specific procedures; and erasing the copied contents from the storage medium only when the identification information of the storage medium is stored in the secret memory area.

[0011] The method may further comprise recording information necessary to reproduce the copied contents and flag information indicating whether or not the copied contents can be moved in a secret area provided in a memory area on the storage medium and accessible by secret specific procedures, at the time of recording the copied contents on the storage medium; and determining if moving of the copied contents is allowable by referring to the flag information.

[0012] The method may further comprise interrupting a subsequent process when a time needed for reading or writing of data to the storage medium does not lie within a predetermined time.

[0013] In the method, the storage medium may be one of a first type of storage medium having identification information of the storage medium stored therein and having a secret area provided therein which is accessible only by secret specific procedures, a second type of storage medium which does not have the secret area but has the identification information of the storage medium, and a third type of storage medium which has neither the secret area nor the identification information of the storage medium. In this case, at the time of recording copied contents on the storage medium, erasing copied contents from the storage medium or reproducing copied contents stored on the storage medium, the type of the storage medium is determined and then a process according to the type is performed.

[0014] According to another aspect of the present invention, there is provided a contents managing apparatus for regulating a number of copied contents storable on a storage medium comprising contents copy recording means for giving a predetermined number of copyable contents for each content, recording the copied contents on the storage medium upon reception of an instruction for copy recording on the storage medium when there is a remainder in the number of copyable contents, and decrementing the number of copyable contents by "1" every time one copied content is recorded on the storage medium at a time of recording; and contents copy moving means for incrementing the number of copyable contents by "1", every time one copied content is erased from the storage medium upon reception of an instruction to erase the copied contents from the storage medium.

[0015] The apparatus may further comprise means for recording information necessary to reproduce the copied contents in a secret area provided in a memory area on the storage medium and accessible by secret specific procedures.

[0016] The apparatus may further comprise means for recording at least the number of copyable contents for each content in a secret memory area accessible by secret specific procedures.

[0017] The apparatus may further comprise means for recording at least the number of copyable contents for each content and identification information of the storage medium having stored the copied contents in a secret memory area accessible by secret specific procedures; and means for erasing the copied contents from the storage medium only when the identification information of the storage medium is stored in the secret memory area.

[0018] The apparatus may further comprise means for recording information necessary to reproduce the copied contents and flag information indicating whether or not the copied contents can be moved in a secret area provided in a memory area on the storage medium and accessible by secret specific procedures; and means for determining if moving of the copied contents is allowable by referring to the flag information.

[0019] The apparatus may further comprise means for interrupting a subsequent process when a time needed for reading or writing of data to the storage medium does not lie within a predetermined time.

[0020] The apparatus may further comprise discrimination means for determining which one of a first type of storage medium having identification information of the storage medium stored therein and having a secret area provided therein which is accessible only by secret specific procedures, a second type of storage medium which does not have the secret area but has the identification information of the storage medium, and a third type of storage medium which has neither the secret area nor the identification information of the storage medium the storage medium is, at a time of recording copied contents on the storage medium, erasing copied contents from the storage medium or reproducing copied contents stored on the storage medium. In this case, this apparatus may further comprise means for performing a process according to the type of the storage medium determined by the discrimination means.

[0021] Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0022] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention in which:

[0023] **FIG. 1** is a diagram exemplifying the structure of a music contents usage managing system (LCM) which uses a contents managing method of regulating the number of copied contents storable on a storage medium according to one embodiment of the present invention;

[0024] **FIG. 2** is a diagram showing one example of the structure of a memory area;

[0025] **FIG. 3** is a diagram exemplifying the internal structure of a recording/reproducing apparatus (PD);

[0026] **FIGS. 4A** to **4**C are diagrams for explaining the characteristics of three types of storage media;

[0027] **FIG. 5** is a diagram exemplifying the internal structure of a media interface (I/F) section;

[0028] **FIG. 6** is a diagram for explaining the recorded contents on a storage medium after checkin;

[0029] **FIGS. 7A** to **7**C are diagrams showing a storage example of a guest book stored in a secret area in the LCM;

[0030] **FIGS. 8A and 8B** are diagrams showing another storage example of the guest book stored in the secret area in the LCM;

[0031] **FIG. 9** is a flowchart for explaining a checkin/checkout routine, illustrating procedures from the determination of the type of a storage medium to the selection of a process according to that type;

[0032] **FIG. 10** is a diagram for explaining checkout procedures when the type of the storage medium is level 2;

[0033] **FIG. 11** is a diagram for explaining checkin procedures when the type of the storage medium is level 2;

[0034] **FIG. 12** is a diagram for explaining playback procedures when the type of the storage medium is level 2;

[0035] **FIG. 13** is a diagram for explaining checkout procedures when the type of the storage medium is level 1;

[0036] **FIG. 14** is a diagram for explaining playback procedures when the type of the storage medium is level 1;

[0037] **FIG. 15** is a diagram for explaining checkout procedures when the type of the storage medium is level 0;

[0038] **FIG. 16** is a diagram for explaining checkin procedures when the type of the storage medium is level 0;

[0039] **FIG. 17** is a diagram for explaining playback procedures when the type of the storage medium is level 0;

[0040] **FIGS. 18A** to **18**C are diagrams showing a further storage example of the guest book which is stored in the secret area in the LCM and includes a flag;

[0041] **FIG. 19** is a flowchart for schematically explaining a checkin routine using a flag;

[0042] **FIG. 20** is a diagram for explaining authentication procedures using a public-key encryption algorithm;

[0043] **FIG. 21** is a diagram exemplifying the architecture of a system in the case where copied contents are recorded on a storage medium over a network;

[0044] **FIG. 22** is a diagram exemplifying the internal structure of a timeout determining section;

[0045] **FIG. 23** is a flowchart for explaining one example of a timeout determining routine;

[0046] **FIG. 24** is a diagram for explaining a file system which constitutes the secret area;

[0047] **FIG. 25** is a flowchart for explaining the operation of a secret-area driver; and

[0048] **FIG. 26** is a flowchart for explaining the operation of the secret-area driver when sector allocation is updated.

DETAILED DESCRIPTION OF THE INVENTION

[0049] A preferred embodiment of the present invention will now be described with reference to the accompanying drawings.

[0050] **FIG. 1** is a diagram exemplifying the structure of a music contents usage managing system (which will hereinafter be simply called "LCM" occasionally) that uses a contents managing method of regulating the number of copied contents storable on a storage medium according to this embodiment. Although music pieces are used here as one example of contents, contents are not limited to this particular type but may be movies, game software, etc. as well. A storage medium is not limited to a memory card (MC), which is used in this embodiment, but various other kinds of storage media such as a floppy disk and DVD may be used as well.

[0051] An EMD (Electronic Music Distributor) is a music distributing server or a music distribution broadcasting station.

[0052] A contents usage managing system **1** is, for example, a personal computer (PC) and comprises receiving sections #1 to #3 association with a plurality of EMDs (EMDs #1 to #3 in this example). The contents usage managing system **1** receives encrypted contents distributed by each EMD or the license of the contents (a usage condition and an encrypted-contents decryption key) or the like. The receiving sections #1 to #3 may have a playback capability and/or a charging capability. The playback capability is used to listen to distributed music contents. The charging capability is used in purchasing desirable contents.

[0053] The LCM **1** further comprises a secure contents server (secure music server (SMS) in this example) **2**, which will hereinafter be simply called "SMS" occasionally. Any content purchased by a user is stored in the SMS **2** via an EMD interface (I/F) section **3**. As needed, the EMD I/F section **3** decrypts a music content, and performs format conversion or re-encryption. When the SMS **2** receives an encrypted content, the SMS **2** stores it in a music data storage section **10** and stores a music-data decryption key in a license storage section **9**. The SMS **2** may have a playback capability, which can allow the SMS **2** to playback a music content it manages on a PC.

[0054] The SMS **2** has a capability of outputting contents data to a medium (which will hereinafter be simply called "MC" (Memory Card) occasionally) **13**. The MC **13** can be loaded into a recording/reproducing apparatus (which will hereinafter be simply called "PD" (Portable Device) occasionally) **12** to playback the contents recorded in the MC **13**.

[0055] Recording contents in the MC **13** from the SMS **2** can be carried out directly via a media (MC) interface (I/F) section **6** or can be performed via the PD **12**.

[0056] The MC **13** has an unrewritable identification (ID) information (MID) specific to that medium, and any content stored in the MC **13** is encrypted with a contents decryption key which depends on the MC **13**.

[0057] The contents decryption key is encrypted with an encryption key Kp stored inside the media I/F section **6** and the PD **12** and the encrypted key is then recorded in the MC **13**.

[0058] The contents and the contents decryption key in the MC **13** can be copied to any separate storage medium (hereinafter referred to as MCb) with the following restrictions.

[0059] 1. Since the legitimate PD **12** alone has the encryption key Kp, only the legitimate PD **12** can play back the contents stored in the MCb.

[0060] 2. Because the ID information MID of the MC **13** cannot be copied, however, the ID information MID of the MCb differs from the ID information MID of the MC **13** which has made the copy, eventually disabling adequate reproduction of the contents copied in the MCb. That is, multiple copying of the copied contents recorded in the MC **13** from one MC to another is prevented.

[0061] The above has described the conventional structure of the LCM **1**. A method and structure according to this embodiment will now be discussed.

[0062] To begin with, checkin/checkout will be discussed with respect to the LCM **1** in **FIG. 1**.

[0063] "Checkout" is the action of the LMS **1** which holds a "parent" content to copy its replica as a "child" content into the MC **13**. While the "child" content can be freely played back on the PD **12**, it is prohibited to create a "grandchild" content from the "child" content. The number of "children" the "parent" can produce is defined as the attribute of the "parent". "Checkin" is to connect, for example, the MC **13** to the LCM **1** and cause the LCM **1** to erase (or disable the use of) a "child" content. This action can allow a "parent" content in the LCM **1** to regain the right to produce one "child" content. This is also called "checkin to "parent"".

[0064] When one attempts to accomplish this checkin/checkout simply by the conventional LCM **1**, the following attack actually occurs. A "child" stored in the MC **13** is saved on a separate storage medium (excluding MID), and the "child" in the MC **13** is let to check in the "parent". Next, the previously saved "child" is written back into the MC **13**. Because checkin has already been finished, the "parent" on the LCM **1** may copy a "child" in another MC **13**. This scheme can permit production of any number of "children".

[0065] This "attack" can be dealt with by performing authentication at the time of transferring data between the MC **13** and the LCM **1**. Specifically, supposing that the MC **13** does not accept data transfer from an illegitimate LCM **1** and the LCM **1** does not accept data transfer from an illegitimate MC **13**, a "child" in the MC **13** cannot be saved in a separate recording medium. It is also impossible to make an unauthorized checkin. The above "attack" can therefore be avoided.

[0066] Actually, however, checkin/checkout cannot be accomplished even on the premise that authentication between the LCM **1** and the MC **13** is made because the following "attack" is possible. First, with no "child" pro-

duced from a "parent" on the LCM **1**, data on the LCM **1** (particularly, information in the license storage section **9**) is backed up in a separate storage medium. After a "child" is copied in the MC **13**, the backed-up data of the LCM **1** is restored. Because the "parent" on the LCM **1** returns to the state of before the production of the "child", it is possible to produce a "child" in another MC **13**. Any number of "children" can be created this way.

[**0067**] A description will now be given of a problem other than those which arise in accomplishing checkin/checkout. This problem is concerned with recording to the MC **13** over a predetermined communications path such as the Internet. The Internet distribution authorized by an EMD is the legitimate distribution that is made upon permission by a copyright owner and thus raises no problem. But, contents may be recorded in the MC **13** via the Internet in the manner that is illustrated in **FIG. 21**. A communications section **201** on a personal computer (PC) in **FIG. 21** is merely relaying a write protocol to the MC **13**. The LCM **1** cannot distinguish the PD **12** that is directly connected to the PC #2 which is activated by this LCM **1** from a PD **12** connected to the PC #2 that is activated by an LCM **1** which is remotely connected via the communications section **201**. This makes it possible to carry out (illegitimate) distribution of contents via a network such as the Internet.

[**0068**] Means or the like for regulating checkin/checkout and the recording of contents into the MC **13** over a network, which is subject matter of the present invention, will now be described in order of the items listed below.

[**0069**] 1. Checkin/checkout

[**0070**] (1-1) Checkin/checkout

[**0071**] (1-2) Checkin/checkout of Copied Contents Using MC of Level 2

[**0072**] (1-3) Guest Book-oriented Management of Copied Contents

[**0073**] (1-4) Playback of Copied Contents Stored in MC of Level 1

[**0074**] (1-5) Checkin/checkout of Copied Contents and Playback of Copied Contents Using MC of Level 1

[**0075**] (1-6) Checkin/checkout of Copied Contents and Playback of Copied Contents Using MC of Level 0

[**0076**] 2. Means for Regulating Recording of Copied Contents in MC over Network

[**0077**] 3. Secret Area

[**0078**] (Checkin/Checkout)

[**0079**] To accomplish checkin/checkout, an area (secret area) which cannot be read or written with known procedures is provided in the memory area in the MC **13** and information needed to decrypt contents is recorded in the secret area (see **FIG. 2**). In addition, an area (secret area) which can be accessed only with secret procedures is provided in the memory area in the LCM **1** (e.g., a hard disk (HDD) when the LCM **1** is constructed by a PC) and a guest book to be described later is stored in the secret area (see **FIG. 2**). Further, an area (secret area) which can be accessed only with secret procedures may be provided in the memory area in the PD **12** so that information needed to decrypt contents is recorded there (see **FIG. 2**). In the following description, an area which is other than secret areas and is accessible by ordinary procedures is called "public area".

[**0080**] As shown in **FIG. 1**, The LCM **1** has a guest book storage section **8** provided in the secret area and a secret-area driver **7** for reading data from the secret area after the SMS **2** carries out secret specific procedures for accessing the guest book storage section **8**.

[**0081**] As shown in **FIG. 4C**, the MC **13** includes an ID-information storage section **13***b* which is designed to be externally unwritable and uncopyable and stores its ID information MID, a secret area **13***c*, a public area **13***a* and a switch (SW) **13***e* which opens the gate so as to be accessible to the secret area **13***c* only when an authentication section **13***d*, which carries out authentication every time the secret area **13***c* is accessed, determines that the accessing side is the legitimate. There are three types of MCs **13** usable in this embodiment. The type of the MC **13** which has both ID information MID and a secret area, as shown in **FIG. 4C**, is called "level 2". The type of the MC **13** which does not have a secret area but ID information MID, as shown in **FIG. 4B**, is called "level 1". The type of the MC **13** which has neither ID information MID nor a secret area, as shown in **FIG. 4C**, is called "level 0". Level 0 can be distinguished from the other types depending on whether or not the MC **13** has ID information MID. Further, level 1 and level 2 can be distinguished from each other based on the structure of the ID information MID. For example, when ID information is a series of values, it is level 2 if the value is equal to or greater than a predetermined value.

[**0082**] The following description will be given of the MC **13** of level 2 unless otherwise specified.

[**0083**] This MC **13** may be loaded either into the PD **12** connected to the LCM **1** or into the LCM **1** directly.

[**0084**] **FIG. 3** exemplifies the structure of the PD **12** in which example the MC **13** is loaded in the a media interface (I/F) section **12***f*. In the case where the LCM **1** reads or writes data to the MC **13** via the PD **12**, the secret area in the MC **13** is accessed via a secret-area accessing section in the PD **12**. The media I/F section **12***f* has the secret-area accessing section for accessing the secret area in the MC **13**. The secret area in the PD **12** may be provided in a flash memory **12***d*. Written in a ROM **12***c* are a program for carrying out mutual authentication with the MC **13** and a program for discriminating the type of the MC **13**. Those programs carry out processes, such as mutual authentication between the PD **12** and the MC **13** and discrimination of the type of the MC **13**, under the control of a CPU **12***a*.

[**0085**] **FIG. 5** shows the structure of the media I/F section **6**, which comprises an authentication section **6***c* which performs mutual authentication with the MC **13**, a media discriminating section **6***b* which discriminates the type of the MC **13**, and a control section **6***a* which performs the general control of the former two sections. The authentication section **6***c* is a secret-area accessing section for accessing to the secret area in the MC **13**.

[**0086**] The guest book which is stored in the secret area in the LCM **1** will now be discussed.

[**0087**] Every music content that is held in the SMS **2** has a content ID (TID) which is ID information to identify that

music content and a predetermined number of copyable contents or the number of remaining children and a checkout list as attribute information. This attribute information is referred to as a guest book. The guest book is recorded in the guest book storage section **8** provided in the secret area in the form as illustrated in **FIG. 7A**.

[**0088**] In **FIG. 7A**, the number of remaining children of, for example, a content ID "TID1" is "2" and its checkout list is L**1**.

[**0089**] The checkout list is a list of ID information of the MC **13** which has recorded copied contents (children). In **FIG. 7A**, for example, it is apparent from the checkout list L**1** that children of the content which has the content ID "TID1" have checked out from two MCs **13** having ID information of "m1" and "m2".

[**0090**] (Checkin/Checkout of Copied Contents Using MC of Level 2)

[**0091**] Next, checkin/checkout using the MC **13** of level 2 which has the structure as shown in **FIG. 4C** will be discussed with reference to FIGS. **9** to **11**.

[**0092**] When the MC **13** is loaded into the media I/F section **6** of the LCM **1** or into the PD **12**, mutual authentication is carried out between the media I/F section **6** and the MC **13** or between the PD **12** and the MC **13** (step S**1** in **FIG. 9**). When both sections have determined that the other is legitimate (step S**2**), the media I/F section **6** or the PD **12** discriminates the type of the MC **13** based on the ID information MID read from the MC **13** (step S**3**). As the type of the MC **13** is level 2 here, the media I/F section **6** or the PD **12** carries out a checkin/checkout routine according to that type (step S**6**).

[**0093**] Referring to **FIG. 10**, a description will now be given of the case where a checkout instruction is given to the SMS **2** via a user interface (I/F) section **15** of the LCM **1** or via the PD **12**. The SMS **2** checks the number of remaining children, n, of a content (e.g., the one whose content ID is "TID1") for which a request for checkout from the guest book has been made (step S**101**). When n>0, the SMS **2** performs mutual authentication with the MC **13** if needed (step S**102**). When their legitimacy is mutually verified, the SMS **2** asks the MC **13** to transfer its ID information MID (e.g., MID=m0) (step S**103**).

[**0094**] The SMS **2** generates a random number r and generates an encryption key w using this random number r, the ID information m0 of the MC **13** and a key generating algorithm W that the legitimate MC **13** and the LCM **1** share. The key generating algorithm W uses two arguments (r and m0 in this example) and serves to change the encryption key w each time. The SMS **2** further encrypts a contents decryption key K(C) for decrypting the encrypted content using both an encryption key Kp, which the MC **13** and the LCM **1** share, and the previously generated encryption key w. This contents decryption key is expressed by w[Kp[k(C)]]. The SMS **2** also encrypts a content C with a key K(C). The encrypted content is expressed by K(C)[C] (step S**104**).

[**0095**] After making a folder having the name of "TID1", for example, in the memory area in the MC **13** (step S**105**), the SMS **2** writes the encrypted content K(C)[C] and the encrypted contents decryption key w[Kp[k(C)]] in the public area in that folder (steps S**106** and S**107**).

[**0096**] Then, the SMS **2** performs mutual authentication with the MC **13** in order to access the secret area **13***c* of the MC **13**, and writes the random number r in an area corresponding to the folder "TID1" in the secret area **13***c* when the gate to the secret area **13***c* is opened as a result of their legitimacy being mutually verified (steps S**108** to S**109**). When this process is completed, the gate that has enabled access to the secret area **13***c* is closed by the switch **13***e*. It is desirable that the route up to the transfer of the random number r to the secret area **13***c* in step S**108** be protected by carrying out a process, such as encrypting the random number r.

[**0097**] Finally, the SMS **2** subtracts "1" from the number of remaining children n of the content having the content ID of "TID1" for which the request for checkout from the guest book has been made and adds the ID information "m0" of the MC **13** to the checkout list L**1** as shown in **FIG. 7B** (step S**110**).

[**0098**] **FIG. 6** shows the recorded contents on the MC **13** when the above-described routine is completed.

[**0099**] Referring to **FIG. 11**, a description will now be given of the case where a checkin instruction is given to the SMS **2** via the user I/F section **15** of the LCM **1** or via the PD **12**.

[**0100**] The SMS **2** performs mutual authentication with the MC **13** if needed (step S**201**). When their legitimacy is mutually verified, the SMS **2** asks the MC **13** to transfer its ID information MID (e.g., MID=m0) (step S**202**).

[**0101**] The SMS **2** generates random numbers r**1** and r**2** when the ID information of the MC **13**, i.e., "m0", is registered in the checkout list in the guest book of the content whose checkin request has been made (e.g., the content has the content ID of "TID1") (step S**203**). Then, the SMS **2** overwrites information stored in the area that corresponds to the folder of this content (folder "TID1" in this example) in the public area **13***a* of the MC **13** with the random number r**2** to erase it (step S**204**). The SMS **2** also performs mutual authentication with the MC **13** in order to access the secret area **13***c* of the MC **13**, and overwrites information in the area that corresponds to the folder "TID1" in the secret area **13***c* of the MC **13** with the random number r**1** to erase it (step S**205**). When this process is completed, the gate that has enabled-access to the secret area **13***c* is closed by the switch **13***e*. It is desirable that the route up to the transfer of the random number r**1** to the secret area **13***c* in step S**205** be protected by carrying out a process, such as encrypting the random number r**1**.

[**0102**] Thereafter, the SMS **2** asks the MC **13** to transfer the values of the individual areas after overwriting to verify the overwriting-oriented erasure (step S**206**) and checks if the values respectively match with the random numbers r**1** and r**2** (step S**207**). When verifying the overwriting-oriented erasure, the SMS **2** erases the folder "TID1" from the MC **13** (step S**208**).

[**0103**] Finally, as shown in **FIG. 7C**, the SMS **2** adds "1" to the number of remaining children n of the content having the content ID of "TID1" for which the request for checking in the guest book has been made and deletes the ID information "m0" of the MC **13** from the checkout list L**1** (step S**209**).

[0104] The random number r recorded in the secret area **13***c* in the MC **13** cannot be saved in a separate storage medium (because no authentication-oriented legitimacy can be confirmed). After the content having the ID information of "TID1" checks in, therefore, the content restored in the MC **13** cannot be used. The guest book that is stored in the secret area in the LCM **1** cannot be saved in a separate recording medium (because no authentication-oriented legitimacy can be confirmed). After the content having the ID information of "TID1" checks out, therefore, the guest book cannot be set back to the state of before the checkout. Apparent from the above, the present invention provides an adequate countermeasure against the aforementioned attack.

[0105] At the time of making checkin, from the viewpoint of security, it is important to overwrite the contents of the secret area in the MC **13** with a random number. It is only the legitimate SMS **2** that can write data in the secret area in the MC **13**. In other words, the legitimate SMS **12** always writes data in the secret area by taking security procedures. The legitimacy of the MC **13** is guaranteed if writing through the security procedures succeeds. That is, it is possible to prevent an illegitimate checking. To enhance the security, the SMS **2** overwrites the information in the secret area with a random number, then reads the contents of the secret area (through the security procedures) and checks if the contents are the overwritten random number.

[0106] (Guest Book-Oriented Management of Copied Contents)

[0107] The SMS **2** may check in a content whose title (content ID) is not listed in the guest book. Alternatively, the SMS **2** may allow checkin from a MC **13** which is not listed in the checkout list. In this case, the guest book does not have a checkout list of the individual contents. This is because the checkout list is to be referred to for the purpose of preventing checkin from an "innocent" MC **13**. **FIG. 8A** shows the stored contents of the guest book in this case.

[0108] As shown in **FIG. 8A**, the guest book of the individual contents has only the content ID of each content and the number of remaining children of that content registered therein.

[0109] Let us consider a case where a content having a content ID of "TID7" checks in from the MC **13** which has the ID information MID=m0. That is, a content whose content ID is "TID7" and which has checked out from a separate SMS **2** is currently stored in the form as shown in **FIG. 6** in this MC **13**.

[0110] The LCM **1** erases the stored contents of the secret area and public area in the MC **13** and deletes the folder "TID7" without going over step **S203** of referring to the checkout list in the procedures illustrated in **FIG. 11**. Then, registration of a new content (TID7, 1) is made into the guest book.

[0111] If the LCM **1** checks in a content which is not listed in the guest book, the following event, for example, becomes possible. Suppose that a "parent" content the LCM **1** which is constructed by a home PC stores can have two "children". The LCM **1** checks out one "child" from the home PC with respect to the MC **13** and checks it in to a friend's PC. This means that the "parent" the LCM **1** purchased has reduced the number of producible "children" and has presented a content to the friend.

[0112] If the LCM **1** is allowed to check in a content which is not listed in the guest book, it is apparently possible to "move" a "child" content via the LCM **1**. While this function is convenient to users, it also provides an opportunity to develop the market of secondhand goods. Actually, the following transaction of used contents can take place. A user purchases a new content from one EMD and checks this content in the LCM **1** of a used-data dealer after a short period of usage. At this time, this user can receive money for the content. The used-data dealer sells the data to another person who wants it at a price cheaper than the normal price at the EMD.

[0113] The establishment of a "secondhand market" where the copyright of contents cannot be controlled is not desirable to copyright holders. To allow each copyright holder to control the checkin to different LCMs **1**, therefore, each content may be provided with a checkout attribute flag f.

[0114] **FIG. 18A** shows the form of the guest book the LCM **1** has in this case.

[0115] As shown in **FIG. 18A**, the guest book of the individual contents has the content ID, the number of remaining children, the checkout list and the checkout attribute flag f of each content registered therein.

[0116] When the flag f is "1", the associated content can check out from and check in another LCM **1**. When the flag f is "0", however, the associated content cannot at least check in another LCM **1**.

[0117] Let us consider a case where a content having a content ID of "TID6" checks out. First, the SMS **2** checks the guest book and confirms that the checkout attribute flag of this content is "1". In this example, it is assumed that with the flag value being "0", the LCM **1** does not check out the content. When the flag f is "1", the number of remaining children with the content ID of "TID6" in the guest book is decremented by "1" by the same procedures as illustrated in **FIG. 10**, so that this number becomes "1" (see **FIG. 18B**). It is to be noted that a checkout list L**6** is empty (denoted by "ϕ") and what is more, the flag f is "1" which allows the associated content to check in an LCM **1** provided on another PC. The guest book need not therefore have a checkout list. It is also to be noted that the flag f is recorded together with the random number r in the secret area in the MC **13**.

[0118] Referring now to the flowchart shown in **FIG. 19**, a description will be given of the case where the content having the content ID of "TID6" checks in the same LCM **1** from which it has checked out or checks in another LCM **1**.

[0119] Through the procedures illustrated in **FIG. 11**, mutual authentication is carried out between the MC **13** and the LCM **1** (step **S11**) to acquire the ID information MID of the MC **13** (step **S12**).

[0120] Regardless of whether or not the content whose checkin request has been made is registered in the guest book, the SMS **2** carries out the above-described security procedures on the secret area **13***c* in the MC **13** (the gate to the secret area **13***c* is opened after mutual authentication with the MC **13** is performed and their legitimacy is verified) to read the flag f from the secret area **13***c* (step **S13**). When the flag f is "1" (step **S14**), the SMS **2** executes steps **S204**

to S208 in FIG. 11 (steps S15 to S16). When the flag f is "0", the SMS 2 terminates the routine. Finally, when the content is not registered in the guest book, new registration (TID6, 1, ϕ, 1) with the number of remaining children of that content being set to "1" is made in the guest book, whereas when the content is registered in the guest book, the number of remaining children of that content is incremented by "1" (step S17).

[0121] (Playback of Copied Contents Stored in MC of Level 1)

[0122] Referring now to FIG. 12, a description will be given of how to play back a copied content stored in the MC 13 of level 2 which has the structure as shown in FIG. 4C. When the MC 13 is loaded into the PD 12, the PD 12 asks the MC 13 to transfer its ID information MID (e.g., MID=m0) (step S301). At this time, the type of the MC 13 can be discriminated to be level 2 based on the ID information MID=m0. Accordingly, the PD 12 reads out w[Kp[k(C)]] from the secret area in the MC 13 (step S302). The PD 12 then performs mutual authentication with the MC 13 to access the secret area 13*c* of the MC 13, and reads a random number r from an area corresponding to the folder "TID1" in the secret area 13*c* when the gate to the secret area 13*c* is opened as a result of their legitimacy being mutually verified (step S303). When this process is completed, the gate that has enabled access to the secret area 13*c* is closed by the switch 13*e*.

[0123] The PD 12 generates an encryption key w using the ID information "m0" of the MC 13 and the key generating algorithm W that the legitimate MC 13 and the PD 12 share. The PD 12 decrypts a contents decryption key K(C) from the encryption key w, the encryption key Kp that the MC 13 and LCM 1 share, and w[Kp[k(C)]] read from the MC 13 (step S304).

[0124] Then, the PD 12 reads an encrypted content K(C)[C] from the public area in the MC 13 (step S305), decrypts the content C in a decryption section 12*g*, decodes the decrypted content in a decoder 12*h*, converts the resultant digital signal to an analog signal in a D/A conversion section 12*i* and plays back the music piece (step S306).

[0125] (Checkin/Checkout of Copied Contents and Playback of Copied Contents Using MC of Level 1)

[0126] Referring now to FIGS. 9 and 13, a description will be given of checkin/checkout using the MC 13 of level 2 which has the structure as shown in FIG. 4B. It is to be noted that the MC 13 of level 1 has no secret area and cannot therefore make checkin.

[0127] The sequence of procedures from the point when the MC 13 is loaded into the media I/F section 6 of the LCM 1 or into the PD 12 up to the discrimination of the type of the MC 13 are the same as those in FIG. 9.

[0128] As the type of the MC 13 is level 1 here, the media I/F section 6 or the PD 12 carries out a checkin/checkout routine according to that type (step S5).

[0129] When an checkin instruction has been made to the SMS 2 via the user I/F section 15 of the LCM 1 or via the PD 12, this instruction is rejected as the type of the MC 13 has been discriminated as level 1.

[0130] Referring now to FIG. 13, a description will be given of the case where a checkout instruction is given to the SMS 2 via the user I/F section 15 of the LCM 1 or via the PD 12.

[0131] The SMS 2 checks the number of remaining children, n, of a content (e.g., the one whose content ID is "TID1") for which a request for checkout from the guest book has been made (step S401). When n>0, the SMS 2 performs mutual authentication with the MC 13 if needed (step S402). When their legitimacy is mutually verified, the SMS 2 asks the MC 13 to transfer its ID information MID (e.g., MID=m0) (step S403).

[0132] As in the case of level 2, the SMS 2 carries out generation of a random number r, generation of an encryption key w, encryption of a content key using the keys w and Kp and encryption of a content C (step S404), and then creates a folder whose name is "TID1", for example, in the memory area (only the public area in this example) in the MC 13 (step S405). Then, the SMS 2 writes the encrypted content K(C)[C], the encrypted contents decryption key w[Kp[k(C)]] and the random number r in this folder (steps S406 to S408).

[0133] Finally, the SMS 2 subtracts "1" from the number of remaining children n of the content having the content ID of "TID1" for which the request for checkout from the guest book has been made and adds the ID information "m0" of the MC 13 to the checkout list L1 as shown in FIG. 7B (step S409).

[0134] Referring now to FIG. 14, a description will be given of how to play back a copied content stored in the MC 13 of level 1. When the MC 13 is loaded into the PD 12, the PD 12 asks the MC 13 to transfer its ID information MID (e.g., MID=m0) (step S501). At this time, the type of the MC 13 can be discriminated to be level 1 based on the ID information MID=m0. Accordingly, the PD 12 reads out w[Kp[k(C)]] and the random number r from the memory area (only the public area) in the MC 13 (steps S502 to S503), and generates an encryption key w using the random number r, the ID information "m0" of the MC 13 and the key generating algorithm W that the legitimate MC 13 and the PD 12 share. The PD 12 decrypts a contents decryption key K(C) from the encryption key w, the encryption key Kp that the MC 13 and LCM 1 share, and w[Kp[k(C)]] read from the MC 13 (step S504).

[0135] Then, the PD 12 reads an encrypted content K(C)[C] from the memory area (only the public area) in the MC 13 (step S505), decrypts the content C in the decryption section 12*g*, decodes the decrypted content in the decoder 12*h*, converts the resultant digital signal to an analog signal in the D/A conversion section 12*i* and plays back the music piece (step S506).

[0136] (Checkin/Checkout of Copied Contents and Playback of Copied Contents Using MC of Level 0)

[0137] Referring now to FIGS. 9, 15 and 16, a description will be given of checkin/checkout using the MC 13 of level 0 which has the structure as shown in FIG. 4A.

[0138] The MC 13 of level 0 cannot perform checkin/checkout and playback without using the PD 12. As this MC 13 does not have ID information MID, the ID information PID of the PD 12 is used instead in carrying out checkin/checkout.

[0139] The sequence of procedures from the point when the MC 13 is loaded into the PD 12 up to the discrimination of the type of the MC 13 are the same as those in FIG. 9.

[0140] As the type of the MC **13** is level 0 in this example, the PD **12** carries out a checkin/checkout routine according to that type (step S**4**).

[0141] Referring now to **FIG. 15**, a description will be given of the case where a checkout instruction is given to the SMS **2** via the PD **12**.

[0142] The SMS **2** checks the number of remaining children, n, of a content (e.g., the one whose content ID is "TID1") for which a request for checkout from the guest book has been made (step S**601**). When n>0, the SMS **2** performs mutual authentication with the PD **12** (step S**602**). When their legitimacy is mutually verified, the SMS **2** asks the PD **12** to transfer its ID information PID (step S**603**).

[0143] As in the case of level 2, the SMS **2** carries out generation of a random number r, generation of an encryption key w, encryption of a content key using the keys w and Kp and encryption of a content C (step S**604**). It is to be noted that the two arguments the key generating algorithm W takes are r and PID.

[0144] Then, the SMS **2** creates a folder whose name is "TID1", for example, in the memory area (only the public area in this example) in the MC **13** (step S**605**). Then, the SMS **2** writes the encrypted content K(C)[C], the encrypted contents decryption key w[Kp[k(C)]] in this folder (steps S**606** to S**607**).

[0145] The SMS **2** writes the random number r in the secret area in the PD **12** (step S**608**). It is desirable that the route up to the transfer of the random number r to the secret area of the PD **12** in step S**608** be protected by carrying out a process, such as encrypting the random number r.

[0146] Finally, the SMS **2** subtracts "1" from the number of remaining children n of the content having the content ID of "TID1" for which the request for checkout from the guest book has been made and adds the ID information "PID" of the PD **12** to the checkout list L**1** as shown in **FIG. 7B** (step S**609**).

[0147] Referring now to **FIG. 16**, a description will be given of the case where a checkin instruction is given to the SMS **2** via the PD **12**.

[0148] The SMS **2** performs mutual authentication with the MC **13** (step S**701**). When their legitimacy is mutually verified, the SMS **2** asks the PD **12** to transfer its ID information PID (step S**702**).

[0149] The SMS **2** generates random numbers r**1** and r**2** when the ID information PID of the PD **12** is registered in the checkout list in the guest book of the content whose checkin request has been made (e.g., the content has the content ID of "TID1") (step S**703**). Then, the SMS **2** overwrites information stored in the area that corresponds to the folder of this content (folder "TID1" in this example) in the public area **13***a* of the MC **13** with the random number r**2** to erase it (step S**704**). The SMS **2** also performs mutual authentication with the PD **12** in order to access the secret area of the PD **12**, and overwrites information in the area that corresponds to the folder "TID1" in the secret area **13***c* with the random number r**1** to erase it (step S**705**). When this process is completed, the gate that has enabled access to the secret area of the PD **12** is closed by the switch **13***e*. It is desirable that the route up to the transfer of the random number r**1** to the secret area **13***c* in step S**705** be protected by carrying out a process, such as encrypting the random number r**1**.

[0150] Thereafter, the SMS **2** asks the MC **13** to transfer the value after overwriting to verify the overwriting-oriented erasure or reads the value of this area after overwriting from the secret area of the PD **12** (step S**706**) and checks if the values respectively match with the random numbers r**1** and r**2** (step S**707**). When verifying the overwriting-oriented erasure, the SMS **2** erases the folder "TID1" from the MC **13** (step S**708**).

[0151] Finally, as shown in **FIG. 7C**, the SMS **2** adds "1" to the number of remaining children n of the content having the content ID of "TID1" for which the request for checking in the guest book has been made and deletes the ID information "PID" of the PD **12** from the checkout list L**1** (step S**709**).

[0152] Referring now to **FIG. 17**, a description will be given of how to play back a copied content stored in the MC **13** of level 0. When the MC **13** is loaded into the PD **12**, the PD **12** asks the MC **13** to transfer its ID information MID but the MC **13** does not have ID information, so that the PD **12** can discriminate that the type of the MC **13** is level 0. Accordingly, the PD **12** reads out w[Kp[k(C)]] from the memory area (only the public area) in the MC **13** (step S**801**), and generates an encryption key w using the ID information "PID" of the PD **12** itself, the random number r stored in the secret area of the PD **12** and the key generating algorithm W. The PD **12** then decrypts a contents decryption key K(C) from the encryption key w, the encryption key Kp and w[Kp[k(C)]] read from the MC **13** (step S**802**).

[0153] Then, the PD **12** reads an encrypted content K(C)[C] from the memory area (only the public area) in the MC **13** (step S**803**), decrypts the content C in the decryption section **12***g*, decodes the decrypted content in the decoder **12***h*, converts the resultant digital signal to an analog signal in the D/A conversion section **12***i* and plays back the music piece (step S**804**).

[0154] (Means for Regulating Recording of Copied Contents in MC over Network)

[0155] To overcome the second conventional problem or to regulate recording of a content to the MC **13** over a network, a timeout discriminating section **4** is provided in the present invention as shown in **FIG. 1**.

[0156] The timeout discriminating section **4** sets a given restriction time and interrupts the sequence of procedures of reading and/or writing to the MC **13** when the sequence is not finished within the restriction time. Because communications over a network usually takes a considerably longer time than communications to a device which is directly connected, the timeout capability can cope with illegitimate copying over the network. It is also possible to use band restriction. Assuming that the band of communications with the device is constant, it is possible to compute the upper limit of the time need to transfer a certain size of data to the device. When the actual transfer time exceeds the computed time, the routine is interrupted.

[0157] The above will be discussed below more specifically referring to the structure of the timeout discriminating

section **4** shown in **FIG. 22** and the flowchart shown in **FIG. 23**. Suppose that the timeout time has been preset to t and the communication bandwidth between the LCM **1** and the PD **12** is b. The operation of the timeout discriminating section **4** will be discussed with reference to the case where check-out is made to the MC **13** that is loaded into, for example, the PD **12**.

[**0158**] When a reading/writing operation which is included in the procedures of making checkout to the MC **13** that is loaded into the PD **12** is initiated, the timeout discriminating section **4** receives a decision start signal from the SMS **2** via a decision-start signal input section **102** (step S**20**) and receives the size s of packet data, which is exchanged between the SMS **2** and the PD **12**, from a data-size input section **101** (step S**21**). A control section **105** acquires the current time T from a clock **107** via a time acquisition section **106** (step S**22**). Accordingly, the control section **105** acquires a bandwidth b from a bandwidth storage section **108** (step S**23**), computes an estimated end time T' (step S**24**) and stores this estimated end time T' in an estimated-end-time storage section **111** (step S**25**).

[**0159**] The estimated end time T' can be acquired from an equation T'=T+s/b using the bandwidth b and the data size s.

[**0160**] When the timeout discriminating section **4** receives a decision-end signal from the SMS **2** via a decision-end signal input section **103** at the same time as the reading/writing operation to the MC **13** loaded in the PD **12** is finished (step S**26**), the control section **105** reacquires the current time T (step S**27**) and compares the difference between the previously computed estimated end time T' and the current time T with the timeout time t (step S**28**). When this difference is greater than the timeout time t, the control section **105** determines that the decision result is "NG" (No Good) and informs the SMS **2** of this decision result (step S**30**). If the PD **12** is connected to a PC #2 which is connected over a network to the LCM **1** that is located in a PC #1 which is different from the PC #2 and performs checkout as illustrated in **FIG. 21**, the decision result of "NG" is obtained so that the LCM **1** in the PC #1 interrupts the subsequent steps in the routine for making checkout.

[**0161**] Alternatively, the decision result may be made "NG" when the reading/writing operation has not been completed yet even after the estimated end time T' has passed.

[**0162**] The timeout discriminating section **4** may operate in two modes. One mode is taken when the data size s is input to the data-size input section **101**, and at this time, the timeout discriminating section **4** computes the estimated end time T'=T+s/b and stores it in the estimated-end-time storage section **111**. Upon reception of the decision-end signal, the timeout discriminating section **4** compares the current time T with the time T' stored in the estimated-end-time storage section **111**. When the former time is smaller than the latter, the timeout discriminating section **4** informs the SMS **2** of the decision result being OK. Otherwise, the timeout discriminating section **4** informs the SMS **2** of the decision result being "NG".

[**0163**] The other mode takes place when the decision-start signal is input to the decision-start signal input section **102**. In this mode, the timeout discriminating section **4** stores the current time T+timeout time t in the estimated-end-time storage section **111**. The operation for determining the timeout in this mode is the same as that done in the first mode.

[**0164**] (Secret Area)

[**0165**] The LCM **1** of the present invention uses a secret area in order to store a checkin/checkout guest book. When the LCM **1** is constructed by a PC, this secret area is created on a hard disk (HDD).

[**0166**] The secret area on the HDD will now be discussed below.

[**0167**] Normally, partitions are present on the HDD. Each partition is recognized as one drive by the OS. Each partition contains a plurality of sectors on which data is recorded. The data allocation in the sectors is called a logical format. A file system generally has a file allocation table on which the positions of individual files and the directory on the sectors are recorded. The OS acquires the position of a file to be accessed by referring to the file allocation table, and accesses the target file. The physical allocation of the sectors is called a physical format. The individual partitions can have different physical formats. The position of each sector can be identified by the head position. The start position of each sector is identified by a magnetic mark.

[**0168**] The OS has a driver for the file system that the OS supports. The driver identifies the physical format and logical format of the file system, and can reach the file allocation table or each file by going over the sectors in each partition and then can read the contents of the file allocation table or the target file or write data therein.

[**0169**] **FIG. 24** shows the file system for constructing the secret area according to the present invention. Although the ordinary file system has sectors allocated at equal intervals, the present file system does not employ such allocation. A sector allocation table is located at the head of the first sector SC**1**. The sector allocation table has sector positions recorded therein in the following form.

[**0170**] Head position #2, head position #3, . . . , and head position #n respectively indicate the positions of the second sector SC**2**, the third sector SC**3**, . . . , and the n-th sector SCn.

[**0171**] The sector allocation table is encrypted. The key that decrypts this encryption depends on an ID specific to the system. The system's specific ID may be the ID of the OS, the ID of the BIOS or the ID of the CPU.

[**0172**] Further, a file allocation table FT is located at the head of the second sector SC**2** in the following form.

[**0173**] (file 1, (sector number, intra-sector position))

[**0174**] (file 2, (sector number, intra-sector position))

[**0175**] .

[**0176**] .

[**0177**] .

[**0178**] The intra-sector position is the number of bytes from the head of the associated sector. The file allocation table FT is also encrypted. The key that decrypts this encryption likewise depends on the specific ID of the system.

[0179] Access to the file system of the present invention is executed by using a special driver (the secret-area driver **7** in **FIG. 1**). **FIG. 25** shows the operation of the secret-area driver **7**. This driver **7** has a capability of altering the sector allocation. **FIG. 26** illustrates the operation of the secret-area driver **7** at the time of altering the sector allocation.

[0180] (Authentication)

[0181] The following will discuss an example of mutual authentication which is carried out, for example, when the MC **13** is loaded into the LCM **1** and an example of an authentication process which is executed at the time of accessing to the secret area. This authentication is the one that has conventionally been employed using a public-key encryption technique, but the present invention is in no way limited to this particular type.

[0182] A description will be given of authentication between two devices (e.g., LCM **1** and MC **13**) A and B in the case where A authenticates B that tries to gain access to A, by referring to **FIG. 20**.

[0183] In this case, the device A has a public key kp and the device B, if capable of accessing the device A, holds a secret key ks corresponding to the public key kp. When receiving a random number R generated by the device A, the device B encrypts the random number with the secret key ks (the encrypted number is represented by ks[R]) and sends ks[R] back to the device A. The device A decrypts ks[R] using the public key, and determines that the device B is legitimate one if the decryption result matches with the previously generated random number R.

[0184] Thereafter, the same procedures are performed on the device A from the device B to thereby ensure mutual authentication. In this case, the device B has a public key and the device A has a secret key and encrypts the random number, generated by the device B, by using the secret key. The device B decrypts the encrypted random number using the public key and checks if the decryption result matches with the previously generated random number.

[0185] As described in details, the present invention can efficiently regulate the number of copied contents and can thus adequately protect the copyright of contents.

[0186] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

1-16. (canceled)

17. A contents managing method capable of controlling content copying, comprising:

providing a content to which a predetermined number of allowable copies is allocated;

decreasing the number of allowable copies allocated to the content when the content is copied onto a recording medium; and

storing identification information of the recording medium in a restricted memory area that is accessible through security procedures when the content is copied onto the recording medium.

18. The contents managing method according to claim 17, wherein the decreasing includes decreasing the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

19. The contents managing method according to claim 17, further comprising:

storing, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied; and

controlling checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

20. A contents managing method capable of controlling content copying, comprising:

providing a content to which a predetermined number of allowable copies is allocated;

decreasing the number of allowable copies allocated to the content when the content is copied onto a recording medium; and

storing flag information, which indicates whether the copied content on the recording medium is movable, in a restricted memory area that is accessible through security procedures.

21. The contents managing method according to claim 20, wherein the decreasing includes decreasing the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

22. The contents managing method according to claim 20, further comprising:

storing, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied; and

controlling checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

23. A contents managing method capable of controlling content copying, comprising:

providing a content to which a predetermined number of allowable copies is allocated; and

decreasing the number of allowable copies allocated to the content when the content is copied onto a recording medium,

wherein the recording medium is one of a first type of recording medium comprising an area for storing identification information of the recording medium and a restricted memory area that is accessible through security procedures, a second type of recording medium comprising an area for storing information of the recording medium and an unrestricted memory area, and a third type of recording medium comprising an unrestricted memory area, and

wherein a type of the recording medium is determined and a content regulation process based on the type is performed when one of recording the content on the recording medium, erasing the copied content on the

recording medium when the identification information of the recording medium is stored in the restricted memory area, or reproducing the copied content on the recording medium is executed.

24. The contents managing method according to claim 23, wherein the decreasing includes decreasing the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

25. The contents managing method according to claim 23, further comprising:

storing, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied; and

controlling checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

26. A contents managing apparatus capable of controlling content copying, comprising:

a storage device configured to provide a content to which a predetermined number of allowable copies is allocated; and

a manager configured to decrease the number of allowable copies allocated to the content when the content is copied onto a recording medium, and to store identification information of the recording medium in a restricted memory area that is accessible through security procedures when the content is copied onto the recording medium.

27. The contents managing apparatus according to claim 26, wherein the manager decreases the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

28. The contents managing apparatus according to claim 26, wherein the manager is further configured to store, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied, and to control checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

29. A contents managing apparatus capable of controlling content copying, comprising:

a storage device configured to provide a content to which a predetermined number of allowable copies is allocated; and

a manager configured to decrease the number of allowable copies allocated to the content when the content is copied onto a recording medium, and to store flag information, which indicates whether the copied content on the recording medium is movable, in a restricted memory area that is accessible through security procedures.

30. The contents managing apparatus according to claim 29, wherein the manager decreases the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

31. The contents managing apparatus according to claim 29, wherein the manager is further configured to store, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied, and to control checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

32. A contents managing apparatus capable of controlling content copying, comprising:

a storage device configured to provide a content to which a predetermined number of allowable copies is allocated; and

a manager configured to decrease the number of allowable copies allocated to the content when the content is copied onto a recording medium, and wherein the recording medium is one of a first type of recording medium comprising an area for storing identification information of the recording medium and a restricted memory area that is accessible through security procedures, a second type of recording medium comprising an area for storing information of the recording medium and an unrestricted memory area, and a third type of recording medium comprising an unrestricted memory area, and the manager is further configured to determine a type of the recording medium and perform a content regulation process based on the type when executing one of recording the content on the recording medium, erasing the copied content on the recording medium, or reproducing the copied content on the recording medium.

33. The contents managing apparatus according to claim 32, wherein the manager decreases the number of allowable copies allocated to the content by "1" every time the content is copied onto the recording medium.

34. The contents managing apparatus according to claim 32, wherein the manager is further configured to store, in addition to the identification information of the content, a corresponding checkout list having identification information of the recording medium onto which the content has been copied, and to control checkout of the content by referring to at least the stored identification information of the content and the corresponding checkout list.

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