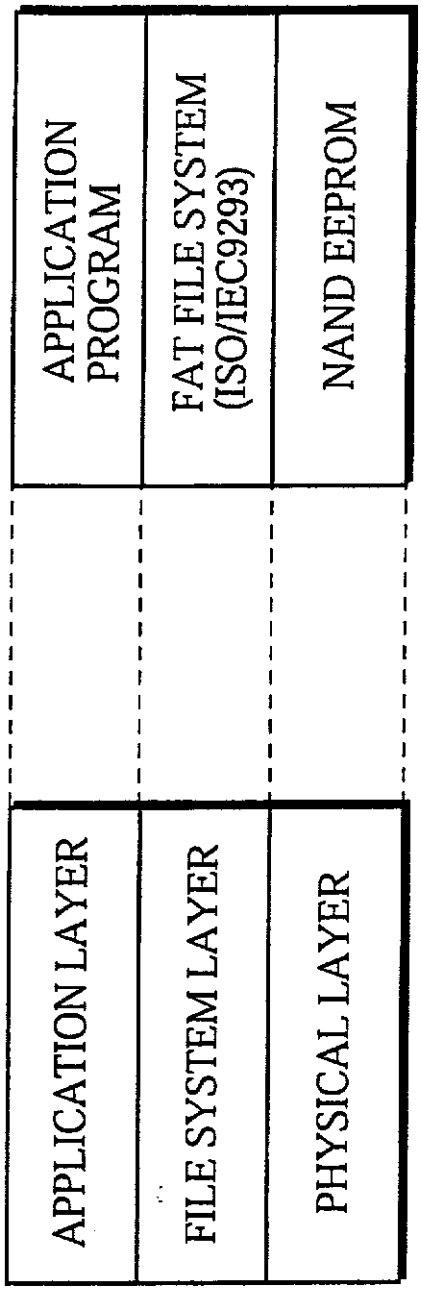

APPLICATION PROGRAM
FAT FILE SYSTEM (ISO/IEC9293)
NAND EEPROM
APPLICATION LAYER
FILE SYSTEM LAYER
PHYSICAL LAYER

FIG. 1A

FIG. 1B

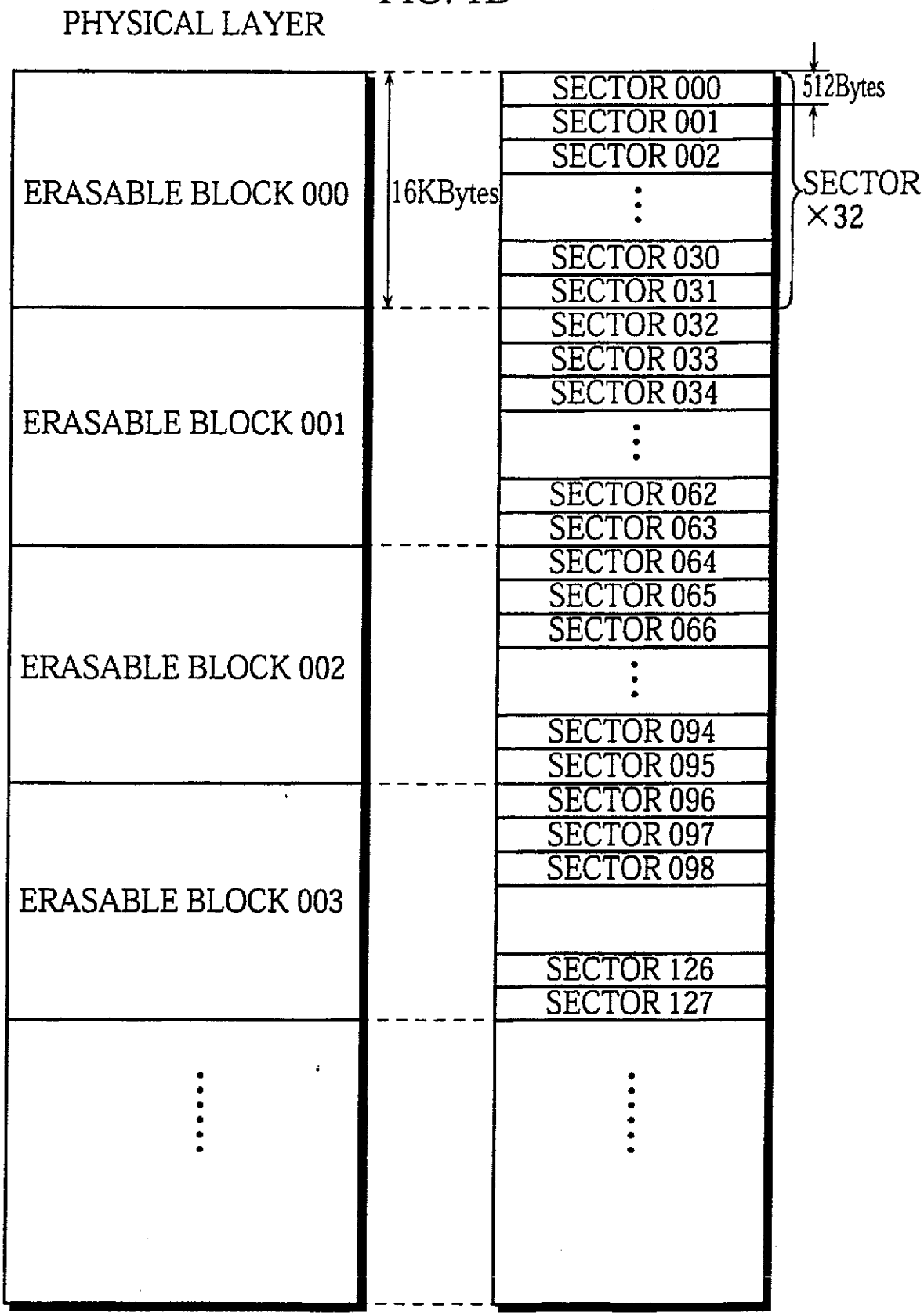

PHYSICAL LAYER
ERASABLE BLOCK 000
ERASABLE BLOCK 001
ERASABLE BLOCK 002
ERASABLE BLOCK 003
16KBytes
SECTOR 000
SECTOR 001
SECTOR 002
SECTOR 030
SECTOR 031
SECTOR 032
SECTOR 033
SECTOR 034
SECTOR 062
SECTOR 063
SECTOR 064
SECTOR 065
SECTOR 066
SECTOR 094
SECTOR 095
SECTOR 096
SECTOR 097
SECTOR 098
SECTOR 126
SECTOR 127
512Bytes
SECTOR ×32

FIG. 1C

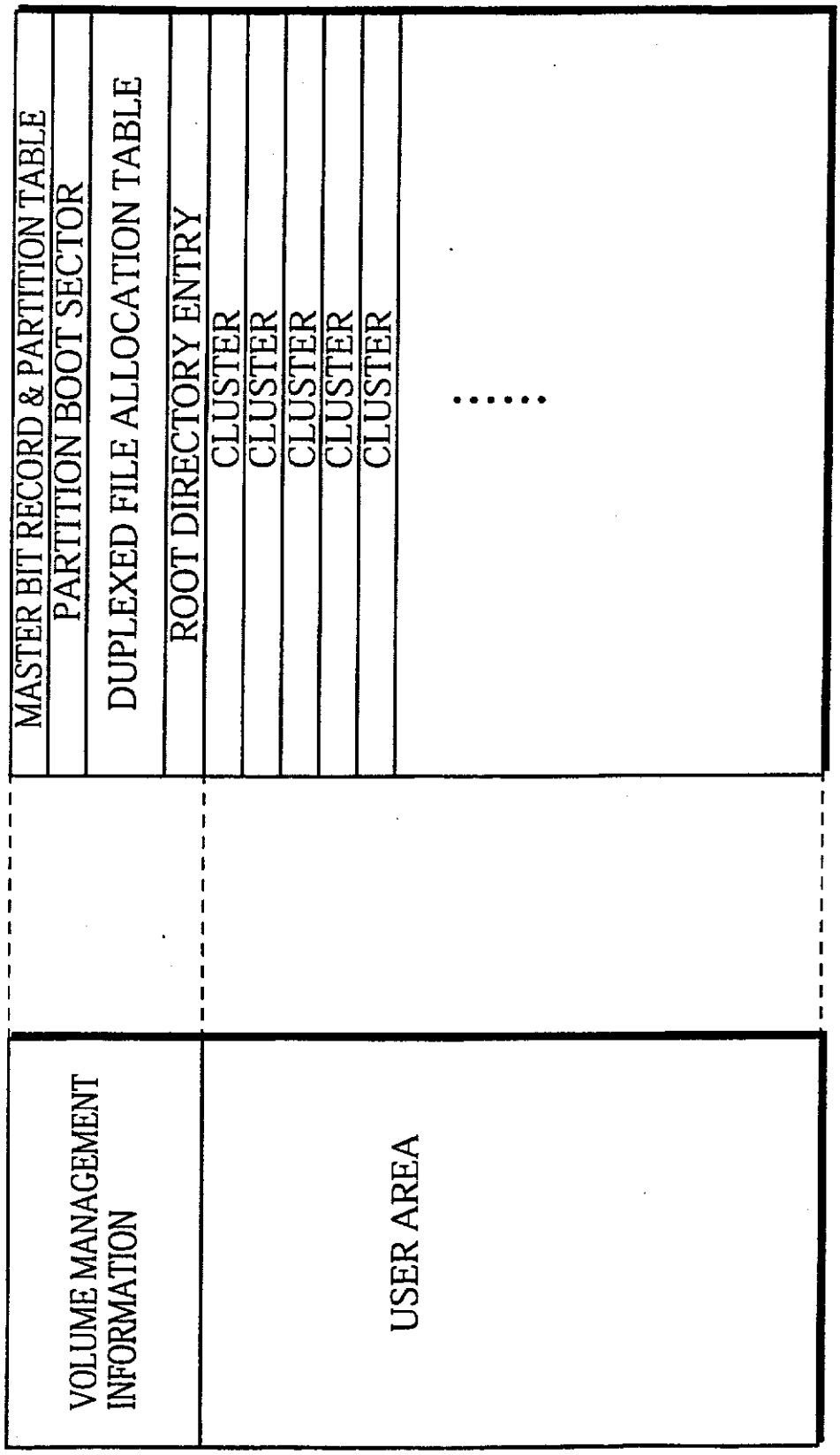

VOLUME MANAGEMENT INFORMATION
USER AREA
MASTER BIT RECORD & PARTITION TABLE
PARTITION BOOT SECTOR
DUPLEXED FILE ALLOCATION TABLE
ROOT DIRECTORY ENTRY
CLUSTER
CLUSTER
CLUSTER
CLUSTER
CLUSTER
.....

FIG. 1D

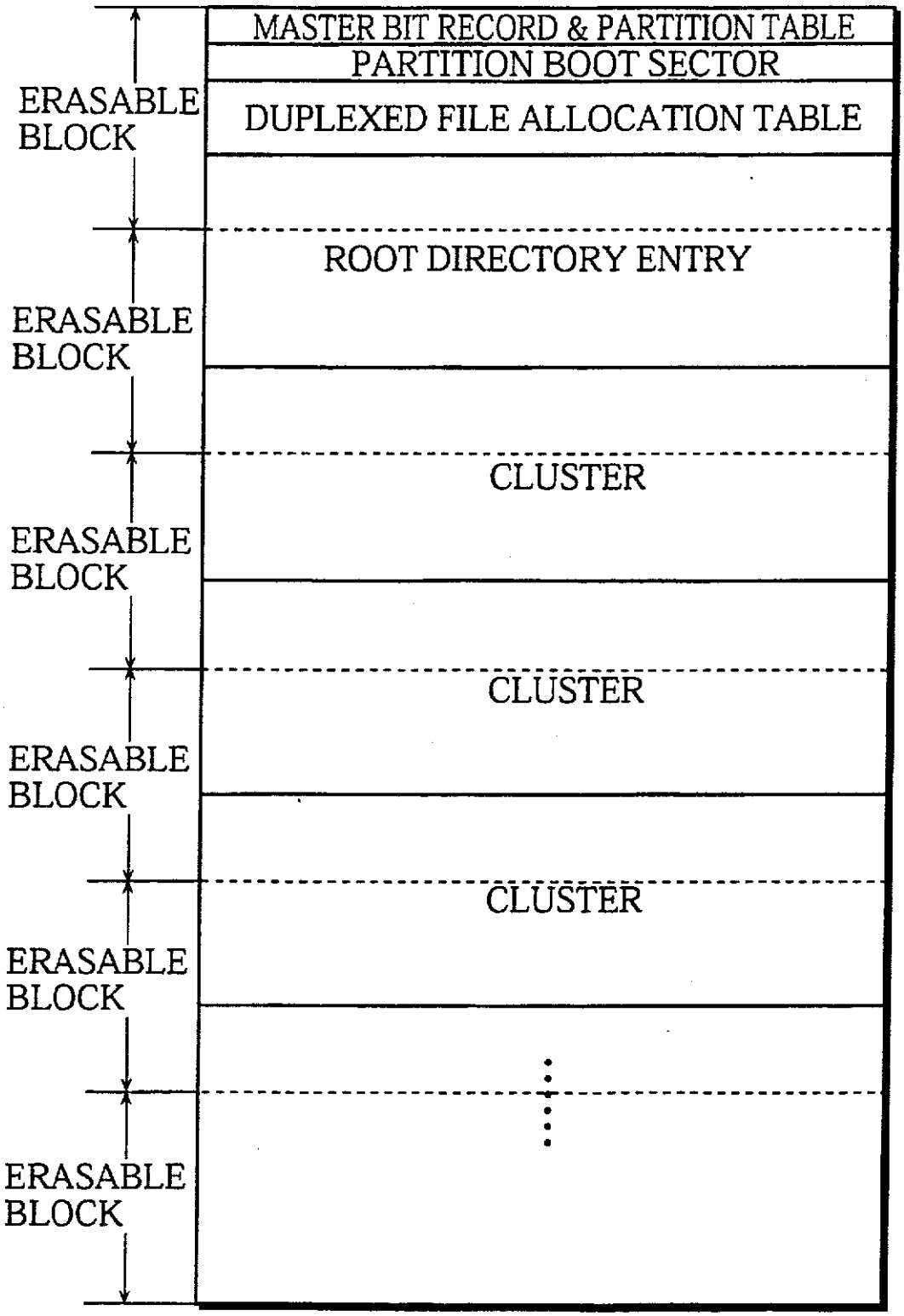

MASTER BIT RECORD & PARTITION TABLE
PARTITION BOOT SECTOR
DUPLEXED FILE ALLOCATION TABLE
ROOT DIRECTORY ENTRY
CLUSTER
CLUSTER
CLUSTER
ERASABLE BLOCK
ERASABLE BLOCK
ERASABLE BLOCK
ERASABLE BLOCK
ERASABLE BLOCK
ERASABLE BLOCK

FIG. 2A

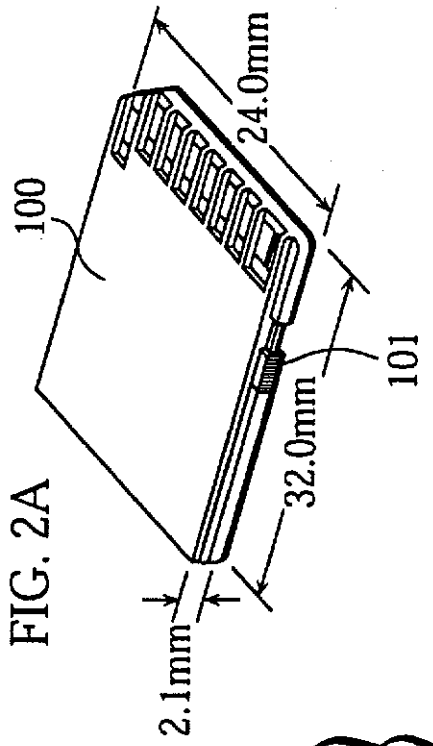


FIG. 2C

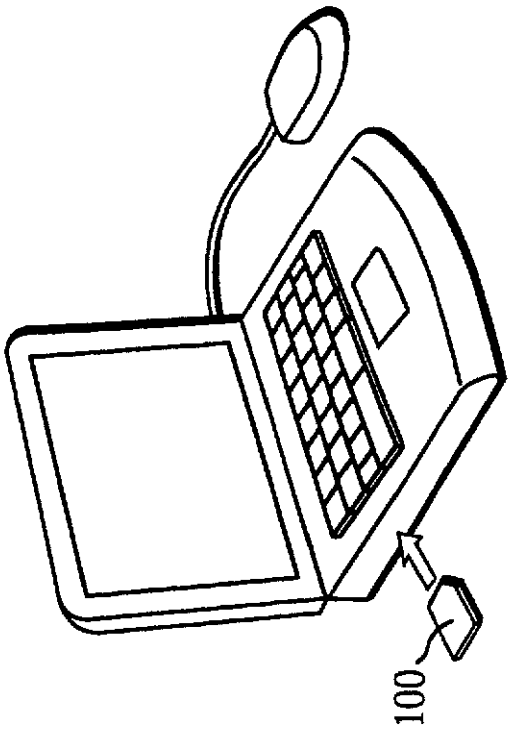
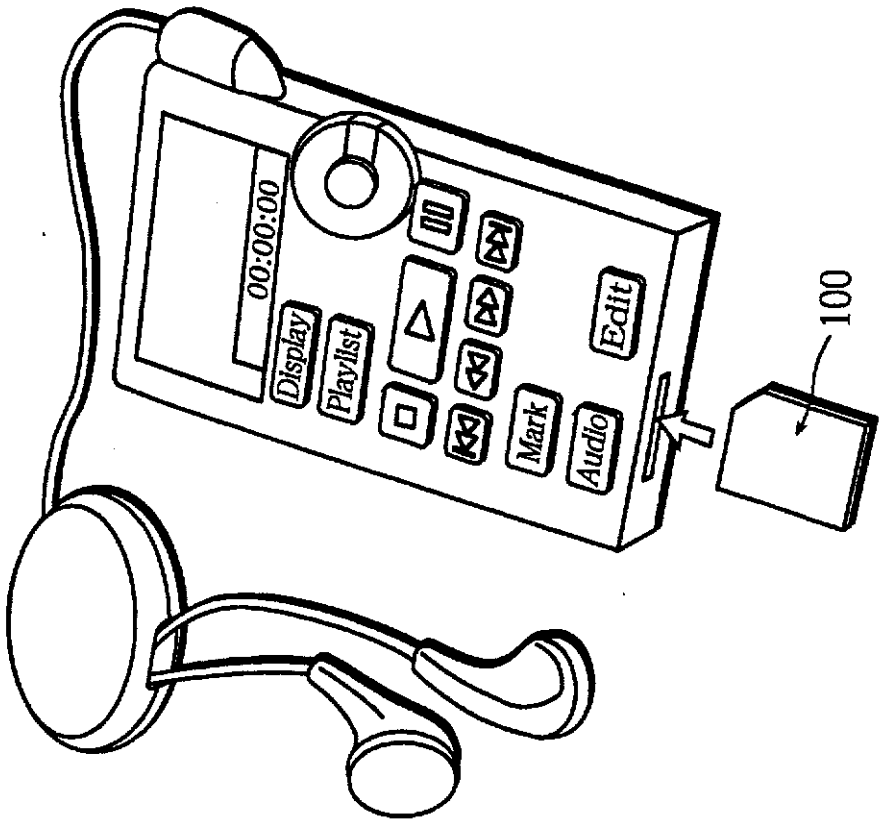


FIG. 2B



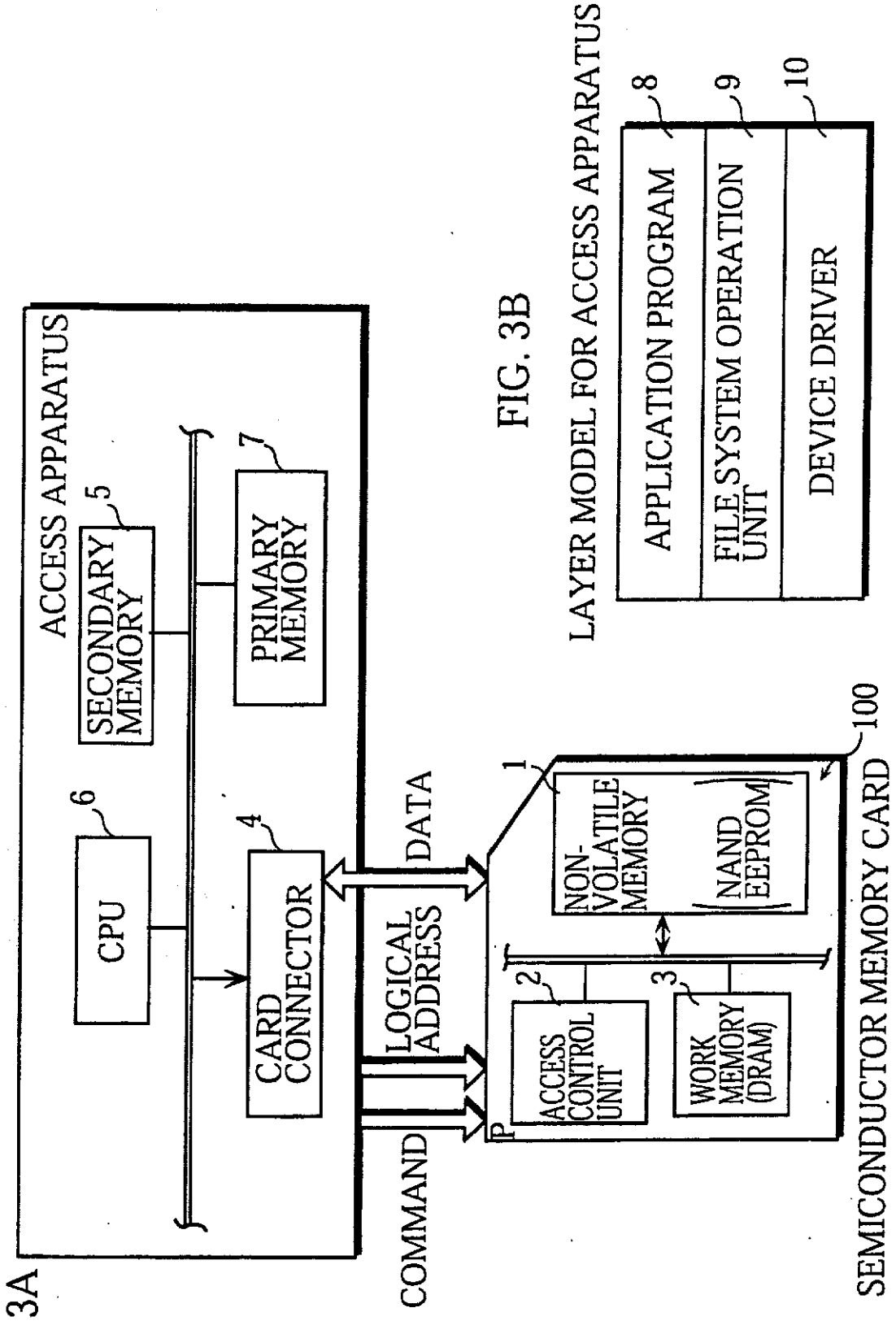

ACCESS APPARATUS
SECONDARY MEMORY
5
PRIMARY MEMORY
7
CPU
6
CARD CONNECTOR
4
DATA
LOGICAL ADDRESS
COMMAND
1
NON-VOLATILE MEMORY
NAND EEPROM
2
ACCESS CONTROL UNIT
3
WORK MEMORY (DRAM)
100
SEMICONDUCTOR MEMORY CARD
LAYER MODEL FOR ACCESS APPARATUS
APPLICATION PROGRAM
8
FILE SYSTEM OPERATION UNIT
9
DEVICE DRIVER
10

FIG. 3A

FIG. 3B

FIG. 4

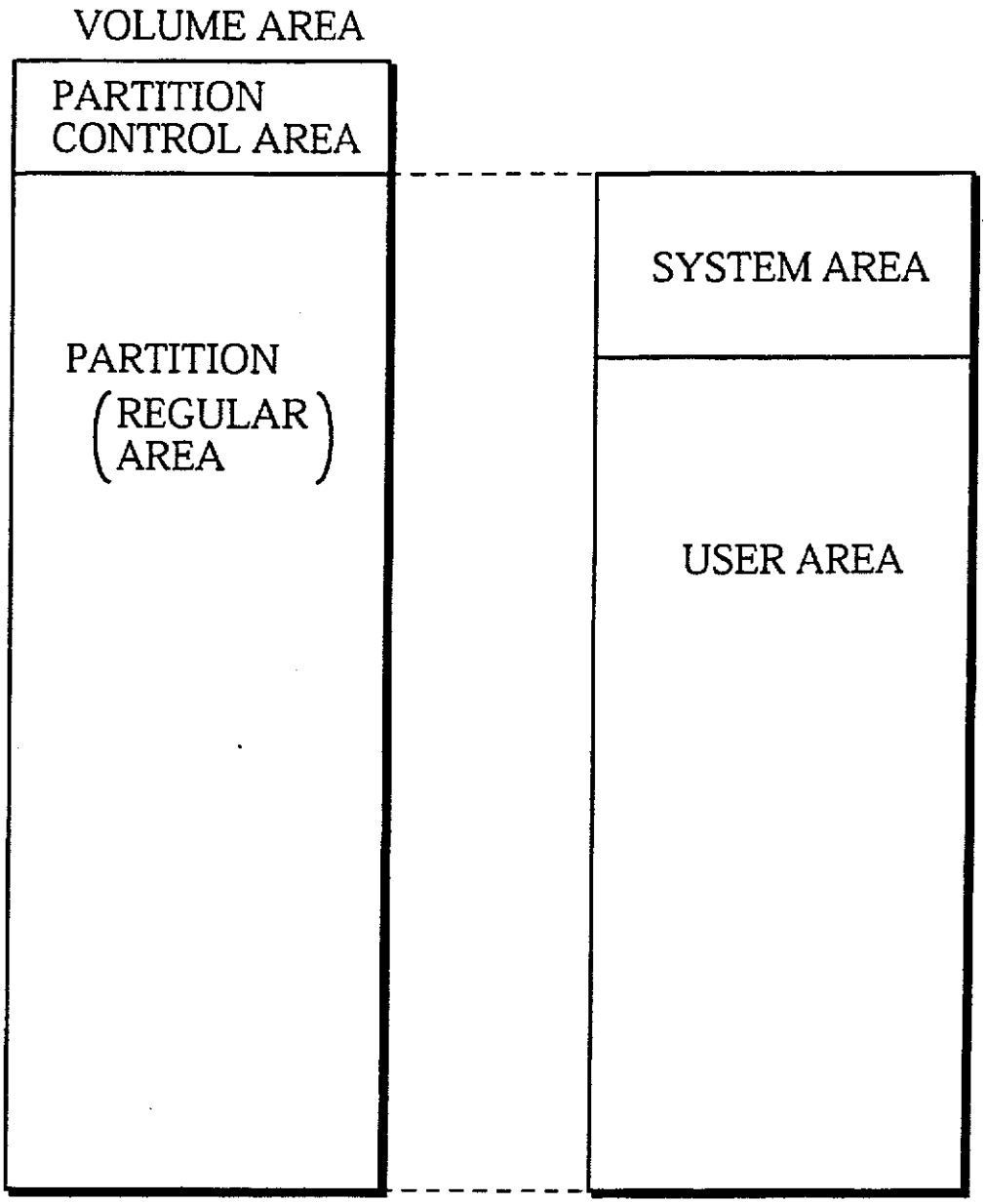

VOLUME AREA
PARTITION CONTROL AREA
PARTITION (REGULAR AREA)
SYSTEM AREA
USER AREA

FIG. 5

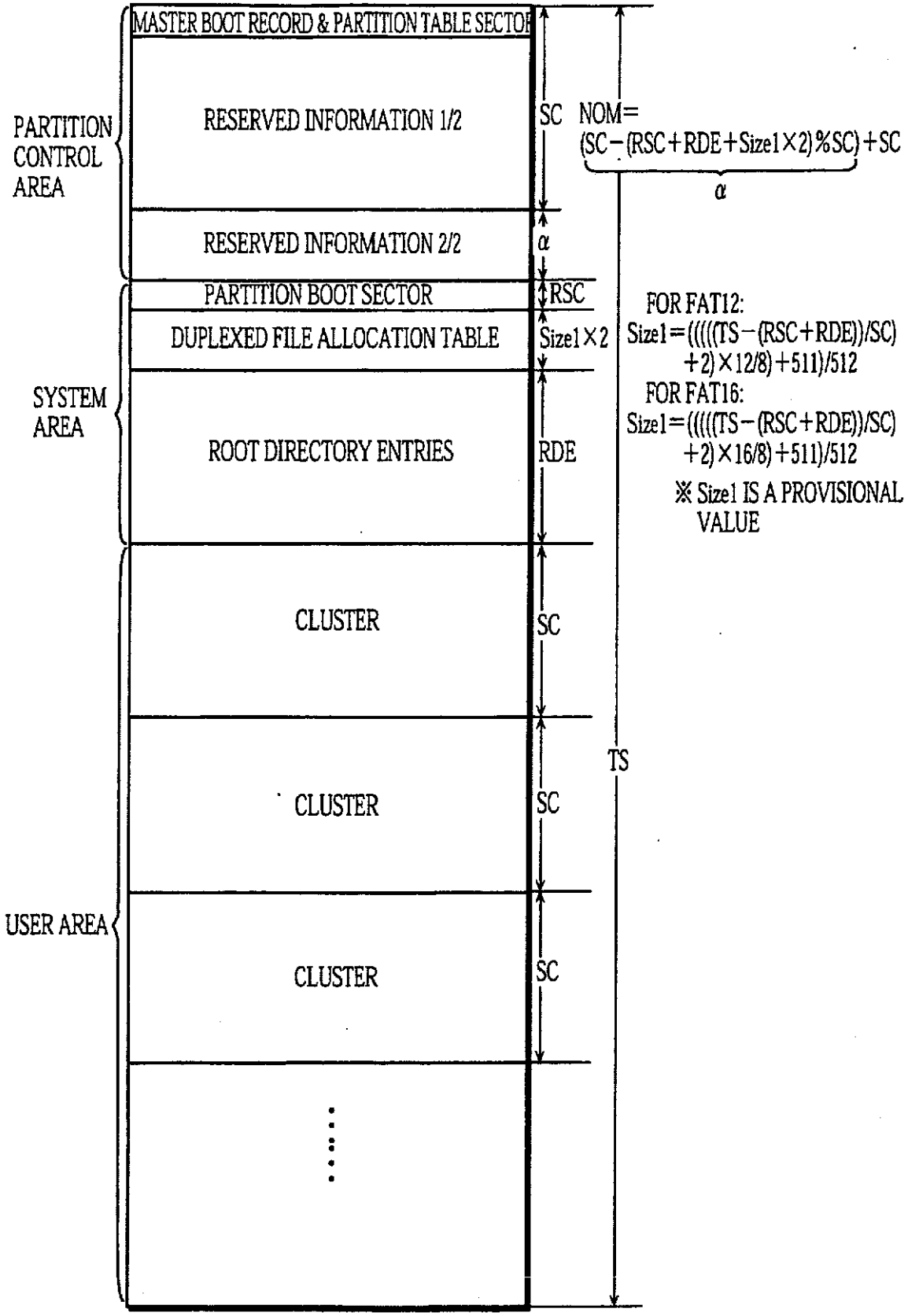

MASTER BOOT RECORD & PARTITION TABLE SECTOR
RESERVED INFORMATION 1/2
RESERVED INFORMATION 2/2
PARTITION BOOT SECTOR
DUPLEXED FILE ALLOCATION TABLE
ROOT DIRECTORY ENTRIES
CLUSTER
CLUSTER
CLUSTER
PARTITION CONTROL AREA
SYSTEM AREA
USER AREA
SC
α
RSC
Size1×2
RDE
SC
SC
SC
NOM=
(SC−(RSC+RDE+Size1×2)%SC)+SC
α
TS
FOR FAT12:
Size1=(((((TS−(RSC+RDE))/SC)
+2)×12/8)+511)/512
FOR FAT16:
Size1=(((((TS−(RSC+RDE))/SC)
+2)×16/8)+511)/512
※ Size1 IS A PROVISIONAL VALUE

FIG. 6A

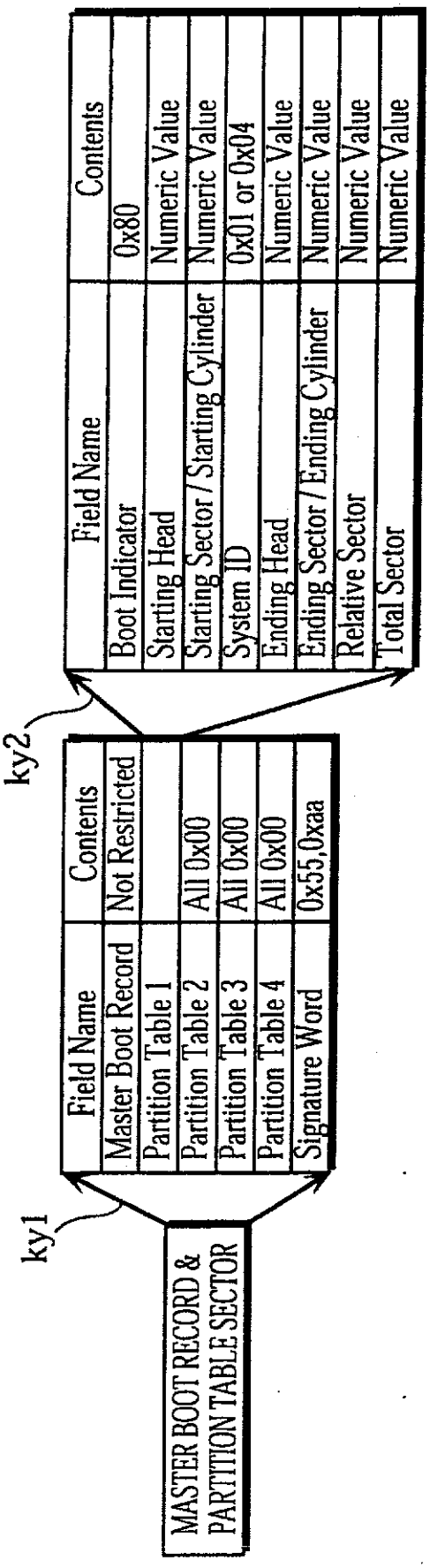
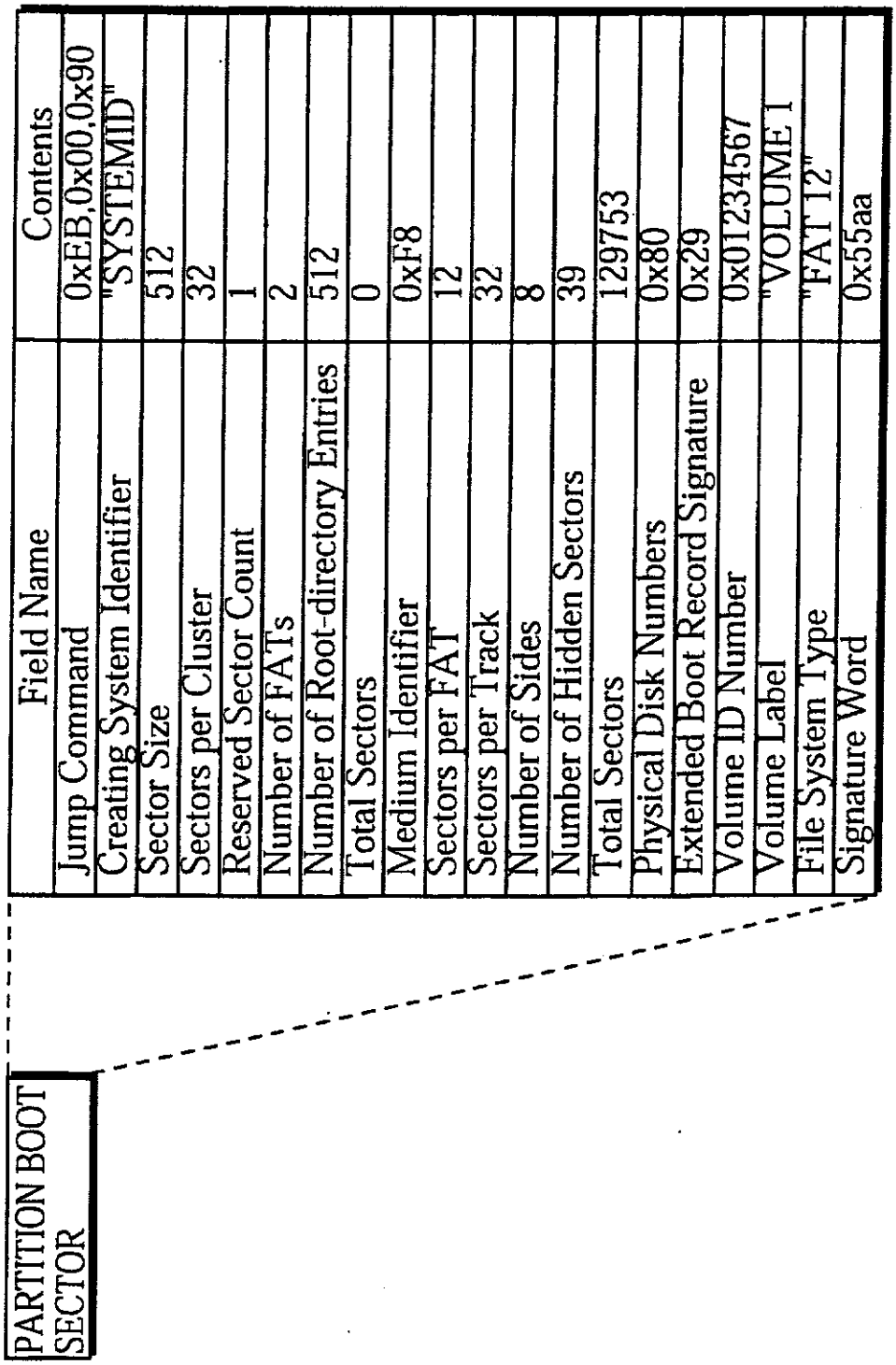

MASTER BOOT RECORD & PARTITION TABLE SECTOR
ky1
Field Name
Contents
Master Boot Record
Not Restricted
Partition Table 1
Partition Table 2
All 0x00
Partition Table 3
All 0x00
Partition Table 4
All 0x00
Signature Word
0x55,0xaa
ky2
Field Name
Contents
Boot Indicator
0x80
Starting Head
Numeric Value
Starting Sector / Starting Cylinder
Numeric Value
System ID
0x01 or 0x04
Ending Head
Numeric Value
Ending Sector / Ending Cylinder
Numeric Value
Relative Sector
Numeric Value
Total Sector
Numeric Value

FIG. 6B



Field Name	Contents
Jump Command	0xEB,0x00,0x90
Creating System Identifier	"SYSTEMID"
Sector Size	512
Sectors per Cluster	32
Reserved Sector Count	1
Number of FATs	2
Number of Root-directory Entries	512
Total Sectors	0
Medium Identifier	0xF8
Sectors per FAT	12
Sectors per Track	32
Number of Sides	8
Number of Hidden Sectors	39
Total Sectors	129753
Physical Disk Numbers	0x80
Extended Boot Record Signature	0x29
Volume ID Number	0x01234567
Volume Label	"VOLUME 1
File System Type	"FAT 12"
Signature Word	0x55aa

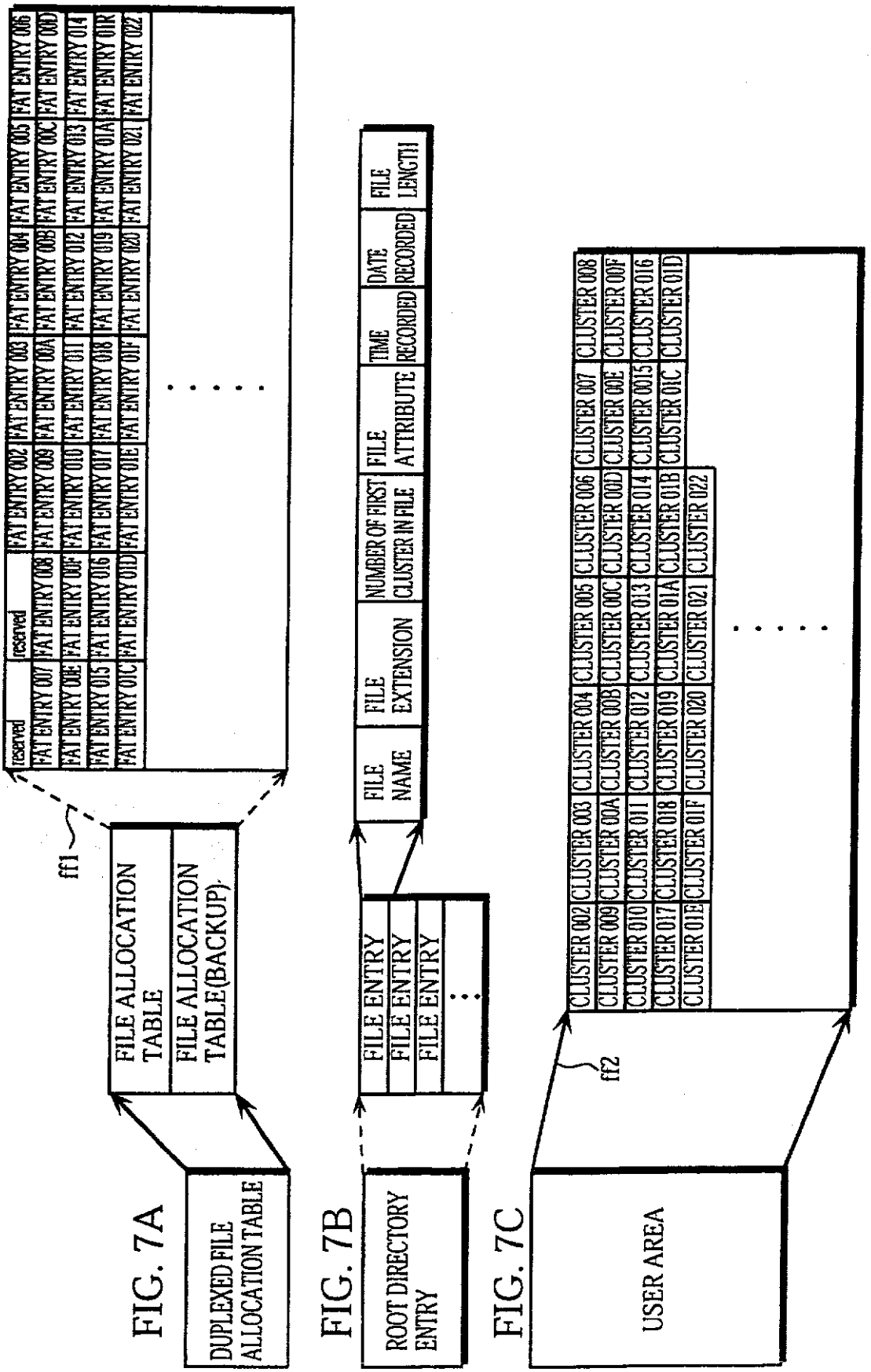

DUPLEXED FILE ALLOCATION TABLE
FILE ALLOCATION TABLE
FILE ALLOCATION TABLE(BACKUP)
ff1
reserved
reserved
FAT ENTRY 002
FAT ENTRY 003
FAT ENTRY 004
FAT ENTRY 005
FAT ENTRY 006
FAT ENTRY 007
FAT ENTRY 008
FAT ENTRY 009
FAT ENTRY 00A
FAT ENTRY 00B
FAT ENTRY 00C
FAT ENTRY 00D
FAT ENTRY 00E
FAT ENTRY 00F
FAT ENTRY 010
FAT ENTRY 011
FAT ENTRY 012
FAT ENTRY 013
FAT ENTRY 014
FAT ENTRY 015
FAT ENTRY 016
FAT ENTRY 017
FAT ENTRY 018
FAT ENTRY 019
FAT ENTRY 01A
FAT ENTRY 01B
FAT ENTRY 01C
FAT ENTRY 01D
FAT ENTRY 01E
FAT ENTRY 01F
FAT ENTRY 020
FAT ENTRY 021
FAT ENTRY 022
FIG. 7A
ROOT DIRECTORY ENTRY
FILE ENTRY
FILE ENTRY
FILE ENTRY
FILE NAME
FILE EXTENSION
NUMBER OF FIRST CLUSTER IN FILE
FILE ATTRIBUTE
TIME RECORDED
DATE RECORDED
FILE LENGTH
FIG. 7B
USER AREA
ff2
CLUSTER 002
CLUSTER 003
CLUSTER 004
CLUSTER 005
CLUSTER 006
CLUSTER 007
CLUSTER 008
CLUSTER 009
CLUSTER 00A
CLUSTER 00B
CLUSTER 00C
CLUSTER 00D
CLUSTER 00E
CLUSTER 00F
CLUSTER 010
CLUSTER 011
CLUSTER 012
CLUSTER 013
CLUSTER 014
CLUSTER 0015
CLUSTER 016
CLUSTER 017
CLUSTER 018
CLUSTER 019
CLUSTER 01A
CLUSTER 01B
CLUSTER 01C
CLUSTER 01D
CLUSTER 01E
CLUSTER 01F
CLUSTER 020
CLUSTER 021
CLUSTER 022
FIG. 7C

FIG. 8

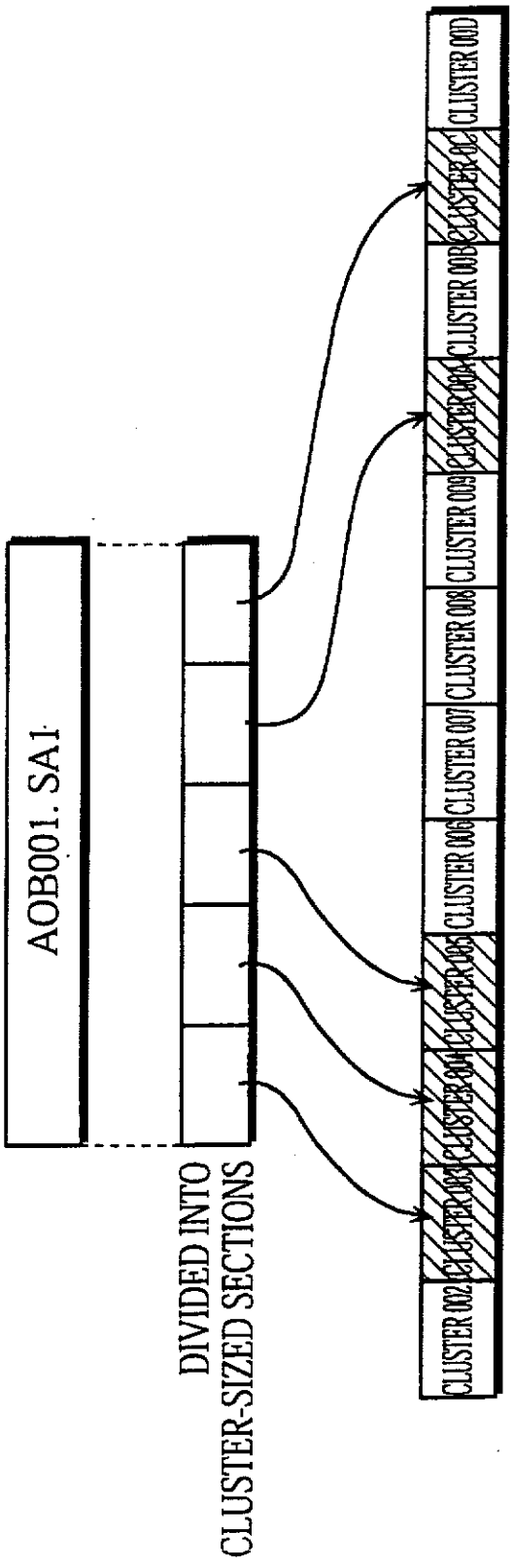

AOB001. SA1
DIVIDED INTO
CLUSTER-SIZED SECTIONS
CLUSTER 000
CLUSTER 001
CLUSTER 002
CLUSTER 003
CLUSTER 004
CLUSTER 005
CLUSTER 006
CLUSTER 007
CLUSTER 008
CLUSTER 009
CLUSTER 00A
CLUSTER 00B
CLUSTER 00C
CLUSTER 00D

FIG. 9

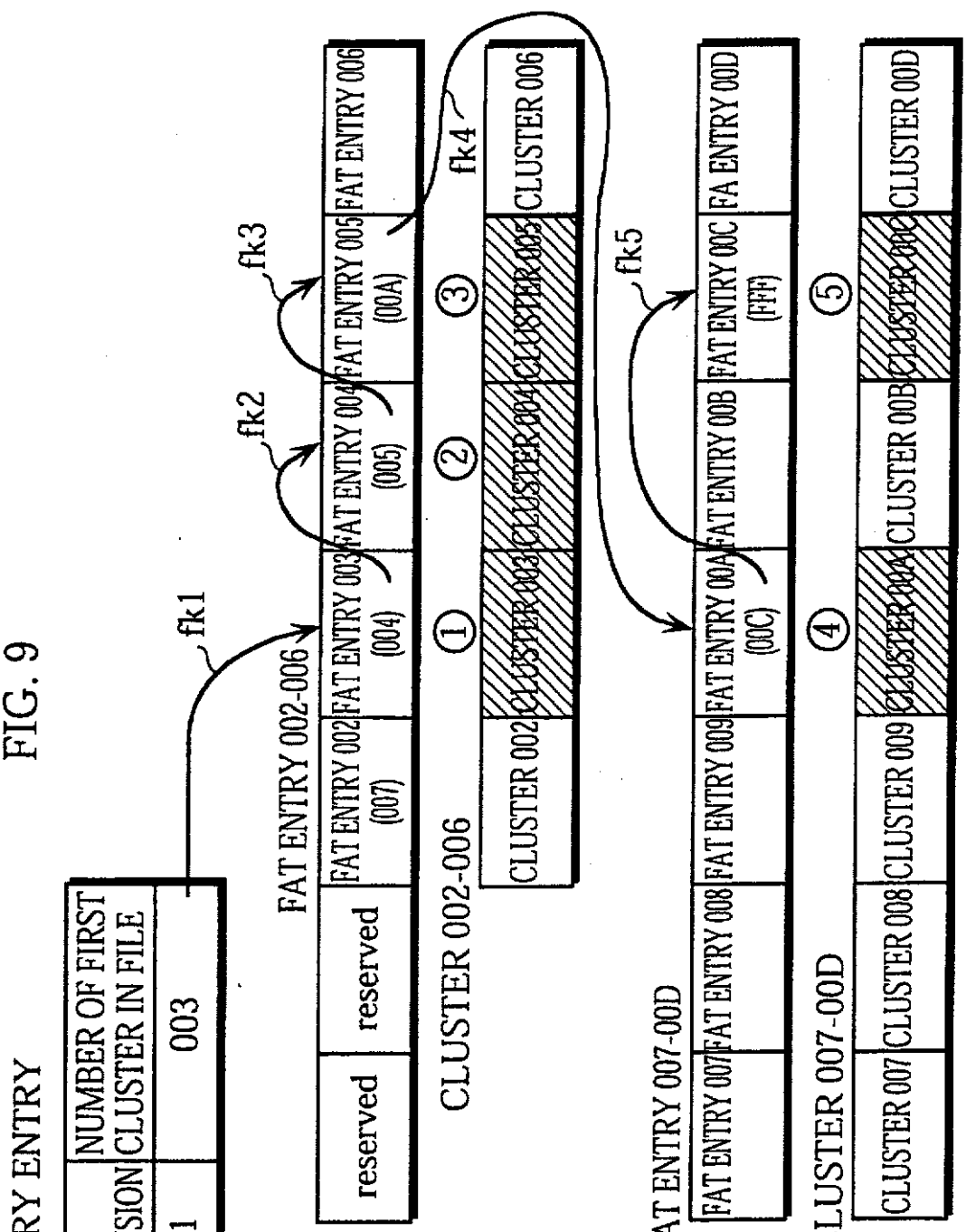

ROOT DIRECTORY ENTRY
FILE NAME
FILE EXTENSION
NUMBER OF FIRST CLUSTER IN FILE
AOB001
SA1
003
fk1
FAT ENTRY 002-006
reserved
reserved
FAT ENTRY 002 (007)
FAT ENTRY 003 (004)
FAT ENTRY 004 (005)
FAT ENTRY 005 (00A)
FAT ENTRY 006
fk2
fk3
fk4
fk5
CLUSTER 002-006
CLUSTER 002
CLUSTER 003
CLUSTER 004
CLUSTER 005
CLUSTER 006
①
②
③
FAT ENTRY 007-00D
FAT ENTRY 007
FAT ENTRY 008
FAT ENTRY 009
FAT ENTRY 00A (00C)
FAT ENTRY 00B
FAT ENTRY 00C (FFF)
FA ENTRY 00D
CLUSTER 007-00D
CLUSTER 007
CLUSTER 008
CLUSTER 009
CLUSTER 00A
CLUSTER 00B
CLUSTER 00C
CLUSTER 00D
④
⑤

FIG. 10A

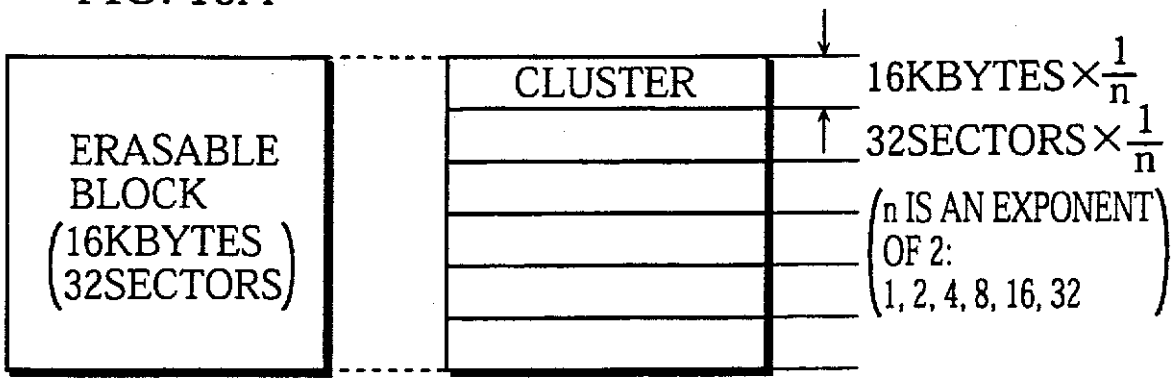


FIG. 10B

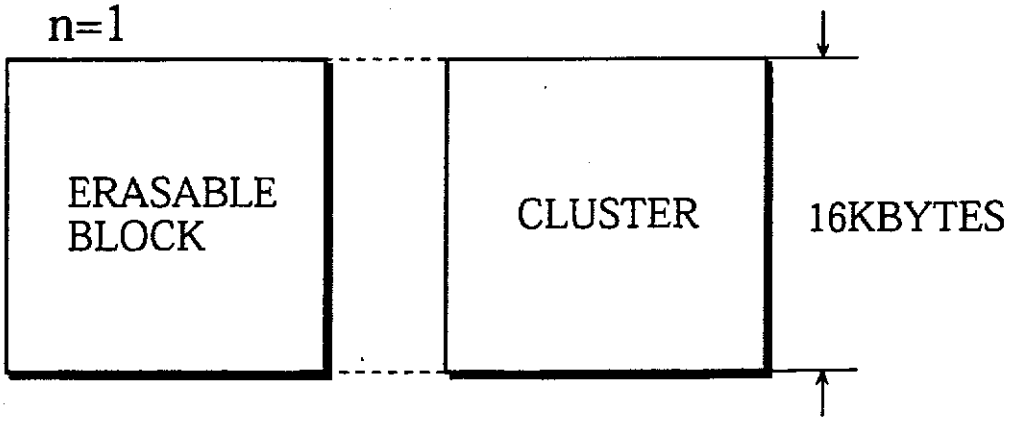


FIG. 10C

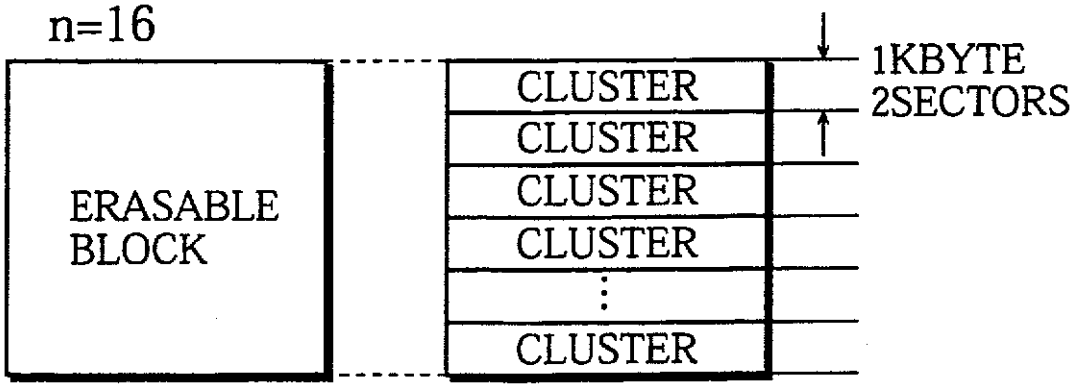


FIG. 11A

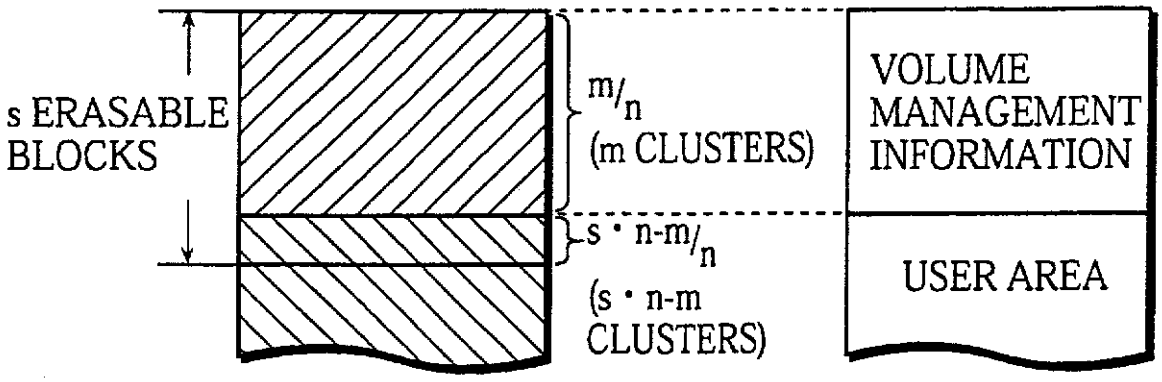


FIG. 11B

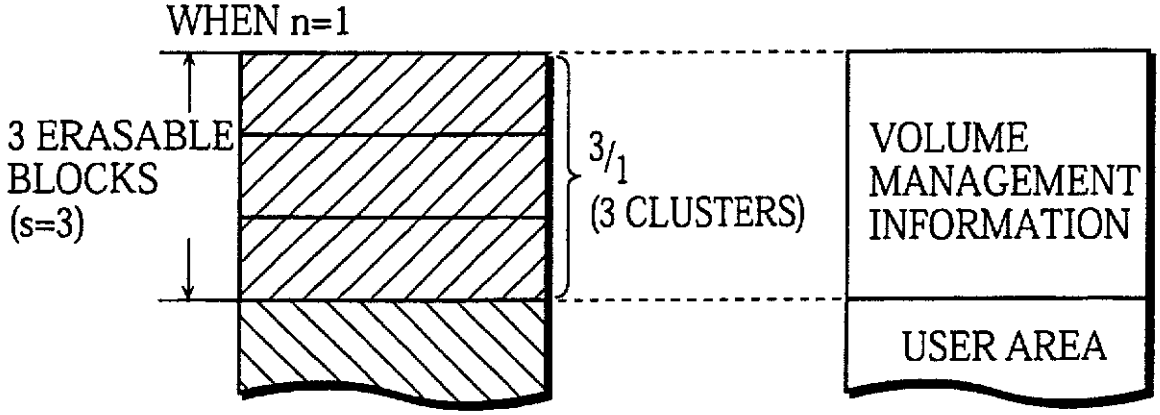


FIG. 11C

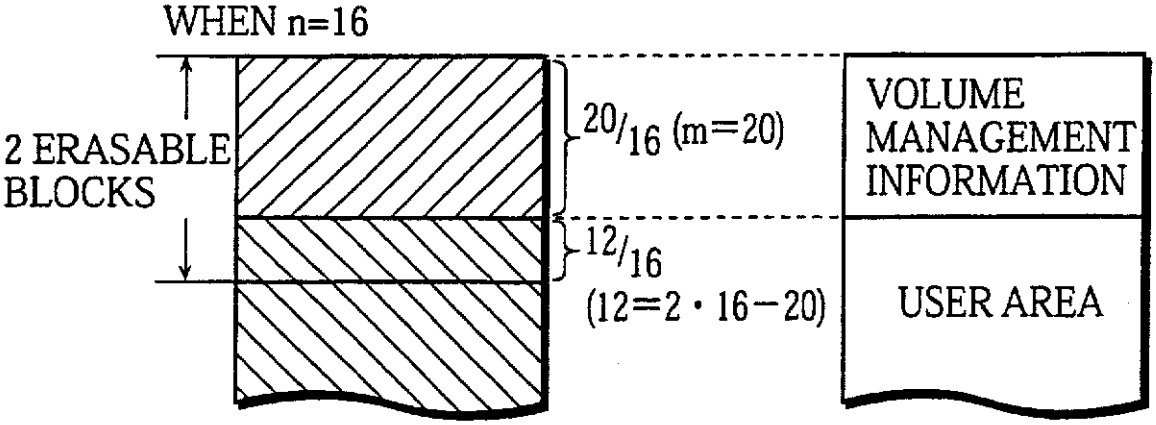


FIG. 12 FORMAT WHEN CLUSTER SIZE IS 16KB(n=1), SIZE TS IS 65600 SECTORS AND A DUPLEXED FAT REQUIRED

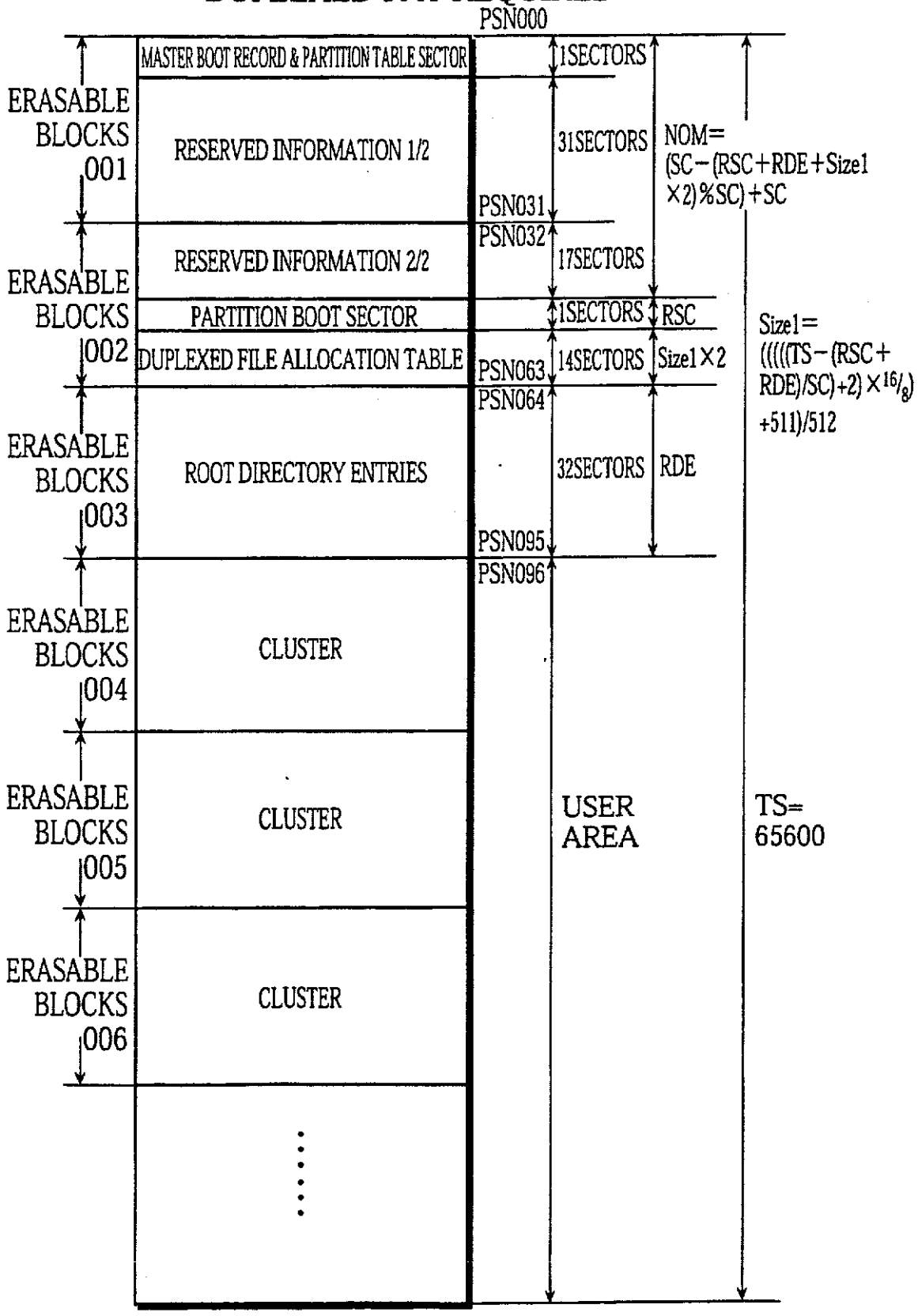


FIG. 13

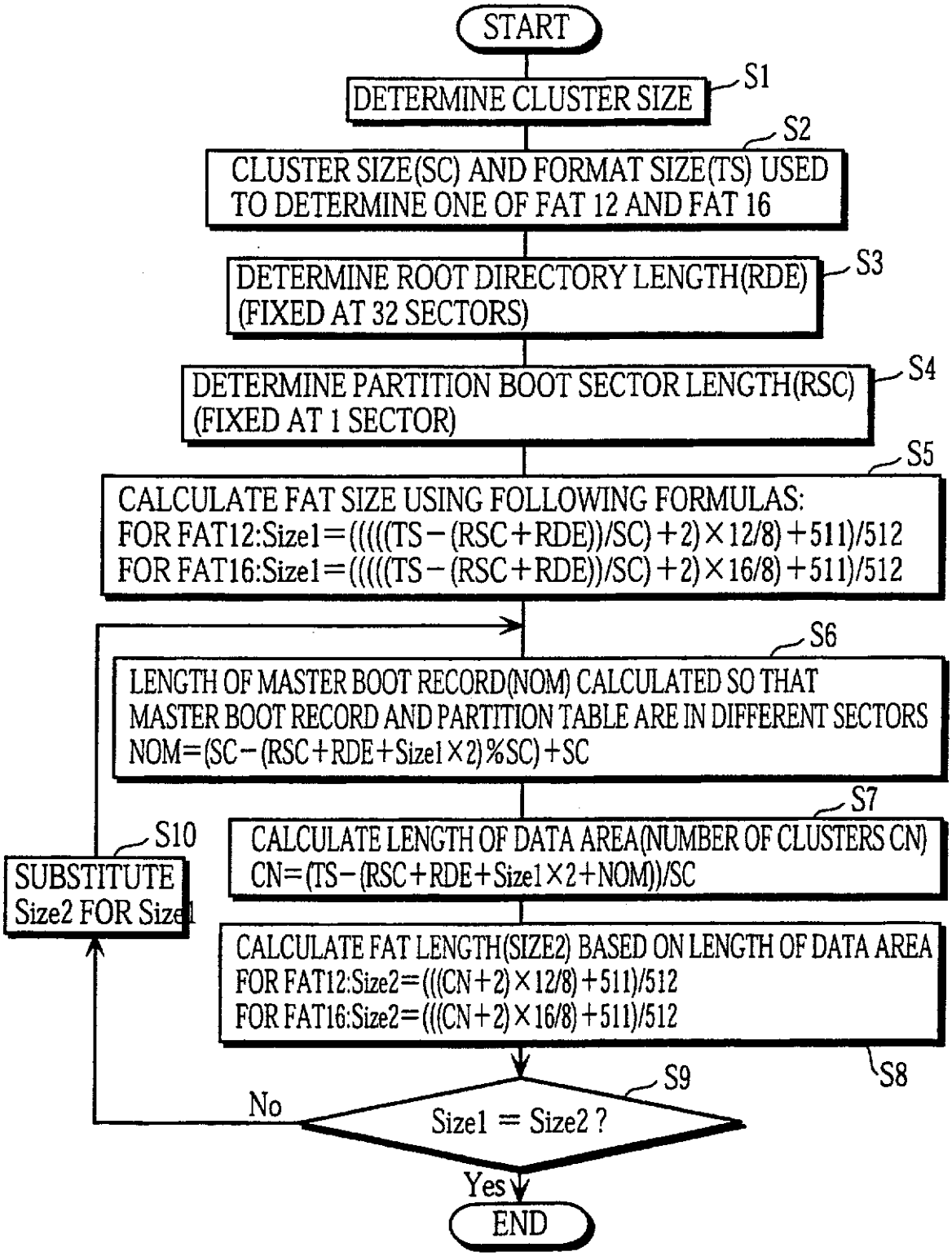

START
DETERMINE CLUSTER SIZE
S1
CLUSTER SIZE(SC) AND FORMAT SIZE(TS) USED TO DETERMINE ONE OF FAT 12 AND FAT 16
S2
DETERMINE ROOT DIRECTORY LENGTH(RDE) (FIXED AT 32 SECTORS)
S3
DETERMINE PARTITION BOOT SECTOR LENGTH(RSC) (FIXED AT 1 SECTOR)
S4
CALCULATE FAT SIZE USING FOLLOWING FORMULAS:
FOR FAT12:Size1=(((((TS−(RSC+RDE))/SC)+2)×12/8)+511)/512
FOR FAT16:Size1=(((((TS−(RSC+RDE))/SC)+2)×16/8)+511)/512
S5
LENGTH OF MASTER BOOT RECORD(NOM) CALCULATED SO THAT MASTER BOOT RECORD AND PARTITION TABLE ARE IN DIFFERENT SECTORS
NOM=(SC−(RSC+RDE+Size1×2)%SC)+SC
S6
CALCULATE LENGTH OF DATA AREA(NUMBER OF CLUSTERS CN)
CN=(TS−(RSC+RDE+Size1×2+NOM))/SC
S7
CALCULATE FAT LENGTH(SIZE2) BASED ON LENGTH OF DATA AREA
FOR FAT12:Size2=(((CN+2)×12/8)+511)/512
FOR FAT16:Size2=(((CN+2)×16/8)+511)/512
S8
Size1 = Size2 ?
S9
No
Yes
SUBSTITUTE Size2 FOR Size1
S10
END

FIG. 14

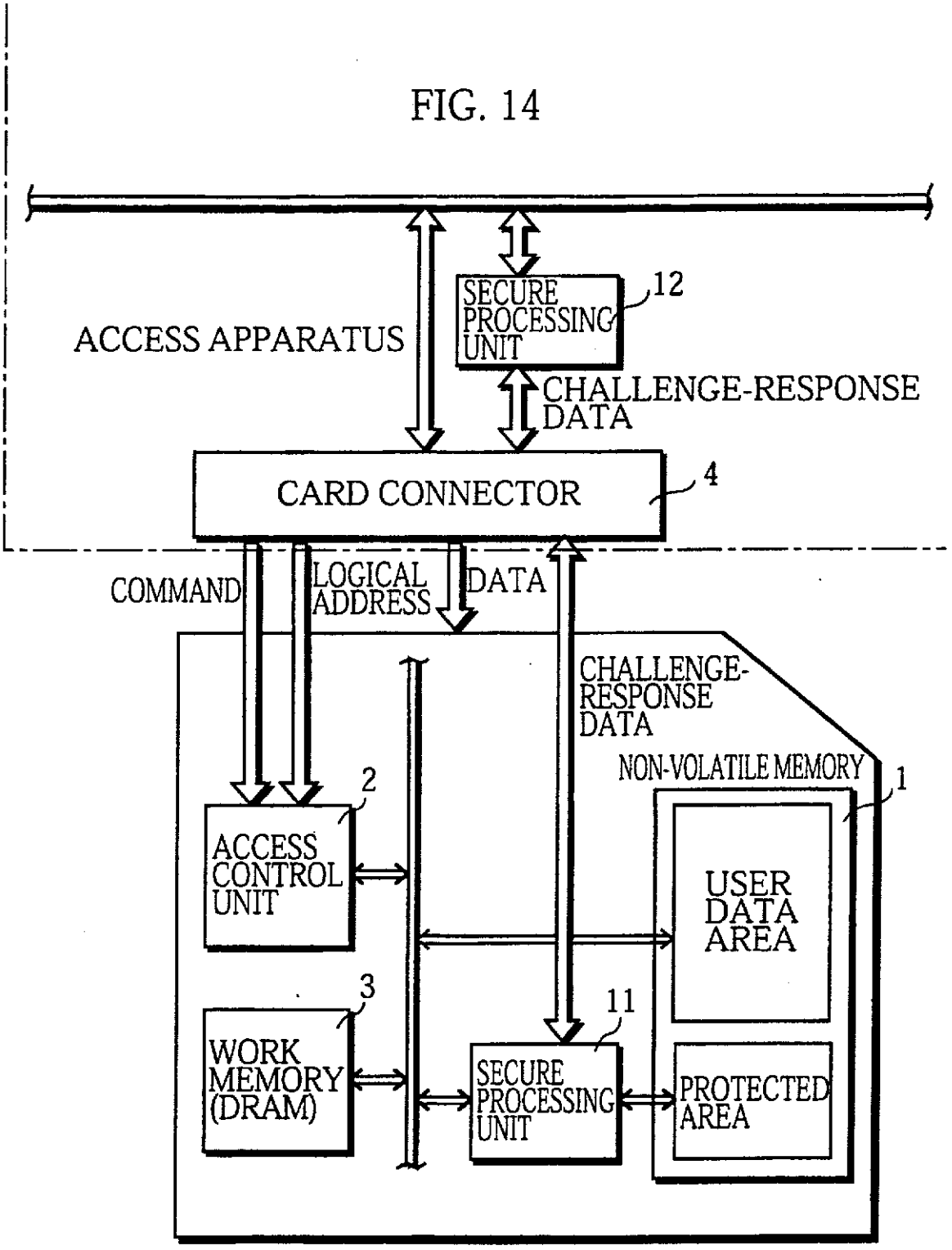

ACCESS APPARATUS
SECURE PROCESSING UNIT
12
CHALLENGE-RESPONSE DATA
CARD CONNECTOR
4
COMMAND
LOGICAL ADDRESS
DATA
CHALLENGE-RESPONSE DATA
NON-VOLATILE MEMORY
1
2
ACCESS CONTROL UNIT
USER DATA AREA
3
11
WORK MEMORY (DRAM)
SECURE PROCESSING UNIT
PROTECTED AREA

FIG. 15

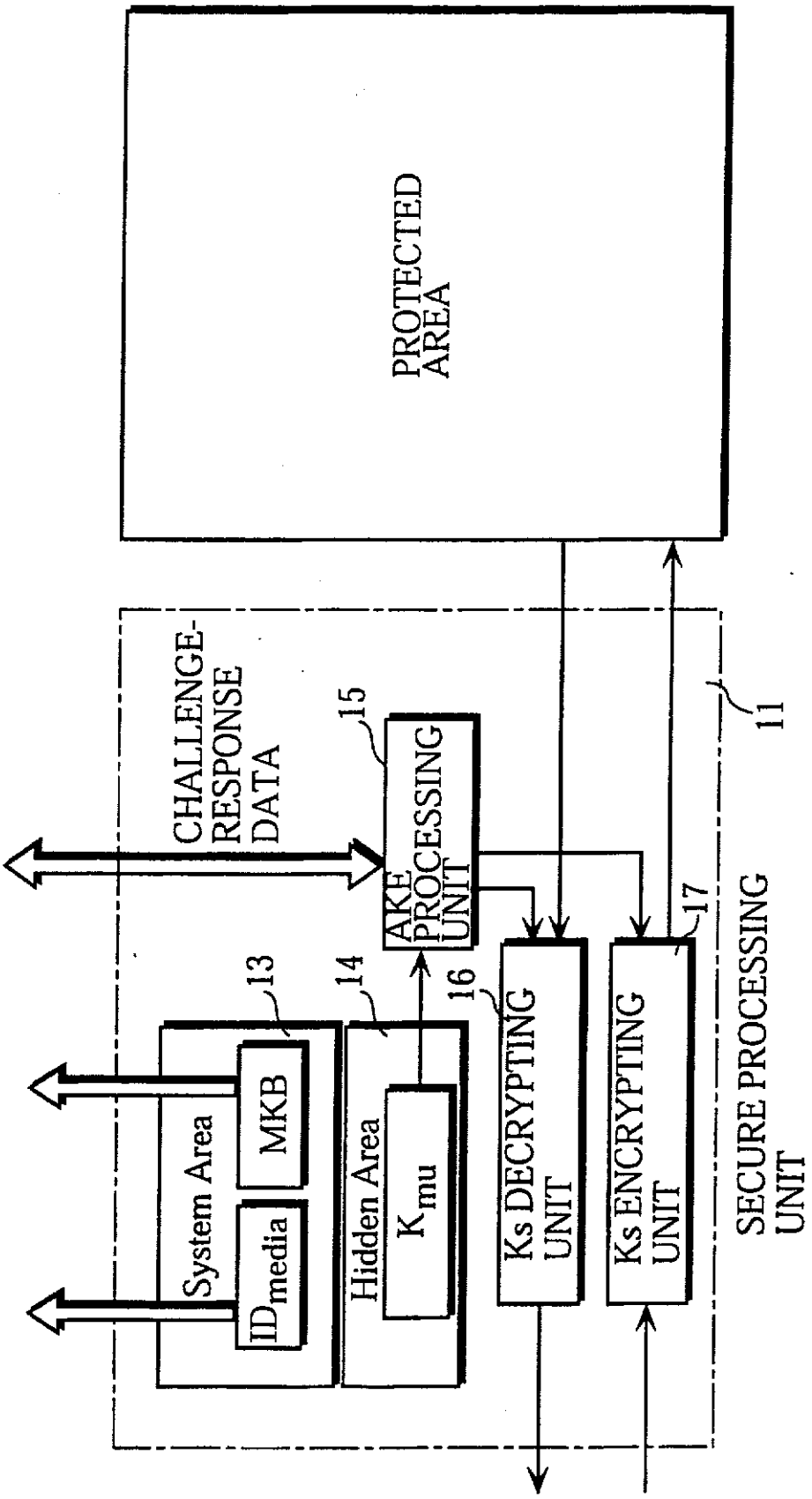

PROTECTED AREA
CHALLENGE-RESPONSE DATA
15
AKE PROCESSING UNIT
11
SECURE PROCESSING UNIT
13
14
16
17
System Area
MKB
ID media
Hidden Area
K mu
Ks DECRYPTING UNIT
Ks ENCRYPTING UNIT

FIG. 16

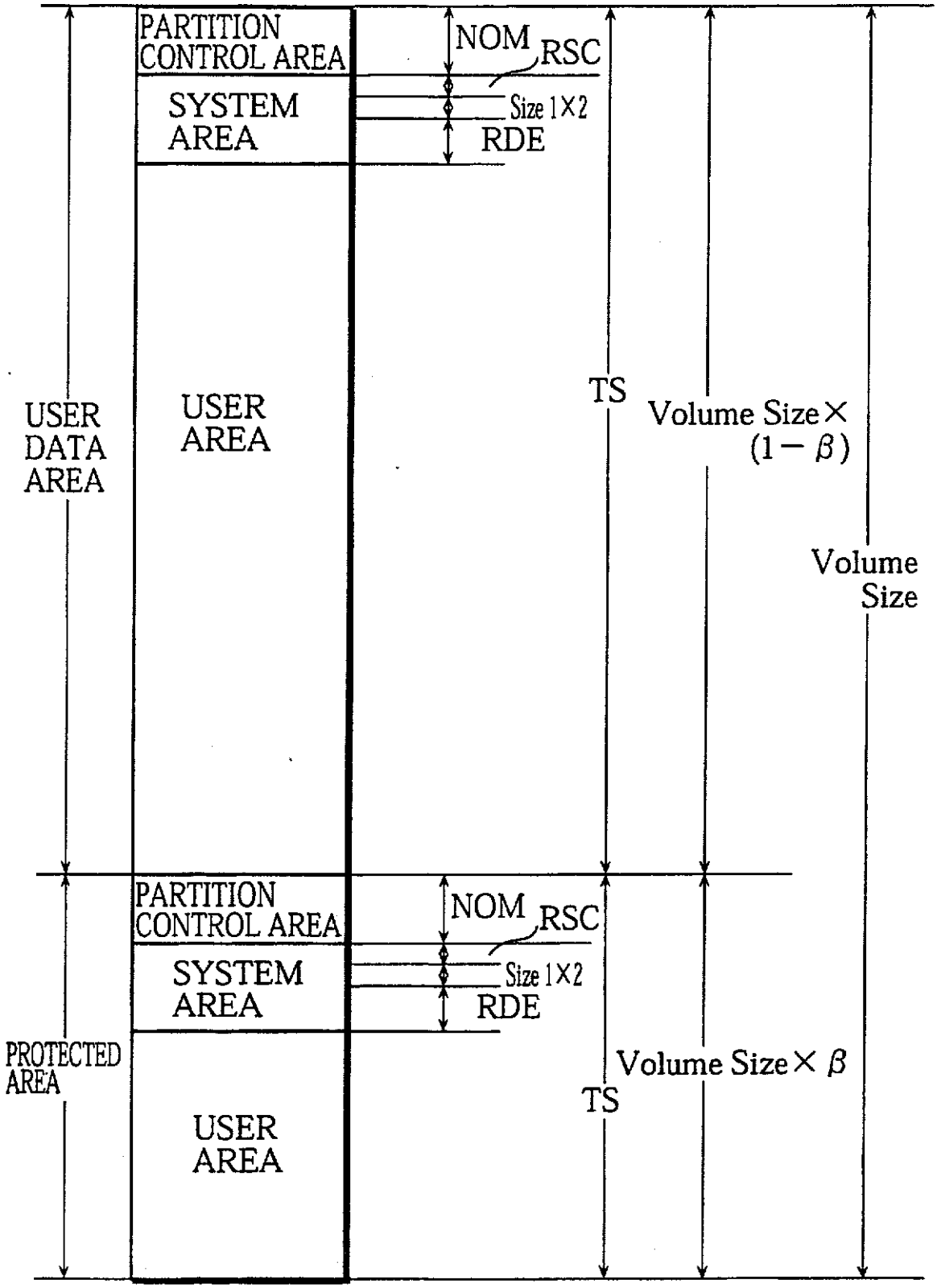

PARTITION CONTROL AREA
SYSTEM AREA
USER AREA
NOM
RSC
Size 1X2
RDE
USER DATA AREA
TS
Volume Size×(1−β)
Volume Size
PARTITION CONTROL AREA
SYSTEM AREA
USER AREA
NOM
RSC
Size 1X2
RDE
PROTECTED AREA
TS
Volume Size×β

FIG. 17 LAYOUT OF USER DATA AREA WHEN CLUSTER SIZE IS 16KB(n=1) AND TS IS SET AT 124160 SECTORS

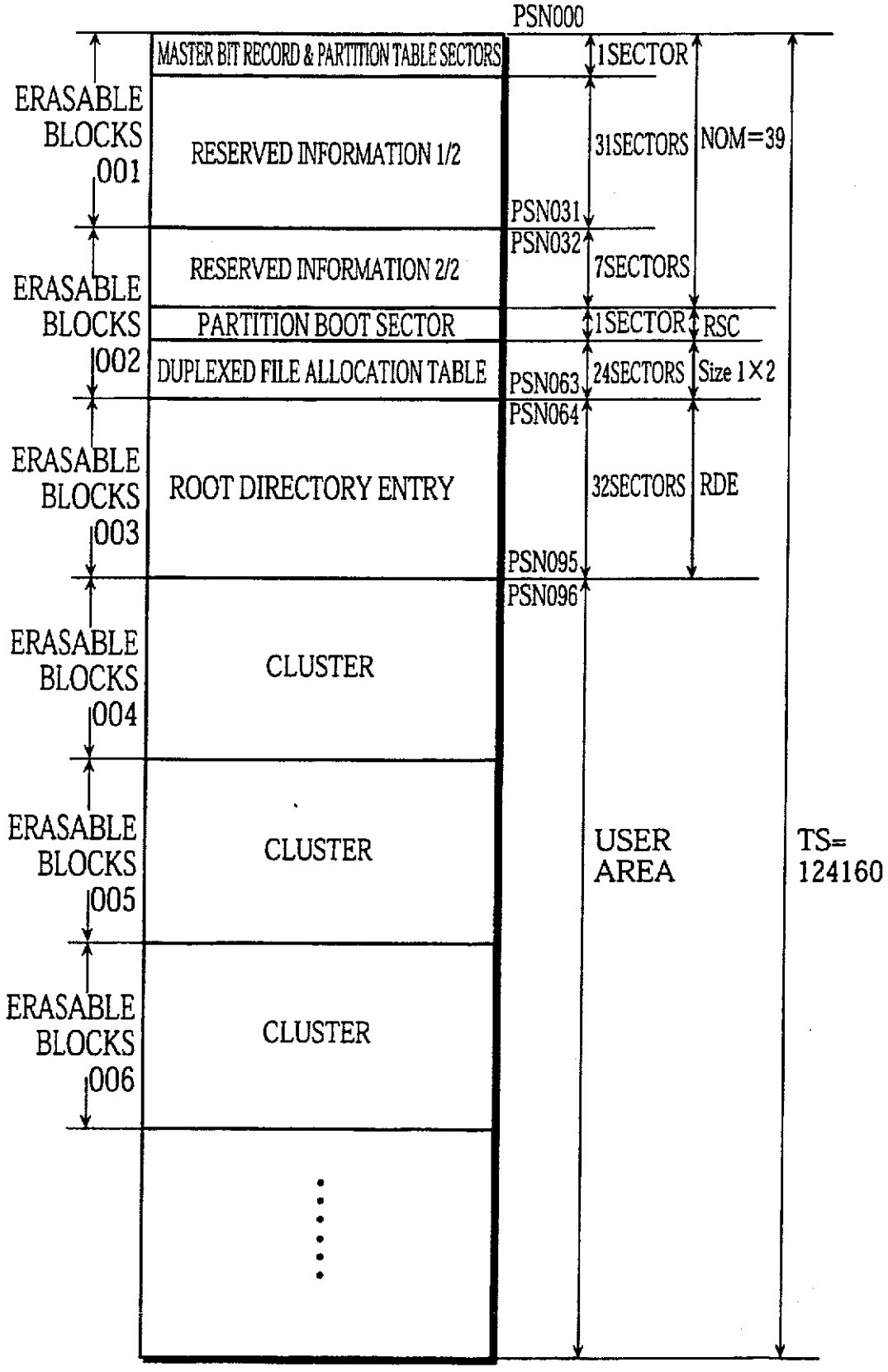


FIG. 18

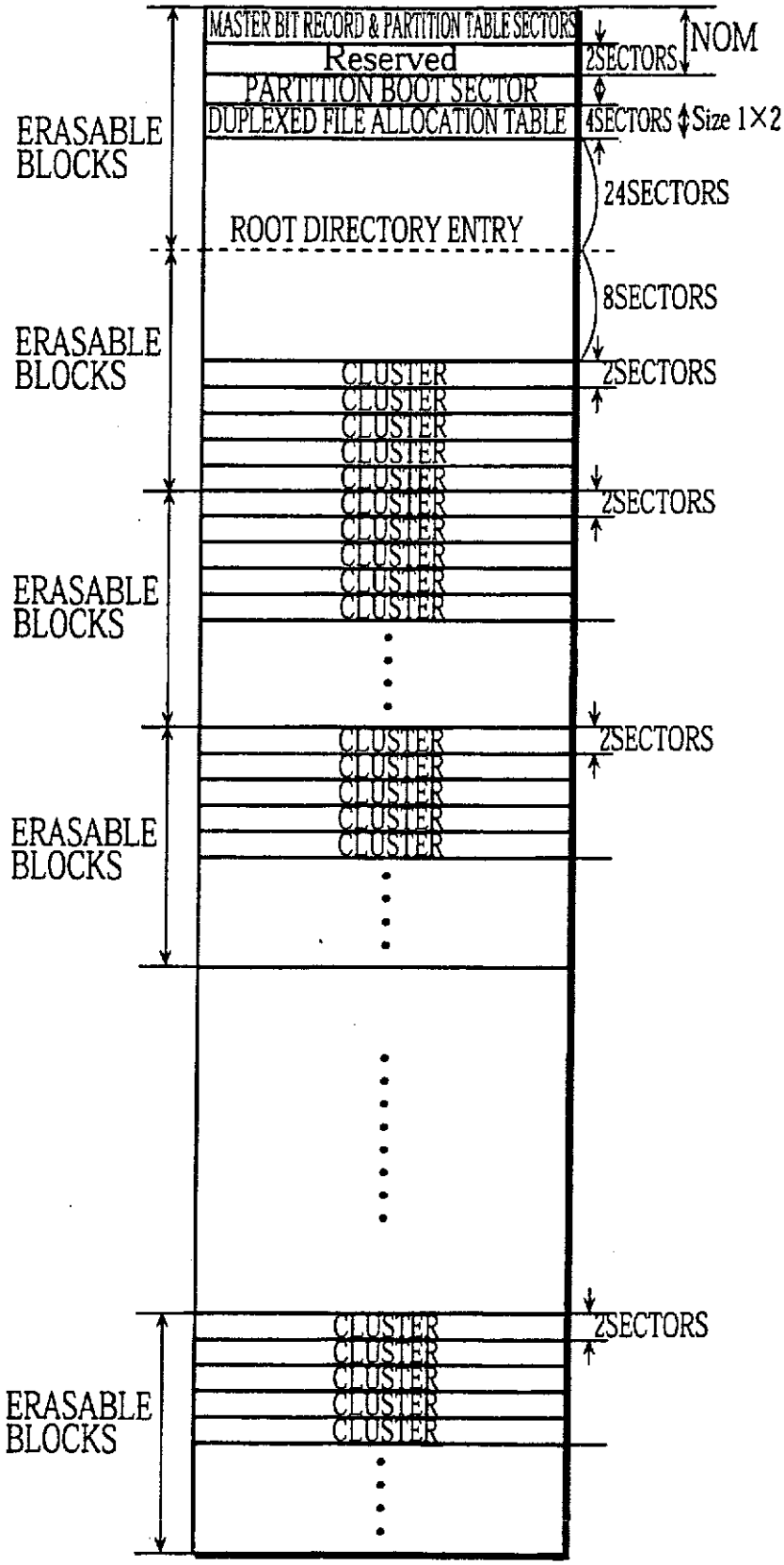

LAYOUT OF PROTECTED AREA WHEN CLUSTER SIZE IS 16KB(n=16), AND TS IS SET AT 1280 SECTORS
MASTER BIT RECORD & PARTITION TABLE SECTORS
Reserved
PARTITION BOOT SECTOR
DUPLEXED FILE ALLOCATION TABLE
ROOT DIRECTORY ENTRY
CLUSTER
2SECTORS
4SECTORS
NOM
Size 1×2
24SECTORS
8SECTORS
ERASABLE BLOCKS

FIG. 19

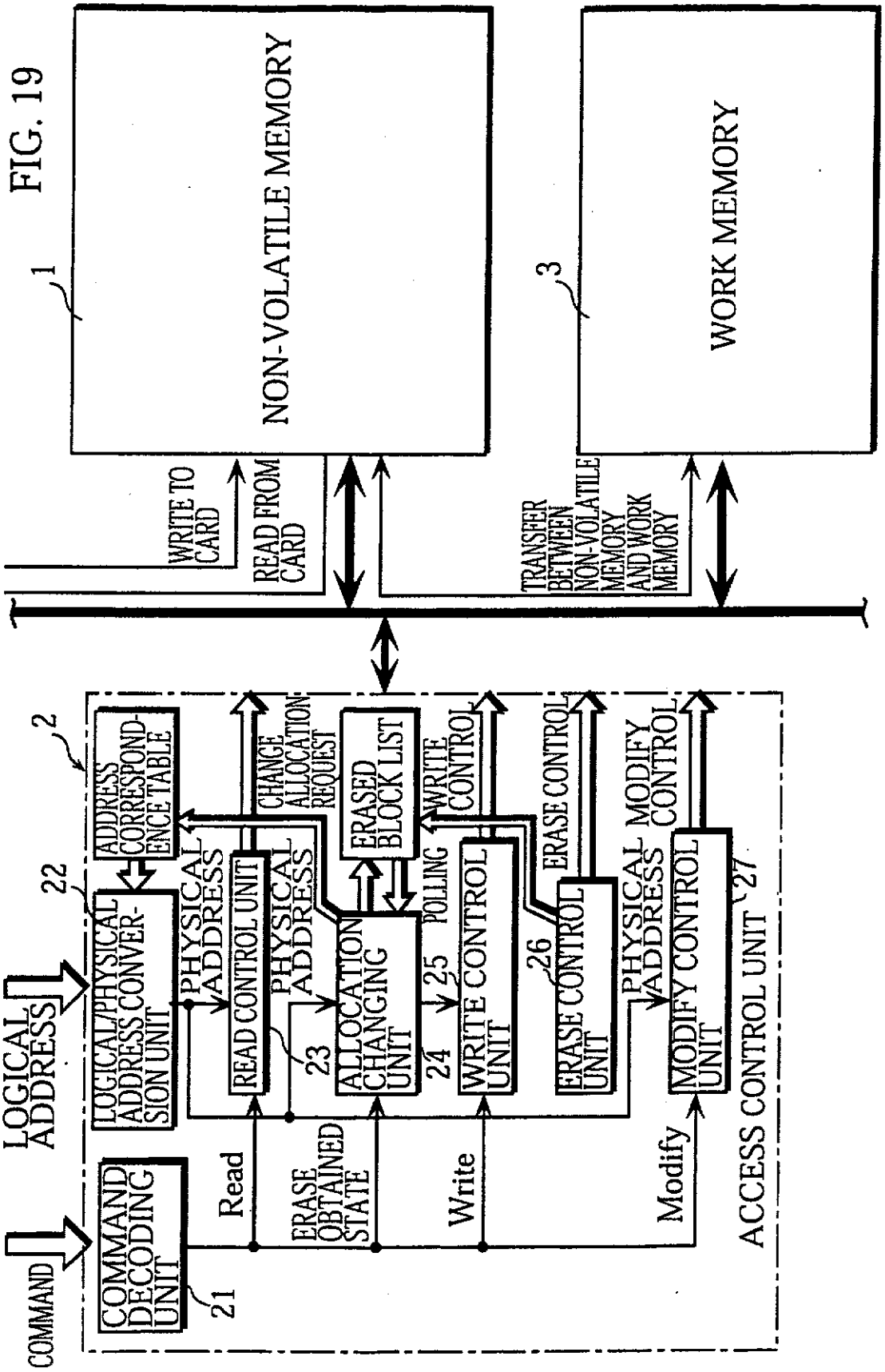

NON-VOLATILE MEMORY
1
WORK MEMORY
3
WRITE TO CARD
READ FROM CARD
TRANSFER BETWEEN NON-VOLATILE MEMORY AND WORK MEMORY
2
ADDRESS CORRESPONDENCE TABLE
LOGICAL ADDRESS
22
LOGICAL/PHYSICAL ADDRESS CONVERSION UNIT
PHYSICAL ADDRESS
READ CONTROL UNIT
PHYSICAL ADDRESS
23
ALLOCATION CHANGING UNIT
CHANGE ALLOCATION REQUEST
ERASED BLOCK LIST
POLLING
24
WRITE CONTROL UNIT
WRITE CONTROL
25
ERASE CONTROL
26
ERASE CONTROL UNIT
PHYSICAL ADDRESS
MODIFY CONTROL
MODIFY CONTROL UNIT
27
ACCESS CONTROL UNIT
COMMAND
COMMAND DECODING UNIT
21
Read
ERASE OBTAINED STATE
Write
Modify

FIG. 20A

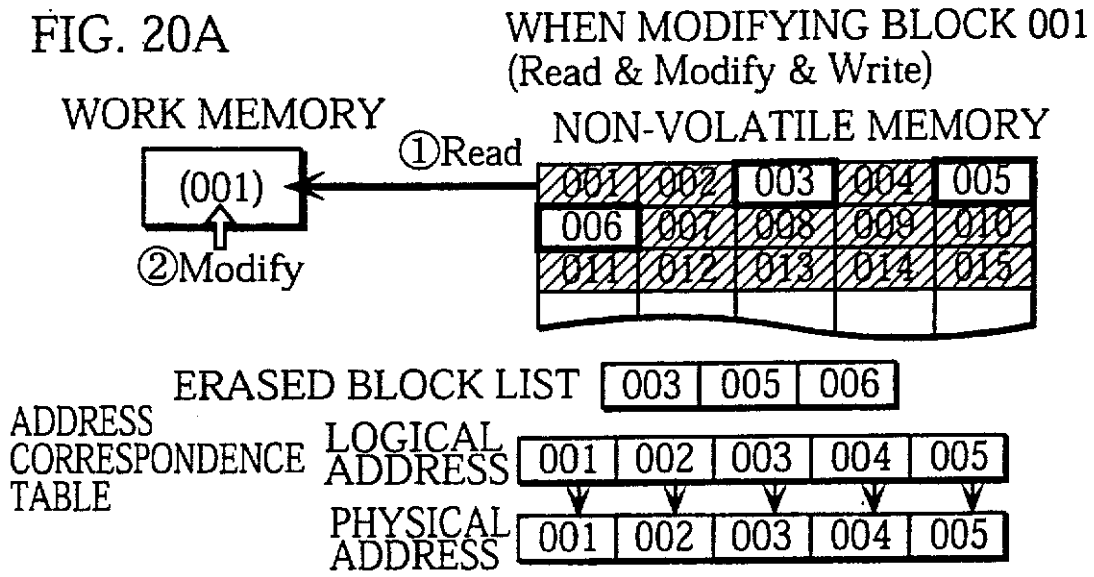


FIG. 20B

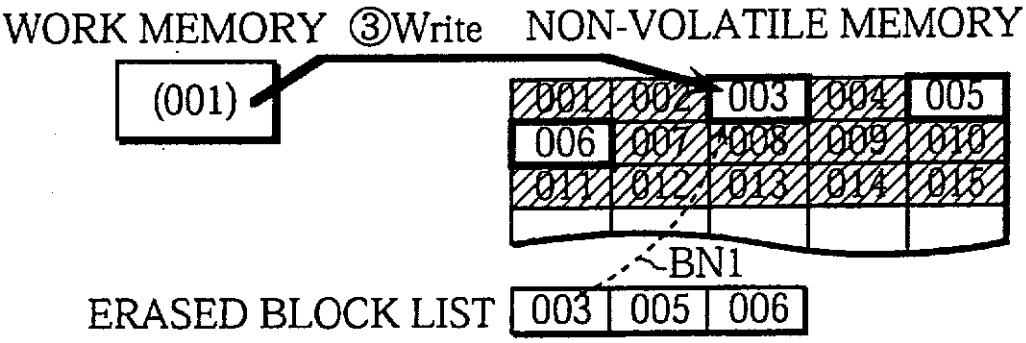


FIG. 20C

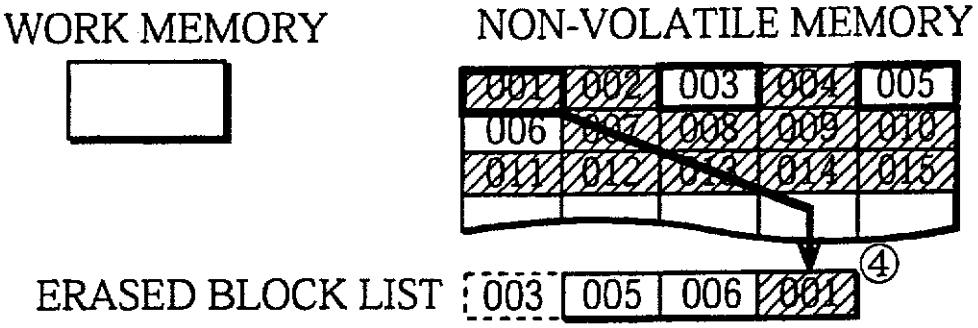


FIG. 20D

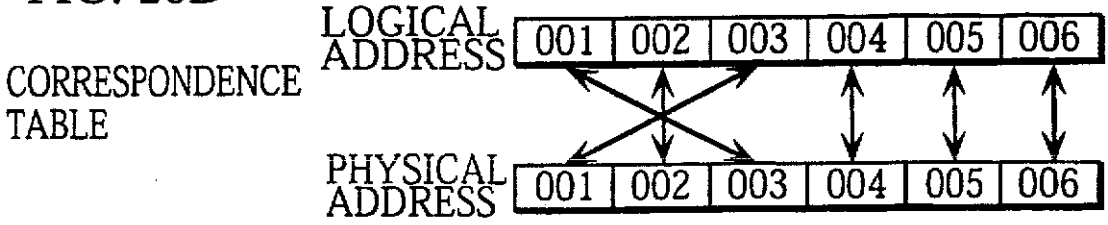


FIG. 21

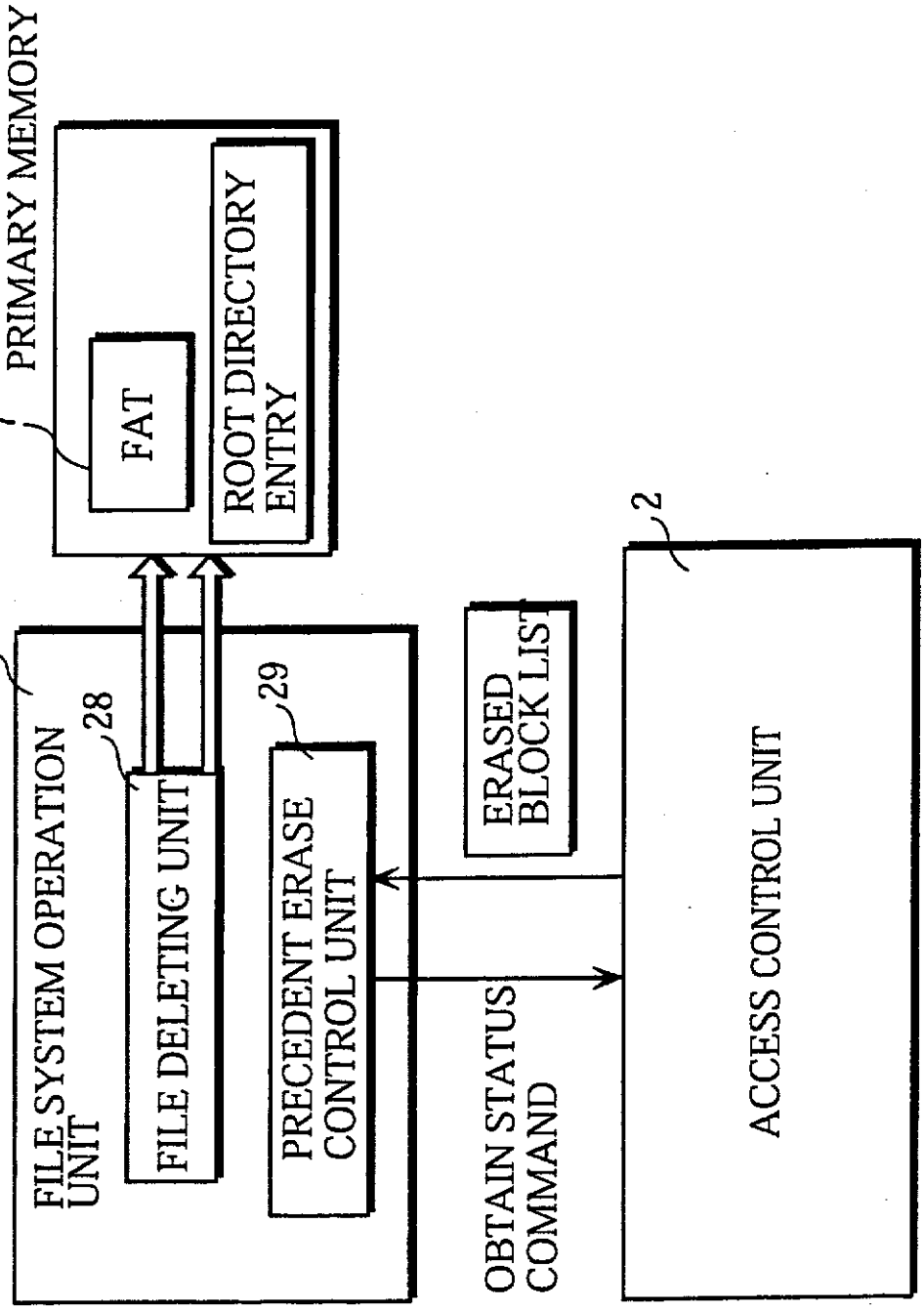

PRIMARY MEMORY
7
FAT
ROOT DIRECTORY ENTRY
9
FILE SYSTEM OPERATION UNIT
28
FILE DELETING UNIT
29
PRECEDENT ERASE CONTROL UNIT
ERASED BLOCK LIST
OBTAIN STATUS COMMAND
2
ACCESS CONTROL UNIT

FIG. 22

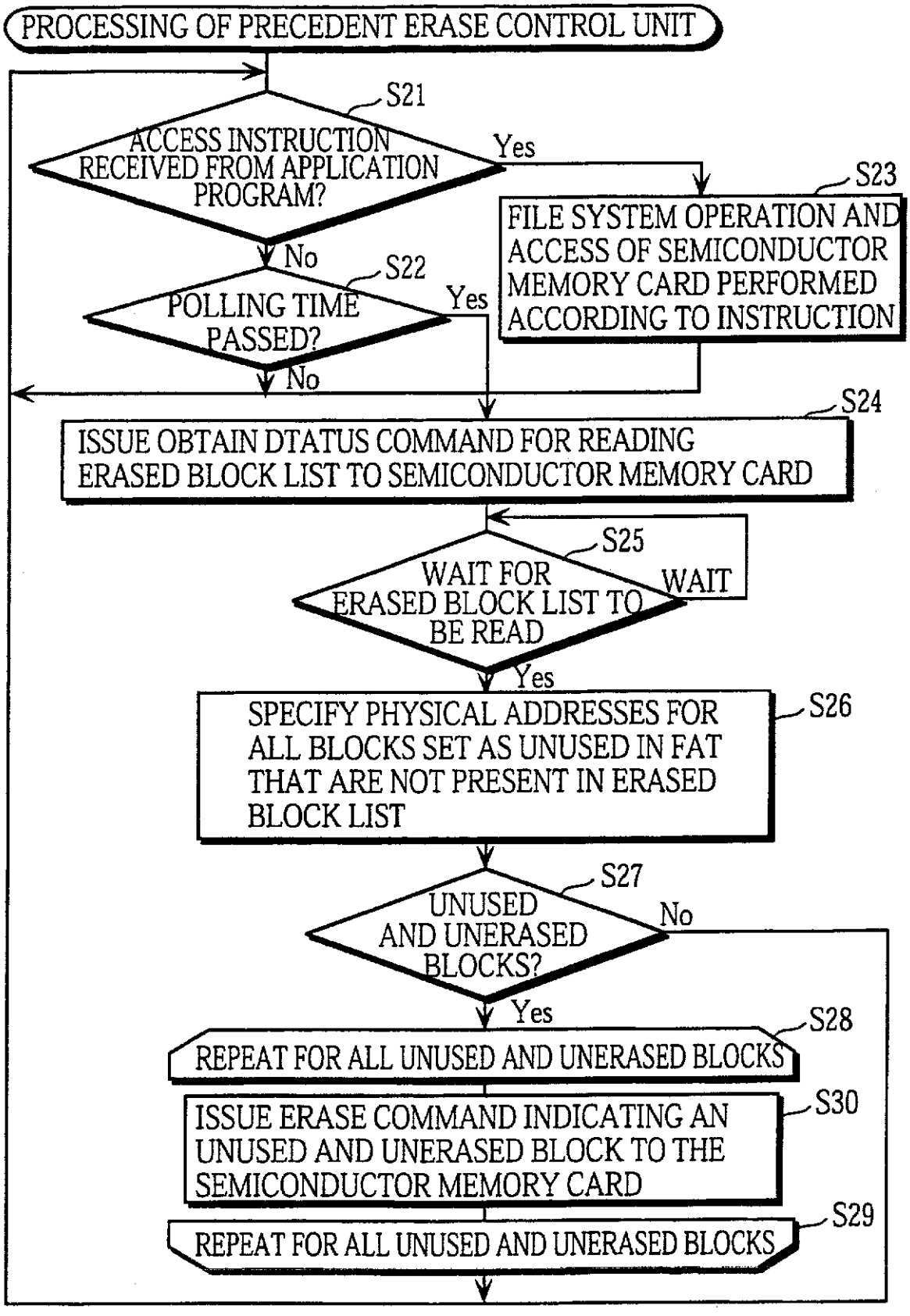

PROCESSING OF PRECEDENT ERASE CONTROL UNIT
S21
ACCESS INSTRUCTION RECEIVED FROM APPLICATION PROGRAM?
Yes
No
S22
POLLING TIME PASSED?
Yes
No
S23
FILE SYSTEM OPERATION AND ACCESS OF SEMICONDUCTOR MEMORY CARD PERFORMED ACCORDING TO INSTRUCTION
S24
ISSUE OBTAIN DTATUS COMMAND FOR READING ERASED BLOCK LIST TO SEMICONDUCTOR MEMORY CARD
S25
WAIT FOR ERASED BLOCK LIST TO BE READ
WAIT
Yes
S26
SPECIFY PHYSICAL ADDRESSES FOR ALL BLOCKS SET AS UNUSED IN FAT THAT ARE NOT PRESENT IN ERASED BLOCK LIST
S27
UNUSED AND UNERASED BLOCKS?
No
Yes
S28
REPEAT FOR ALL UNUSED AND UNERASED BLOCKS
S30
ISSUE ERASE COMMAND INDICATING AN UNUSED AND UNERASED BLOCK TO THE SEMICONDUCTOR MEMORY CARD
S29
REPEAT FOR ALL UNUSED AND UNERASED BLOCKS

FIG. 23A

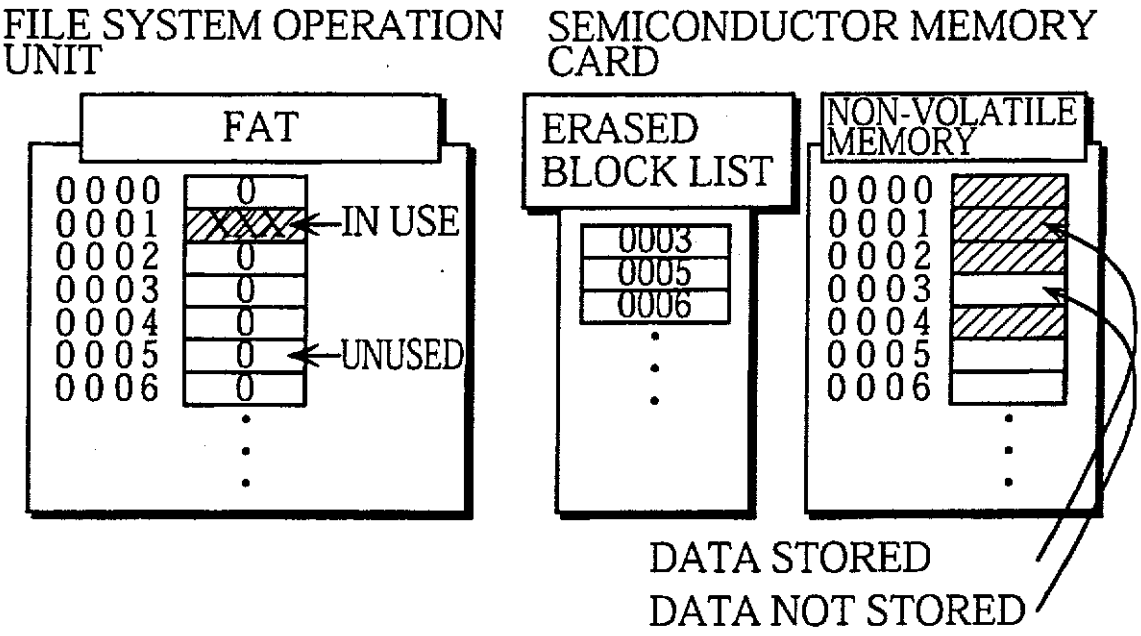


FIG. 23B

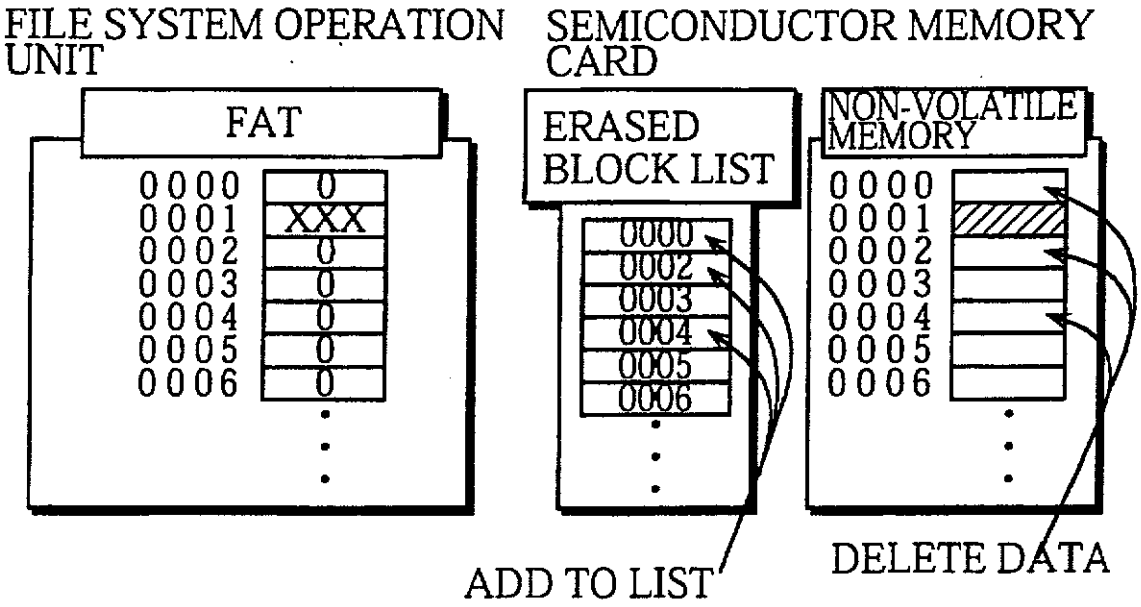


FIG. 24

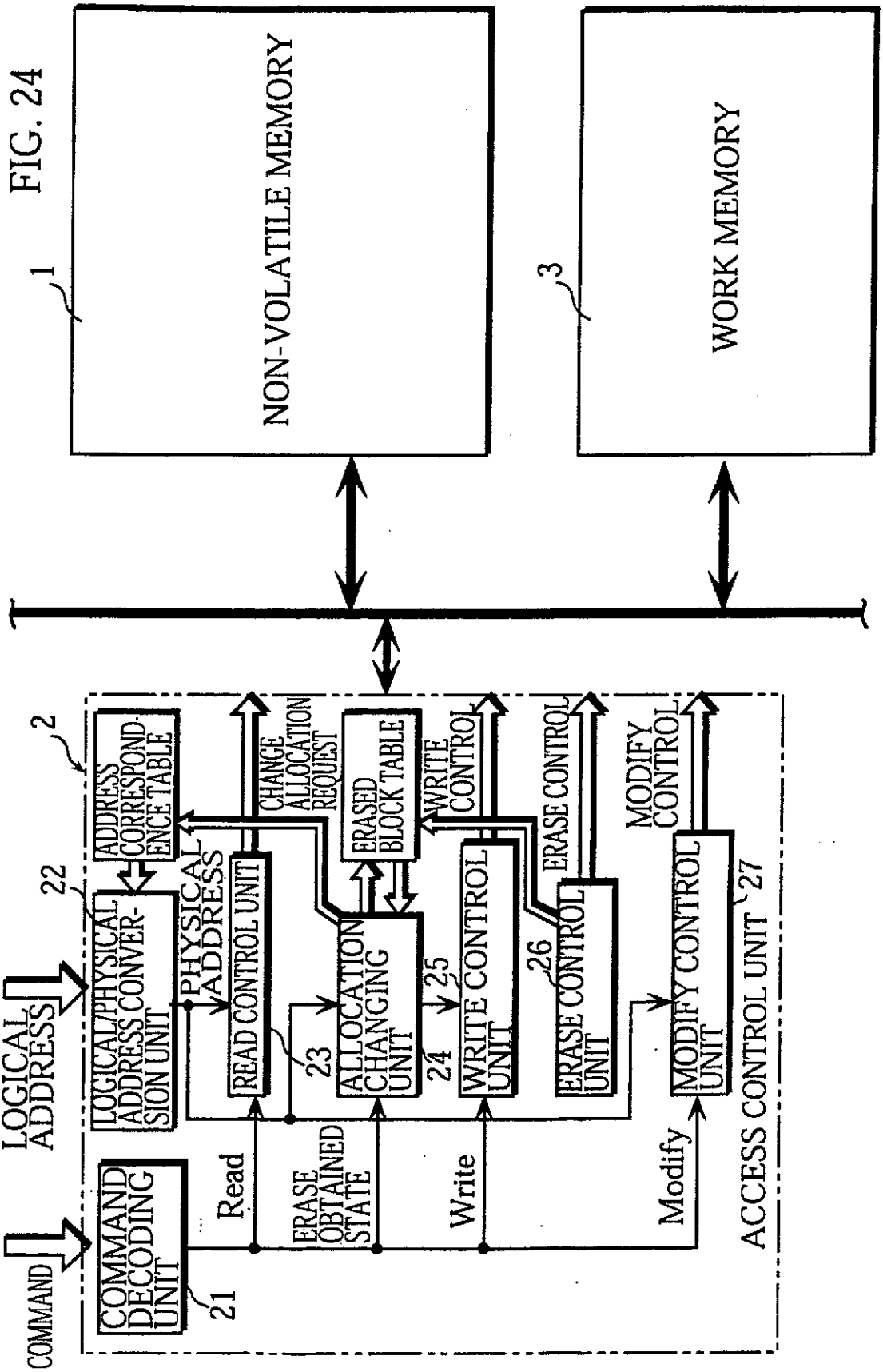

NON-VOLATILE MEMORY
1
WORK MEMORY
3
2
ACCESS CONTROL UNIT
LOGICAL ADDRESS
COMMAND
COMMAND DECODING UNIT
21
LOGICAL/PHYSICAL ADDRESS CONVERSION UNIT
22
ADDRESS CORRESPONDENCE TABLE
PHYSICAL ADDRESS
READ CONTROL UNIT
23
ALLOCATION CHANGING UNIT
24
WRITE CONTROL UNIT
25
ERASE CONTROL UNIT
26
MODIFY CONTROL UNIT
27
CHANGE ALLOCATION REQUEST
ERASED BLOCK TABLE
WRITE CONTROL
ERASE CONTROL
MODIFY CONTROL
Read
ERASE OBTAINED STATE
Write
Modify

FIG. 25

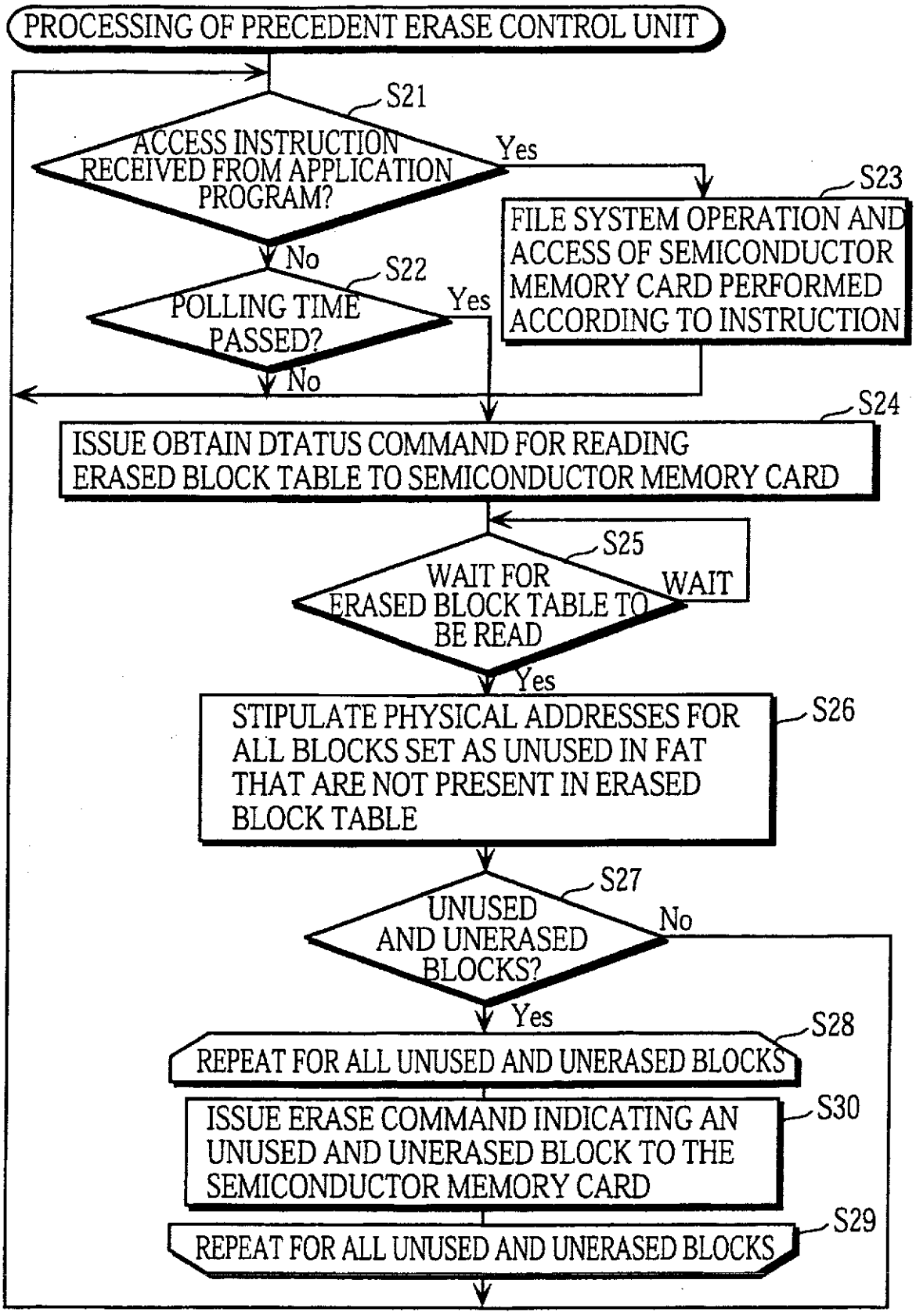

PROCESSING OF PRECEDENT ERASE CONTROL UNIT
S21
ACCESS INSTRUCTION RECEIVED FROM APPLICATION PROGRAM?
Yes
No
S23
FILE SYSTEM OPERATION AND ACCESS OF SEMICONDUCTOR MEMORY CARD PERFORMED ACCORDING TO INSTRUCTION
S22
POLLING TIME PASSED?
Yes
No
S24
ISSUE OBTAIN DTATUS COMMAND FOR READING ERASED BLOCK TABLE TO SEMICONDUCTOR MEMORY CARD
S25
WAIT FOR ERASED BLOCK TABLE TO BE READ
WAIT
Yes
S26
STIPULATE PHYSICAL ADDRESSES FOR ALL BLOCKS SET AS UNUSED IN FAT THAT ARE NOT PRESENT IN ERASED BLOCK TABLE
S27
UNUSED AND UNERASED BLOCKS?
No
Yes
S28
REPEAT FOR ALL UNUSED AND UNERASED BLOCKS
S30
ISSUE ERASE COMMAND INDICATING AN UNUSED AND UNERASED BLOCK TO THE SEMICONDUCTOR MEMORY CARD
S29
REPEAT FOR ALL UNUSED AND UNERASED BLOCKS

FIG. 26A

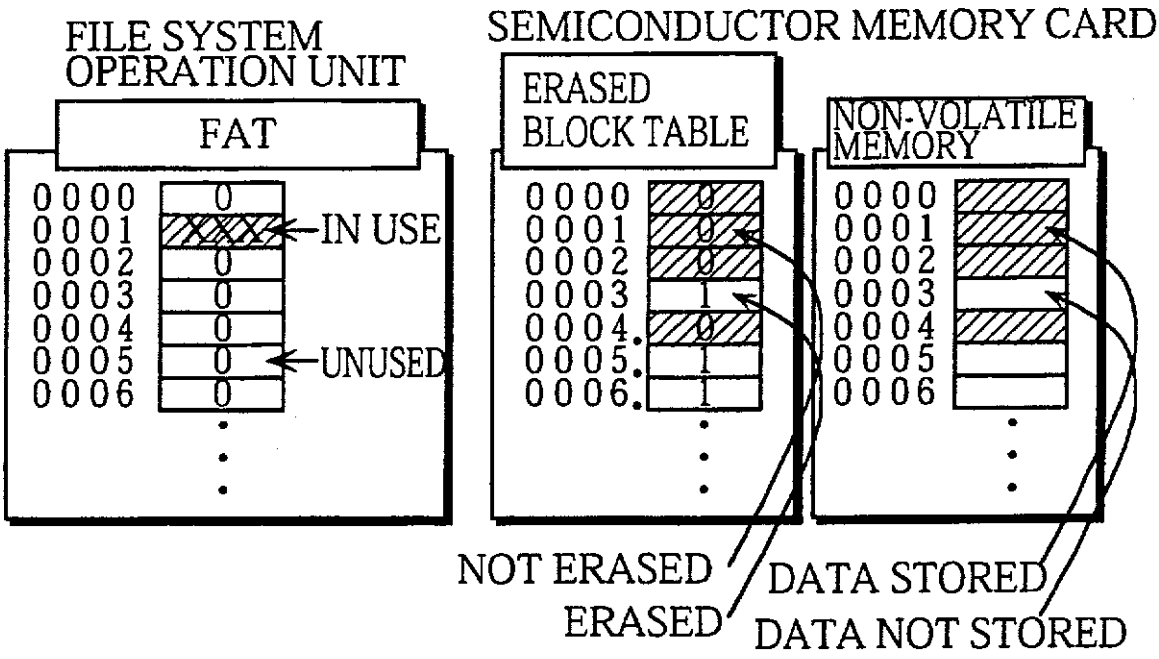


FIG. 26B

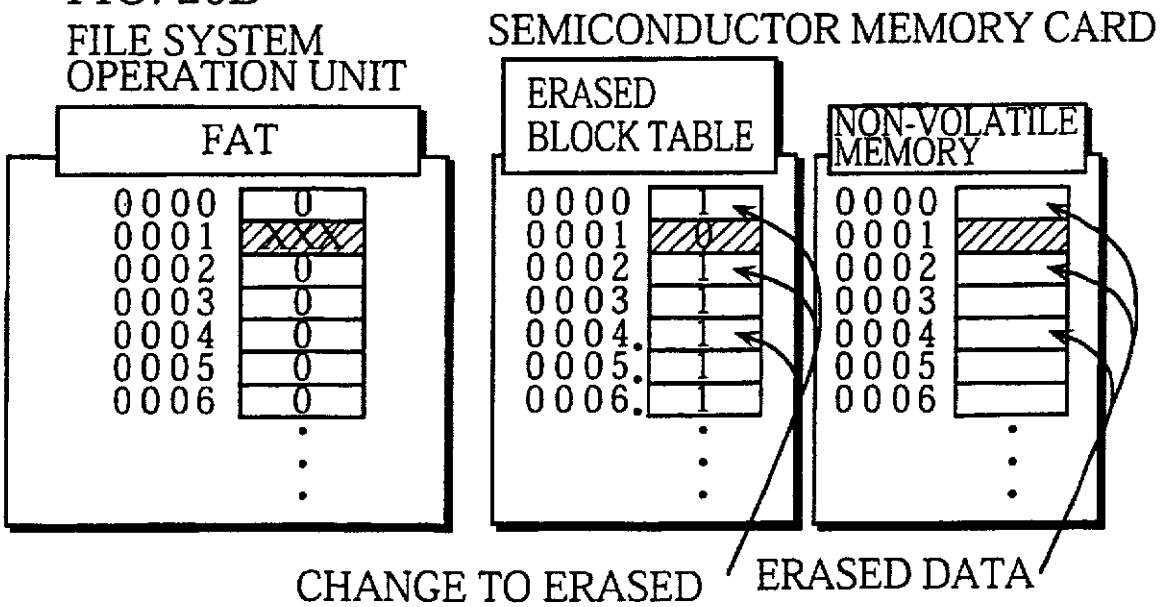


FIG. 27A

EXAMPLE OF NON-CONSECUTIVE MEMORY

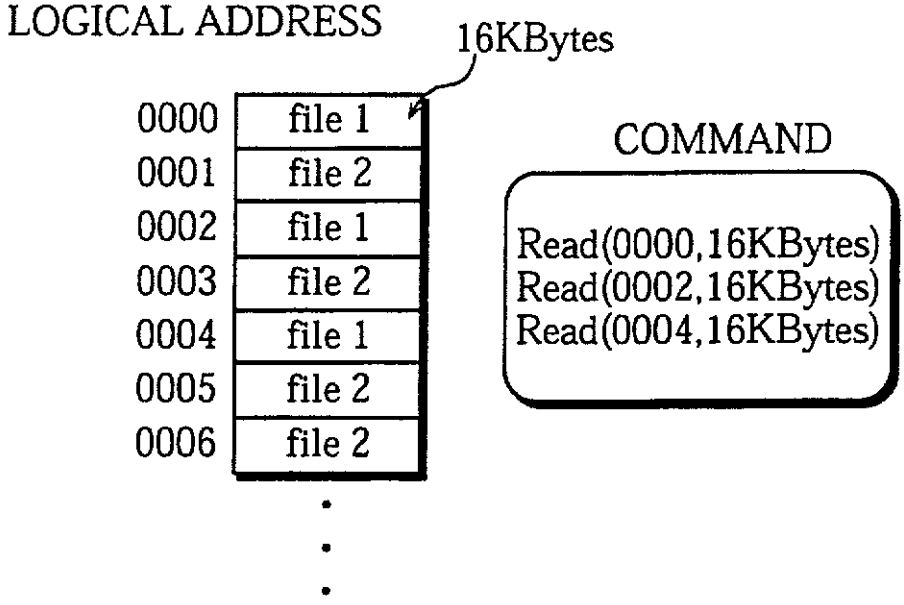


FIG. 27B

EXAMPLE OF CONSECUTIVE MEMORY

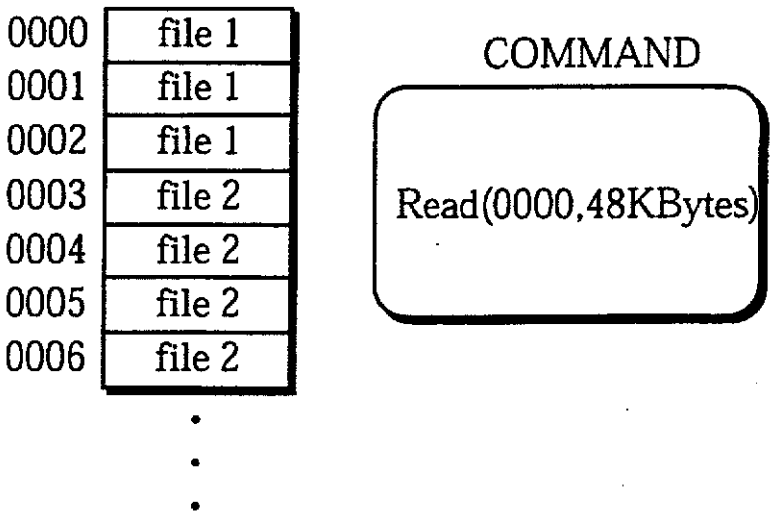


FIG. 28

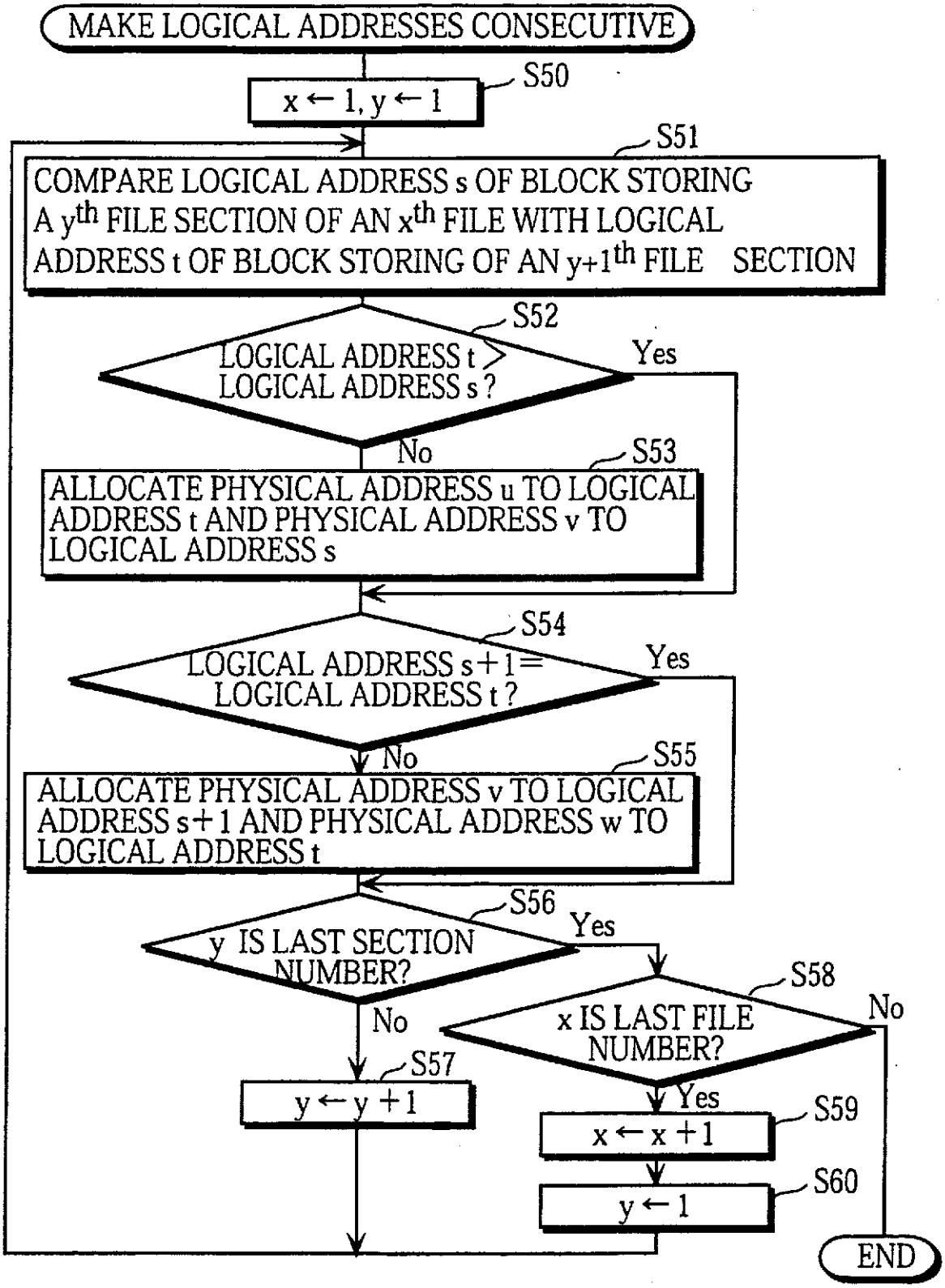

MAKE LOGICAL ADDRESSES CONSECUTIVE
S50
x ← 1, y ← 1
S51
COMPARE LOGICAL ADDRESS s OF BLOCK STORING A y^th FILE SECTION OF AN x^th FILE WITH LOGICAL ADDRESS t OF BLOCK STORING OF AN y+1^th FILE SECTION
S52
LOGICAL ADDRESS t > LOGICAL ADDRESS s ?
Yes
No
S53
ALLOCATE PHYSICAL ADDRESS u TO LOGICAL ADDRESS t AND PHYSICAL ADDRESS v TO LOGICAL ADDRESS s
S54
LOGICAL ADDRESS s+1 = LOGICAL ADDRESS t ?
Yes
No
S55
ALLOCATE PHYSICAL ADDRESS v TO LOGICAL ADDRESS s+1 AND PHYSICAL ADDRESS w TO LOGICAL ADDRESS t
S56
y IS LAST SECTION NUMBER?
Yes
No
S58
x IS LAST FILE NUMBER?
No
Yes
S57
y ← y + 1
S59
x ← x + 1
S60
y ← 1
END

FIG. 29A

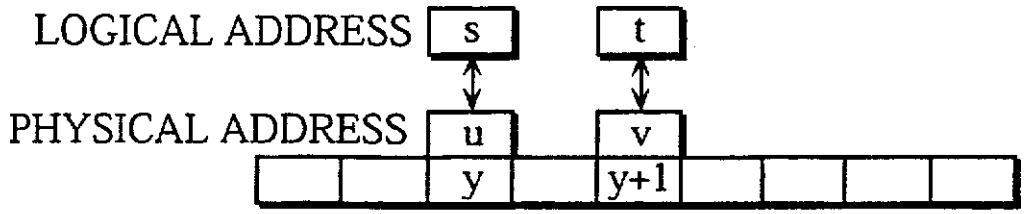


FIG. 29B

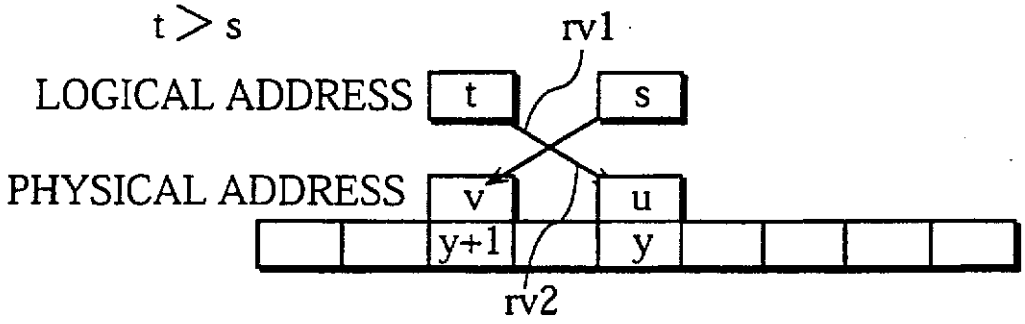


FIG. 29C

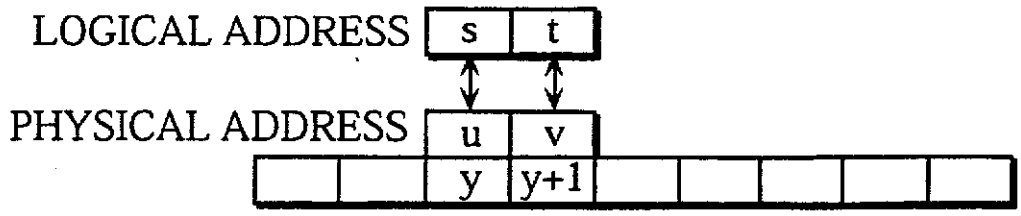


FIG. 29D

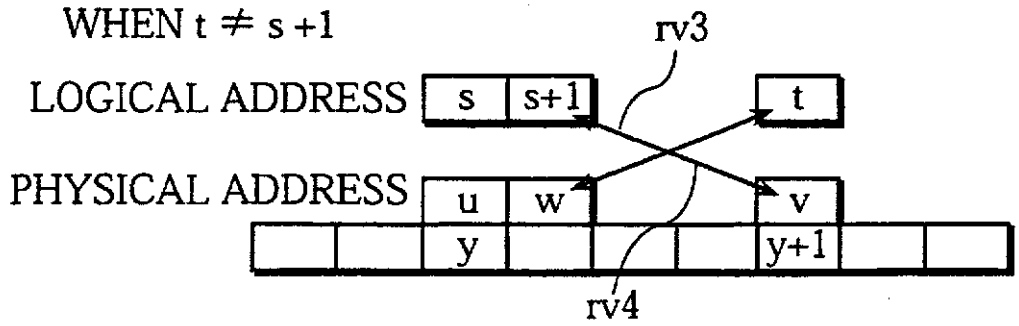


FIG. 30A

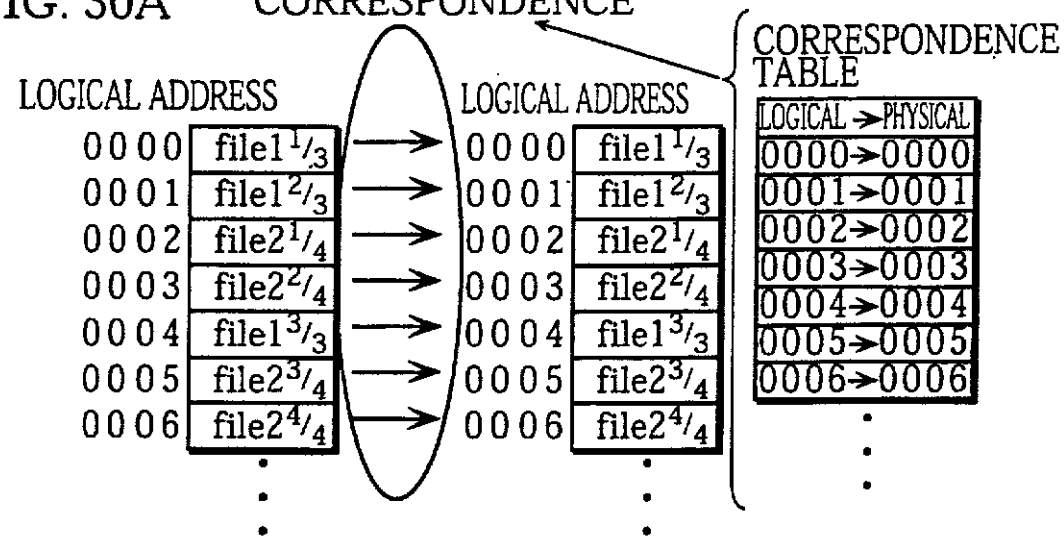


FIG. 30B

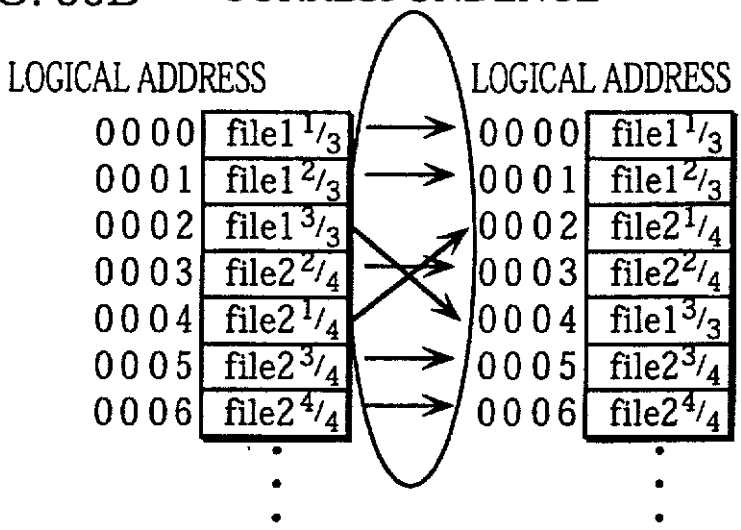


FIG. 30C

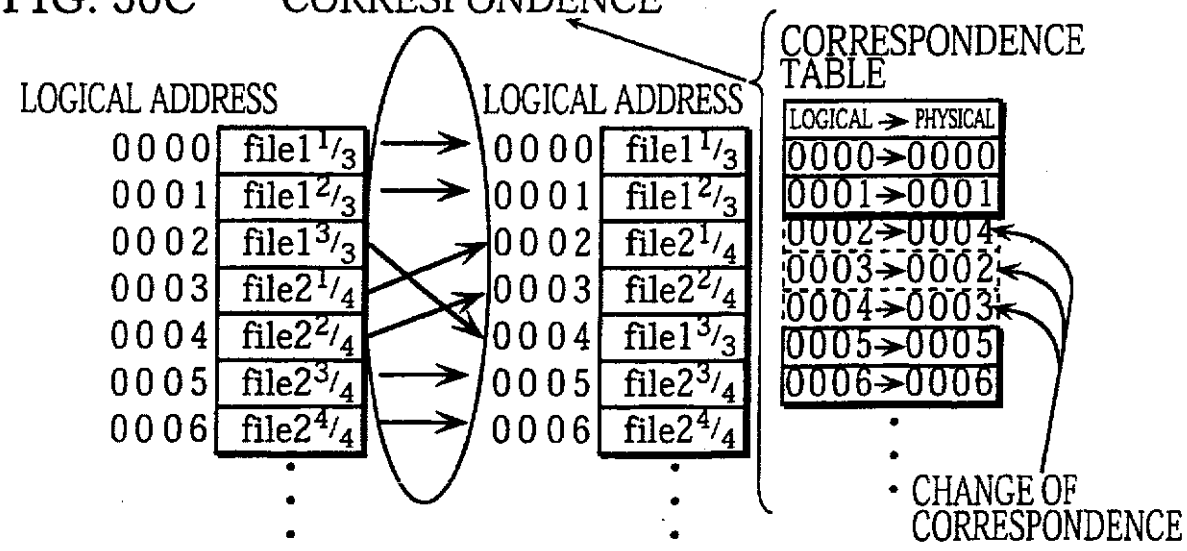


FIG. 31

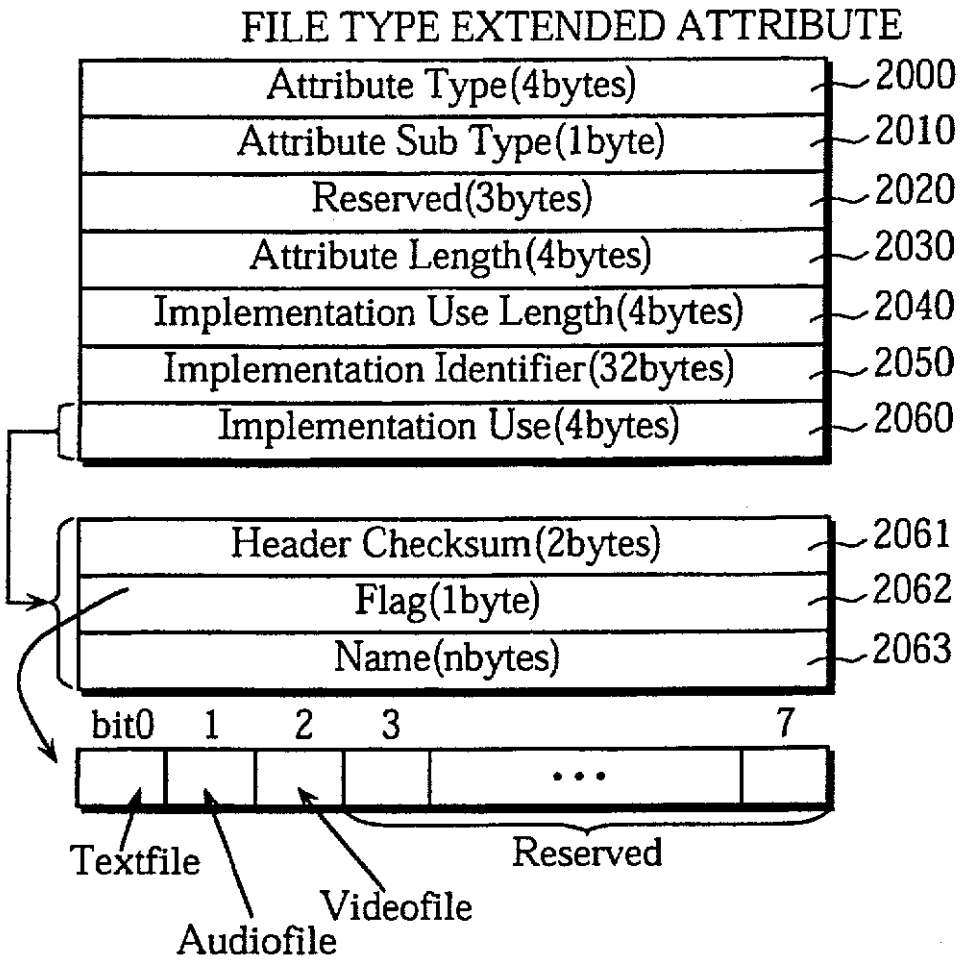

FILE TYPE EXTENDED ATTRIBUTE
Attribute Type(4bytes)
2000
Attribute Sub Type(1byte)
2010
Reserved(3bytes)
2020
Attribute Length(4bytes)
2030
Implementation Use Length(4bytes)
2040
Implementation Identifier(32bytes)
2050
Implementation Use(4bytes)
2060
Header Checksum(2bytes)
2061
Flag(1byte)
2062
Name(nbytes)
2063
bit0
1
2
3
7
Textfile
Audiofile
Videofile
Reserved

FIG. 32

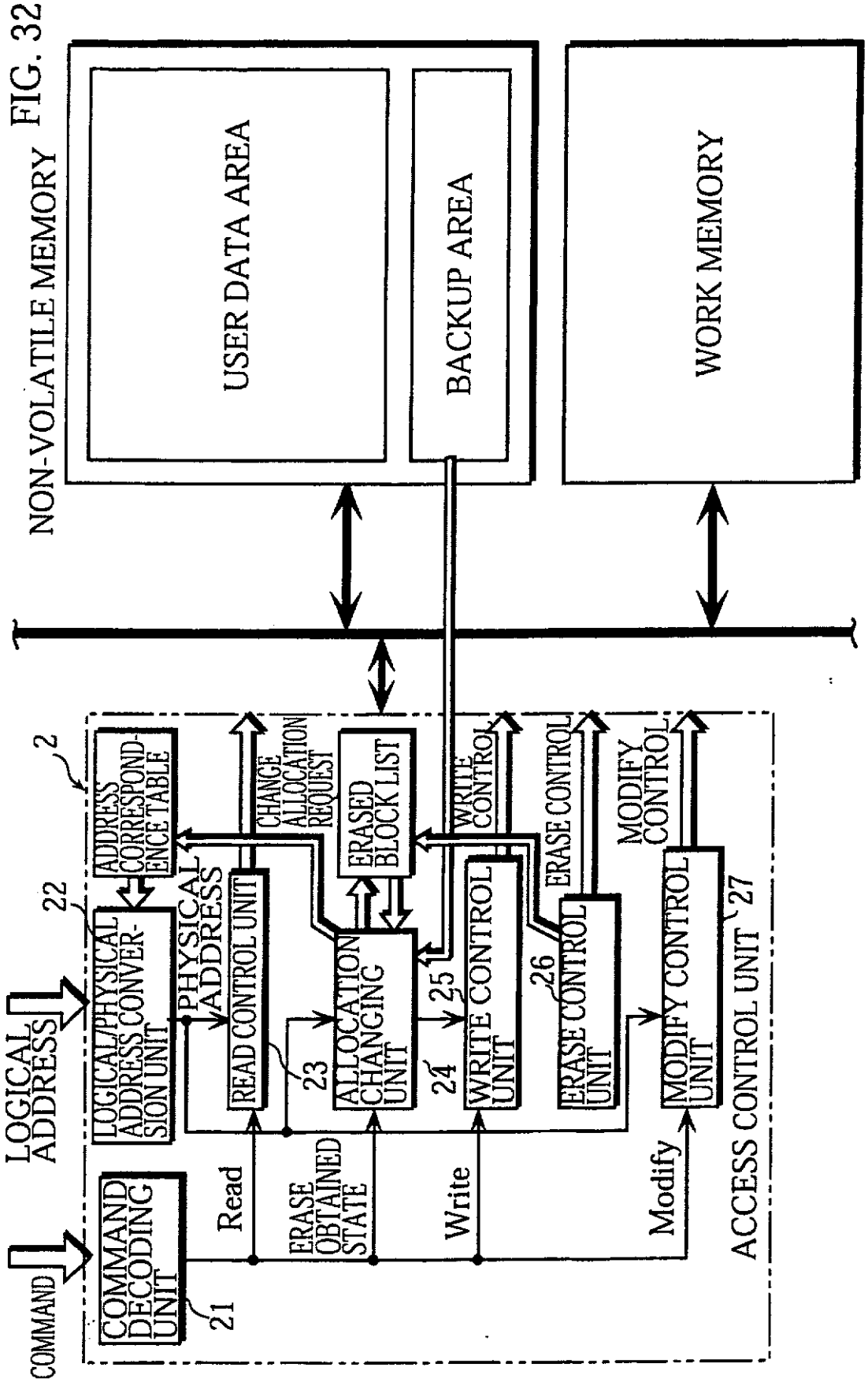

NON-VOLATILE MEMORY
USER DATA AREA
BACKUP AREA
WORK MEMORY
2
ADDRESS CORRESPONDENCE TABLE
22
LOGICAL/PHYSICAL ADDRESS CONVERSION UNIT
PHYSICAL ADDRESS
READ CONTROL UNIT
23
CHANGE ALLOCATION REQUEST
ERASED BLOCK LIST
ALLOCATION CHANGING UNIT
25
WRITE CONTROL
24
WRITE CONTROL UNIT
ERASE CONTROL
26
ERASE CONTROL UNIT
MODIFY CONTROL
MODIFY CONTROL UNIT
27
ACCESS CONTROL UNIT
LOGICAL ADDRESS
COMMAND
COMMAND DECODING UNIT
21
Read
ERASE OBTAINED STATE
Write
Modify

FIG. 33

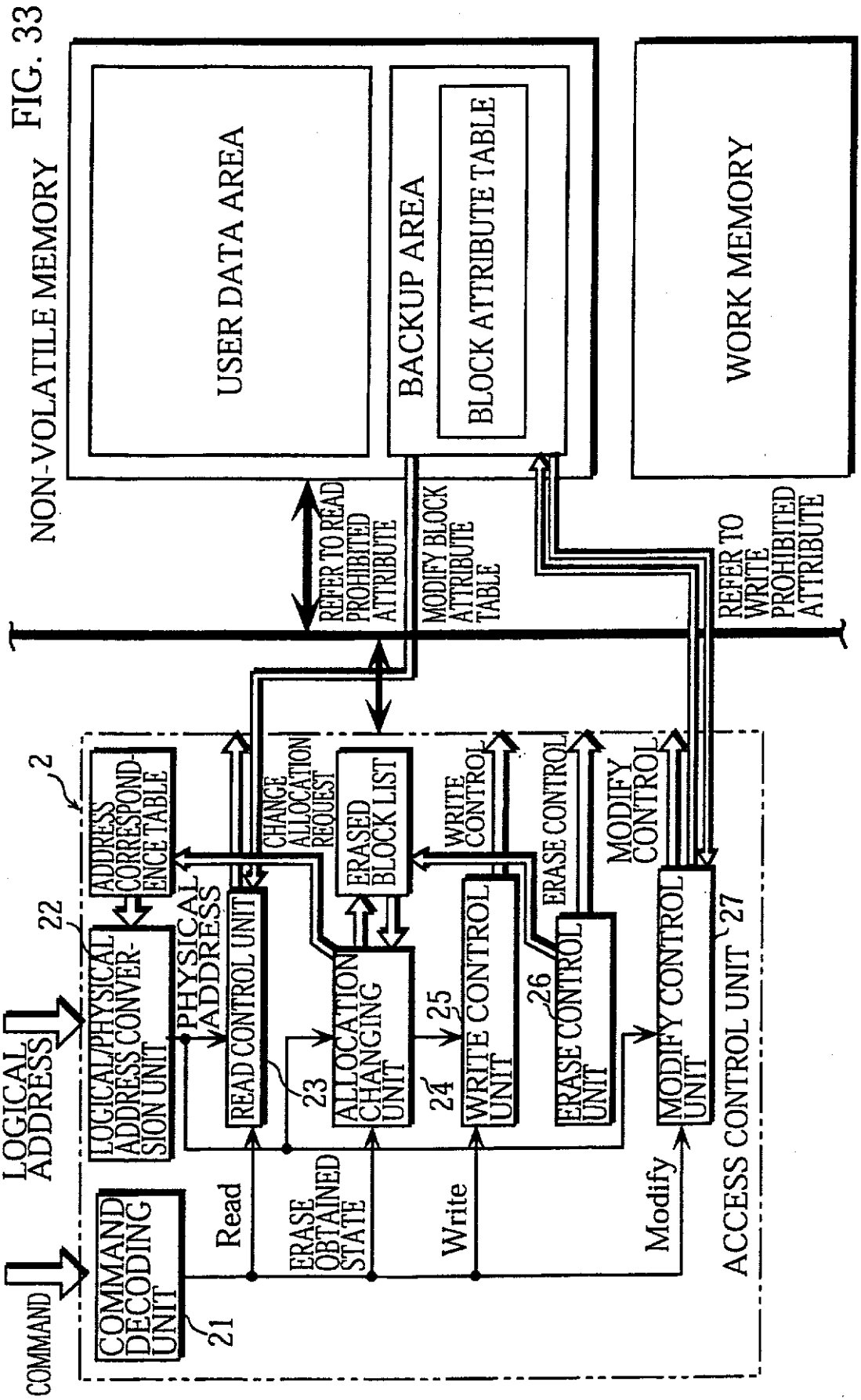

NON-VOLATILE MEMORY
USER DATA AREA
BACKUP AREA
BLOCK ATTRIBUTE TABLE
WORK MEMORY
REFER TO READ PROHIBITED ATTRIBUTE
MODIFY BLOCK ATTRIBUTE TABLE
REFER TO WRITE PROHIBITED ATTRIBUTE
ACCESS CONTROL UNIT
2
ADDRESS CORRESPONDENCE TABLE
CHANGE ALLOCATION REQUEST
ERASED BLOCK LIST
WRITE CONTROL
ERASE CONTROL
MODIFY CONTROL
LOGICAL ADDRESS
22
LOGICAL/PHYSICAL ADDRESS CONVERSION UNIT
PHYSICAL ADDRESS
READ CONTROL UNIT
23
ALLOCATION CHANGING UNIT
25
24
WRITE CONTROL UNIT
26
ERASE CONTROL UNIT
MODIFY CONTROL UNIT
27
COMMAND
COMMAND DECODING UNIT
21
Read
ERASE OBTAINED STATE
Write
Modify

FIG. 34A

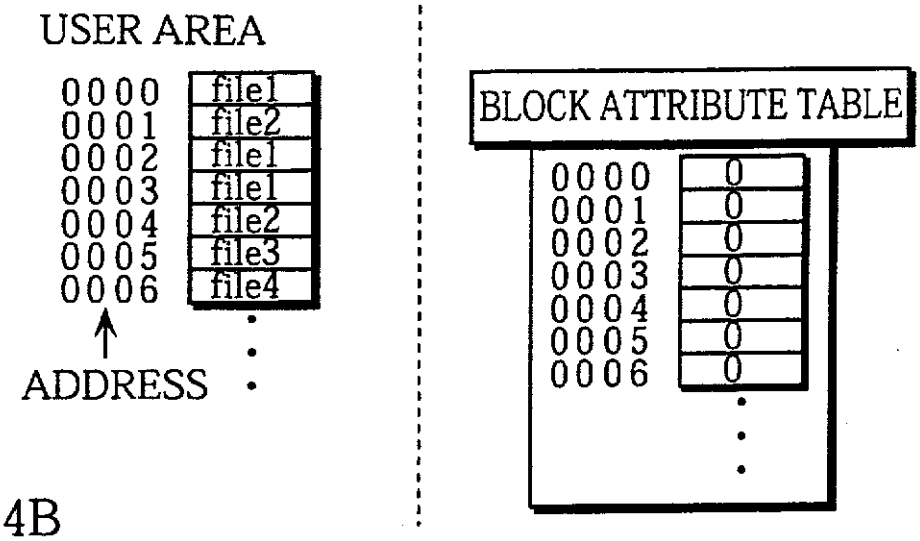


FIG. 34B

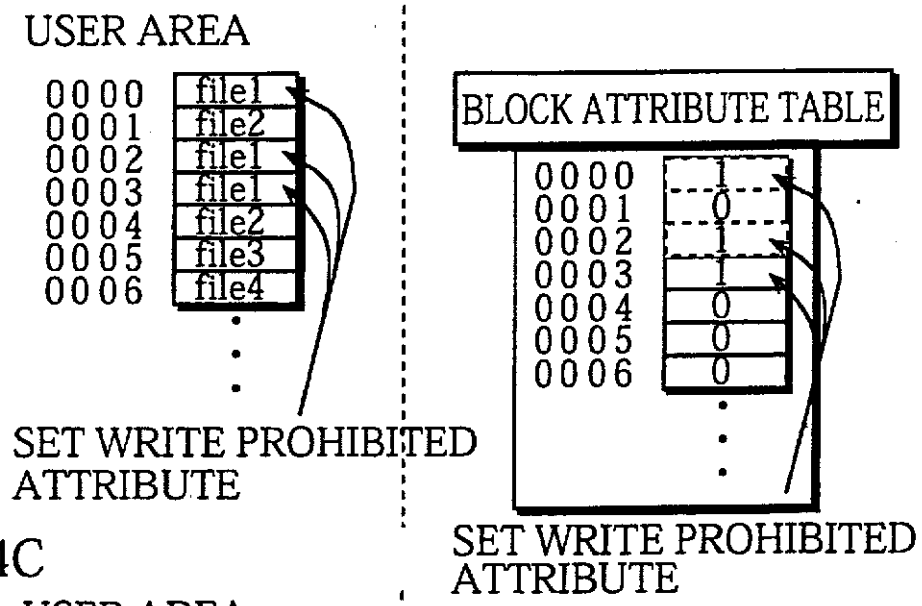


FIG. 34C

