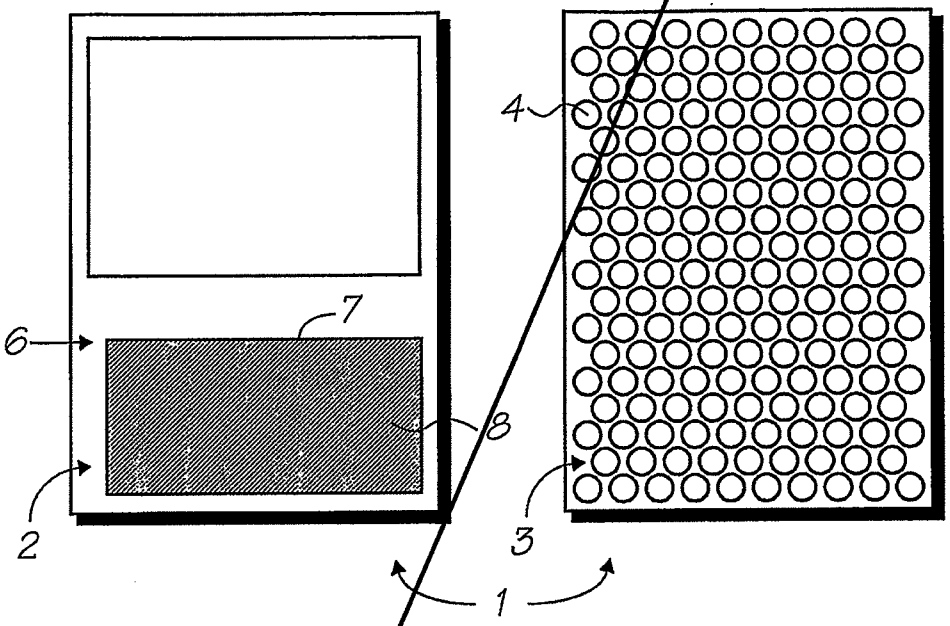

FIG. 1

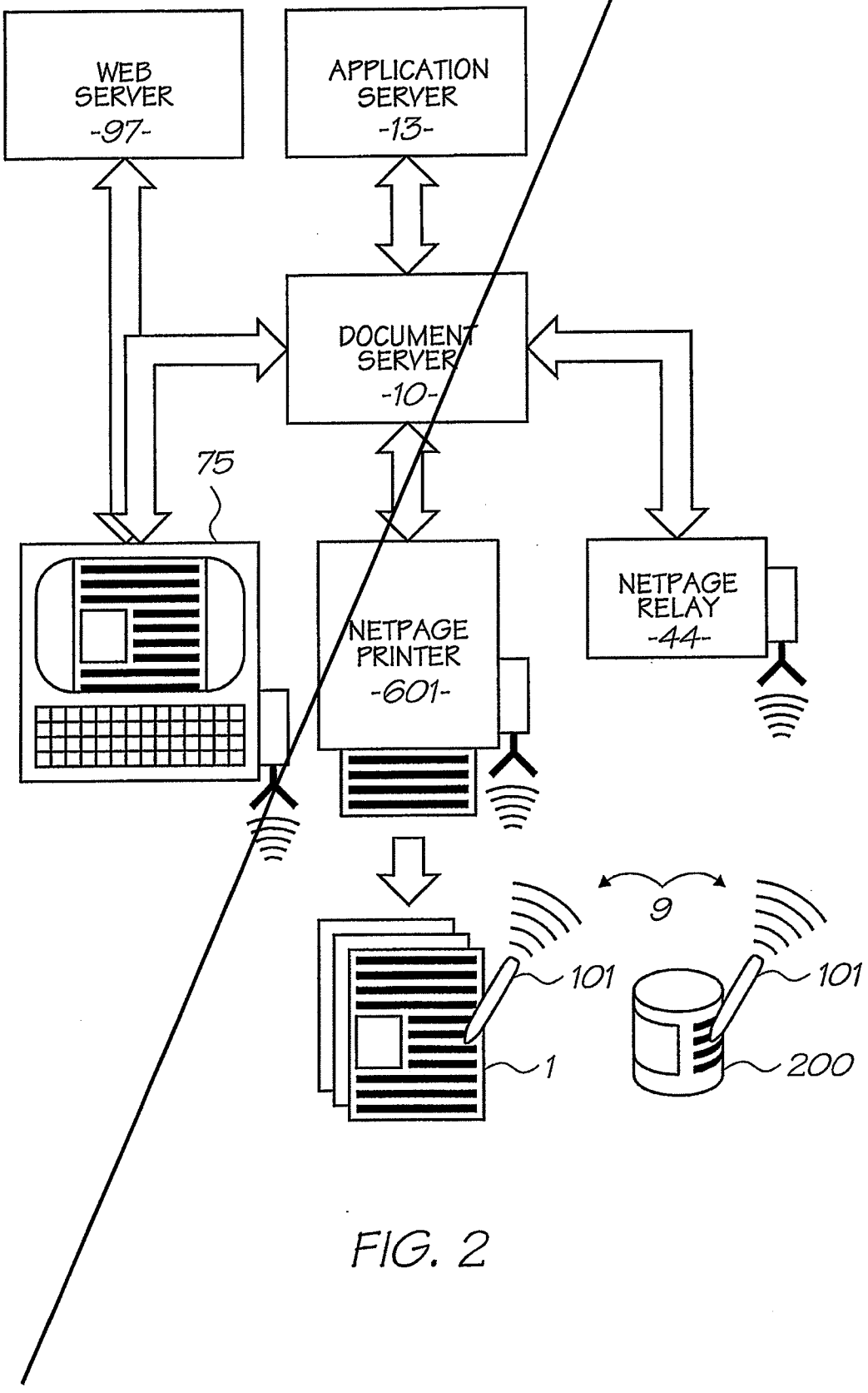
WEB SERVER -97-
APPLICATION SERVER -13-
DOCUMENT SERVER -10-
75
NETPAGE PRINTER -601-
NETPAGE RELAY -44-
9
101
101
1
200

FIG. 2

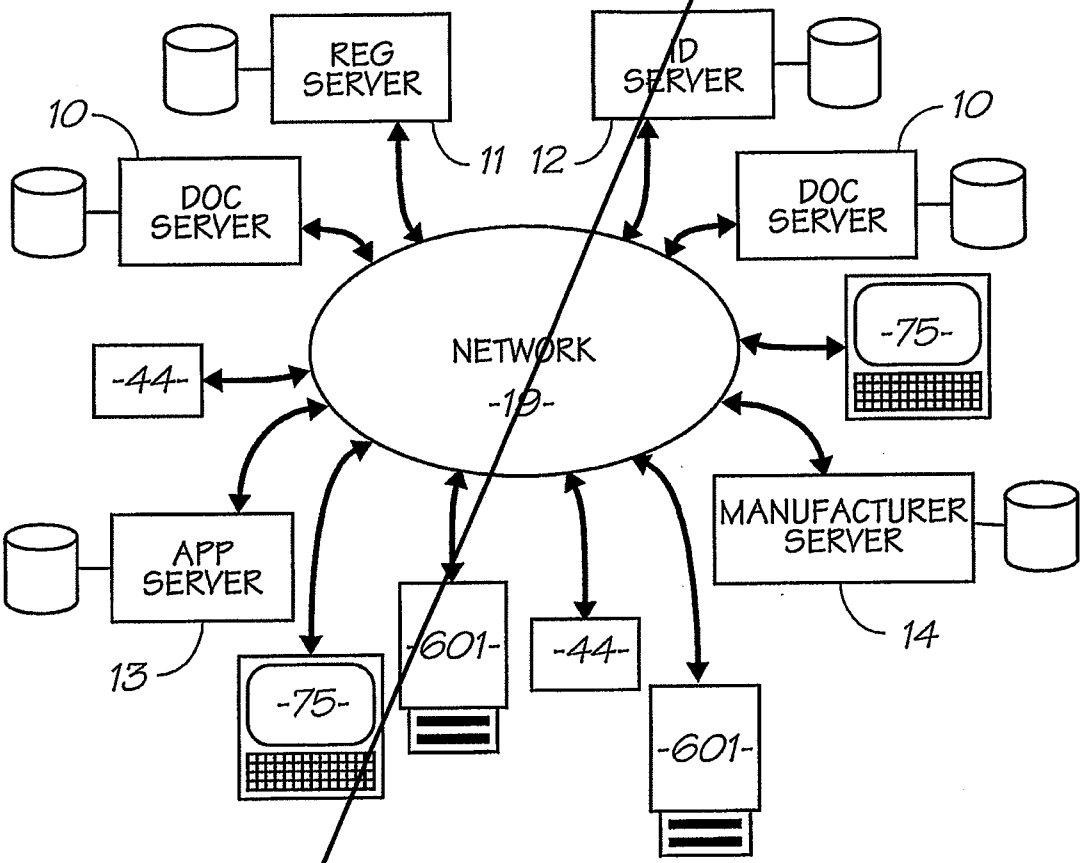
REG SERVER
ID SERVER
10
DOC SERVER
11
12
10
DOC SERVER
NETWORK
-10-
-44-
-75-
APP SERVER
13
-75-
-601-
-44-
-601-
MANUFACTURER SERVER
14

FIG. 3

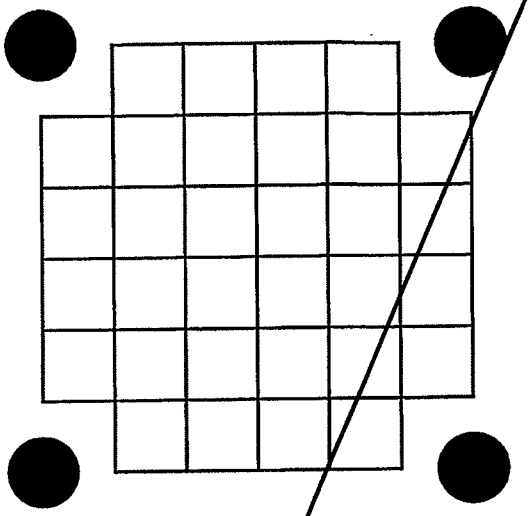

FIG. 4

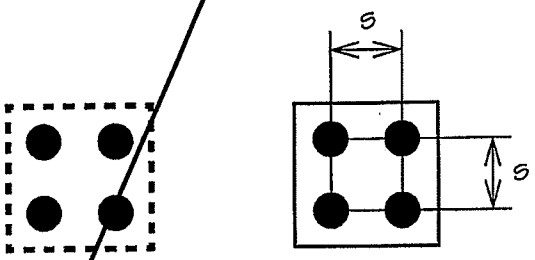

FIG. 5

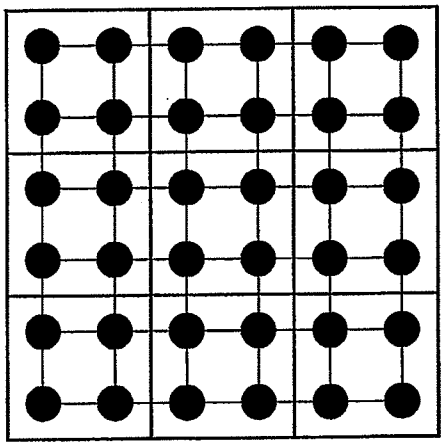

FIG. 6

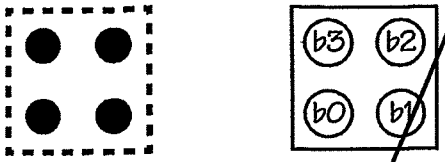

FIG. 7

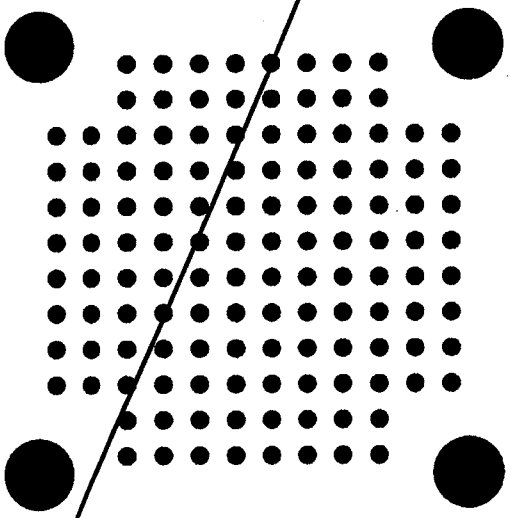

FIG. 8

00	10
01	11

FIG. 9

00	10	00	10	00	10
01	11	01	11	01	11
00	10	00	10	00	10
01	11	01	11	01	11

FIG. 10

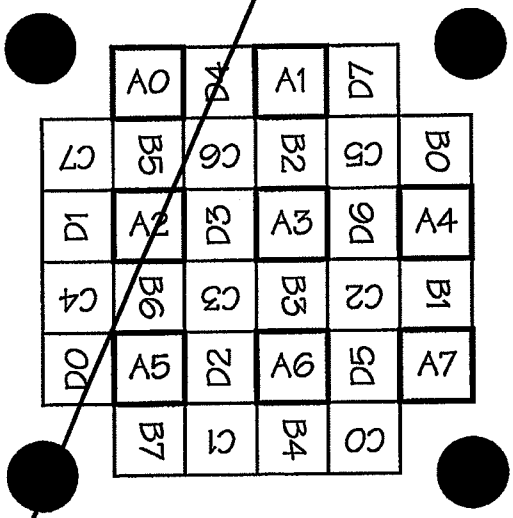

FIG. 11

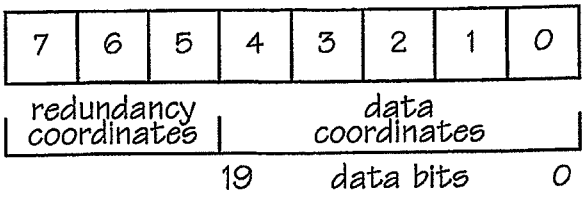

FIG. 12

3	2	1
4	-	0
5	6	7

FIG. 13

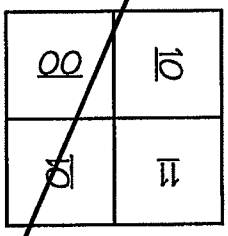

FIG. 14

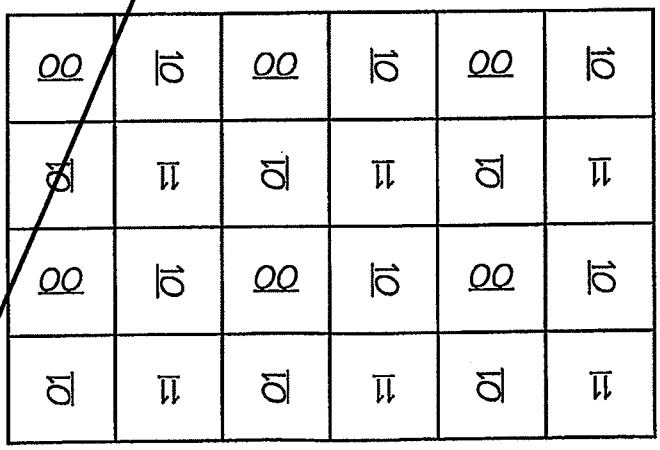

FIG. 15

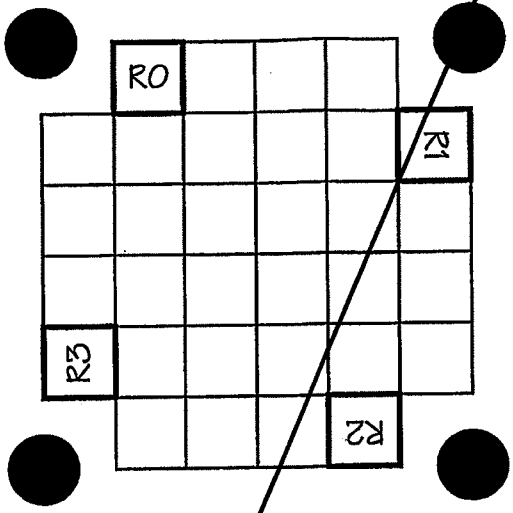

FIG. 16

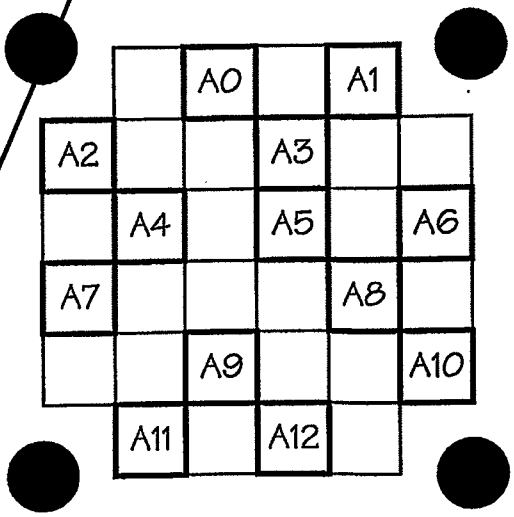

FIG. 17

B0
B1
E6
C9
B5
E14
C1
B4
E4
C11
B2
E12
C3
D11
B6
D14
B3
E7
C8
D10
B7
C0
E5
C10
D13
E13
C2
D9
D12
D8
B8
B12
B9
E2
C13
B13
E10
C5
E0
D7
B10
E8
C7
D3
B14
D6
B11
E3
C12
D2
E11
C4
E1
C14
D5
E9
C6
D1
D4
D0

FIG. 18

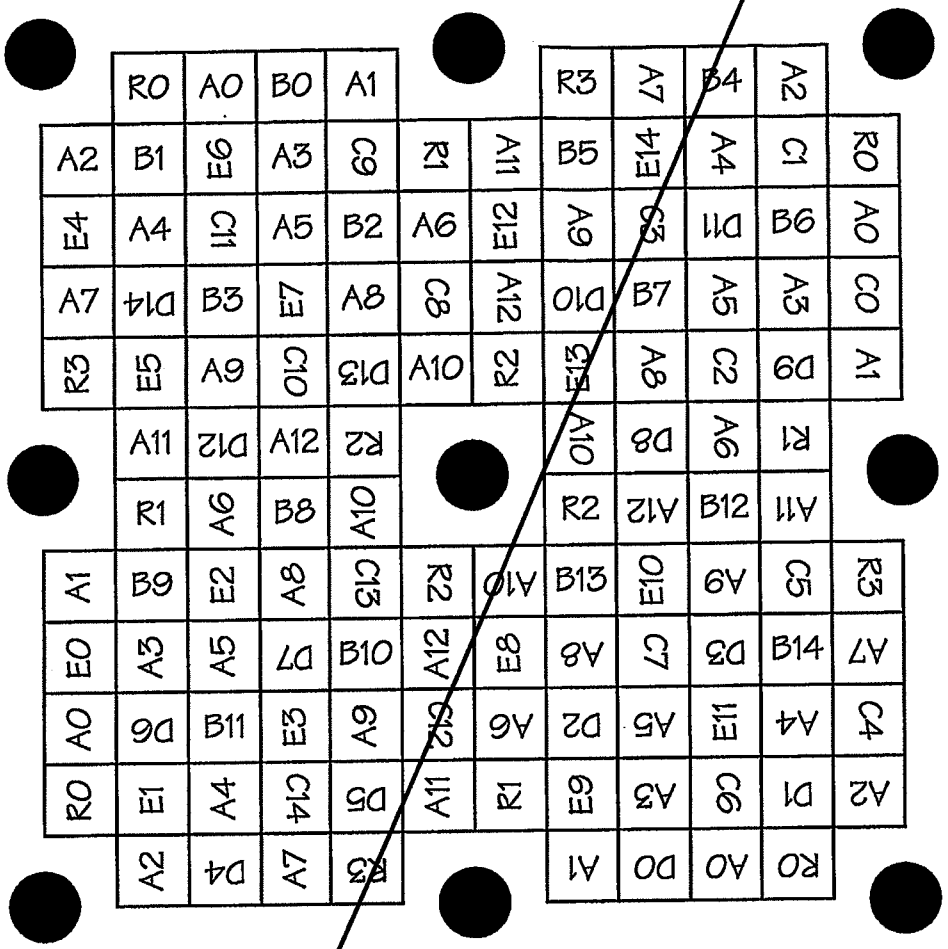
R0 A0 B0 A1
A2 B1 E6 A3 C9 R1 A11 B5 E14 A4 C1 R0
E4 A4 C11 A5 B2 A6 E12 A9 C3 D11 B6 A0
A7 D14 B3 E7 A8 C8 A12 D10 B7 A5 A3 C0
R3 E5 A9 C10 D13 A10 R2 E13 A8 C2 D9 A1
A11 D12 A12 R2 A10 D8 A6 R1
R1 A6 B8 A10 R2 A12 B12 A11
A1 B9 E2 A8 C13 R2 A10 B13 E10 A9 C5 R3
E0 A3 A5 D7 B10 A12 E8 A8 C7 D3 B14 A7
A0 D6 B11 E3 A9 C12 A6 D2 A5 E11 A4 C4
R0 E1 A4 C14 D5 A11 R1 E9 A3 C6 D1 A2
A2 D4 A7 R3 A1 D0 A0 R0

FIG. 19

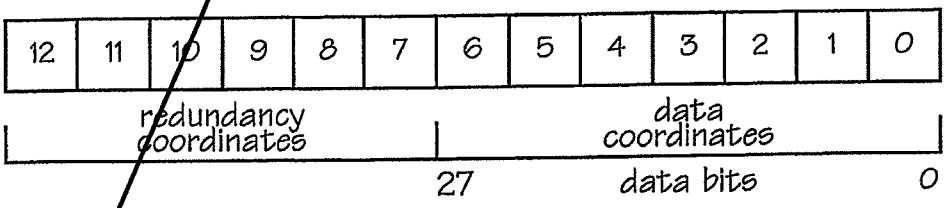
12 11 10 9 8 7 6 5 4 3 2 1 0
redundancy coordinates
data coordinates
27
data bits
0

FIG. 20

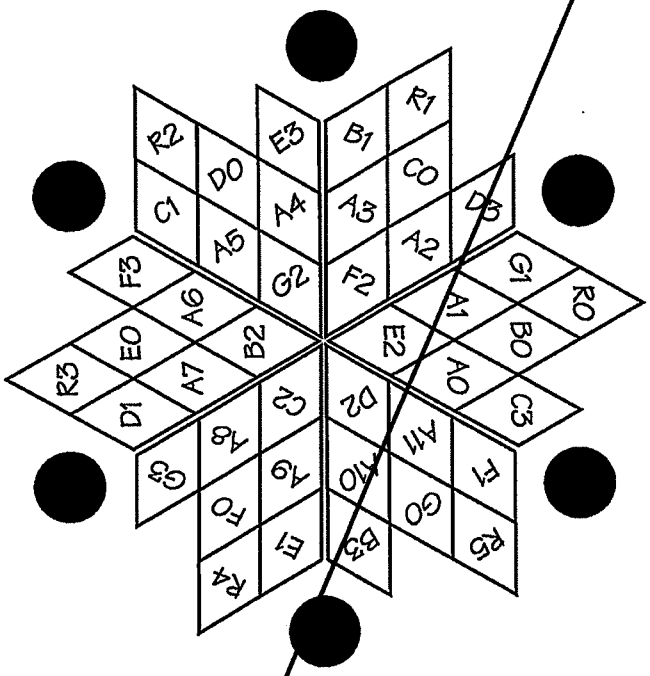
R2
E3
B1
R1
D0
C0
C1
A4
A3
D3
A5
A2
F3
G2
F2
G1
A6
A1
R0
E0
B2
E2
B0
R3
A7
A0
C3
D1
C2
D2
A8
A11
G3
A9
A10
E1
F0
G0
B3
R5
R4

FIG. 21

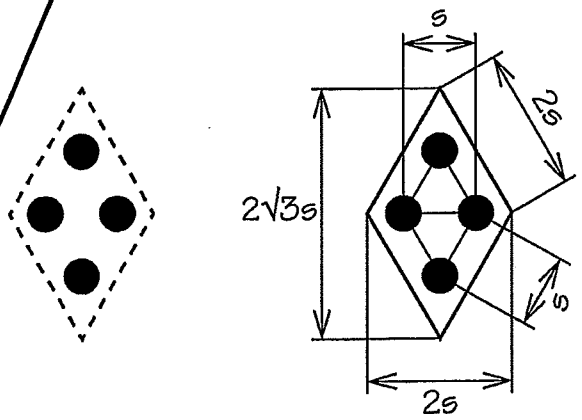
s
2s
2√3s
s
2s

FIG. 22

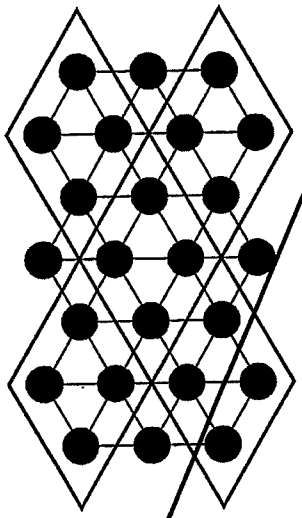

FIG. 23

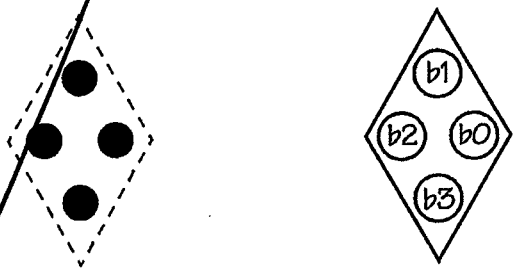

FIG. 24

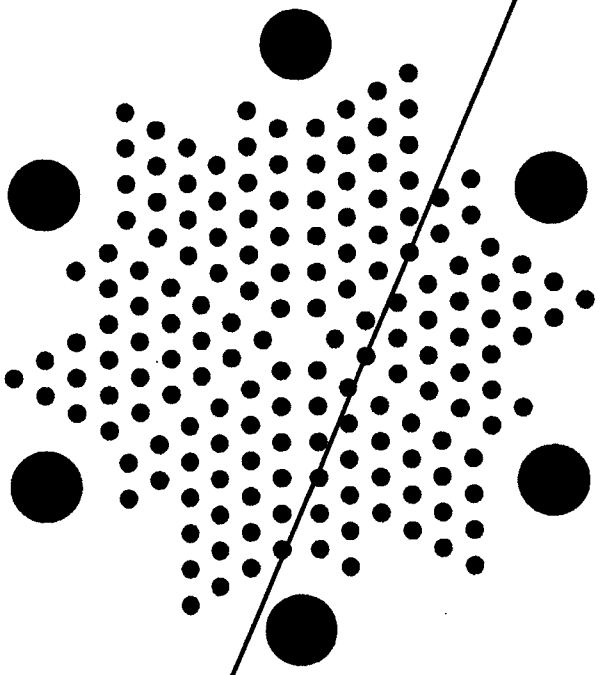

FIG. 25

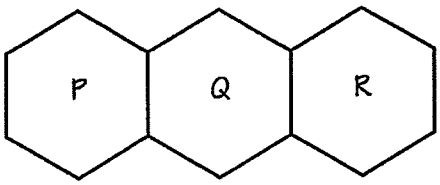

FIG. 26

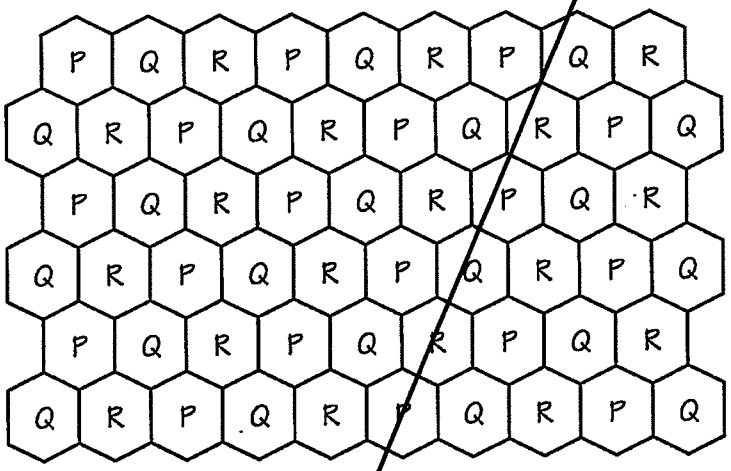
P Q R P Q R P Q R
Q R P Q R P Q R P Q
P Q R P Q R P Q R
Q R P Q R P Q R P Q
P Q R P Q R P Q R
Q R P Q R P Q R P Q

FIG. 27

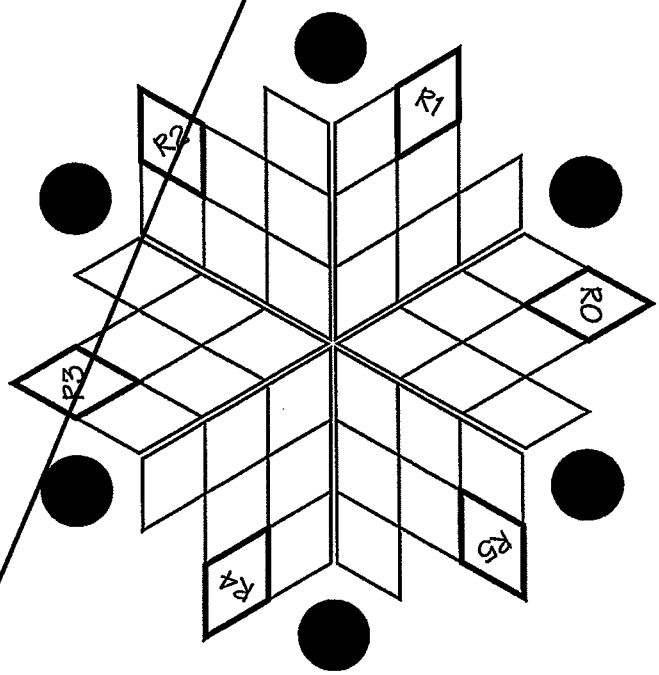
R1
R2
R0
R3
R4
R5

FIG. 28

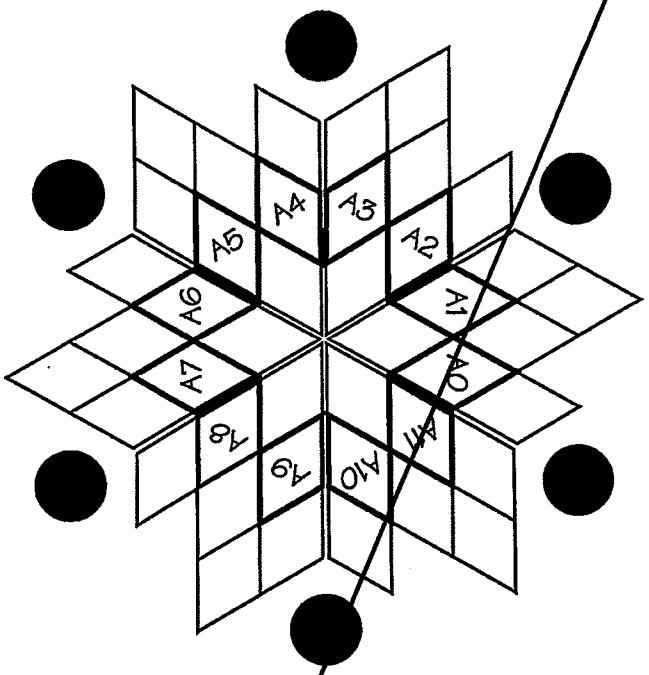
A4
A3
A5
A2
A6
A1
A7
A0
A8
A11
A9
A10

FIG. 29

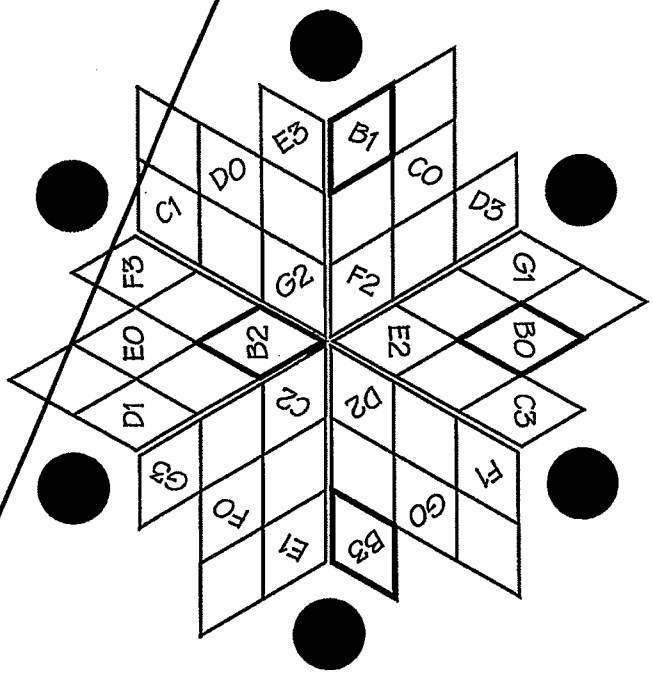
E3
B1
D0
C0
C1
D3
F3
G2
F2
G1
E0
B2
E2
B0
D1
C2
D2
C3
G3
F0
E1
B3
G0
F1

FIG. 30

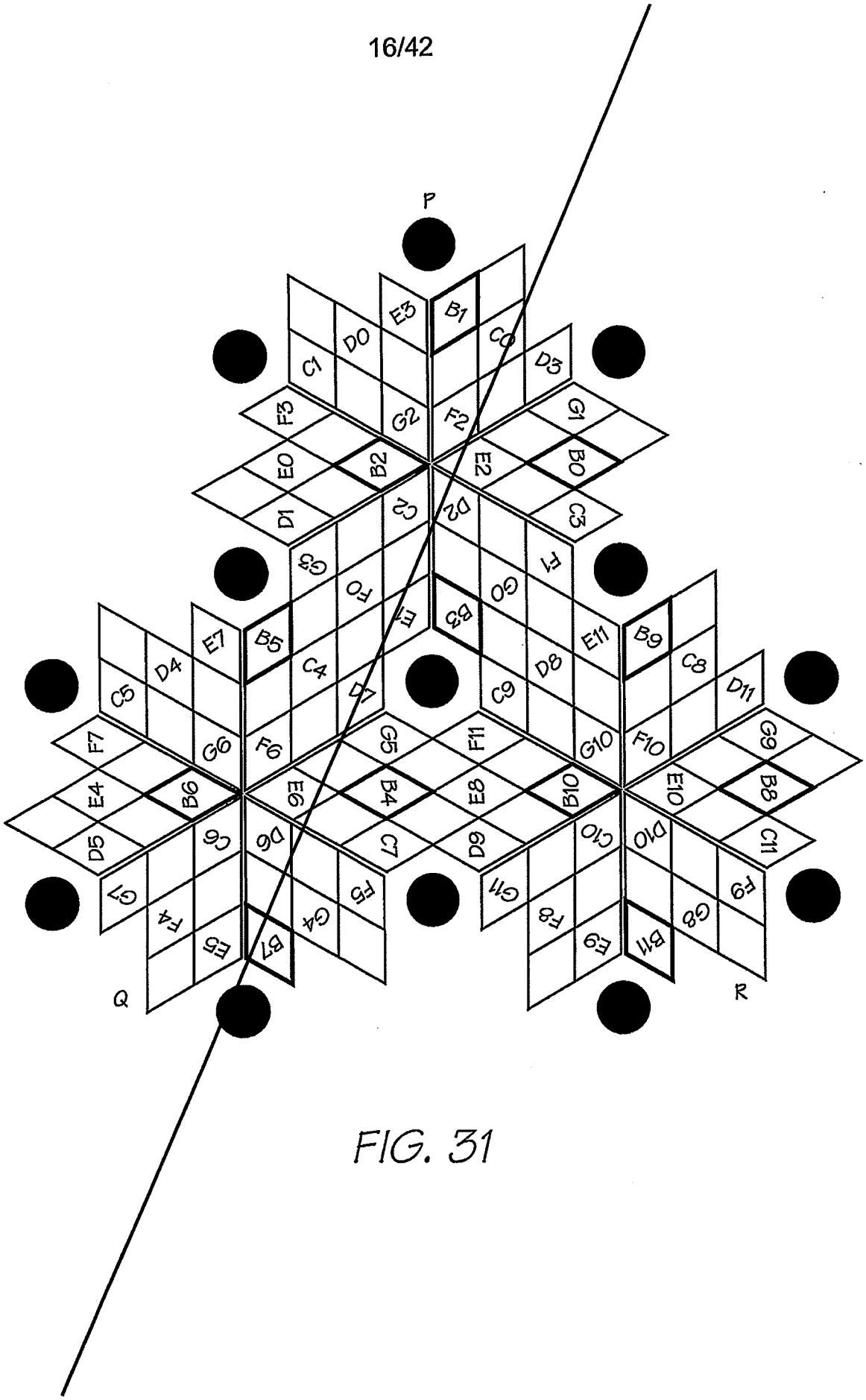
P
Q
R
E3
B1
C0
D0
C1
D3
F3
G2
F2
G1
E0
B2
E2
B0
D1
C2
D2
C3
G3
F0
E1
B3
G0
F1
E7
B5
C4
D7
E11
B9
C8
D11
D4
C5
D8
C9
F7
G6
F6
G5
F11
G10
F10
G9
E4
B6
E6
B4
E8
B10
E10
B8
D5
C6
D6
C7
D9
C10
D10
C11
G7
F4
E5
B7
F5
G4
G11
F8
E9
B11
G8
F9

FIG. 31

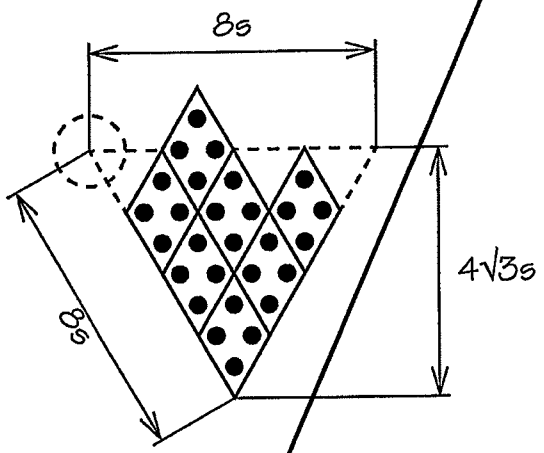

FIG. 32

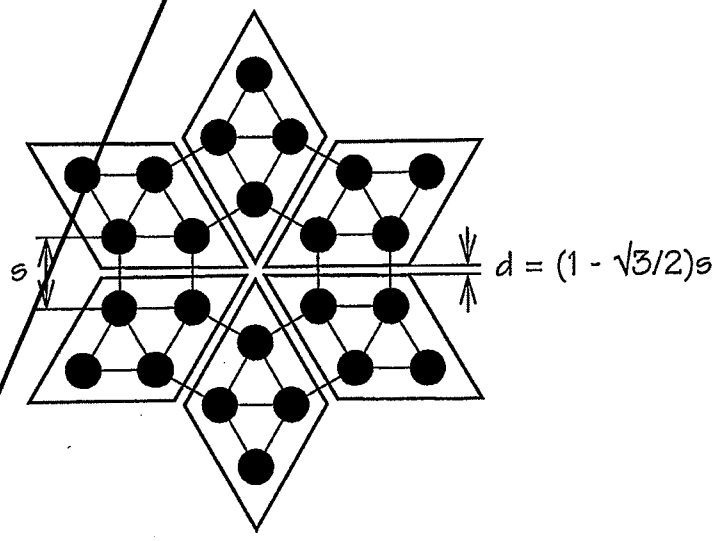

FIG. 33

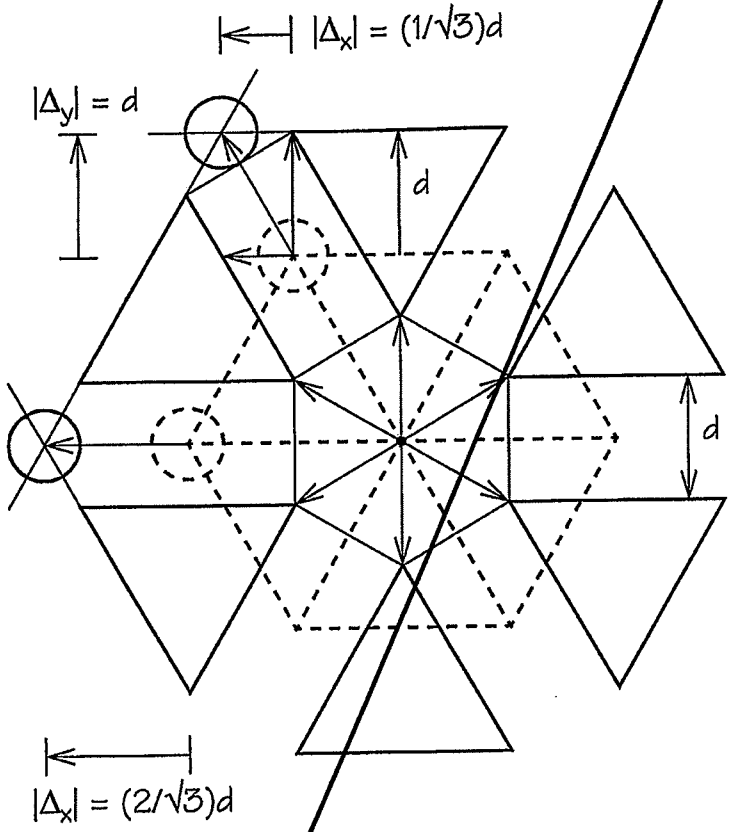
$|\Delta_x| = (1/\sqrt{3})d$
$|\Delta_y| = d$
d
d
$|\Delta_x| = (2/\sqrt{3})d$

FIG. 34

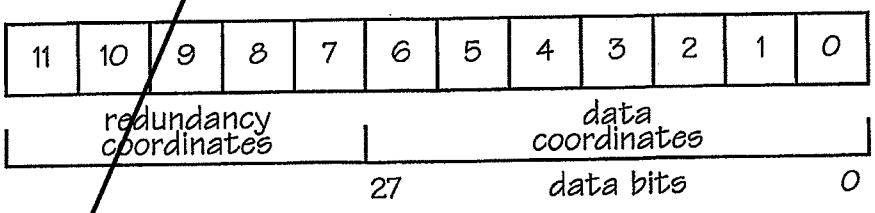
11
10
9
8
7
6
5
4
3
2
1
0
redundancy coordinates
data coordinates
27
data bits
0

FIG. 35

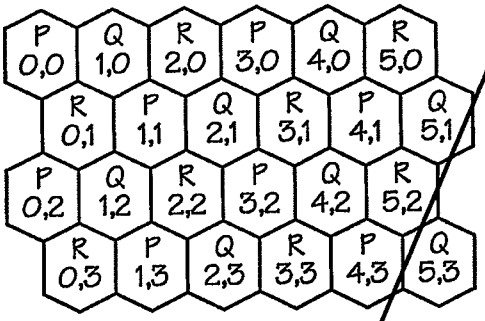

FIG. 36

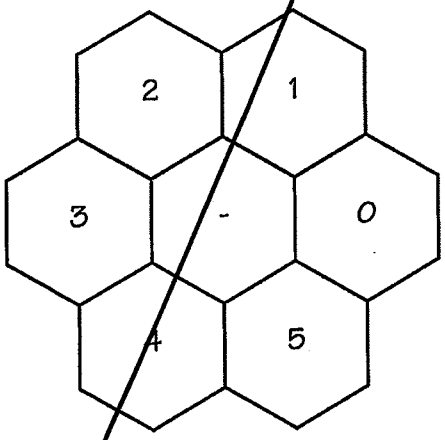

FIG. 37

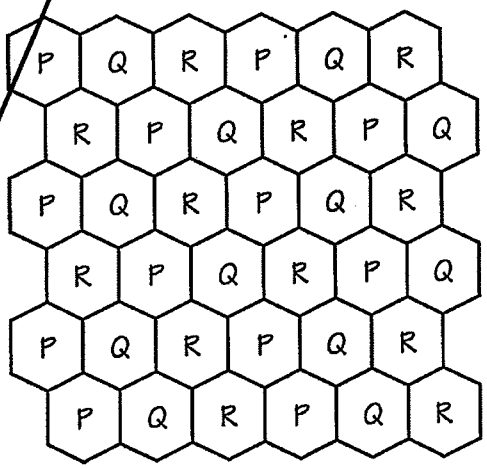

FIG. 38

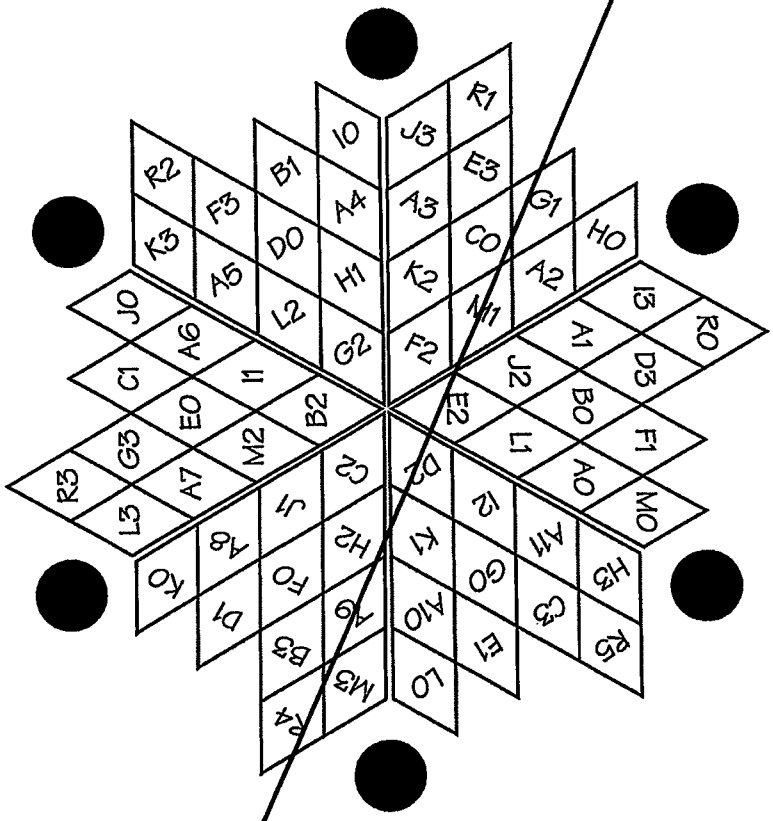
I0
J3
R1
R2
B1
E3
F3
A4
A3
G1
K3
D0
C0
H0
A5
H1
K2
A2
J0
L2
M1
I3
A6
G2
F2
A1
R0
C1
I1
J2
D3
E0
B2
E2
B0
G3
M2
L1
F1
R3
A7
C2
D2
A0
M0
L3
J1
I2
A11
A8
H2
K1
G0
H3
K0
F0
A10
C3
D1
A9
E1
E3
B3
L0
M3
F4

FIG. 39

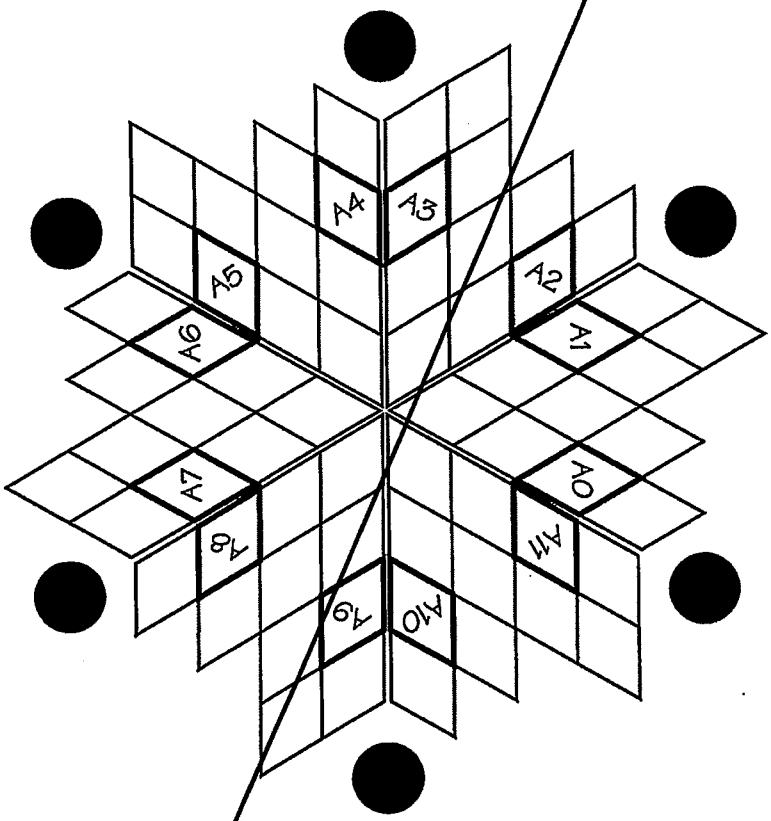

FIG. 40

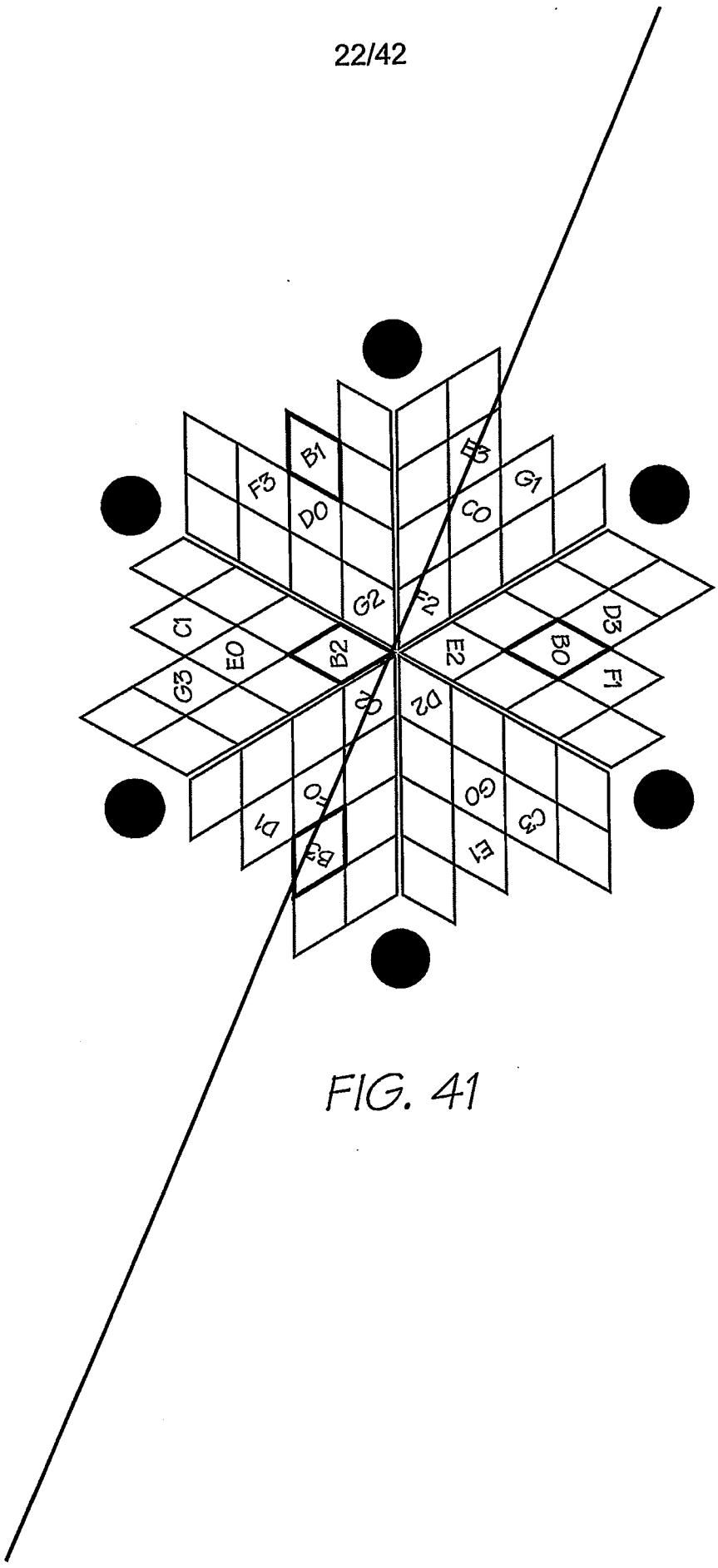

FIG. 41

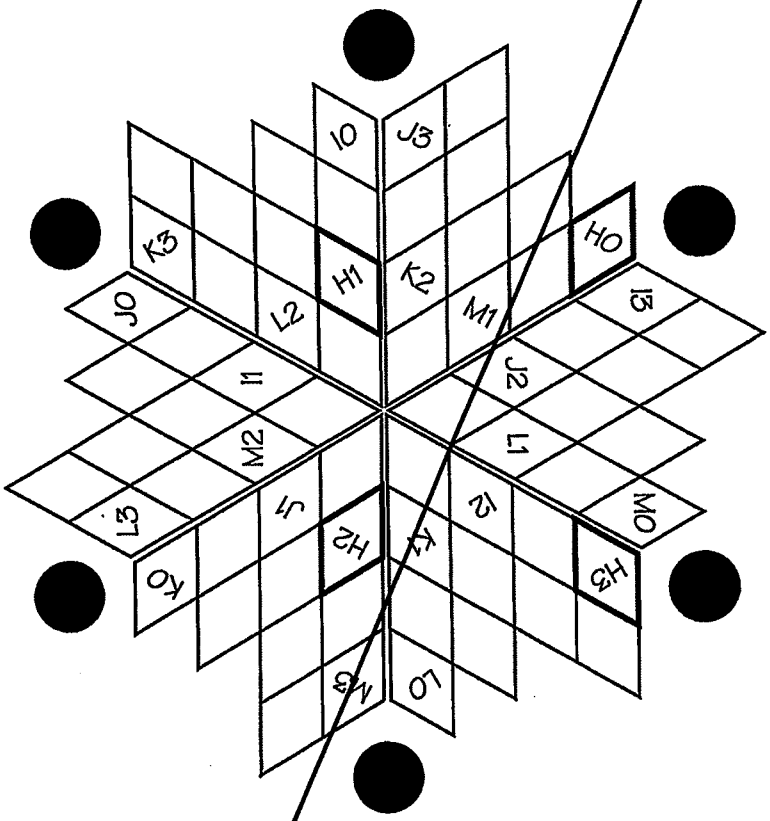
I0
J3
K3
H1
K2
H0
J0
L2
M1
I3
I1
J2
M2
L1
L3
J1
I2
K1
M0
K0
H2
J2
H3
M3
L0

FIG. 42

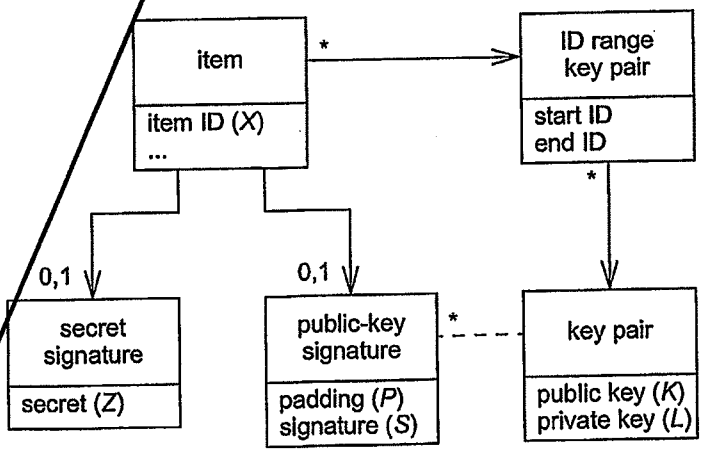
item
item ID (X)
...
*
ID range
key pair
start ID
end ID
*
0,1
0,1
secret
signature
secret (Z)
public-key
signature
padding (P)
signature (S)
*
key pair
public key (K)
private key (L)

FIG. 43

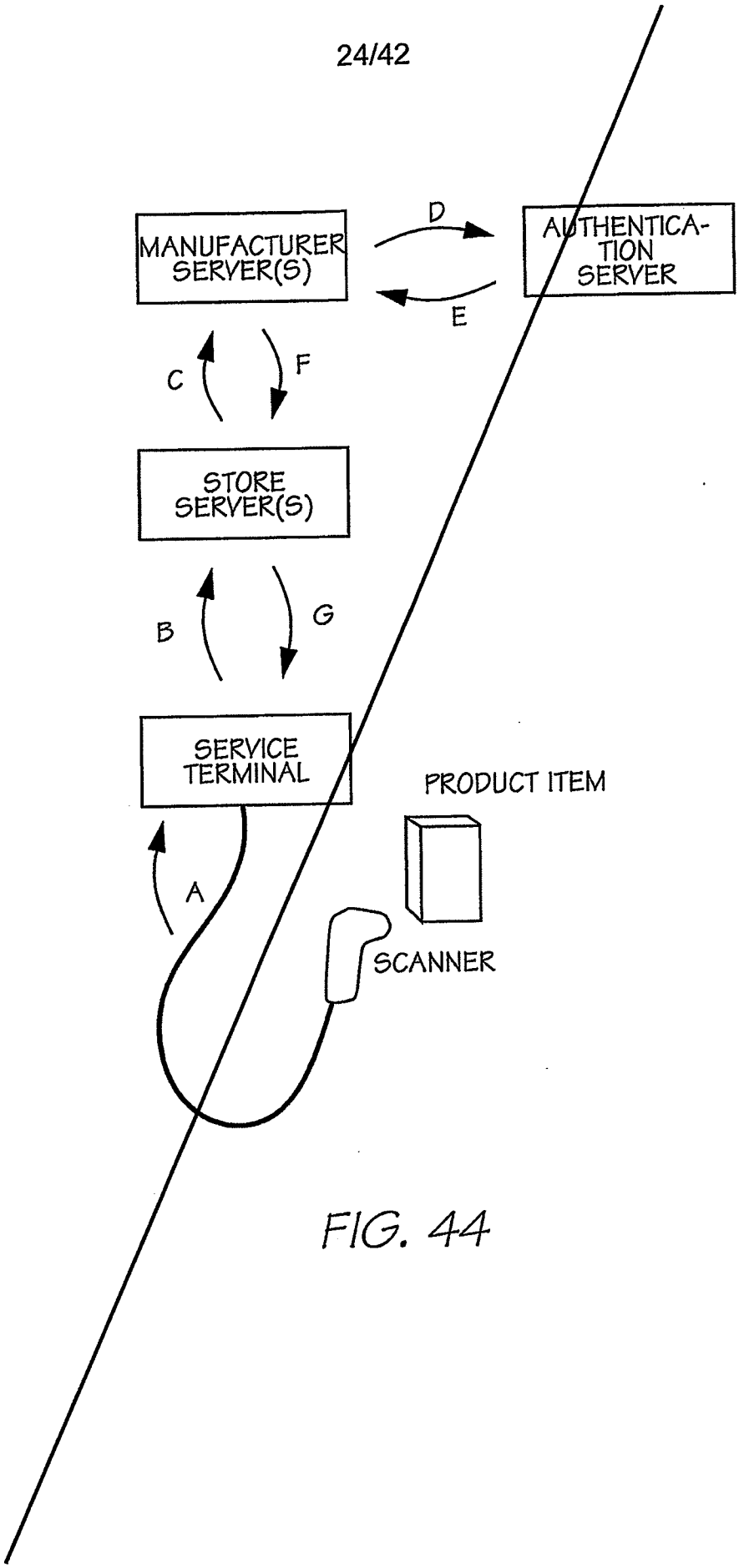
MANUFACTURER SERVER(S)
AUTHENTICA-TION SERVER
D
E
C
F
STORE SERVER(S)
B
G
SERVICE TERMINAL
PRODUCT ITEM
A
SCANNER

FIG. 44

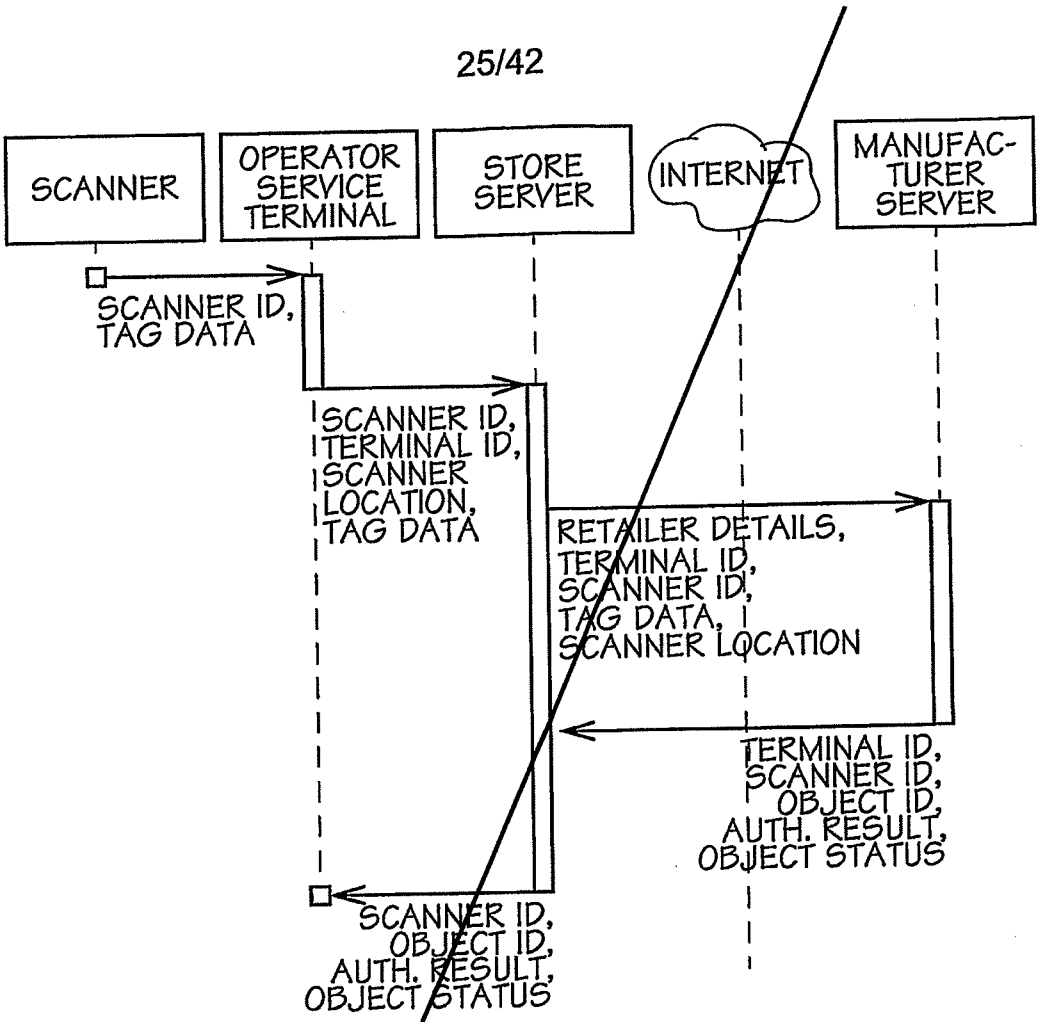
SCANNER
OPERATOR SERVICE TERMINAL
STORE SERVER
INTERNET
MANUFAC-TURER SERVER
SCANNER ID, TAG DATA
SCANNER ID, TERMINAL ID, SCANNER LOCATION, TAG DATA
RETAILER DETAILS, TERMINAL ID, SCANNER ID, TAG DATA, SCANNER LOCATION
TERMINAL ID, SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS

FIG. 45

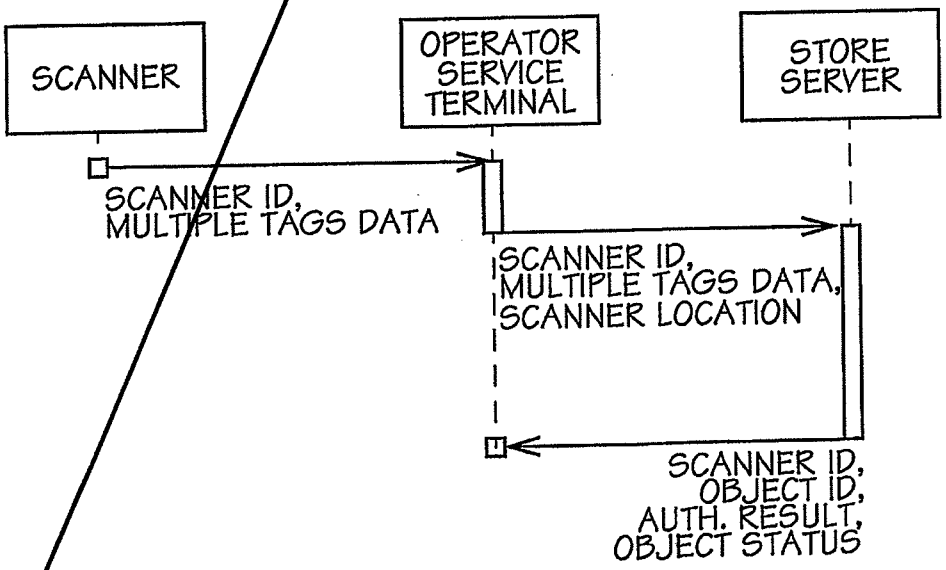
SCANNER
OPERATOR SERVICE TERMINAL
STORE SERVER
SCANNER ID, MULTIPLE TAGS DATA
SCANNER ID, MULTIPLE TAGS DATA, SCANNER LOCATION
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS

FIG. 46

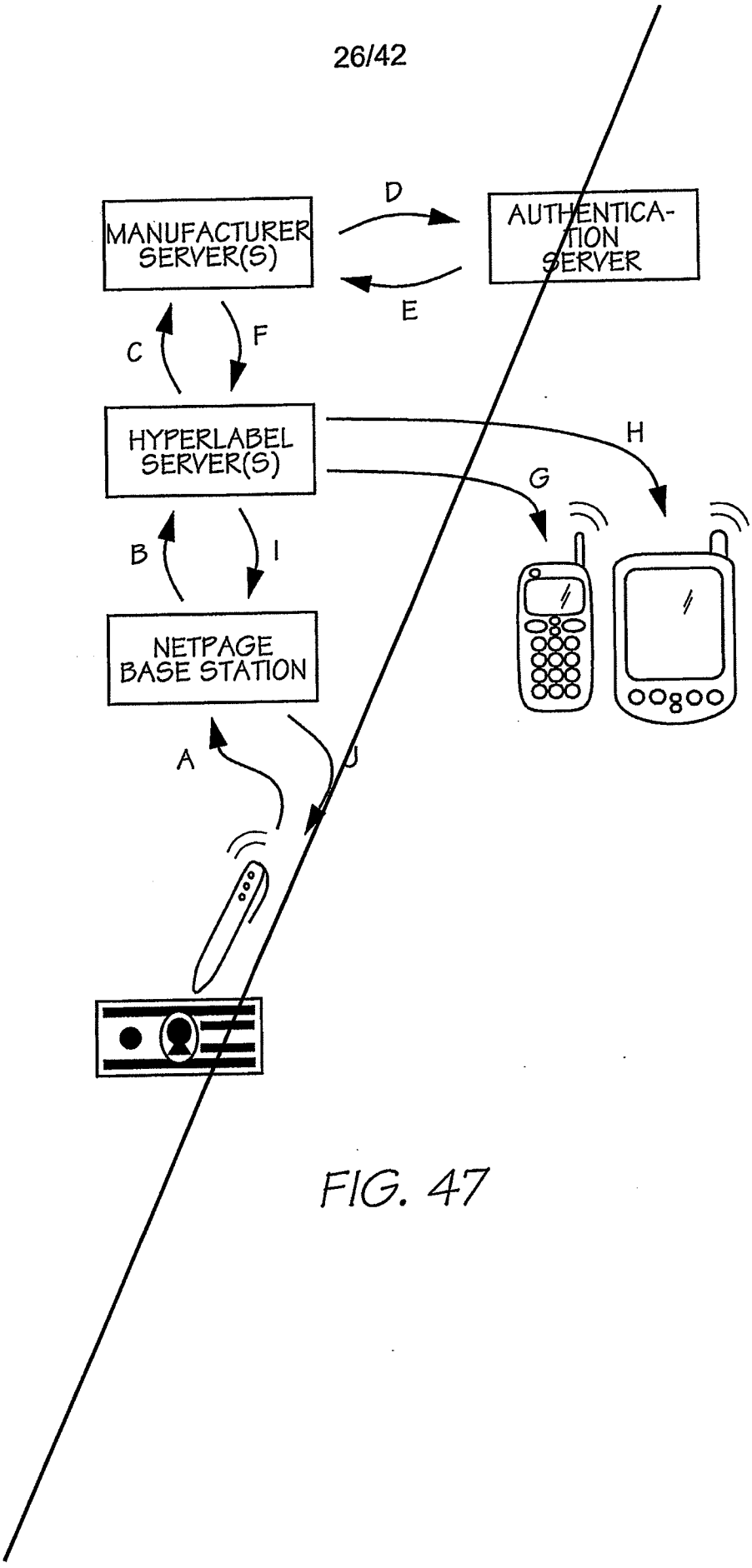
MANUFACTURER SERVER(S)
AUTHENTICA-TION SERVER
D
E
C
F
HYPERLABEL SERVER(S)
H
G
B
I
NETPAGE BASE STATION
A
J

FIG. 47

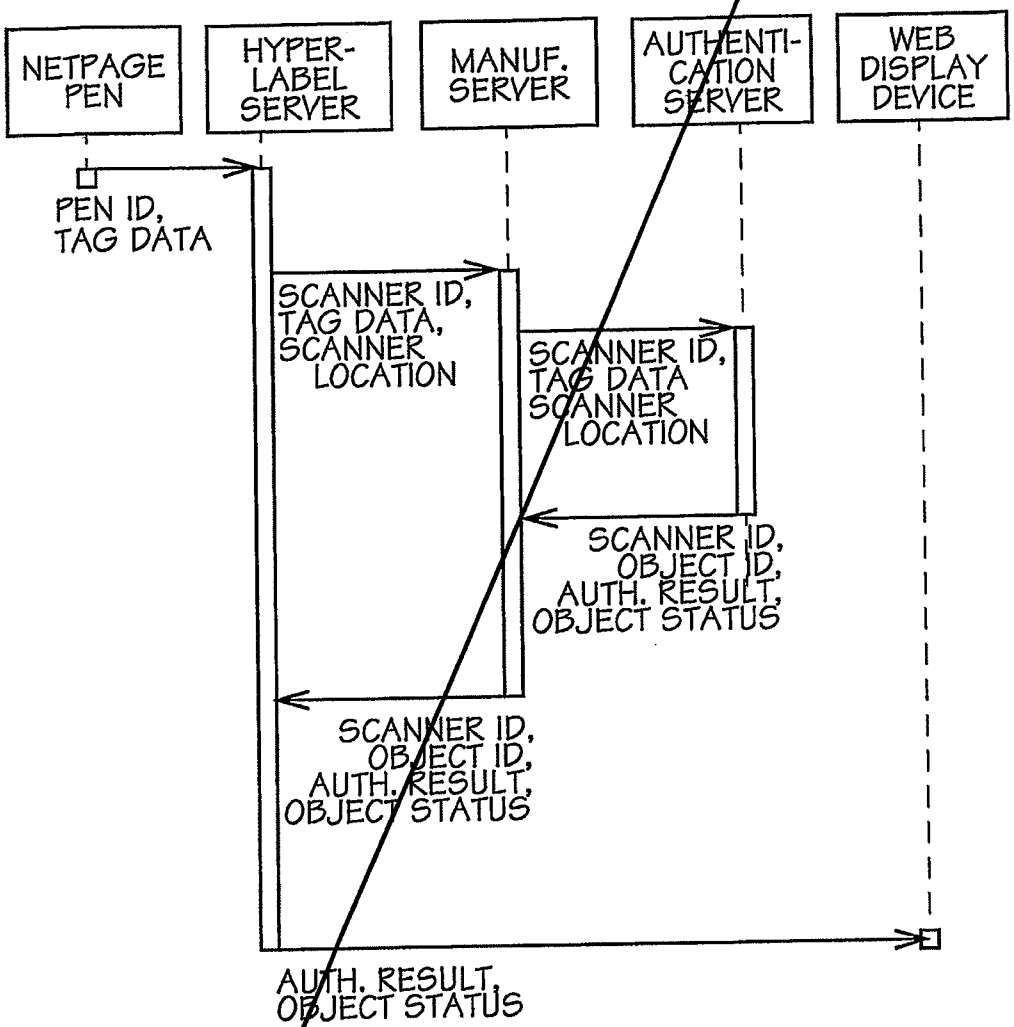
NETPAGE PEN
HYPER-LABEL SERVER
MANUF. SERVER
AUTHENTI-CATION SERVER
WEB DISPLAY DEVICE
PEN ID, TAG DATA
SCANNER ID, TAG DATA, SCANNER LOCATION
SCANNER ID, TAG DATA SCANNER LOCATION
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
AUTH. RESULT, OBJECT STATUS

FIG. 48

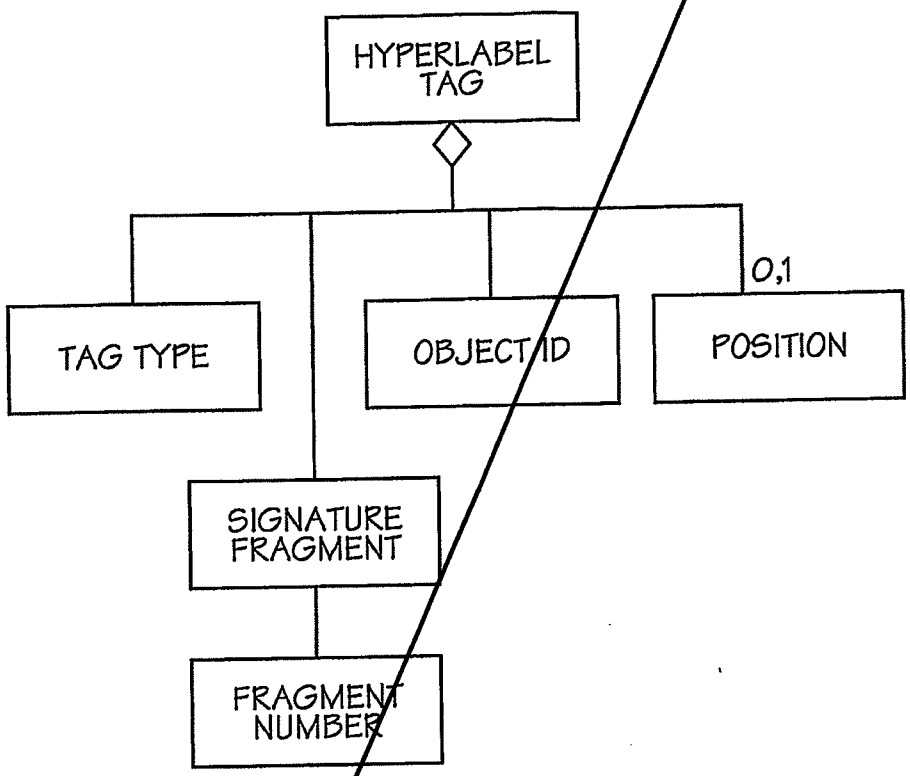
HYPERLABEL TAG
TAG TYPE
OBJECT ID
0,1
POSITION
SIGNATURE FRAGMENT
FRAGMENT NUMBER

FIG. 49

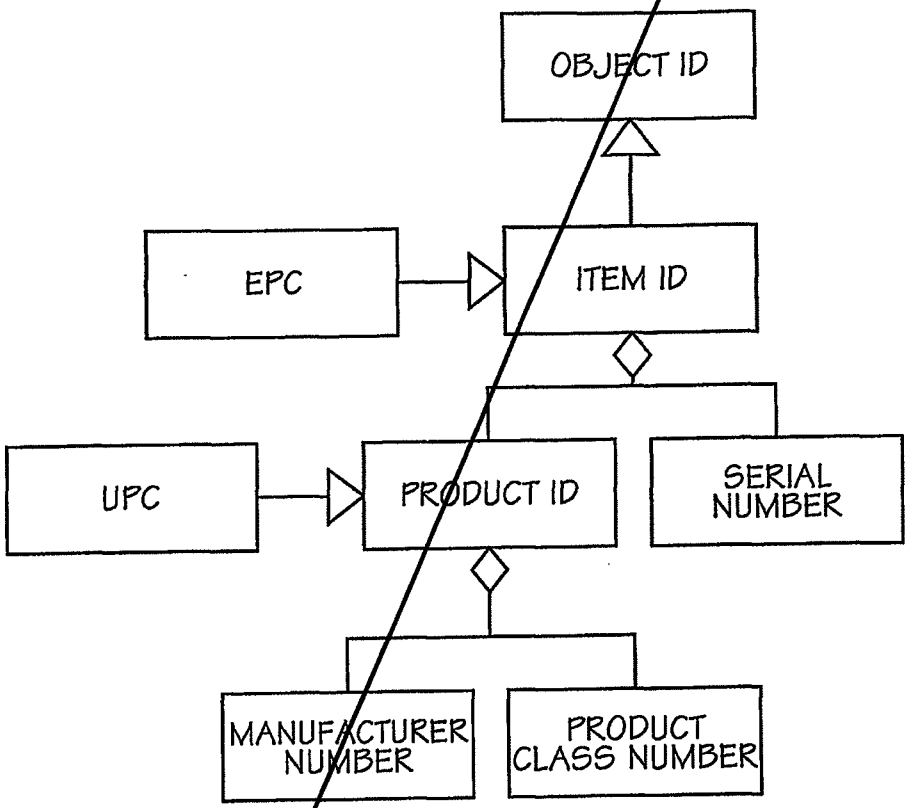
OBJECT ID
EPC
ITEM ID
UPC
PRODUCT ID
SERIAL NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 50

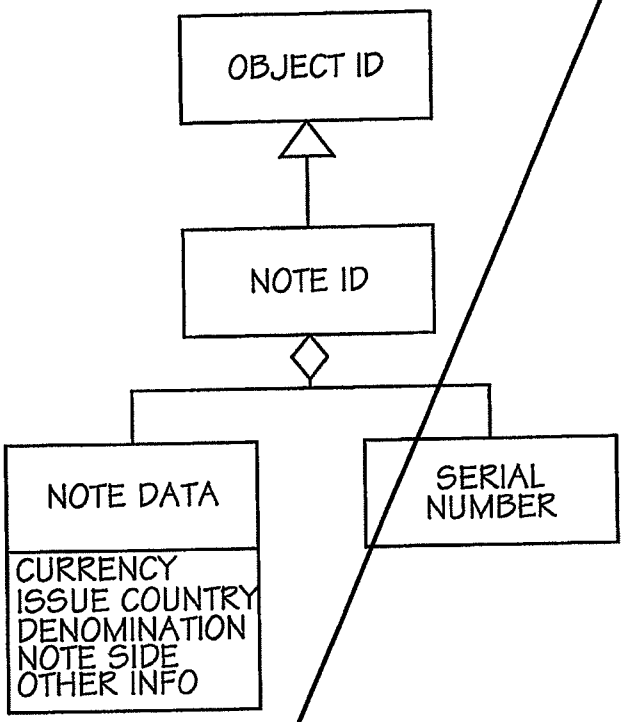
OBJECT ID
NOTE ID
NOTE DATA
CURRENCY
ISSUE COUNTRY
DENOMINATION
NOTE SIDE
OTHER INFO
SERIAL NUMBER

FIG. 51

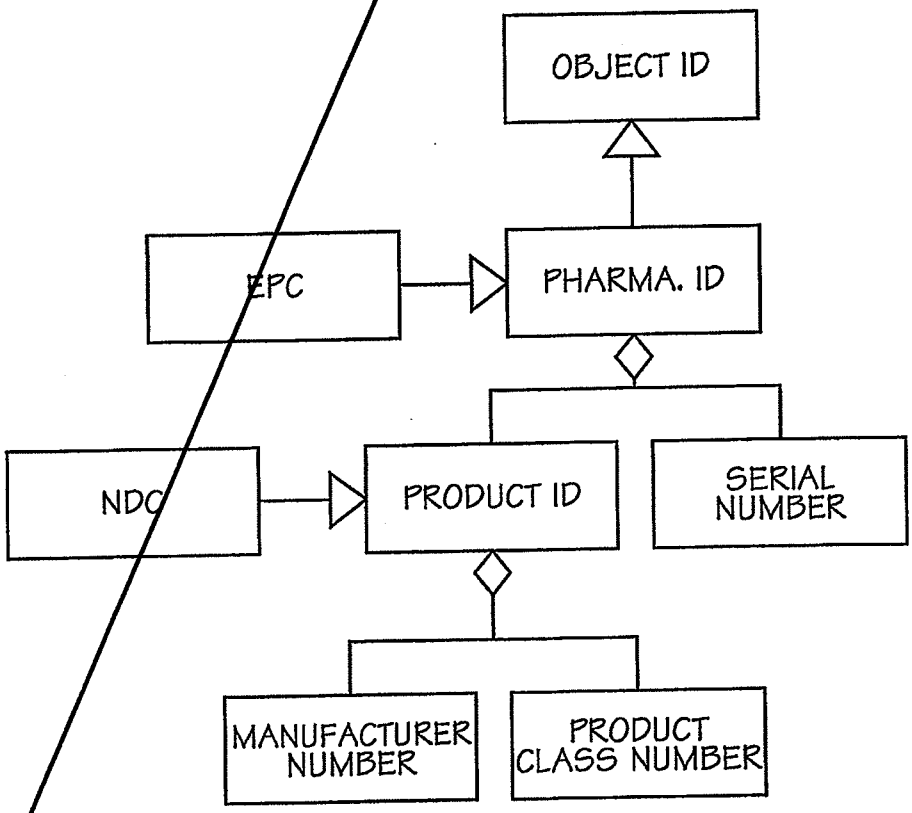
OBJECT ID
EPC
PHARMA. ID
NDC
PRODUCT ID
SERIAL NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 52

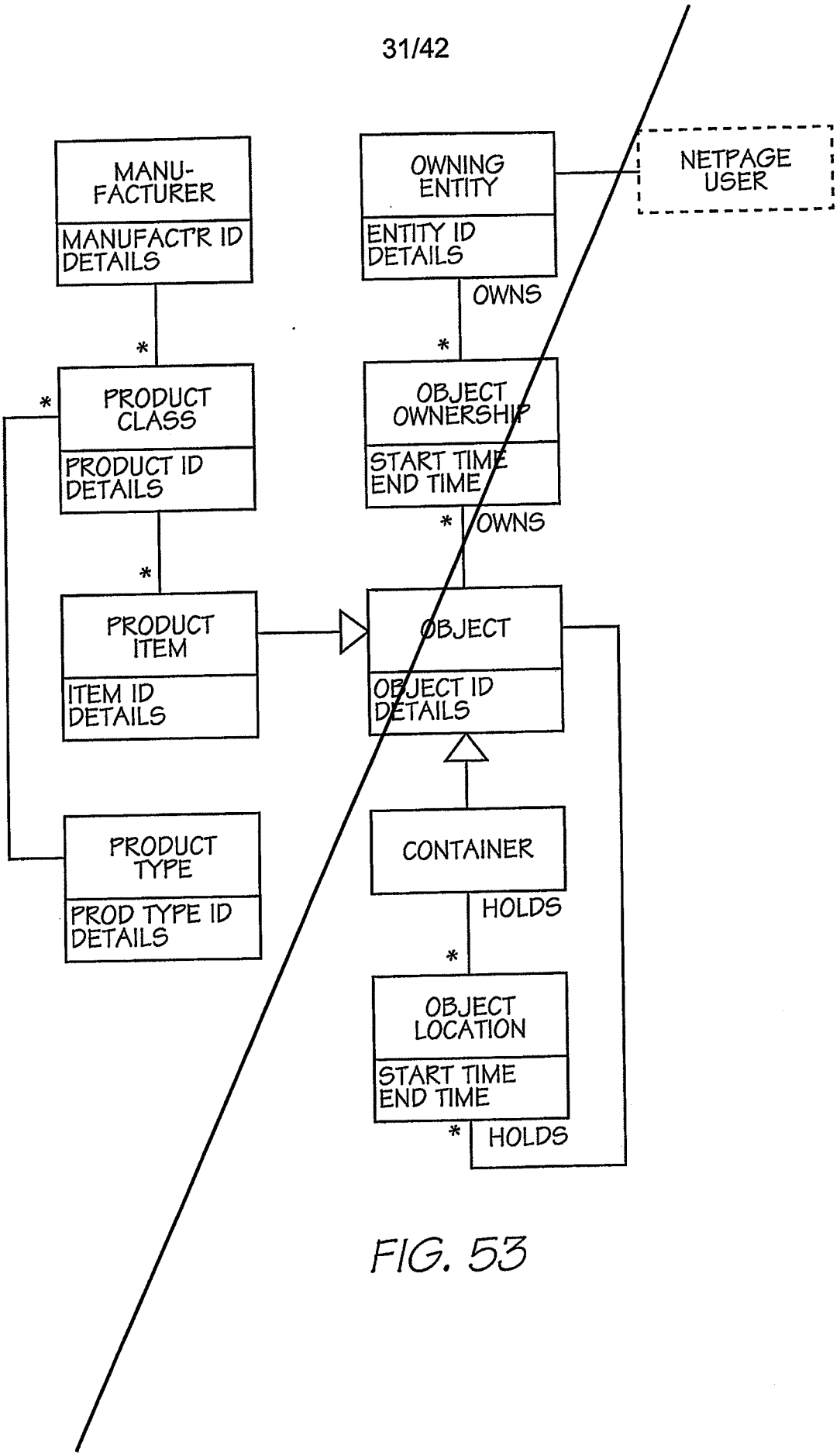
MANU-
FACTURER
MANUFACT'R ID
DETAILS
OWNING
ENTITY
ENTITY ID
DETAILS
NETPAGE
USER
OWNS
*
PRODUCT
CLASS
PRODUCT ID
DETAILS
OBJECT
OWNERSHIP
START TIME
END TIME
OWNS
PRODUCT
ITEM
ITEM ID
DETAILS
OBJECT
OBJECT ID
DETAILS
PRODUCT
TYPE
PROD TYPE ID
DETAILS
CONTAINER
HOLDS
OBJECT
LOCATION
START TIME
END TIME
HOLDS

FIG. 53

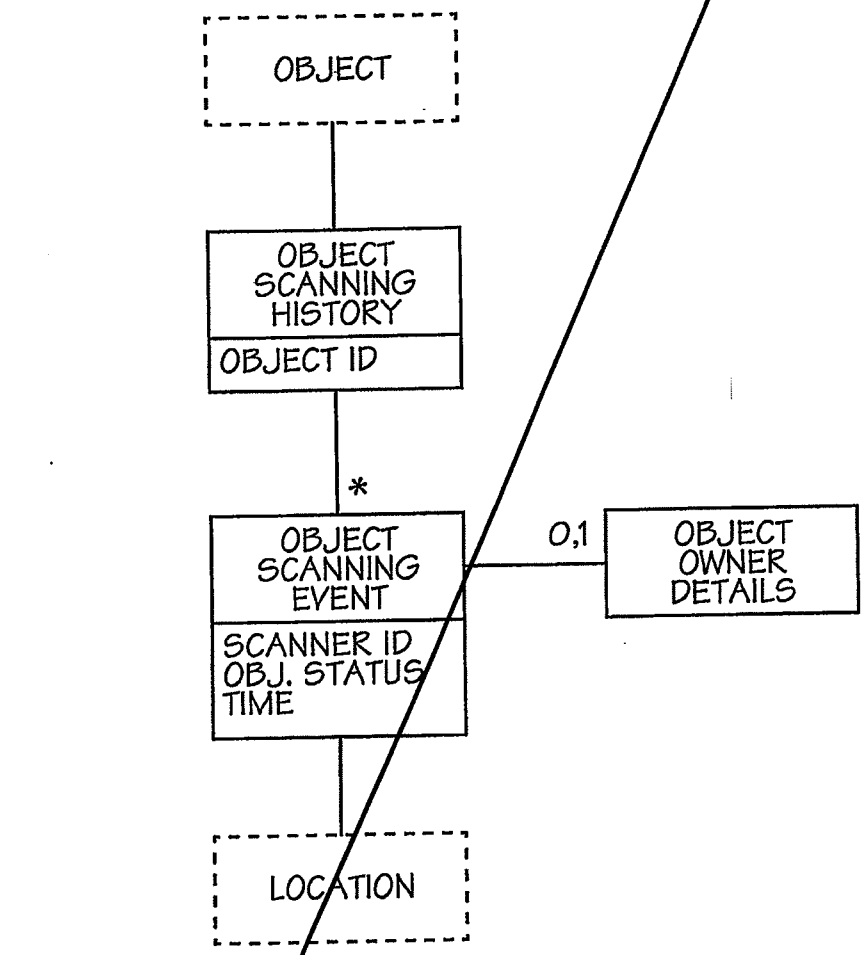
OBJECT
OBJECT SCANNING HISTORY
OBJECT ID
*
OBJECT SCANNING EVENT
SCANNER ID
OBJ. STATUS
TIME
0,1
OBJECT OWNER DETAILS
LOCATION

FIG. 54

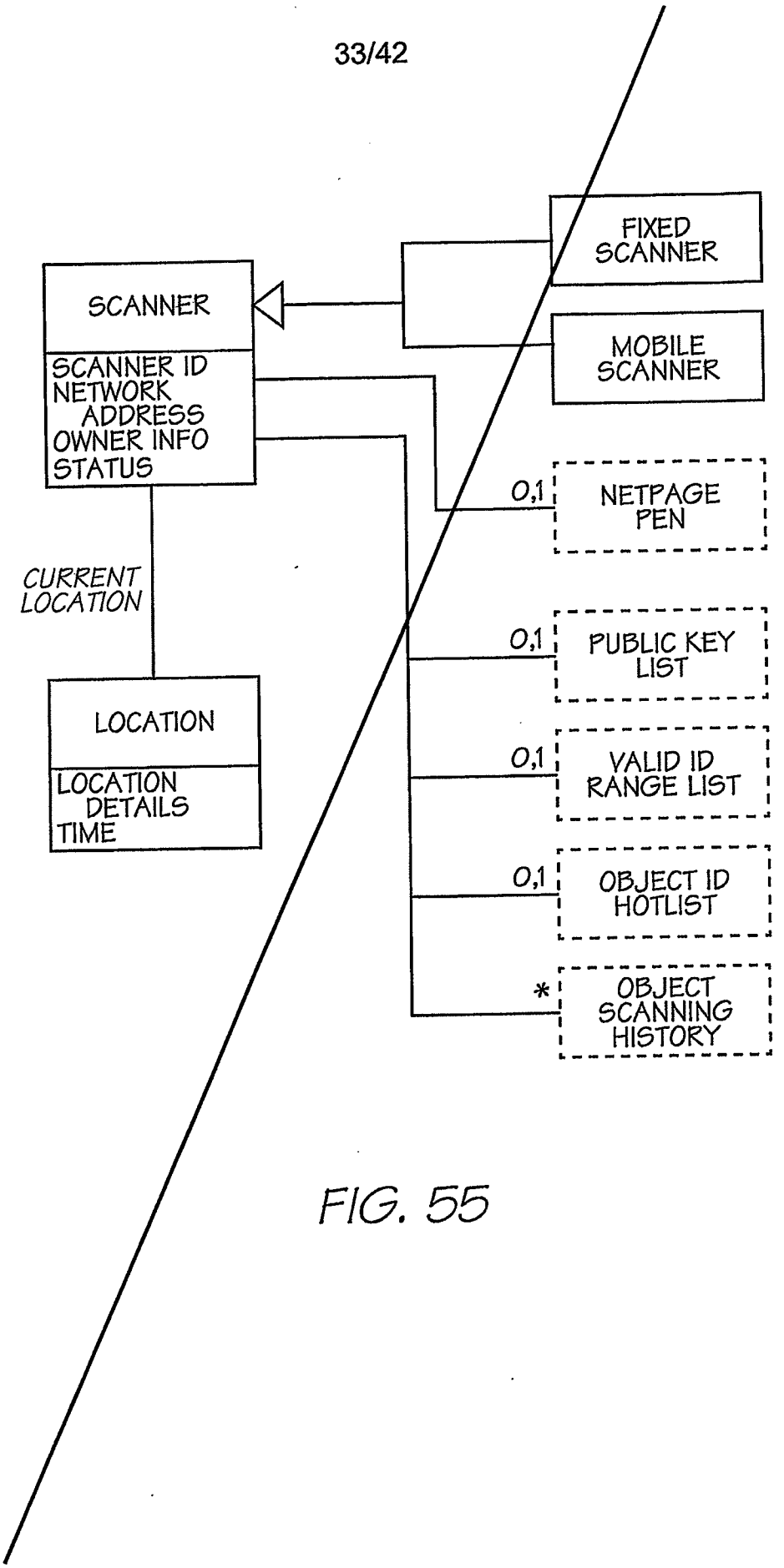
SCANNER
SCANNER ID
NETWORK ADDRESS
OWNER INFO
STATUS
FIXED SCANNER
MOBILE SCANNER
0,1
NETPAGE PEN
CURRENT LOCATION
0,1
PUBLIC KEY LIST
LOCATION
LOCATION DETAILS
TIME
0,1
VALID ID RANGE LIST
0,1
OBJECT ID HOTLIST
*
OBJECT SCANNING HISTORY

FIG. 55

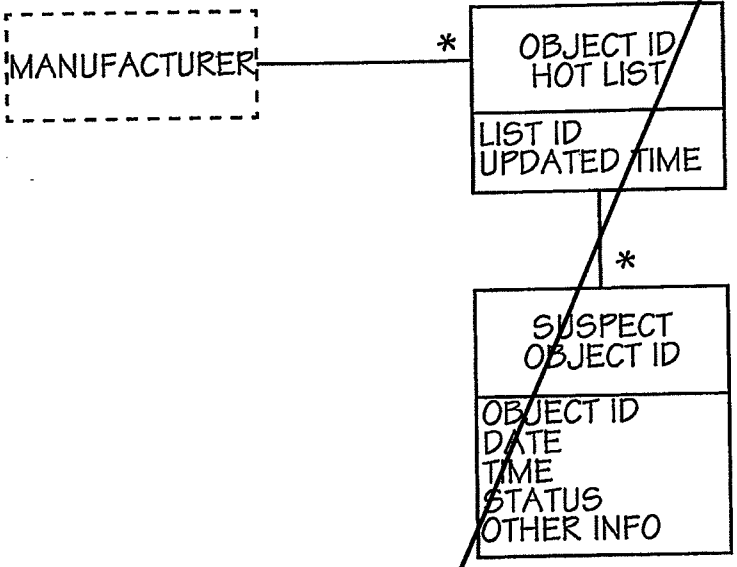
MANUFACTURER
*
OBJECT ID
HOT LIST
LIST ID
UPDATED TIME
*
SUSPECT
OBJECT ID
OBJECT ID
DATE
TIME
STATUS
OTHER INFO

FIG. 56

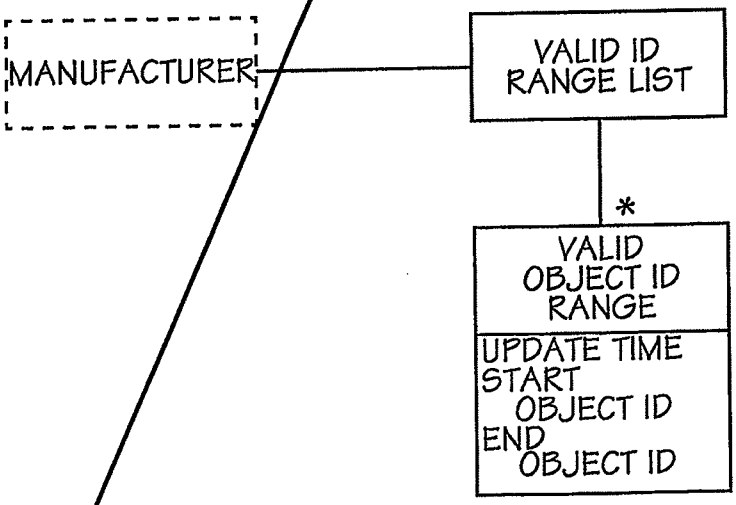
MANUFACTURER
VALID ID
RANGE LIST
*
VALID
OBJECT ID
RANGE
UPDATE TIME
START
OBJECT ID
END
OBJECT ID

FIG. 57

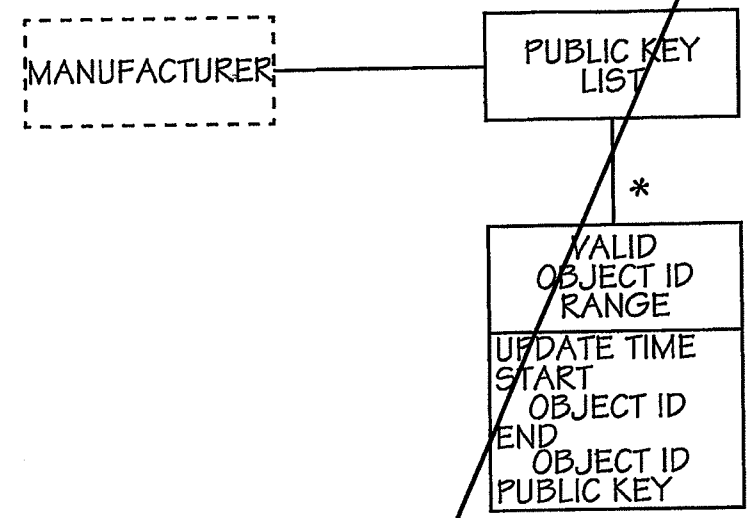
MANUFACTURER
PUBLIC KEY LIST
*
VALID OBJECT ID RANGE
UPDATE TIME
START OBJECT ID
END OBJECT ID
PUBLIC KEY

FIG. 58

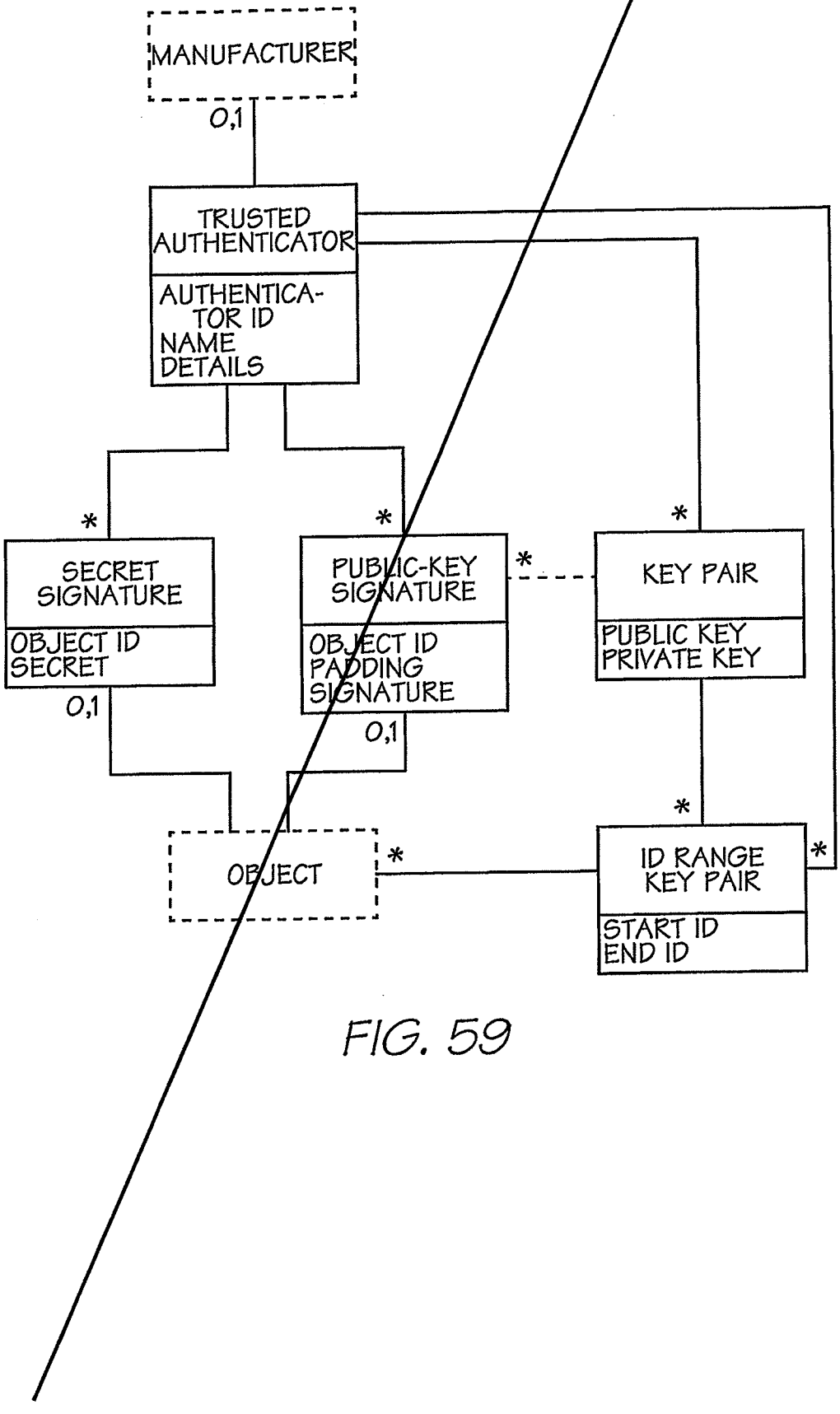
MANUFACTURER
0,1
TRUSTED AUTHENTICATOR
AUTHENTICA-TOR ID
NAME
DETAILS
*
*
*
SECRET SIGNATURE
OBJECT ID
SECRET
PUBLIC-KEY SIGNATURE
OBJECT ID
PADDING
SIGNATURE
*
KEY PAIR
PUBLIC KEY
PRIVATE KEY
0,1
0,1
*
OBJECT
*
ID RANGE KEY PAIR
START ID
END ID
*

FIG. 59

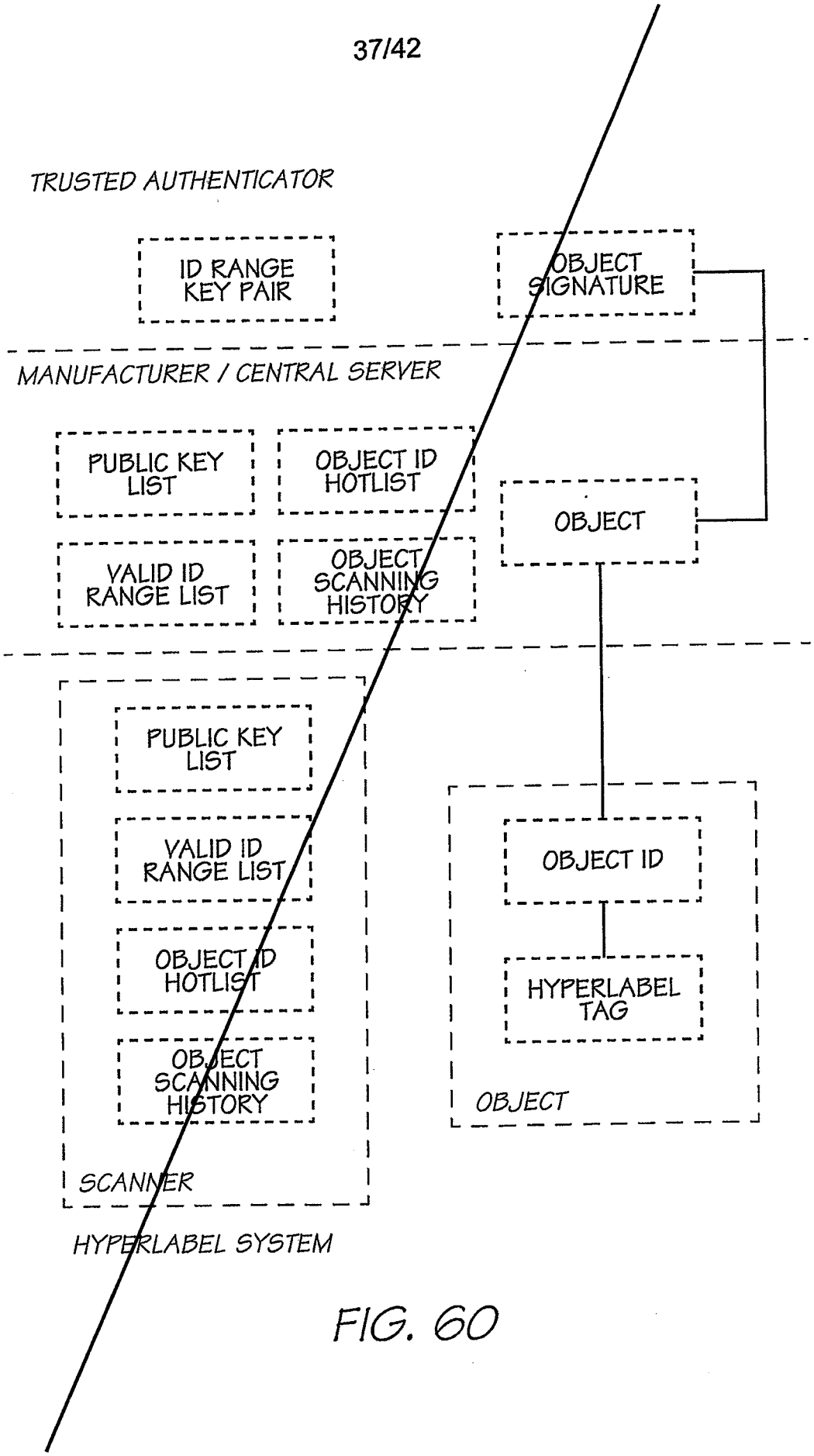
TRUSTED AUTHENTICATOR
ID RANGE KEY PAIR
OBJECT SIGNATURE
MANUFACTURER / CENTRAL SERVER
PUBLIC KEY LIST
OBJECT ID HOTLIST
OBJECT
VALID ID RANGE LIST
OBJECT SCANNING HISTORY
PUBLIC KEY LIST
VALID ID RANGE LIST
OBJECT ID HOTLIST
OBJECT SCANNING HISTORY
SCANNER
OBJECT ID
HYPERLABEL TAG
OBJECT
HYPERLABEL SYSTEM

FIG. 60

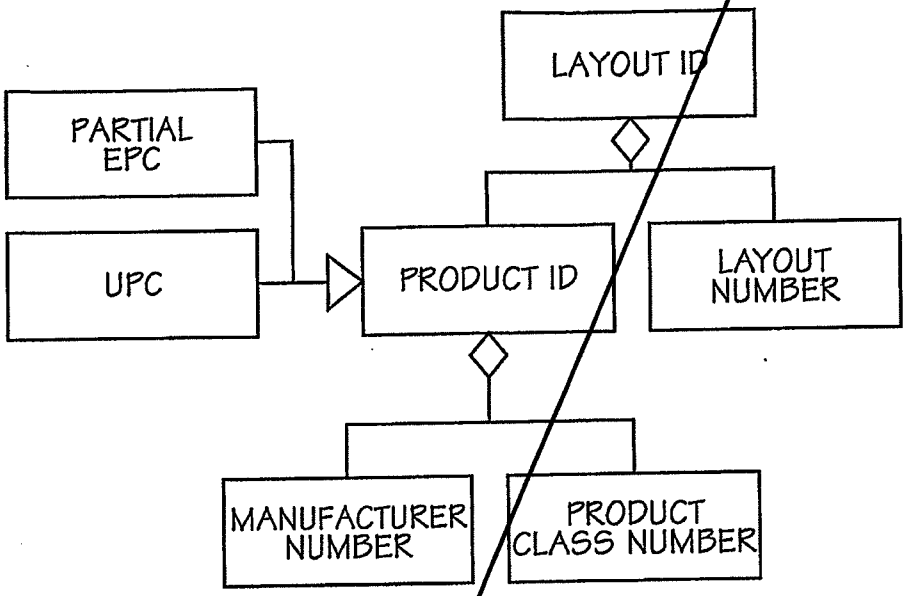
LAYOUT ID
PARTIAL EPC
UPC
PRODUCT ID
LAYOUT NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 61

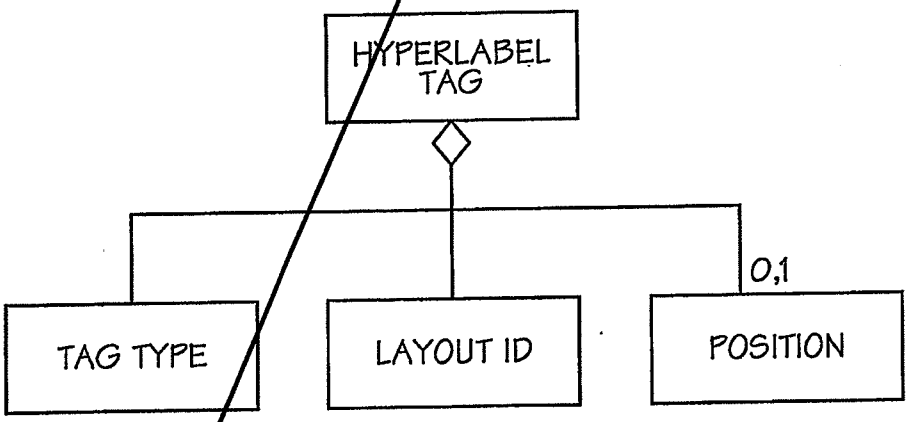
HYPERLABEL TAG
0,1
TAG TYPE
LAYOUT ID
POSITION

FIG. 62

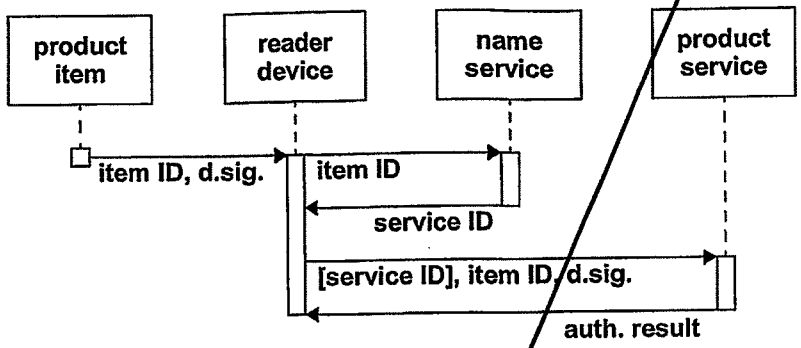
product item
reader device
name service
product service
item ID, d.sig.
item ID
service ID
[service ID], item ID, d.sig.
auth. result

FIG. 63

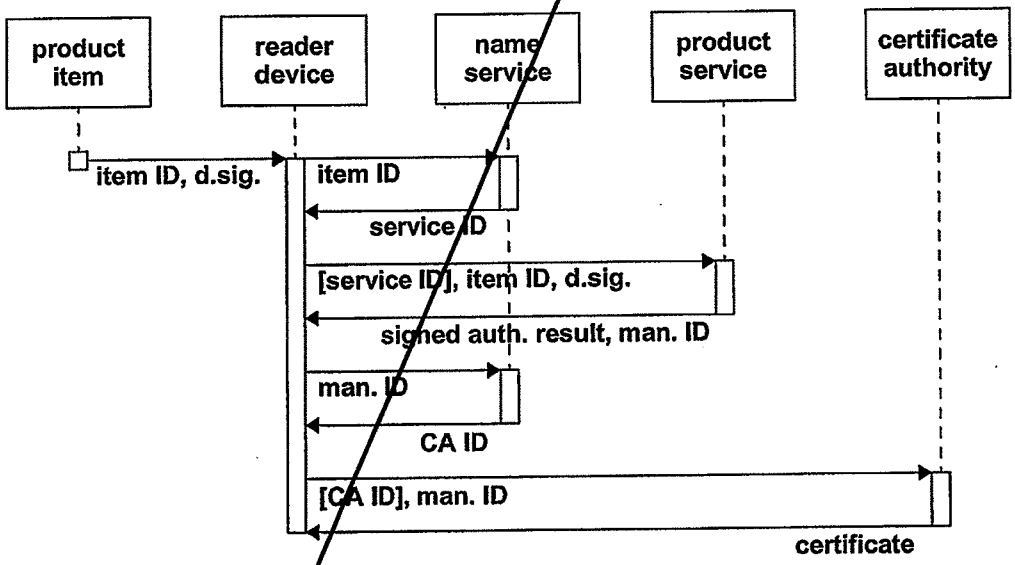
product item
reader device
name service
product service
certificate authority
item ID, d.sig.
item ID
service ID
[service ID], item ID, d.sig.
signed auth. result, man. ID
man. ID
CA ID
[CA ID], man. ID
certificate

FIG. 64

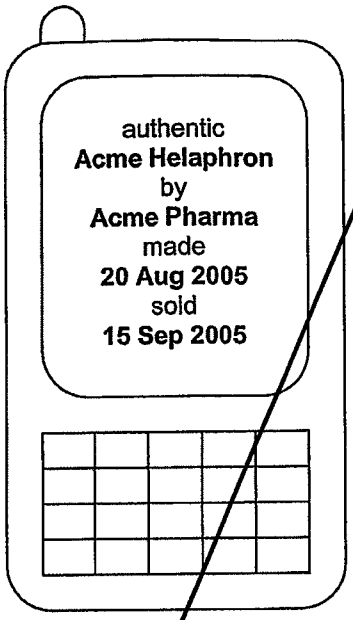
authentic
Acme Helaphron
by
Acme Pharma
made
20 Aug 2005
sold
15 Sep 2005

FIG. 65

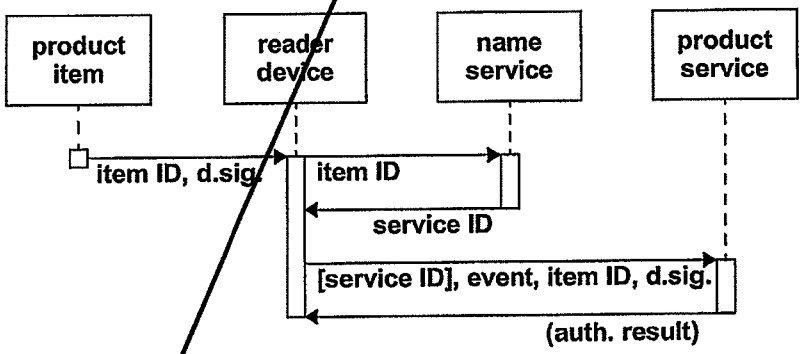
product item
reader device
name service
product service
item ID, d.sig.
item ID
service ID
[service ID], event, item ID, d.sig.
(auth. result)

FIG. 66

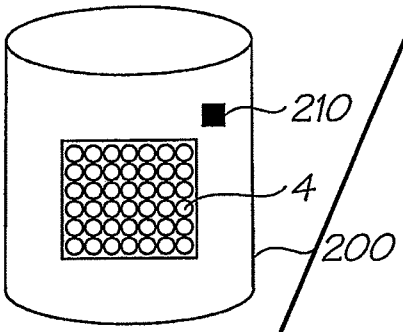

FIG. 67

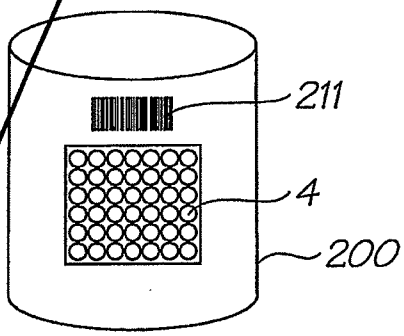

FIG. 68

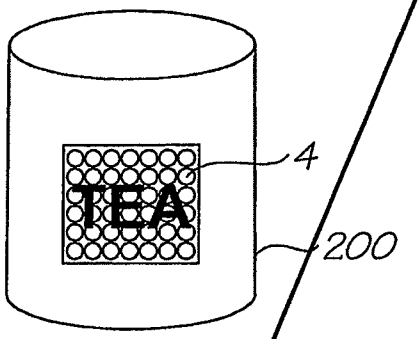

FIG. 69

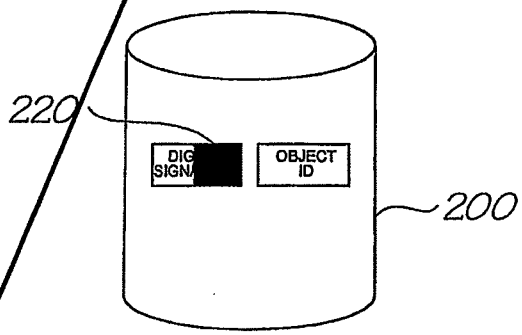

FIG. 70

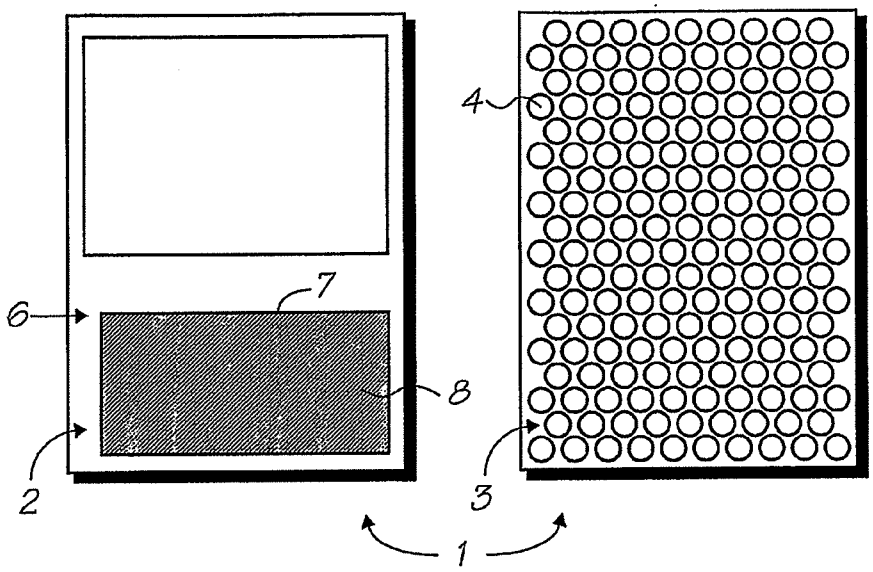

FIG. 1

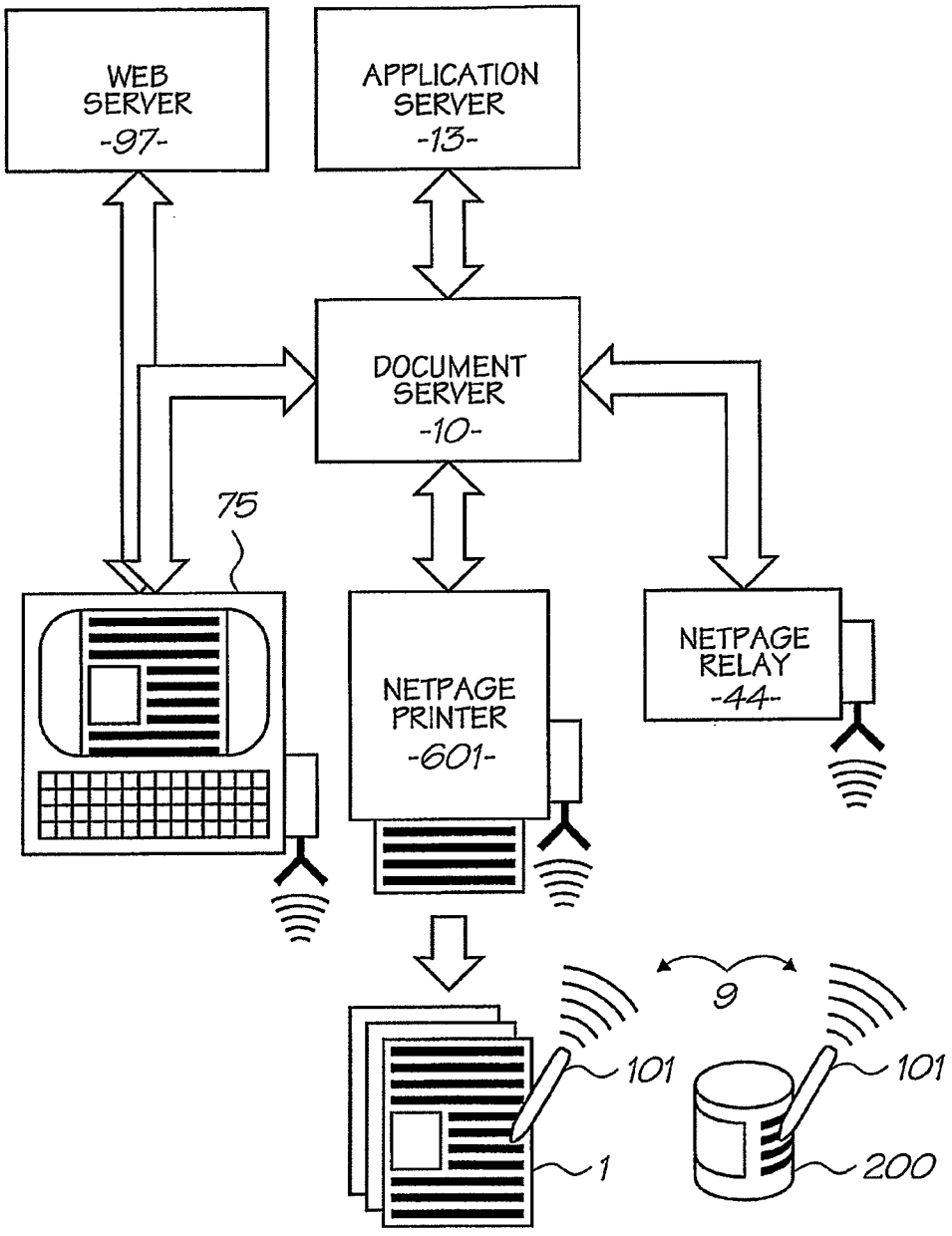
WEB SERVER -97-
APPLICATION SERVER -13-
DOCUMENT SERVER -10-
75
NETPAGE PRINTER -601-
NETPAGE RELAY -44-
9
101
101
1
200

FIG. 2

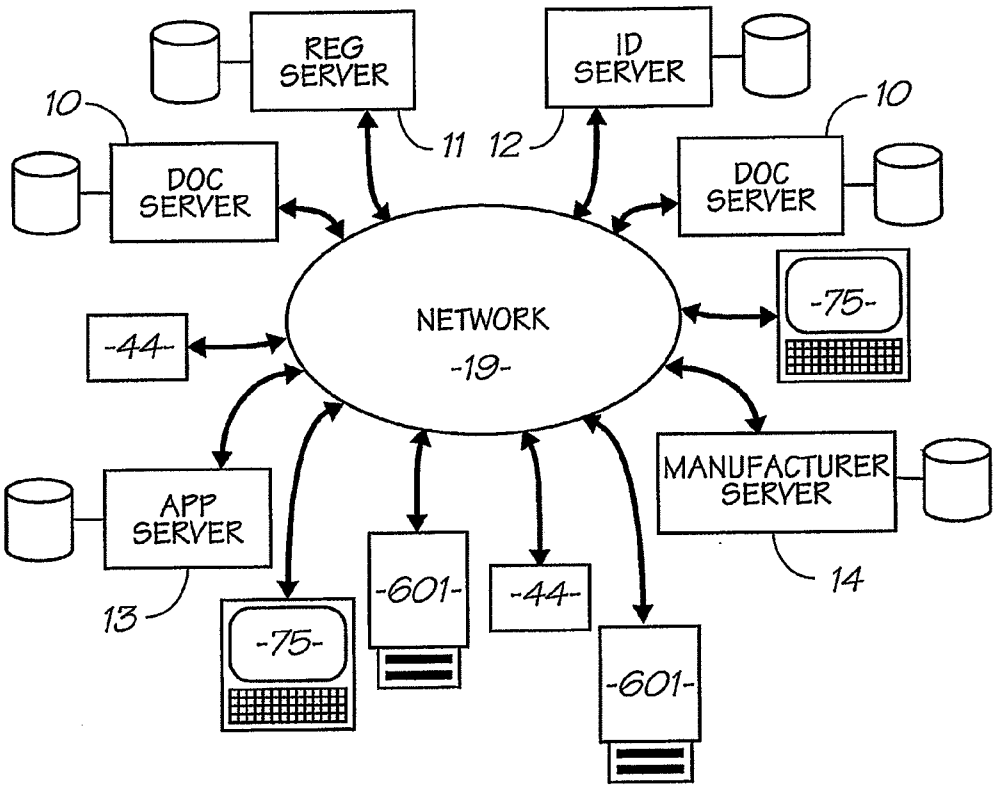
REG SERVER
ID SERVER
10
DOC SERVER
11
12
DOC SERVER
10
NETWORK
-19-
-44-
-75-
APP SERVER
13
-601-
-44-
MANUFACTURER SERVER
14
-75-
-601-

FIG. 3

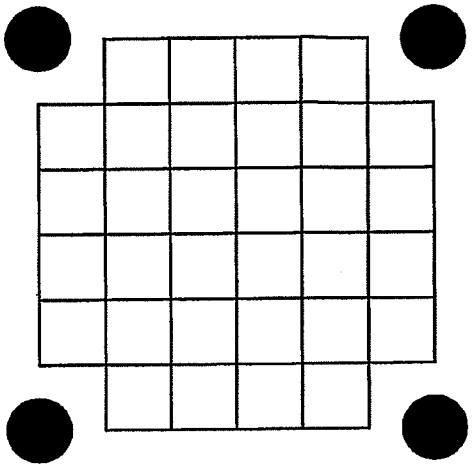

FIG. 4

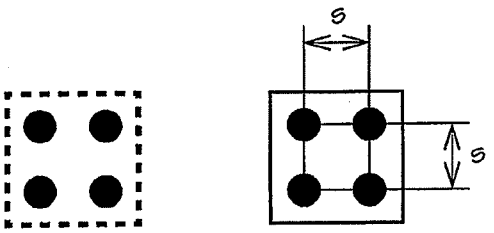

FIG. 5

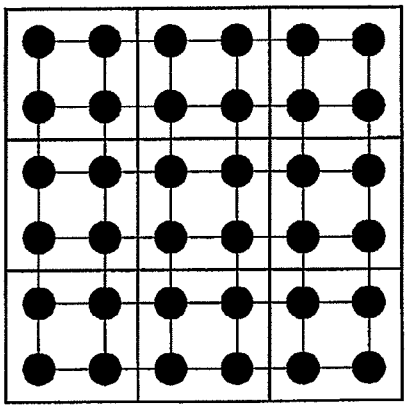

FIG. 6

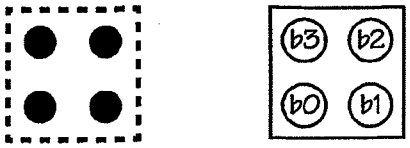

FIG. 7

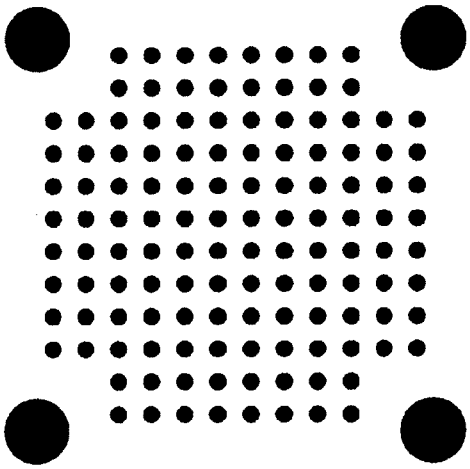

FIG. 8

00	10
01	11

FIG. 9

00	10	00	10	00	10
01	11	01	11	01	11
00	10	00	10	00	10
01	11	01	11	01	11

FIG. 10

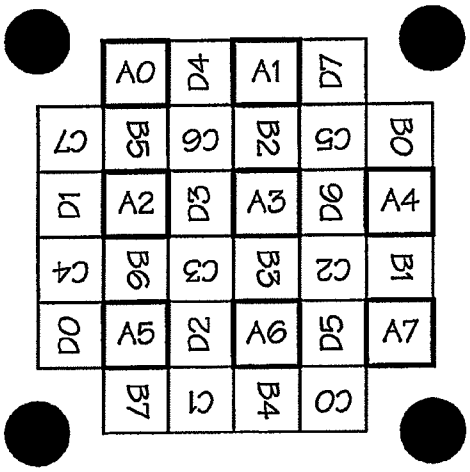

FIG. 11

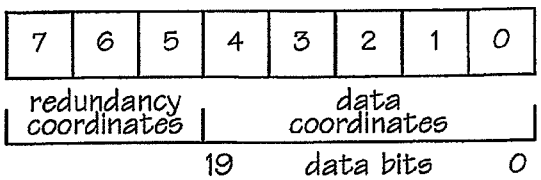

FIG. 12

3	2	1
4	-	0
5	6	7

FIG. 13

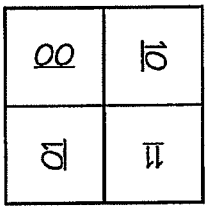

FIG. 14

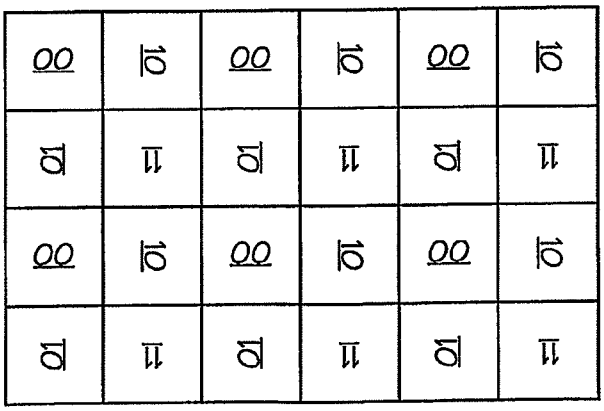

FIG. 15

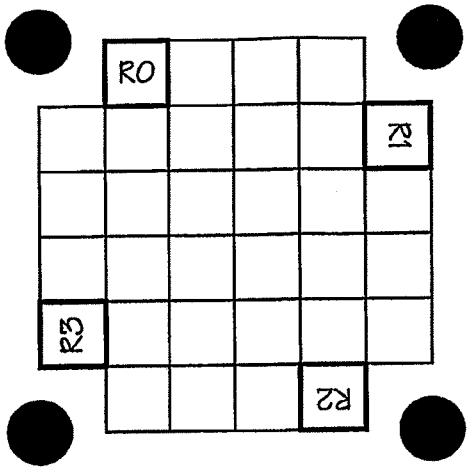

FIG. 16

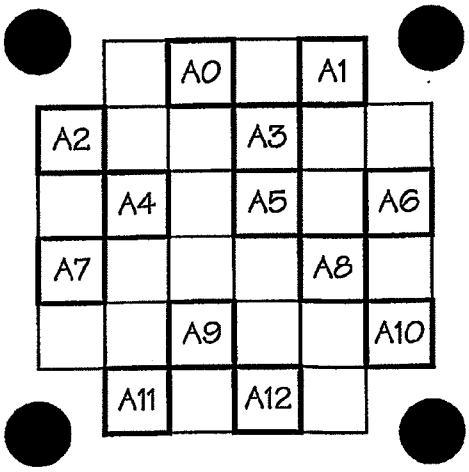

FIG. 17

B0
B4
B1
E6
C9
B5
E14
C1
E4
C11
B2
E12
C3
D11
B6
D14
B3
E7
C8
D10
B7
C0
E5
C10
D13
E13
C2
D9
D12
D8
B8
B12
B9
E2
C13
B13
E10
C5
E0
D7
B10
E8
C7
D3
B14
D6
B11
E3
C12
D2
E11
C4
E1
C14
D5
E9
C6
D1
D4
D0

FIG. 18

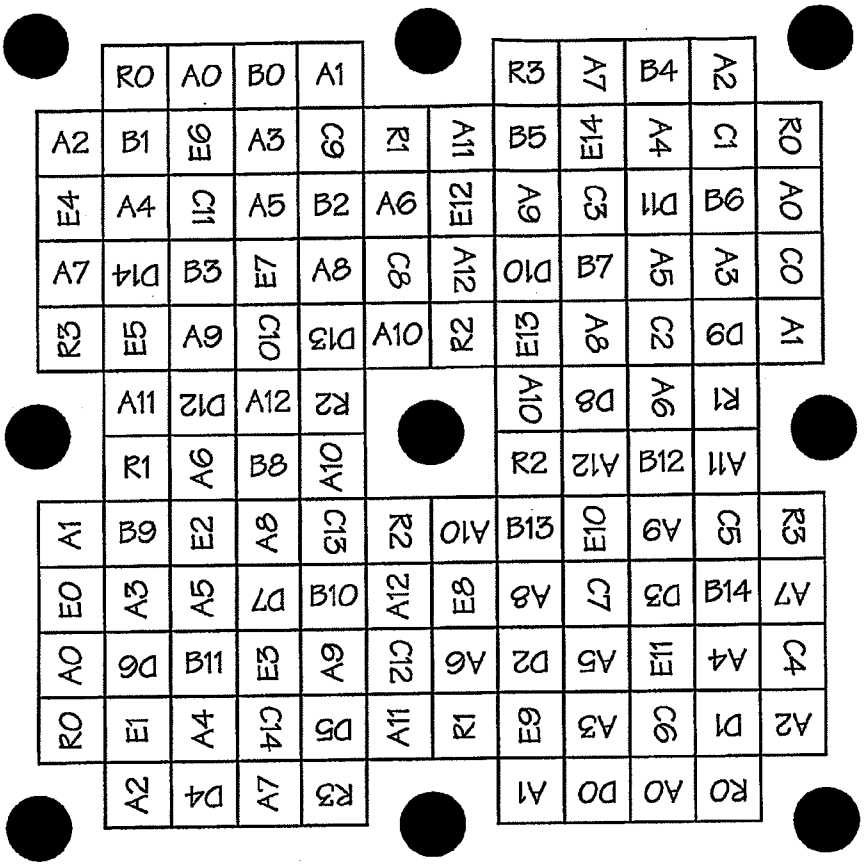
R0 A0 B0 A1
R3 A7 B4 A2
A2 B1 E6 A3 C3 R1 A11 B5 E14 A4 C1 R0
E4 A4 C1 A5 B2 A6 E12 A9 C3 D11 B6 A0
A7 D14 B3 E7 A8 C8 A12 D10 B7 A5 A3 C0
R3 E5 A9 C0 D13 A10 R2 E13 A8 C2 D9 A1
A11 D12 A12 R2 A10 D8 A6 R1
R1 A6 B8 A10 R2 A12 B12 A11
A1 B9 E2 A8 C13 R2 A10 B13 E10 A9 C5 R3
E0 A3 A5 D7 B10 A12 E8 A8 C7 D3 B14 A7
A0 D6 B11 E3 A9 C12 A6 D2 A5 E11 A4 C4
R0 E1 A4 C14 D5 A11 R1 E9 A3 C6 D1 A2
A2 D4 A7 R3 A1 D0 A0 R0

FIG. 19

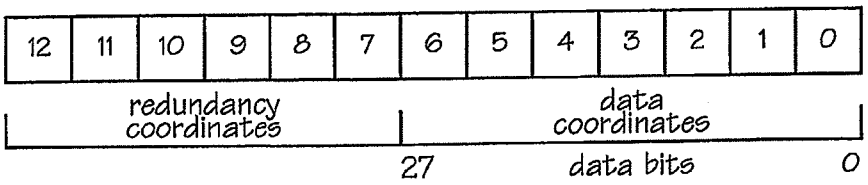
12 11 10 9 8 7 6 5 4 3 2 1 0
redundancy coordinates
data coordinates
27
data bits
0

FIG. 20

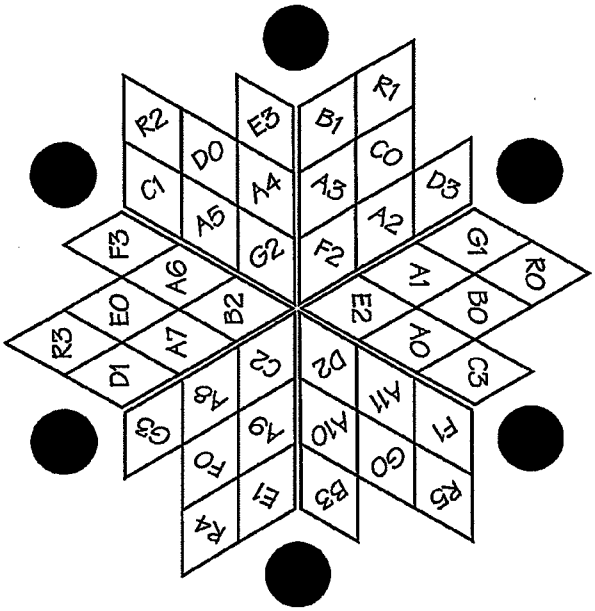
R1
R2
E3
B1
C0
D0
C1
A4
A3
D3
A5
A2
F3
G2
F2
G1
A6
A1
R0
E0
B2
E2
B0
R3
A7
A0
C3
D1
C2
D2
A11
G3
A8
A9
A10
E1
F0
G0
E2
R4
E1
B3

FIG. 21

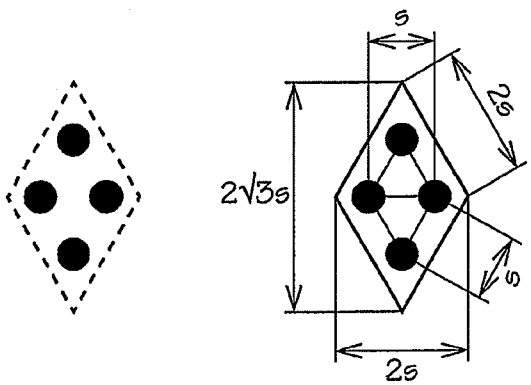
s
2s
2√3s
s
2s

FIG. 22

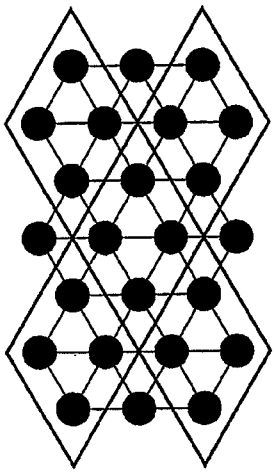

FIG. 23

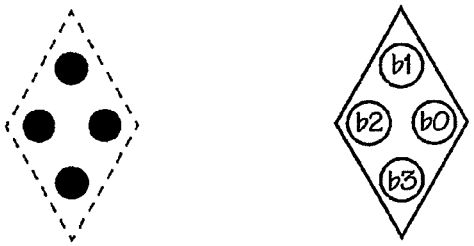

FIG. 24

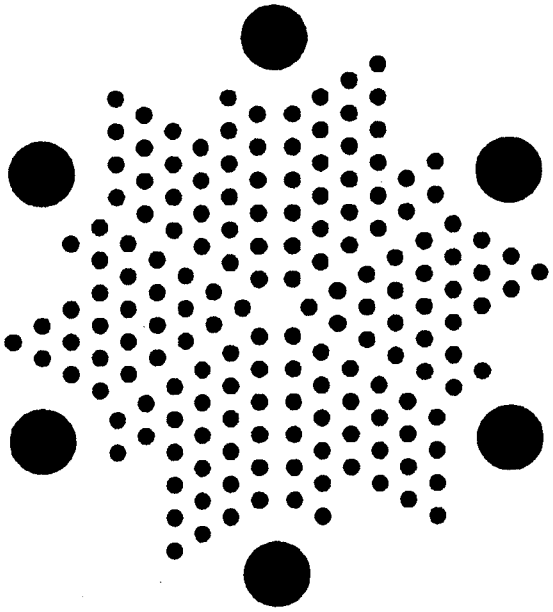

FIG. 25

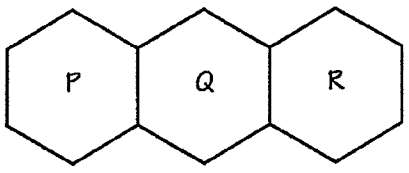

FIG. 26

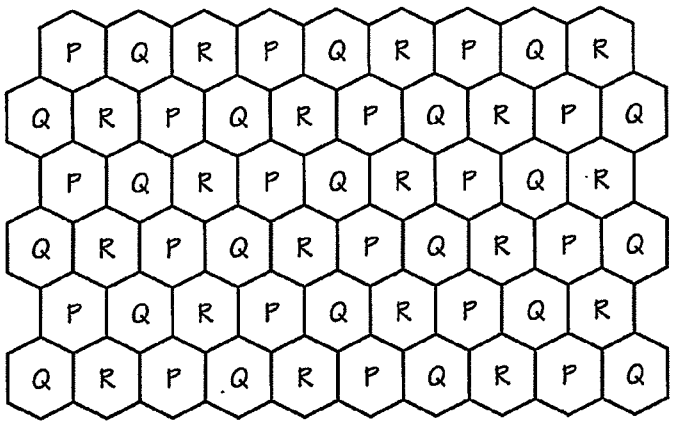
P Q R P Q R P Q R
Q R P Q R P Q R P Q
P Q R P Q R P Q R
Q R P Q R P Q R P Q
P Q R P Q R P Q R
Q R P Q R P Q R P Q

FIG. 27

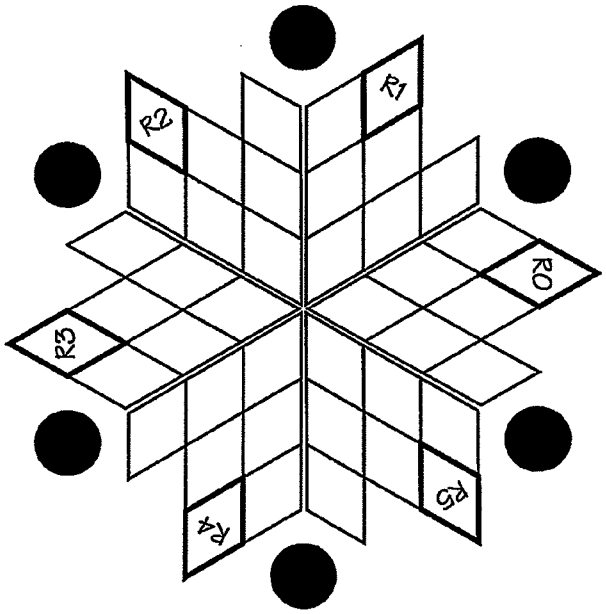
R1
R2
R0
R3
R4
R5

FIG. 28

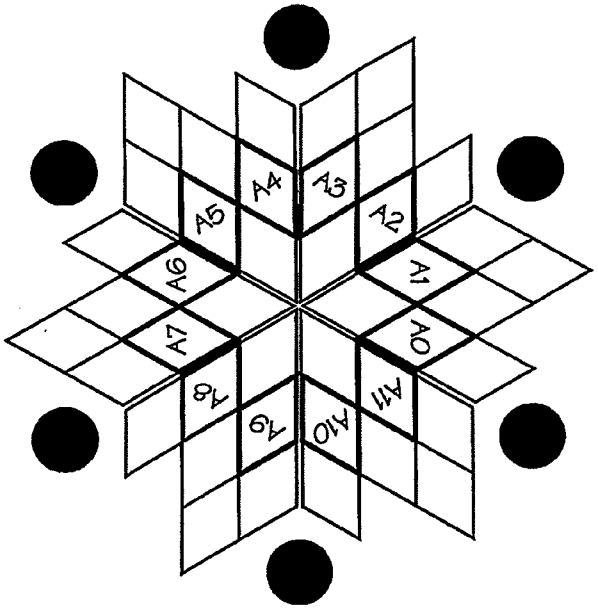
A4
A3
A5
A2
A6
A1
A7
A0
A8
A11
A9
A10

FIG. 29

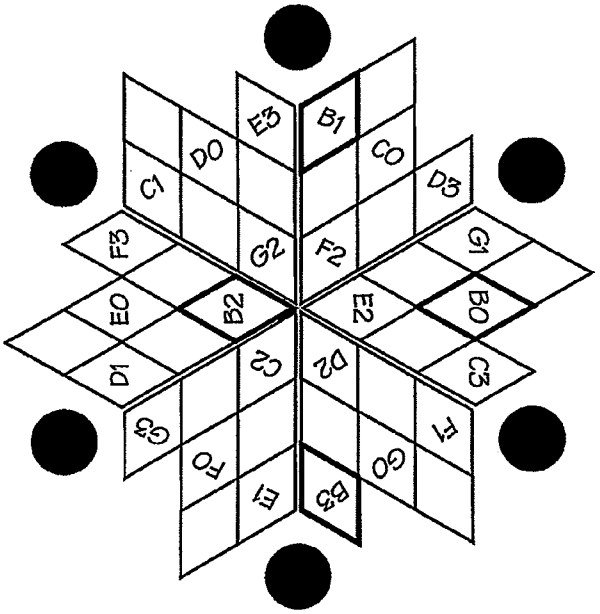
E3
B1
D0
C0
C1
D3
F3
G2
F2
G1
E0
B2
E2
B0
D1
C2
D2
C3
G3
F0
E1
G0
F1
B3

FIG. 30

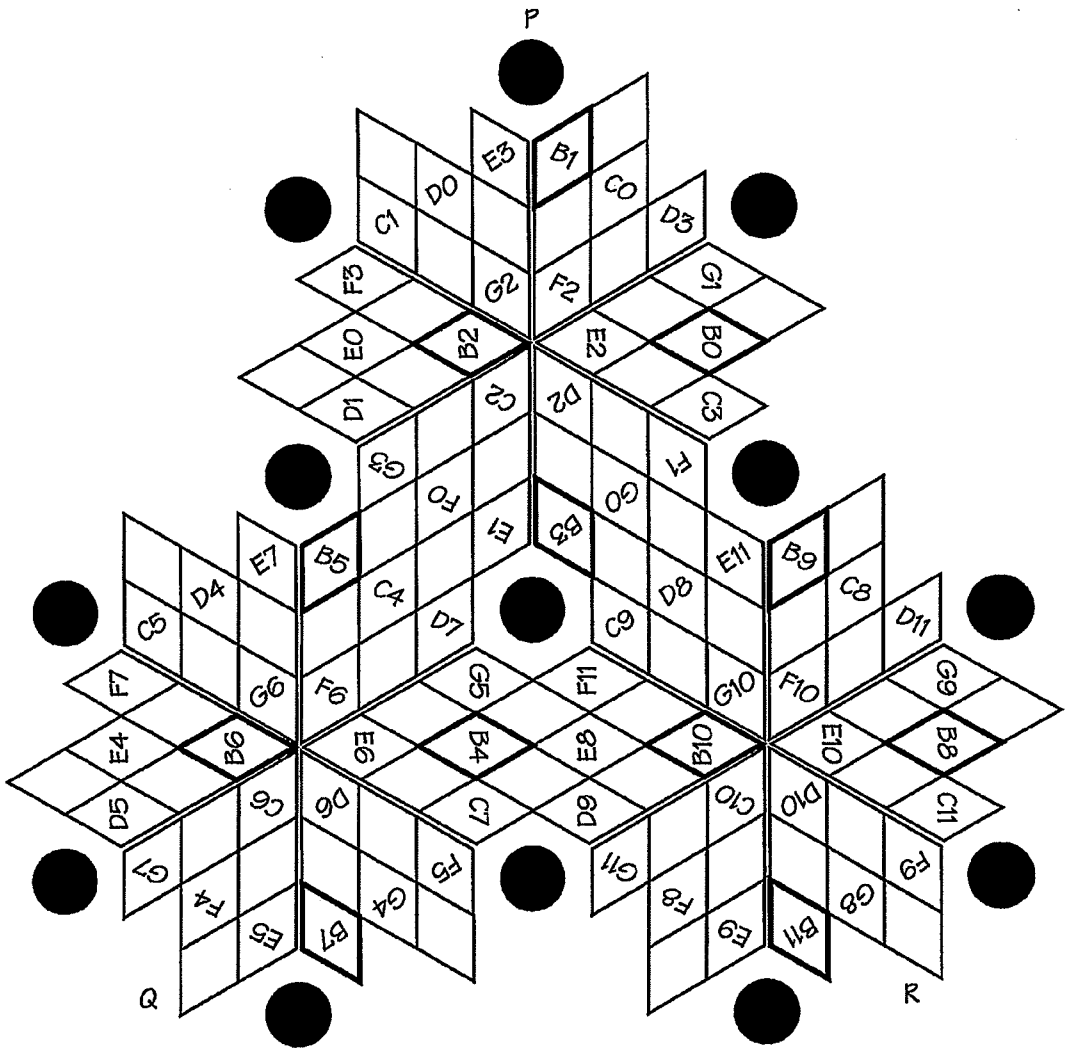
P
Q
R
E3
B1
C0
D3
C1
D0
G1
F2
G2
F3
B0
E2
B2
E0
C3
D2
C2
D1
F1
G0
E1
F0
G3
B3
E11
B9
C8
D11
D8
C9
G10
F10
G9
F11
G5
E8
B8
E10
B10
C10
D10
C11
D9
C7
G11
F9
G8
B11
E9
F8
F5
G4
B7
E5
F4
G7
D6
C6
D5
E4
B6
G6
F6
E6
B4
F7
D4
C5
E7
B5
C4
D7

FIG. 31

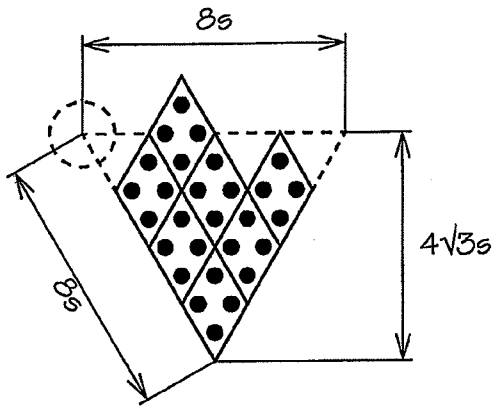

FIG. 32

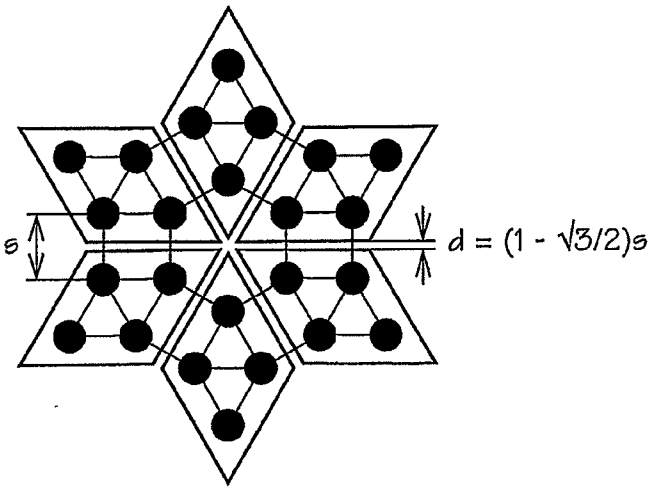

FIG. 33

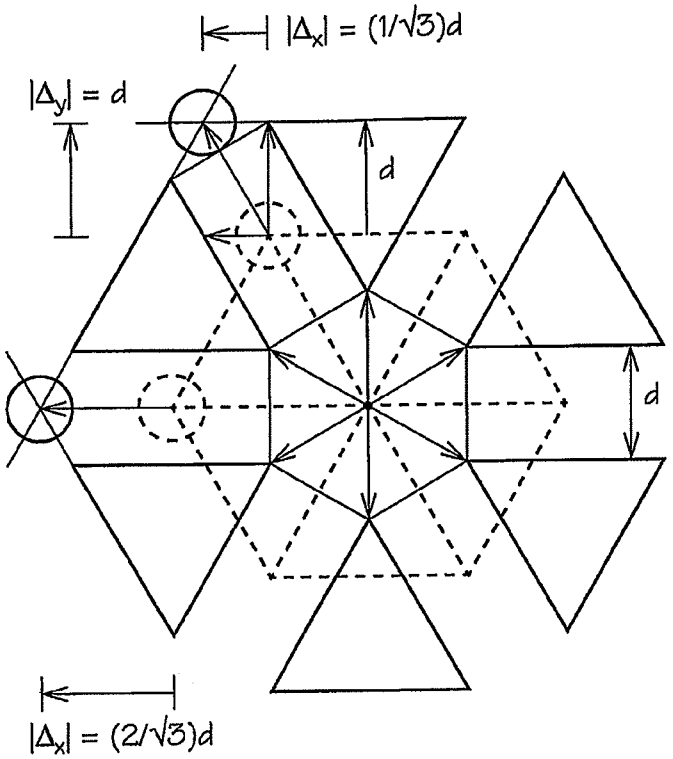
$|\Delta_x| = (1/\sqrt{3})d$
$|\Delta_y| = d$
d
d
$|\Delta_x| = (2/\sqrt{3})d$

FIG. 34

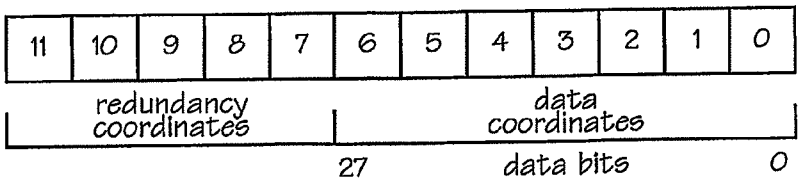
11
10
9
8
7
6
5
4
3
2
1
0
redundancy coordinates
data coordinates
27
data bits
0

FIG. 35

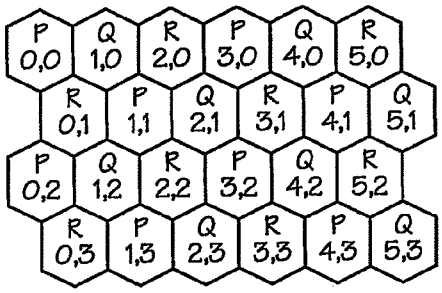

FIG. 36

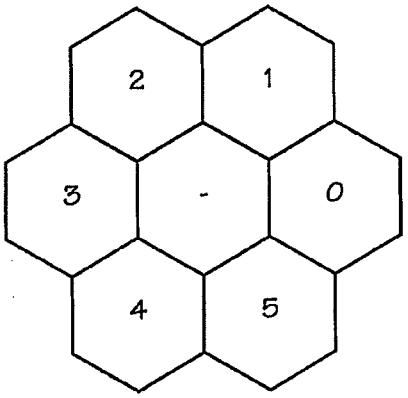

FIG. 37

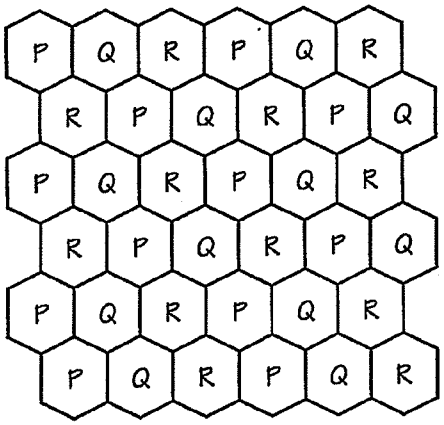

FIG. 38

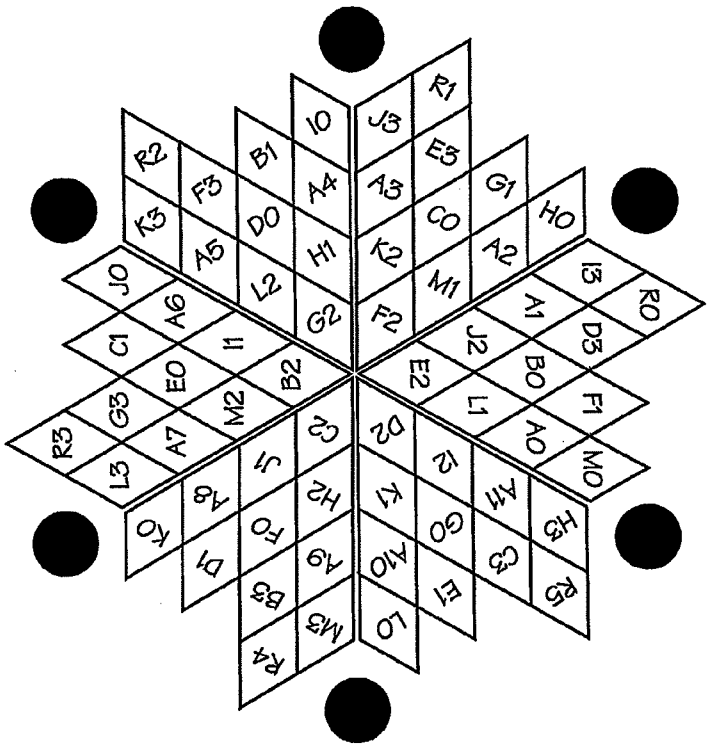
R1
J3
I0
E3
B1
R2
A3
G1
A4
F3
H0
C0
D0
K3
A2
A5
H1
K2
I3
L2
M1
J0
A1
R0
A6
G2
F2
D3
C1
J2
I1
B0
E0
B2
E2
F1
G3
L1
M2
A0
R3
A7
M0
C2
D2
J1
I2
L3
A8
A1
H2
K1
K0
F0
G0
H3
D1
A9
A0
C3
B3
E1
B2
M3
L0
R4

FIG. 39

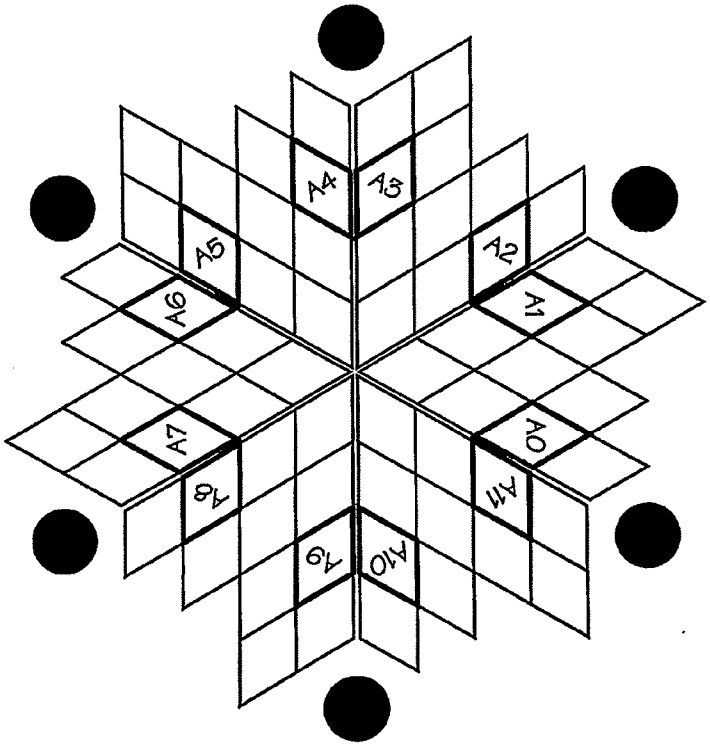

FIG. 40

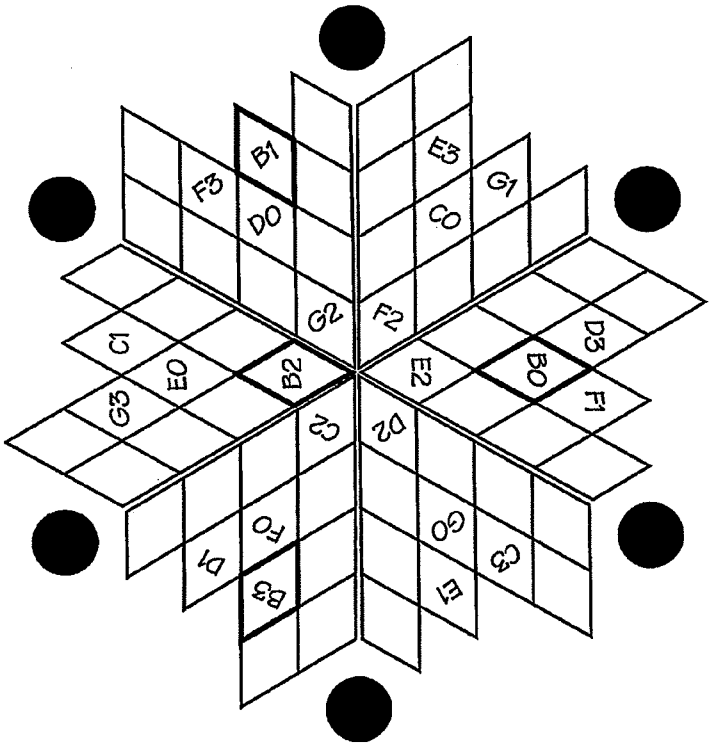

FIG. 41

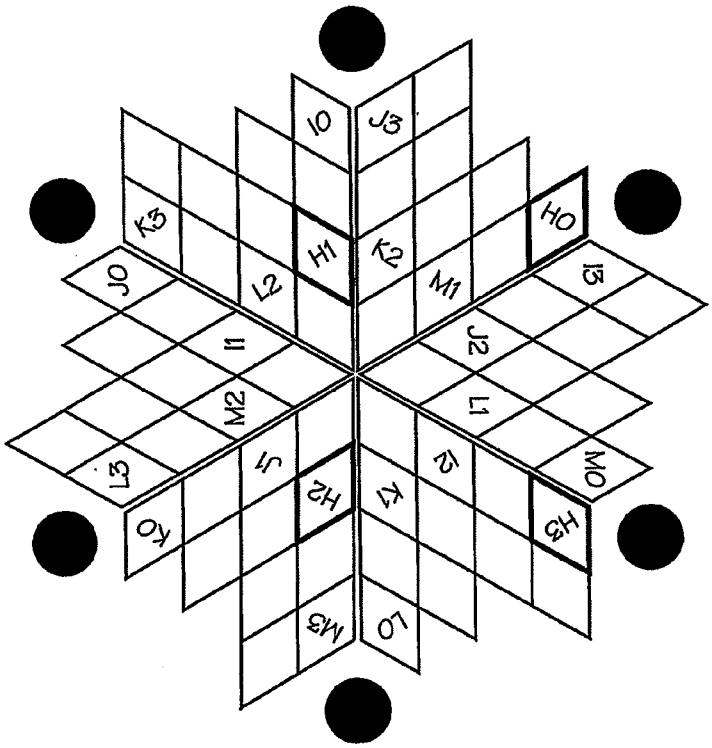
I0
J3
K3
H1
K2
H0
J0
L2
M1
I3
I1
J2
M2
L1
L3
J1
I2
M0
K0
H2
K1
H3
M3
L0

FIG. 42

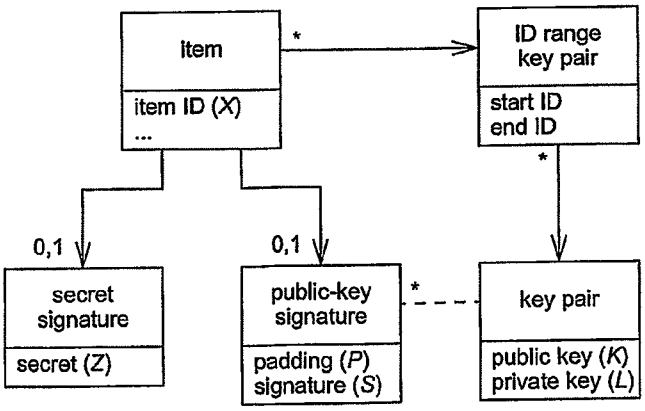
item
item ID (X)
...
*
ID range
key pair
start ID
end ID
*
0,1
0,1
secret
signature
secret (Z)
public-key
signature
padding (P)
signature (S)
*
key pair
public key (K)
private key (L)

FIG. 43

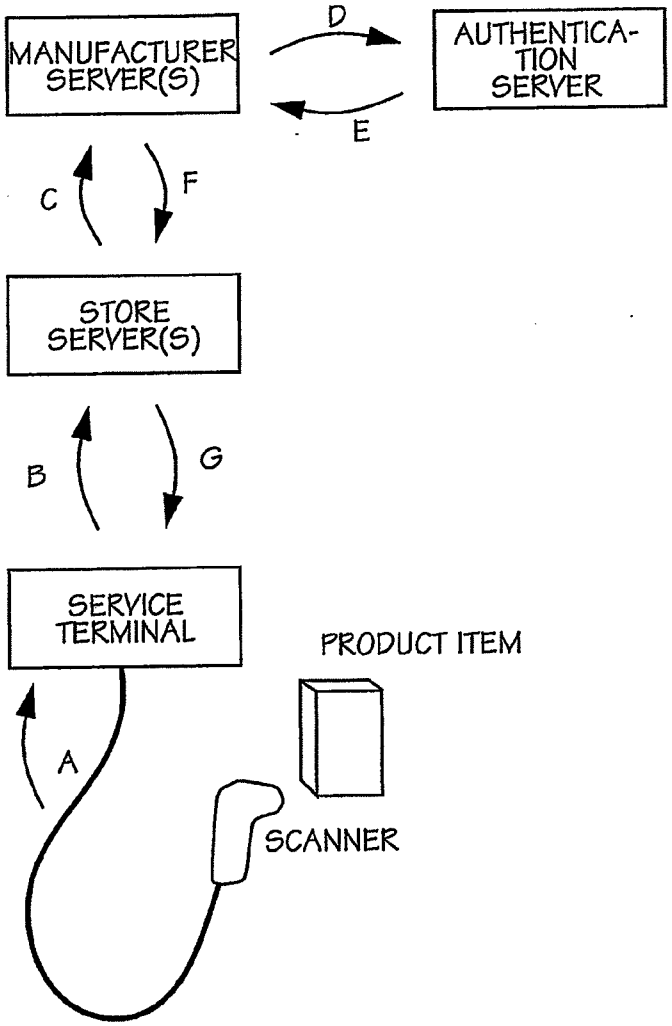
MANUFACTURER SERVER(S)
D
AUTHENTICA-TION SERVER
E
C
F
STORE SERVER(S)
B
G
SERVICE TERMINAL
PRODUCT ITEM
A
SCANNER

FIG. 44

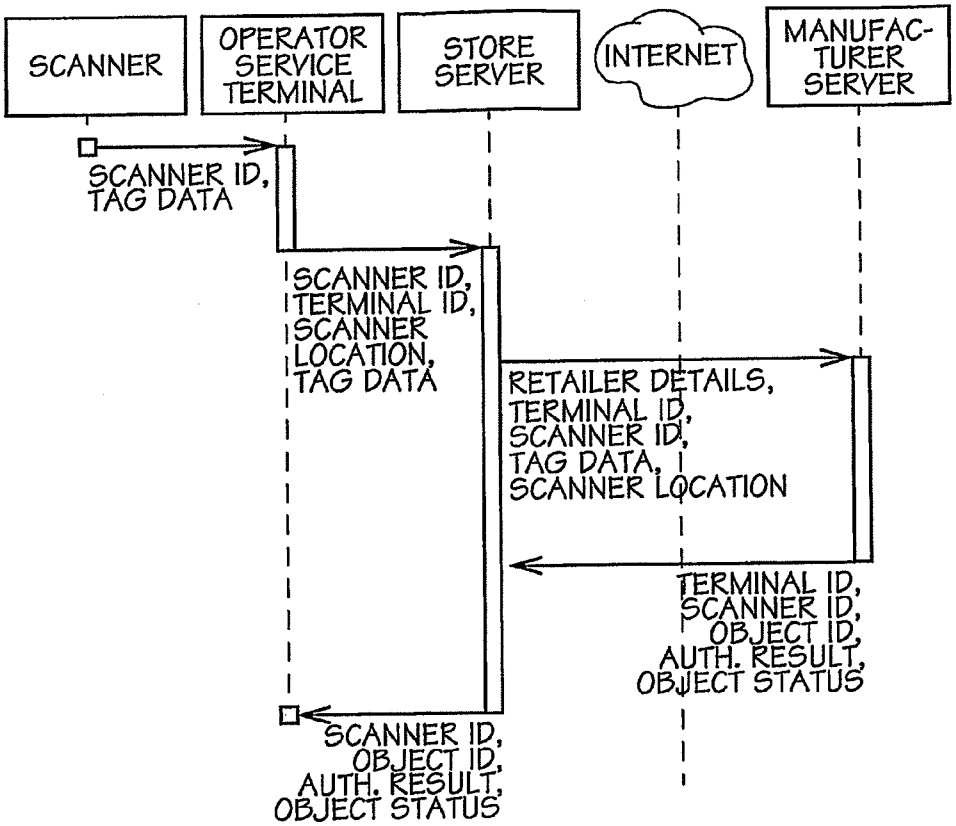
SCANNER
OPERATOR SERVICE TERMINAL
STORE SERVER
INTERNET
MANUFAC-TURER SERVER
SCANNER ID, TAG DATA
SCANNER ID, TERMINAL ID, SCANNER LOCATION, TAG DATA
RETAILER DETAILS, TERMINAL ID, SCANNER ID, TAG DATA, SCANNER LOCATION
TERMINAL ID, SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS

FIG. 45

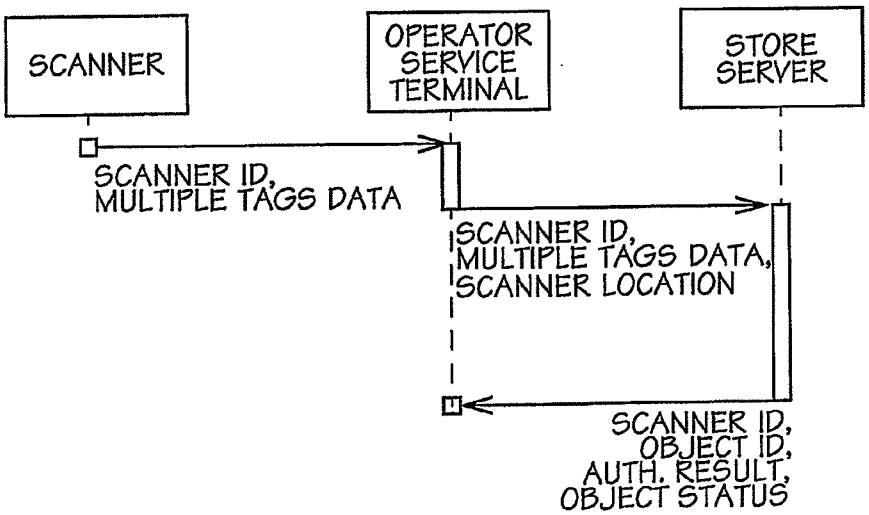
SCANNER
OPERATOR SERVICE TERMINAL
STORE SERVER
SCANNER ID, MULTIPLE TAGS DATA
SCANNER ID, MULTIPLE TAGS DATA, SCANNER LOCATION
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS

FIG. 46

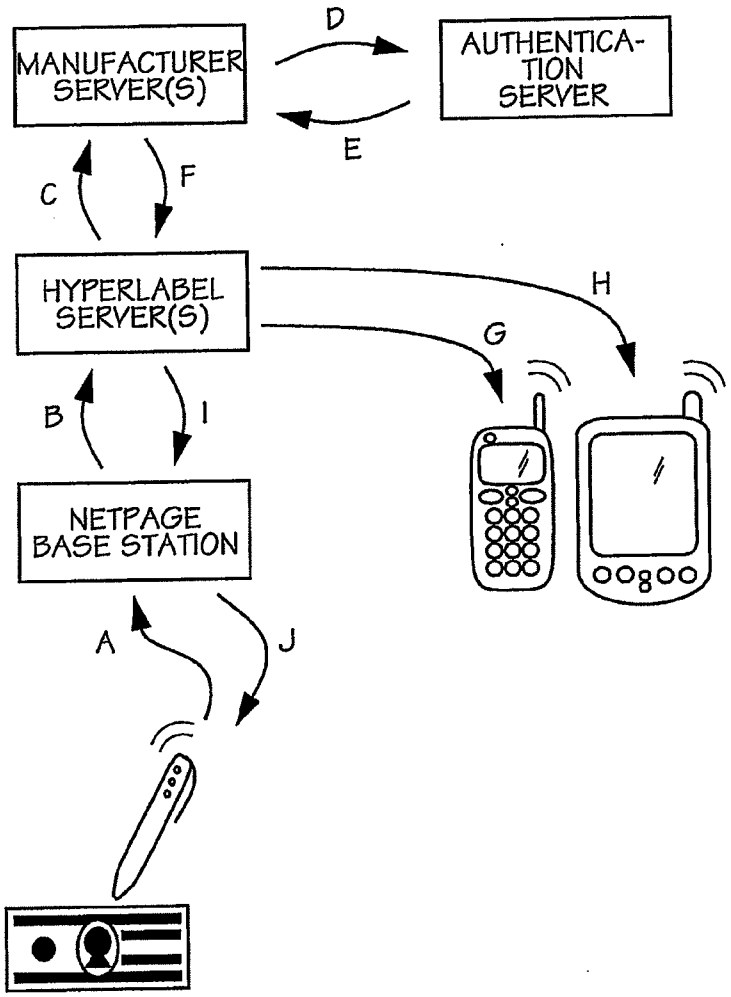
MANUFACTURER SERVER(S)
AUTHENTICA-TION SERVER
D
E
C
F
HYPERLABEL SERVER(S)
H
G
B
I
NETPAGE BASE STATION
A
J

FIG. 47

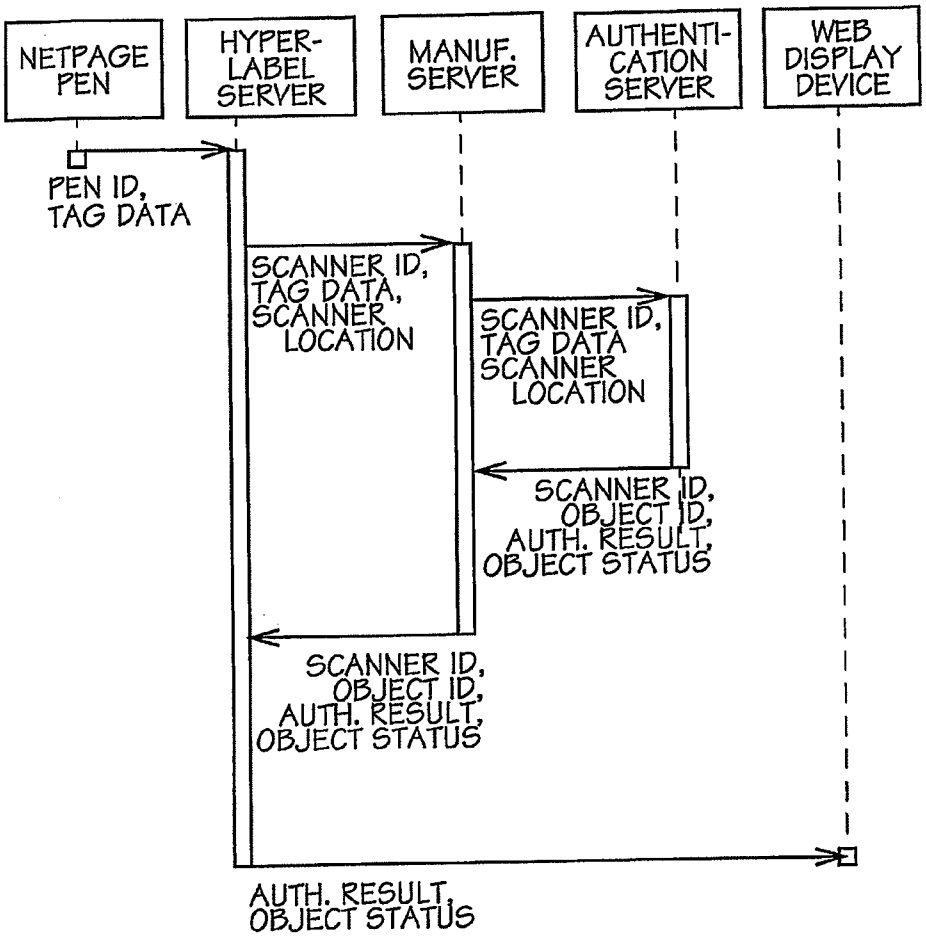
NETPAGE PEN
HYPER-LABEL SERVER
MANUF. SERVER
AUTHENTI-CATION SERVER
WEB DISPLAY DEVICE
PEN ID, TAG DATA
SCANNER ID, TAG DATA, SCANNER LOCATION
SCANNER ID, TAG DATA SCANNER LOCATION
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
SCANNER ID, OBJECT ID, AUTH. RESULT, OBJECT STATUS
AUTH. RESULT, OBJECT STATUS

FIG. 48

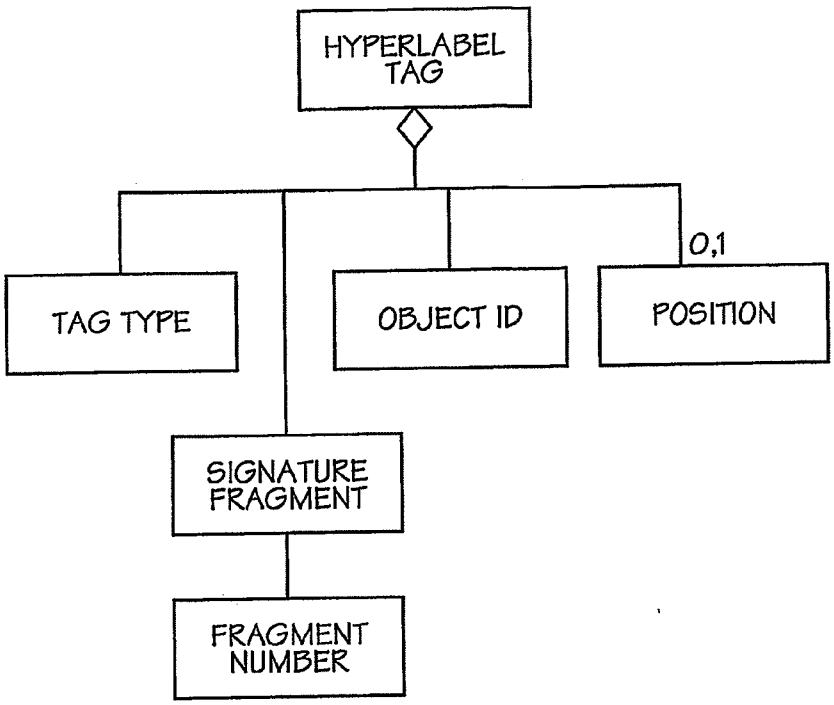
HYPERLABEL TAG
0,1
TAG TYPE
OBJECT ID
POSITION
SIGNATURE FRAGMENT
FRAGMENT NUMBER

FIG. 49

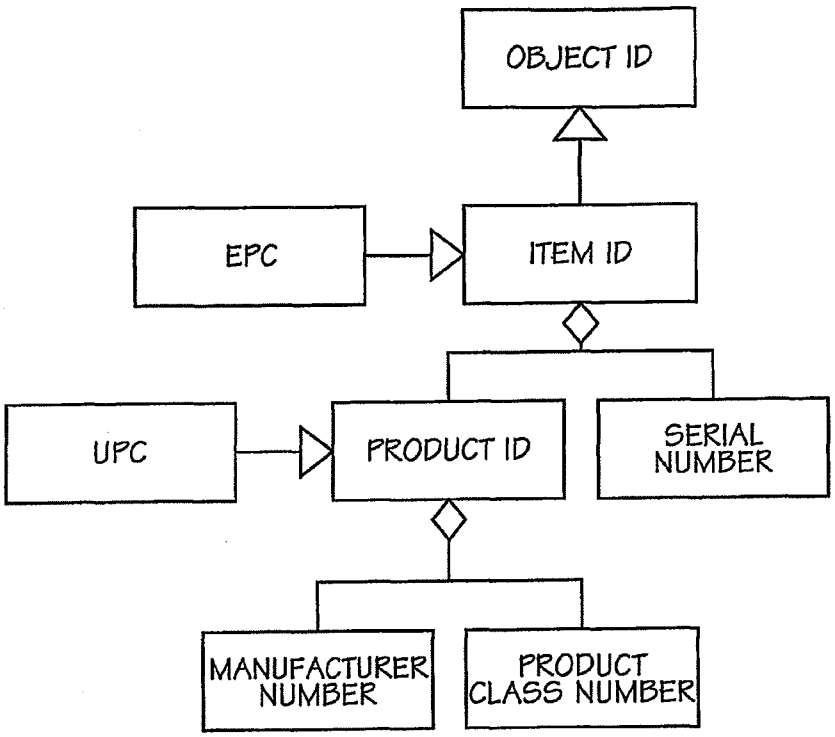
OBJECT ID
EPC
ITEM ID
UPC
PRODUCT ID
SERIAL NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 50

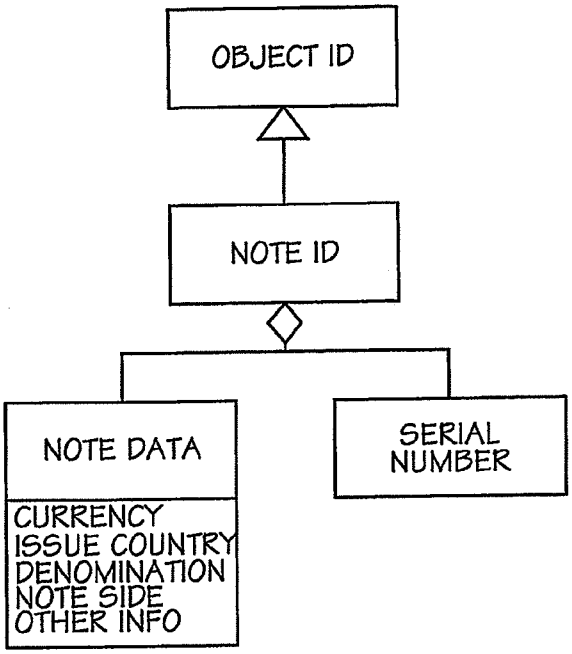
OBJECT ID
NOTE ID
NOTE DATA
CURRENCY
ISSUE COUNTRY
DENOMINATION
NOTE SIDE
OTHER INFO
SERIAL NUMBER

FIG. 51

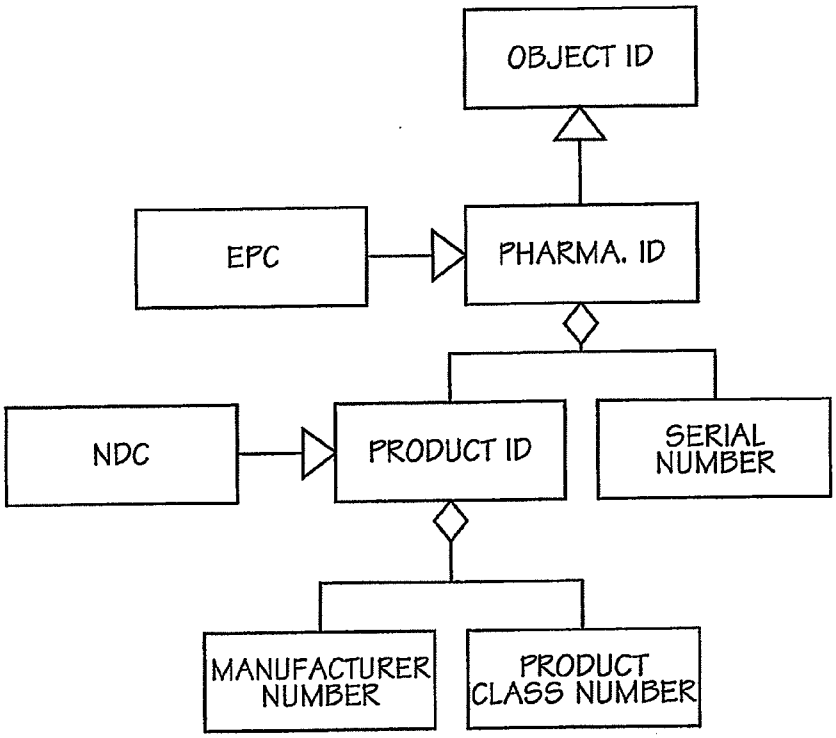
OBJECT ID
EPC
PHARMA. ID
NDC
PRODUCT ID
SERIAL NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 52

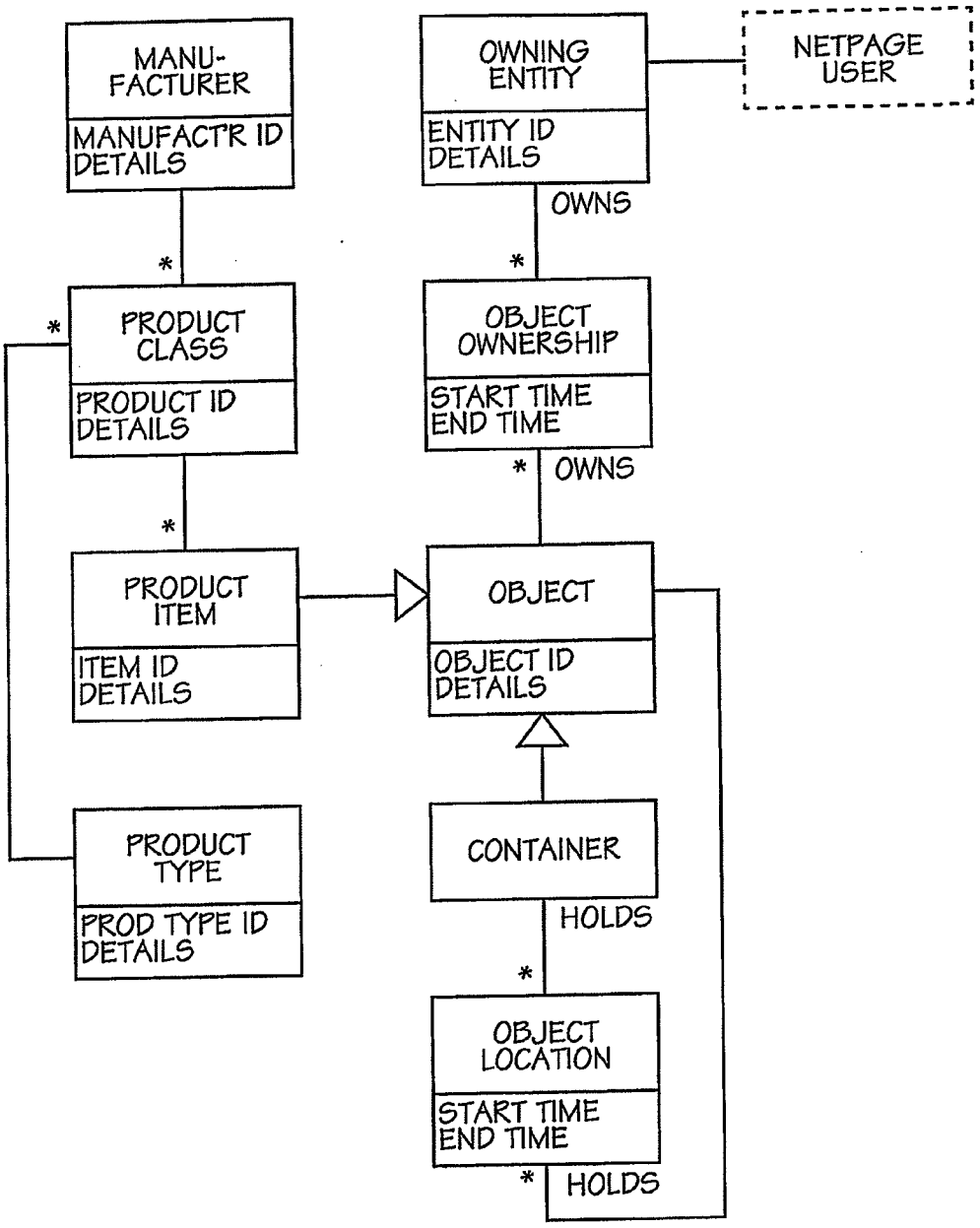
MANU-
FACTURER
MANUFACT'R ID
DETAILS
OWNING
ENTITY
ENTITY ID
DETAILS
NETPAGE
USER
OWNS
*
*
PRODUCT
CLASS
PRODUCT ID
DETAILS
OBJECT
OWNERSHIP
START TIME
END TIME
OWNS
PRODUCT
ITEM
ITEM ID
DETAILS
OBJECT
OBJECT ID
DETAILS
PRODUCT
TYPE
PROD TYPE ID
DETAILS
CONTAINER
HOLDS
OBJECT
LOCATION
START TIME
END TIME
HOLDS

FIG. 53

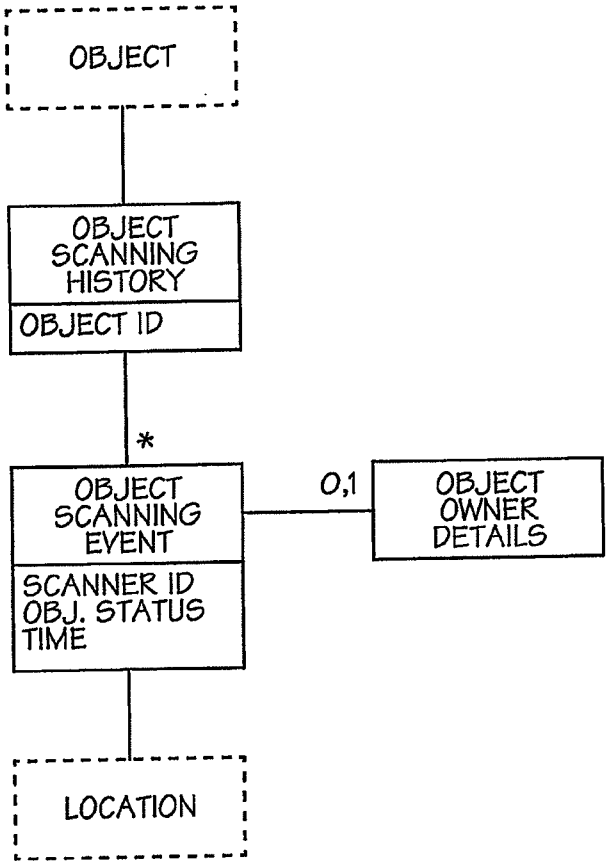
OBJECT
OBJECT SCANNING HISTORY
OBJECT ID
*
OBJECT SCANNING EVENT
SCANNER ID
OBJ. STATUS
TIME
0,1
OBJECT OWNER DETAILS
LOCATION

FIG. 54

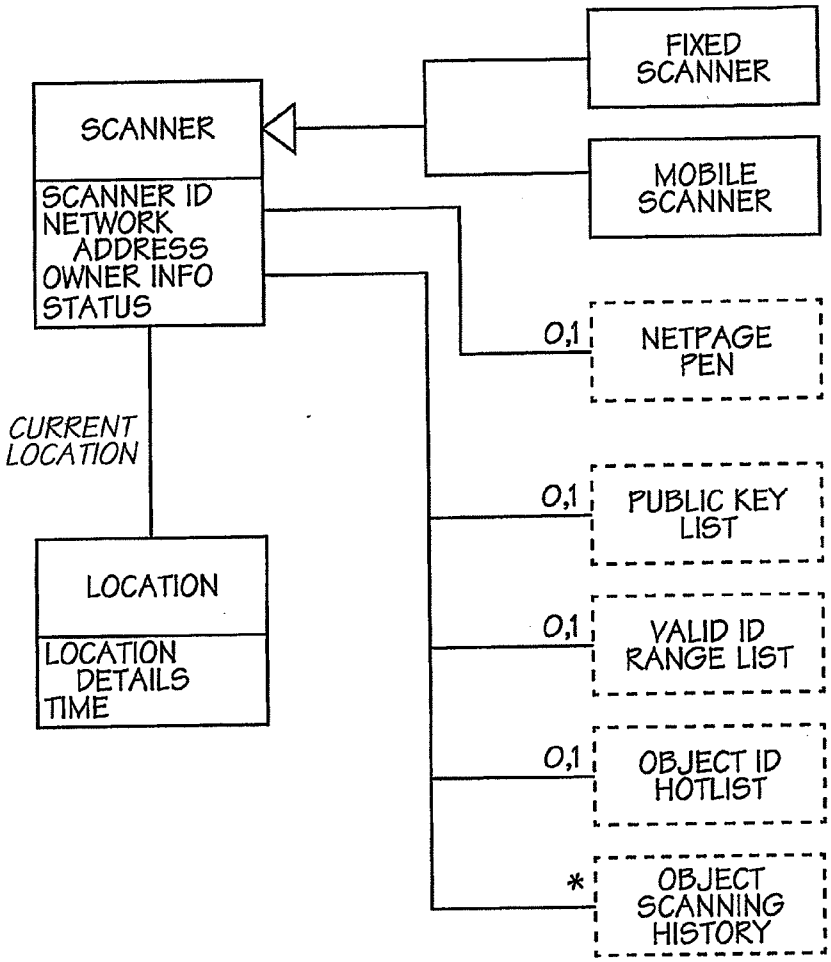
FIXED SCANNER
SCANNER
MOBILE SCANNER
SCANNER ID
NETWORK ADDRESS
OWNER INFO
STATUS
0,1
NETPAGE PEN
CURRENT LOCATION
0,1
PUBLIC KEY LIST
LOCATION
0,1
VALID ID RANGE LIST
LOCATION DETAILS
TIME
0,1
OBJECT ID HOTLIST
*
OBJECT SCANNING HISTORY

FIG. 55

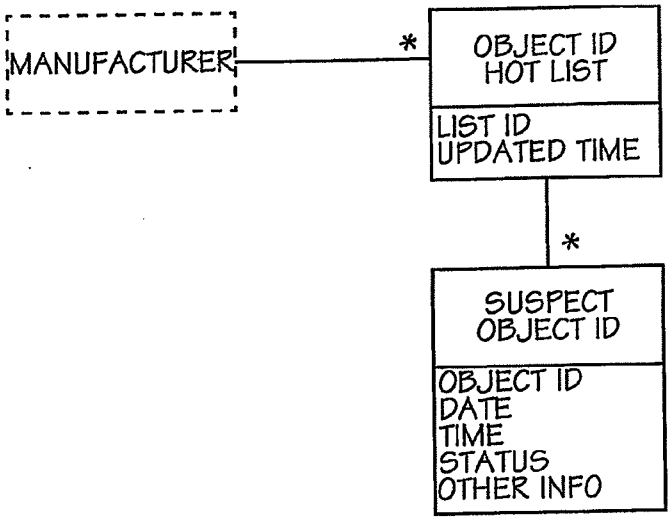
MANUFACTURER
*
OBJECT ID
HOT LIST
LIST ID
UPDATED TIME
*
SUSPECT
OBJECT ID
OBJECT ID
DATE
TIME
STATUS
OTHER INFO

FIG. 56

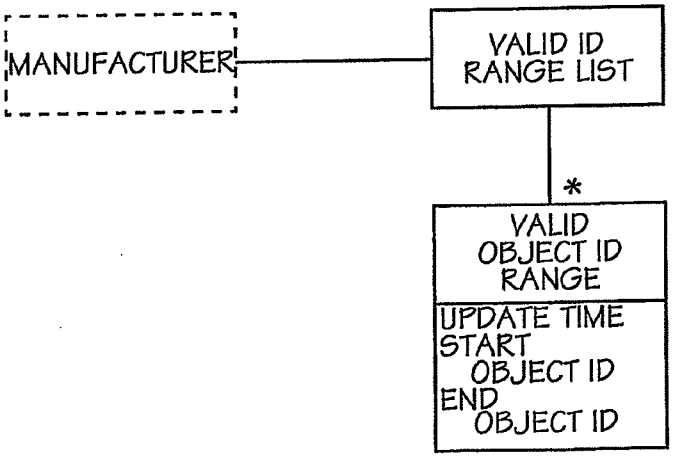
MANUFACTURER
VALID ID
RANGE LIST
*
VALID
OBJECT ID
RANGE
UPDATE TIME
START
OBJECT ID
END
OBJECT ID

FIG. 57

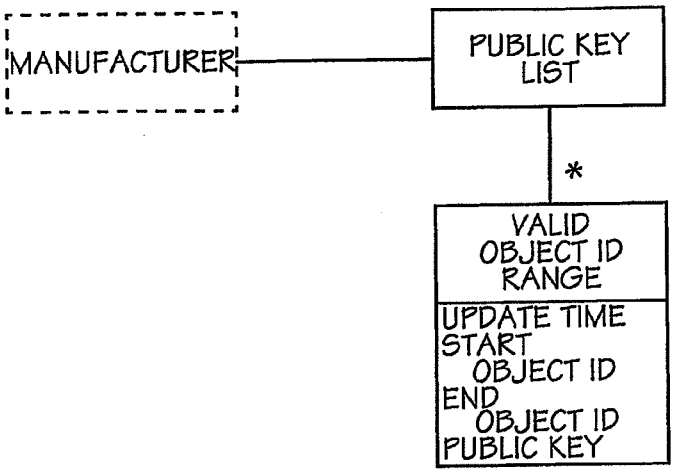
MANUFACTURER
PUBLIC KEY LIST
*
VALID OBJECT ID RANGE
UPDATE TIME
START OBJECT ID
END OBJECT ID
PUBLIC KEY

FIG. 58

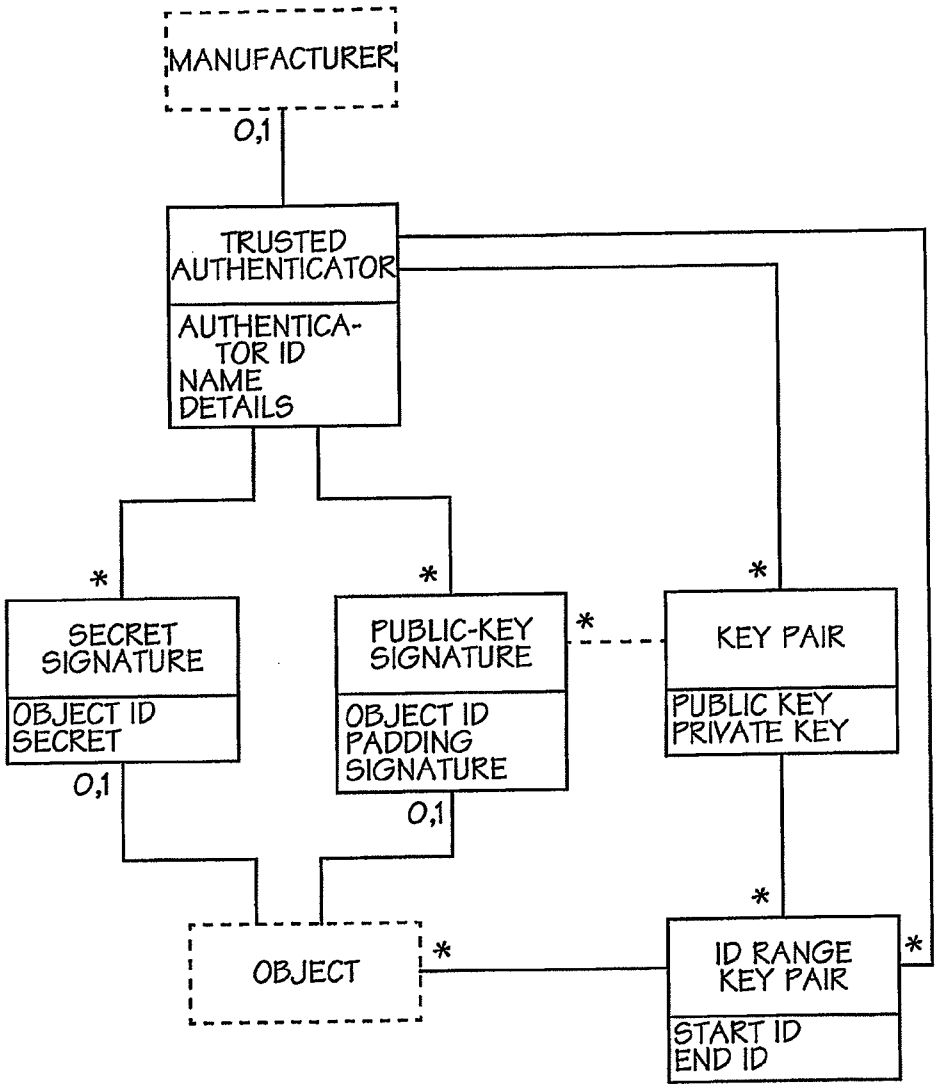
MANUFACTURER
0,1
TRUSTED AUTHENTICATOR
AUTHENTICA-TOR ID
NAME
DETAILS
*
*
*
SECRET SIGNATURE
OBJECT ID
SECRET
PUBLIC-KEY SIGNATURE
OBJECT ID
PADDING
SIGNATURE
KEY PAIR
PUBLIC KEY
PRIVATE KEY
0,1
0,1
*
*
*
OBJECT
ID RANGE KEY PAIR
START ID
END ID

FIG. 59

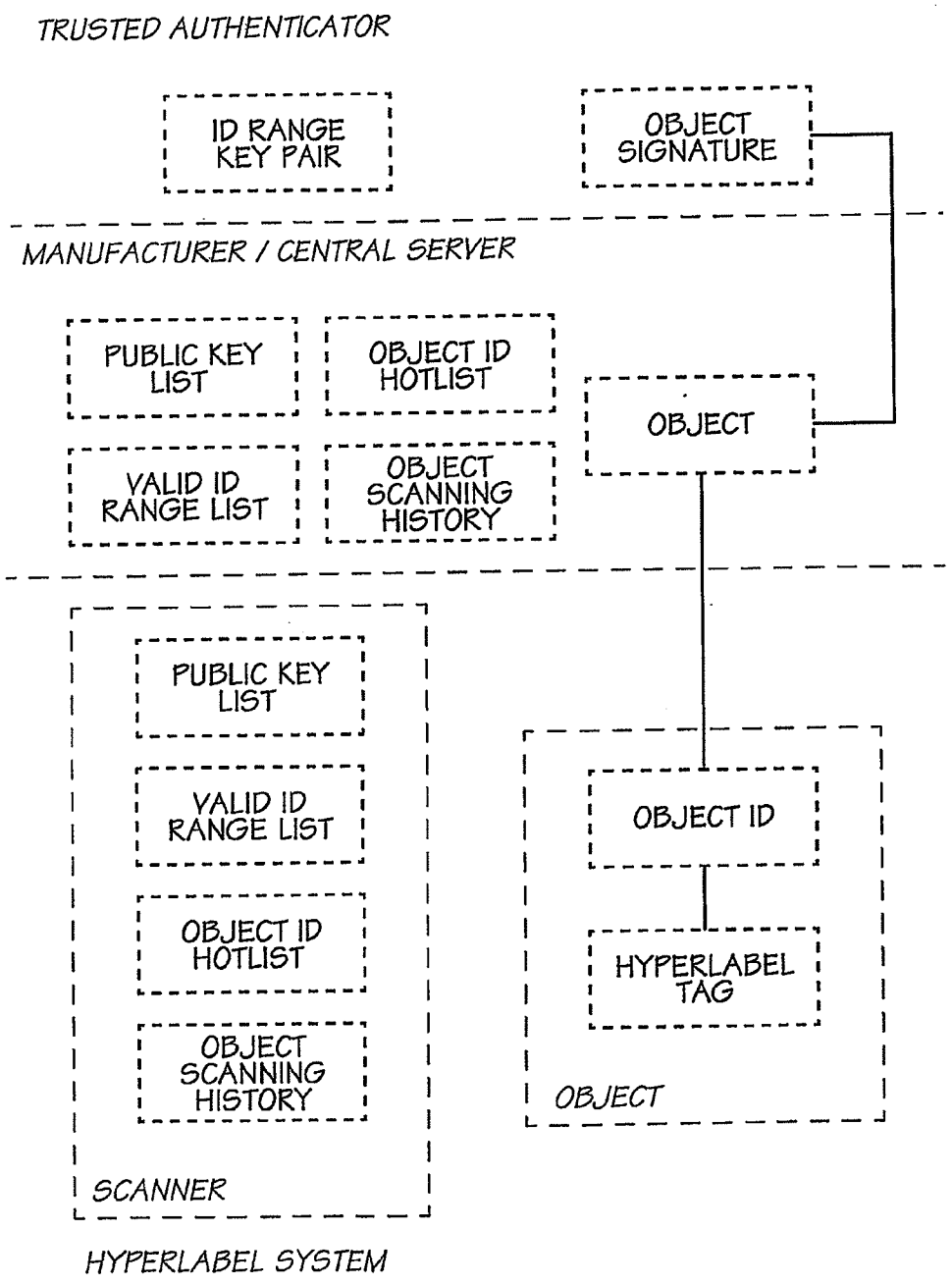
TRUSTED AUTHENTICATOR
ID RANGE KEY PAIR
OBJECT SIGNATURE
MANUFACTURER / CENTRAL SERVER
PUBLIC KEY LIST
OBJECT ID HOTLIST
OBJECT
VALID ID RANGE LIST
OBJECT SCANNING HISTORY
PUBLIC KEY LIST
VALID ID RANGE LIST
OBJECT ID HOTLIST
OBJECT SCANNING HISTORY
SCANNER
OBJECT ID
HYPERLABEL TAG
OBJECT
HYPERLABEL SYSTEM

FIG. 60

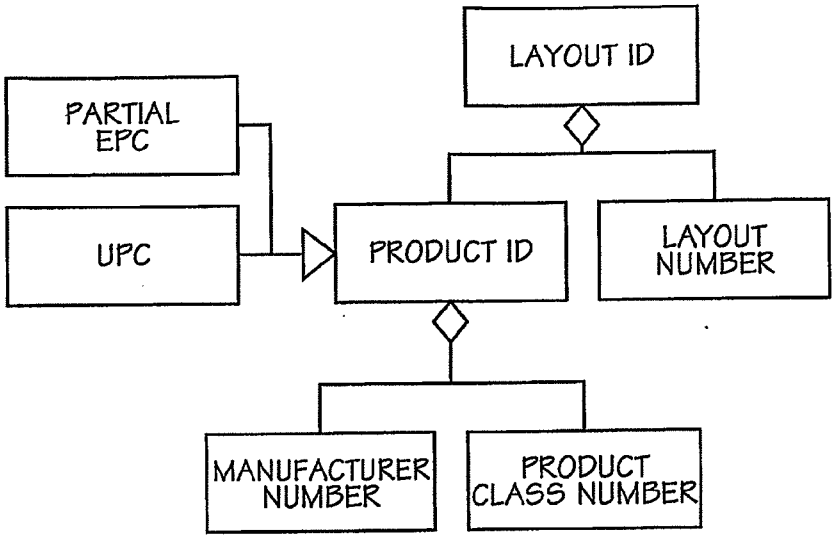
LAYOUT ID
PARTIAL EPC
UPC
PRODUCT ID
LAYOUT NUMBER
MANUFACTURER NUMBER
PRODUCT CLASS NUMBER

FIG. 61

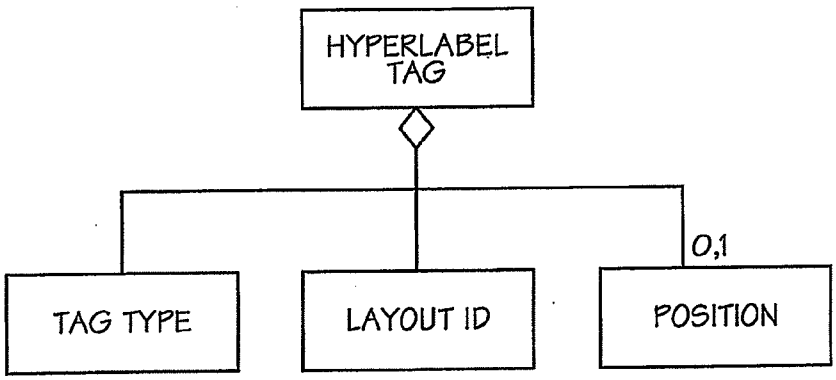
HYPERLABEL TAG
0,1
TAG TYPE
LAYOUT ID
POSITION

FIG. 62

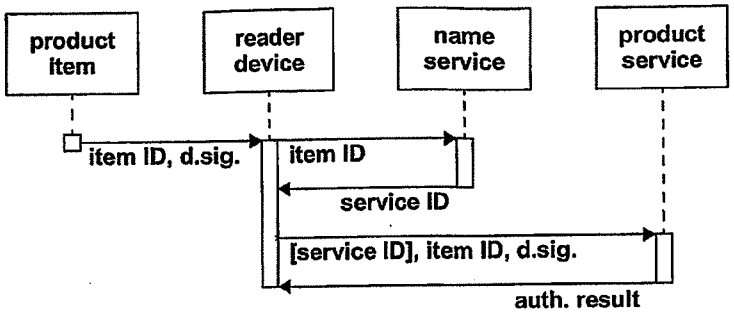
product item
reader device
name service
product service
item ID, d.sig.
item ID
service ID
[service ID], item ID, d.sig.
auth. result

FIG. 63

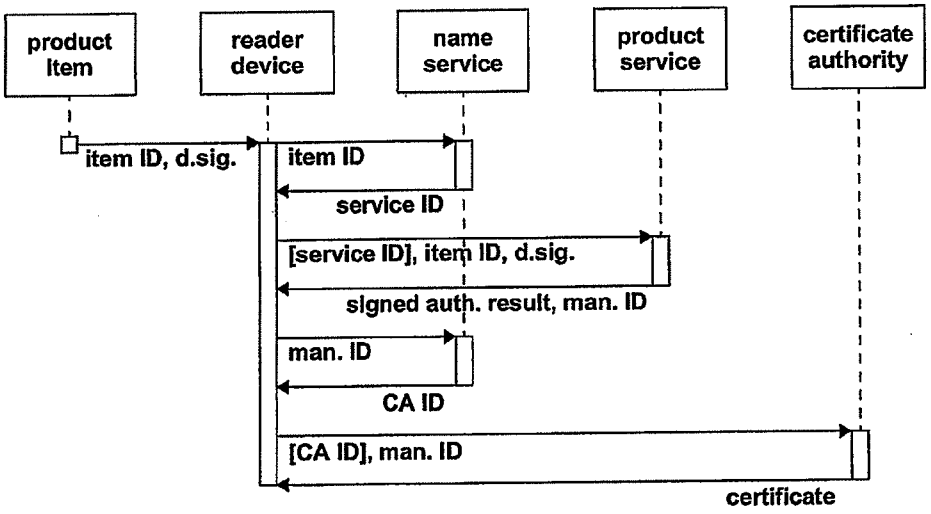
product item
reader device
name service
product service
certificate authority
item ID, d.sig.
item ID
service ID
[service ID], item ID, d.sig.
signed auth. result, man. ID
man. ID
CA ID
[CA ID], man. ID
certificate

FIG. 64

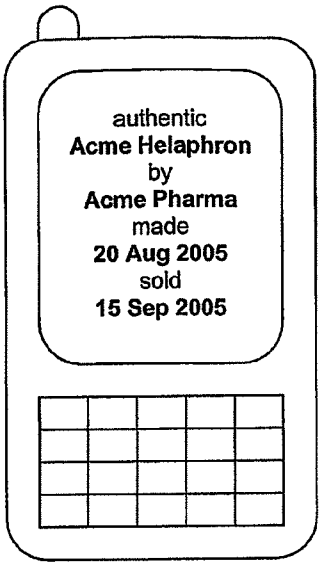
authentic
Acme Helaphron
by
Acme Pharma
made
20 Aug 2005
sold
15 Sep 2005

FIG. 65

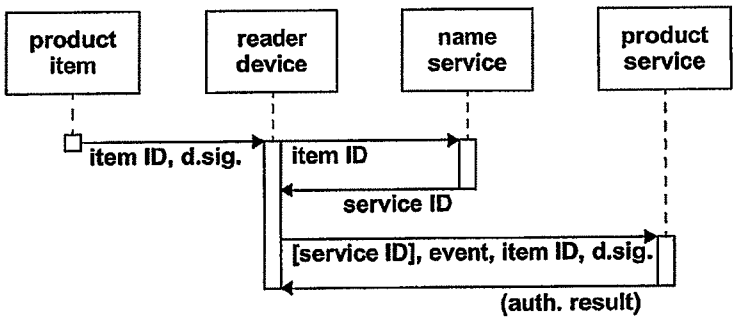
product item
reader device
name service
product service
item ID, d.sig.
item ID
service ID
[service ID], event, item ID, d.sig.
(auth. result)

FIG. 66

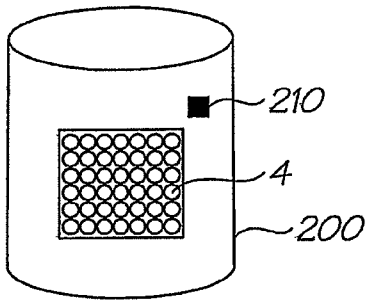

FIG. 67

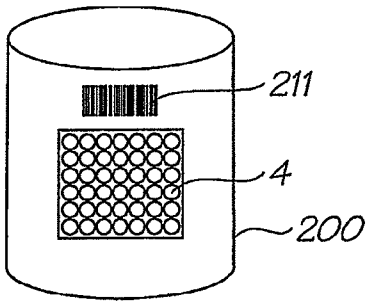

FIG. 68

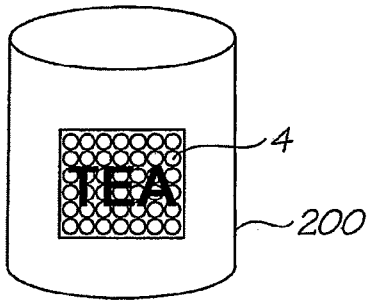

FIG. 69

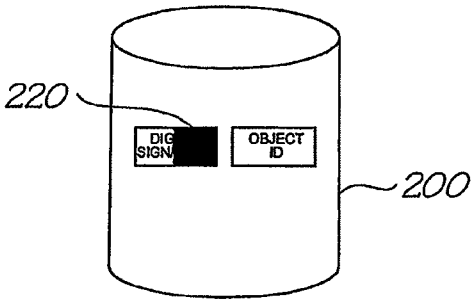

FIG. 70