FIG. 1

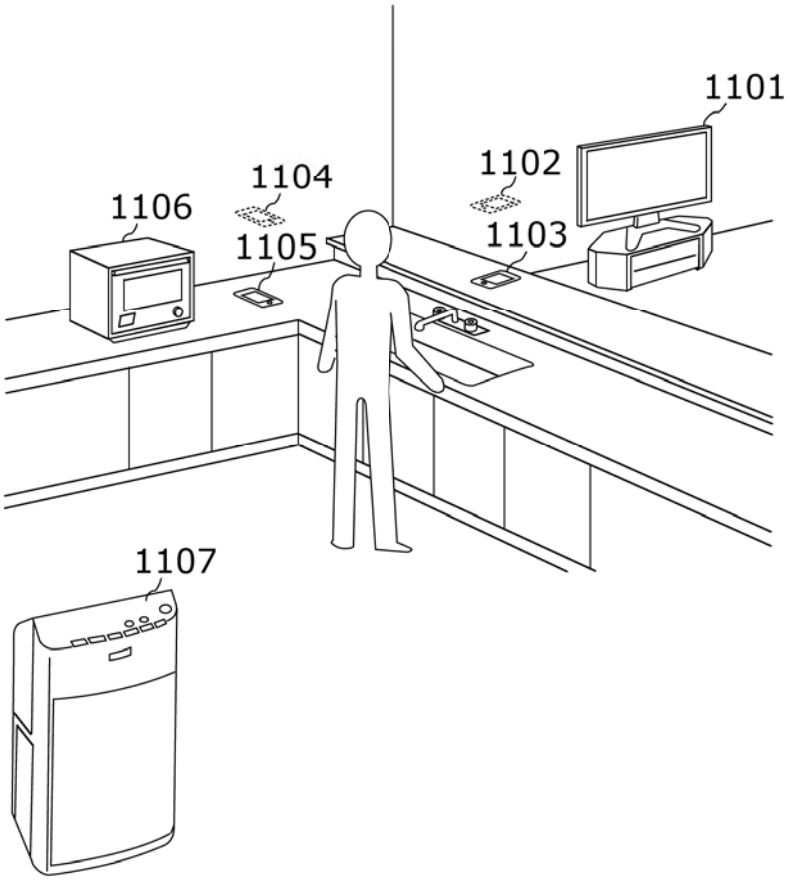


FIG. 2

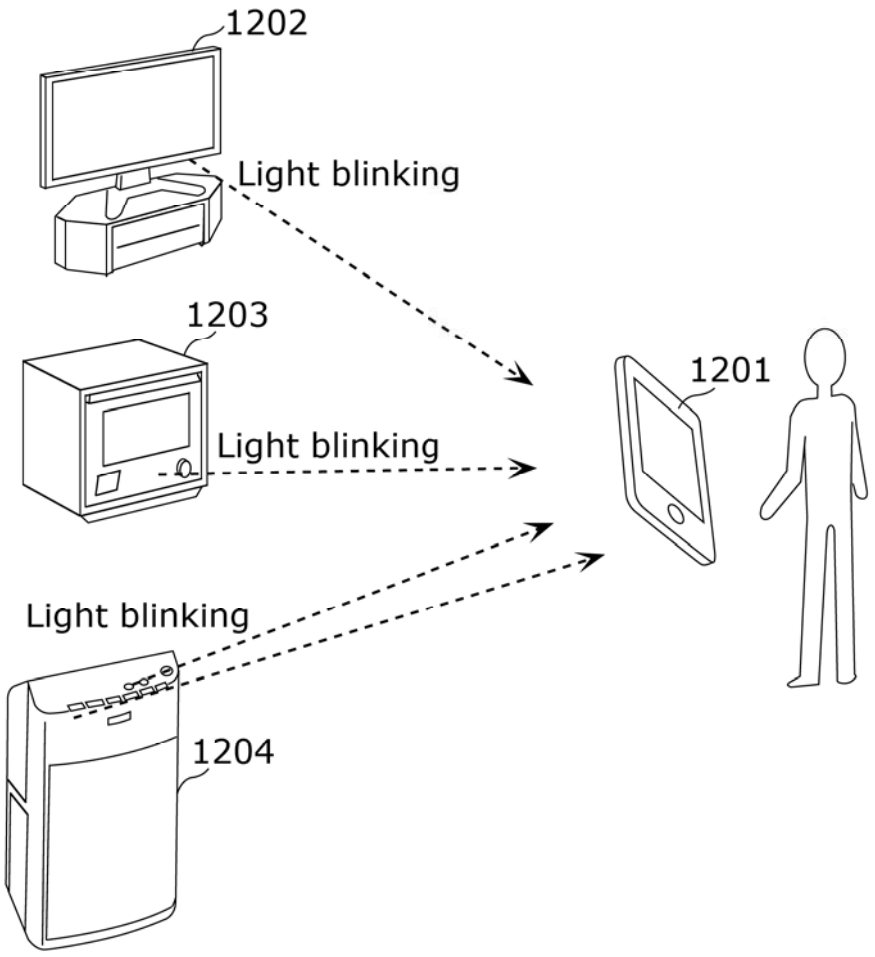

1202
Light blinking
1203
Light blinking
1201
Light blinking
1204

FIG. 3

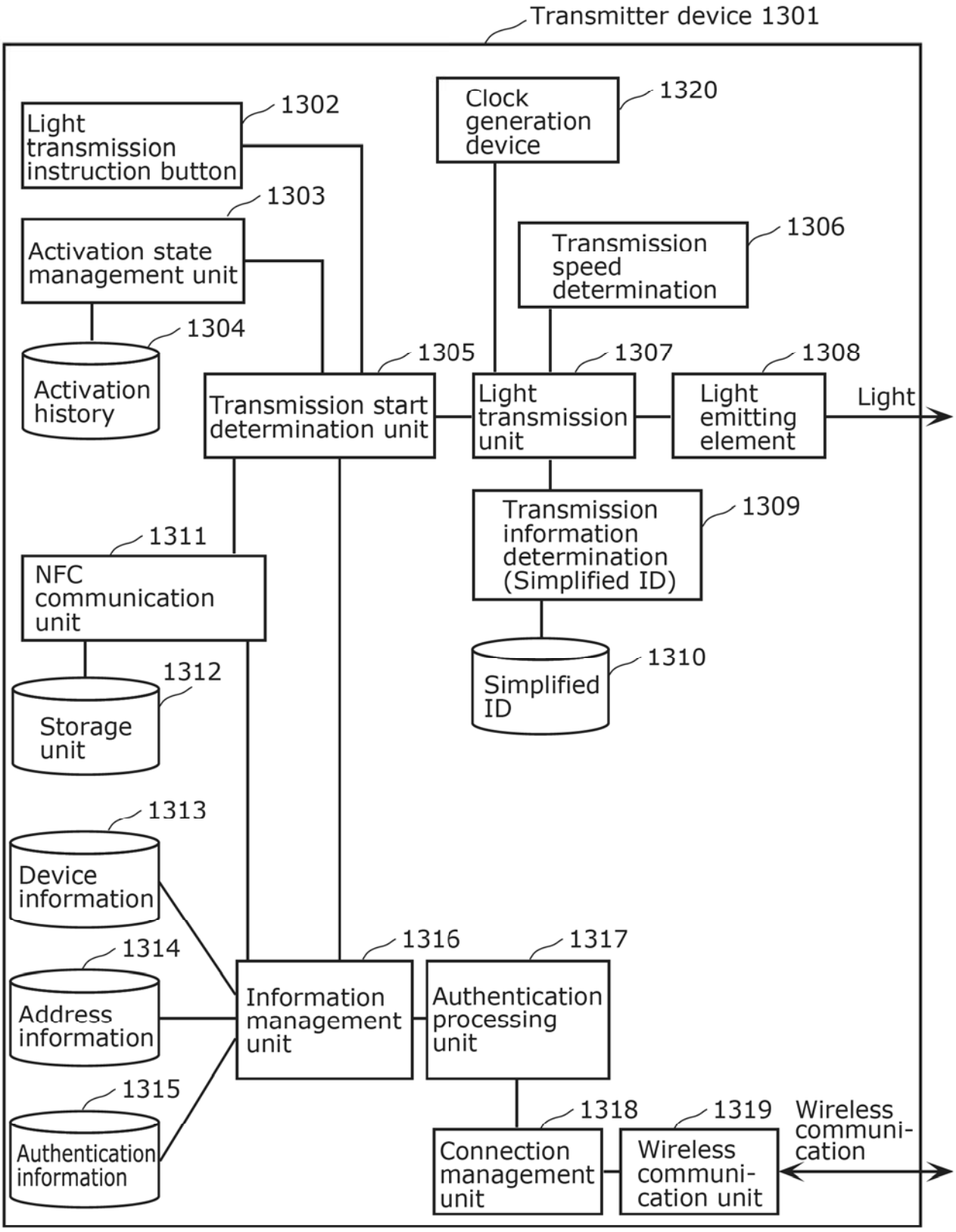

Transmitter device 1301
Light transmission instruction button
1302
Clock generation device
1320
Activation state management unit
1303
Transmission speed determination
1306
Activation history
1304
Transmission start determination unit
1305
Light transmission unit
1307
Light emitting element
1308
Light
Transmission information determination (Simplified ID)
1309
NFC communication unit
1311
Simplified ID
1310
Storage unit
1312
Device information
1313
Address information
1314
Information management unit
1316
Authentication processing unit
1317
Authentication information
1315
Connection management unit
1318
Wireless communi-cation unit
1319
Wireless communi-cation

FIG. 4

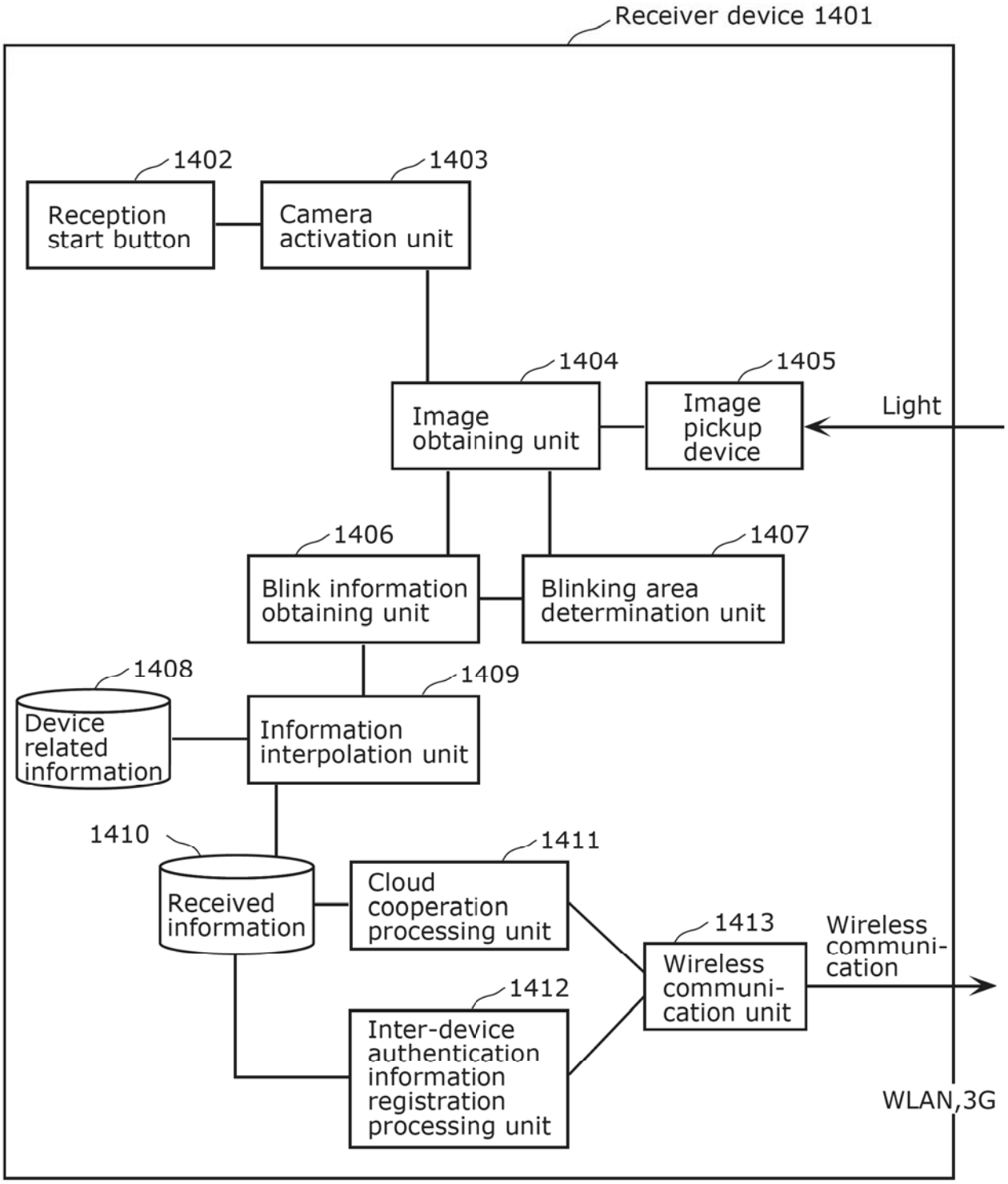

Receiver device 1401
1402
Reception start button
1403
Camera activation unit
1404
Image obtaining unit
1405
Image pickup device
Light
1406
Blink information obtaining unit
1407
Blinking area determination unit
1408
Device related information
1409
Information interpolation unit
1410
Received information
1411
Cloud cooperation processing unit
1412
Inter-device authentication information registration processing unit
1413
Wireless communi-cation unit
Wireless communi-cation
WLAN,3G

FIG. 5

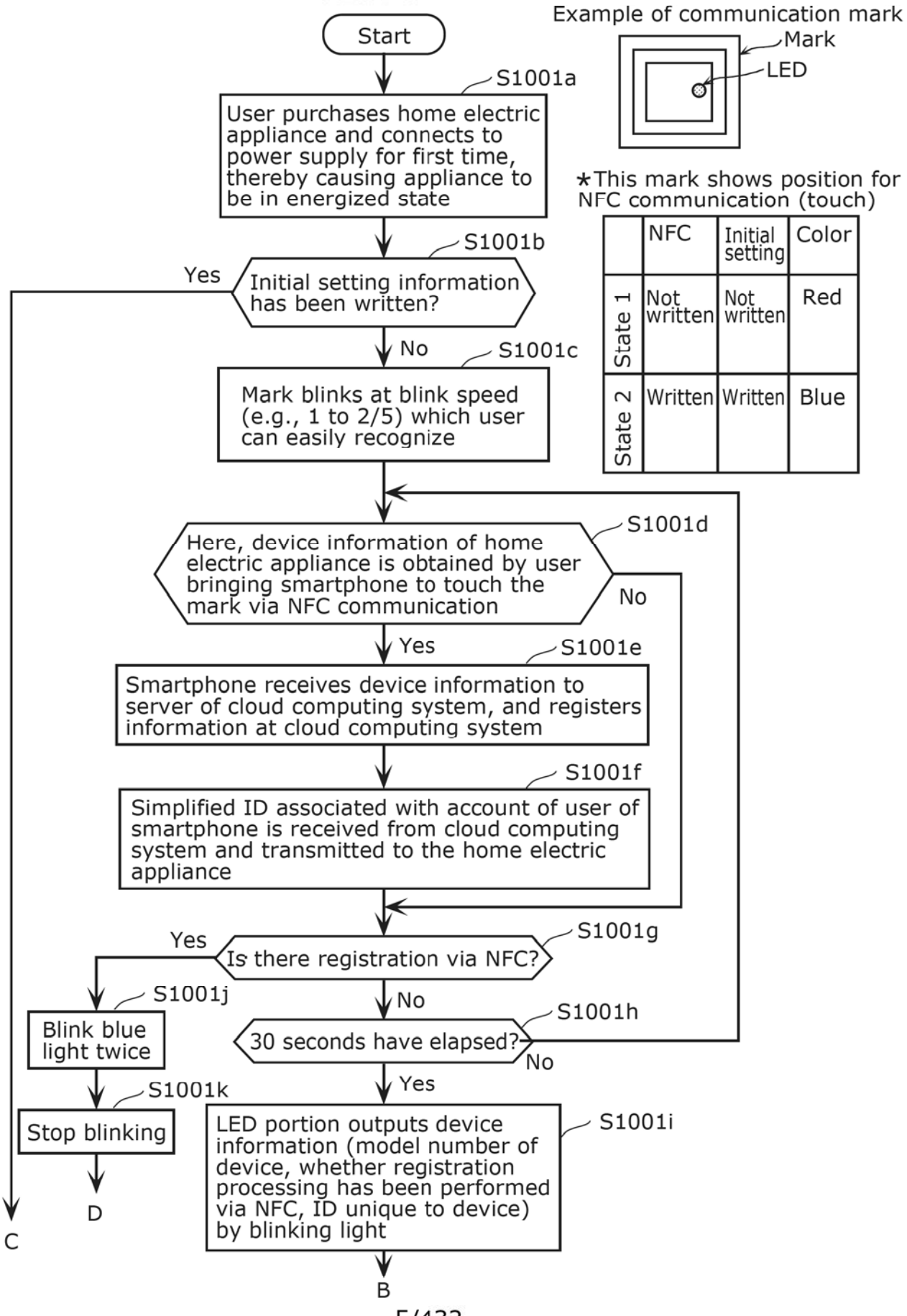

Start
S1001a
User purchases home electric appliance and connects to power supply for first time, thereby causing appliance to be in energized state
S1001b
Initial setting information has been written?
Yes
No
S1001c
Mark blinks at blink speed (e.g., 1 to 2/5) which user can easily recognize
S1001d
Here, device information of home electric appliance is obtained by user bringing smartphone to touch the mark via NFC communication
No
Yes
S1001e
Smartphone receives device information to server of cloud computing system, and registers information at cloud computing system
S1001f
Simplified ID associated with account of user of smartphone is received from cloud computing system and transmitted to the home electric appliance
S1001g
Is there registration via NFC?
Yes
No
S1001j
Blink blue light twice
S1001h
30 seconds have elapsed?
No
Yes
S1001k
Stop blinking
S1001i
LED portion outputs device information (model number of device, whether registration processing has been performed via NFC, ID unique to device) by blinking light
C
D
B
Example of communication mark
Mark
LED
*This mark shows position for NFC communication (touch)
NFC
Initial setting
Color
State 1
Not written
Not written
Red
State 2
Written
Written
Blue

FIG. 6

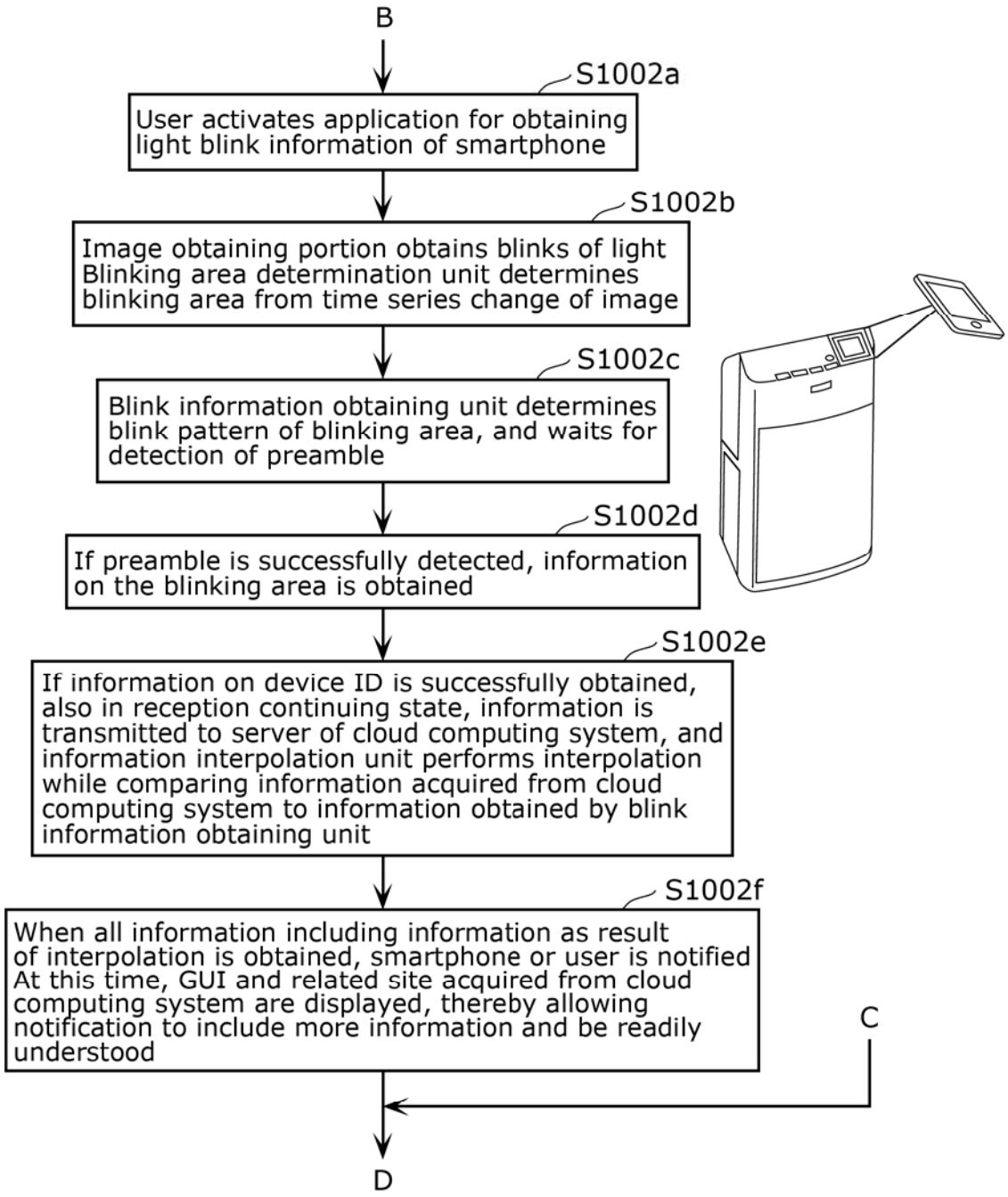

B
S1002a
User activates application for obtaining light blink information of smartphone
S1002b
Image obtaining portion obtains blinks of light Blinking area determination unit determines blinking area from time series change of image
S1002c
Blink information obtaining unit determines blink pattern of blinking area, and waits for detection of preamble
S1002d
If preamble is successfully detected, information on the blinking area is obtained
S1002e
If information on device ID is successfully obtained, also in reception continuing state, information is transmitted to server of cloud computing system, and information interpolation unit performs interpolation while comparing information acquired from cloud computing system to information obtained by blink information obtaining unit
S1002f
When all information including information as result of interpolation is obtained, smartphone or user is notified At this time, GUI and related site acquired from cloud computing system are displayed, thereby allowing notification to include more information and be readily understood
C
D

FIG. 7

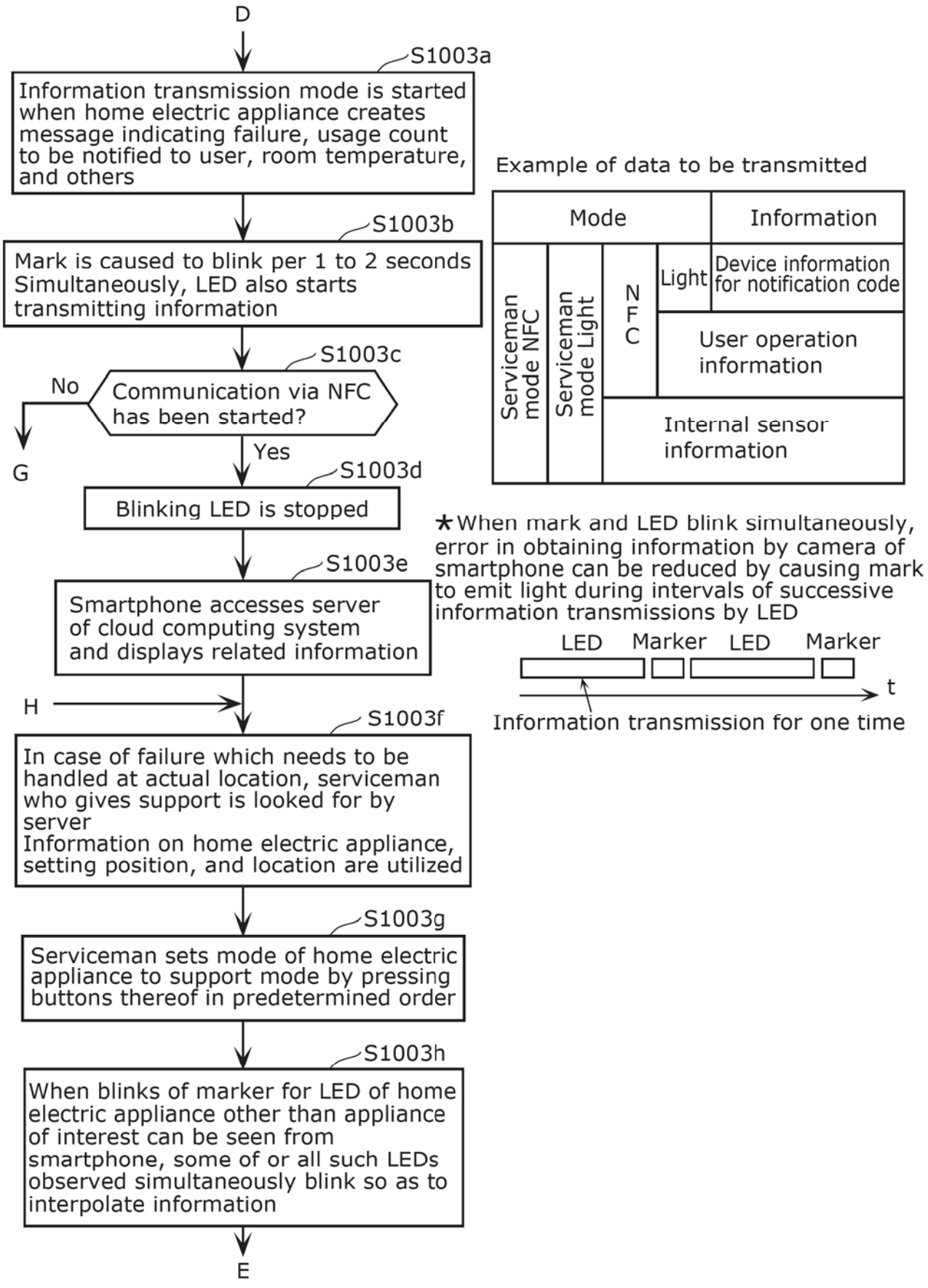

D
S1003a
Information transmission mode is started when home electric appliance creates message indicating failure, usage count to be notified to user, room temperature, and others
S1003b
Mark is caused to blink per 1 to 2 seconds Simultaneously, LED also starts transmitting information
S1003c
No
Communication via NFC has been started?
G
Yes
S1003d
Blinking LED is stopped
S1003e
Smartphone accesses server of cloud computing system and displays related information
H
S1003f
In case of failure which needs to be handled at actual location, serviceman who gives support is looked for by server
Information on home electric appliance, setting position, and location are utilized
S1003g
Serviceman sets mode of home electric appliance to support mode by pressing buttons thereof in predetermined order
S1003h
When blinks of marker for LED of home electric appliance other than appliance of interest can be seen from smartphone, some of or all such LEDs observed simultaneously blink so as to interpolate information
E
Example of data to be transmitted
Mode
Information
Serviceman mode NFC
Serviceman mode Light
NFC
Light
Device information for notification code
User operation information
Internal sensor information
★When mark and LED blink simultaneously, error in obtaining information by camera of smartphone can be reduced by causing mark to emit light during intervals of successive information transmissions by LED
LED
Marker
LED
Marker
t
Information transmission for one time

FIG. 8

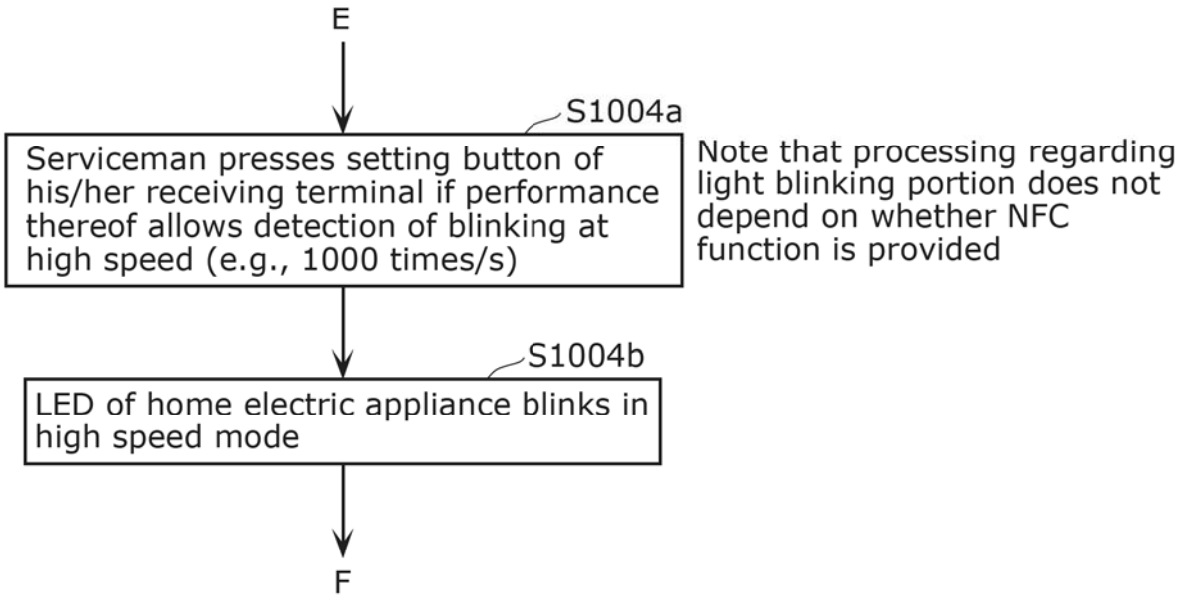

E
S1004a
Serviceman presses setting button of his/her receiving terminal if performance thereof allows detection of blinking at high speed (e.g., 1000 times/s)
Note that processing regarding light blinking portion does not depend on whether NFC function is provided
S1004b
LED of home electric appliance blinks in high speed mode
F

FIG. 9

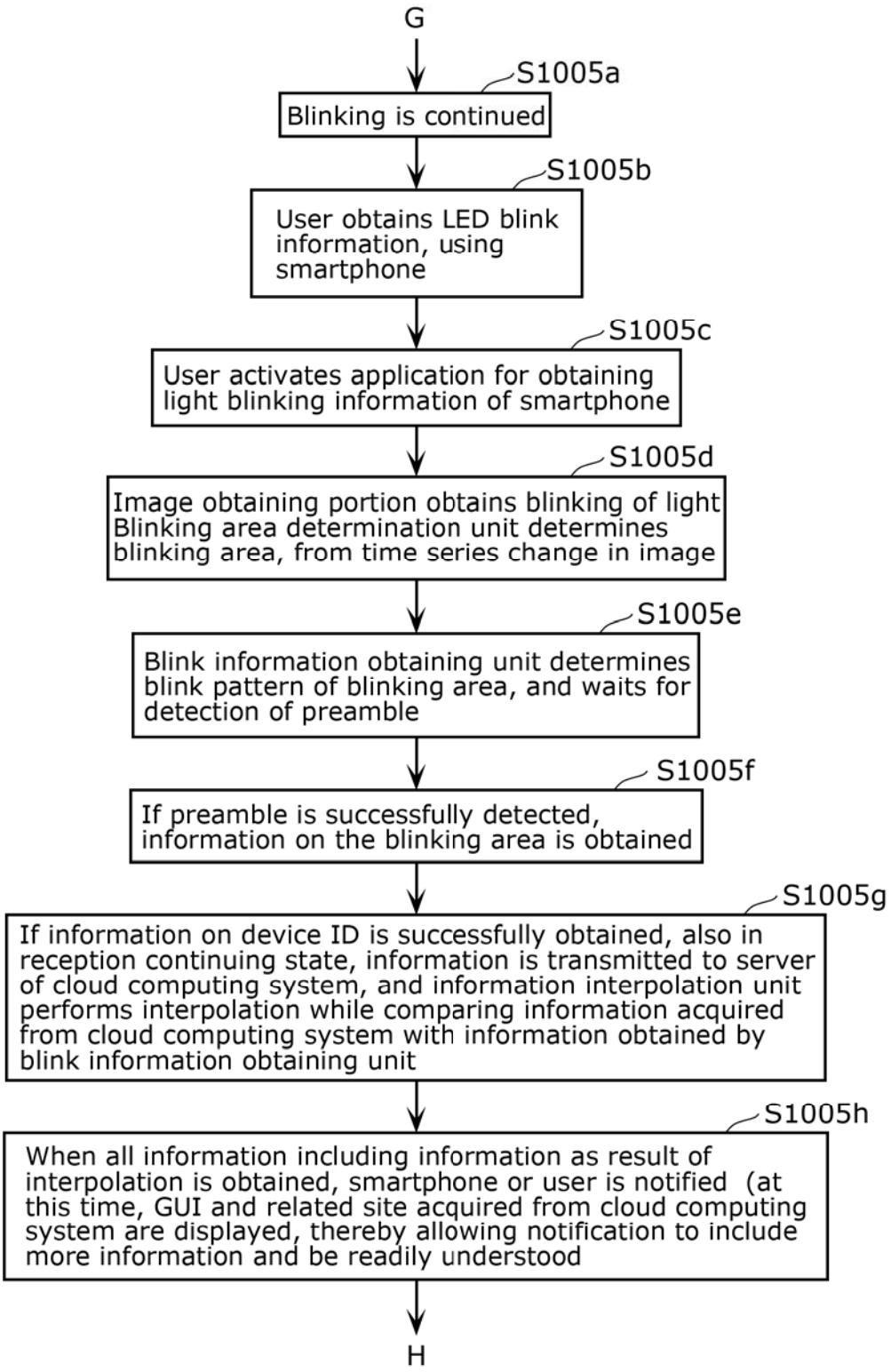

G
S1005a
Blinking is continued
S1005b
User obtains LED blink information, using smartphone
S1005c
User activates application for obtaining light blinking information of smartphone
S1005d
Image obtaining portion obtains blinking of light Blinking area determination unit determines blinking area, from time series change in image
S1005e
Blink information obtaining unit determines blink pattern of blinking area, and waits for detection of preamble
S1005f
If preamble is successfully detected, information on the blinking area is obtained
S1005g
If information on device ID is successfully obtained, also in reception continuing state, information is transmitted to server of cloud computing system, and information interpolation unit performs interpolation while comparing information acquired from cloud computing system with information obtained by blink information obtaining unit
S1005h
When all information including information as result of interpolation is obtained, smartphone or user is notified (at this time, GUI and related site acquired from cloud computing system are displayed, thereby allowing notification to include more information and be readily understood
H

FIG. 10

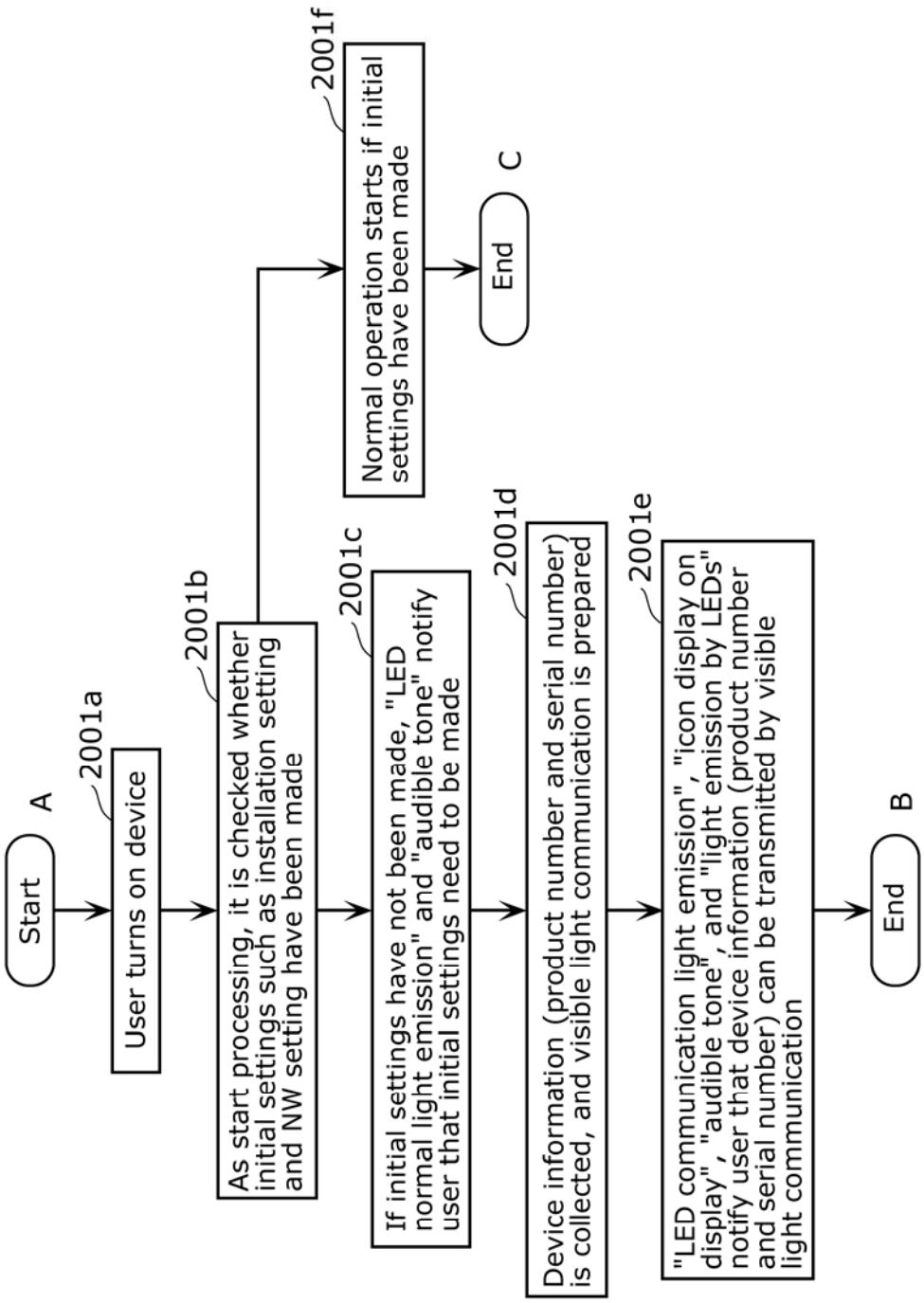

Start
A
2001a
User turns on device
2001b
As start processing, it is checked whether initial settings such as installation setting and NW setting have been made
2001c
If initial settings have not been made, "LED normal light emission" and "audible tone" notify user that initial settings need to be made
2001d
Device information (product number and serial number) is collected, and visible light communication is prepared
2001e
"LED communication light emission", "icon display on display", "audible tone", and "light emission by LEDs" notify user that device information (product number and serial number) can be transmitted by visible light communication
End
B
2001f
Normal operation starts if initial settings have been made
End
C

FIG. 11

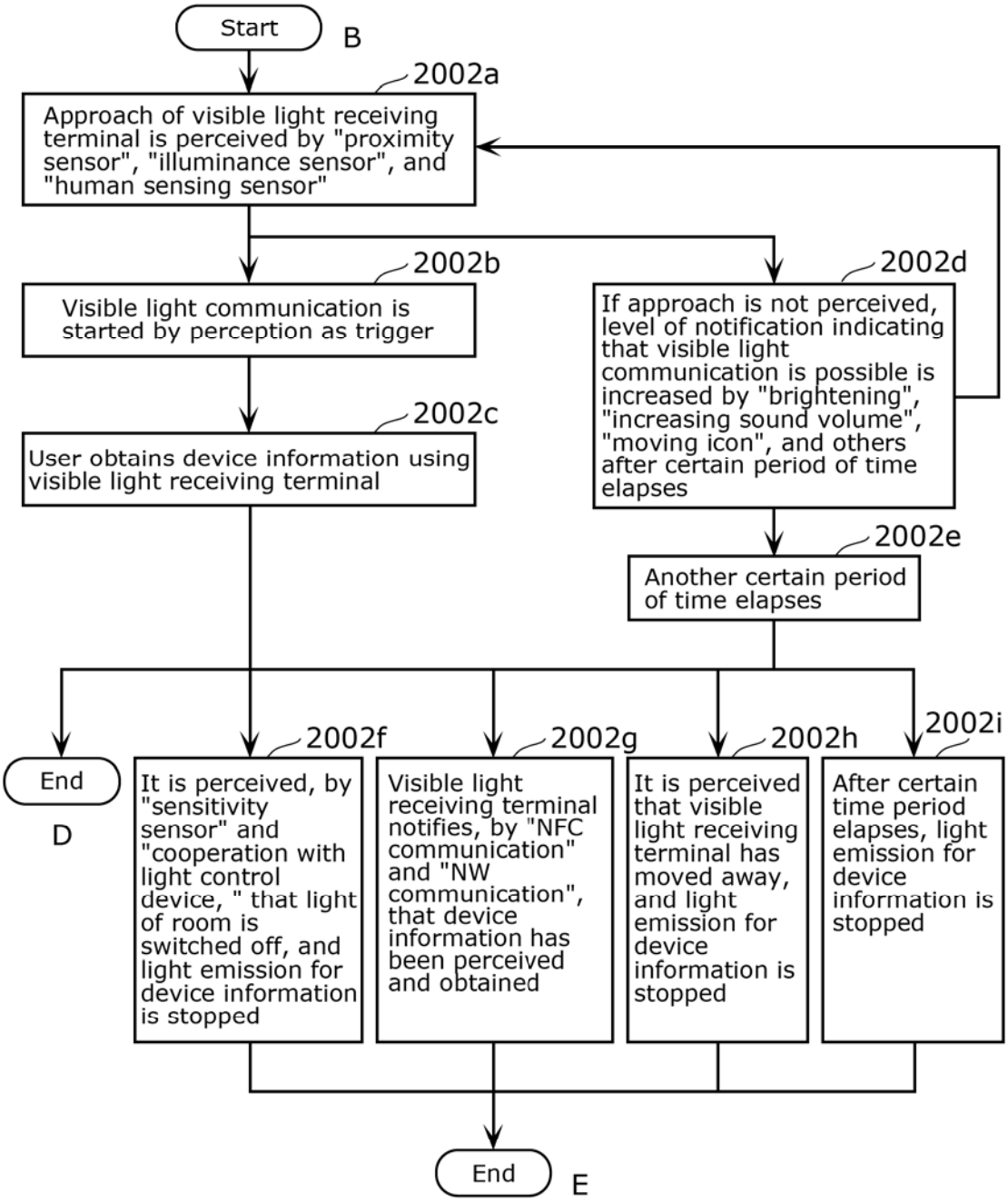

Start
B
2002a
Approach of visible light receiving terminal is perceived by "proximity sensor", "illuminance sensor", and "human sensing sensor"
2002b
Visible light communication is started by perception as trigger
2002c
User obtains device information using visible light receiving terminal
2002d
If approach is not perceived, level of notification indicating that visible light communication is possible is increased by "brightening", "increasing sound volume", "moving icon", and others after certain period of time elapses
2002e
Another certain period of time elapses
End
D
2002f
It is perceived, by "sensitivity sensor" and "cooperation with light control device, " that light of room is switched off, and light emission for device information is stopped
2002g
Visible light receiving terminal notifies, by "NFC communication" and "NW communication", that device information has been perceived and obtained
2002h
It is perceived that visible light receiving terminal has moved away, and light emission for device information is stopped
2002i
After certain time period elapses, light emission for device information is stopped
End
E

FIG. 12

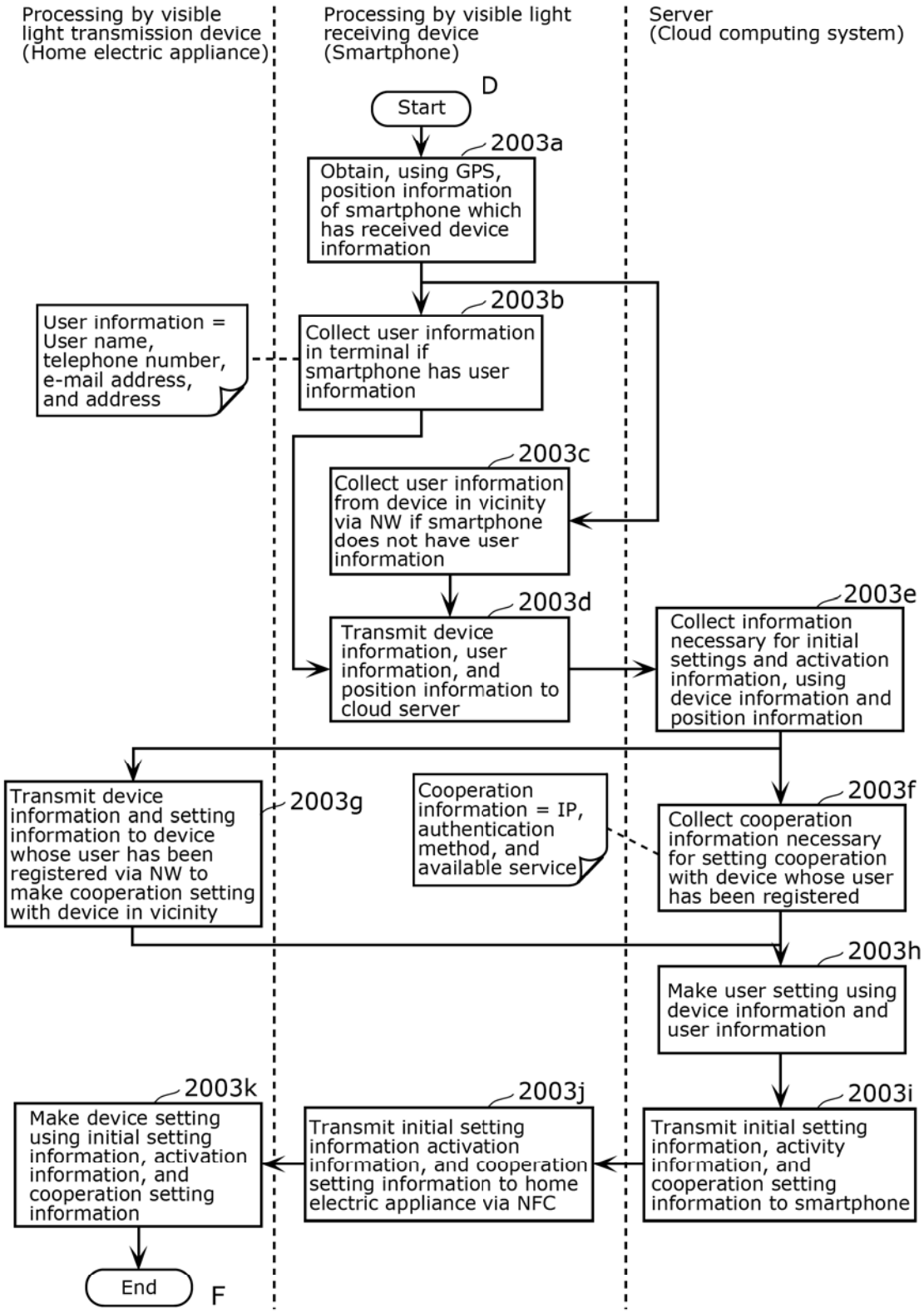

Processing by visible light transmission device (Home electric appliance)
Processing by visible light receiving device (Smartphone)
Server (Cloud computing system)
D
Start
2003a
Obtain, using GPS, position information of smartphone which has received device information
2003b
User information = User name, telephone number, e-mail address, and address
Collect user information in terminal if smartphone has user information
2003c
Collect user information from device in vicinity via NW if smartphone does not have user information
2003d
Transmit device information, user information, and position information to cloud server
2003e
Collect information necessary for initial settings and activation information, using device information and position information
Transmit device information and setting information to device whose user has been registered via NW to make cooperation setting with device in vicinity
2003g
Cooperation information = IP, authentication method, and available service
2003f
Collect cooperation information necessary for setting cooperation with device whose user has been registered
2003h
Make user setting using device information and user information
2003k
Make device setting using initial setting information, activation information, and cooperation setting information
2003j
Transmit initial setting information activation information, and cooperation setting information to home electric appliance via NFC
2003i
Transmit initial setting information, activity information, and cooperation setting information to smartphone
End
F

FIG. 13

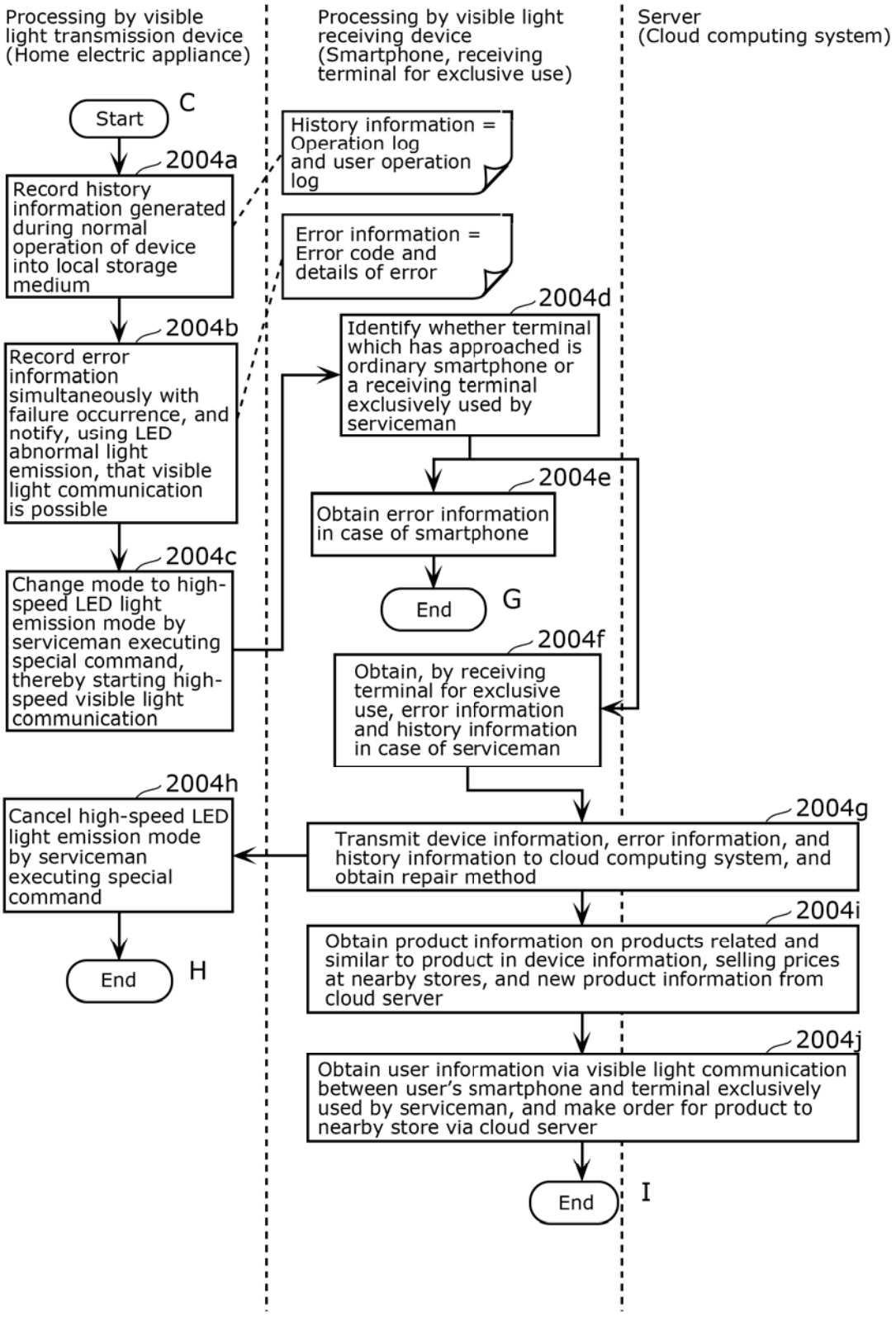

Processing by visible light transmission device (Home electric appliance)
Processing by visible light receiving device (Smartphone, receiving terminal for exclusive use)
Server (Cloud computing system)
Start
C
2004a
Record history information generated during normal operation of device into local storage medium
History information = Operation log and user operation log
Error information = Error code and details of error
2004b
Record error information simultaneously with failure occurrence, and notify, using LED abnormal light emission, that visible light communication is possible
2004d
Identify whether terminal which has approached is ordinary smartphone or a receiving terminal exclusively used by serviceman
2004e
Obtain error information in case of smartphone
End
G
2004c
Change mode to high-speed LED light emission mode by serviceman executing special command, thereby starting high-speed visible light communication
2004f
Obtain, by receiving terminal for exclusive use, error information and history information in case of serviceman
2004h
Cancel high-speed LED light emission mode by serviceman executing special command
2004g
Transmit device information, error information, and history information to cloud computing system, and obtain repair method
End
H
2004i
Obtain product information on products related and similar to product in device information, selling prices at nearby stores, and new product information from cloud server
2004j
Obtain user information via visible light communication between user's smartphone and terminal exclusively used by serviceman, and make order for product to nearby store via cloud server
End
I

FIG. 14

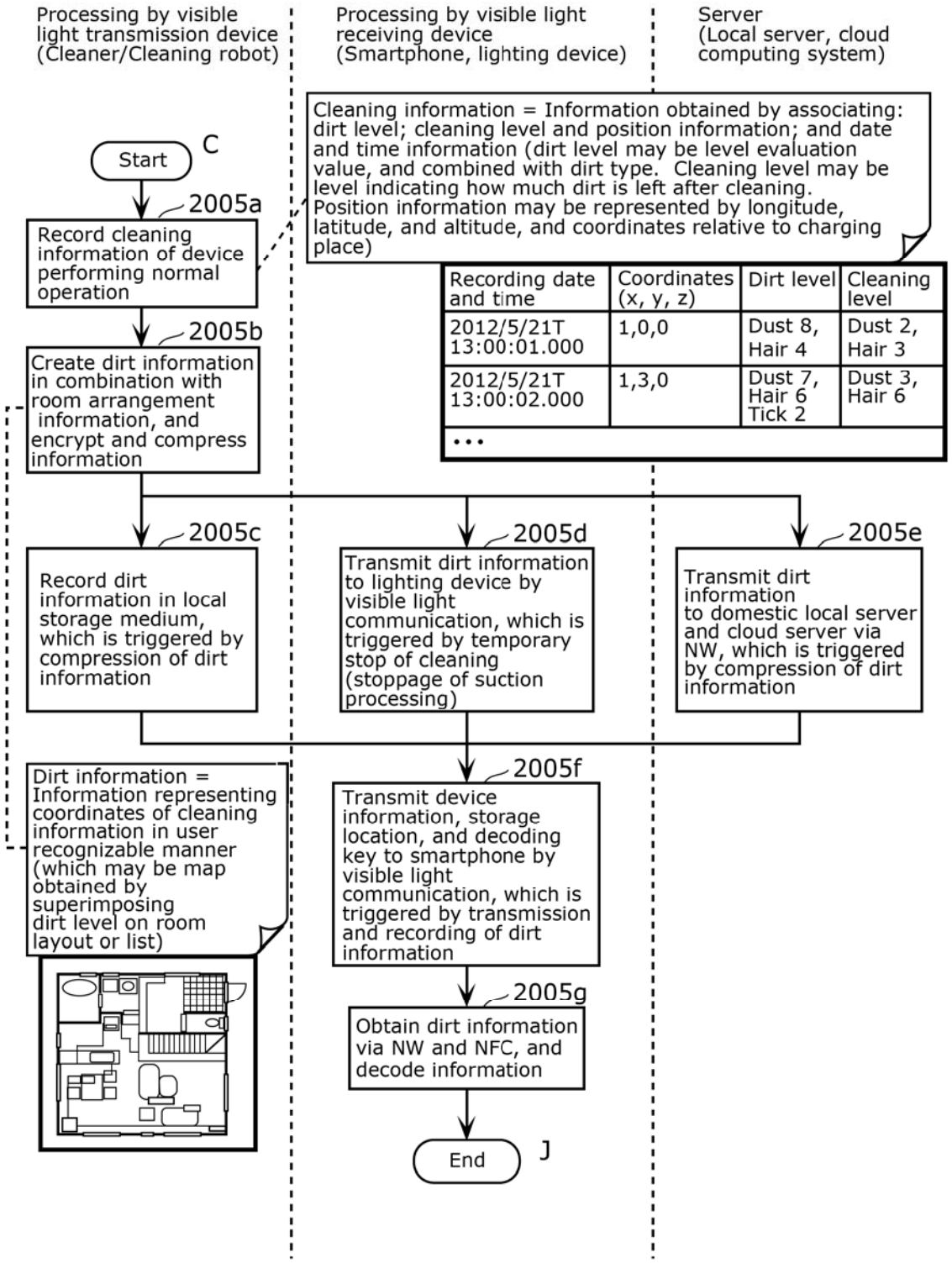
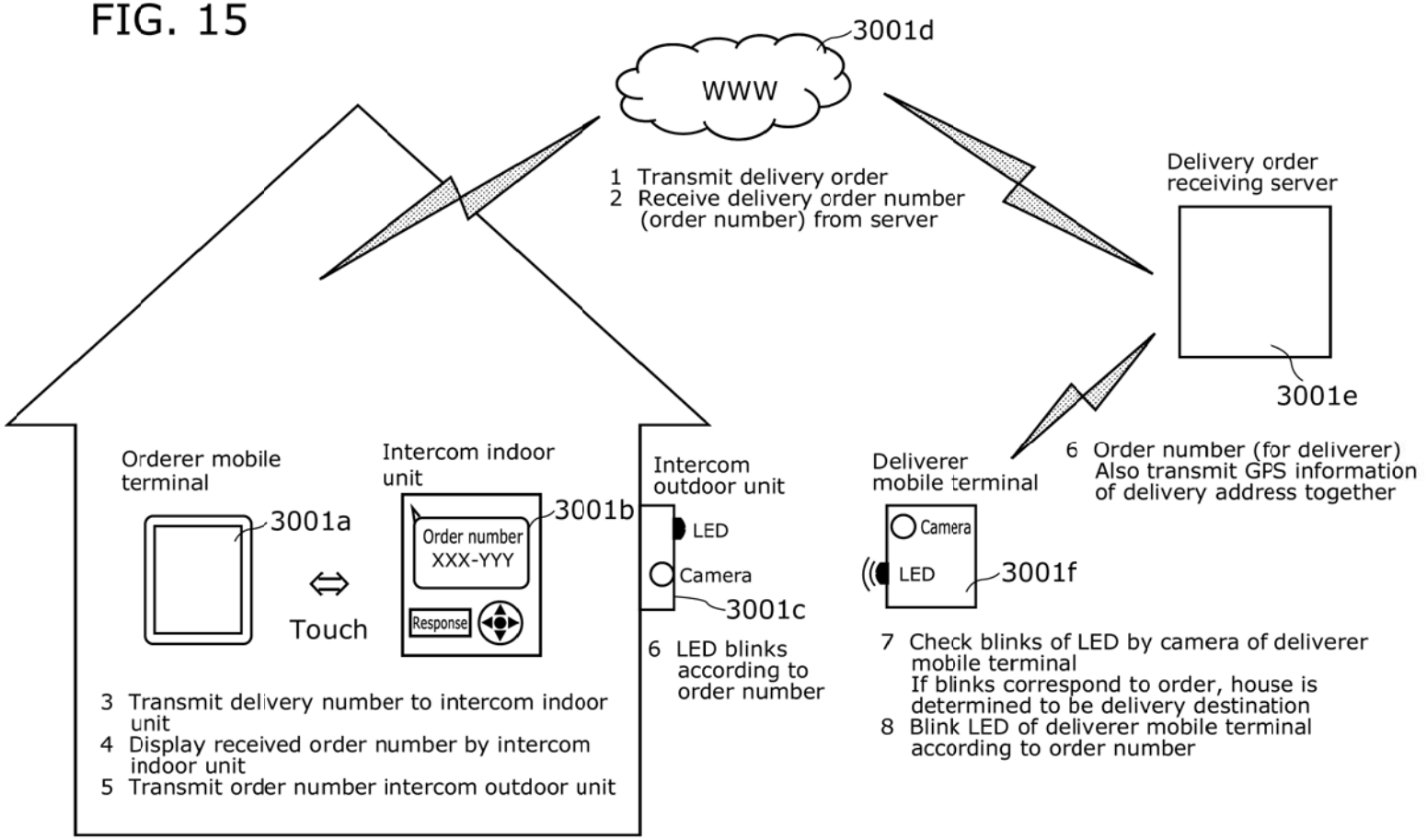

Processing by visible light transmission device (Cleaner/Cleaning robot)
Processing by visible light receiving device (Smartphone, lighting device)
Server (Local server, cloud computing system)
Cleaning information = Information obtained by associating: dirt level; cleaning level and position information; and date and time information (dirt level may be level evaluation value, and combined with dirt type. Cleaning level may be level indicating how much dirt is left after cleaning. Position information may be represented by longitude, latitude, and altitude, and coordinates relative to charging place)
Recording date and time
Coordinates (x, y, z)
Dirt level
Cleaning level
2012/5/21T 13:00:01.000
1,0,0
Dust 8, Hair 4
Dust 2, Hair 3
2012/5/21T 13:00:02.000
1,3,0
Dust 7, Hair 6 Tick 2
Dust 3, Hair 6
Start
C
2005a
Record cleaning information of device performing normal operation
2005b
Create dirt information in combination with room arrangement information, and encrypt and compress information
2005c
Record dirt information in local storage medium, which is triggered by compression of dirt information
2005d
Transmit dirt information to lighting device by visible light communication, which is triggered by temporary stop of cleaning (stoppage of suction processing)
2005e
Transmit dirt information to domestic local server and cloud server via NW, which is triggered by compression of dirt information
Dirt information = Information representing coordinates of cleaning information in user recognizable manner (which may be map obtained by superimposing dirt level on room layout or list)
2005f
Transmit device information, storage location, and decoding key to smartphone by visible light communication, which is triggered by transmission and recording of dirt information
2005g
Obtain dirt information via NW and NFC, and decode information
End
J

FIG. 15



9 Check blinks of LED of deliverer mobile terminal using camera of intercom
If order number corresponds to blinks, arrival of delivery is notified to intercom indoor unit

10 Upon reception of notification from intercom outdoor unit, intercom indoor unit notifies user of arrival of delivery

FIG. 16

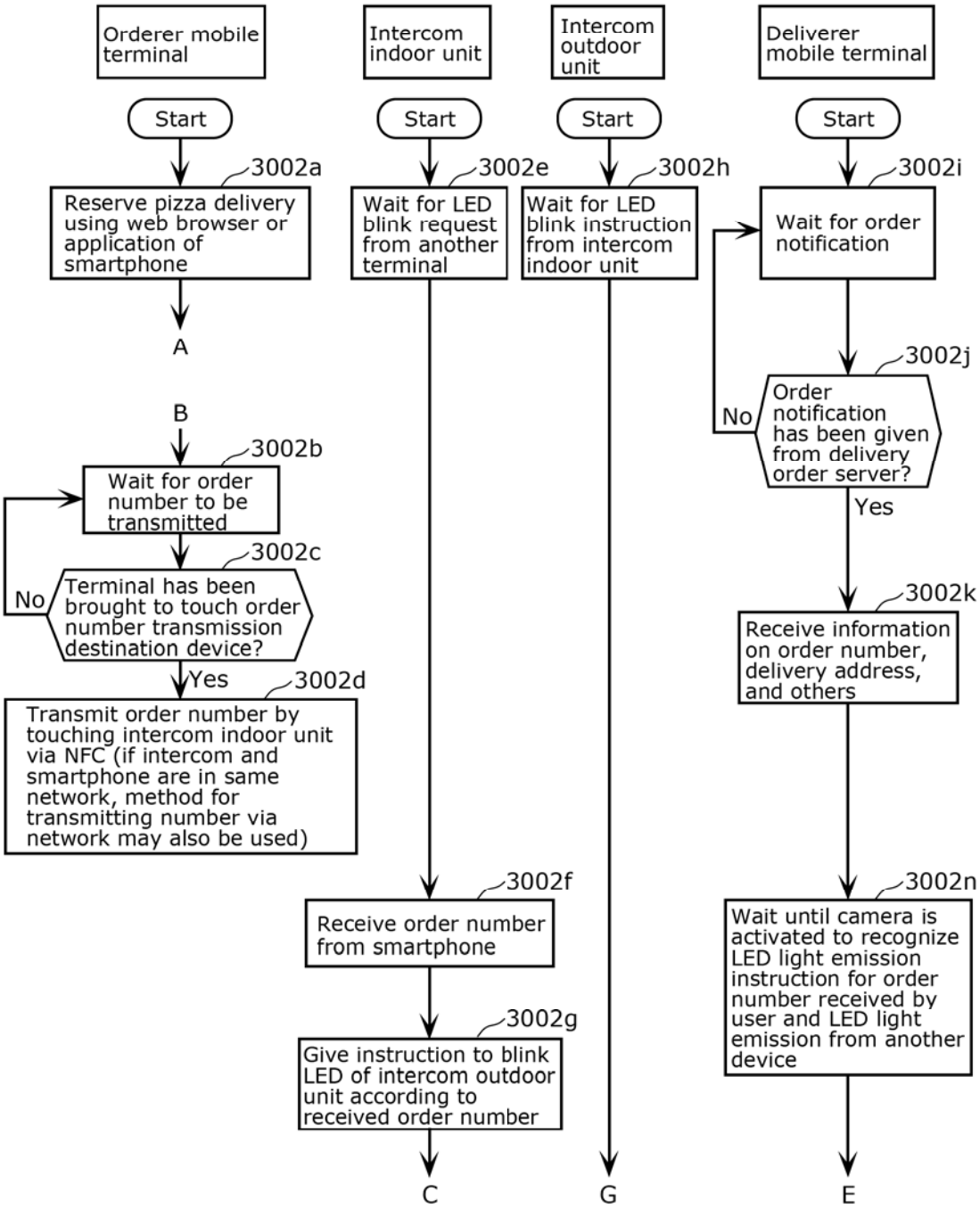

Orderer mobile terminal
Intercom indoor unit
Intercom outdoor unit
Deliverer mobile terminal
Start
Start
Start
Start
3002a
Reserve pizza delivery using web browser or application of smartphone
A
B
3002b
Wait for order number to be transmitted
3002c
No
Terminal has been brought to touch order number transmission destination device?
Yes
3002d
Transmit order number by touching intercom indoor unit via NFC (if intercom and smartphone are in same network, method for transmitting number via network may also be used)
3002e
Wait for LED blink request from another terminal
3002h
Wait for LED blink instruction from intercom indoor unit
3002i
Wait for order notification
3002j
No
Order notification has been given from delivery order server?
Yes
3002k
Receive information on order number, delivery address, and others
3002f
Receive order number from smartphone
3002g
Give instruction to blink LED of intercom outdoor unit according to received order number
3002n
Wait until camera is activated to recognize LED light emission instruction for order number received by user and LED light emission from another device
C
G
E

FIG. 17

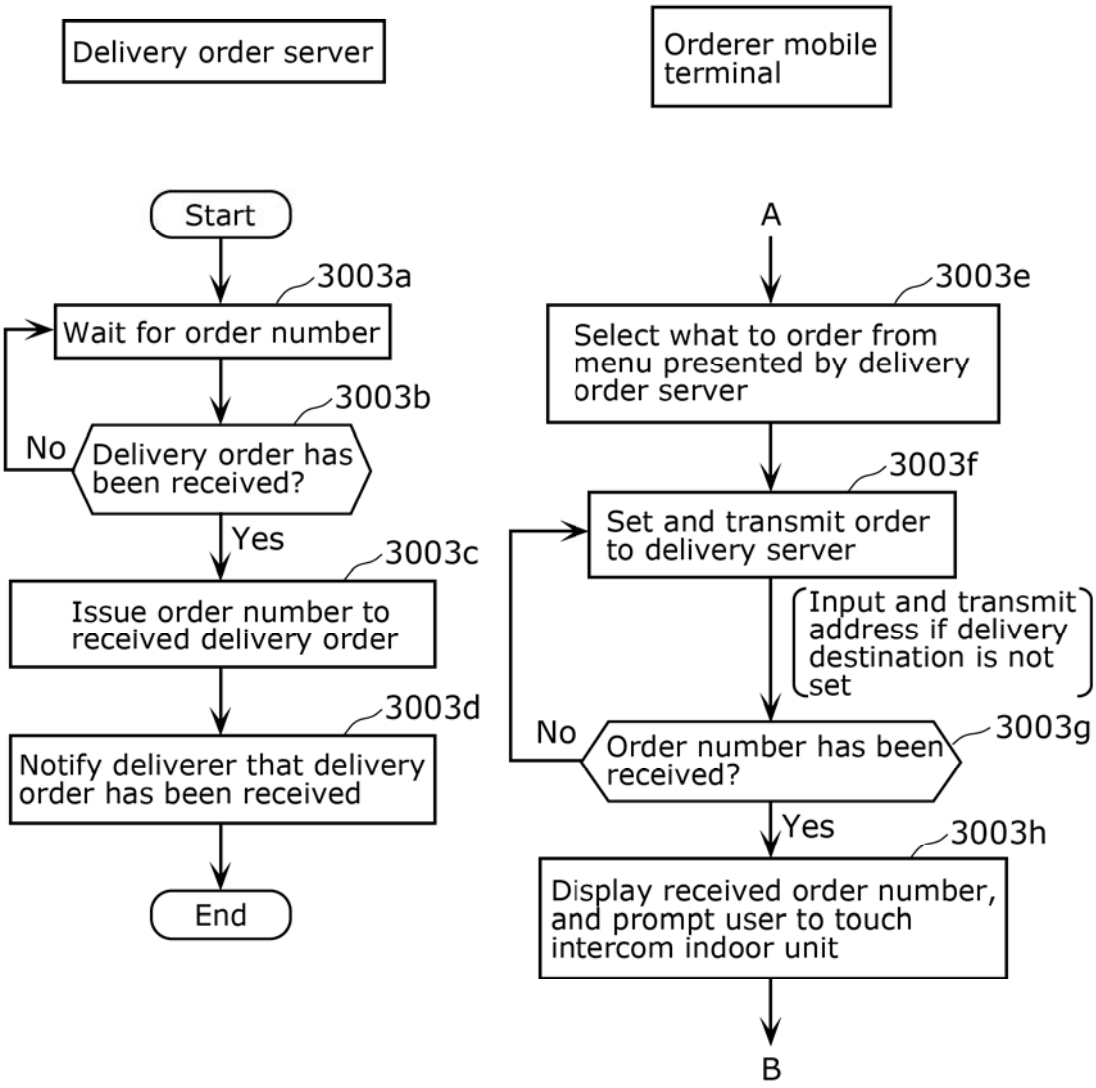

Delivery order server
Orderer mobile terminal
Start
3003a
Wait for order number
3003b
No
Delivery order has been received?
Yes
3003c
Issue order number to received delivery order
3003d
Notify deliverer that delivery order has been received
End
A
3003e
Select what to order from menu presented by delivery order server
3003f
Set and transmit order to delivery server
Input and transmit address if delivery destination is not set
No
Order number has been received?
3003g
Yes
3003h
Display received order number, and prompt user to touch intercom indoor unit
B

FIG. 18

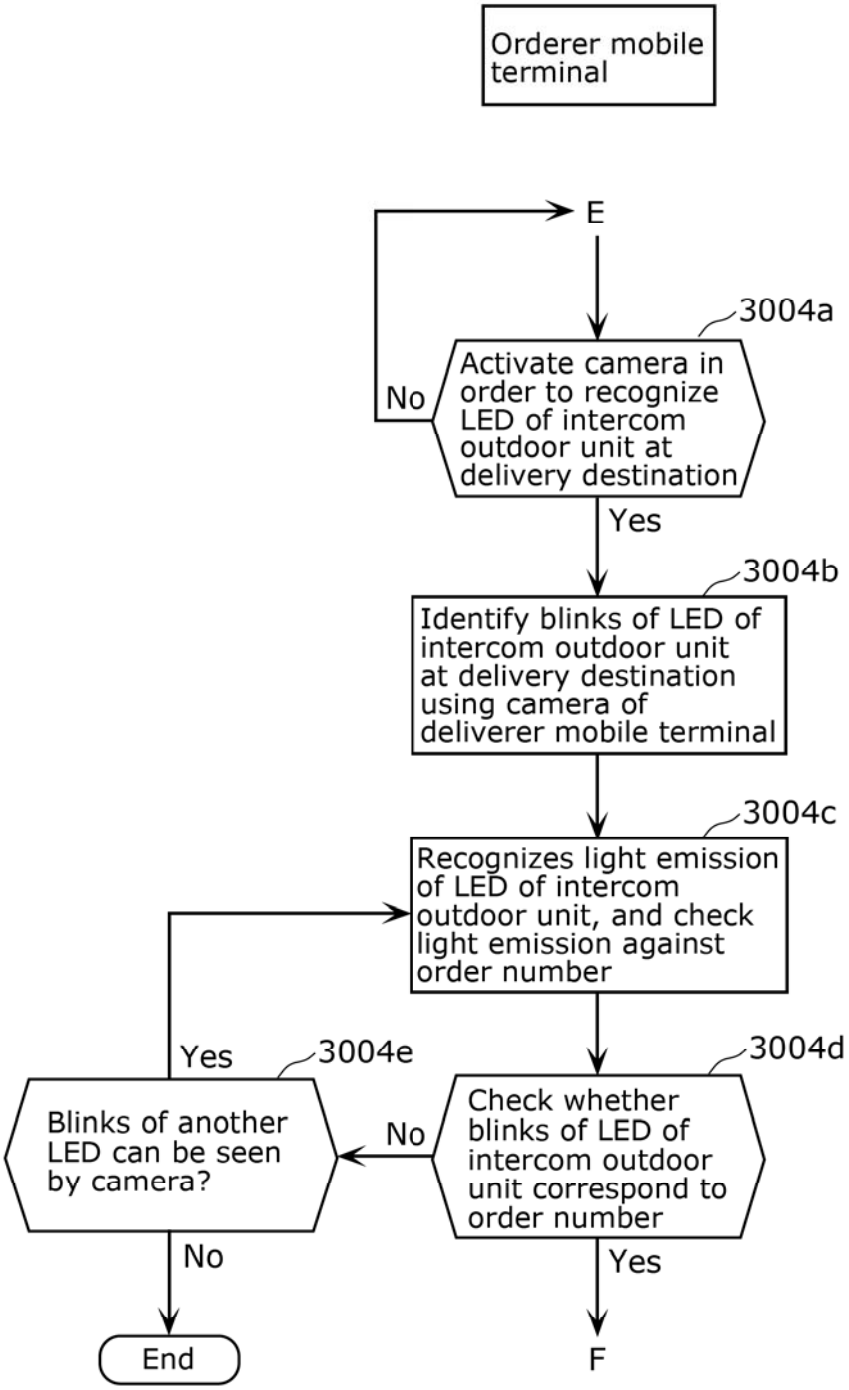

Orderer mobile terminal
E
3004a
Activate camera in order to recognize LED of intercom outdoor unit at delivery destination
No
Yes
3004b
Identify blinks of LED of intercom outdoor unit at delivery destination using camera of deliverer mobile terminal
3004c
Recognizes light emission of LED of intercom outdoor unit, and check light emission against order number
3004d
Check whether blinks of LED of intercom outdoor unit correspond to order number
No
Yes
3004e
Blinks of another LED can be seen by camera?
Yes
No
End
F

FIG. 19

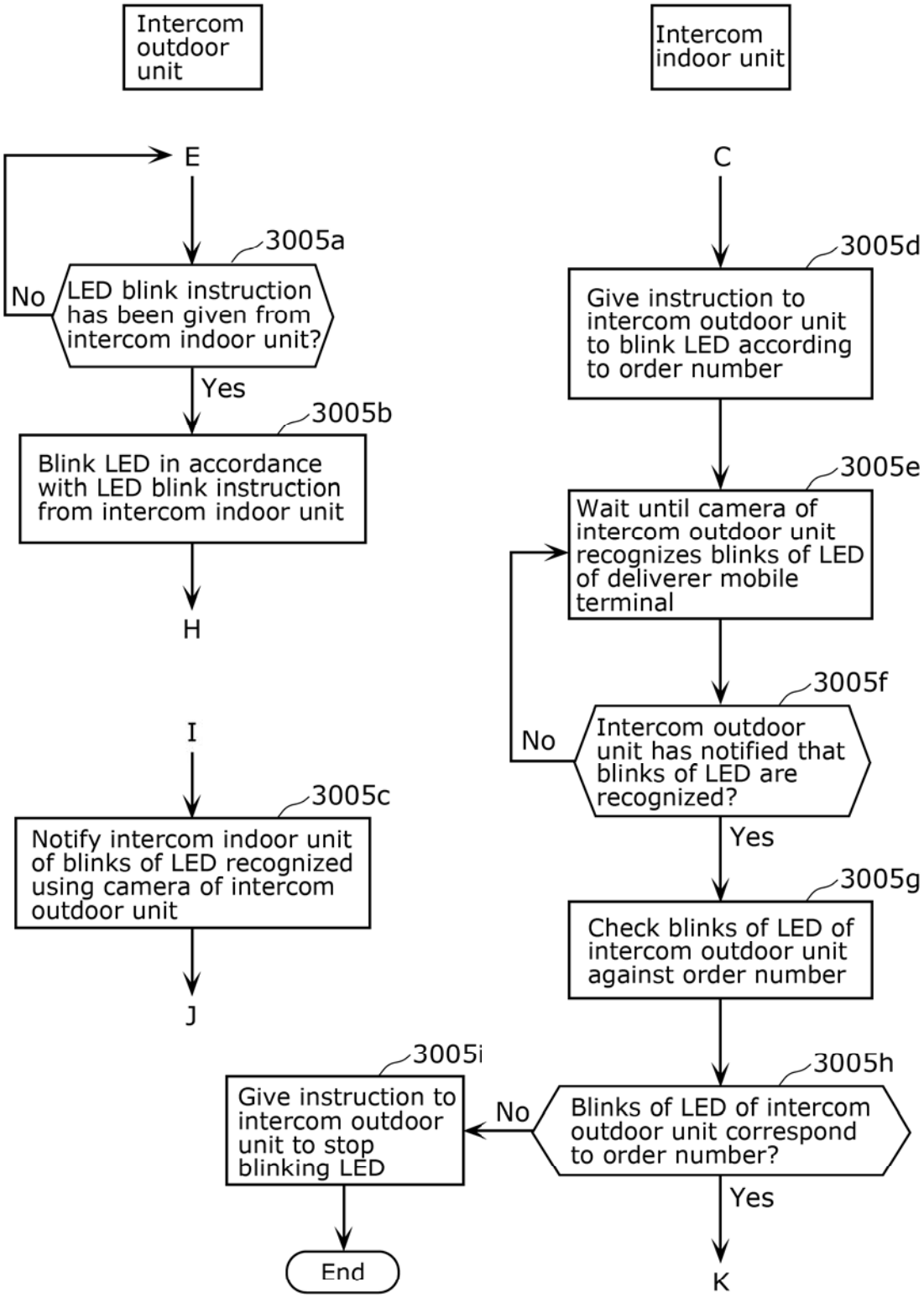

Intercom outdoor unit
Intercom indoor unit
E
C
3005a
3005d
No
LED blink instruction has been given from intercom indoor unit?
Give instruction to intercom outdoor unit to blink LED according to order number
Yes
3005b
3005e
Blink LED in accordance with LED blink instruction from intercom indoor unit
Wait until camera of intercom outdoor unit recognizes blinks of LED of deliverer mobile terminal
H
3005f
I
No
Intercom outdoor unit has notified that blinks of LED are recognized?
3005c
Yes
3005g
Notify intercom indoor unit of blinks of LED recognized using camera of intercom outdoor unit
Check blinks of LED of intercom outdoor unit against order number
J
3005i
3005h
Give instruction to intercom outdoor unit to stop blinking LED
No
Blinks of LED of intercom outdoor unit correspond to order number?
Yes
End
K

FIG. 20

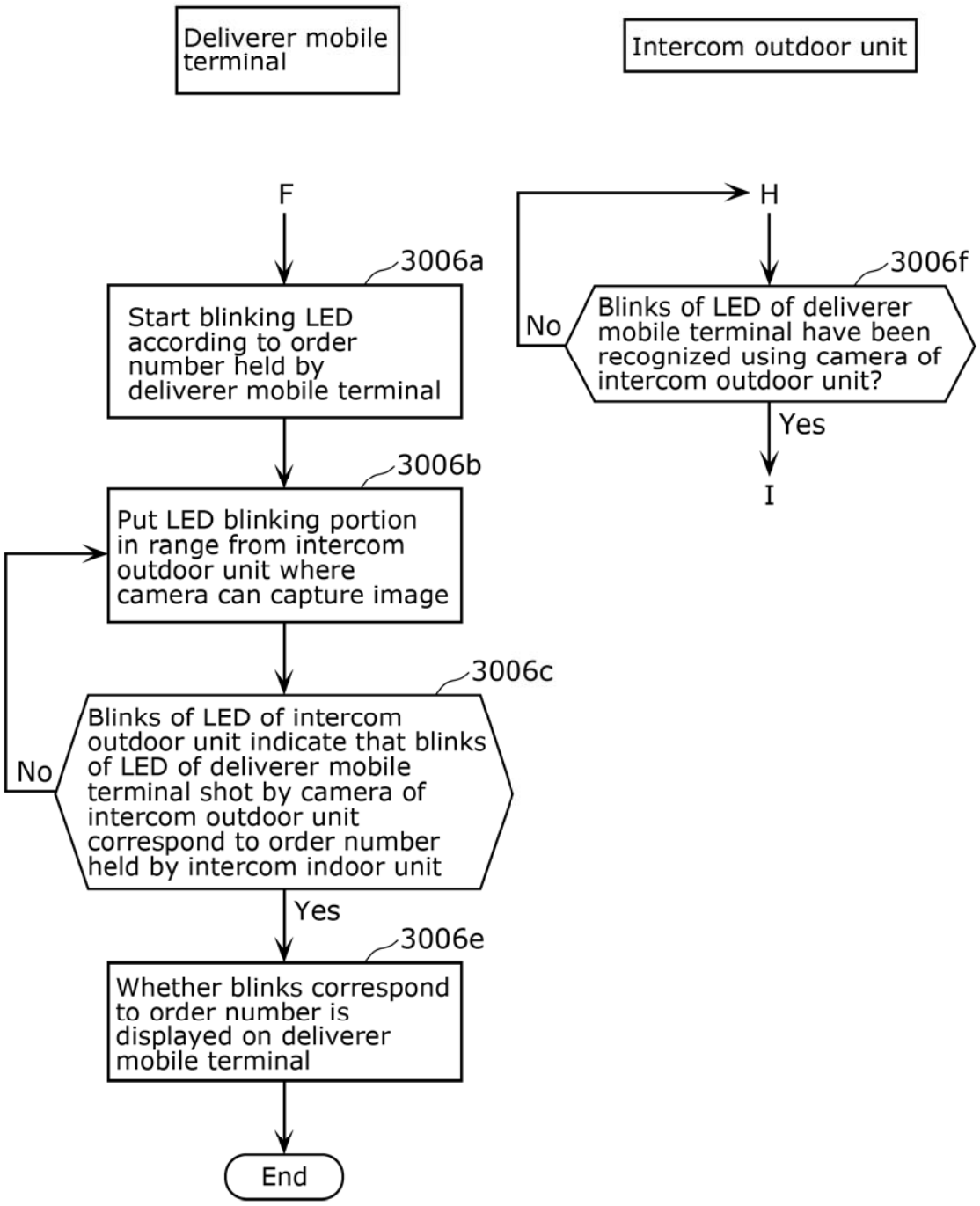

Deliverer mobile terminal
Intercom outdoor unit
F
3006a
Start blinking LED according to order number held by deliverer mobile terminal
3006b
Put LED blinking portion in range from intercom outdoor unit where camera can capture image
3006c
Blinks of LED of intercom outdoor unit indicate that blinks of LED of deliverer mobile terminal shot by camera of intercom outdoor unit correspond to order number held by intercom indoor unit
No
Yes
3006e
Whether blinks correspond to order number is displayed on deliverer mobile terminal
End
H
3006f
Blinks of LED of deliverer mobile terminal have been recognized using camera of intercom outdoor unit?
No
Yes
I

FIG. 21

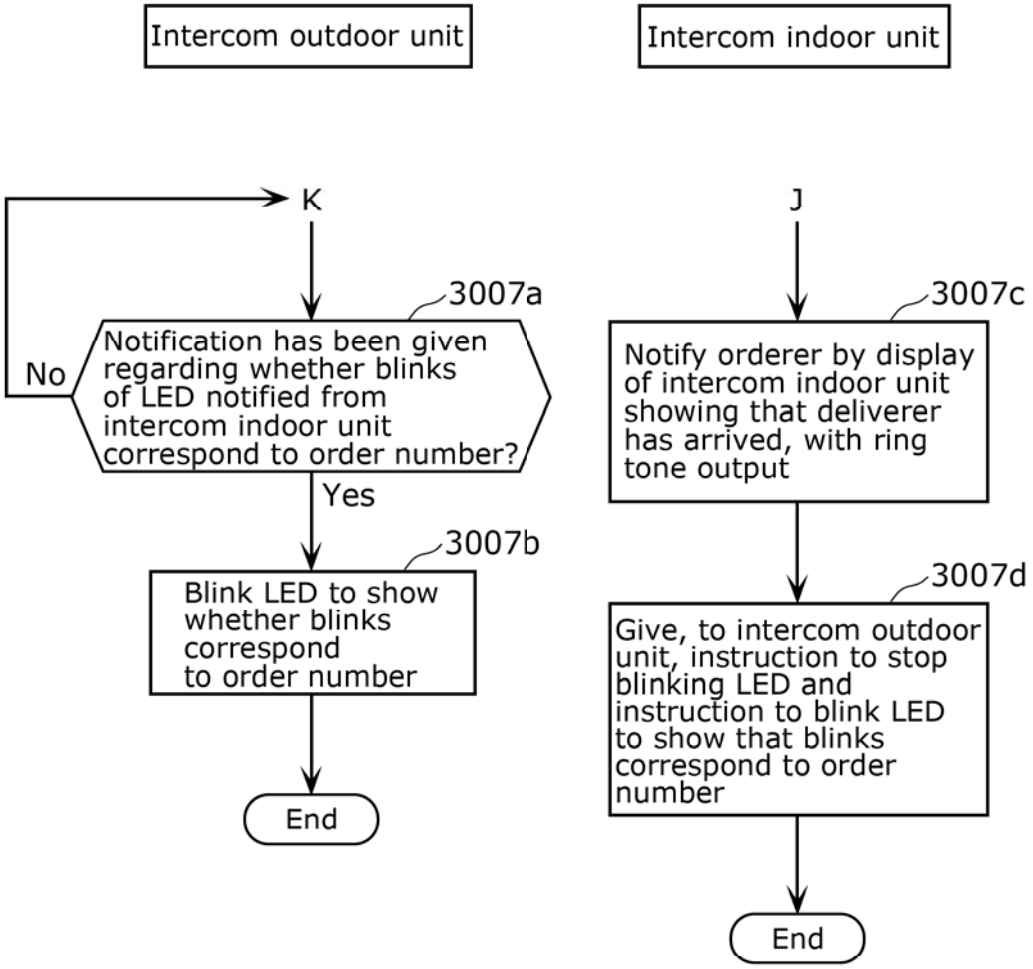

Intercom outdoor unit
Intercom indoor unit
K
J
3007a
Notification has been given regarding whether blinks of LED notified from intercom indoor unit correspond to order number?
No
Yes
3007b
Blink LED to show whether blinks correspond to order number
End
3007c
Notify orderer by display of intercom indoor unit showing that deliverer has arrived, with ring tone output
3007d
Give, to intercom outdoor unit, instruction to stop blinking LED and instruction to blink LED to show that blinks correspond to order number
End

FIG. 22

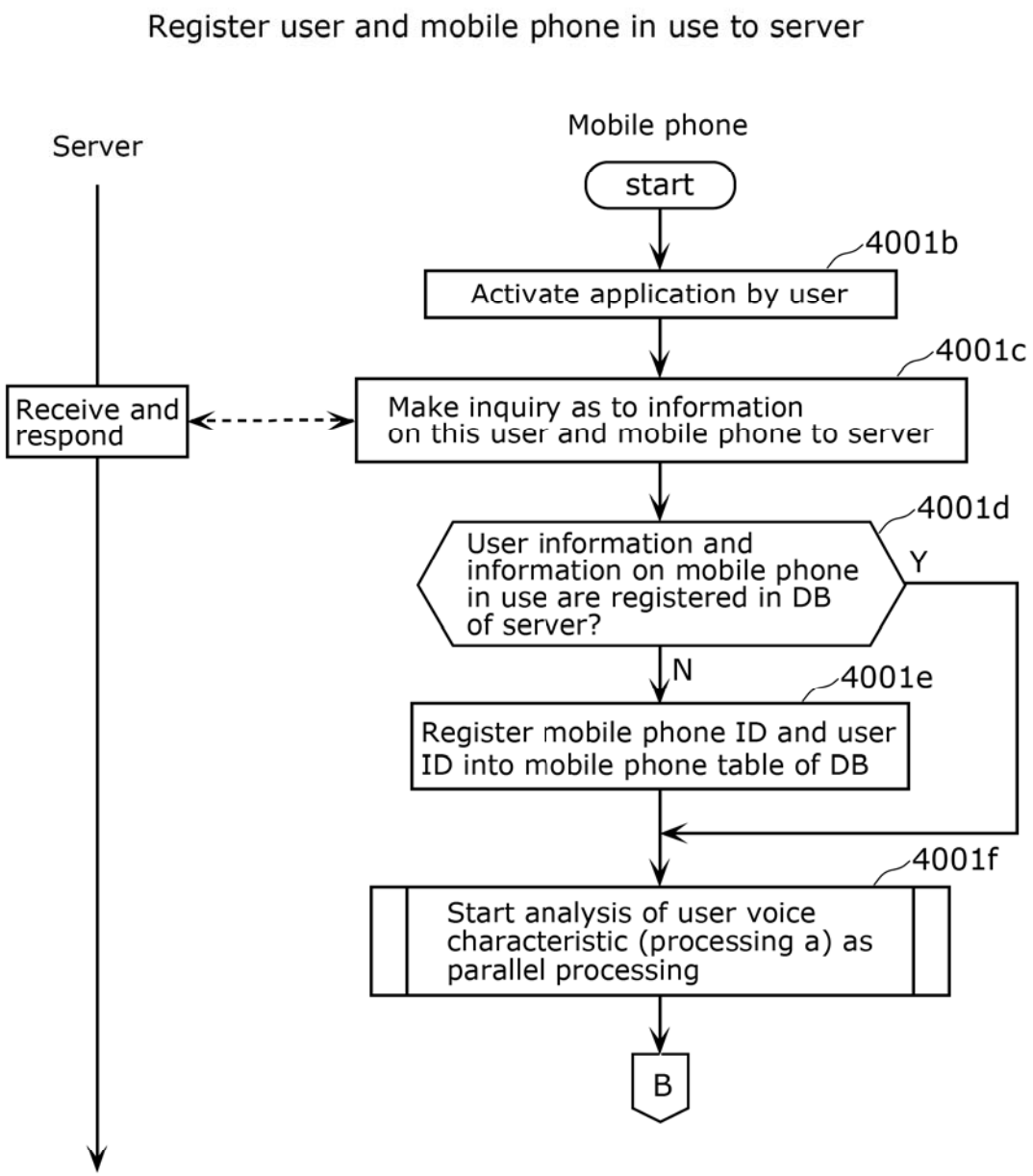

Register user and mobile phone in use to server
Server
Mobile phone
start
4001b
Activate application by user
4001c
Receive and respond
Make inquiry as to information on this user and mobile phone to server
4001d
User information and information on mobile phone in use are registered in DB of server?
Y
N
4001e
Register mobile phone ID and user ID into mobile phone table of DB
4001f
Start analysis of user voice characteristic (processing a) as parallel processing
B

FIG. 23

(Processing a) Analyze user voice characteristics

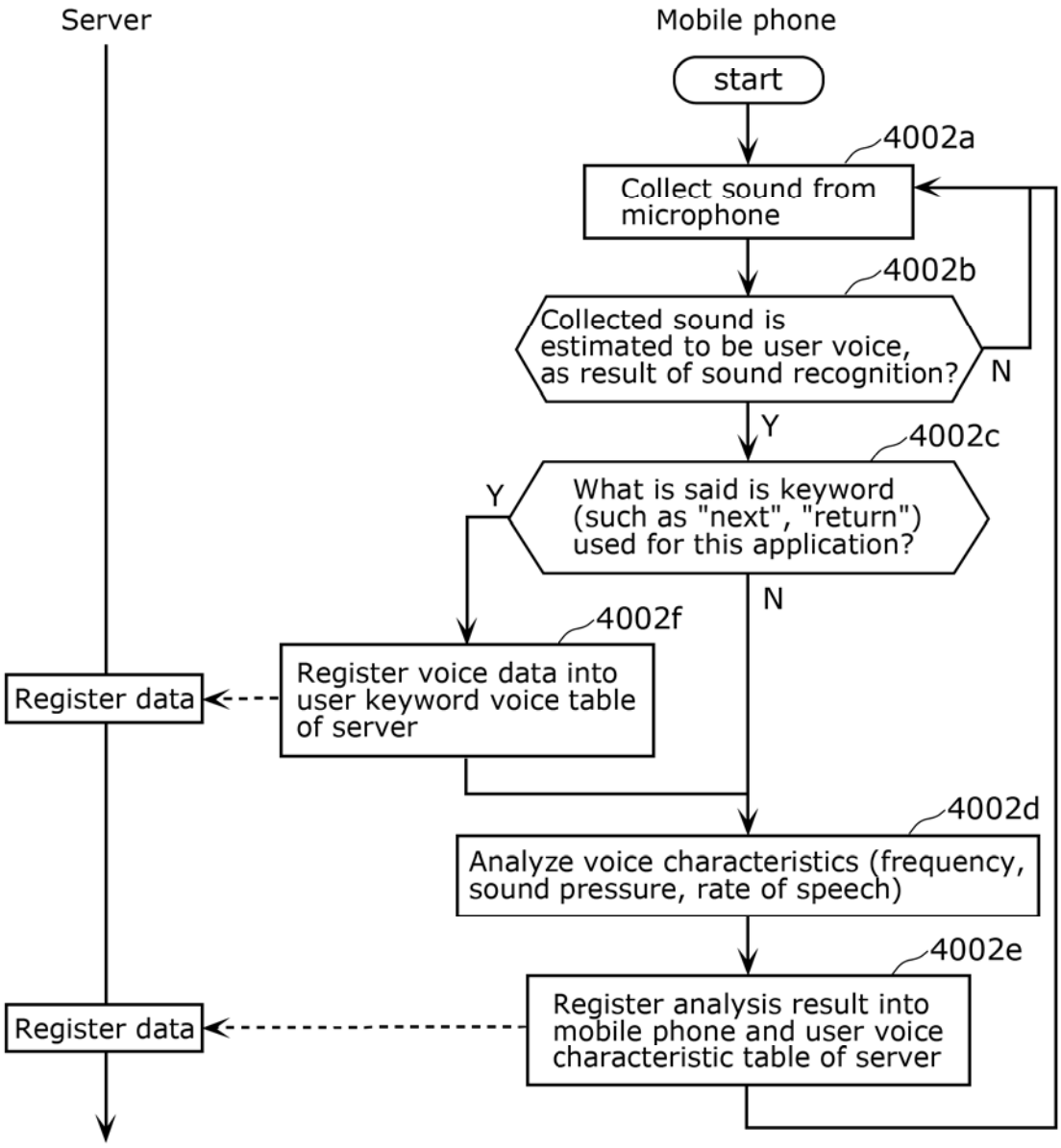


FIG. 24

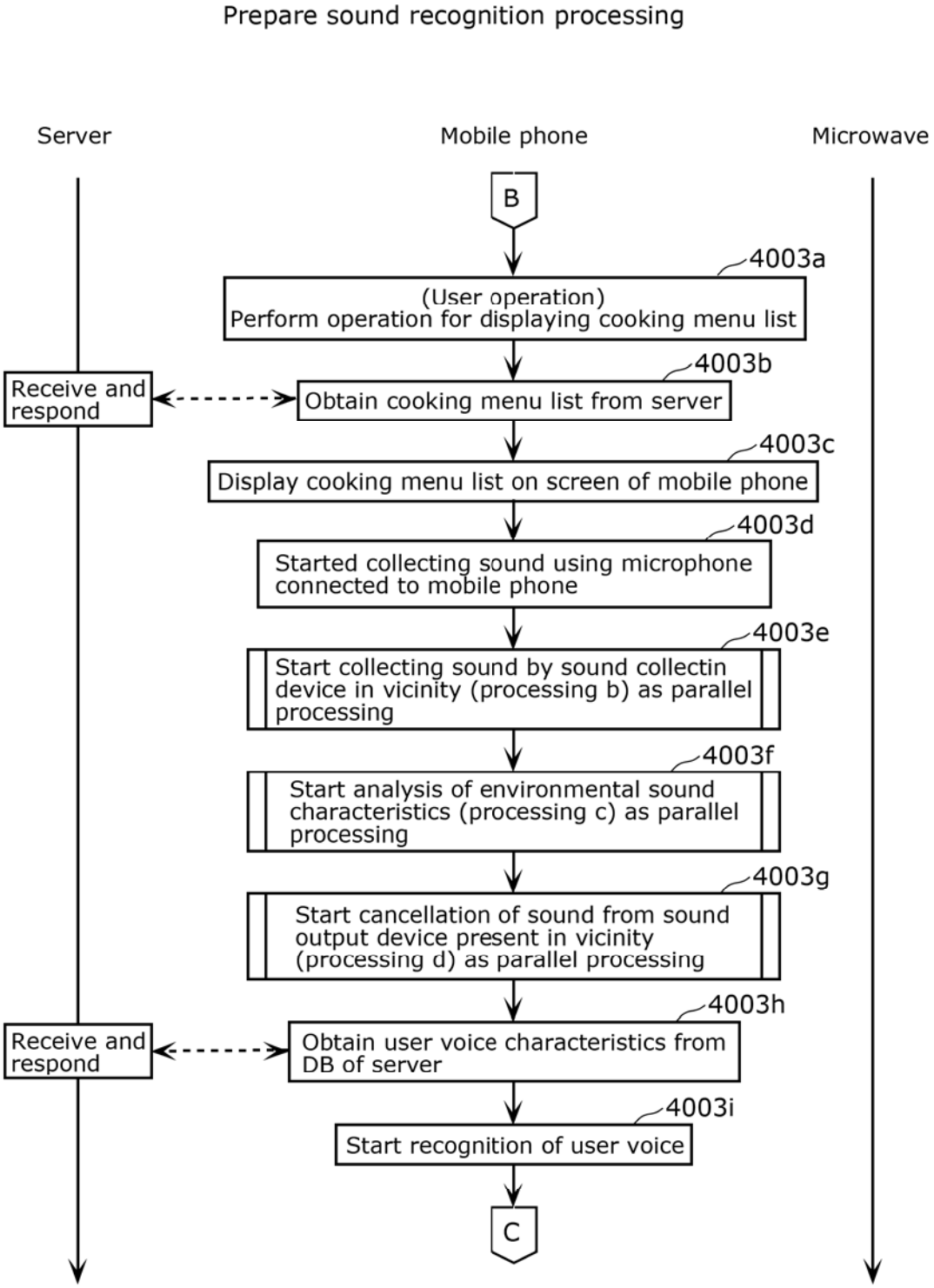

Prepare sound recognition processing
Server
Mobile phone
Microwave
B
4003a
(User operation)
Perform operation for displaying cooking menu list
4003b
Receive and respond
Obtain cooking menu list from server
4003c
Display cooking menu list on screen of mobile phone
4003d
Started collecting sound using microphone connected to mobile phone
4003e
Start collecting sound by sound collectin device in vicinity (processing b) as parallel processing
4003f
Start analysis of environmental sound characteristics (processing c) as parallel processing
4003g
Start cancellation of sound from sound output device present in vicinity (processing d) as parallel processing
4003h
Receive and respond
Obtain user voice characteristics from DB of server
4003i
Start recognition of user voice
C

FIG. 25

(Processing b) Collect sound by sound collecting device in vicinity

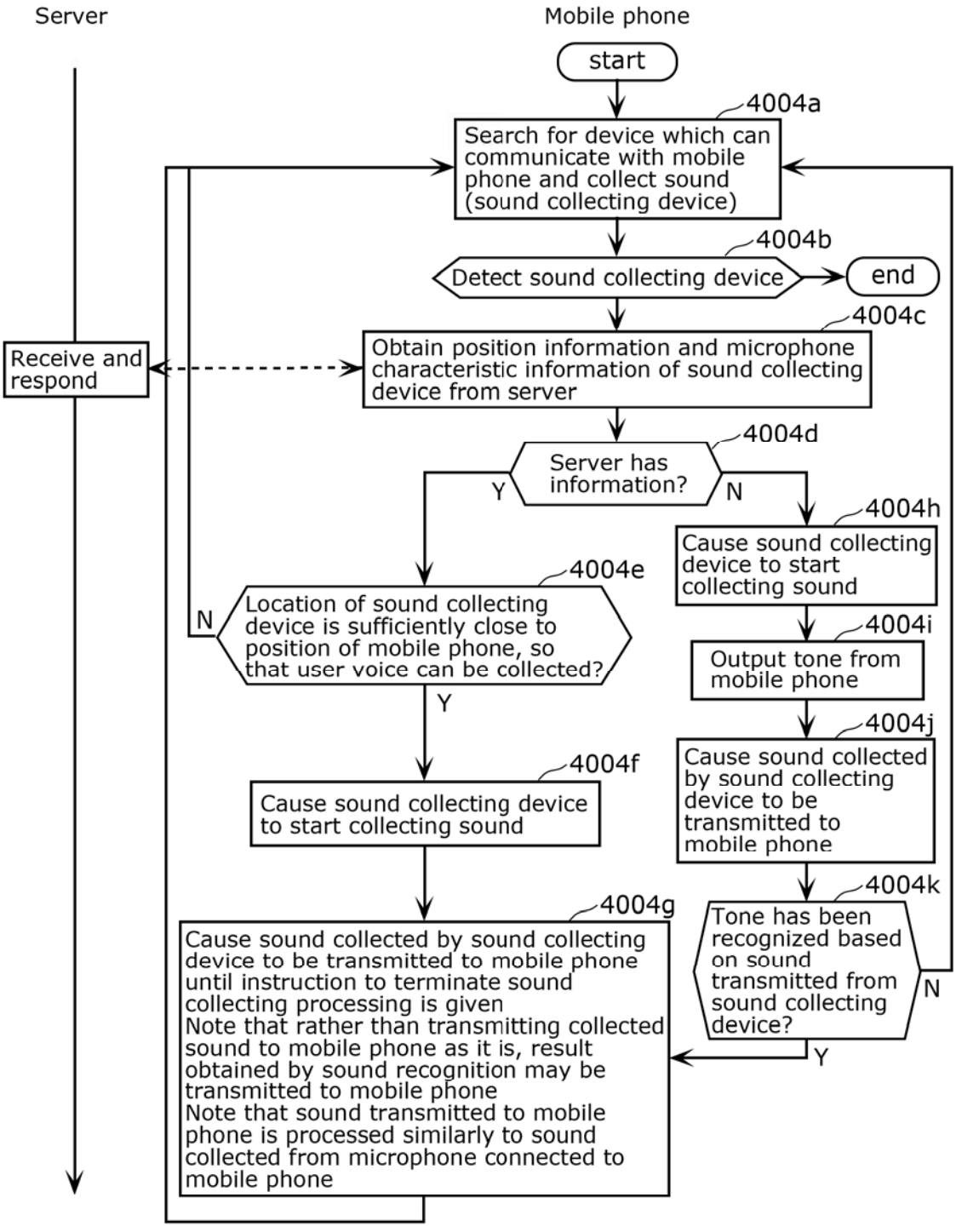


FIG. 26

(Processing c) Analyze environmental sound characteristics

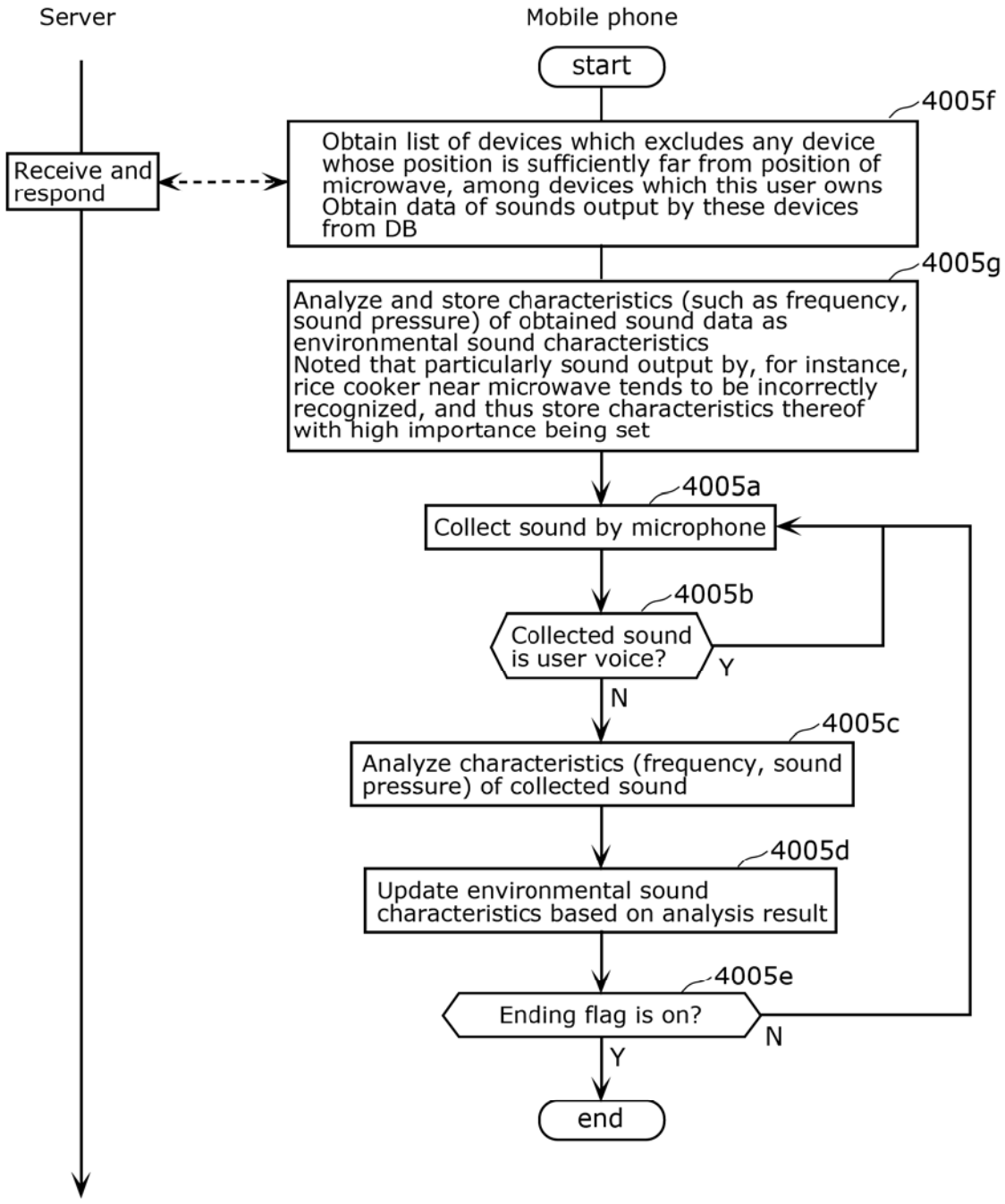


FIG. 27

(Processing d) Cancel sound from sound output device present in vicinity

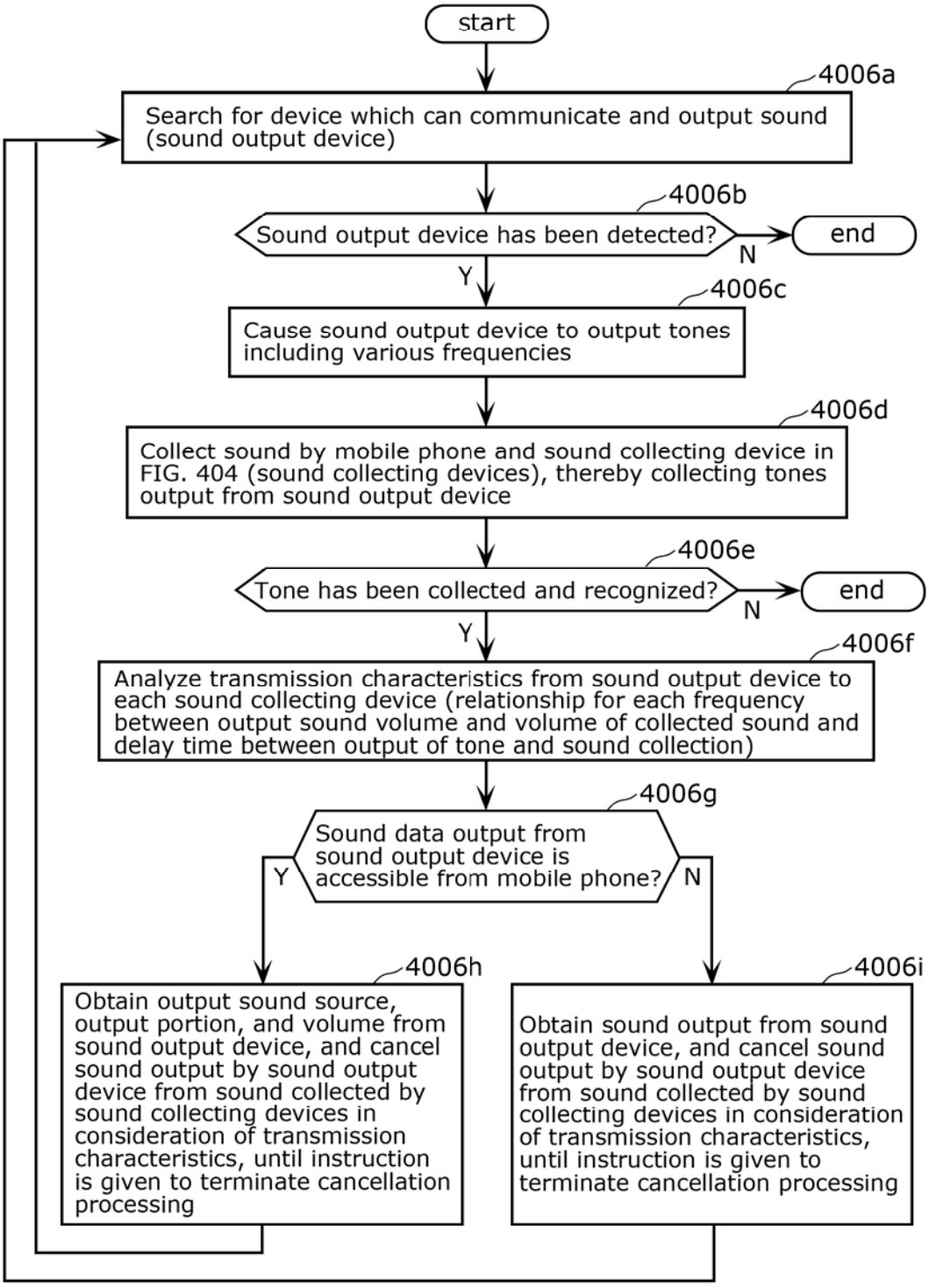


FIG. 28

Select what to cook, and set detailed operation in microwave

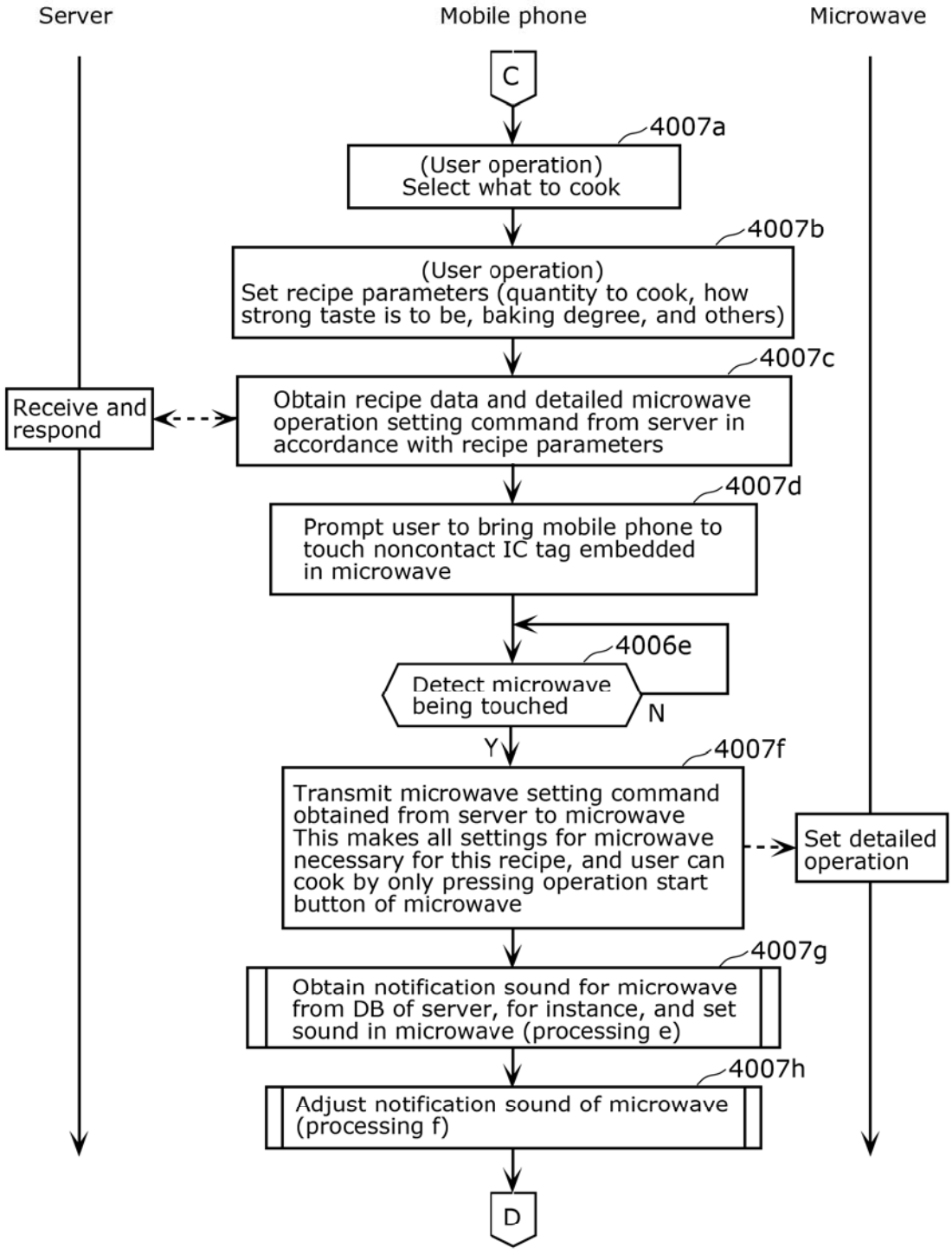


FIG. 29

(Processing e) Obtain notification sound for microwave from DB of server, for instance, and set sound in microwave

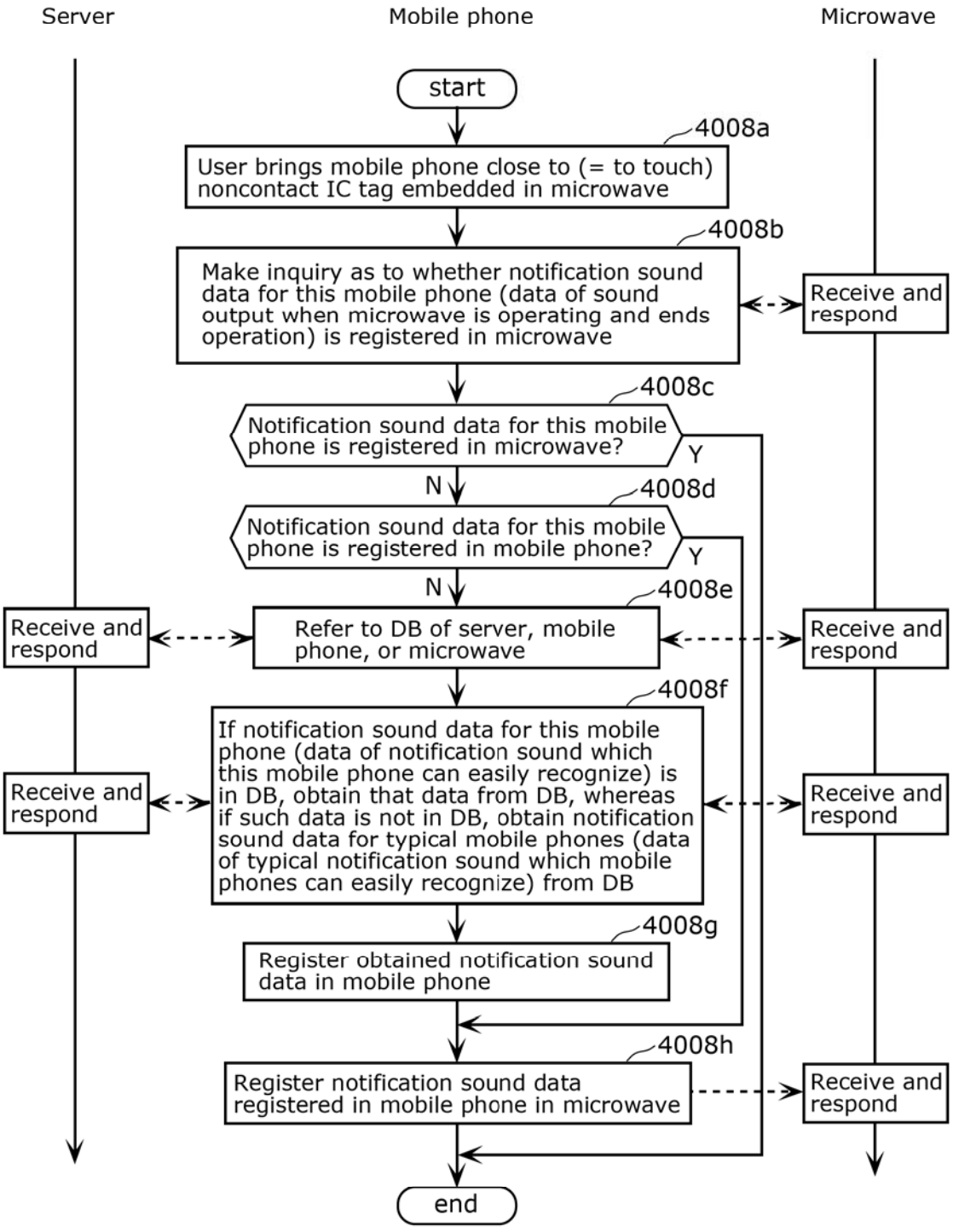


FIG. 30

(Processing f) Adjust notification sound of microwave

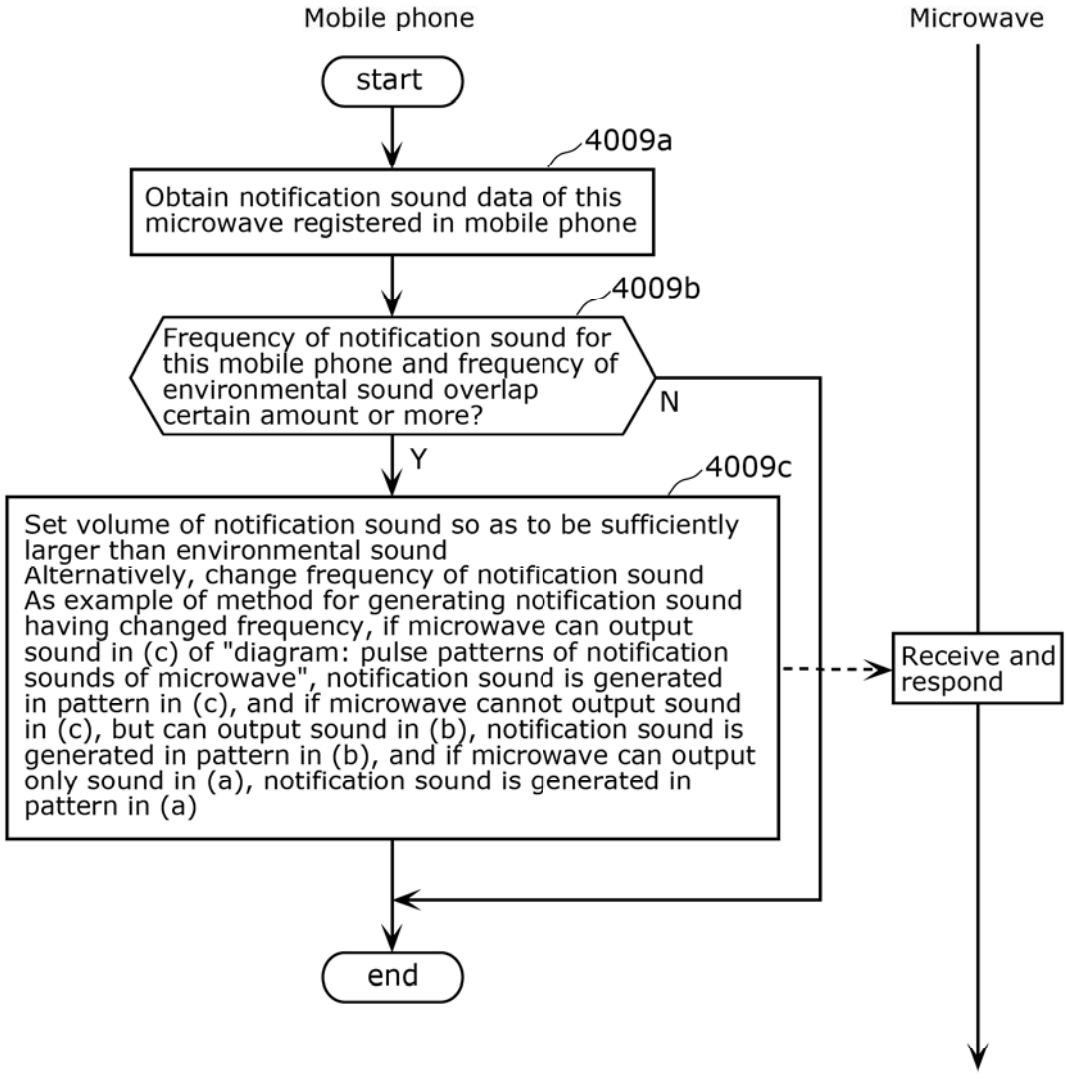


FIG. 31

Diagram: Pulse patterns of notification sounds of microwave

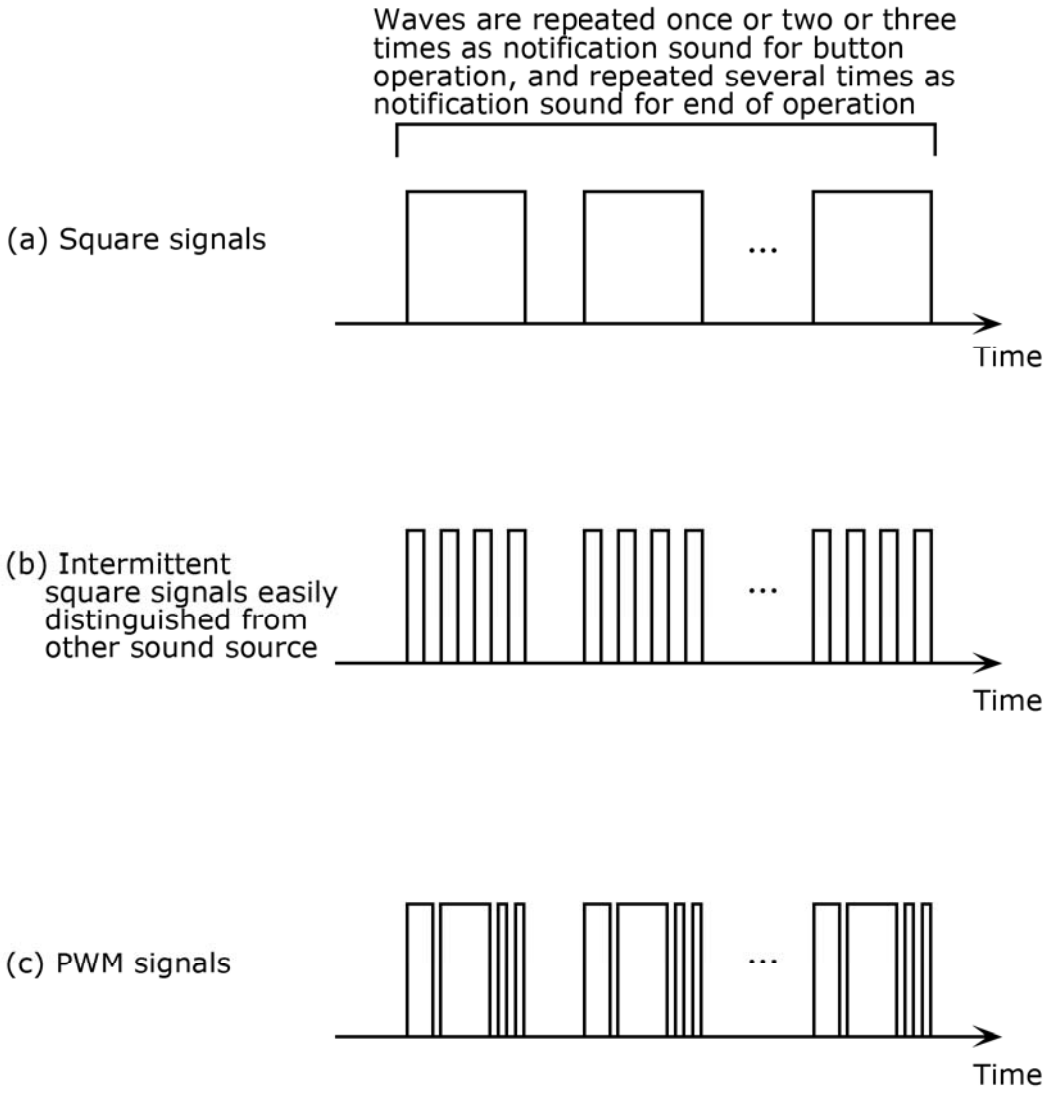


FIG. 32

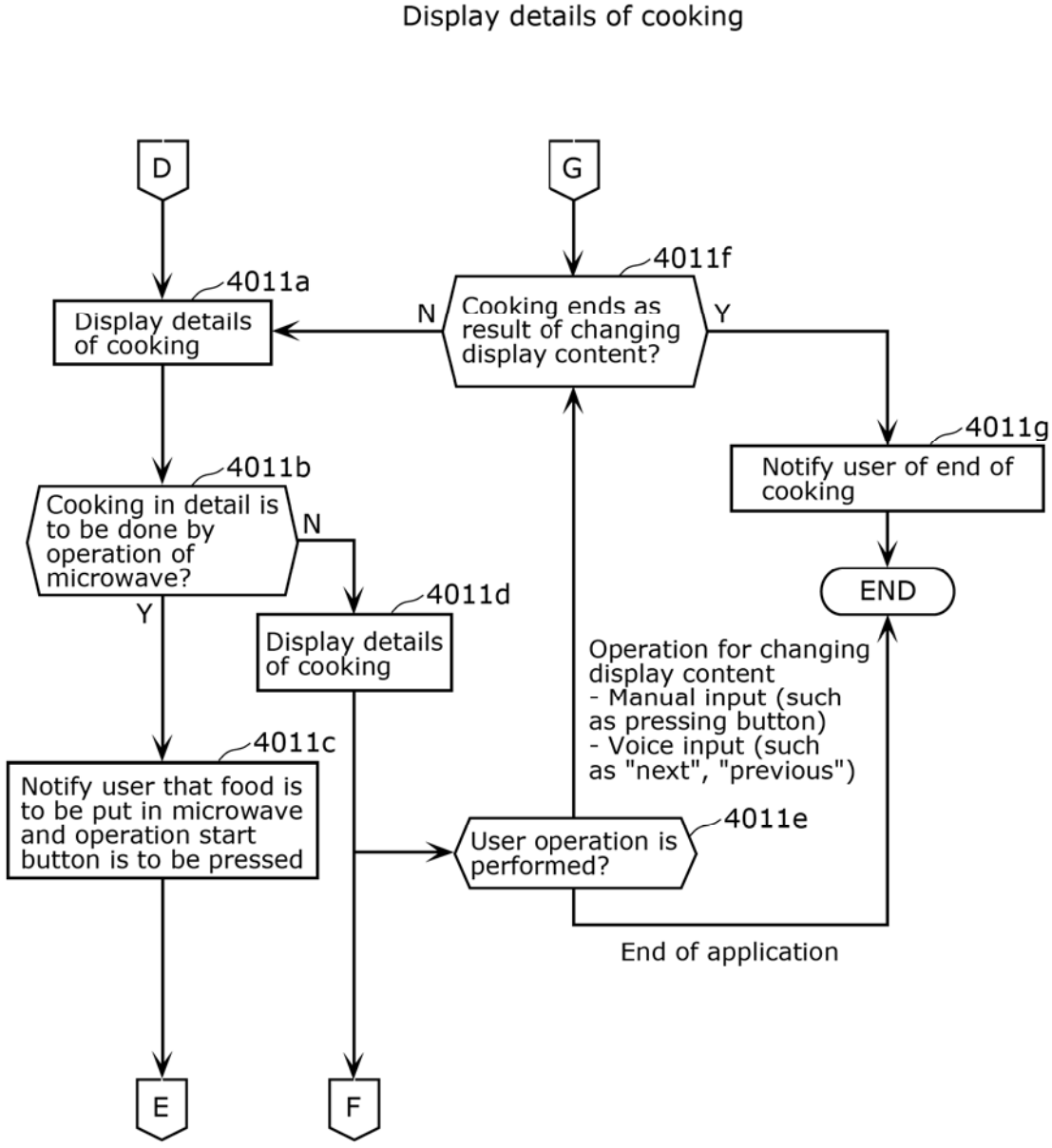

Display details of cooking
D
G
4011a
Display details of cooking
4011f
Cooking ends as result of changing display content?
N
Y
4011b
Cooking in detail is to be done by operation of microwave?
N
Y
4011d
Display details of cooking
4011g
Notify user of end of cooking
END
4011c
Notify user that food is to be put in microwave and operation start button is to be pressed
Operation for changing display content
- Manual input (such as pressing button)
- Voice input (such as "next", "previous")
4011e
User operation is performed?
End of application
E
F

FIG. 33

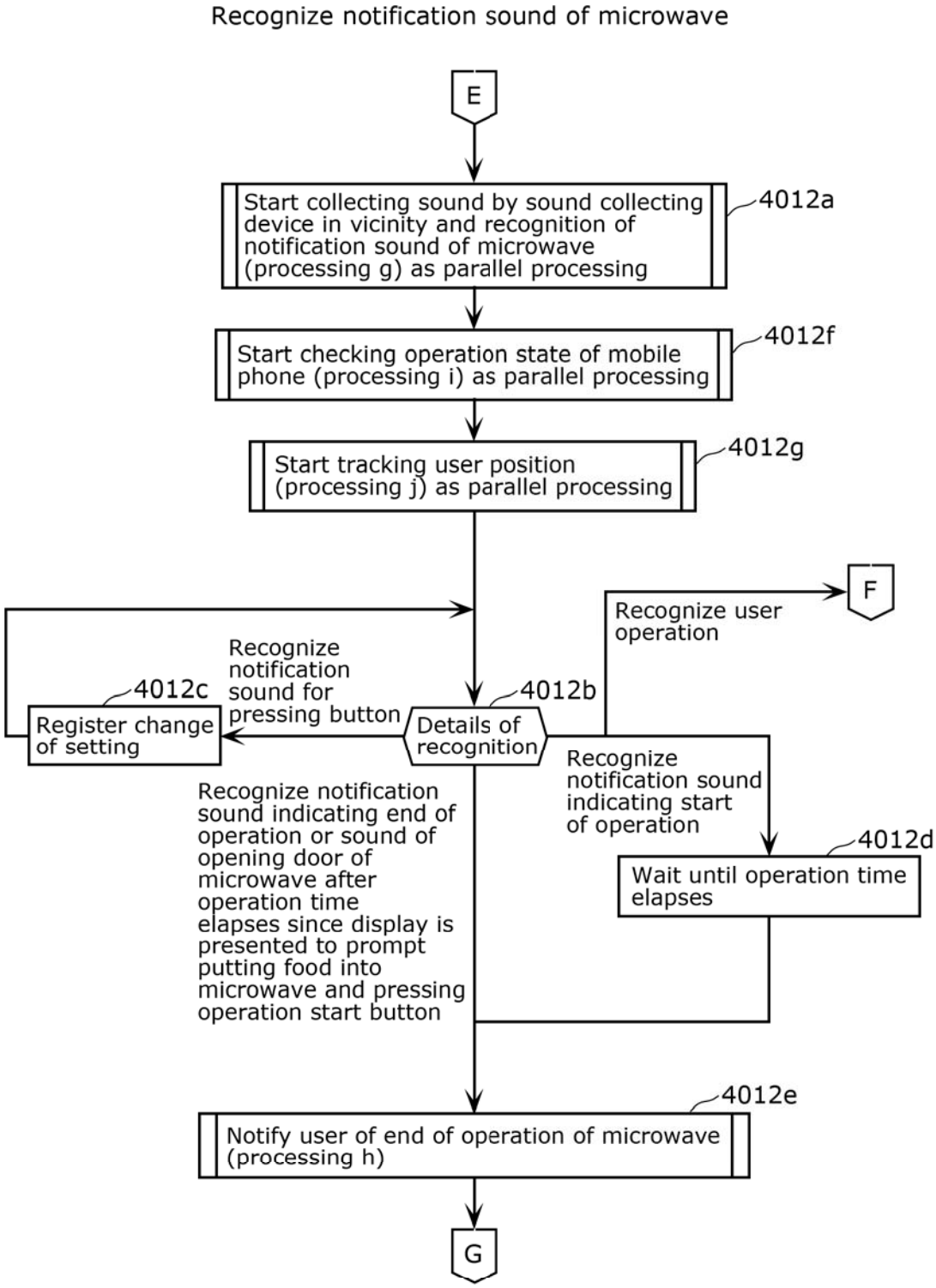

Recognize notification sound of microwave
E
Start collecting sound by sound collecting device in vicinity and recognition of notification sound of microwave (processing g) as parallel processing
4012a
Start checking operation state of mobile phone (processing i) as parallel processing
4012f
Start tracking user position (processing j) as parallel processing
4012g
F
Recognize user operation
Recognize notification sound for pressing button
4012c
Register change of setting
4012b
Details of recognition
Recognize notification sound indicating start of operation
4012d
Wait until operation time elapses
Recognize notification sound indicating end of operation or sound of opening door of microwave after operation time elapses since display is presented to prompt putting food into microwave and pressing operation start button
4012e
Notify user of end of operation of microwave (processing h)
G

FIG. 34

(Processing g) Collect sound by sound collecting device in vicinity and recognize notification sound of microwave

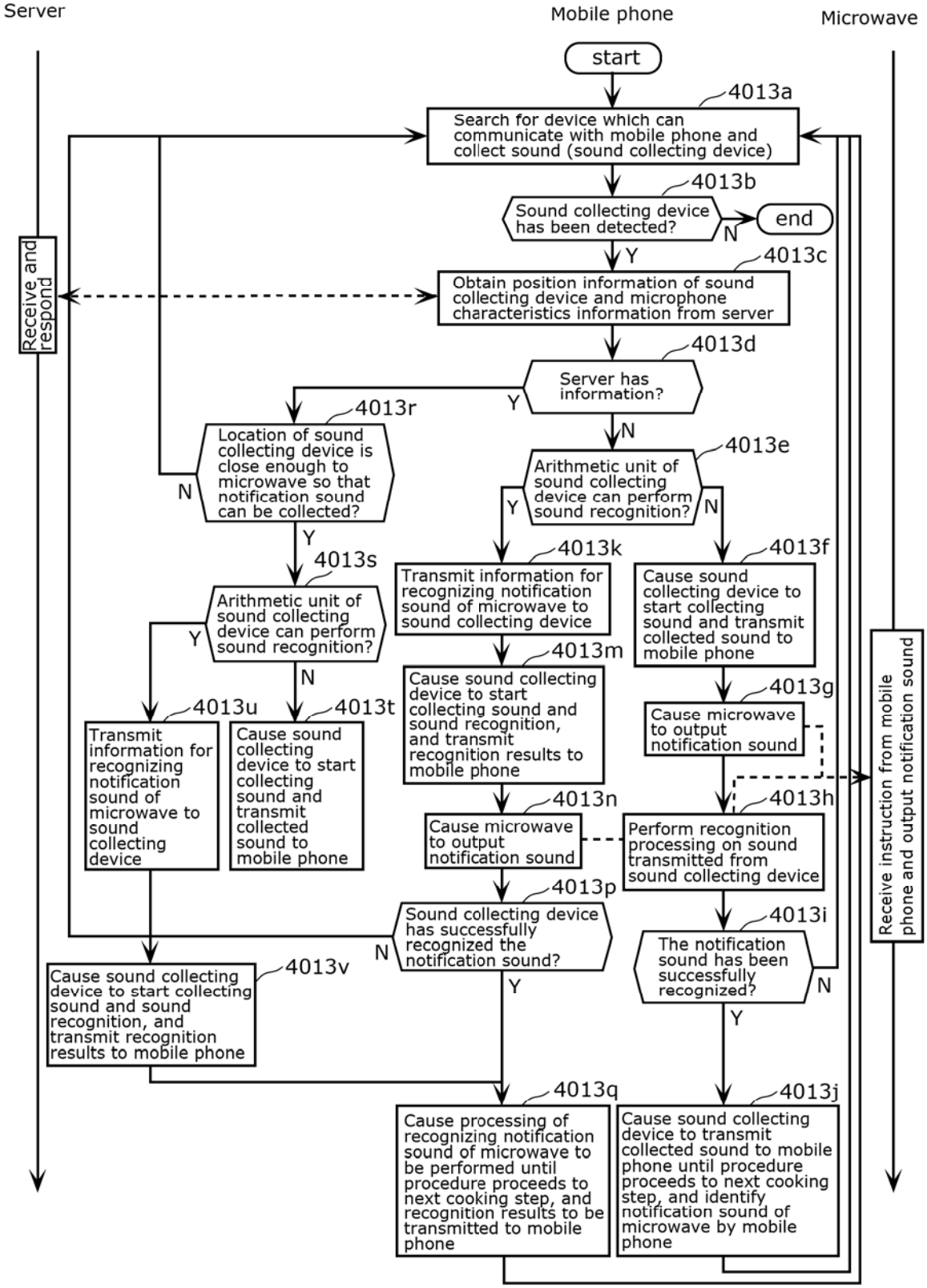


FIG. 35

(Processing h) Notify user of end of operation of microwave

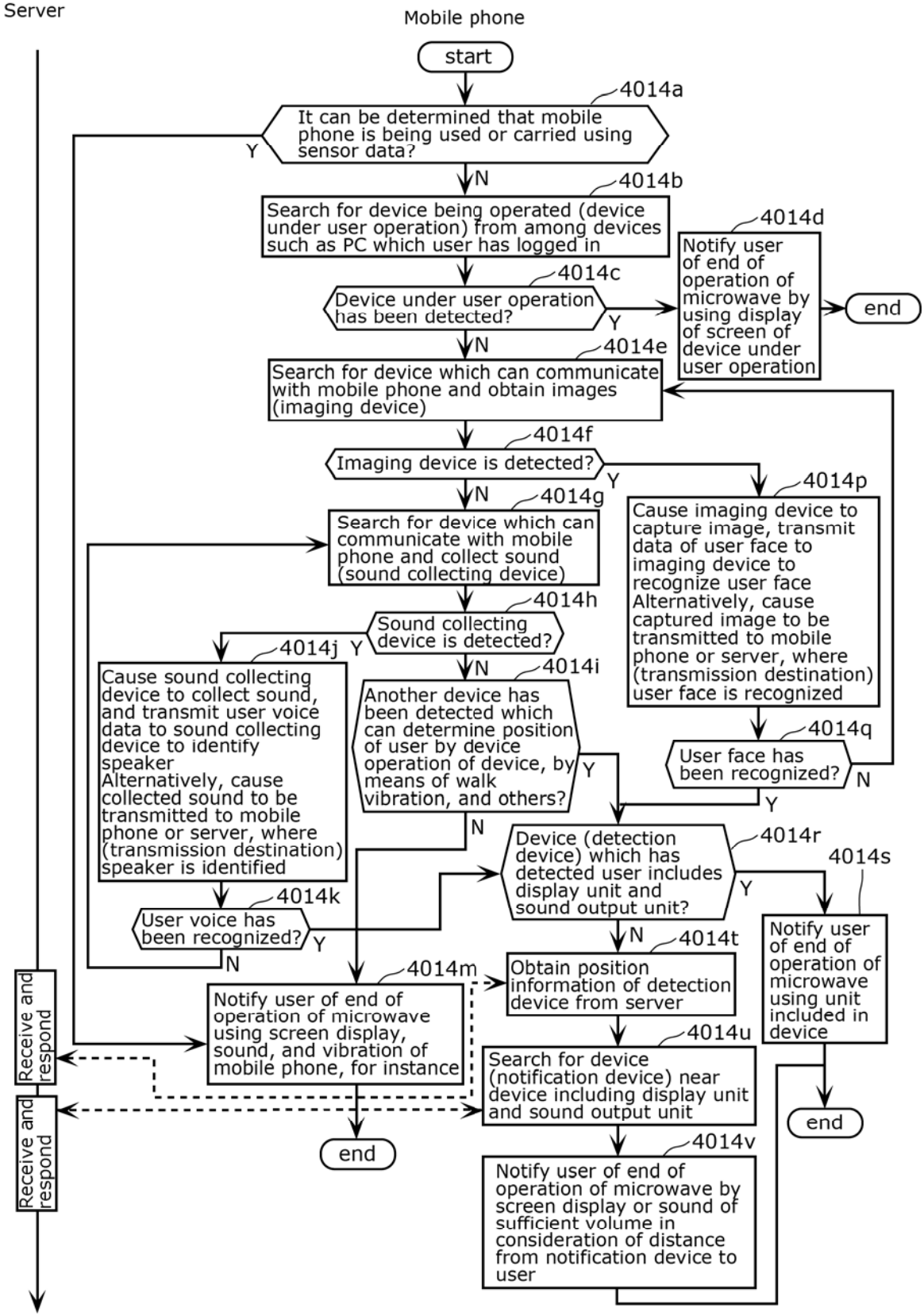


FIG. 36

(Processing i) Check operation state of mobile phone

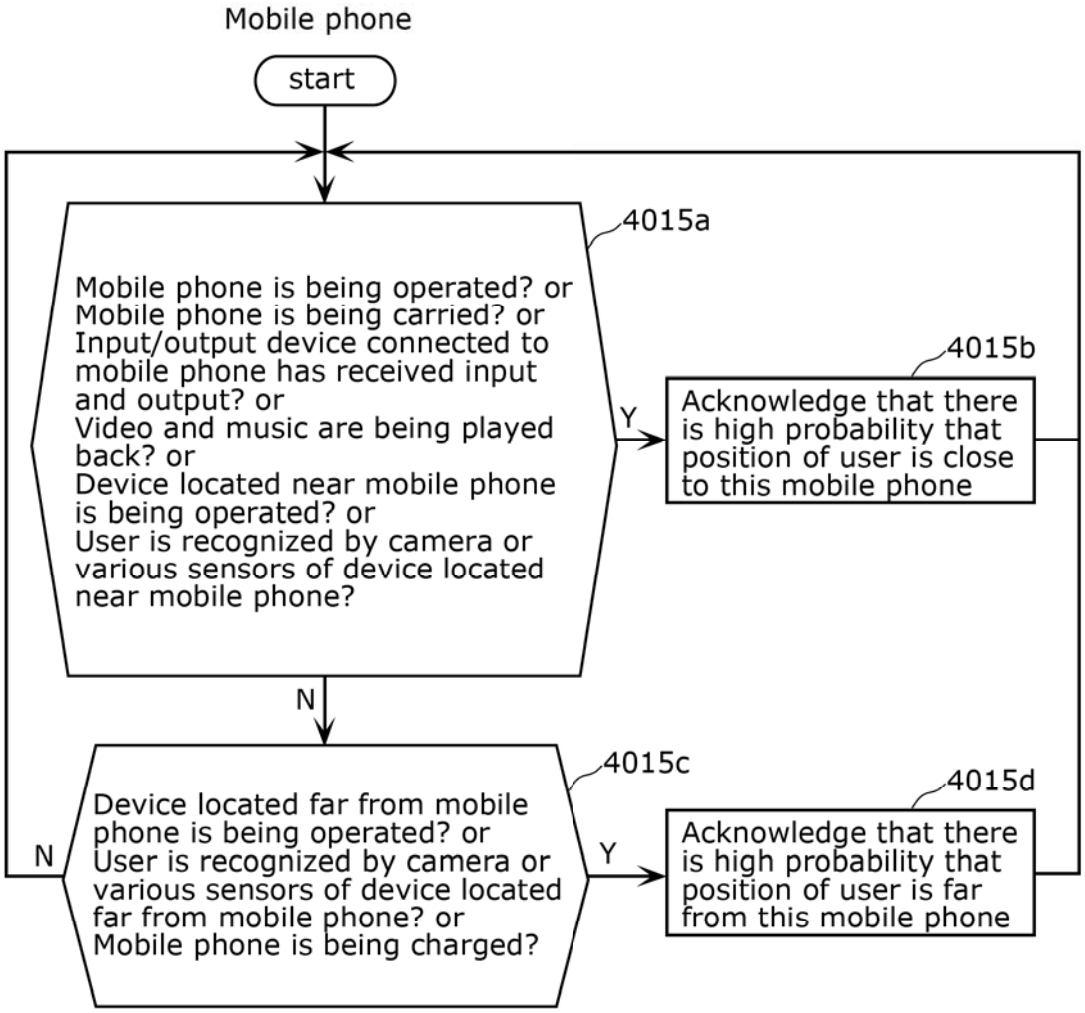


FIG. 37

(Processing j) Track user position

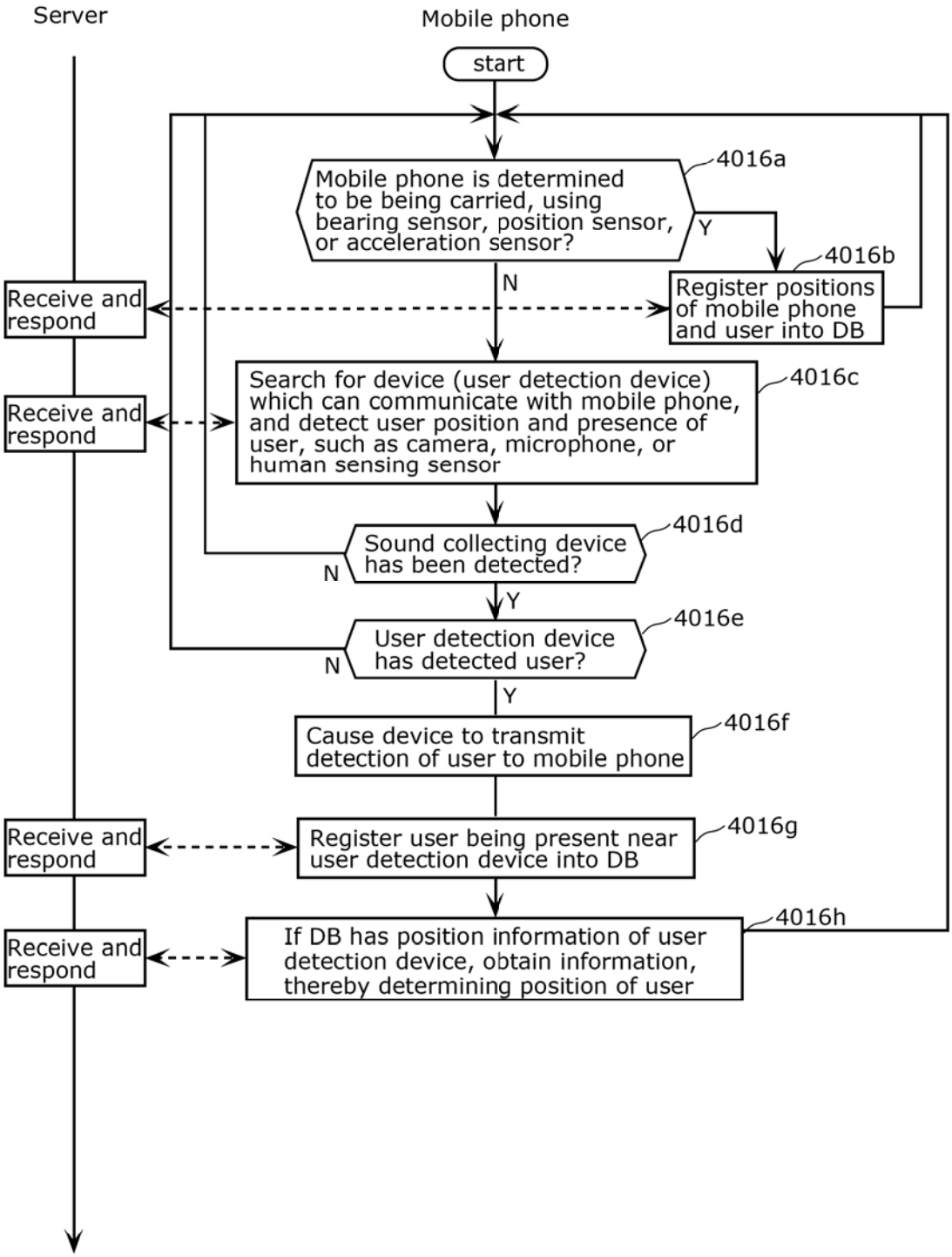


FIG. 38

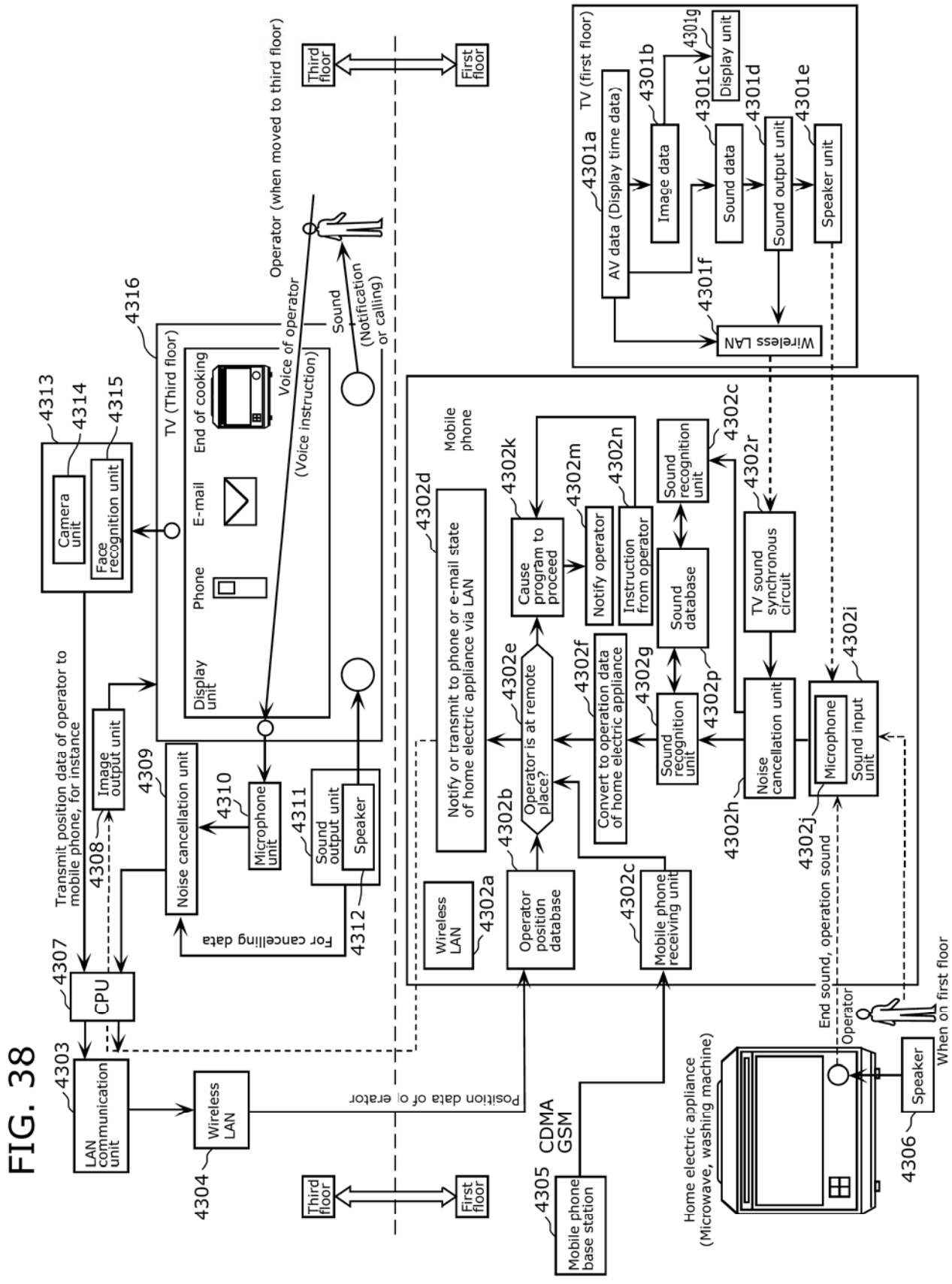

4303
LAN communication unit
4307
CPU
4304
Wireless LAN
Third floor
First floor
Position data of operator
4305
CDMA GSM
Mobile phone base station
Home electric appliance (Microwave, washing machine)
4306
Speaker
When on first floor
End sound, operation sound
Operator
4302j
Microphone
Sound input unit
4302i
4302h
Noise cancellation unit
4302p
Sound recognition unit
4302g
Sound database
4302r
TV sound synchronous circuit
4302c
Sound recognition unit
4302f
Convert to operation data of home electric appliance
4302n
Instruction from operator
4302m
Notify operator
4302k
Cause program to proceed
4302e
Operator is at remote place?
4302b
Operator position database
4302a
Wireless LAN
4302c
Mobile phone receiving unit
4302d
Mobile phone
Notify or transmit to phone or e-mail state of home electric appliance via LAN
4301a
TV (first floor)
AV data (Display time data)
4301b
Image data
4301c
Sound data
4301d
Sound output unit
4301e
Speaker unit
4301g
Display unit
4301f
Wireless LAN
4316
TV (Third floor)
Display unit
Phone
E-mail
End of cooking
Voice of operator
(Voice instruction)
Operator (when moved to third floor)
Sound
(Notification or calling)
4313
Camera unit
4314
Face recognition unit
4315
Transmit position data of operator to mobile phone, for instance
4308
Image output unit
4309
Noise cancellation unit
4310
Microphone unit
4311
Sound output unit
Speaker
4312
For cancelling data

FIG. 39

Database

Microwave table 4040a

Model ID of microwave	Data for identifying sound which can be output by microwave (speaker characteristics and modulation method, for instance)	Notification sound data for mobile phone model A (sound easily recognized by A)	Notification sound data for mobile phone model B (sound easily recognized by B)	...	Notification sound data for typical mobile phone (sound easily recognized on average)

Mobile phone table 4040a

Mobile phone ID	Mobile phone model ID	User ID	Mobile phone position data

Mobile phone model table 4040c

Mobile phone model ID	Sound-collecting characteristics

User voice characteristic table 4040d

User ID	User voice acoustic feature

User keyword voice table 4040e

User ID	Voice waveform data obtained when user says keyword

User owned device position table 4040f

User ID	Owned device ID	Owned device position data

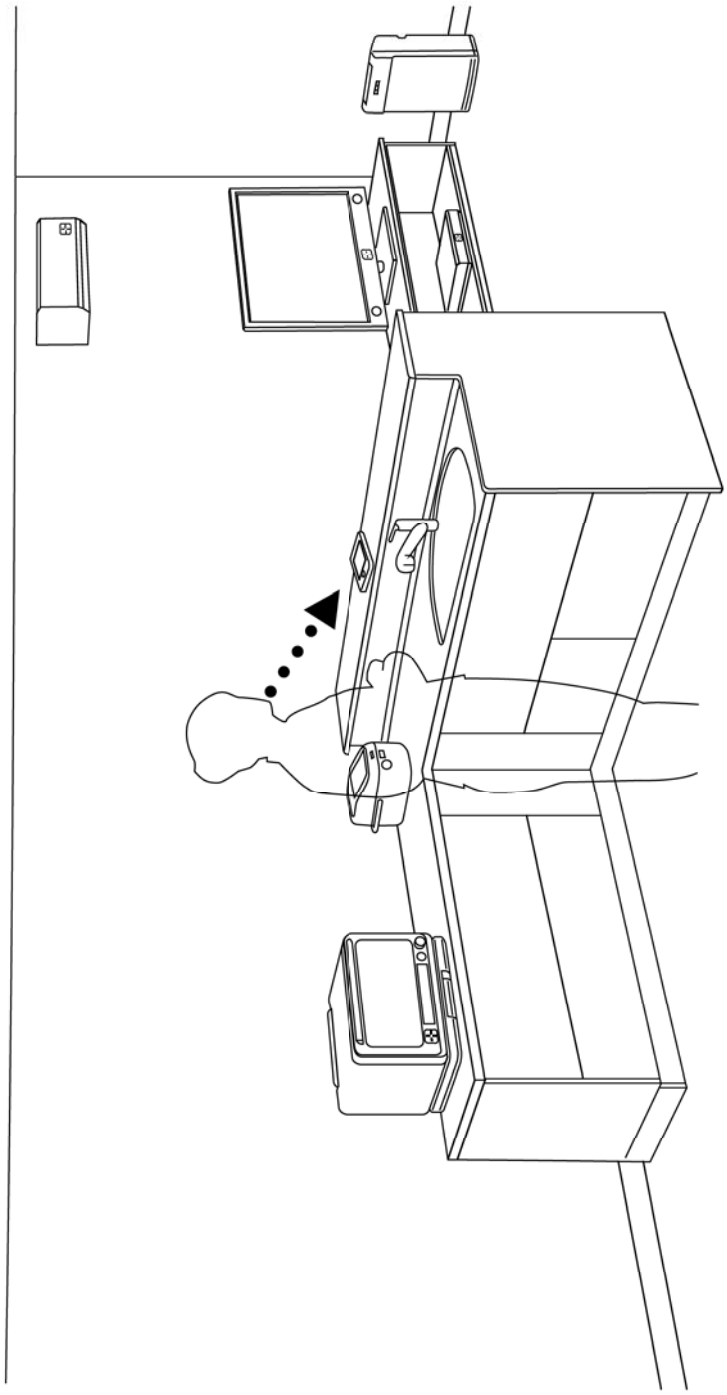
User owned device sound data table 4040g

User ID	Owned device ID	Sound data output by owned device

User position table 4040h

User ID	User position data

FIG. 40



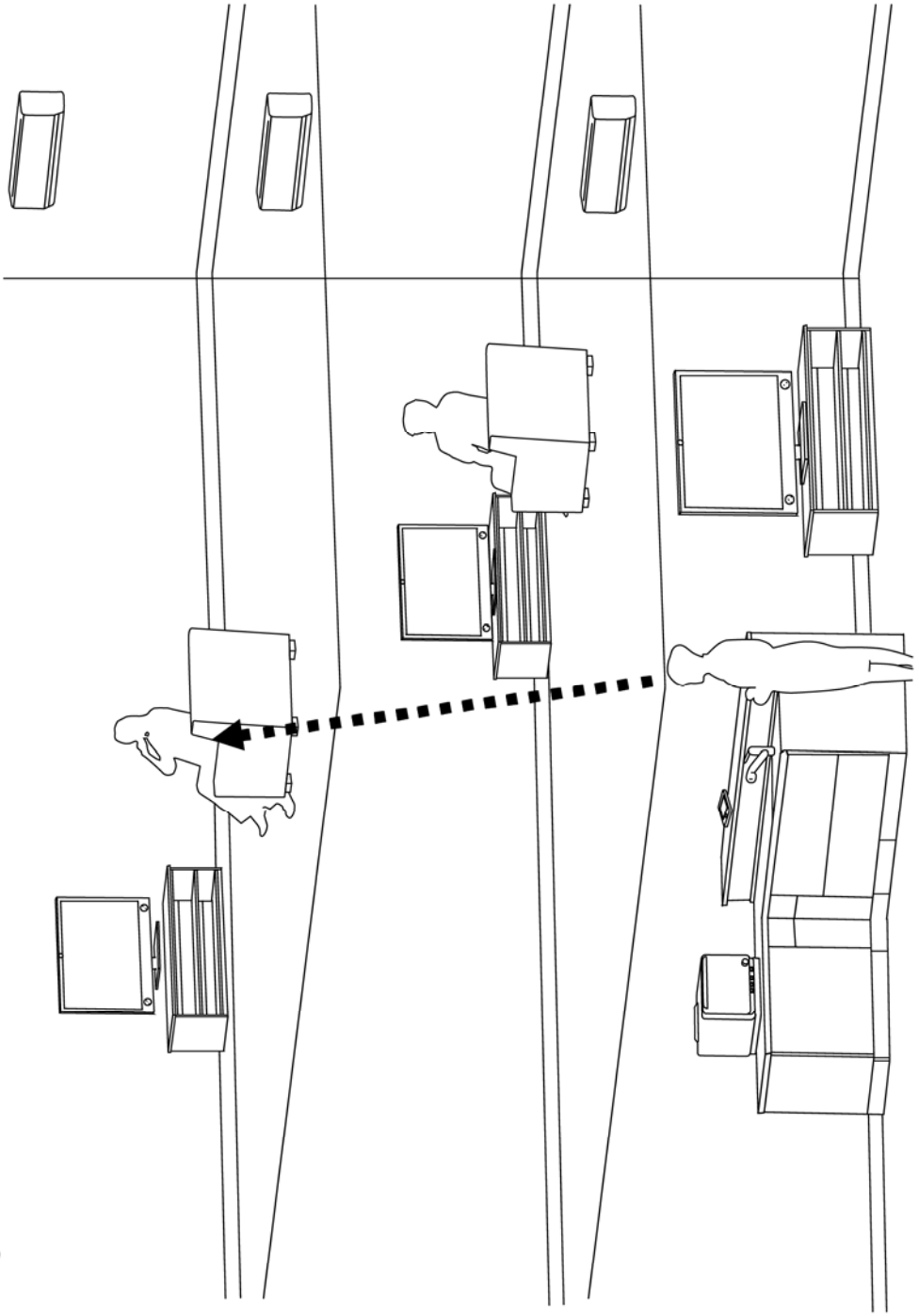


FIG. 41

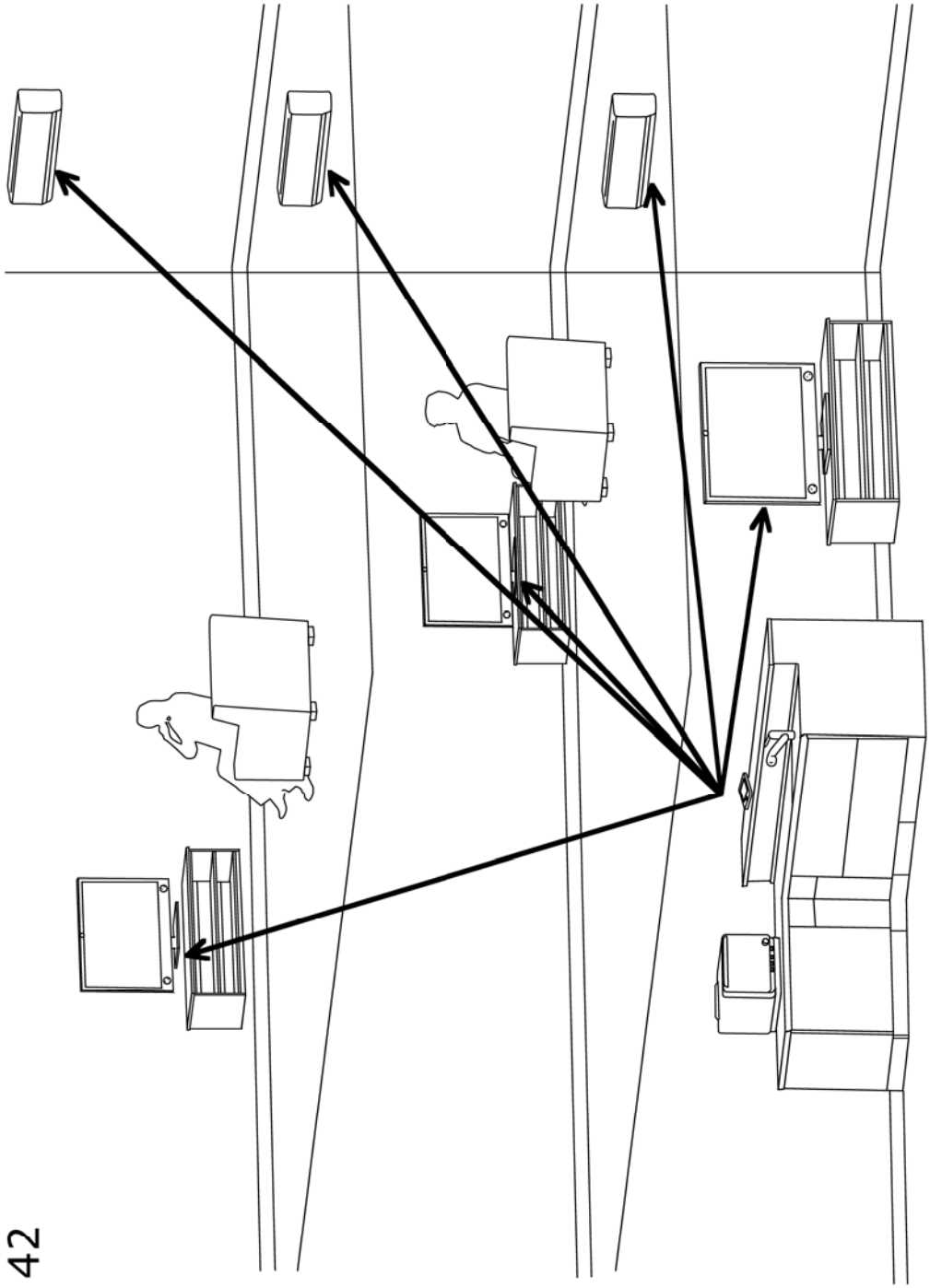


FIG. 42

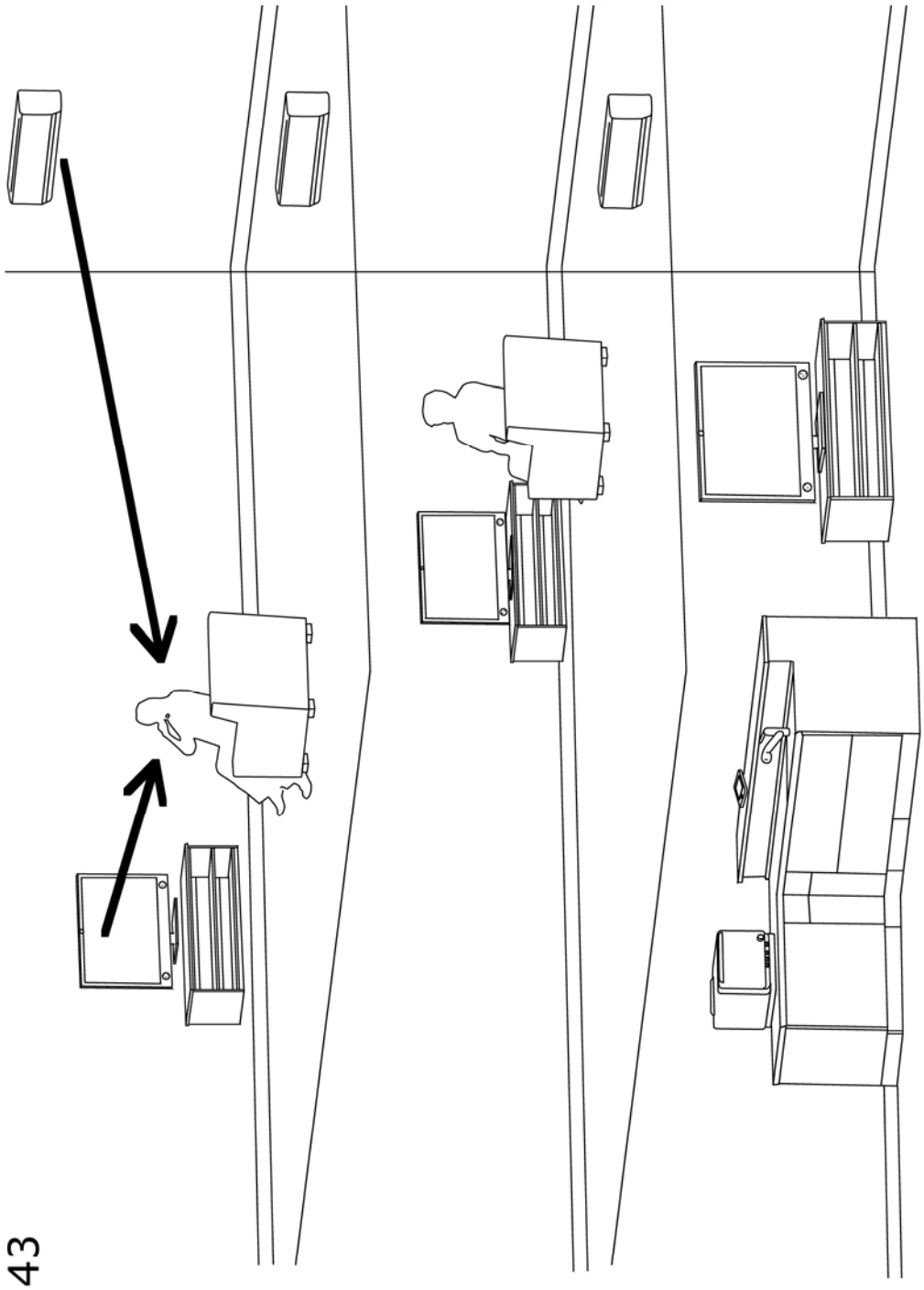


FIG. 43

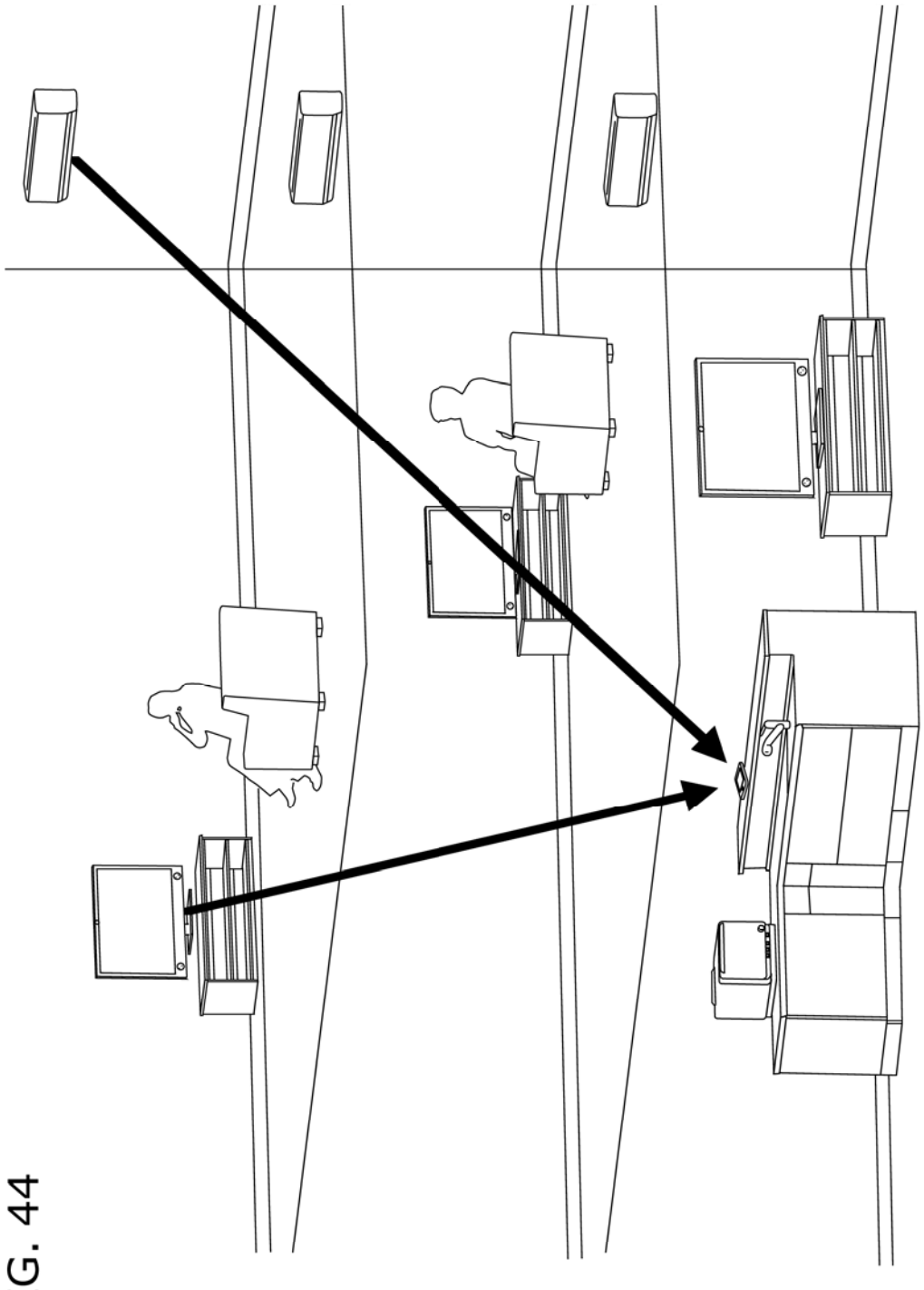
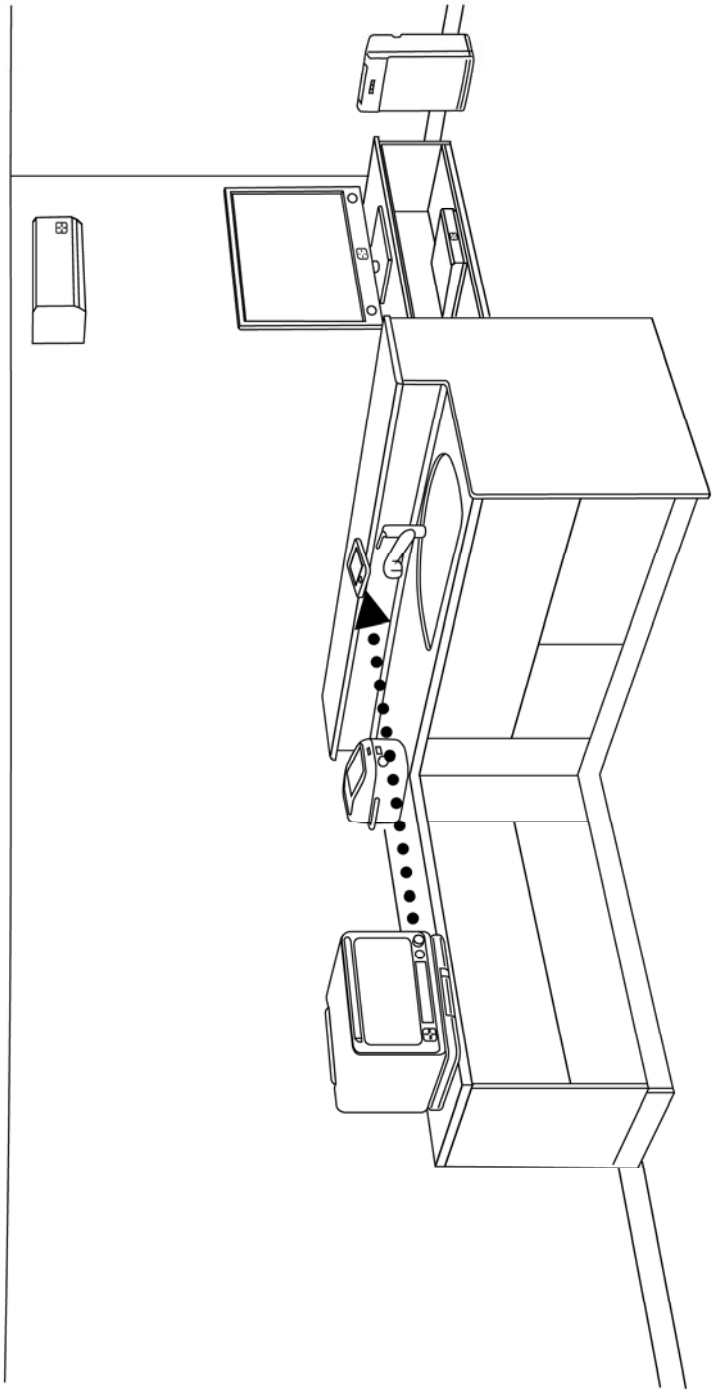


FIG. 44

FIG. 45



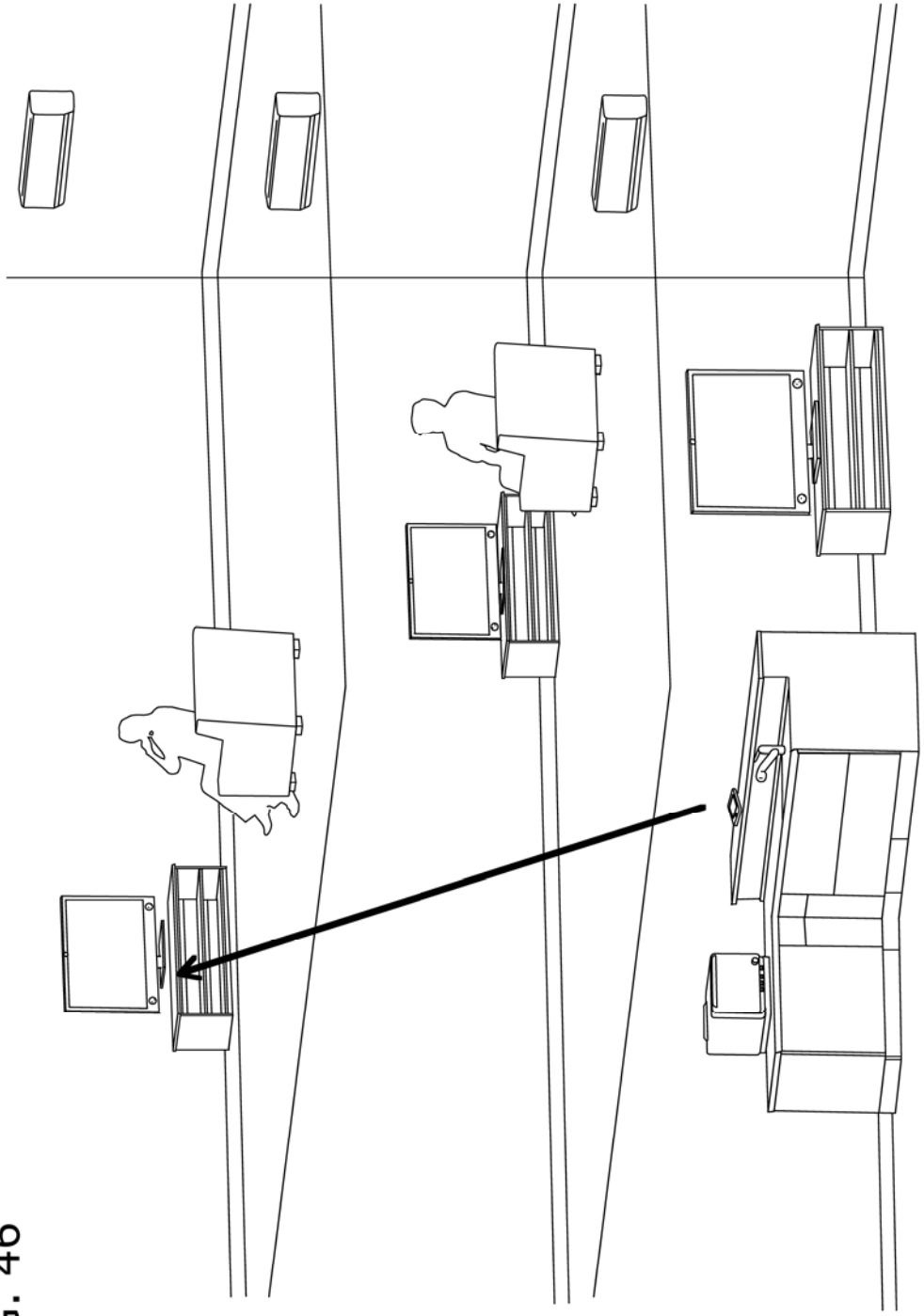


FIG. 46

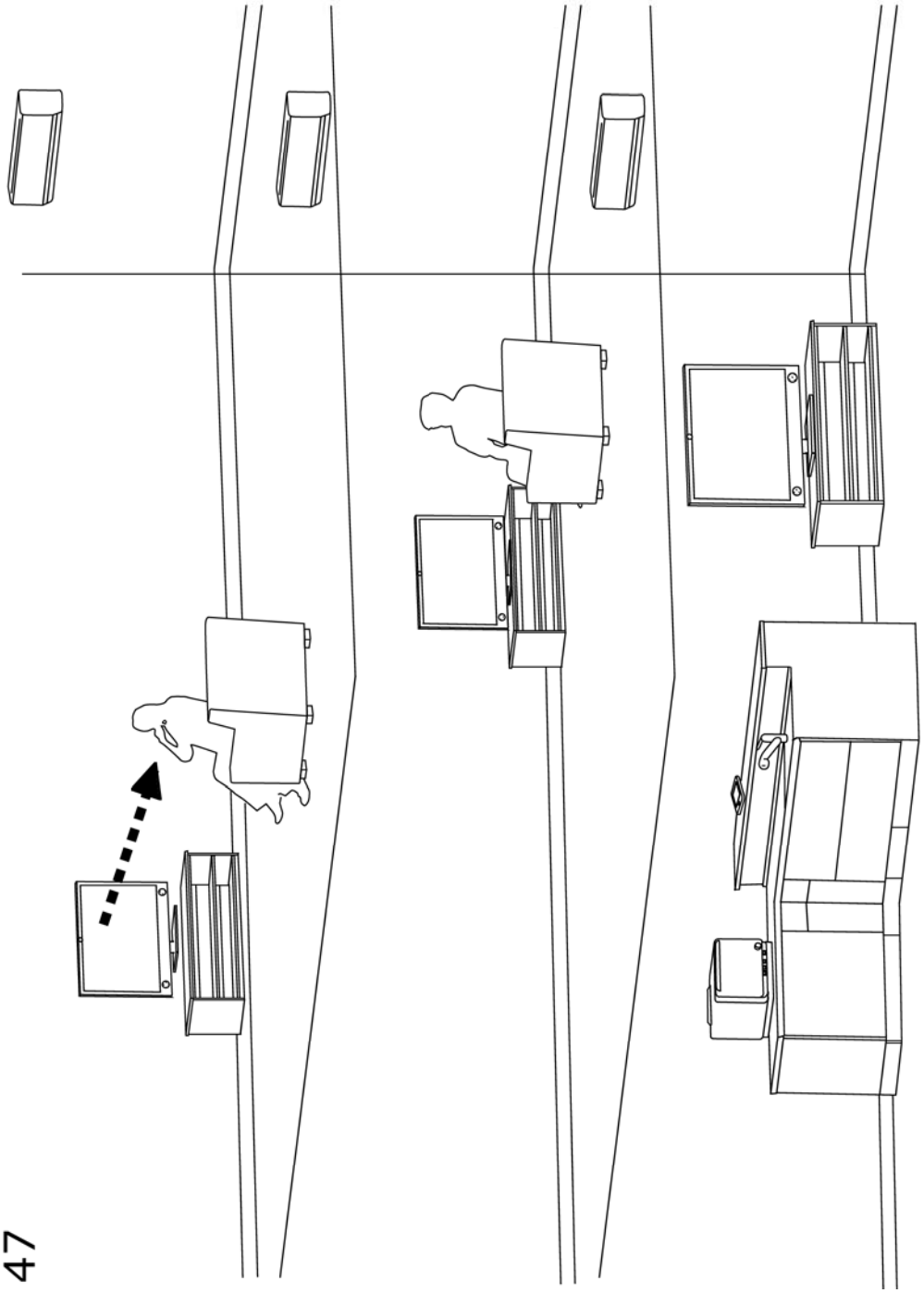
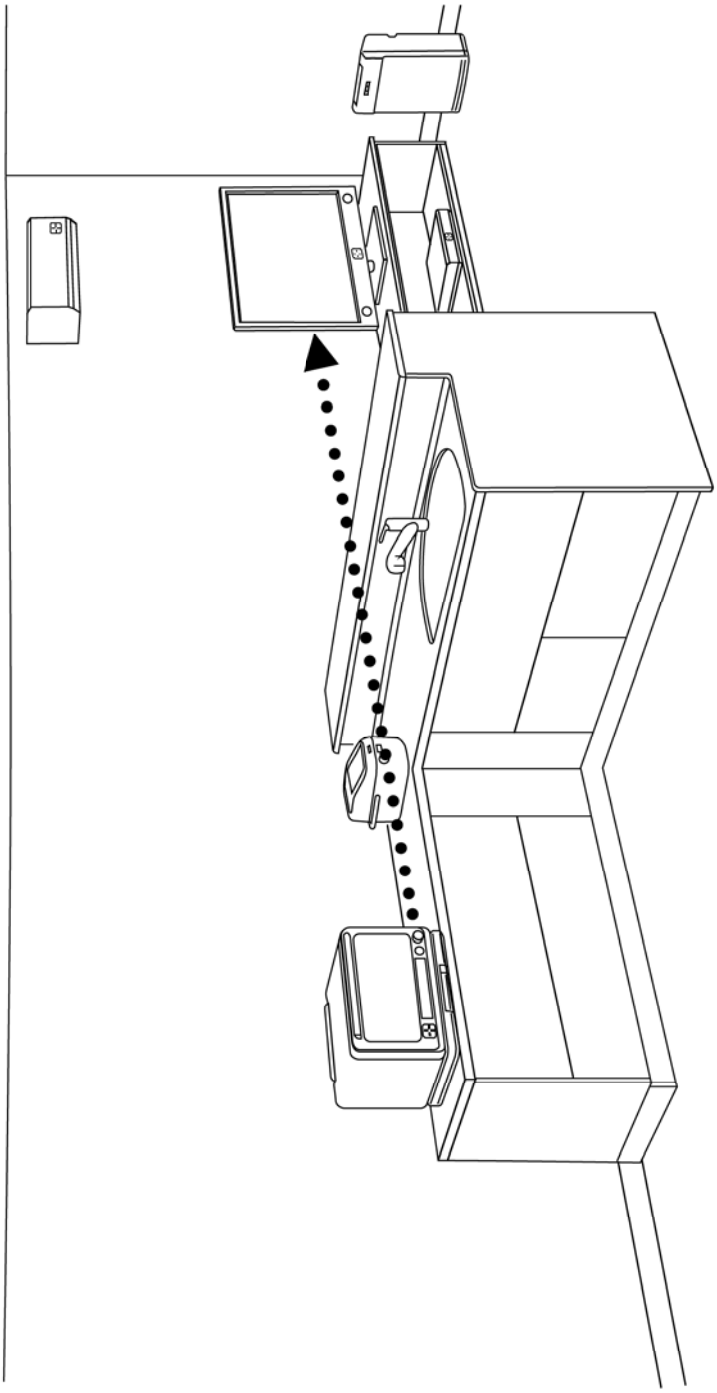


FIG. 47

FIG. 48



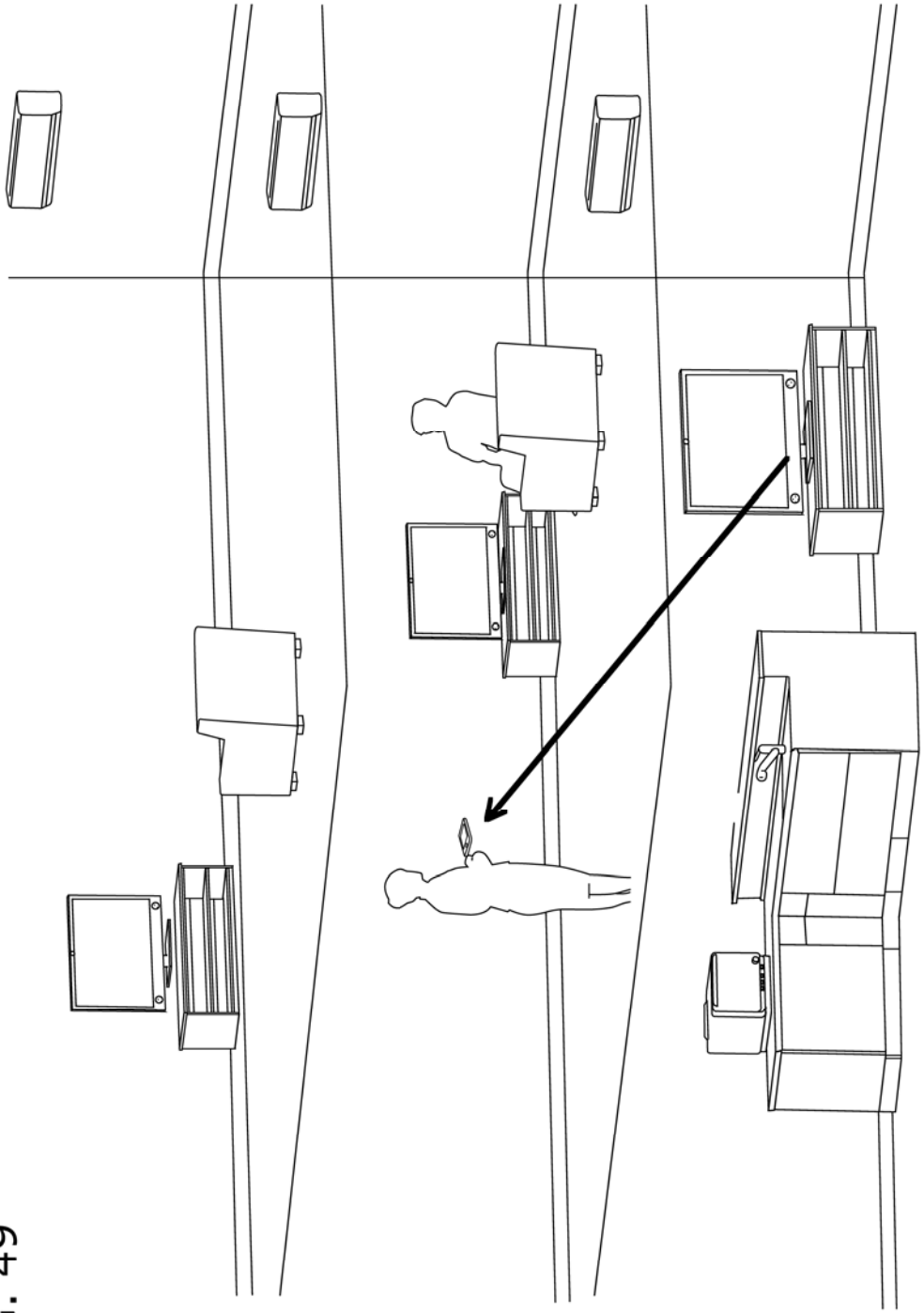


FIG. 49

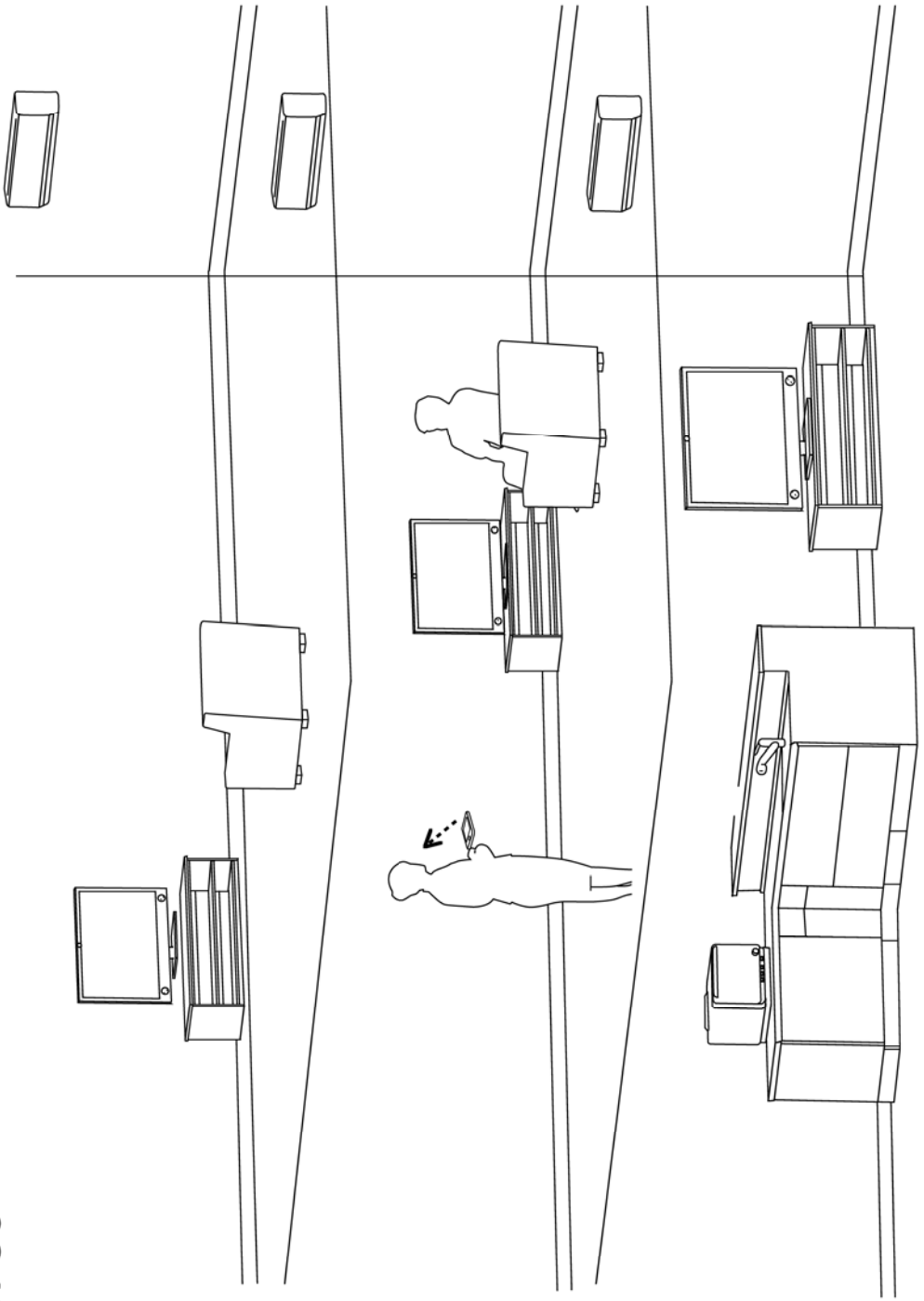
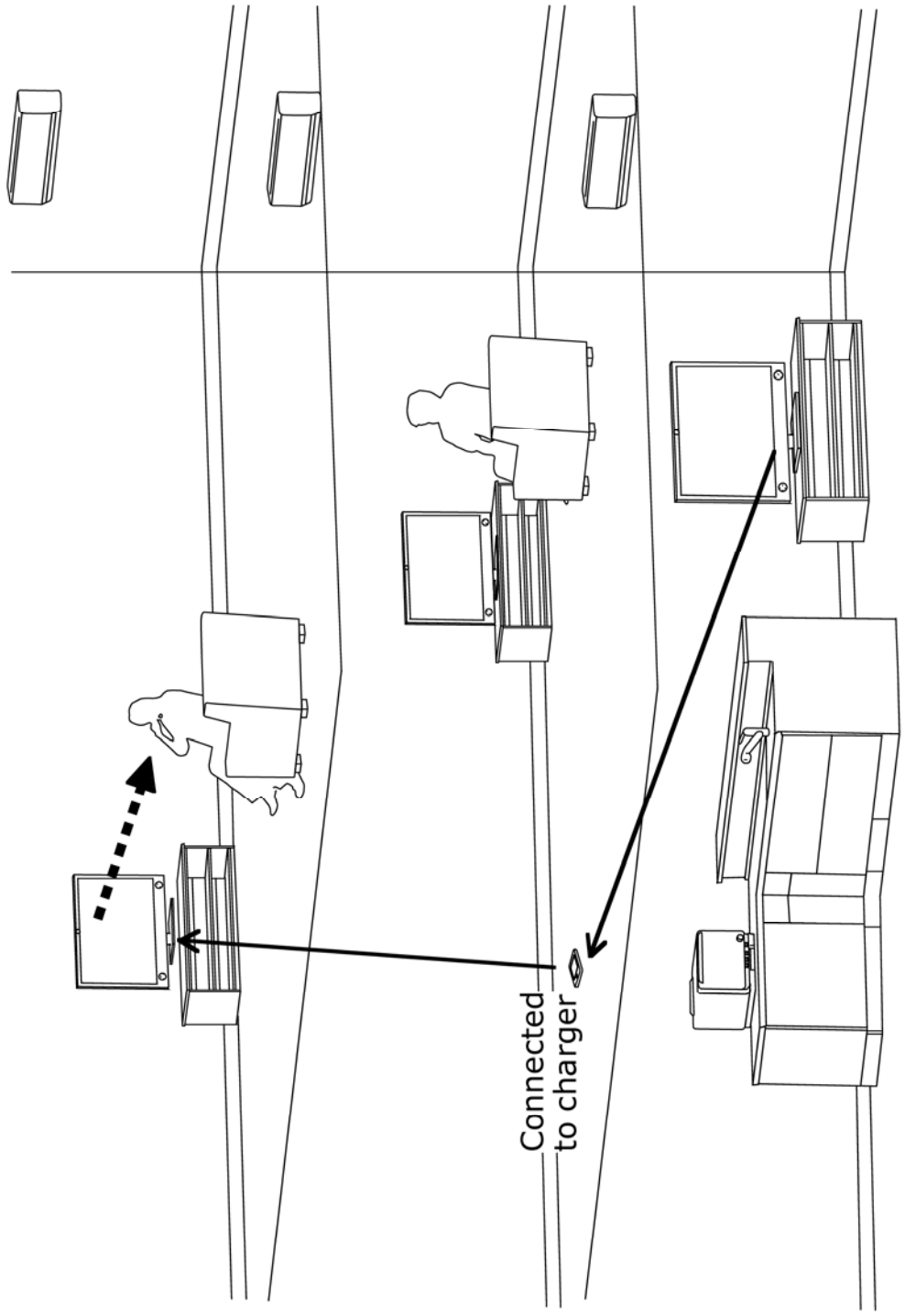


FIG. 50

FIG. 51



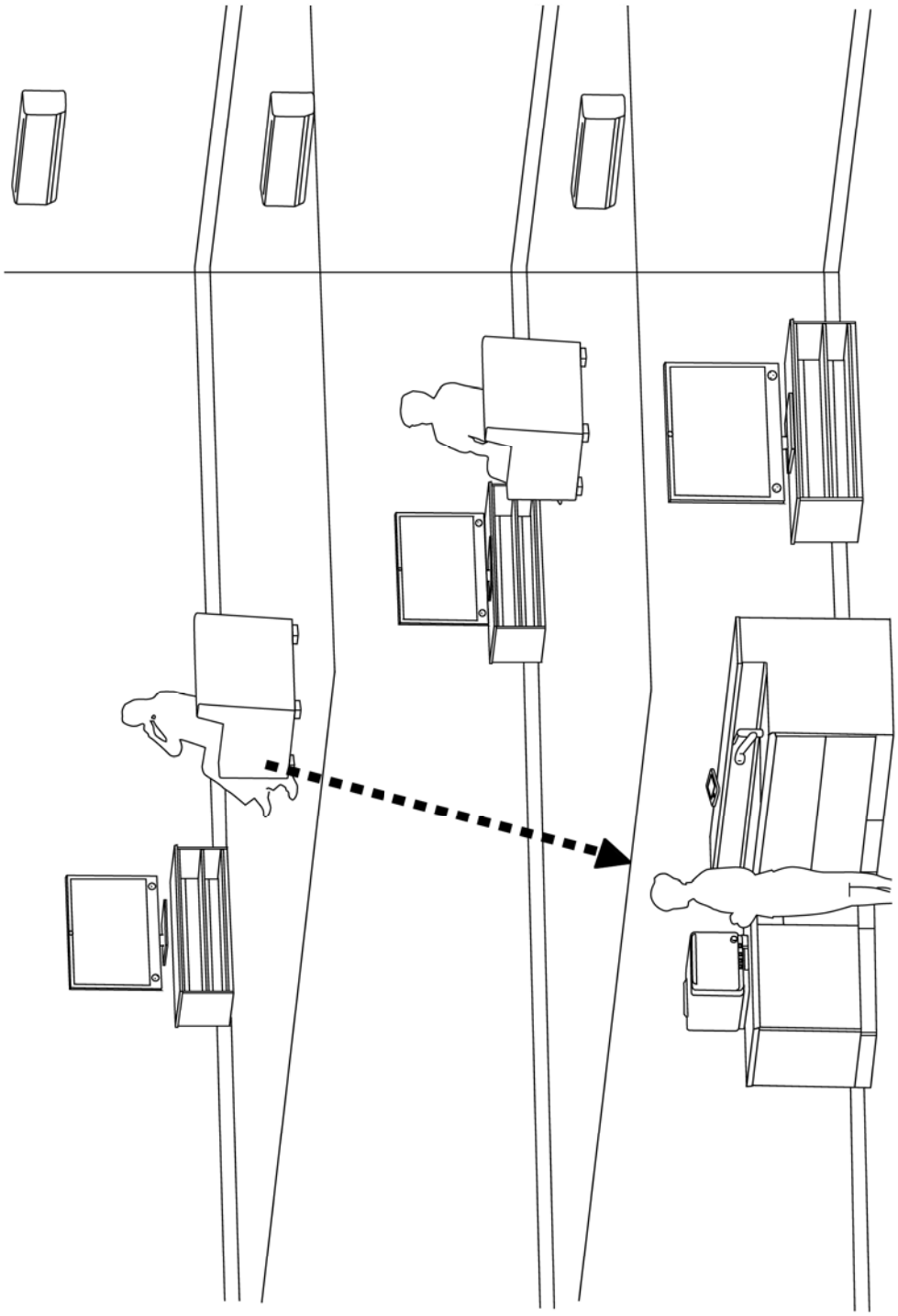


FIG. 52

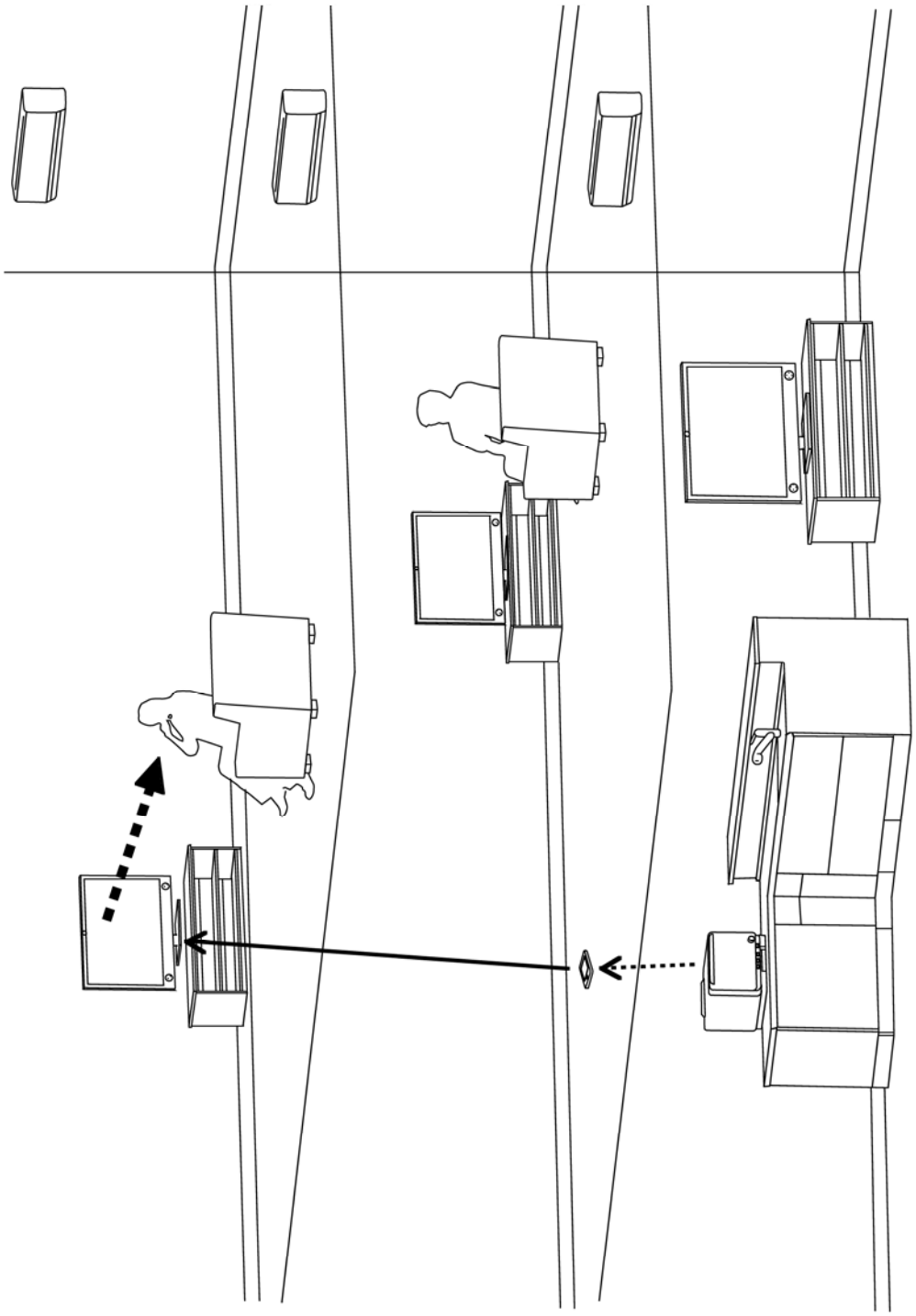


FIG. 53

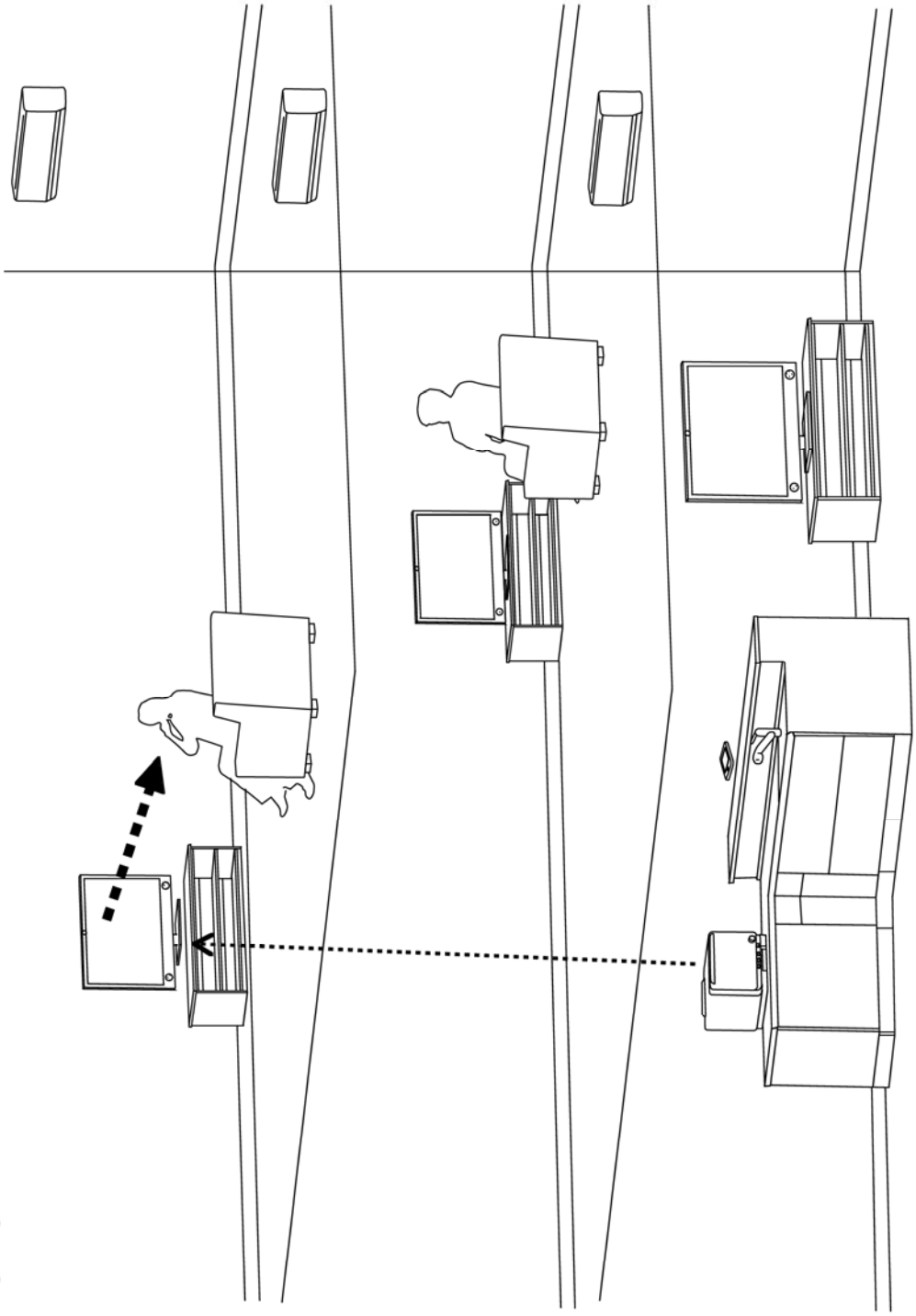


FIG. 54

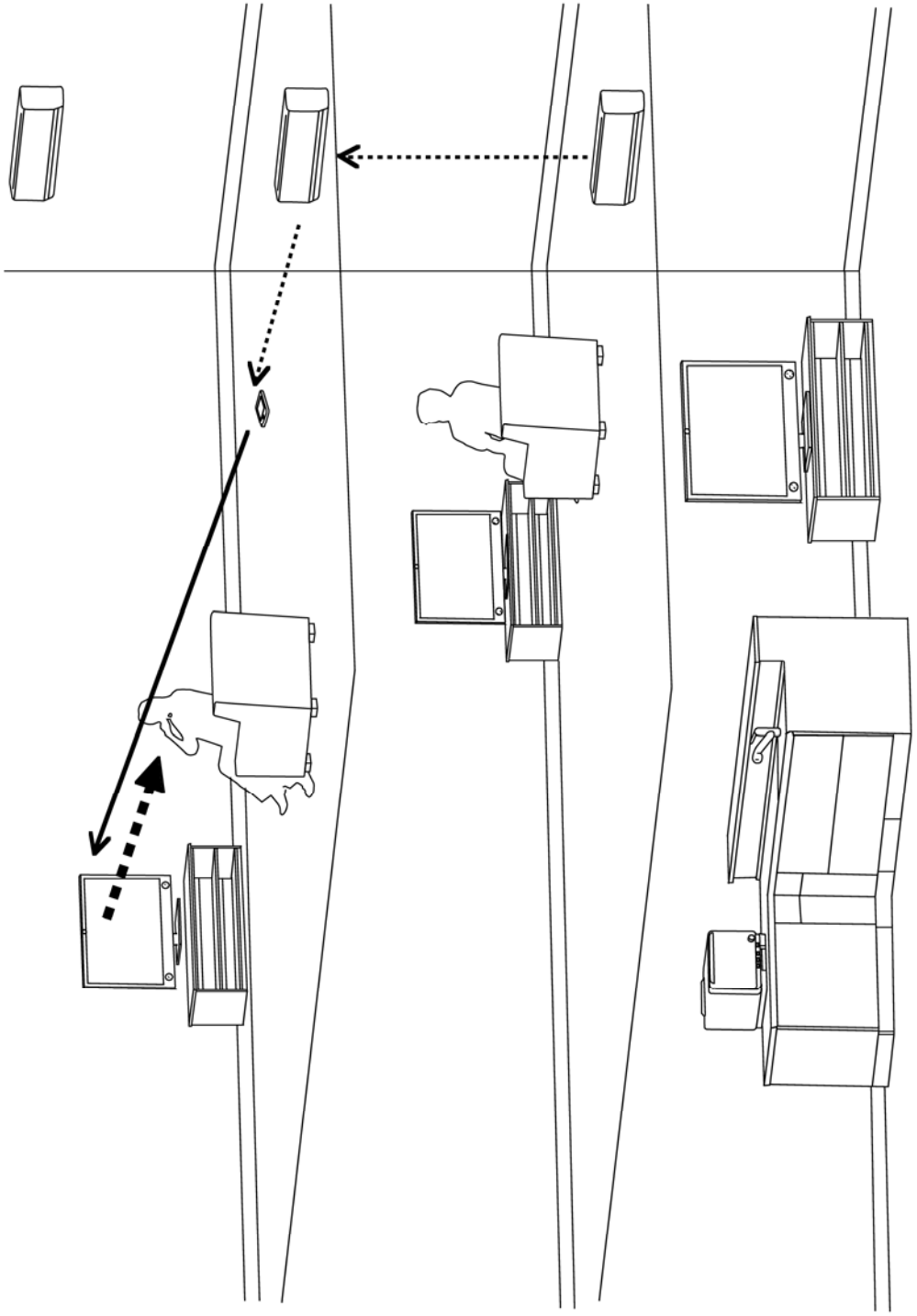


FIG. 55

FIG. 56

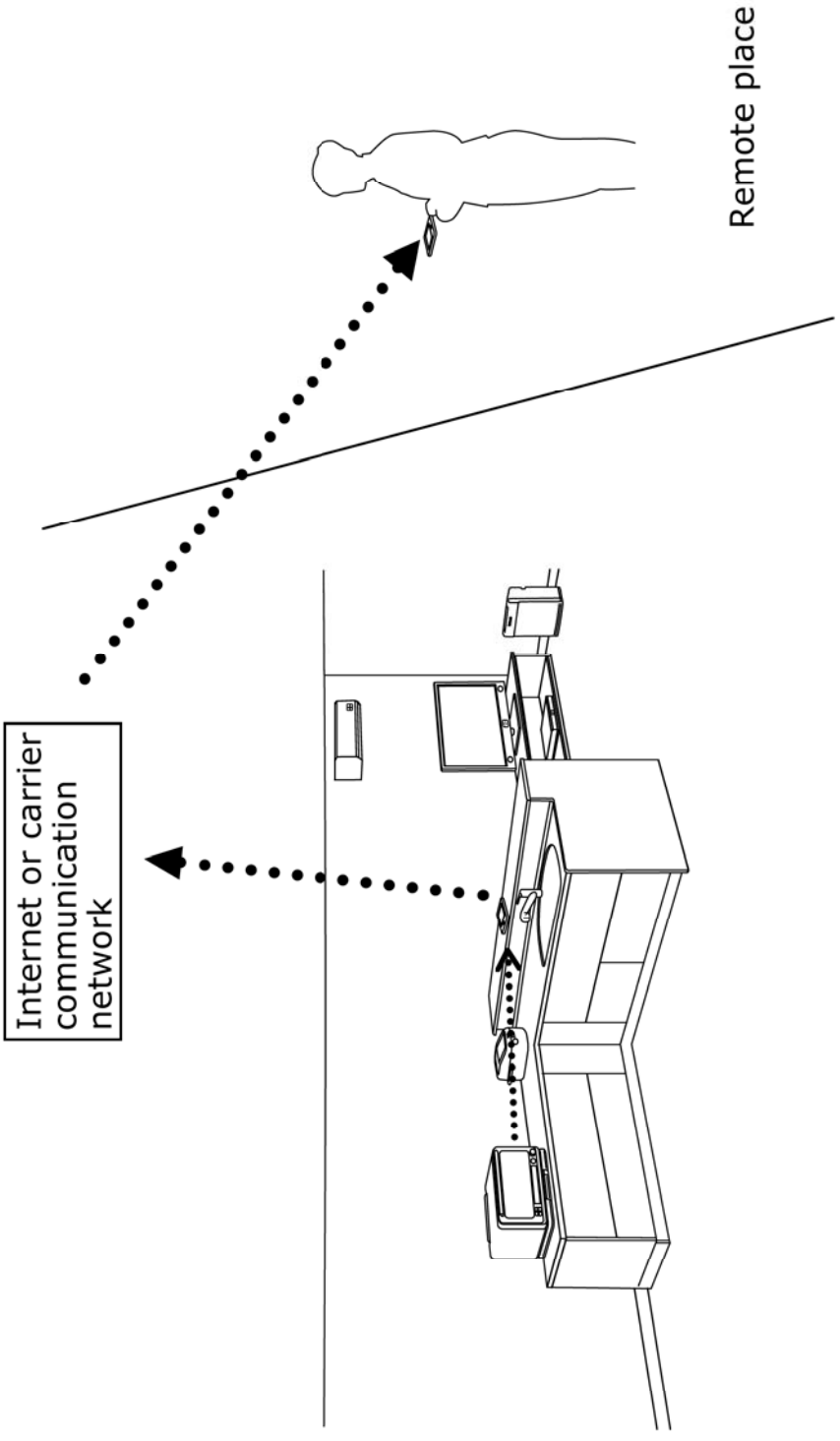


FIG. 57

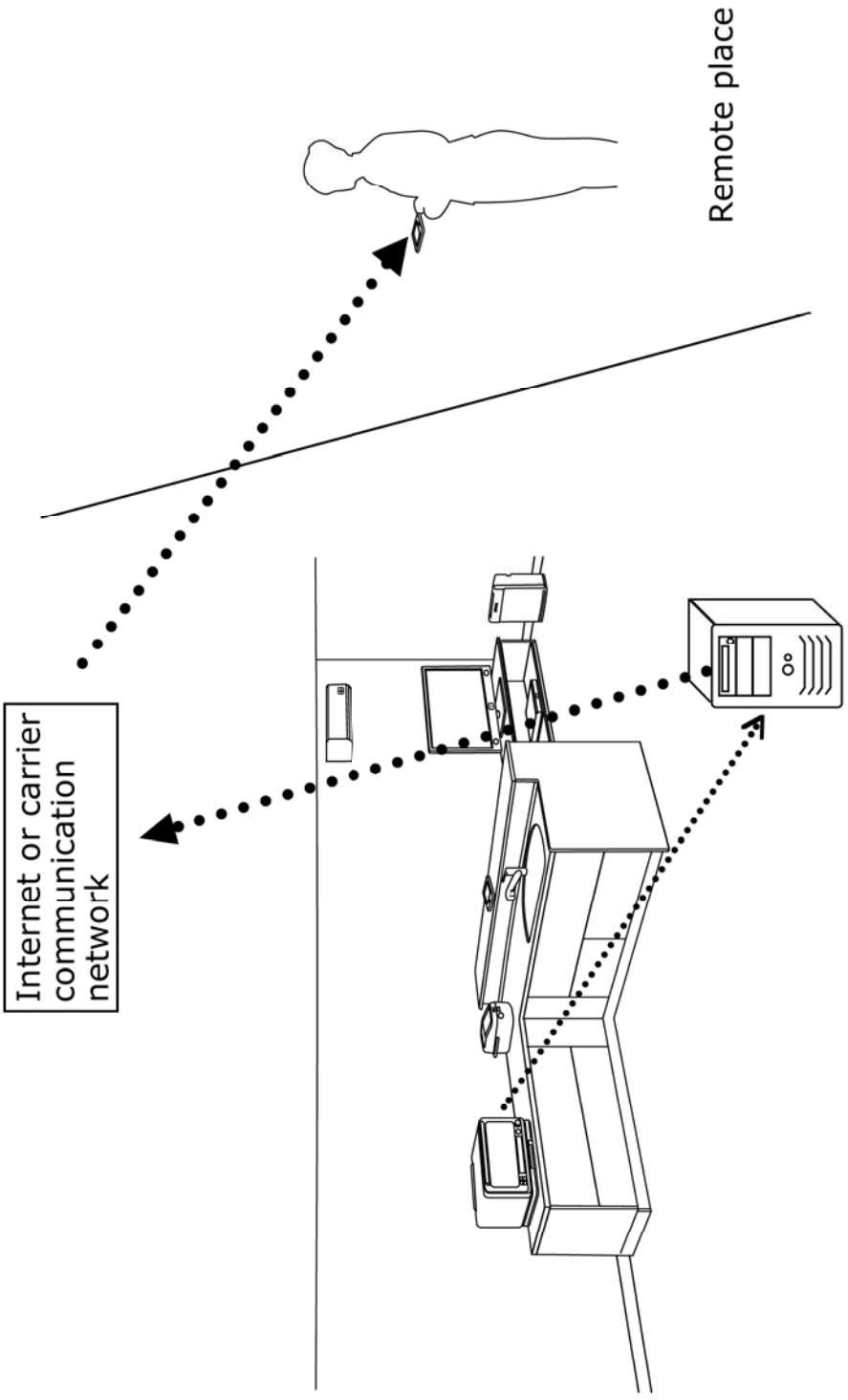


FIG. 58

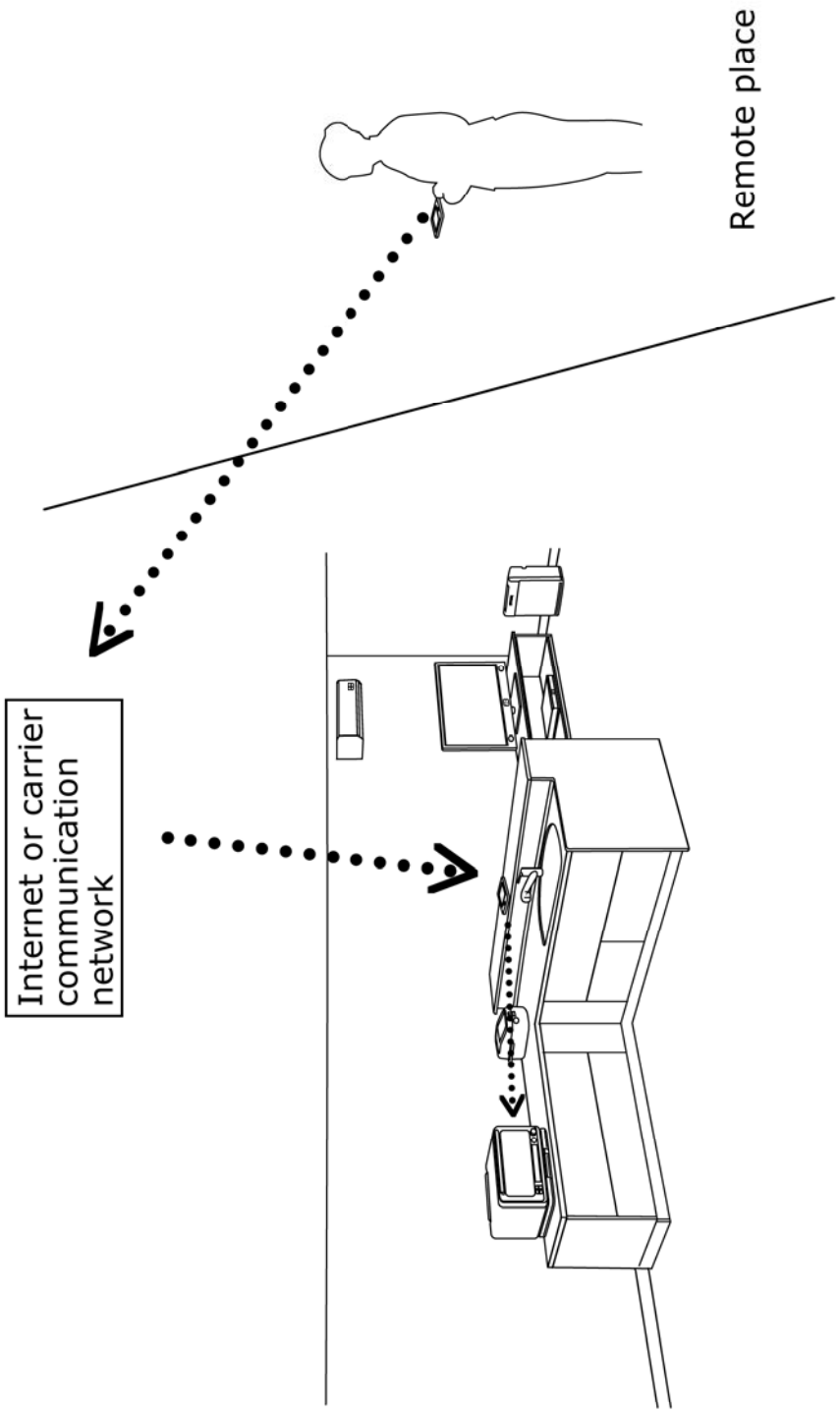
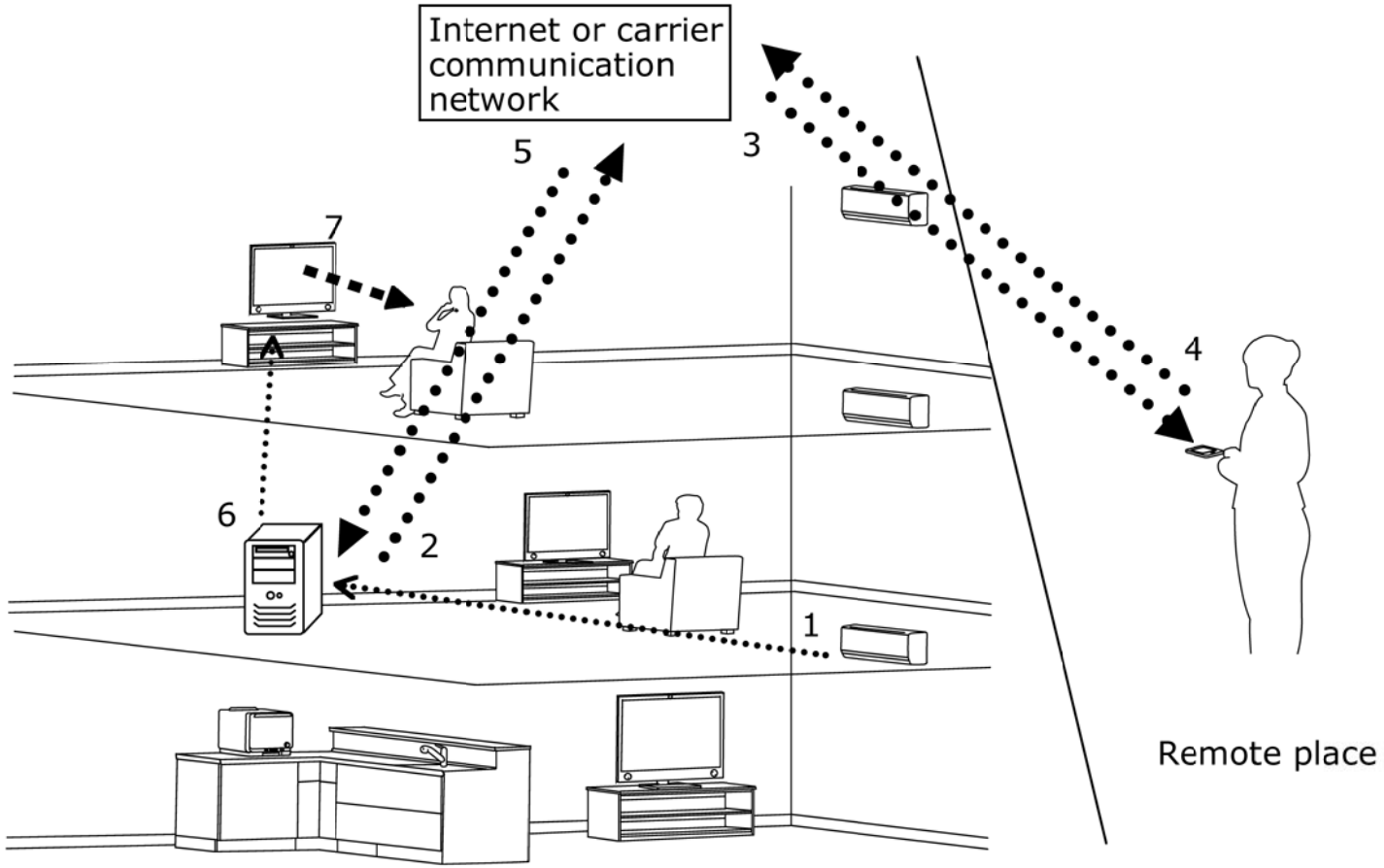


FIG. 59


Internet or carrier communication network
5
3
7
4
6
2
1
Remote place

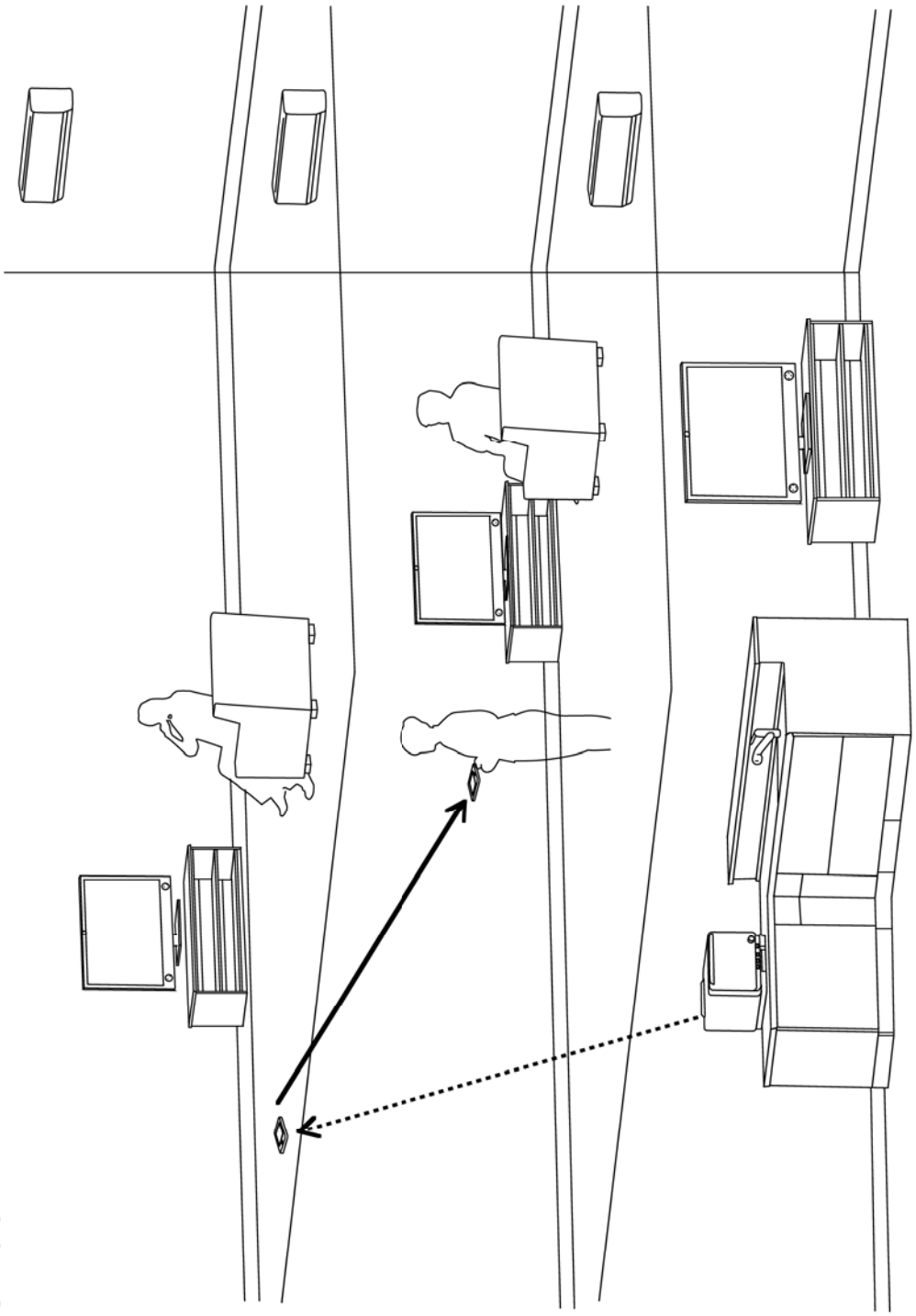


FIG. 60

FIG. 61

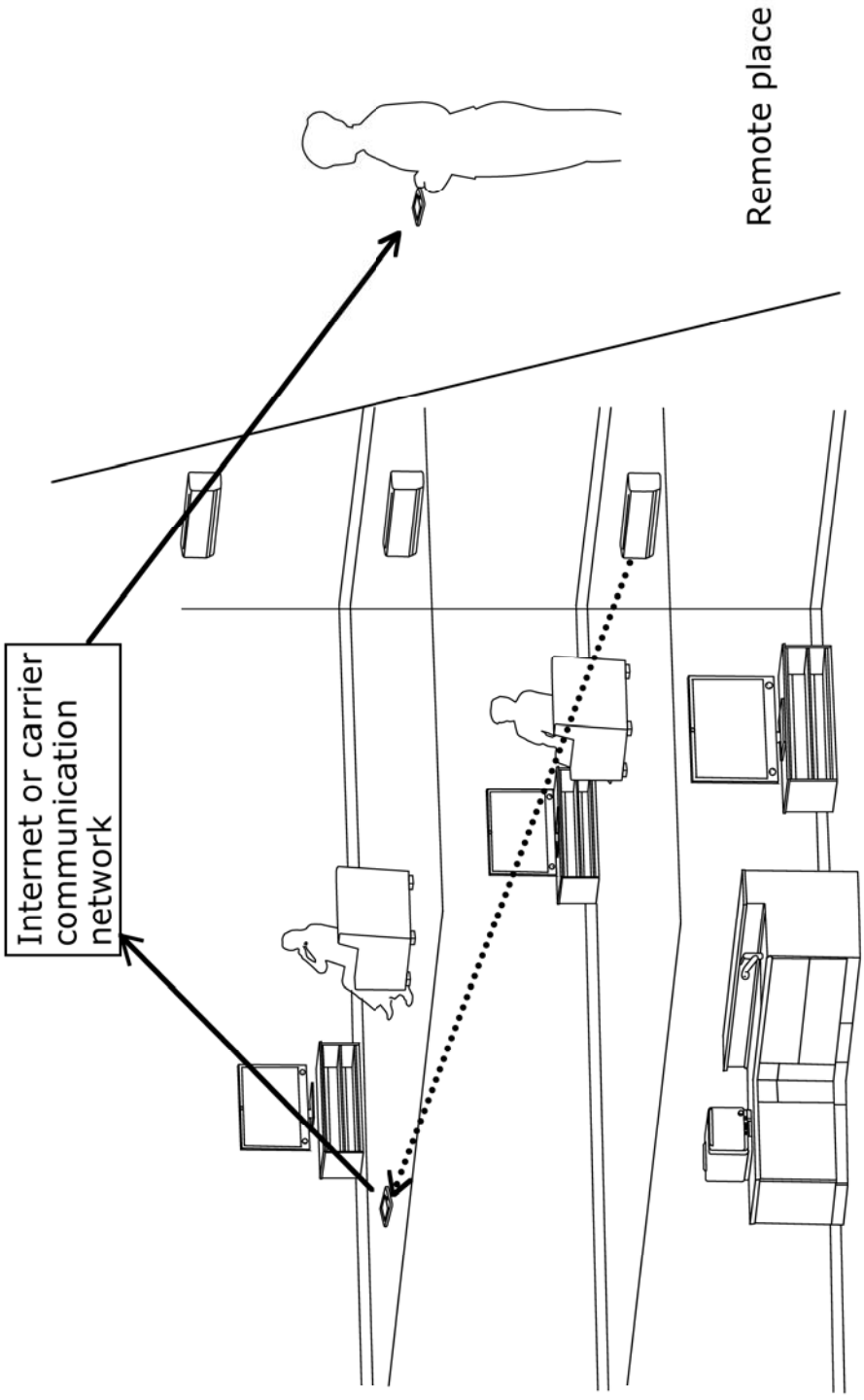


FIG. 62

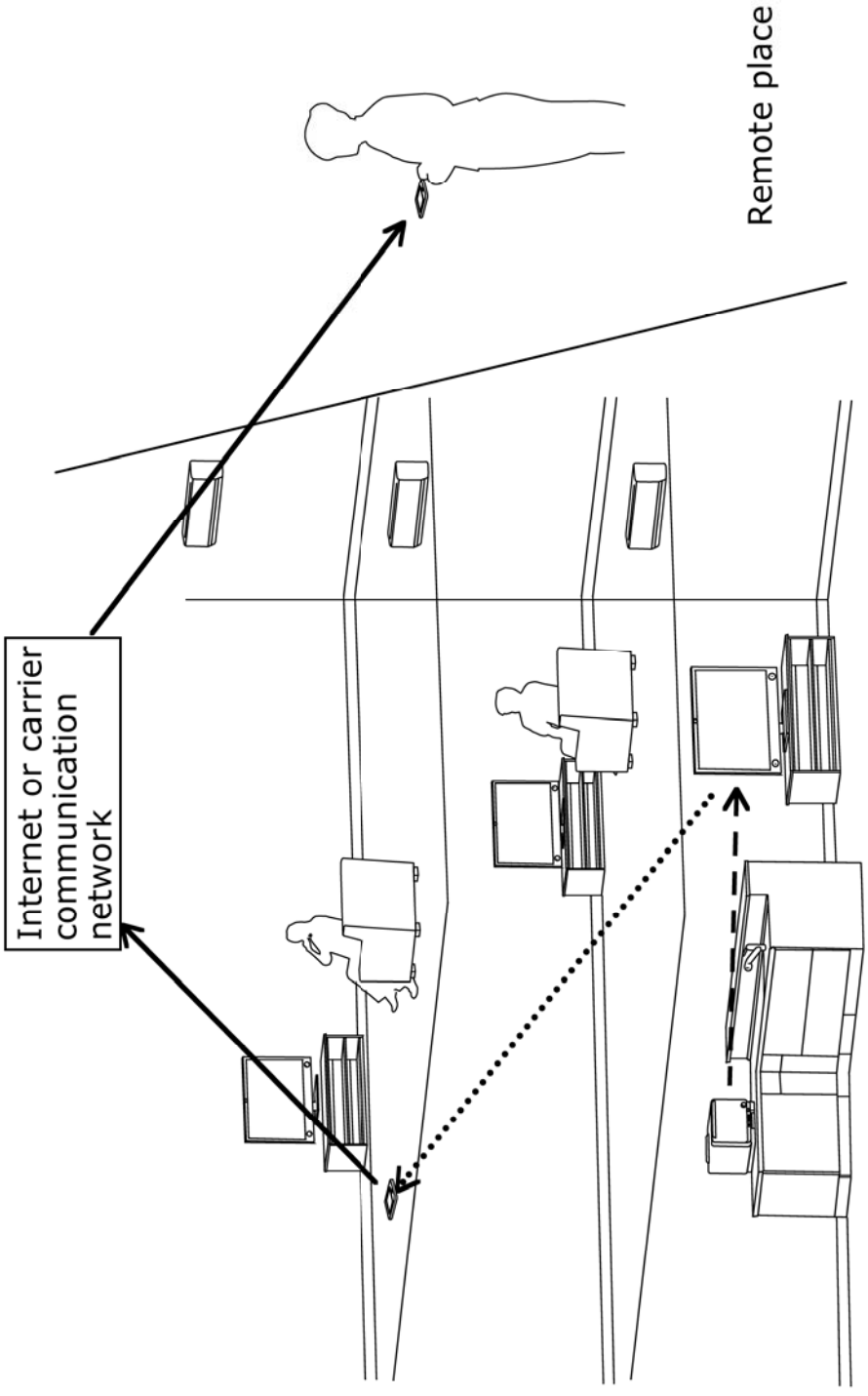


FIG. 63

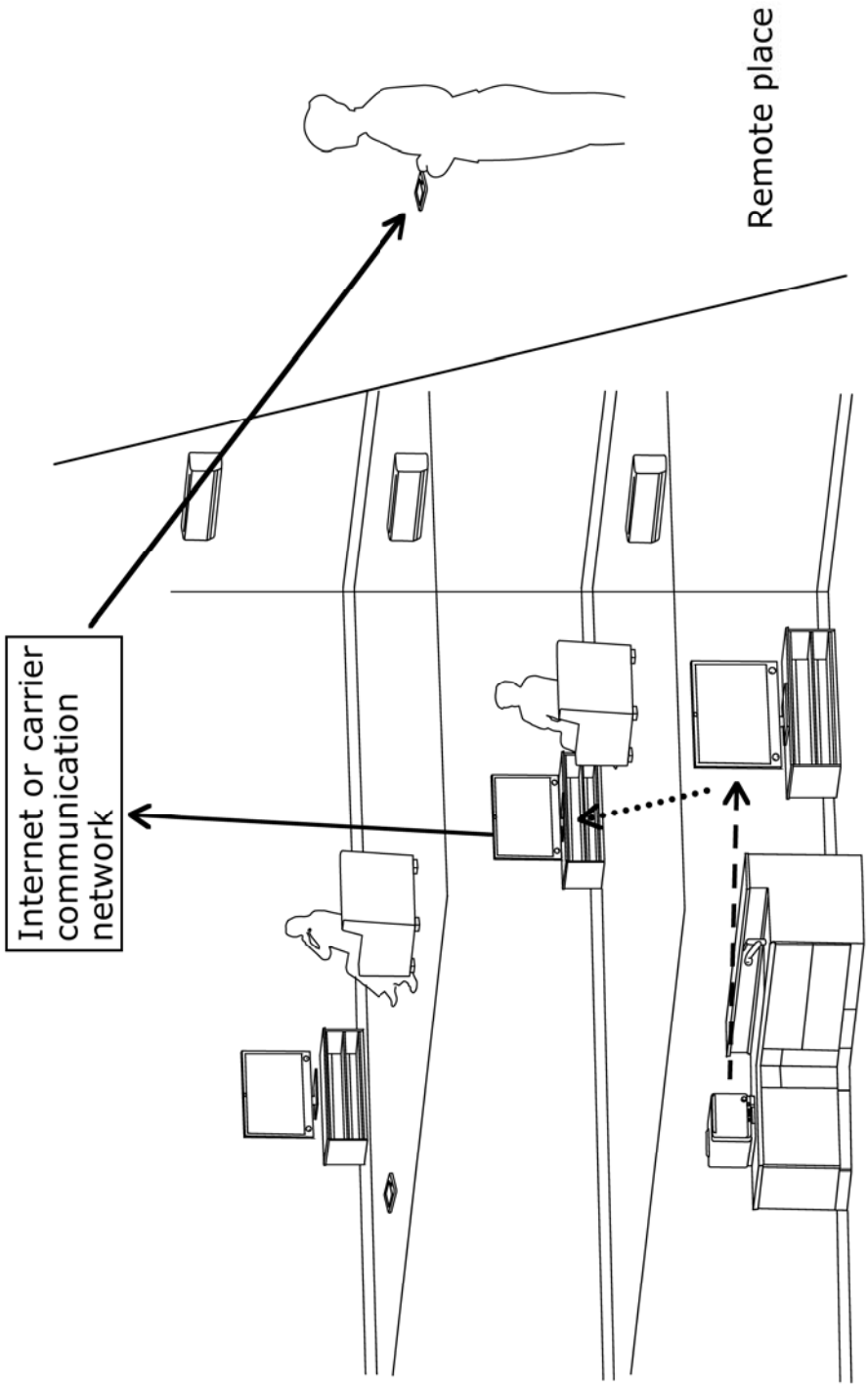


FIG. 64

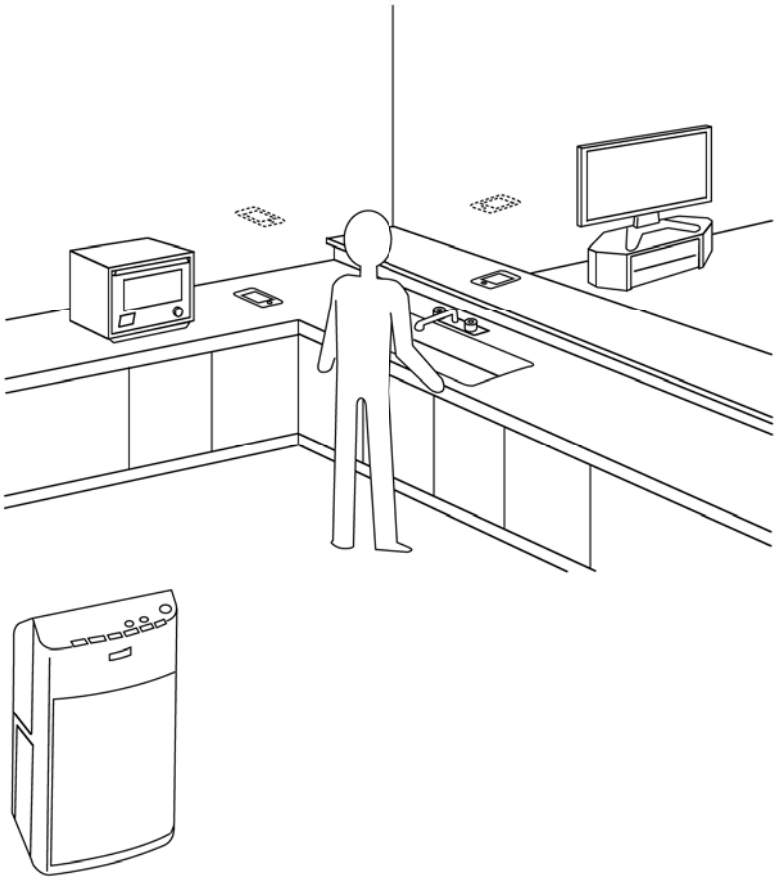


FIG. 65

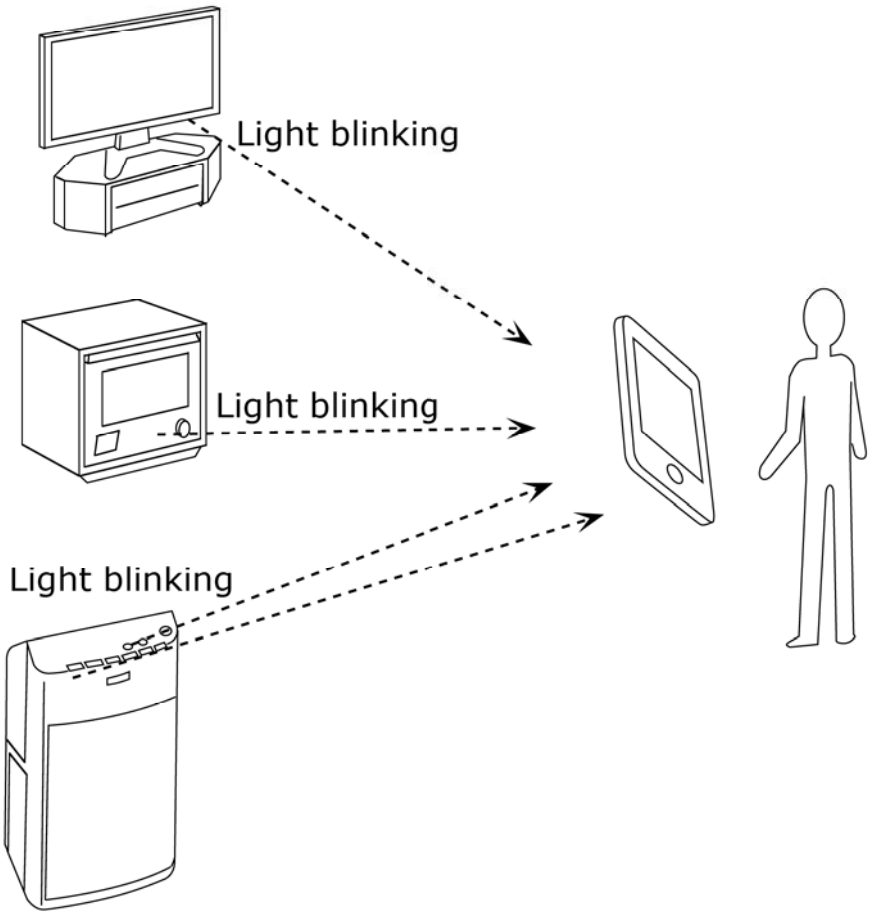


FIG. 66

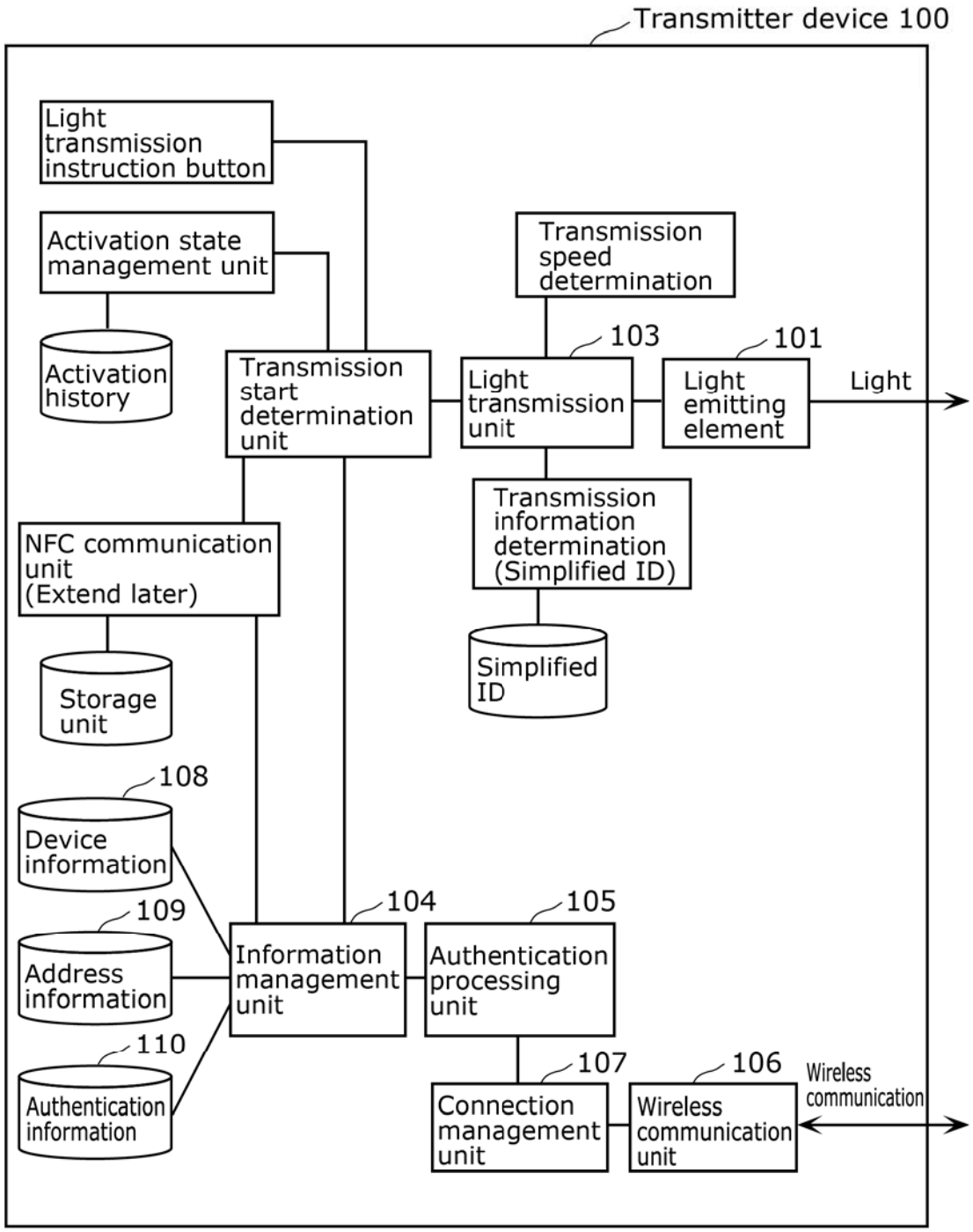

Transmitter device 100
Light transmission instruction button
Activation state management unit
Activation history
Transmission start determination unit
Transmission speed determination
103
Light transmission unit
101
Light emitting element
Light
Transmission information determination (Simplified ID)
Simplified ID
NFC communication unit (Extend later)
Storage unit
108
Device information
109
Address information
110
Authentication information
104
Information management unit
105
Authentication processing unit
107
Connection management unit
106
Wireless communication unit
Wireless communication

FIG. 67

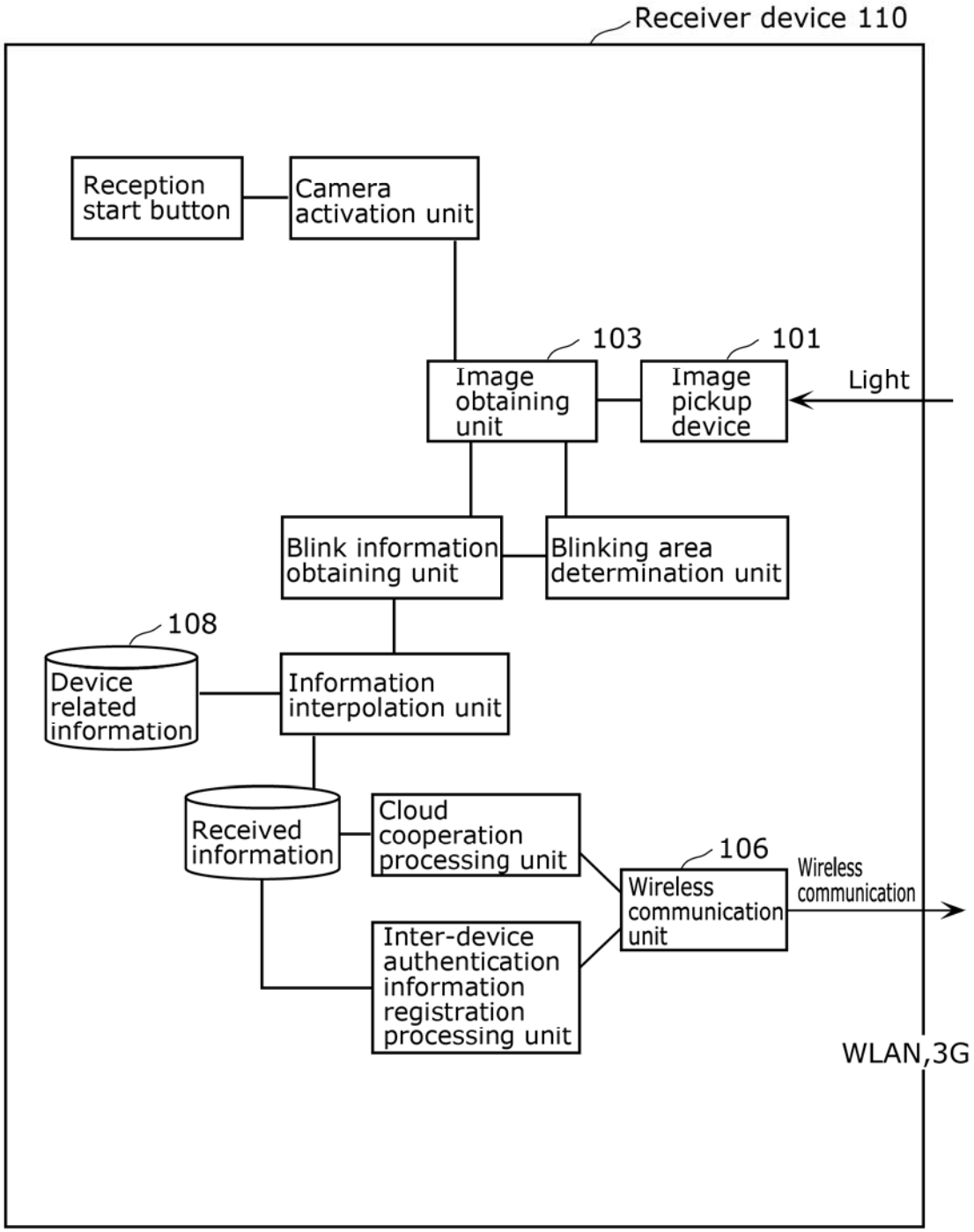

Receiver device 110
Reception start button
Camera activation unit
103
101
Image obtaining unit
Image pickup device
Light
Blink information obtaining unit
Blinking area determination unit
108
Device related information
Information interpolation unit
Received information
Cloud cooperation processing unit
106
Wireless communication unit
Wireless communication
Inter-device authentication information registration processing unit
WLAN,3G

FIG. 68

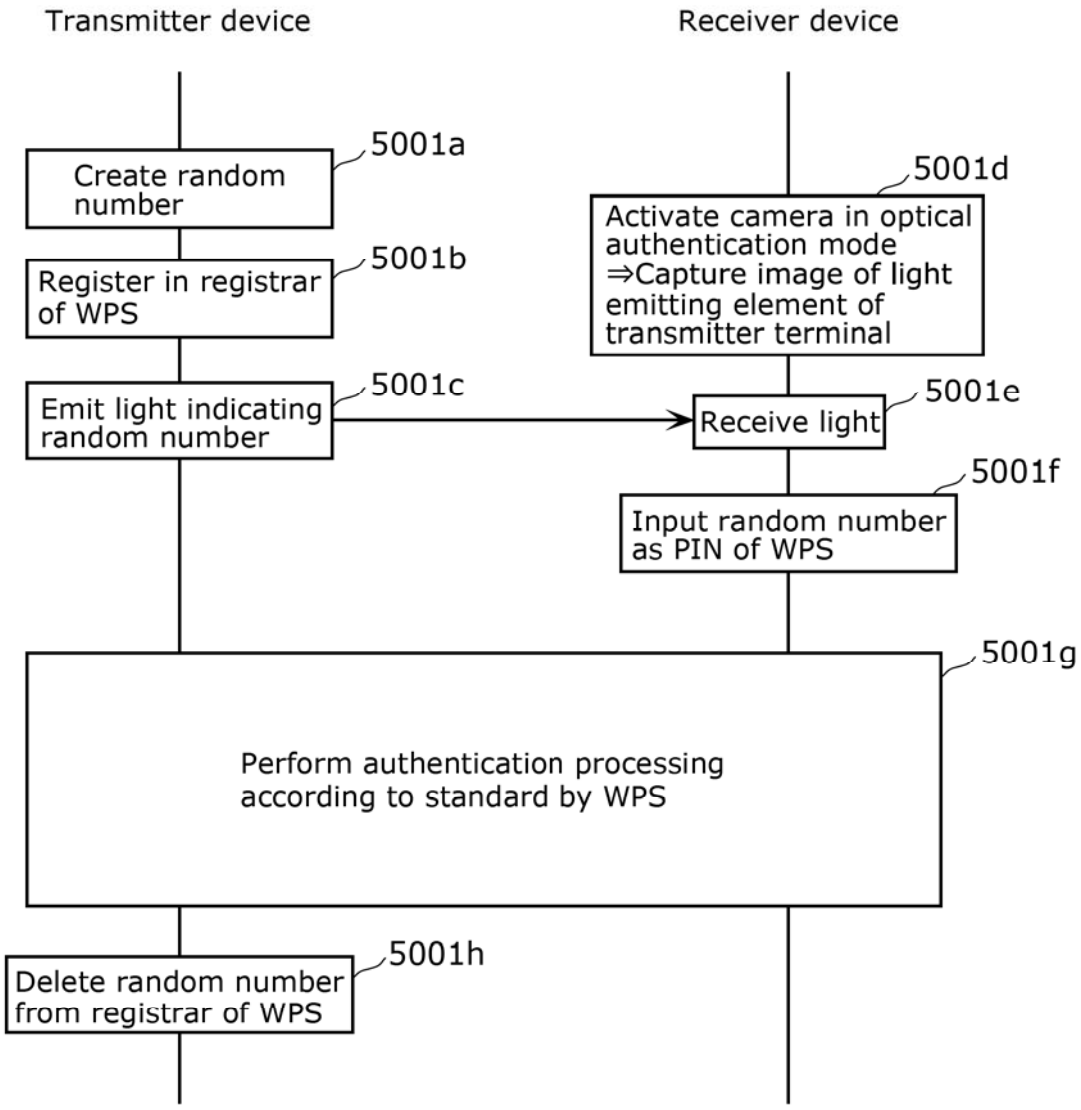

Transmitter device
Receiver device
Create random number
5001a
Register in registrar of WPS
5001b
Emit light indicating random number
5001c
Activate camera in optical authentication mode ⇒Capture image of light emitting element of transmitter terminal
5001d
Receive light
5001e
Input random number as PIN of WPS
5001f
Perform authentication processing according to standard by WPS
5001g
Delete random number from registrar of WPS
5001h

FIG. 69

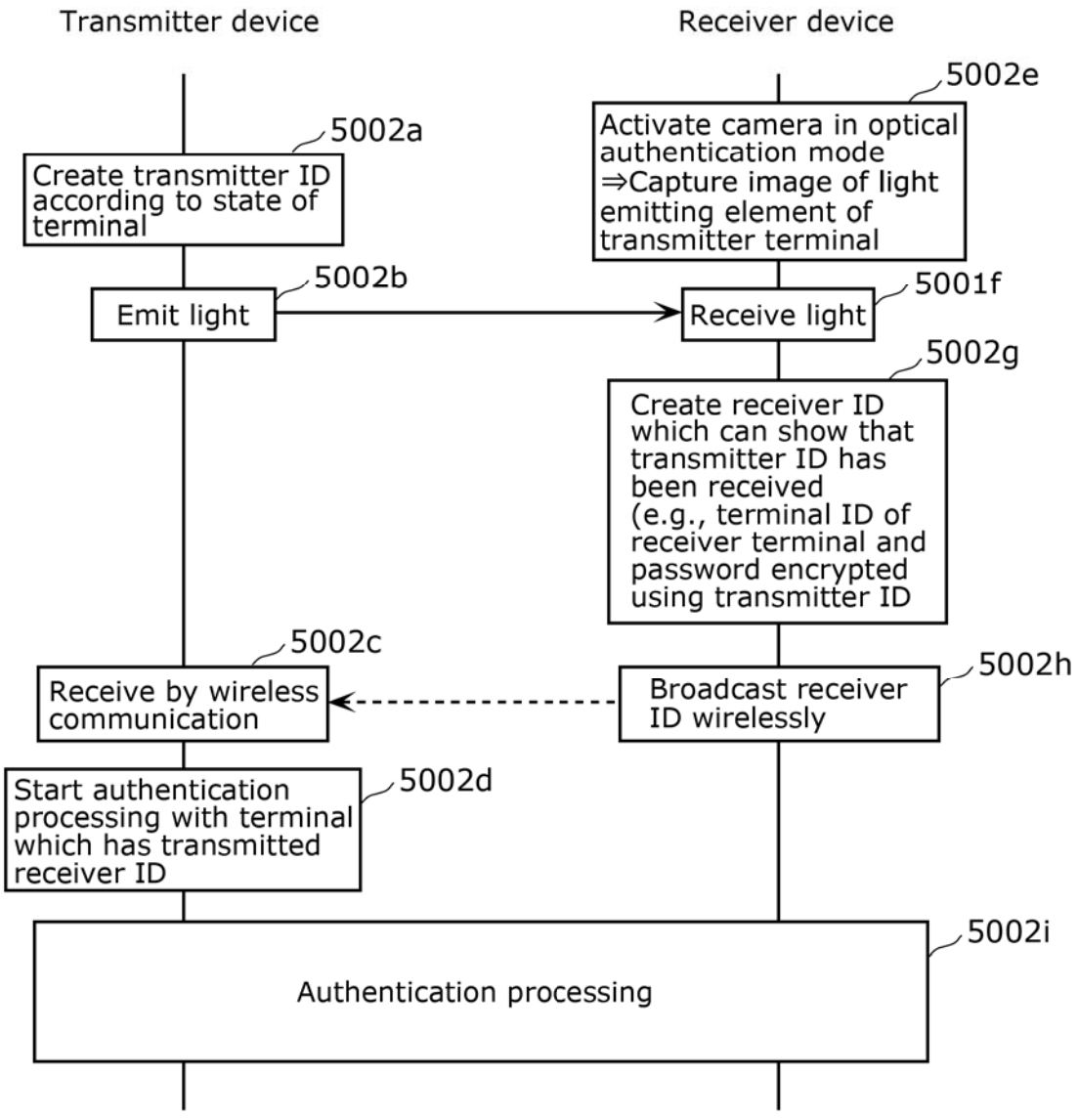

Transmitter device
Receiver device
5002e
Activate camera in optical authentication mode ⇒Capture image of light emitting element of transmitter terminal
5002a
Create transmitter ID according to state of terminal
5002b
Emit light
5001f
Receive light
5002g
Create receiver ID which can show that transmitter ID has been received (e.g., terminal ID of receiver terminal and password encrypted using transmitter ID
5002c
Receive by wireless communication
5002h
Broadcast receiver ID wirelessly
5002d
Start authentication processing with terminal which has transmitted receiver ID
5002i
Authentication processing

FIG. 70

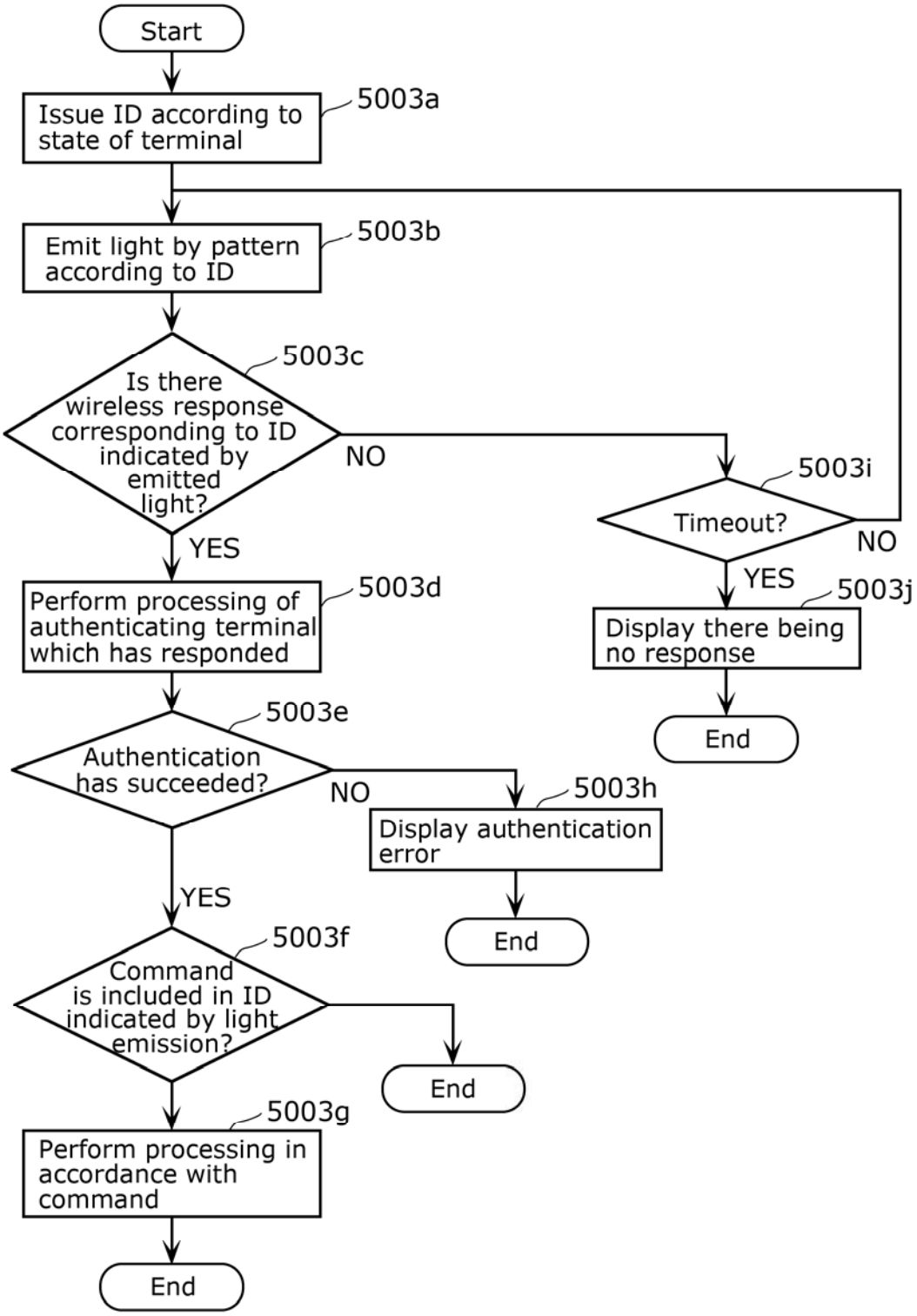

Start
Issue ID according to state of terminal
5003a
Emit light by pattern according to ID
5003b
Is there wireless response corresponding to ID indicated by emitted light?
5003c
NO
YES
Timeout?
5003i
NO
YES
Perform processing of authenticating terminal which has responded
5003d
Display there being no response
5003j
End
Authentication has succeeded?
5003e
NO
Display authentication error
5003h
End
YES
Command is included in ID indicated by light emission?
5003f
End
Perform processing in accordance with command
5003g
End

FIG. 71

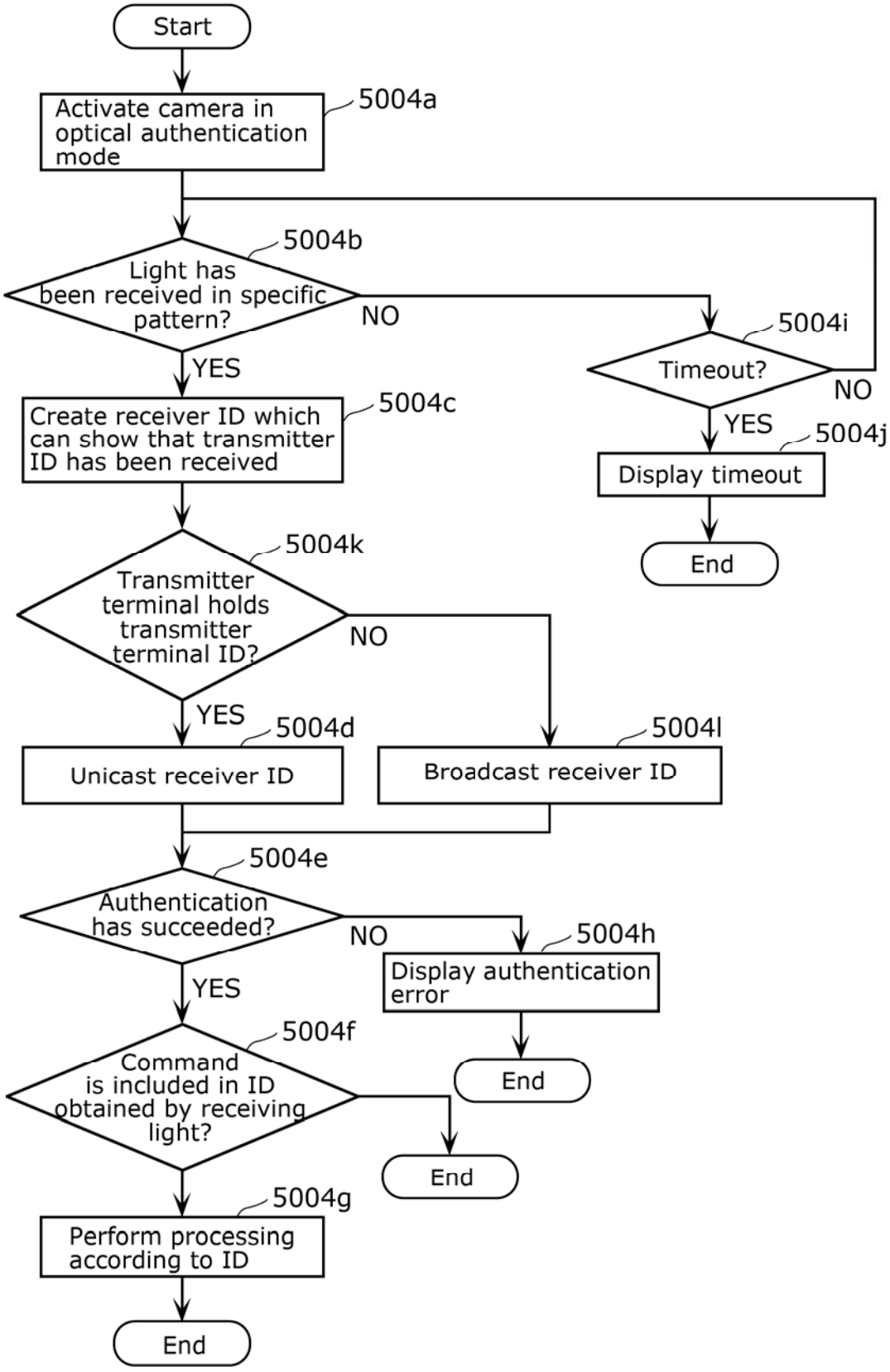

Start
Activate camera in optical authentication mode
5004a
Light has been received in specific pattern?
5004b
NO
YES
Timeout?
5004i
NO
YES
Display timeout
5004j
End
Create receiver ID which can show that transmitter ID has been received
5004c
Transmitter terminal holds transmitter terminal ID?
5004k
NO
YES
Unicast receiver ID
5004d
Broadcast receiver ID
5004l
Authentication has succeeded?
5004e
NO
Display authentication error
5004h
End
YES
Command is included in ID obtained by receiving light?
5004f
End
Perform processing according to ID
5004g
End

FIG. 72

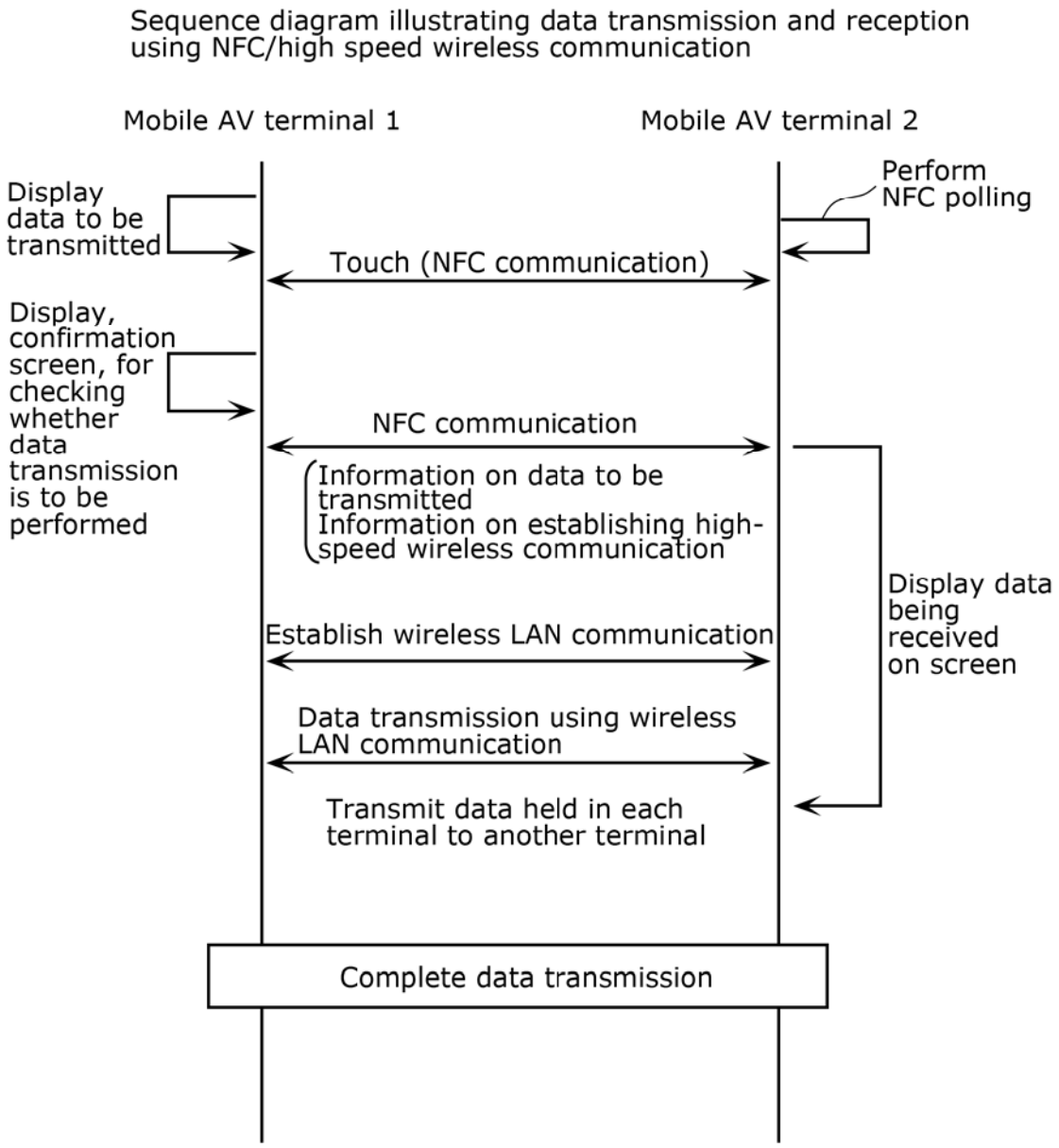

Sequence diagram illustrating data transmission and reception using NFC/high speed wireless communication
Mobile AV terminal 1
Mobile AV terminal 2
Display data to be transmitted
Perform NFC polling
Touch (NFC communication)
Display, confirmation screen, for checking whether data transmission is to be performed
NFC communication
Information on data to be transmitted
Information on establishing high-speed wireless communication
Display data being received on screen
Establish wireless LAN communication
Data transmission using wireless LAN communication
Transmit data held in each terminal to another terminal
Complete data transmission

FIG. 73

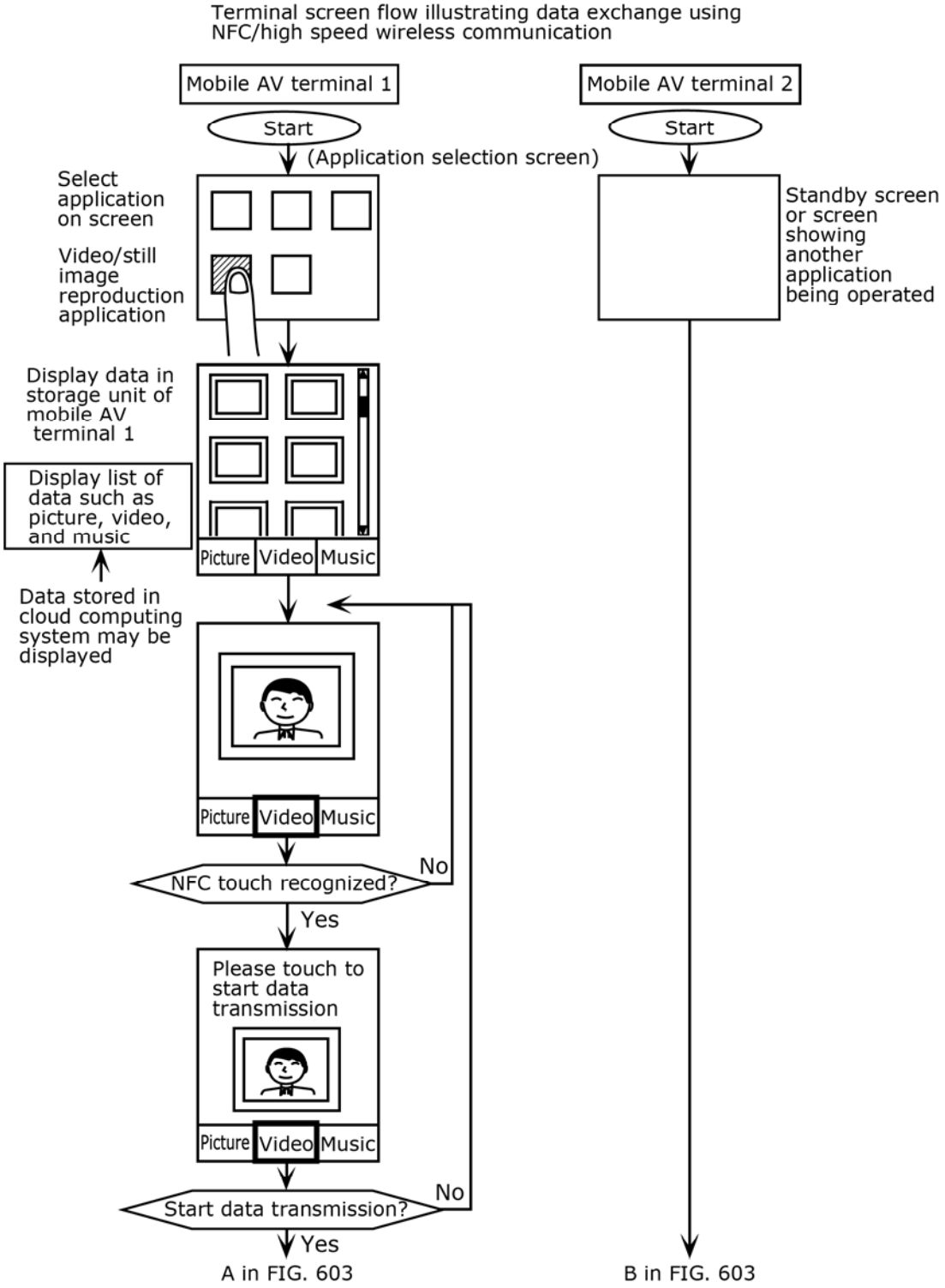

Terminal screen flow illustrating data exchange using NFC/high speed wireless communication
Mobile AV terminal 1
Mobile AV terminal 2
Start
Start
(Application selection screen)
Select application on screen
Video/still image reproduction application
Standby screen or screen showing another application being operated
Display data in storage unit of mobile AV terminal 1
Display list of data such as picture, video, and music
Picture
Video
Music
Data stored in cloud computing system may be displayed
Picture
Video
Music
NFC touch recognized?
No
Yes
Please touch to start data transmission
Picture
Video
Music
Start data transmission?
No
Yes
A in FIG. 603
B in FIG. 603

FIG. 74

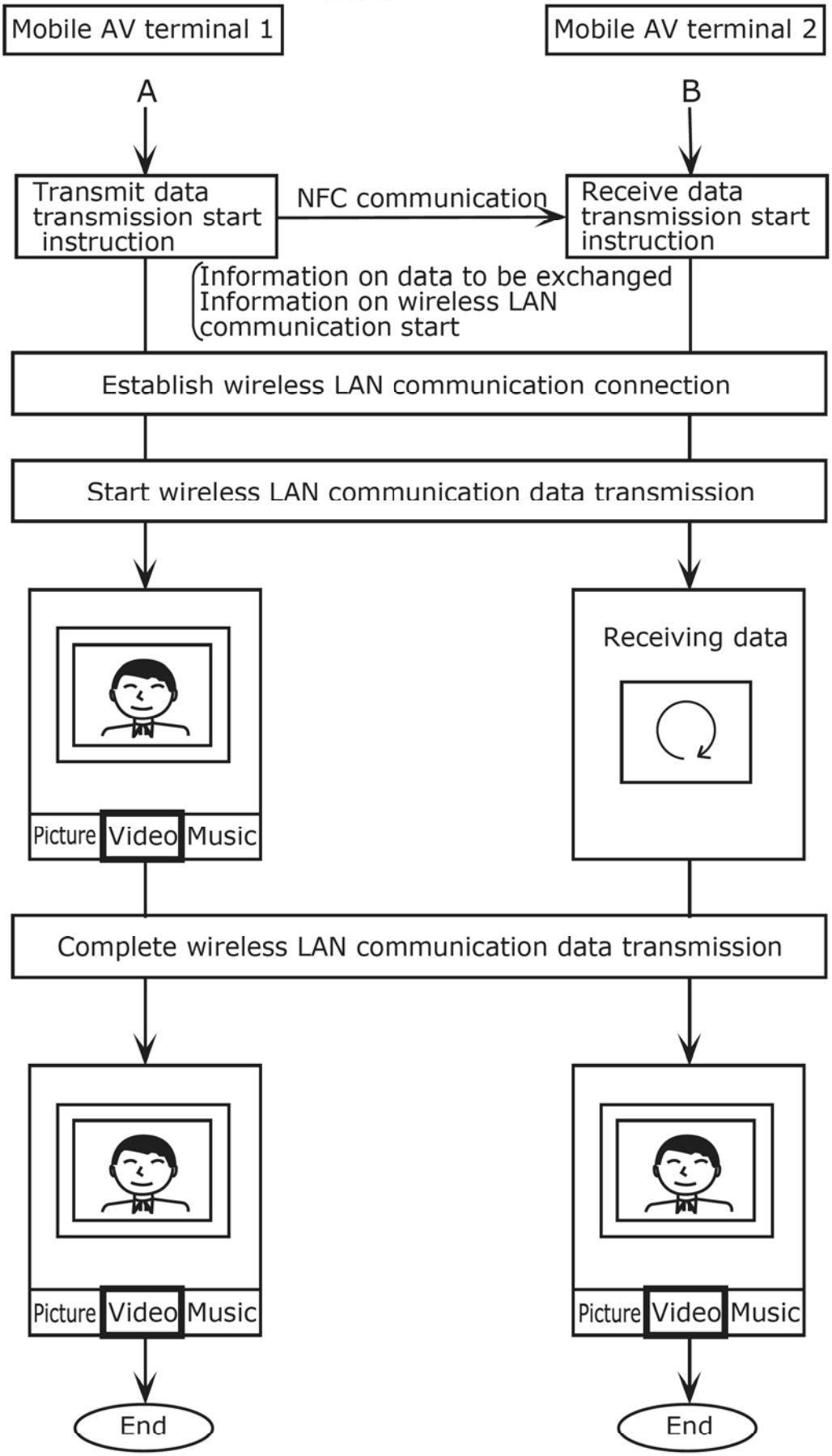

Mobile AV terminal 1
Mobile AV terminal 2
A
B
Transmit data transmission start instruction
NFC communication
Receive data transmission start instruction
Information on data to be exchanged
Information on wireless LAN communication start
Establish wireless LAN communication connection
Start wireless LAN communication data transmission
Receiving data
Picture
Video
Music
Complete wireless LAN communication data transmission
Picture
Video
Music
Picture
Video
Music
End
End

FIG. 75

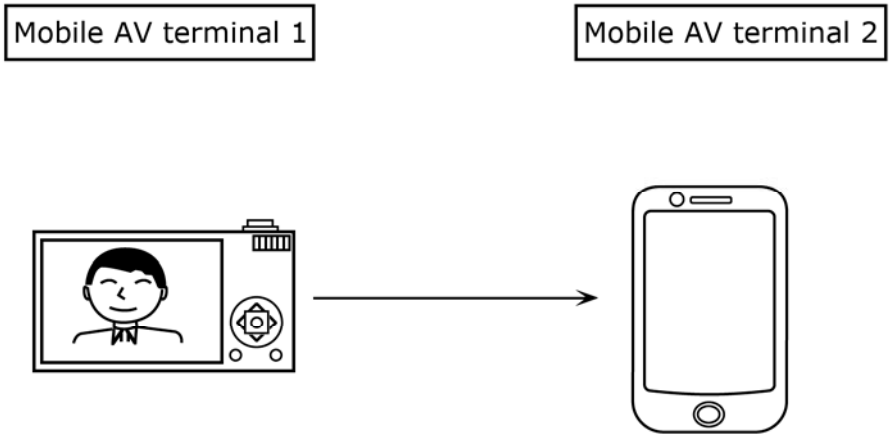


FIG. 76

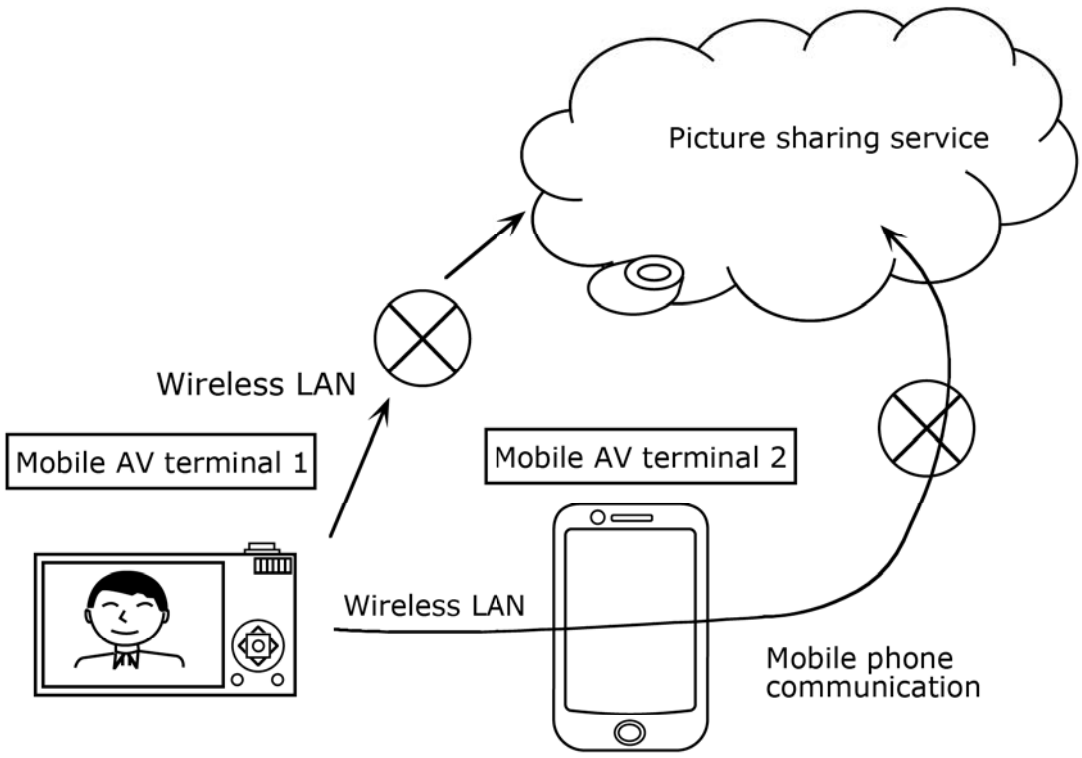

Picture sharing service
Wireless LAN
Mobile AV terminal 1
Mobile AV terminal 2
Wireless LAN
Mobile phone
communication

FIG. 77

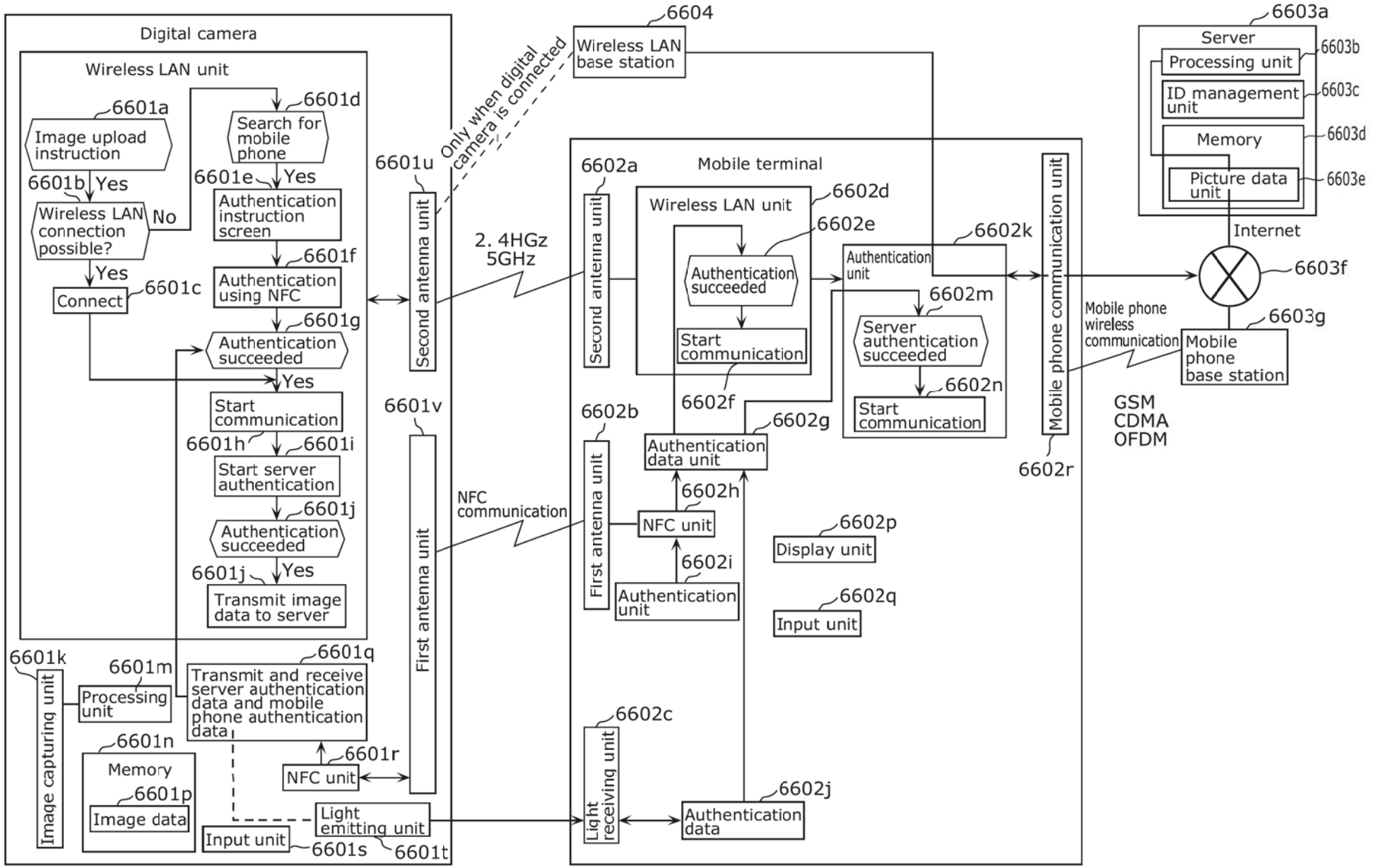

Digital camera
Wireless LAN unit
6601a
Image upload instruction
6601b
Yes
Wireless LAN connection possible?
No
Yes
Connect
6601c
6601d
Search for mobile phone
6601e
Yes
Authentication instruction screen
6601f
Authentication using NFC
6601g
Authentication succeeded
Yes
Start communication
6601h
6601i
Start server authentication
6601j
Authentication succeeded
6601j
Yes
Transmit image data to server
6601k
Image capturing unit
6601m
Processing unit
6601q
Transmit and receive server authentication data and mobile phone authentication data
6601n
Memory
6601p
Image data
6601r
NFC unit
Input unit
6601s
Light emitting unit
6601t
6601u
Second antenna unit
6601v
First antenna unit
Only when digital camera is connected
2. 4HGz
5GHz
NFC communication
6604
Wireless LAN base station
6602a
Second antenna unit
Mobile terminal
Wireless LAN unit
6602d
6602e
Authentication succeeded
Start communication
6602f
6602k
Authentication unit
6602m
Server authentication succeeded
6602n
Start communication
6602b
First antenna unit
Authentication data unit
6602g
6602h
NFC unit
6602i
Authentication unit
6602p
Display unit
6602q
Input unit
6602c
Light receiving unit
6602j
Authentication data
6602r
Mobile phone communication unit
6603a
Server
Processing unit
6603b
ID management unit
6603c
Memory
6603d
Picture data unit
6603e
Internet
6603f
6603g
Mobile phone base station
Mobile phone wireless communication
GSM
CDMA
OFDM

FIG. 78

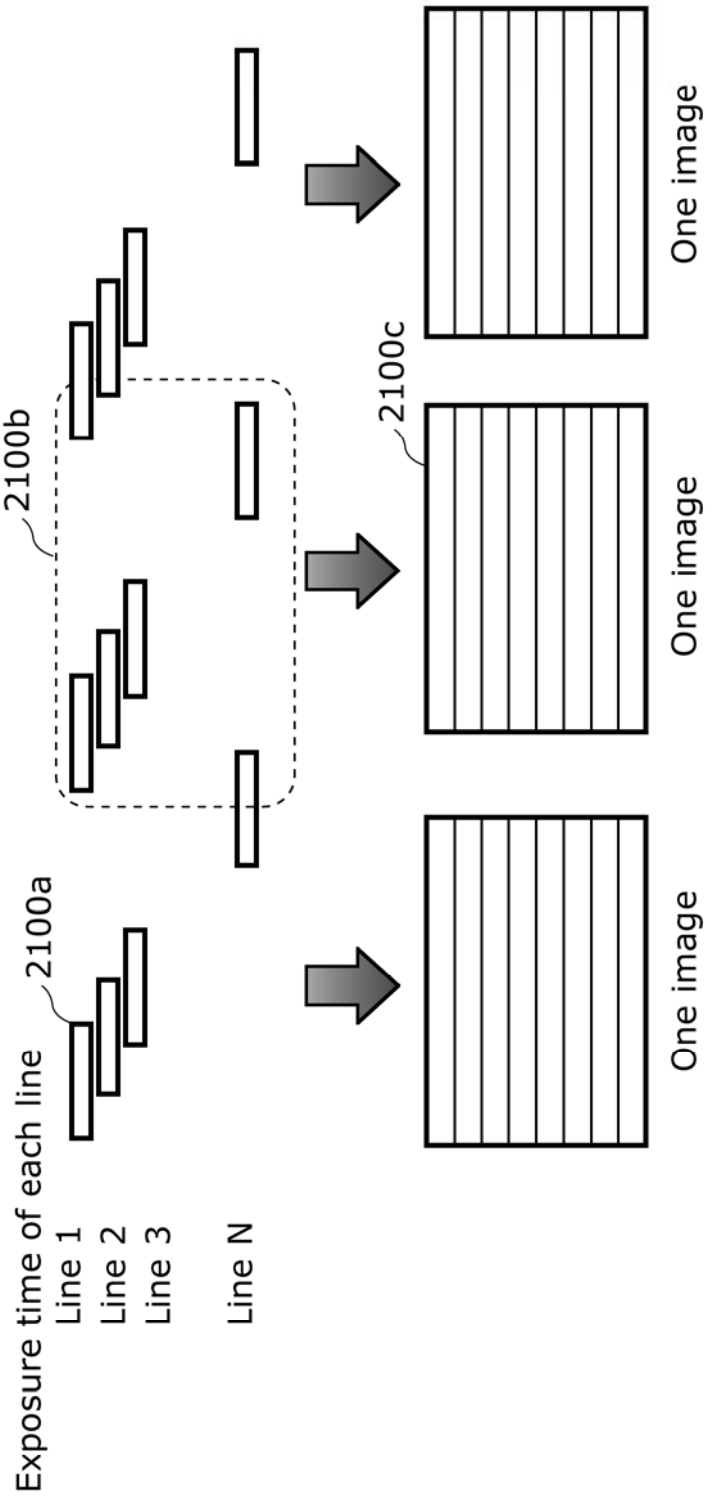

time
Exposure time of each line
Line 1
Line 2
Line 3
Line N
2100a
2100b
2100c
One image
One image
One image

FIG. 79

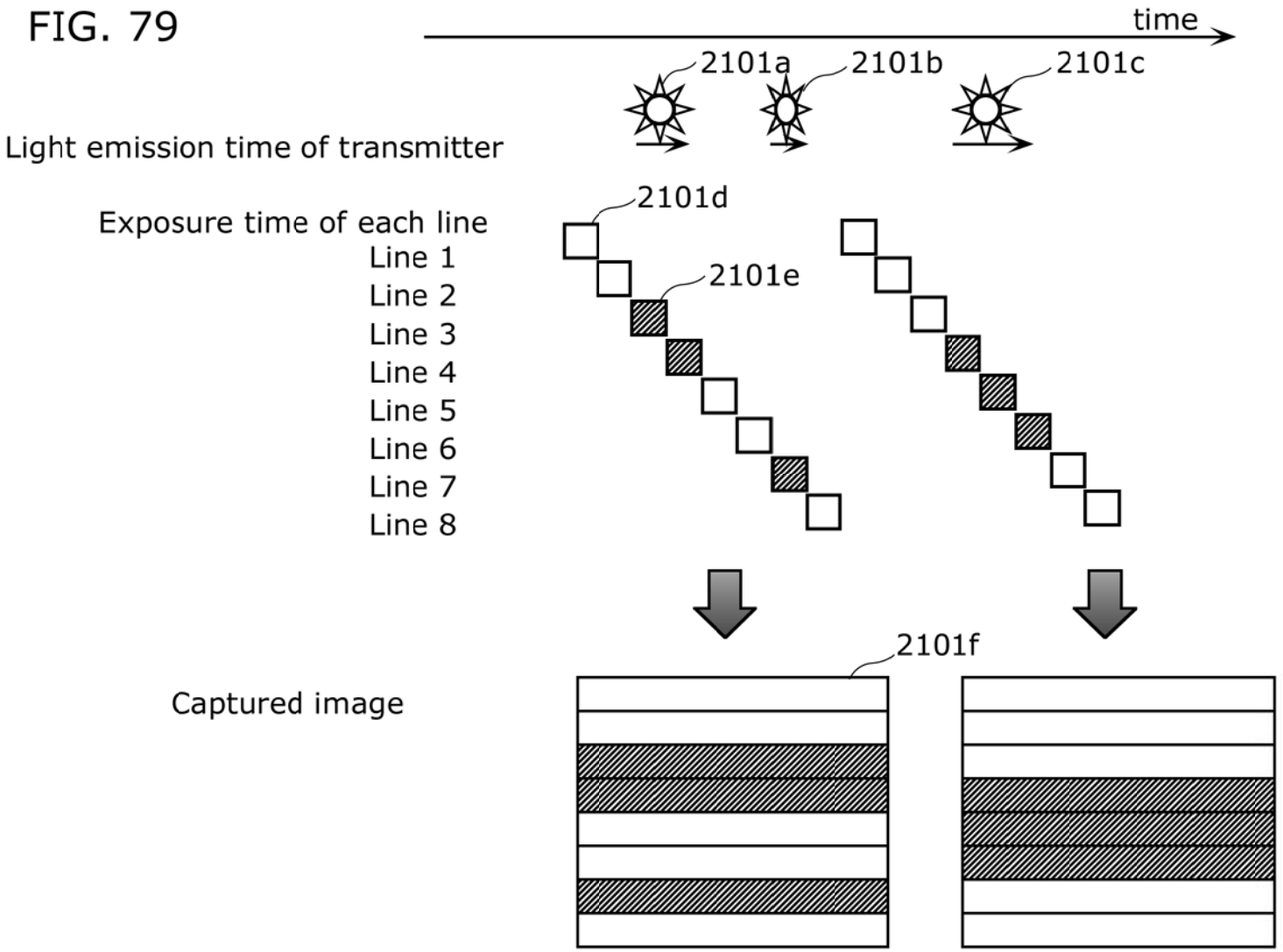

time
2101a
2101b
2101c
Light emission time of transmitter
Exposure time of each line
2101d
2101e
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
2101f
Captured image

FIG. 80

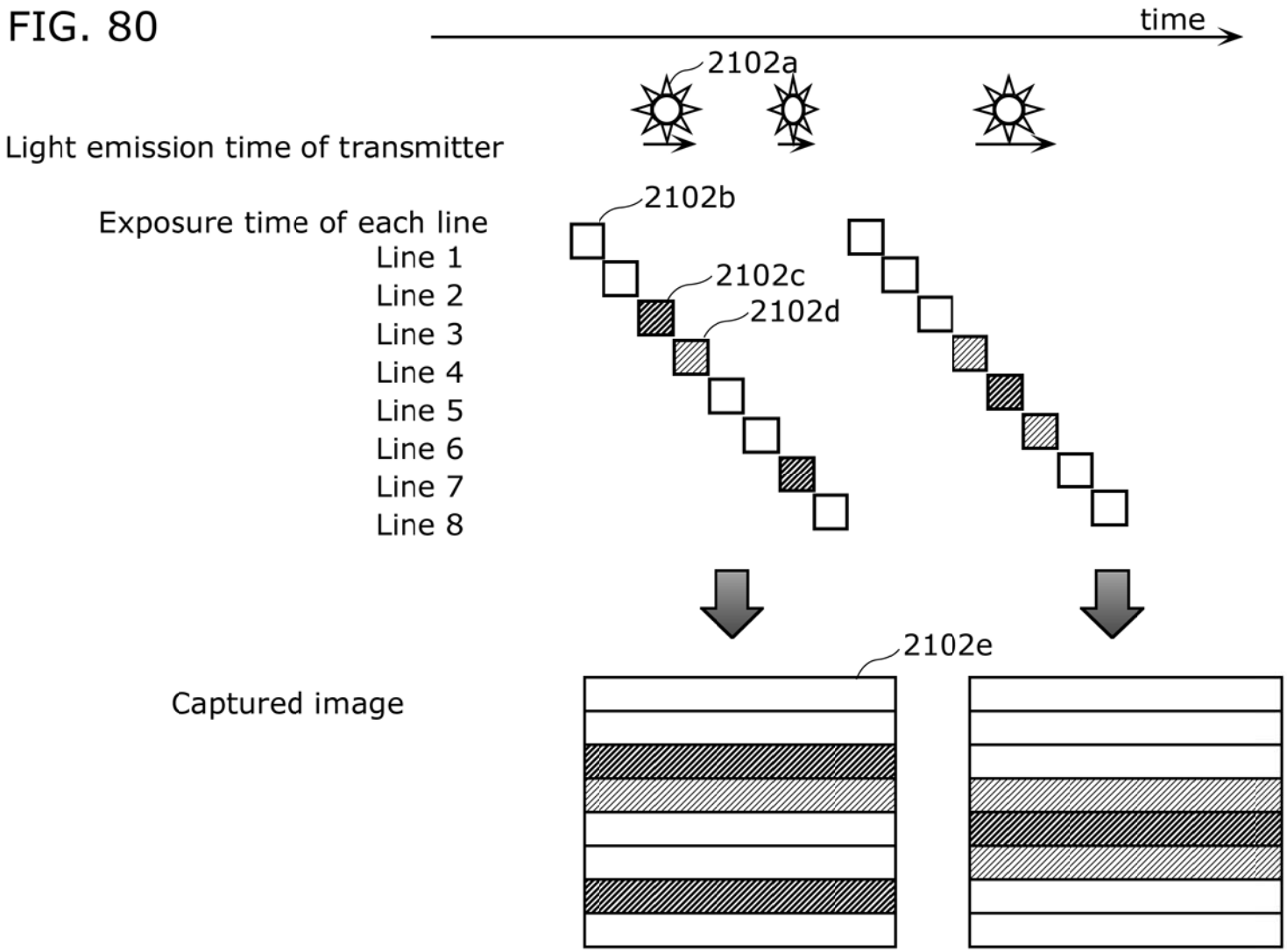

time
2102a
Light emission time of transmitter
2102b
Exposure time of each line
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
2102c
2102d
2102e
Captured image

FIG. 81A

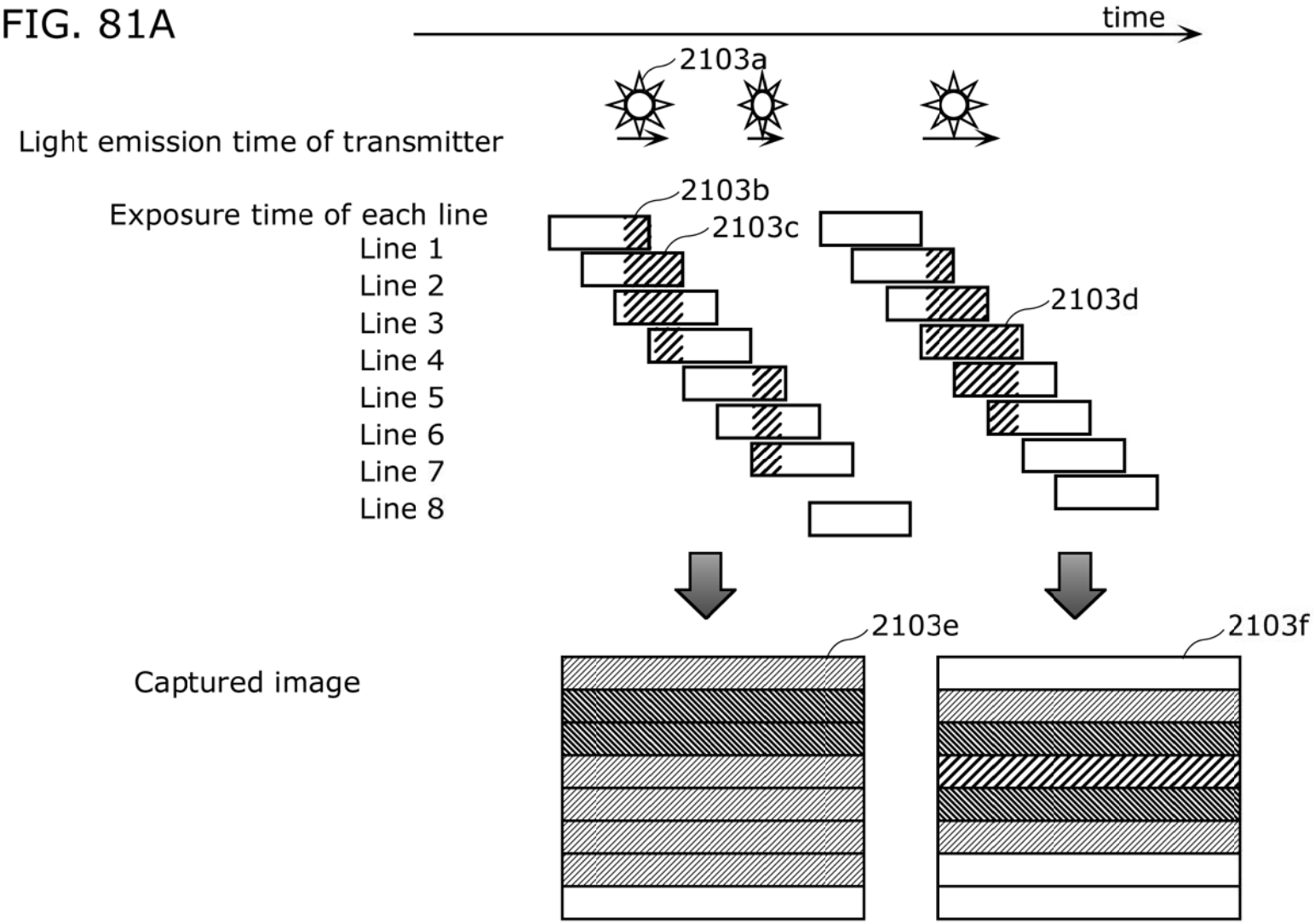

time
2103a
Light emission time of transmitter
2103b
Exposure time of each line
2103c
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
2103d
2103e
2103f
Captured image

FIG. 81B

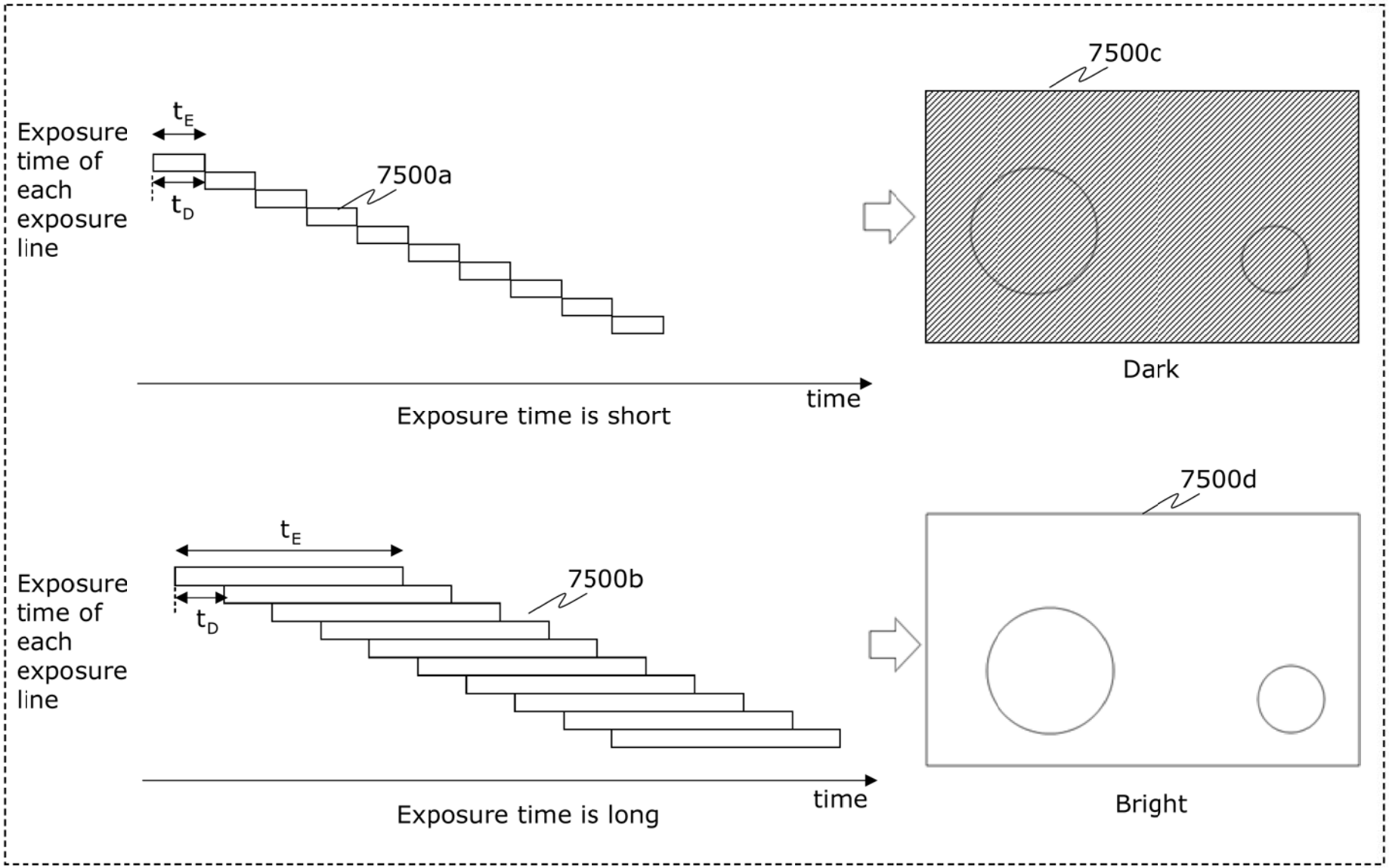

Exposure time of each exposure line
t_E
t_D
7500a
time
Exposure time is short
7500c
Dark
Exposure time of each exposure line
t_E
t_D
7500b
time
Exposure time is long
7500d
Bright

FIG. 81C

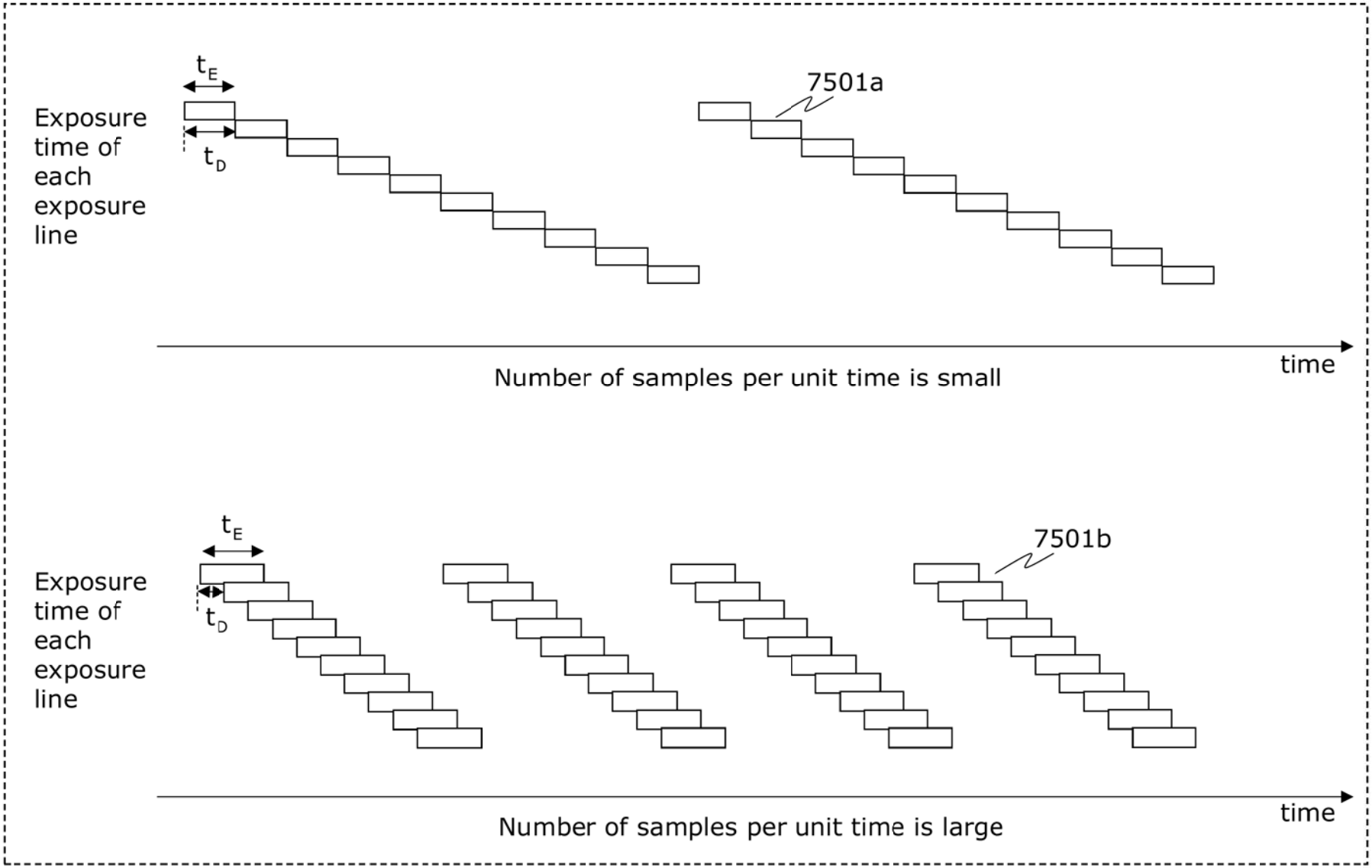

Exposure time of each exposure line
t_E
t_D
7501a
time
Number of samples per unit time is small
Exposure time of each exposure line
t_E
t_D
7501b
time
Number of samples per unit time is large

FIG. 81D

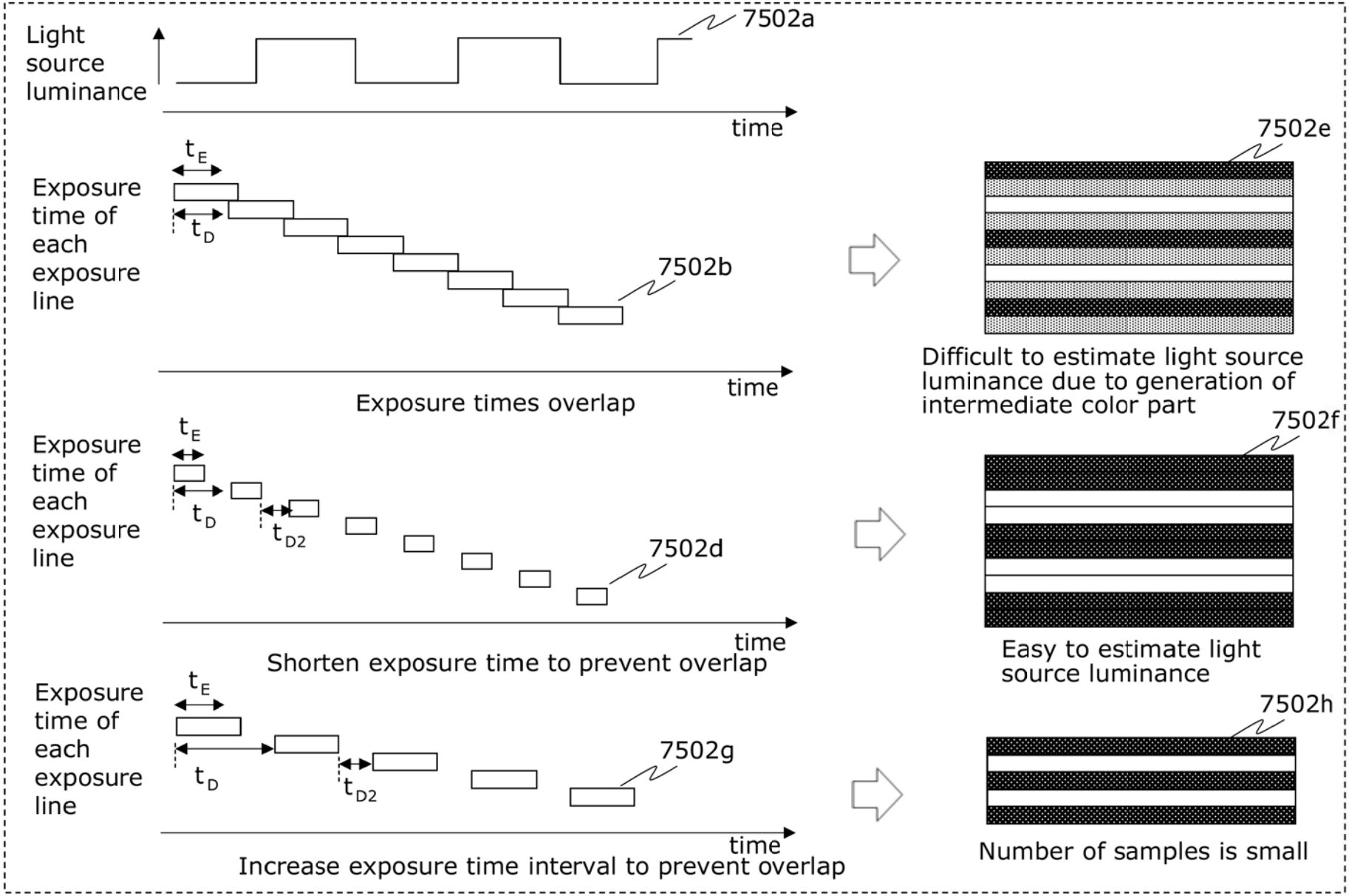

Light source luminance
7502a
time
Exposure time of each exposure line
t_E
t_D
7502b
time
Exposure times overlap
7502e
Difficult to estimate light source luminance due to generation of intermediate color part
Exposure time of each exposure line
t_E
t_D
t_{D2}
7502d
time
Shorten exposure time to prevent overlap
7502f
Easy to estimate light source luminance
Exposure time of each exposure line
t_E
t_D
t_{D2}
7502g
time
Increase exposure time interval to prevent overlap
7502h
Number of samples is small

FIG. 81E

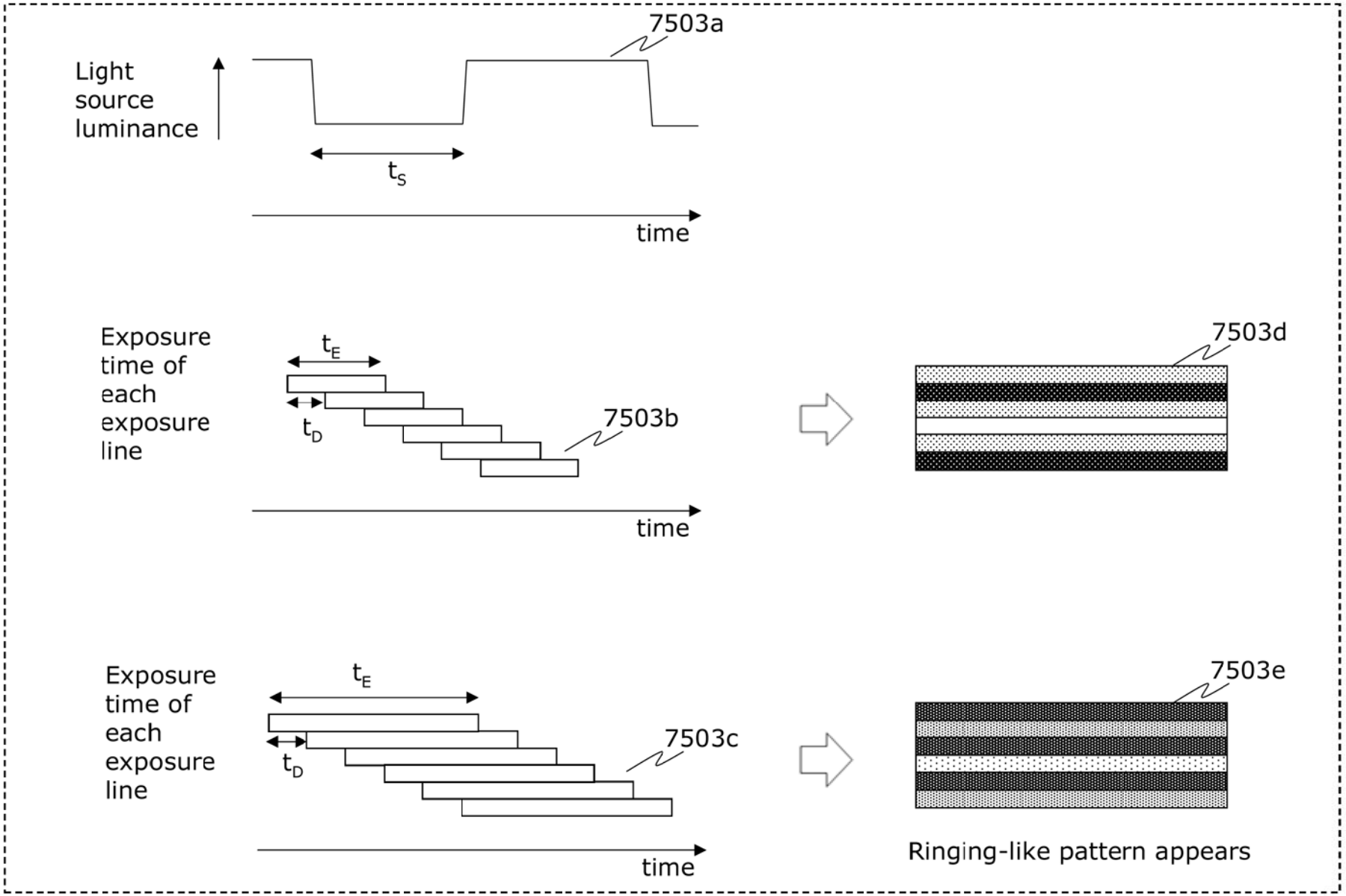

7503a
Light source luminance
t_S
time
Exposure time of each exposure line
t_E
t_D
7503b
time
7503d
Exposure time of each exposure line
t_E
t_D
7503c
time
7503e
Ringing-like pattern appears

FIG. 81F

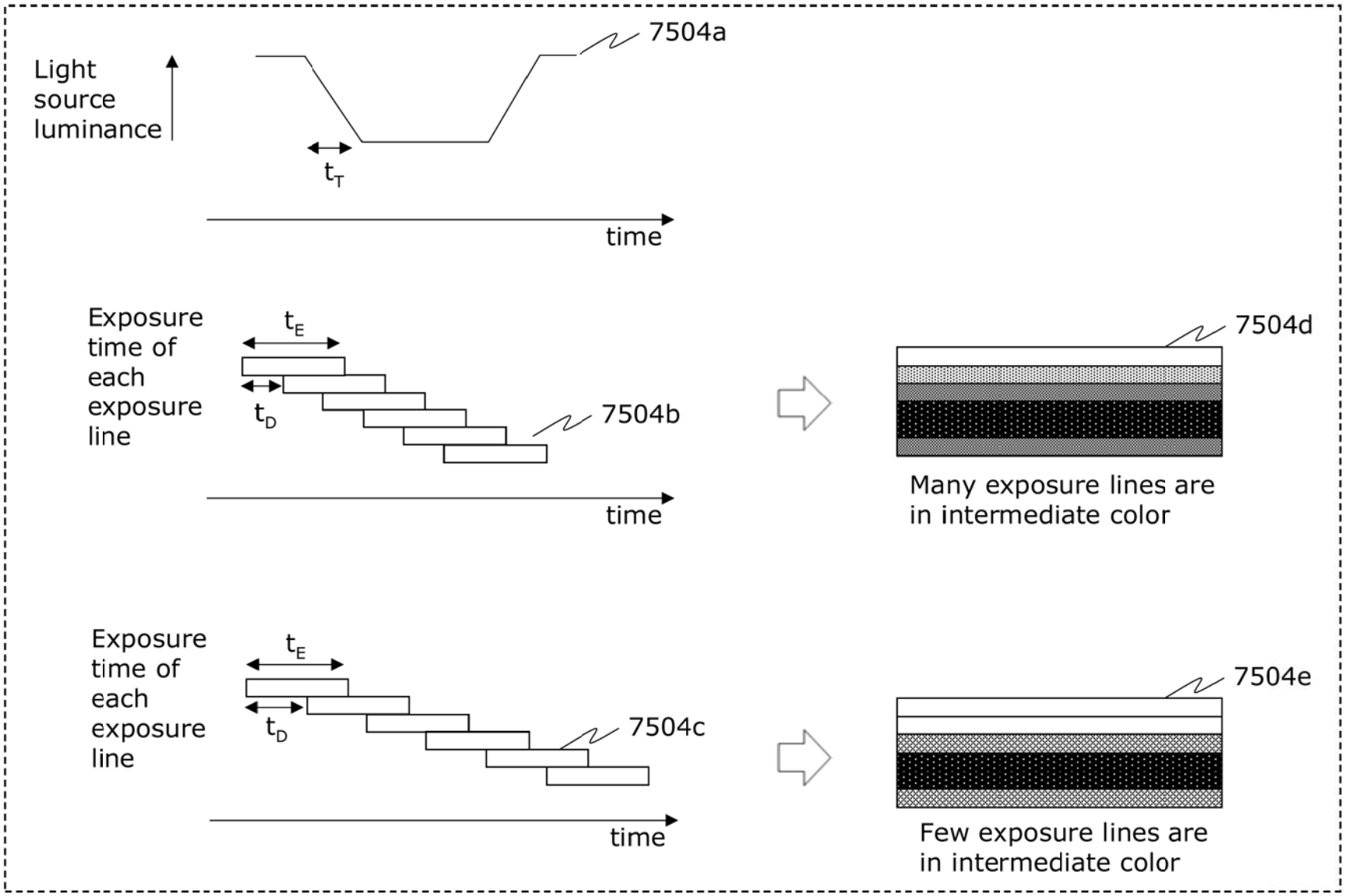

7504a
Light source luminance
t_T
time
Exposure time of each exposure line
t_E
t_D
7504b
time
7504d
Many exposure lines are in intermediate color
Exposure time of each exposure line
t_E
t_D
7504c
time
7504e
Few exposure lines are in intermediate color

FIG. 81G

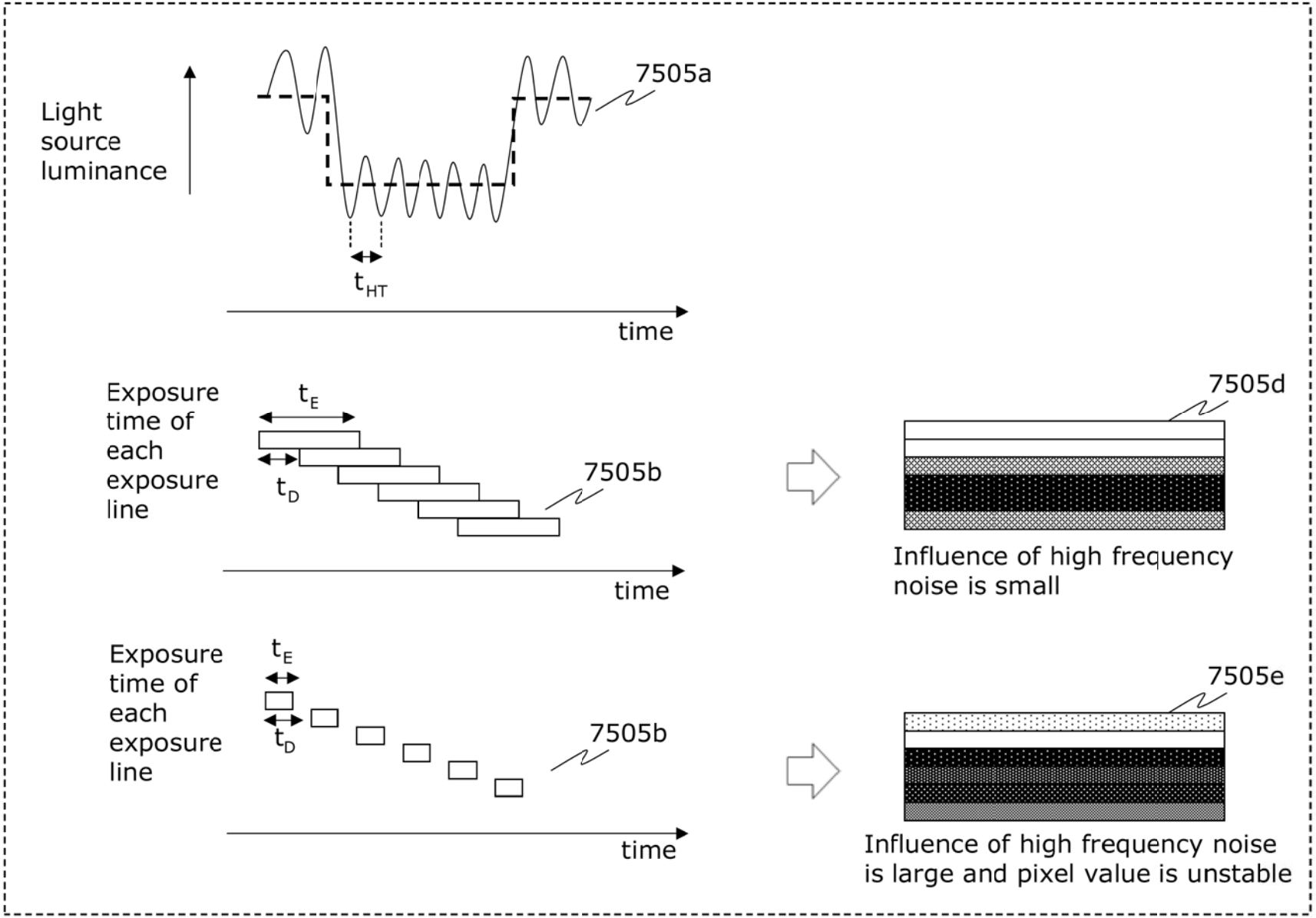

Light source luminance
7505a
t_{HT}
time
Exposure time of each exposure line
t_E
t_D
7505b
time
7505d
Influence of high frequency noise is small
Exposure time of each exposure line
t_E
t_D
7505b
time
7505e
Influence of high frequency noise is large and pixel value is unstable

FIG. 81H

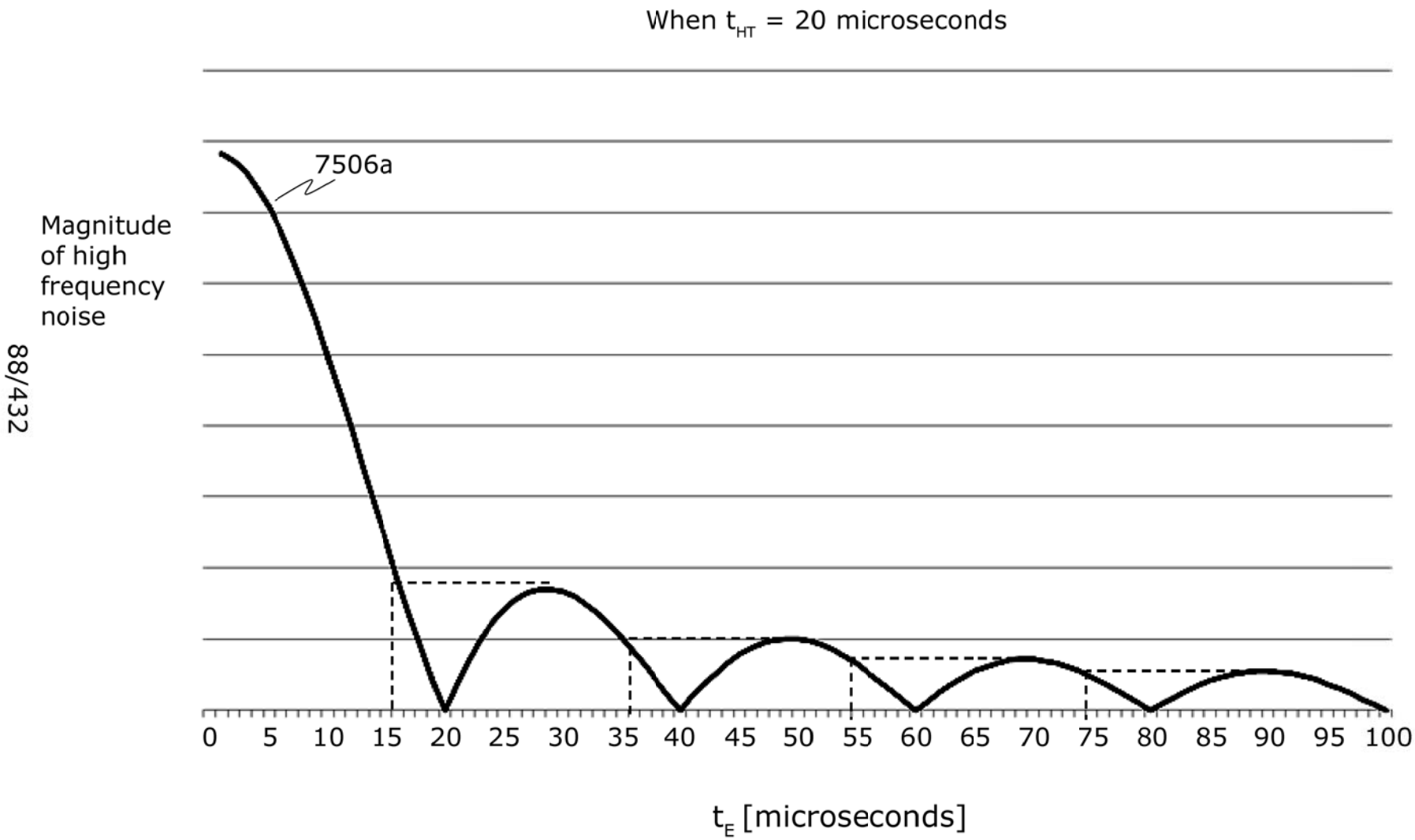

When t_{HT} = 20 microseconds
7506a
Magnitude of high frequency noise
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
t_E [microseconds]

FIG. 81I

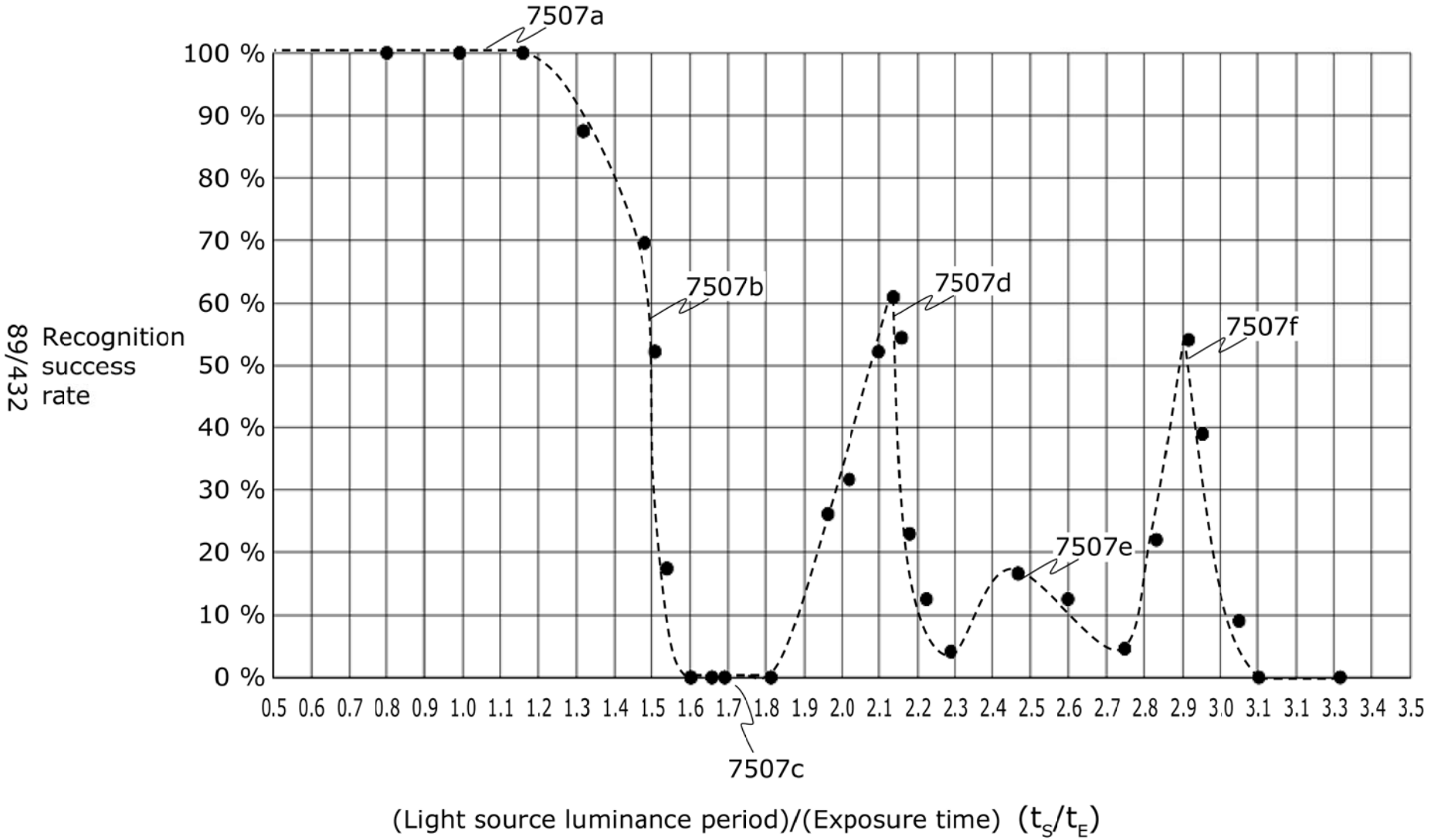

7507a
7507b
7507c
7507d
7507e
7507f
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
Recognition success rate
89/432
0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0 3.1 3.1 3.3 3.4 3.5
(Light source luminance period)/(Exposure time) (t_S/t_E)

FIG. 82

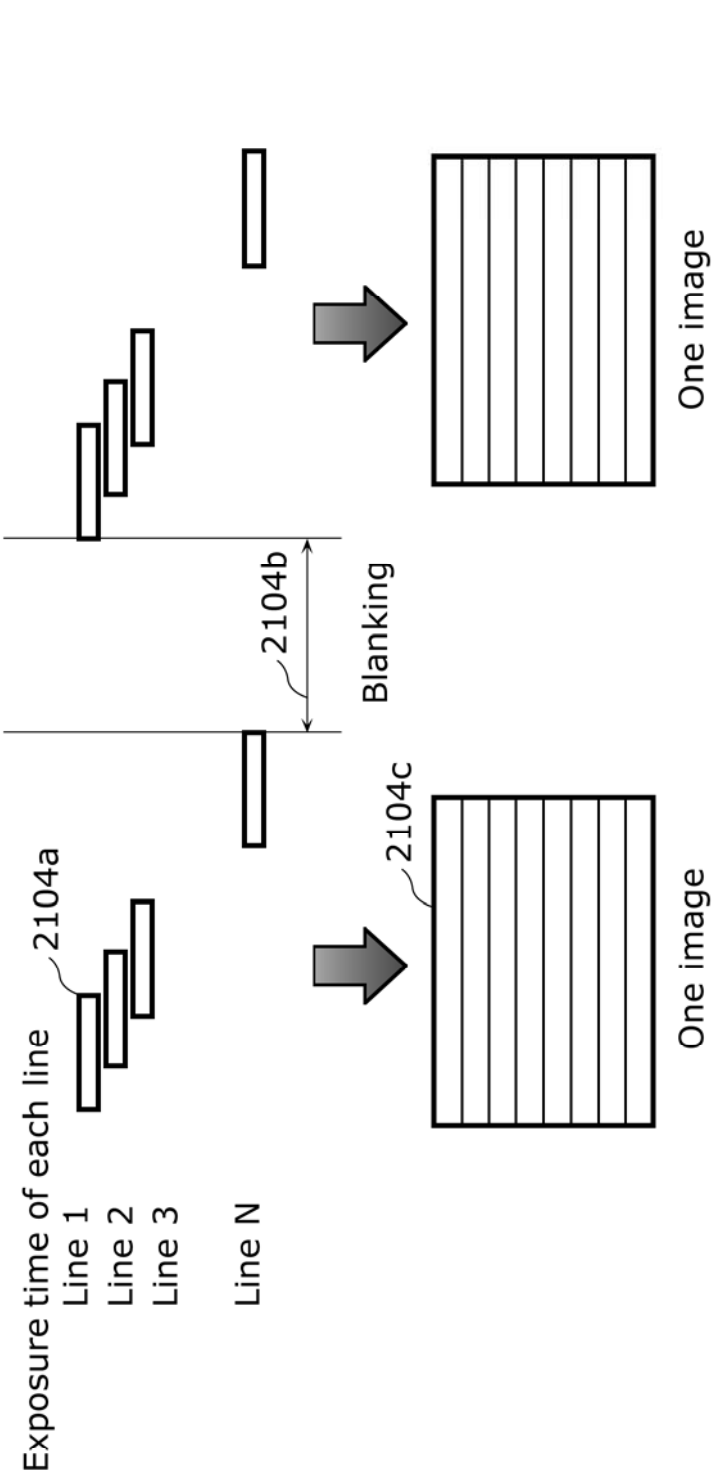

time
Exposure time of each line
Line 1
Line 2
Line 3
Line N
2104a
2104b
Blanking
2104c
One image
One image

FIG. 83

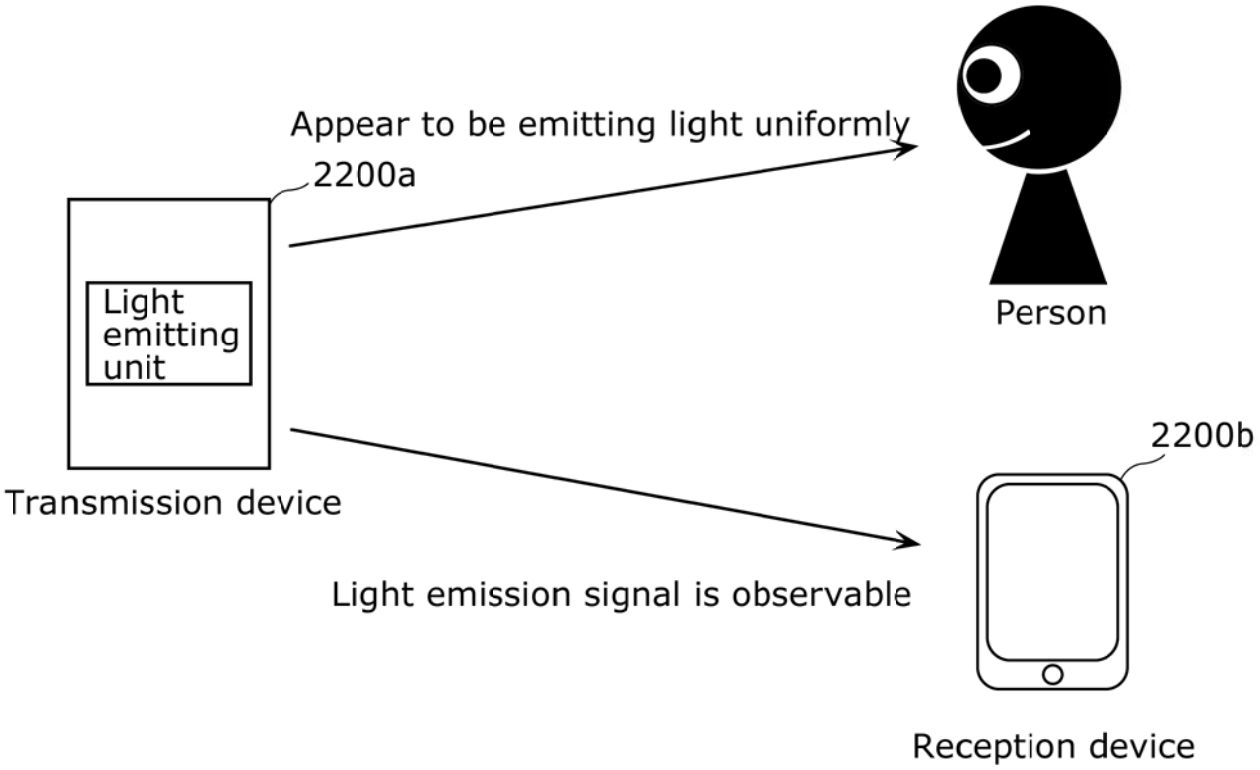

Appear to be emitting light uniformly
2200a
Light emitting unit
Transmission device
Person
2200b
Light emission signal is observable
Reception device

FIG. 84

2200.1a

Transmission signal	Modulated signal
0	01
1	10

FIG. 85

2200.2a

Transmission signal	Modulated signal
00 (0)	0111
01 (1)	1011
10 (2)	1101
11 (3)	1110

FIG. 86

2200.3a

Transmission signal	Modulated signal
000 (0)	01111111
001 (1)	10111111
010 (2)	11011111
011 (3)	11101111
100 (4)	11110111
101 (5)	11111011
110 (6)	11111101
111 (7)	11111110

FIG. 87

2200.4a

Transmission signal	Modulated signal
00 (0)	1000
01 (1)	0100
10 (2)	0010
11 (3)	0001

FIG. 88

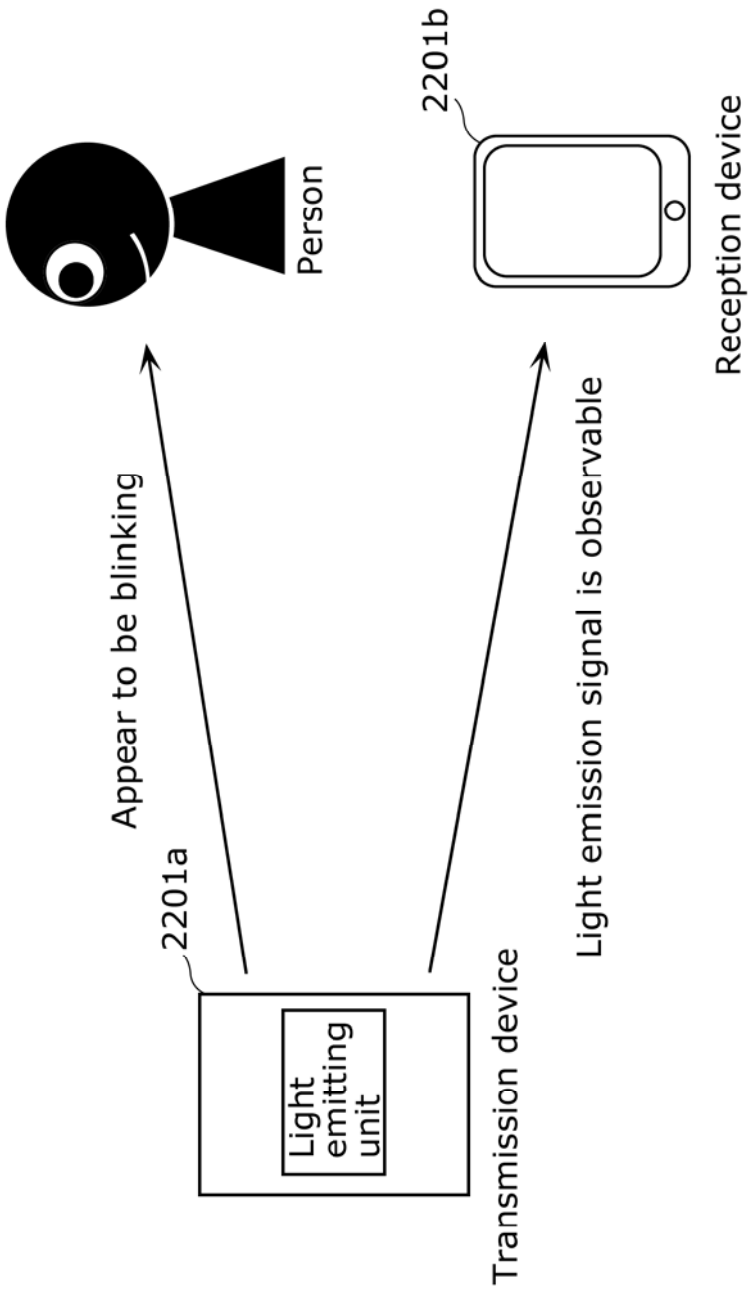

Person
2201b
Reception device
Appear to be blinking
2201a
Light emitting unit
Transmission device
Light emission signal is observable

FIG. 89

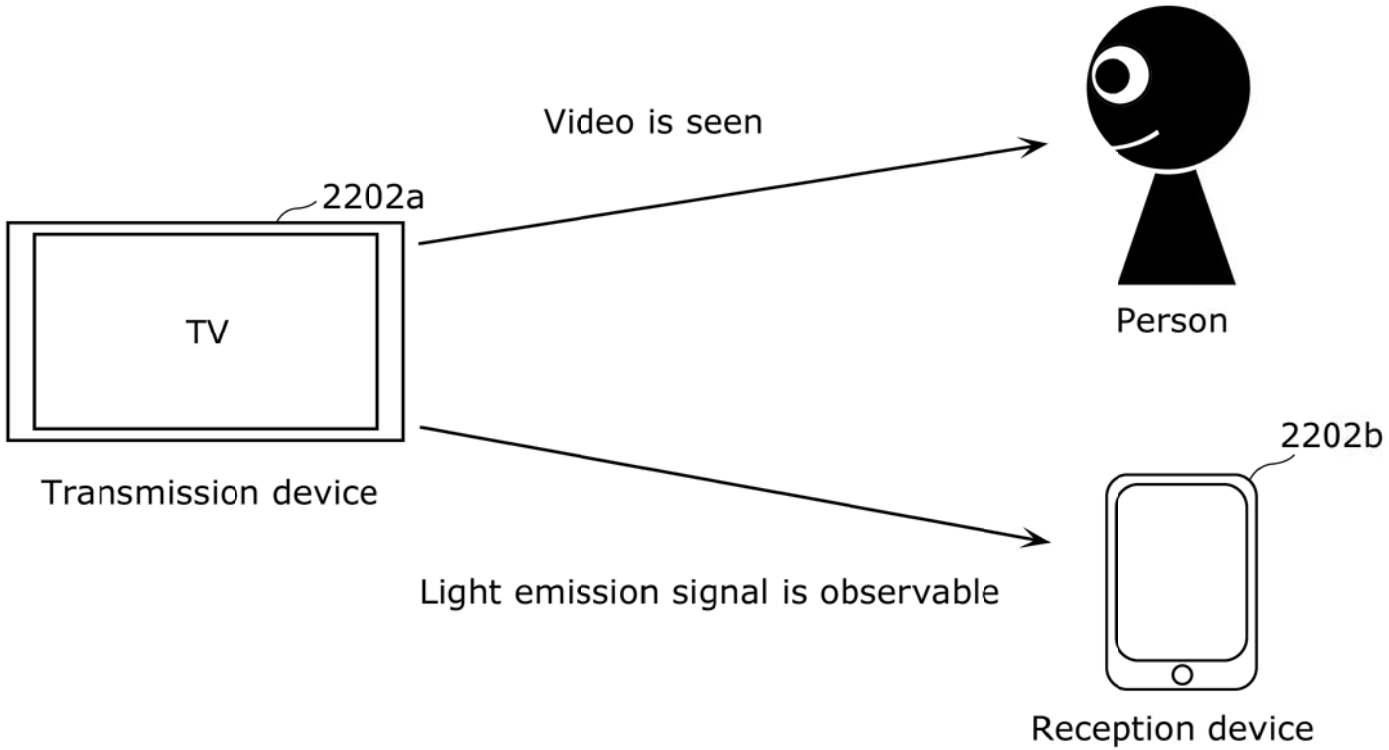

Video is seen
2202a
TV
Transmission device
Person
2202b
Light emission signal is observable
Reception device

FIG. 90

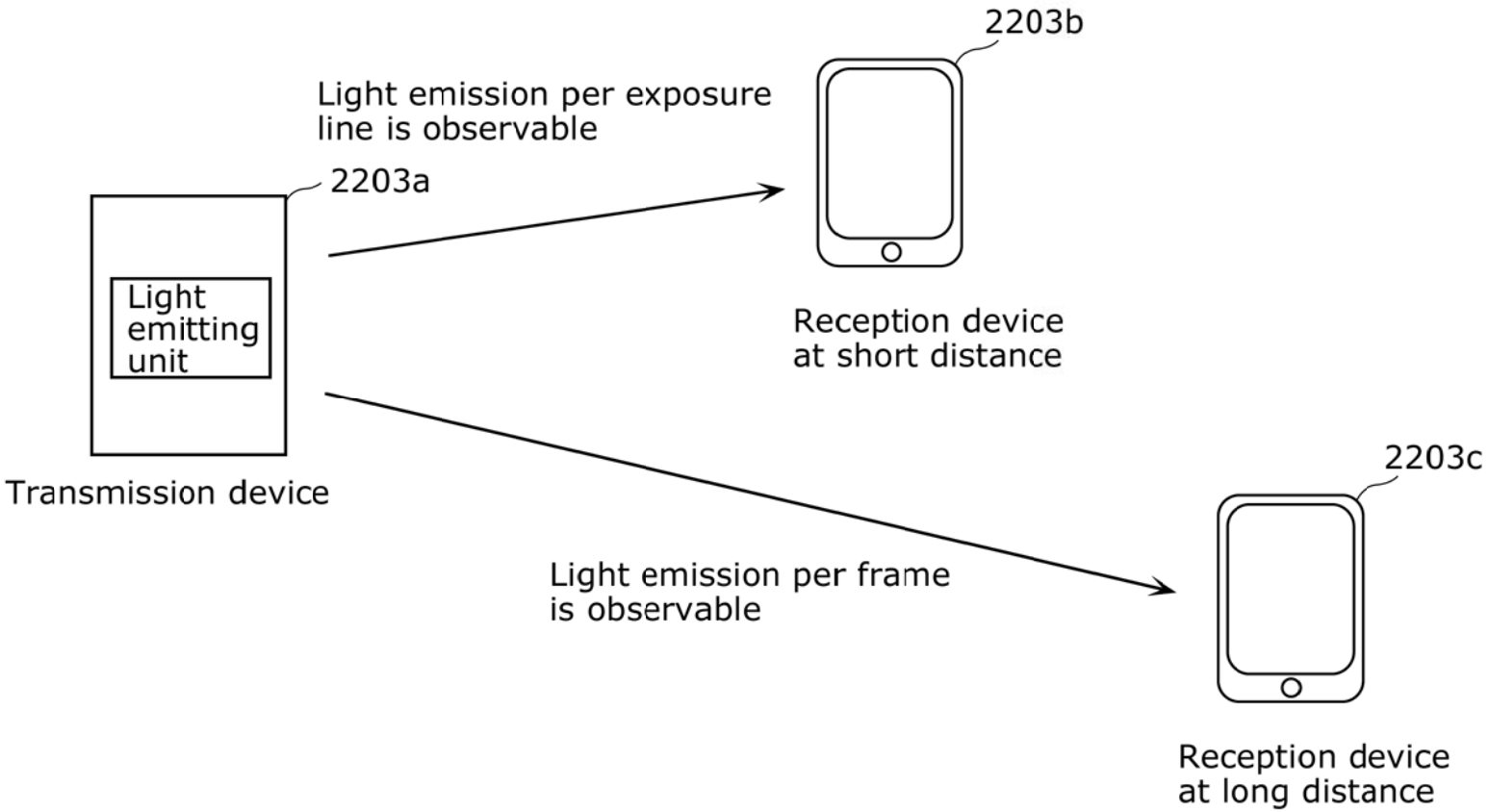

2203b
Light emission per exposure line is observable
2203a
Light emitting unit
Reception device at short distance
Transmission device
2203c
Light emission per frame is observable
Reception device at long distance

FIG. 91

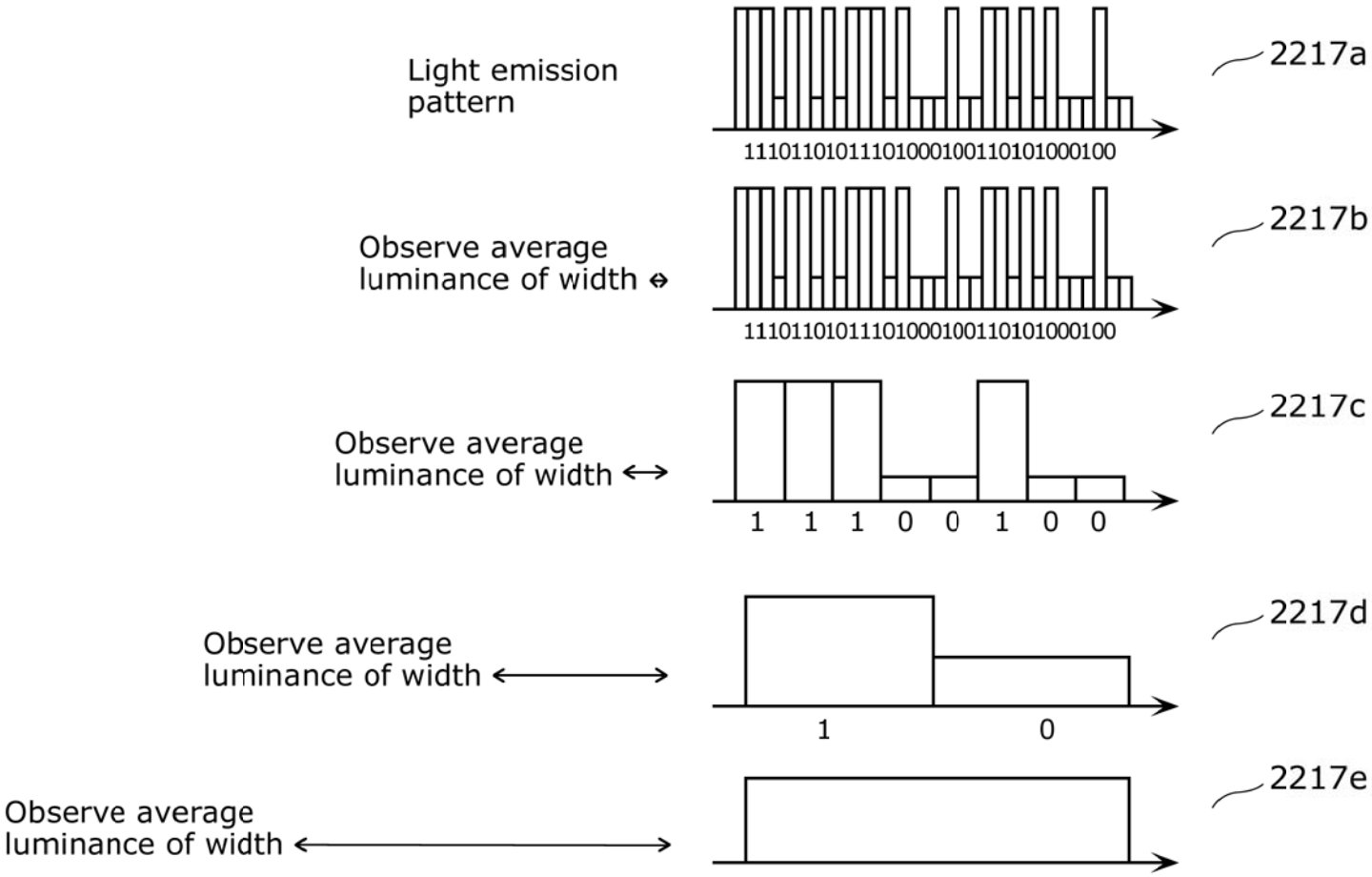

Light emission pattern
11101101011101000100110101000100
2217a
Observe average luminance of width ⇔
11101101011101000100110101000100
2217b
Observe average luminance of width ↔
1 1 1 0 0 1 0 0
2217c
Observe average luminance of width ⟷
1
0
2217d
Observe average luminance of width ⟷
2217e

FIG. 92

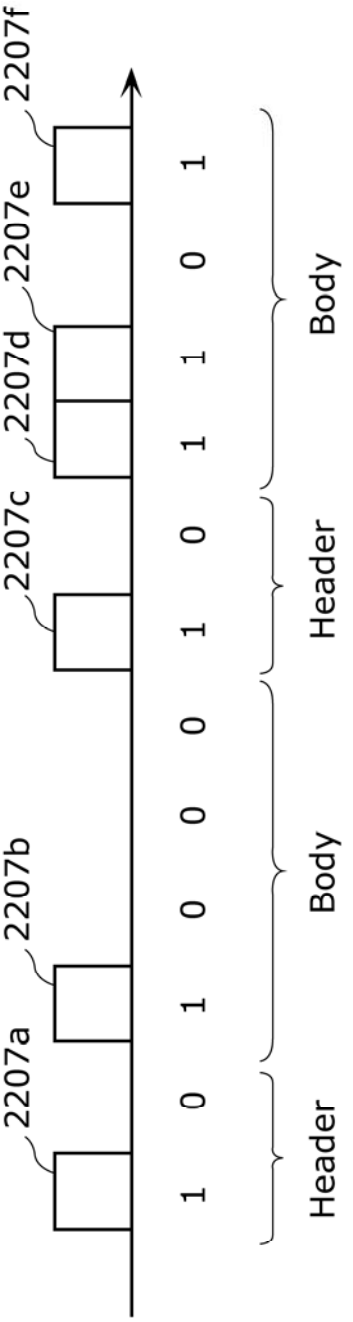

2207a
2207b
2207c
2207d
2207e
2207f
1 0 1 0 0 0 1 0 1 1 0 1
Header
Body
Header
Body

FIG. 93

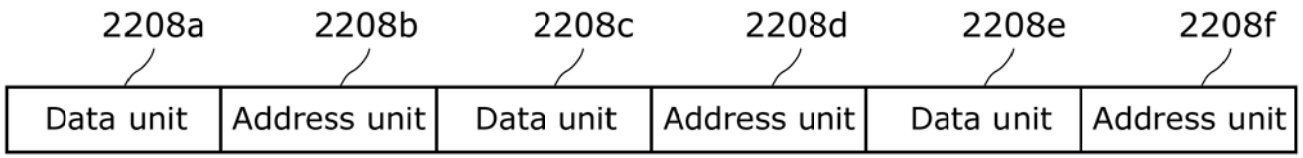

2208a
2208b
2208c
2208d
2208e
2208f
Data unit
Address unit
Data unit
Address unit
Data unit
Address unit

FIG. 94

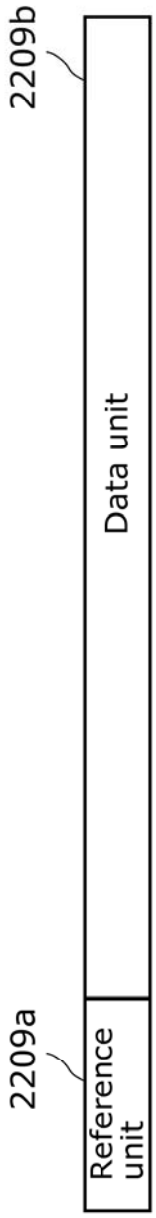


FIG. 95

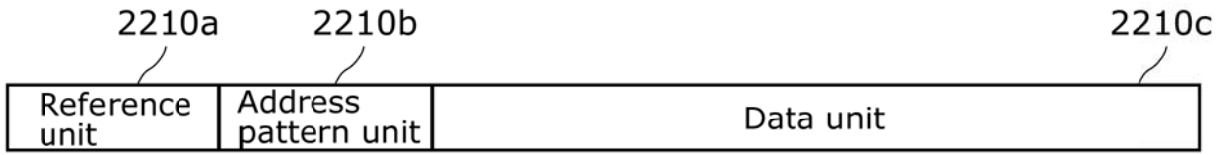

2210a
2210b
2210c
Reference unit
Address pattern unit
Data unit

FIG. 96

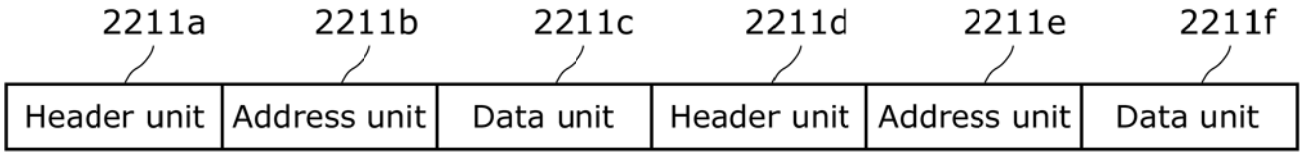

2211a
2211b
2211c
2211d
2211e
2211f
Header unit
Address unit
Data unit
Header unit
Address unit
Data unit

FIG. 97

Transmission information	Priority
Information 1	3 (High)
Information 2	2 (Normal)
Information 3	1 (Low)

Transmission order 1

Information 1	Information 1	Information 1	Information 1	Information 1	Information 1	Information 2	Information 2	Information 2	Information 2	Information 3	Information 3

Transmission order 2

Information 1	Information 2	Information 1	Information 3	Information 1	Information 2	Information 1	Information 2	Information 1	Information 3	Information 1	Information 2

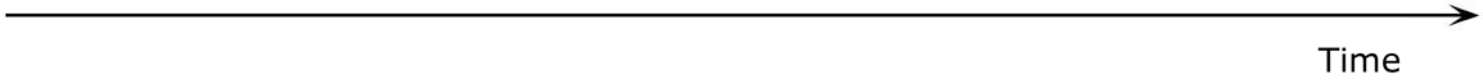


FIG. 98

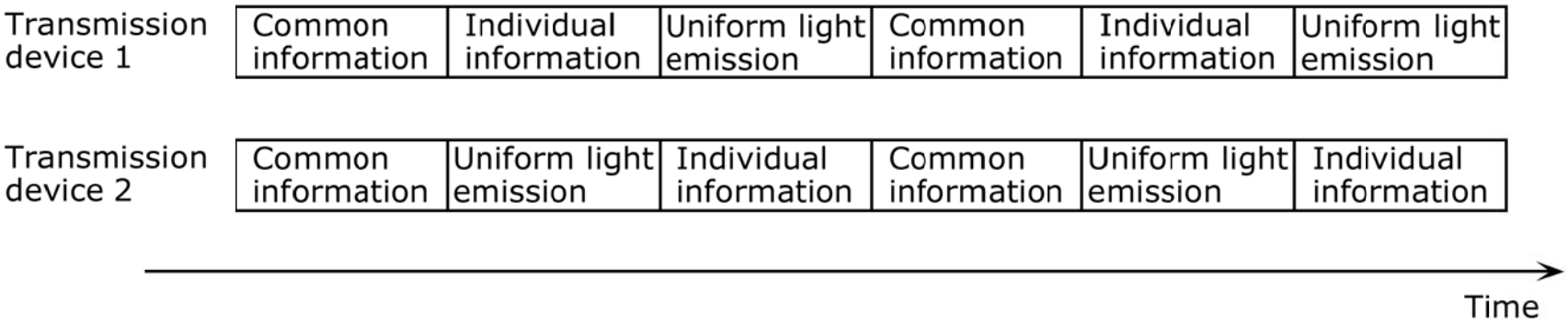

Transmission device 1
Common information
Individual information
Uniform light emission
Common information
Individual information
Uniform light emission
Transmission device 2
Common information
Uniform light emission
Individual information
Common information
Uniform light emission
Individual information
Time

FIG. 99

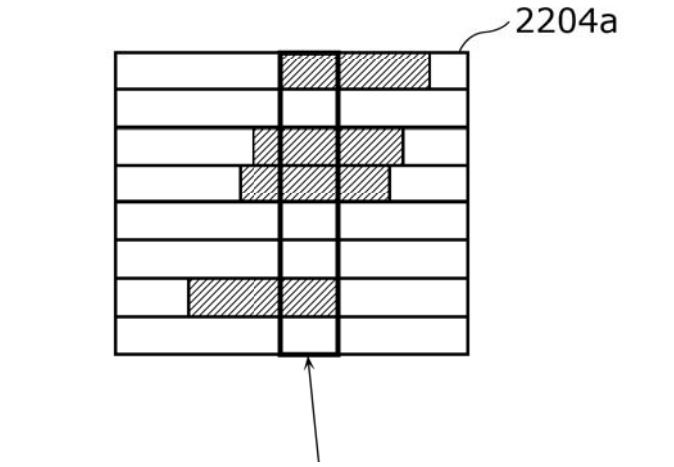

2204a
Column in which light emitting unit is captured most
Pixel detecting light emission

FIG. 100

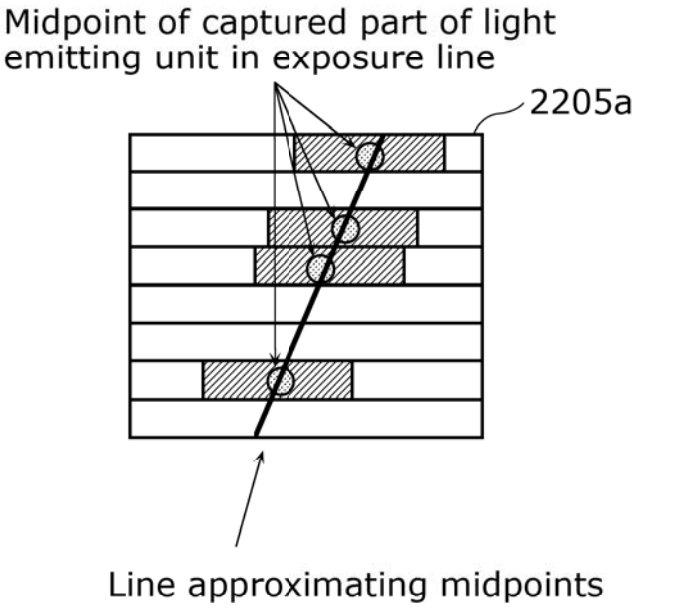

Midpoint of captured part of light emitting unit in exposure line
2205a
Line approximating midpoints
Pixel detecting light emission

FIG. 101

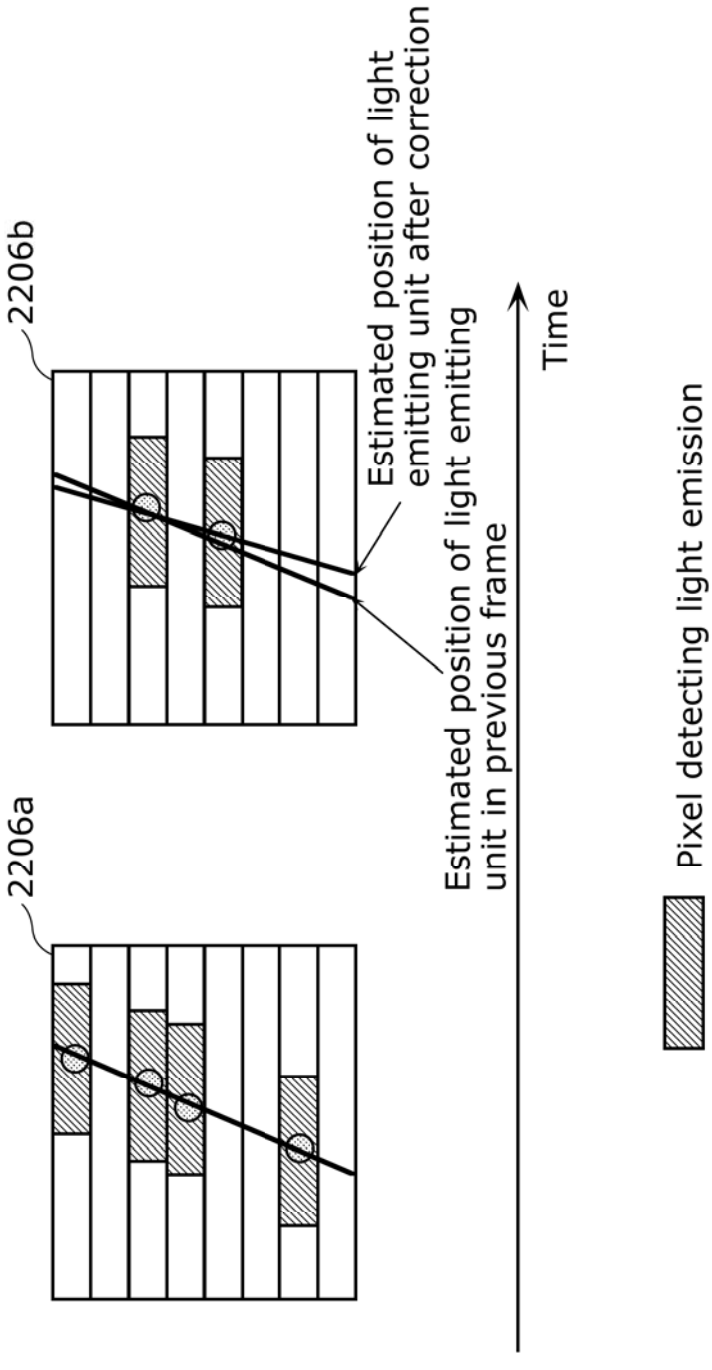

2206b
2206a
Estimated position of light emitting unit after correction
Estimated position of light emitting unit in previous frame
Time
Pixel detecting light emission

FIG. 102

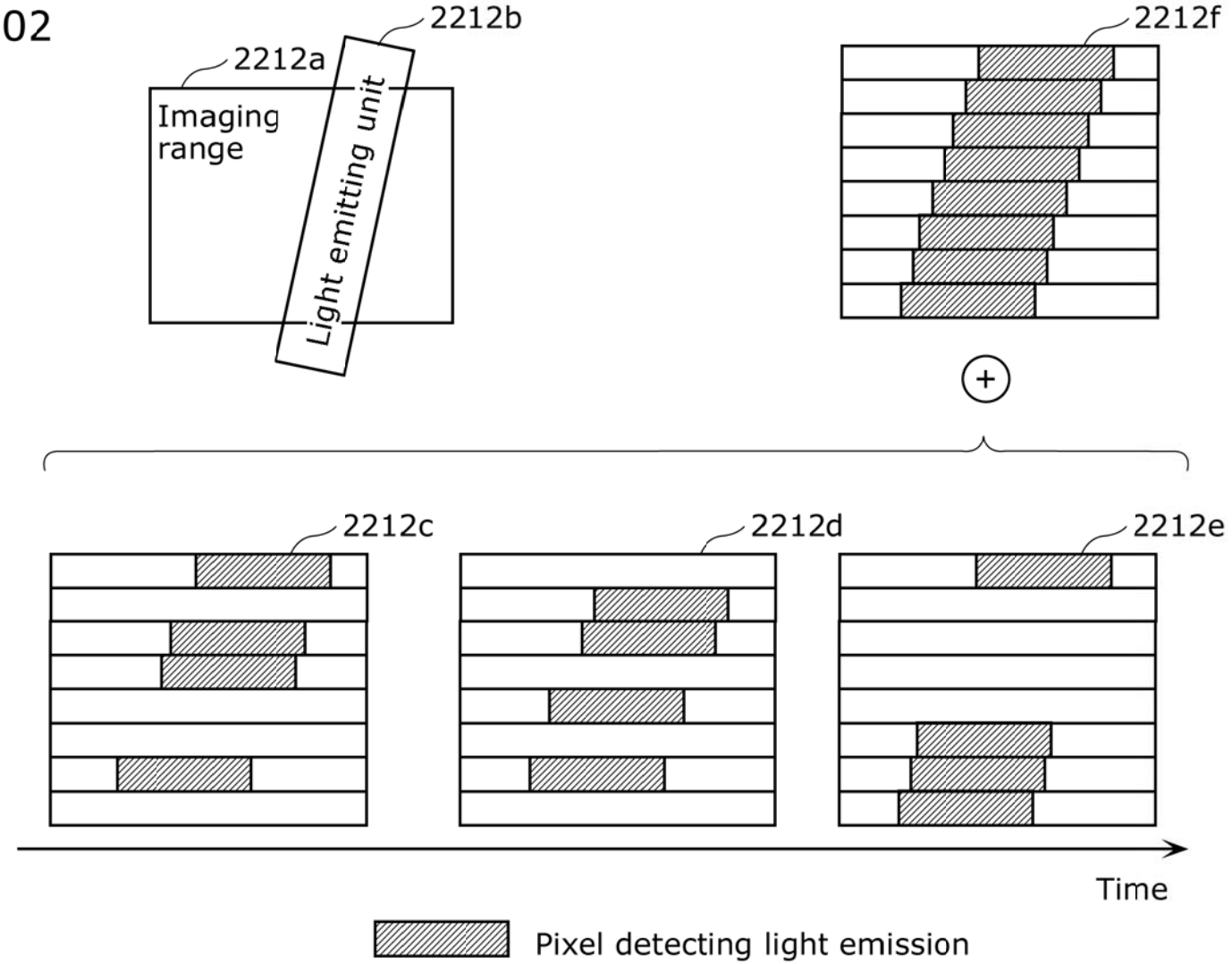

2212a
2212b
Imaging range
Light emitting unit
2212f
+
2212c
2212d
2212e
Time
Pixel detecting light emission

FIG. 103

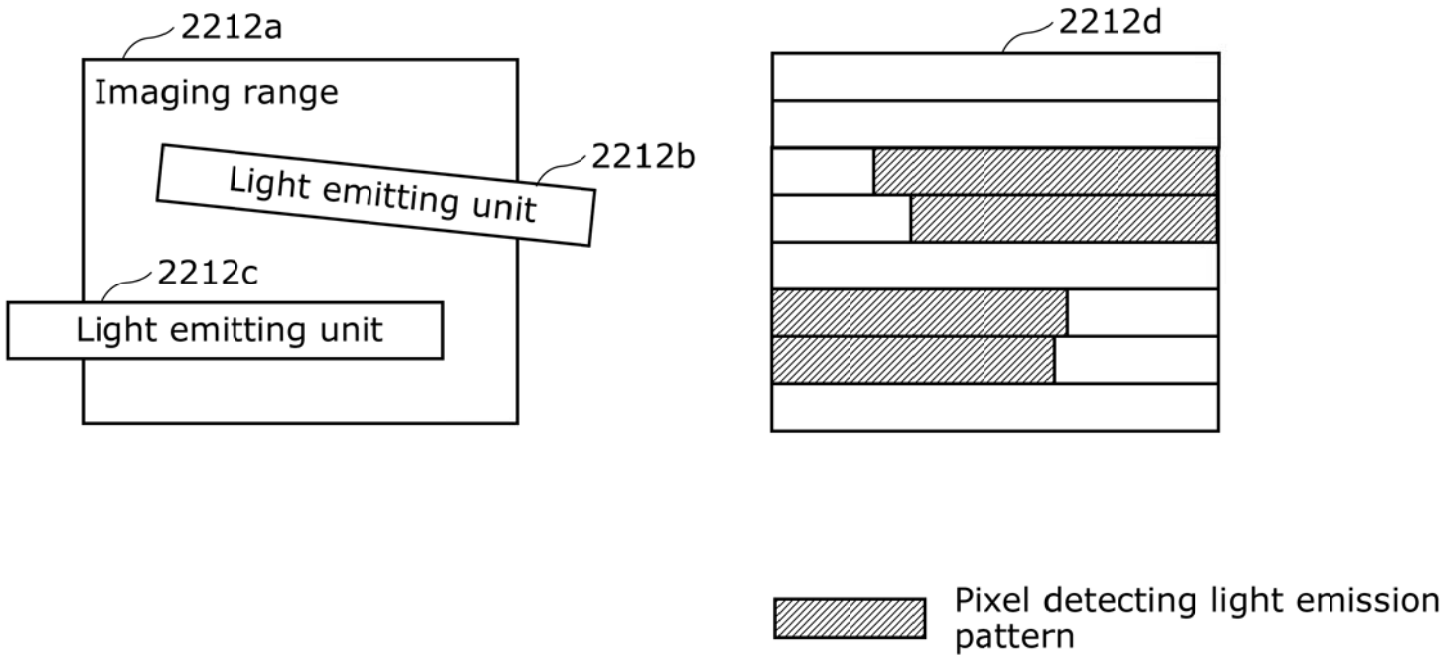

2212a
Imaging range
2212b
Light emitting unit
2212c
Light emitting unit
2212d
Pixel detecting light emission pattern

FIG. 104

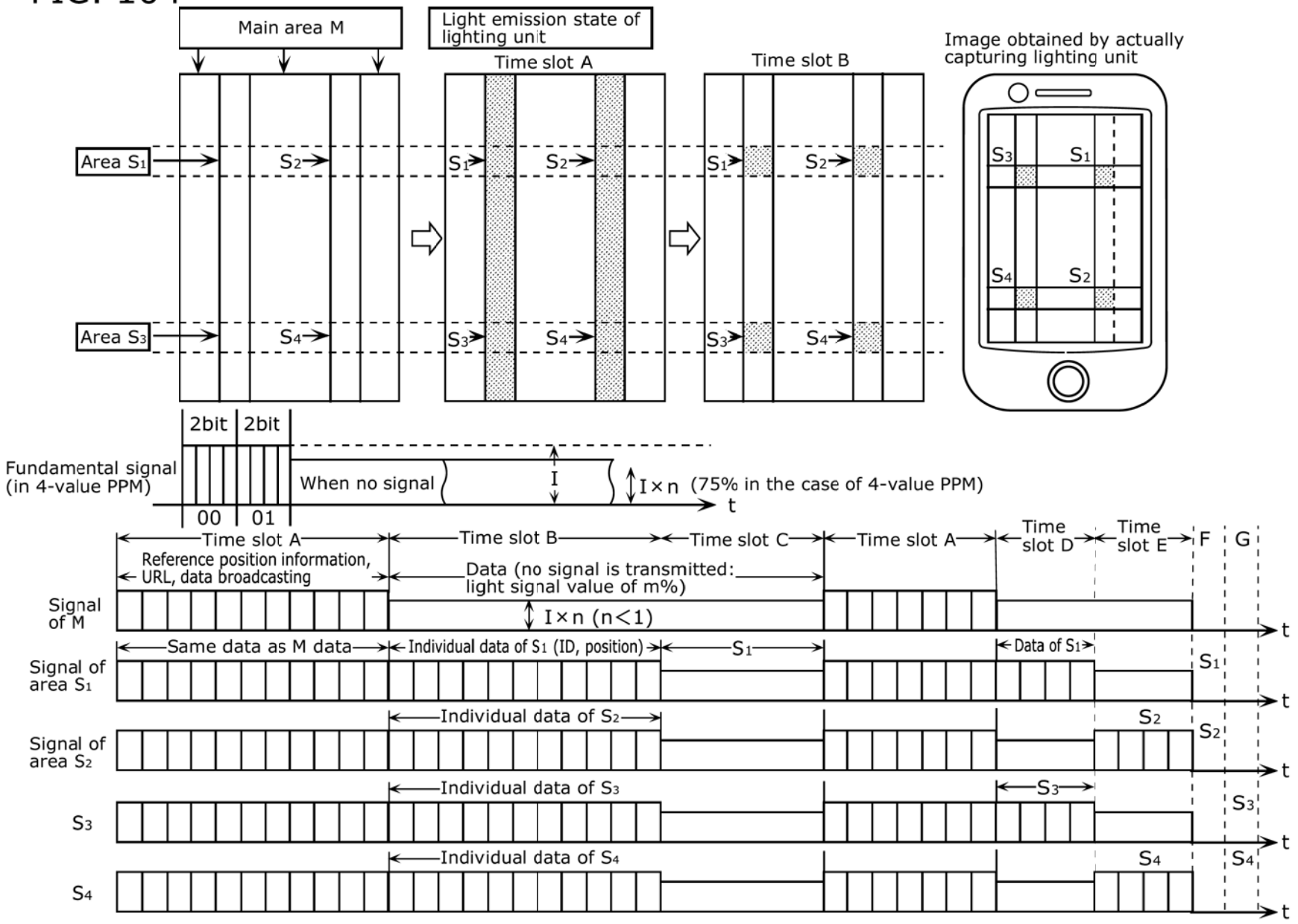

Main area M
Light emission state of lighting unit
Time slot A
Time slot B
Image obtained by actually capturing lighting unit
Area S1
Area S3
S1
S2
S3
S4
2bit
2bit
Fundamental signal (in 4-value PPM)
When no signal
I
I×n (75% in the case of 4-value PPM)
00
01
t
Time slot A
Time slot B
Time slot C
Time slot A
Time slot D
Time slot E
F
G
Reference position information, URL, data broadcasting
Data (no signal is transmitted: light signal value of m%)
Signal of M
I×n (n<1)
Same data as M data
Individual data of S1 (ID, position)
Data of S1
Signal of area S1
Individual data of S2
Signal of area S2
Individual data of S3
Individual data of S4

FIG. 105

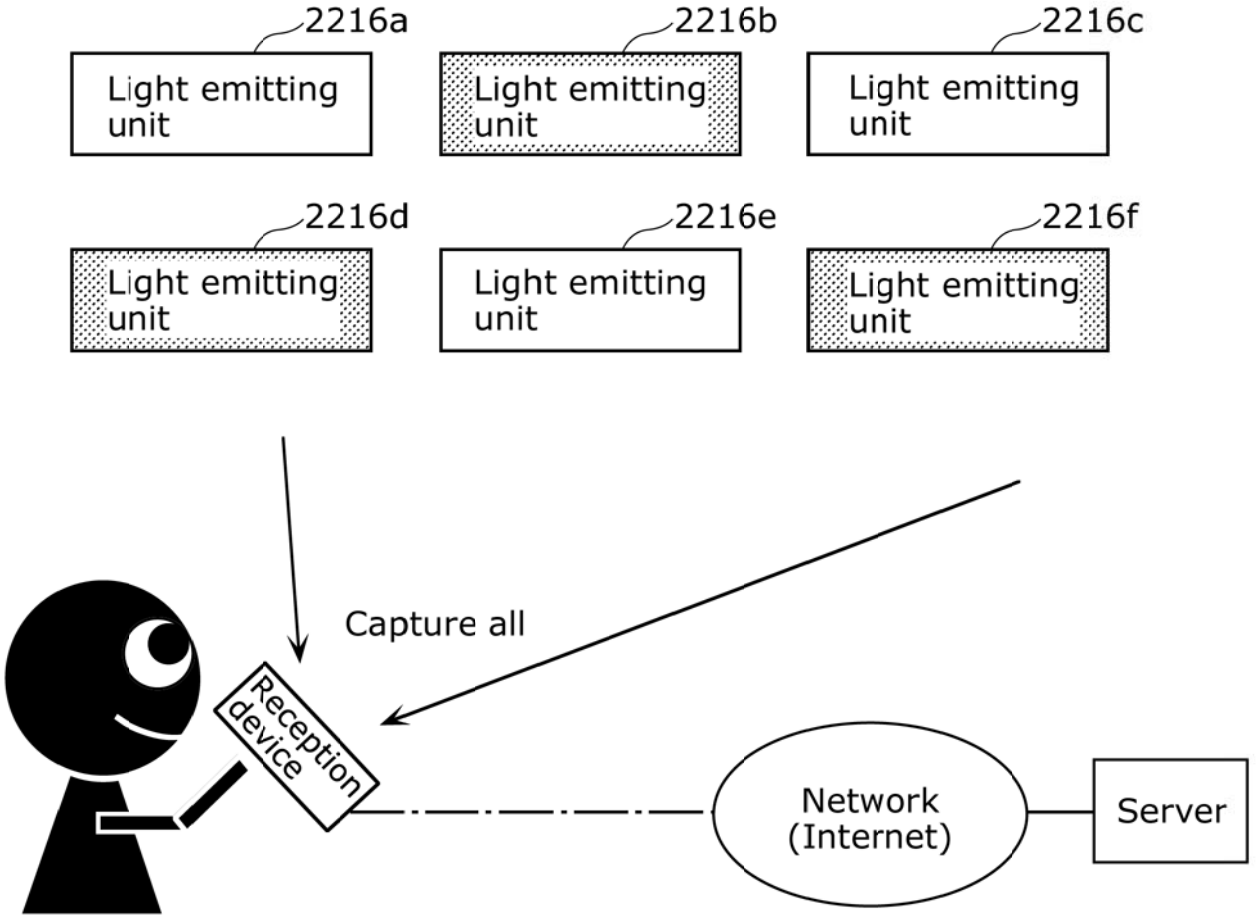
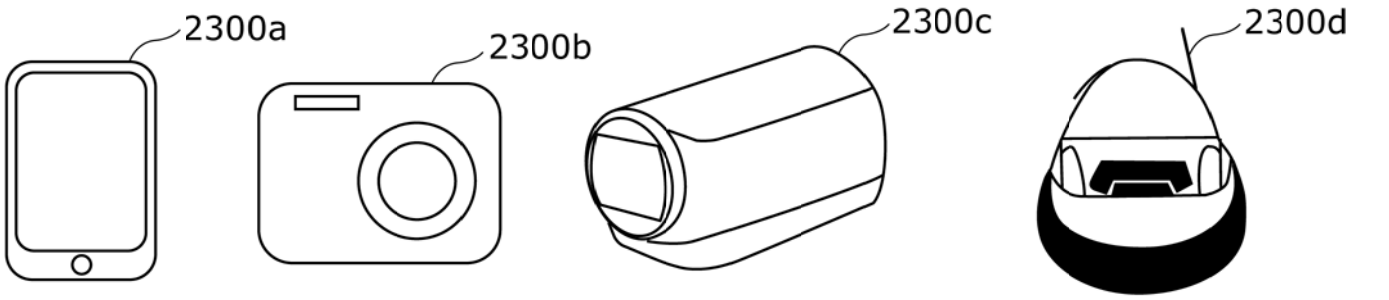
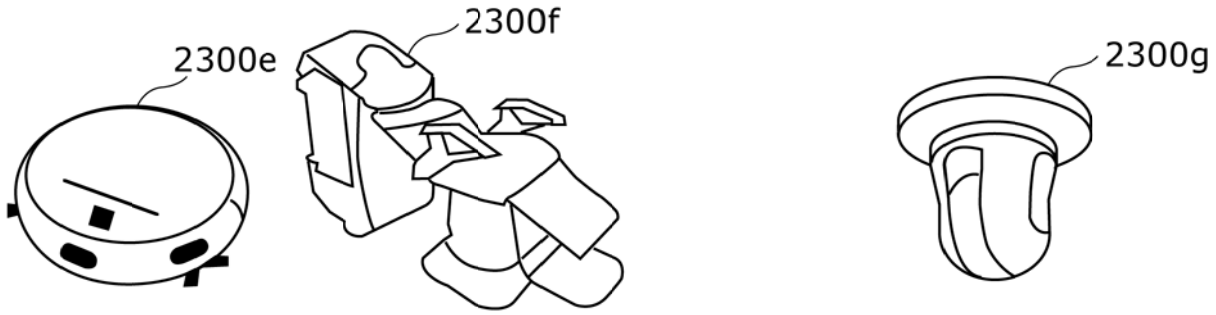

2216a
Light emitting unit
2216b
Light emitting unit
2216c
Light emitting unit
2216d
Light emitting unit
2216e
Light emitting unit
2216f
Light emitting unit
Capture all
Reception device
Network (Internet)
Server

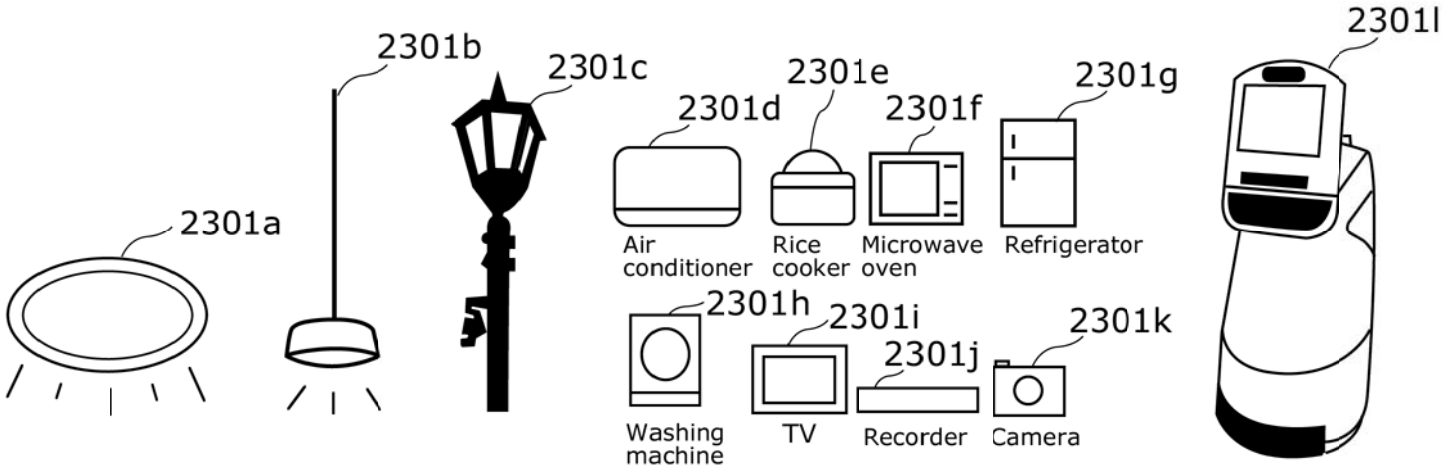
FIG. 106





Example of reception device

FIG. 107



Example of transmission device

FIG. 108

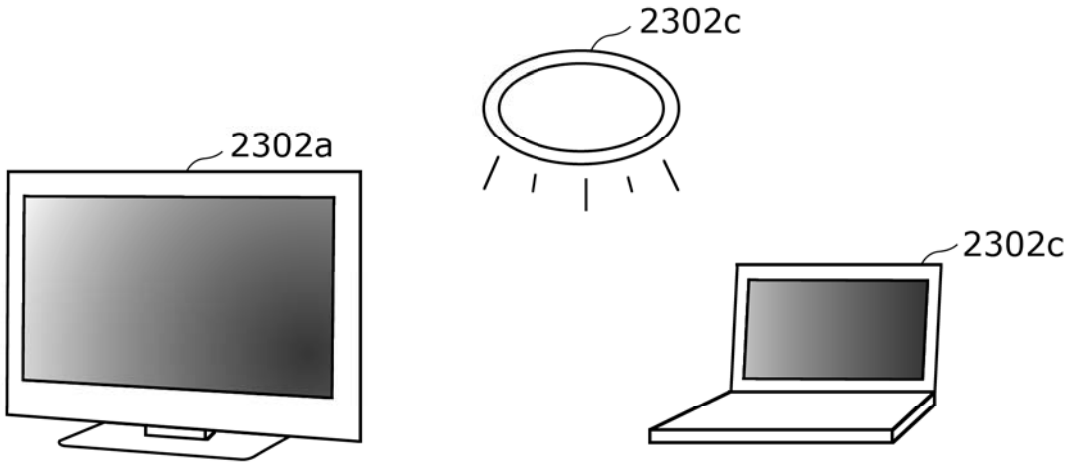


FIG. 109

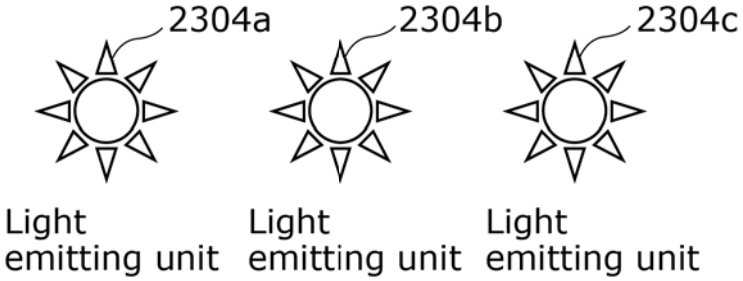

2304a
2304b
2304c
Light emitting unit
Light emitting unit
Light emitting unit

FIG. 110

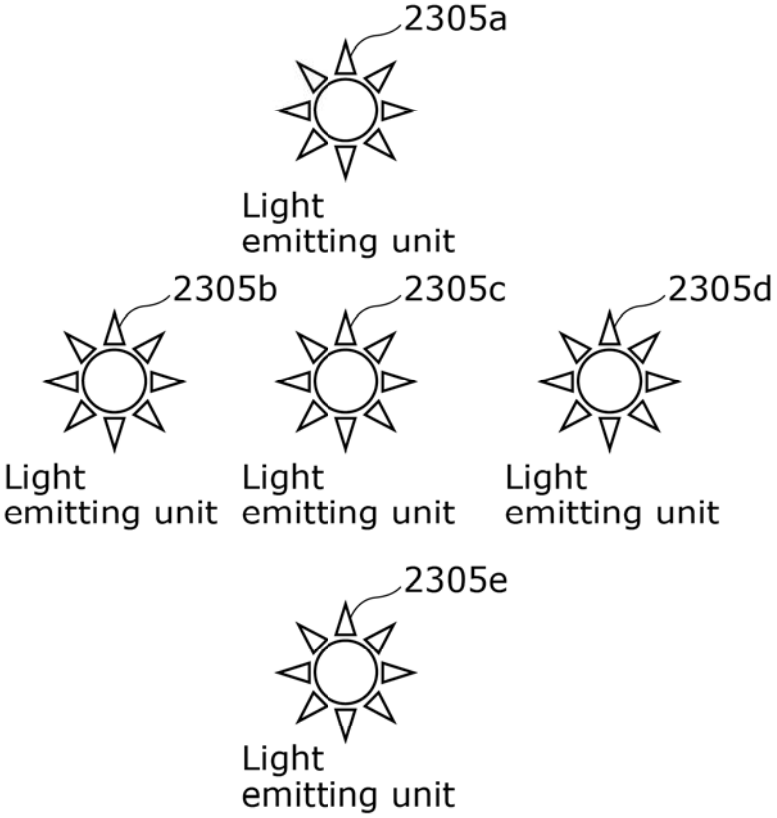

2305a
Light emitting unit
2305b
Light emitting unit
2305c
Light emitting unit
2305d
Light emitting unit
2305e
Light emitting unit

FIG. 111

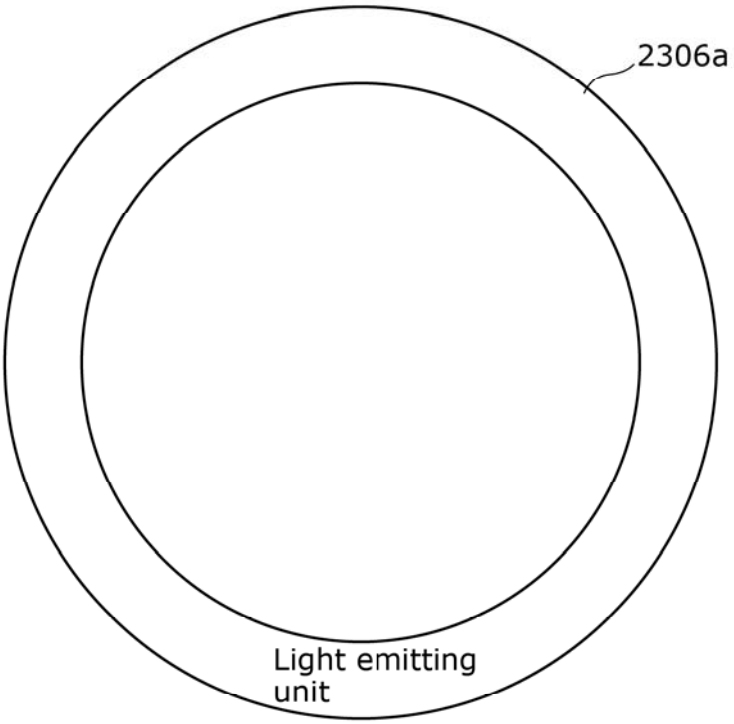


FIG. 112

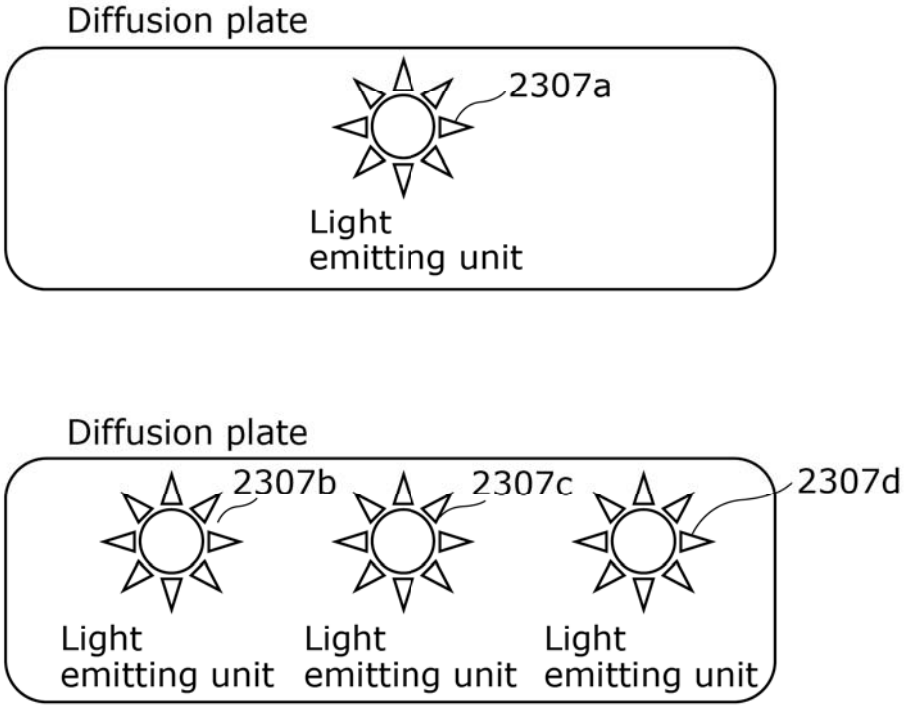

Diffusion plate
2307a
Light
emitting unit
Diffusion plate
2307b
2307c
2307d
Light
emitting unit
Light
emitting unit
Light
emitting unit

FIG. 113


Transmit signal A
2308a
2308b
Light emitting unit
Light emitting unit
Transmit signal B
2308c
2308d
Light emitting unit
Light emitting unit

FIG. 114

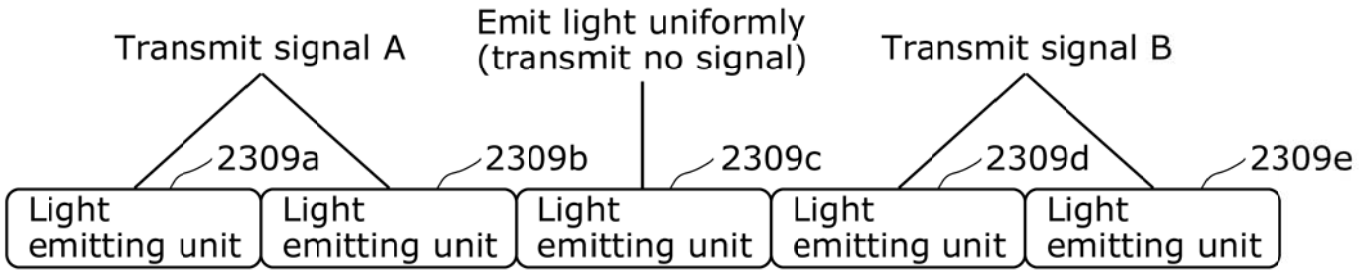

Transmit signal A
Emit light uniformly
(transmit no signal)
Transmit signal B
2309a
2309b
2309c
2309d
2309e
Light emitting unit
Light emitting unit
Light emitting unit
Light emitting unit
Light emitting unit

FIG. 115

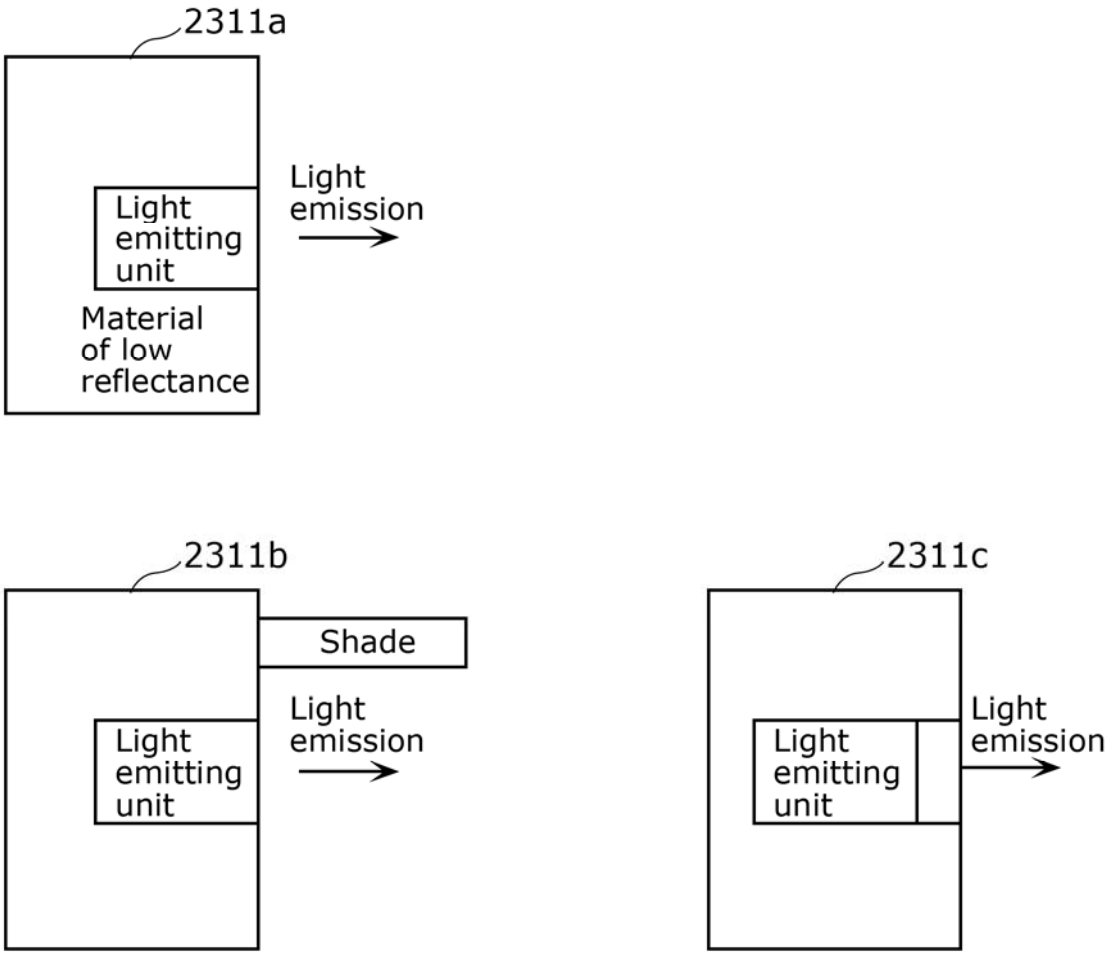

2311a
Light emitting unit
Material of low reflectance
Light emission
2311b
Shade
Light emitting unit
Light emission
2311c
Light emitting unit
Light emission

FIG. 116

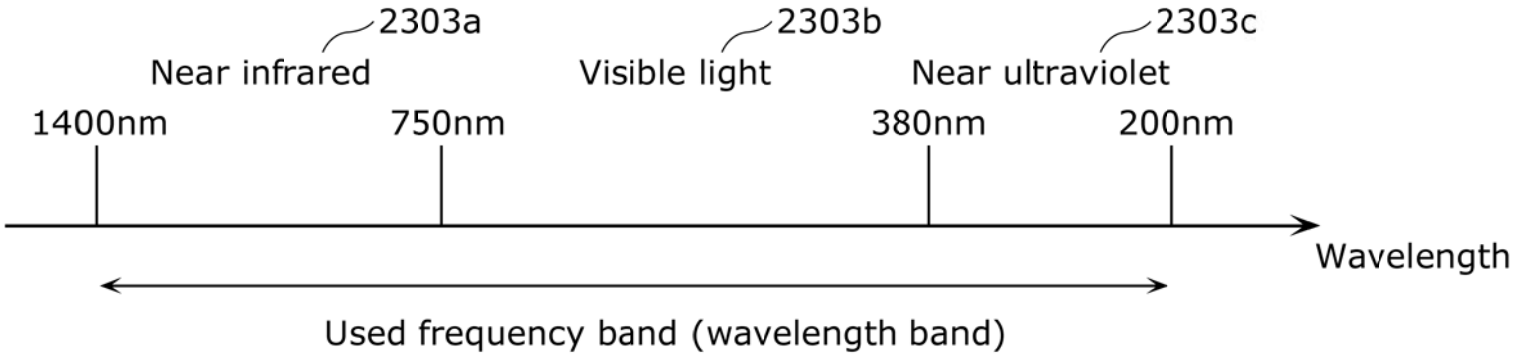

2303a
2303b
2303c
Near infrared
Visible light
Near ultraviolet
1400nm
750nm
380nm
200nm
Wavelength
Used frequency band (wavelength band)

FIG. 117

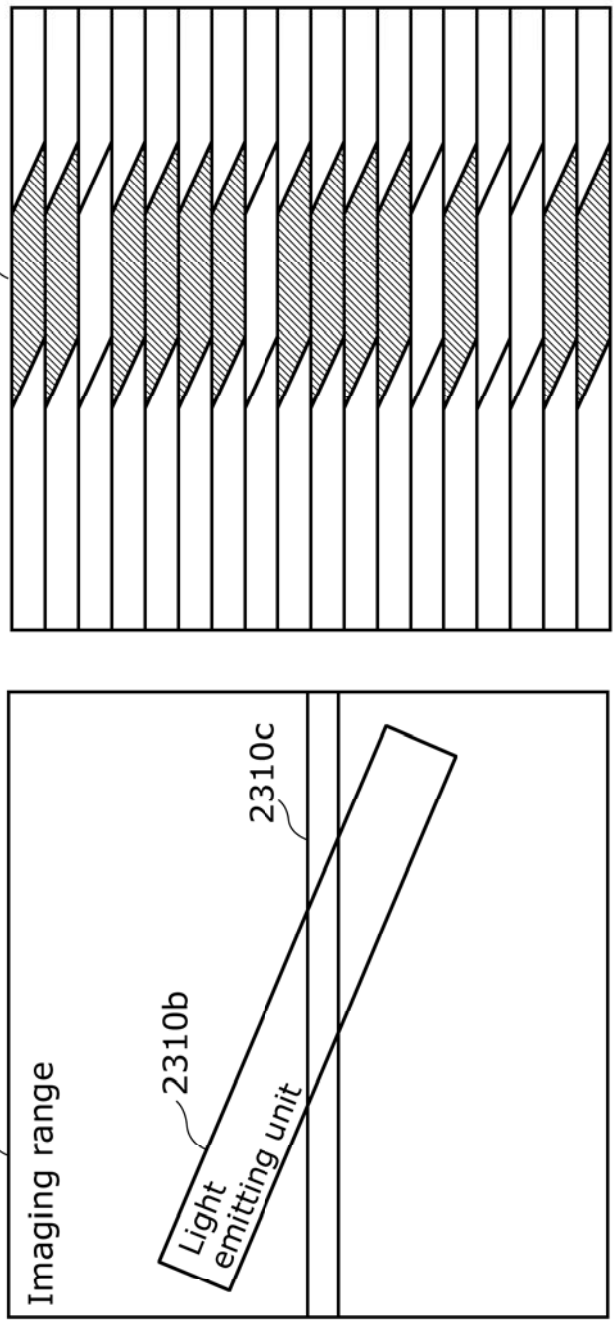


FIG. 118

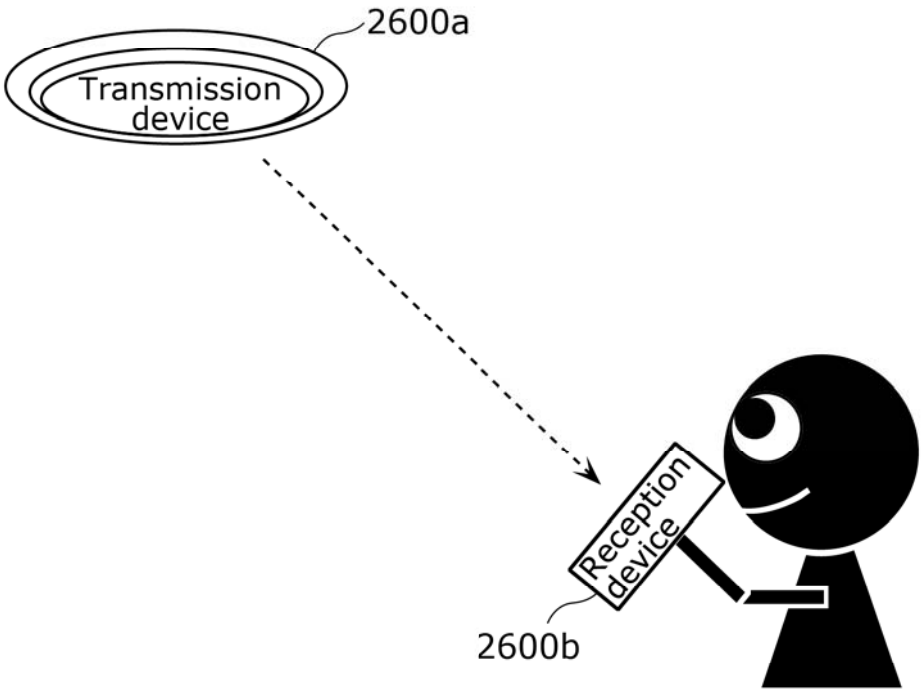


FIG. 119

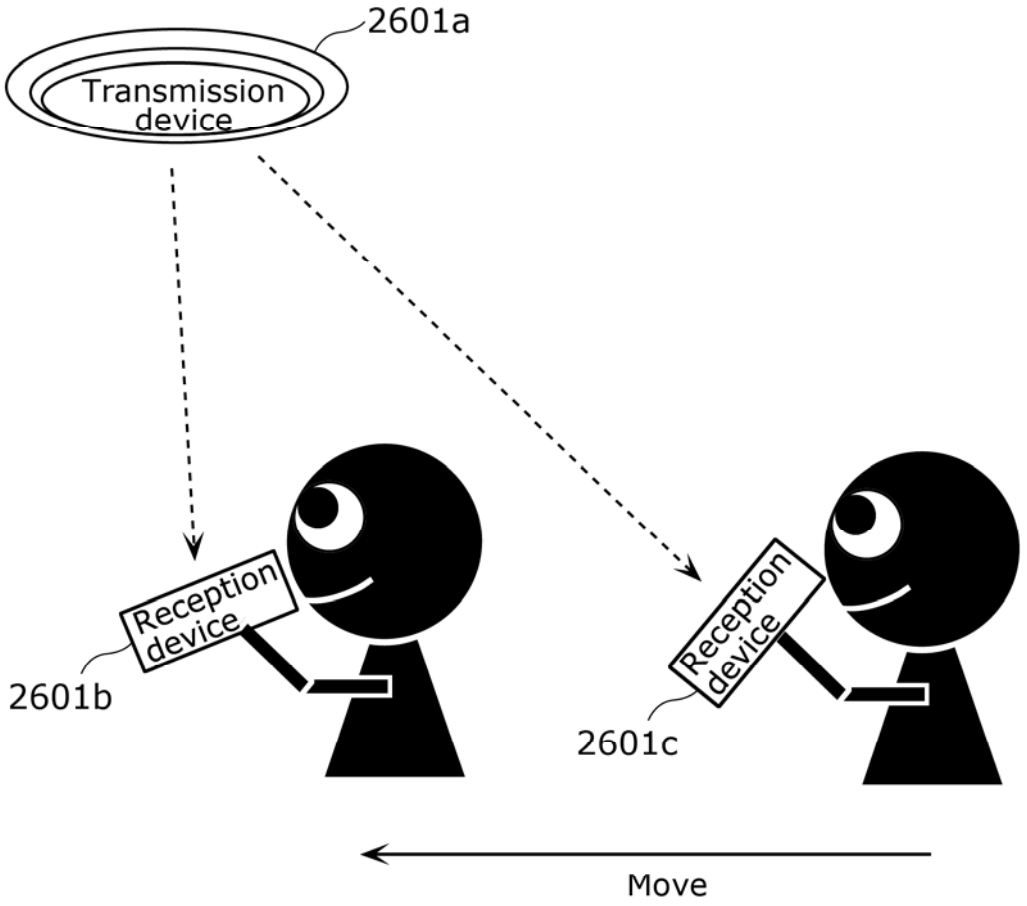

2601a
Transmission device
Reception device
2601b
Reception device
2601c
Move

FIG. 120

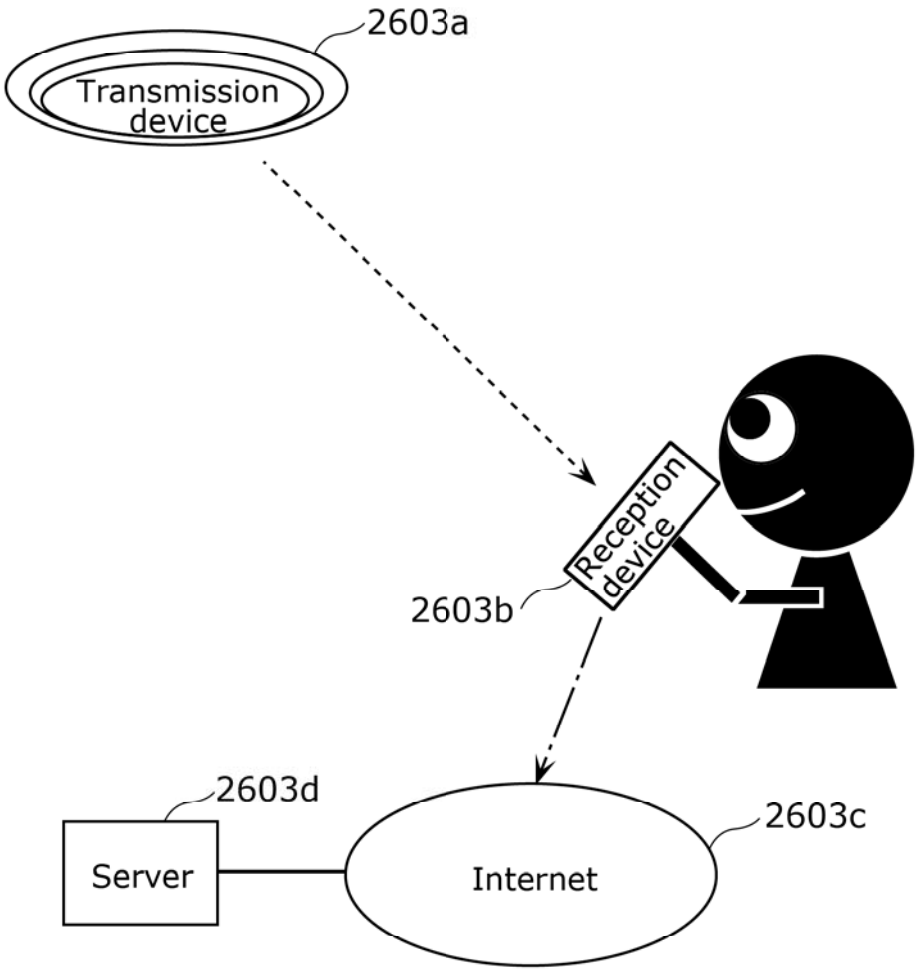

2603a
Transmission device
Reception device
2603b
2603d
Server
Internet
2603c

FIG. 121

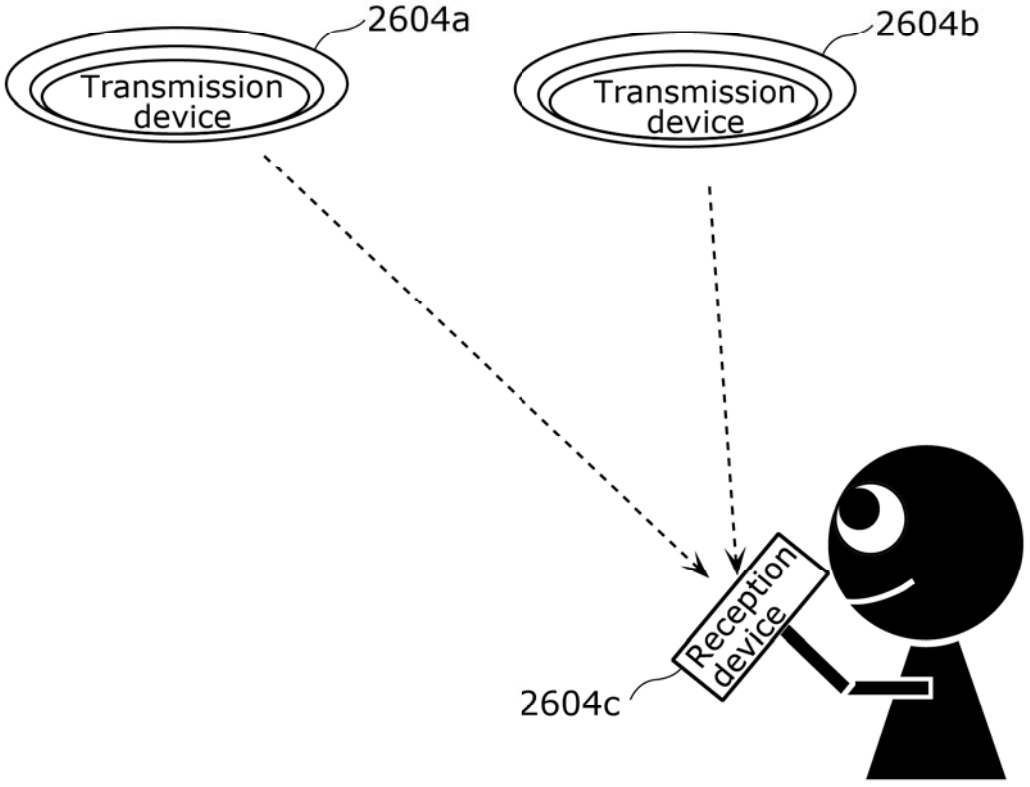

2604a
Transmission device
2604b
Transmission device
Reception device
2604c

FIG. 122

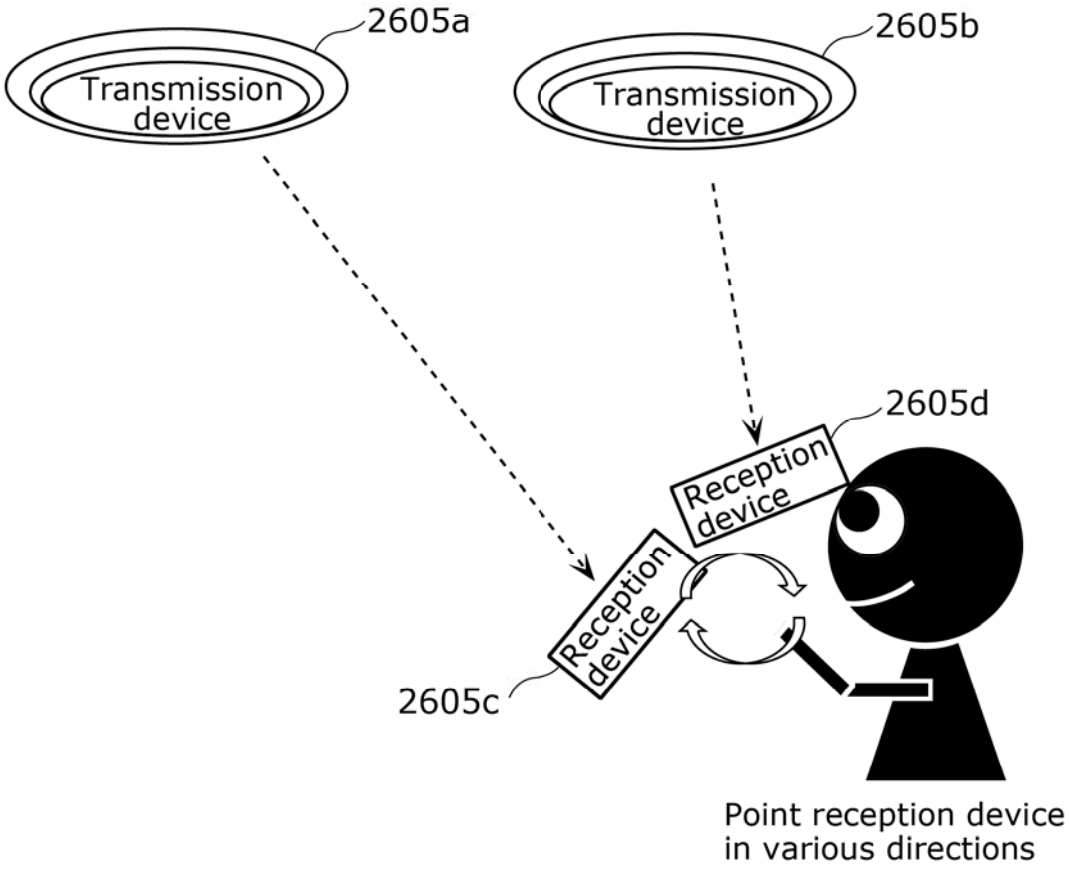

2605a
Transmission device
2605b
Transmission device
2605d
Reception device
Reception device
2605c
Point reception device in various directions

FIG. 123

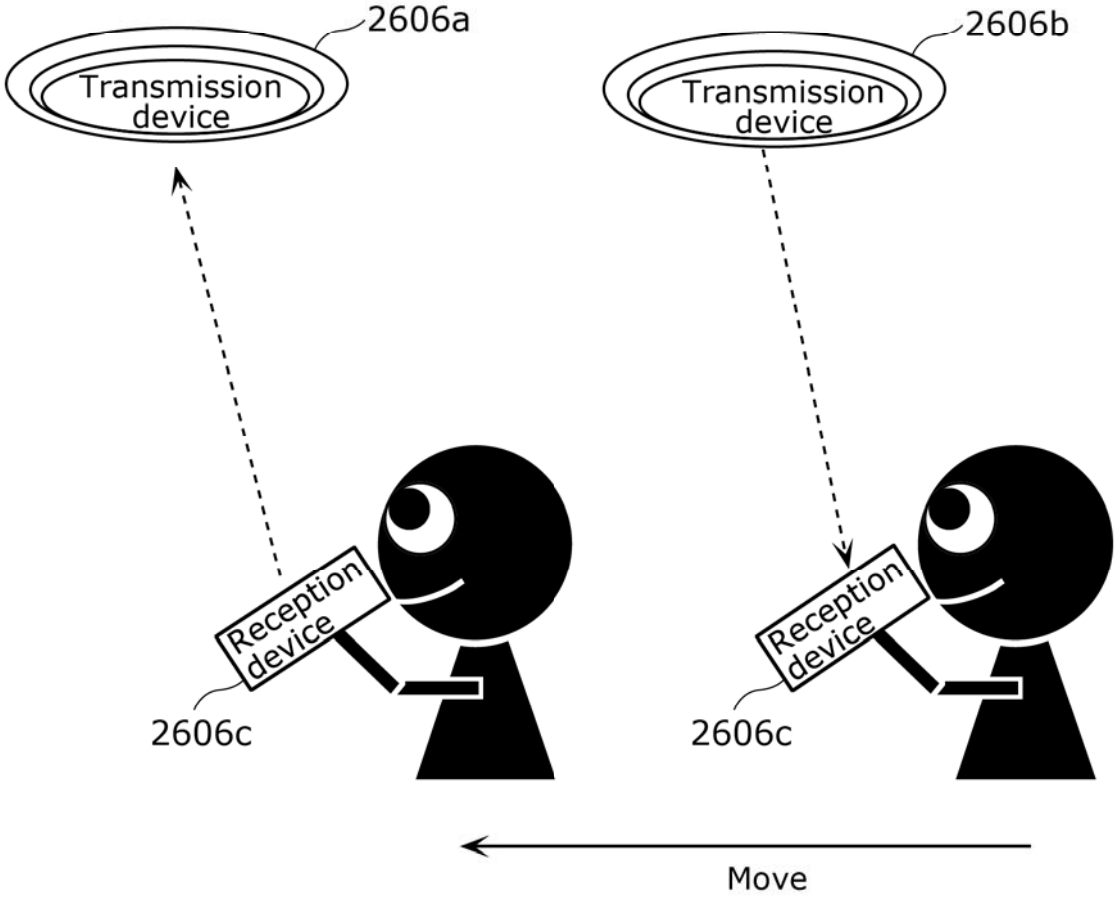

2606a
Transmission device
2606b
Transmission device
Reception device
2606c
Reception device
2606c
Move

FIG. 124

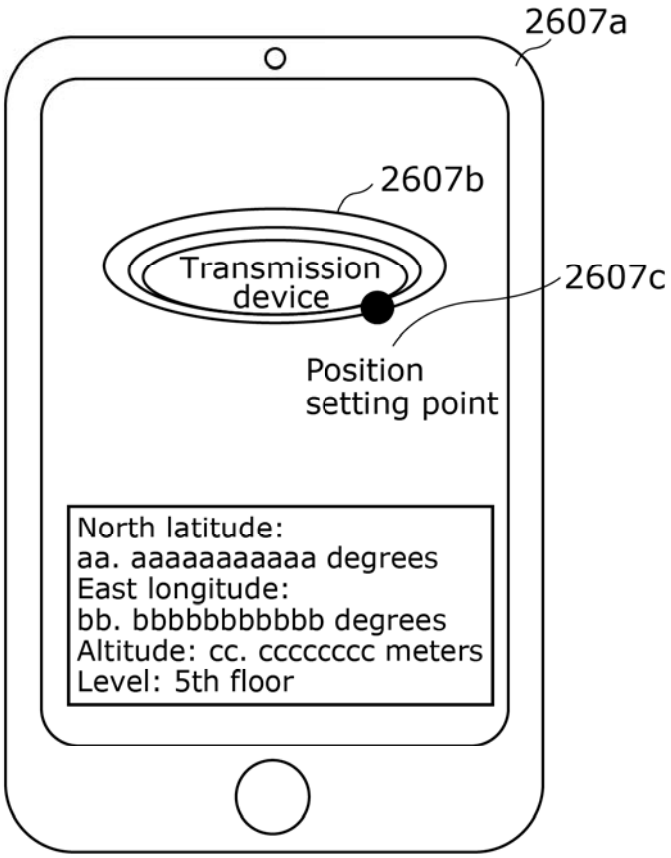

2607a
2607b
Transmission device
2607c
Position setting point
North latitude:
aa. aaaaaaaaaaa degrees
East longitude:
bb. bbbbbbbbbbb degrees
Altitude: cc. cccccccc meters
Level: 5th floor

FIG. 125

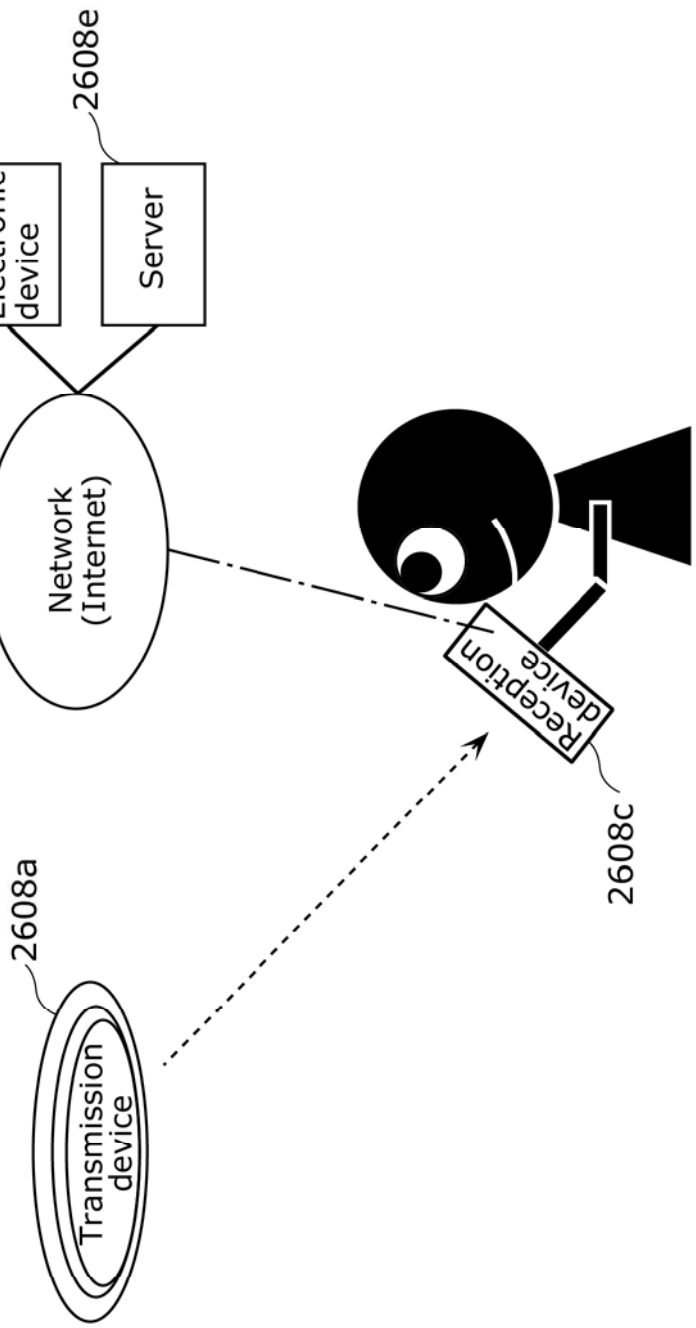

2608d
Electronic device
2608e
Server
2608b
Network (Internet)
2608a
Transmission device
Reception device
2608c

FIG. 126

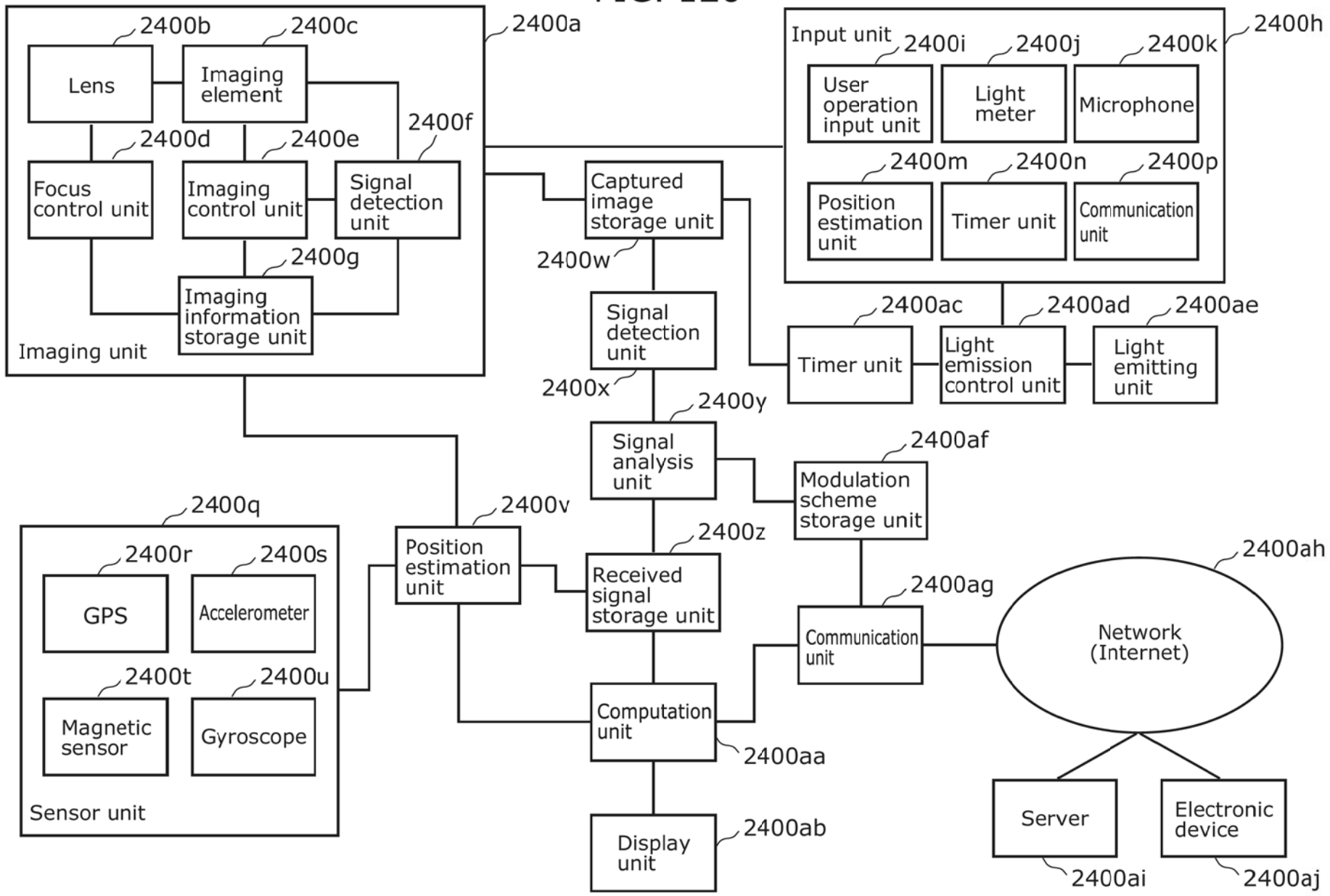

2400a
2400b
Lens
2400c
Imaging element
2400d
Focus control unit
2400e
Imaging control unit
2400f
Signal detection unit
2400g
Imaging information storage unit
Imaging unit
Input unit
2400h
2400i
User operation input unit
2400j
Light meter
2400k
Microphone
2400m
Position estimation unit
2400n
Timer unit
2400p
Communication unit
2400w
Captured image storage unit
2400x
Signal detection unit
2400y
Signal analysis unit
2400ac
Timer unit
2400ad
Light emission control unit
2400ae
Light emitting unit
2400af
Modulation scheme storage unit
2400q
2400r
GPS
2400s
Accelerometer
2400t
Magnetic sensor
2400u
Gyroscope
Sensor unit
2400v
Position estimation unit
2400z
Received signal storage unit
2400ag
Communication unit
2400ah
Network (Internet)
Computation unit
2400aa
Display unit
2400ab
Server
2400ai
Electronic device
2400aj

FIG. 127

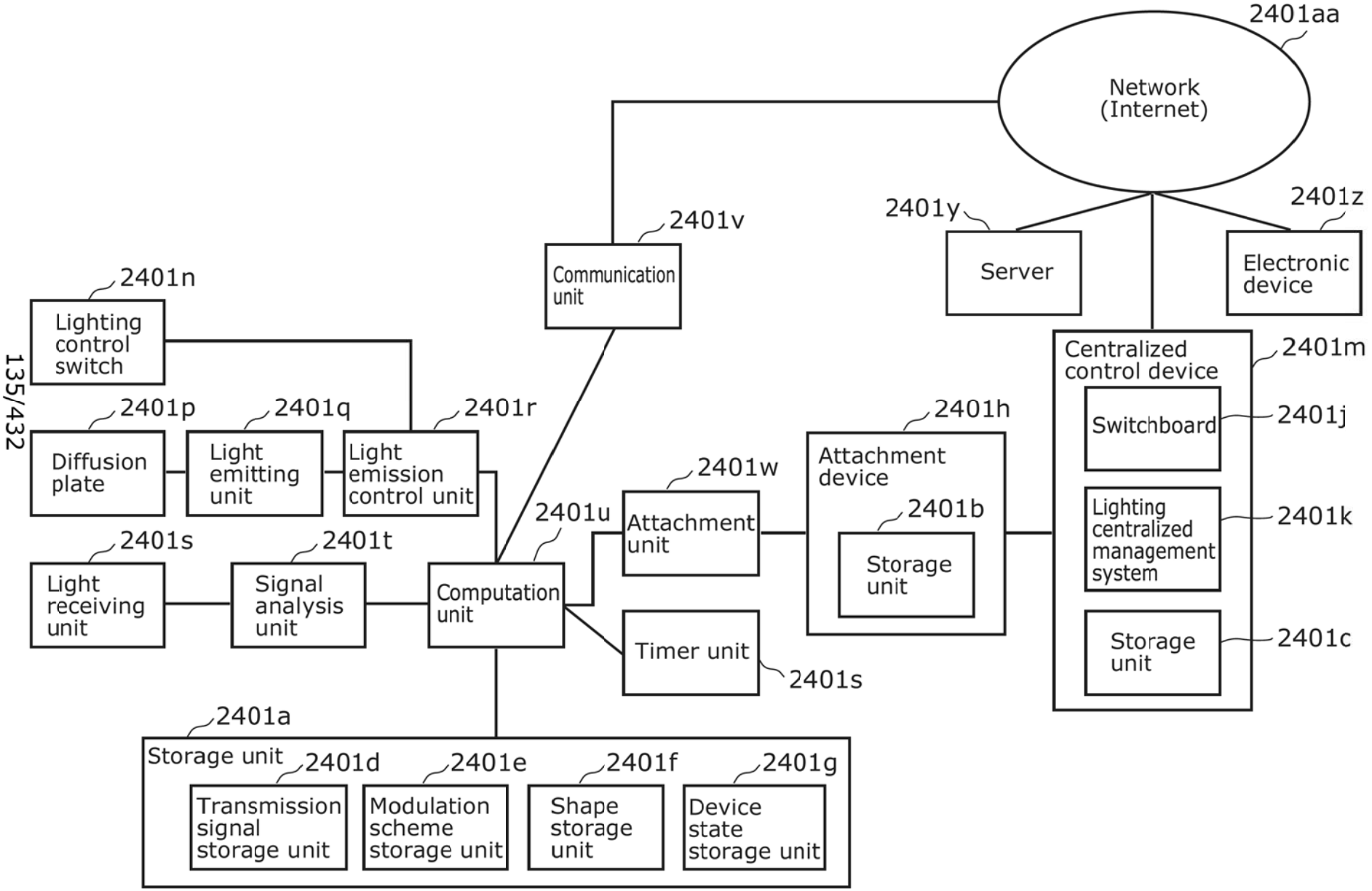

2401aa
Network (Internet)
2401y
Server
2401z
Electronic device
2401v
Communication unit
2401n
Lighting control switch
2401p
Diffusion plate
2401q
Light emitting unit
2401r
Light emission control unit
2401s
Light receiving unit
2401t
Signal analysis unit
2401u
Computation unit
2401w
Attachment unit
2401h
Attachment device
2401b
Storage unit
Timer unit
2401s
Centralized control device
2401m
Switchboard
2401j
Lighting centralized management system
2401k
Storage unit
2401c
2401a
Storage unit
2401d
Transmission signal storage unit
2401e
Modulation scheme storage unit
2401f
Shape storage unit
2401g
Device state storage unit

FIG. 128

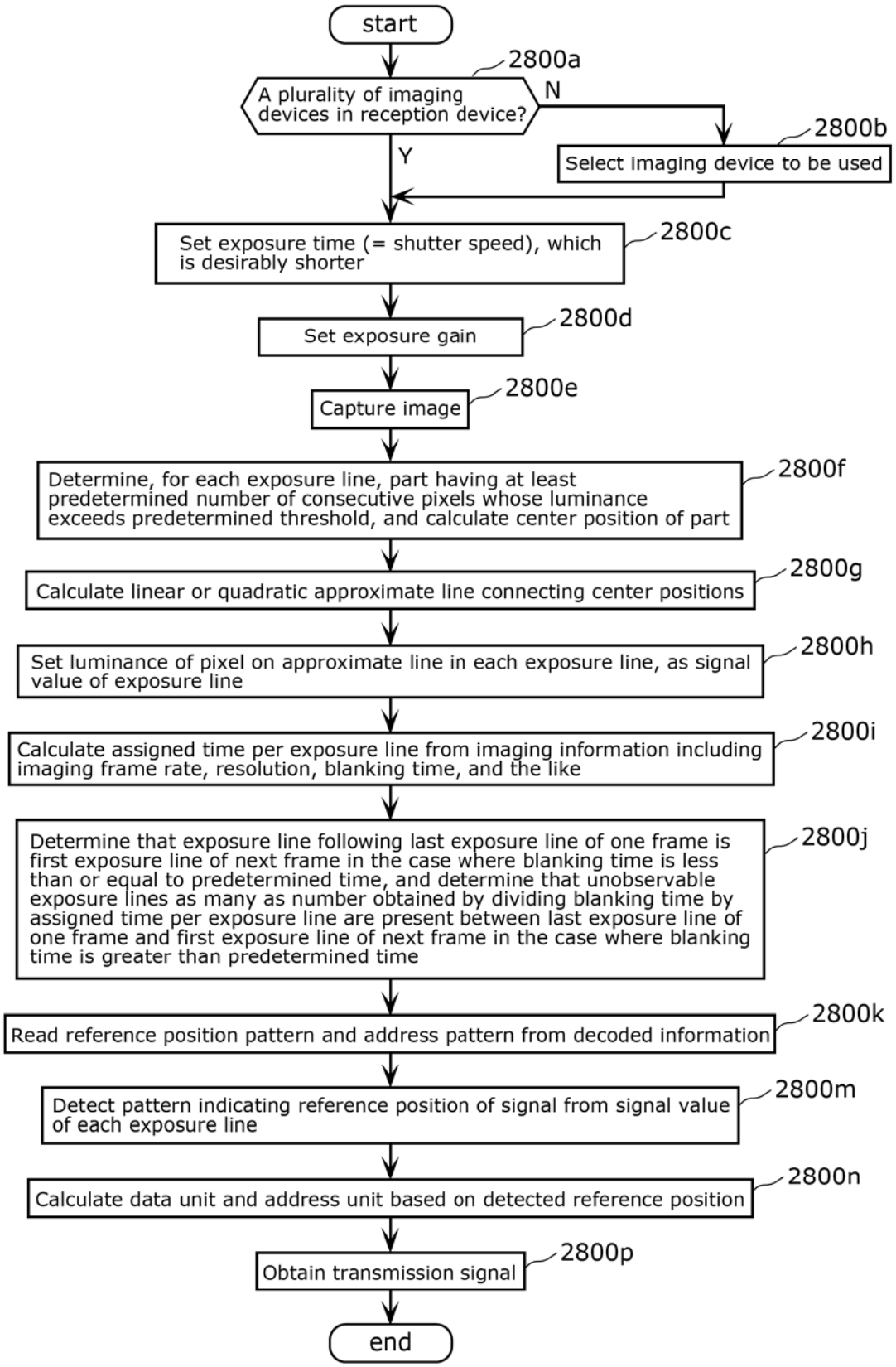

start
2800a
A plurality of imaging devices in reception device?
N
Y
2800b
Select imaging device to be used
Set exposure time (= shutter speed), which is desirably shorter
2800c
Set exposure gain
2800d
Capture image
2800e
Determine, for each exposure line, part having at least predetermined number of consecutive pixels whose luminance exceeds predetermined threshold, and calculate center position of part
2800f
Calculate linear or quadratic approximate line connecting center positions
2800g
Set luminance of pixel on approximate line in each exposure line, as signal value of exposure line
2800h
Calculate assigned time per exposure line from imaging information including imaging frame rate, resolution, blanking time, and the like
2800i
Determine that exposure line following last exposure line of one frame is first exposure line of next frame in the case where blanking time is less than or equal to predetermined time, and determine that unobservable exposure lines as many as number obtained by dividing blanking time by assigned time per exposure line are present between last exposure line of one frame and first exposure line of next frame in the case where blanking time is greater than predetermined time
2800j
Read reference position pattern and address pattern from decoded information
2800k
Detect pattern indicating reference position of signal from signal value of each exposure line
2800m
Calculate data unit and address unit based on detected reference position
2800n
Obtain transmission signal
2800p
end

FIG. 129

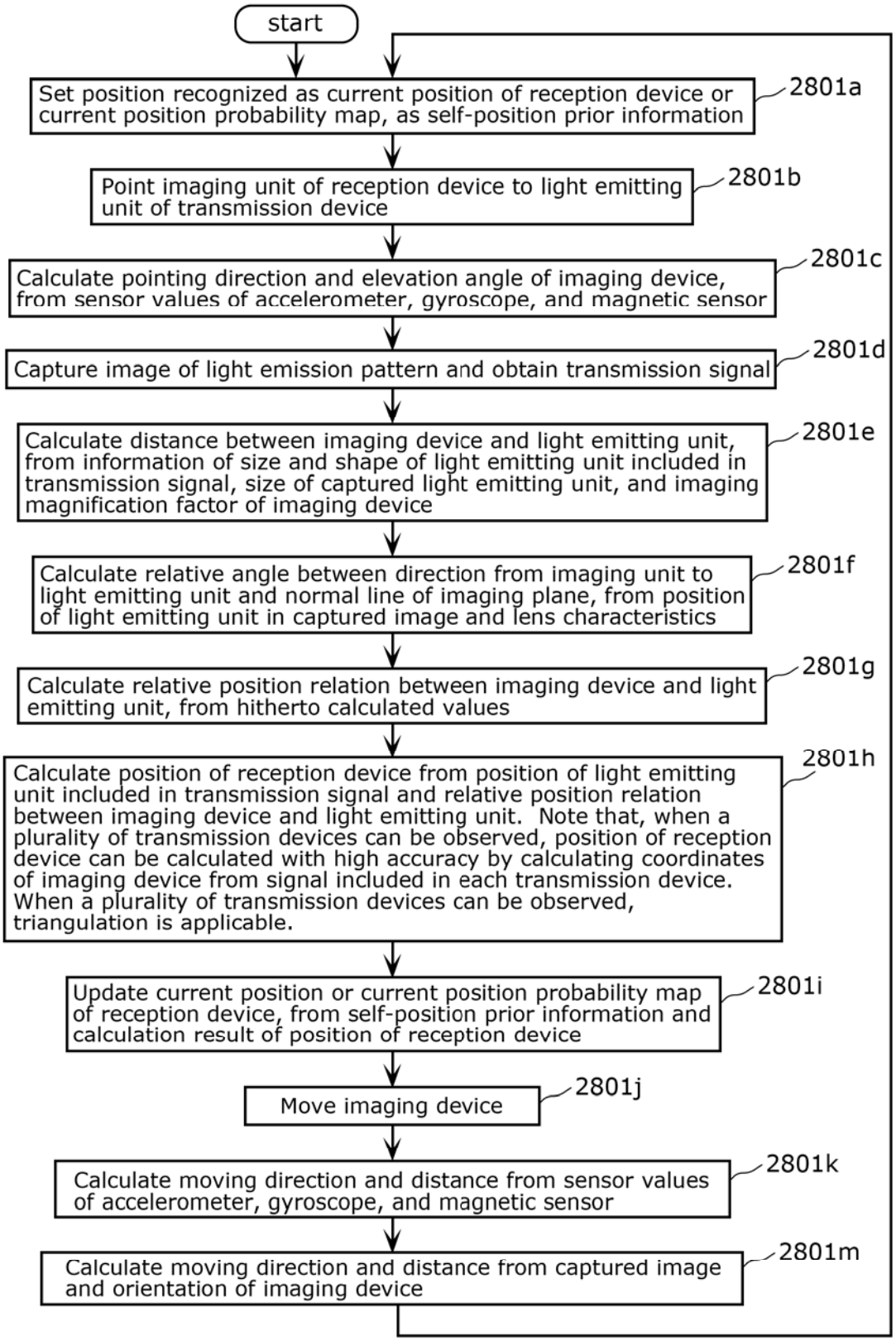

start
Set position recognized as current position of reception device or current position probability map, as self-position prior information
2801a
Point imaging unit of reception device to light emitting unit of transmission device
2801b
Calculate pointing direction and elevation angle of imaging device, from sensor values of accelerometer, gyroscope, and magnetic sensor
2801c
Capture image of light emission pattern and obtain transmission signal
2801d
Calculate distance between imaging device and light emitting unit, from information of size and shape of light emitting unit included in transmission signal, size of captured light emitting unit, and imaging magnification factor of imaging device
2801e
Calculate relative angle between direction from imaging unit to light emitting unit and normal line of imaging plane, from position of light emitting unit in captured image and lens characteristics
2801f
Calculate relative position relation between imaging device and light emitting unit, from hitherto calculated values
2801g
Calculate position of reception device from position of light emitting unit included in transmission signal and relative position relation between imaging device and light emitting unit. Note that, when a plurality of transmission devices can be observed, position of reception device can be calculated with high accuracy by calculating coordinates of imaging device from signal included in each transmission device. When a plurality of transmission devices can be observed, triangulation is applicable.
2801h
Update current position or current position probability map of reception device, from self-position prior information and calculation result of position of reception device
2801i
Move imaging device
2801j
Calculate moving direction and distance from sensor values of accelerometer, gyroscope, and magnetic sensor
2801k
Calculate moving direction and distance from captured image and orientation of imaging device
2801m

FIG. 130

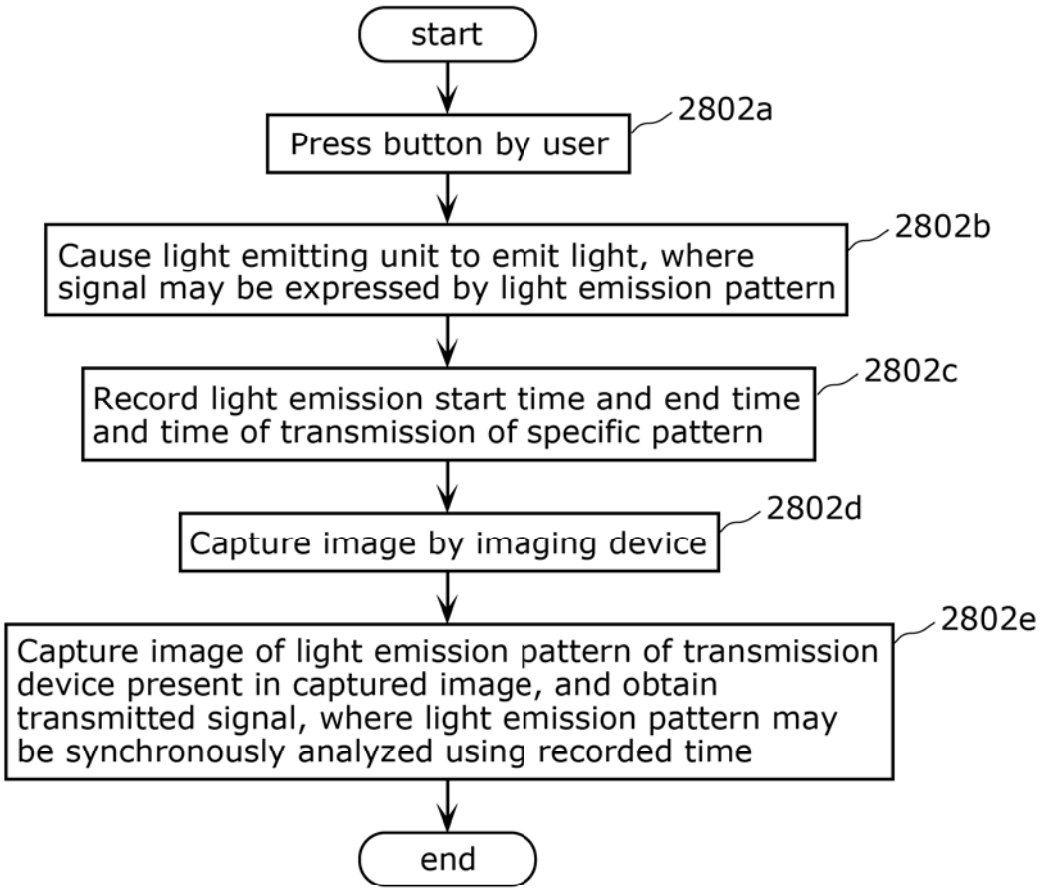

start
Press button by user
2802a
Cause light emitting unit to emit light, where signal may be expressed by light emission pattern
2802b
Record light emission start time and end time and time of transmission of specific pattern
2802c
Capture image by imaging device
2802d
Capture image of light emission pattern of transmission device present in captured image, and obtain transmitted signal, where light emission pattern may be synchronously analyzed using recorded time
2802e
end

FIG. 131

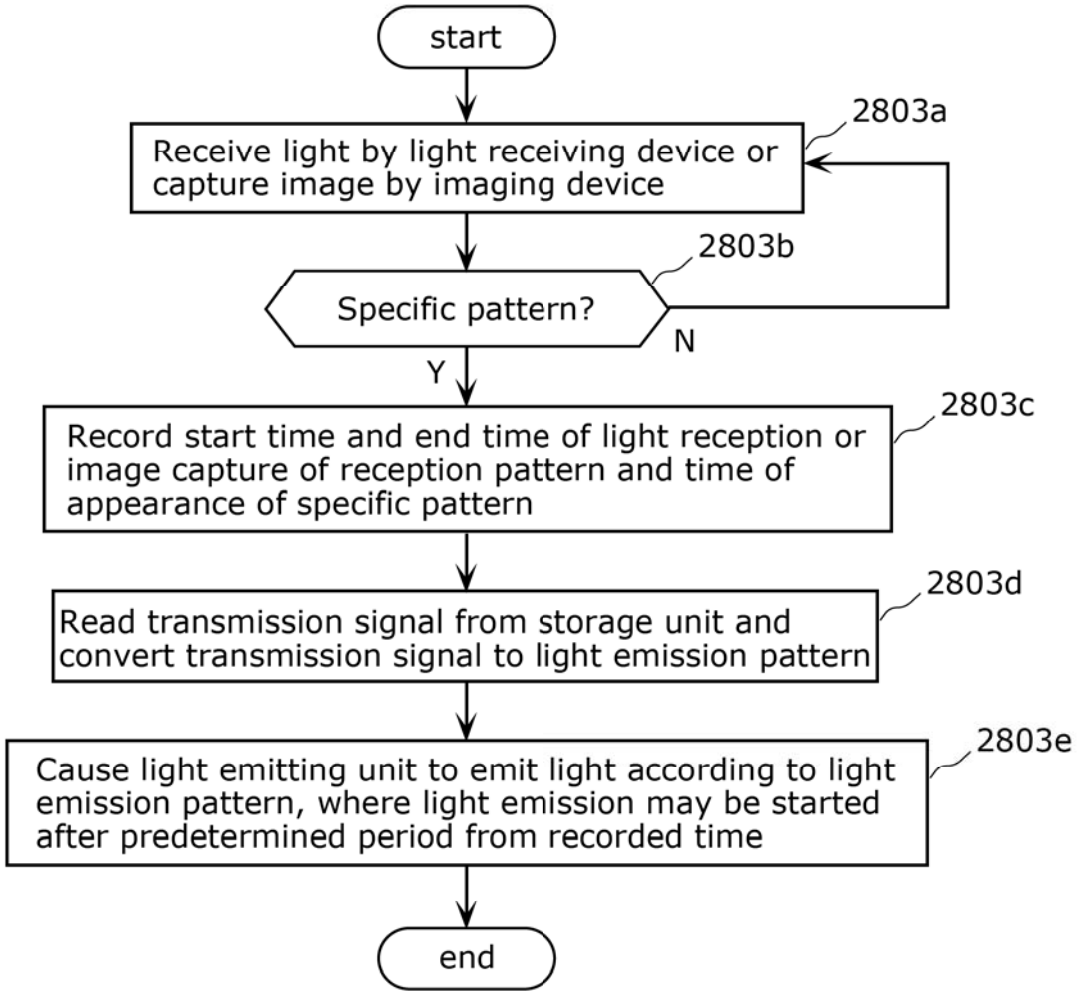

start
2803a
Receive light by light receiving device or capture image by imaging device
2803b
Specific pattern?
N
Y
2803c
Record start time and end time of light reception or image capture of reception pattern and time of appearance of specific pattern
2803d
Read transmission signal from storage unit and convert transmission signal to light emission pattern
2803e
Cause light emitting unit to emit light according to light emission pattern, where light emission may be started after predetermined period from recorded time
end

FIG. 132

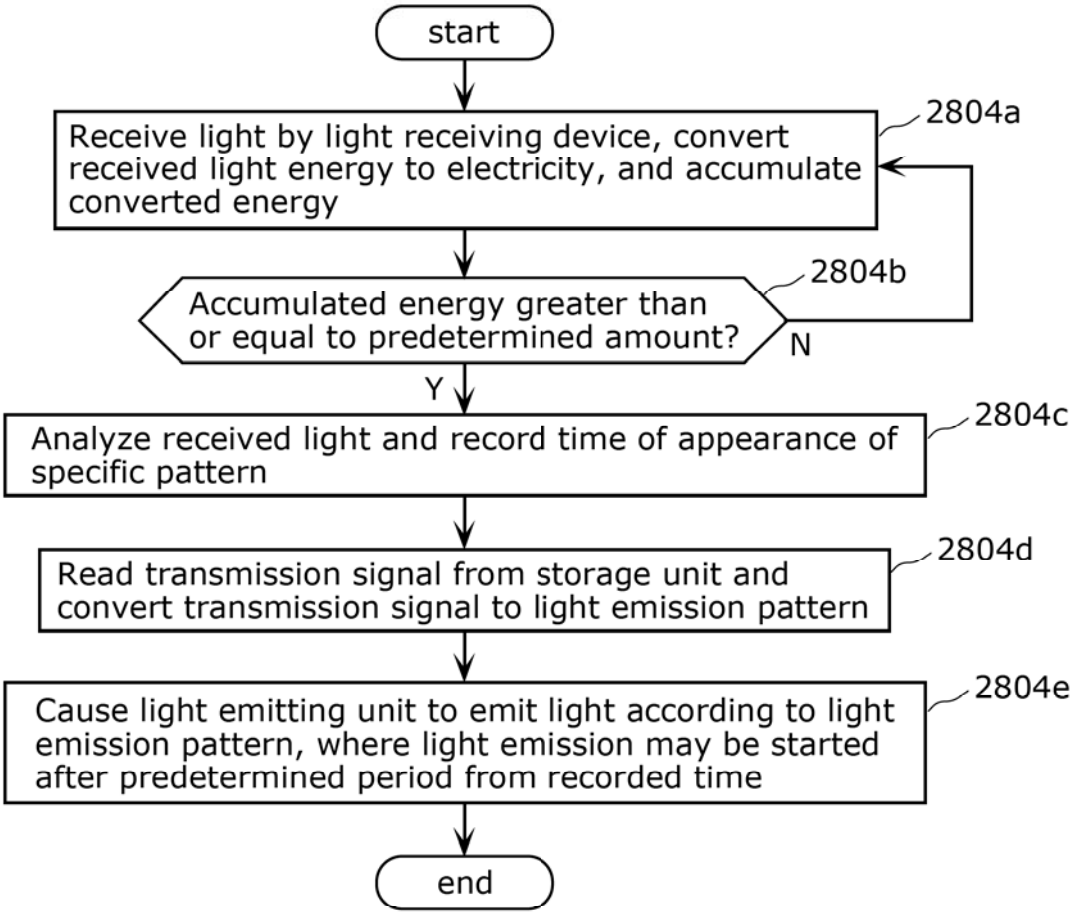

start
Receive light by light receiving device, convert received light energy to electricity, and accumulate converted energy
2804a
Accumulated energy greater than or equal to predetermined amount?
2804b
N
Y
Analyze received light and record time of appearance of specific pattern
2804c
Read transmission signal from storage unit and convert transmission signal to light emission pattern
2804d
Cause light emitting unit to emit light according to light emission pattern, where light emission may be started after predetermined period from recorded time
2804e
end

FIG. 133

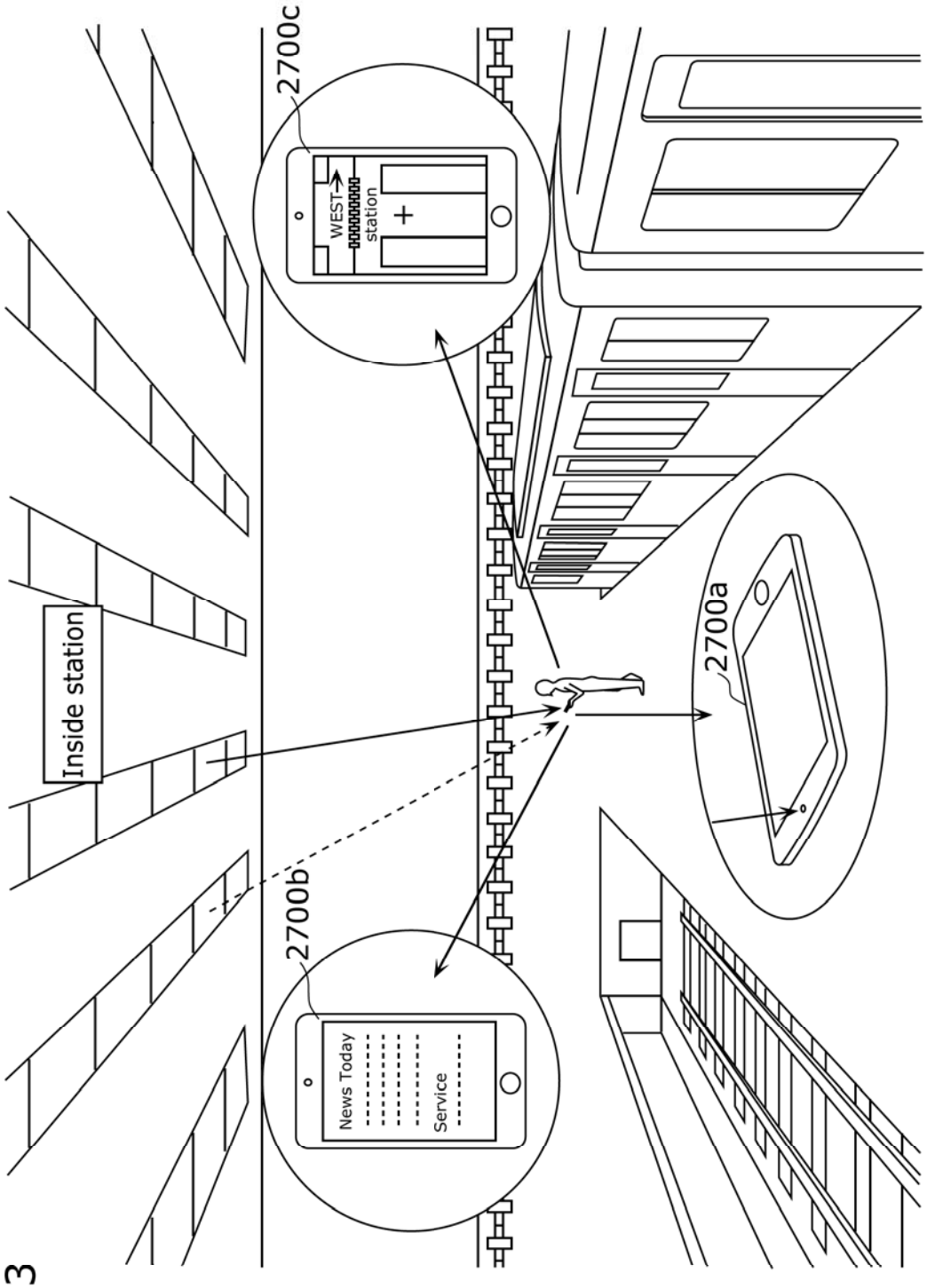

Inside station
2700c
WEST
station
2700b
News Today
Service
2700a

FIG. 134

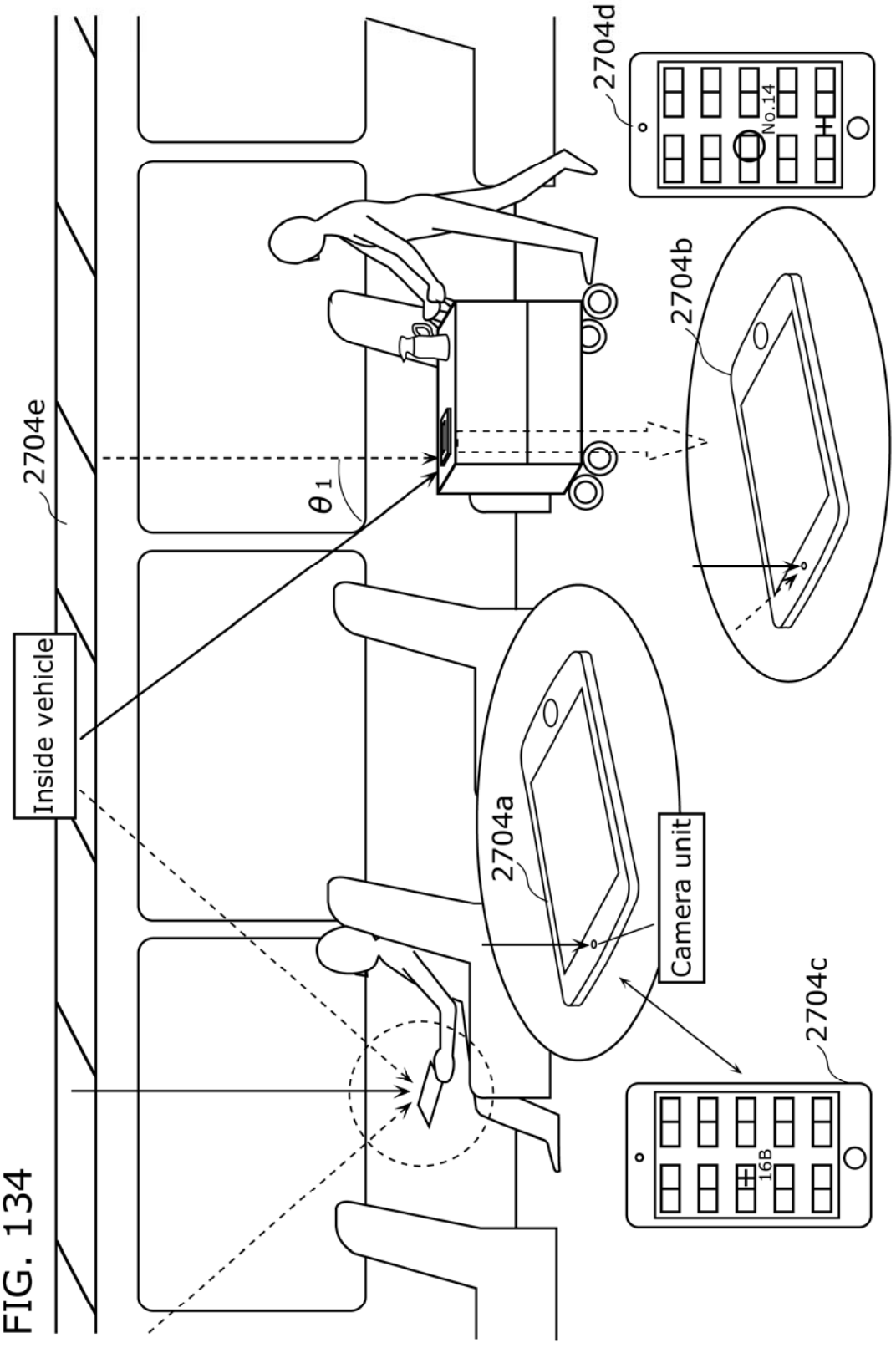

2704e
Inside vehicle
θ_1
2704d
No.14
2704b
2704a
Camera unit
2704c
16B

FIG. 135

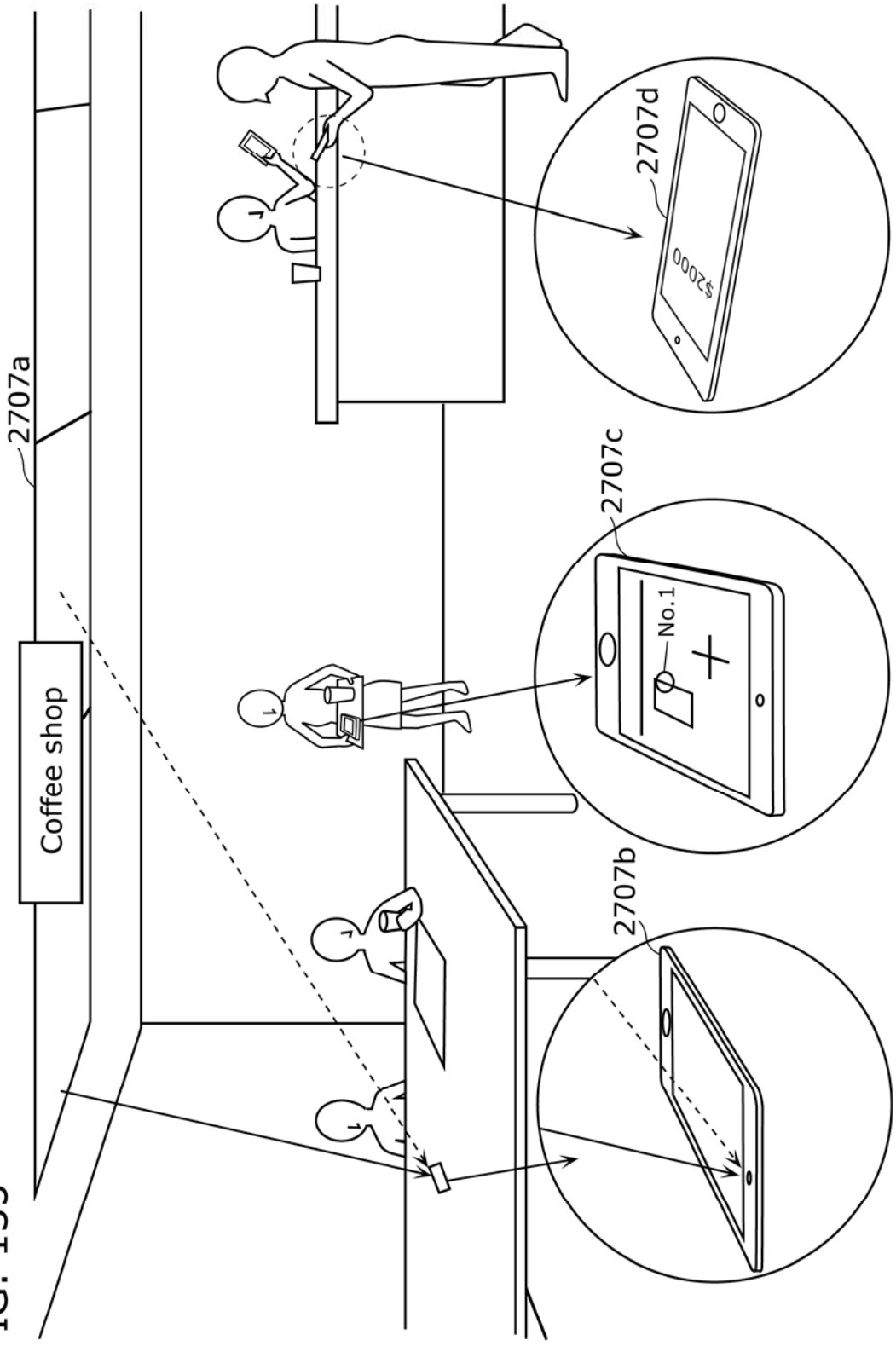


FIG. 136

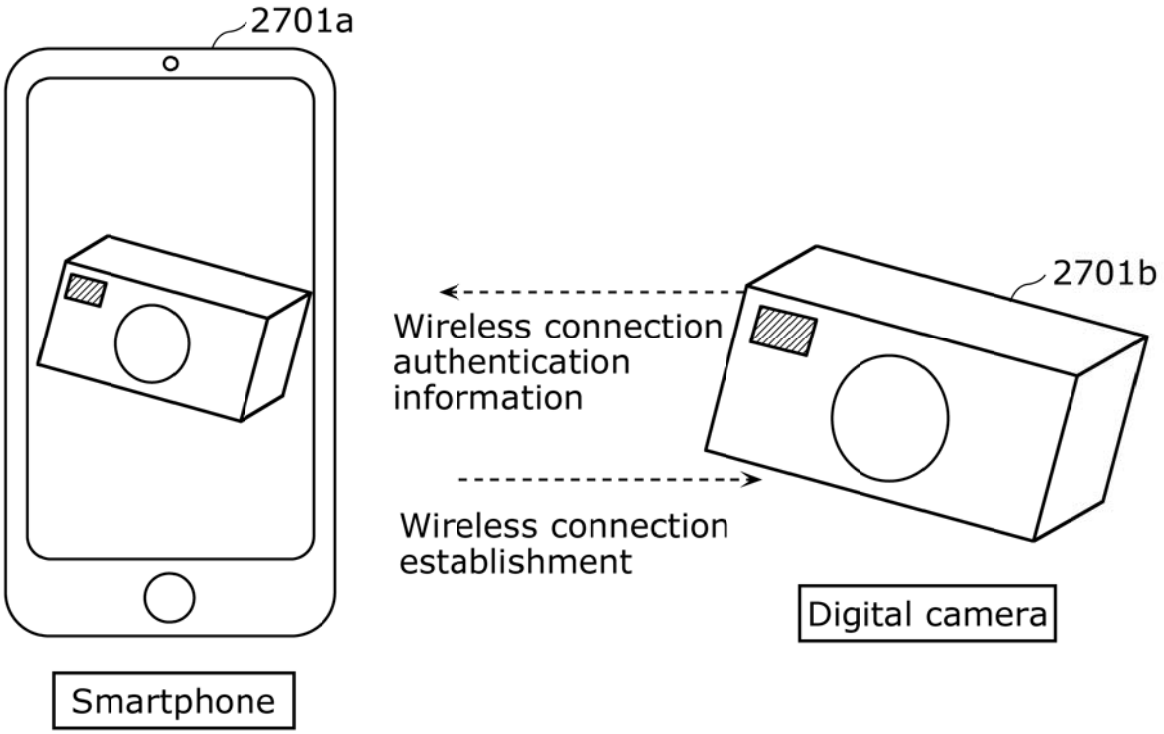

2701a
2701b
Wireless connection authentication information
Wireless connection establishment
Smartphone
Digital camera

FIG. 137

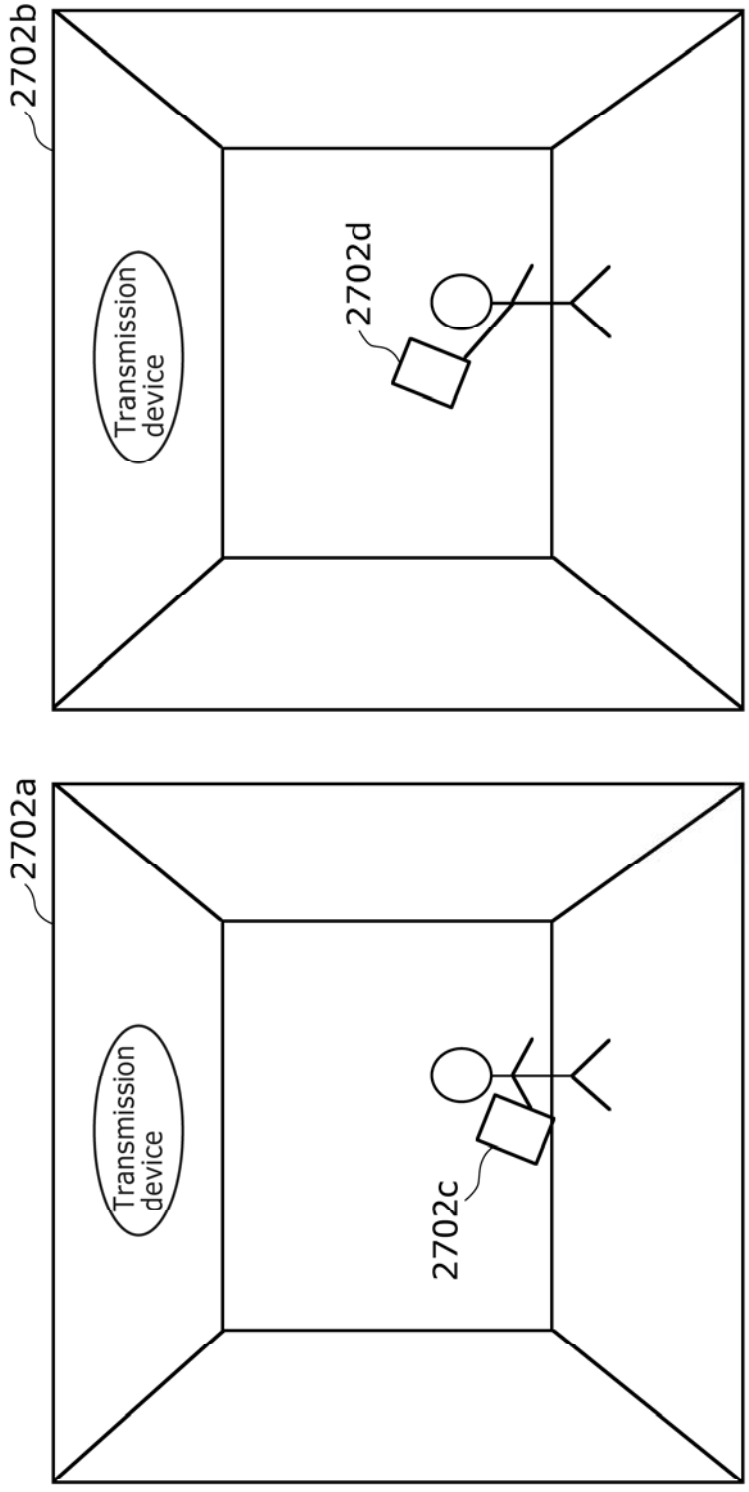
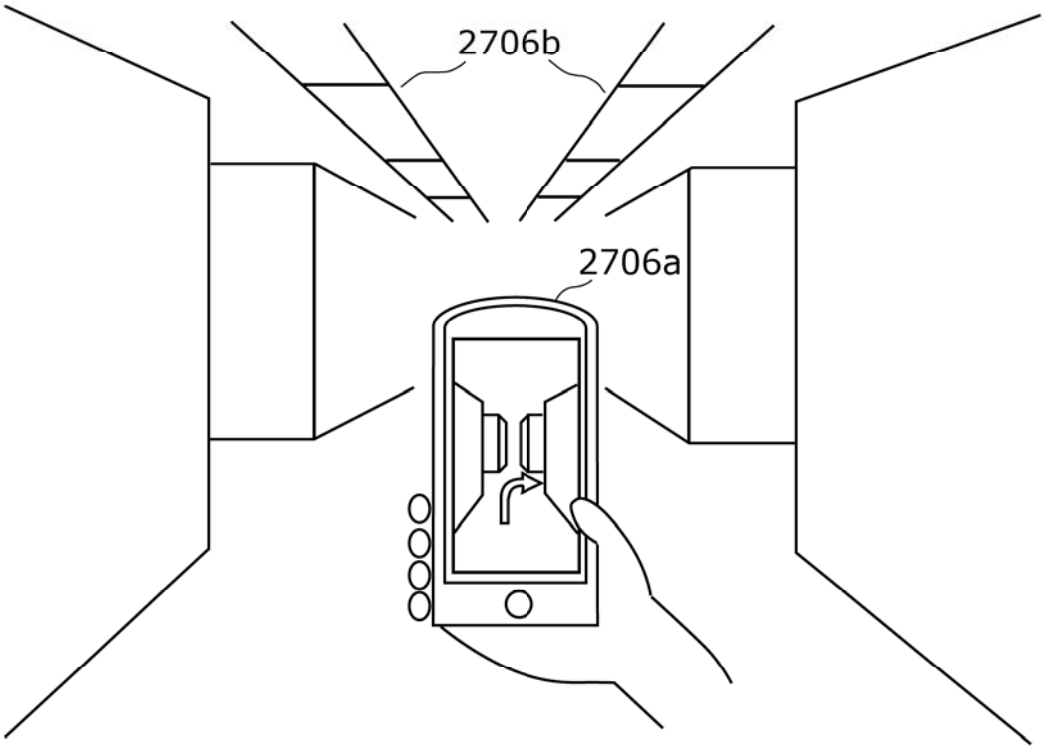

2702b
Transmission device
2702d
2702a
Transmission device
2702c

FIG. 138



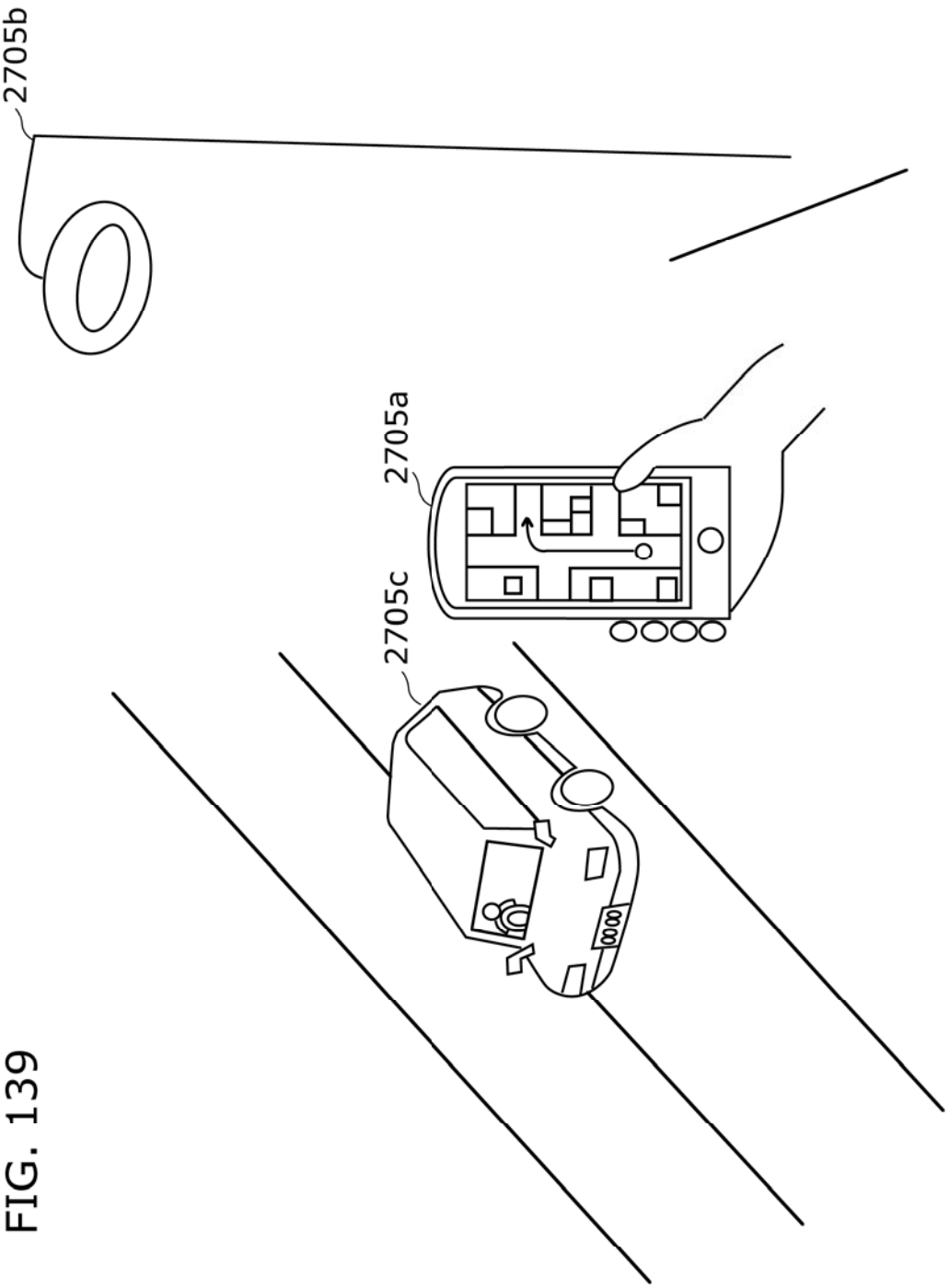


FIG. 139

FIG. 140

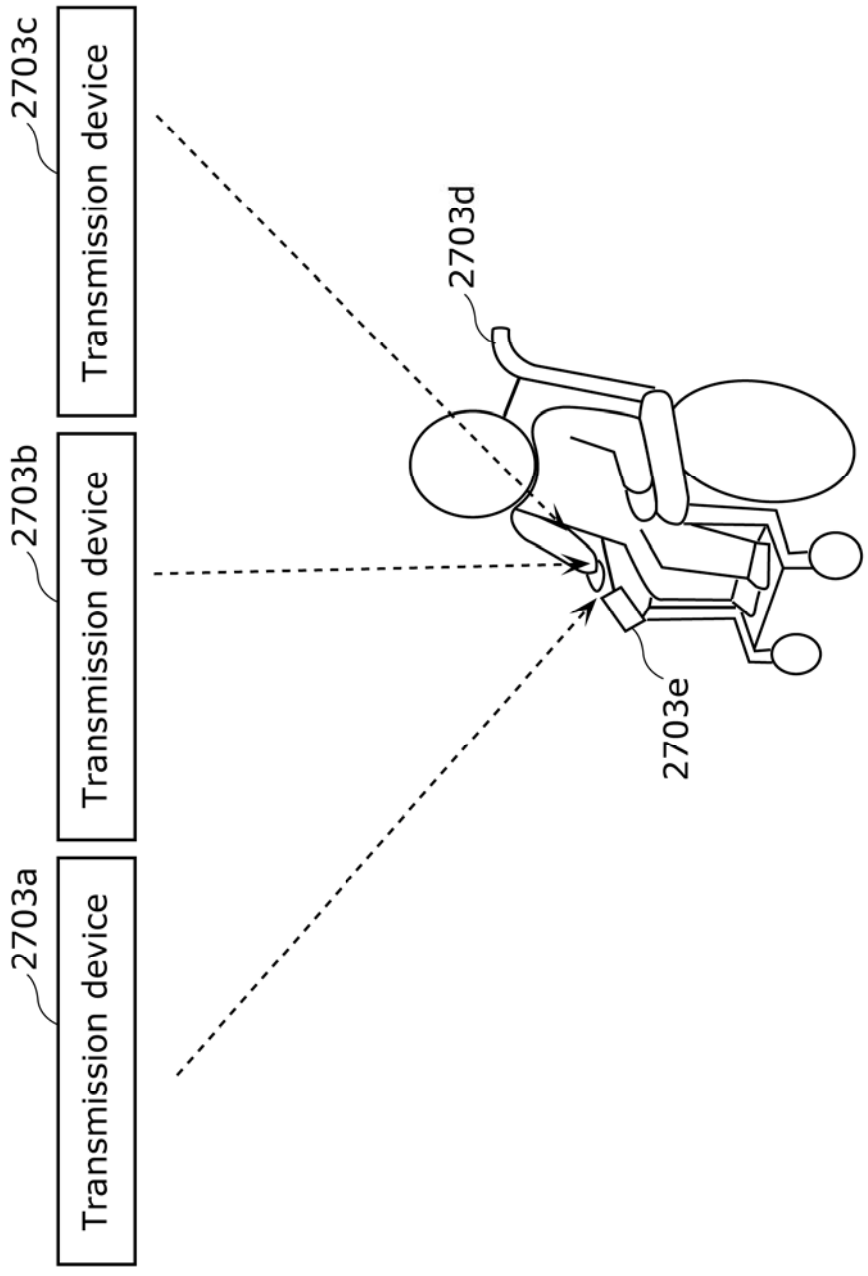

2703a
Transmission device
2703b
Transmission device
2703c
Transmission device
2703d
2703e

FIG. 141

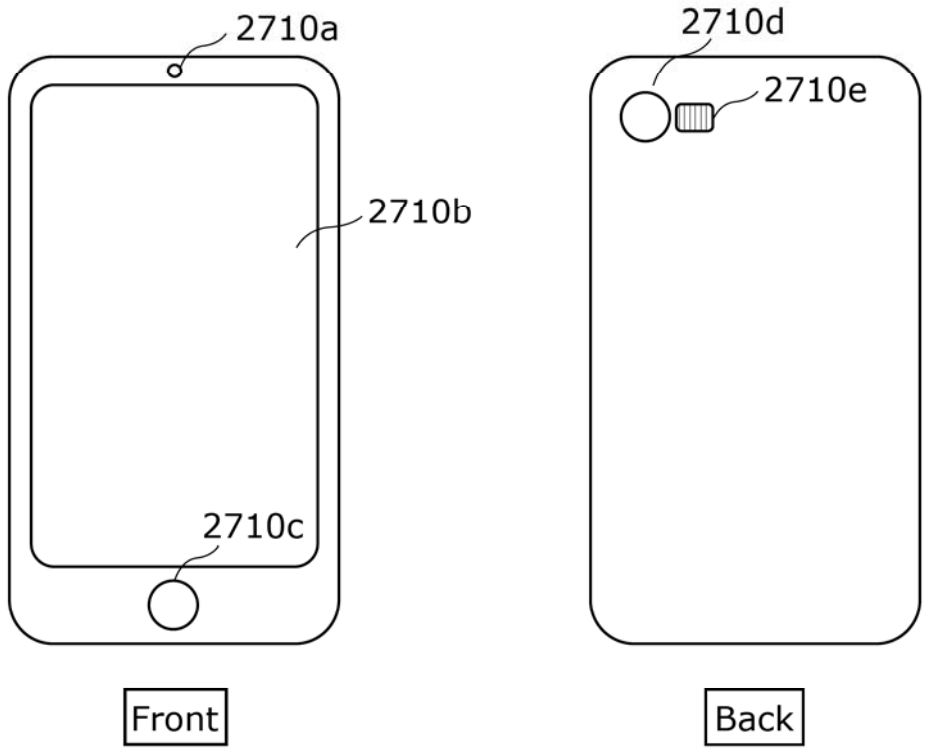


FIG. 142

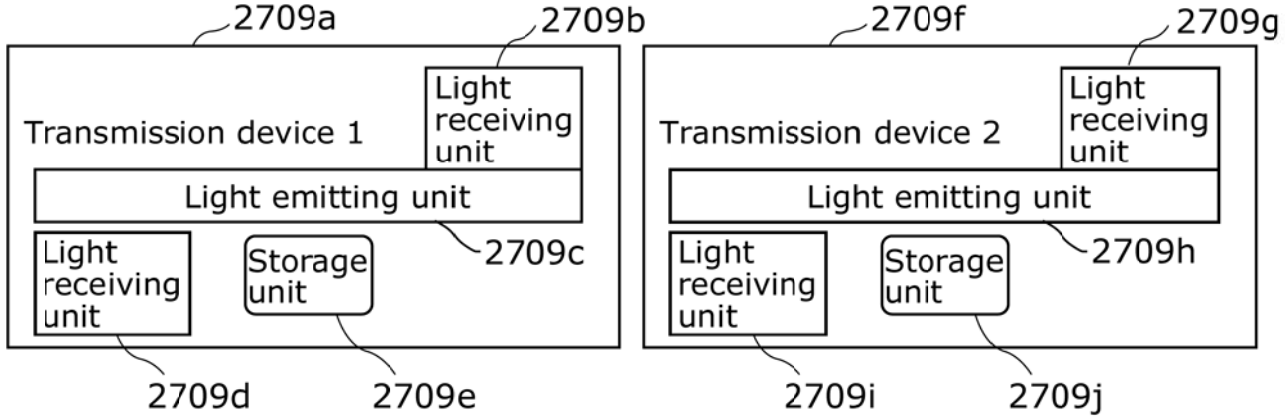

2709a
2709b
2709f
2709g
Transmission device 1
Light receiving unit
Light emitting unit
2709c
Light receiving unit
Storage unit
2709d
2709e
Transmission device 2
Light receiving unit
Light emitting unit
2709h
Light receiving unit
Storage unit
2709i
2709j

FIG. 143

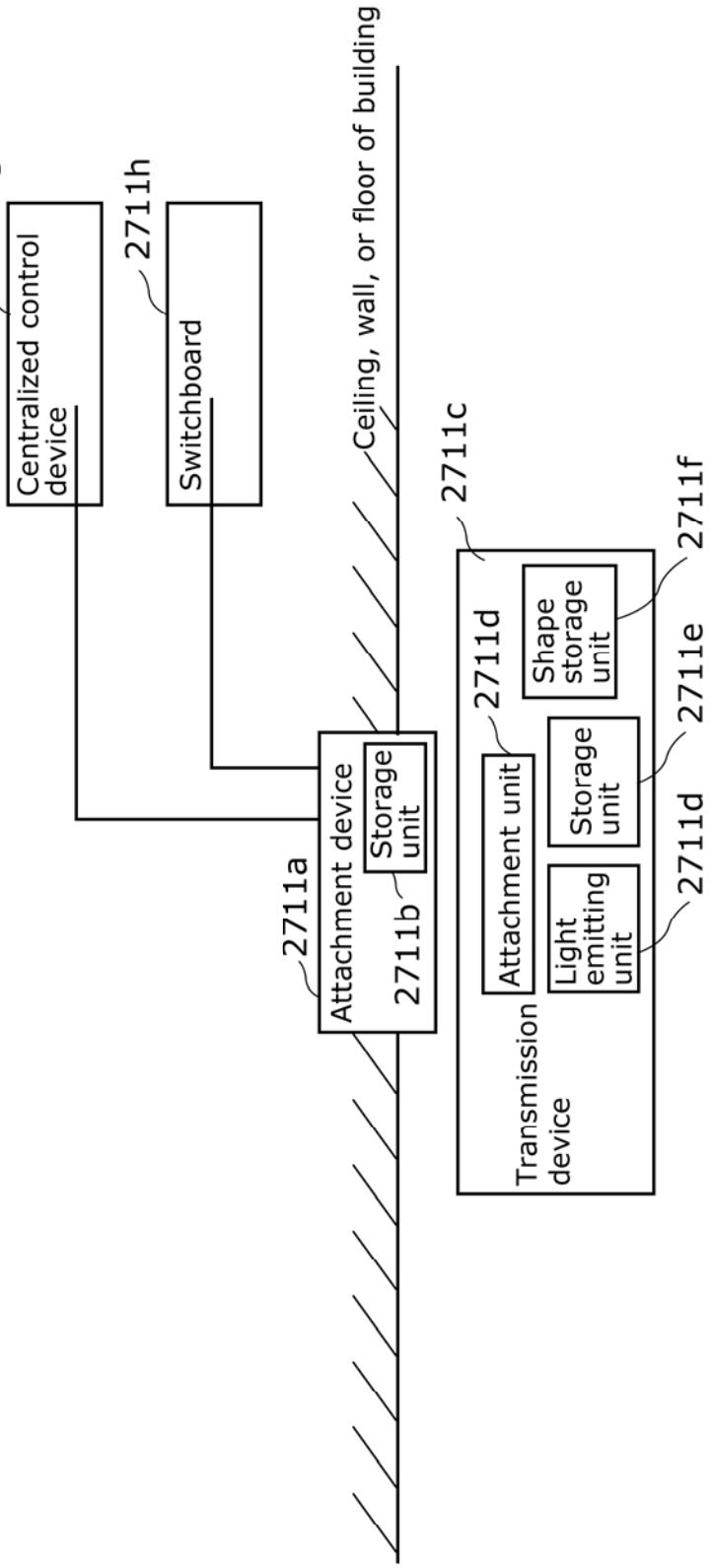

2711g
Centralized control device
2711h
Switchboard
Ceiling, wall, or floor of building
2711c
2711a
Attachment device
Storage unit
2711b
2711d
Attachment unit
Transmission device
Light emitting unit
Storage unit
2711e
Shape storage unit
2711f
2711d

FIG. 144

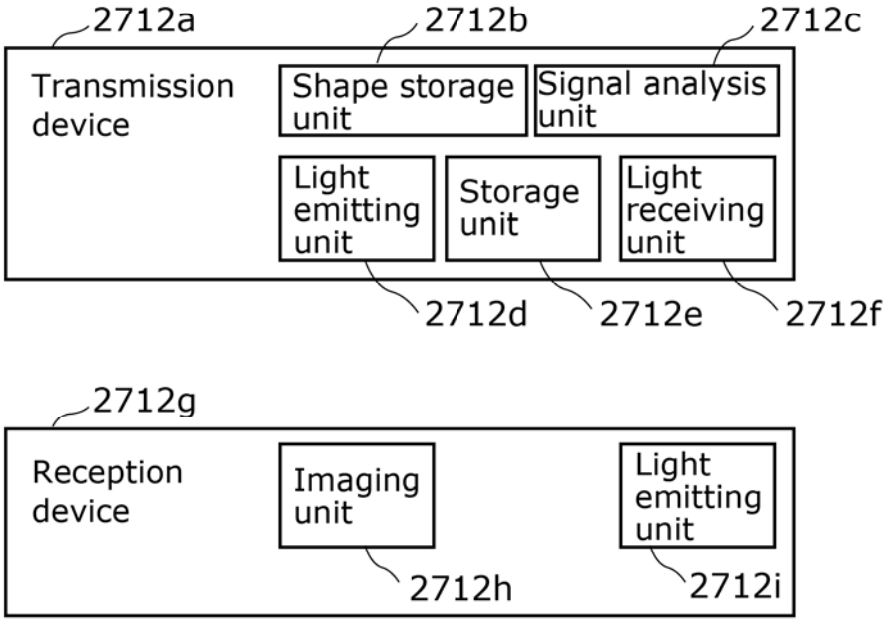

2712a
2712b
2712c
Transmission device
Shape storage unit
Signal analysis unit
Light emitting unit
Storage unit
Light receiving unit
2712d
2712e
2712f
2712g
Reception device
Imaging unit
Light emitting unit
2712h
2712i

FIG. 145

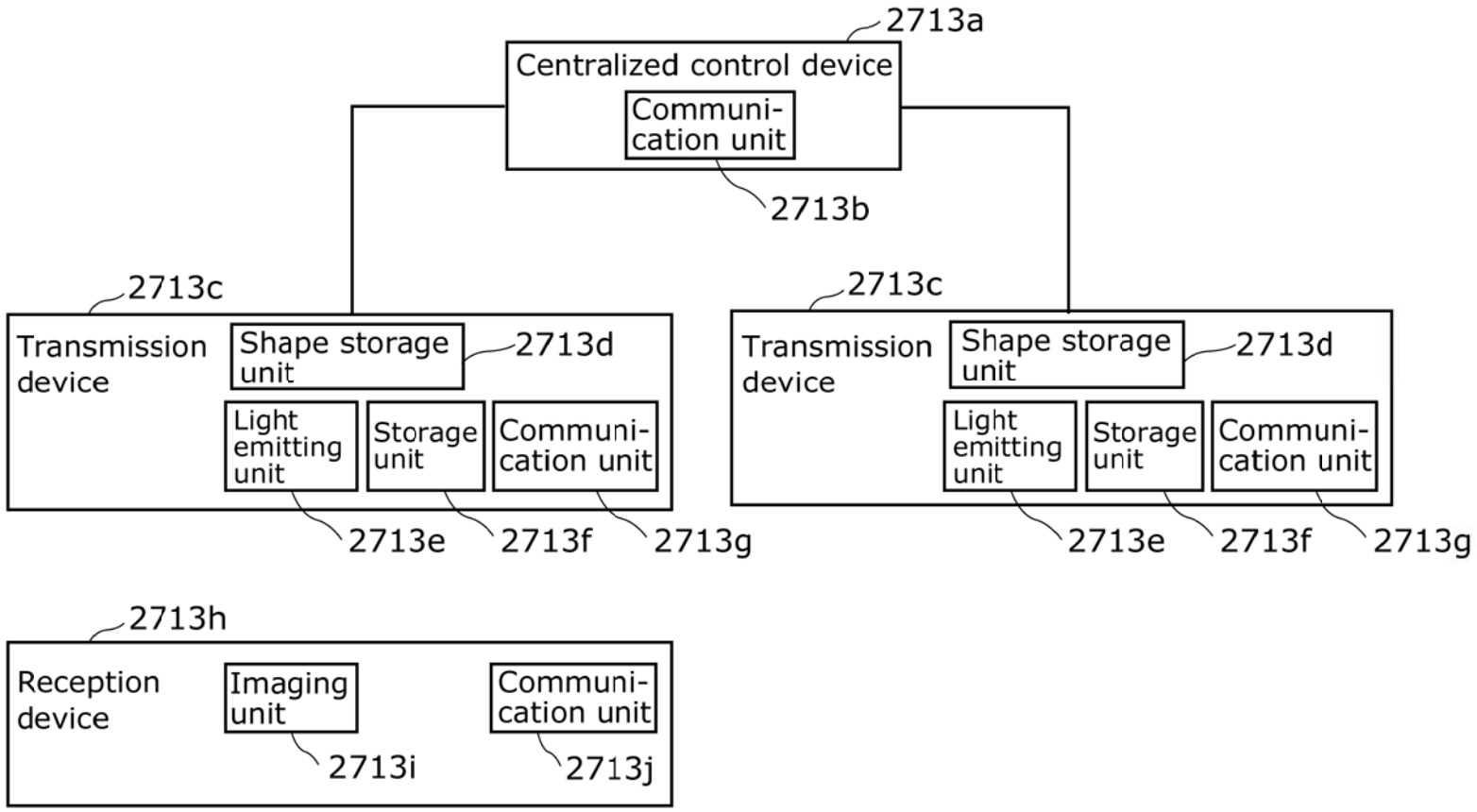

2713a
Centralized control device
Communi-cation unit
2713b
2713c
Transmission device
Shape storage unit
2713d
Light emitting unit
Storage unit
Communi-cation unit
2713e
2713f
2713g
2713c
Transmission device
Shape storage unit
2713d
Light emitting unit
Storage unit
Communi-cation unit
2713e
2713f
2713g
2713h
Reception device
Imaging unit
2713i
Communi-cation unit
2713j

FIG. 146

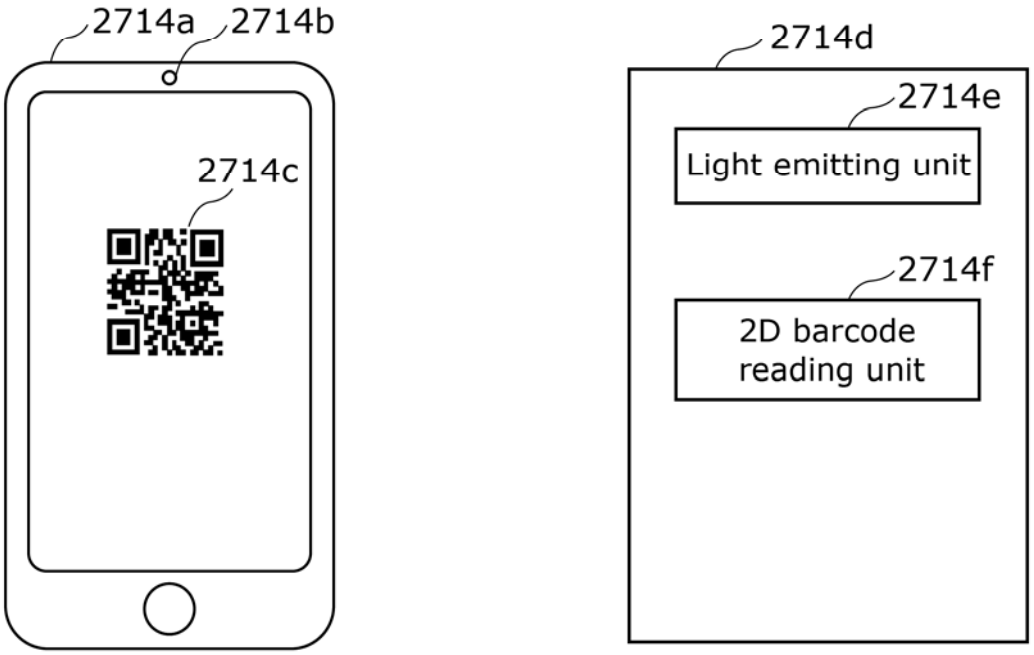

2714a
2714b
2714c
2714d
2714e
Light emitting unit
2714f
2D barcode reading unit

FIG. 147

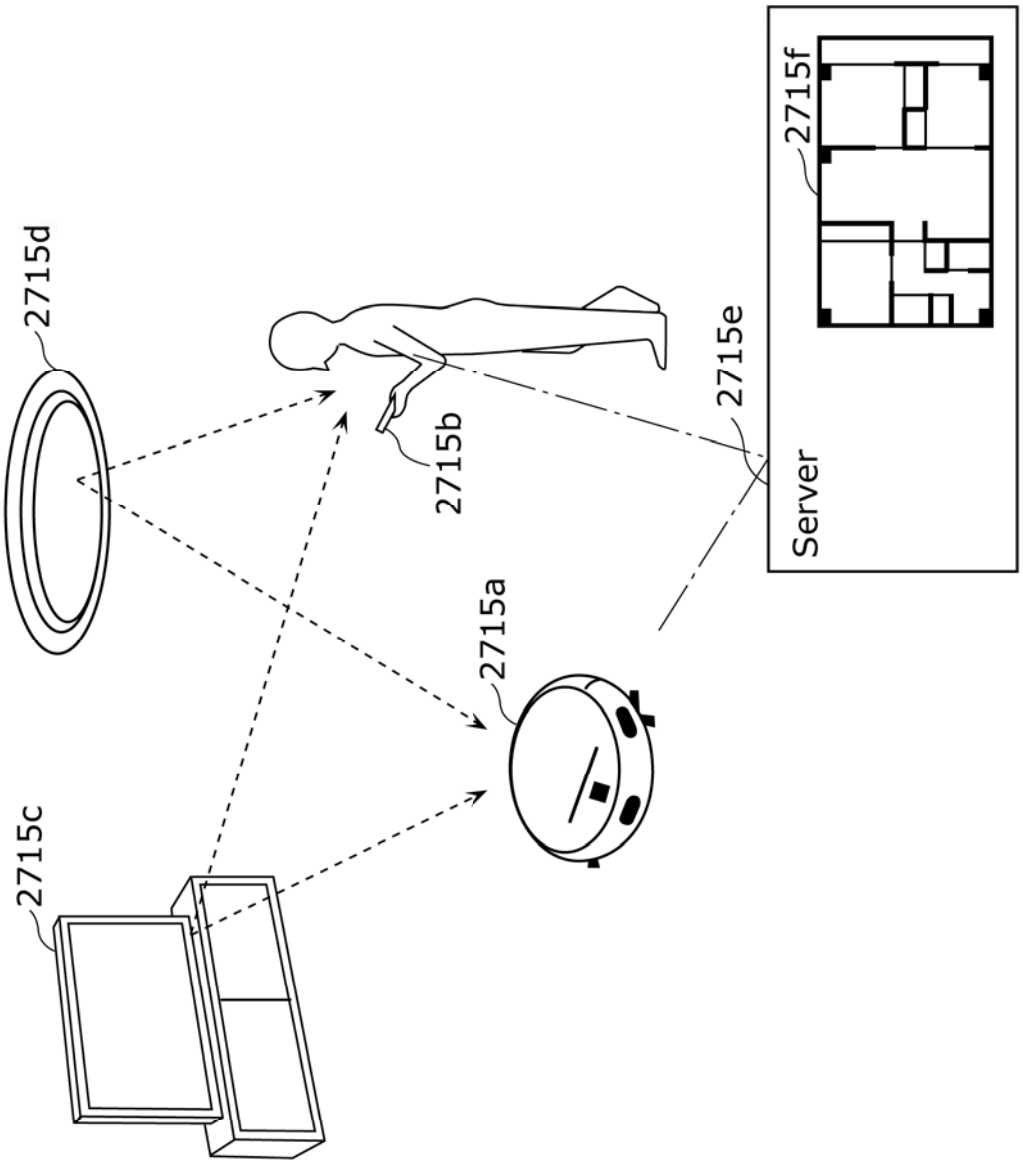


FIG. 148

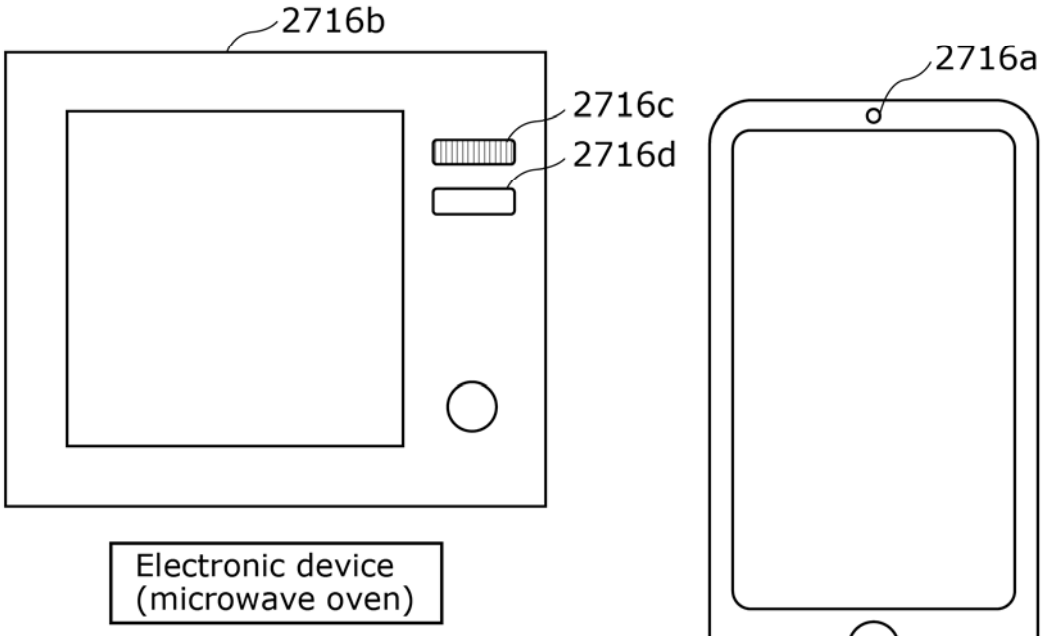


FIG. 149

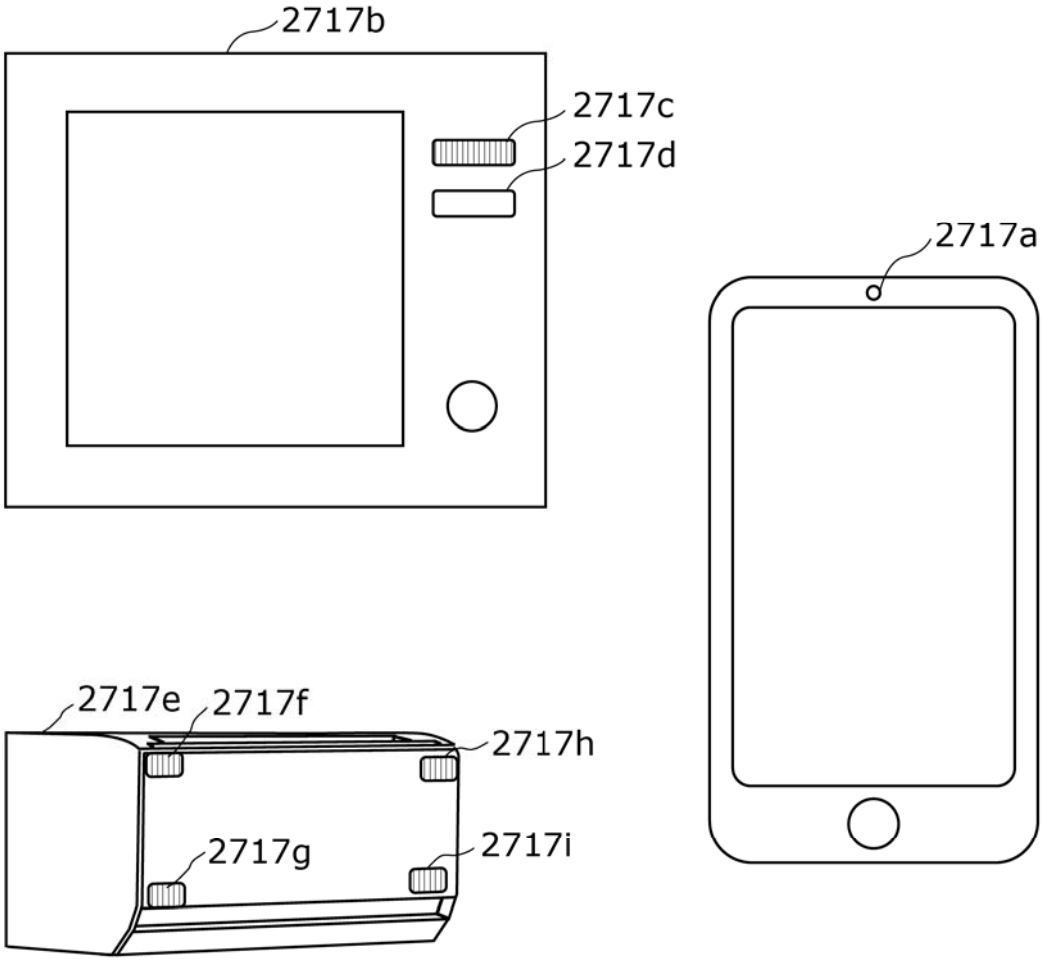


FIG. 150

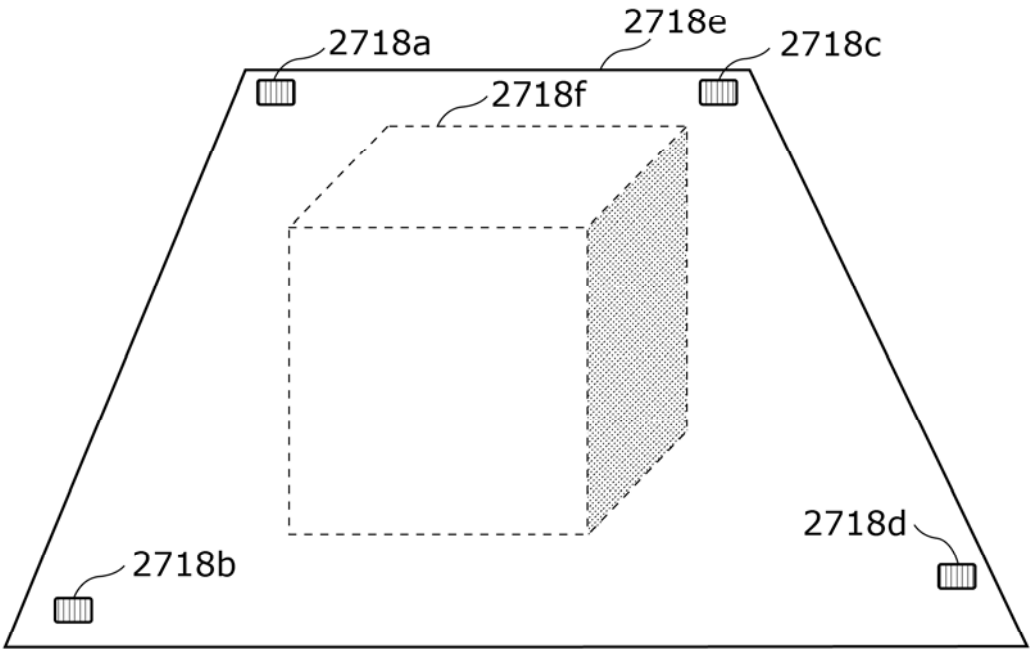


FIG. 151

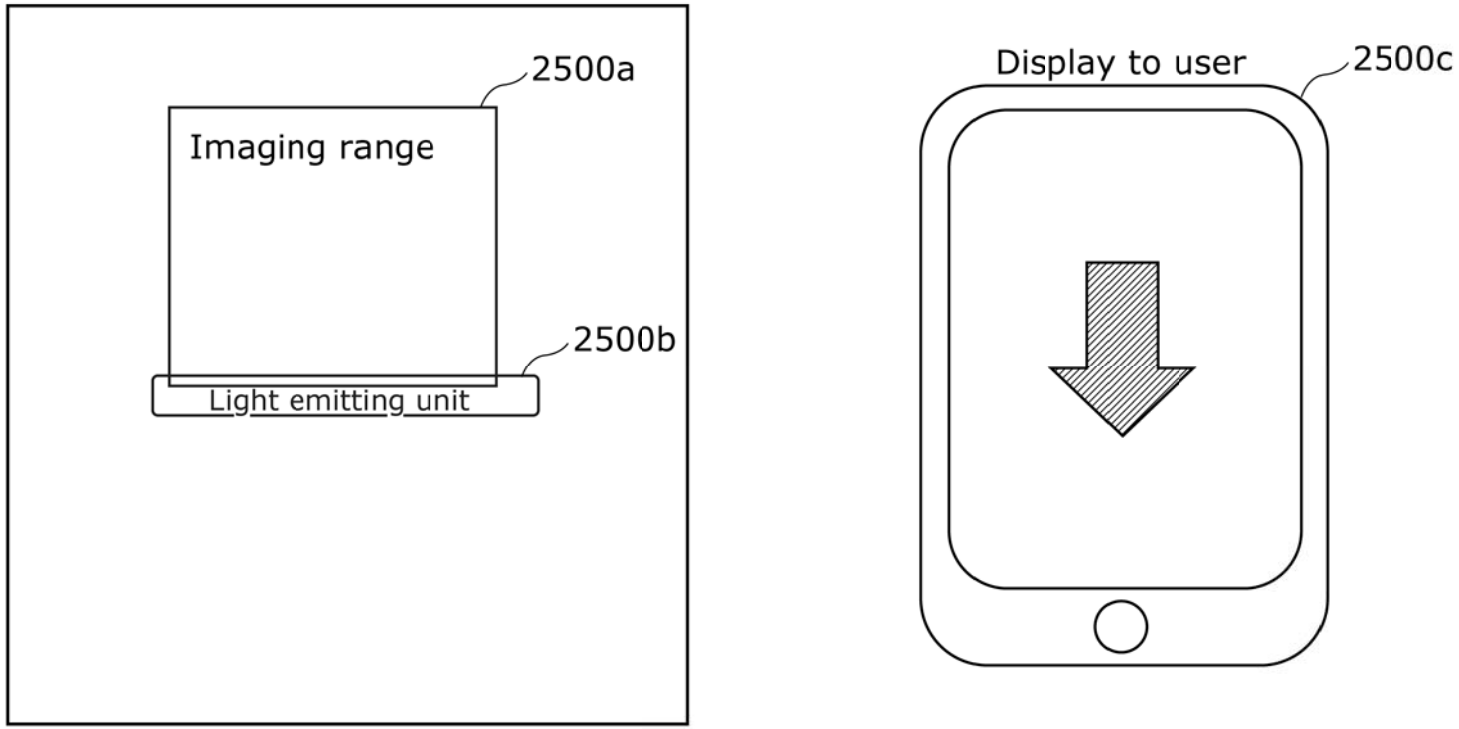

2500a
Imaging range
2500b
Light emitting unit
Display to user
2500c

FIG. 152

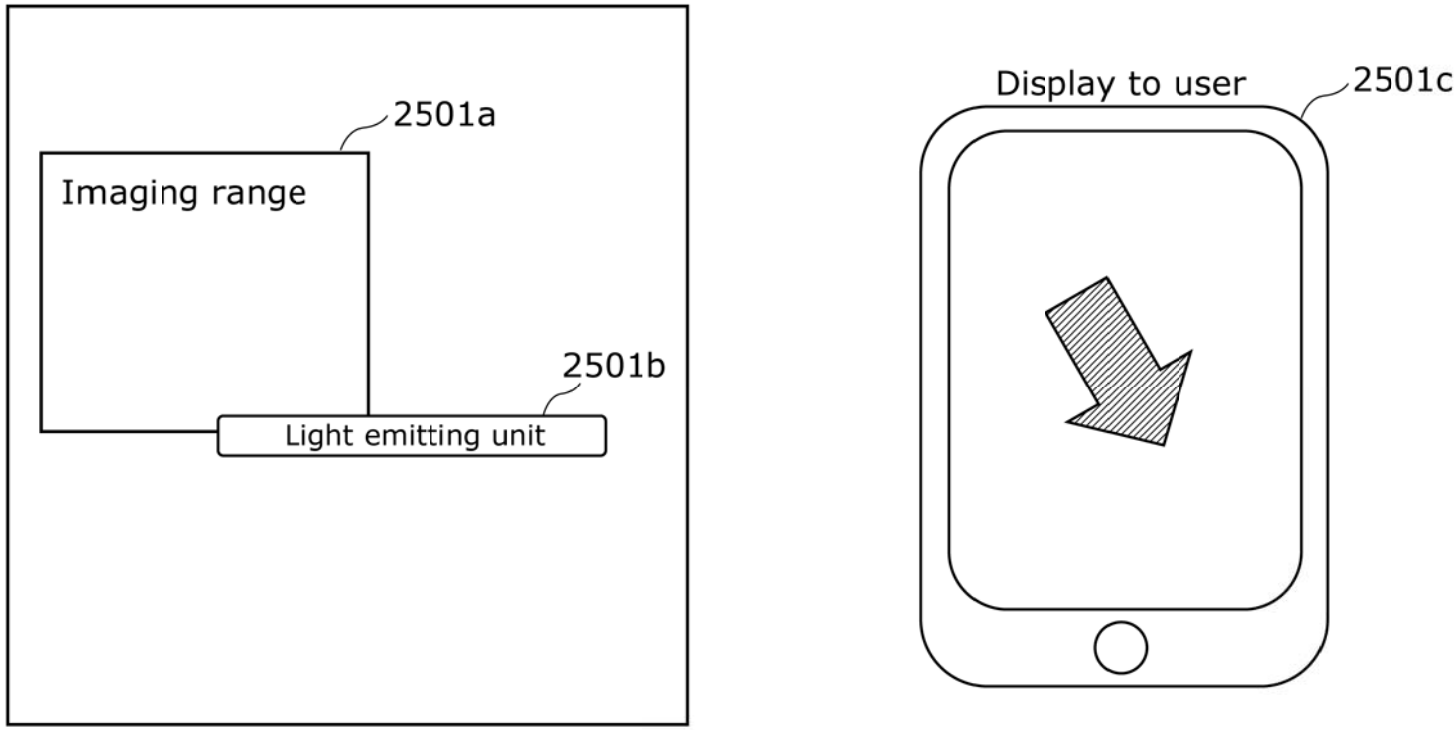

2501a
Imaging range
2501b
Light emitting unit
Display to user
2501c

FIG. 153

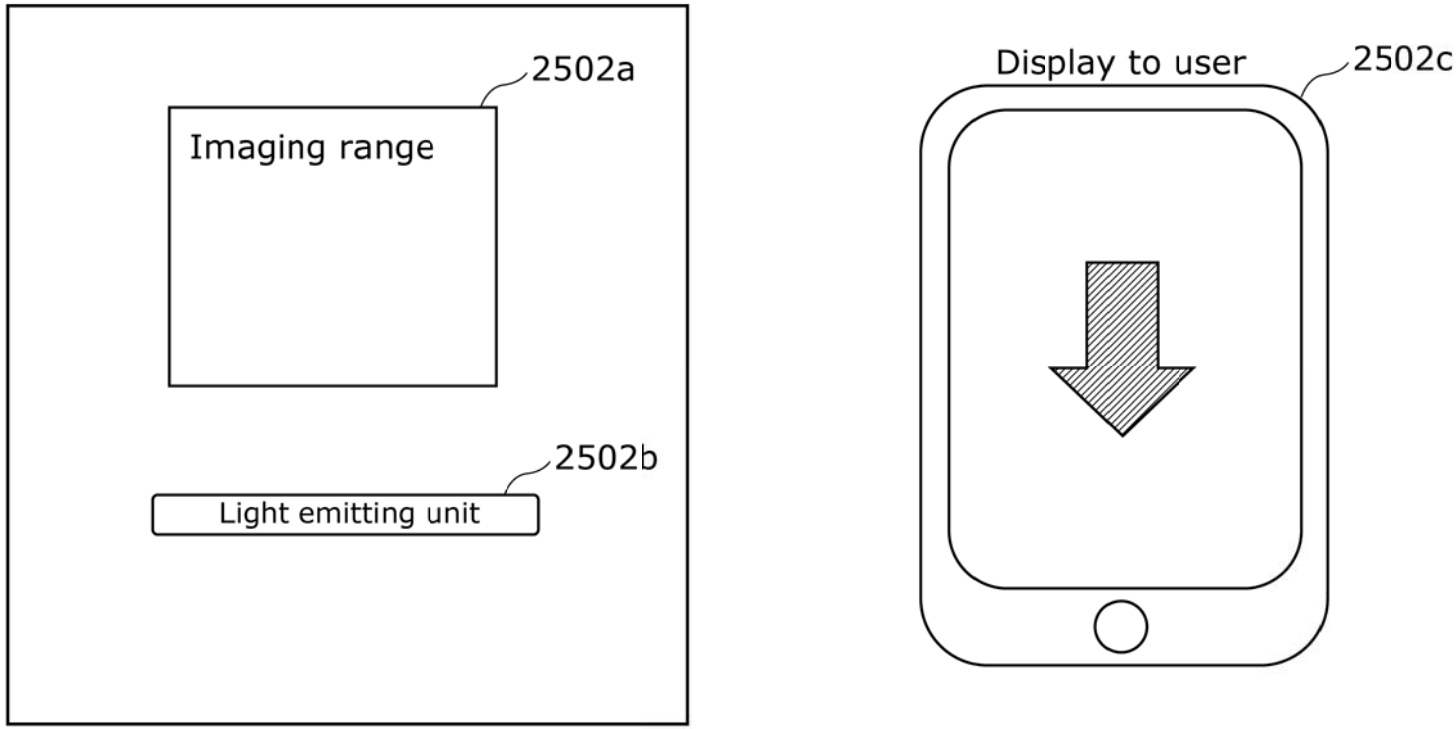

2502a
Imaging range
2502b
Light emitting unit
Display to user
2502c

FIG. 154

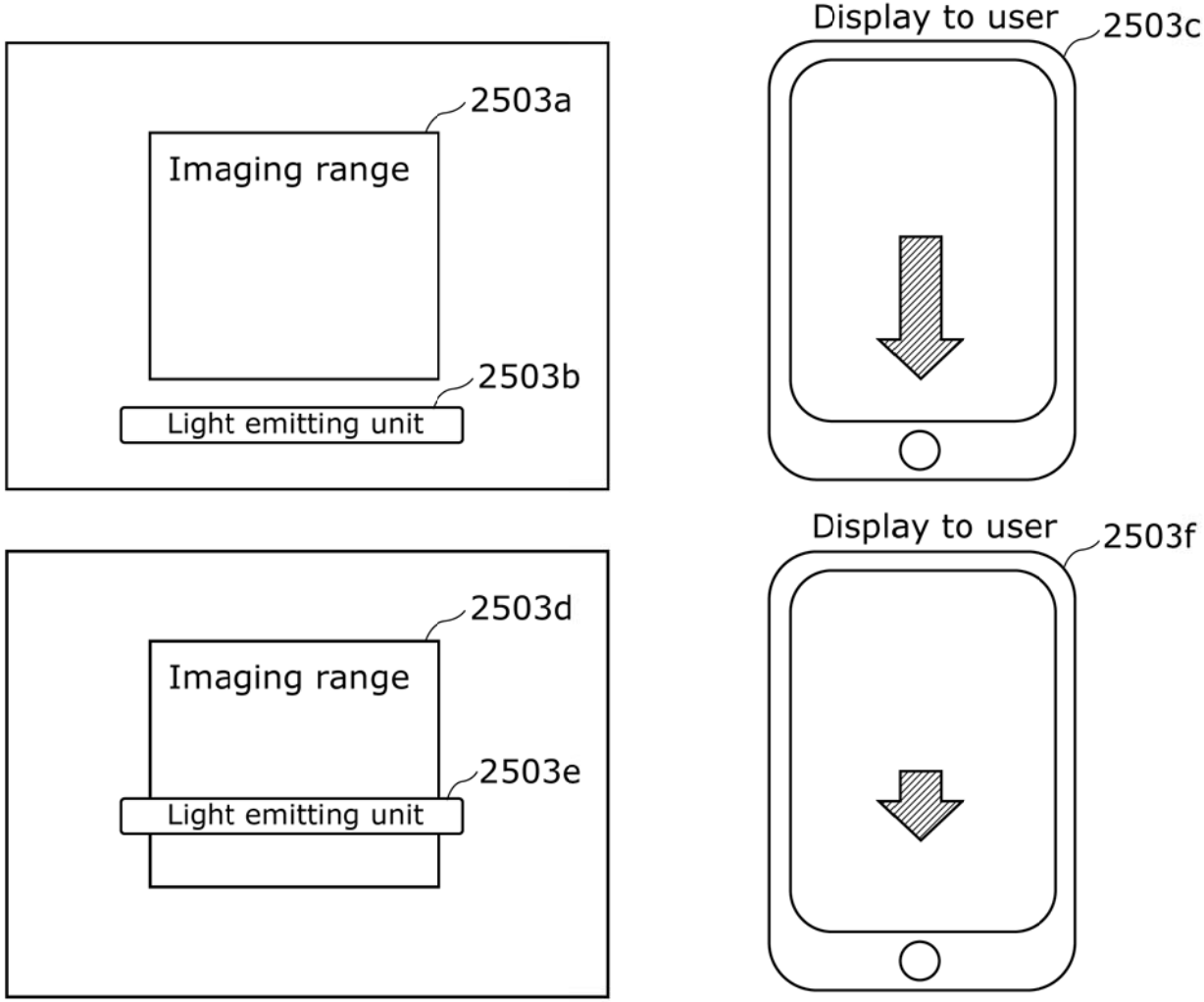

2503a
Imaging range
2503b
Light emitting unit
Display to user
2503c
2503d
Imaging range
2503e
Light emitting unit
Display to user
2503f

FIG. 155

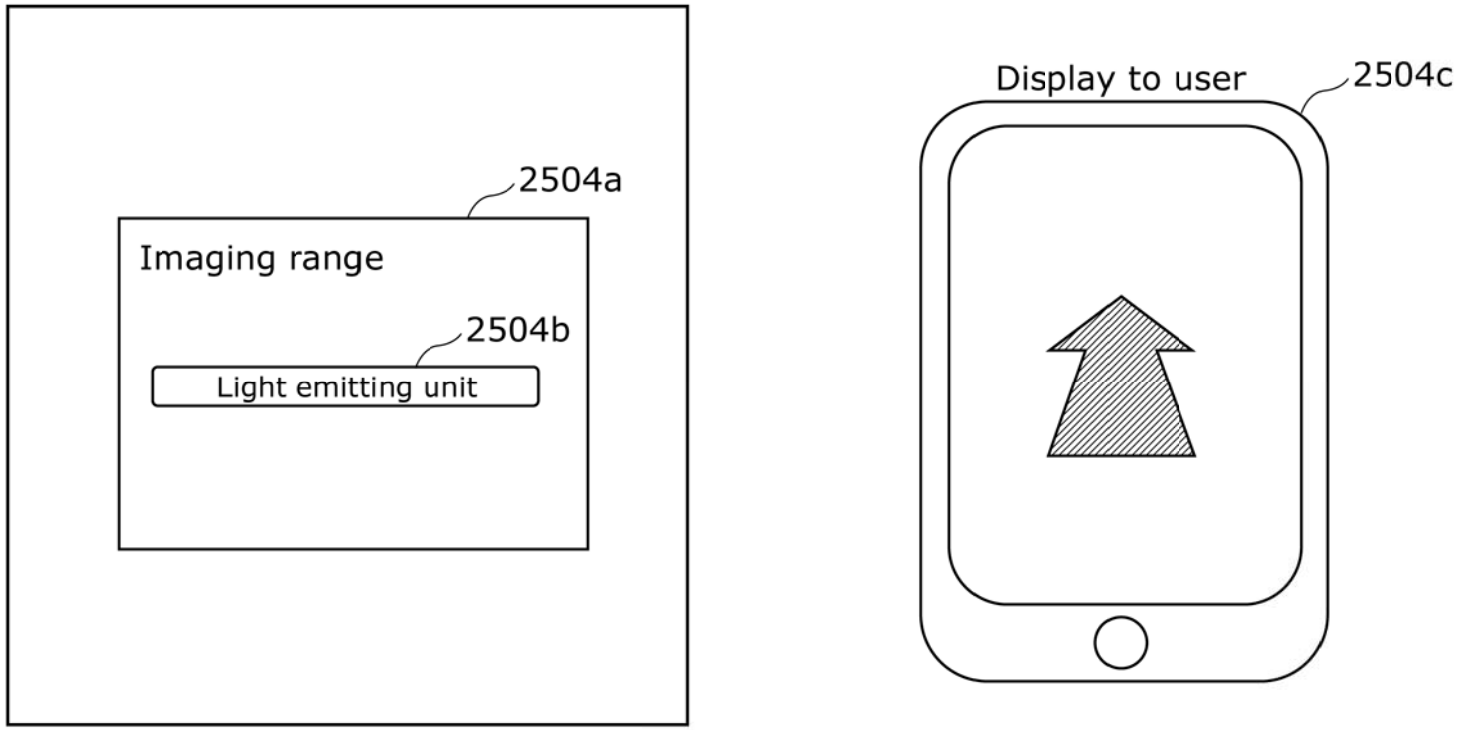

2504a
Imaging range
2504b
Light emitting unit
Display to user
2504c

FIG. 156

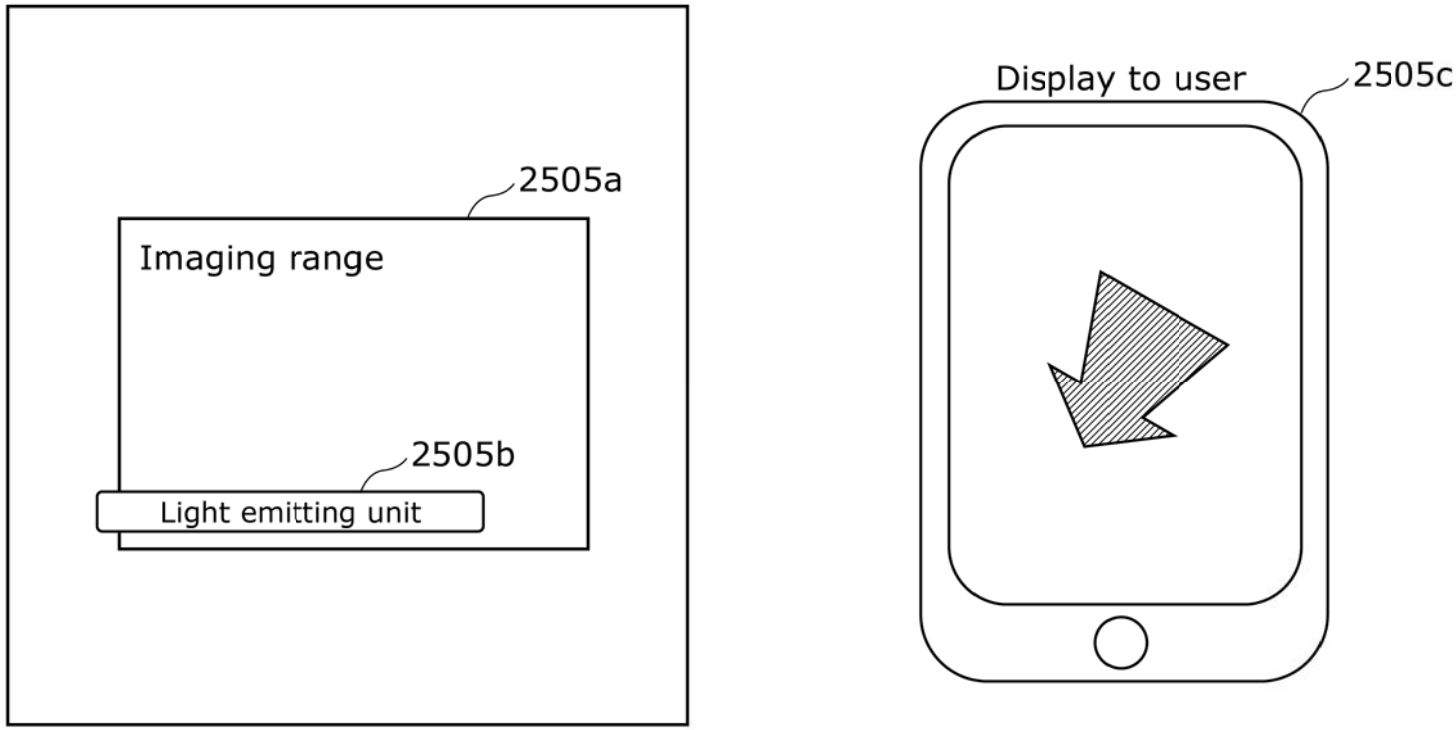

2505a
Imaging range
2505b
Light emitting unit
Display to user
2505c

FIG. 157

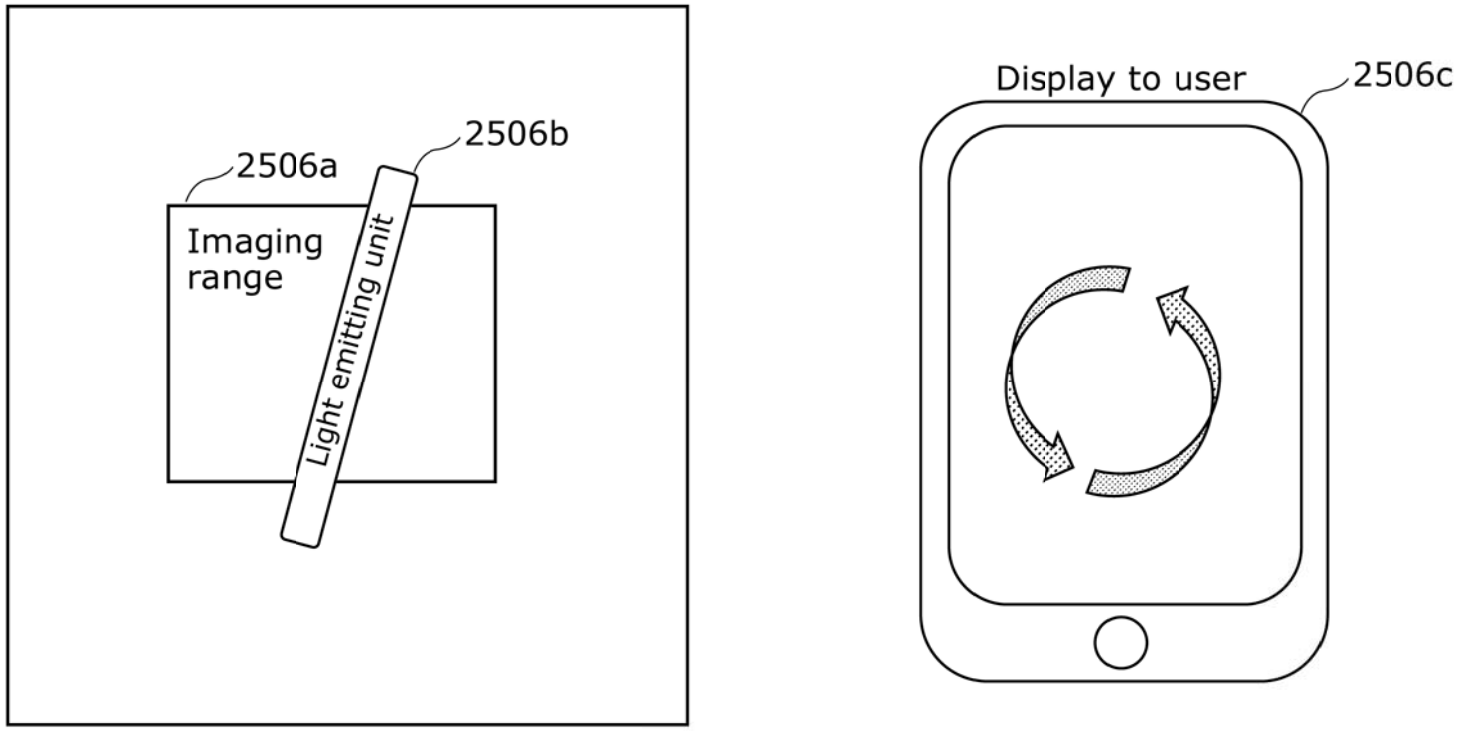

2506a
2506b
Imaging range
Light emitting unit
Display to user
2506c

FIG. 158

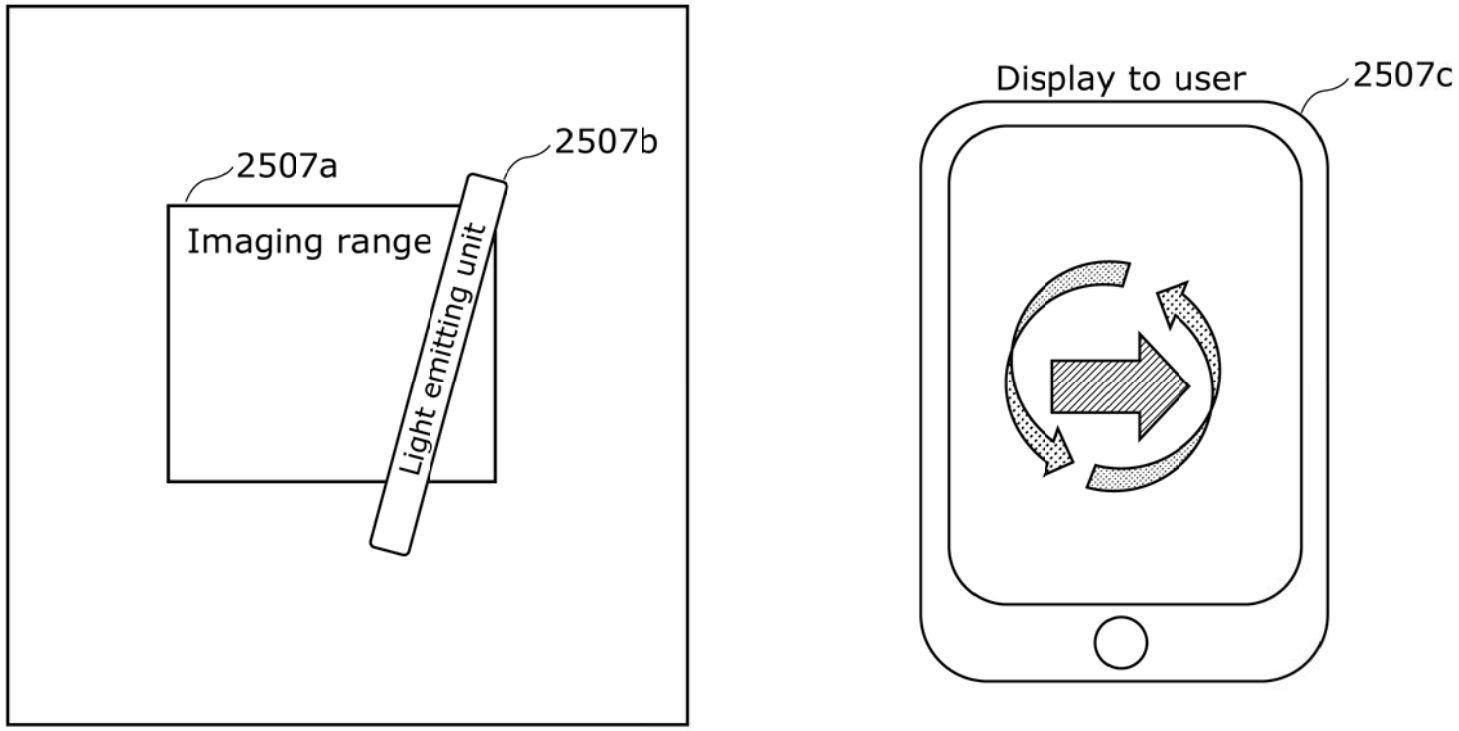

2507a
2507b
Imaging range
Light emitting unit
Display to user
2507c

FIG. 159

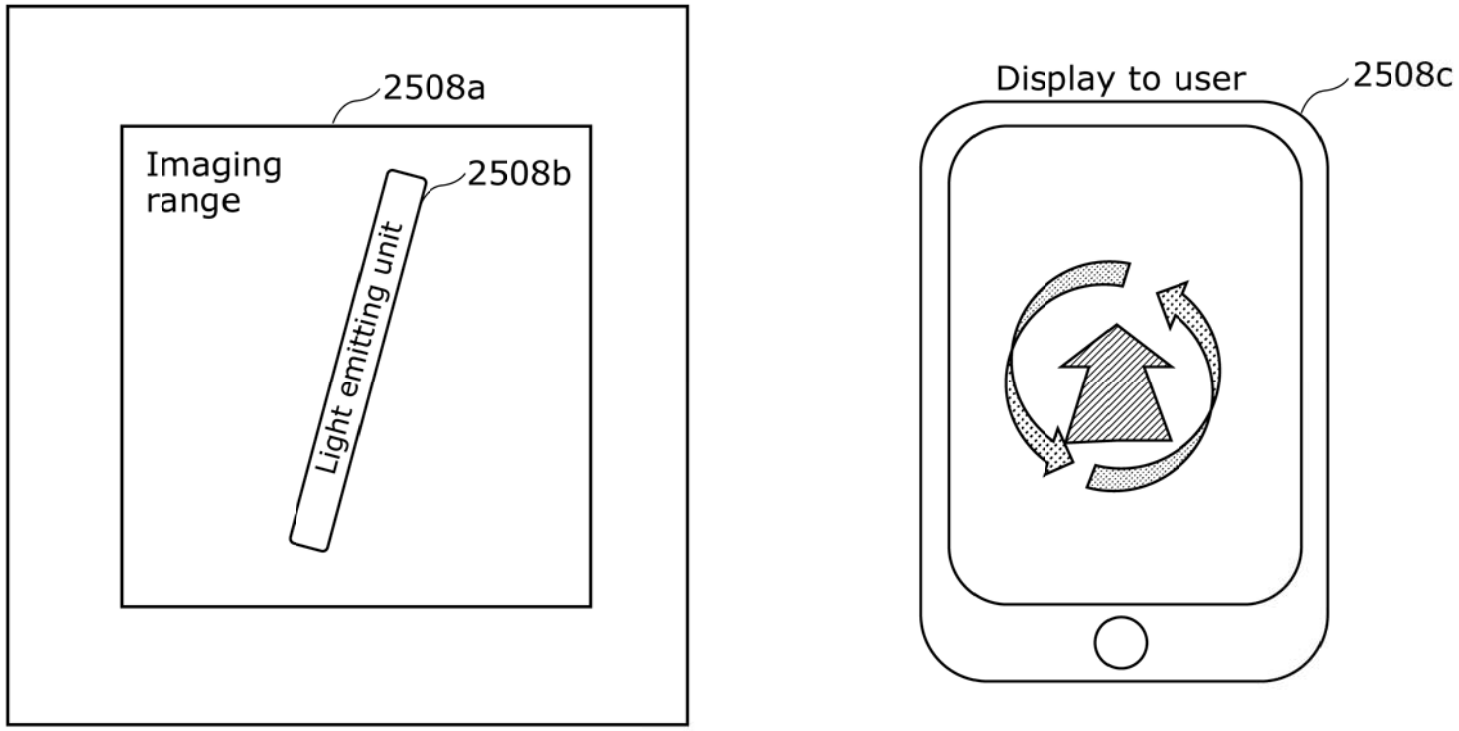

2508a
Imaging range
2508b
Light emitting unit
Display to user
2508c

FIG. 160

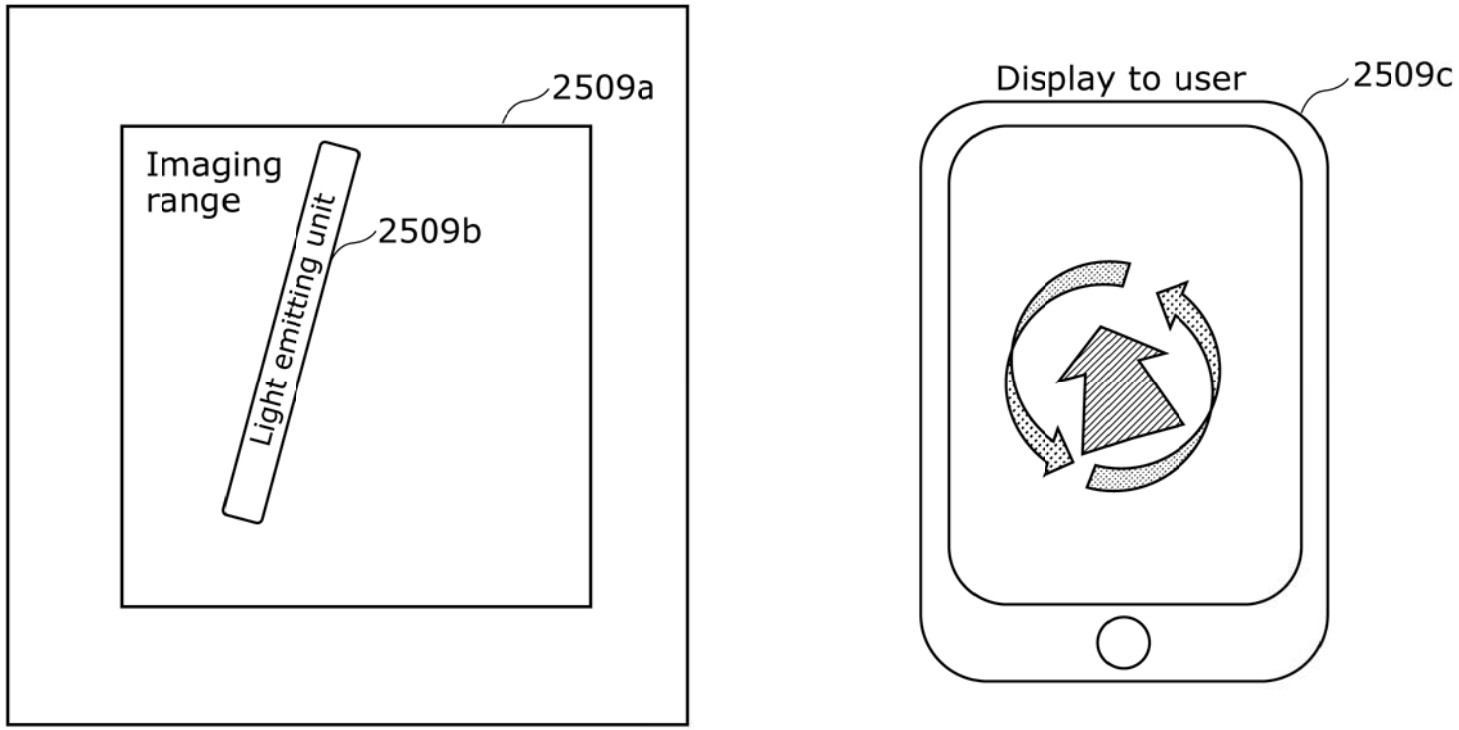

2509a
Imaging range
2509b
Light emitting unit
Display to user
2509c

FIG. 161

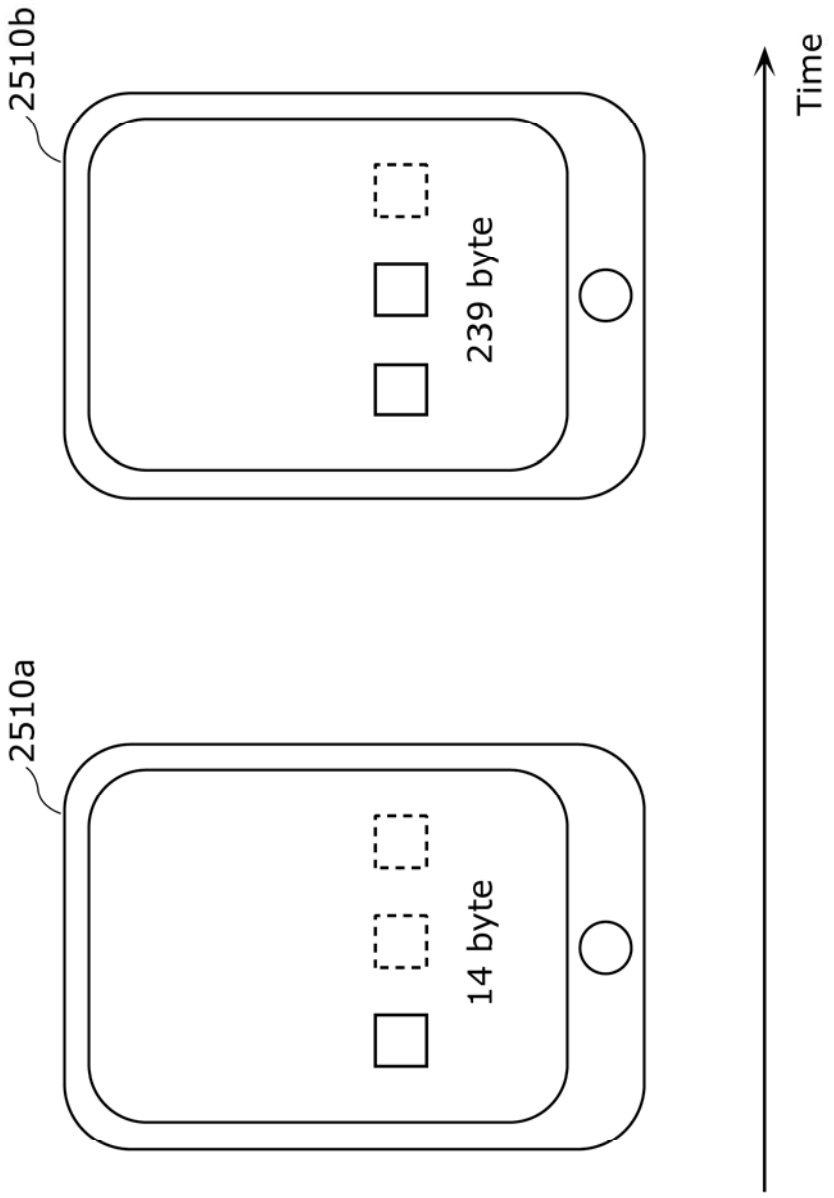


FIG. 162

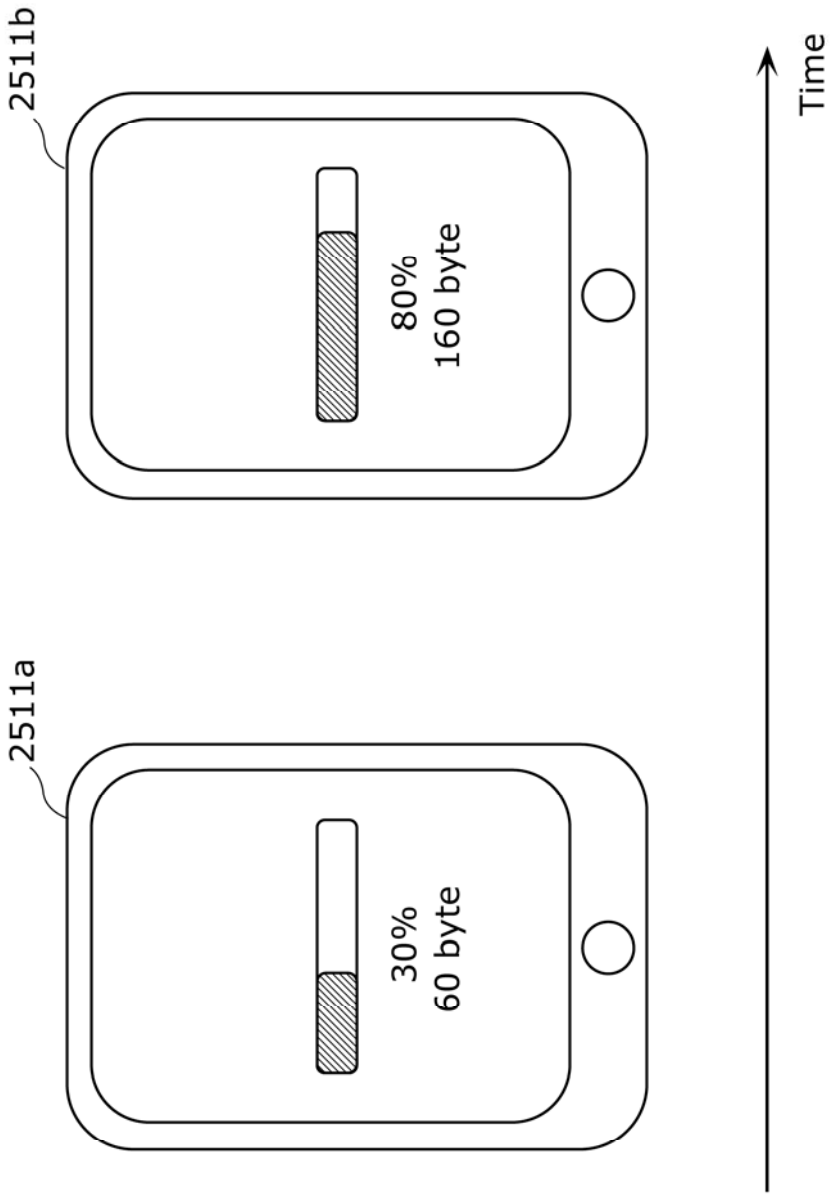


FIG. 163

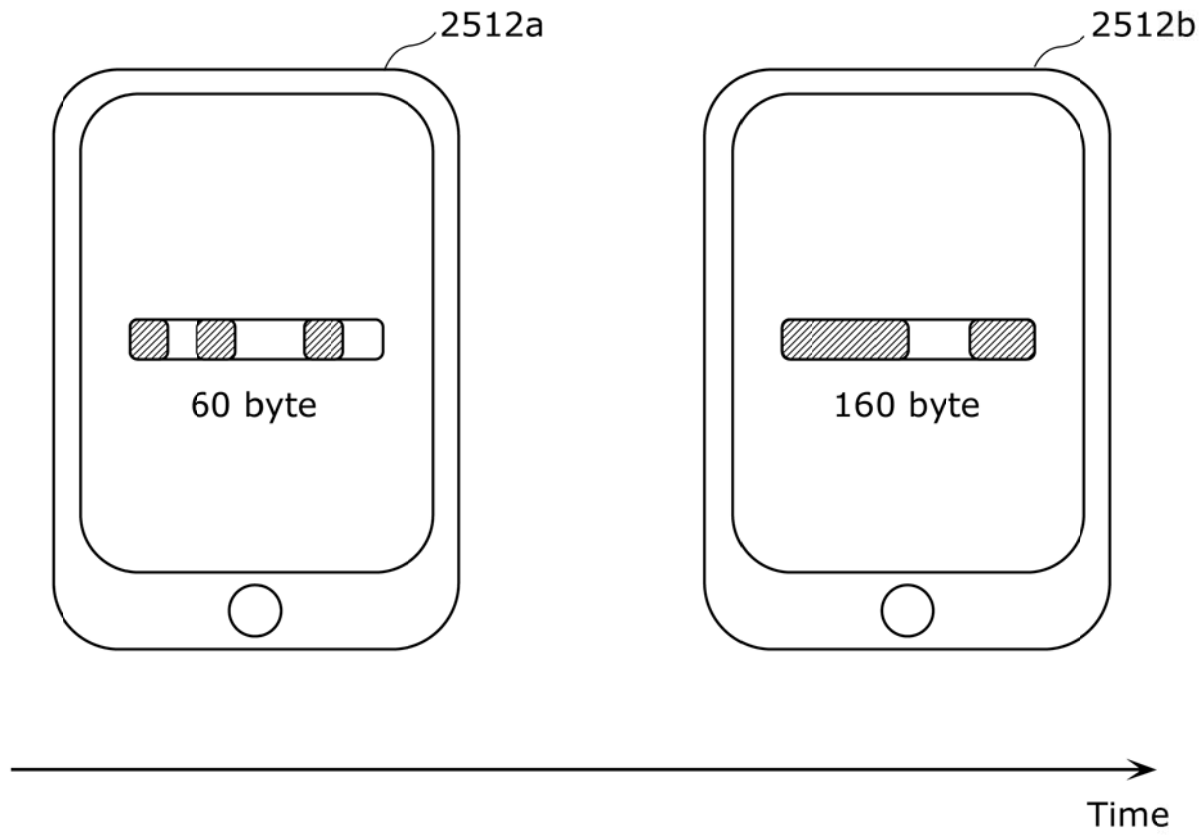


FIG. 164

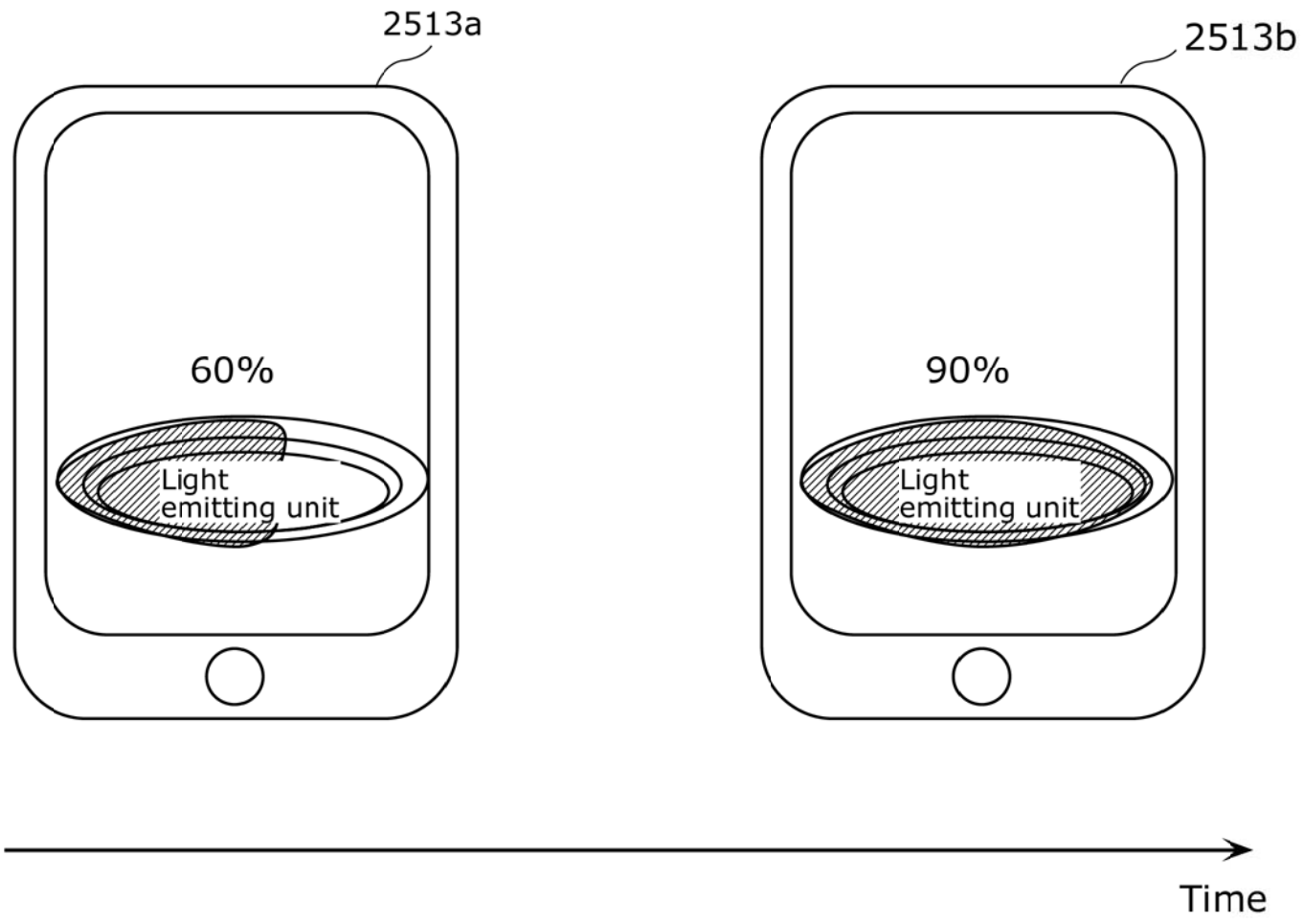

2513a
2513b
60%
90%
Light emitting unit
Light emitting unit
Time

FIG. 165

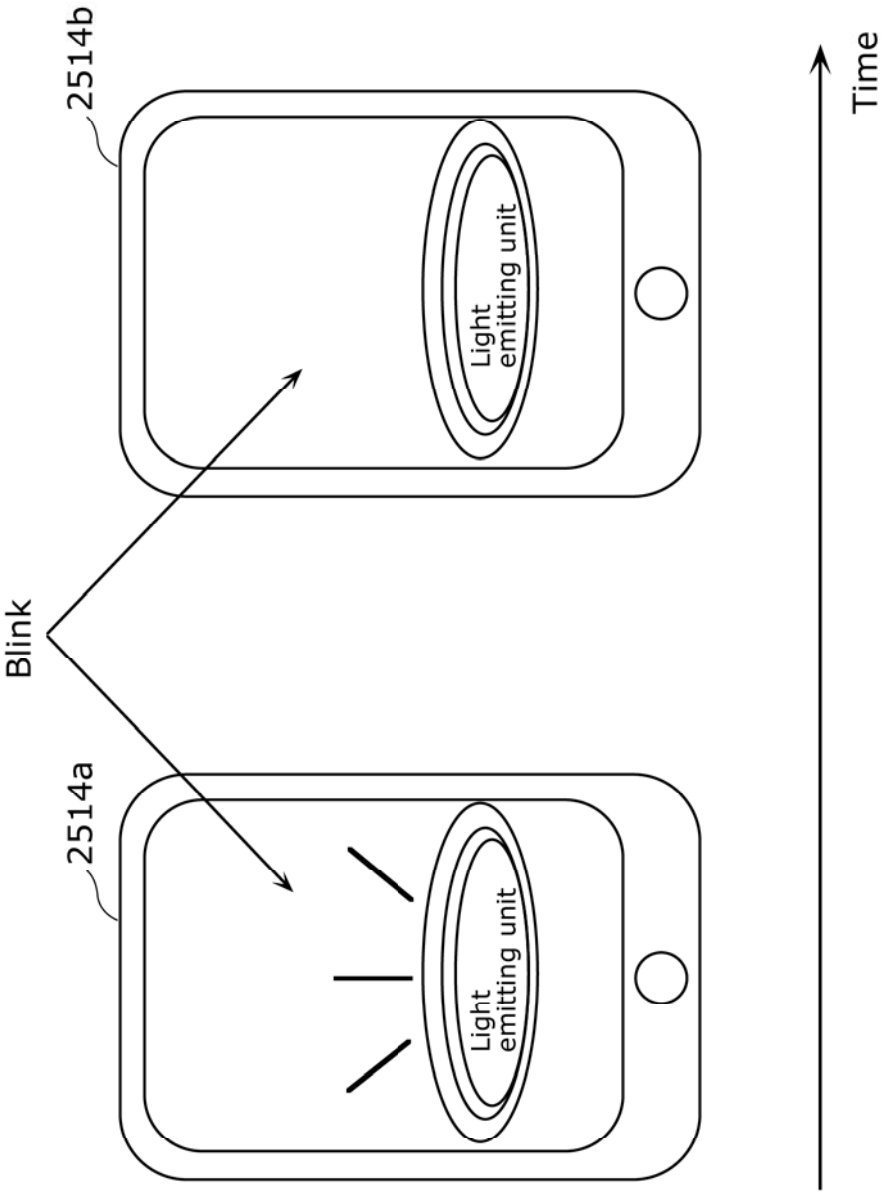

2514b
Light emitting unit
Blink
2514a
Light emitting unit
Time

FIG. 166

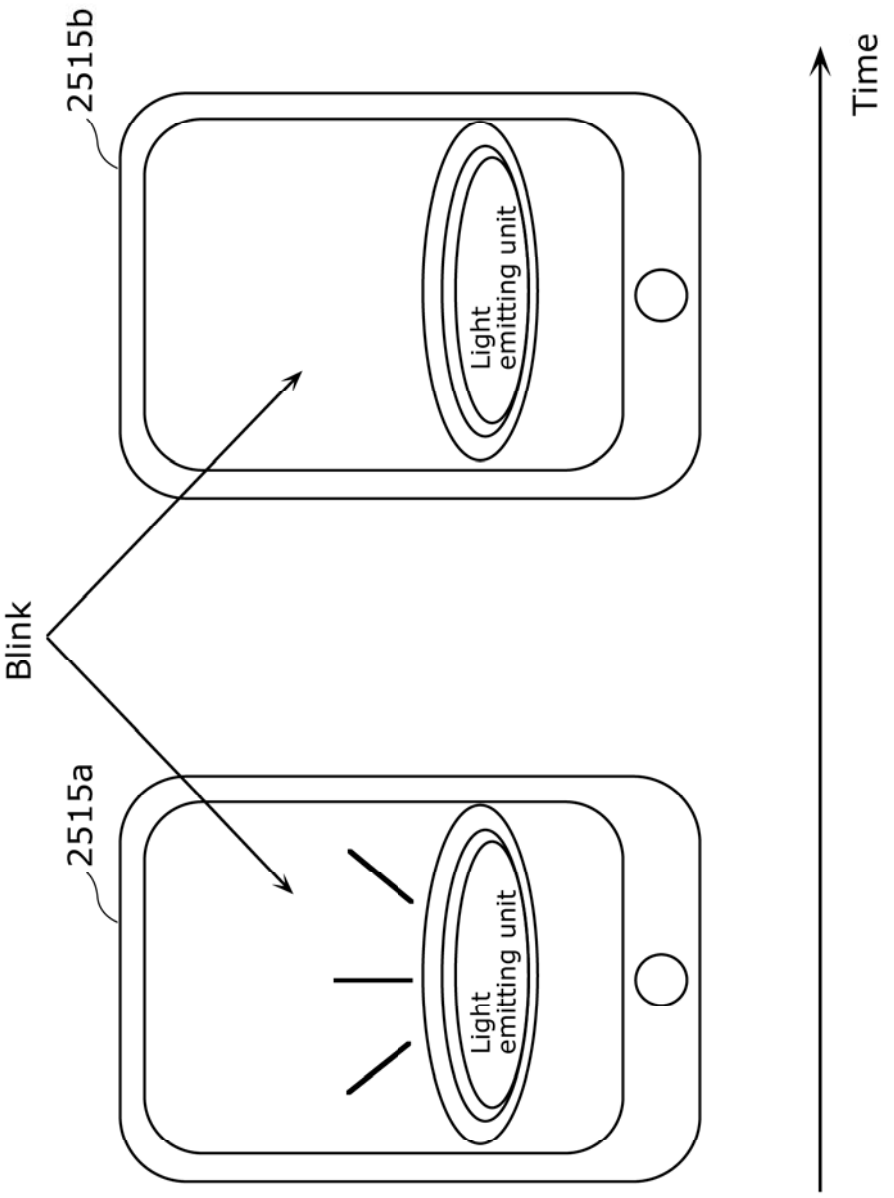

2515b
Light emitting unit
Blink
2515a
Light emitting unit
Time

FIG. 167

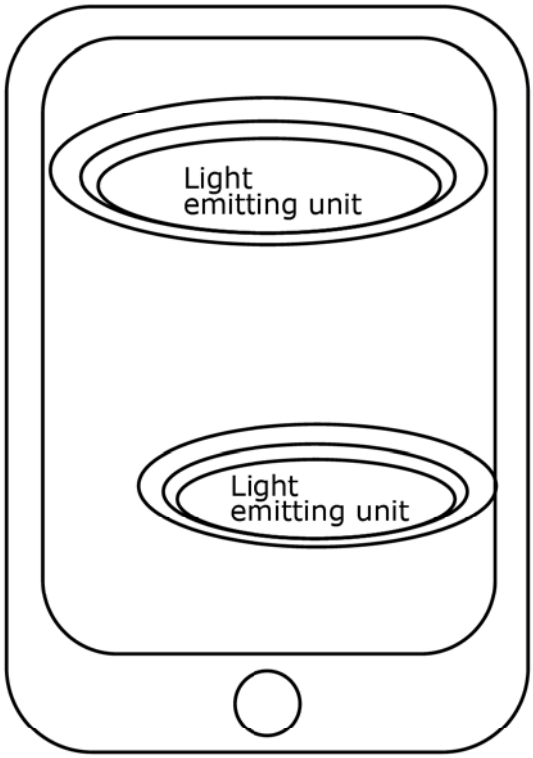


FIG. 168

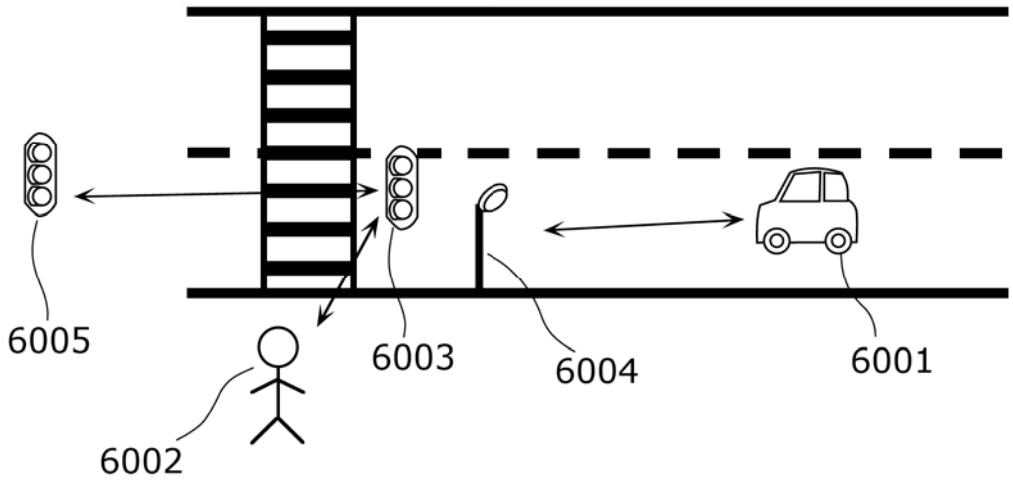


FIG. 169

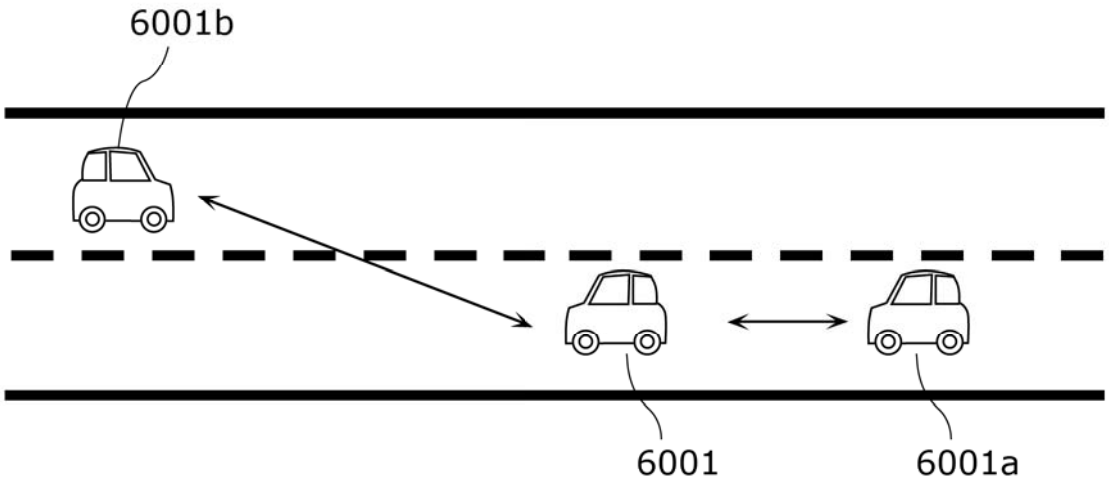


FIG. 170

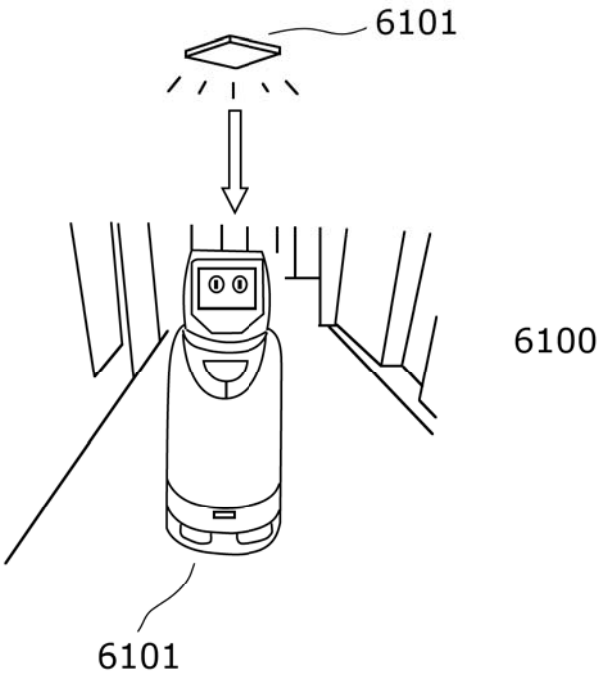


FIG. 171

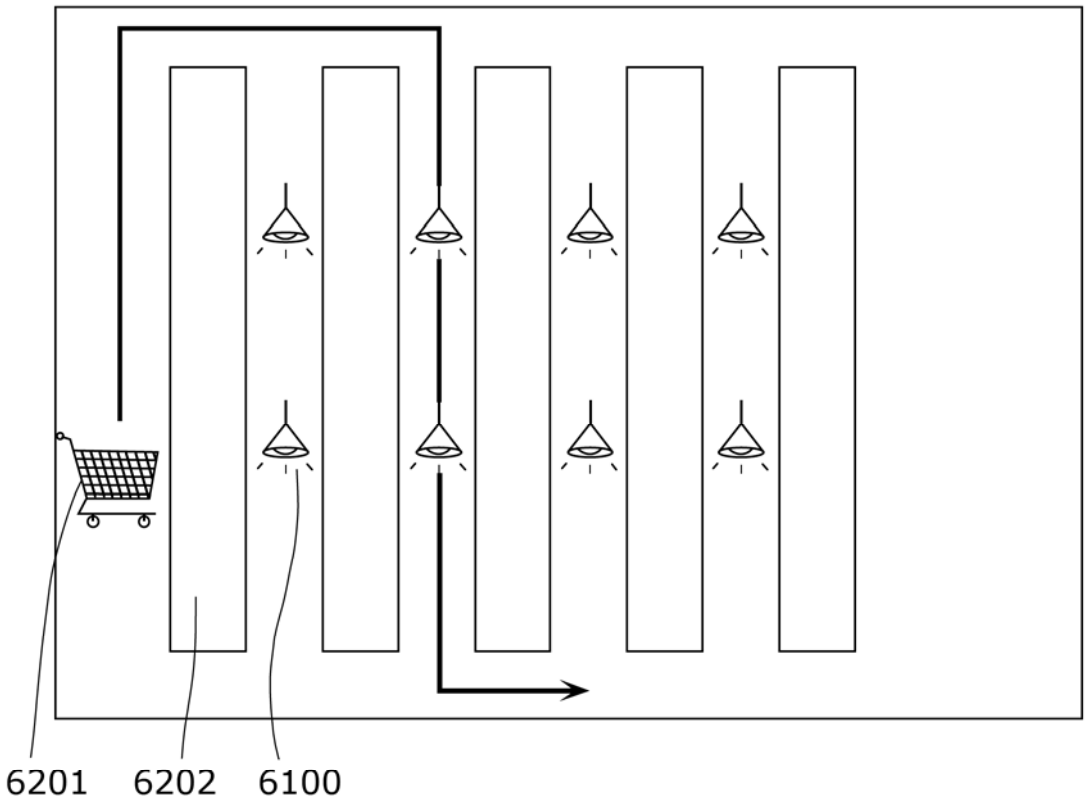


FIG. 172

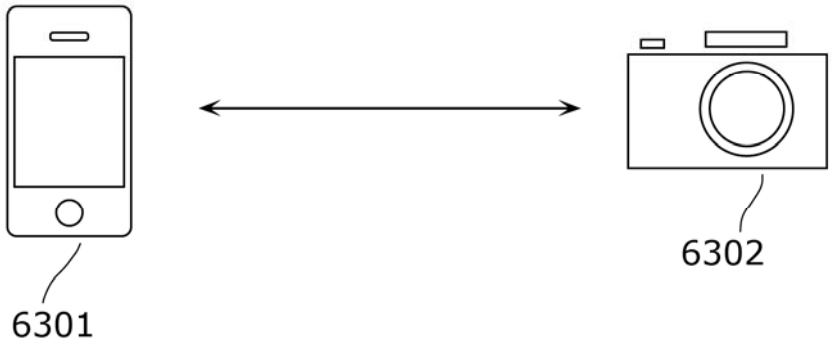


FIG. 173

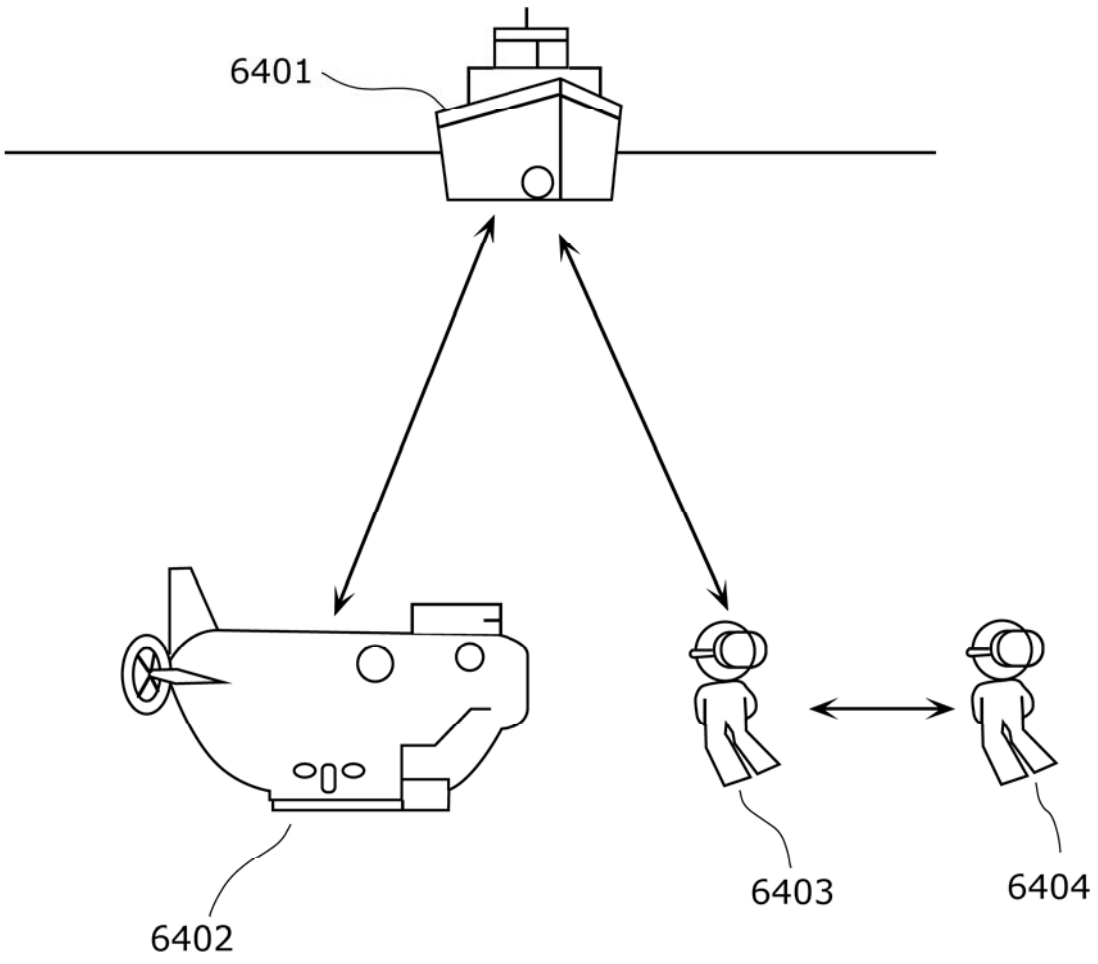


FIG. 174

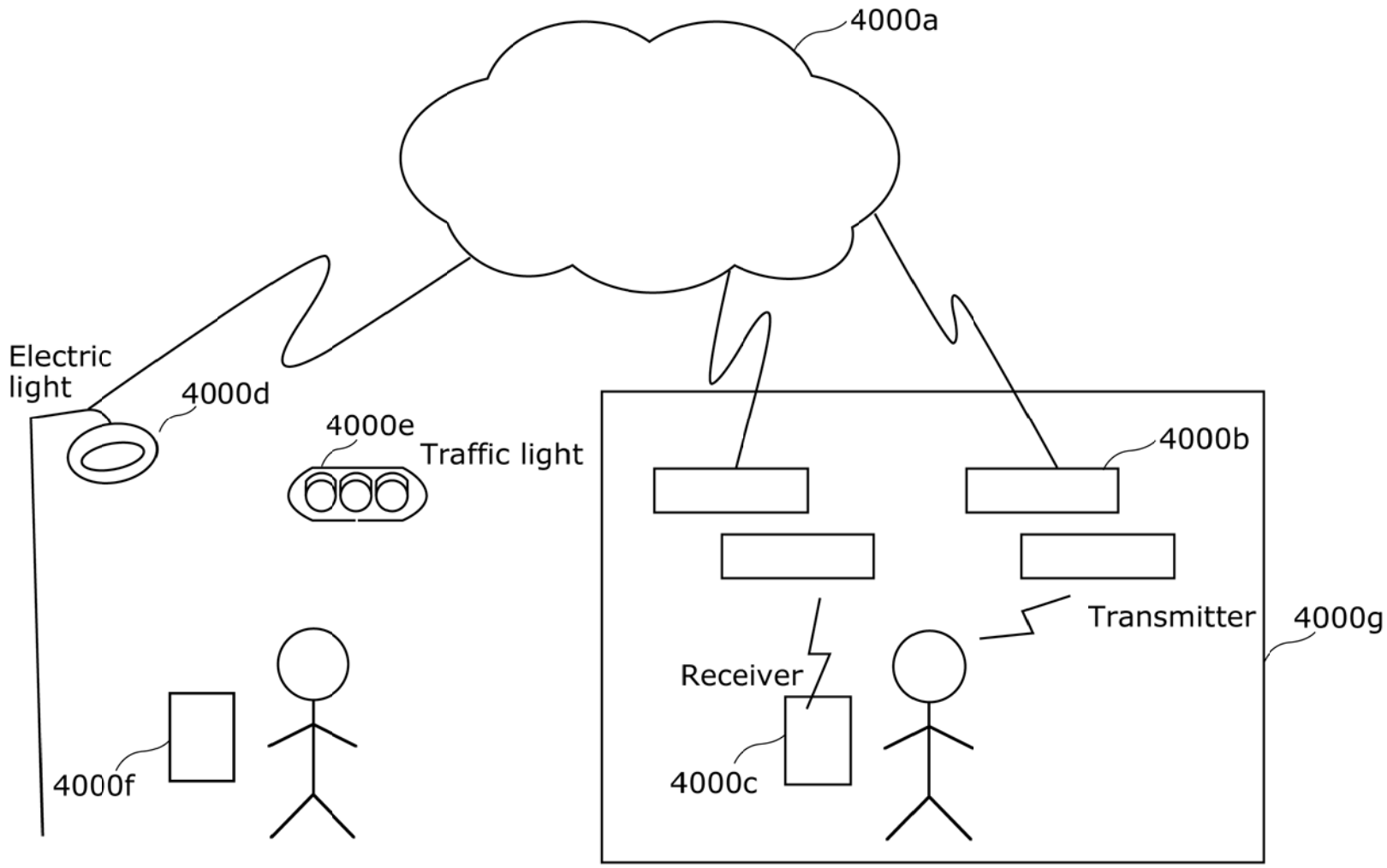

4000a
Electric light
4000d
4000e
Traffic light
4000b
Transmitter
4000g
Receiver
4000c
4000f

FIG. 175

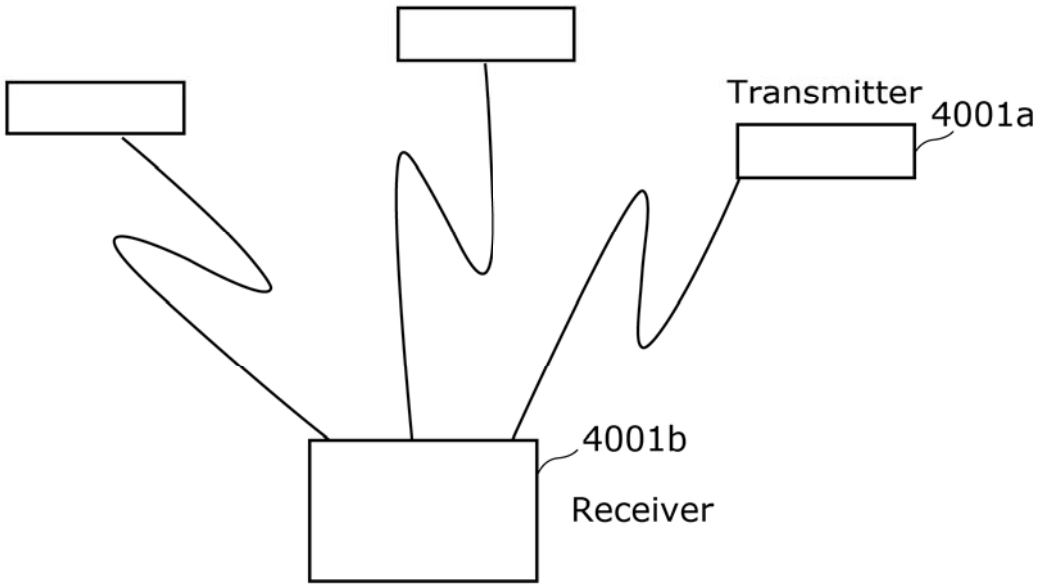


FIG. 176

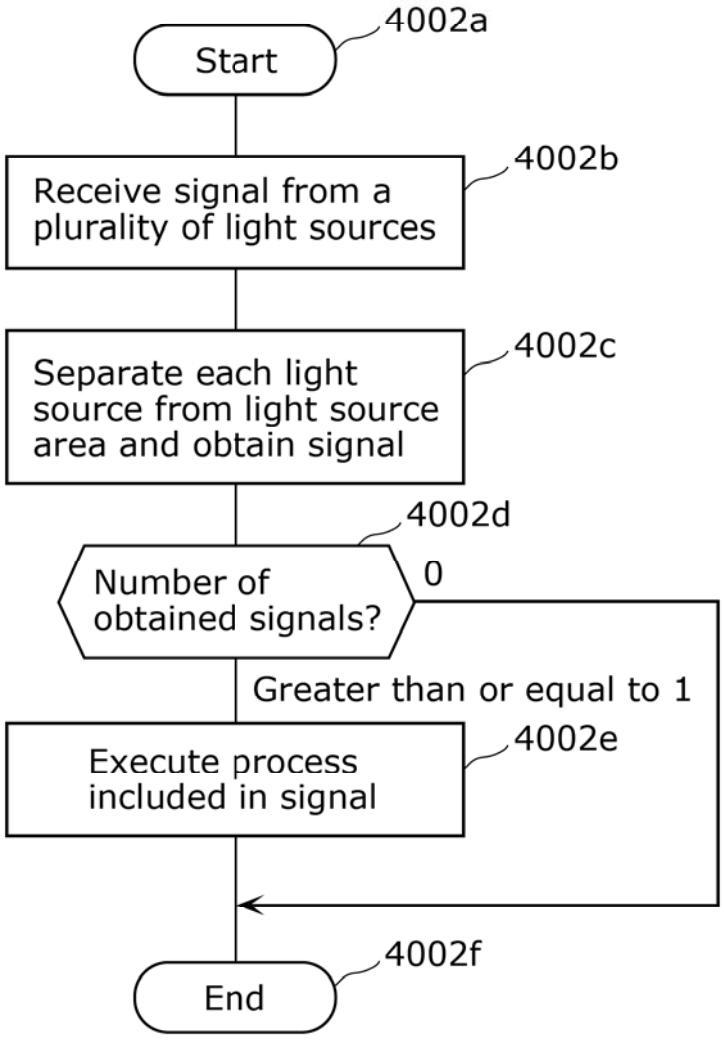

Start
4002a
Receive signal from a plurality of light sources
4002b
Separate each light source from light source area and obtain signal
4002c
Number of obtained signals?
4002d
0
Greater than or equal to 1
Execute process included in signal
4002e
End
4002f

FIG. 177

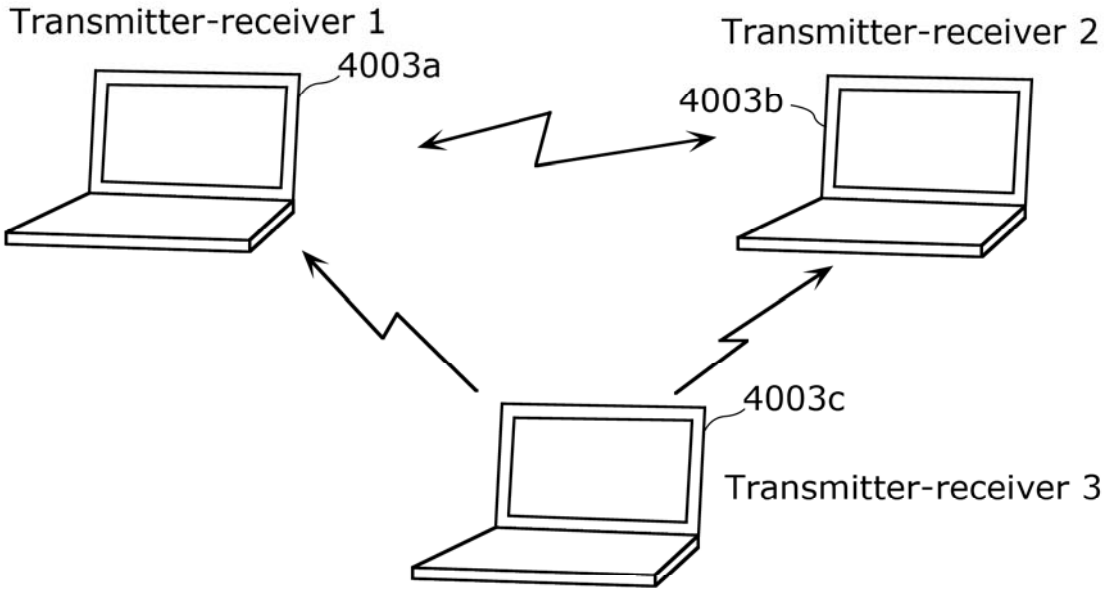

Transmitter-receiver 1
4003a
Transmitter-receiver 2
4003b
4003c
Transmitter-receiver 3

FIG. 178

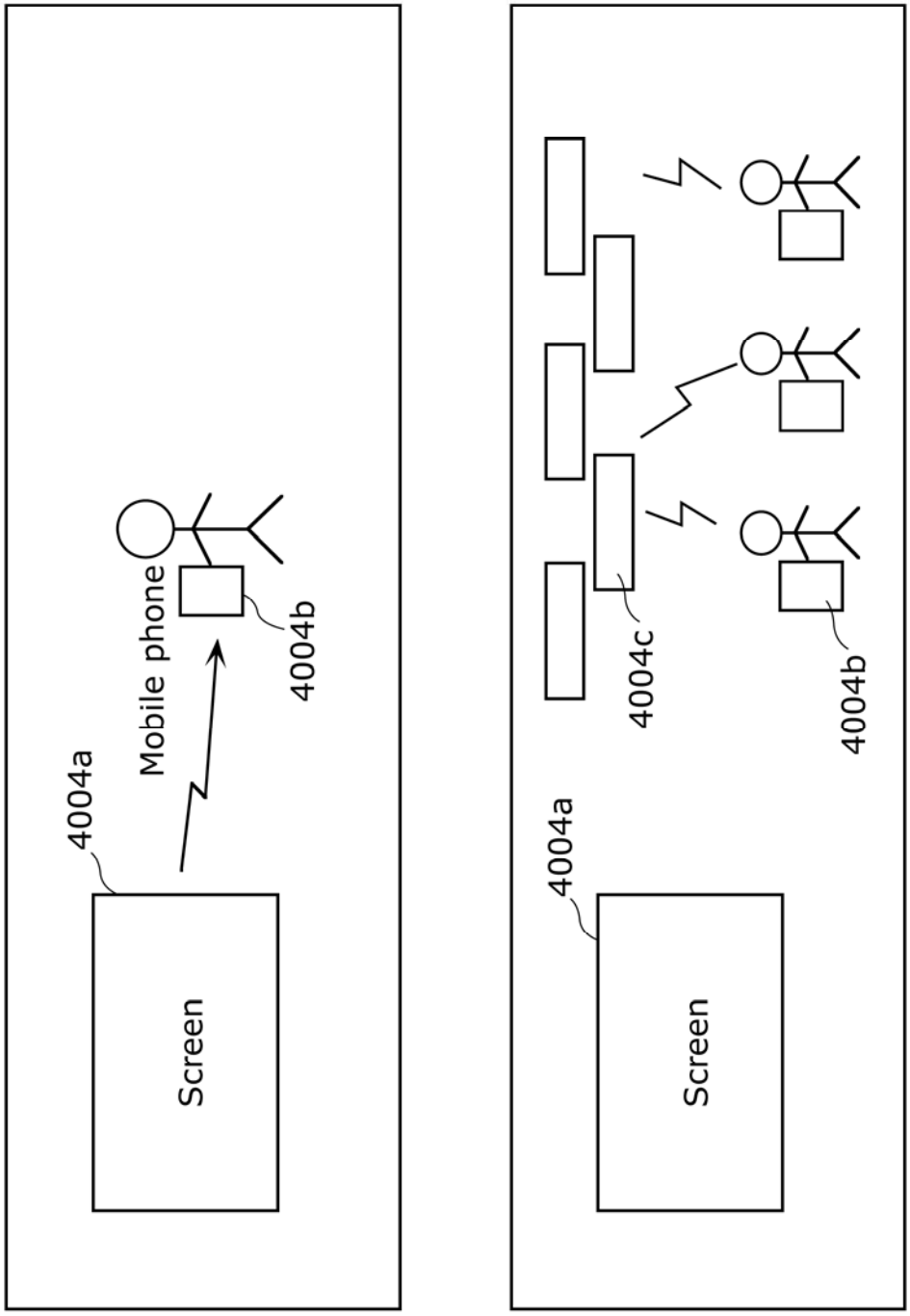


FIG. 179

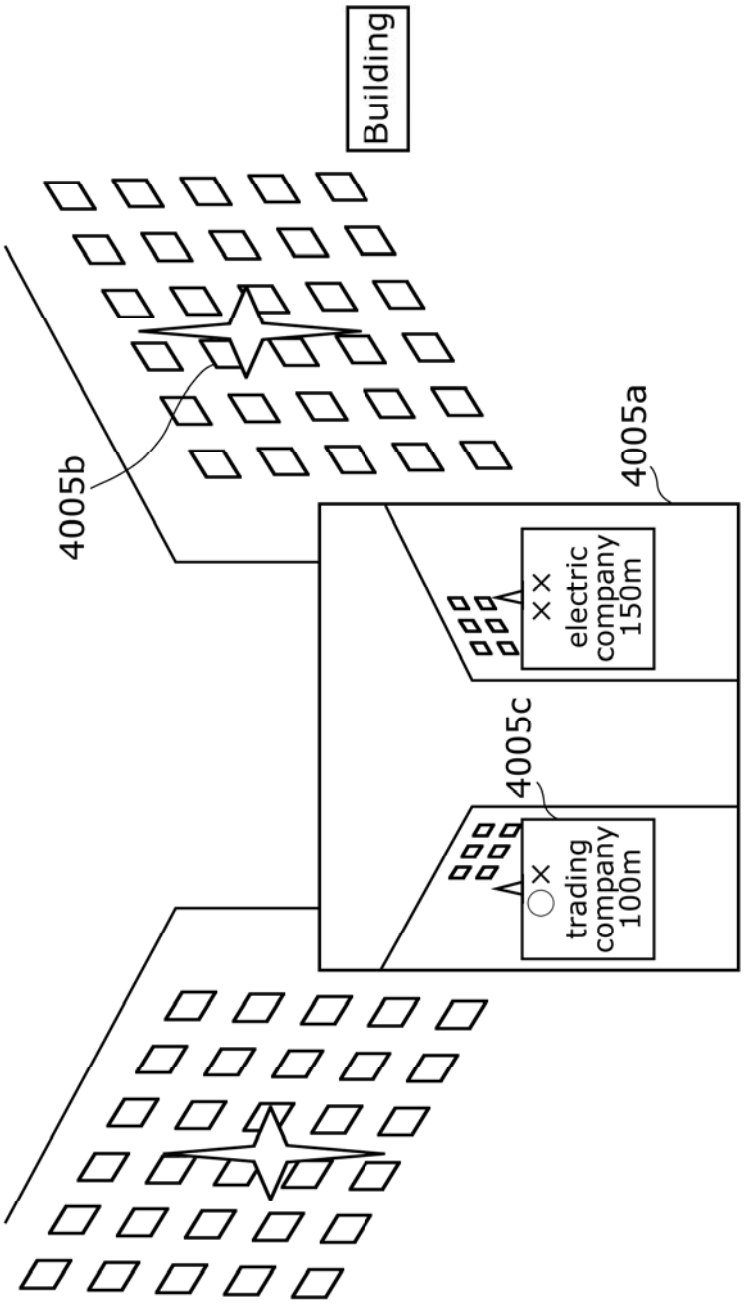

Building
4005b
4005a
XX electric company 150m
4005c
○X trading company 100m

FIG. 180

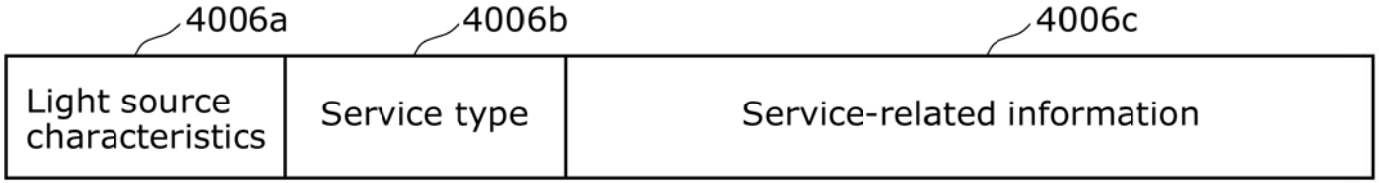

4006a
4006b
4006c
Light source characteristics
Service type
Service-related information

FIG. 181

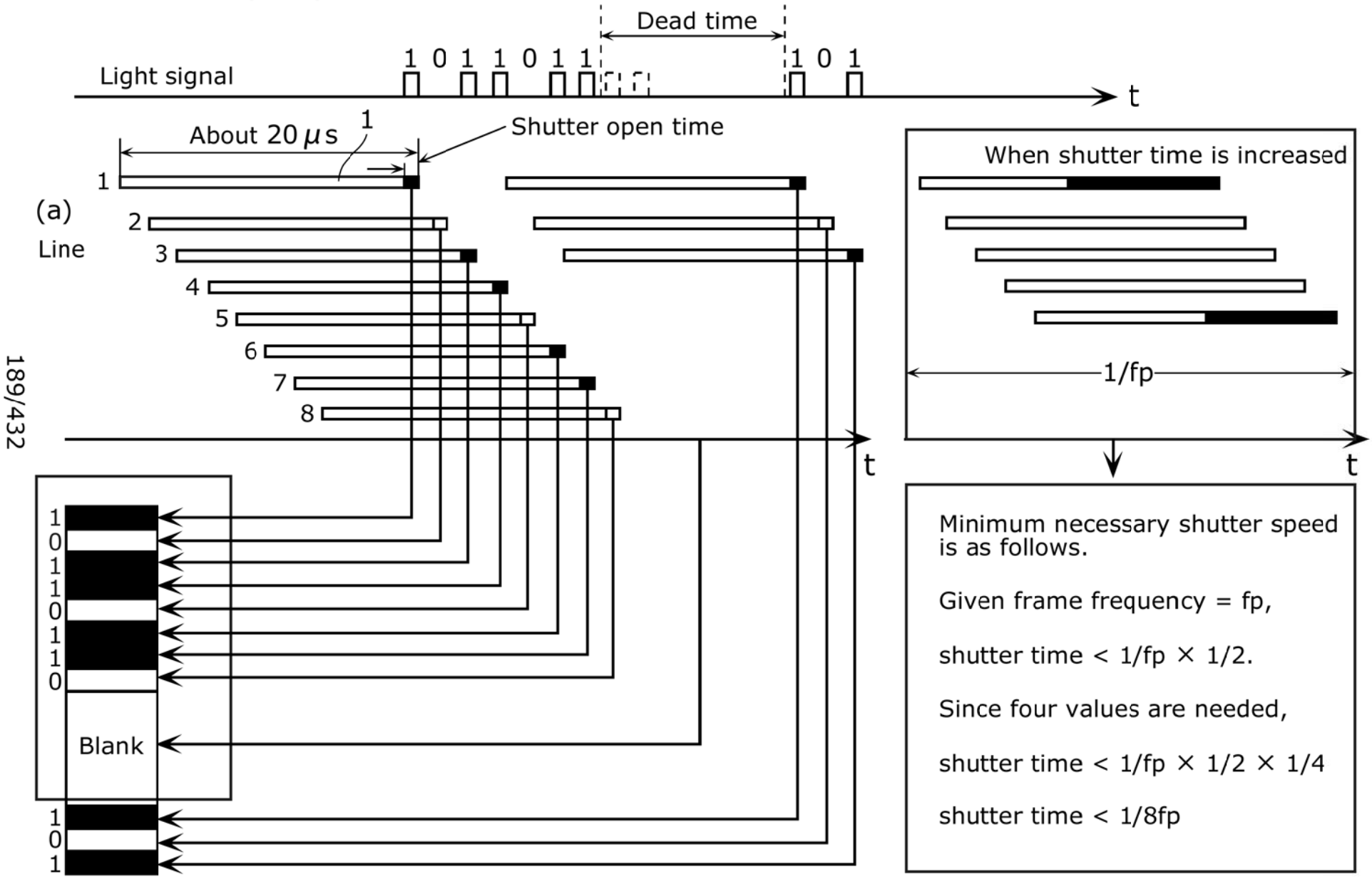

Dead time
Light signal
1 0 1 1 0 1 1
1 0 1
t
About 20 μs
1
Shutter open time
(a)
Line
1
2
3
4
5
6
7
8
t
When shutter time is increased
1/fp
t
1
0
1
1
0
1
1
0
Blank
1
0
1
Minimum necessary shutter speed is as follows.
Given frame frequency = fp,
shutter time < 1/fp × 1/2.
Since four values are needed,
shutter time < 1/fp × 1/2 × 1/4
shutter time < 1/8fp

FIG. 182

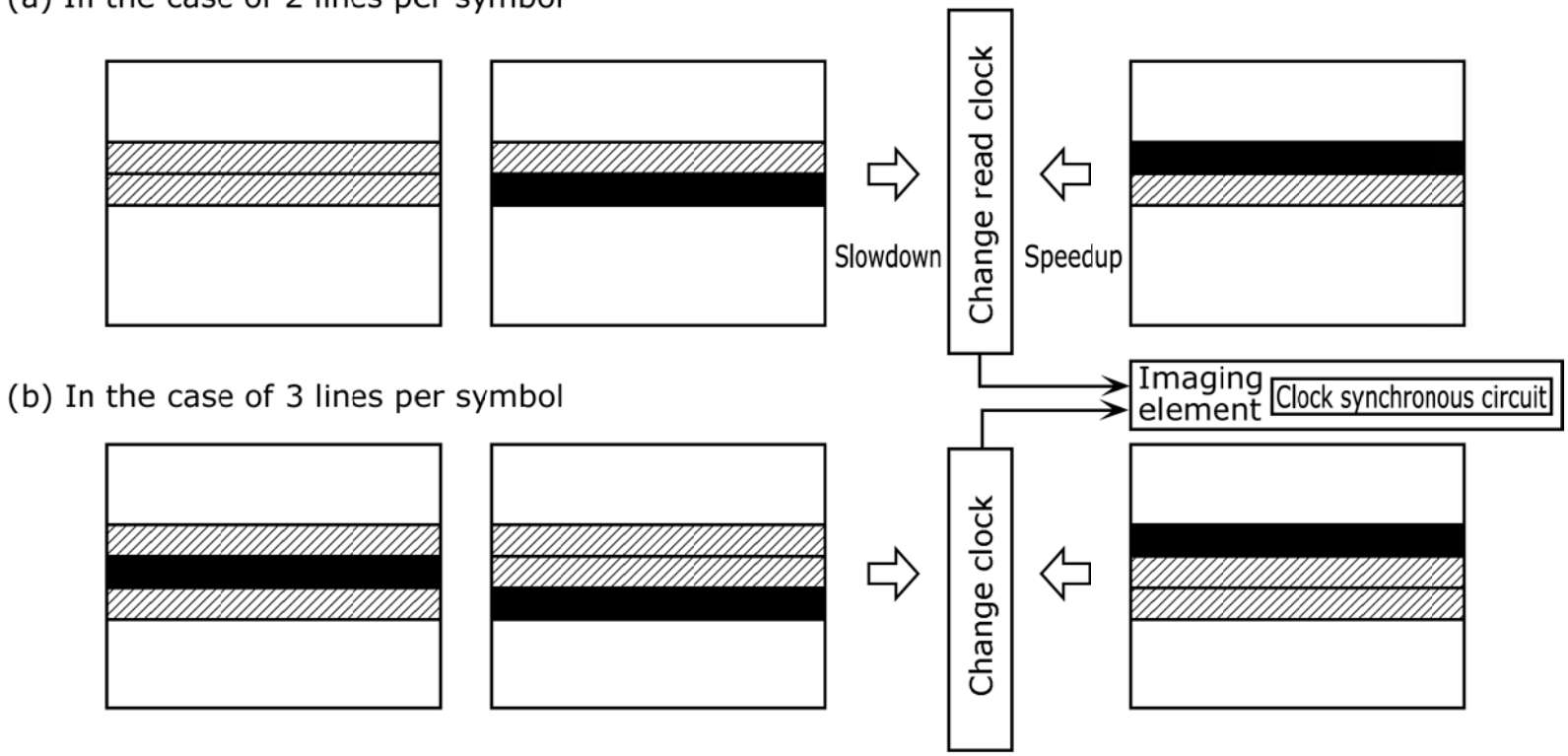

(a) In the case of 2 lines per symbol
Slowdown
Change read clock
Speedup
Imaging element
Clock synchronous circuit
(b) In the case of 3 lines per symbol
Change clock

FIG. 183

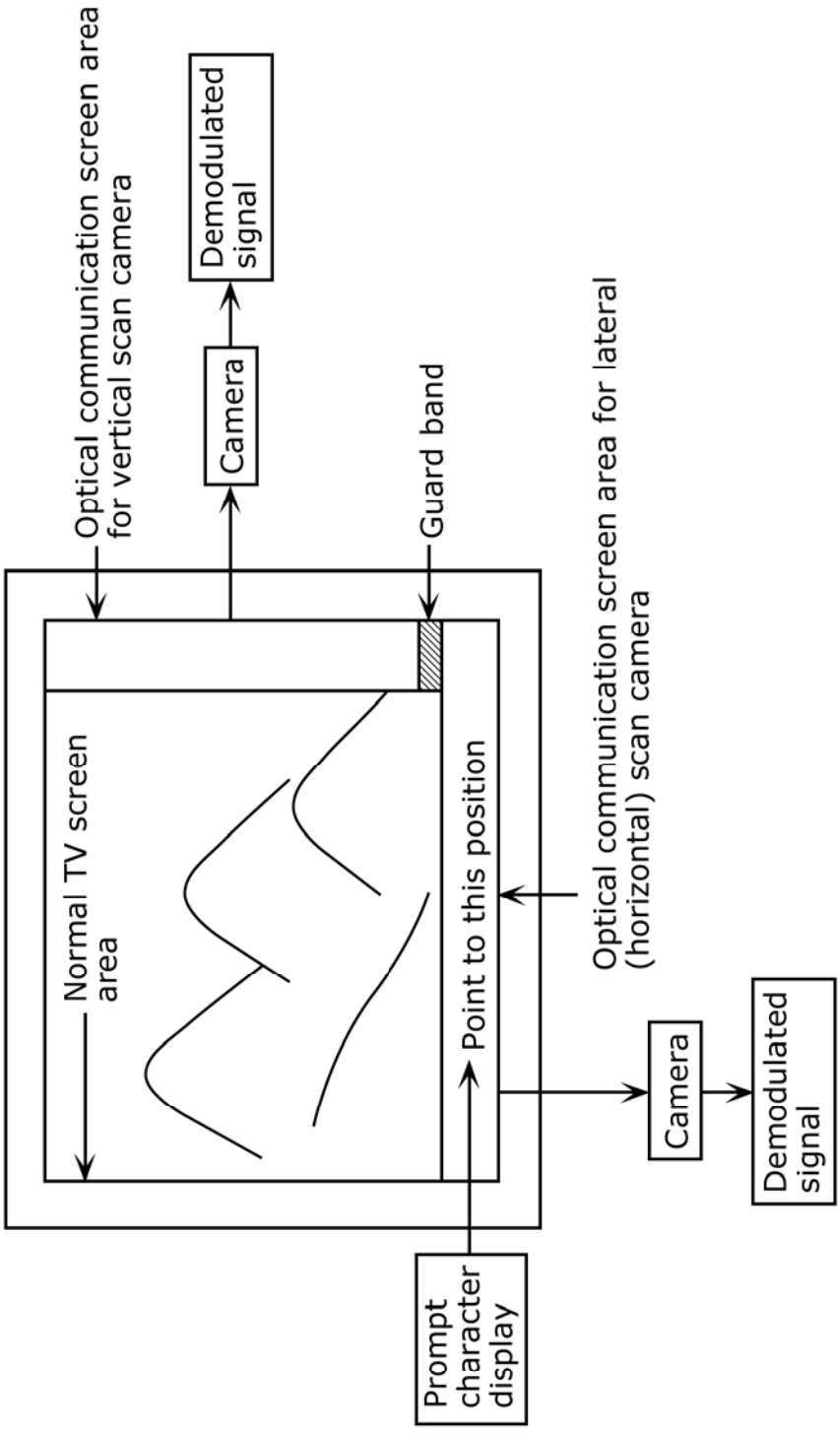

Optical communication screen area for vertical scan camera
Demodulated signal
Camera
Guard band
Normal TV screen area
Point to this position
Optical communication screen area for lateral (horizontal) scan camera
Camera
Demodulated signal
Prompt character display

FIG. 184

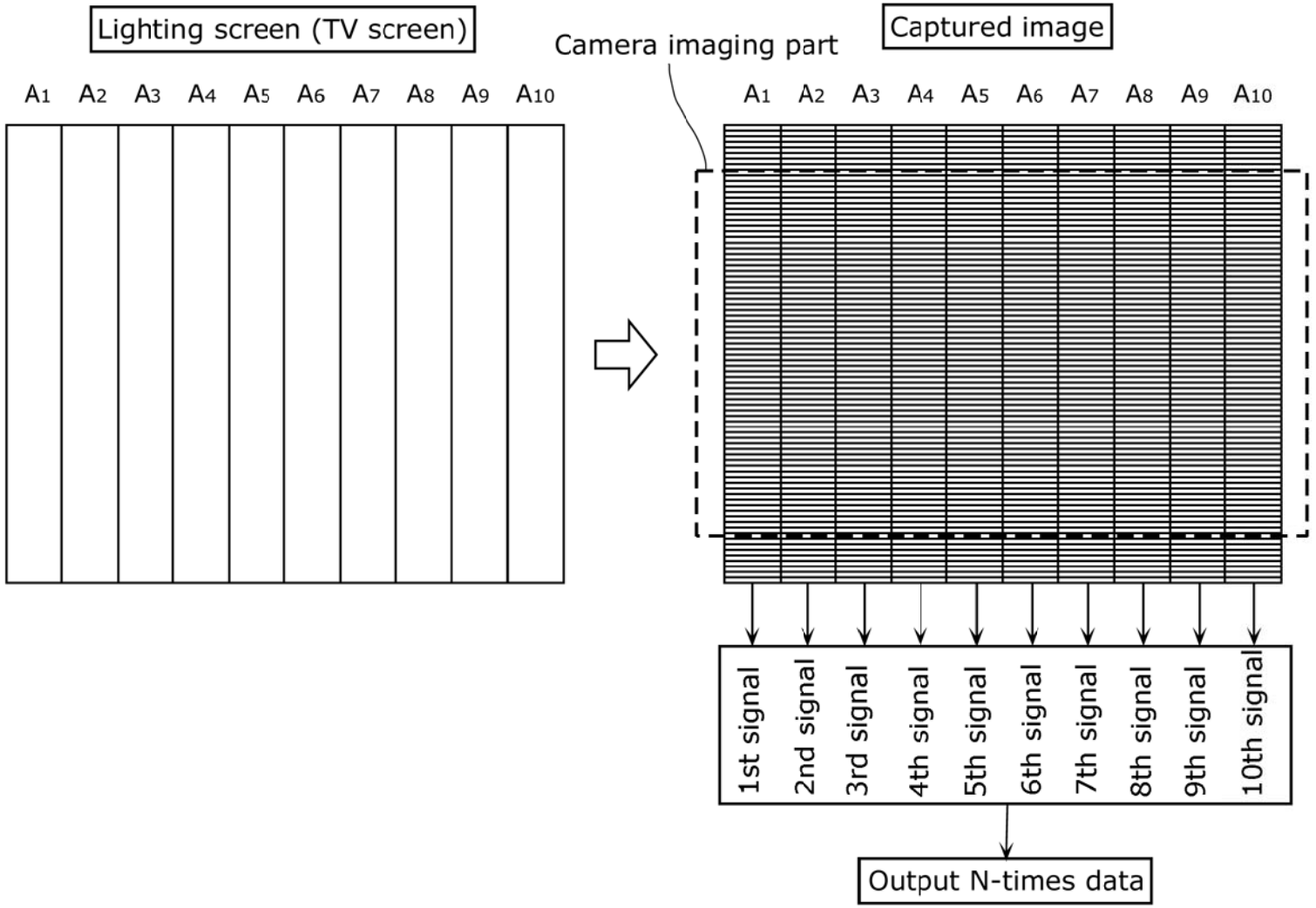

Lighting screen (TV screen)
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10
Camera imaging part
Captured image
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10
1st signal
2nd signal
3rd signal
4th signal
5th signal
6th signal
7th signal
8th signal
9th signal
10th signal
Output N-times data

FIG. 185

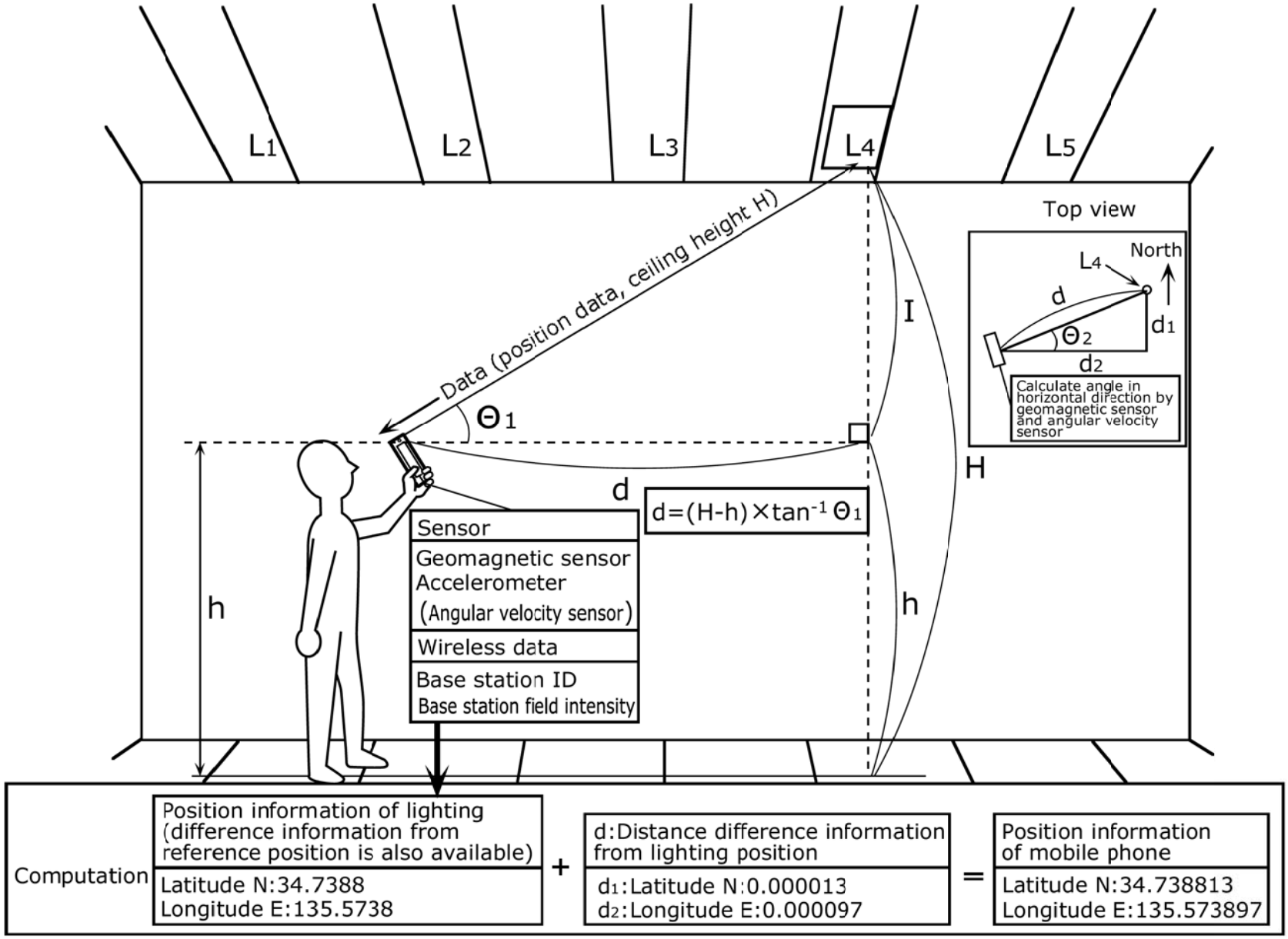

L1
L2
L3
L4
L5
Top view
North
L4
d
d1
Θ2
d2
Calculate angle in horizontal direction by geomagnetic sensor and angular velocity sensor
Data (position data, ceiling height H)
Θ1
I
H
h
h
d
d=(H-h)×tan-1 Θ1
Sensor
Geomagnetic sensor
Accelerometer
(Angular velocity sensor)
Wireless data
Base station ID
Base station field intensity
Computation
Position information of lighting (difference information from reference position is also available)
Latitude N:34.7388
Longitude E:135.5738
+
d:Distance difference information from lighting position
d1:Latitude N:0.000013
d2:Longitude E:0.000097
=
Position information of mobile phone
Latitude N:34.738813
Longitude E:135.573897

FIG. 186A

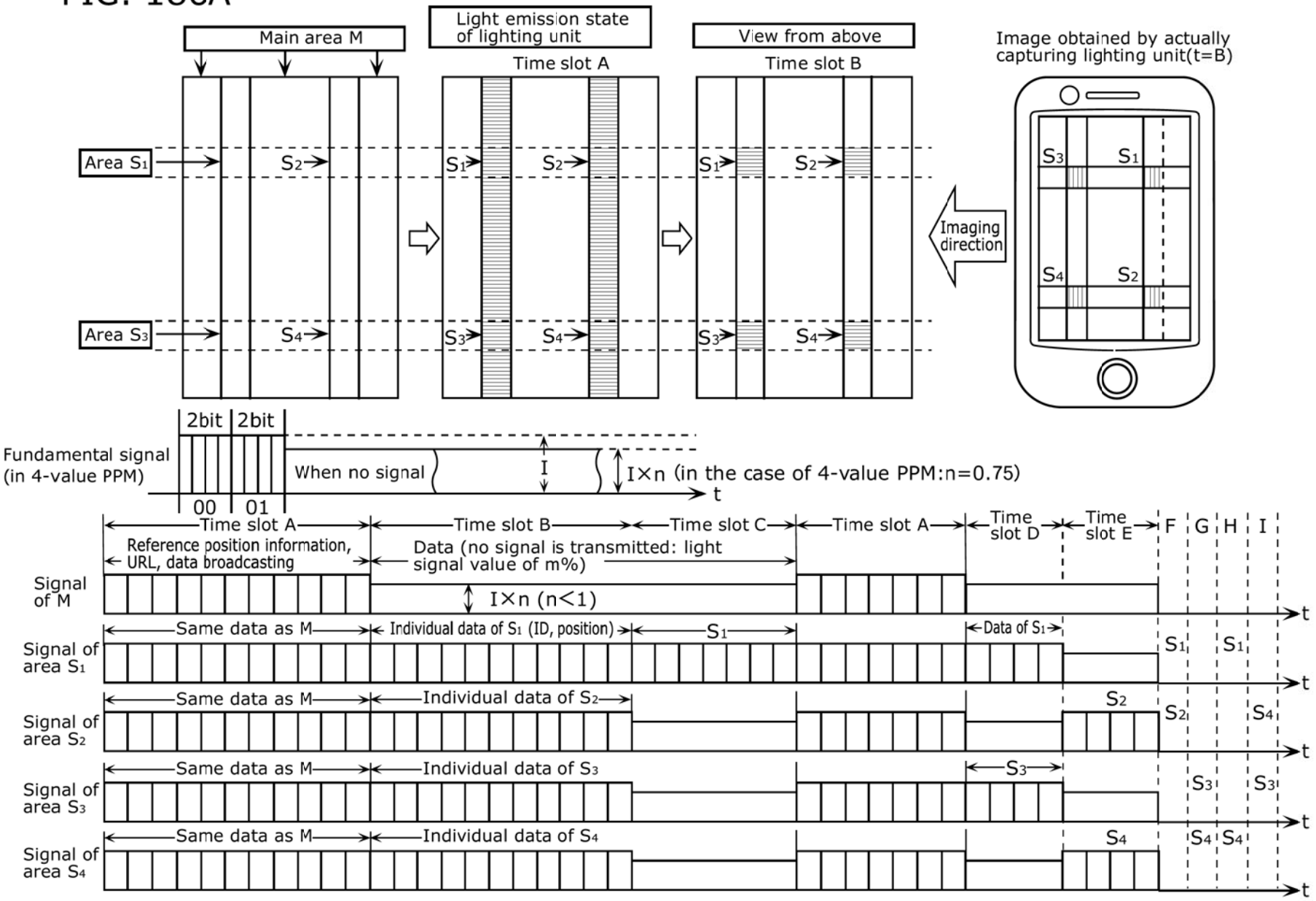

Main area M
Light emission state of lighting unit
Time slot A
View from above
Time slot B
Image obtained by actually capturing lighting unit(t=B)
Area S1
Area S3
Imaging direction
2bit
2bit
Fundamental signal (in 4-value PPM)
When no signal
I
I×n (in the case of 4-value PPM:n=0.75)
00
01
t
Time slot A
Time slot B
Time slot C
Time slot A
Time slot D
Time slot E
F
G
H
I
Reference position information, URL, data broadcasting
Data (no signal is transmitted: light signal value of m%)
Signal of M
I×n (n<1)
Same data as M
Individual data of S1 (ID, position)
Data of S1
Signal of area S1
Individual data of S2
Signal of area S2
Individual data of S3
Signal of area S3
Individual data of S4
Signal of area S4

FIG. 186B

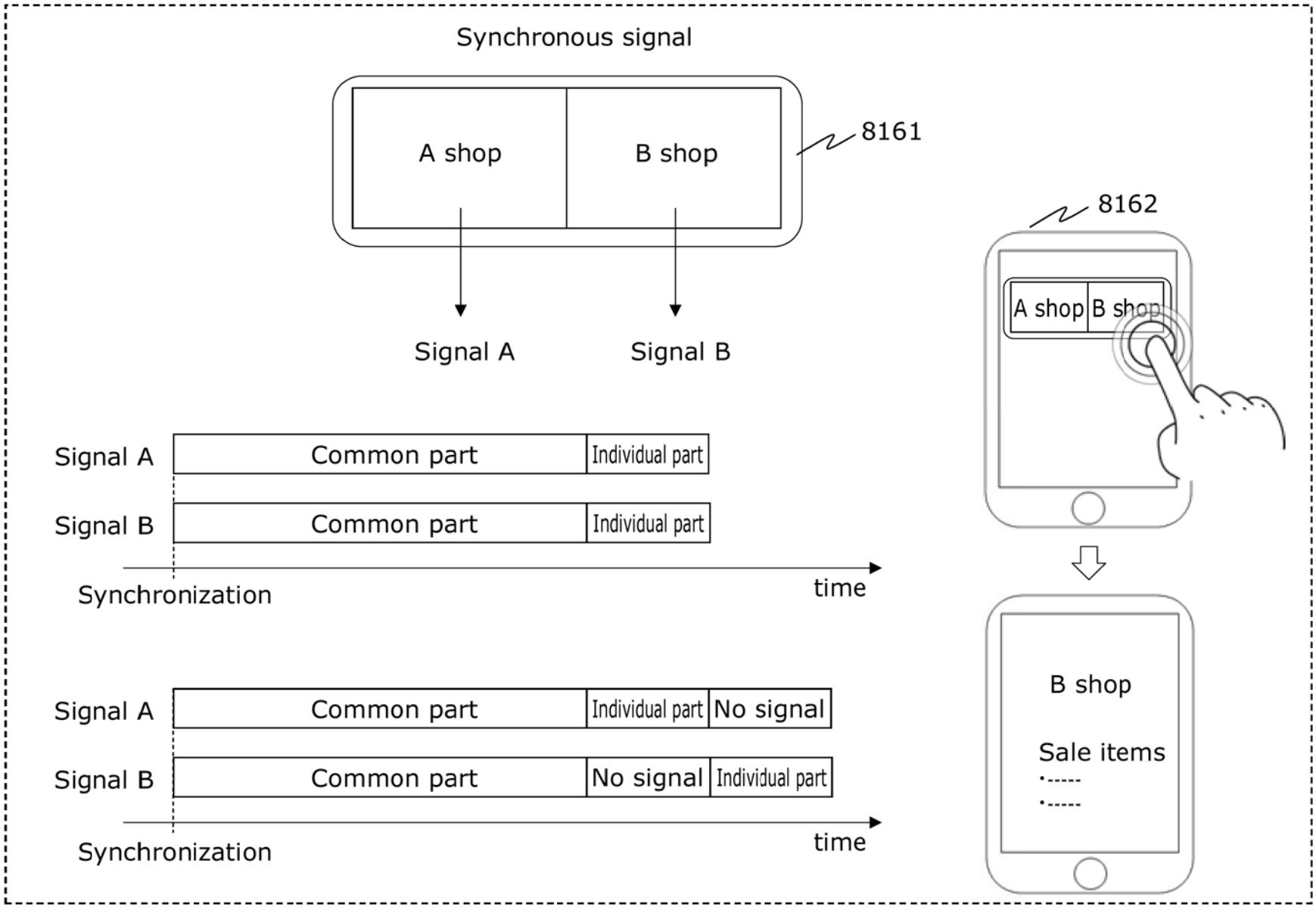

Synchronous signal
A shop
B shop
8161
Signal A
Signal B
8162
A shop
B shop
Signal A
Common part
Individual part
Signal B
Common part
Individual part
Synchronization
time
B shop
Sale items
•-----
•-----
Signal A
Common part
Individual part
No signal
Signal B
Common part
No signal
Individual part
Synchronization
time

FIG. 186C

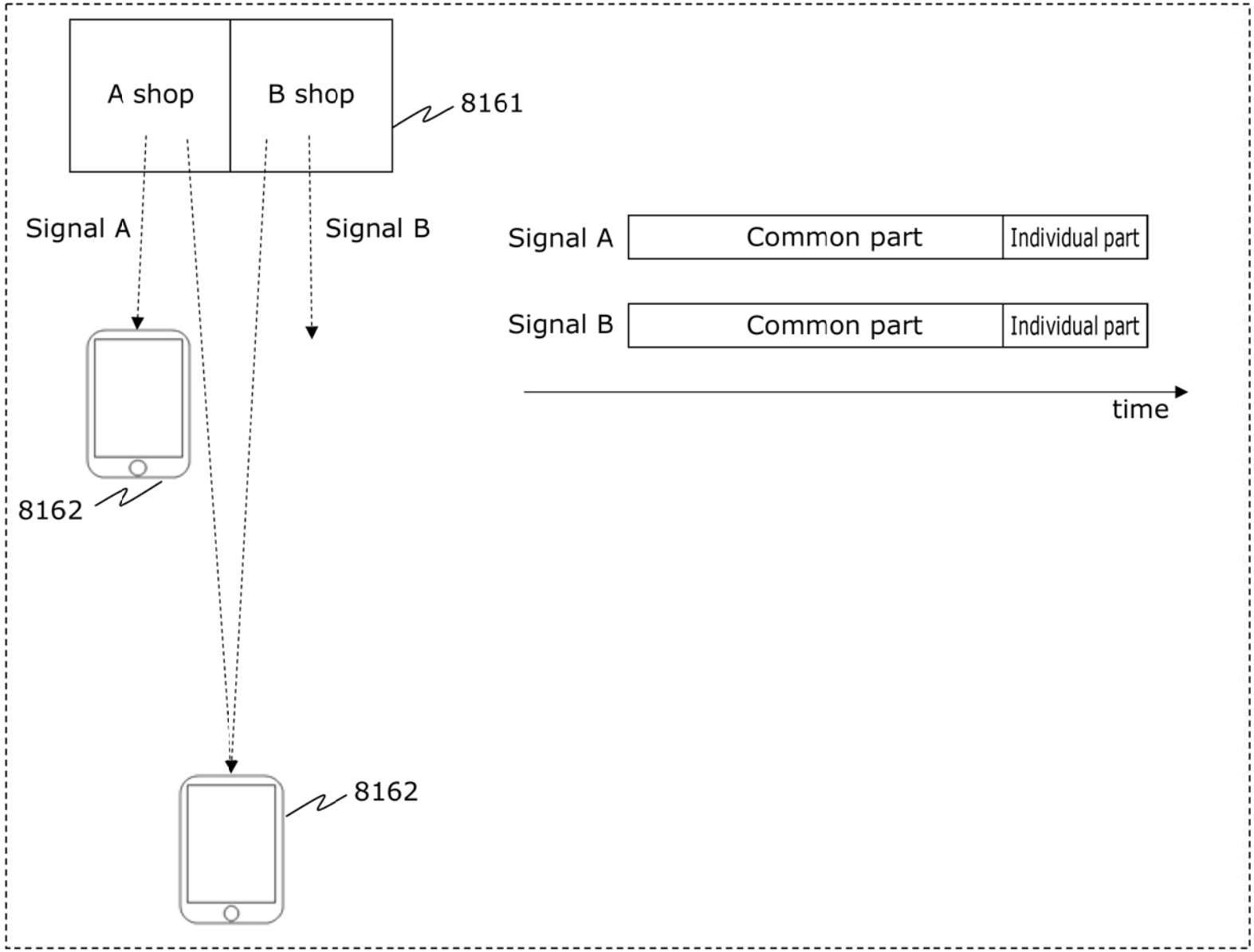

A shop
B shop
8161
Signal A
Signal B
8162
8162
Signal A
Common part
Individual part
Signal B
Common part
Individual part
time

FIG. 187

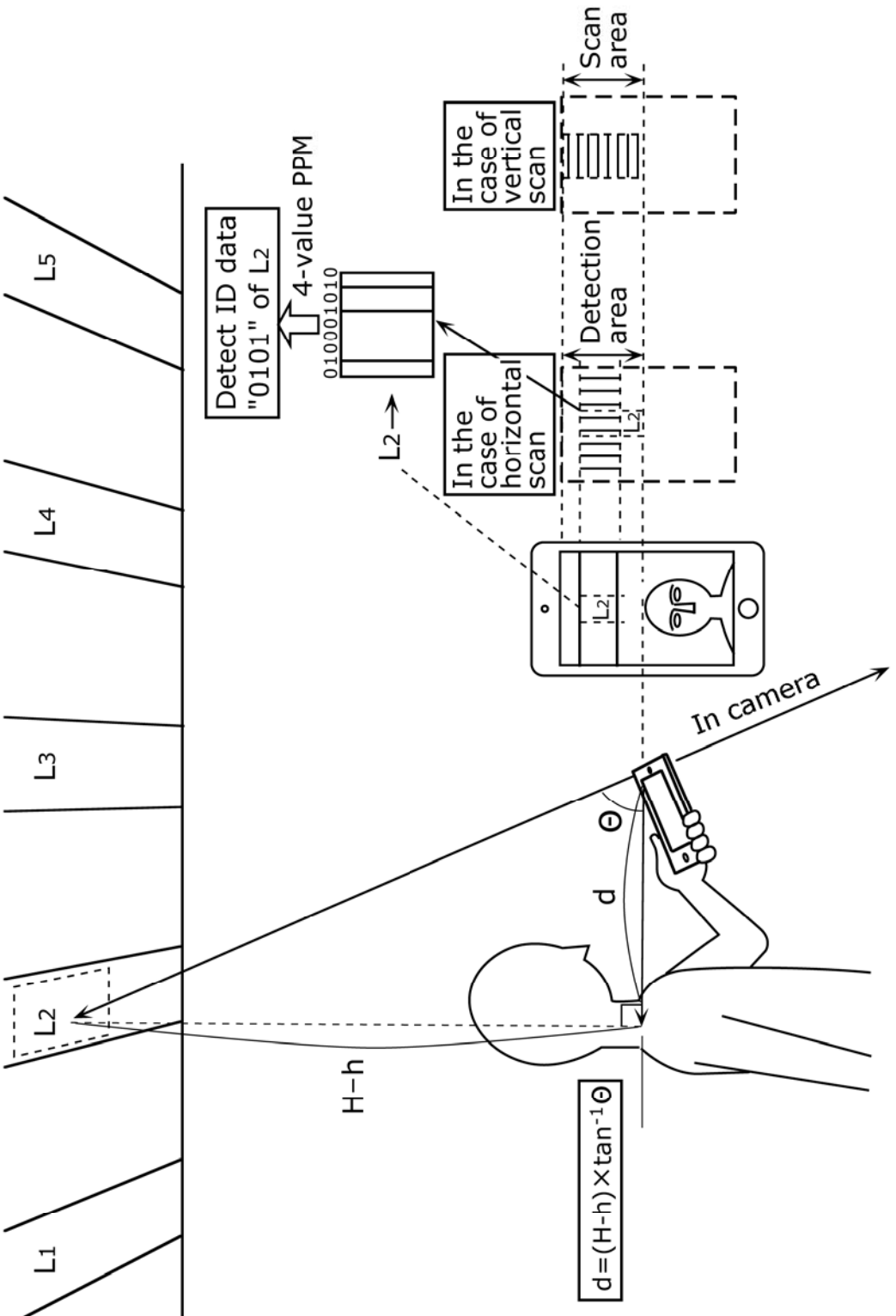

L1
L2
L3
L4
L5
H−h
d=(H-h)×tan⁻¹Θ
d
Θ
In camera
L2'
Detect ID data "0101" of L2
4-value PPM
0100010010
L2
In the case of horizontal scan
Detection area
In the case of vertical scan
Scan area

FIG. 188

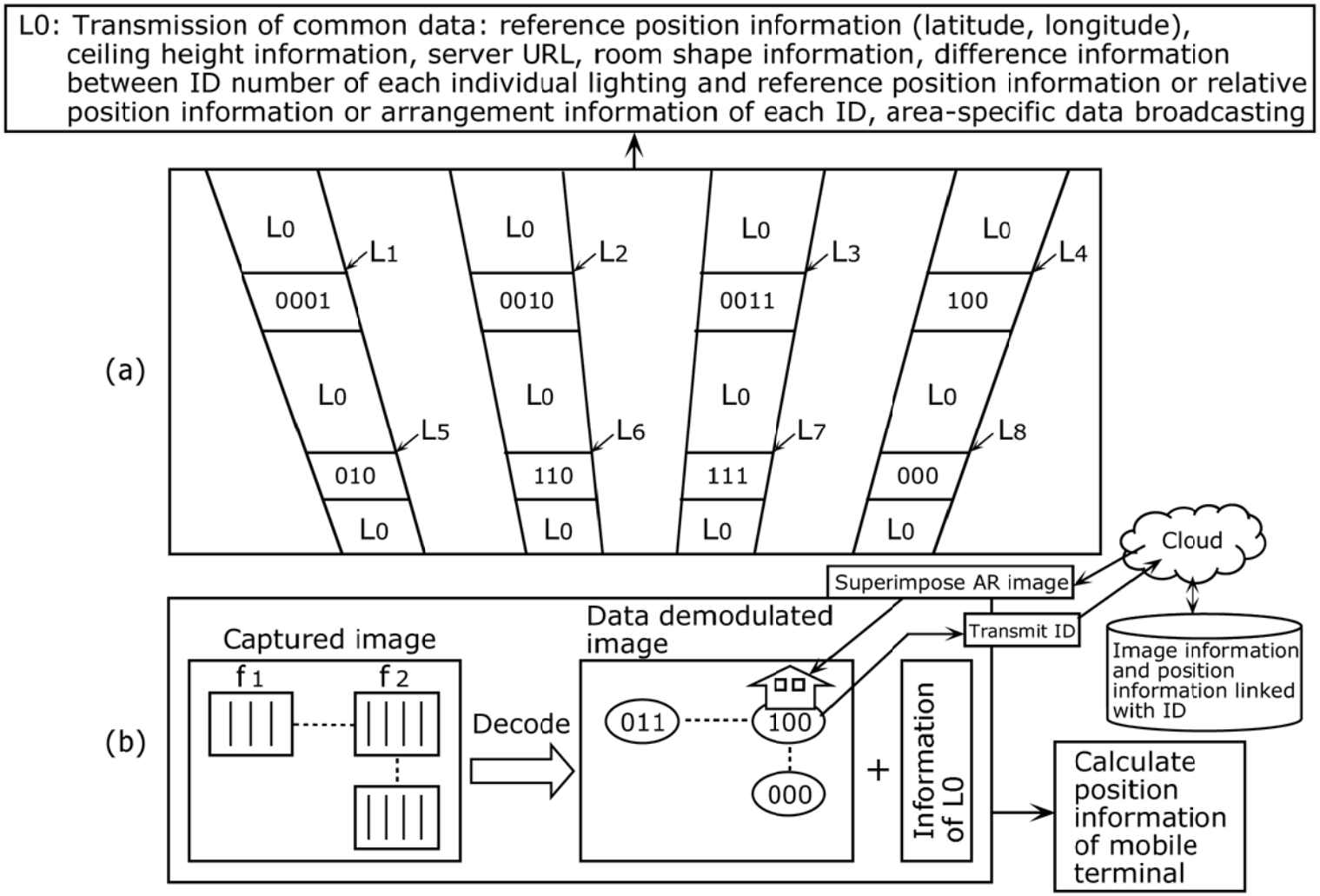

L0: Transmission of common data: reference position information (latitude, longitude), ceiling height information, server URL, room shape information, difference information between ID number of each individual lighting and reference position information or relative position information or arrangement information of each ID, area-specific data broadcasting
(a)
L0
L1
0001
L0
L5
010
L0
L0
L2
0010
L0
L6
110
L0
L0
L3
0011
L0
L7
111
L0
L0
L4
100
L0
L8
000
L0
(b)
Captured image
f1
f2
Decode
Data demodulated image
011
100
000
+
Information of L0
Superimpose AR image
Transmit ID
Cloud
Image information and position information linked with ID
Calculate position information of mobile terminal

FIG. 189

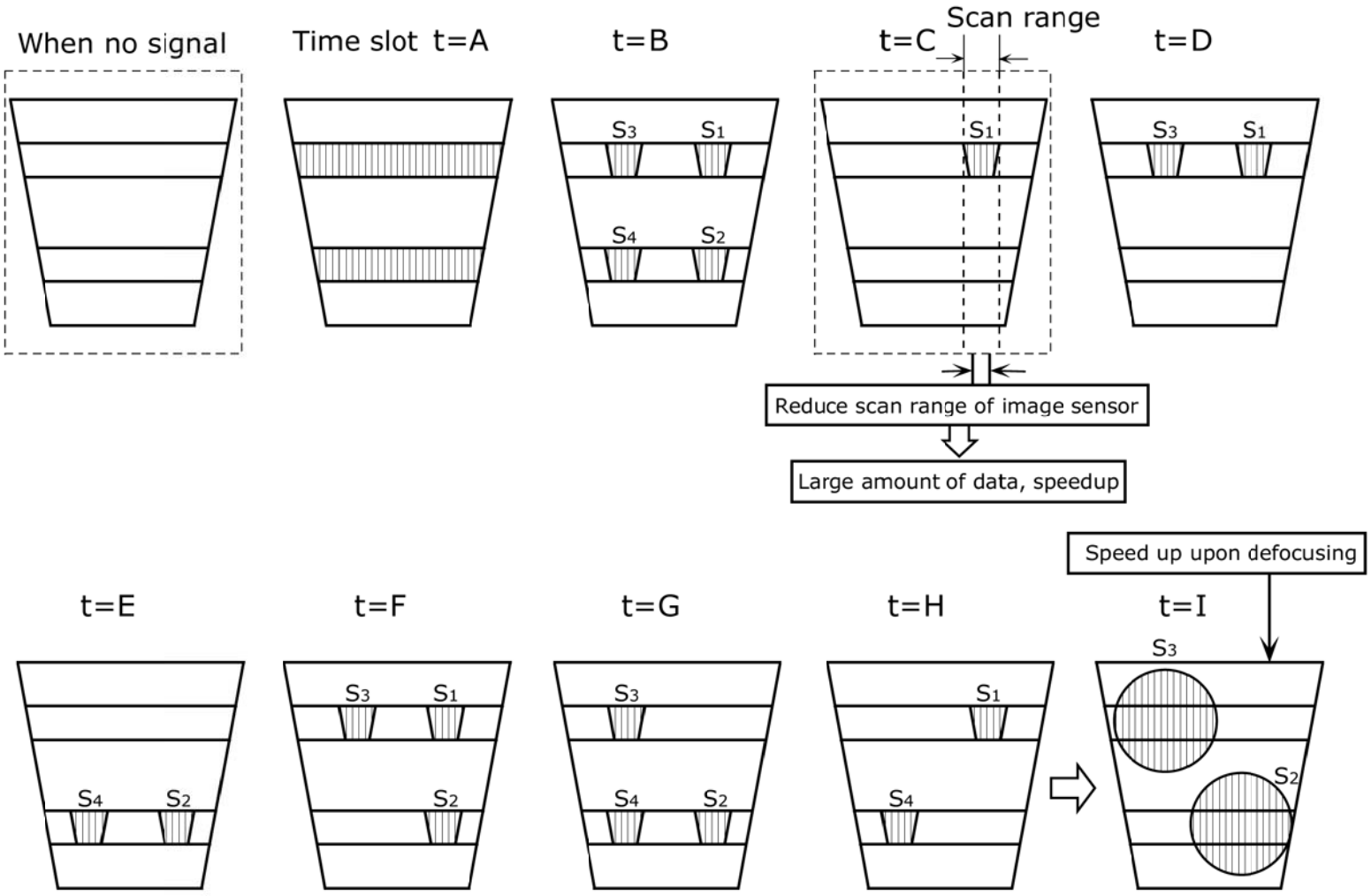

When no signal
Time slot t=A
t=B
t=C
Scan range
t=D
S3
S1
S4
S2
Reduce scan range of image sensor
Large amount of data, speedup
Speed up upon defocusing
t=E
t=F
t=G
t=H
t=I

FIG. 190

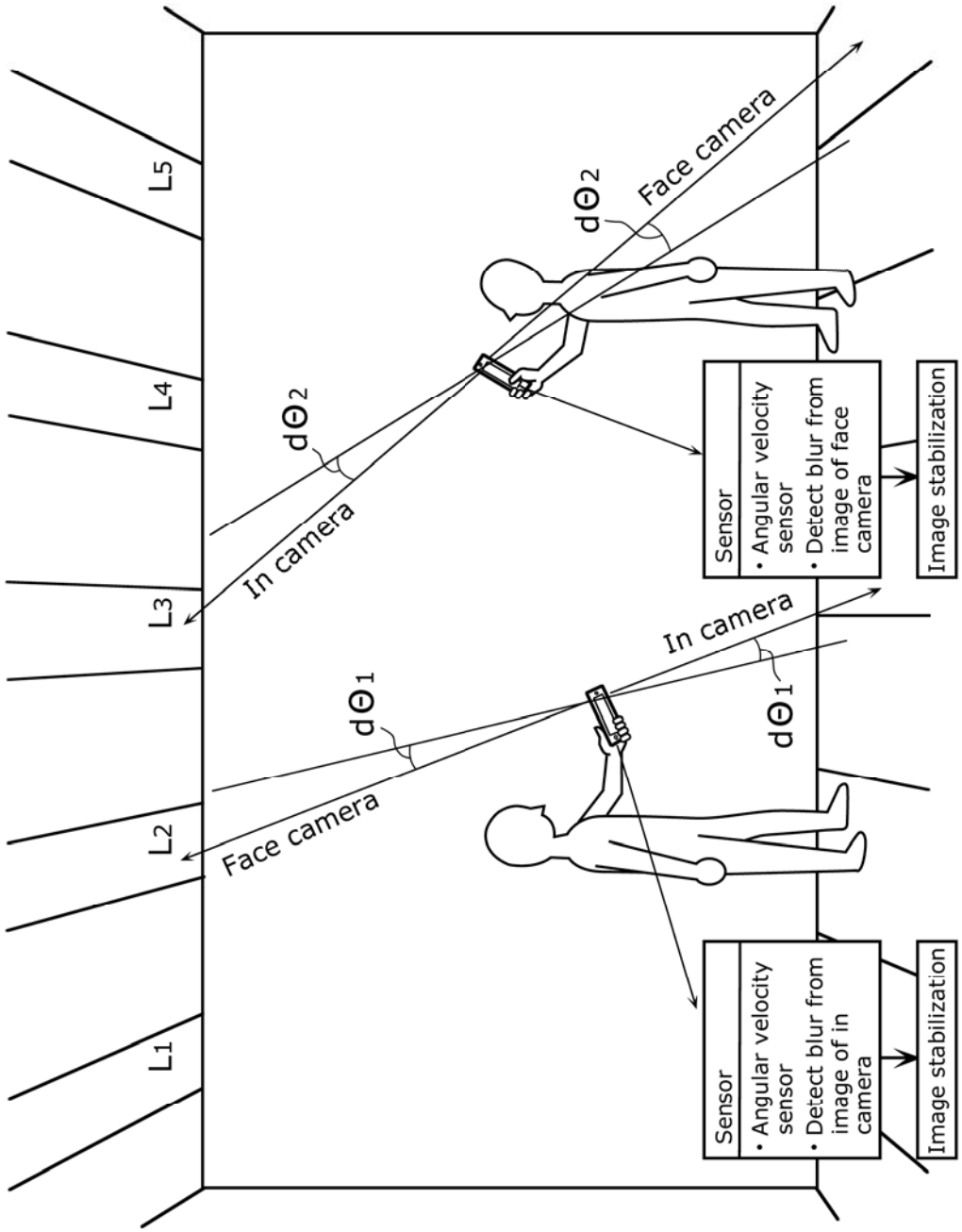

L5
L4
L3
L2
L1
dΘ2
Face camera
dΘ2
In camera
Sensor
• Angular velocity sensor
• Detect blur from image of face camera
Image stabilization
In camera
dΘ1
dΘ1
Face camera
Sensor
• Angular velocity sensor
• Detect blur from image of in camera
Image stabilization

FIG. 191

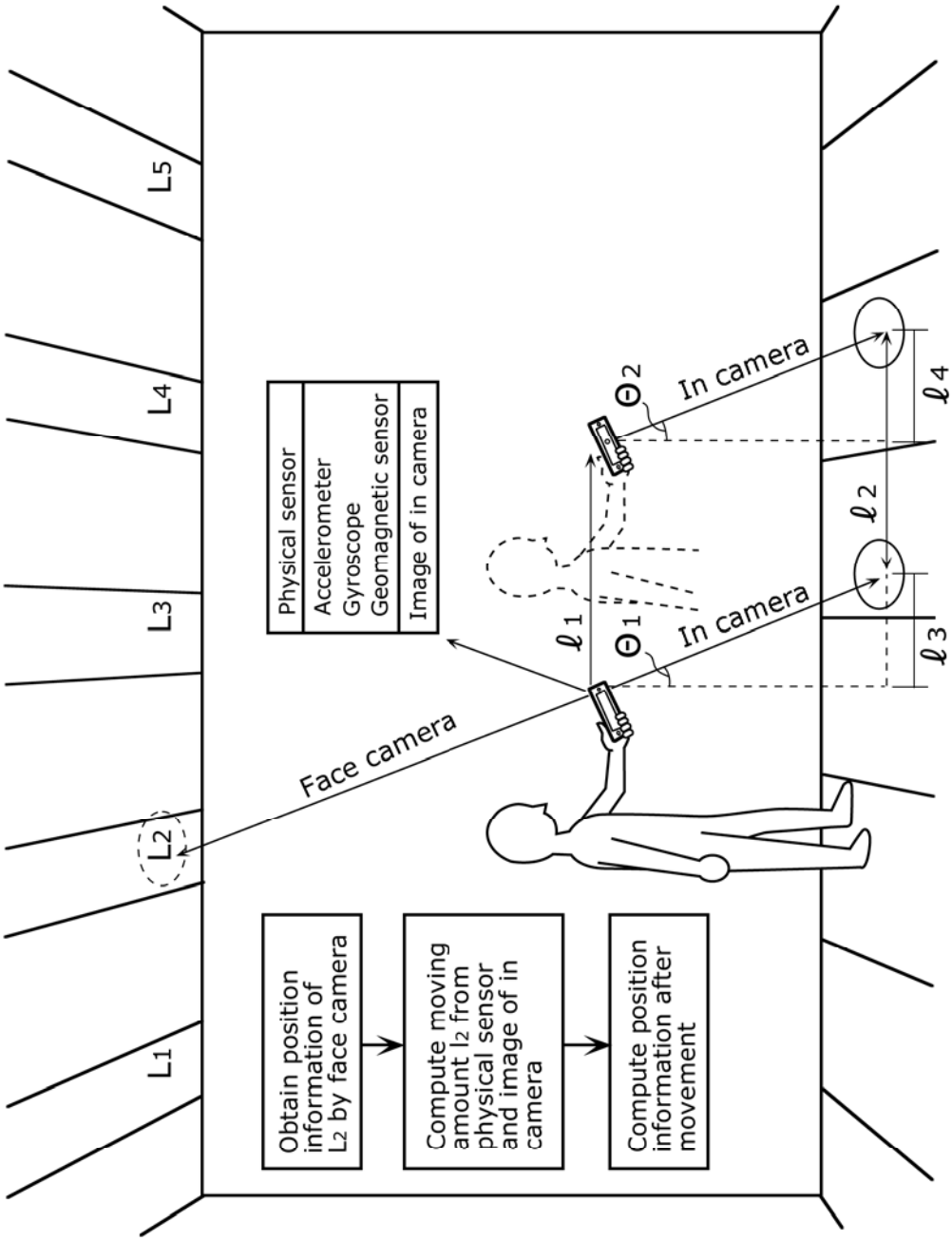

L1
L2
L3
L4
L5
Face camera
Physical sensor
Accelerometer
Gyroscope
Geomagnetic sensor
Image of in camera
In camera
In camera
Θ1
Θ2
ℓ1
ℓ2
ℓ3
ℓ4
Obtain position information of L2 by face camera
Compute moving amount l2 from physical sensor and image of in camera
Compute position information after movement

FIG. 192

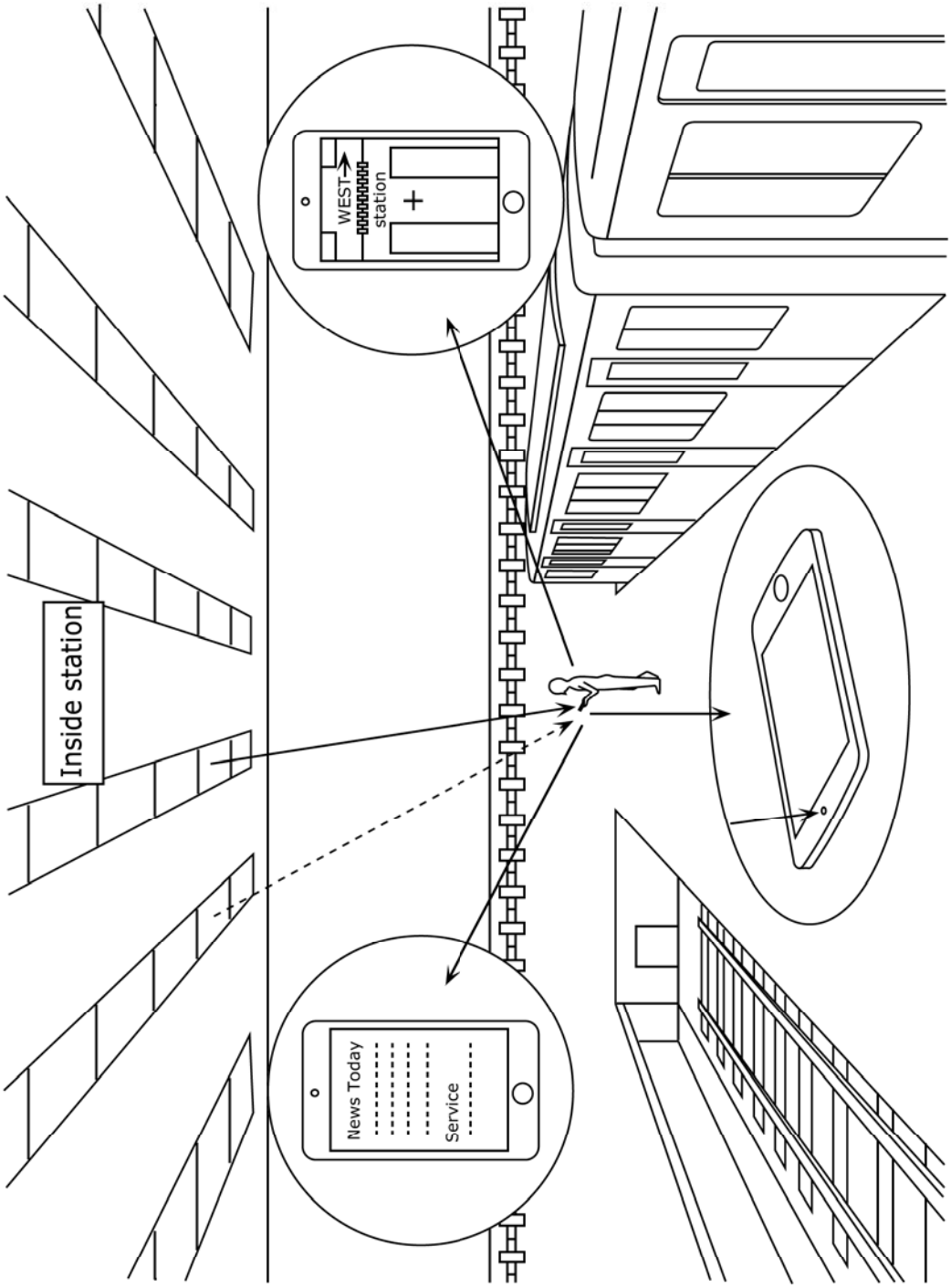


FIG. 193

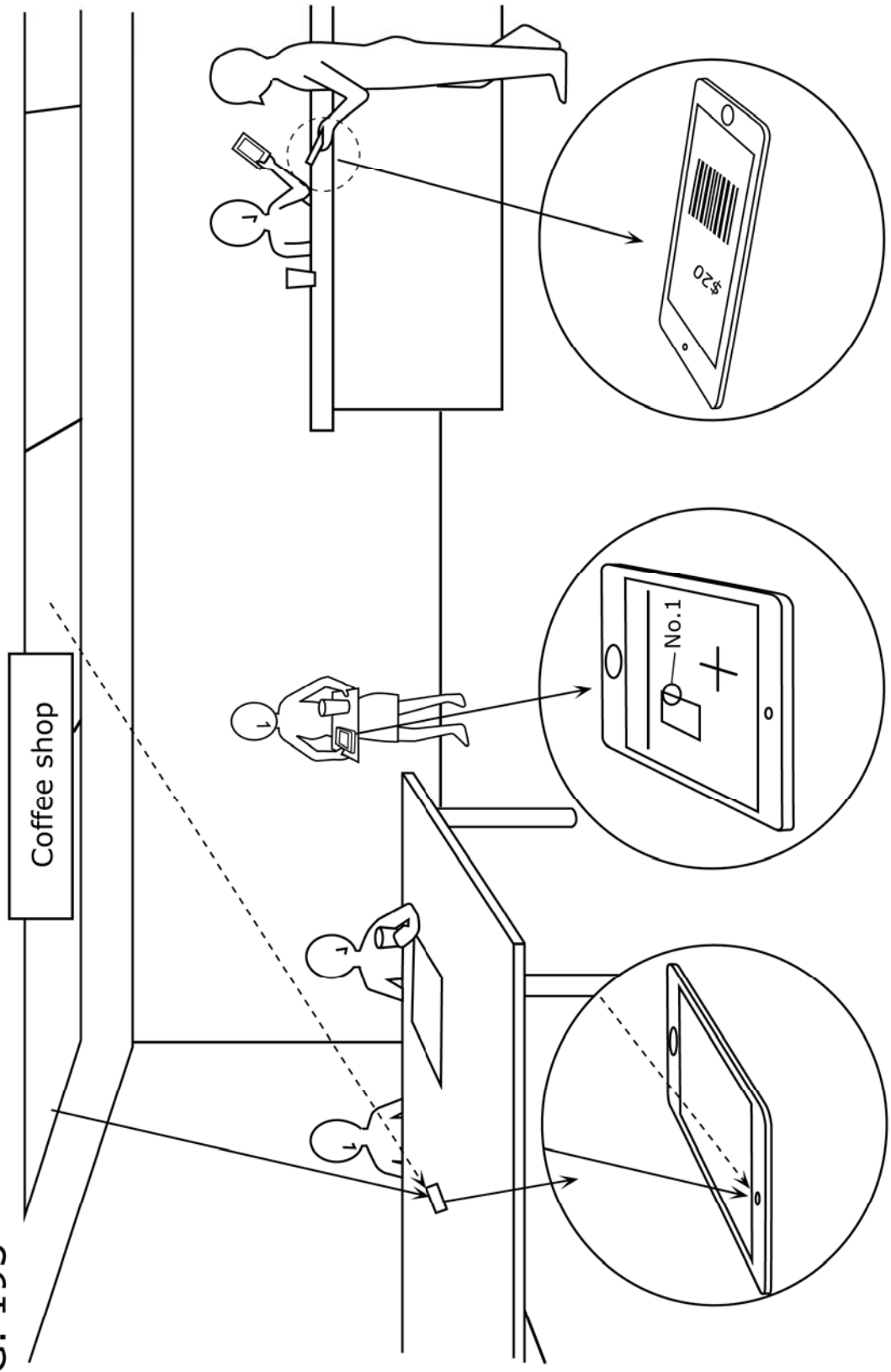


FIG. 194

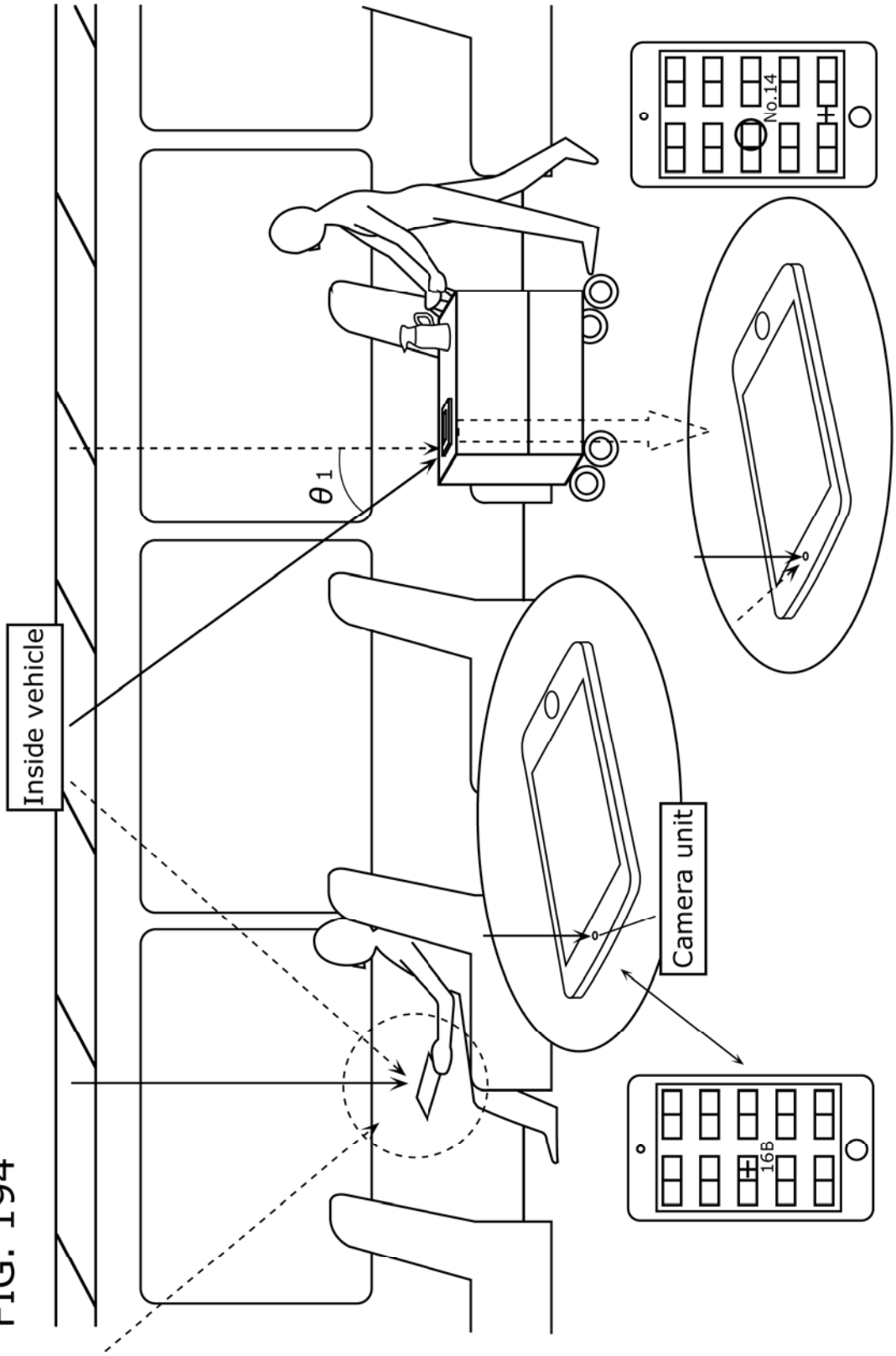


FIG. 195

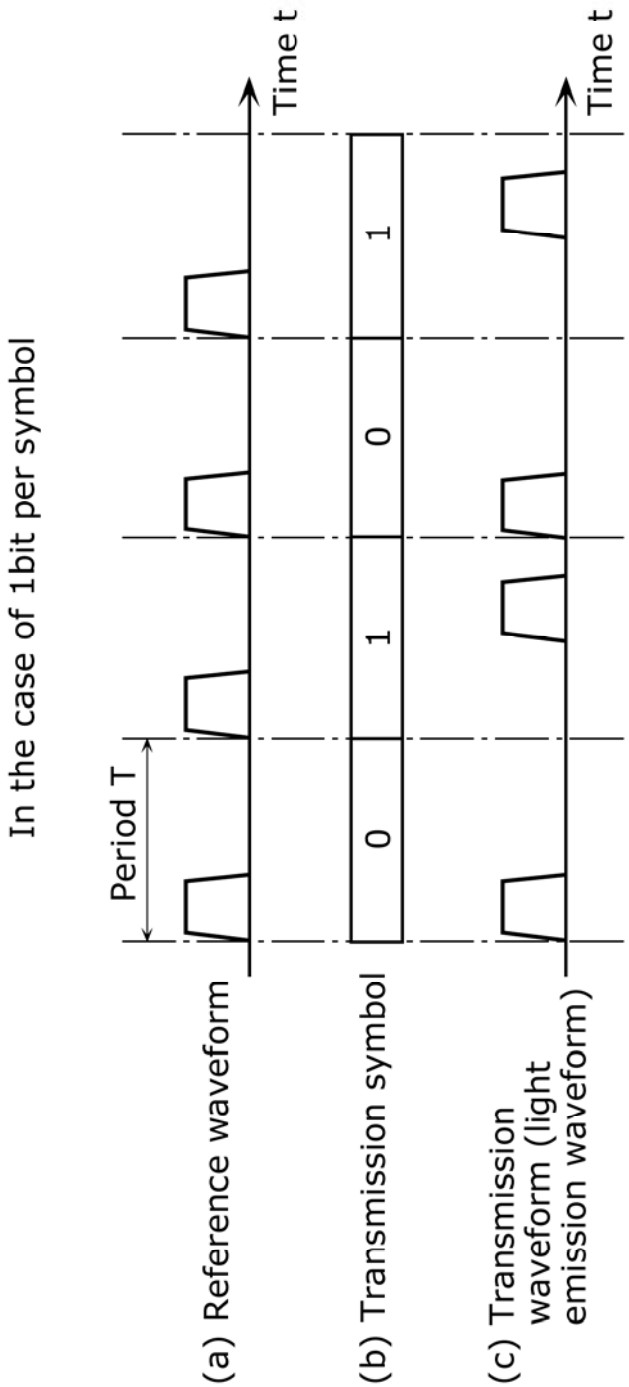

In the case of 1bit per symbol
Period T
Time t
Time t
(a) Reference waveform
(b) Transmission symbol
0
1
0
1
(c) Transmission waveform (light emission waveform)

FIG. 196

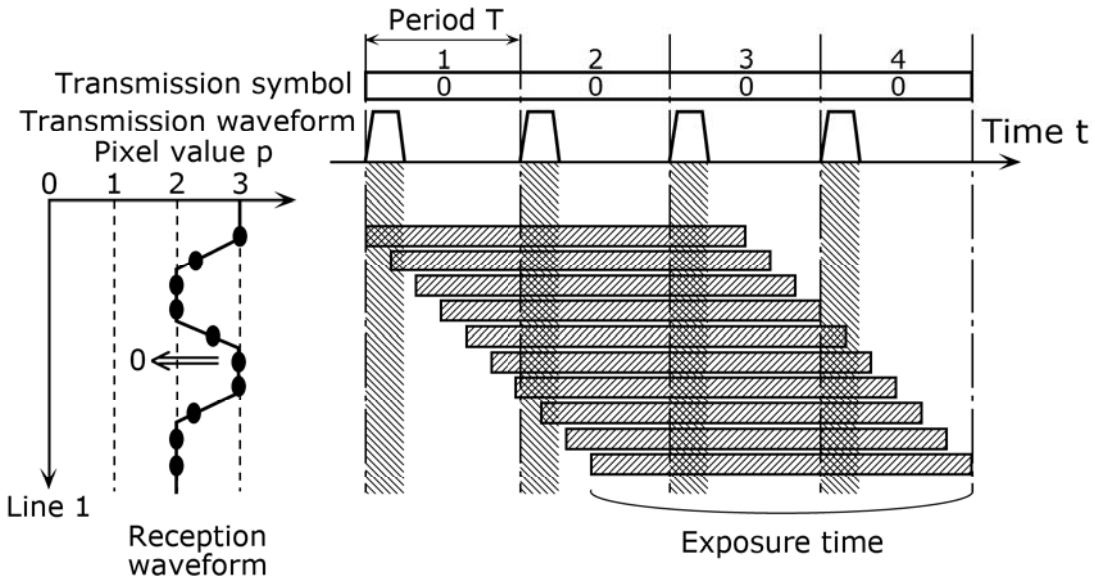

In the case of symbol 0 → 0
Period T
1
2
3
4
Transmission symbol
0
0
0
0
Transmission waveform
Time t
Pixel value p
0
1
2
3
0
Line 1
Reception waveform
Exposure time

FIG. 197

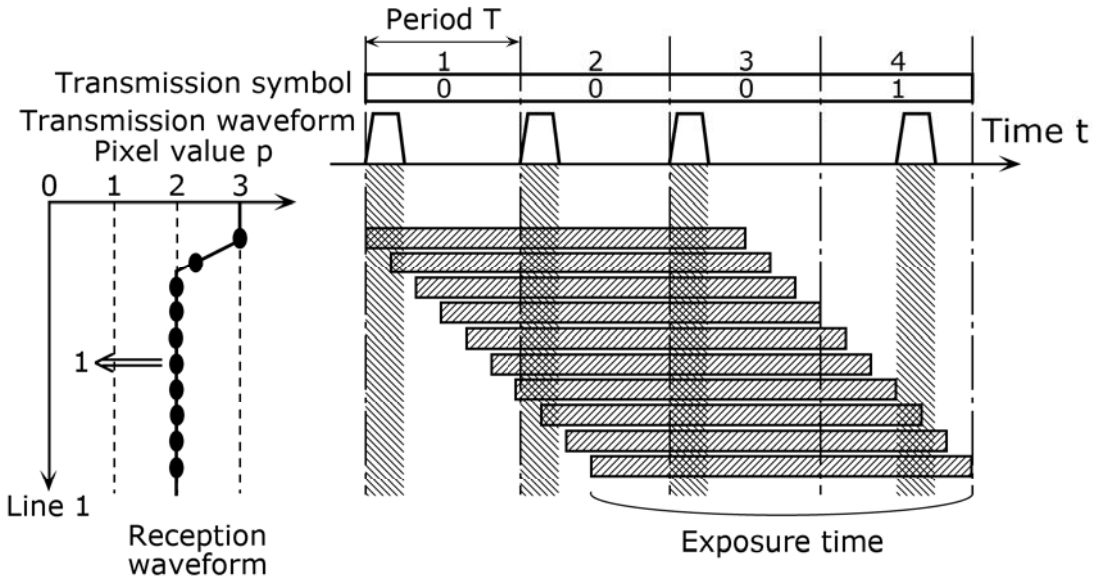

In the case of symbol 0 → 1
Period T
1
2
3
4
Transmission symbol
0
0
0
1
Transmission waveform
Time t
Pixel value p
0
1
2
3
1
Line 1
Reception waveform
Exposure time

FIG. 198

In the case of symbol 1 → 0

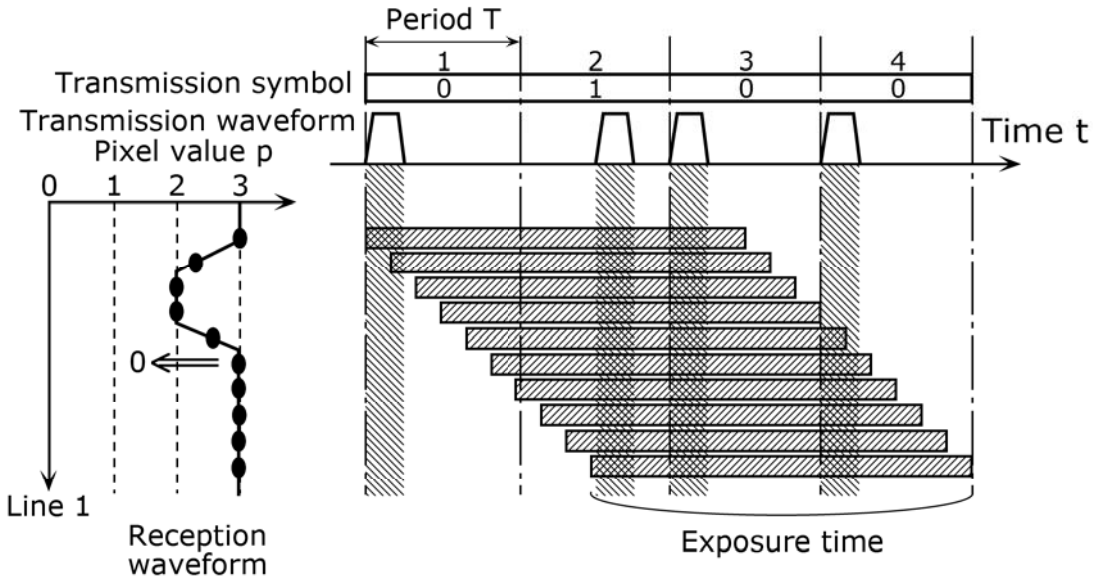


FIG. 199

In the case of symbol 1 → 1

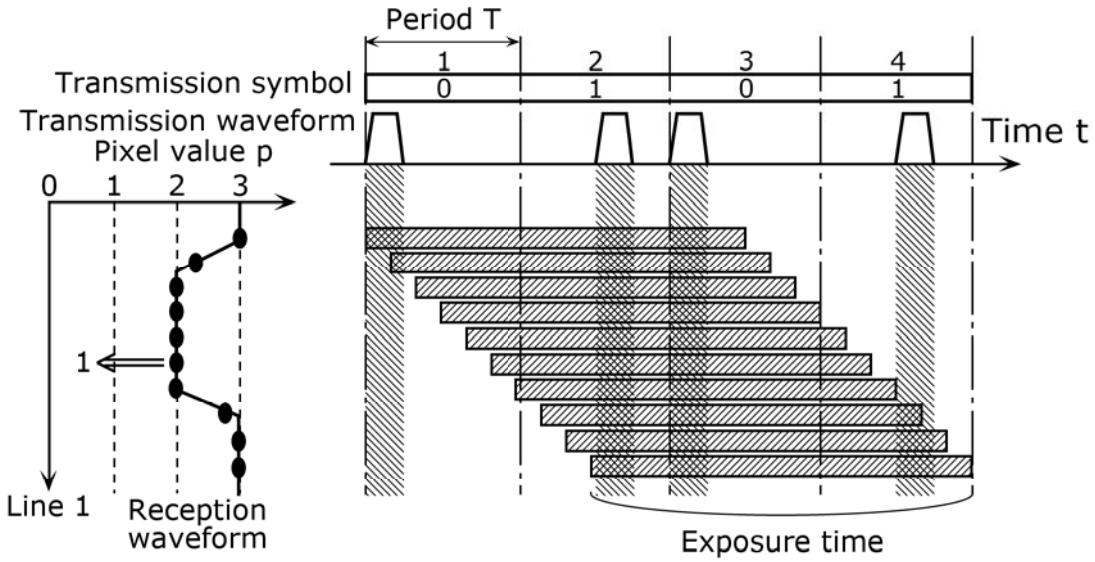


FIG. 200

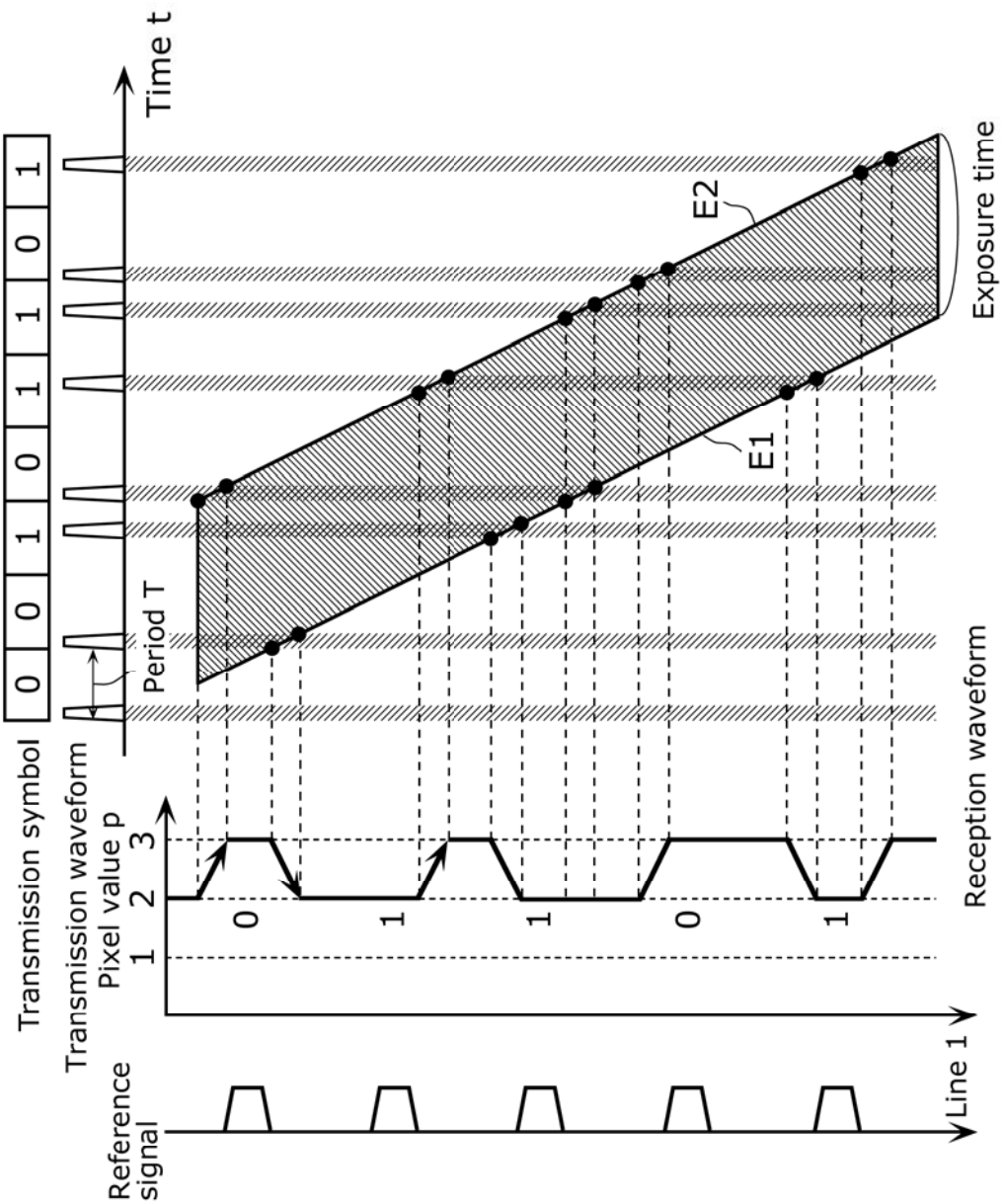

Time t
Transmission symbol
1 2 3 4 5 6 7 8
0 0 1 0 1 1 0 1
Period T
Transmission waveform
Pixel value p
1 2 3
0 1 1 0 1
Reference signal
Line 1
E1
E2
Exposure time
Reception waveform

FIG. 201

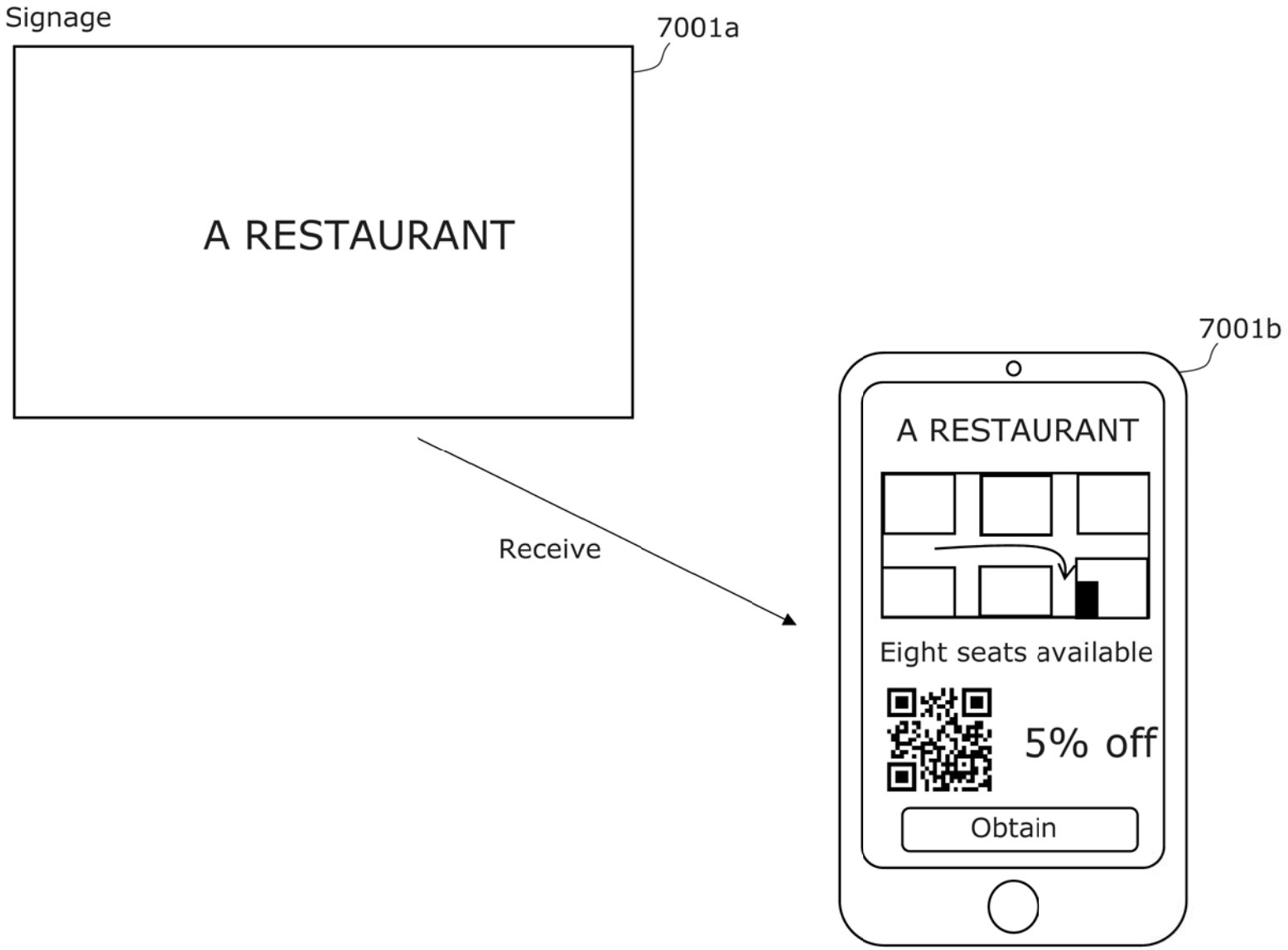

Signage
7001a
A RESTAURANT
Receive
7001b
A RESTAURANT
Eight seats available
5% off
Obtain

FIG. 202

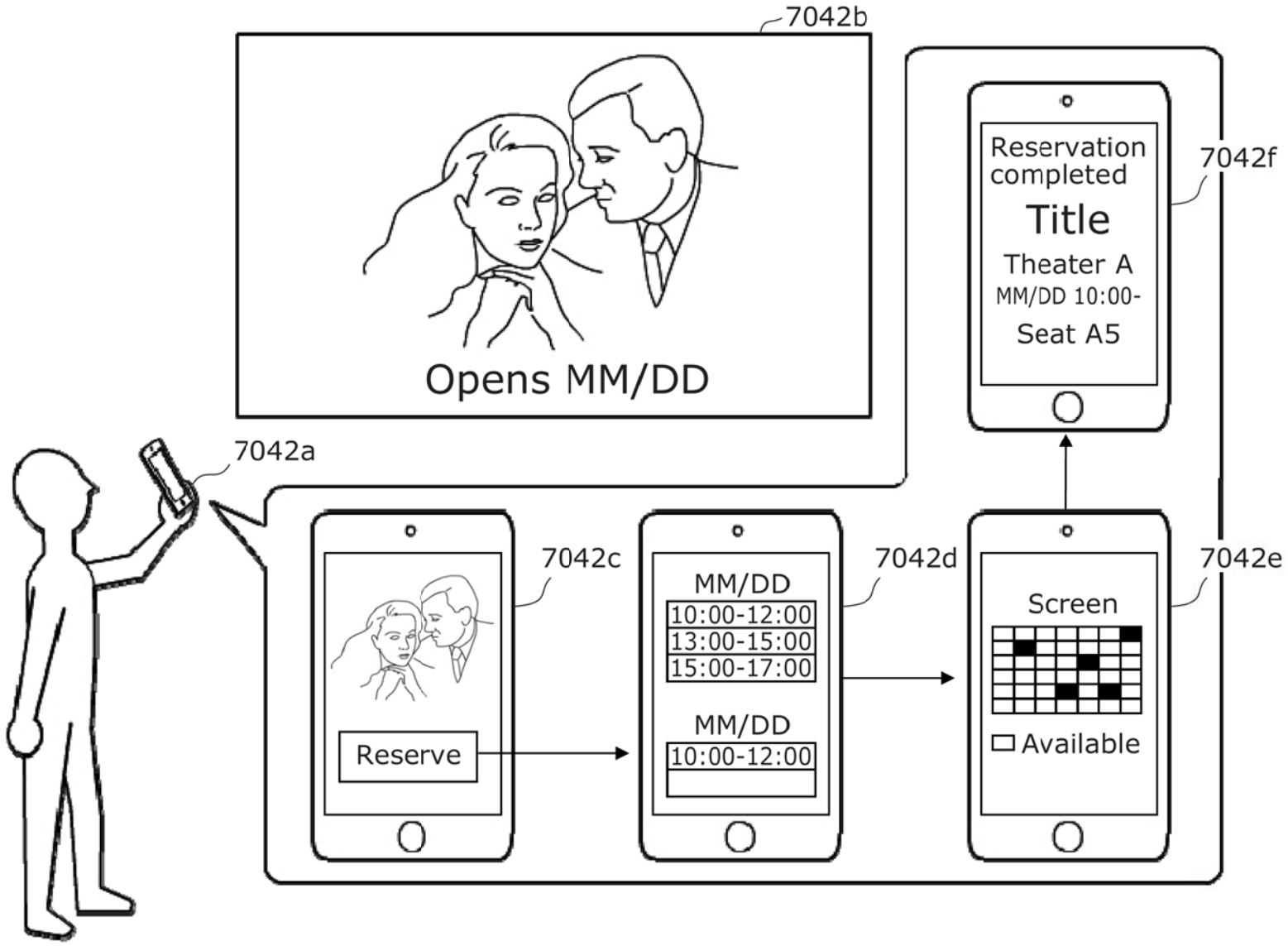

7042b
Opens MM/DD
7042a
7042c
Reserve
7042d
MM/DD
10:00-12:00
13:00-15:00
15:00-17:00
MM/DD
10:00-12:00
7042e
Screen
Available
7042f
Reservation completed
Title
Theater A
MM/DD 10:00-
Seat A5

FIG. 203

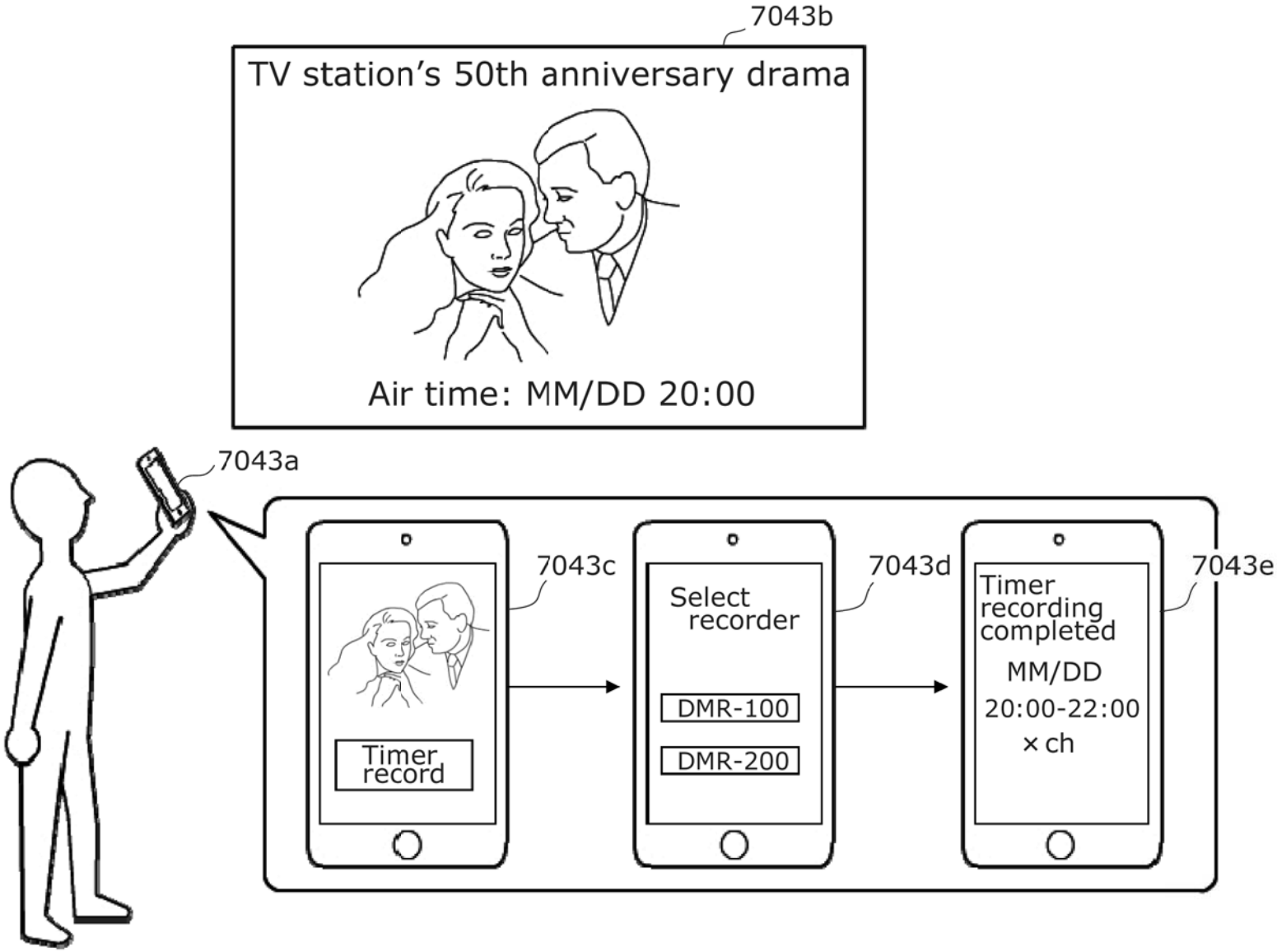

7043b
TV station's 50th anniversary drama
Air time: MM/DD 20:00
7043a
7043c
Timer record
7043d
Select recorder
DMR-100
DMR-200
7043e
Timer recording completed
MM/DD
20:00-22:00
× ch

FIG. 204

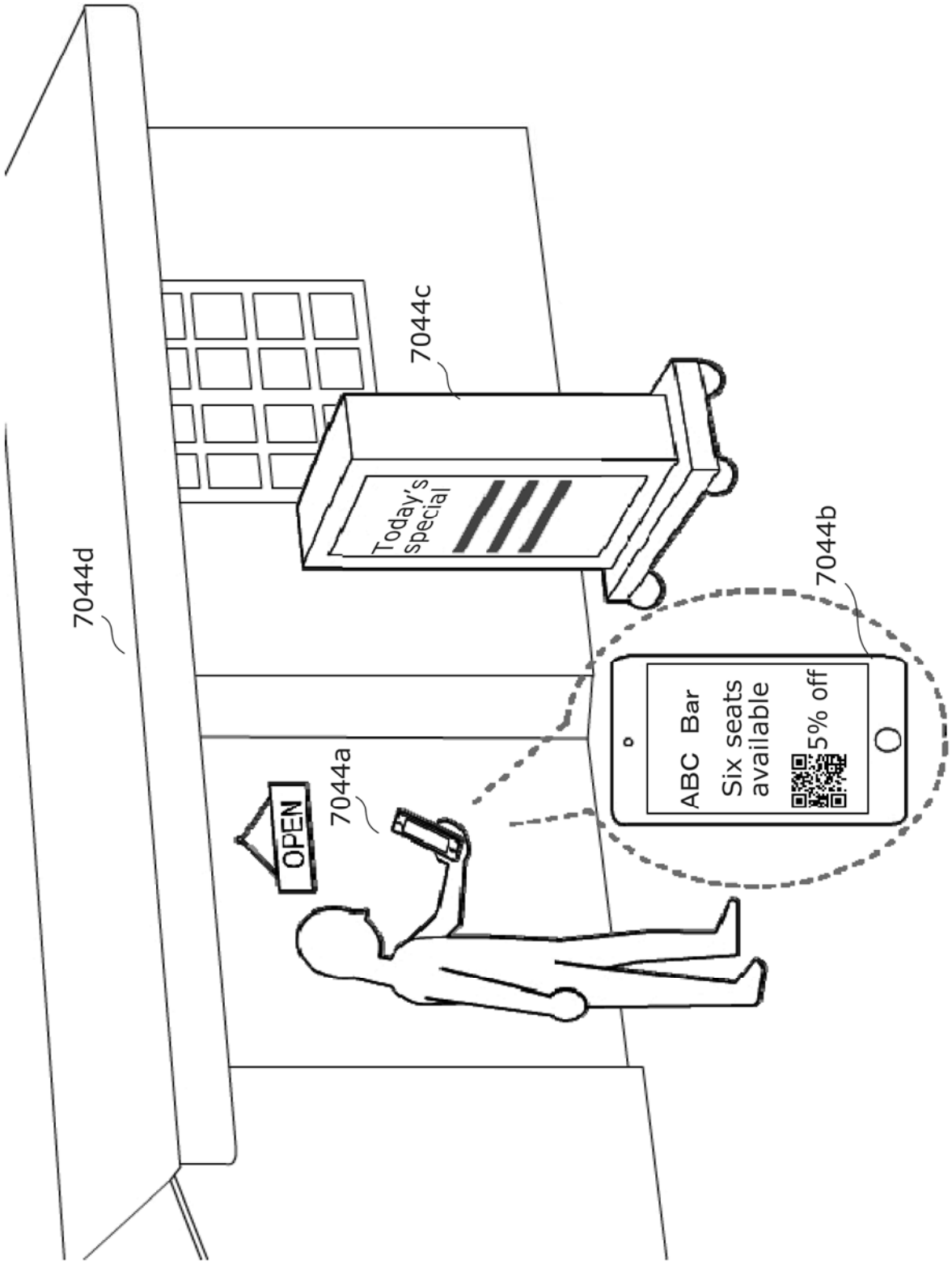

7044d
7044c
Today's special
7044b
ABC Bar
Six seats available
5% off
7044a
OPEN

FIG. 205

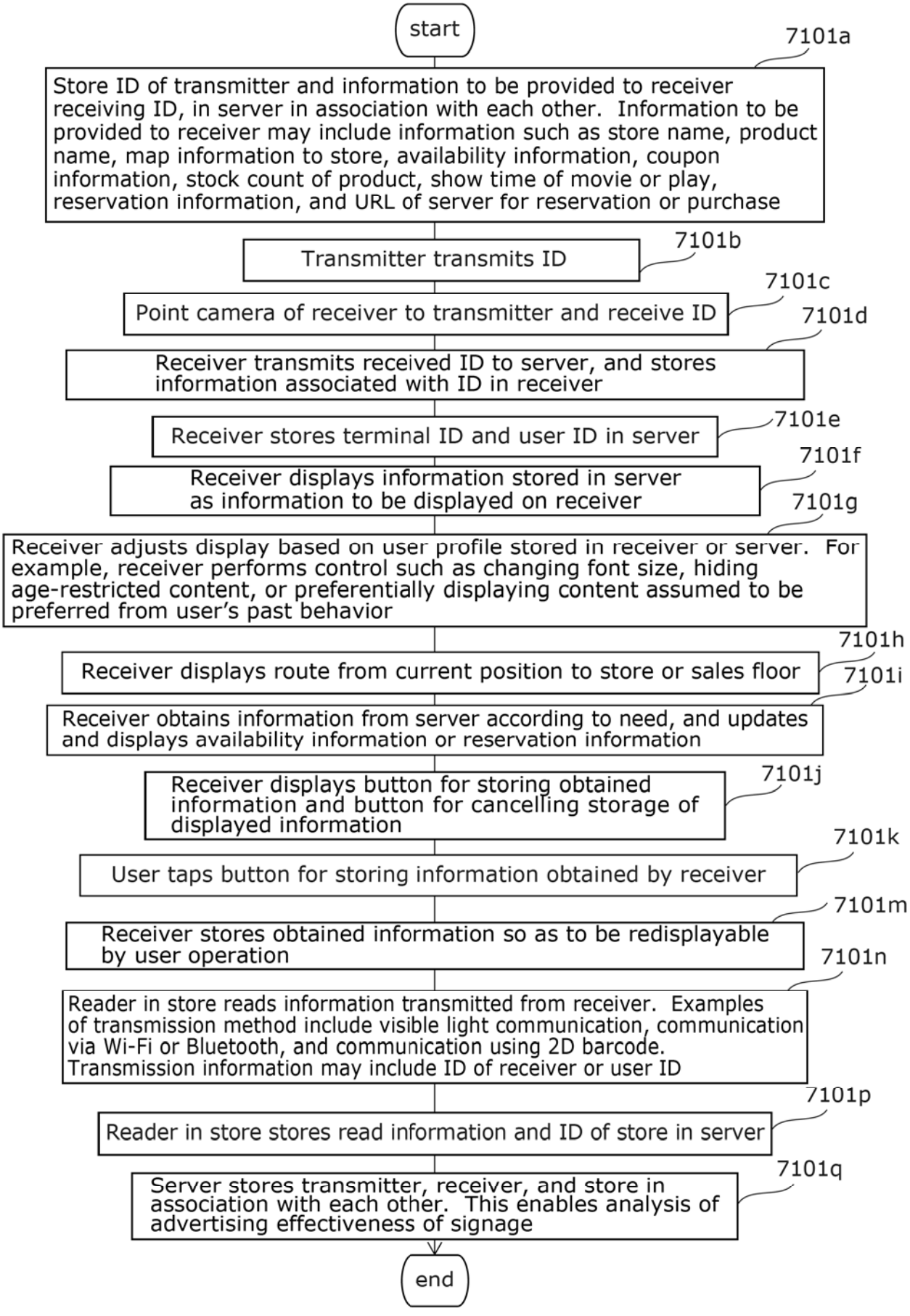

start
7101a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase
Transmitter transmits ID
7101b
Point camera of receiver to transmitter and receive ID
7101c
Receiver transmits received ID to server, and stores information associated with ID in receiver
7101d
Receiver stores terminal ID and user ID in server
7101e
Receiver displays information stored in server as information to be displayed on receiver
7101f
Receiver adjusts display based on user profile stored in receiver or server. For example, receiver performs control such as changing font size, hiding age-restricted content, or preferentially displaying content assumed to be preferred from user's past behavior
7101g
Receiver displays route from current position to store or sales floor
7101h
Receiver obtains information from server according to need, and updates and displays availability information or reservation information
7101i
Receiver displays button for storing obtained information and button for cancelling storage of displayed information
7101j
User taps button for storing information obtained by receiver
7101k
Receiver stores obtained information so as to be redisplayable by user operation
7101m
Reader in store reads information transmitted from receiver. Examples of transmission method include visible light communication, communication via Wi-Fi or Bluetooth, and communication using 2D barcode. Transmission information may include ID of receiver or user ID
7101n
Reader in store stores read information and ID of store in server
7101p
Server stores transmitter, receiver, and store in association with each other. This enables analysis of advertising effectiveness of signage
7101q
end

FIG. 206

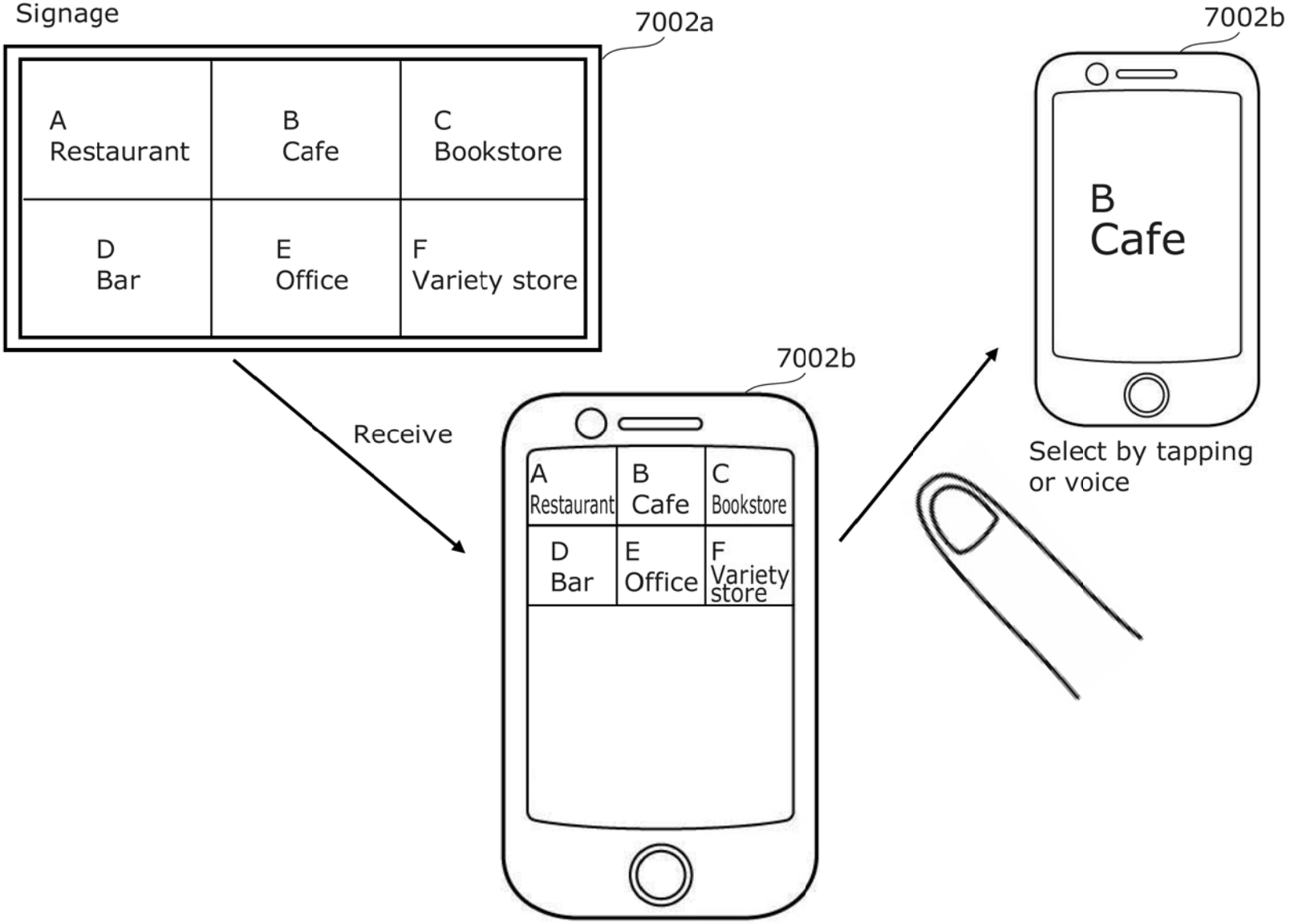

Signage
7002a
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety store
Receive
7002b
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety
store
7002b
B
Cafe
Select by tapping
or voice

FIG. 207

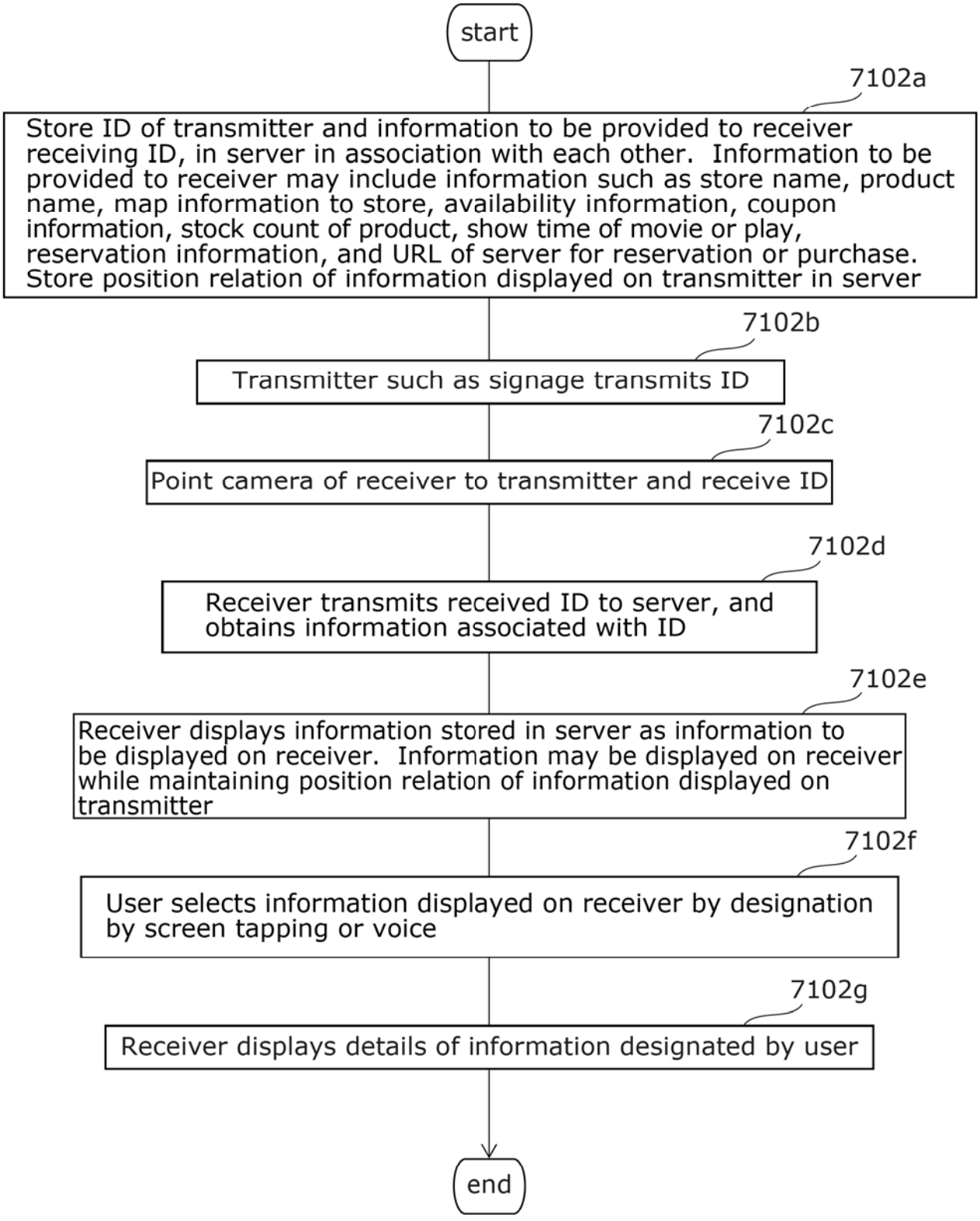

start
7102a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase. Store position relation of information displayed on transmitter in server
7102b
Transmitter such as signage transmits ID
7102c
Point camera of receiver to transmitter and receive ID
7102d
Receiver transmits received ID to server, and obtains information associated with ID
7102e
Receiver displays information stored in server as information to be displayed on receiver. Information may be displayed on receiver while maintaining position relation of information displayed on transmitter
7102f
User selects information displayed on receiver by designation by screen tapping or voice
7102g
Receiver displays details of information designated by user
end

FIG. 208

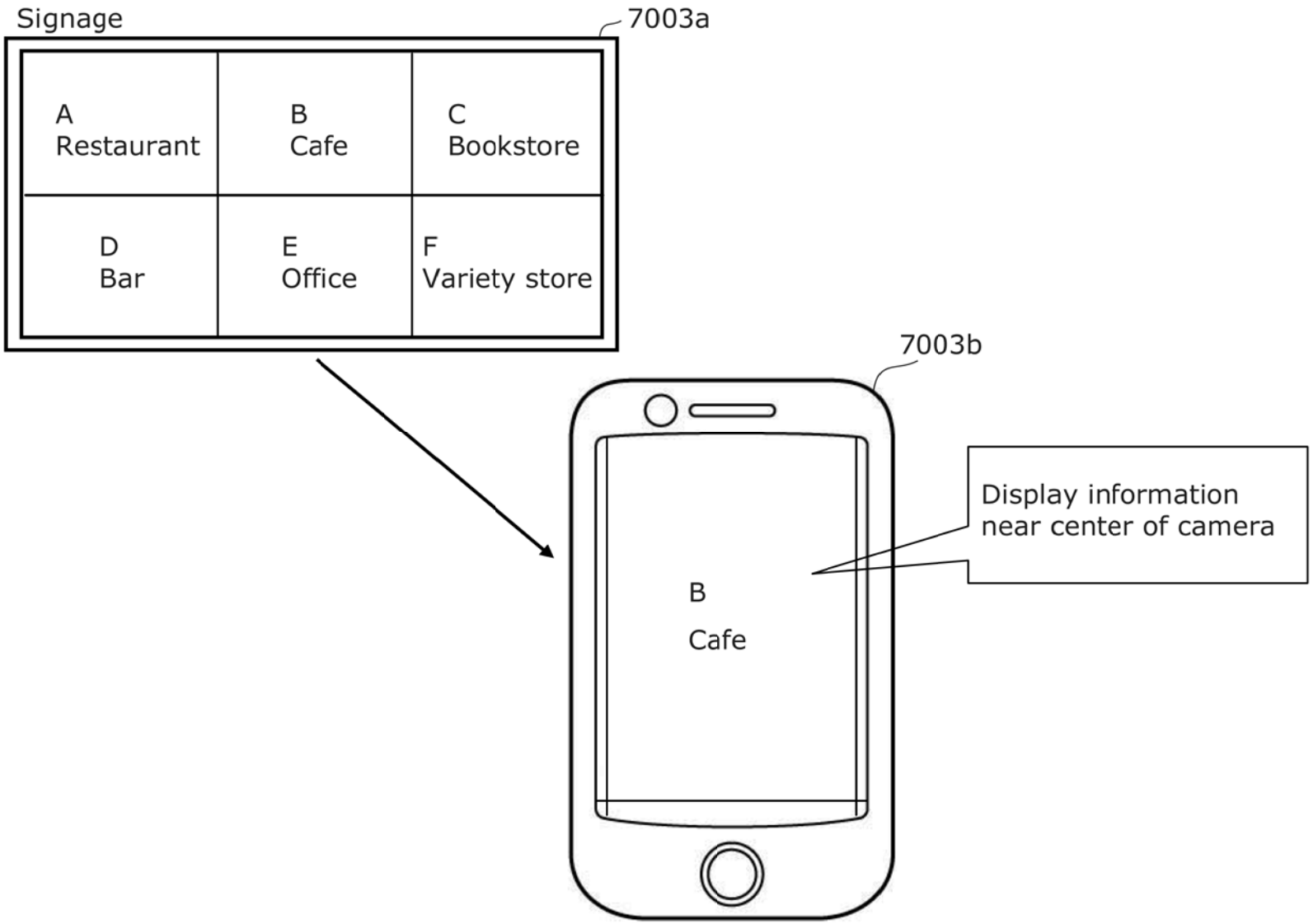

Signage
7003a
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety store
7003b
Display information
near center of camera
B
Cafe

FIG. 209

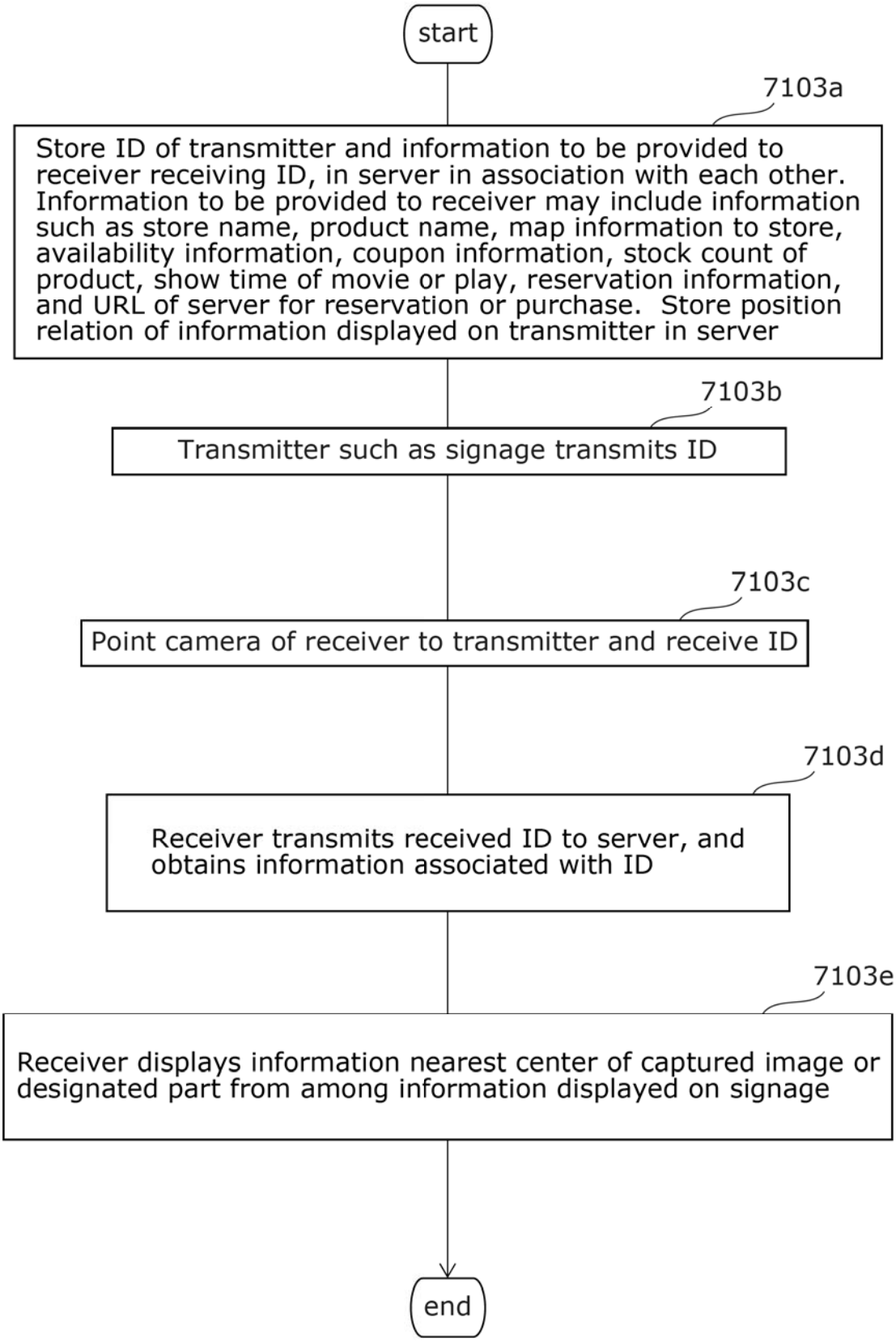

start
7103a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase. Store position relation of information displayed on transmitter in server
7103b
Transmitter such as signage transmits ID
7103c
Point camera of receiver to transmitter and receive ID
7103d
Receiver transmits received ID to server, and obtains information associated with ID
7103e
Receiver displays information nearest center of captured image or designated part from among information displayed on signage
end

FIG. 210

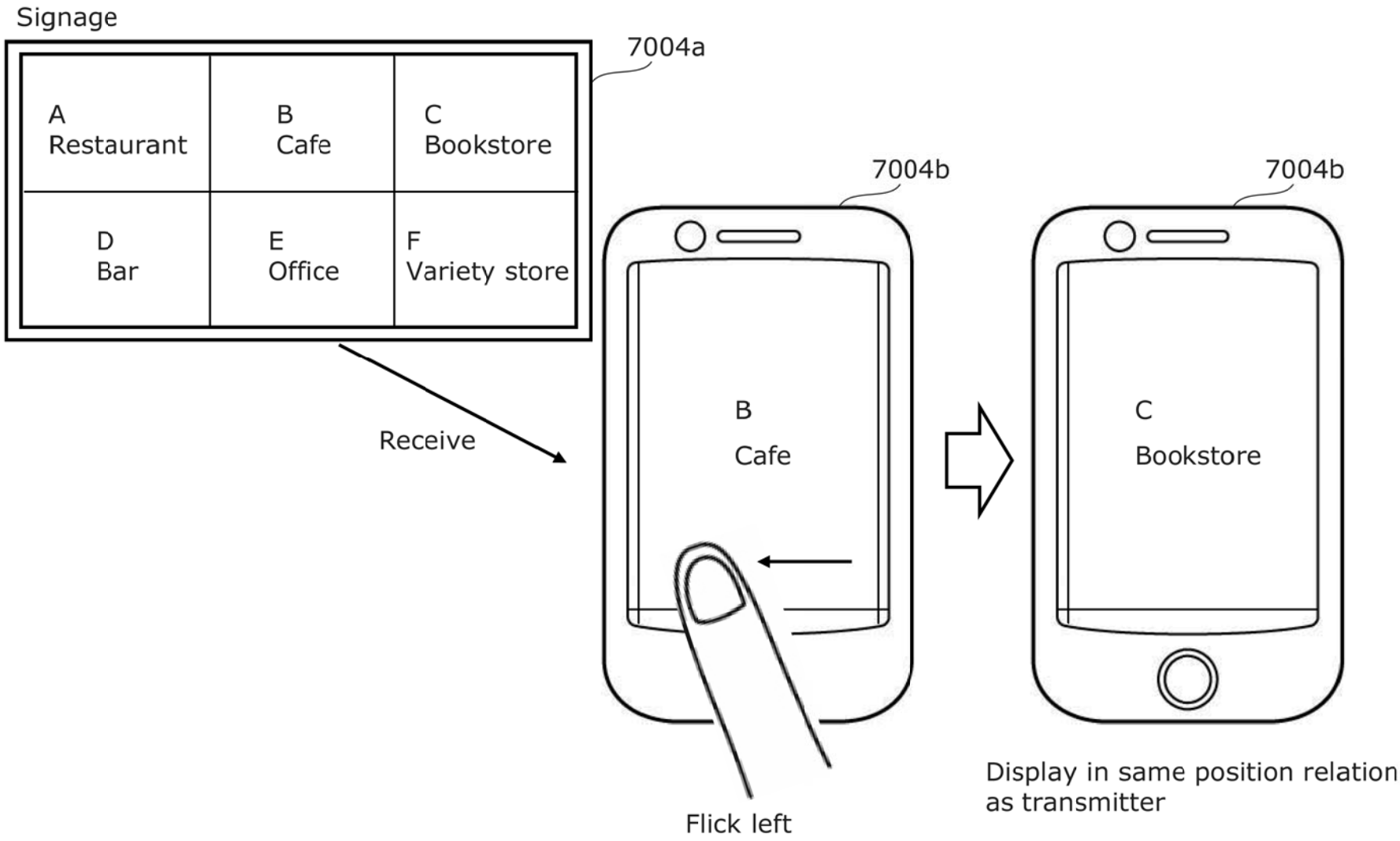

Signage
7004a
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety store
7004b
7004b
Receive
B
Cafe
C
Bookstore
Flick left
Display in same position relation
as transmitter

FIG. 211

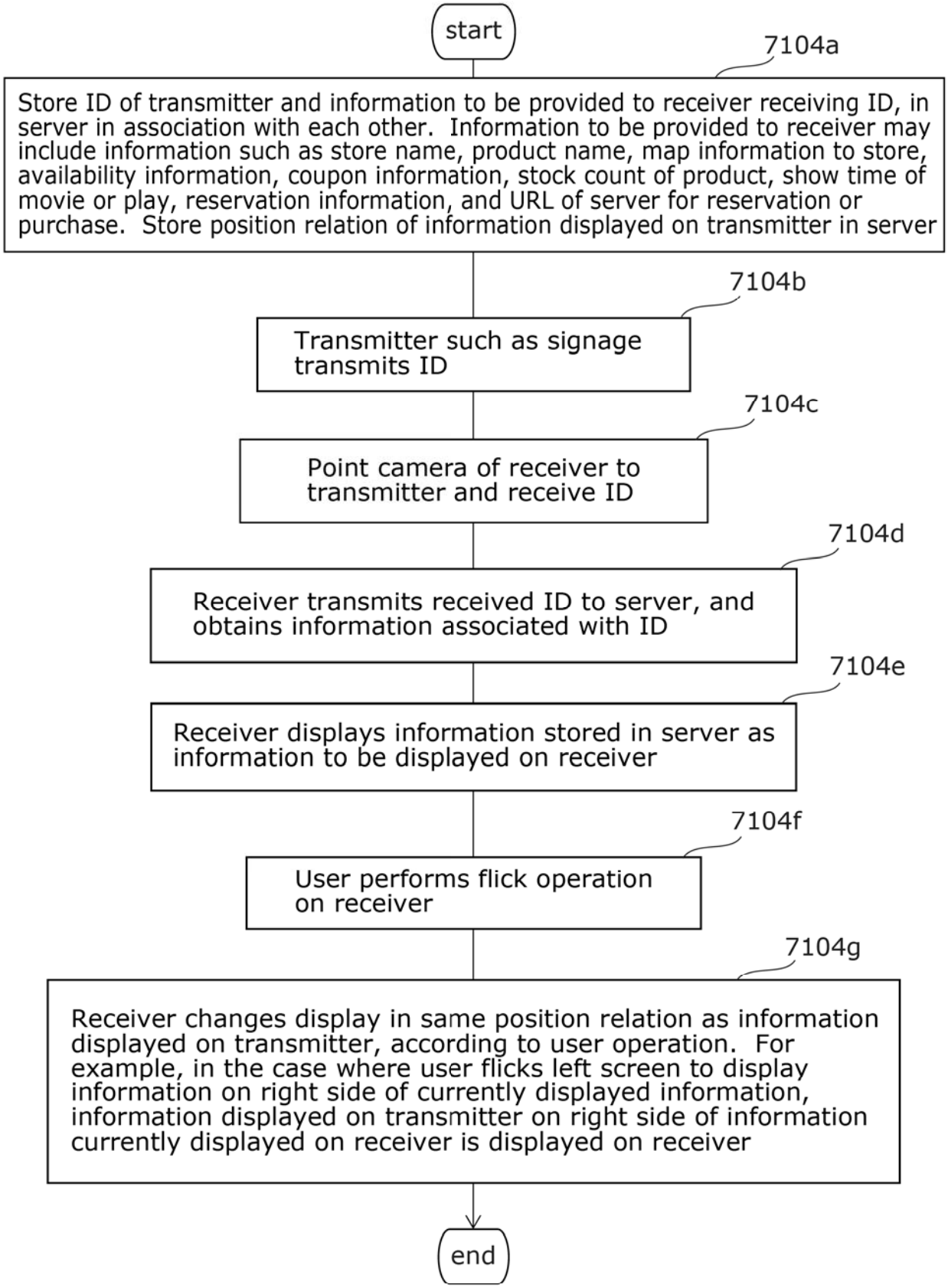

start
7104a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase. Store position relation of information displayed on transmitter in server
7104b
Transmitter such as signage transmits ID
7104c
Point camera of receiver to transmitter and receive ID
7104d
Receiver transmits received ID to server, and obtains information associated with ID
7104e
Receiver displays information stored in server as information to be displayed on receiver
7104f
User performs flick operation on receiver
7104g
Receiver changes display in same position relation as information displayed on transmitter, according to user operation. For example, in the case where user flicks left screen to display information on right side of currently displayed information, information displayed on transmitter on right side of information currently displayed on receiver is displayed on receiver
end

FIG. 212

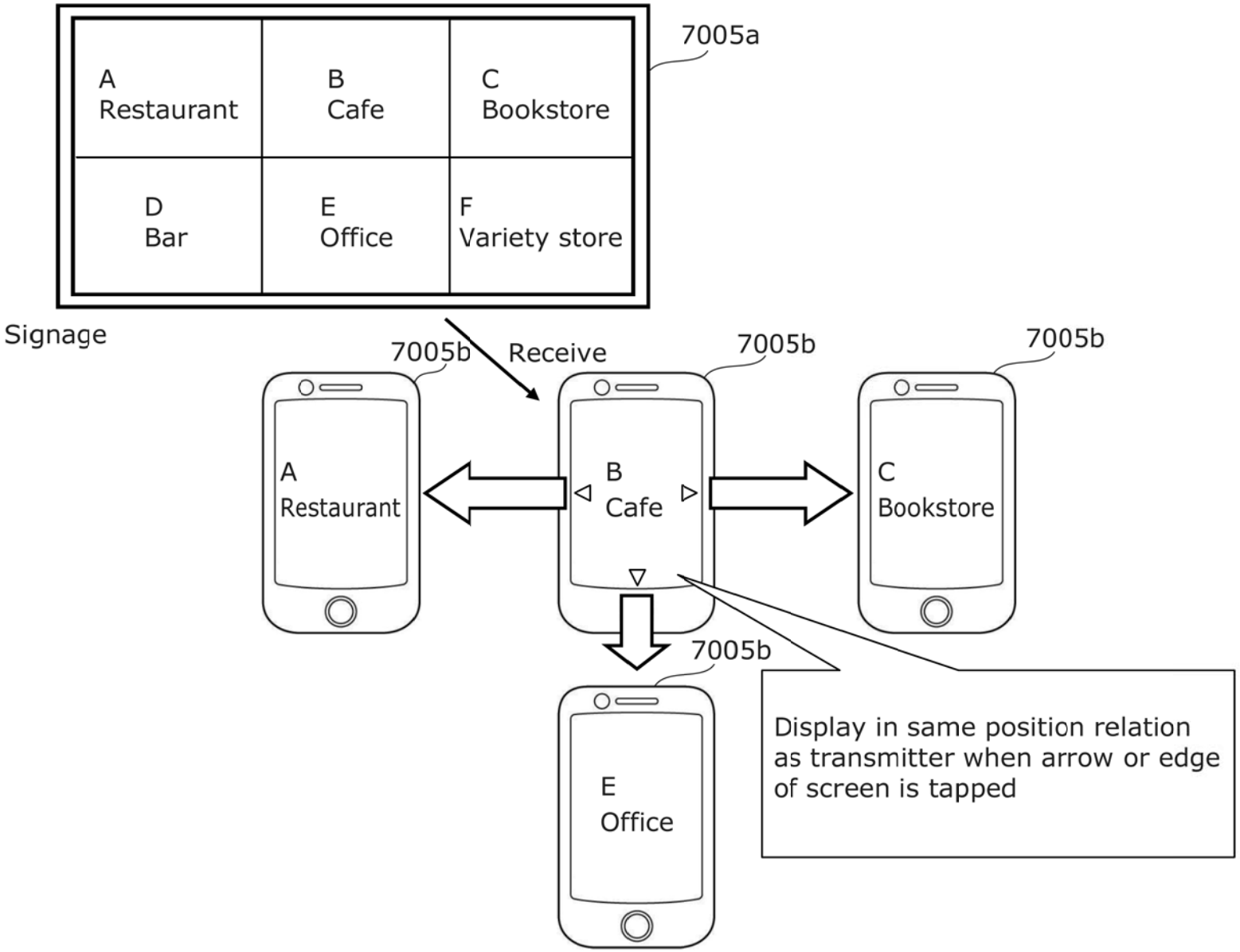

7005a
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety store
Signage
Receive
7005b
7005b
7005b
A
Restaurant
B
Cafe
C
Bookstore
E
Office
Display in same position relation as transmitter when arrow or edge of screen is tapped

FIG. 213

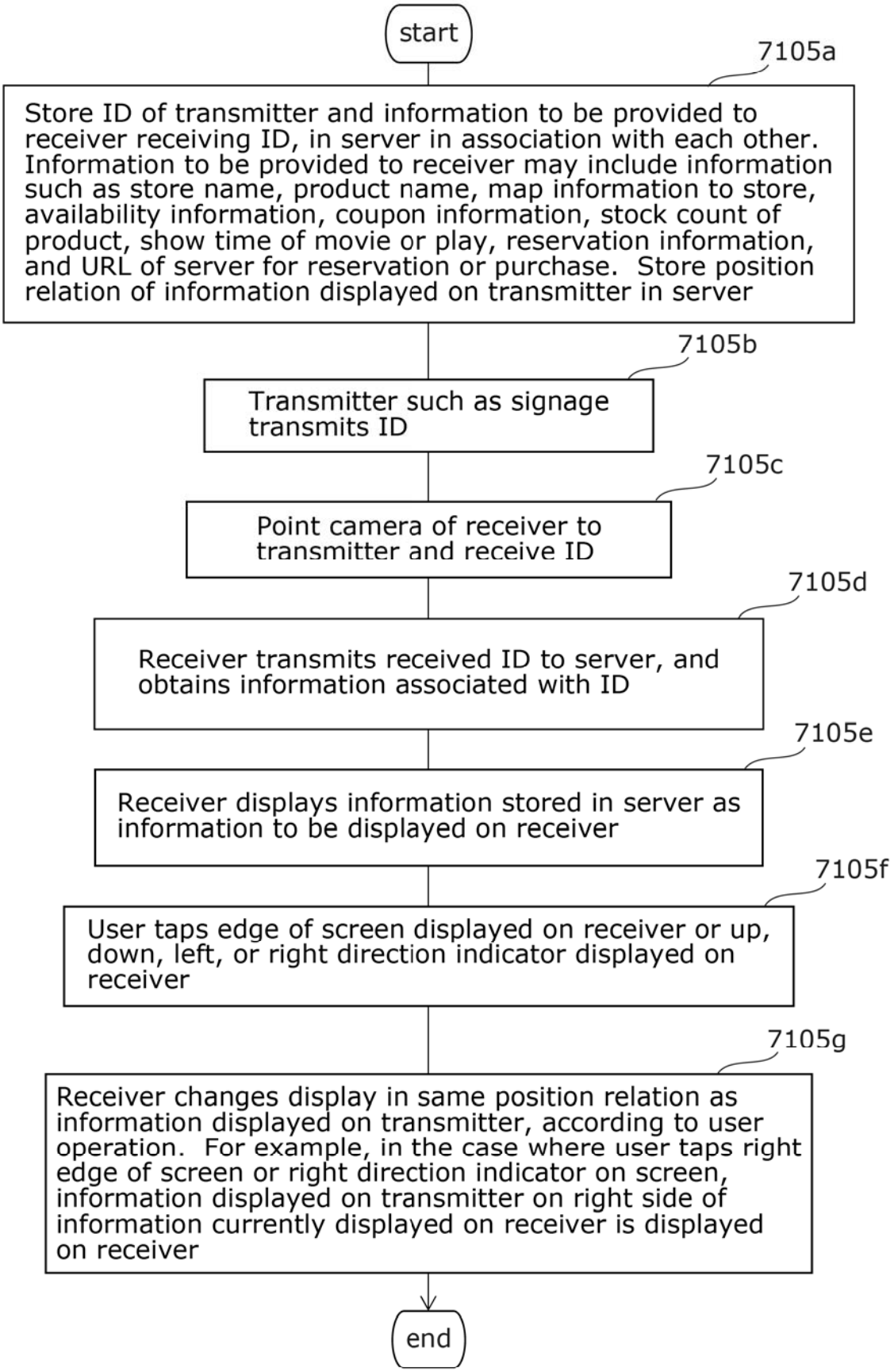

start
7105a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase. Store position relation of information displayed on transmitter in server
7105b
Transmitter such as signage transmits ID
7105c
Point camera of receiver to transmitter and receive ID
7105d
Receiver transmits received ID to server, and obtains information associated with ID
7105e
Receiver displays information stored in server as information to be displayed on receiver
7105f
User taps edge of screen displayed on receiver or up, down, left, or right direction indicator displayed on receiver
7105g
Receiver changes display in same position relation as information displayed on transmitter, according to user operation. For example, in the case where user taps right edge of screen or right direction indicator on screen, information displayed on transmitter on right side of information currently displayed on receiver is displayed on receiver
end

FIG. 214

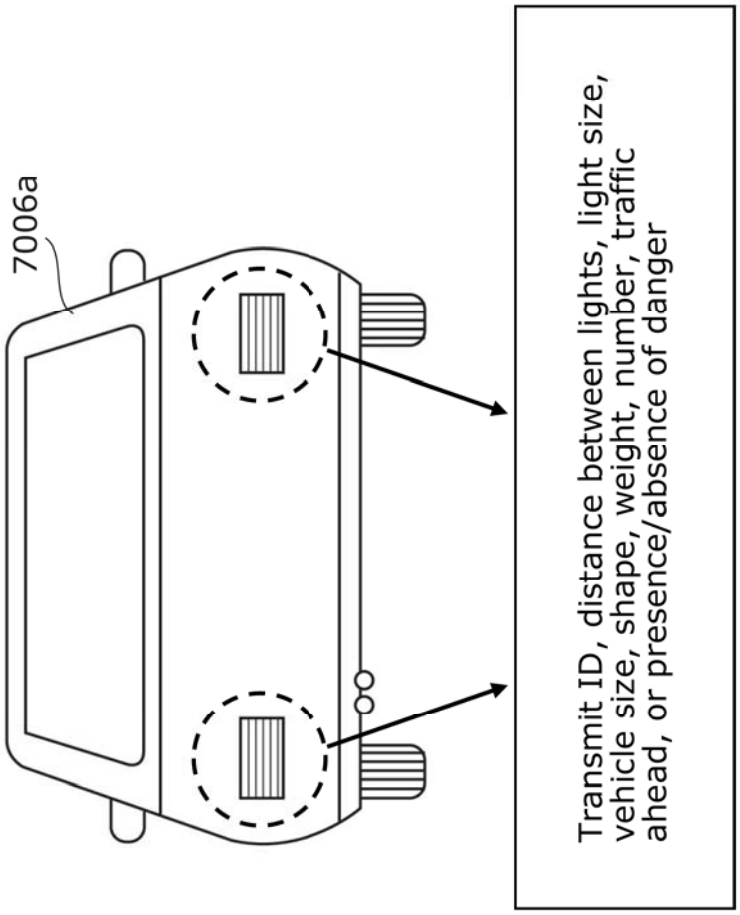

7006a
Transmit ID, distance between lights, light size, vehicle size, shape, weight, number, traffic ahead, or presence/absence of danger

FIG. 215

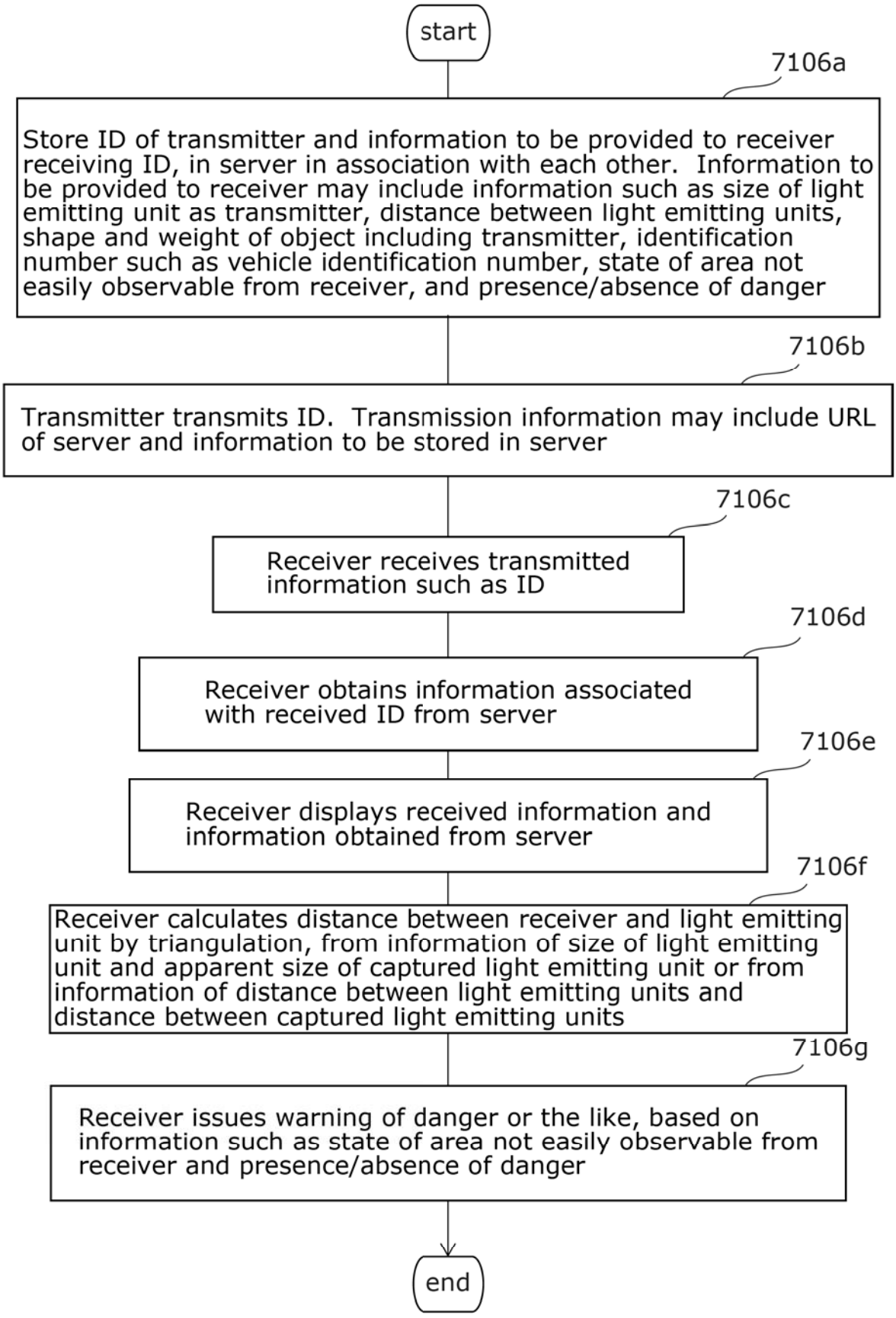

start
7106a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as size of light emitting unit as transmitter, distance between light emitting units, shape and weight of object including transmitter, identification number such as vehicle identification number, state of area not easily observable from receiver, and presence/absence of danger
7106b
Transmitter transmits ID. Transmission information may include URL of server and information to be stored in server
7106c
Receiver receives transmitted information such as ID
7106d
Receiver obtains information associated with received ID from server
7106e
Receiver displays received information and information obtained from server
7106f
Receiver calculates distance between receiver and light emitting unit by triangulation, from information of size of light emitting unit and apparent size of captured light emitting unit or from information of distance between light emitting units and distance between captured light emitting units
7106g
Receiver issues warning of danger or the like, based on information such as state of area not easily observable from receiver and presence/absence of danger
end

FIG. 216

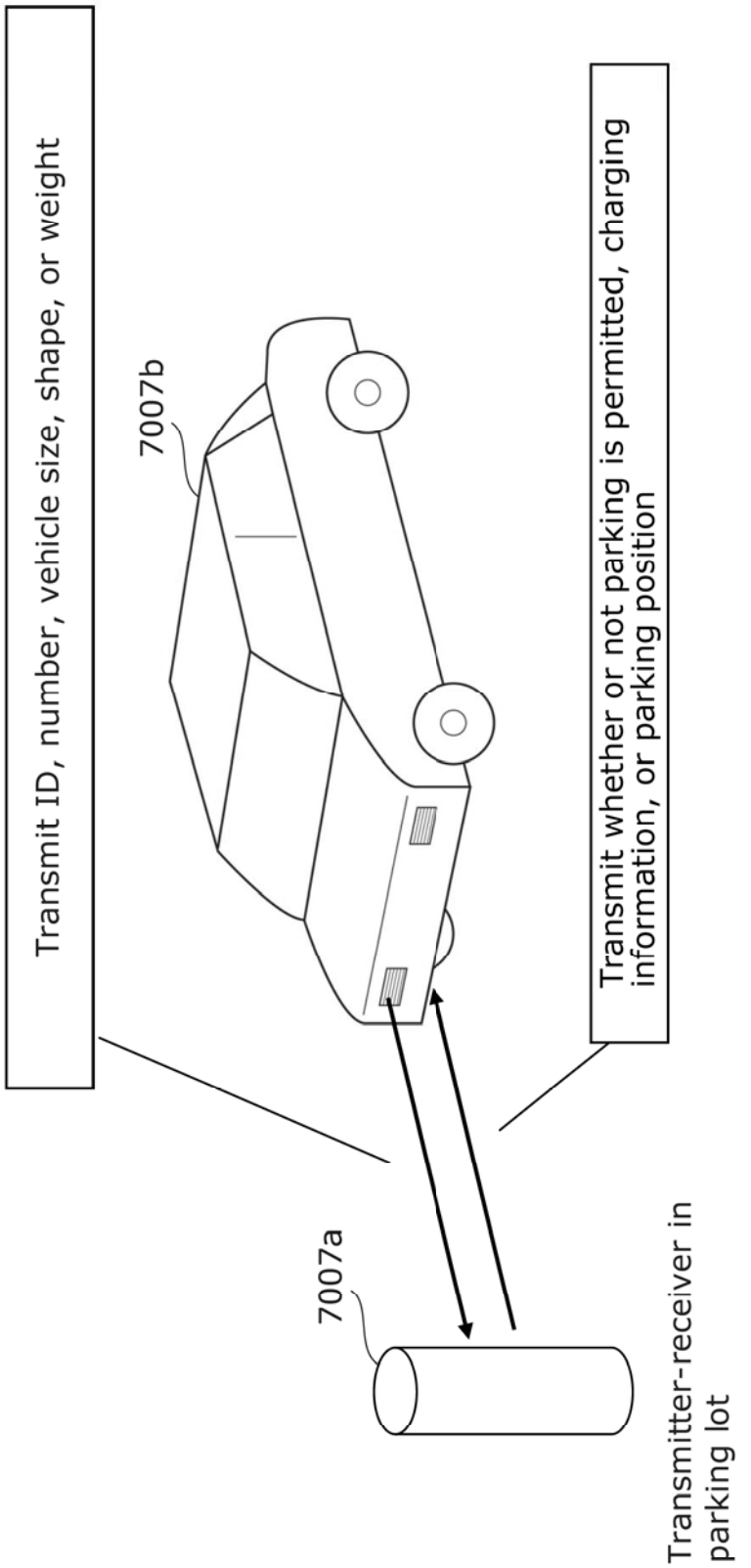

Transmit ID, number, vehicle size, shape, or weight
7007b
Transmit whether or not parking is permitted, charging information, or parking position
7007a
Transmitter-receiver in parking lot

FIG. 217

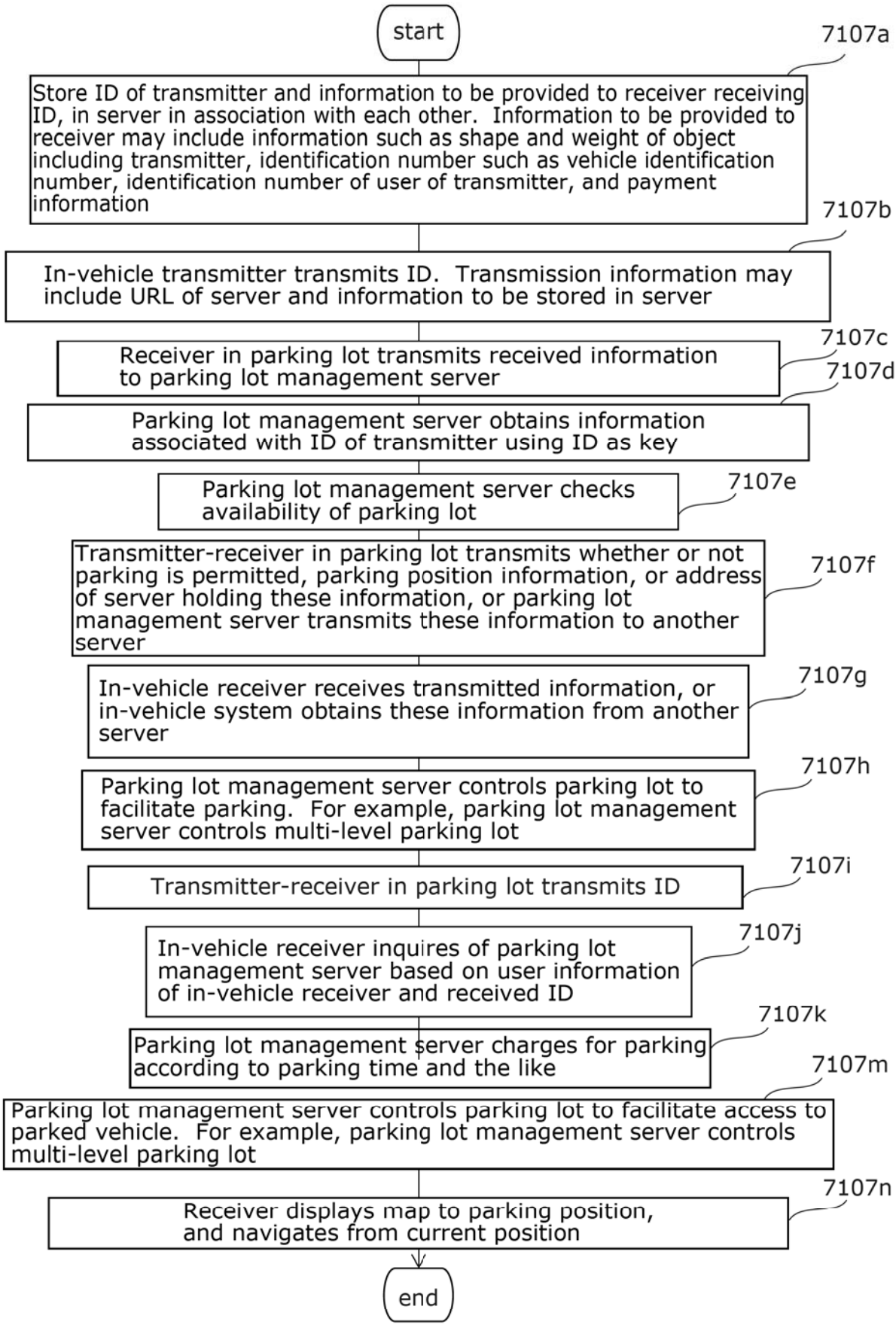

start
7107a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as shape and weight of object including transmitter, identification number such as vehicle identification number, identification number of user of transmitter, and payment information
7107b
In-vehicle transmitter transmits ID. Transmission information may include URL of server and information to be stored in server
7107c
Receiver in parking lot transmits received information to parking lot management server
7107d
Parking lot management server obtains information associated with ID of transmitter using ID as key
Parking lot management server checks availability of parking lot
7107e
Transmitter-receiver in parking lot transmits whether or not parking is permitted, parking position information, or address of server holding these information, or parking lot management server transmits these information to another server
7107f
In-vehicle receiver receives transmitted information, or in-vehicle system obtains these information from another server
7107g
Parking lot management server controls parking lot to facilitate parking. For example, parking lot management server controls multi-level parking lot
7107h
Transmitter-receiver in parking lot transmits ID
7107i
In-vehicle receiver inquires of parking lot management server based on user information of in-vehicle receiver and received ID
7107j
Parking lot management server charges for parking according to parking time and the like
7107k
Parking lot management server controls parking lot to facilitate access to parked vehicle. For example, parking lot management server controls multi-level parking lot
7107m
Receiver displays map to parking position, and navigates from current position
7107n
end

FIG. 218

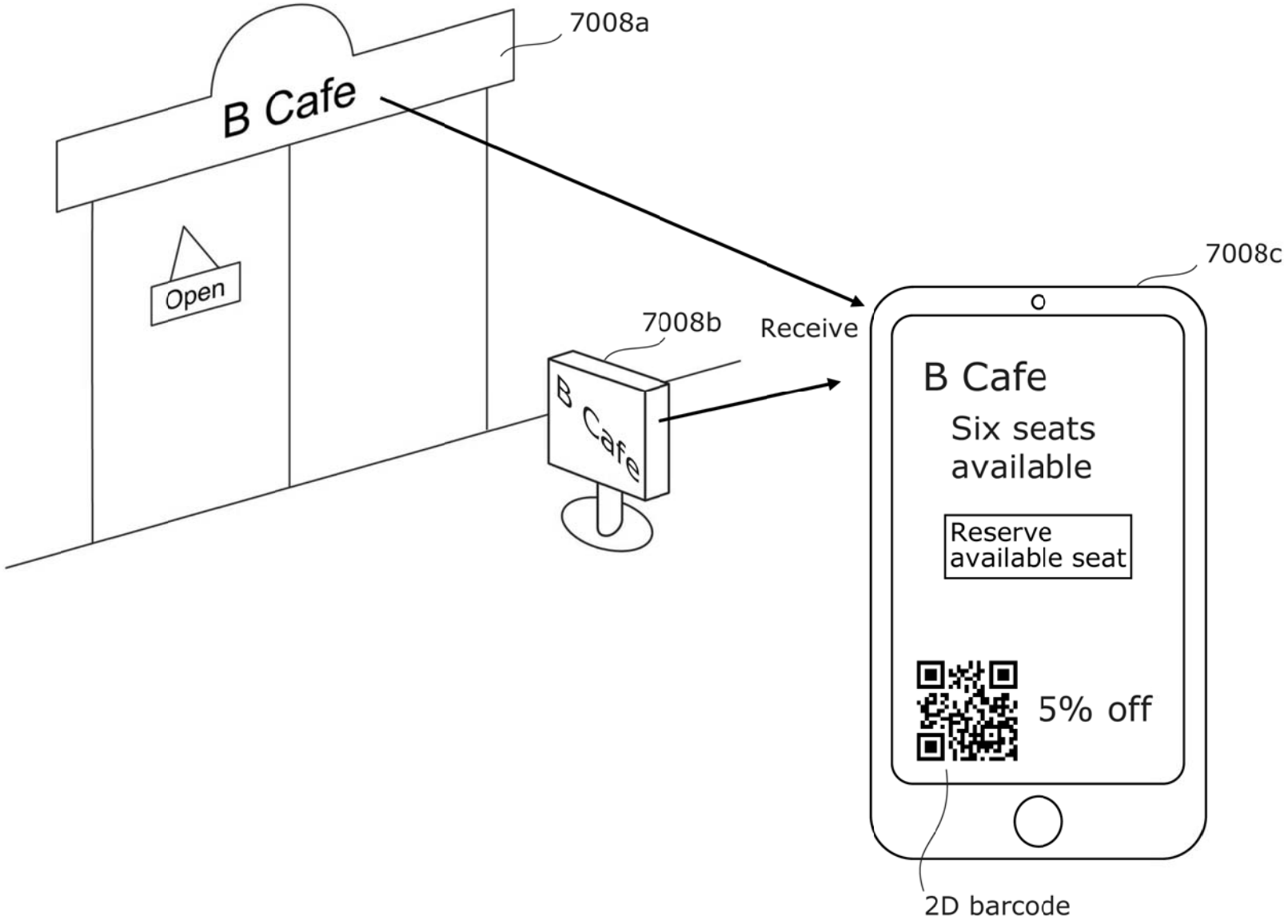

7008a
B Cafe
Open
7008b
B Cafe
Receive
7008c
B Cafe
Six seats available
Reserve available seat
5% off
2D barcode

FIG. 219

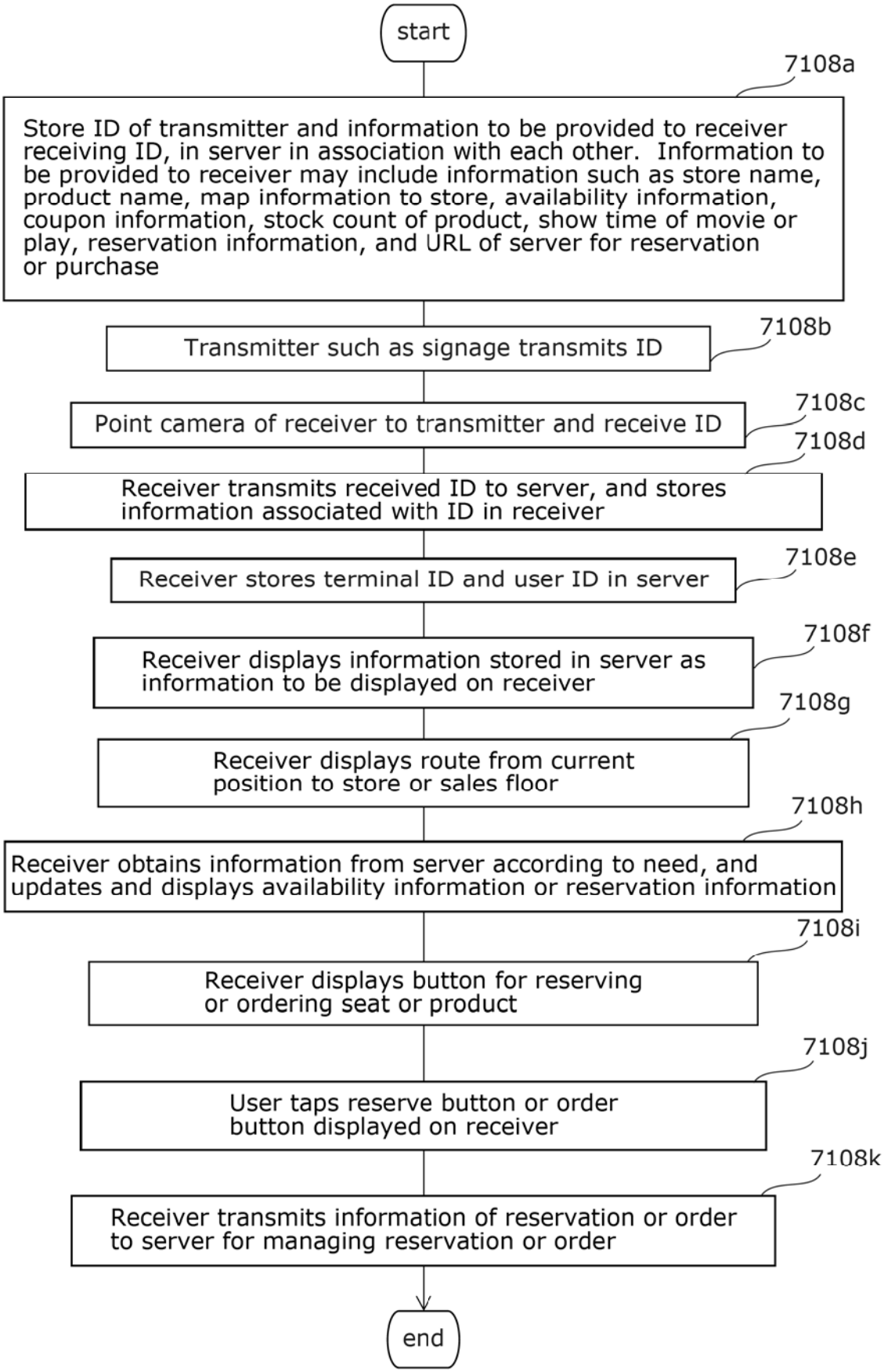

start
7108a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information such as store name, product name, map information to store, availability information, coupon information, stock count of product, show time of movie or play, reservation information, and URL of server for reservation or purchase
7108b
Transmitter such as signage transmits ID
7108c
Point camera of receiver to transmitter and receive ID
7108d
Receiver transmits received ID to server, and stores information associated with ID in receiver
7108e
Receiver stores terminal ID and user ID in server
7108f
Receiver displays information stored in server as information to be displayed on receiver
7108g
Receiver displays route from current position to store or sales floor
7108h
Receiver obtains information from server according to need, and updates and displays availability information or reservation information
7108i
Receiver displays button for reserving or ordering seat or product
7108j
User taps reserve button or order button displayed on receiver
7108k
Receiver transmits information of reservation or order to server for managing reservation or order
end

FIG. 220

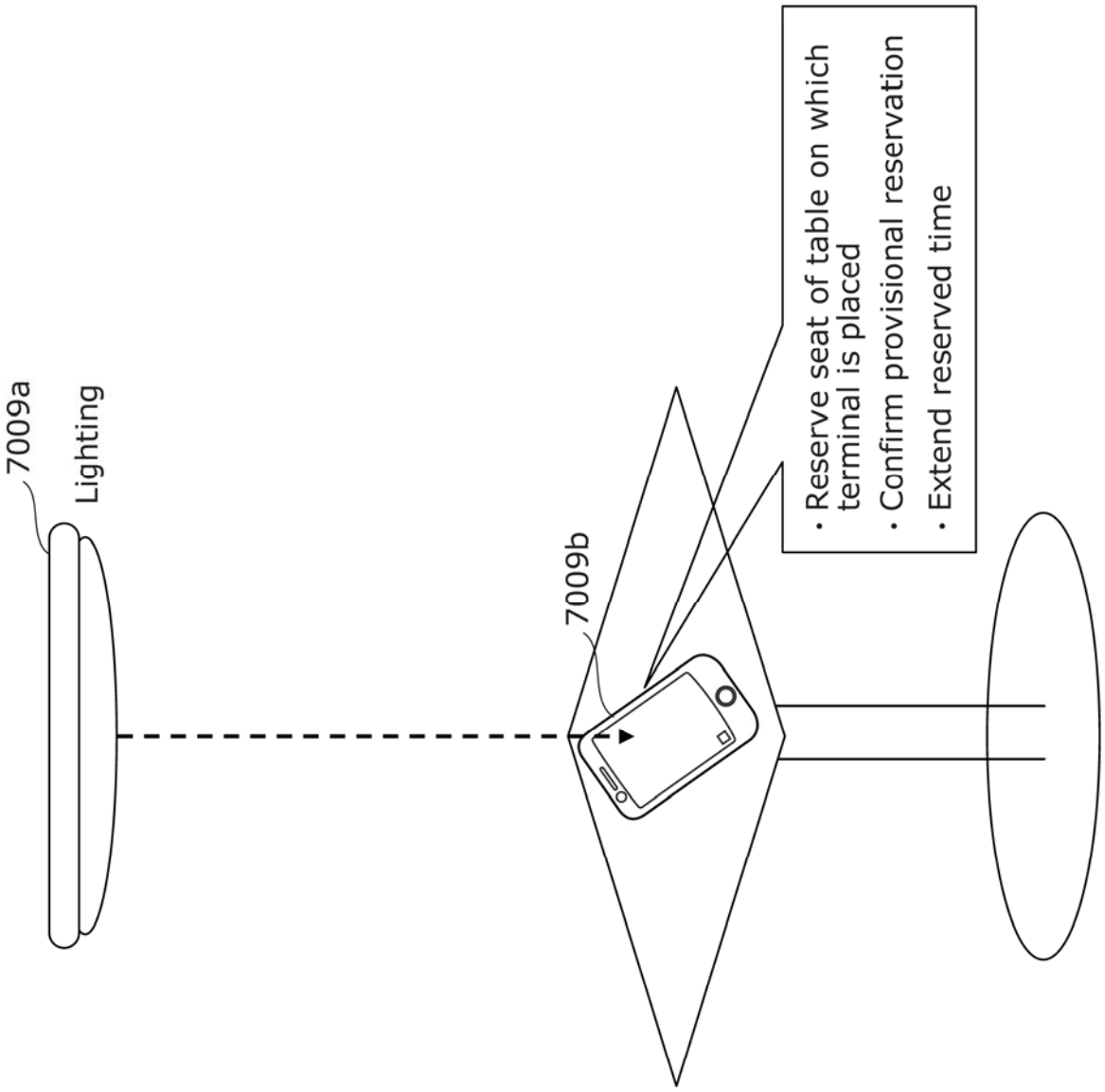

7009a
Lighting
7009b
・Reserve seat of table on which terminal is placed
・Confirm provisional reservation
・Extend reserved time

FIG. 221

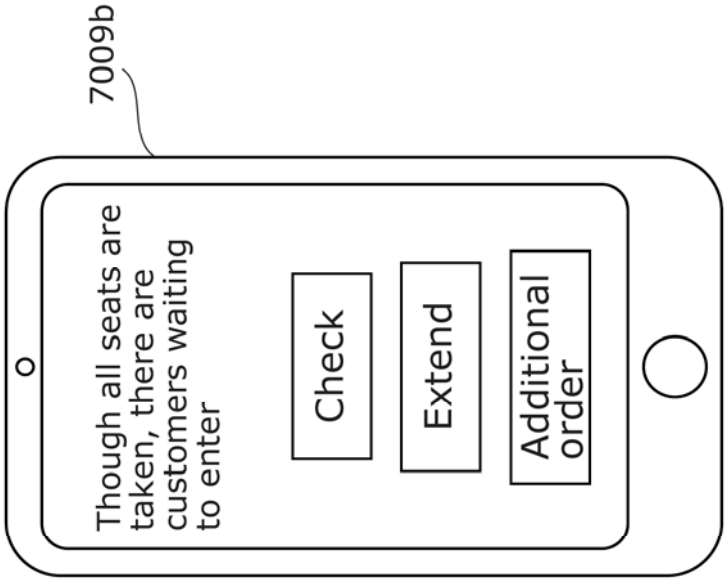

7009b
Though all seats are taken, there are customers waiting to enter
Check
Extend
Additional order

FIG. 222

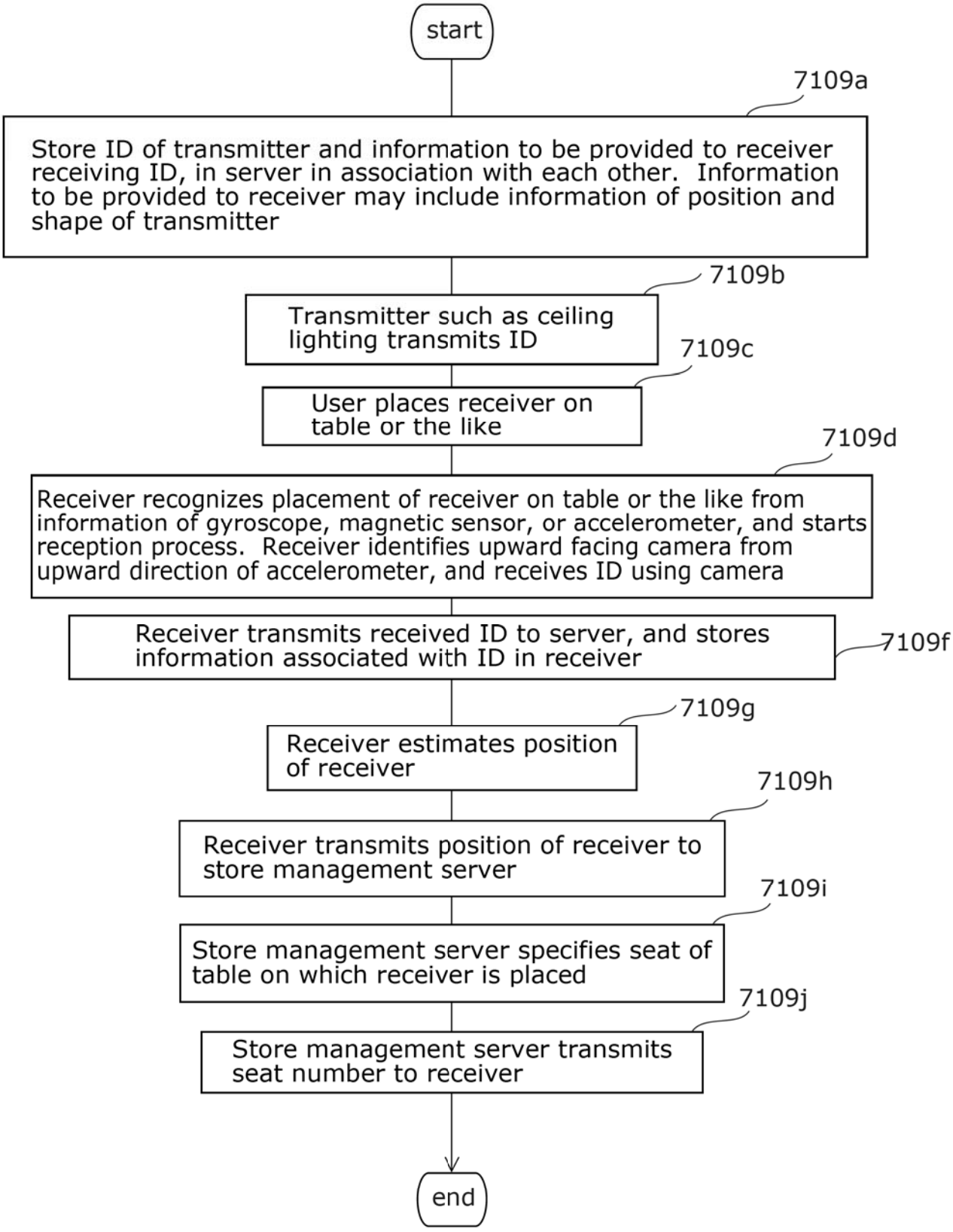

start
7109a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information of position and shape of transmitter
7109b
Transmitter such as ceiling lighting transmits ID
7109c
User places receiver on table or the like
7109d
Receiver recognizes placement of receiver on table or the like from information of gyroscope, magnetic sensor, or accelerometer, and starts reception process. Receiver identifies upward facing camera from upward direction of accelerometer, and receives ID using camera
Receiver transmits received ID to server, and stores information associated with ID in receiver
7109f
7109g
Receiver estimates position of receiver
7109h
Receiver transmits position of receiver to store management server
7109i
Store management server specifies seat of table on which receiver is placed
7109j
Store management server transmits seat number to receiver
end

FIG. 223

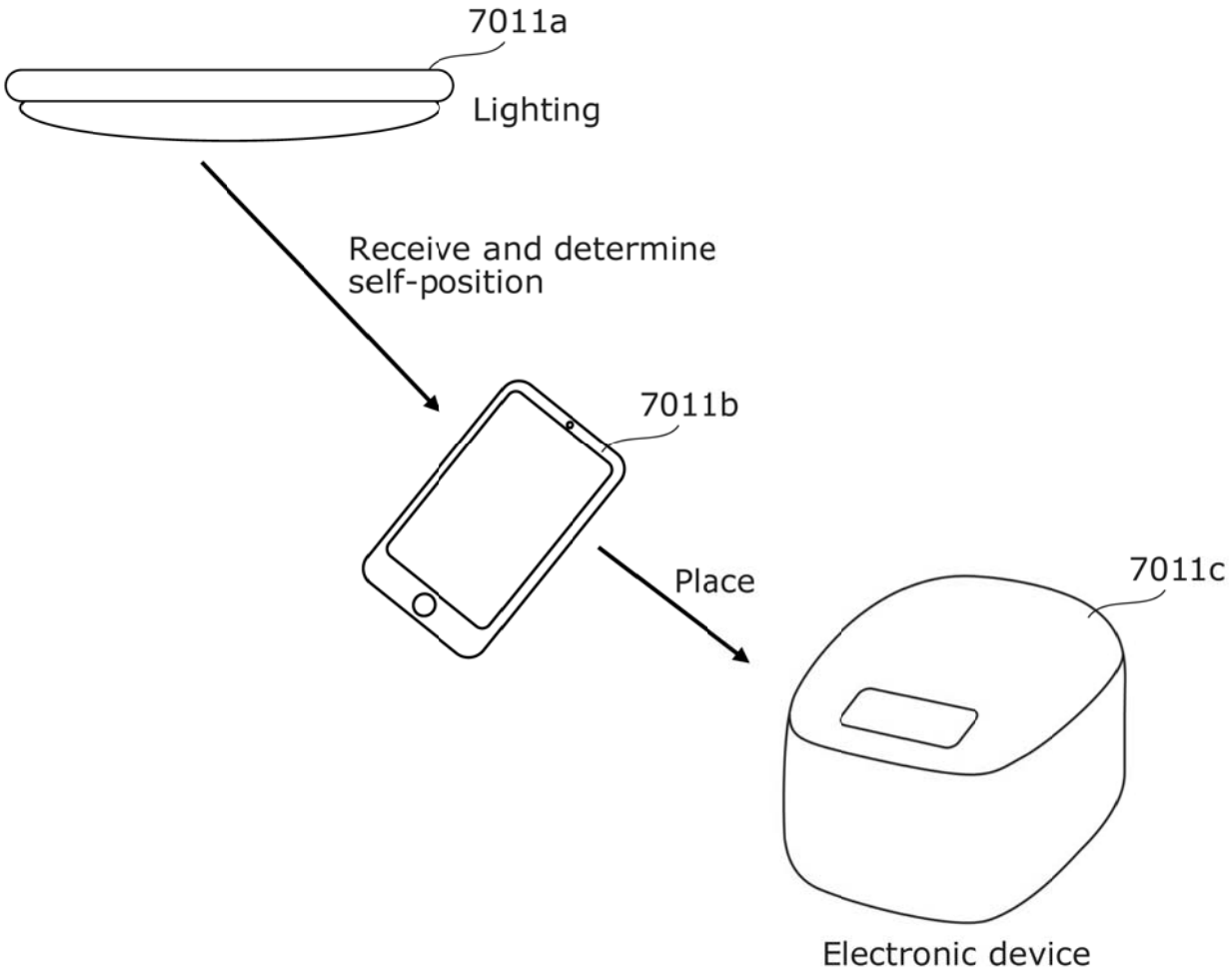

7011a
Lighting
Receive and determine self-position
7011b
Place
7011c
Electronic device

FIG. 224

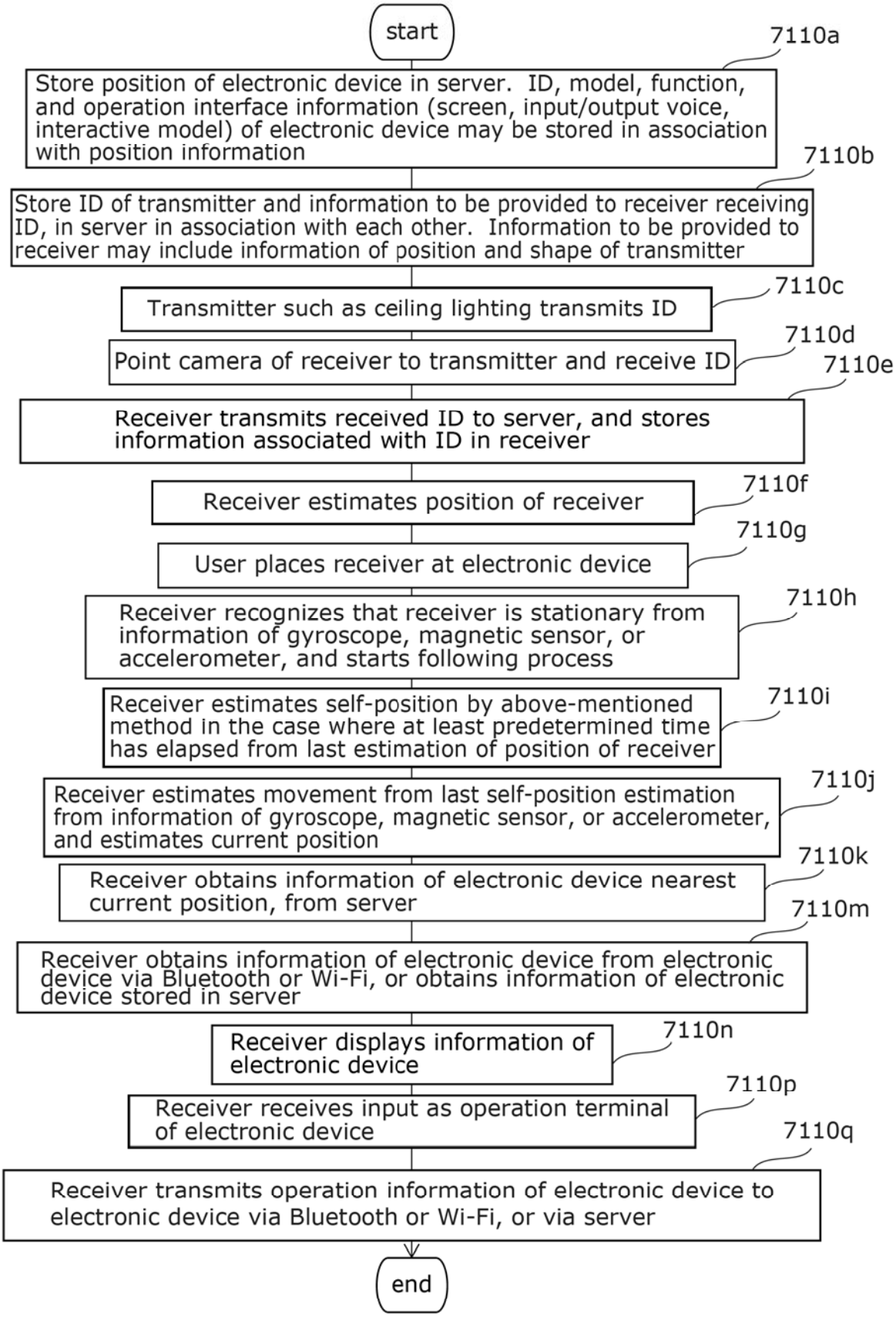

start
7110a
Store position of electronic device in server. ID, model, function, and operation interface information (screen, input/output voice, interactive model) of electronic device may be stored in association with position information
7110b
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include information of position and shape of transmitter
7110c
Transmitter such as ceiling lighting transmits ID
7110d
Point camera of receiver to transmitter and receive ID
7110e
Receiver transmits received ID to server, and stores information associated with ID in receiver
7110f
Receiver estimates position of receiver
7110g
User places receiver at electronic device
7110h
Receiver recognizes that receiver is stationary from information of gyroscope, magnetic sensor, or accelerometer, and starts following process
7110i
Receiver estimates self-position by above-mentioned method in the case where at least predetermined time has elapsed from last estimation of position of receiver
7110j
Receiver estimates movement from last self-position estimation from information of gyroscope, magnetic sensor, or accelerometer, and estimates current position
7110k
Receiver obtains information of electronic device nearest current position, from server
7110m
Receiver obtains information of electronic device from electronic device via Bluetooth or Wi-Fi, or obtains information of electronic device stored in server
7110n
Receiver displays information of electronic device
7110p
Receiver receives input as operation terminal of electronic device
7110q
Receiver transmits operation information of electronic device to electronic device via Bluetooth or Wi-Fi, or via server
end

FIG. 225

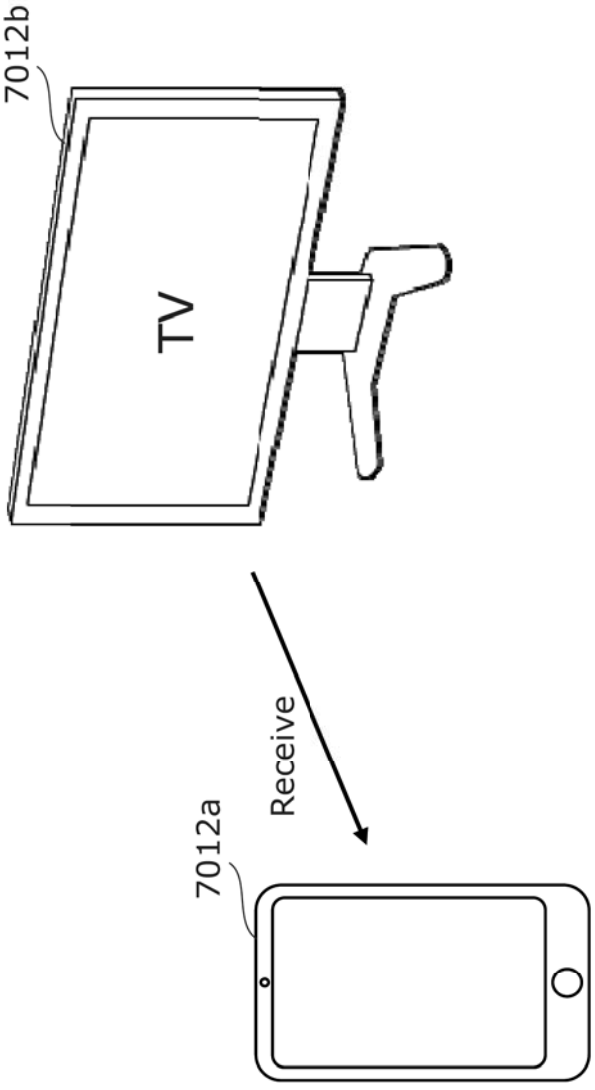


FIG. 226

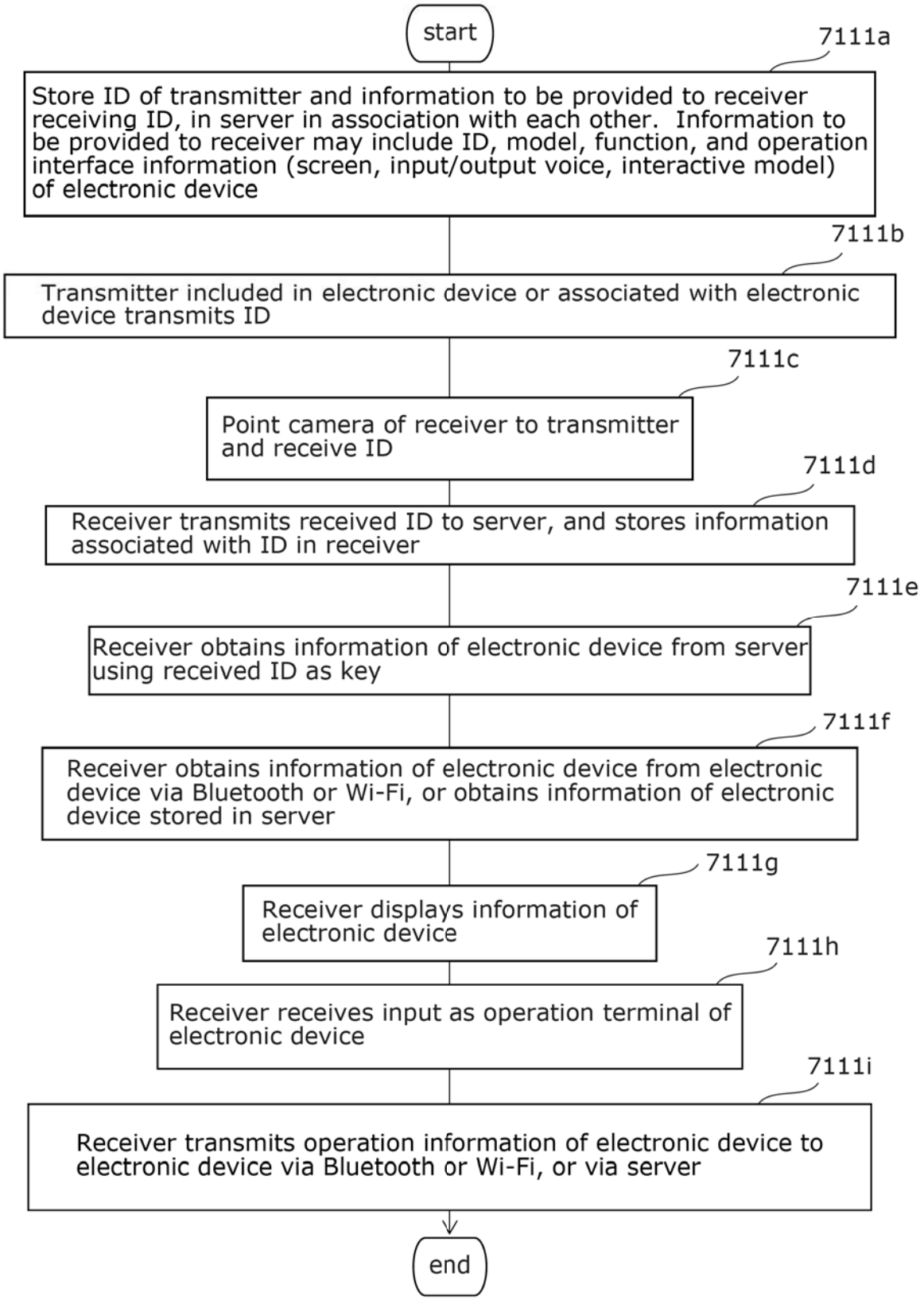

start
7111a
Store ID of transmitter and information to be provided to receiver receiving ID, in server in association with each other. Information to be provided to receiver may include ID, model, function, and operation interface information (screen, input/output voice, interactive model) of electronic device
7111b
Transmitter included in electronic device or associated with electronic device transmits ID
7111c
Point camera of receiver to transmitter and receive ID
7111d
Receiver transmits received ID to server, and stores information associated with ID in receiver
7111e
Receiver obtains information of electronic device from server using received ID as key
7111f
Receiver obtains information of electronic device from electronic device via Bluetooth or Wi-Fi, or obtains information of electronic device stored in server
7111g
Receiver displays information of electronic device
7111h
Receiver receives input as operation terminal of electronic device
7111i
Receiver transmits operation information of electronic device to electronic device via Bluetooth or Wi-Fi, or via server
end

FIG. 227

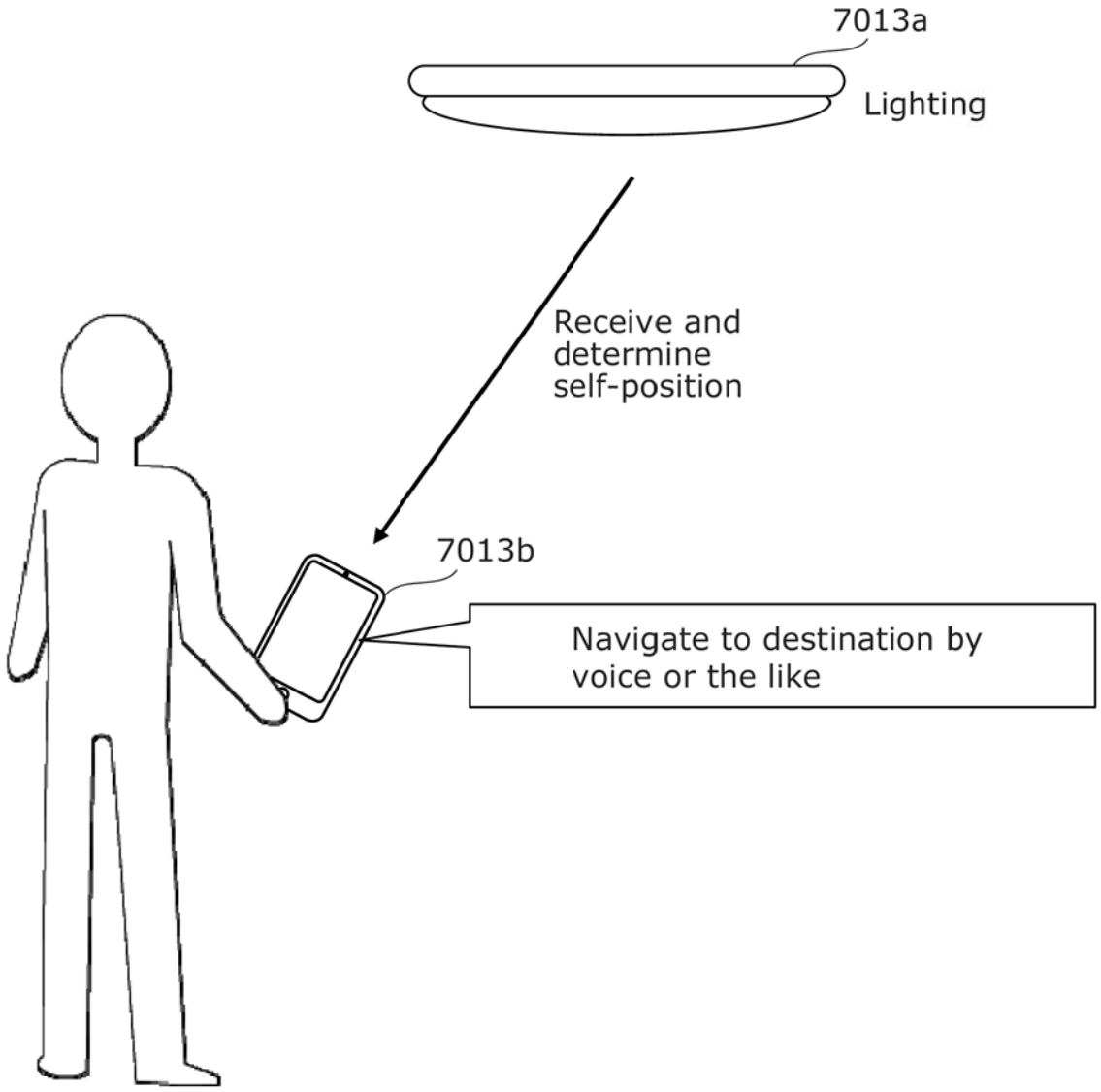

7013a
Lighting
Receive and
determine
self-position
7013b
Navigate to destination by
voice or the like

FIG. 228

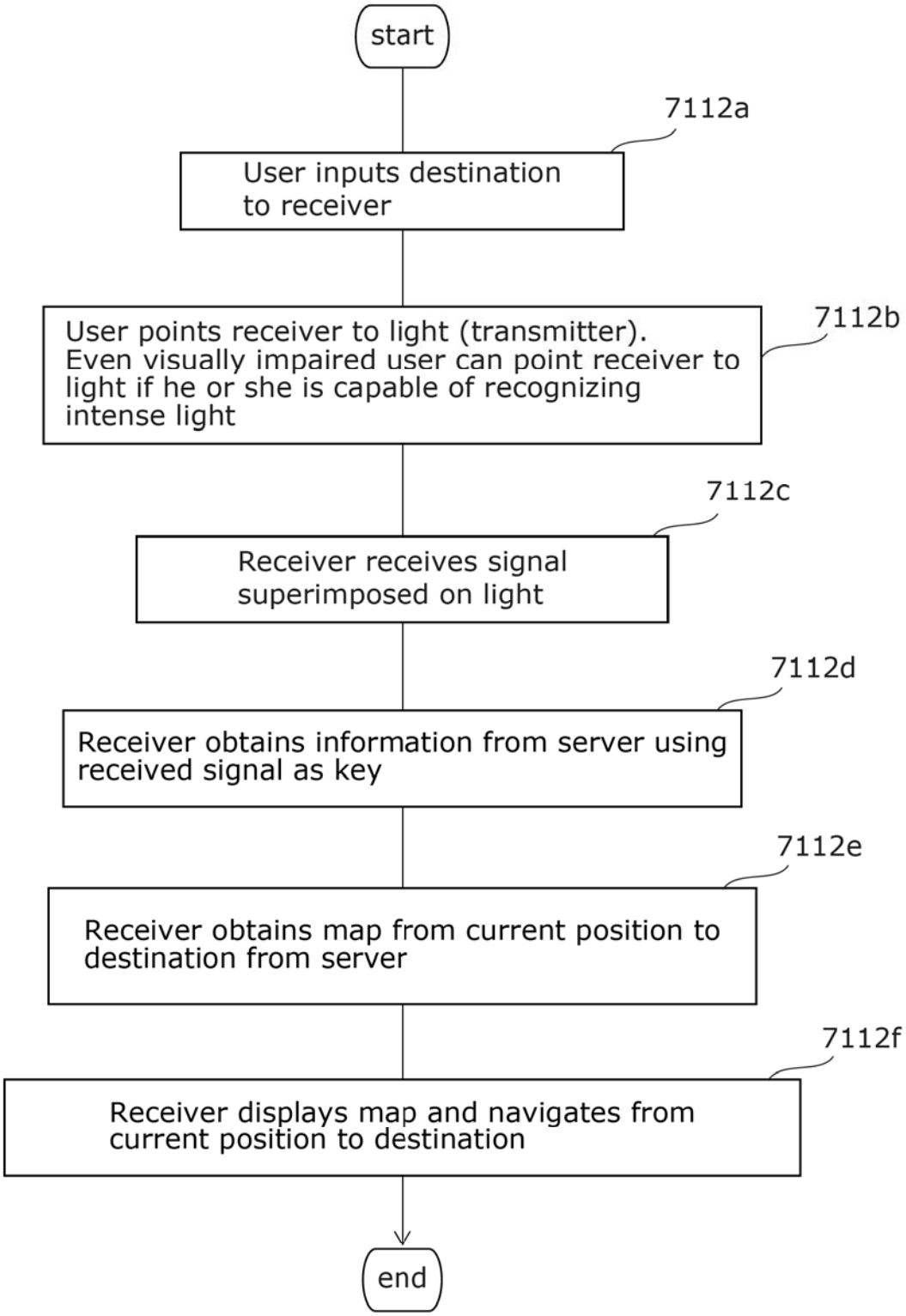

start
7112a
User inputs destination to receiver
User points receiver to light (transmitter). Even visually impaired user can point receiver to light if he or she is capable of recognizing intense light
7112b
7112c
Receiver receives signal superimposed on light
7112d
Receiver obtains information from server using received signal as key
7112e
Receiver obtains map from current position to destination from server
7112f
Receiver displays map and navigates from current position to destination
end

FIG. 229

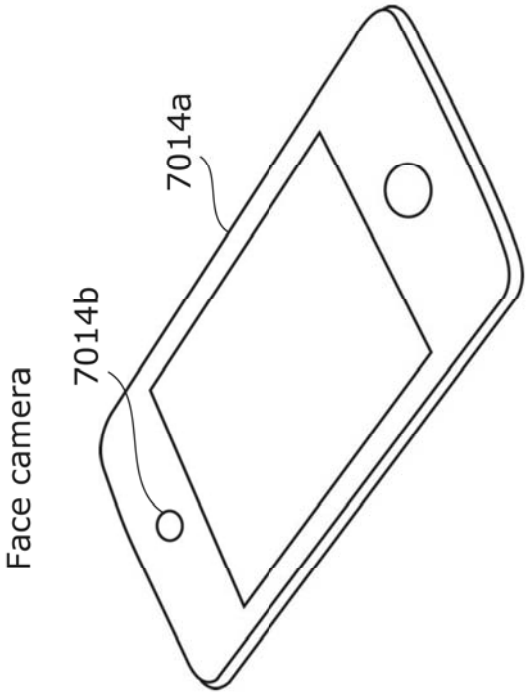


FIG. 230

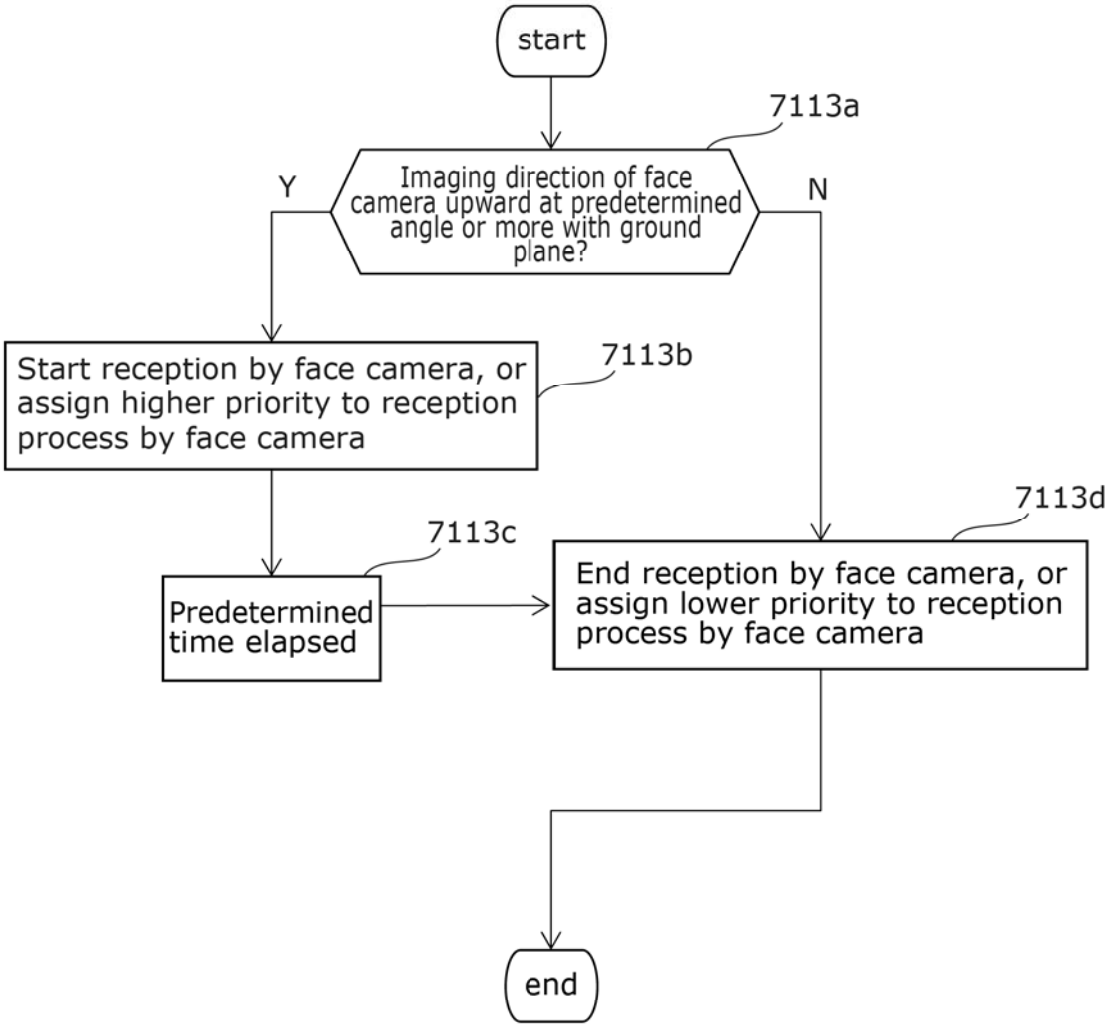

start
7113a
Imaging direction of face camera upward at predetermined angle or more with ground plane?
Y
N
Start reception by face camera, or assign higher priority to reception process by face camera
7113b
7113c
Predetermined time elapsed
7113d
End reception by face camera, or assign lower priority to reception process by face camera
end

FIG. 231

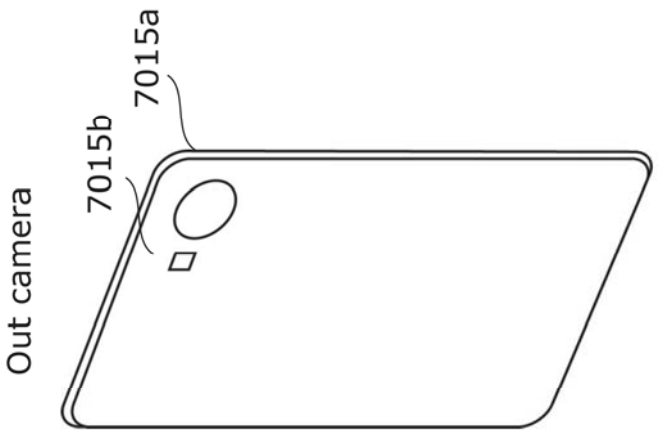


FIG. 232

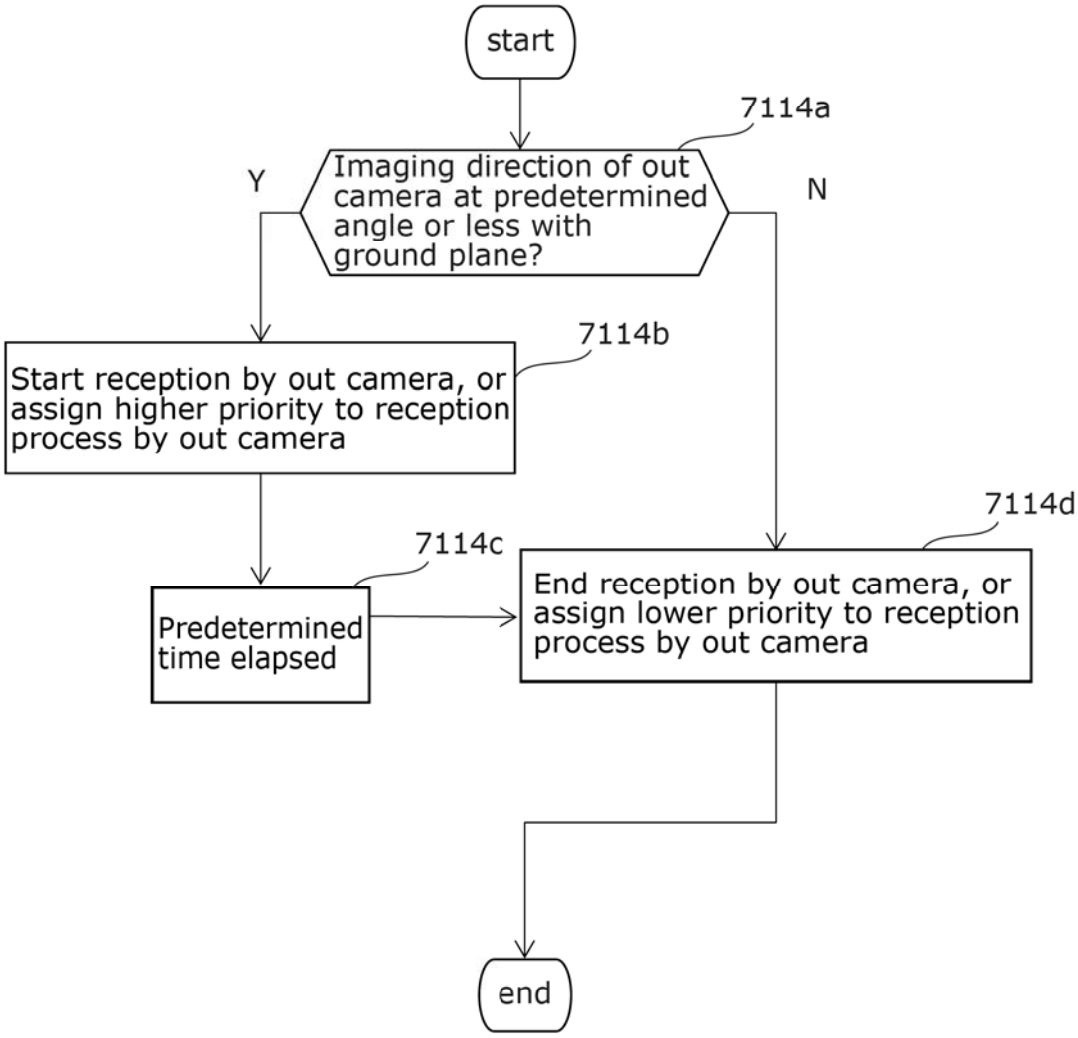

start
7114a
Imaging direction of out camera at predetermined angle or less with ground plane?
Y
N
7114b
Start reception by out camera, or assign higher priority to reception process by out camera
7114c
Predetermined time elapsed
7114d
End reception by out camera, or assign lower priority to reception process by out camera
end

FIG. 233

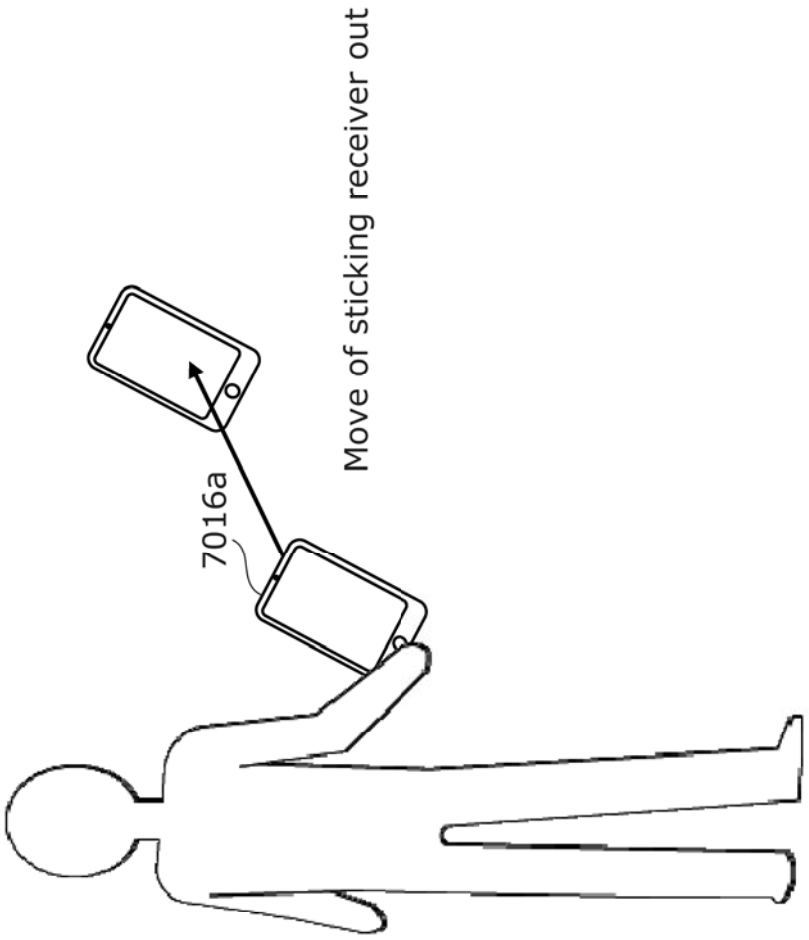


FIG. 234

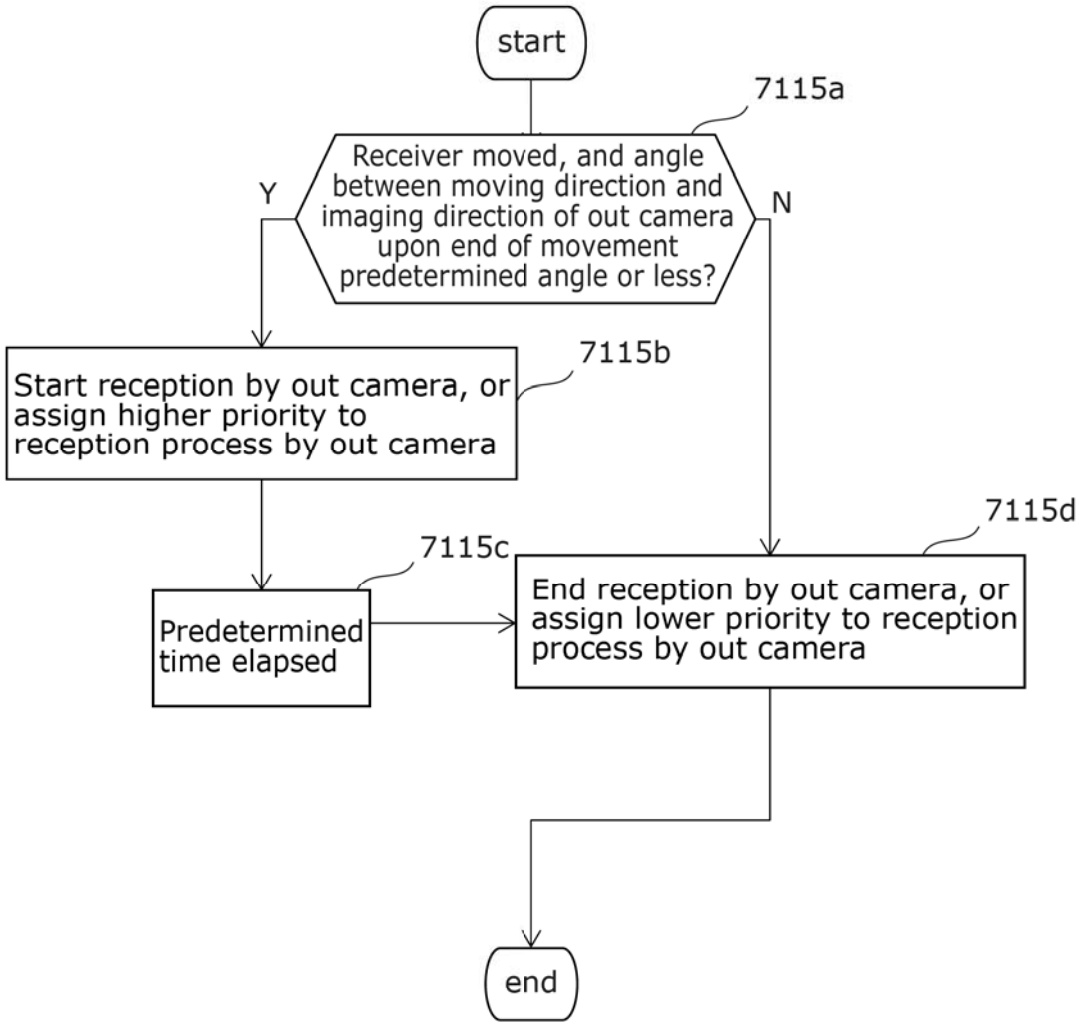

start
7115a
Receiver moved, and angle between moving direction and imaging direction of out camera upon end of movement predetermined angle or less?
Y
N
7115b
Start reception by out camera, or assign higher priority to reception process by out camera
7115c
Predetermined time elapsed
7115d
End reception by out camera, or assign lower priority to reception process by out camera
end

FIG. 235

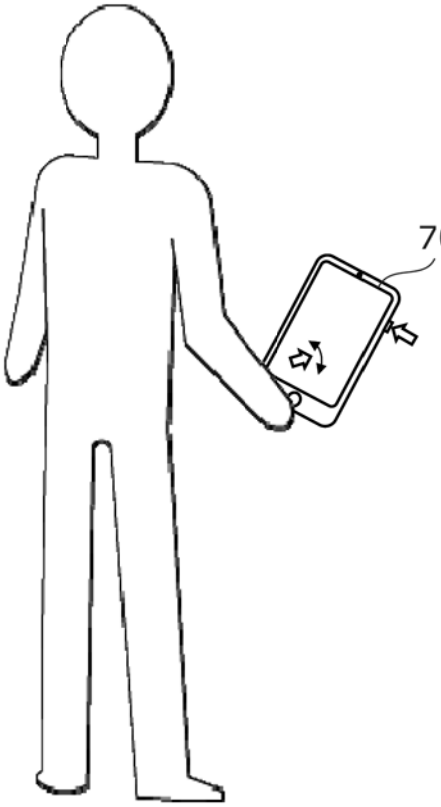


FIG. 236

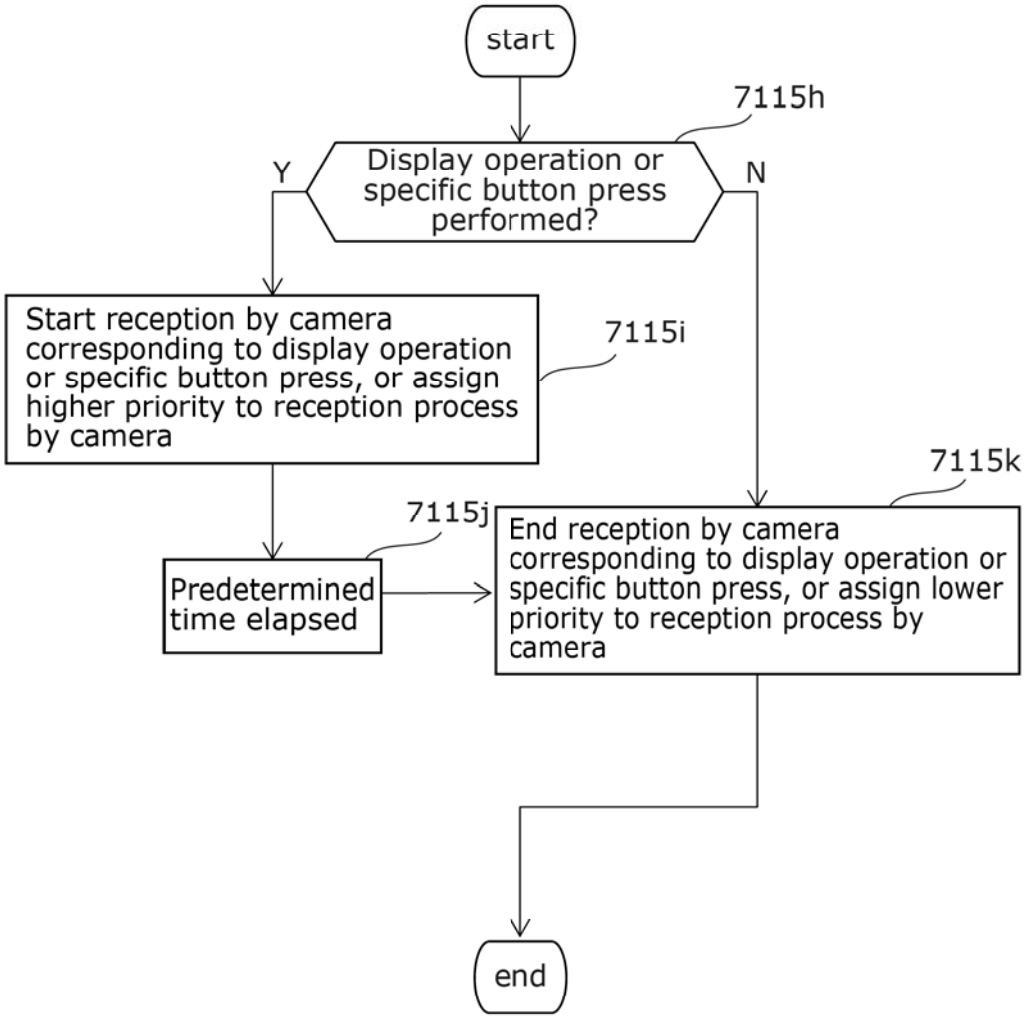

start
7115h
Display operation or specific button press performed?
Y
N
Start reception by camera corresponding to display operation or specific button press, or assign higher priority to reception process by camera
7115i
7115k
7115j
Predetermined time elapsed
End reception by camera corresponding to display operation or specific button press, or assign lower priority to reception process by camera
end

FIG. 237

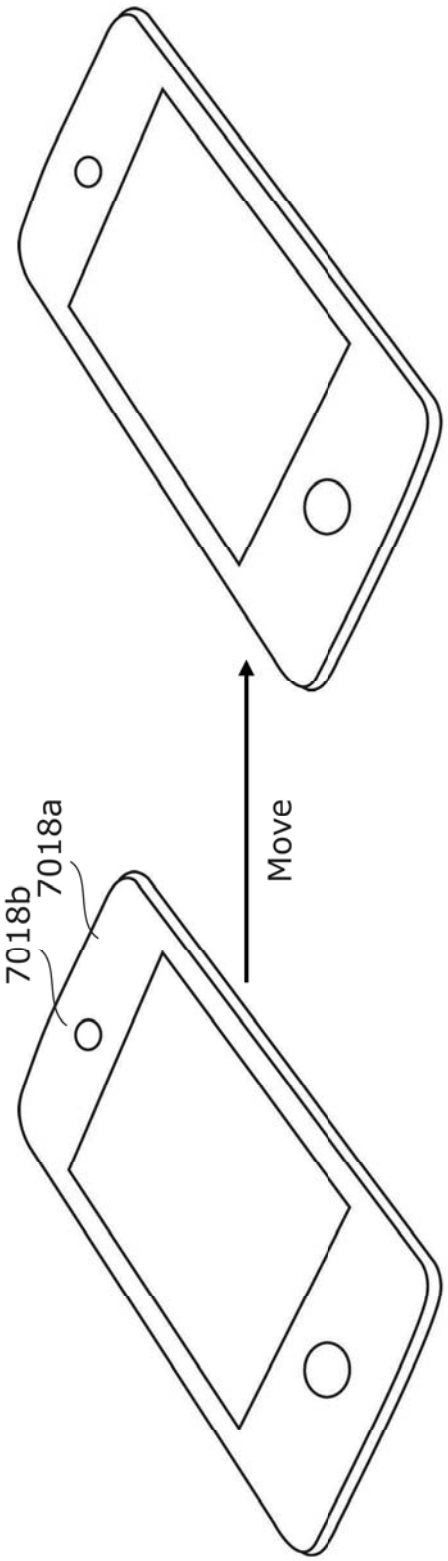


FIG. 238

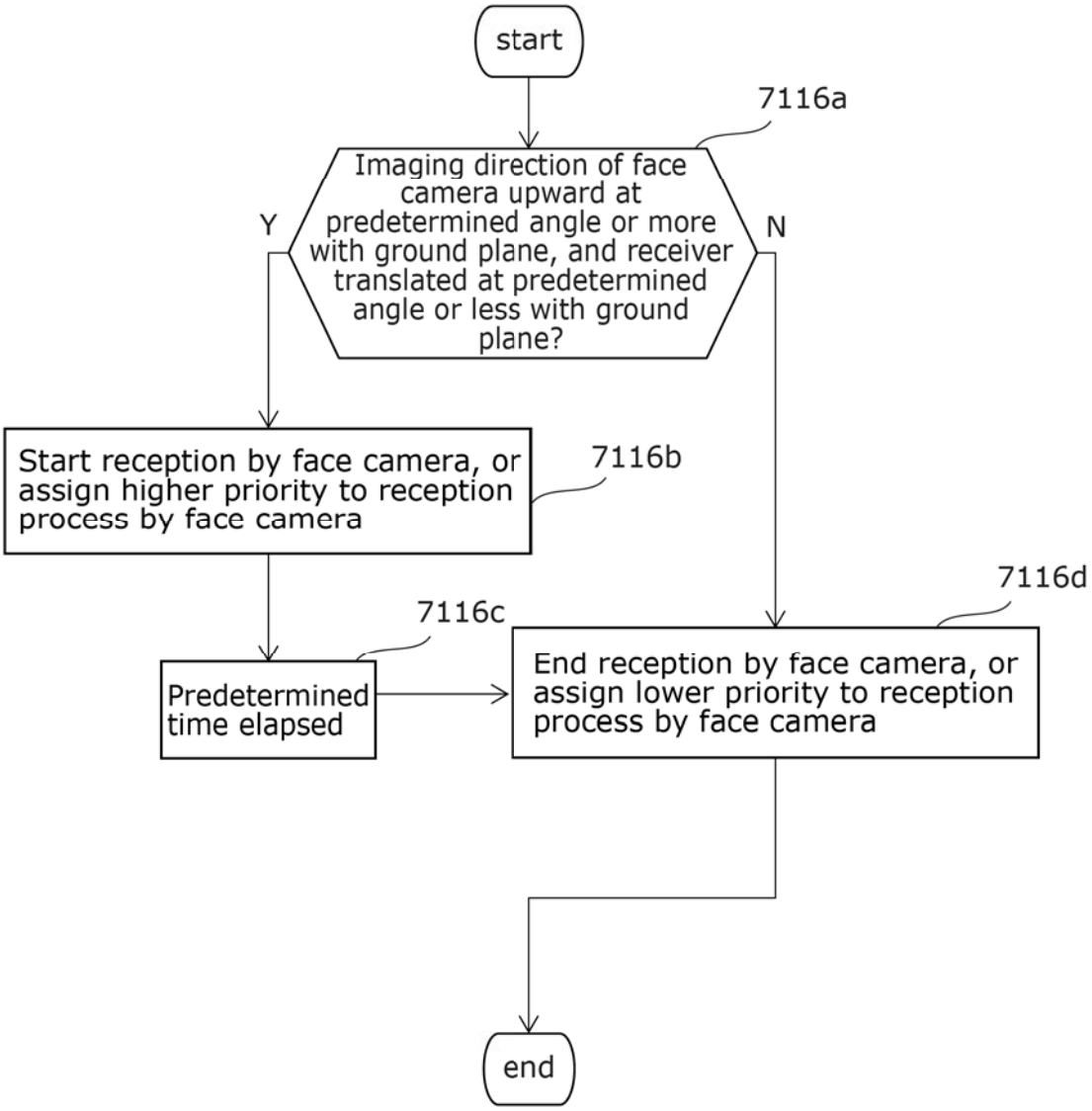

start
7116a
Imaging direction of face camera upward at predetermined angle or more with ground plane, and receiver translated at predetermined angle or less with ground plane?
Y
N
Start reception by face camera, or assign higher priority to reception process by face camera
7116b
7116c
Predetermined time elapsed
7116d
End reception by face camera, or assign lower priority to reception process by face camera
end

FIG. 239

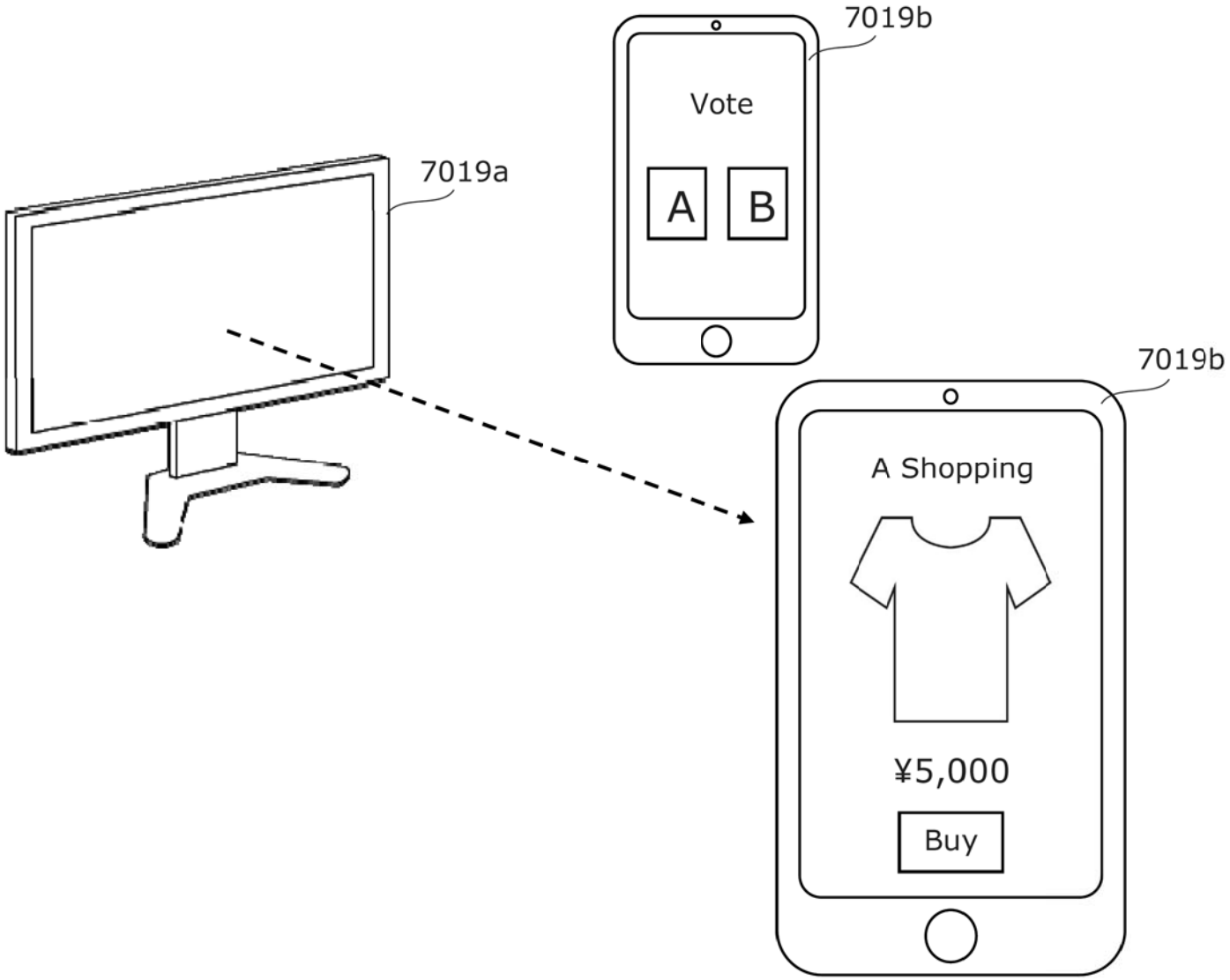


FIG. 240

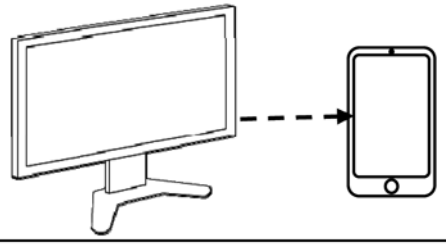
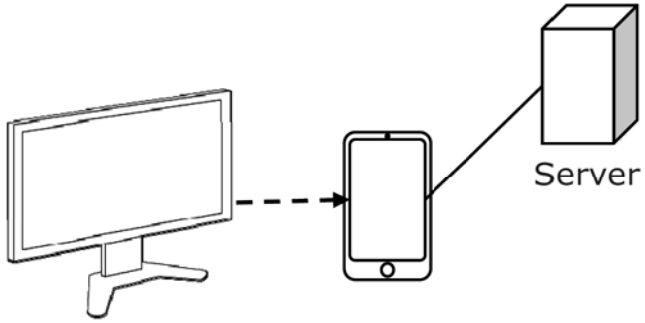
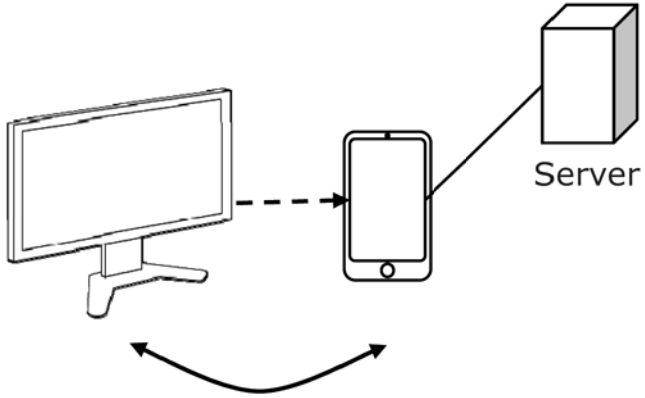
(a) 	Directly transmit and receive necessary information
(b) 	Transmit and receive displayed channel, and inquire of server for necessary information
(c) 	Transmit and receive ID of TV or information necessary for wireless connection, inquire of TV or recorder for displayed channel, and obtain necessary information from server

FIG. 241

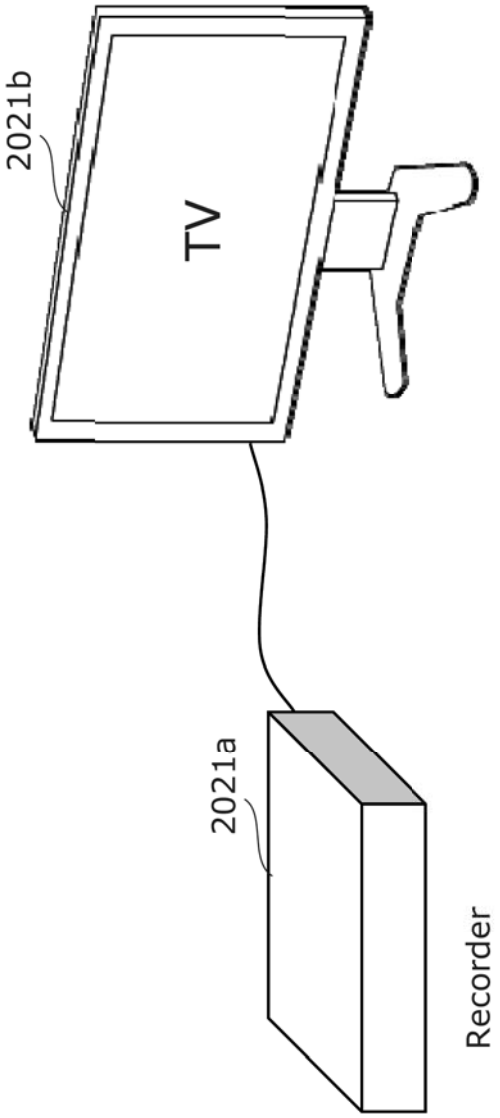


FIG. 242

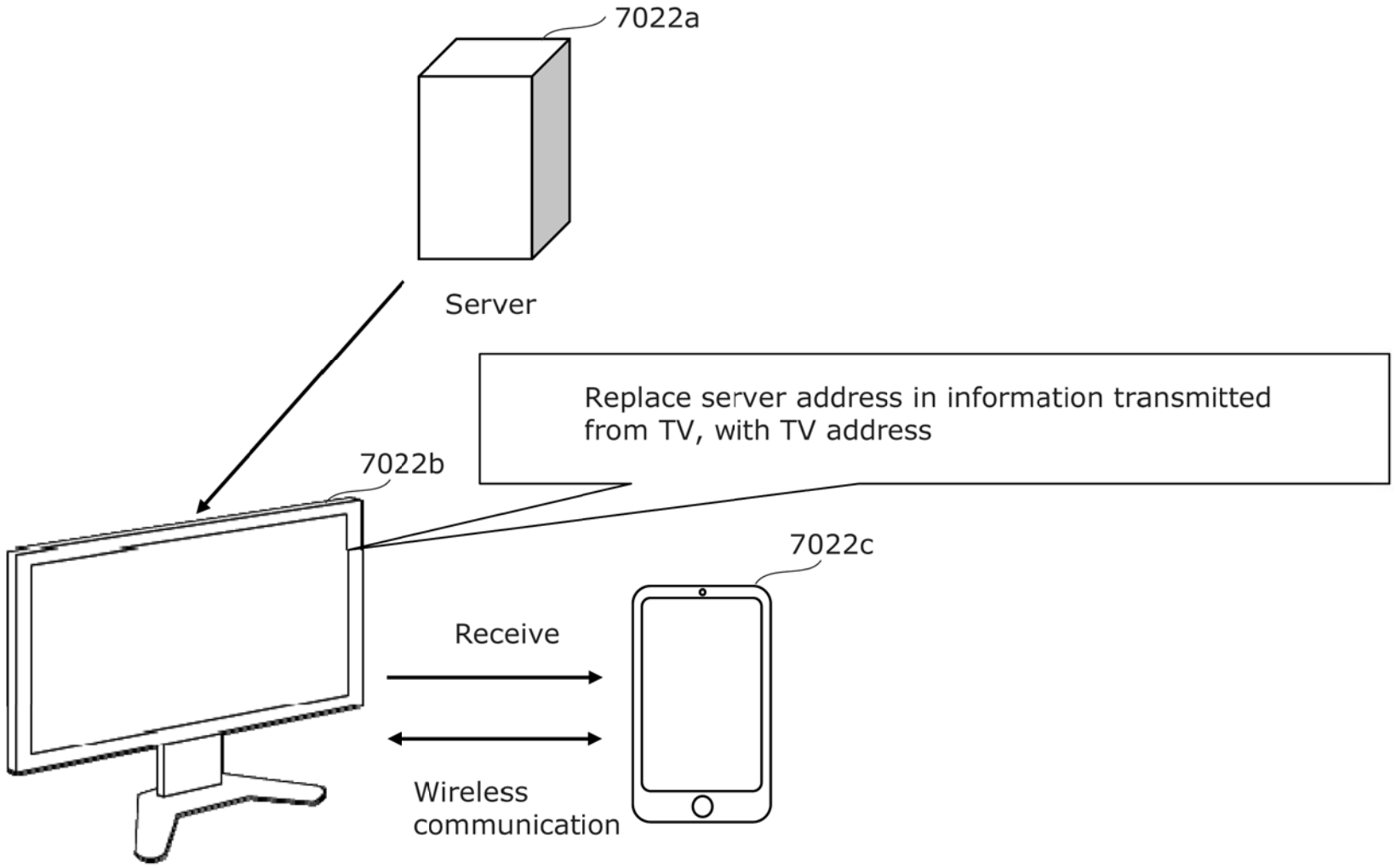

7022a
Server
Replace server address in information transmitted from TV, with TV address
7022b
7022c
Receive
Wireless communication

FIG. 243

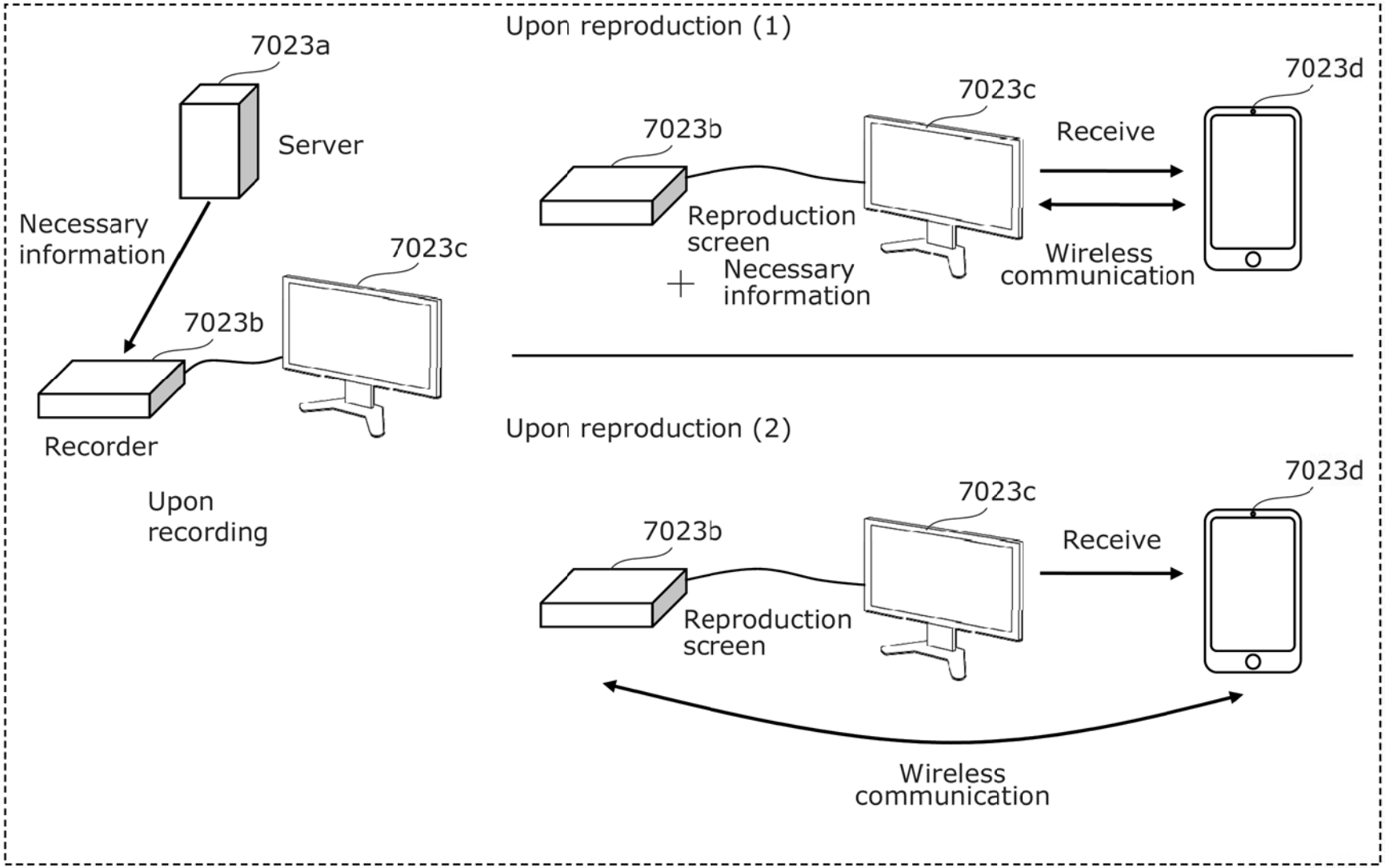

7023a
Server
Necessary information
7023c
7023b
Recorder
Upon recording
Upon reproduction (1)
7023d
7023c
7023b
Receive
Reproduction screen
+ Necessary information
Wireless communication
Upon reproduction (2)
7023d
7023c
7023b
Receive
Reproduction screen
Wireless communication

FIG. 244

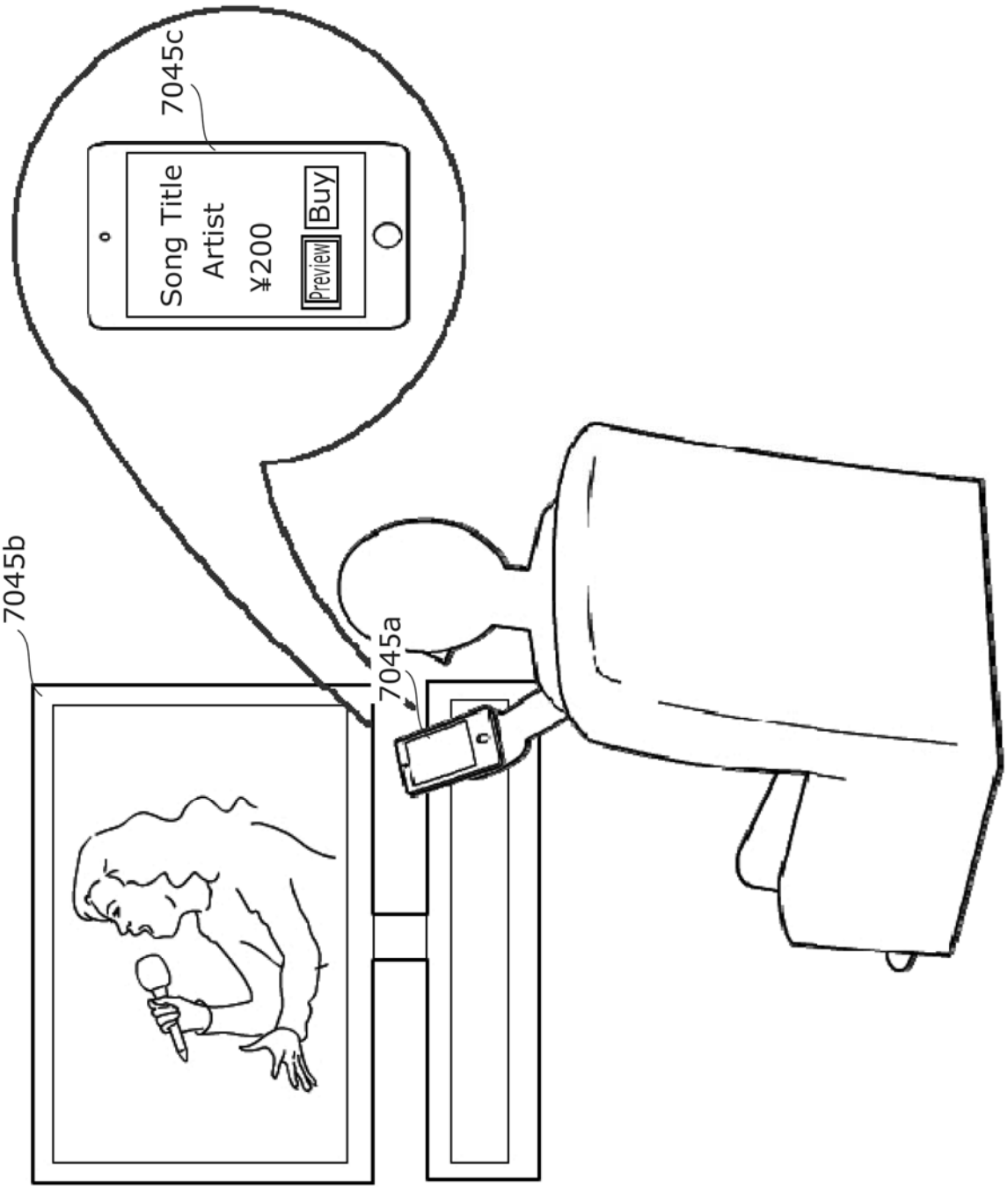


FIG. 245

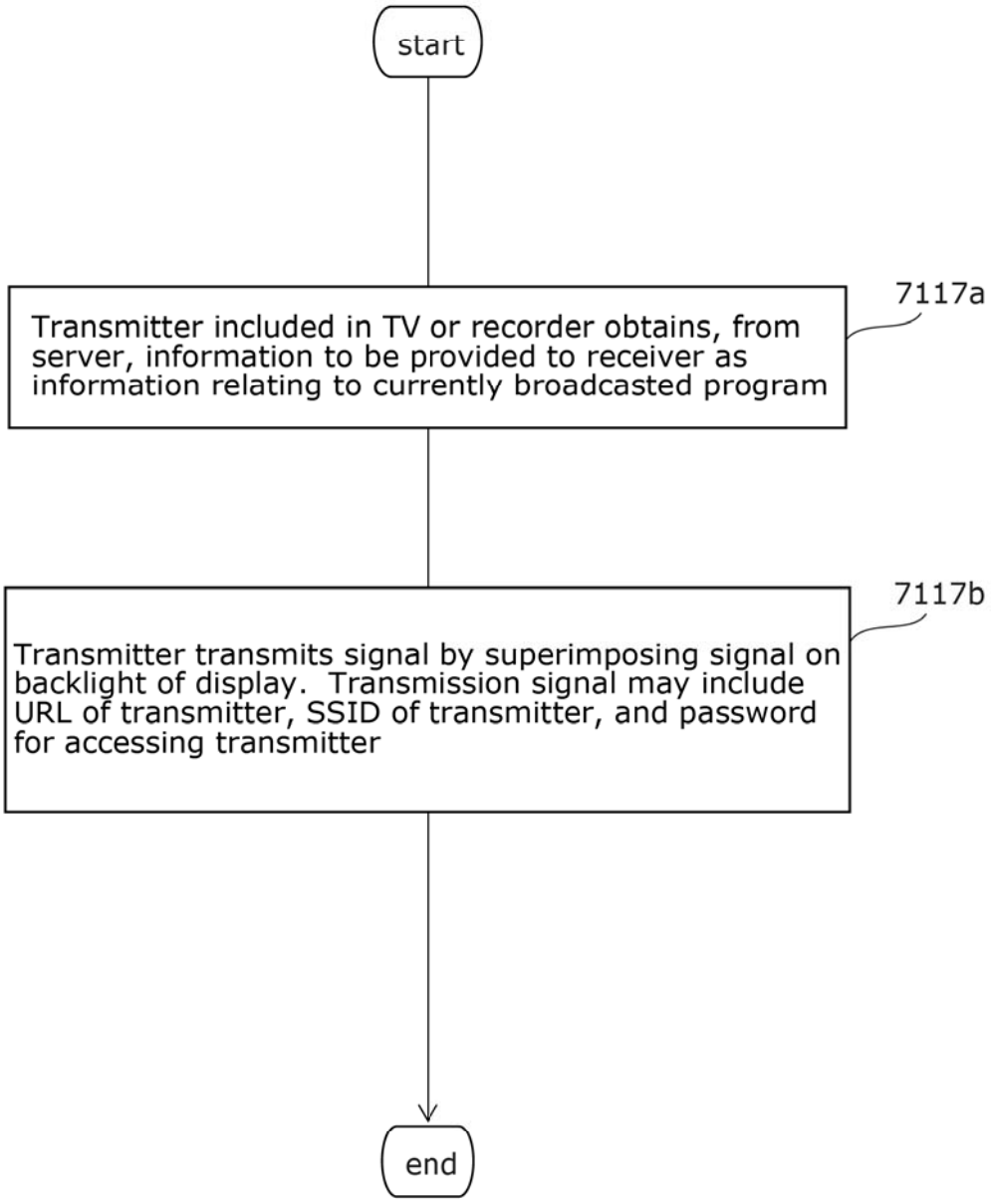

start
Transmitter included in TV or recorder obtains, from server, information to be provided to receiver as information relating to currently broadcasted program
7117a
Transmitter transmits signal by superimposing signal on backlight of display. Transmission signal may include URL of transmitter, SSID of transmitter, and password for accessing transmitter
7117b
end

FIG. 246

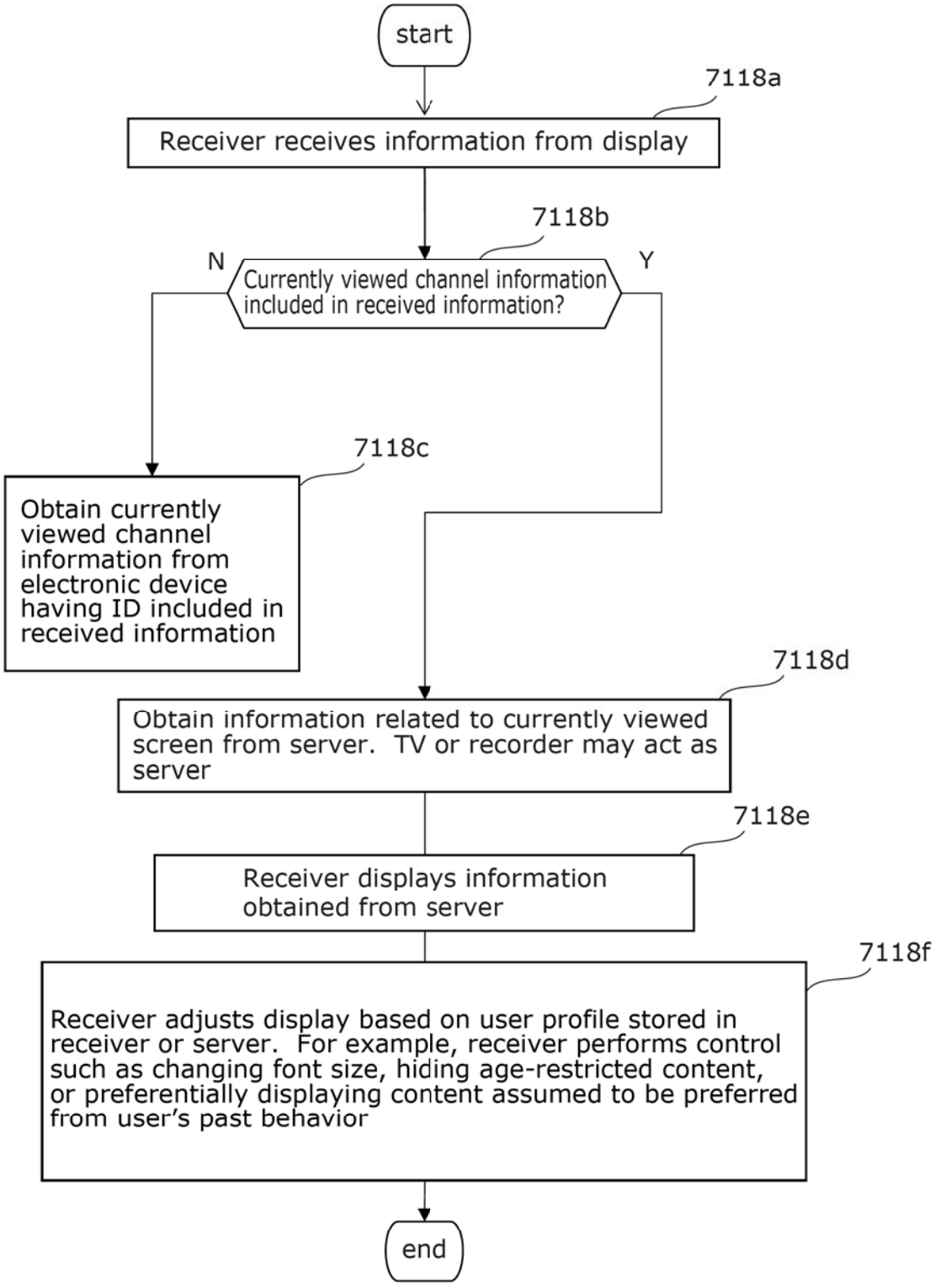

start
7118a
Receiver receives information from display
7118b
N
Currently viewed channel information included in received information?
Y
7118c
Obtain currently viewed channel information from electronic device having ID included in received information
7118d
Obtain information related to currently viewed screen from server. TV or recorder may act as server
7118e
Receiver displays information obtained from server
7118f
Receiver adjusts display based on user profile stored in receiver or server. For example, receiver performs control such as changing font size, hiding age-restricted content, or preferentially displaying content assumed to be preferred from user's past behavior
end

FIG. 247

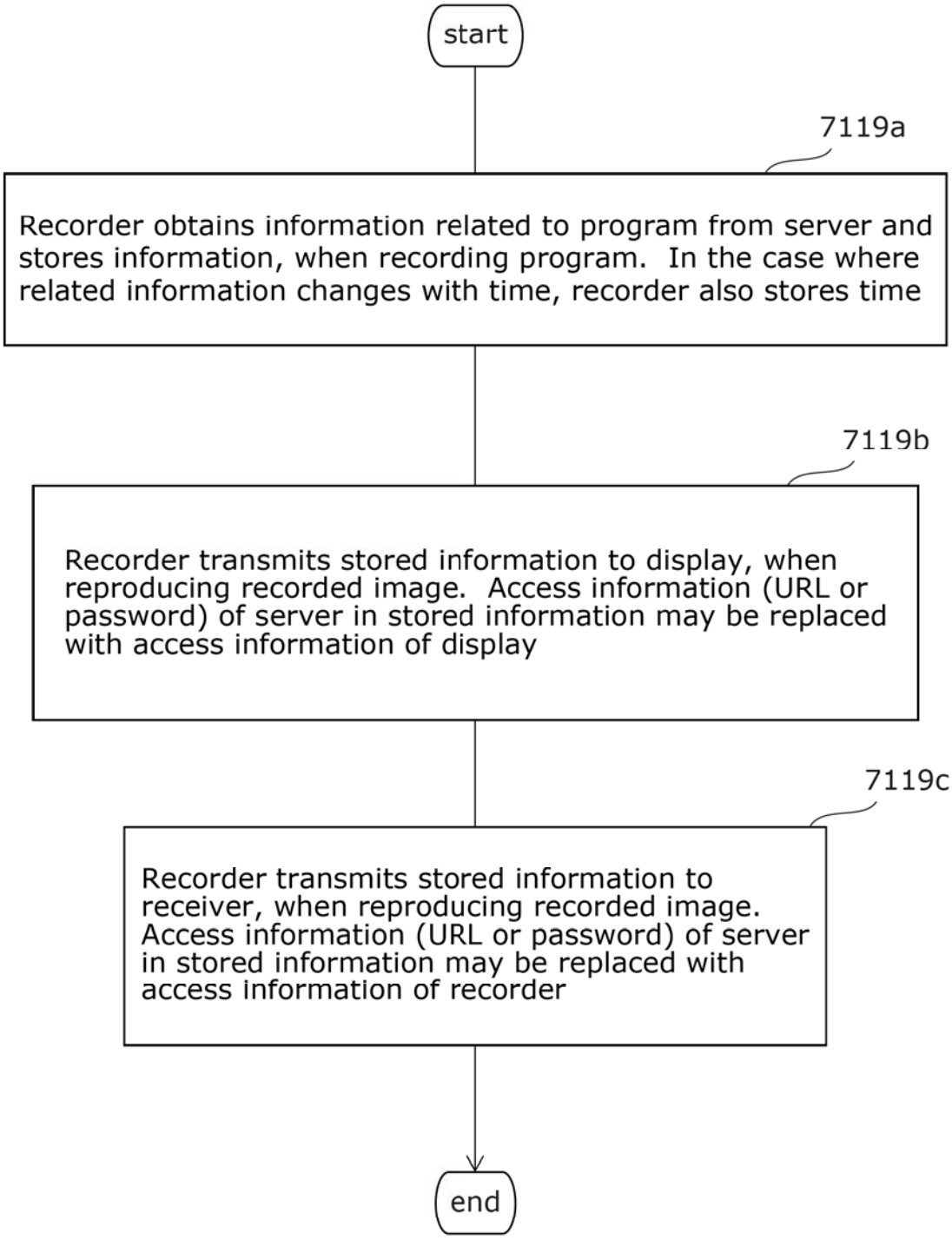

start
7119a
Recorder obtains information related to program from server and stores information, when recording program. In the case where related information changes with time, recorder also stores time
7119b
Recorder transmits stored information to display, when reproducing recorded image. Access information (URL or password) of server in stored information may be replaced with access information of display
7119c
Recorder transmits stored information to receiver, when reproducing recorded image. Access information (URL or password) of server in stored information may be replaced with access information of recorder
end

FIG. 248

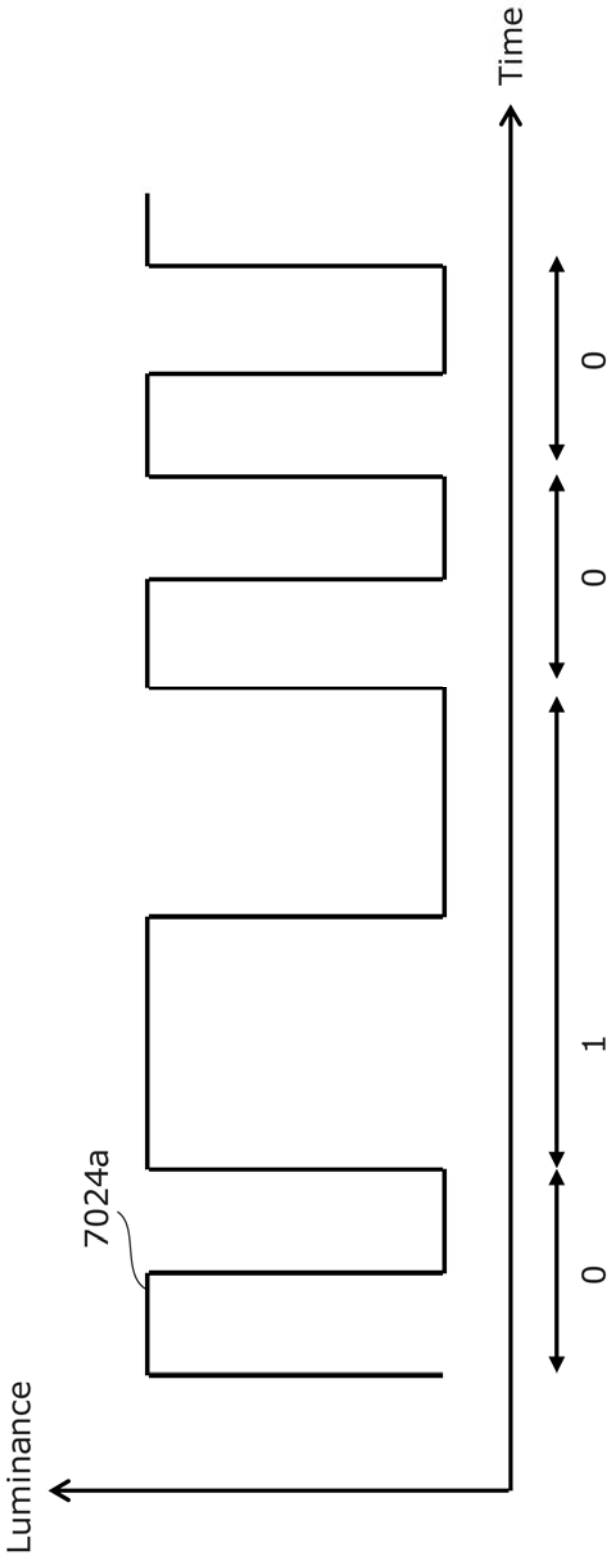


FIG. 249

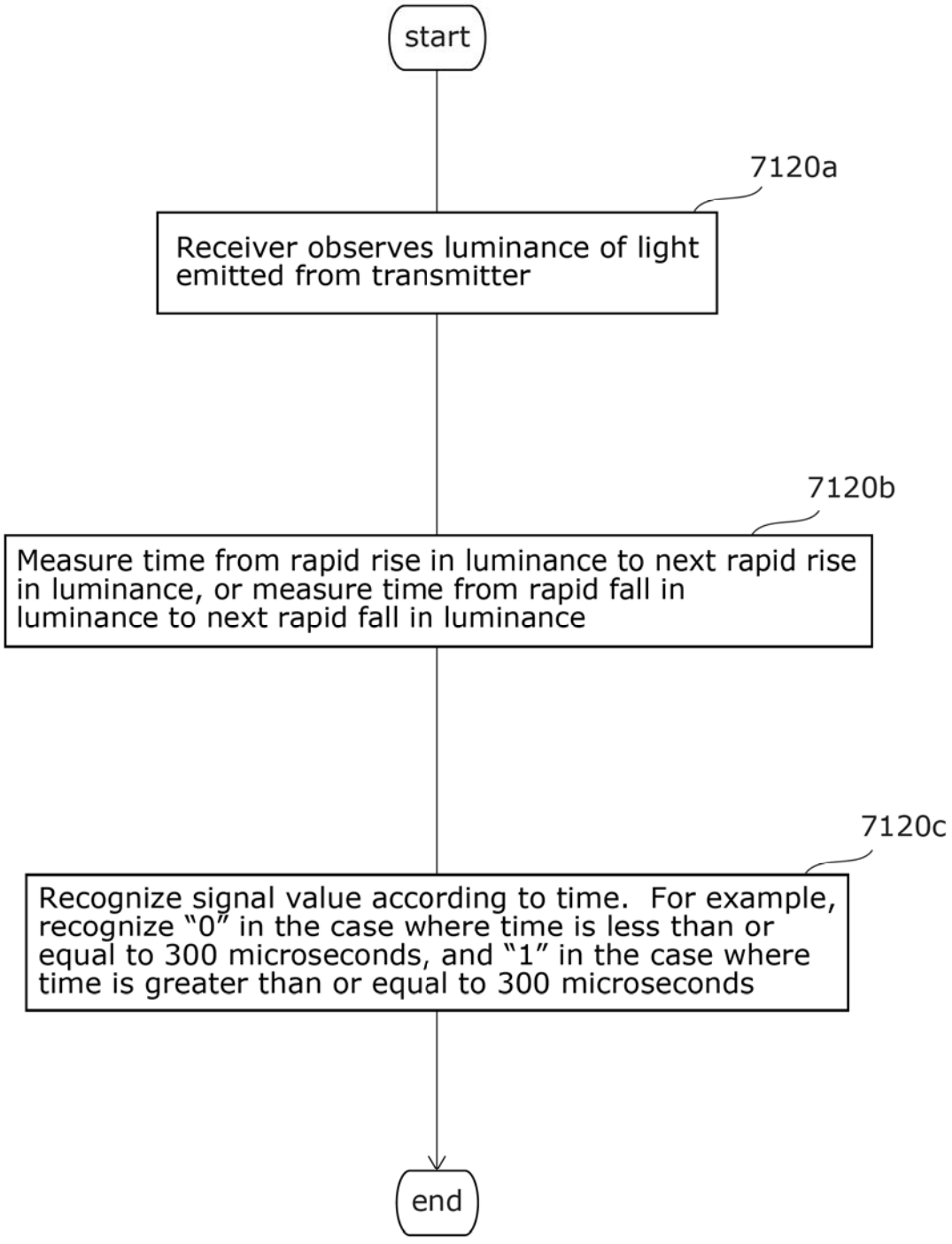

start
7120a
Receiver observes luminance of light emitted from transmitter
7120b
Measure time from rapid rise in luminance to next rapid rise in luminance, or measure time from rapid fall in luminance to next rapid fall in luminance
7120c
Recognize signal value according to time. For example, recognize "0" in the case where time is less than or equal to 300 microseconds, and "1" in the case where time is greater than or equal to 300 microseconds
end

FIG. 250

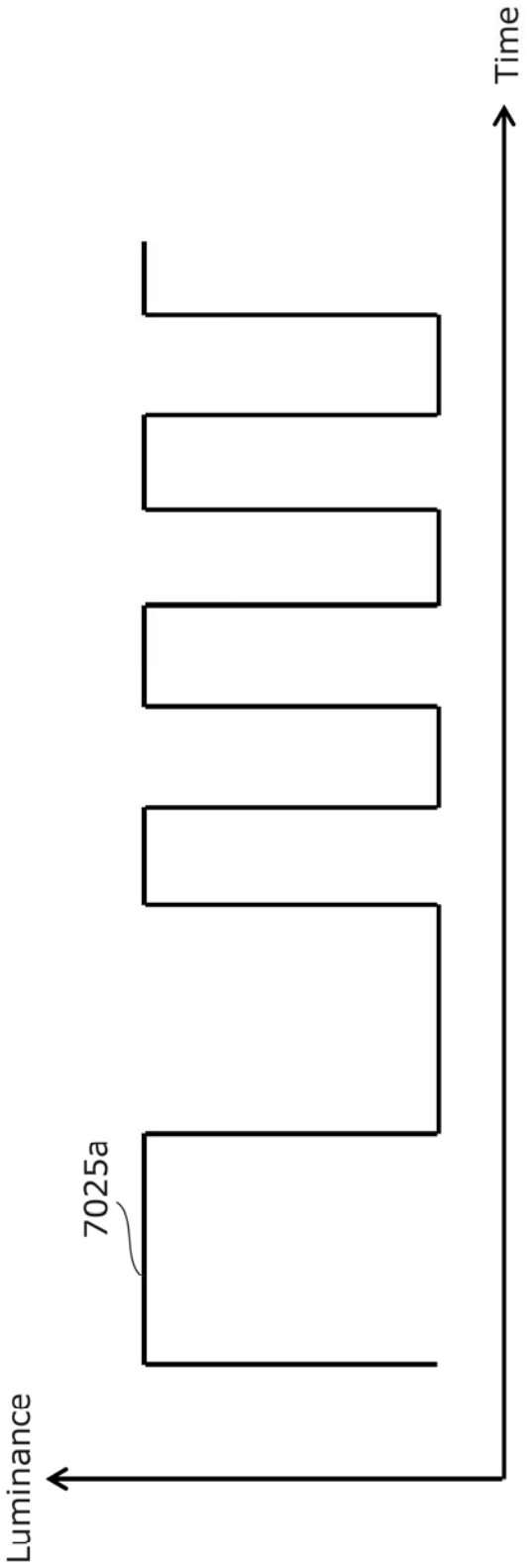


FIG. 251

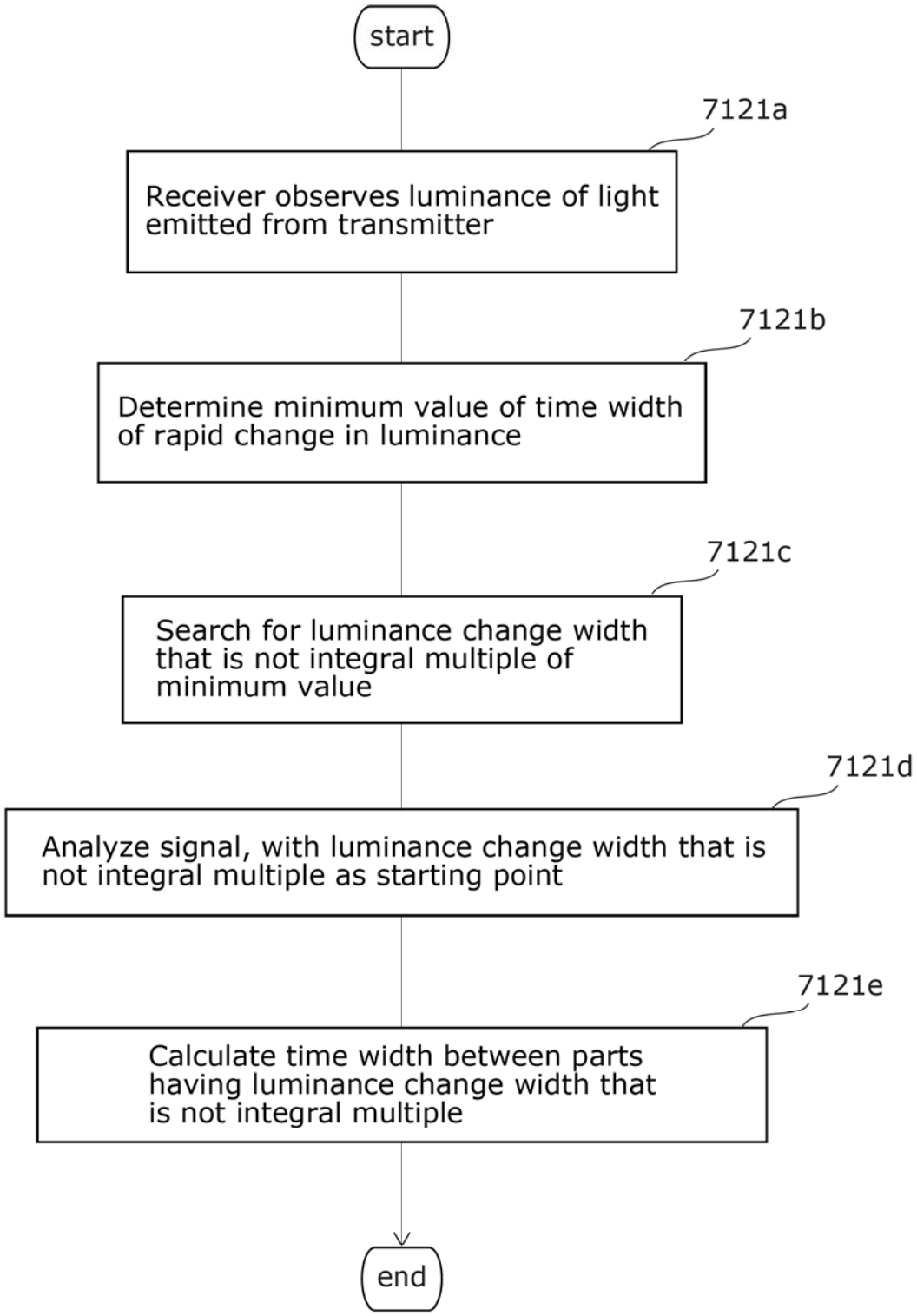

start
7121a
Receiver observes luminance of light emitted from transmitter
7121b
Determine minimum value of time width of rapid change in luminance
7121c
Search for luminance change width that is not integral multiple of minimum value
7121d
Analyze signal, with luminance change width that is not integral multiple as starting point
7121e
Calculate time width between parts having luminance change width that is not integral multiple
end

FIG. 252

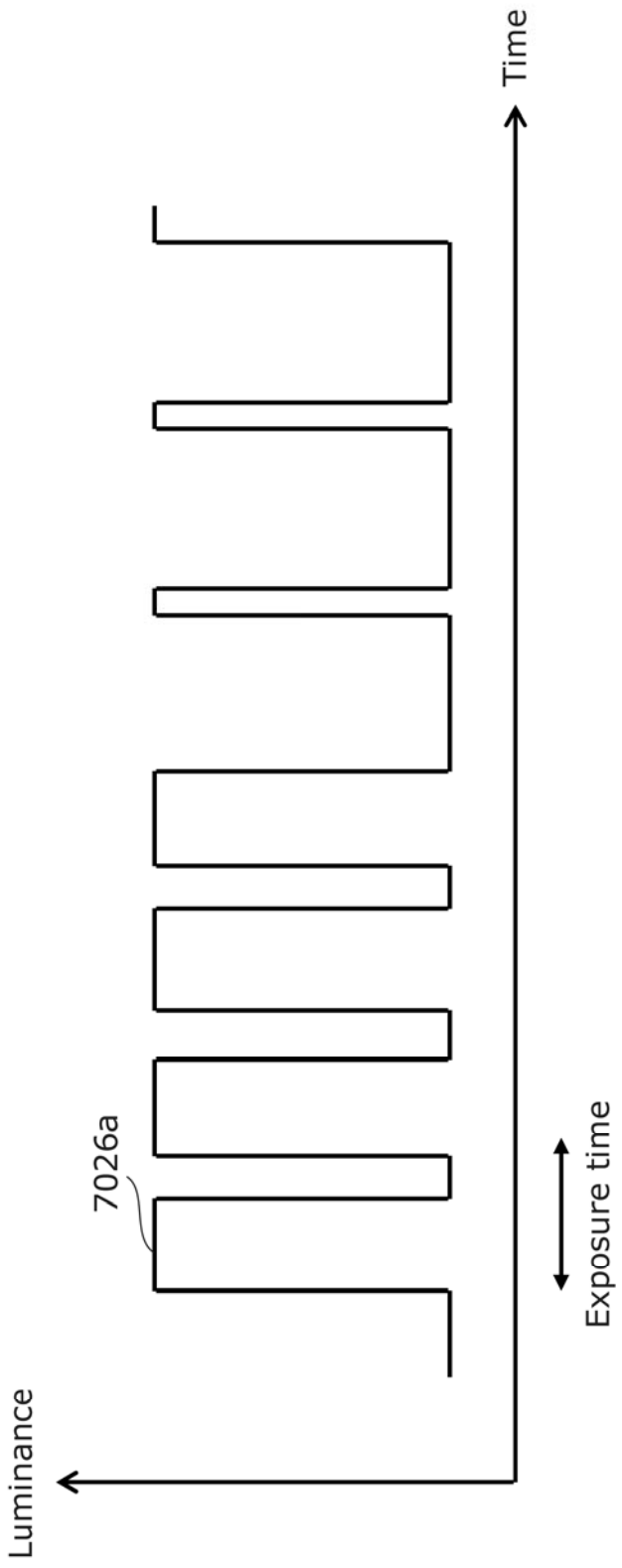


FIG. 253

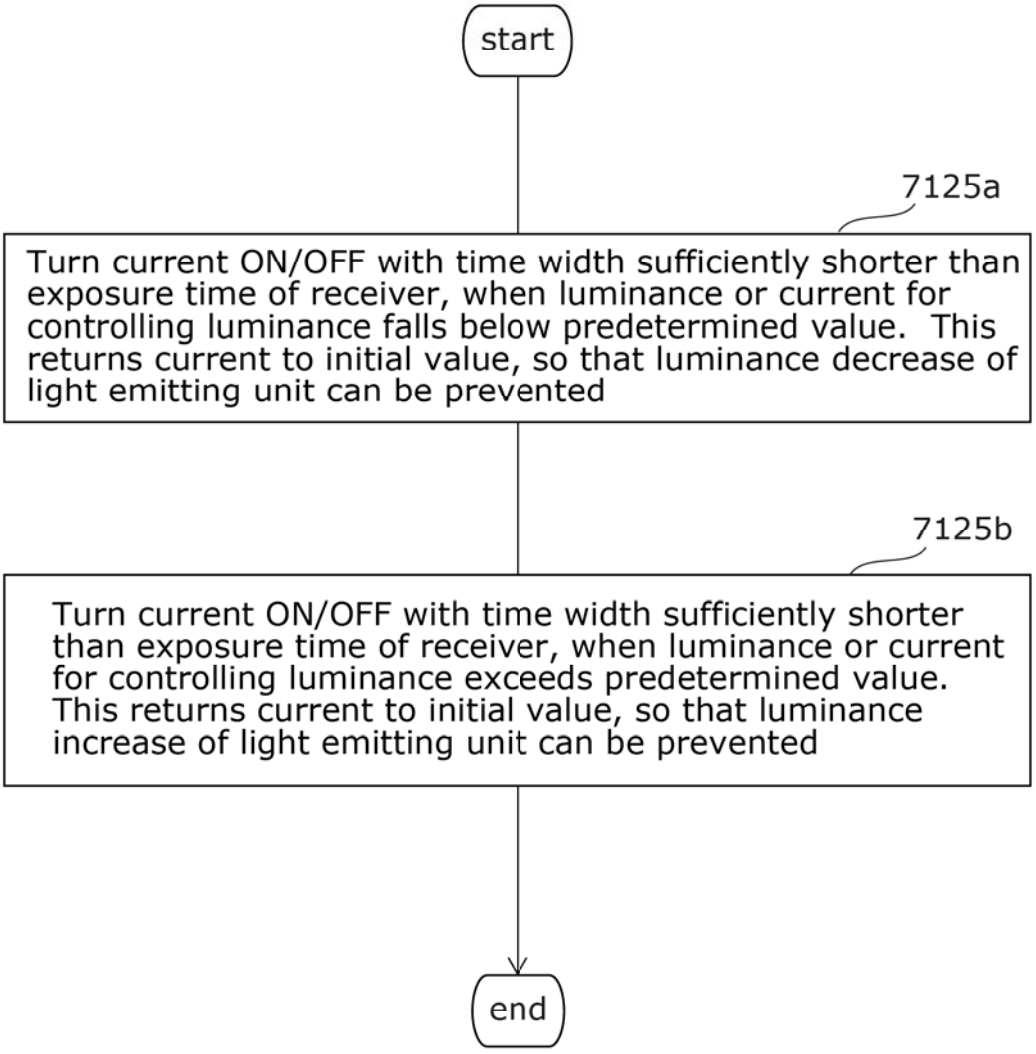

start
7125a
Turn current ON/OFF with time width sufficiently shorter than exposure time of receiver, when luminance or current for controlling luminance falls below predetermined value. This returns current to initial value, so that luminance decrease of light emitting unit can be prevented
7125b
Turn current ON/OFF with time width sufficiently shorter than exposure time of receiver, when luminance or current for controlling luminance exceeds predetermined value. This returns current to initial value, so that luminance increase of light emitting unit can be prevented
end

FIG. 254

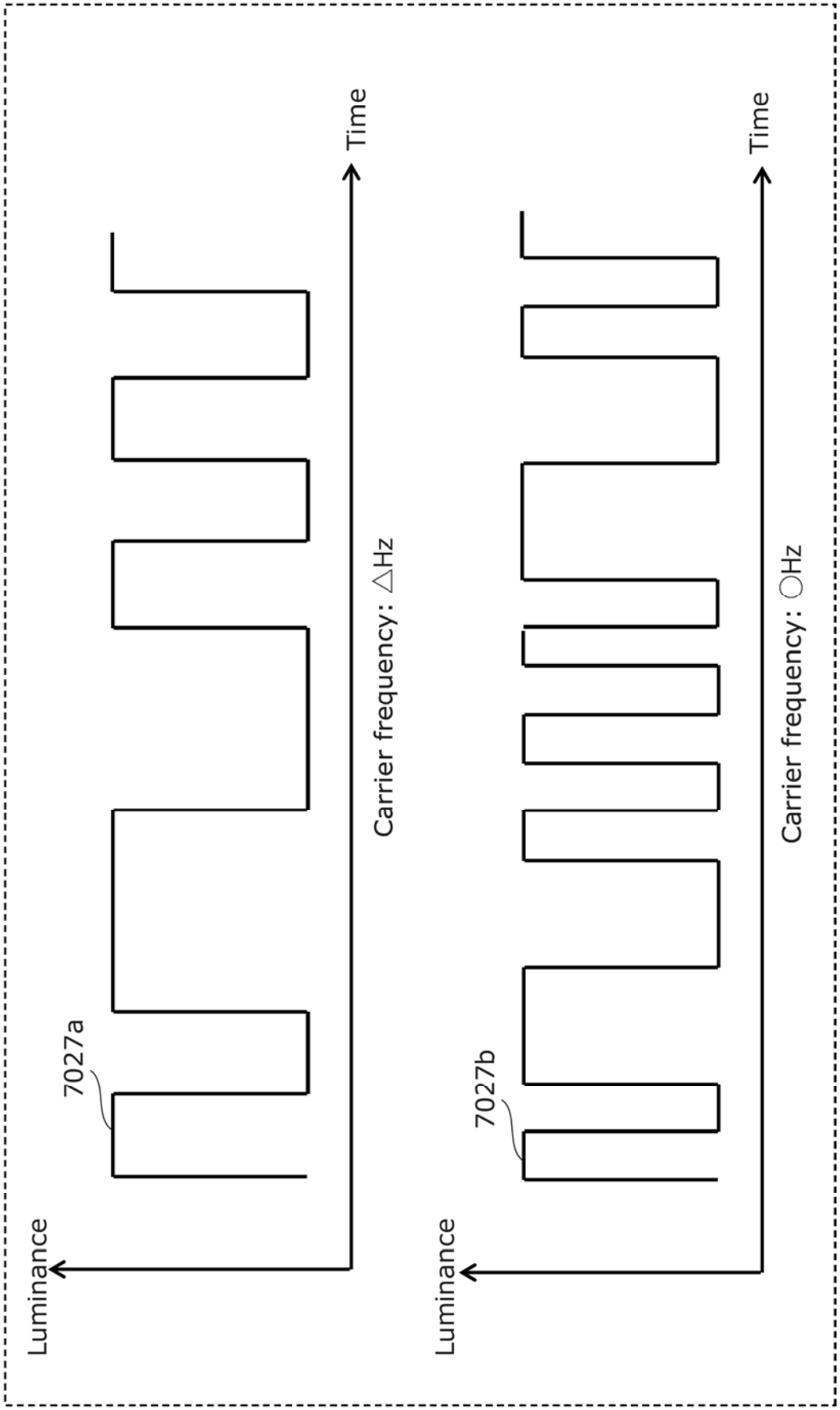

Luminance
Time
Carrier frequency: △Hz
7027a
Luminance
Time
Carrier frequency: ○Hz
7027b

FIG. 255

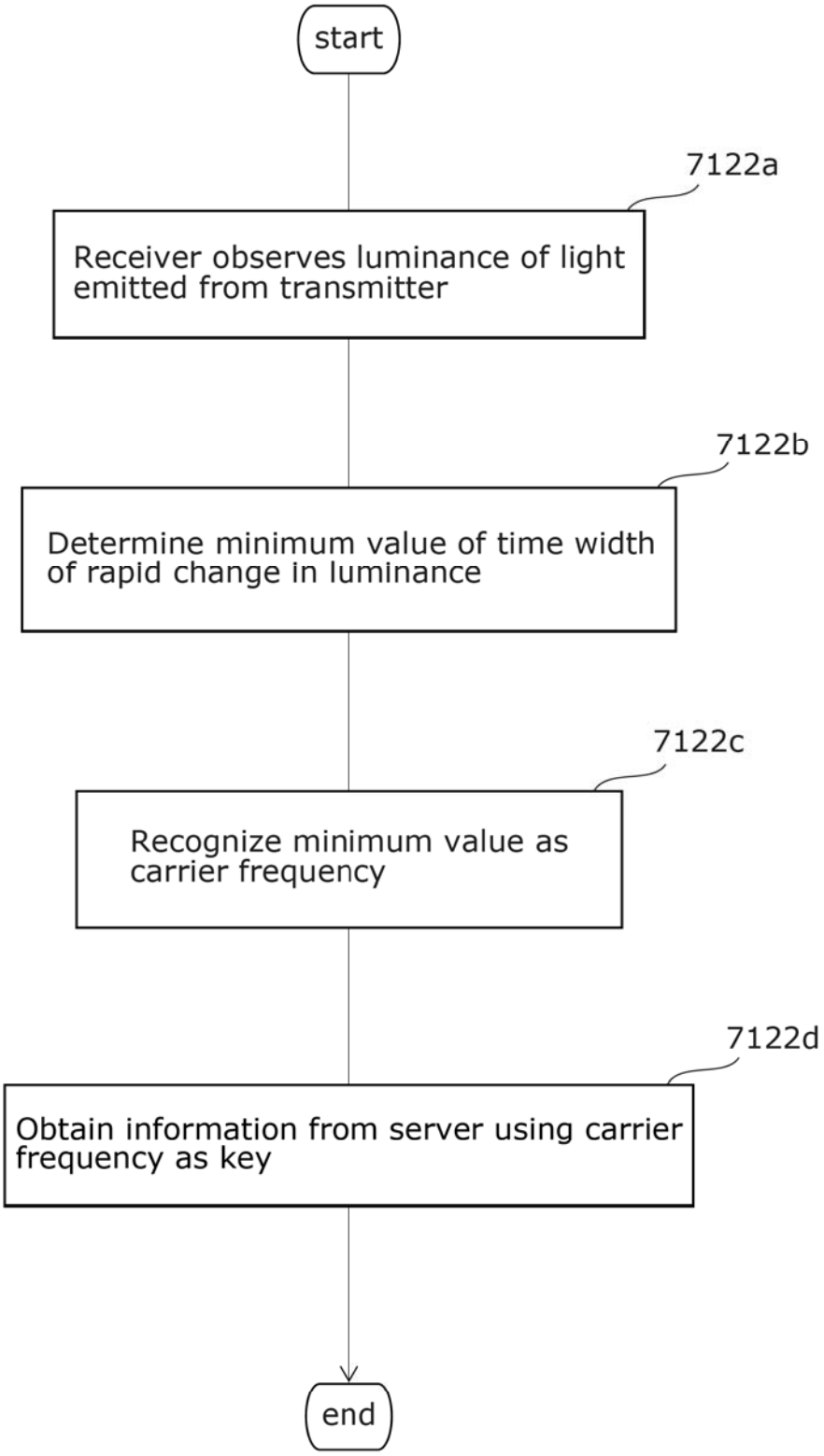

start
7122a
Receiver observes luminance of light emitted from transmitter
7122b
Determine minimum value of time width of rapid change in luminance
7122c
Recognize minimum value as carrier frequency
7122d
Obtain information from server using carrier frequency as key
end

FIG. 256

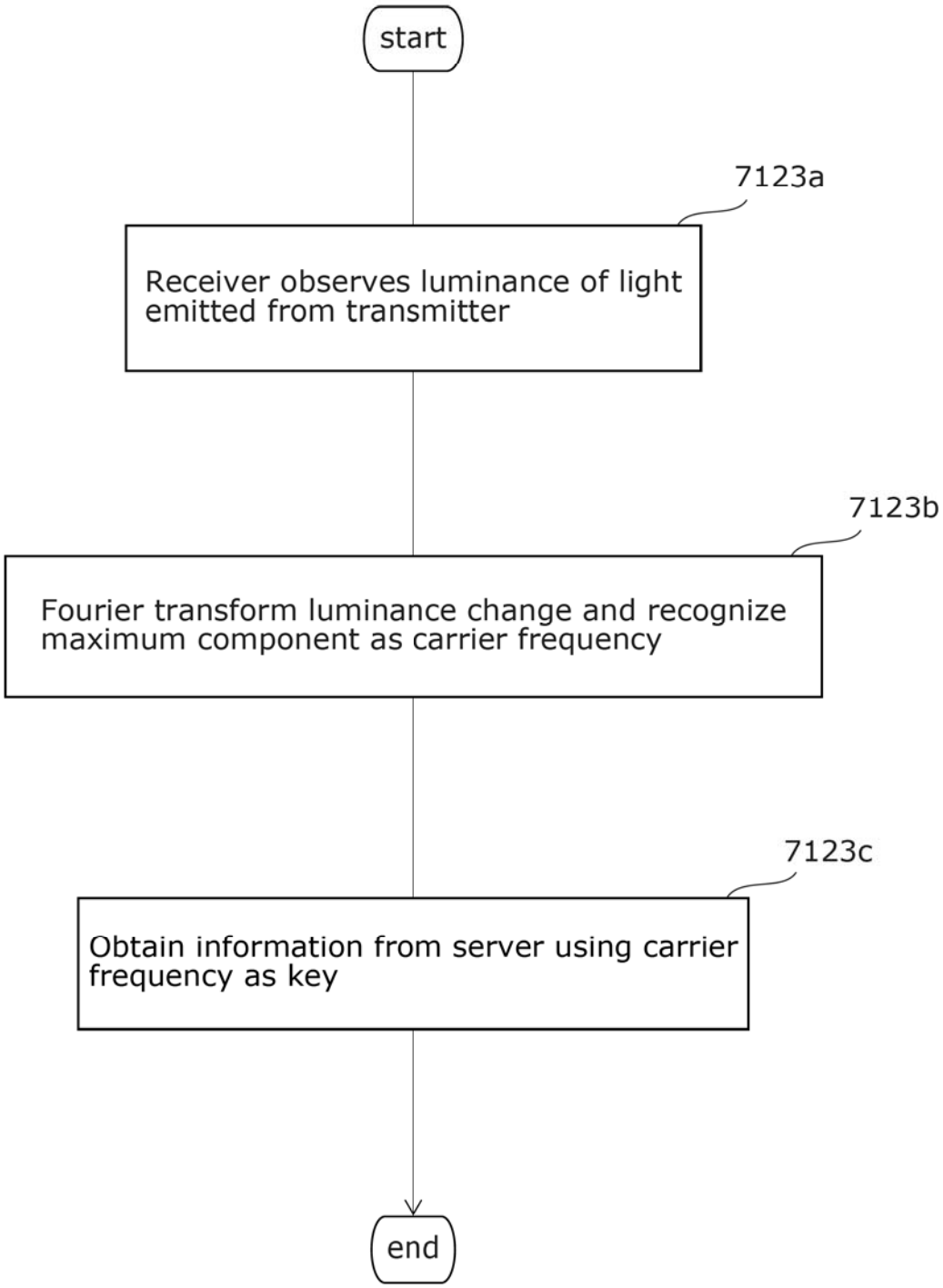

start
7123a
Receiver observes luminance of light emitted from transmitter
7123b
Fourier transform luminance change and recognize maximum component as carrier frequency
7123c
Obtain information from server using carrier frequency as key
end

FIG. 257

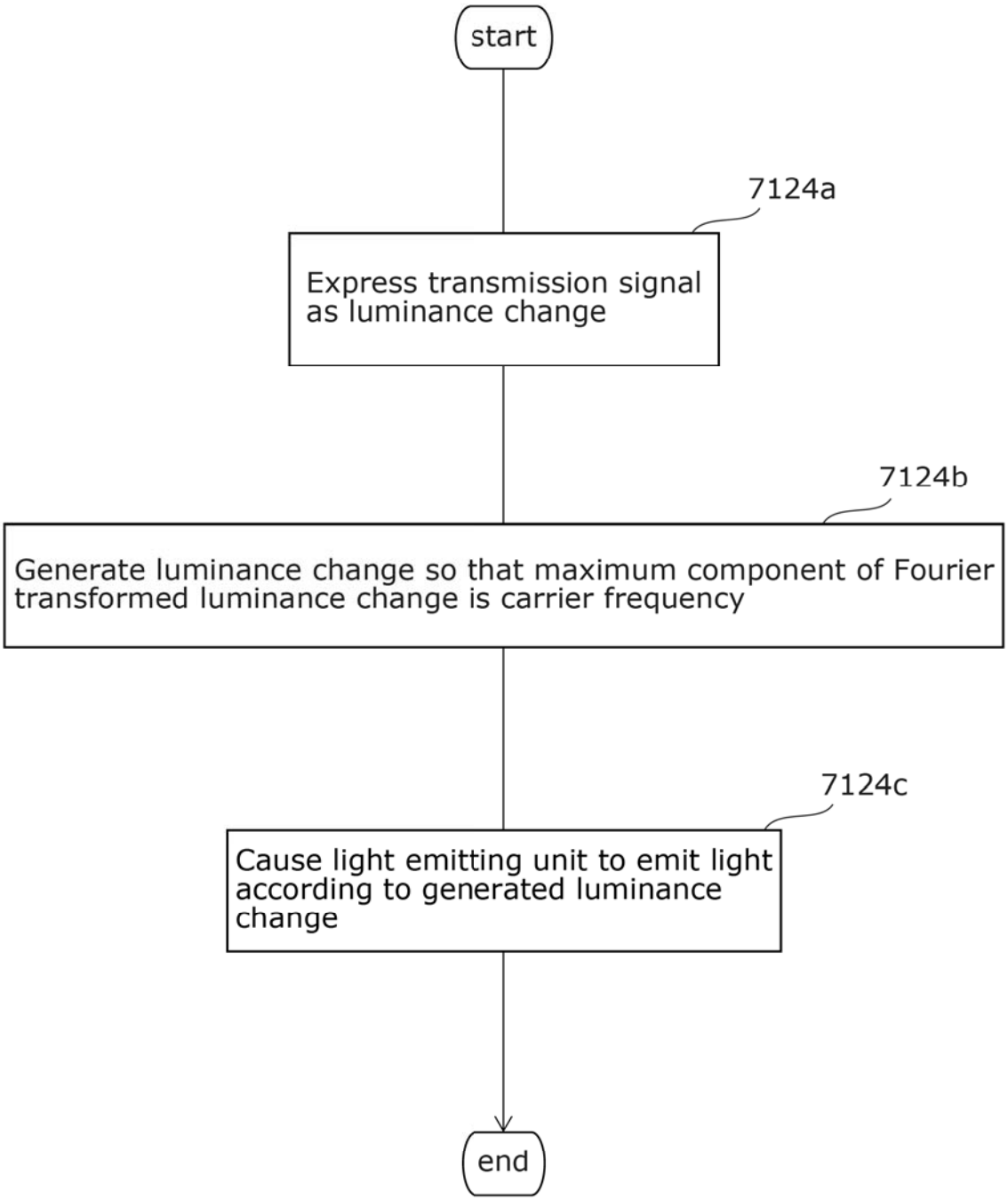

start
7124a
Express transmission signal as luminance change
7124b
Generate luminance change so that maximum component of Fourier transformed luminance change is carrier frequency
7124c
Cause light emitting unit to emit light according to generated luminance change
end

FIG. 258

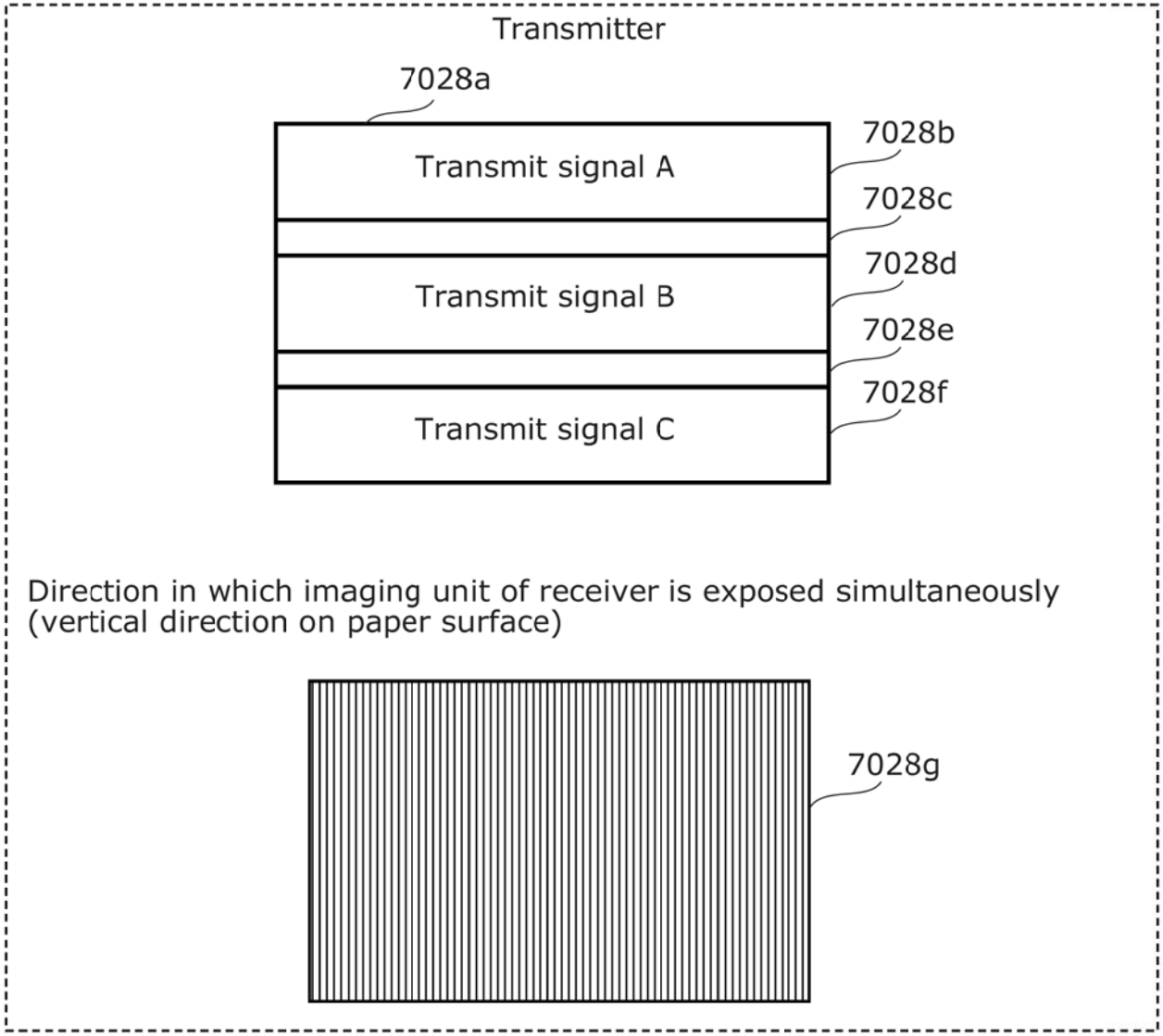

Transmitter
7028a
Transmit signal A
7028b
7028c
Transmit signal B
7028d
7028e
Transmit signal C
7028f
Direction in which imaging unit of receiver is exposed simultaneously
(vertical direction on paper surface)
7028g

FIG. 259

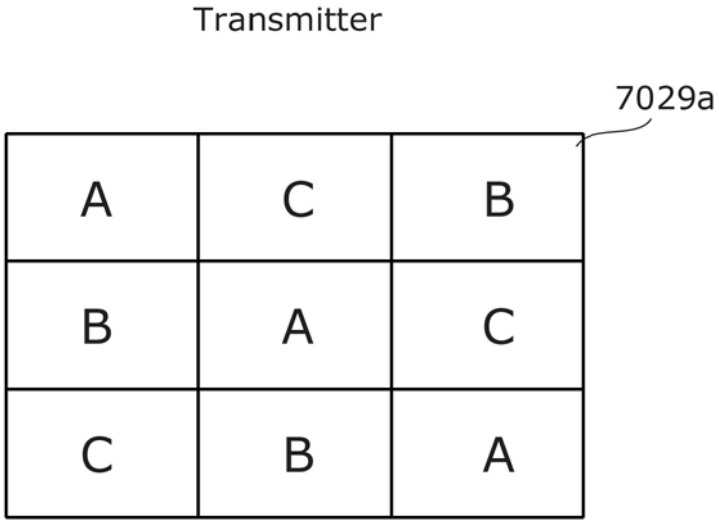


FIG. 260

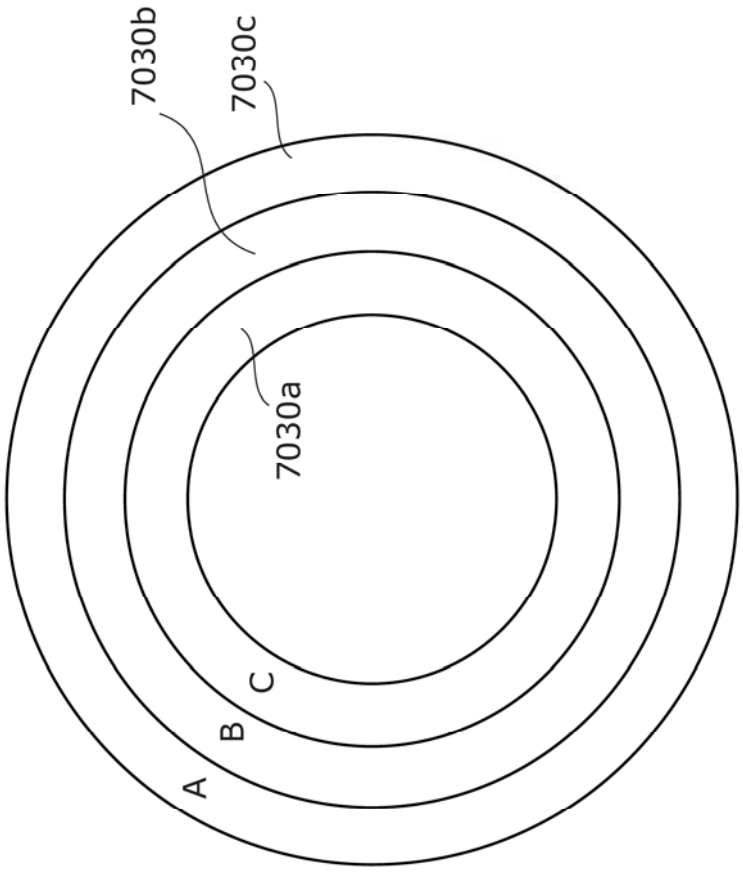


FIG. 261

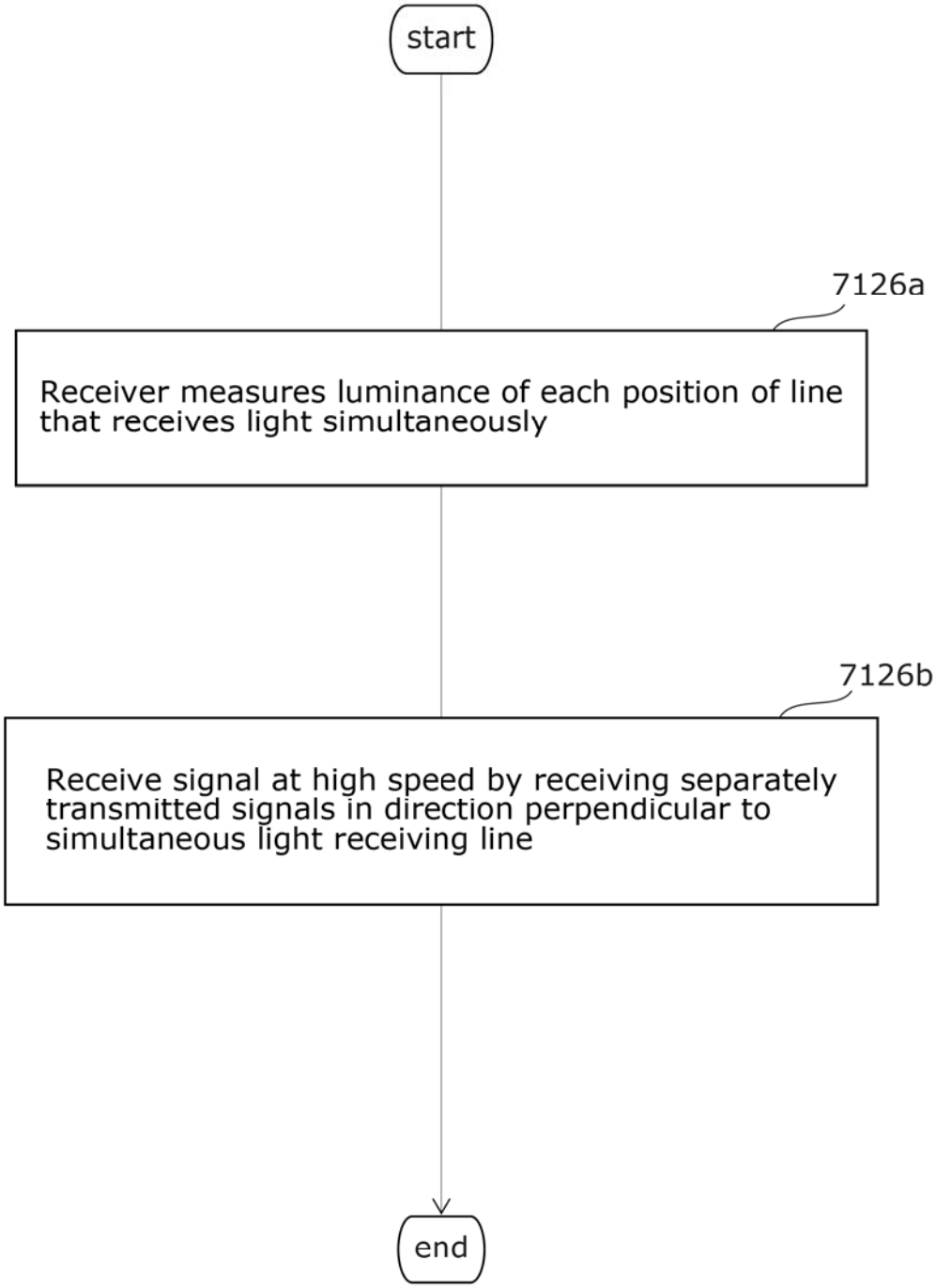

start
7126a
Receiver measures luminance of each position of line that receives light simultaneously
7126b
Receive signal at high speed by receiving separately transmitted signals in direction perpendicular to simultaneous light receiving line
end

FIG. 262

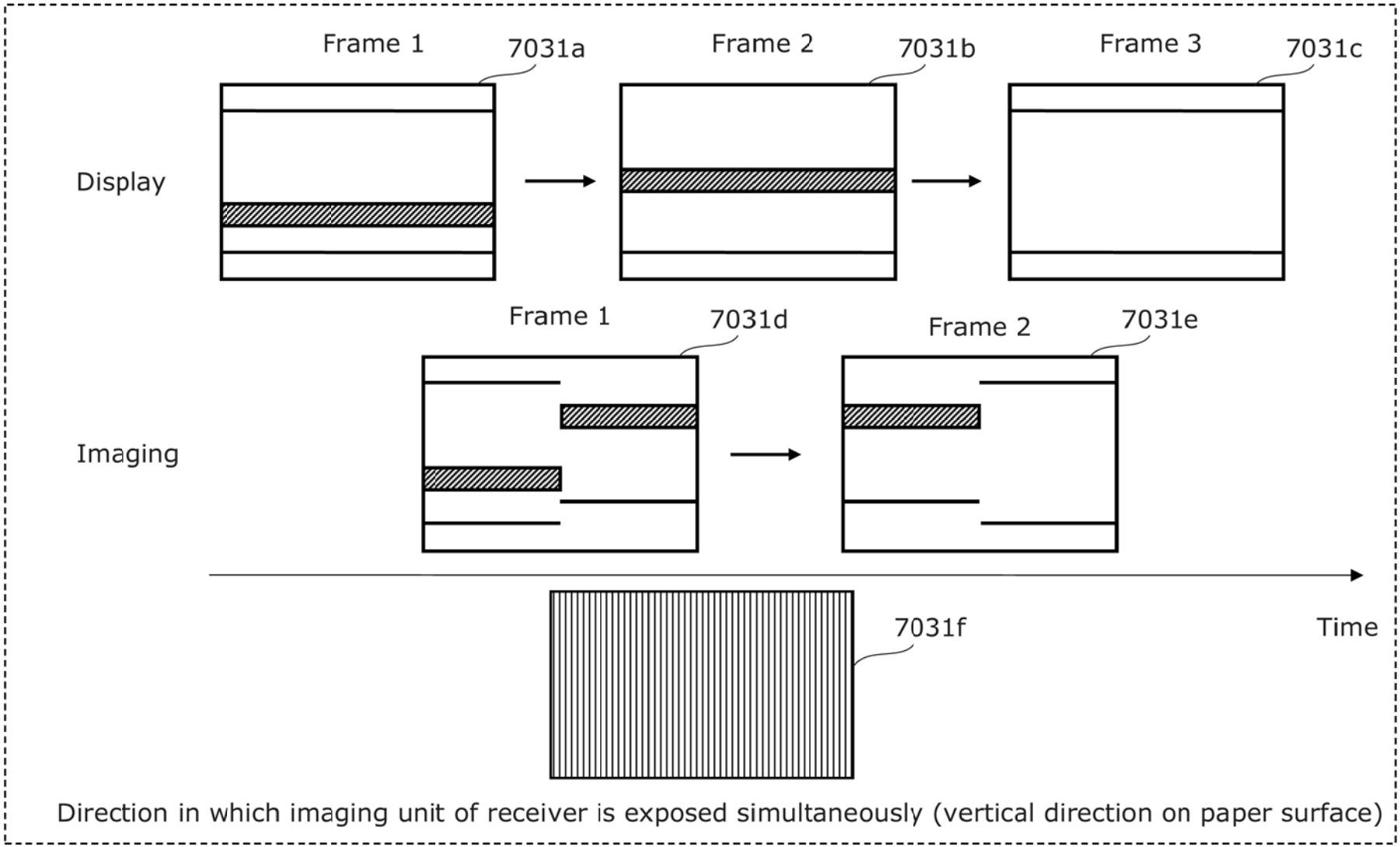

Frame 1
7031a
Frame 2
7031b
Frame 3
7031c
Display
Frame 1
7031d
Frame 2
7031e
Imaging
7031f
Time
Direction in which imaging unit of receiver is exposed simultaneously (vertical direction on paper surface)

FIG. 263

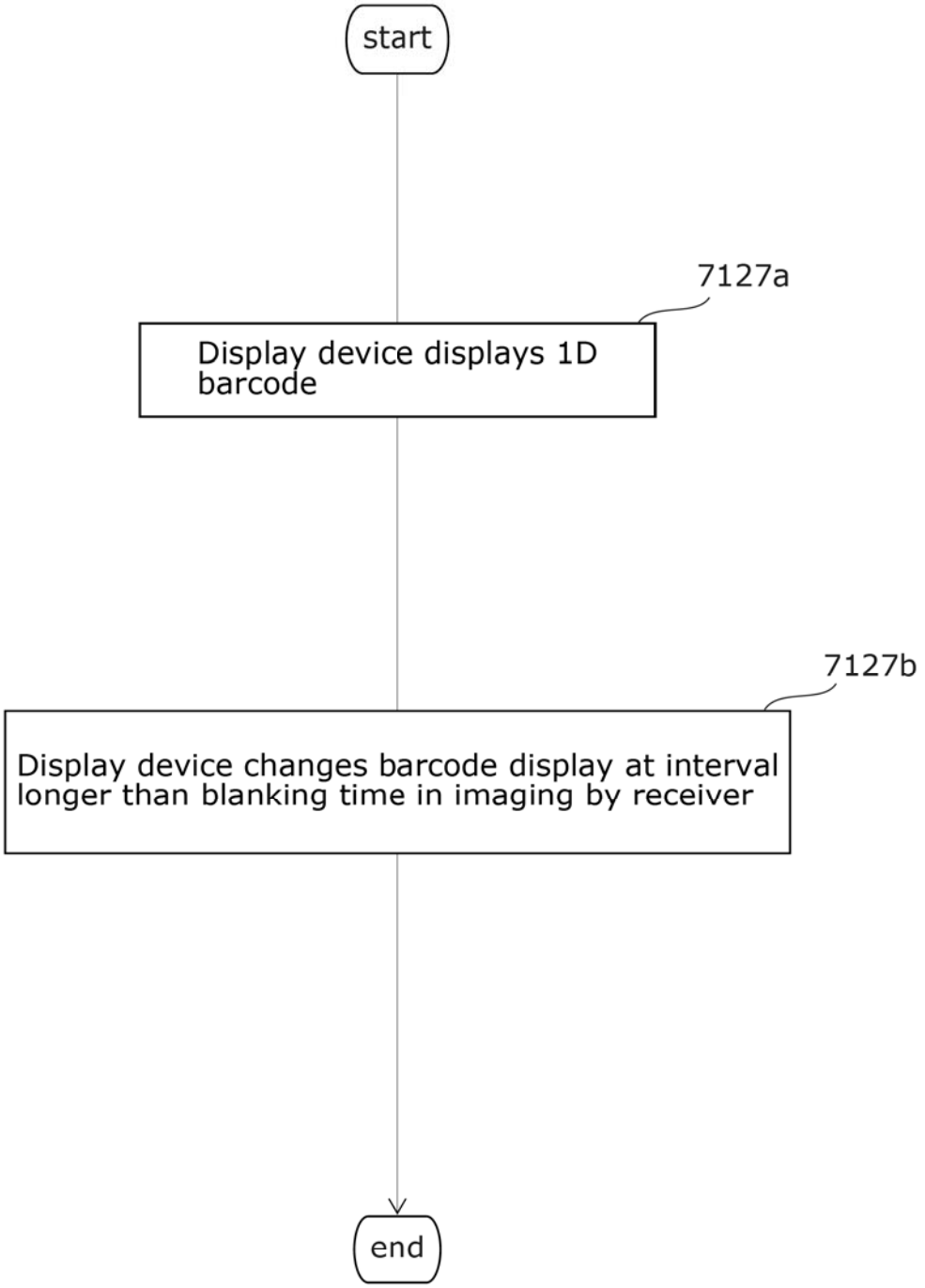

start
7127a
Display device displays 1D barcode
7127b
Display device changes barcode display at interval longer than blanking time in imaging by receiver
end

FIG. 264

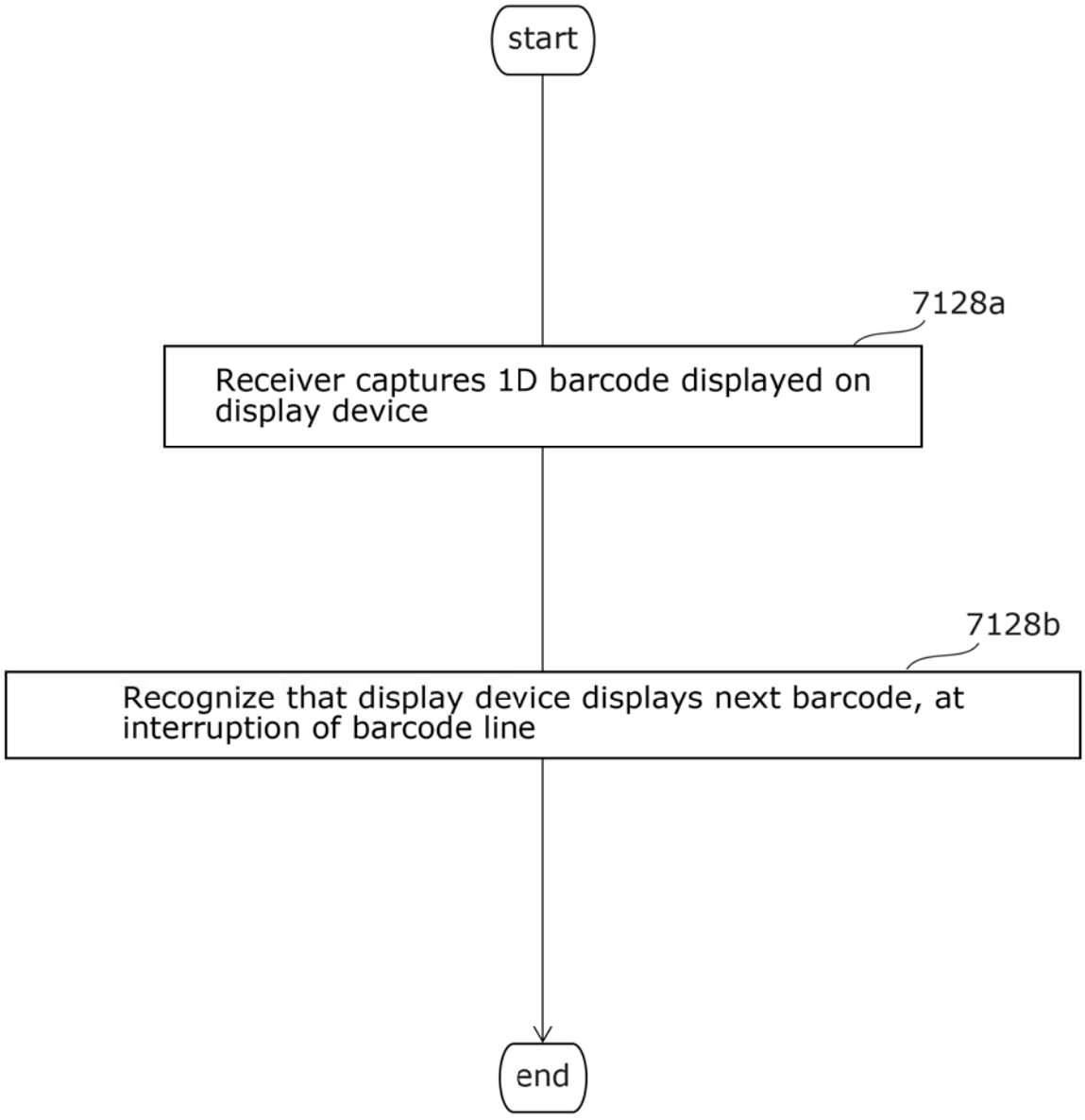

start
7128a
Receiver captures 1D barcode displayed on display device
7128b
Recognize that display device displays next barcode, at interruption of barcode line
end

FIG. 265

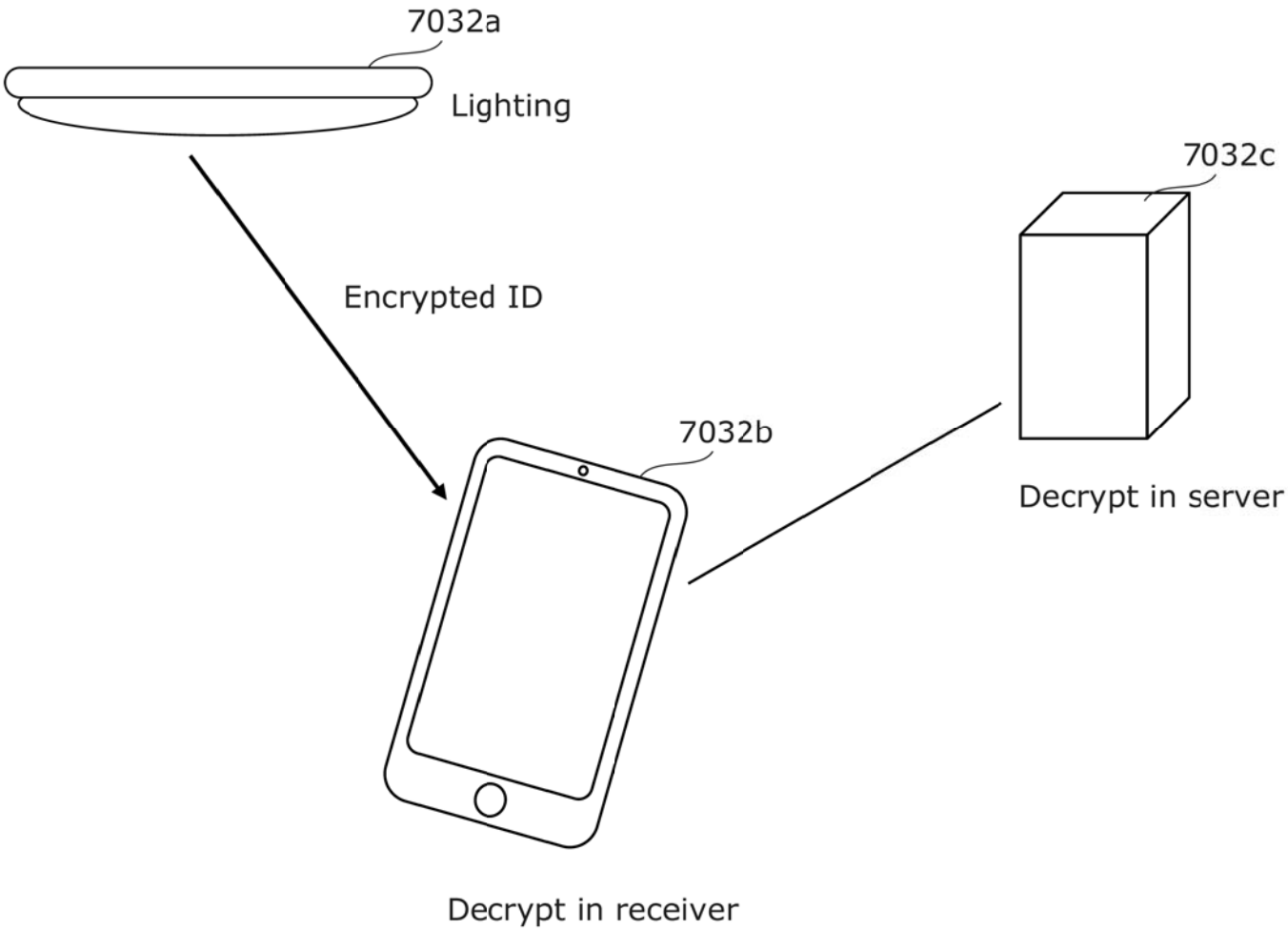

7032a
Lighting
Encrypted ID
7032c
Decrypt in server
7032b
Decrypt in receiver

FIG. 266

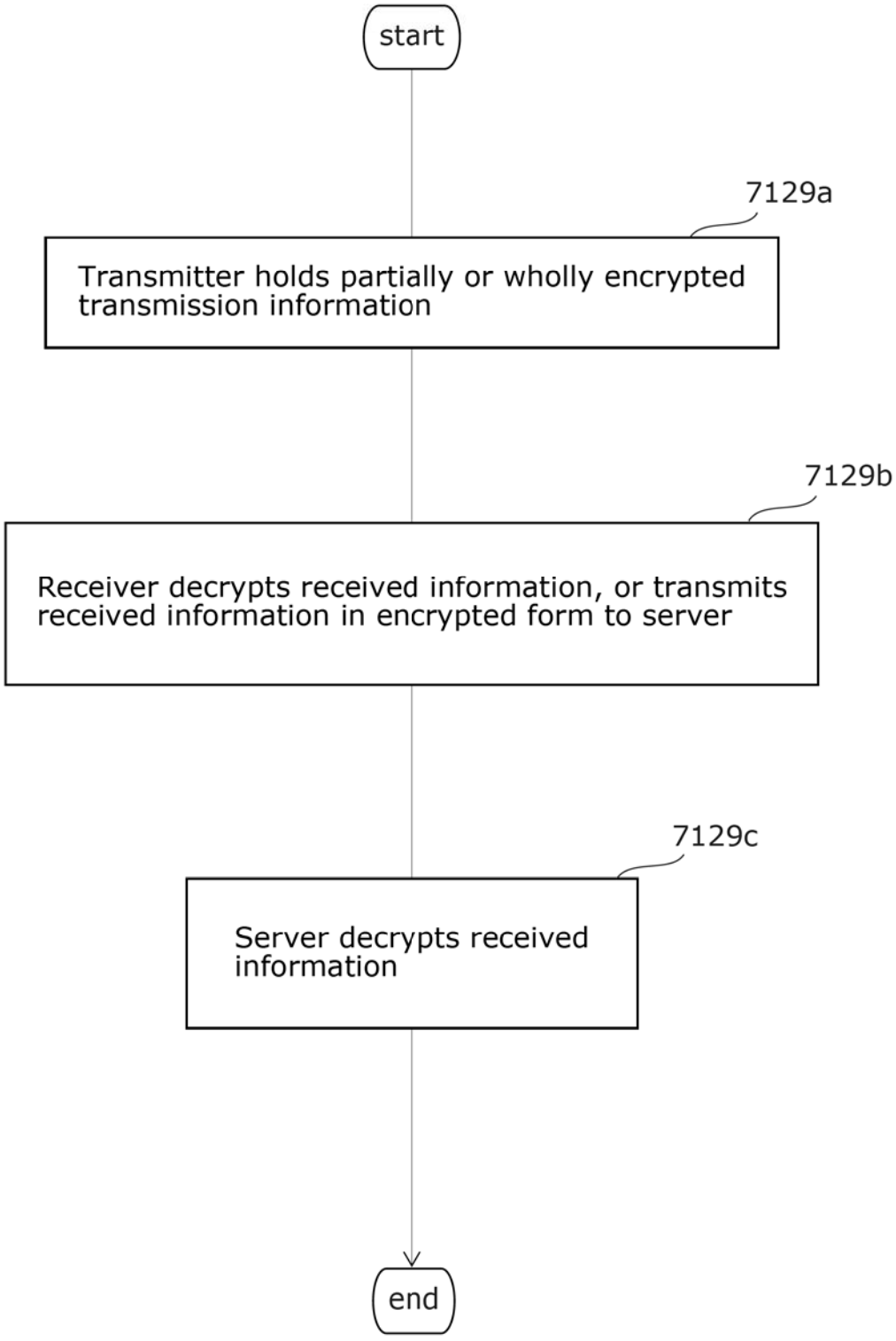

start
7129a
Transmitter holds partially or wholly encrypted transmission information
7129b
Receiver decrypts received information, or transmits received information in encrypted form to server
7129c
Server decrypts received information
end

FIG. 267



Stop reception in the case where value of illuminance sensor is low and receiver is estimated to be in call state

FIG. 268

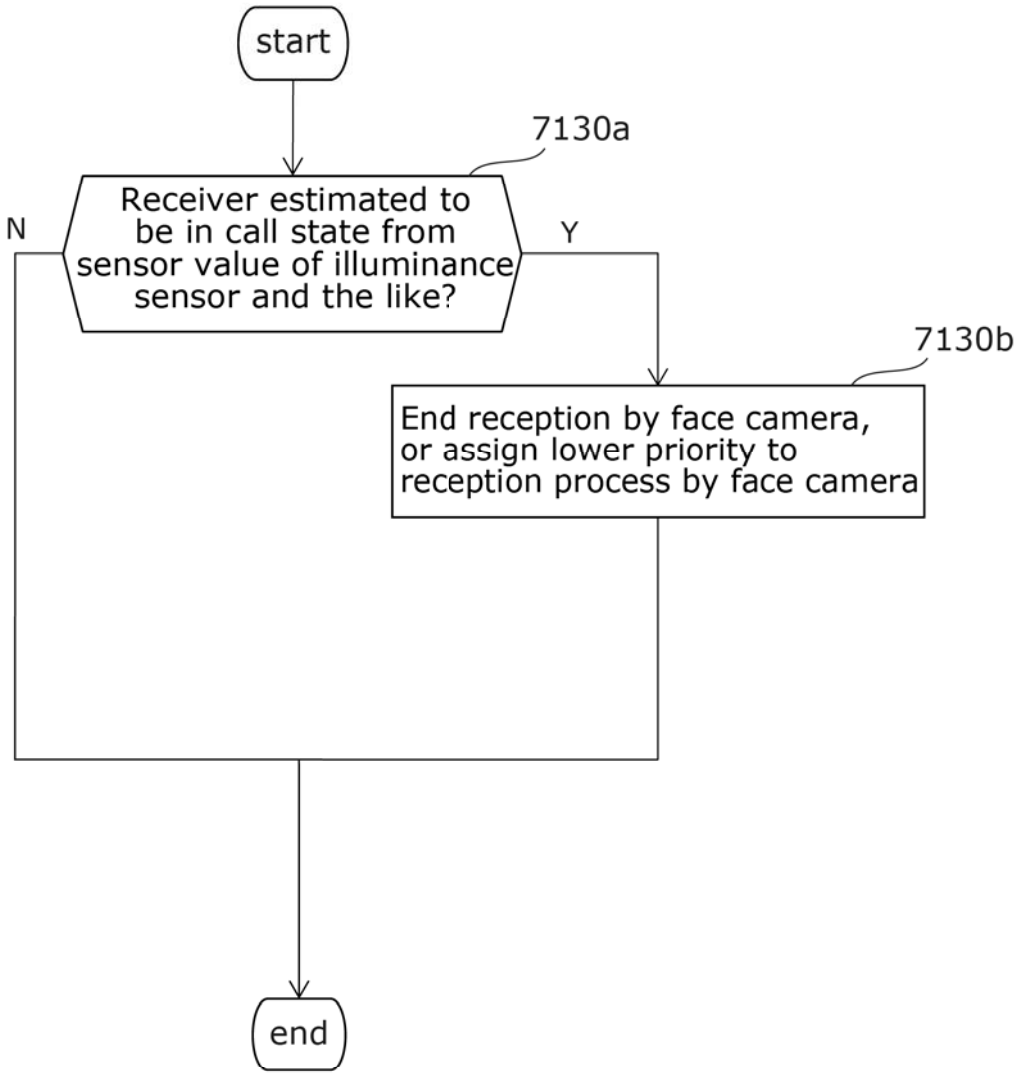
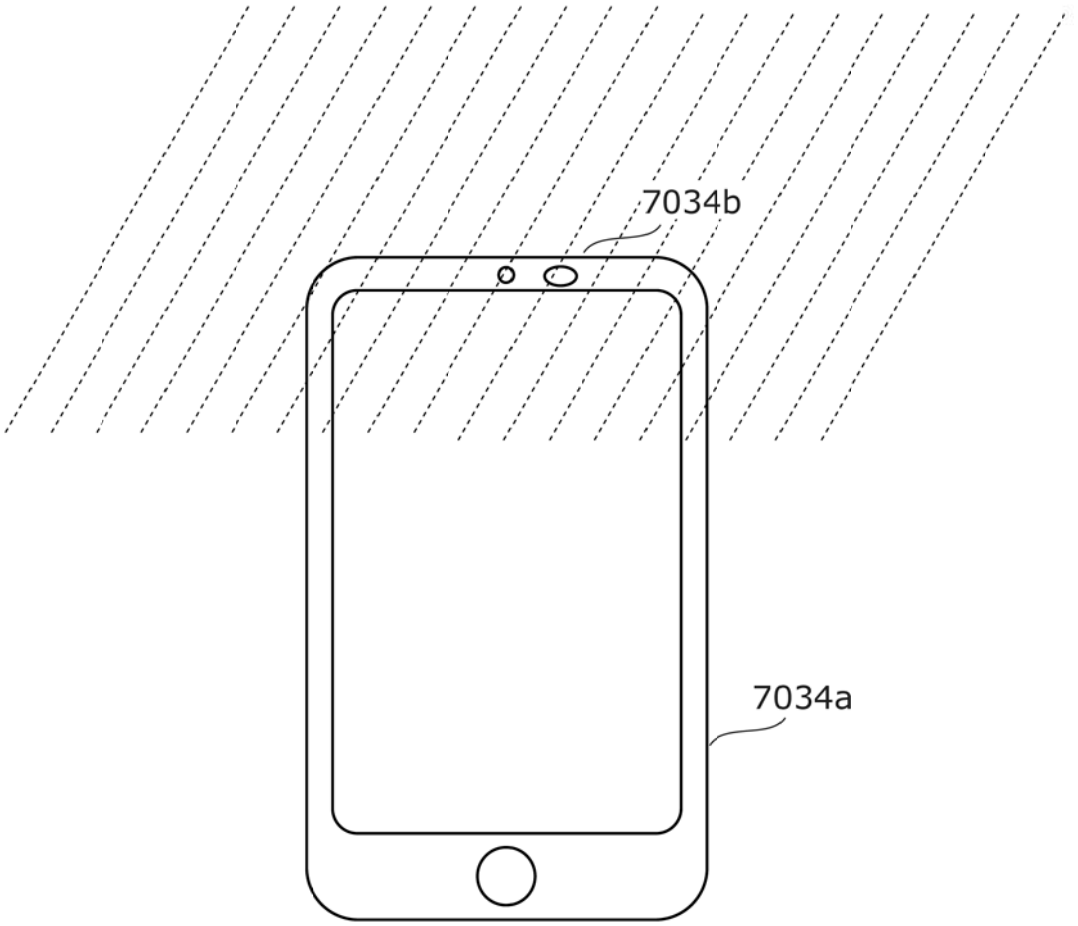

start
7130a
Receiver estimated to be in call state from sensor value of illuminance sensor and the like?
N
Y
7130b
End reception by face camera, or assign lower priority to reception process by face camera
end

FIG. 269



Stop reception process by imaging device on illuminance sensor side or assign lower priority to reception process, in the case where measurement value of illuminance sensor is less than or equal to predetermined value

FIG. 270

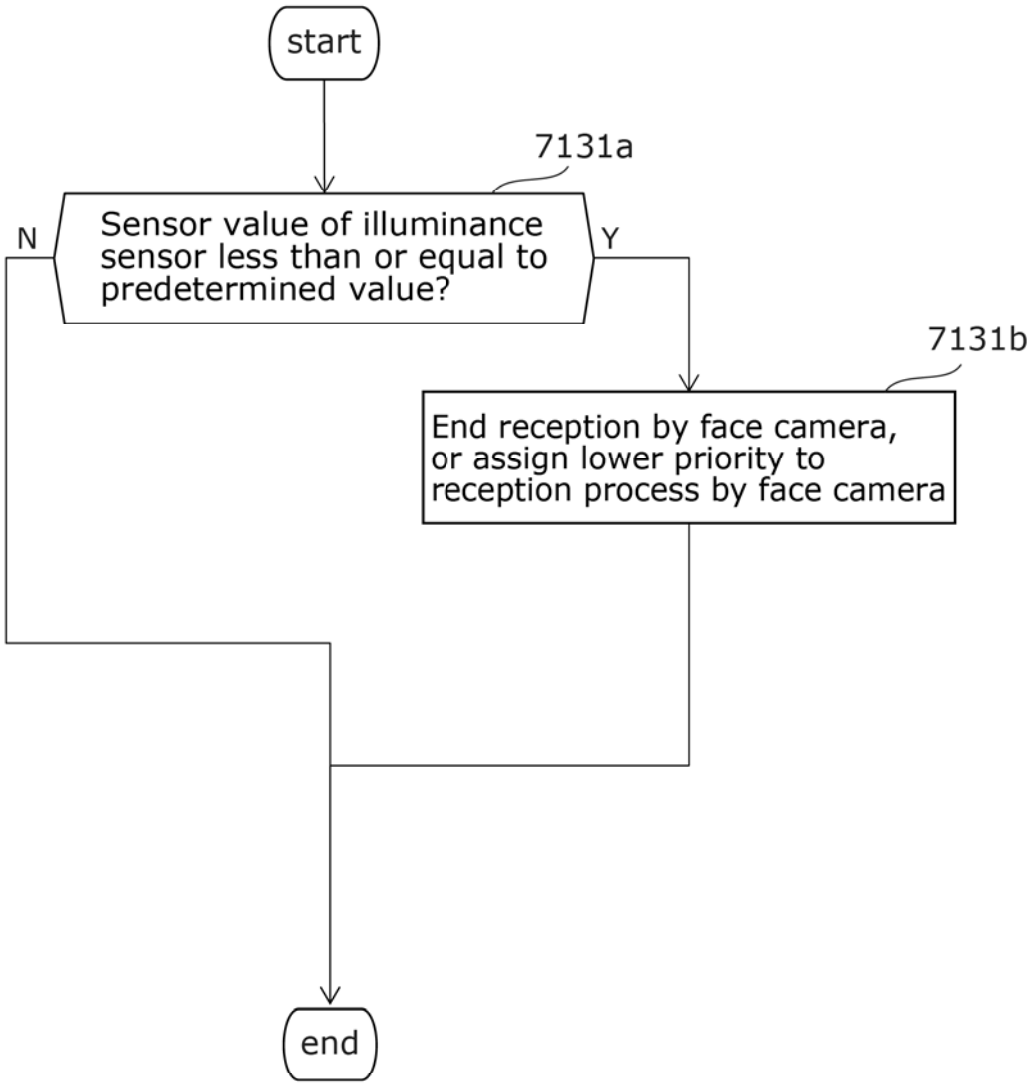

start
7131a
Sensor value of illuminance sensor less than or equal to predetermined value?
N
Y
7131b
End reception by face camera, or assign lower priority to reception process by face camera
end

FIG. 271

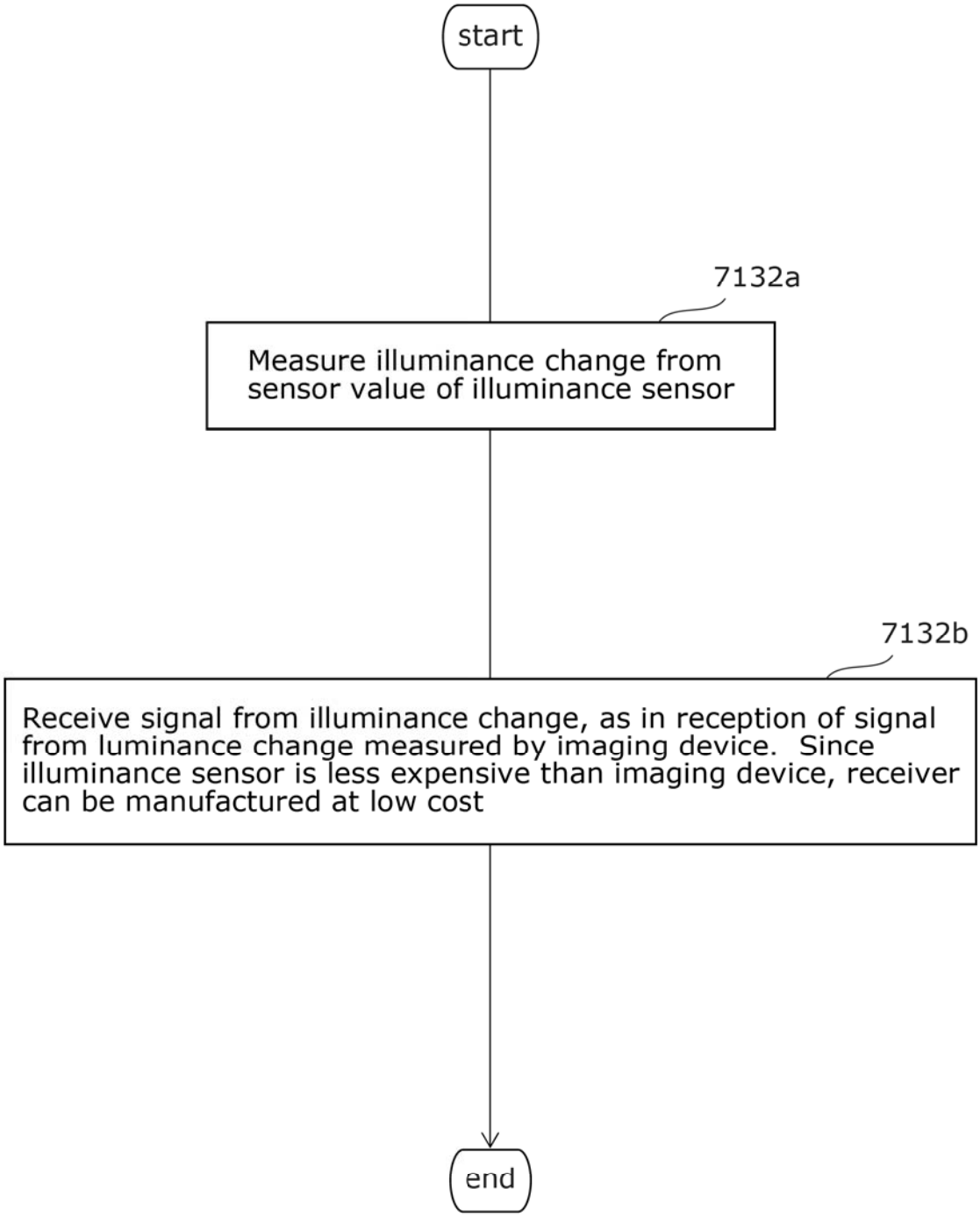
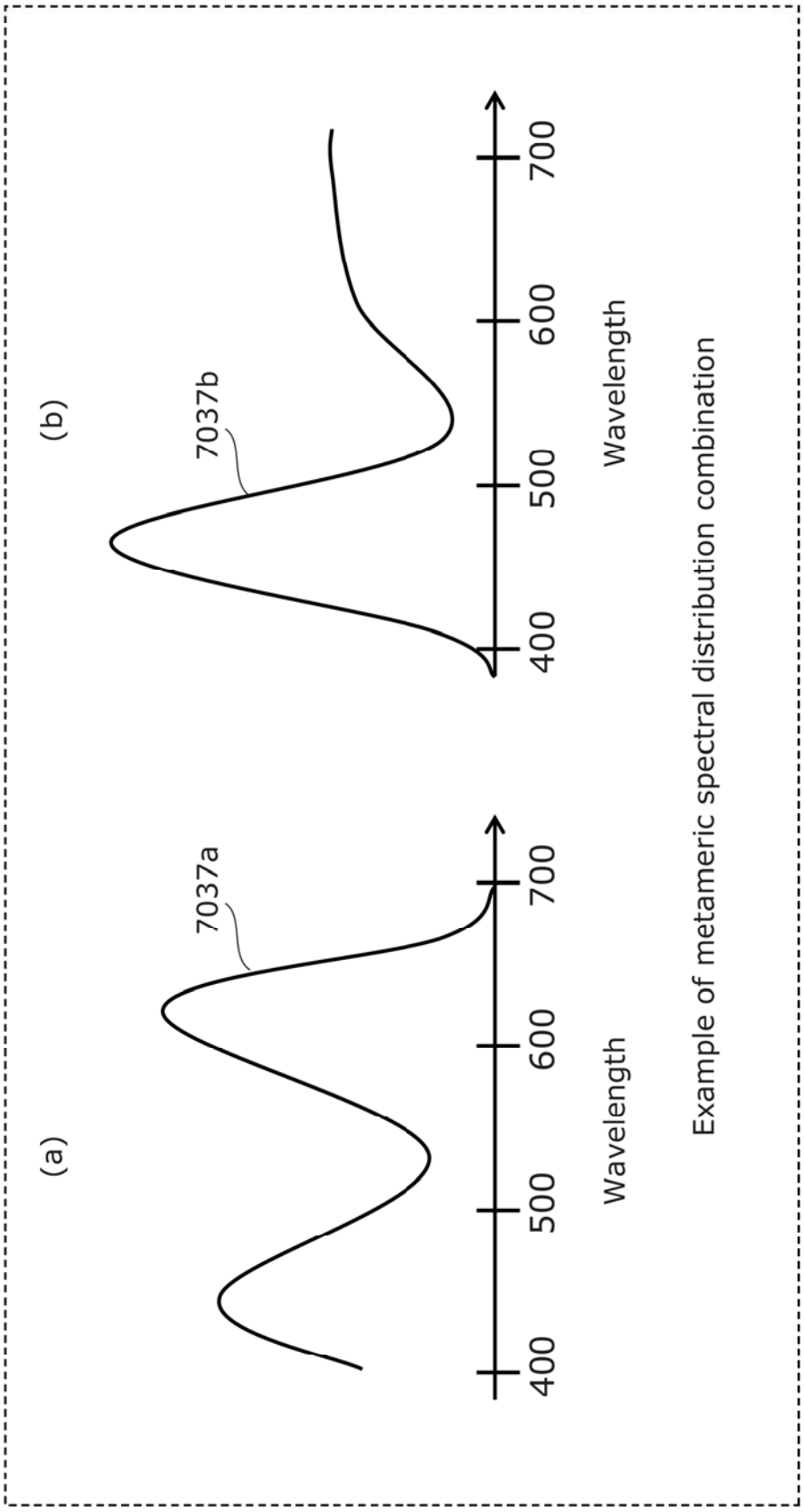

start
7132a
Measure illuminance change from sensor value of illuminance sensor
7132b
Receive signal from illuminance change, as in reception of signal from luminance change measured by imaging device. Since illuminance sensor is less expensive than imaging device, receiver can be manufactured at low cost
end

FIG. 272



Example of metameric spectral distribution combination

FIG. 273

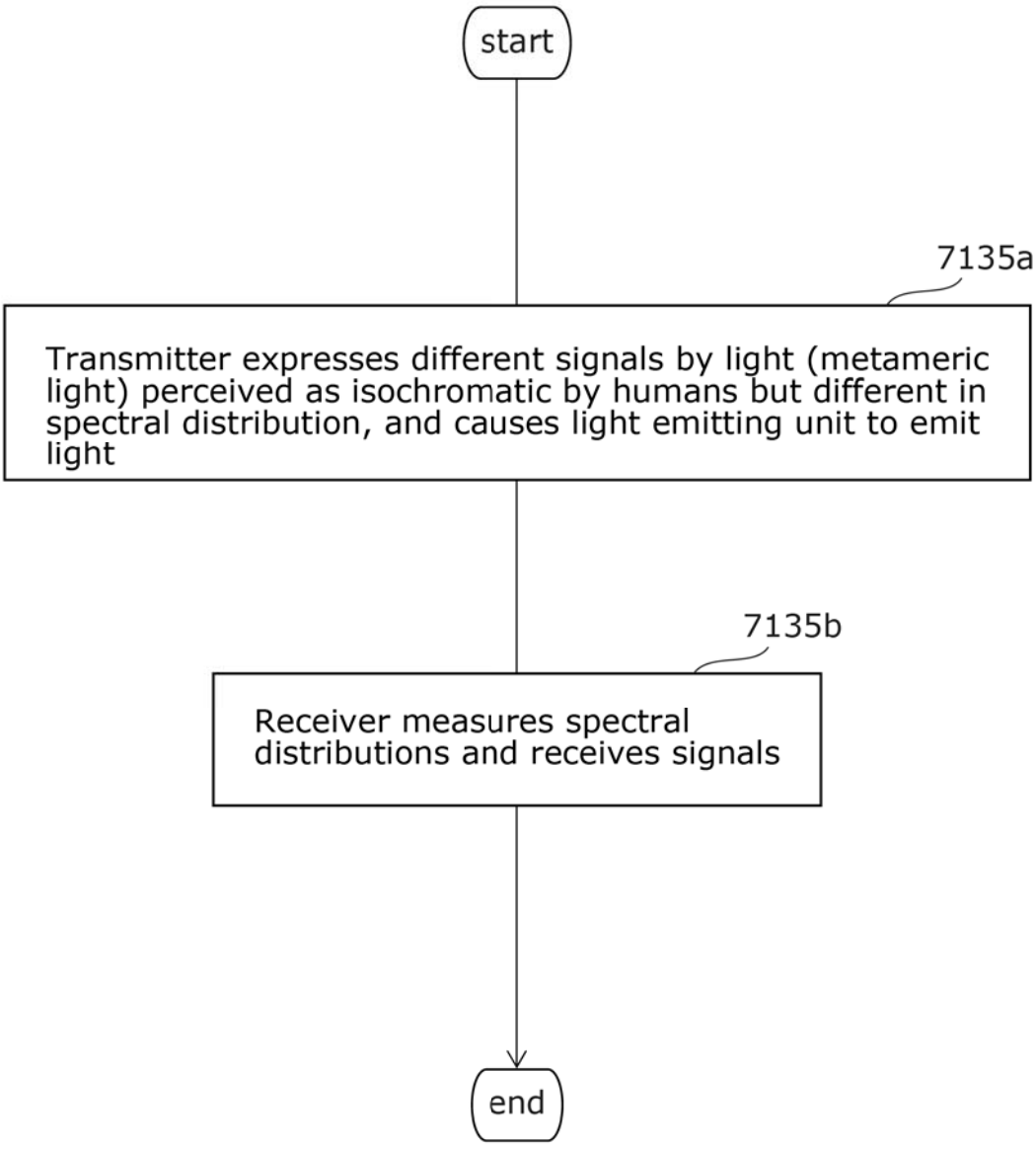

start
7135a
Transmitter expresses different signals by light (metameric light) perceived as isochromatic by humans but different in spectral distribution, and causes light emitting unit to emit light
7135b
Receiver measures spectral distributions and receives signals
end

FIG. 274

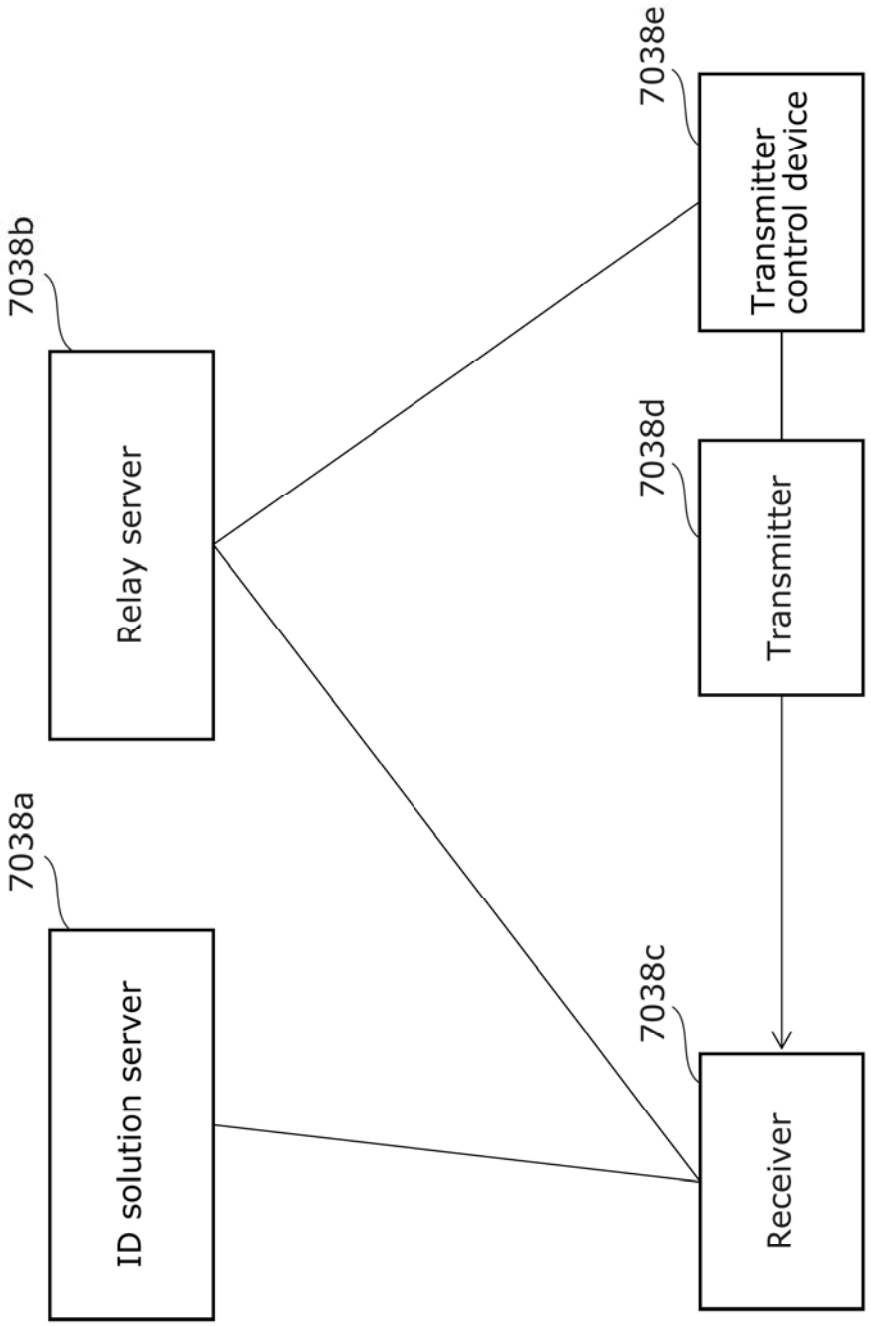

7038a
ID solution server
7038b
Relay server
7038c
Receiver
7038d
Transmitter
7038e
Transmitter control device

FIG. 275

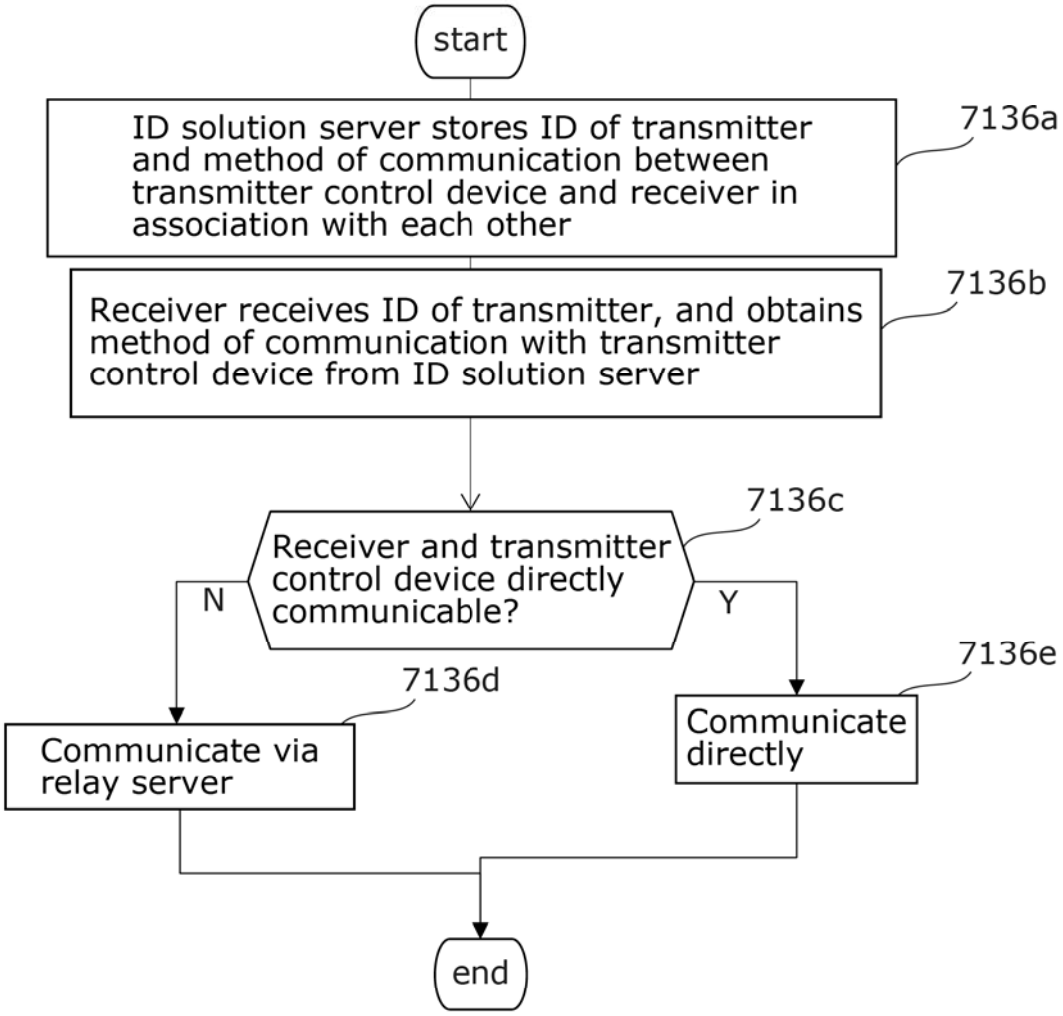

start
ID solution server stores ID of transmitter and method of communication between transmitter control device and receiver in association with each other
7136a
Receiver receives ID of transmitter, and obtains method of communication with transmitter control device from ID solution server
7136b
Receiver and transmitter control device directly communicable?
7136c
N
Y
Communicate via relay server
7136d
Communicate directly
7136e
end

FIG. 276

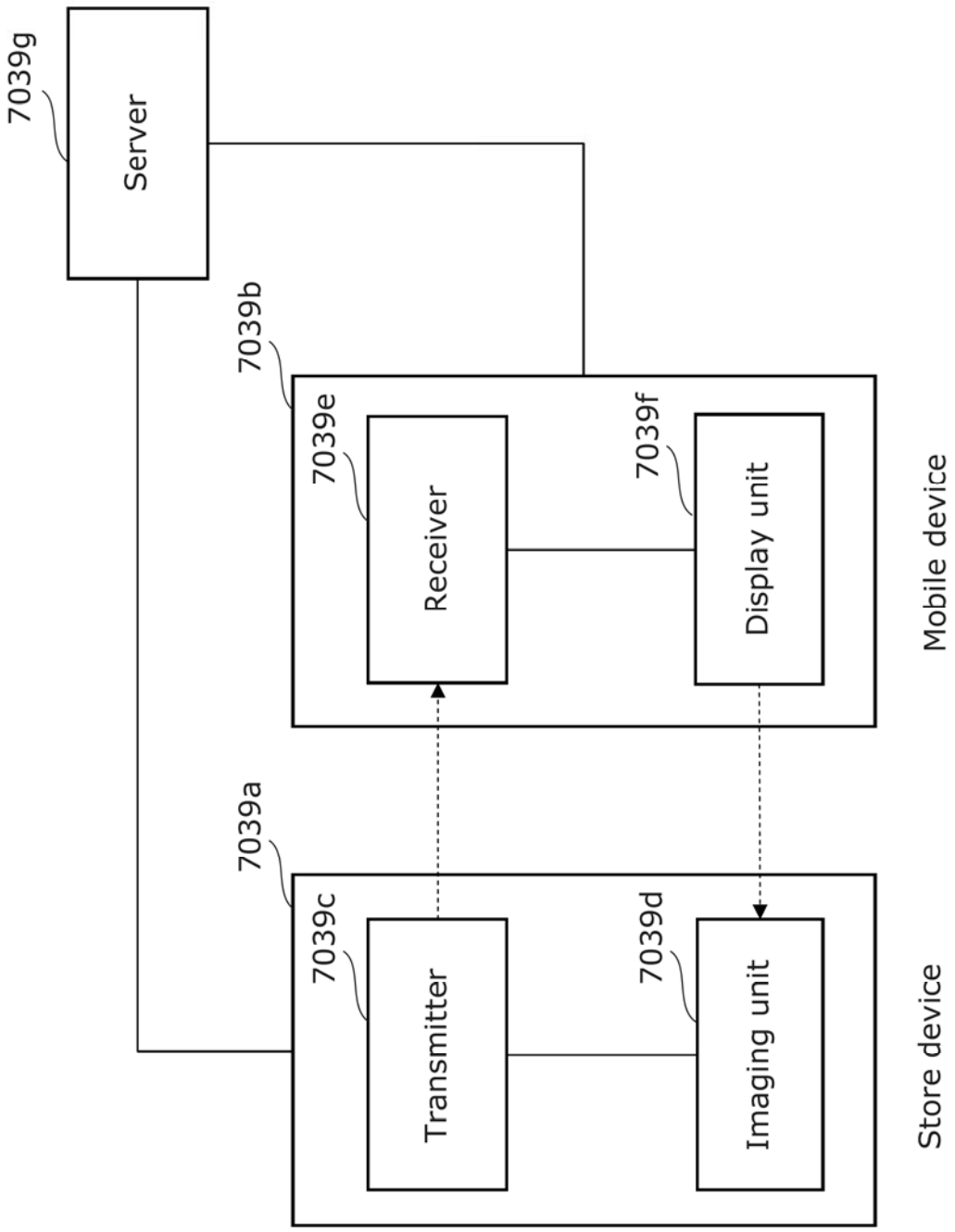

7039g
Server
7039b
7039e
Receiver
7039f
Display unit
Mobile device
7039a
7039c
Transmitter
7039d
Imaging unit
Store device

FIG. 277

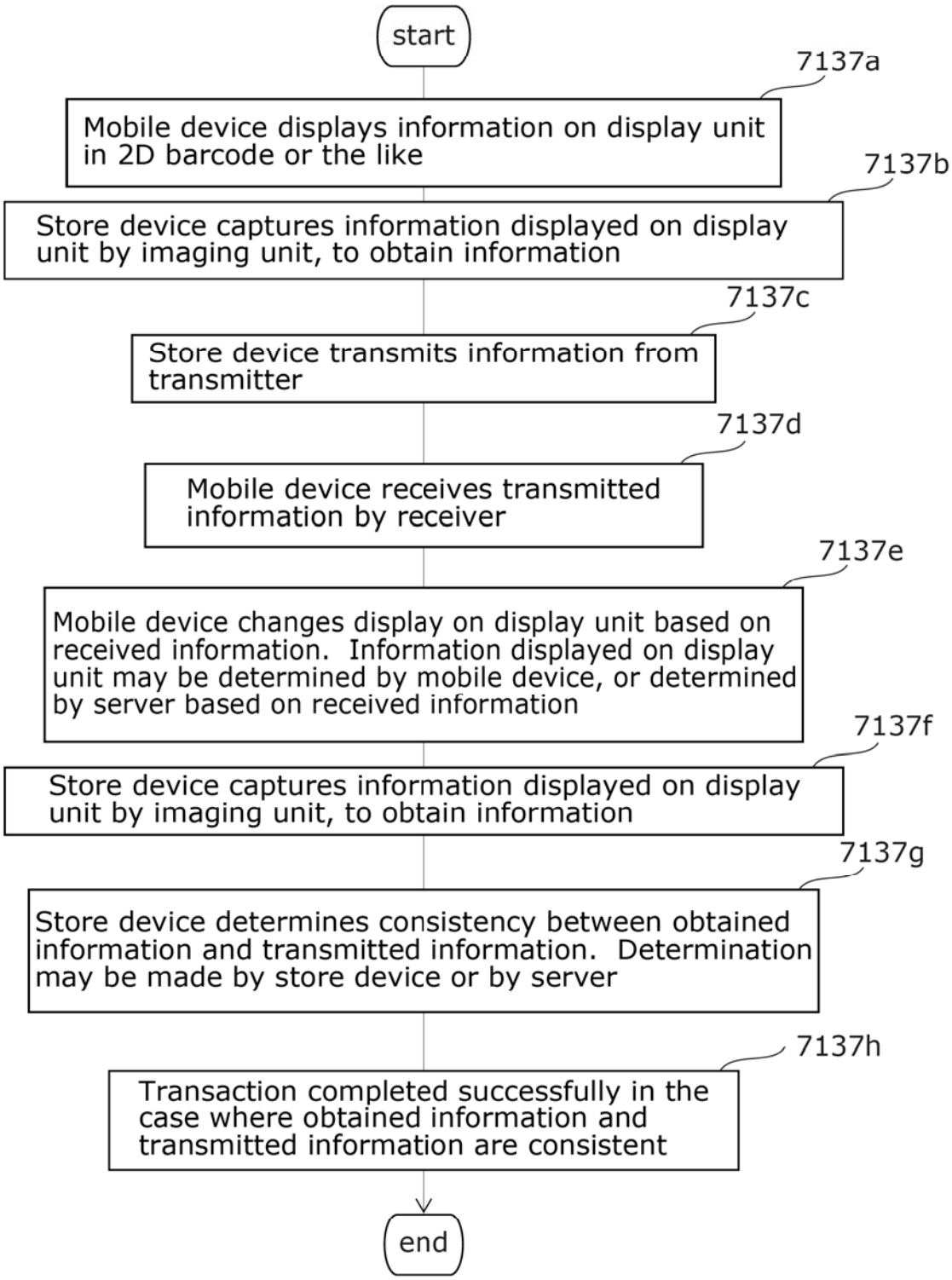

start
7137a
Mobile device displays information on display unit in 2D barcode or the like
7137b
Store device captures information displayed on display unit by imaging unit, to obtain information
7137c
Store device transmits information from transmitter
7137d
Mobile device receives transmitted information by receiver
7137e
Mobile device changes display on display unit based on received information. Information displayed on display unit may be determined by mobile device, or determined by server based on received information
7137f
Store device captures information displayed on display unit by imaging unit, to obtain information
7137g
Store device determines consistency between obtained information and transmitted information. Determination may be made by store device or by server
7137h
Transaction completed successfully in the case where obtained information and transmitted information are consistent
end

FIG. 278

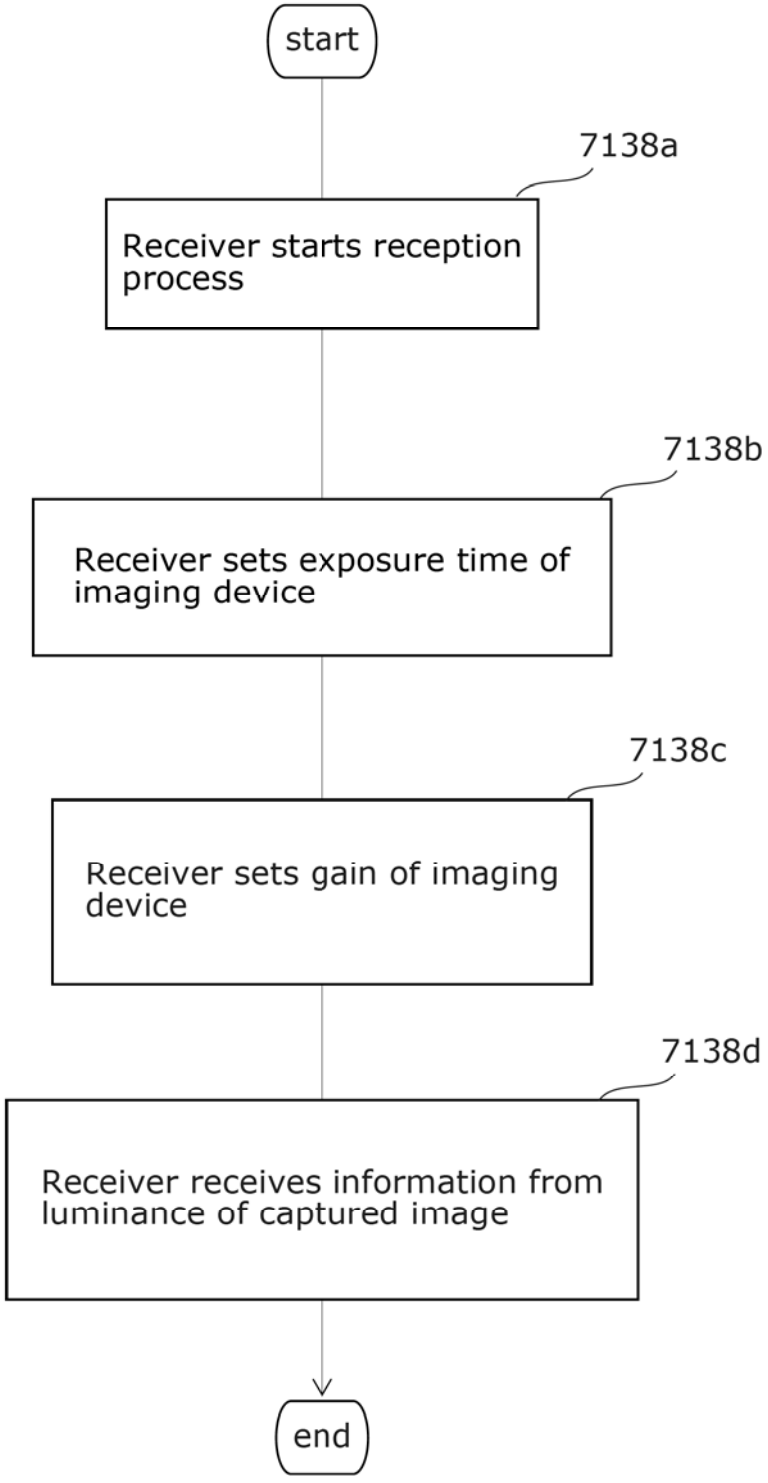

start
7138a
Receiver starts reception process
7138b
Receiver sets exposure time of imaging device
7138c
Receiver sets gain of imaging device
7138d
Receiver receives information from luminance of captured image
end

FIG. 279

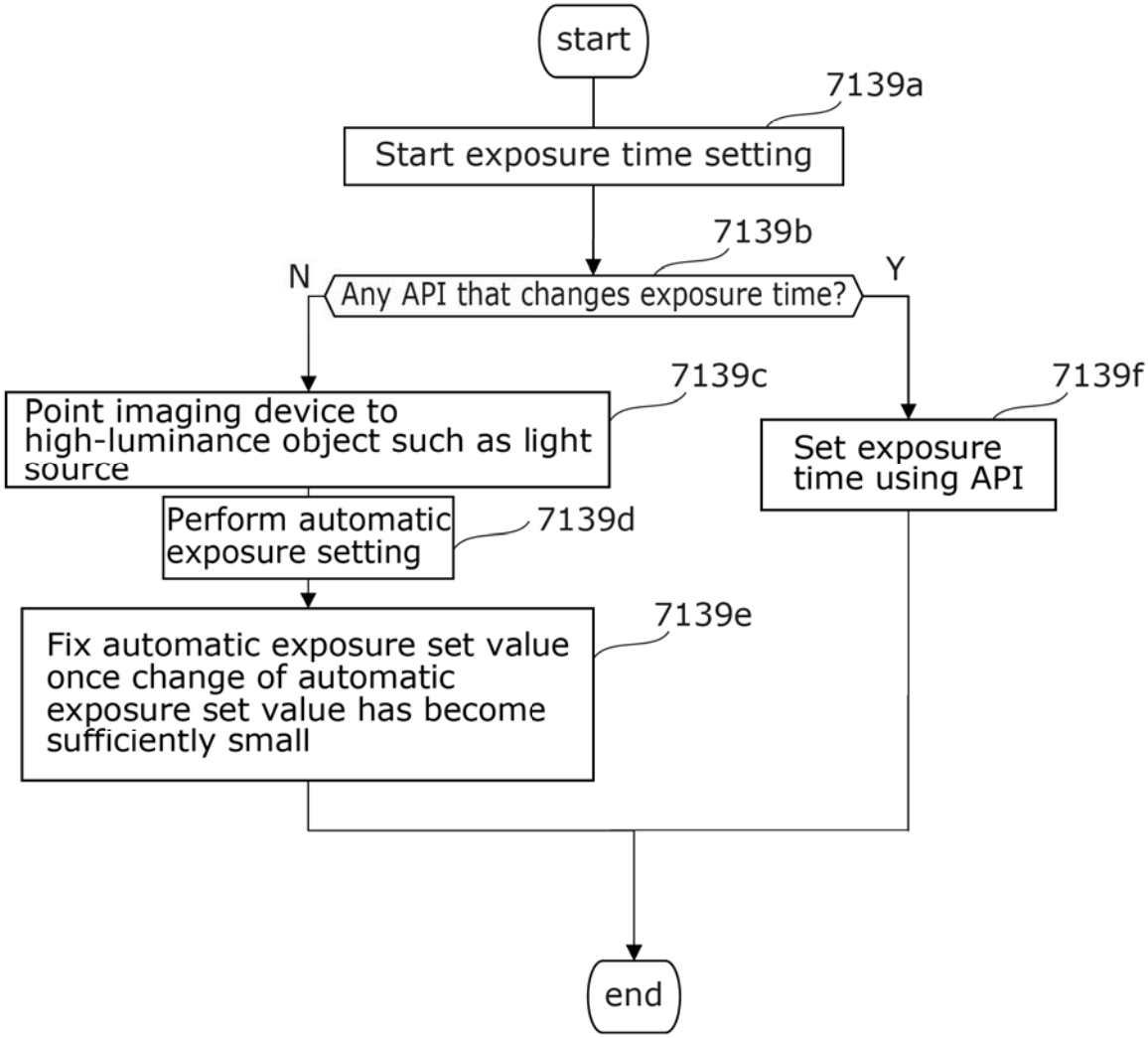

start
7139a
Start exposure time setting
7139b
N
Any API that changes exposure time?
Y
7139c
Point imaging device to high-luminance object such as light source
7139f
Set exposure time using API
Perform automatic exposure setting
7139d
7139e
Fix automatic exposure set value once change of automatic exposure set value has become sufficiently small
end

FIG. 280

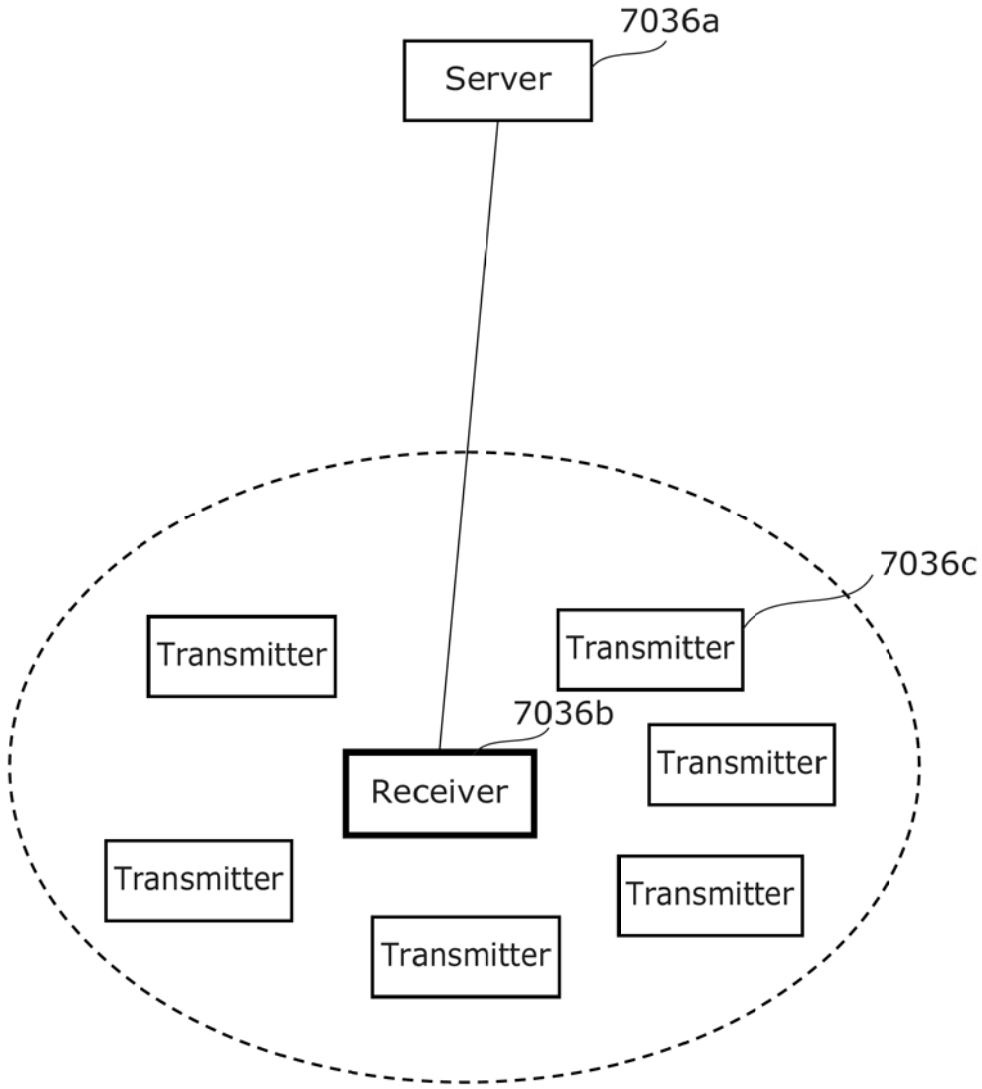

7036a
Server
7036c
Transmitter
Transmitter
7036b
Transmitter
Receiver
Transmitter
Transmitter
Transmitter

FIG. 281

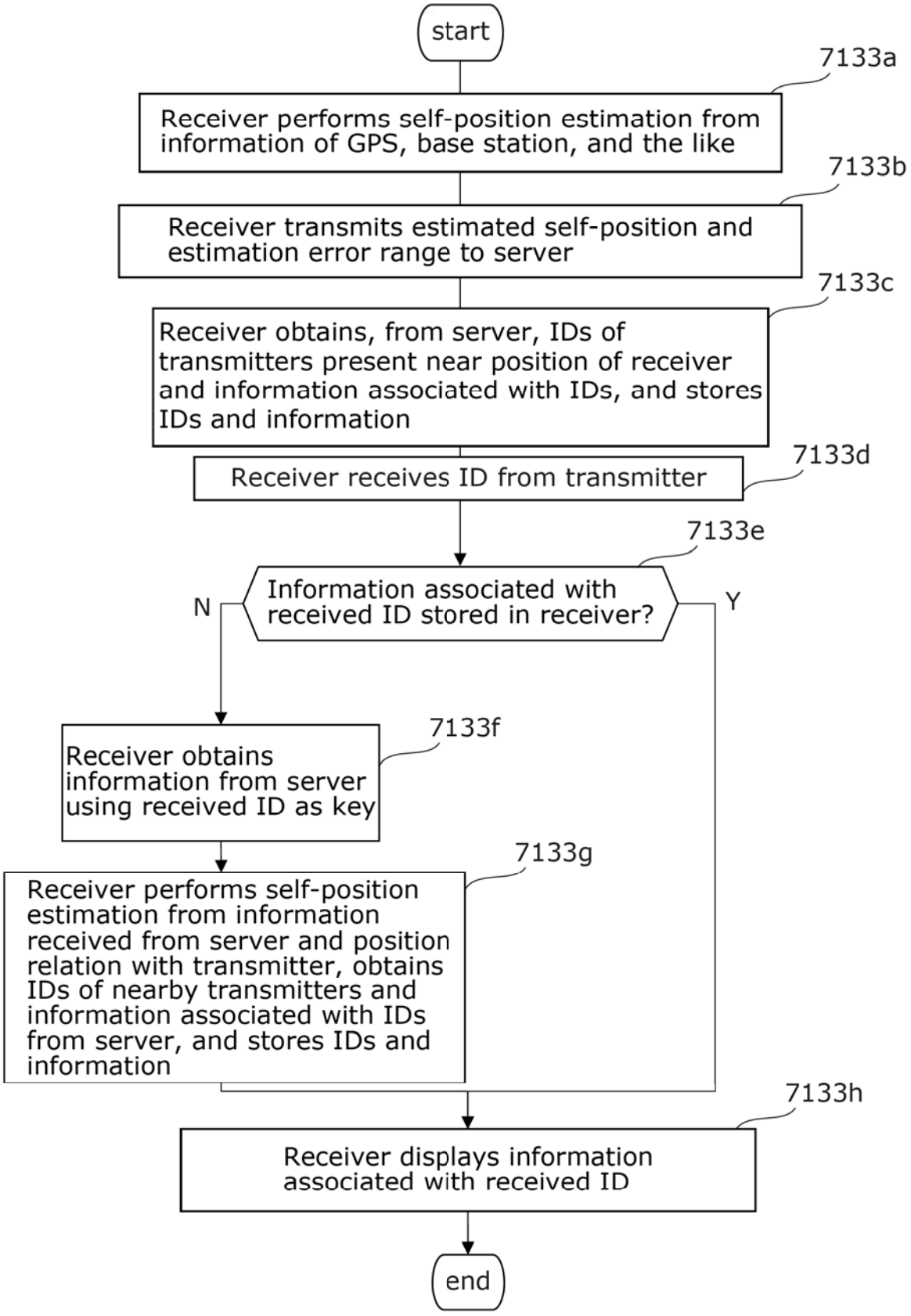

start
7133a
Receiver performs self-position estimation from information of GPS, base station, and the like
7133b
Receiver transmits estimated self-position and estimation error range to server
7133c
Receiver obtains, from server, IDs of transmitters present near position of receiver and information associated with IDs, and stores IDs and information
7133d
Receiver receives ID from transmitter
7133e
Information associated with received ID stored in receiver?
N
Y
7133f
Receiver obtains information from server using received ID as key
7133g
Receiver performs self-position estimation from information received from server and position relation with transmitter, obtains IDs of nearby transmitters and information associated with IDs from server, and stores IDs and information
7133h
Receiver displays information associated with received ID
end

FIG. 282

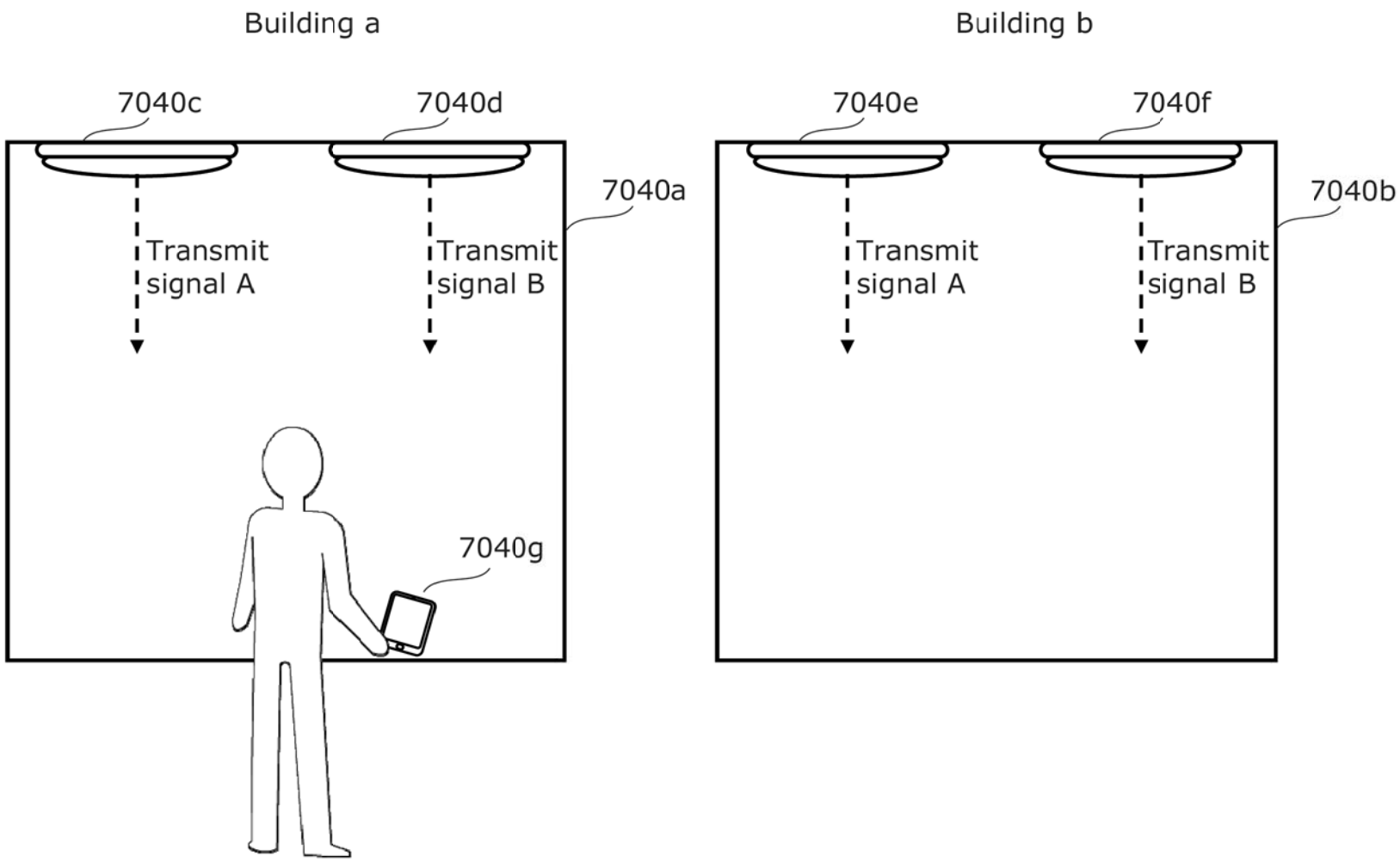

Building a
Building b
7040c
7040d
7040e
7040f
7040a
7040b
Transmit signal A
Transmit signal B
Transmit signal A
Transmit signal B
7040g

FIG. 283

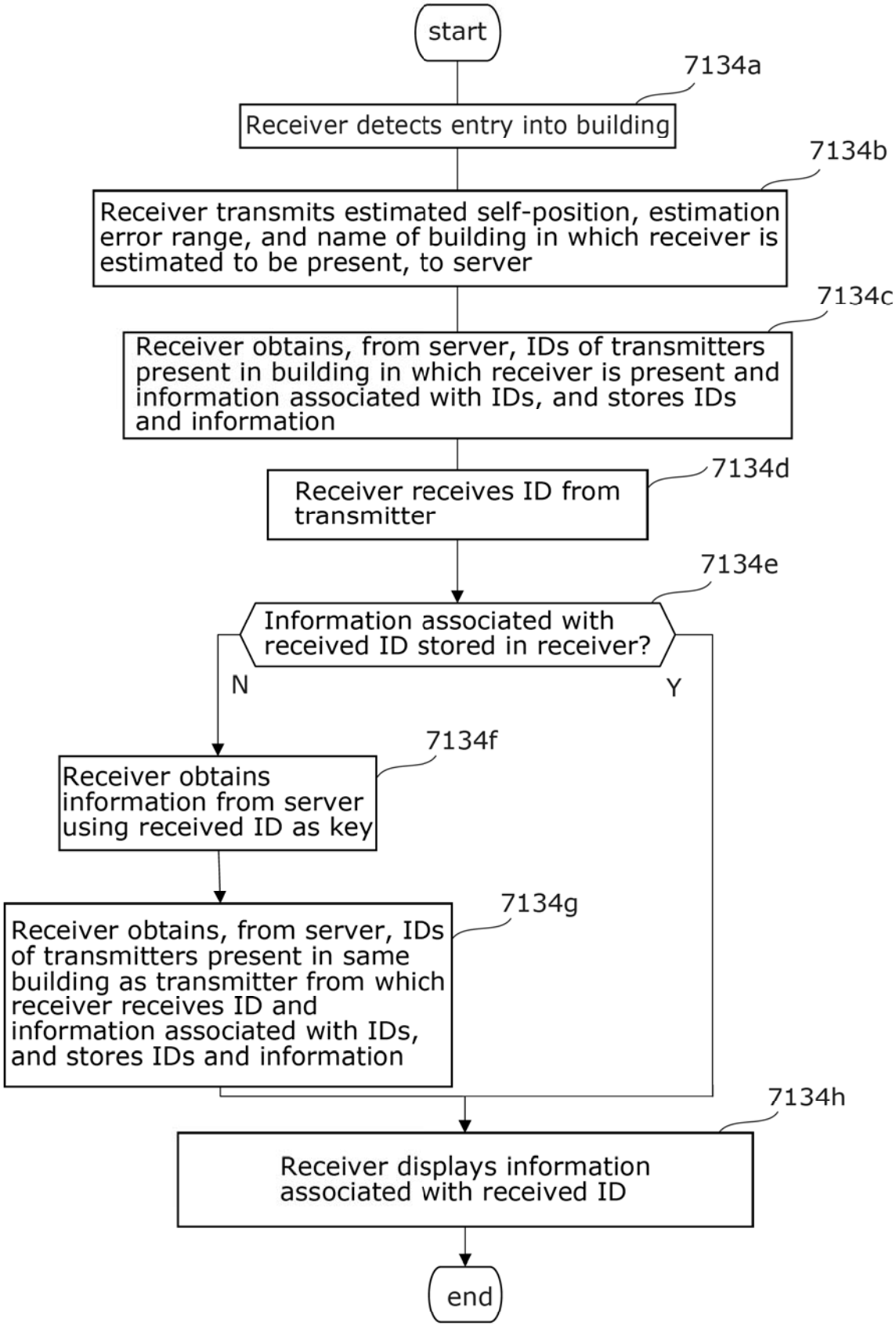

start
7134a
Receiver detects entry into building
7134b
Receiver transmits estimated self-position, estimation error range, and name of building in which receiver is estimated to be present, to server
7134c
Receiver obtains, from server, IDs of transmitters present in building in which receiver is present and information associated with IDs, and stores IDs and information
7134d
Receiver receives ID from transmitter
7134e
Information associated with received ID stored in receiver?
N
Y
7134f
Receiver obtains information from server using received ID as key
7134g
Receiver obtains, from server, IDs of transmitters present in same building as transmitter from which receiver receives ID and information associated with IDs, and stores IDs and information
7134h
Receiver displays information associated with received ID
end

FIG. 284

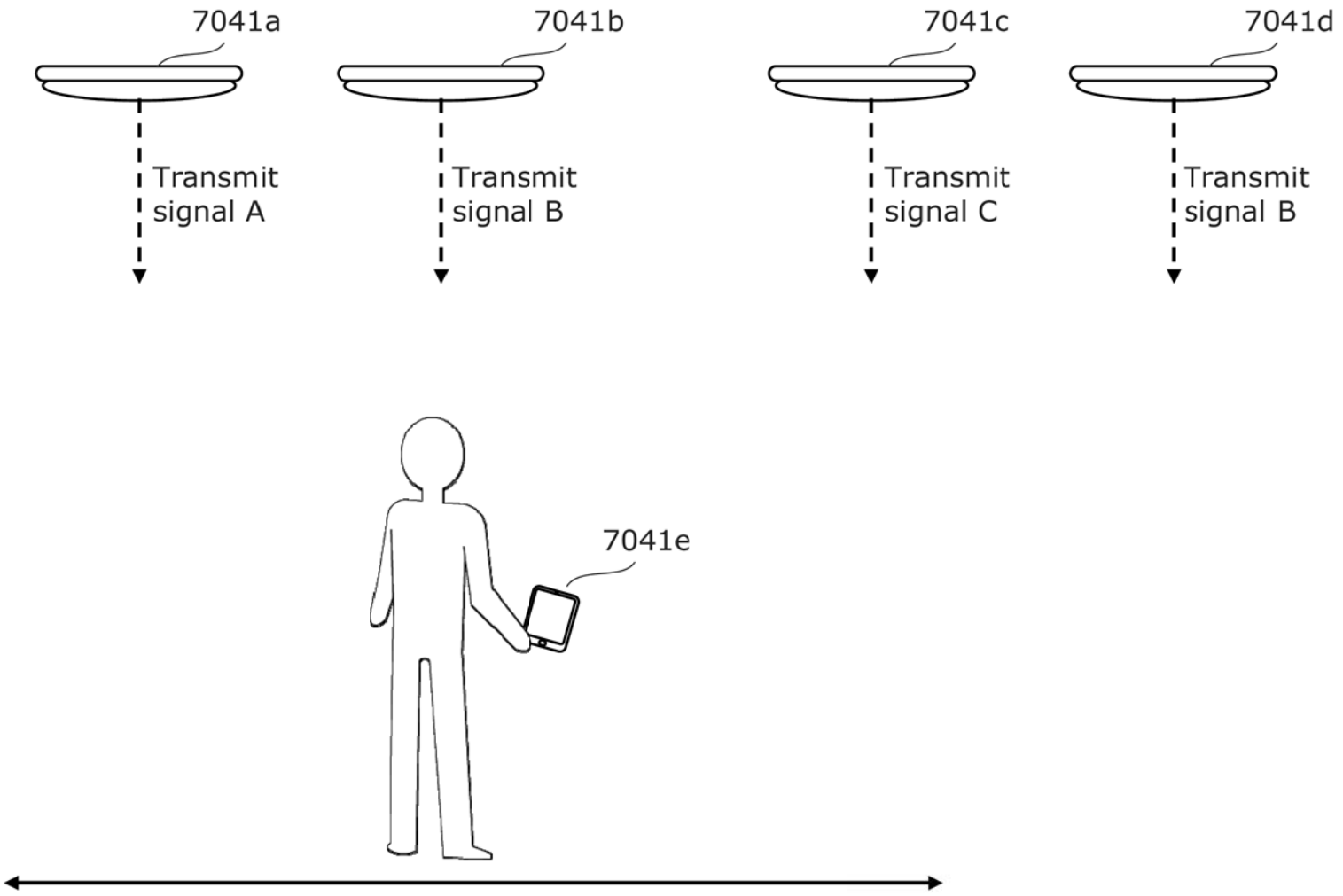

7041a
7041b
7041c
7041d
Transmit signal A
Transmit signal B
Transmit signal C
Transmit signal B
7041e
Error range of self-position estimation by other means

FIG. 285

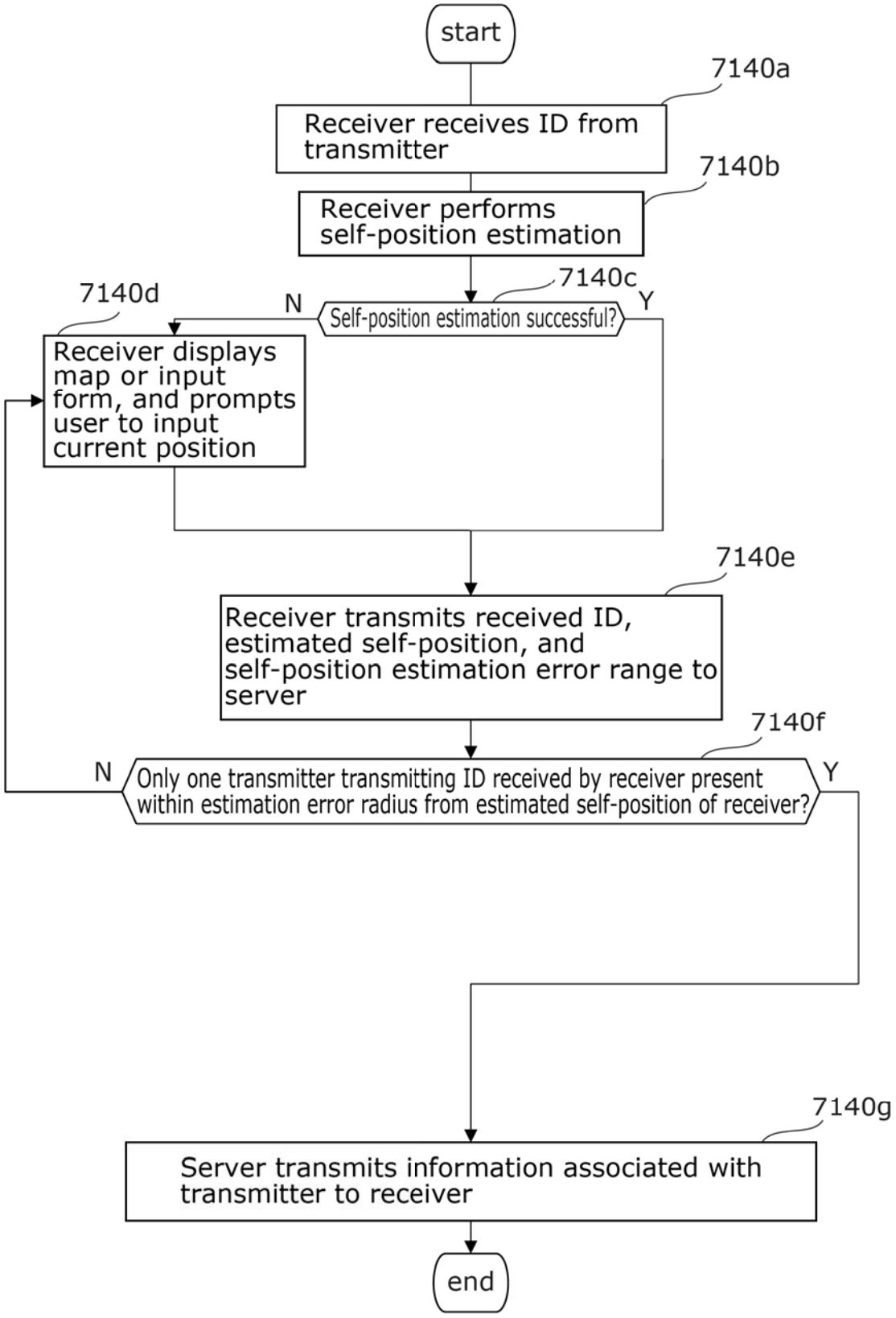

start
7140a
Receiver receives ID from transmitter
7140b
Receiver performs self-position estimation
7140c
Self-position estimation successful?
N
Y
7140d
Receiver displays map or input form, and prompts user to input current position
7140e
Receiver transmits received ID, estimated self-position, and self-position estimation error range to server
7140f
Only one transmitter transmitting ID received by receiver present within estimation error radius from estimated self-position of receiver?
N
Y
7140g
Server transmits information associated with transmitter to receiver
end

FIG. 286

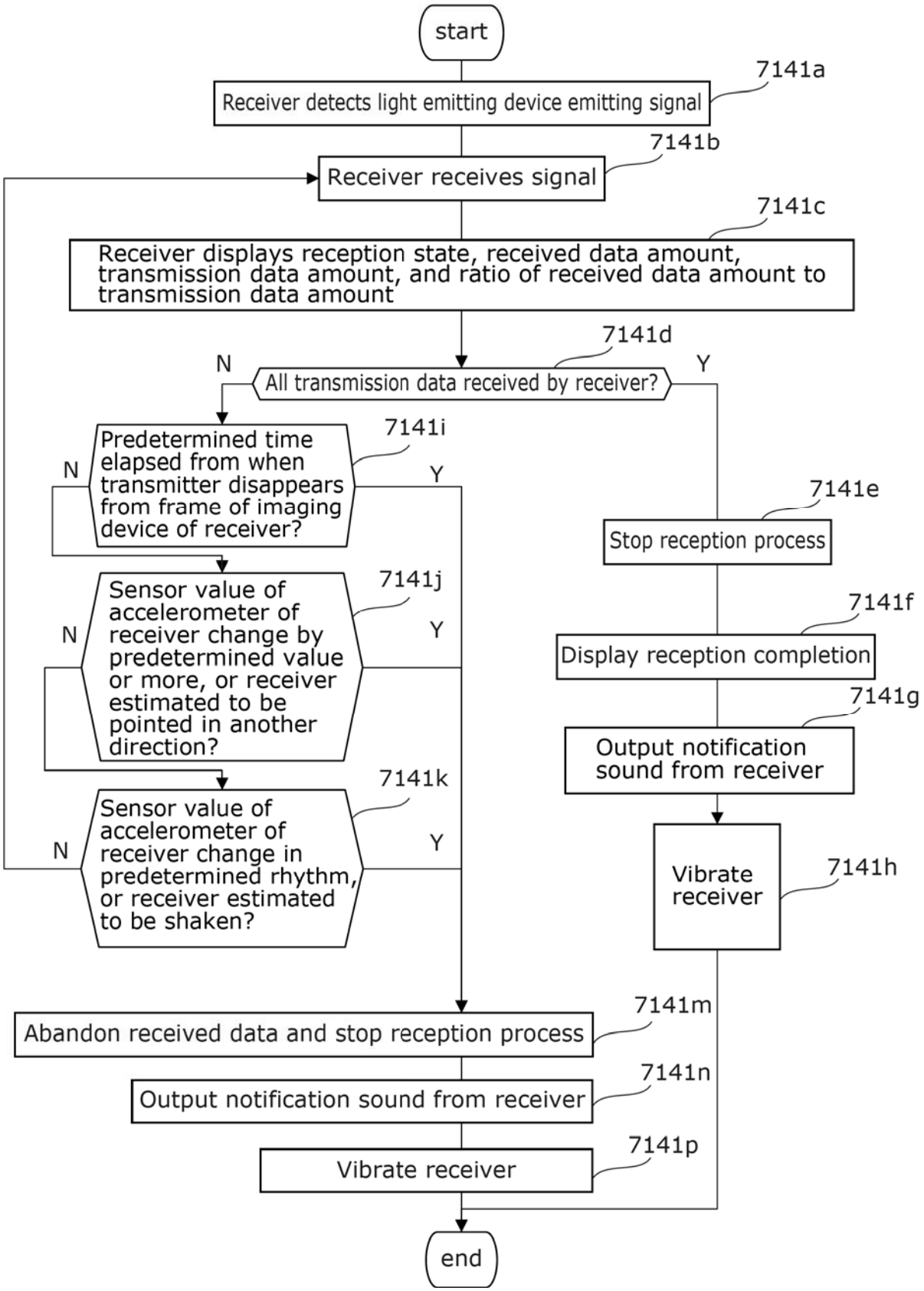

start
Receiver detects light emitting device emitting signal
7141a
Receiver receives signal
7141b
Receiver displays reception state, received data amount, transmission data amount, and ratio of received data amount to transmission data amount
7141c
All transmission data received by receiver?
7141d
N
Y
Predetermined time elapsed from when transmitter disappears from frame of imaging device of receiver?
7141i
N
Y
Sensor value of accelerometer of receiver change by predetermined value or more, or receiver estimated to be pointed in another direction?
7141j
N
Y
Sensor value of accelerometer of receiver change in predetermined rhythm, or receiver estimated to be shaken?
7141k
N
Y
Stop reception process
7141e
Display reception completion
7141f
Output notification sound from receiver
7141g
Vibrate receiver
7141h
Abandon received data and stop reception process
7141m
Output notification sound from receiver
7141n
Vibrate receiver
7141p
end

FIG. 287A

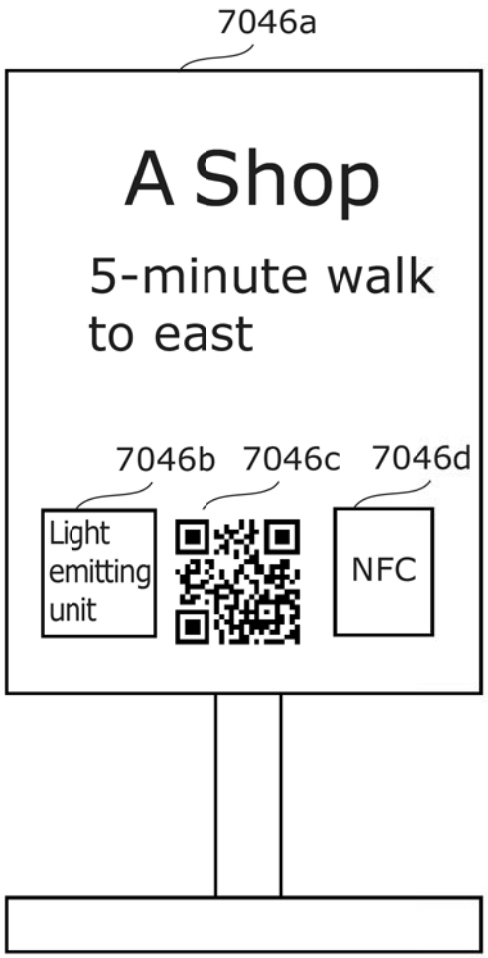


FIG. 287B



FIG. 288

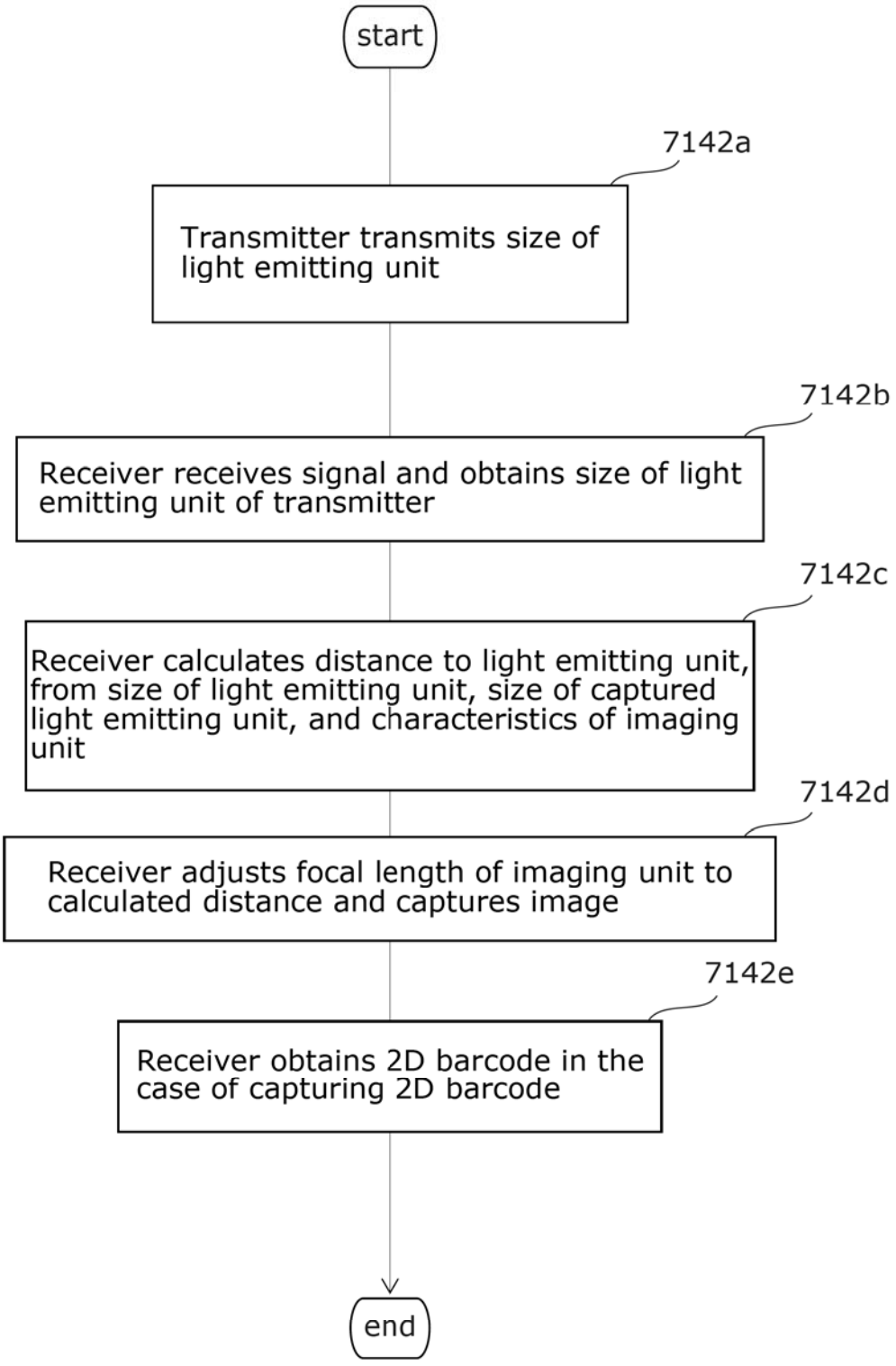

start
7142a
Transmitter transmits size of light emitting unit
7142b
Receiver receives signal and obtains size of light emitting unit of transmitter
7142c
Receiver calculates distance to light emitting unit, from size of light emitting unit, size of captured light emitting unit, and characteristics of imaging unit
7142d
Receiver adjusts focal length of imaging unit to calculated distance and captures image
7142e
Receiver obtains 2D barcode in the case of capturing 2D barcode
end

FIG. 289

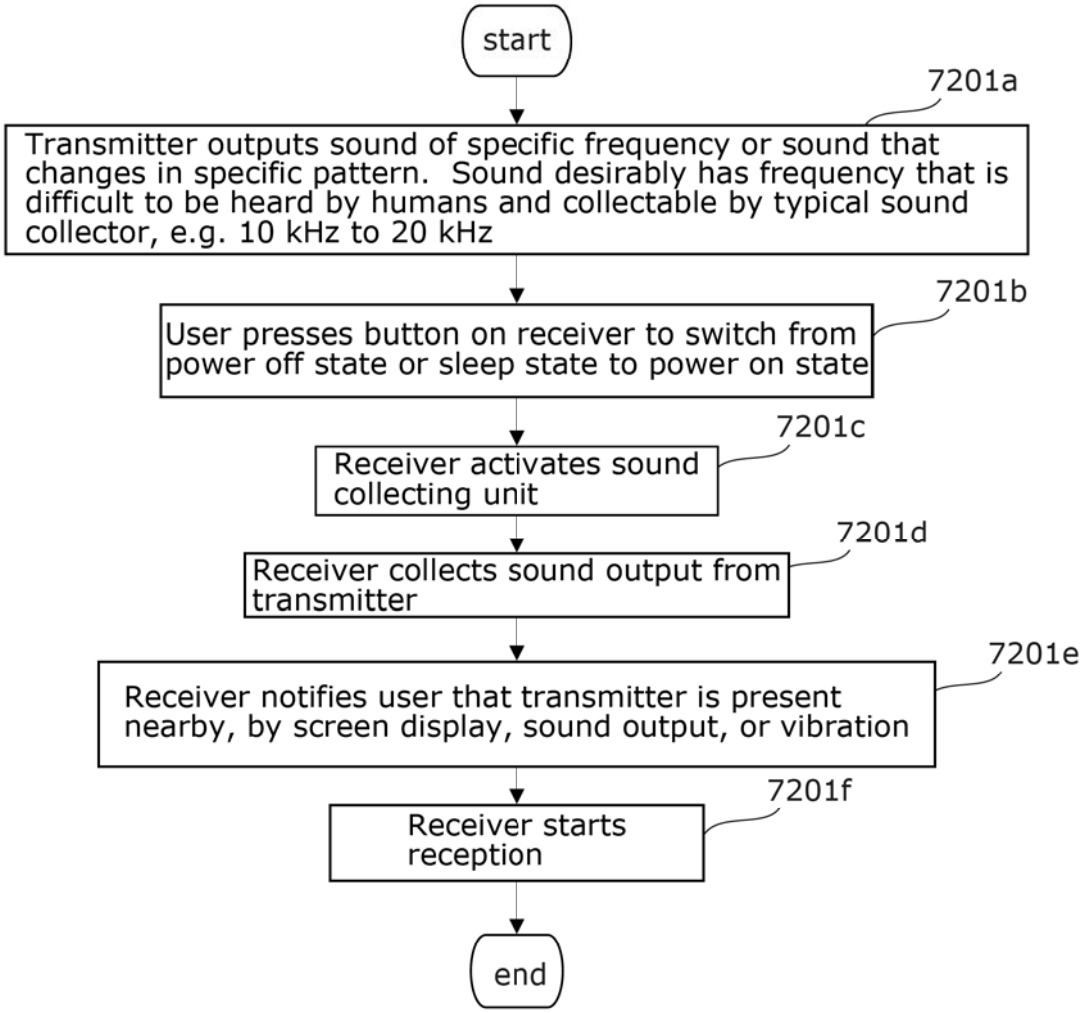

start
7201a
Transmitter outputs sound of specific frequency or sound that changes in specific pattern. Sound desirably has frequency that is difficult to be heard by humans and collectable by typical sound collector, e.g. 10 kHz to 20 kHz
7201b
User presses button on receiver to switch from power off state or sleep state to power on state
7201c
Receiver activates sound collecting unit
7201d
Receiver collects sound output from transmitter
7201e
Receiver notifies user that transmitter is present nearby, by screen display, sound output, or vibration
7201f
Receiver starts reception
end

FIG. 290

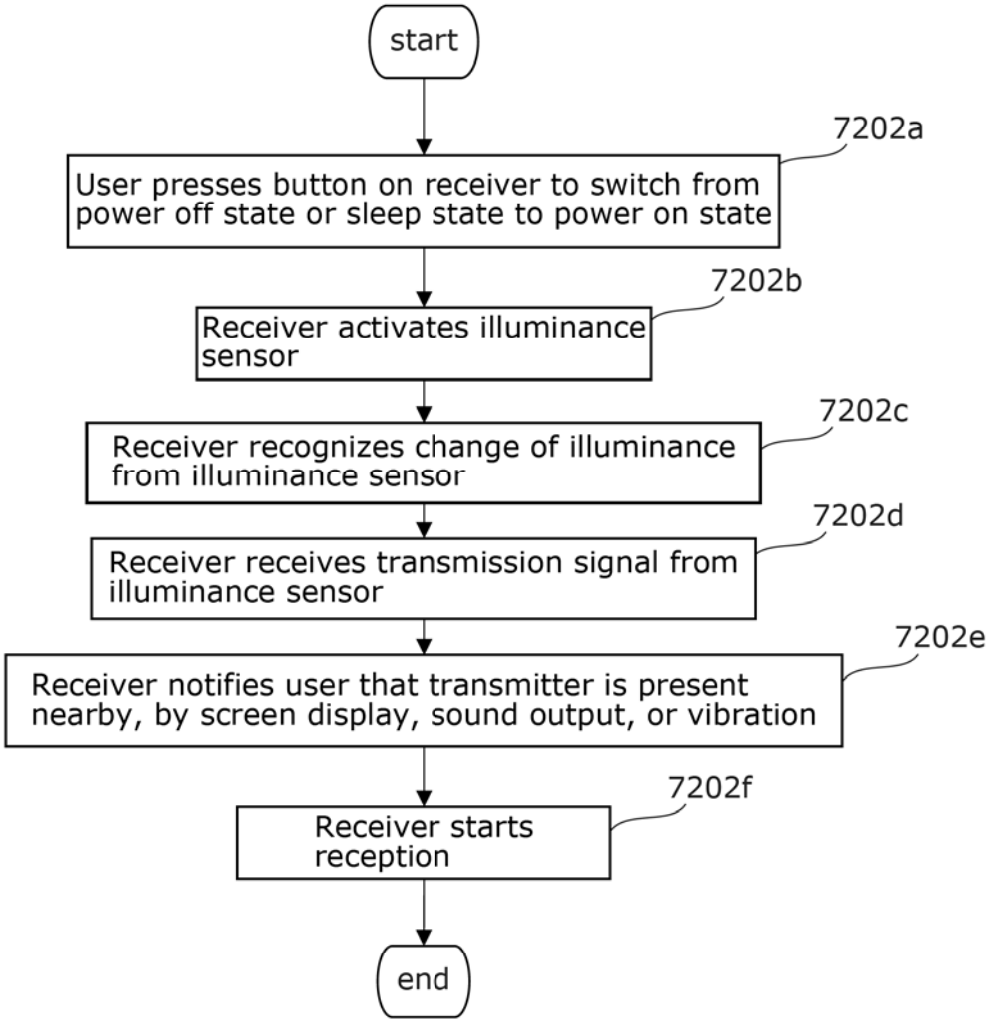

start
7202a
User presses button on receiver to switch from power off state or sleep state to power on state
7202b
Receiver activates illuminance sensor
7202c
Receiver recognizes change of illuminance from illuminance sensor
7202d
Receiver receives transmission signal from illuminance sensor
7202e
Receiver notifies user that transmitter is present nearby, by screen display, sound output, or vibration
7202f
Receiver starts reception
end

FIG. 291

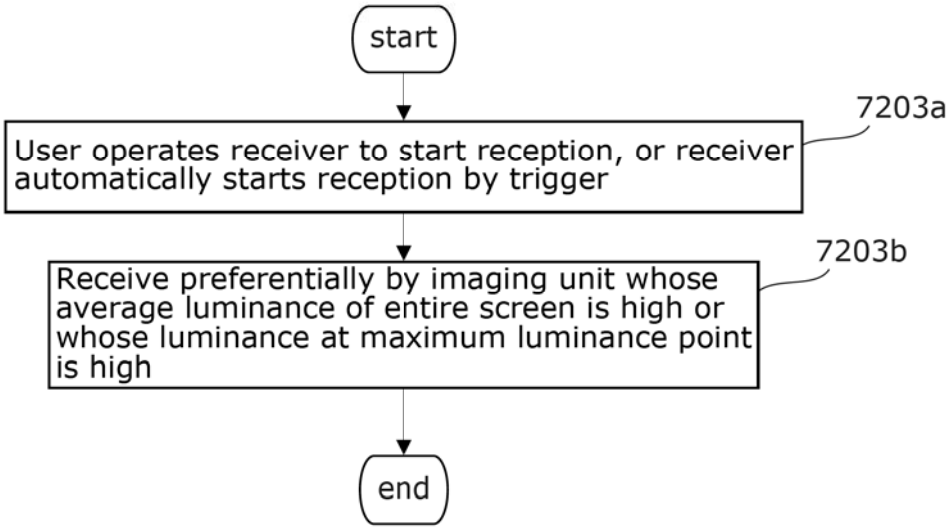

start
User operates receiver to start reception, or receiver automatically starts reception by trigger
7203a
Receive preferentially by imaging unit whose average luminance of entire screen is high or whose luminance at maximum luminance point is high
7203b
end

FIG. 292

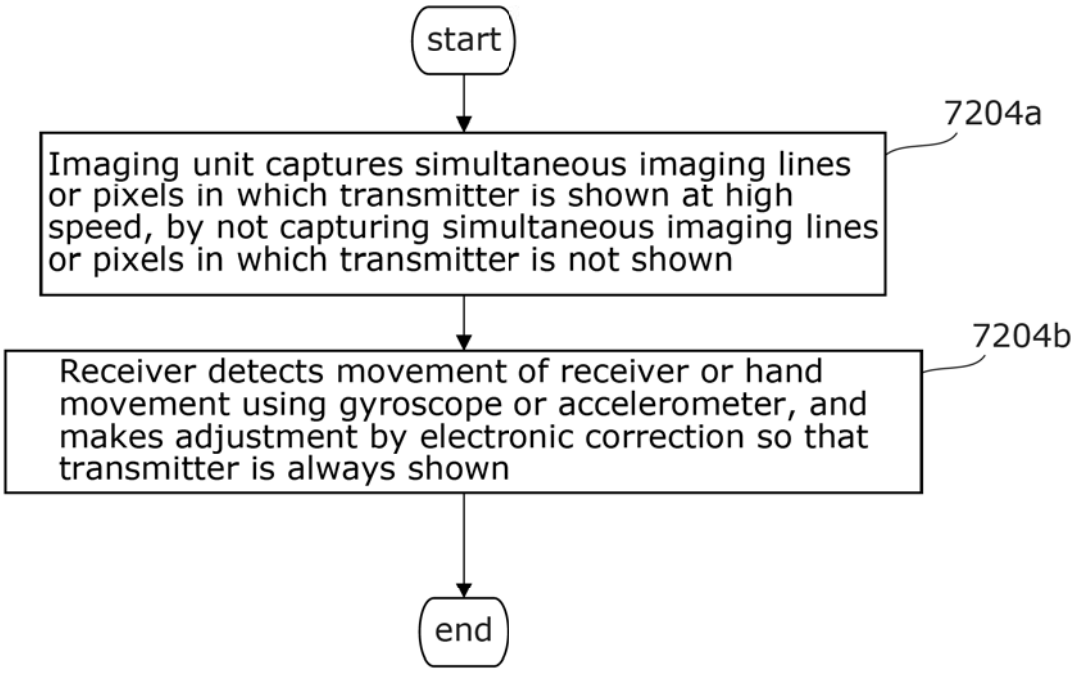

start
7204a
Imaging unit captures simultaneous imaging lines or pixels in which transmitter is shown at high speed, by not capturing simultaneous imaging lines or pixels in which transmitter is not shown
7204b
Receiver detects movement of receiver or hand movement using gyroscope or accelerometer, and makes adjustment by electronic correction so that transmitter is always shown
end

FIG. 293

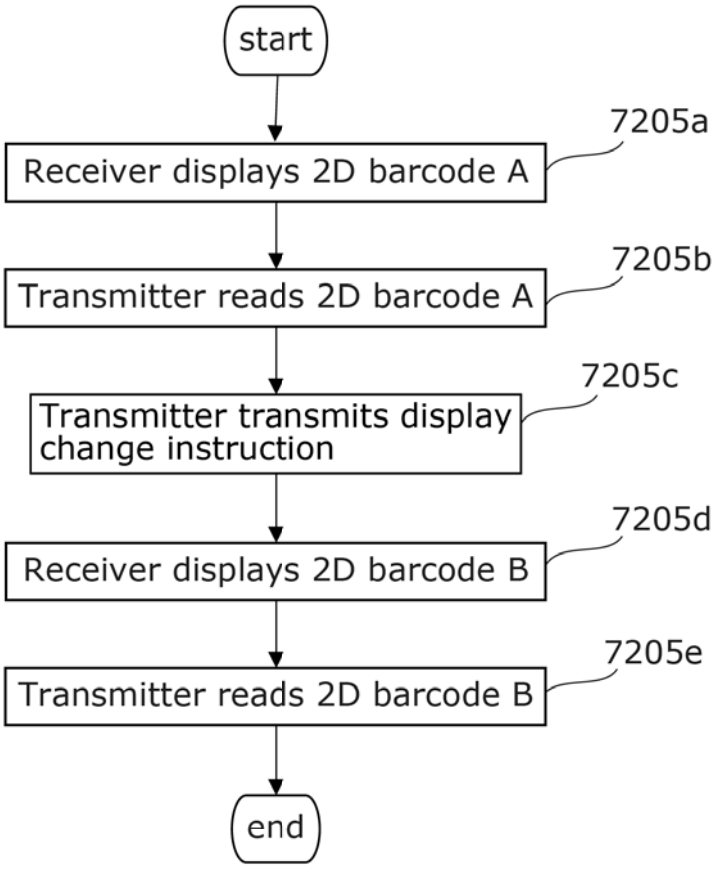
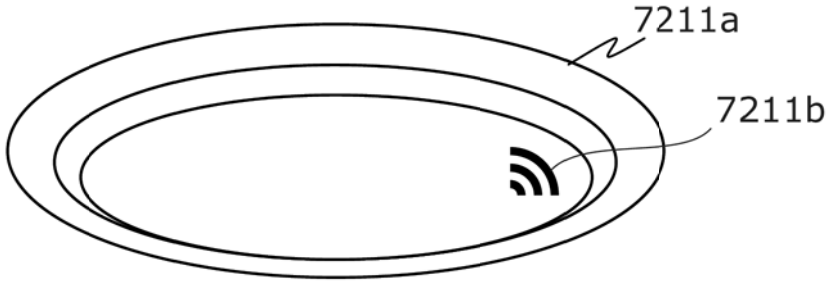
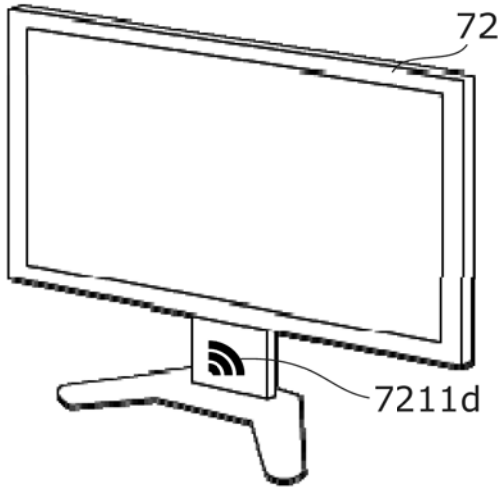

start
Receiver displays 2D barcode A
7205a
Transmitter reads 2D barcode A
7205b
Transmitter transmits display change instruction
7205c
Receiver displays 2D barcode B
7205d
Transmitter reads 2D barcode B
7205e
end

FIG. 294





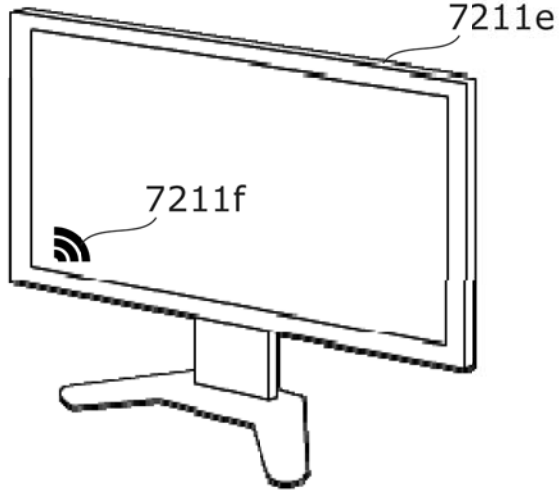


FIG. 295

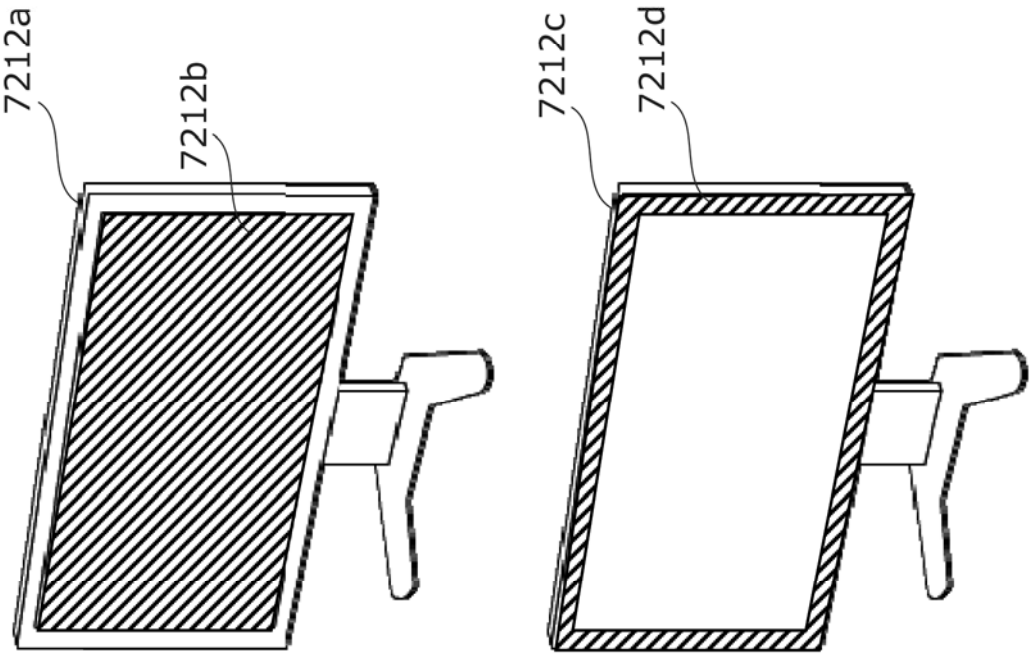


FIG. 296

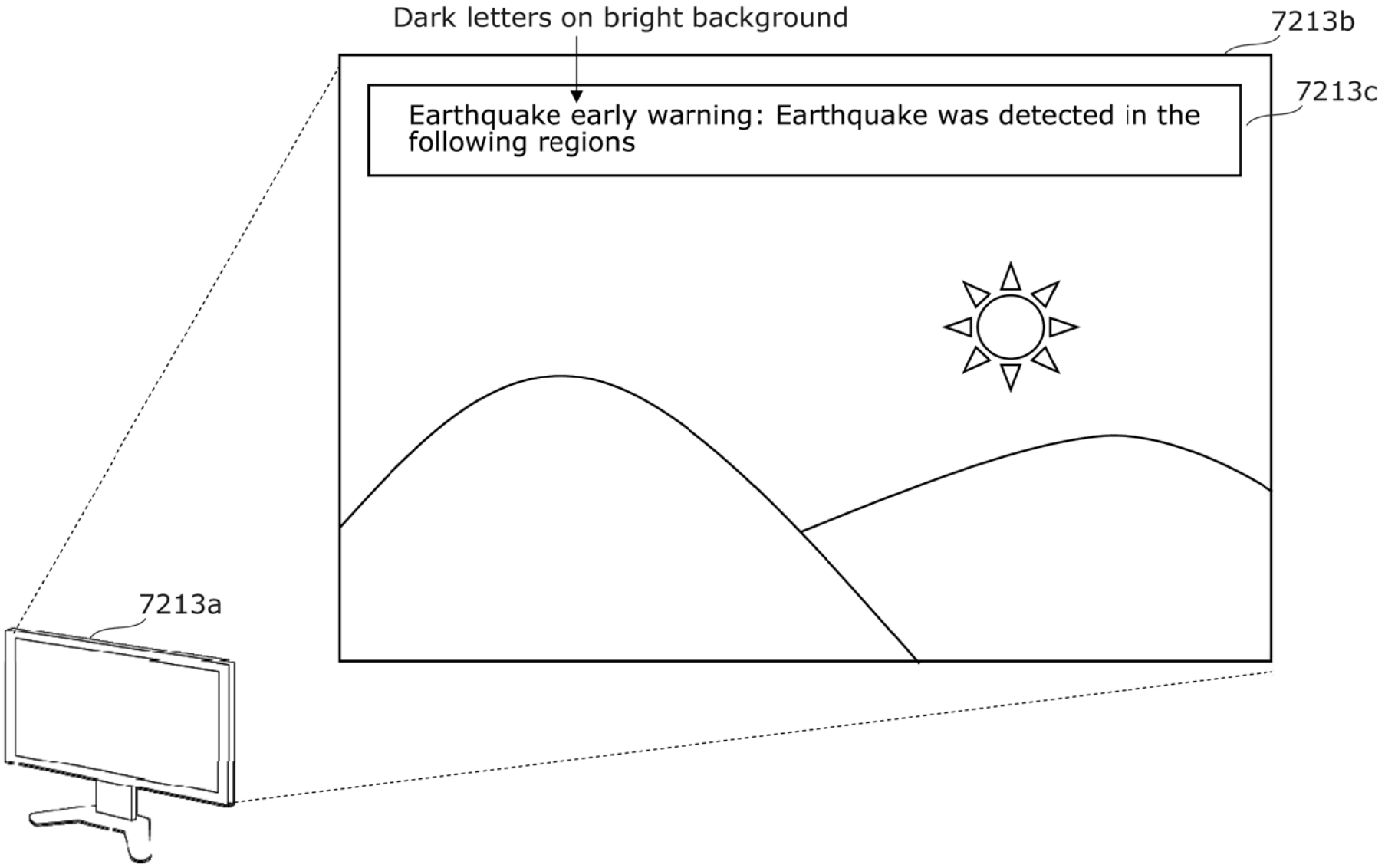

Dark letters on bright background
7213b
7213c
Earthquake early warning: Earthquake was detected in the following regions
7213a

FIG. 297

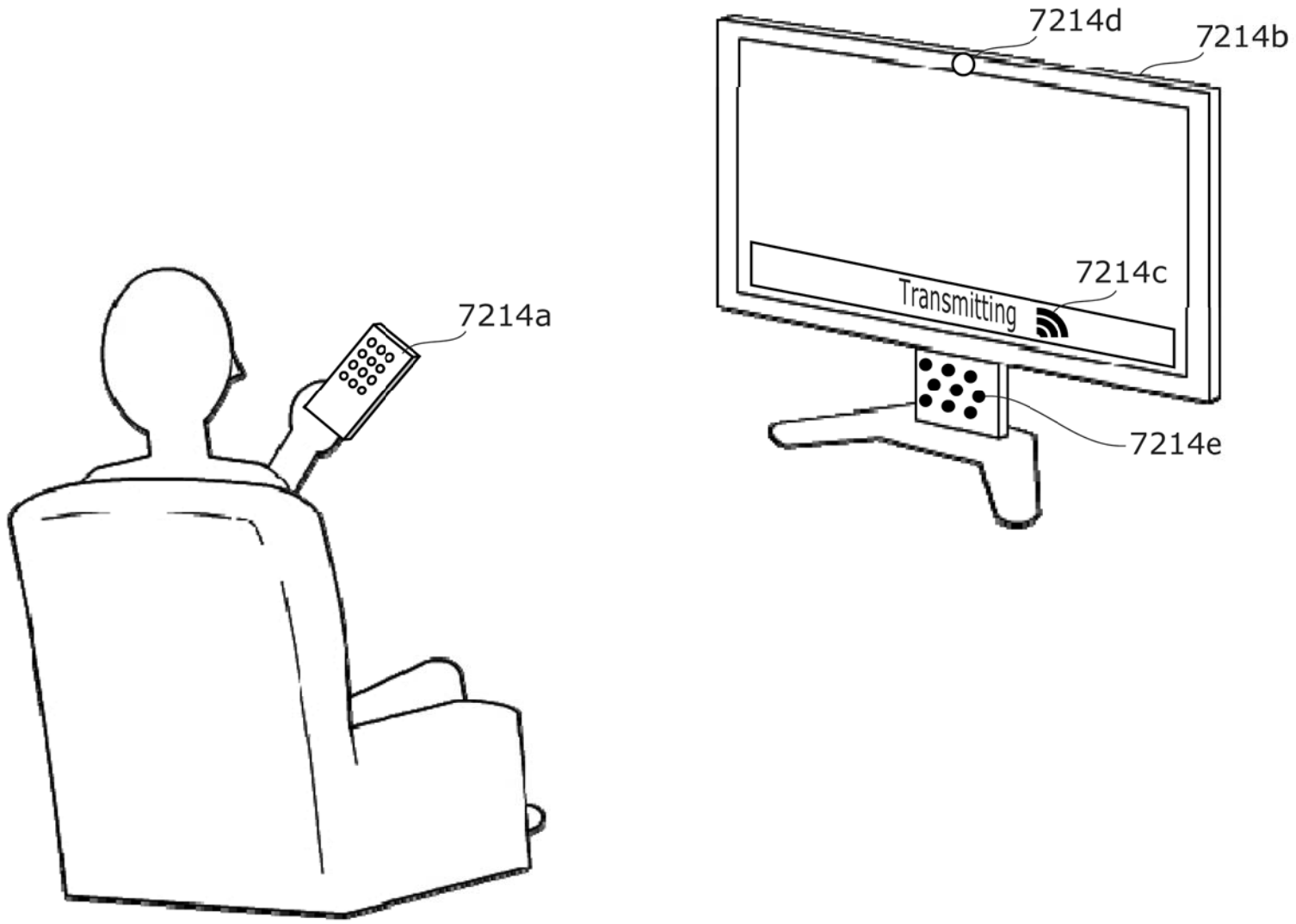


FIG. 298

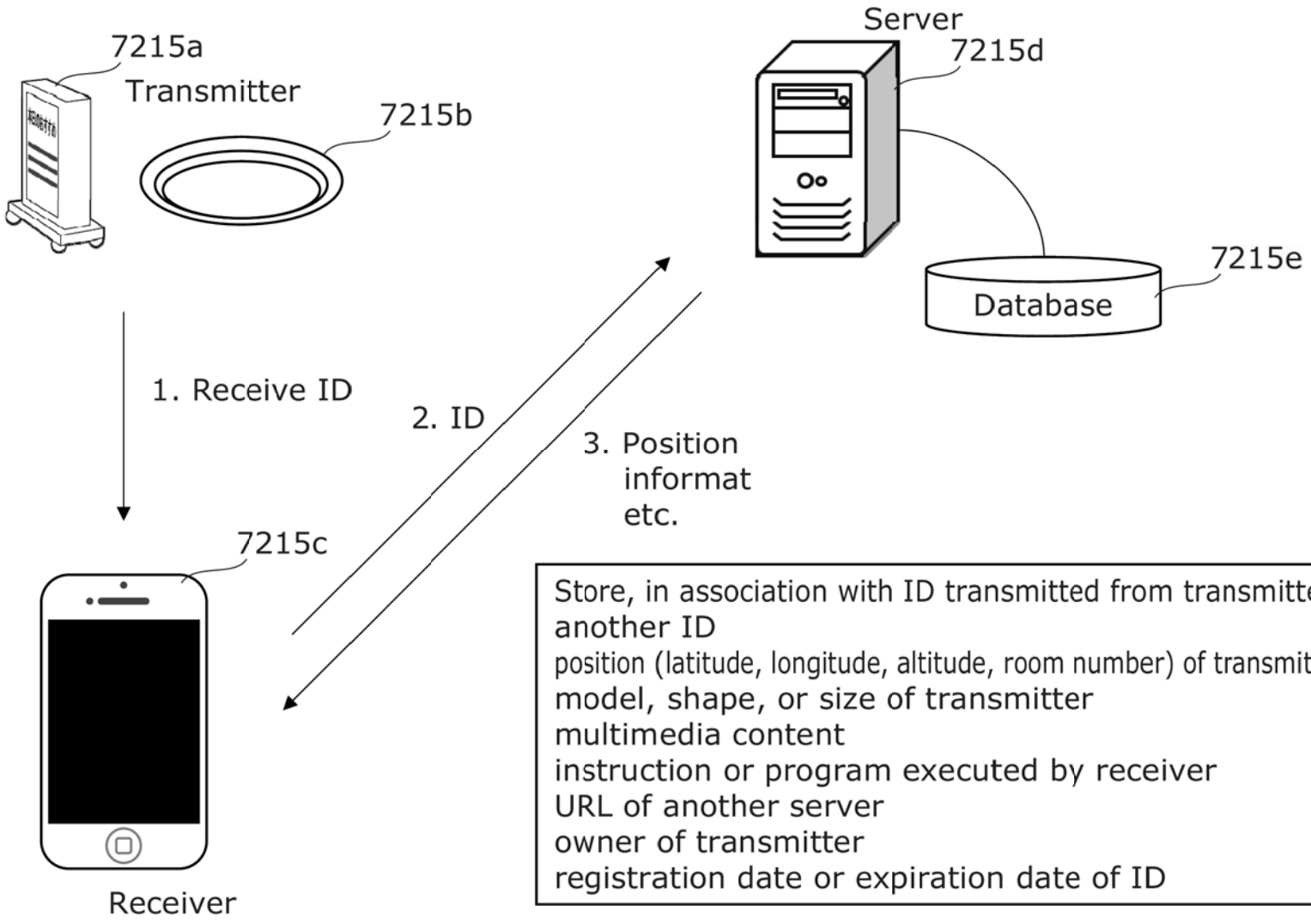

7215a
Transmitter
7215b
Server
7215d
7215e
Database
1. Receive ID
2. ID
3. Position
informat
etc.
7215c
Receiver
Store, in association with ID transmitted from transmitter:
another ID
position (latitude, longitude, altitude, room number) of transmitter
model, shape, or size of transmitter
multimedia content
instruction or program executed by receiver
URL of another server
owner of transmitter
registration date or expiration date of ID

FIG. 299

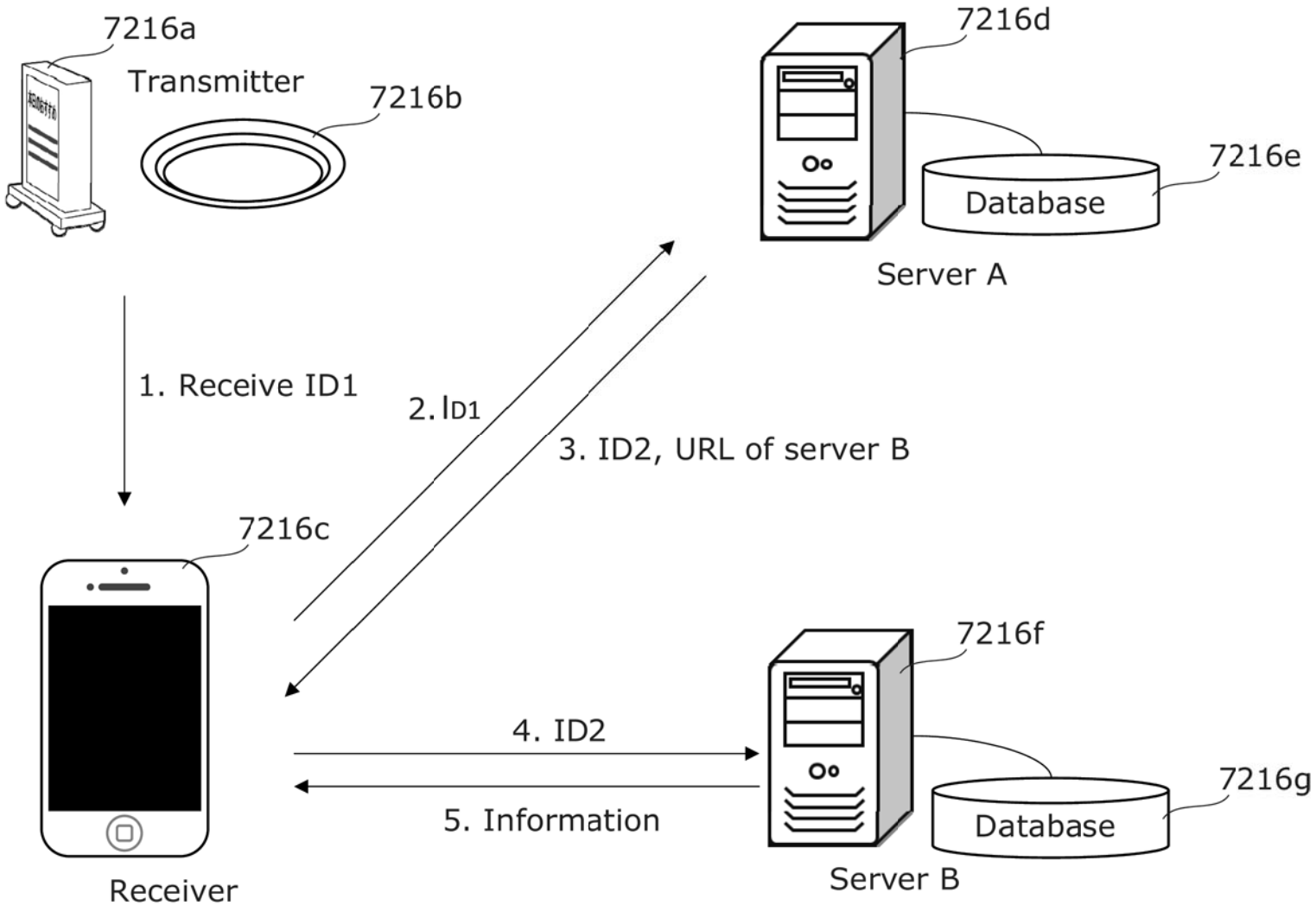

7216a
Transmitter
7216b
7216d
7216e
Database
Server A
1. Receive ID1
2. ID1
3. ID2, URL of server B
7216c
7216f
4. ID2
5. Information
7216g
Database
Receiver
Server B

FIG. 300

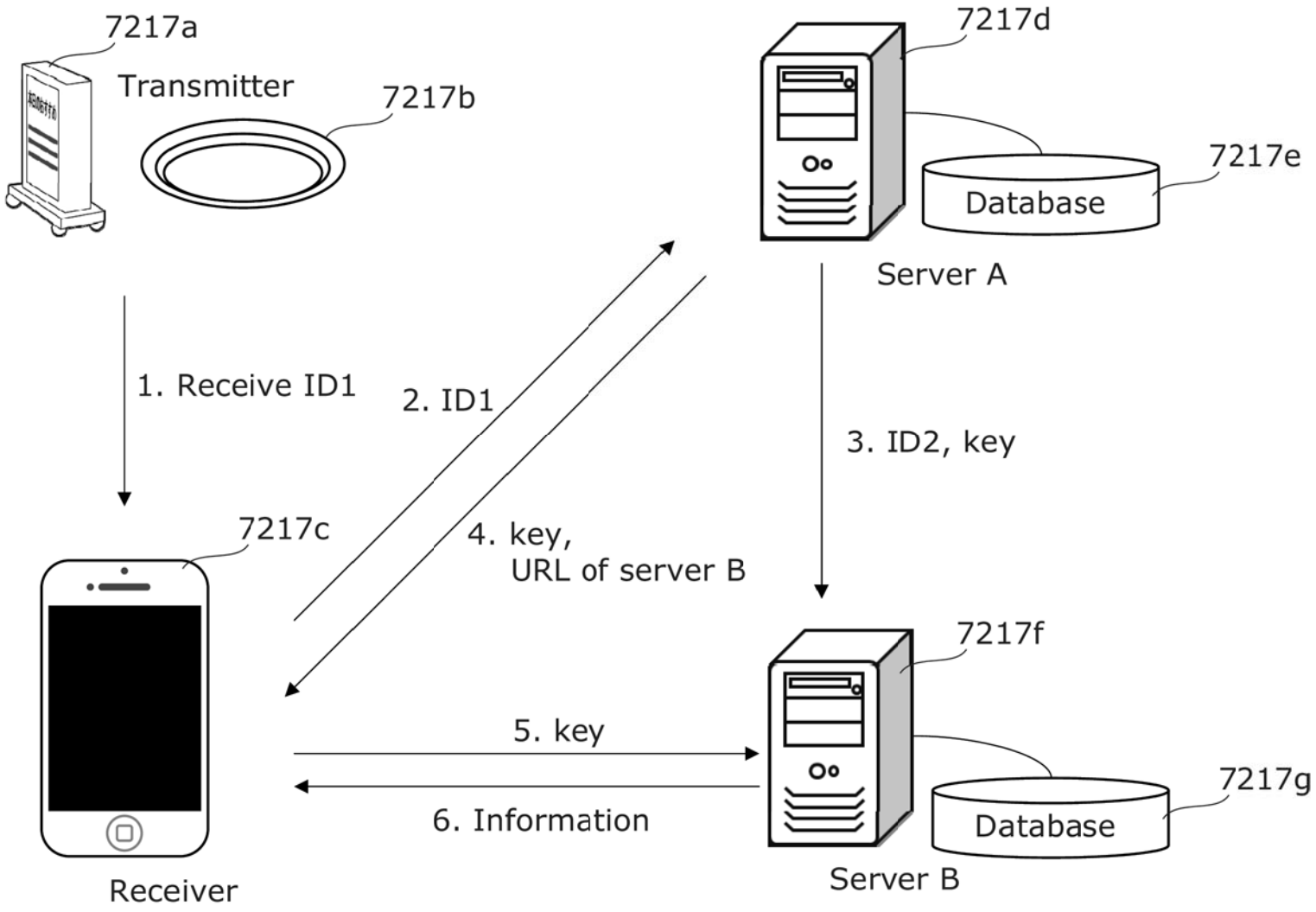

7217a
Transmitter
7217b
7217d
7217e
Database
Server A
1. Receive ID1
2. ID1
3. ID2, key
4. key,
URL of server B
7217c
7217f
5. key
6. Information
7217g
Database
Receiver
Server B

FIG. 301A

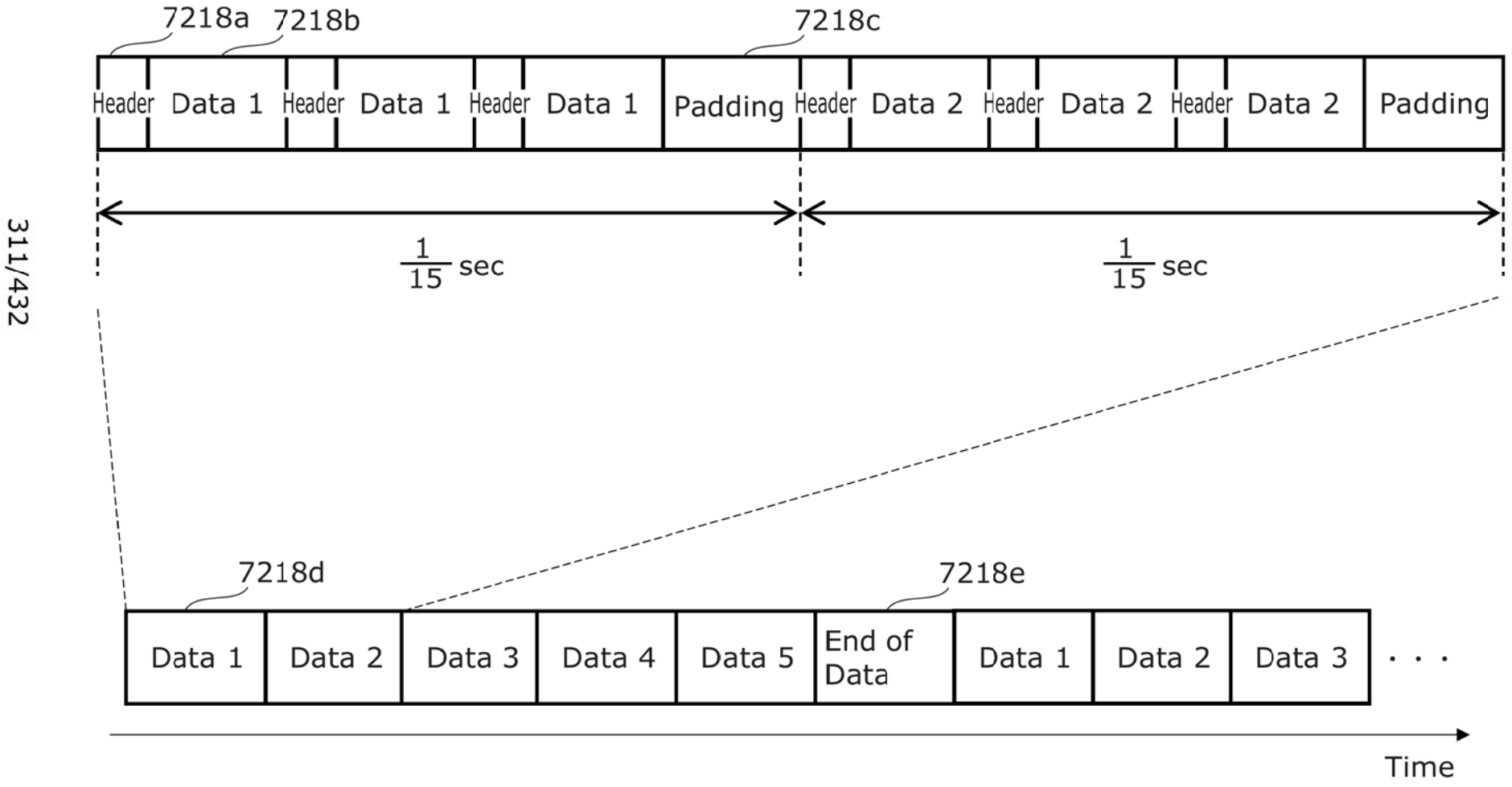

311/432
7218a
7218b
7218c
Header
Data 1
Header
Data 1
Header
Data 1
Padding
Header
Data 2
Header
Data 2
Header
Data 2
Padding
1/15 sec
1/15 sec
7218d
7218e
Data 1
Data 2
Data 3
Data 4
Data 5
End of Data
Data 1
Data 2
Data 3
Time

FIG. 301B

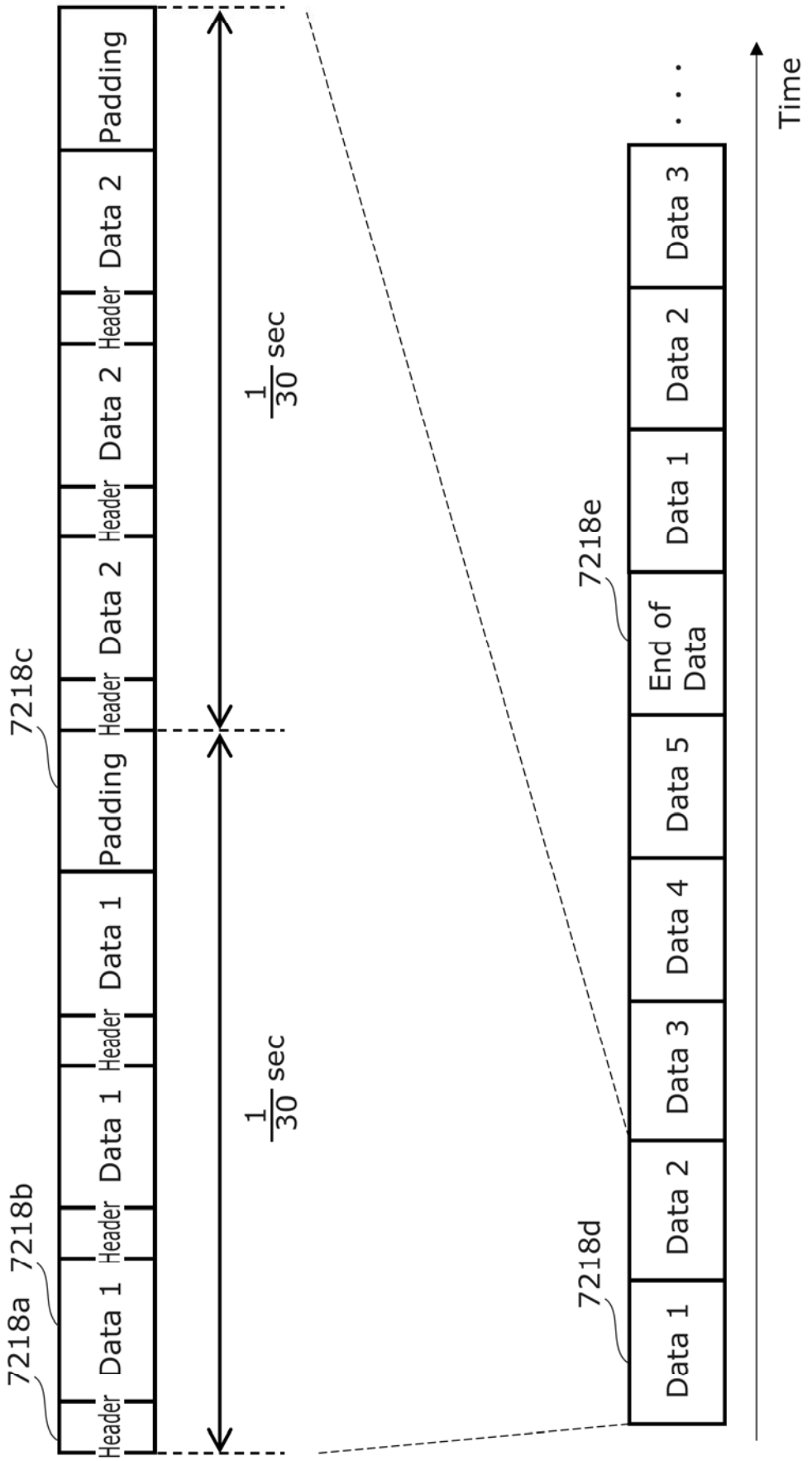

Header
Data 1
Header
Data 1
Header
Data 1
Padding
Header
Data 2
Header
Data 2
Header
Data 2
Padding
7218a
7218b
7218c
1/30 sec
1/30 sec
Data 1
Data 2
Data 3
Data 4
Data 5
End of Data
Data 1
Data 2
Data 3
. . .
7218d
7218e
Time

FIG. 302

7219a

Transmission signal	Modulated signal
00 (0)	01111
01 (1)	10111
10 (2)	11011
11 (3)	11101
Header	11110

FIG. 303A

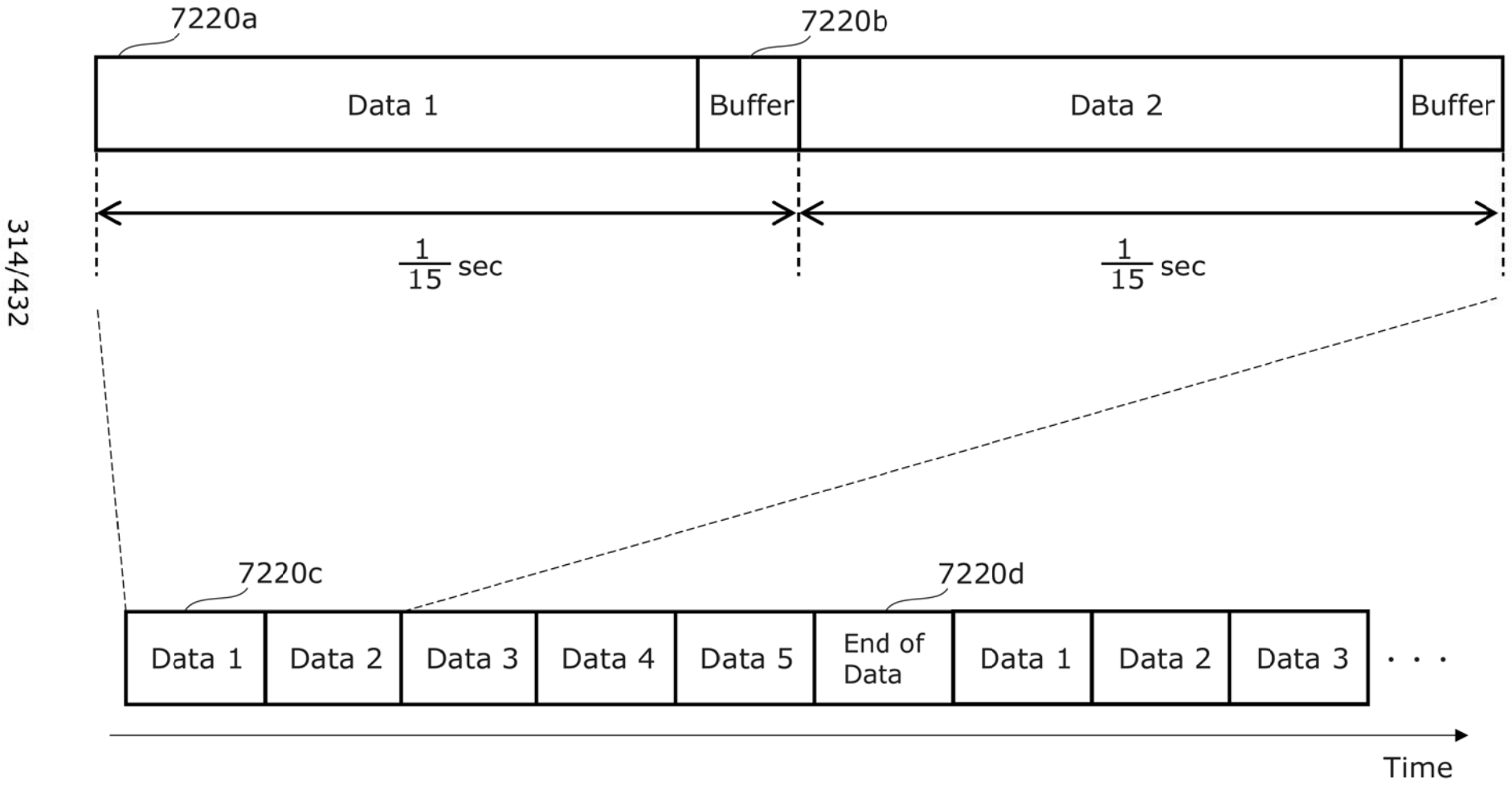

314/432
7220a
7220b
Data 1
Buffer
Data 2
Buffer
1/15 sec
1/15 sec
7220c
7220d
Data 1
Data 2
Data 3
Data 4
Data 5
End of Data
Data 1
Data 2
Data 3
Time

FIG. 303B

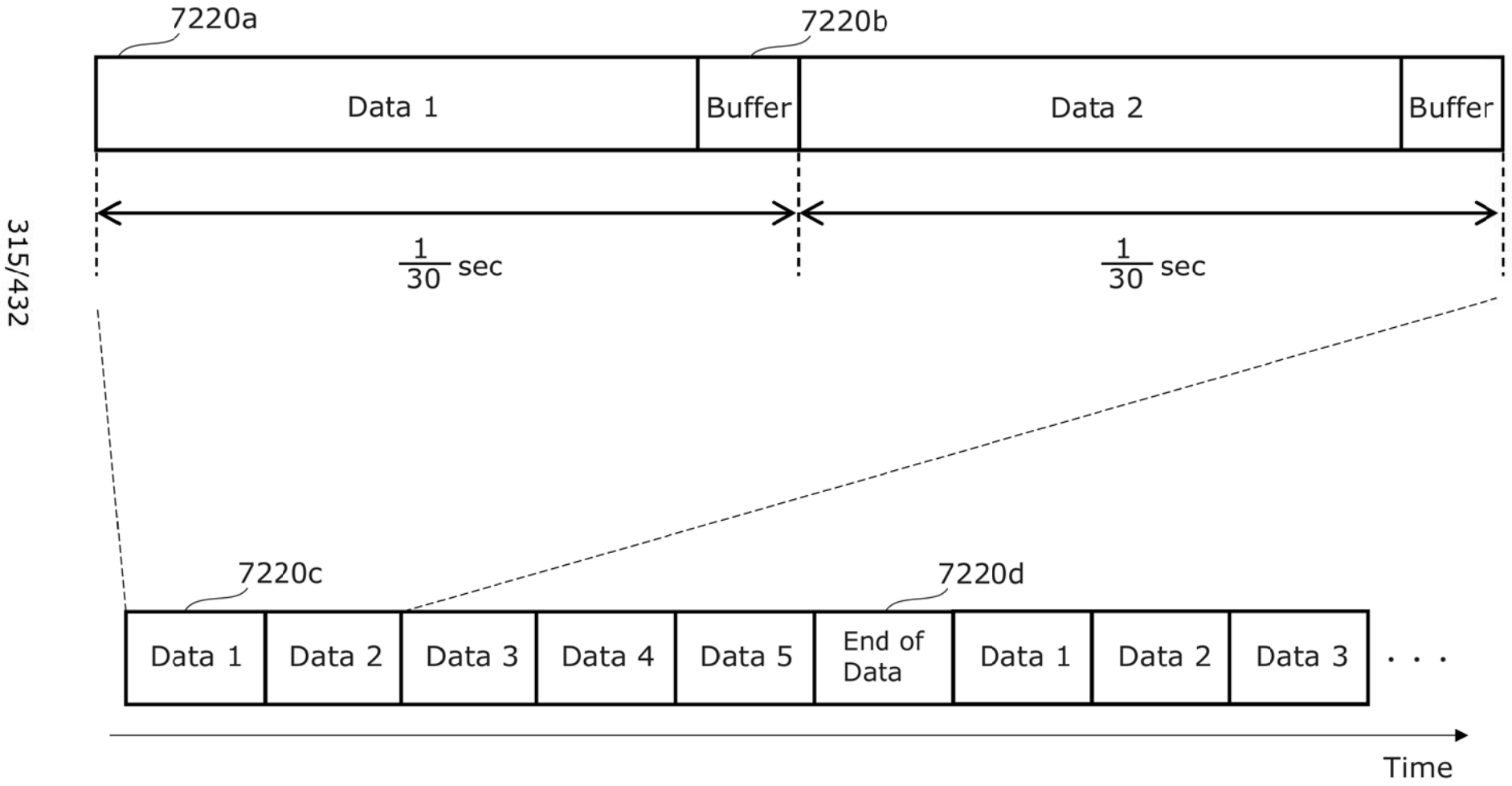

315/432
7220a
7220b
Data 1
Buffer
Data 2
Buffer
1/30 sec
1/30 sec
7220c
7220d
Data 1
Data 2
Data 3
Data 4
Data 5
End of Data
Data 1
Data 2
Data 3
. . .
Time

FIG. 304

7221a

Transmission signal	Modulation frequency
00 (0)	500Hz
01 (1)	1000Hz
10 (2)	2000Hz
11 (3)	5000Hz

FIG. 305A

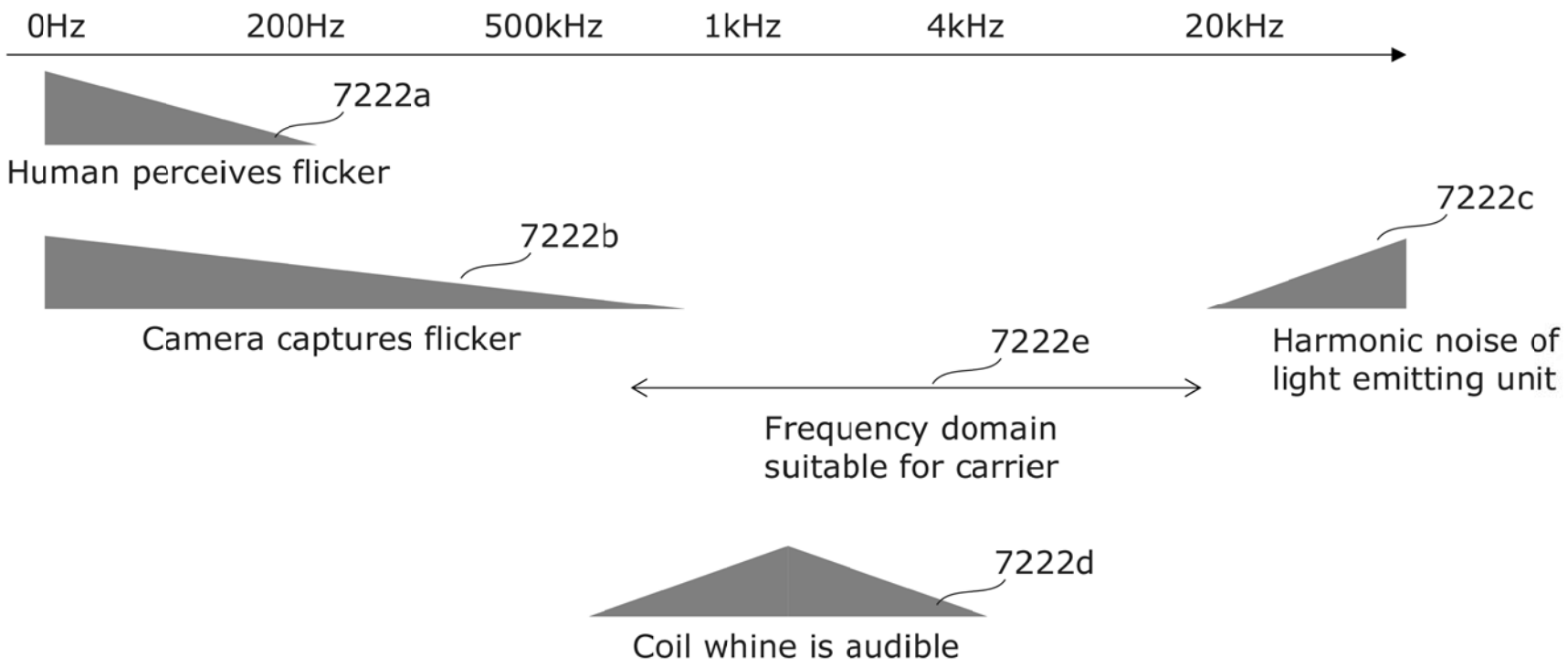

0Hz
200Hz
500kHz
1kHz
4kHz
20kHz
7222a
Human perceives flicker
7222b
Camera captures flicker
7222c
Harmonic noise of light emitting unit
7222e
Frequency domain suitable for carrier
7222d
Coil whine is audible

FIG. 305B

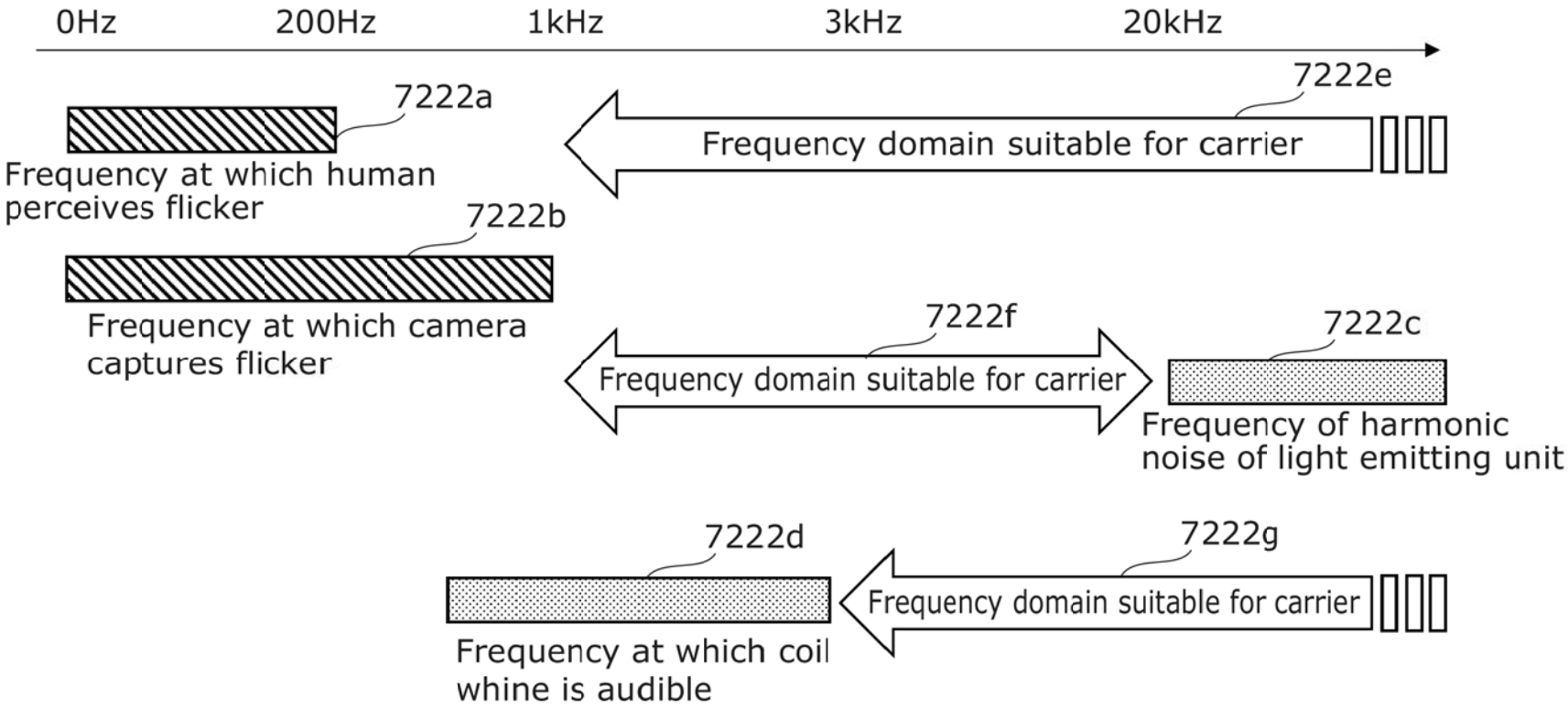

0Hz
200Hz
1kHz
3kHz
20kHz
7222a
Frequency at which human perceives flicker
7222e
Frequency domain suitable for carrier
7222b
Frequency at which camera captures flicker
7222f
Frequency domain suitable for carrier
7222c
Frequency of harmonic noise of light emitting unit
7222d
Frequency at which coil whine is audible
7222g
Frequency domain suitable for carrier

FIG. 306

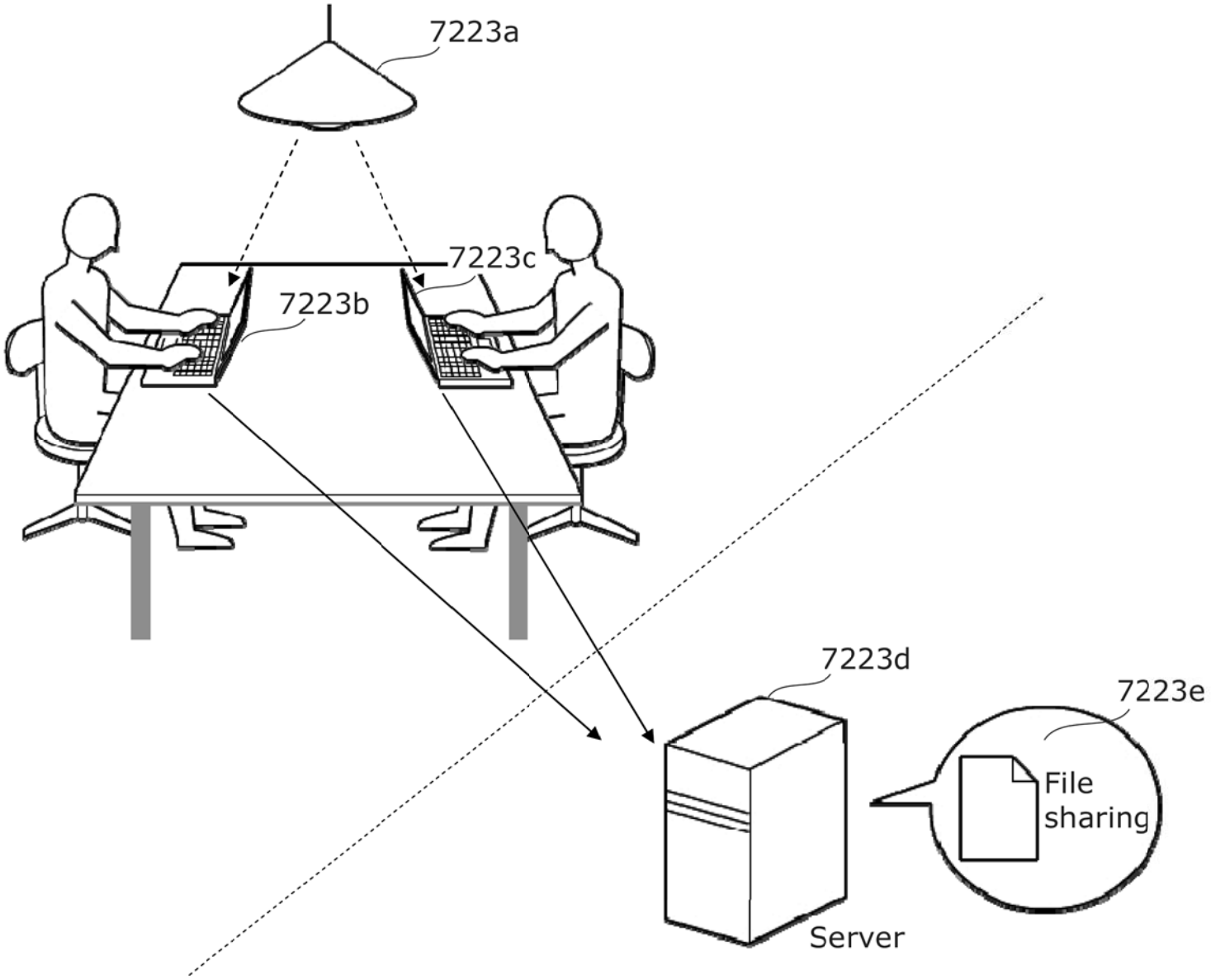


FIG. 307

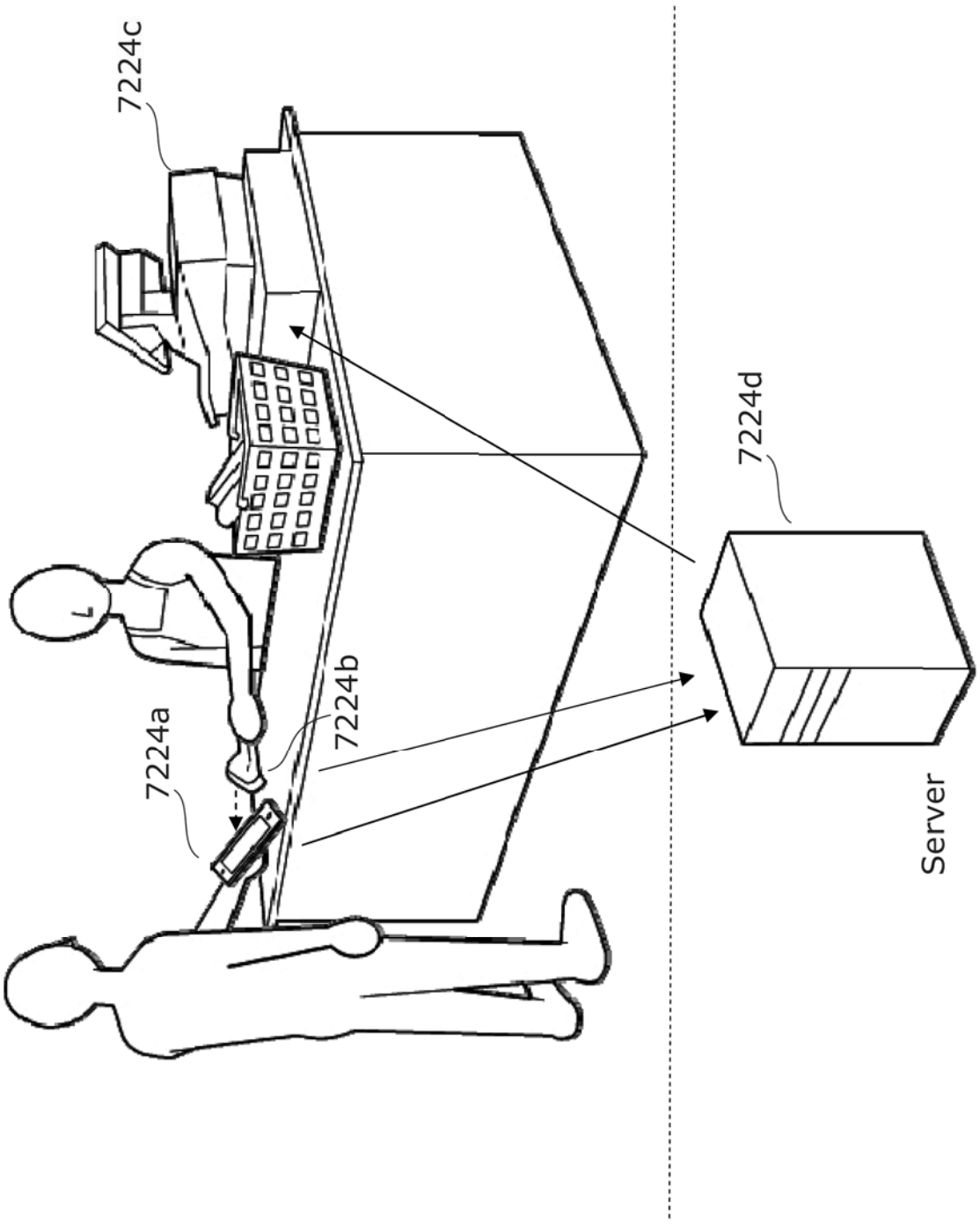


FIG. 308

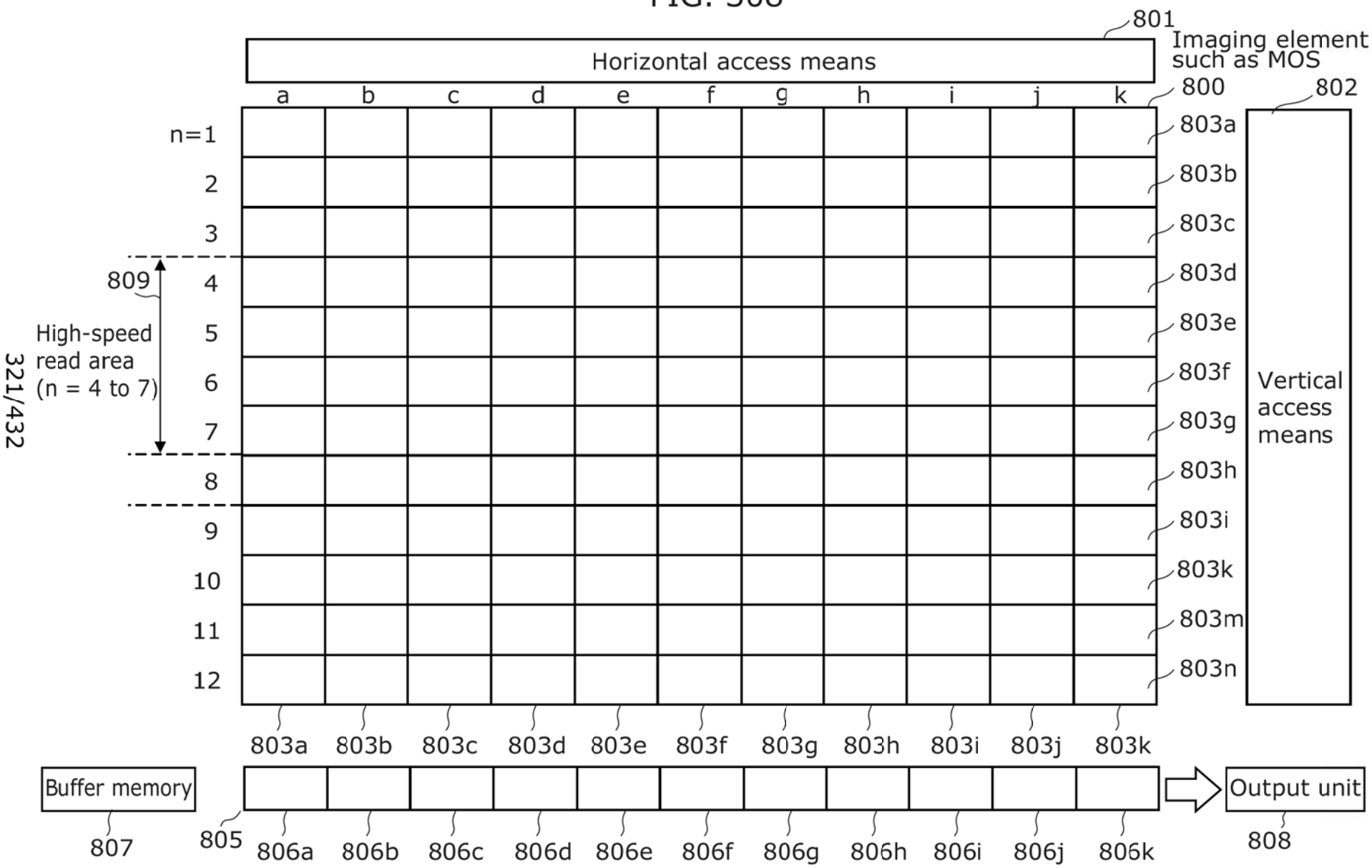

801
Horizontal access means
Imaging element such as MOS
800
802
a
b
c
d
e
f
g
h
i
j
k
n=1
2
3
4
5
6
7
8
9
10
11
12
809
High-speed read area (n = 4 to 7)
321/432
803a
803b
803c
803d
803e
803f
803g
803h
803i
803k
803m
803n
Vertical access means
Buffer memory
807
805
806a
806b
806c
806d
806e
806f
806g
806h
806i
806j
806k
Output unit
808

FIG. 309

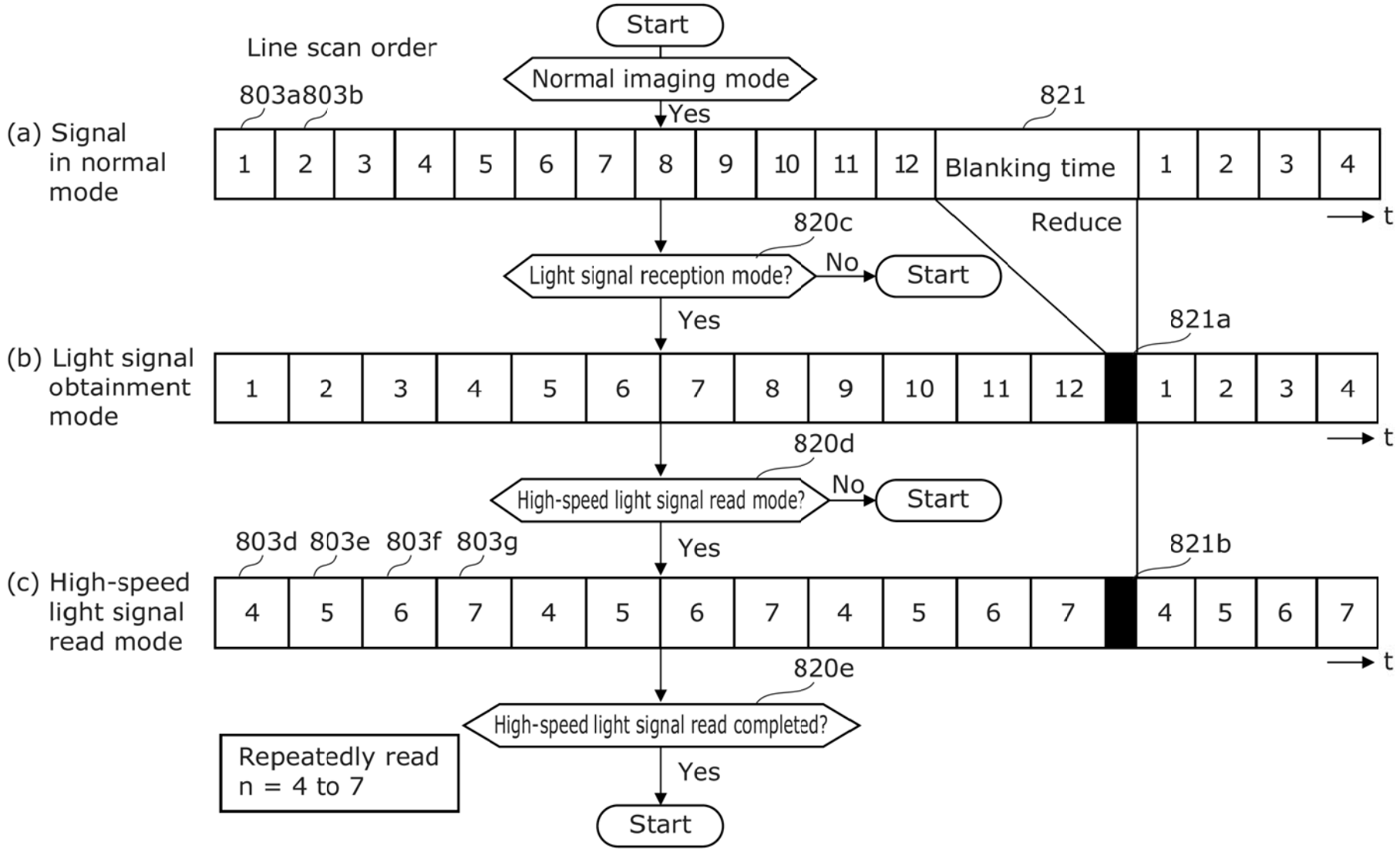

Start
Line scan order
Normal imaging mode
803a803b
821
Yes
(a) Signal in normal mode
1 2 3 4 5 6 7 8 9 10 11 12 Blanking time 1 2 3 4
t
Reduce
820c
Light signal reception mode?
No
Start
Yes
821a
(b) Light signal obtainment mode
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4
t
820d
High-speed light signal read mode?
No
Start
803d 803e 803f 803g
Yes
821b
(c) High-speed light signal read mode
4 5 6 7 4 5 6 7 4 5 6 7 4 5 6 7
t
820e
High-speed light signal read completed?
Repeatedly read n = 4 to 7
Yes
Start

FIG. 310

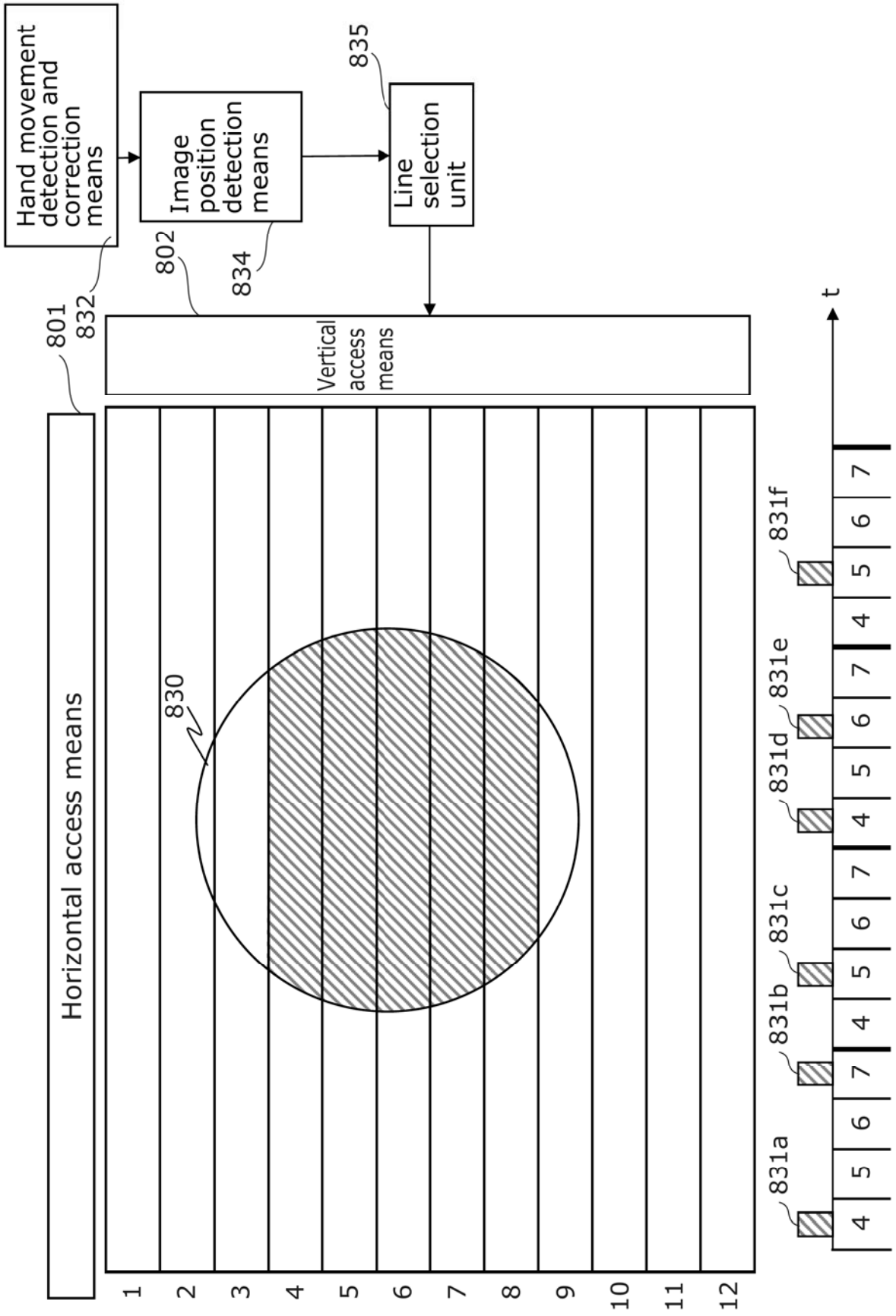

Hand movement detection and correction means
Image position detection means
Line selection unit
835
834
802
832
801
Vertical access means
Horizontal access means
830
1
2
3
4
5
6
7
8
9
10
11
12
t
831a
831b
831c
831d
831e
831f
4
5
6
7

FIG. 311A

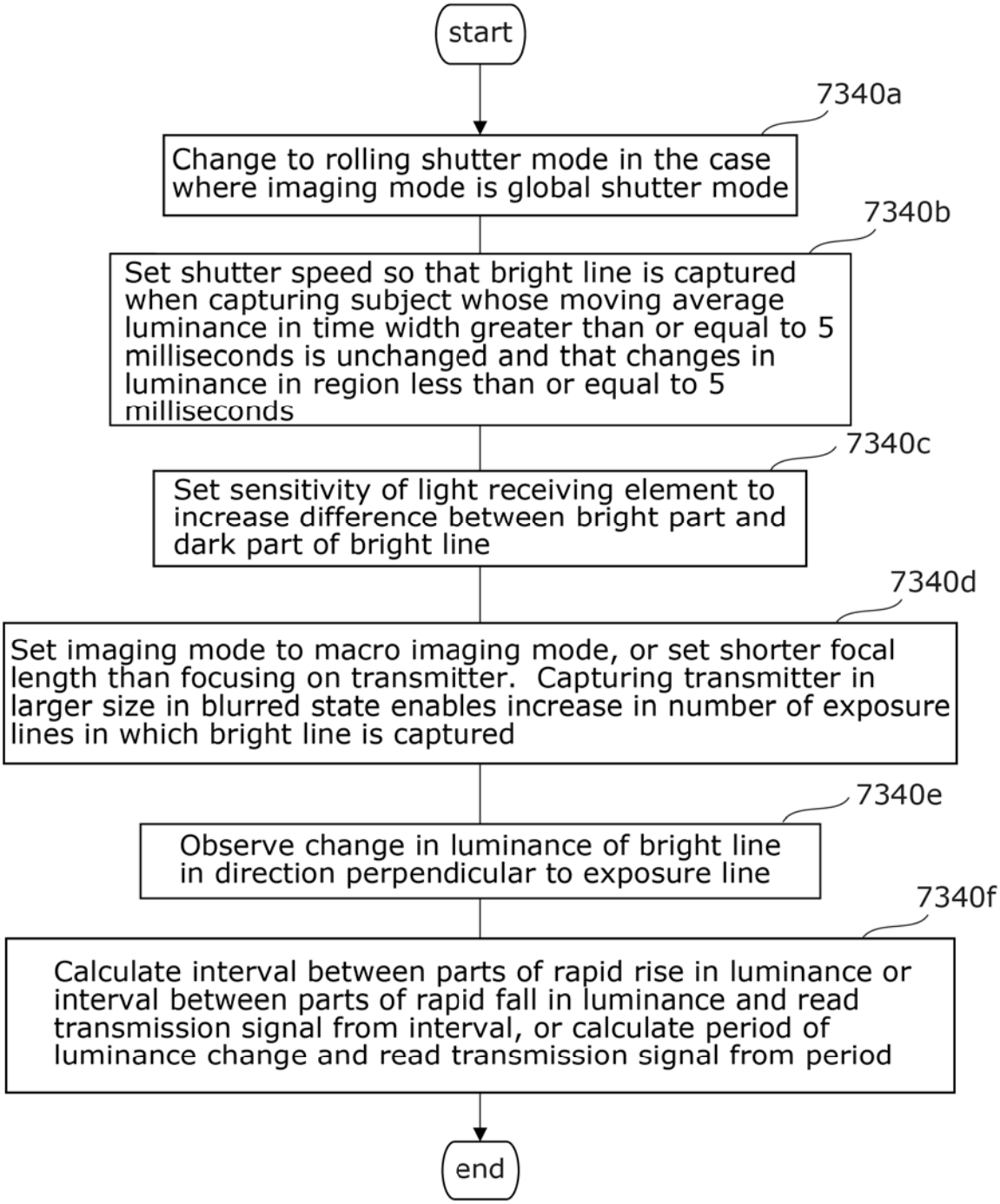

start
7340a
Change to rolling shutter mode in the case where imaging mode is global shutter mode
7340b
Set shutter speed so that bright line is captured when capturing subject whose moving average luminance in time width greater than or equal to 5 milliseconds is unchanged and that changes in luminance in region less than or equal to 5 milliseconds
7340c
Set sensitivity of light receiving element to increase difference between bright part and dark part of bright line
7340d
Set imaging mode to macro imaging mode, or set shorter focal length than focusing on transmitter. Capturing transmitter in larger size in blurred state enables increase in number of exposure lines in which bright line is captured
7340e
Observe change in luminance of bright line in direction perpendicular to exposure line
7340f
Calculate interval between parts of rapid rise in luminance or interval between parts of rapid fall in luminance and read transmission signal from interval, or calculate period of luminance change and read transmission signal from period
end

FIG. 311B

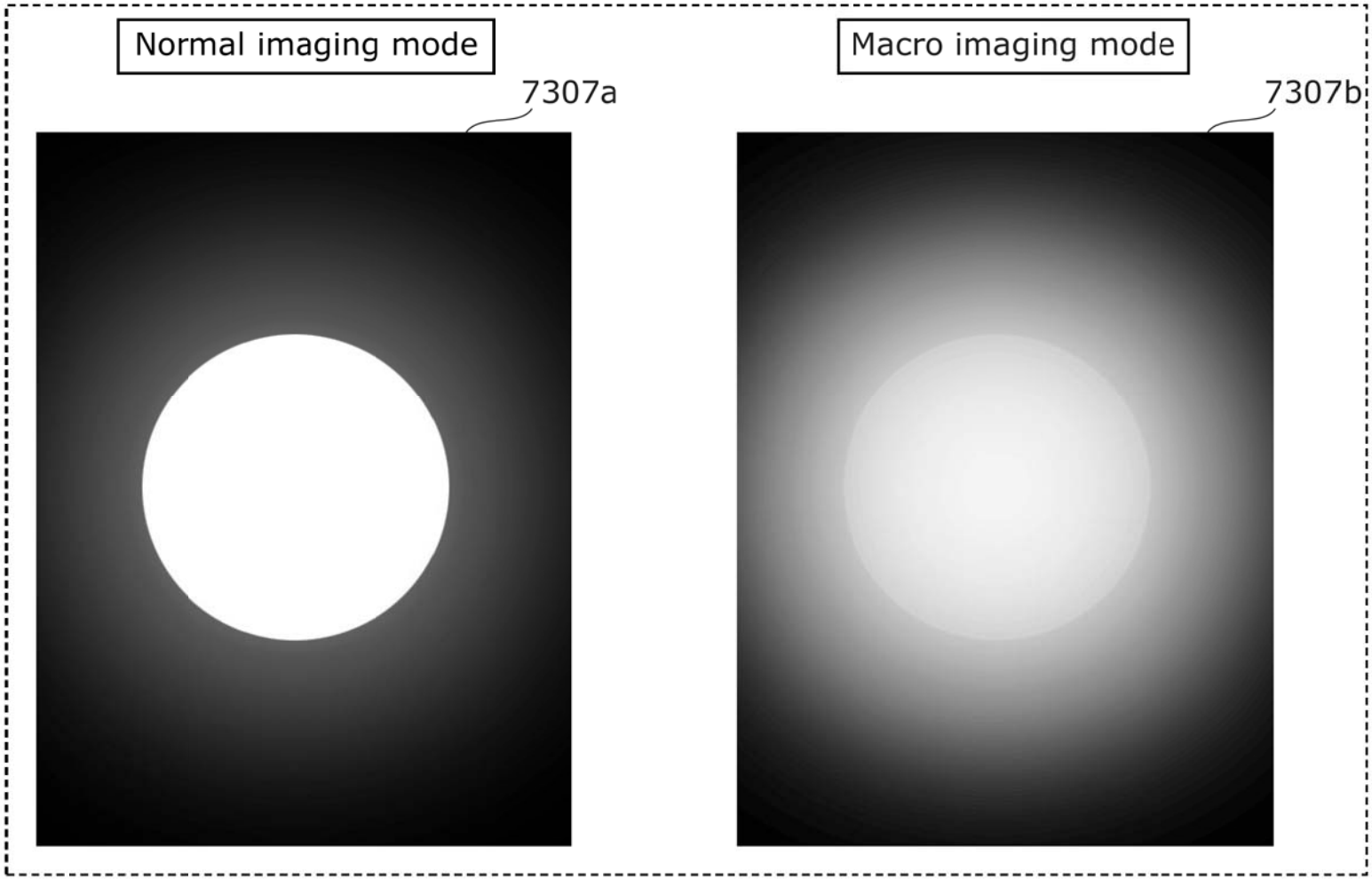


FIG. 312

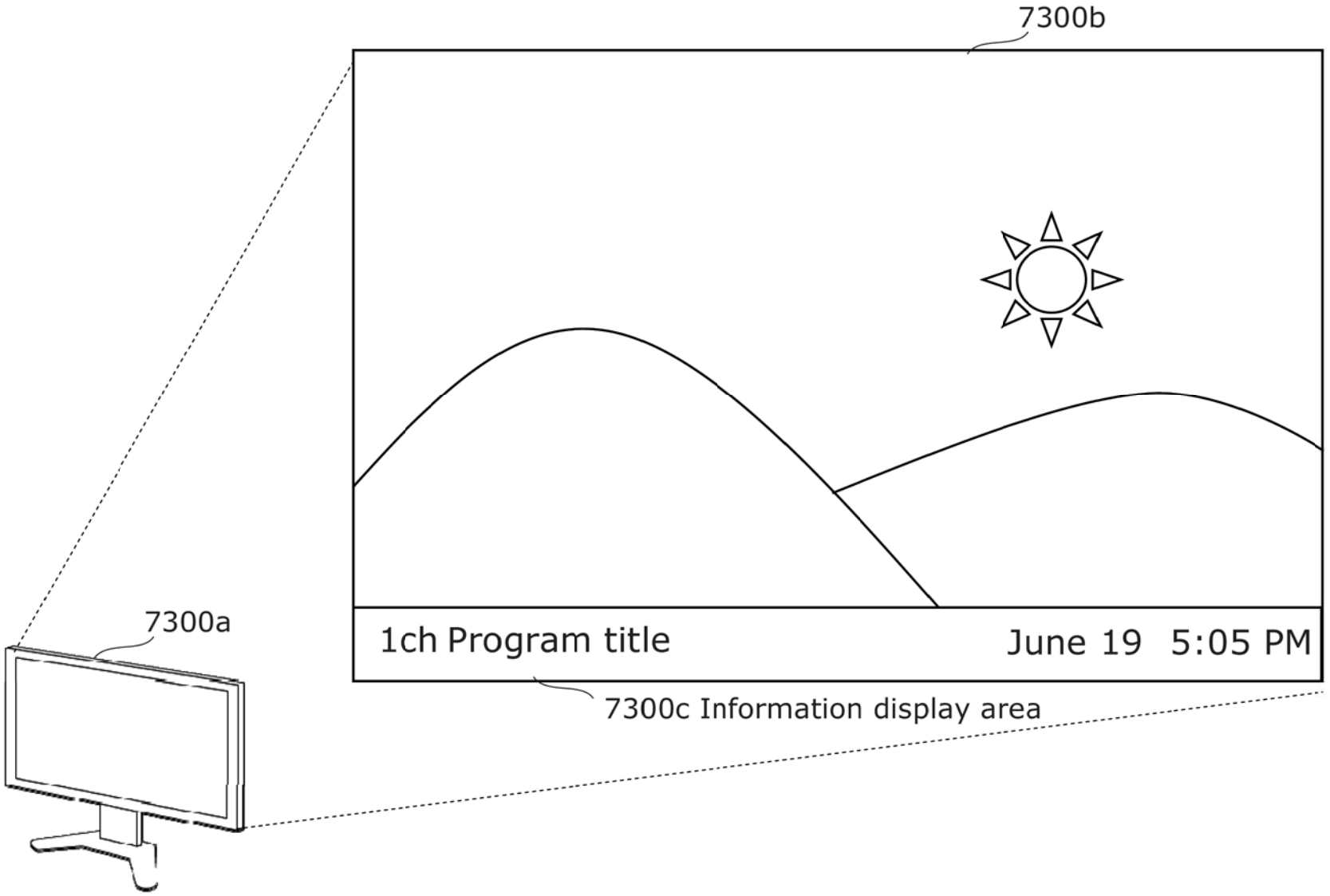

7300b
1ch Program title
June 19 5:05 PM
7300c Information display area
7300a

FIG. 313

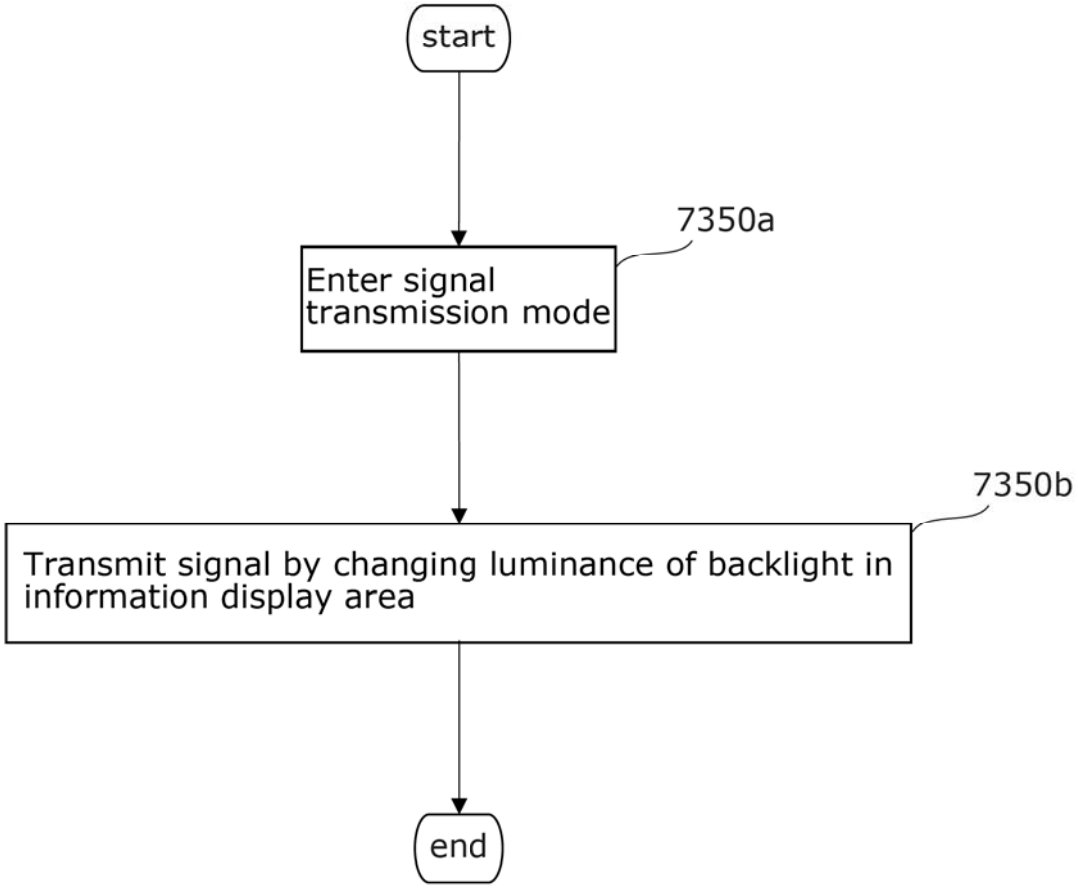

start
7350a
Enter signal transmission mode
7350b
Transmit signal by changing luminance of backlight in information display area
end

FIG. 314

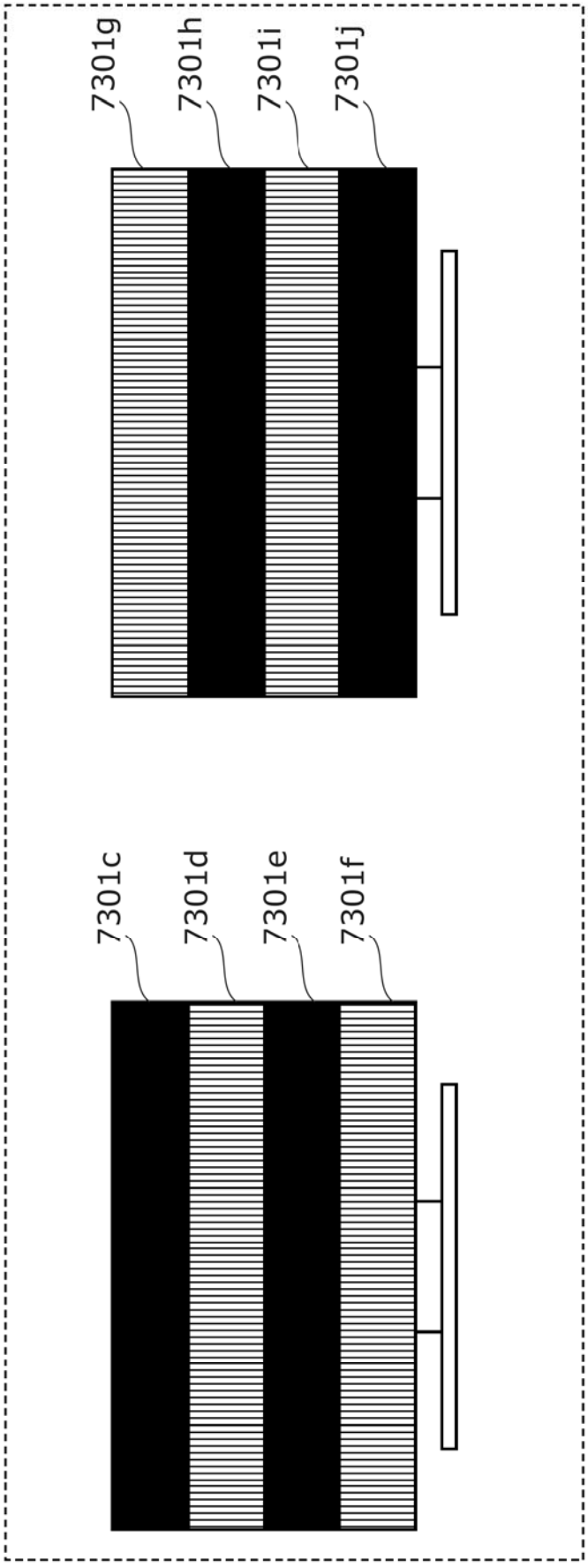


FIG. 315

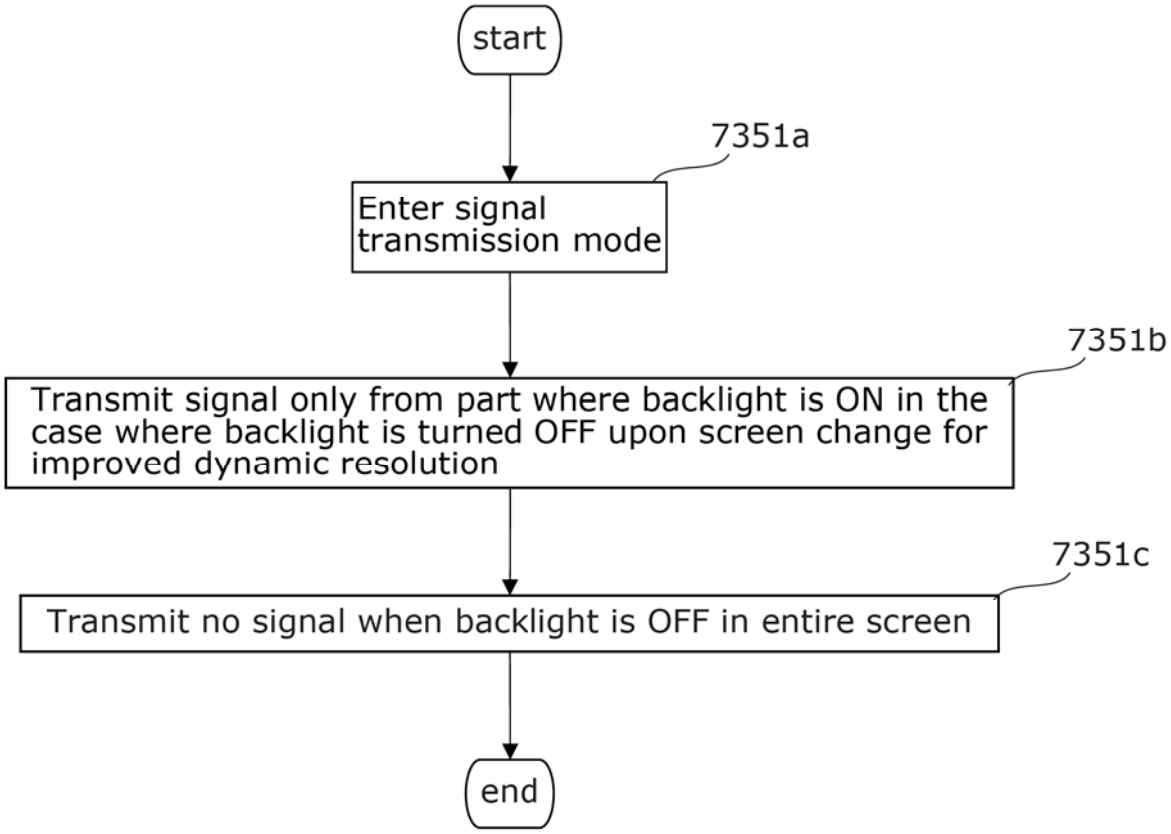

start
7351a
Enter signal transmission mode
7351b
Transmit signal only from part where backlight is ON in the case where backlight is turned OFF upon screen change for improved dynamic resolution
7351c
Transmit no signal when backlight is OFF in entire screen
end

FIG. 316

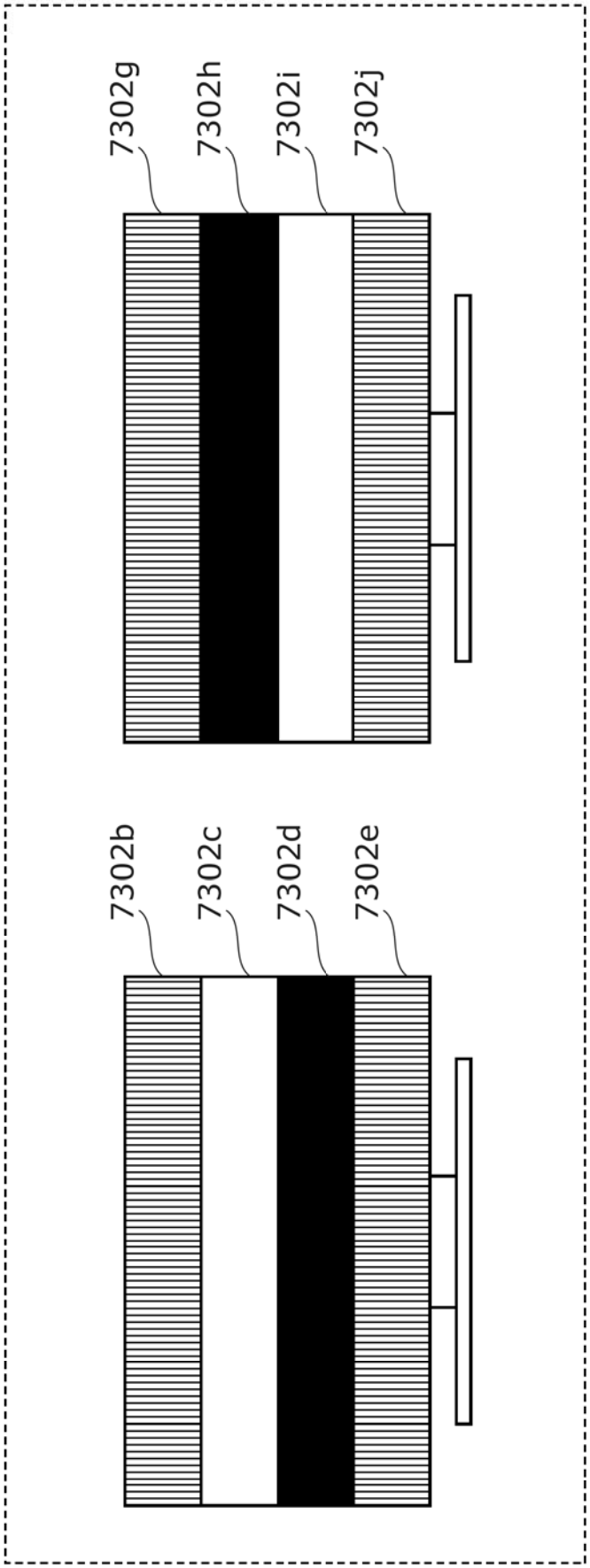


FIG. 317

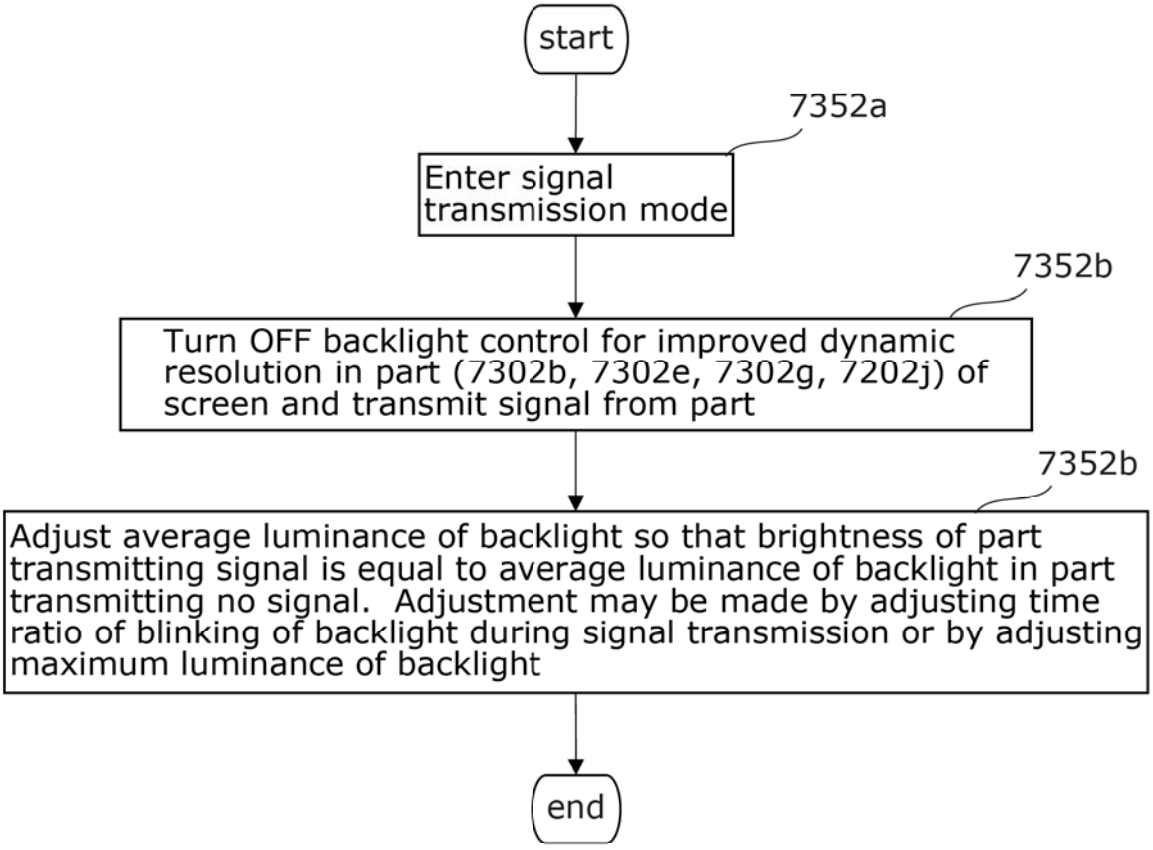

start
7352a
Enter signal transmission mode
7352b
Turn OFF backlight control for improved dynamic resolution in part (7302b, 7302e, 7302g, 7202j) of screen and transmit signal from part
7352b
Adjust average luminance of backlight so that brightness of part transmitting signal is equal to average luminance of backlight in part transmitting no signal. Adjustment may be made by adjusting time ratio of blinking of backlight during signal transmission or by adjusting maximum luminance of backlight
end

FIG. 318

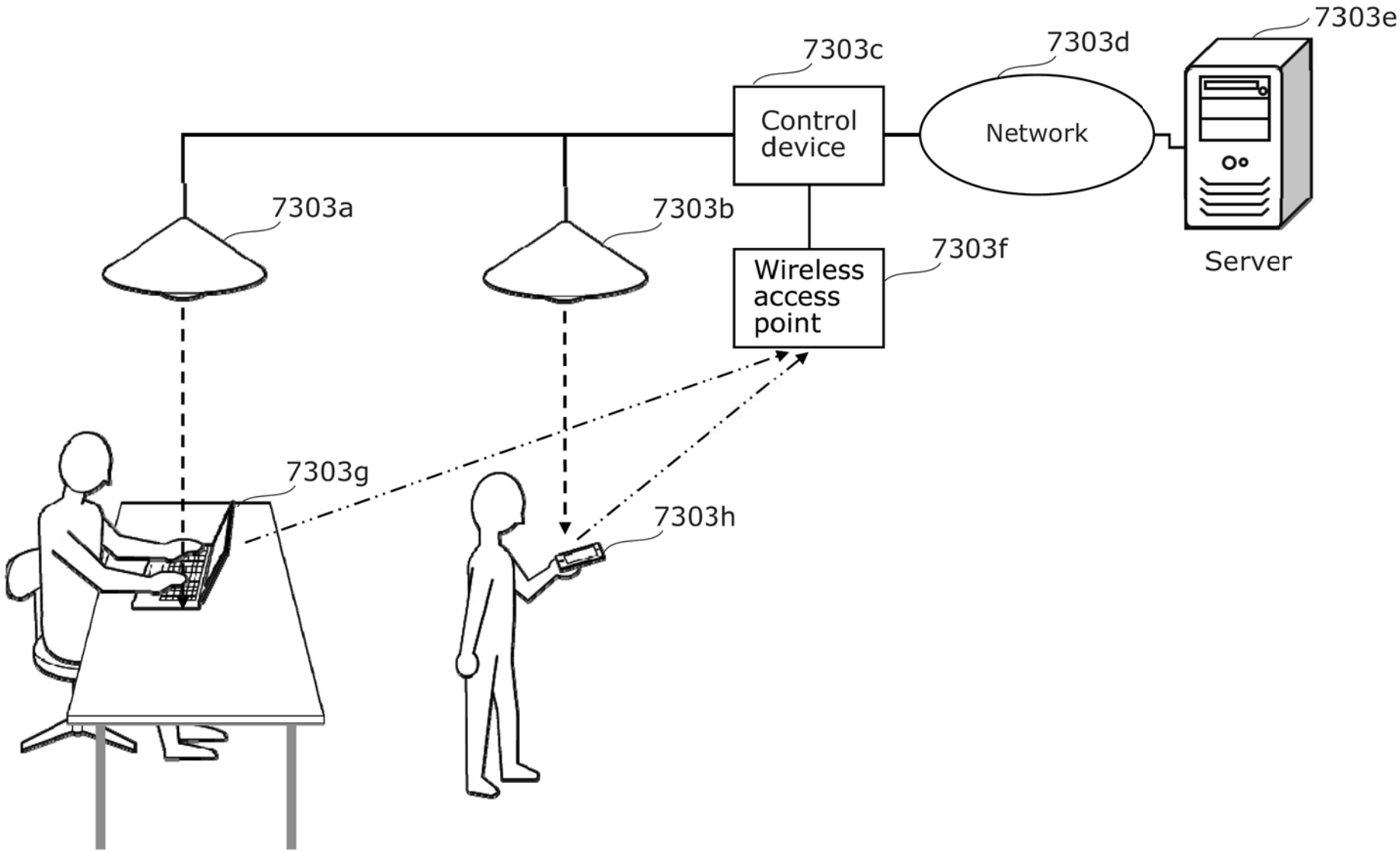

7303e
7303c
7303d
Control device
Network
7303a
7303b
7303f
Wireless access point
Server
7303g
7303h

FIG. 319

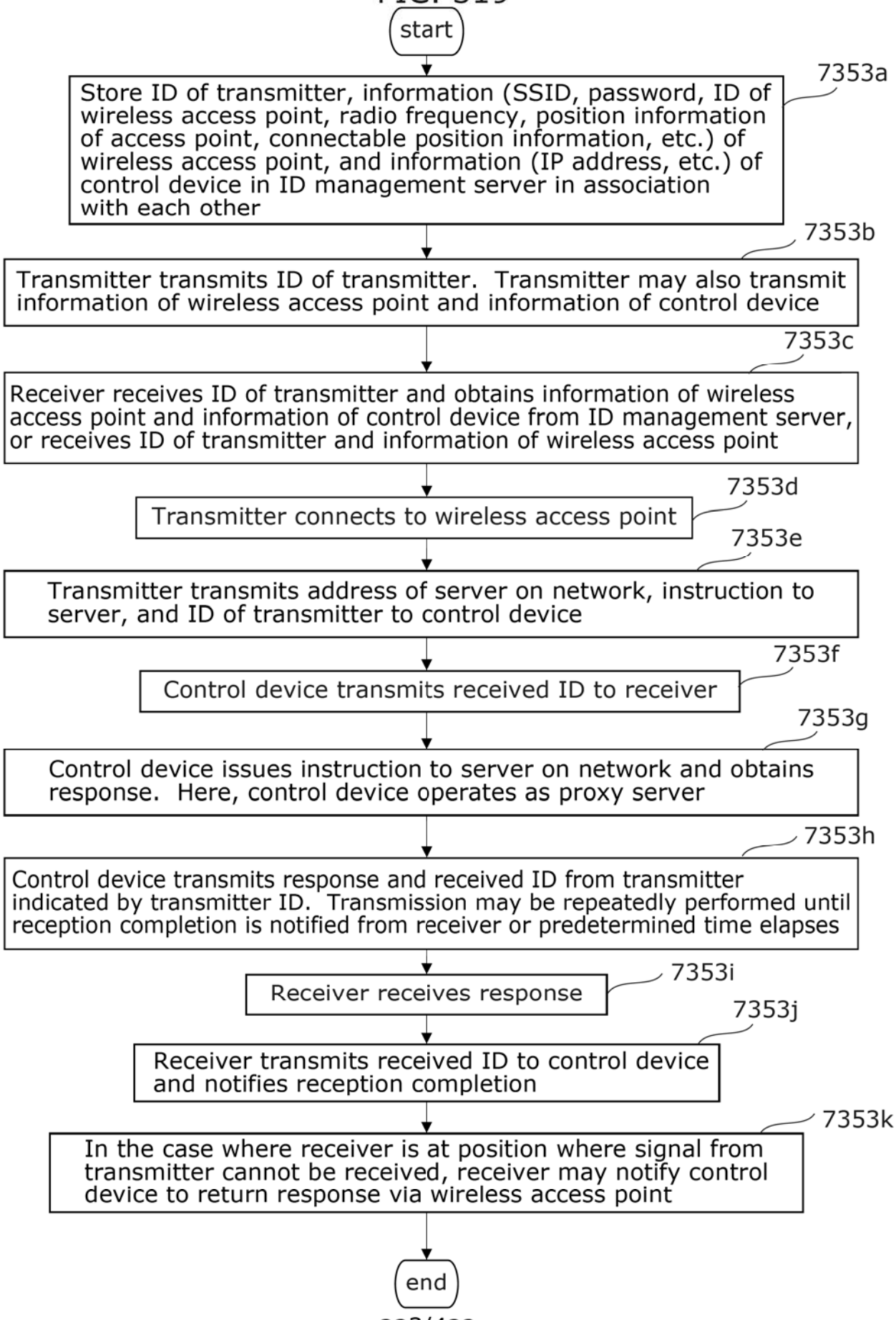

start
Store ID of transmitter, information (SSID, password, ID of wireless access point, radio frequency, position information of access point, connectable position information, etc.) of wireless access point, and information (IP address, etc.) of control device in ID management server in association with each other
7353a
Transmitter transmits ID of transmitter. Transmitter may also transmit information of wireless access point and information of control device
7353b
Receiver receives ID of transmitter and obtains information of wireless access point and information of control device from ID management server, or receives ID of transmitter and information of wireless access point
7353c
Transmitter connects to wireless access point
7353d
Transmitter transmits address of server on network, instruction to server, and ID of transmitter to control device
7353e
Control device transmits received ID to receiver
7353f
Control device issues instruction to server on network and obtains response. Here, control device operates as proxy server
7353g
Control device transmits response and received ID from transmitter indicated by transmitter ID. Transmission may be repeatedly performed until reception completion is notified from receiver or predetermined time elapses
7353h
Receiver receives response
7353i
Receiver transmits received ID to control device and notifies reception completion
7353j
In the case where receiver is at position where signal from transmitter cannot be received, receiver may notify control device to return response via wireless access point
7353k
end

FIG. 320

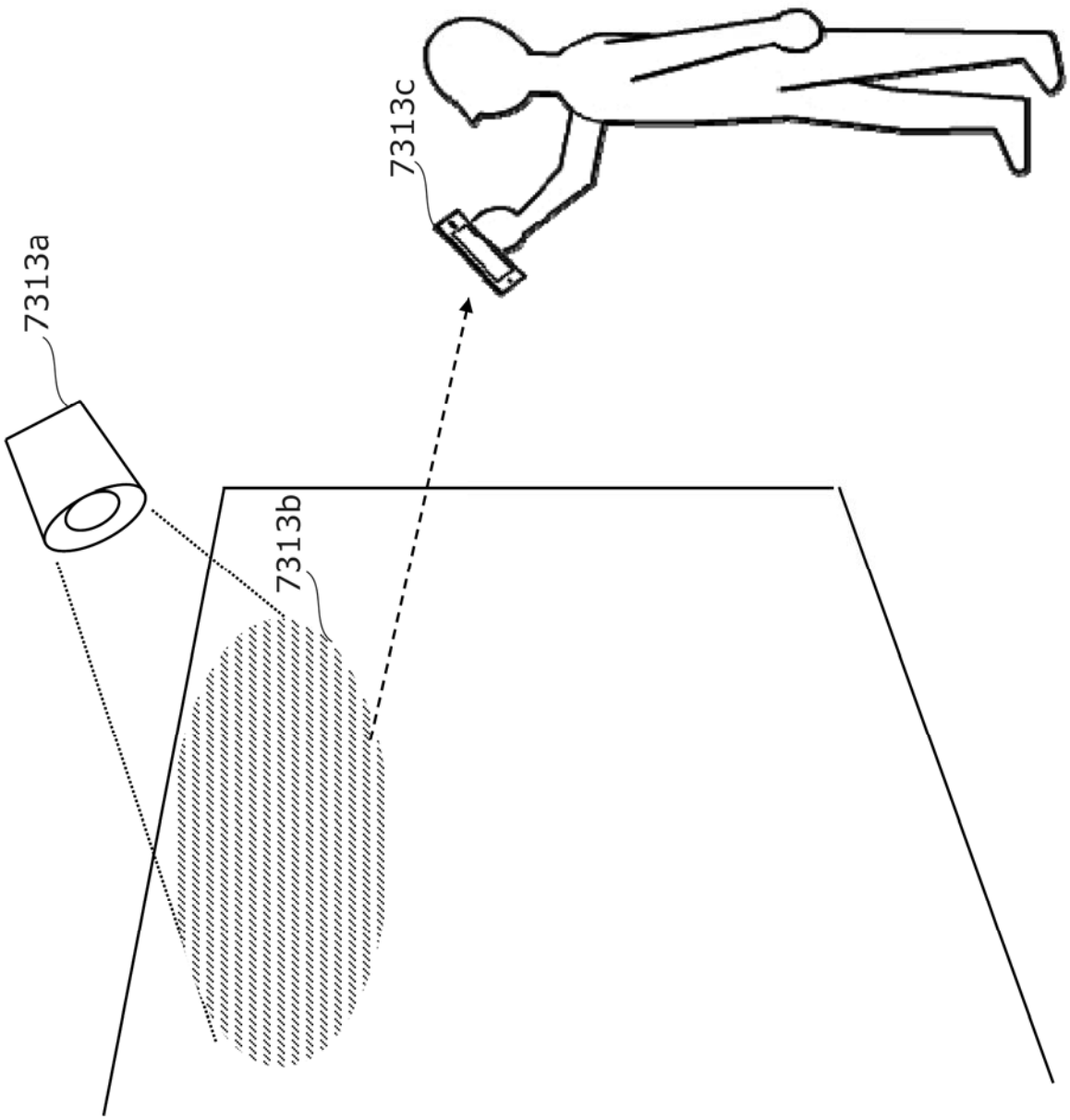


FIG. 321

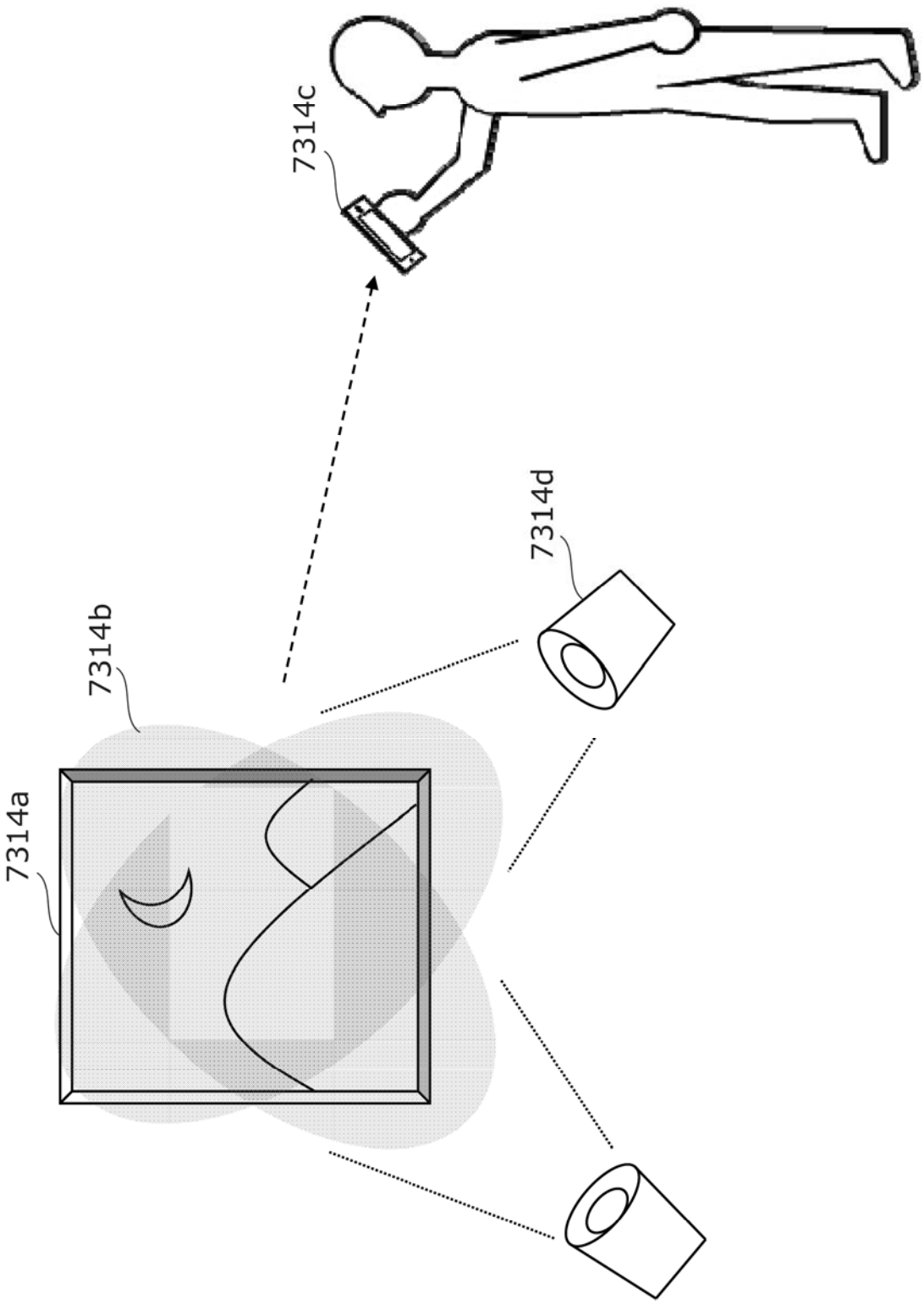


FIG. 322

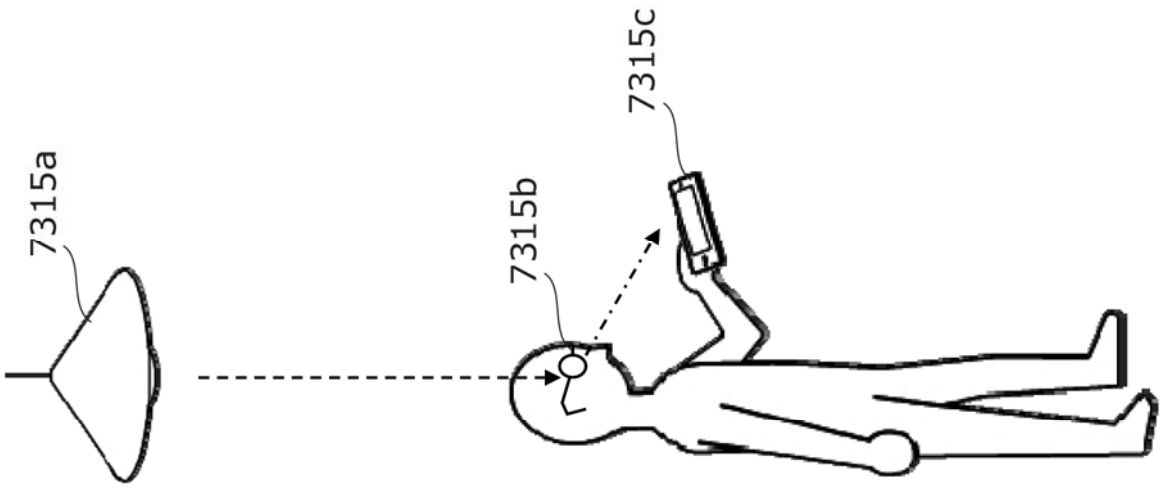


FIG. 323A

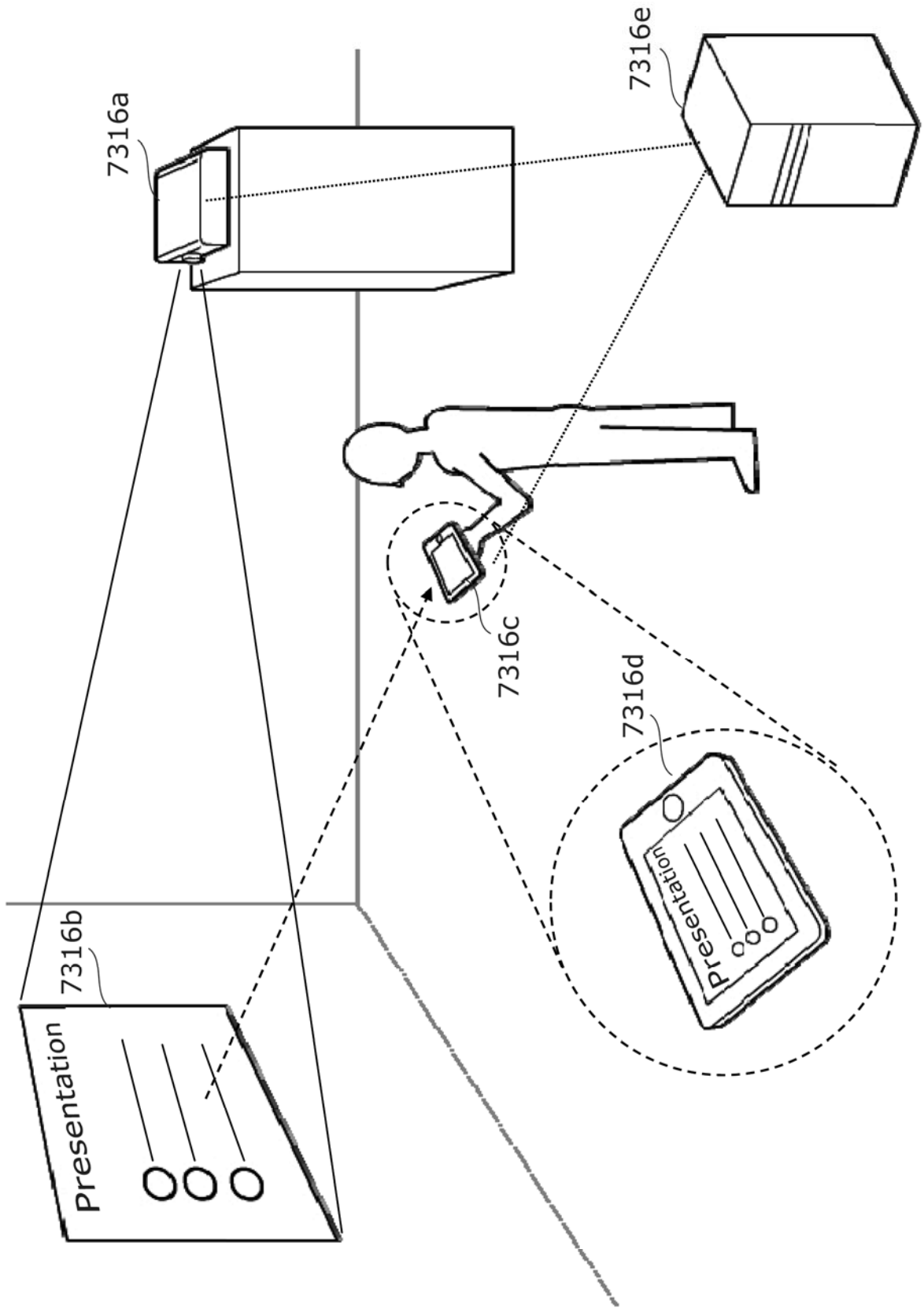


FIG. 323B

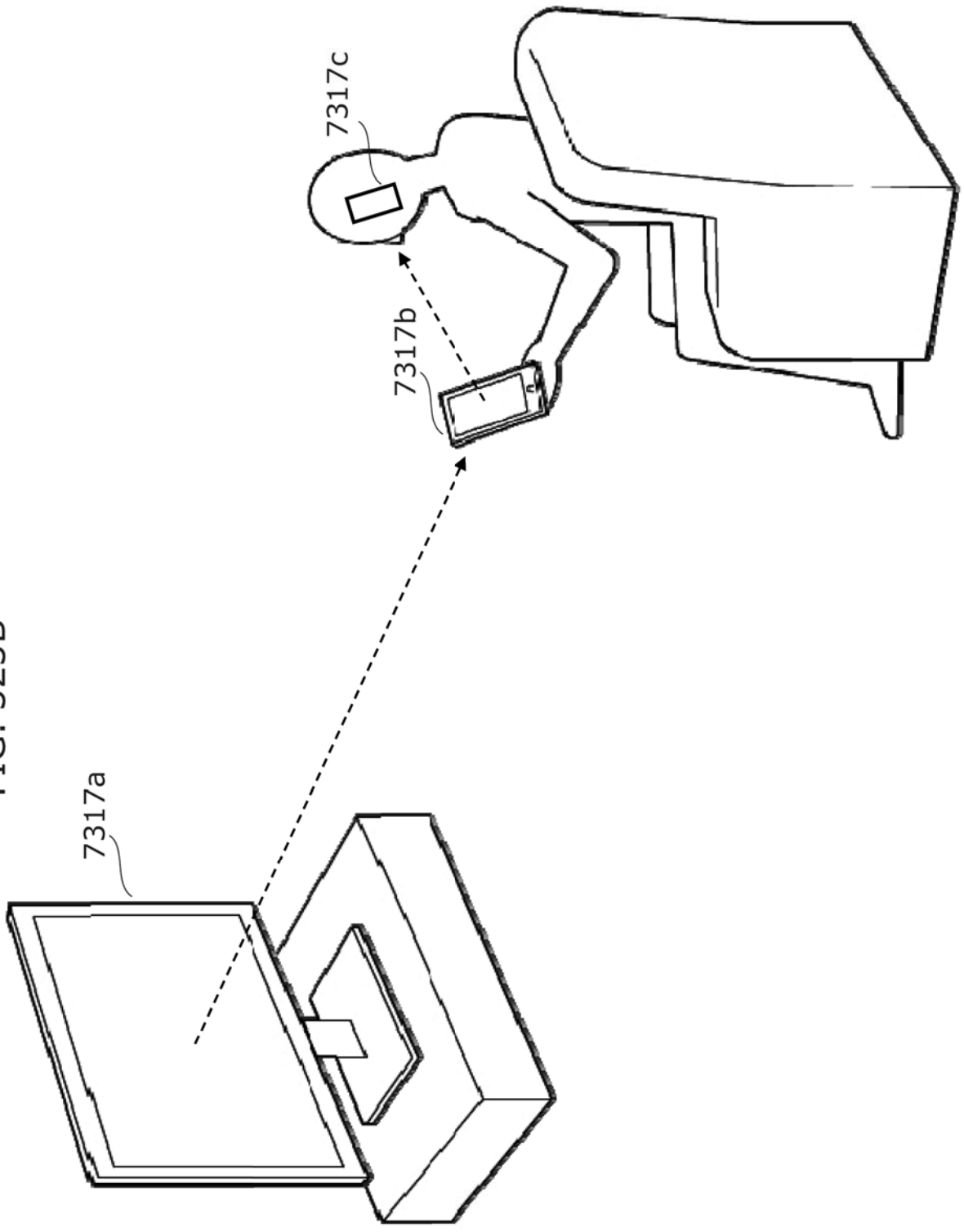


FIG. 323C

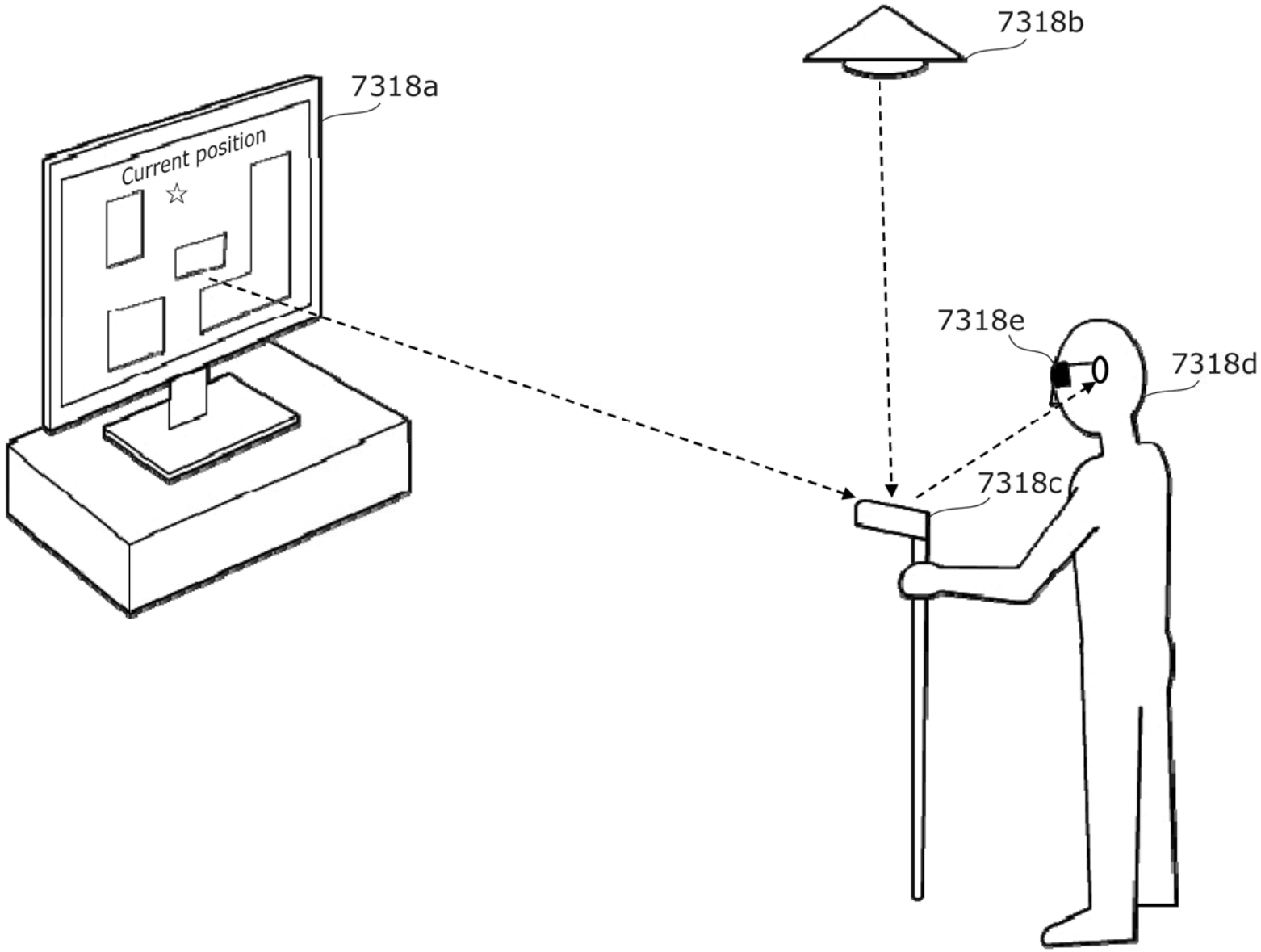


FIG. 323D

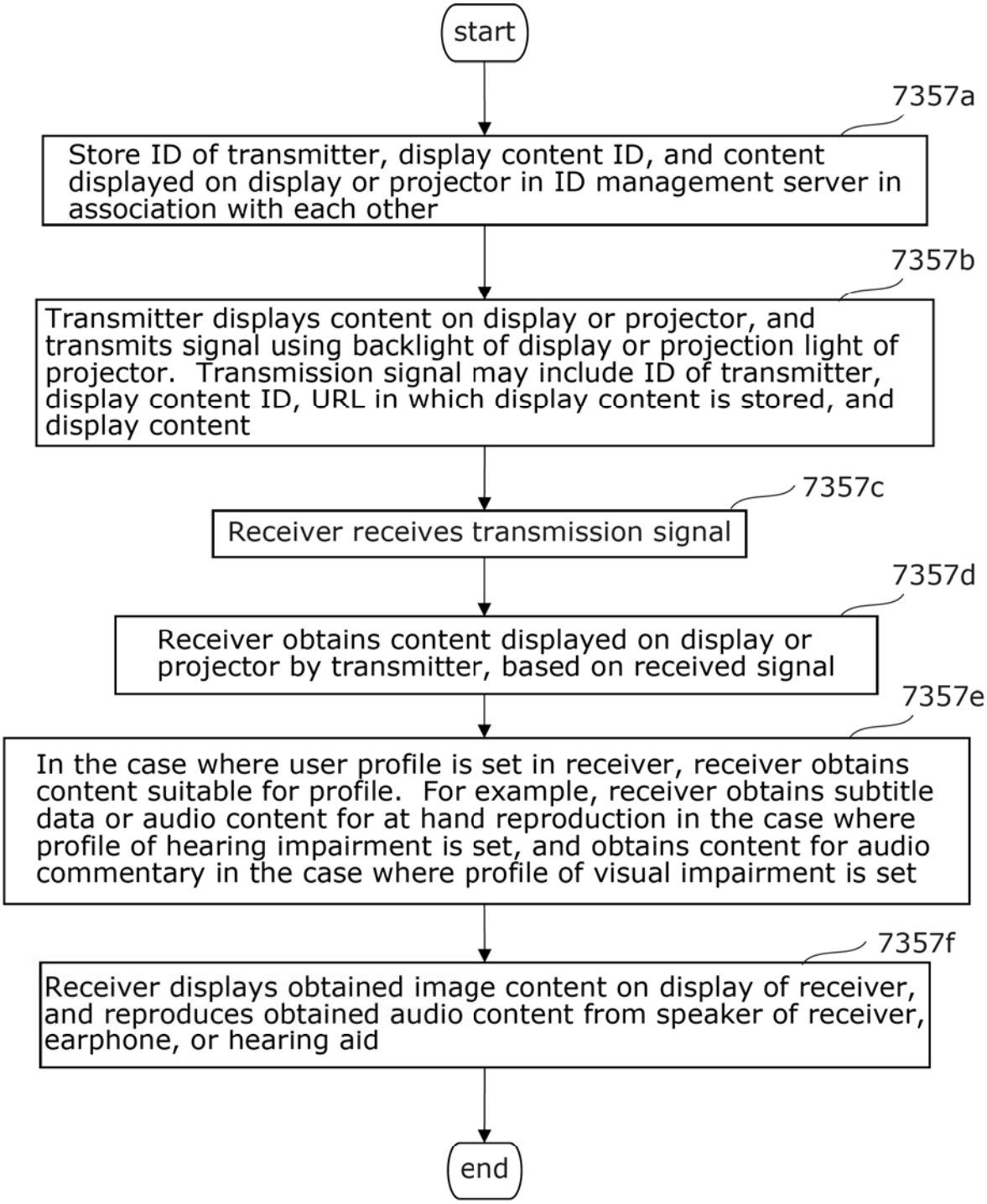

start
7357a
Store ID of transmitter, display content ID, and content displayed on display or projector in ID management server in association with each other
7357b
Transmitter displays content on display or projector, and transmits signal using backlight of display or projection light of projector. Transmission signal may include ID of transmitter, display content ID, URL in which display content is stored, and display content
7357c
Receiver receives transmission signal
7357d
Receiver obtains content displayed on display or projector by transmitter, based on received signal
7357e
In the case where user profile is set in receiver, receiver obtains content suitable for profile. For example, receiver obtains subtitle data or audio content for at hand reproduction in the case where profile of hearing impairment is set, and obtains content for audio commentary in the case where profile of visual impairment is set
7357f
Receiver displays obtained image content on display of receiver, and reproduces obtained audio content from speaker of receiver, earphone, or hearing aid
end

FIG. 324

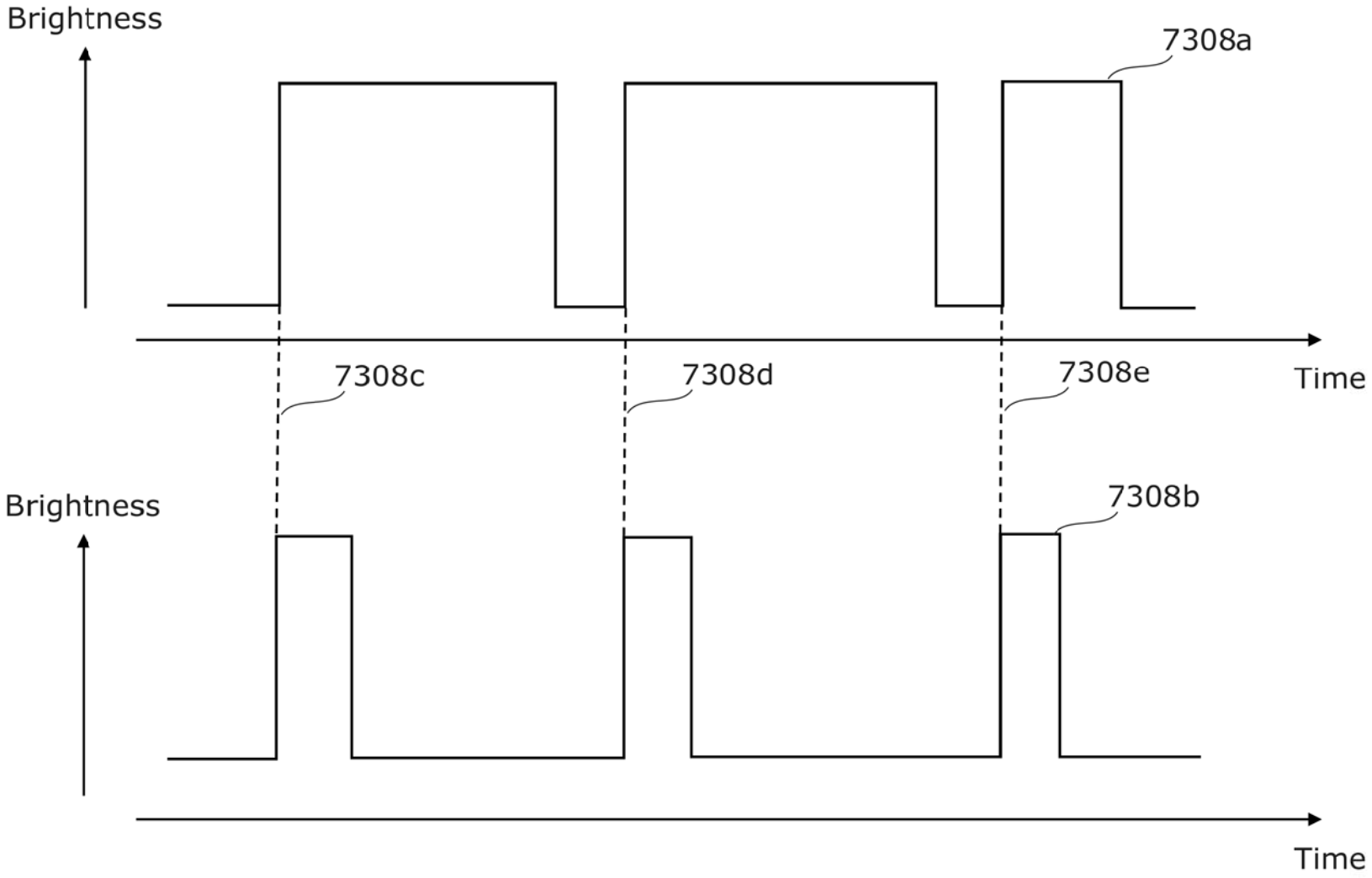

Brightness
7308a
7308c
7308d
7308e
Time
Brightness
7308b
Time

FIG. 325

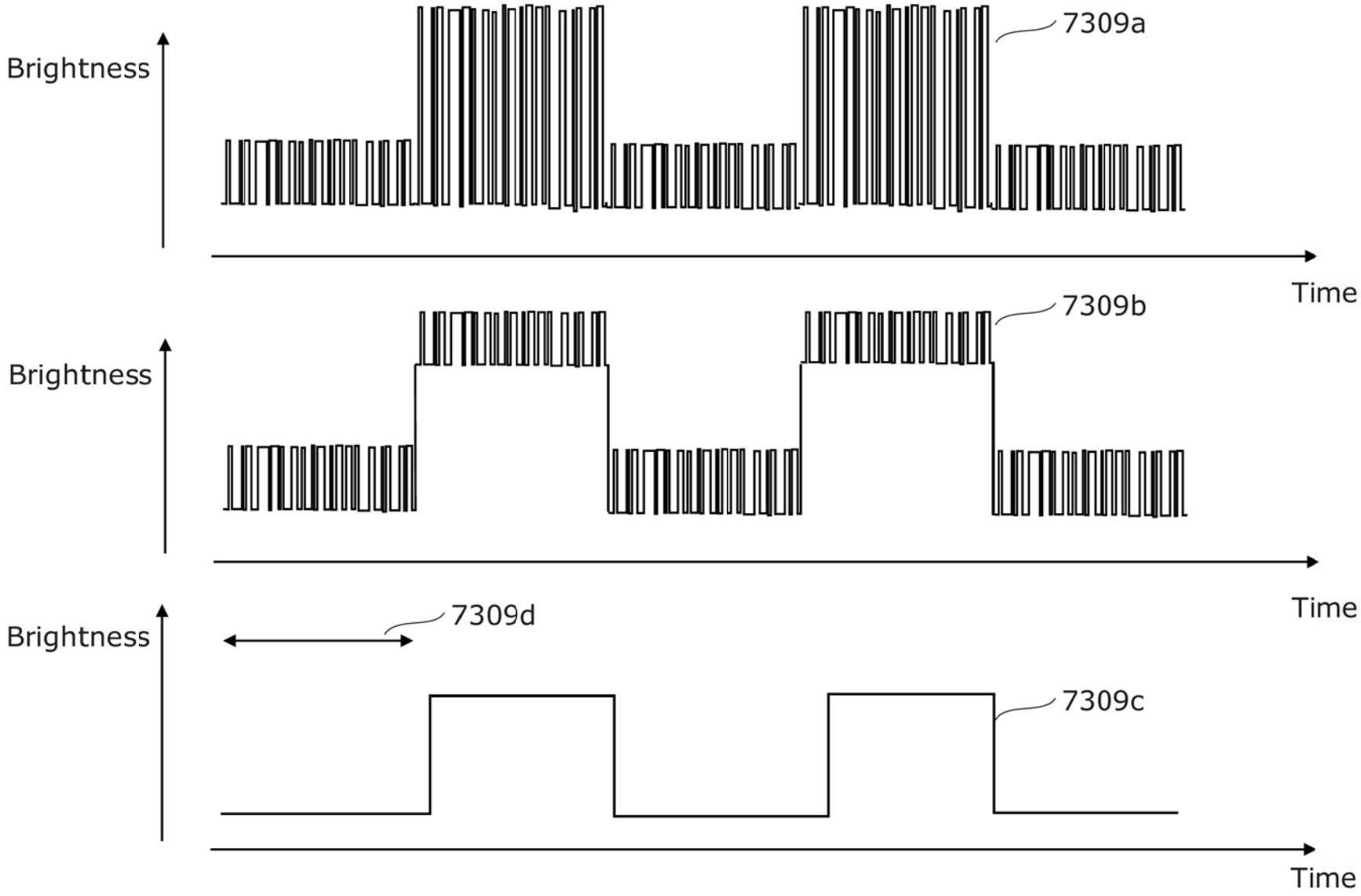

Brightness
7309a
Time
Brightness
7309b
Time
Brightness
7309d
7309c
Time

FIG. 326

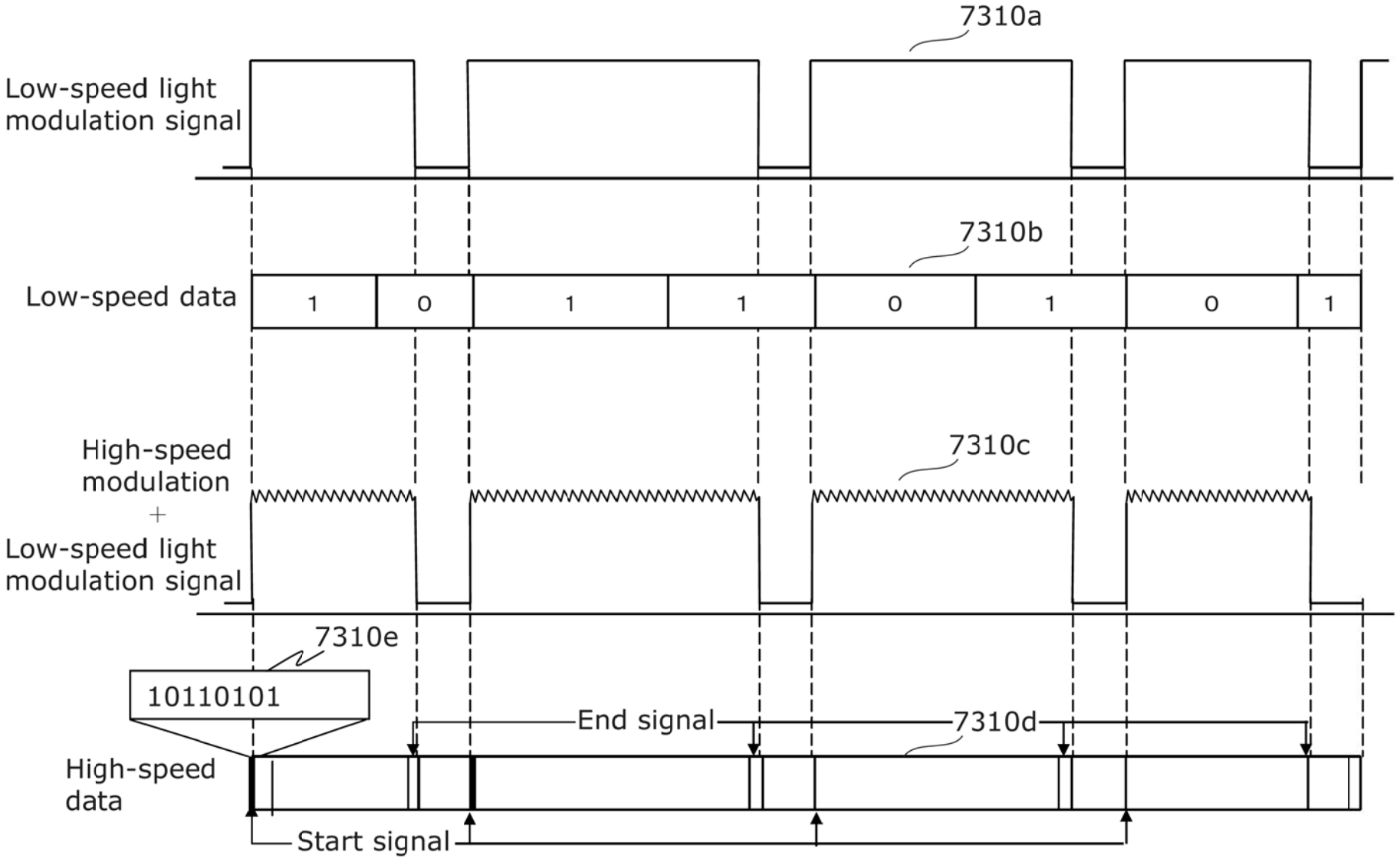

7310a
Low-speed light modulation signal
7310b
Low-speed data
1
0
1
1
0
1
0
1
High-speed modulation
+
Low-speed light modulation signal
7310c
7310e
10110101
End signal
7310d
High-speed data
Start signal

FIG. 327A

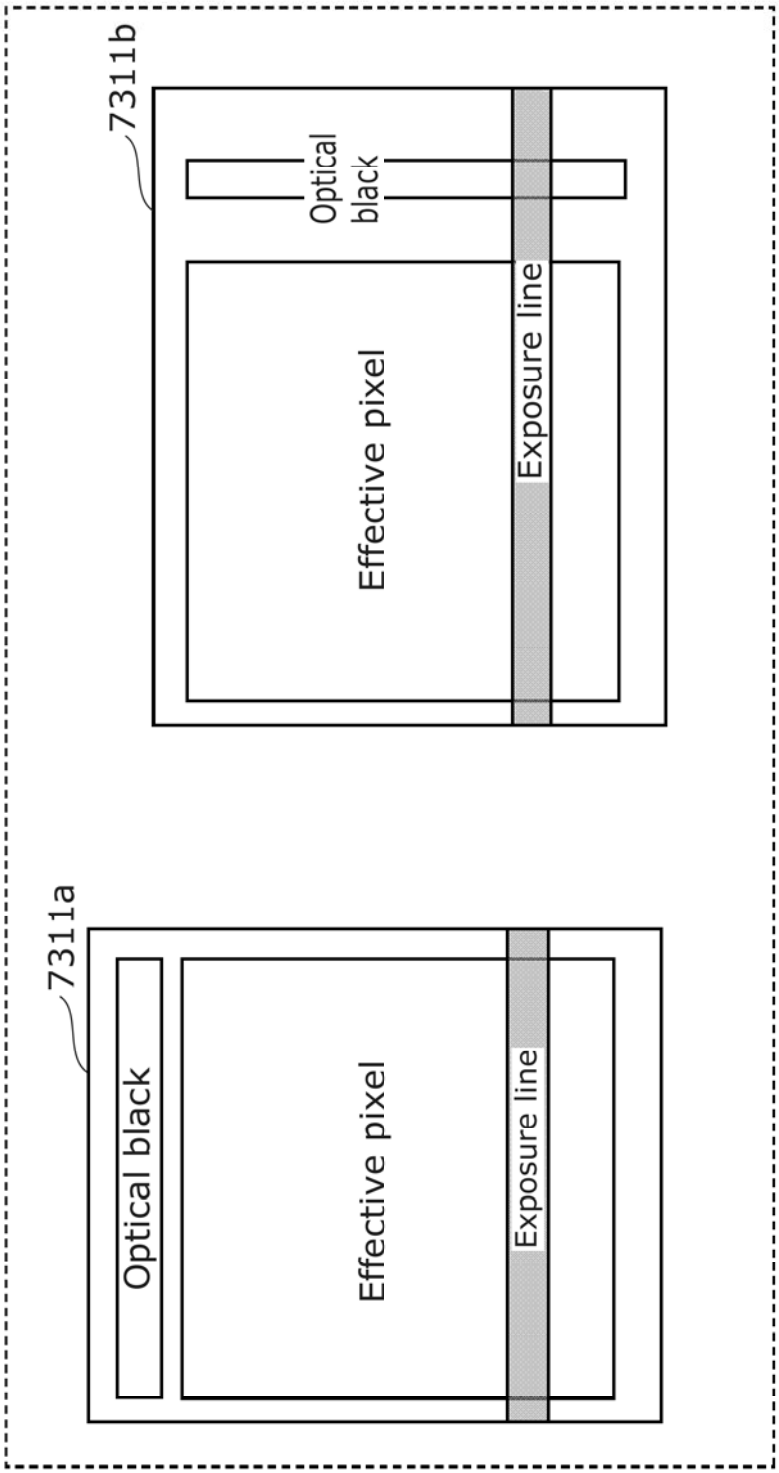

7311b
Optical black
Effective pixel
Exposure line
7311a
Optical black
Effective pixel
Exposure line

FIG. 327B

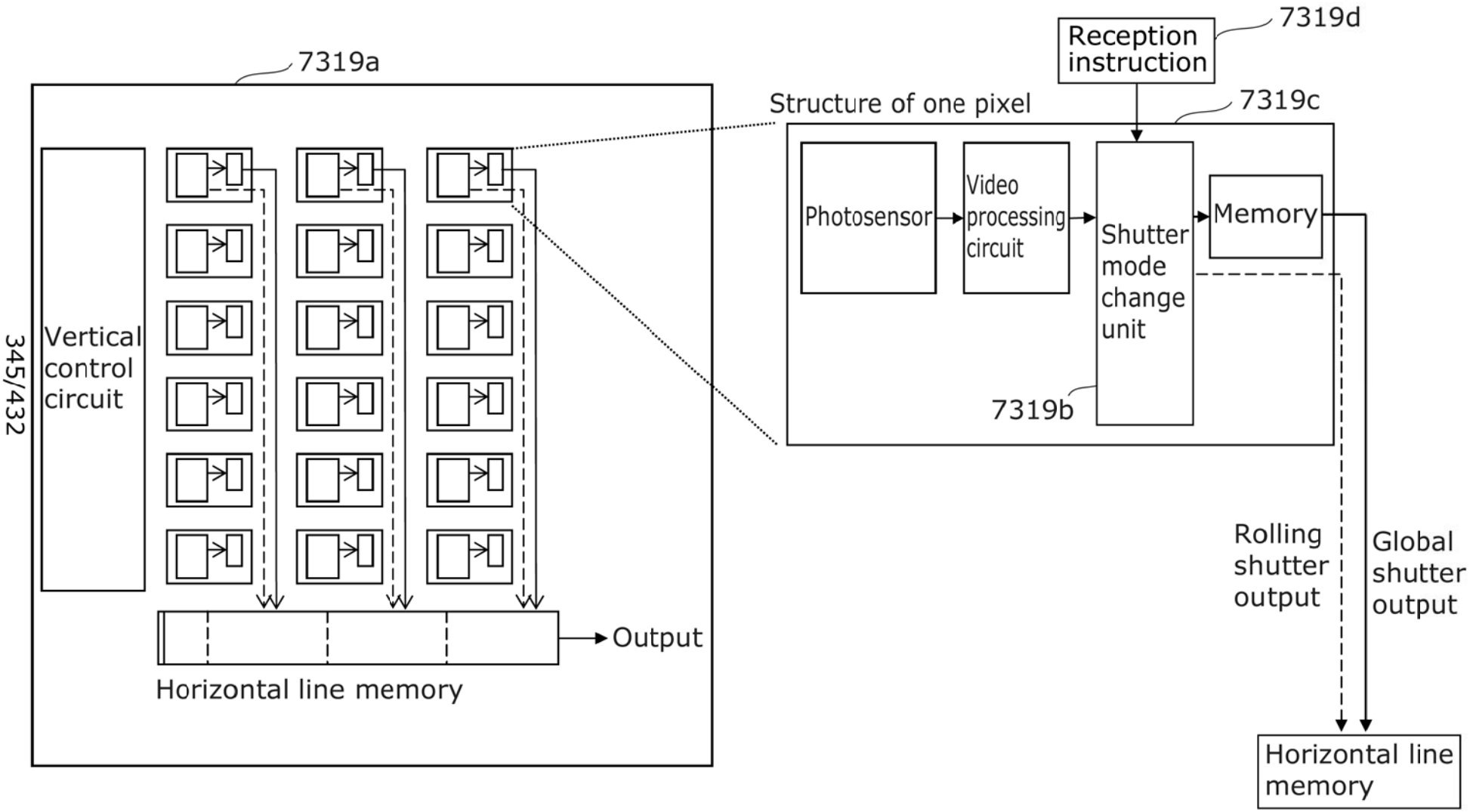

7319a
345/432
Vertical control circuit
Output
Horizontal line memory
Structure of one pixel
Reception instruction
7319d
7319c
Photosensor
Video processing circuit
Shutter mode change unit
Memory
7319b
Rolling shutter output
Global shutter output
Horizontal line memory

FIG. 327C

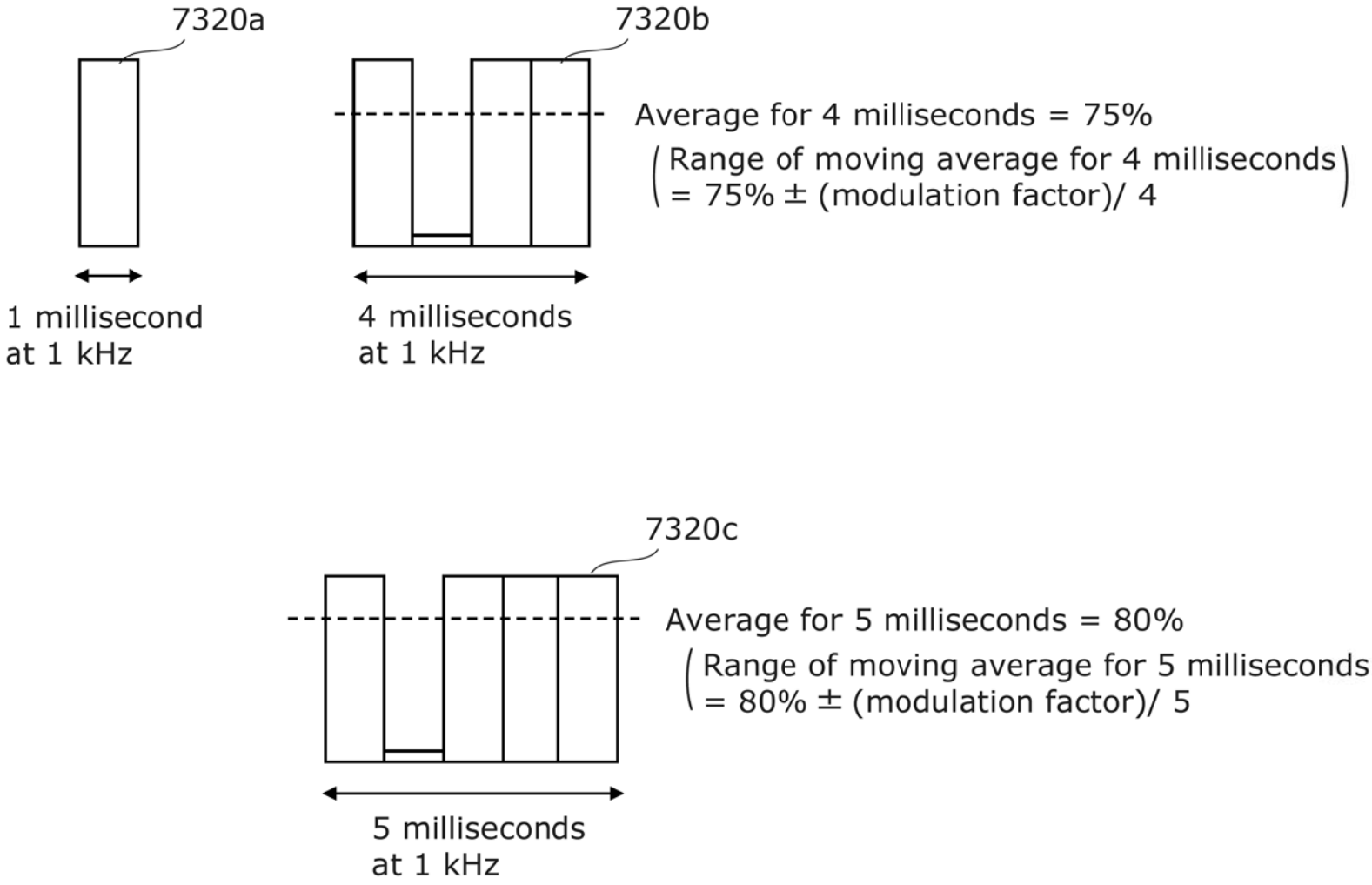

7320a
7320b
Average for 4 milliseconds = 75%
Range of moving average for 4 milliseconds = 75% ± (modulation factor)/ 4
1 millisecond at 1 kHz
4 milliseconds at 1 kHz
7320c
Average for 5 milliseconds = 80%
Range of moving average for 5 milliseconds = 80% ± (modulation factor)/ 5
5 milliseconds at 1 kHz

FIG. 327D

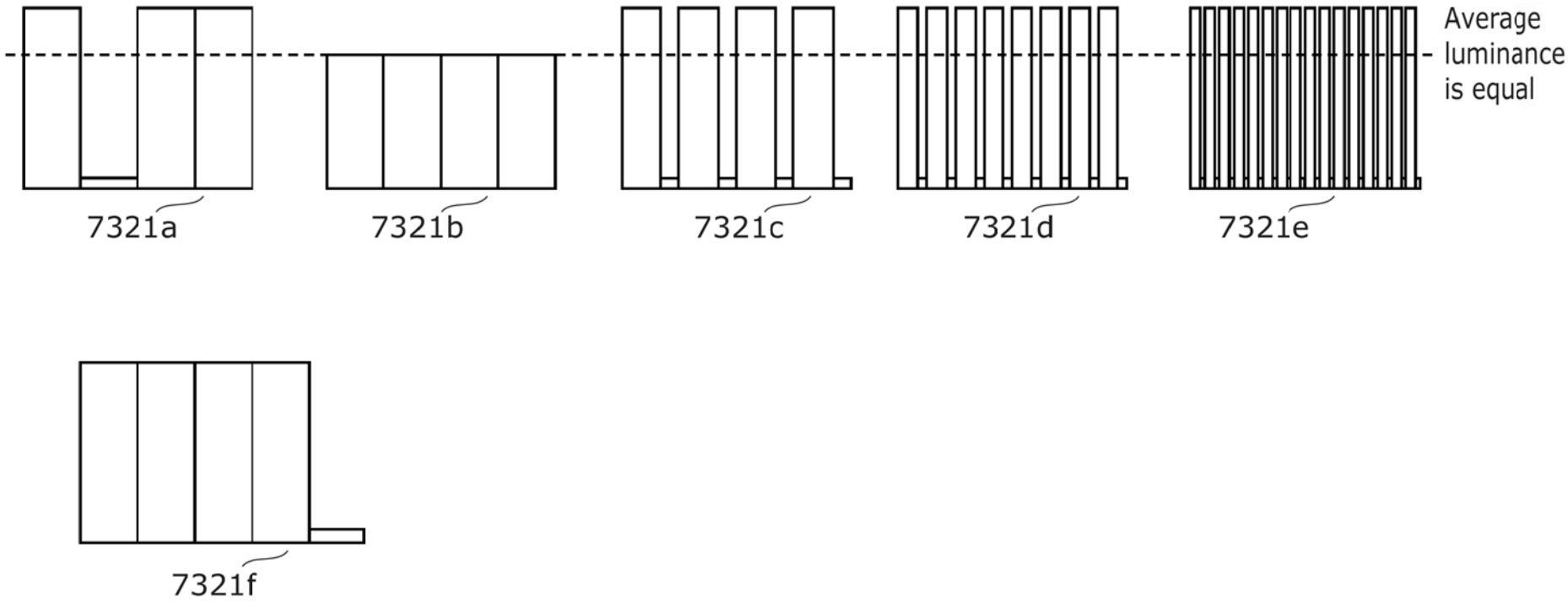

Average luminance is equal
7321a
7321b
7321c
7321d
7321e
7321f

FIG. 328A

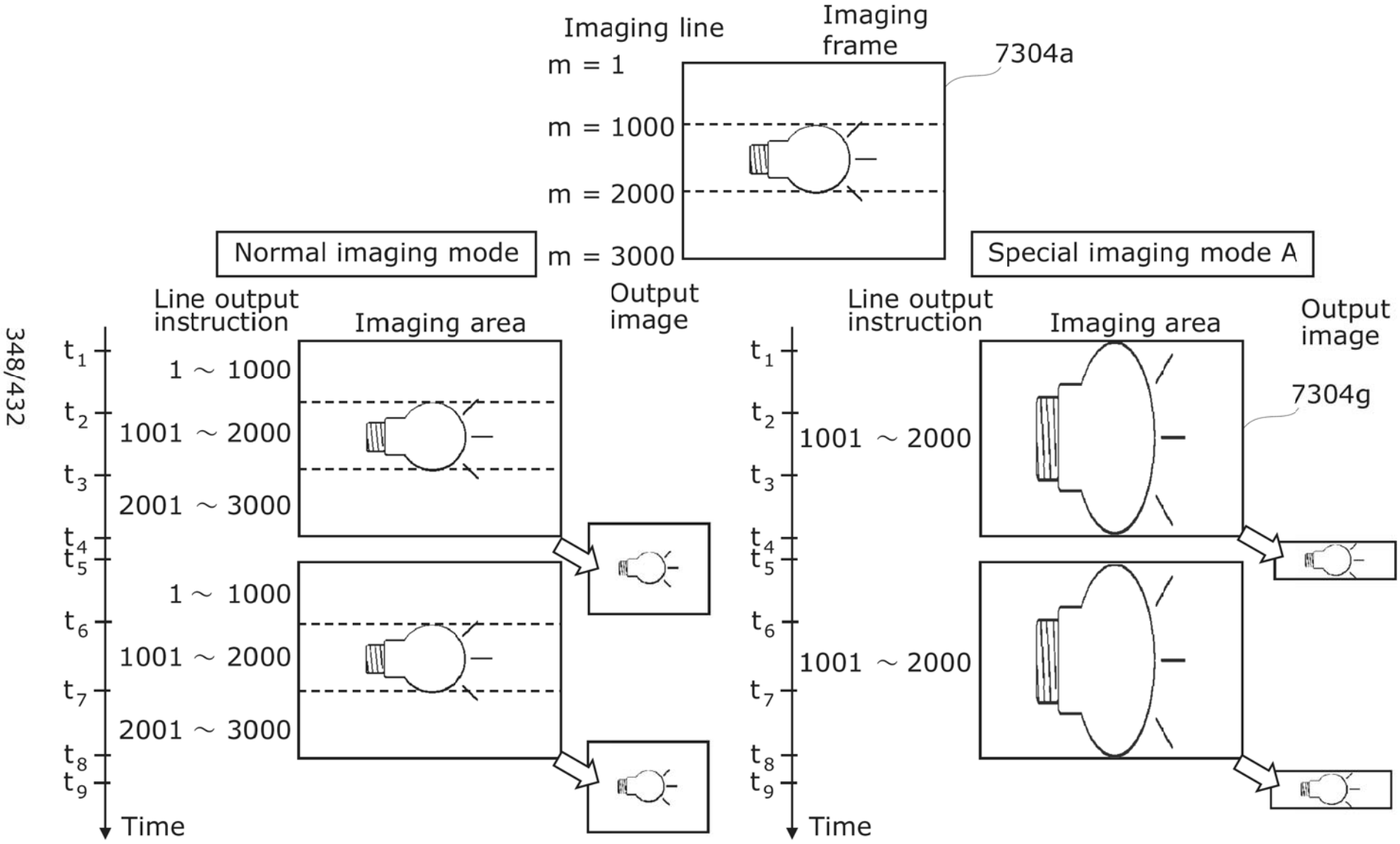

Imaging line
Imaging frame
7304a
m = 1
m = 1000
m = 2000
m = 3000
Normal imaging mode
Special imaging mode A
Line output instruction
Imaging area
Output image
t1
t2
t3
t4
t5
t6
t7
t8
t9
1 ~ 1000
1001 ~ 2000
2001 ~ 3000
Time
7304g

FIG. 328B

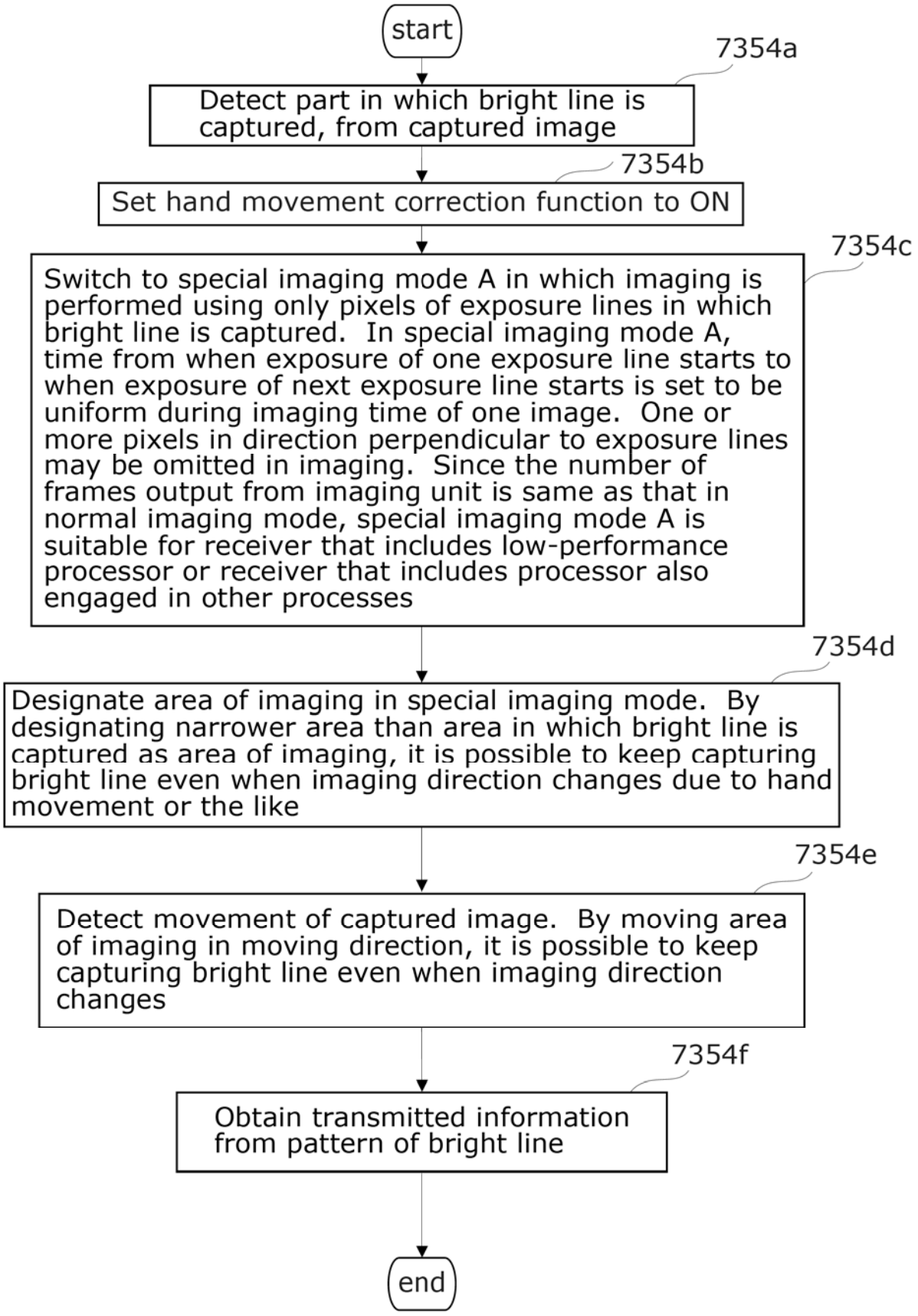

start
7354a
Detect part in which bright line is captured, from captured image
7354b
Set hand movement correction function to ON
7354c
Switch to special imaging mode A in which imaging is performed using only pixels of exposure lines in which bright line is captured. In special imaging mode A, time from when exposure of one exposure line starts to when exposure of next exposure line starts is set to be uniform during imaging time of one image. One or more pixels in direction perpendicular to exposure lines may be omitted in imaging. Since the number of frames output from imaging unit is same as that in normal imaging mode, special imaging mode A is suitable for receiver that includes low-performance processor or receiver that includes processor also engaged in other processes
7354d
Designate area of imaging in special imaging mode. By designating narrower area than area in which bright line is captured as area of imaging, it is possible to keep capturing bright line even when imaging direction changes due to hand movement or the like
7354e
Detect movement of captured image. By moving area of imaging in moving direction, it is possible to keep capturing bright line even when imaging direction changes
7354f
Obtain transmitted information from pattern of bright line
end

FIG. 329A

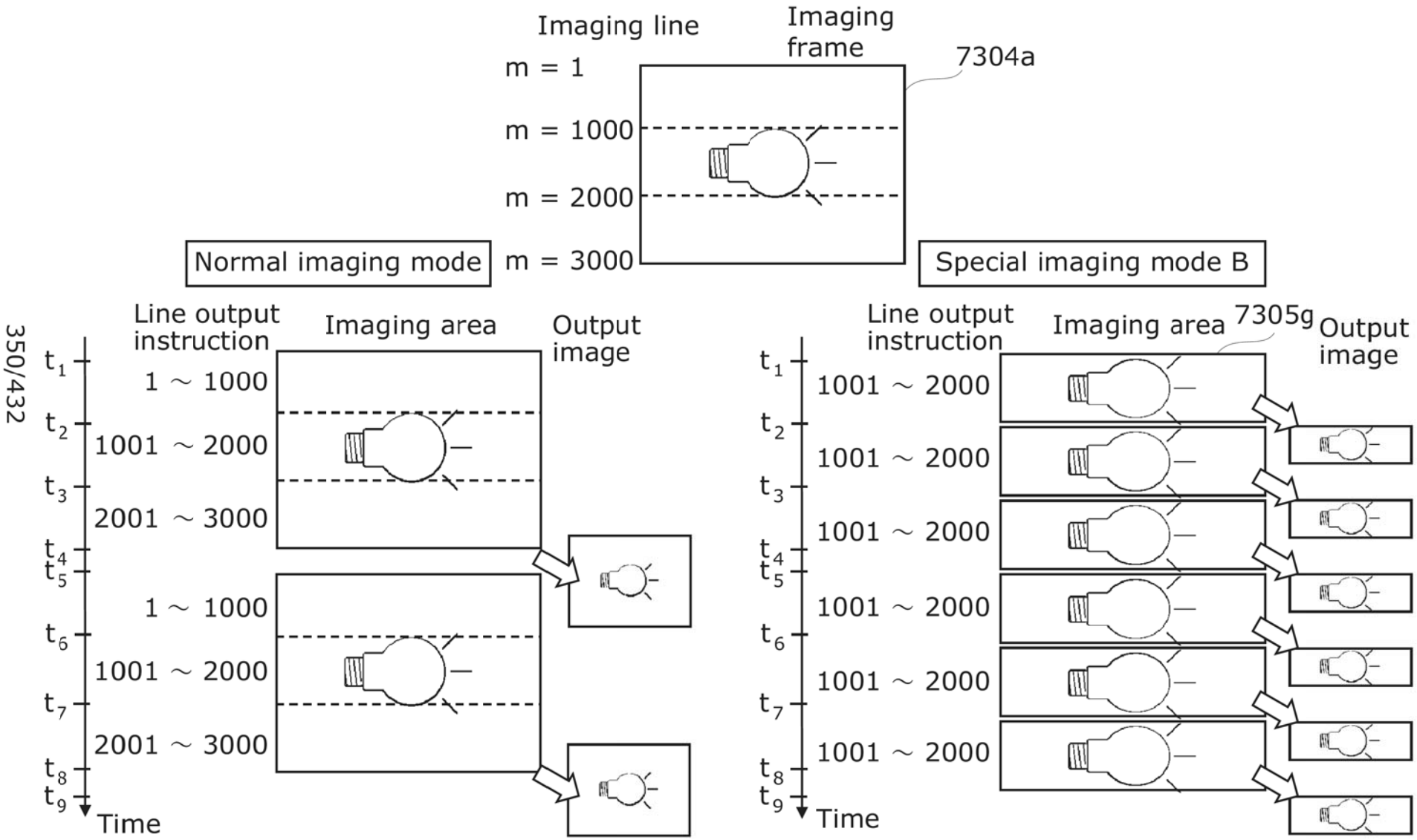

Imaging line
Imaging frame
7304a
m = 1
m = 1000
m = 2000
m = 3000
Normal imaging mode
Special imaging mode B
Line output instruction
Imaging area
Output image
7305g
1 ~ 1000
1001 ~ 2000
2001 ~ 3000
Time
350/432

FIG. 329B

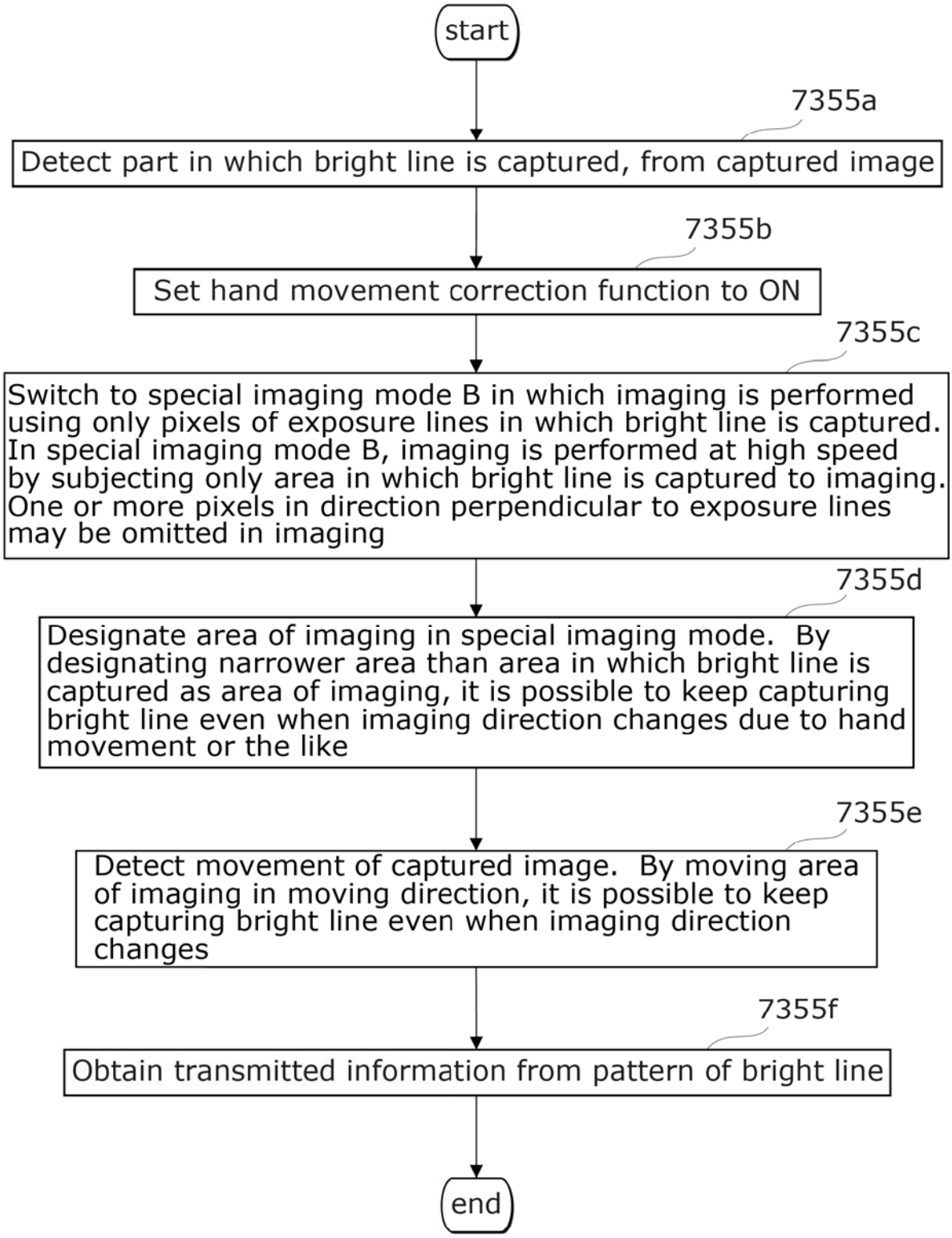

start
7355a
Detect part in which bright line is captured, from captured image
7355b
Set hand movement correction function to ON
7355c
Switch to special imaging mode B in which imaging is performed using only pixels of exposure lines in which bright line is captured. In special imaging mode B, imaging is performed at high speed by subjecting only area in which bright line is captured to imaging. One or more pixels in direction perpendicular to exposure lines may be omitted in imaging
7355d
Designate area of imaging in special imaging mode. By designating narrower area than area in which bright line is captured as area of imaging, it is possible to keep capturing bright line even when imaging direction changes due to hand movement or the like
7355e
Detect movement of captured image. By moving area of imaging in moving direction, it is possible to keep capturing bright line even when imaging direction changes
7355f
Obtain transmitted information from pattern of bright line
end

FIG. 330A

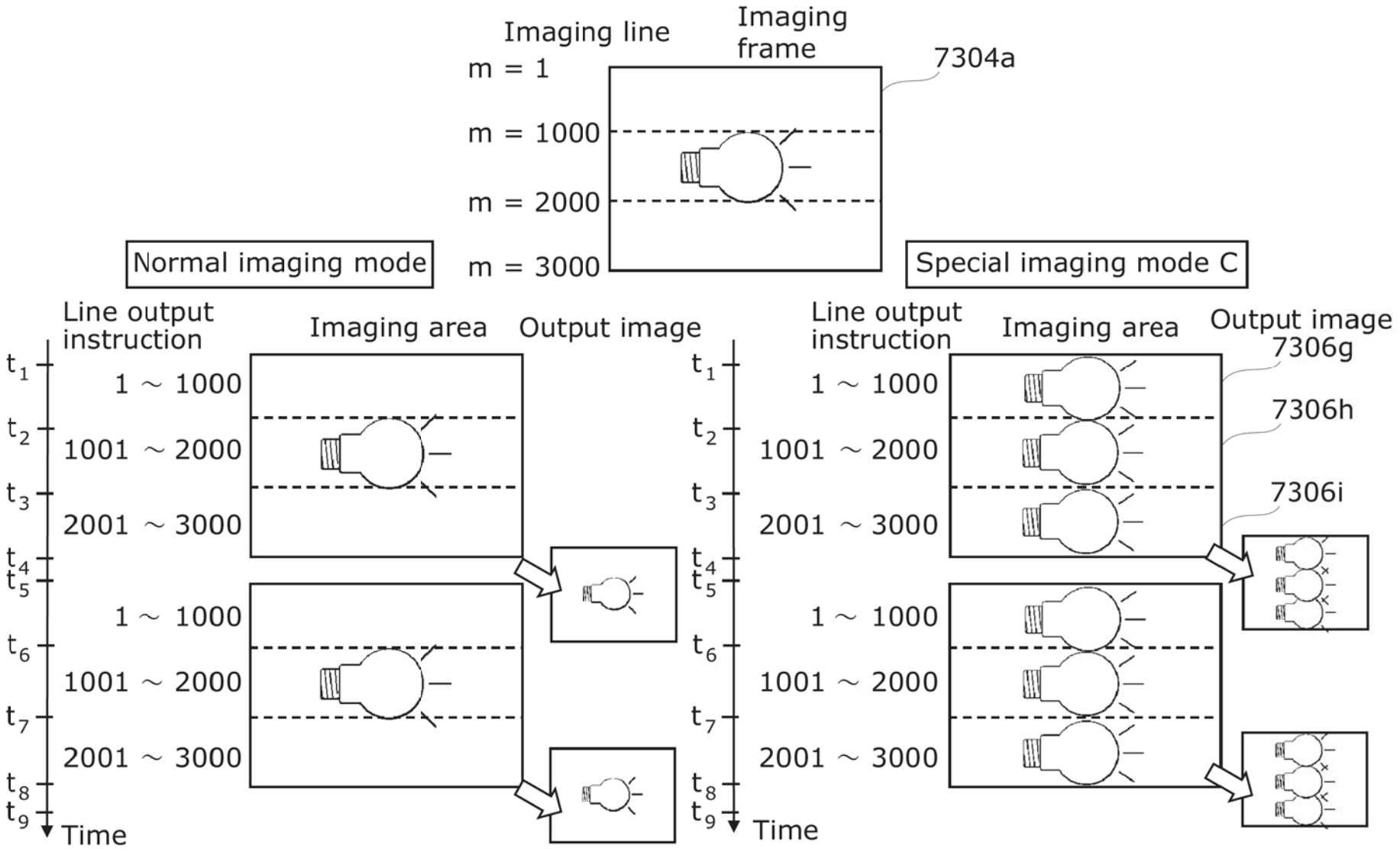

Imaging line
Imaging frame
7304a
m = 1
m = 1000
m = 2000
m = 3000
Normal imaging mode
Special imaging mode C
Line output instruction
Imaging area
Output image
t1
t2
t3
t4
t5
t6
t7
t8
t9
1 ~ 1000
1001 ~ 2000
2001 ~ 3000
Time
7306g
7306h
7306i

FIG. 330B

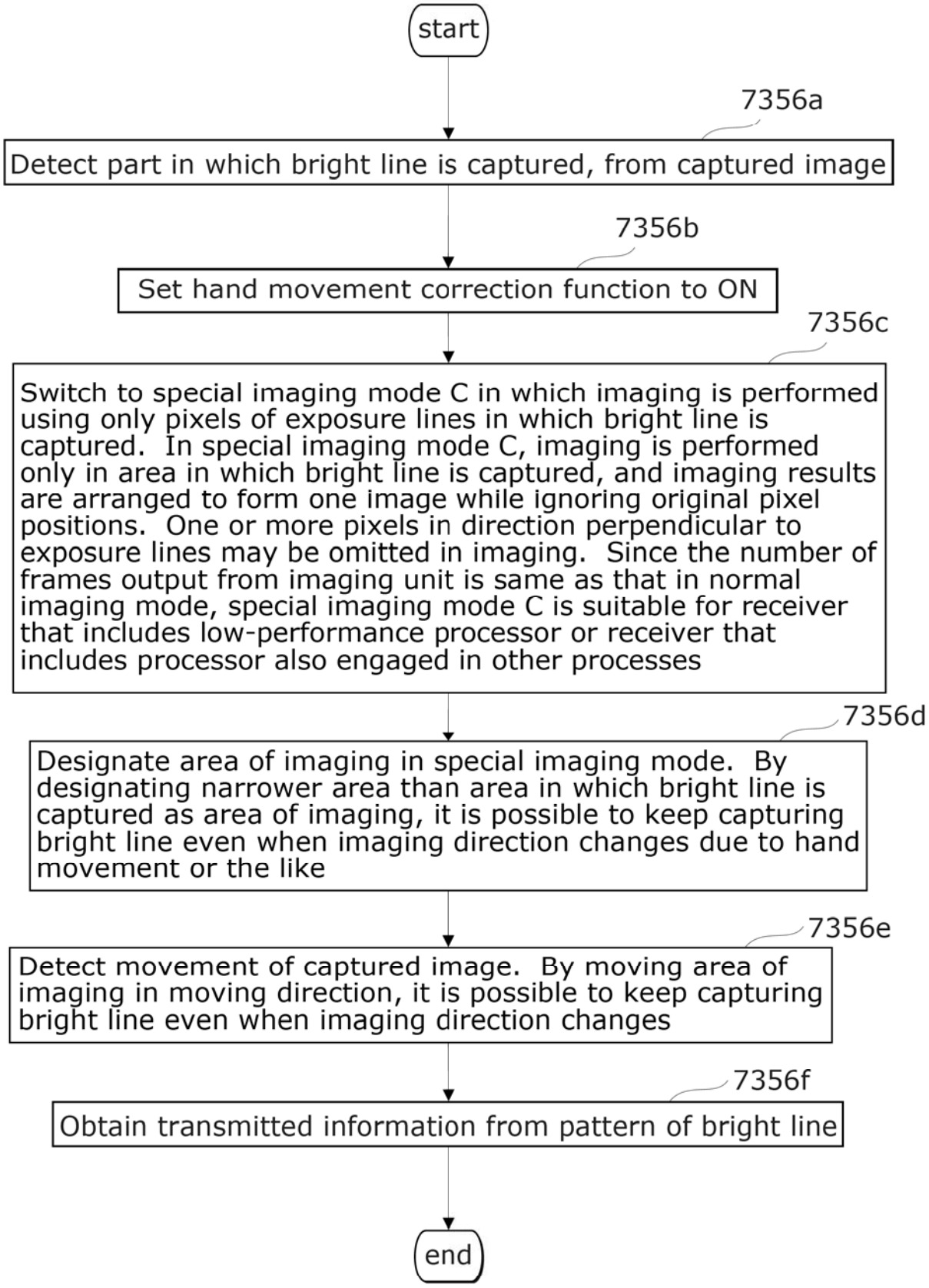

start
7356a
Detect part in which bright line is captured, from captured image
7356b
Set hand movement correction function to ON
7356c
Switch to special imaging mode C in which imaging is performed using only pixels of exposure lines in which bright line is captured. In special imaging mode C, imaging is performed only in area in which bright line is captured, and imaging results are arranged to form one image while ignoring original pixel positions. One or more pixels in direction perpendicular to exposure lines may be omitted in imaging. Since the number of frames output from imaging unit is same as that in normal imaging mode, special imaging mode C is suitable for receiver that includes low-performance processor or receiver that includes processor also engaged in other processes
7356d
Designate area of imaging in special imaging mode. By designating narrower area than area in which bright line is captured as area of imaging, it is possible to keep capturing bright line even when imaging direction changes due to hand movement or the like
7356e
Detect movement of captured image. By moving area of imaging in moving direction, it is possible to keep capturing bright line even when imaging direction changes
7356f
Obtain transmitted information from pattern of bright line
end

FIG. 331A

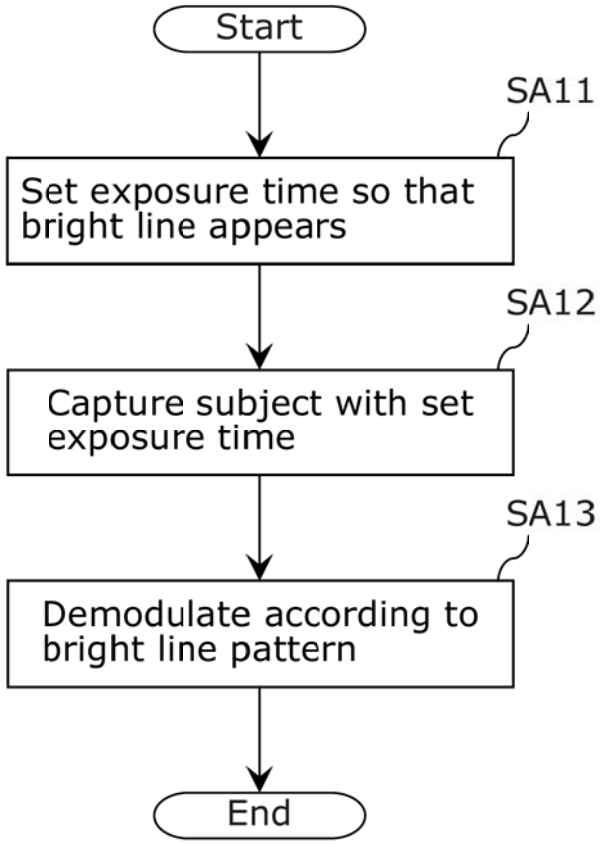


FIG. 331B

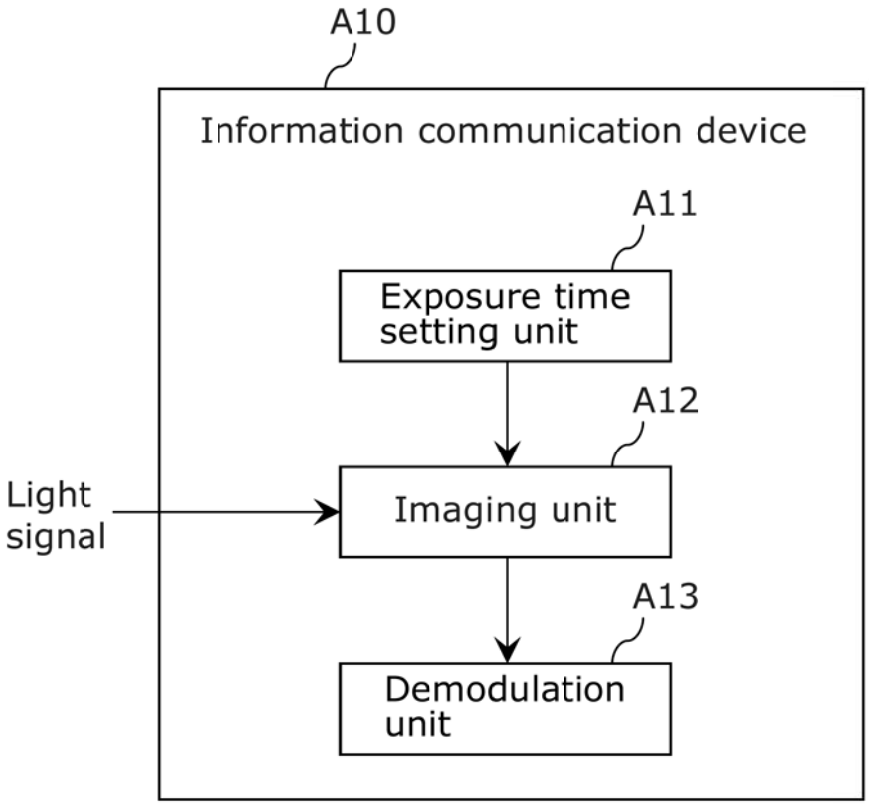


FIG. 331C

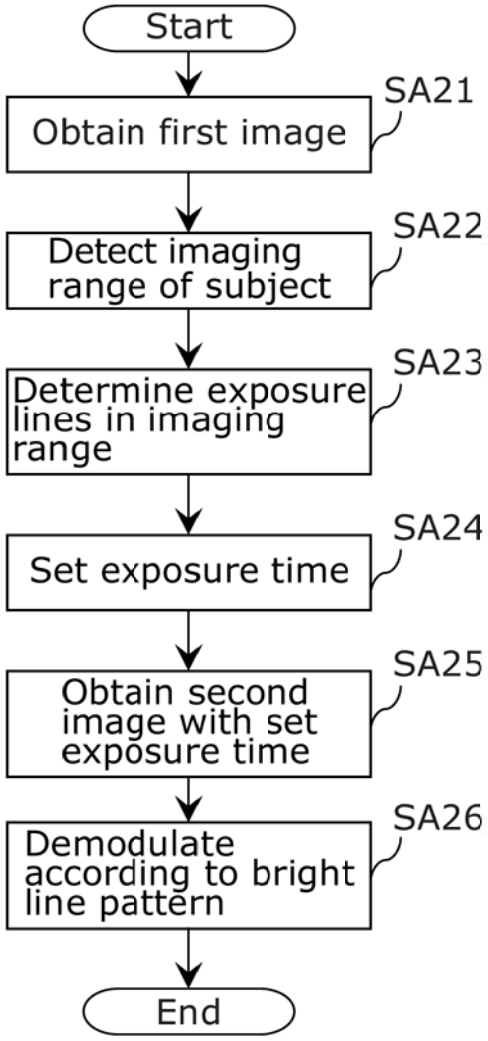
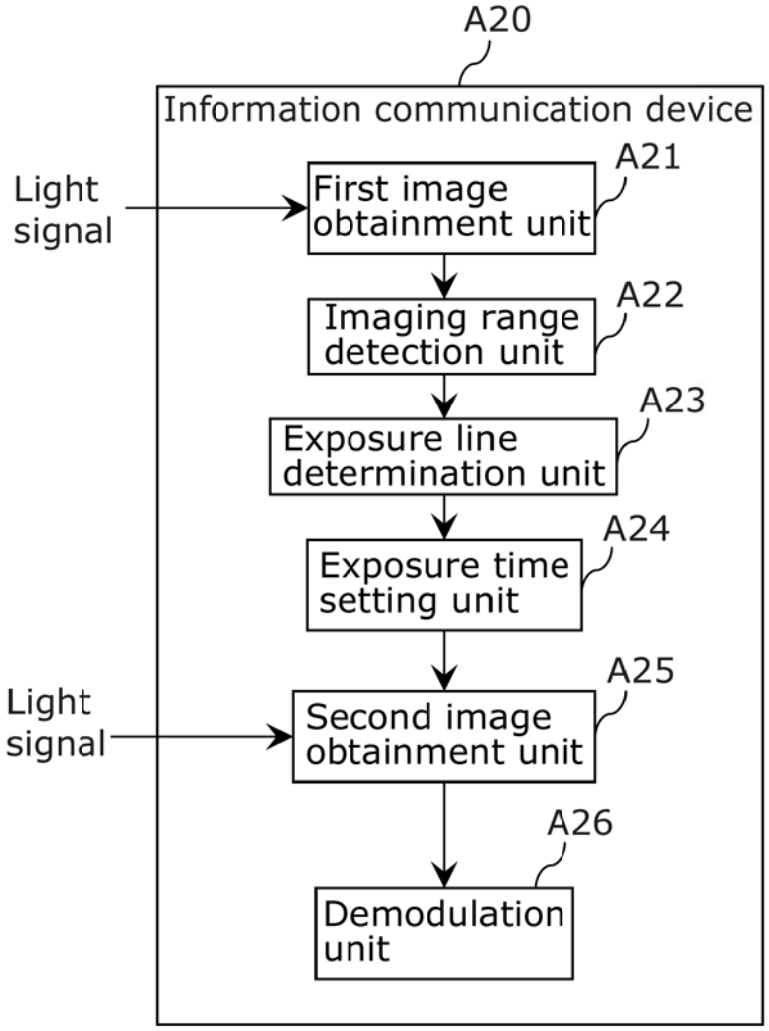


FIG. 331D



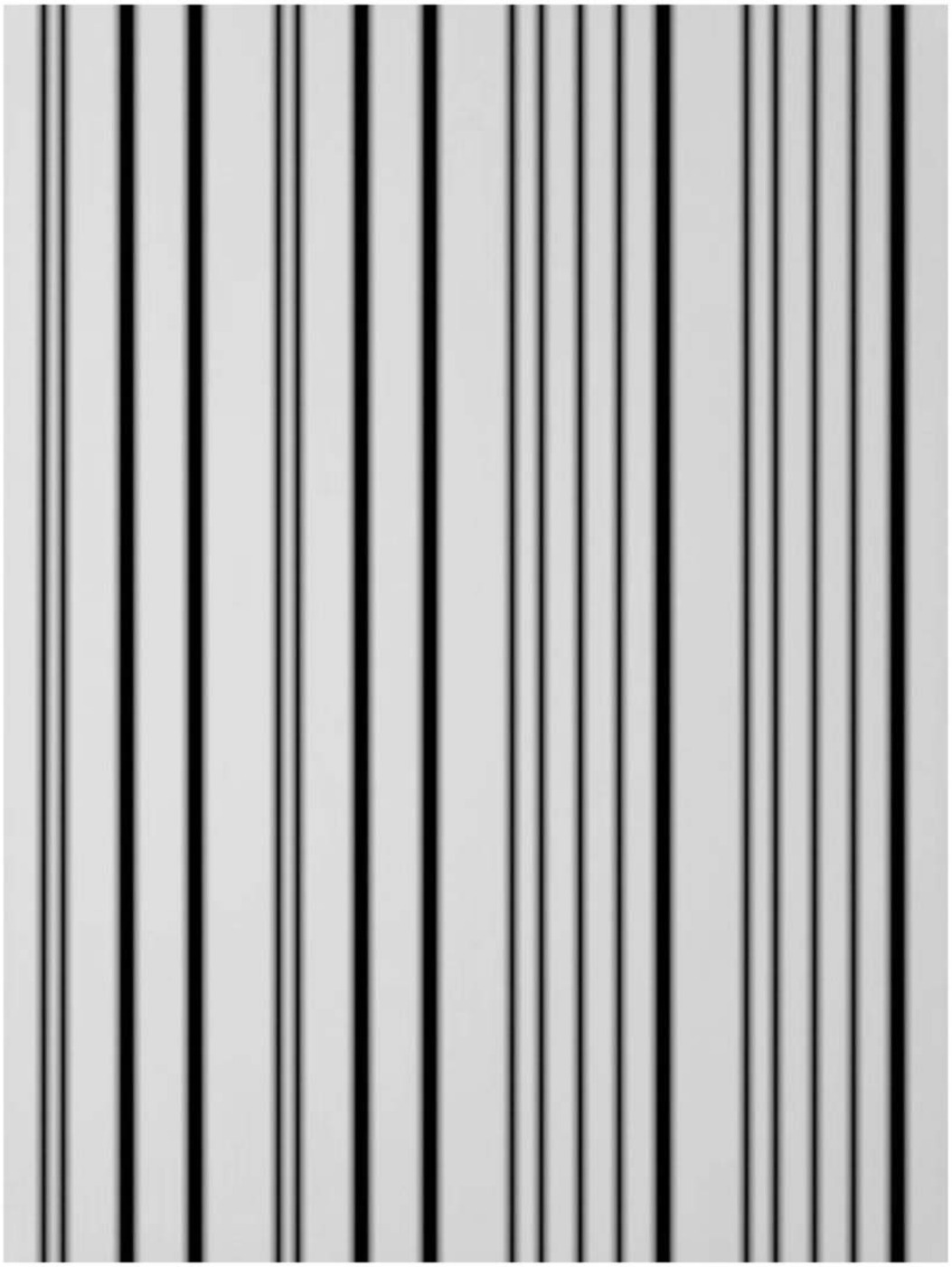


FIG. 332

FIG. 333A

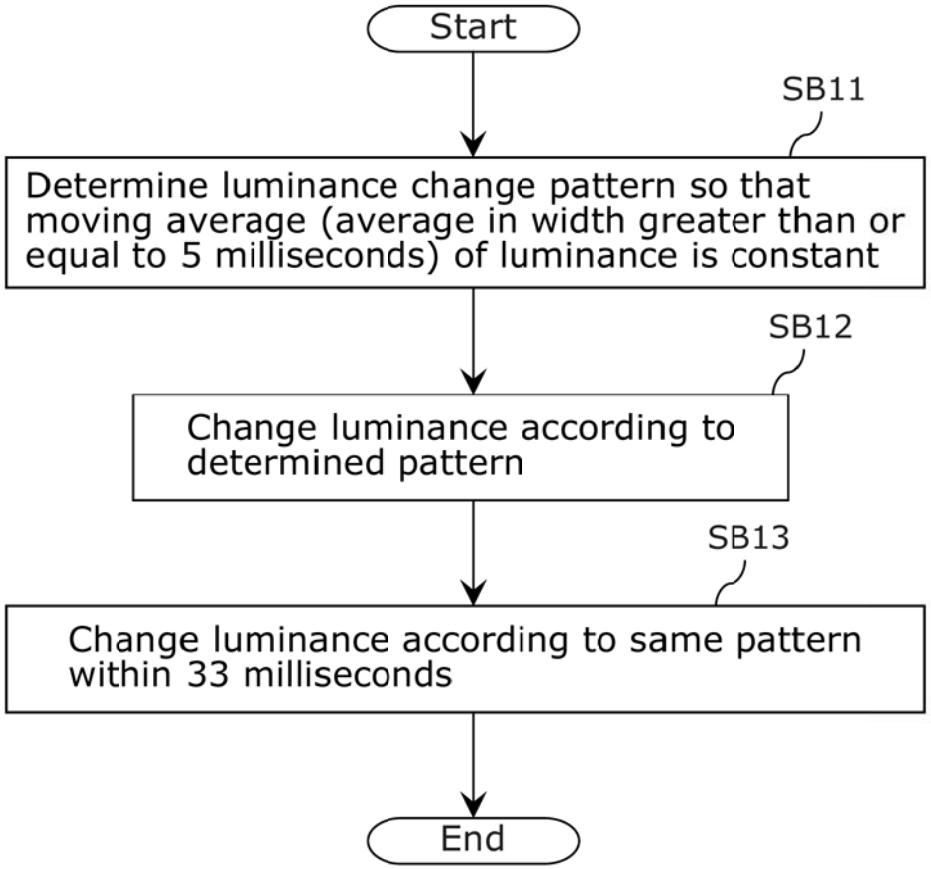


FIG. 333B

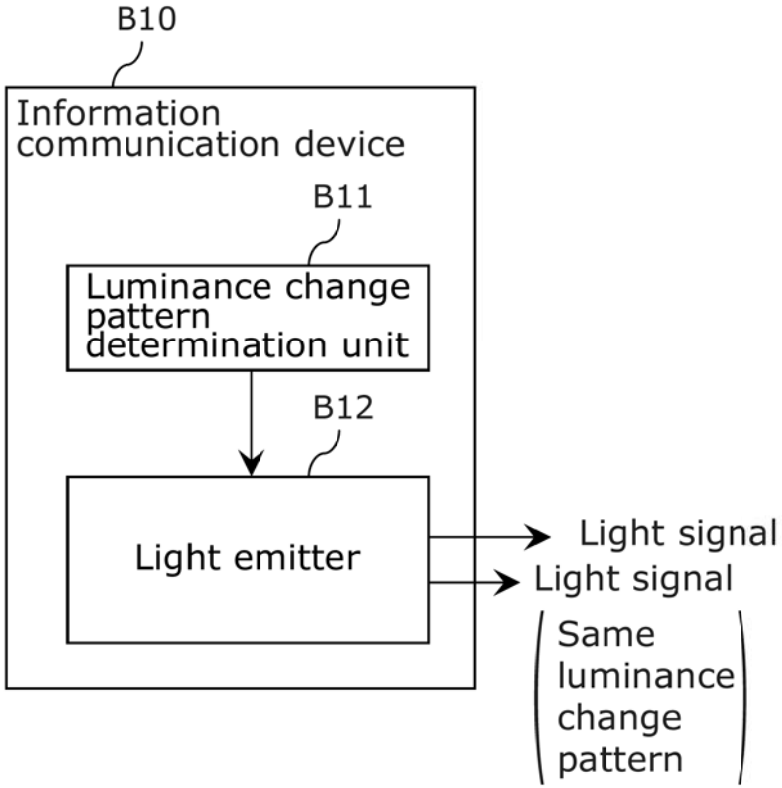


FIG. 334A

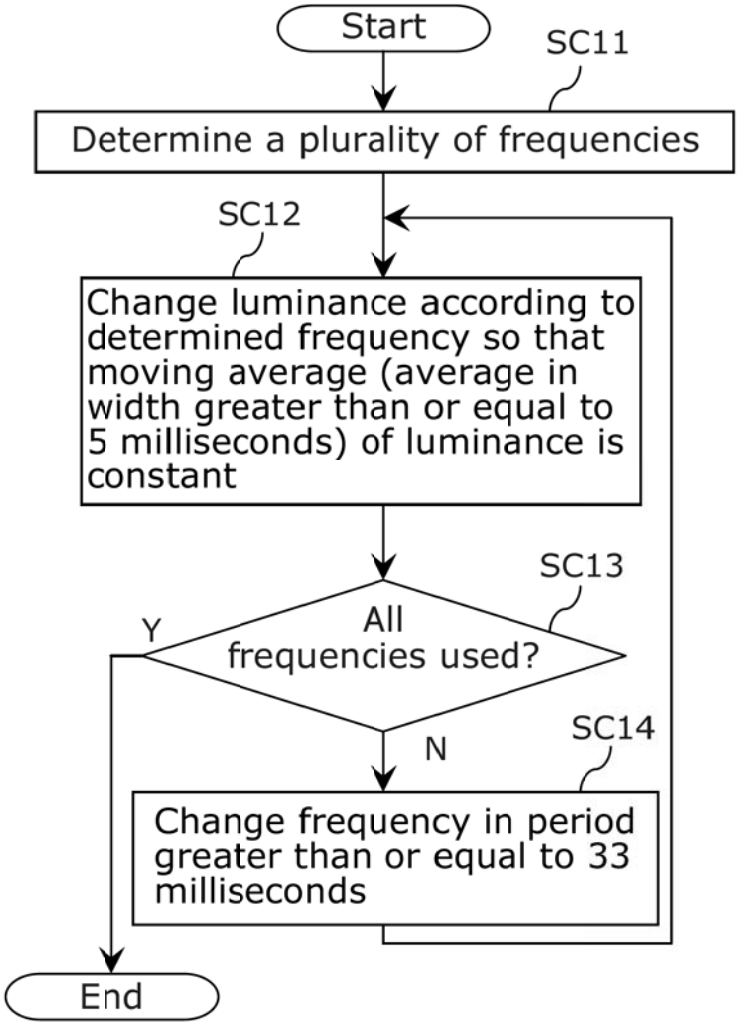


FIG. 334B

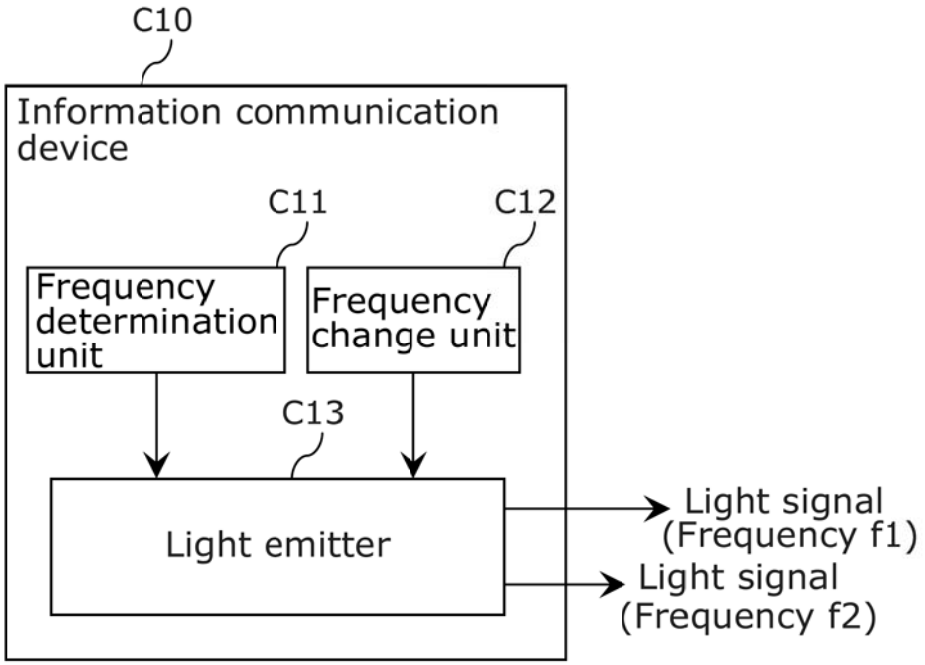


FIG. 335

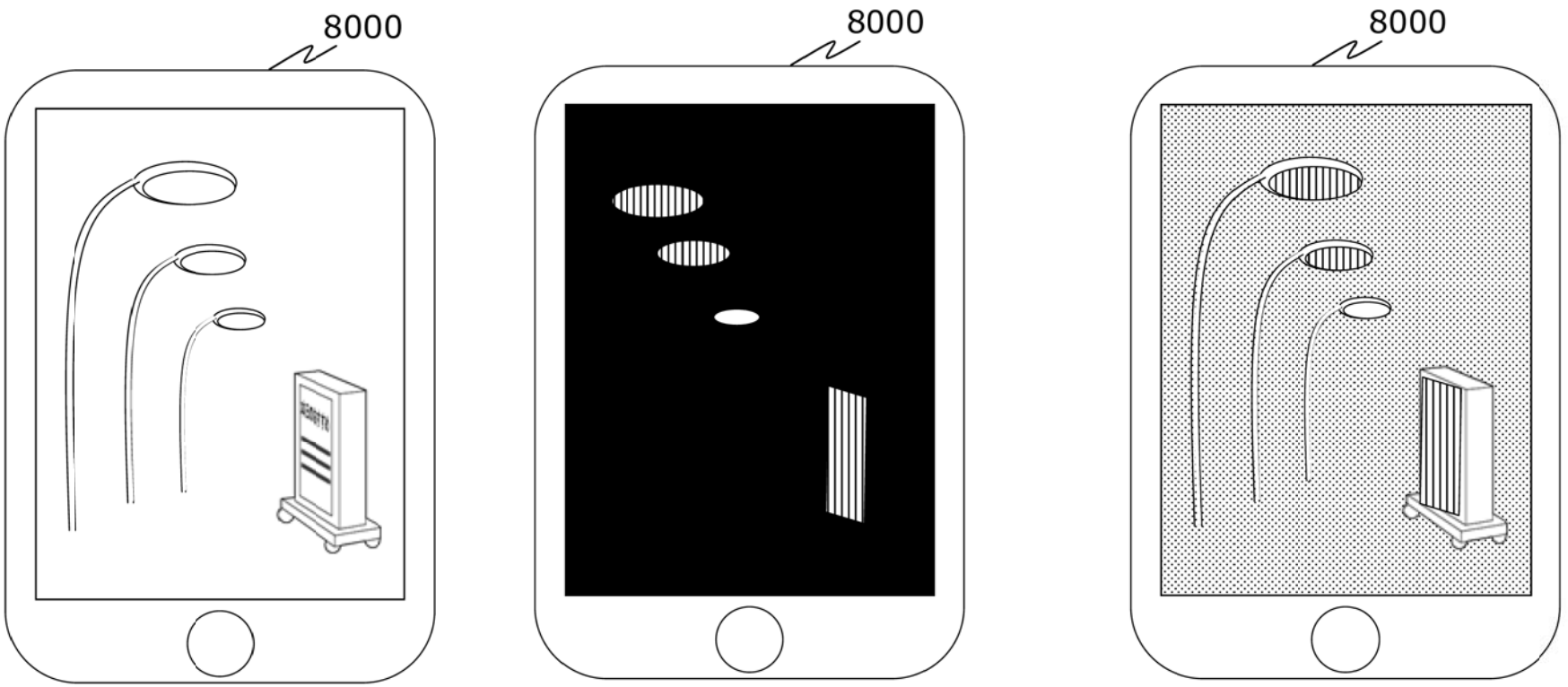

8000
8000
8000
Normal imaging mode
Example of shutter speed
1/100 sec
Visible light communication mode
1/10000 sec
Intermediate mode
1/3000 sec

FIG. 336

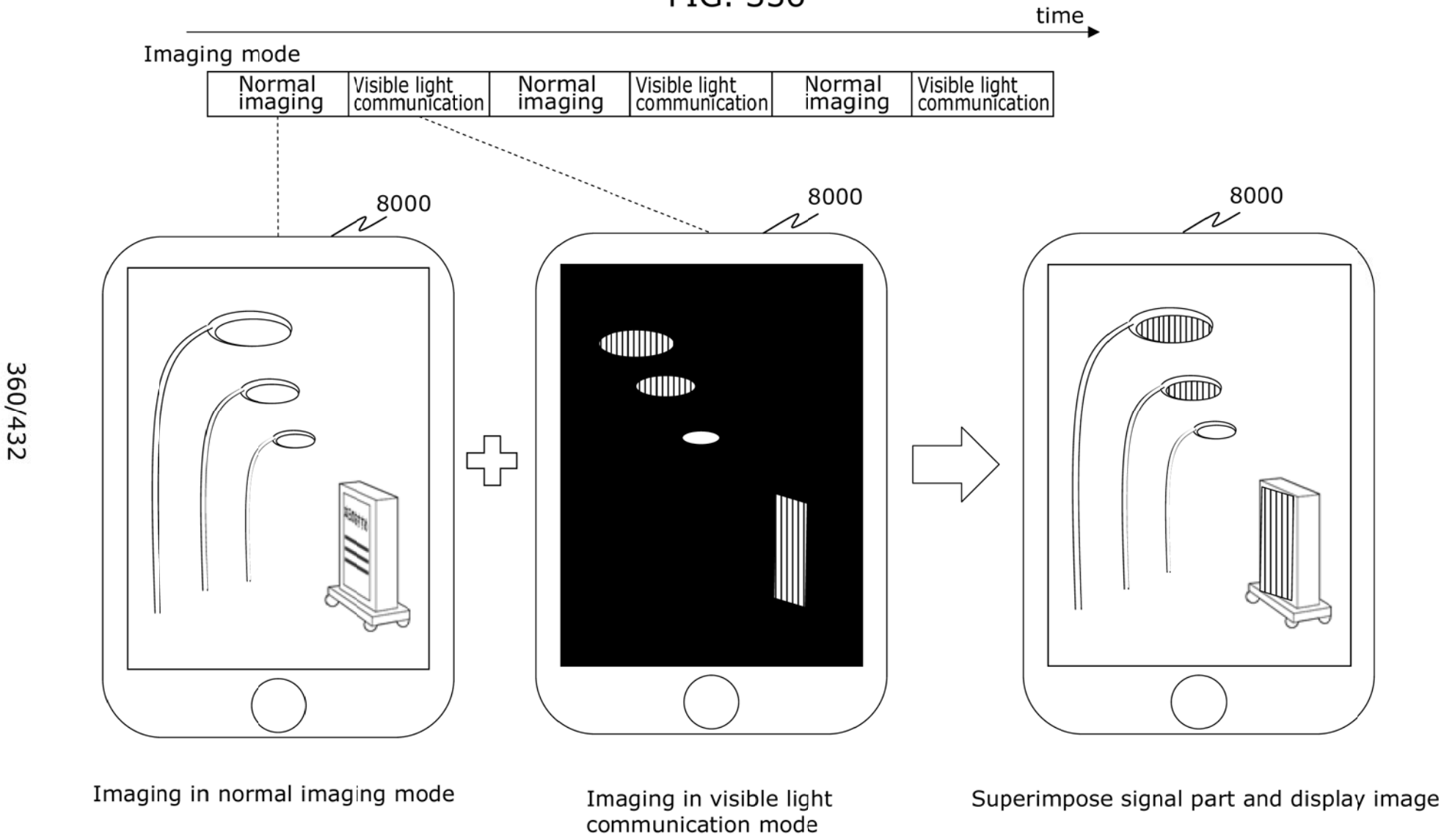

time
Imaging mode
Normal imaging
Visible light communication
Normal imaging
Visible light communication
Normal imaging
Visible light communication
8000
8000
8000
Imaging in normal imaging mode
Imaging in visible light communication mode
Superimpose signal part and display image

FIG. 337

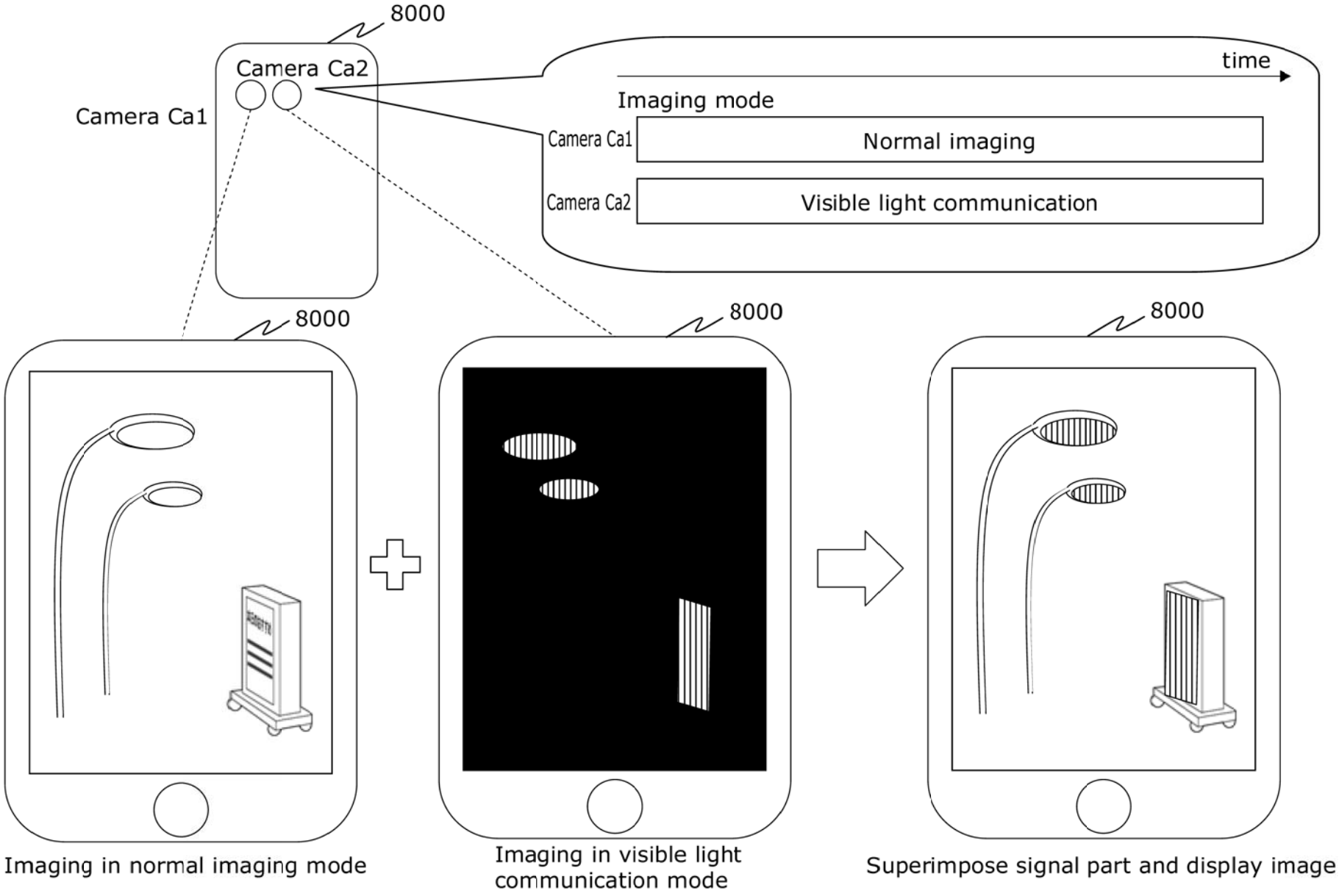

8000
Camera Ca2
Camera Ca1
time
Imaging mode
Camera Ca1
Normal imaging
Camera Ca2
Visible light communication
8000
8000
8000
Imaging in normal imaging mode
Imaging in visible light communication mode
Superimpose signal part and display image

FIG. 338A

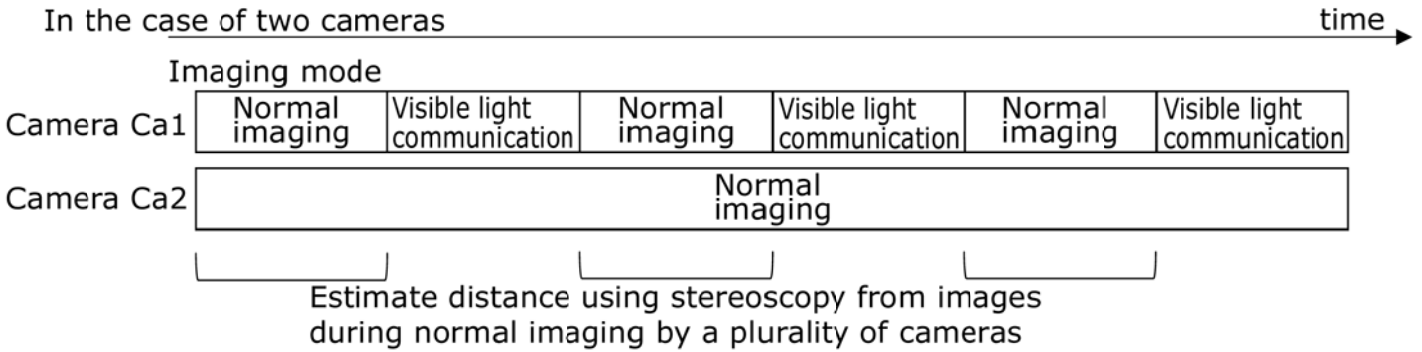


FIG. 338B

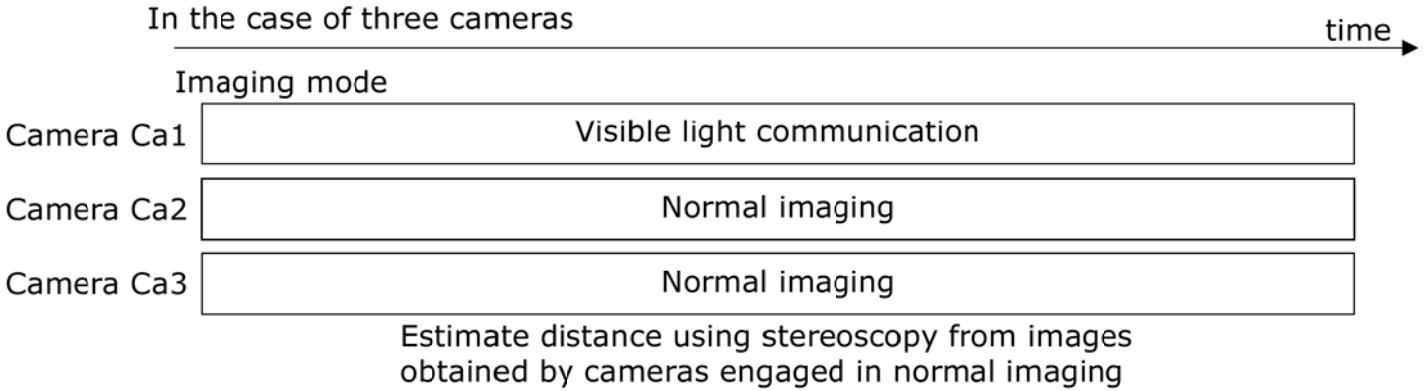


FIG. 338C

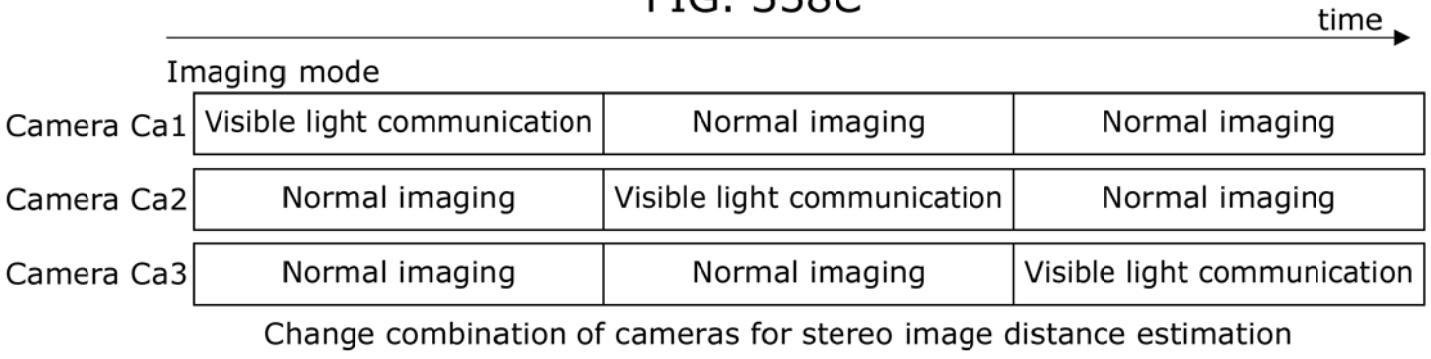


FIG. 339A

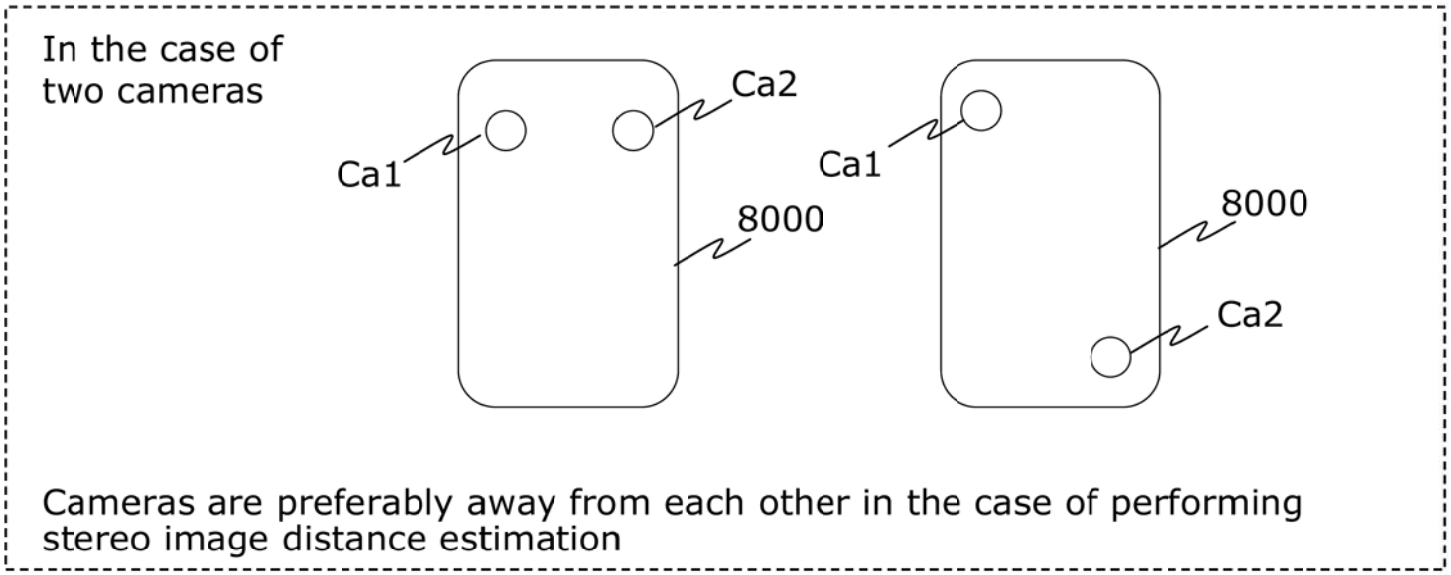


FIG. 339B

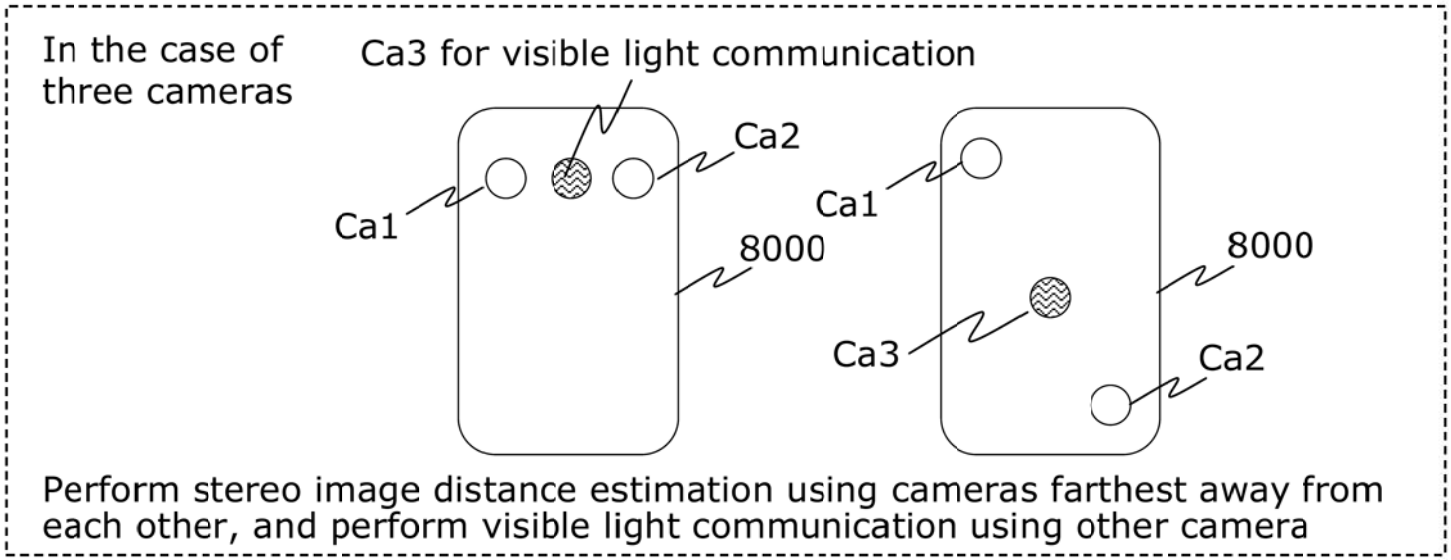
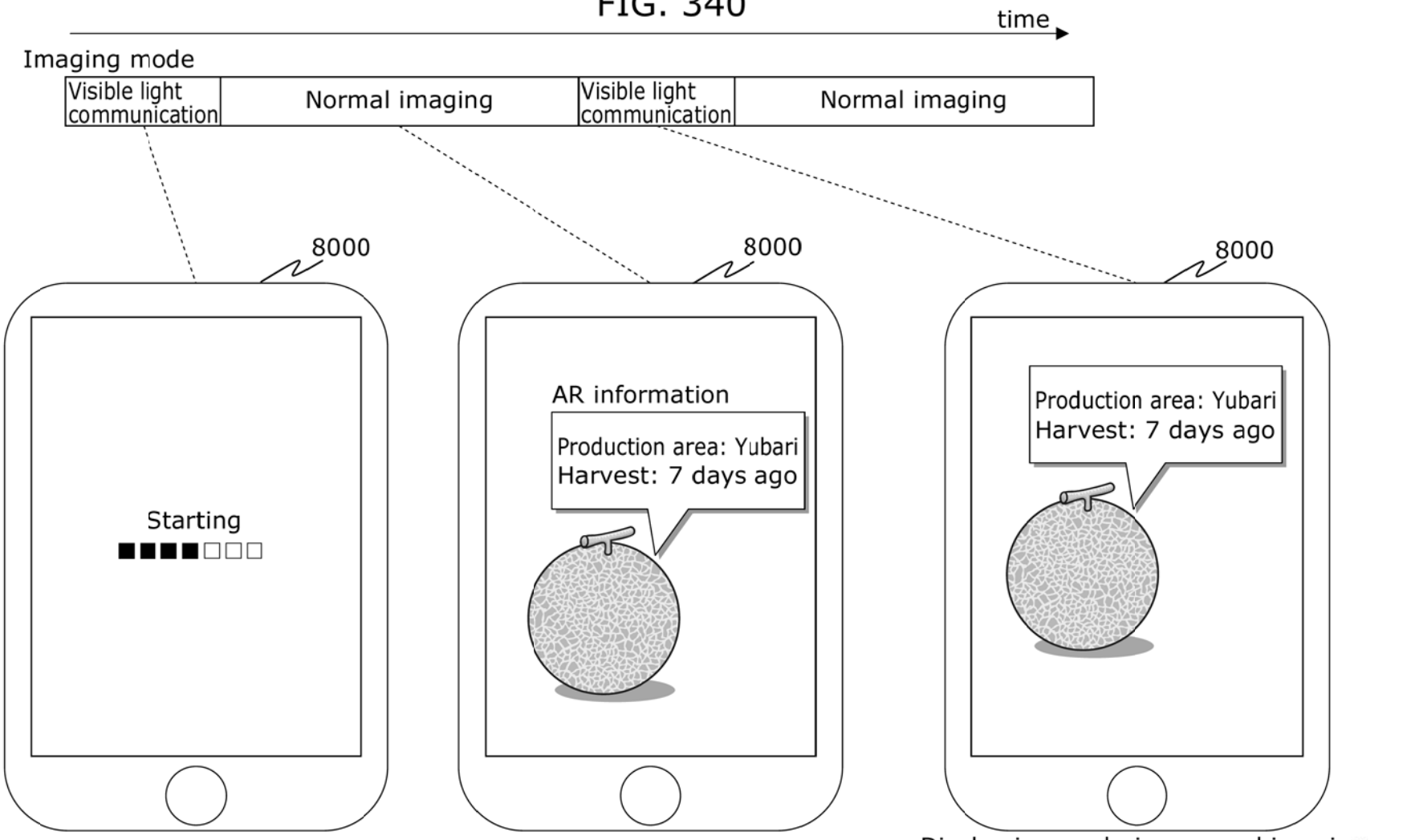


FIG. 340



Receive signal from transmitter in visible light communication, and perform self-position estimation

Display AR information
Estimate movement and direction change of receiver from image processing and value of 9-axis sensor

Display image during normal imaging
Estimate movement and direction change of receiver, and enlarge/reduce and move display image so as to be displayed in same way as preview image during normal imaging

FIG. 341

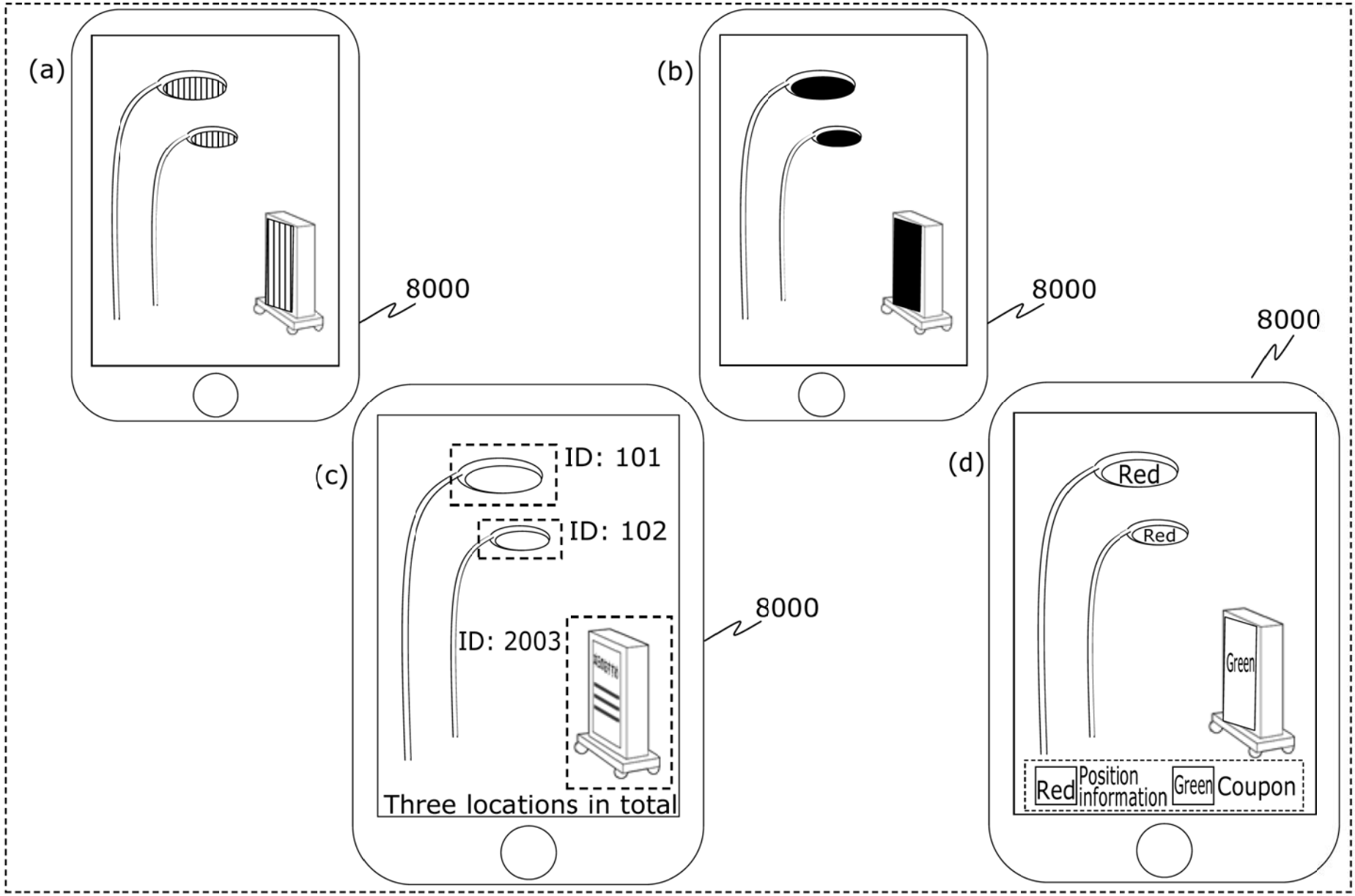
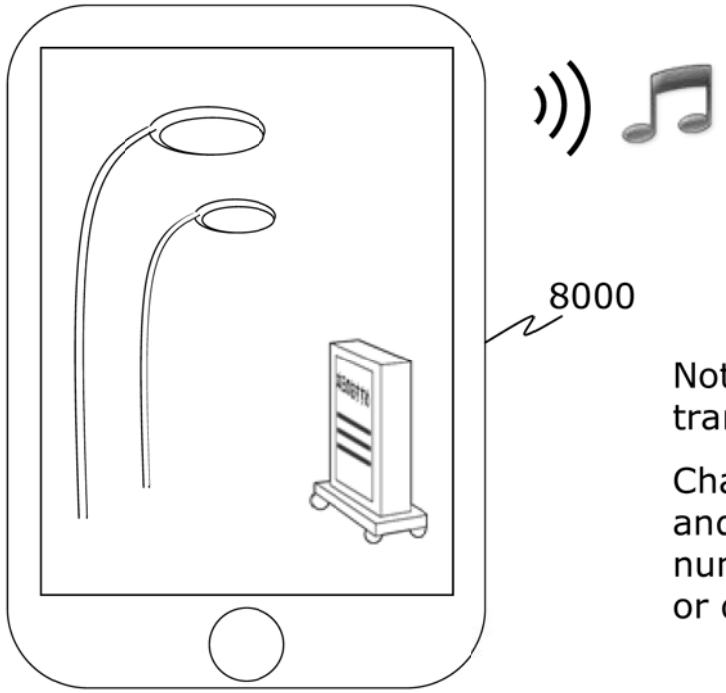

(a)
8000
(b)
8000
8000
(c)
ID: 101
ID: 102
ID: 2003
8000
Three locations in total
(d)
Red
Red
Green
Red
Position information
Green
Coupon

FIG. 342



Notify by sound upon discovery of transmitter and upon signal reception

Change sound type, reproduction time, and number of reproductions according to number of transmitters or type of received or display information

FIG. 343

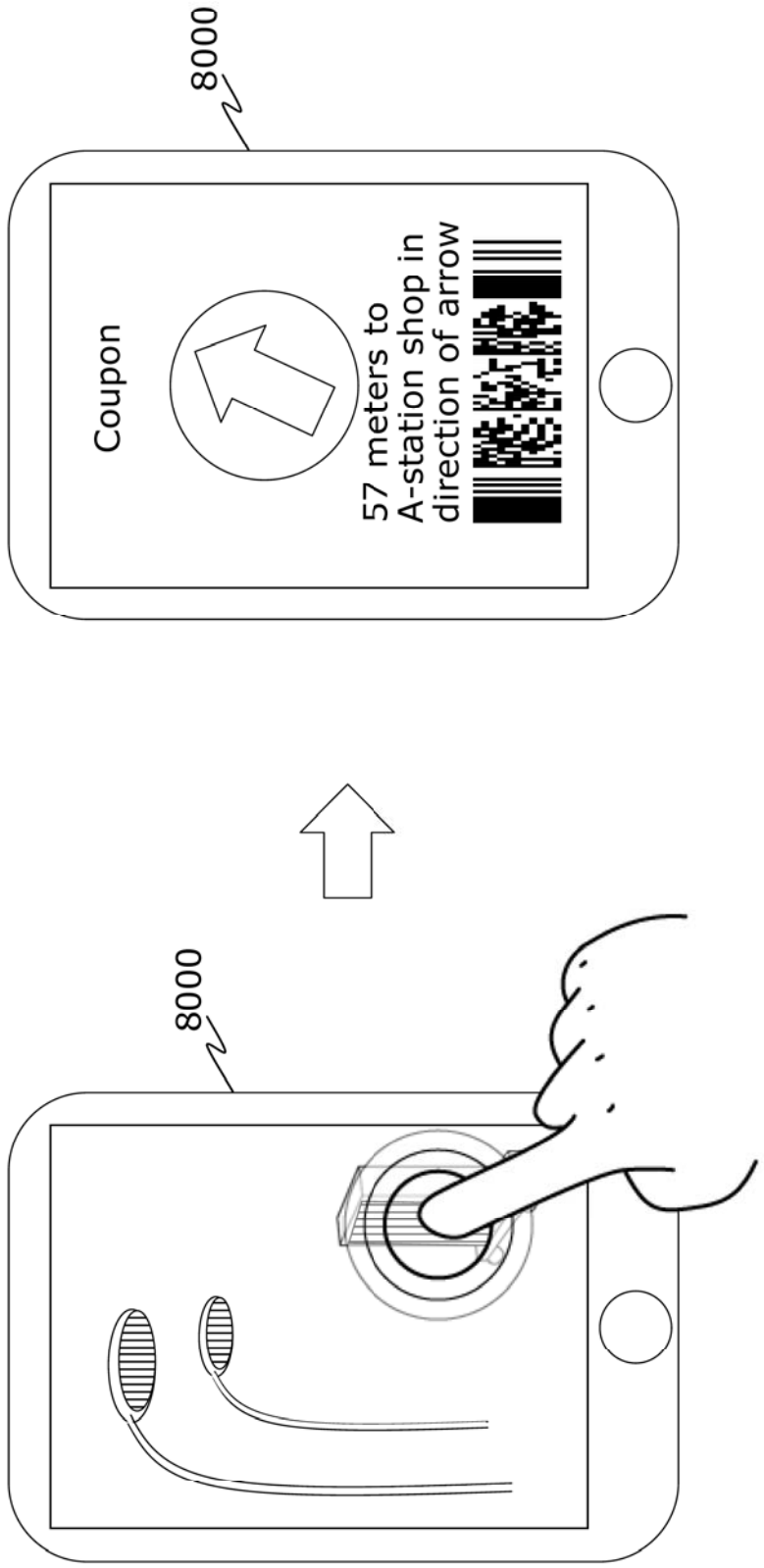

8000
Coupon
57 meters to
A-station shop in
direction of arrow
8000

FIG. 344

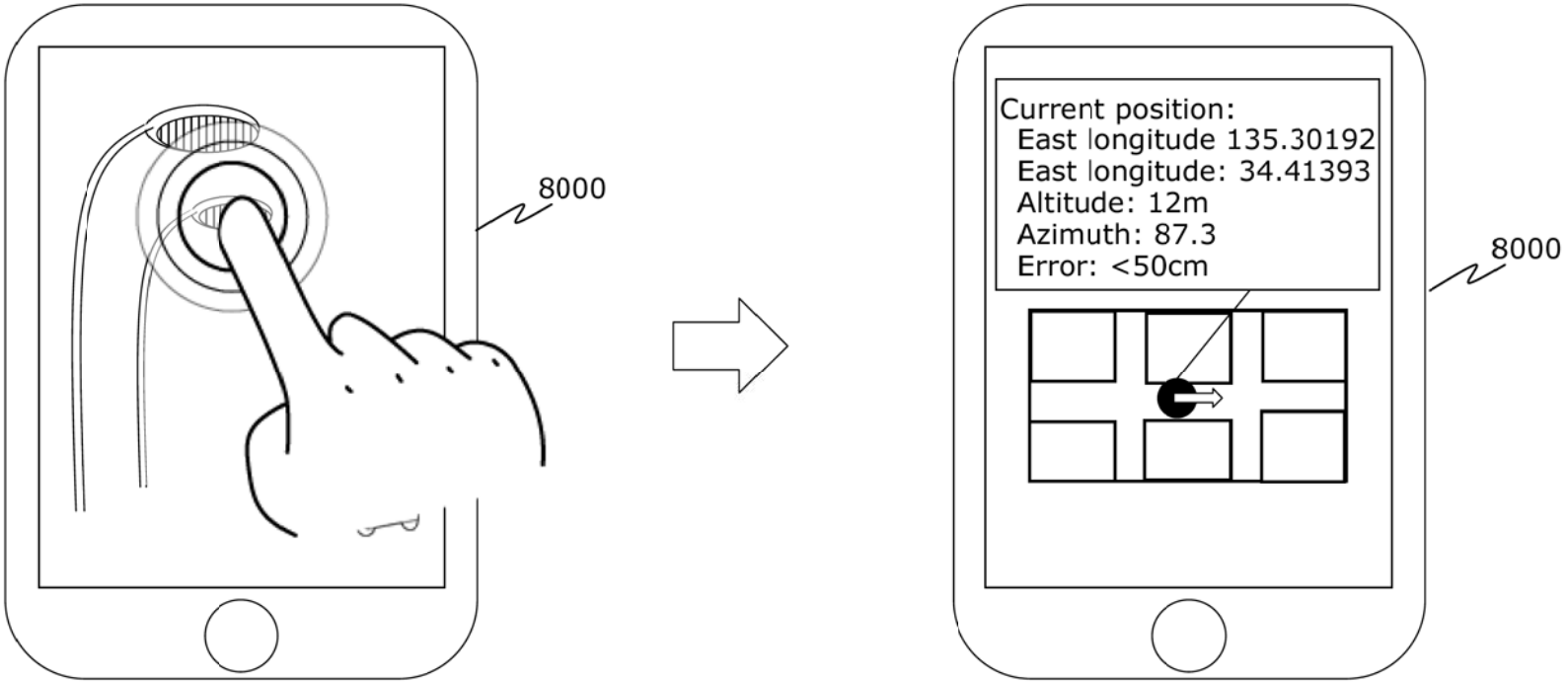

8000
Current position:
East longitude 135.30192
East longitude: 34.41393
Altitude: 12m
Azimuth: 87.3
Error: <50cm
8000

FIG. 345

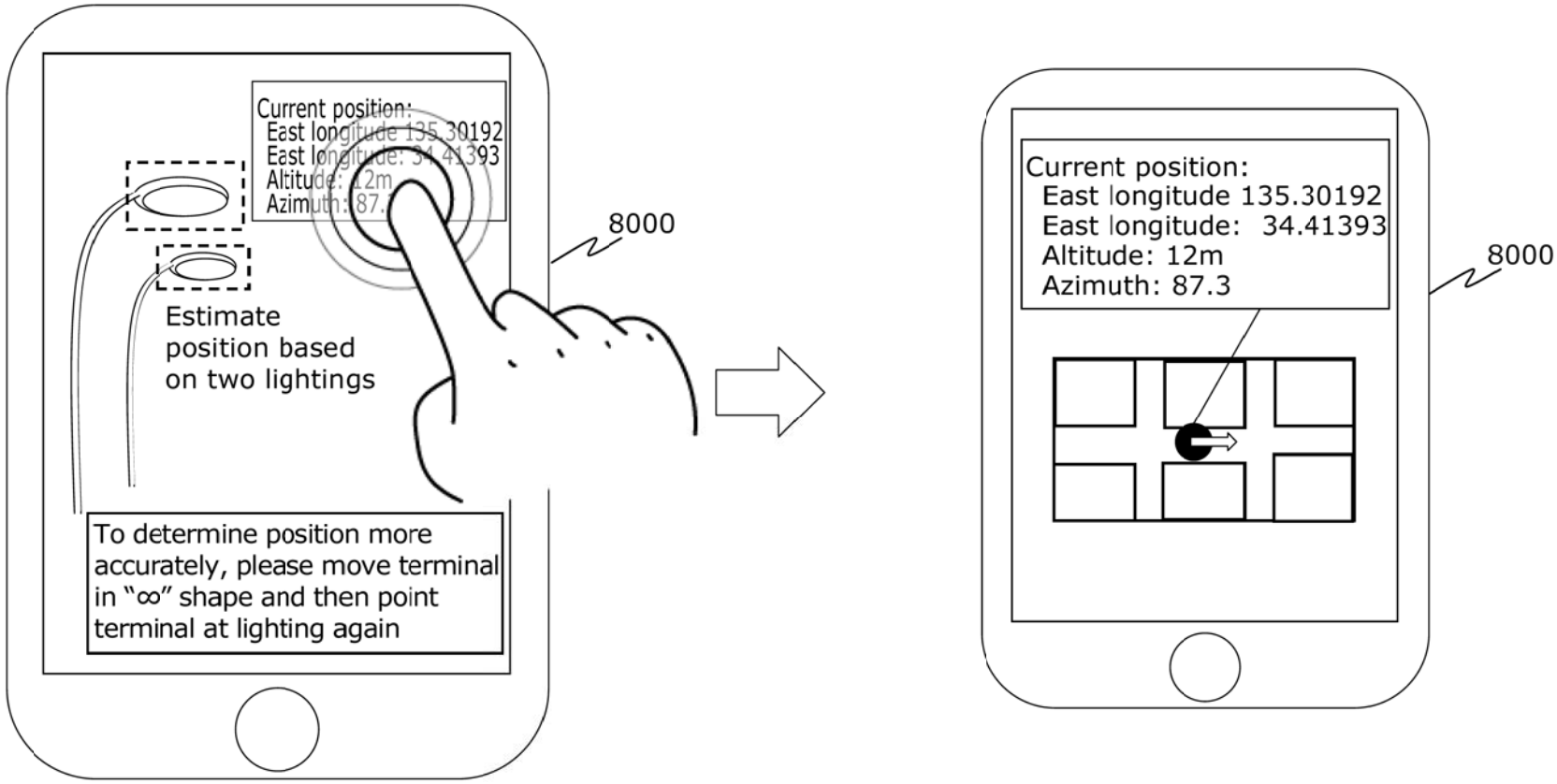

Current position:
East longitude 135.30192
East longitude: 34.41393
Altitude: 12m
Azimuth: 87.3
Estimate position based on two lightings
To determine position more accurately, please move terminal in "∞" shape and then point terminal at lighting again
8000
Current position:
East longitude 135.30192
East longitude: 34.41393
Altitude: 12m
Azimuth: 87.3
8000

FIG. 346

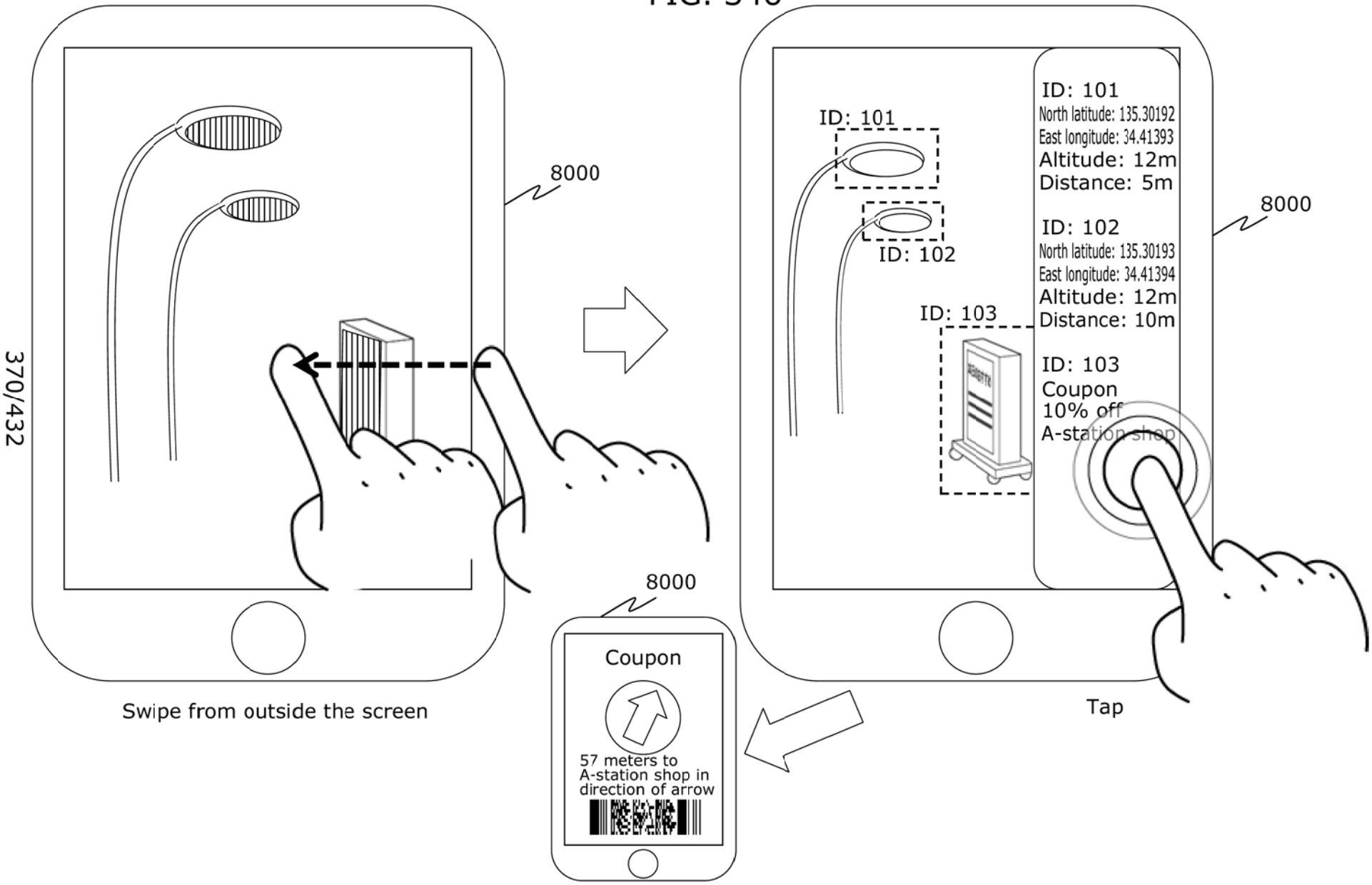

370/432
8000
Swipe from outside the screen
8000
Coupon
57 meters to
A-station shop in
direction of arrow
8000
ID: 101
ID: 102
ID: 103
ID: 101
North latitude: 135.30192
East longitude: 34.41393
Altitude: 12m
Distance: 5m
ID: 102
North latitude: 135.30193
East longitude: 34.41394
Altitude: 12m
Distance: 10m
ID: 103
Coupon
10% off
A-station shop
Tap

FIG. 347

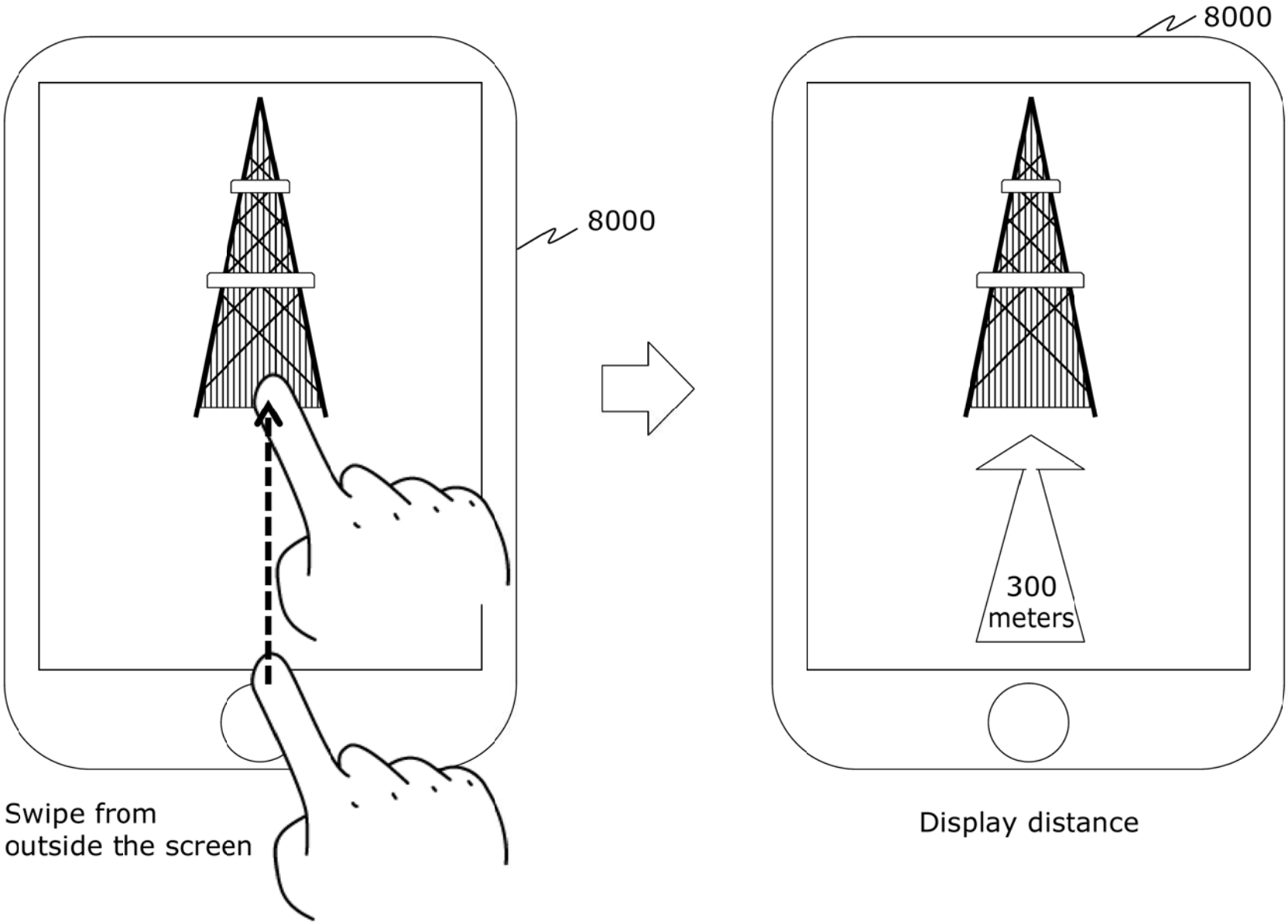

8000
8000
300
meters
Swipe from
outside the screen
Display distance

FIG. 348

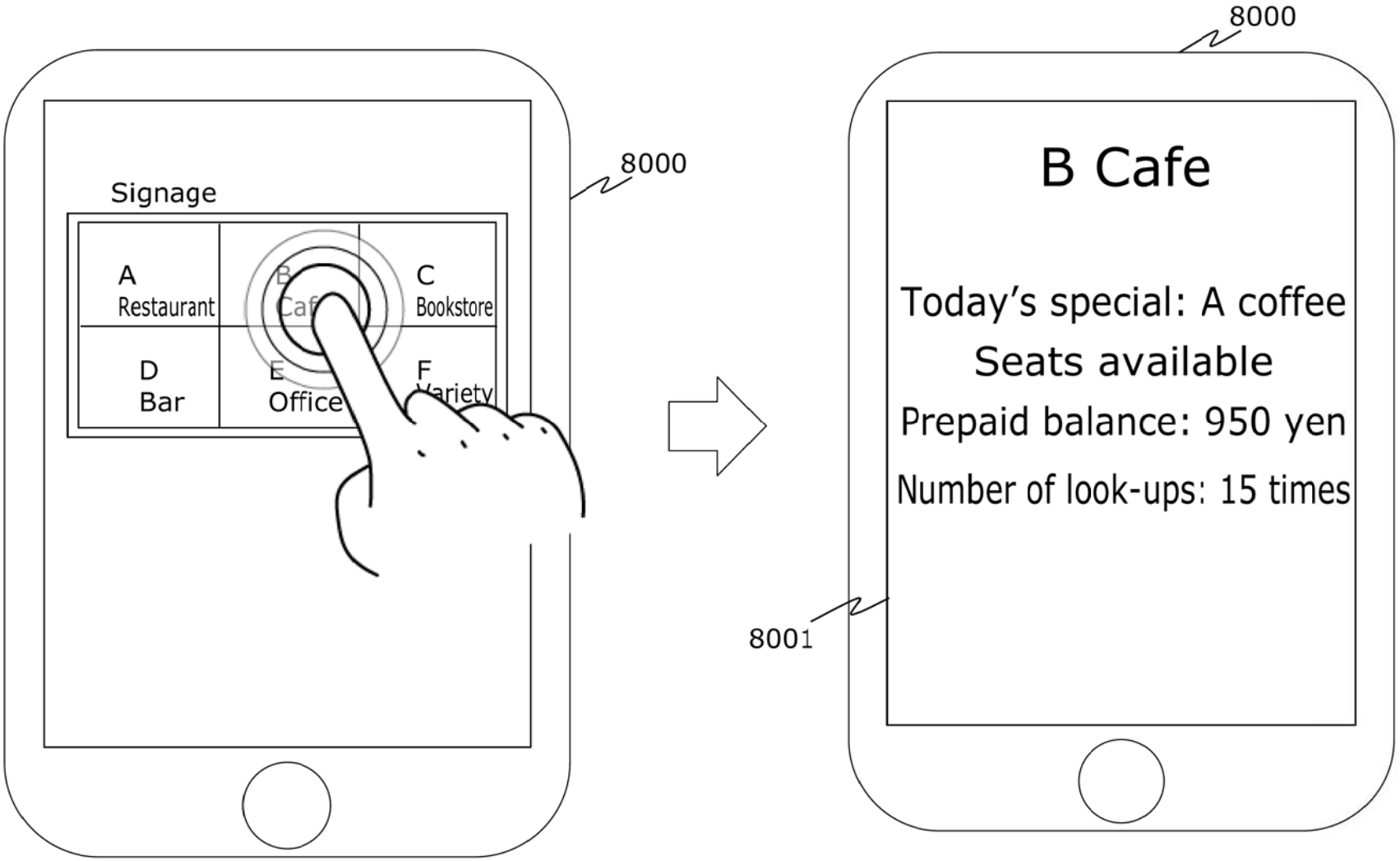

8000
Signage
A
Restaurant
B
Cafe
C
Bookstore
D
Bar
E
Office
F
Variety
8000
B Cafe
Today's special: A coffee
Seats available
Prepaid balance: 950 yen
Number of look-ups: 15 times
8001

FIG. 349

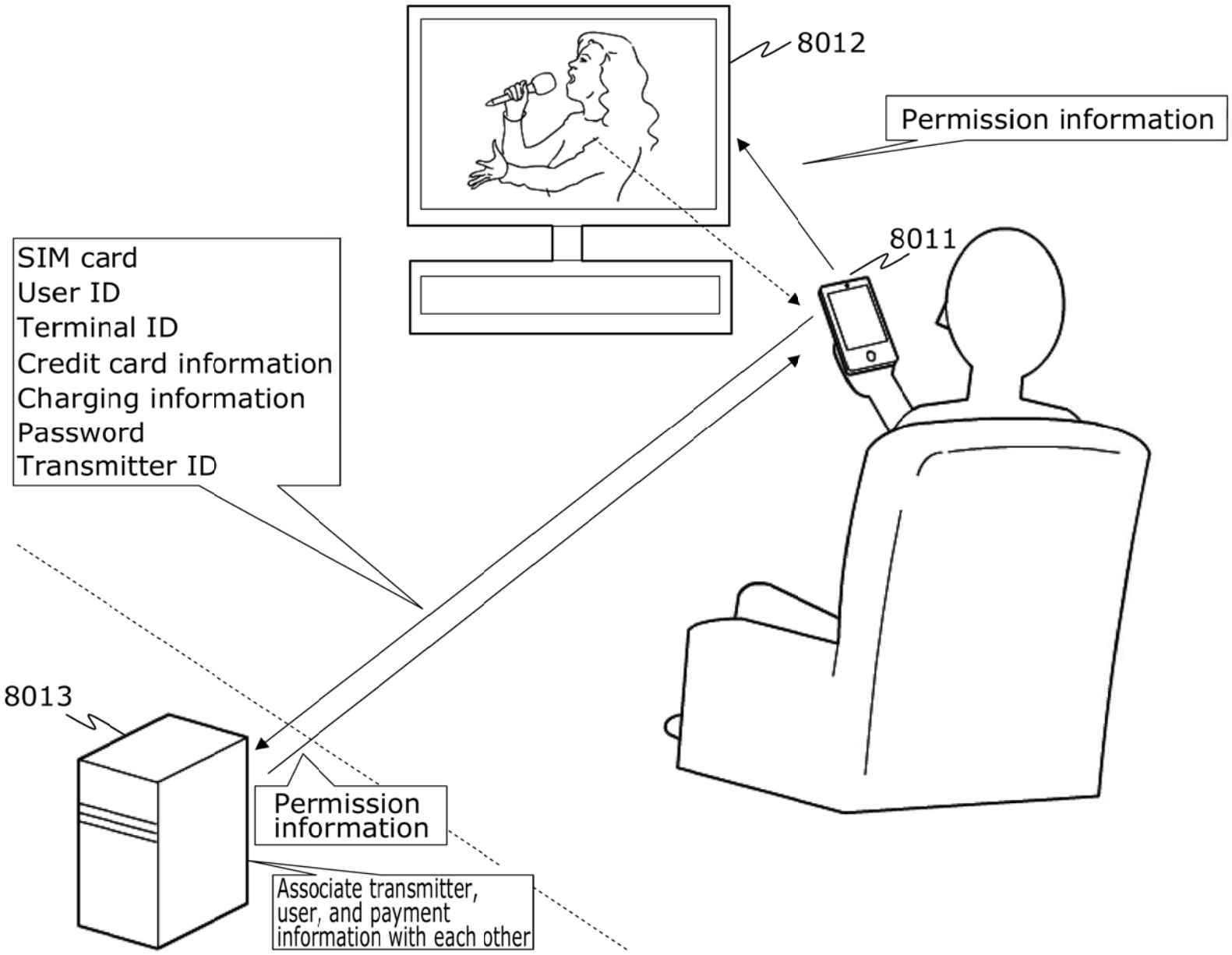

8012
Permission information
8011
SIM card
User ID
Terminal ID
Credit card information
Charging information
Password
Transmitter ID
8013
Permission information
Associate transmitter, user, and payment information with each other

FIG. 350

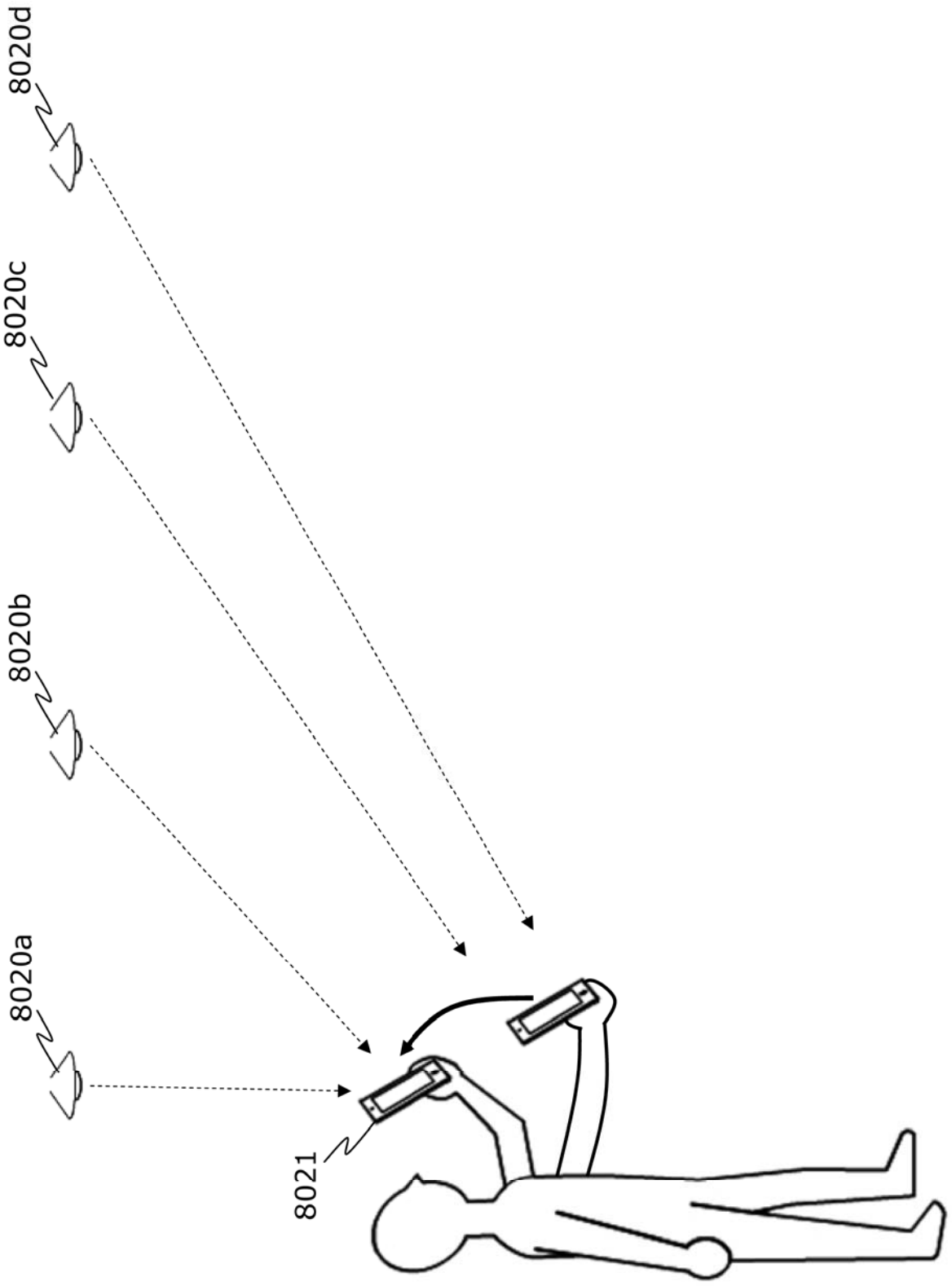


FIG. 351

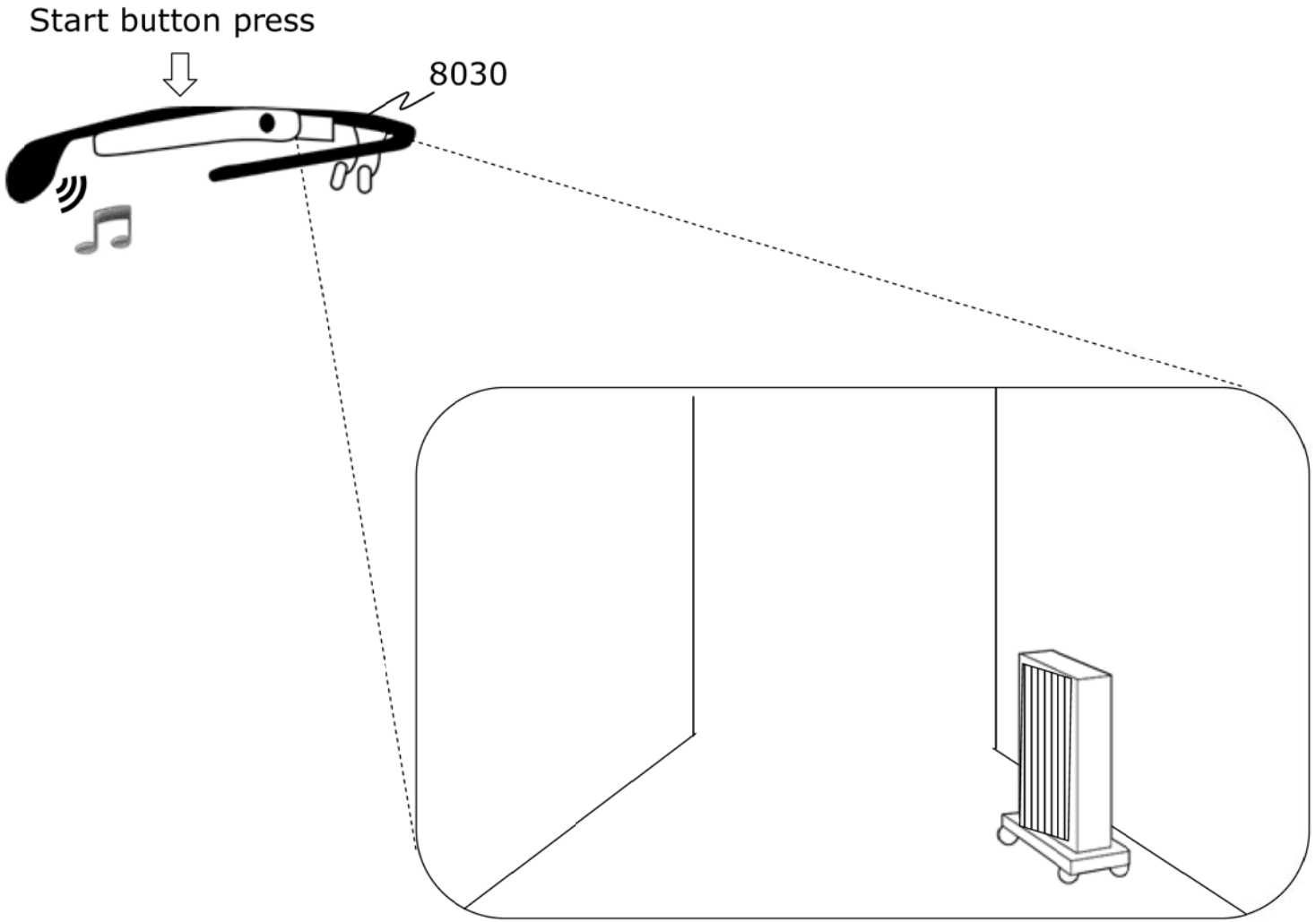
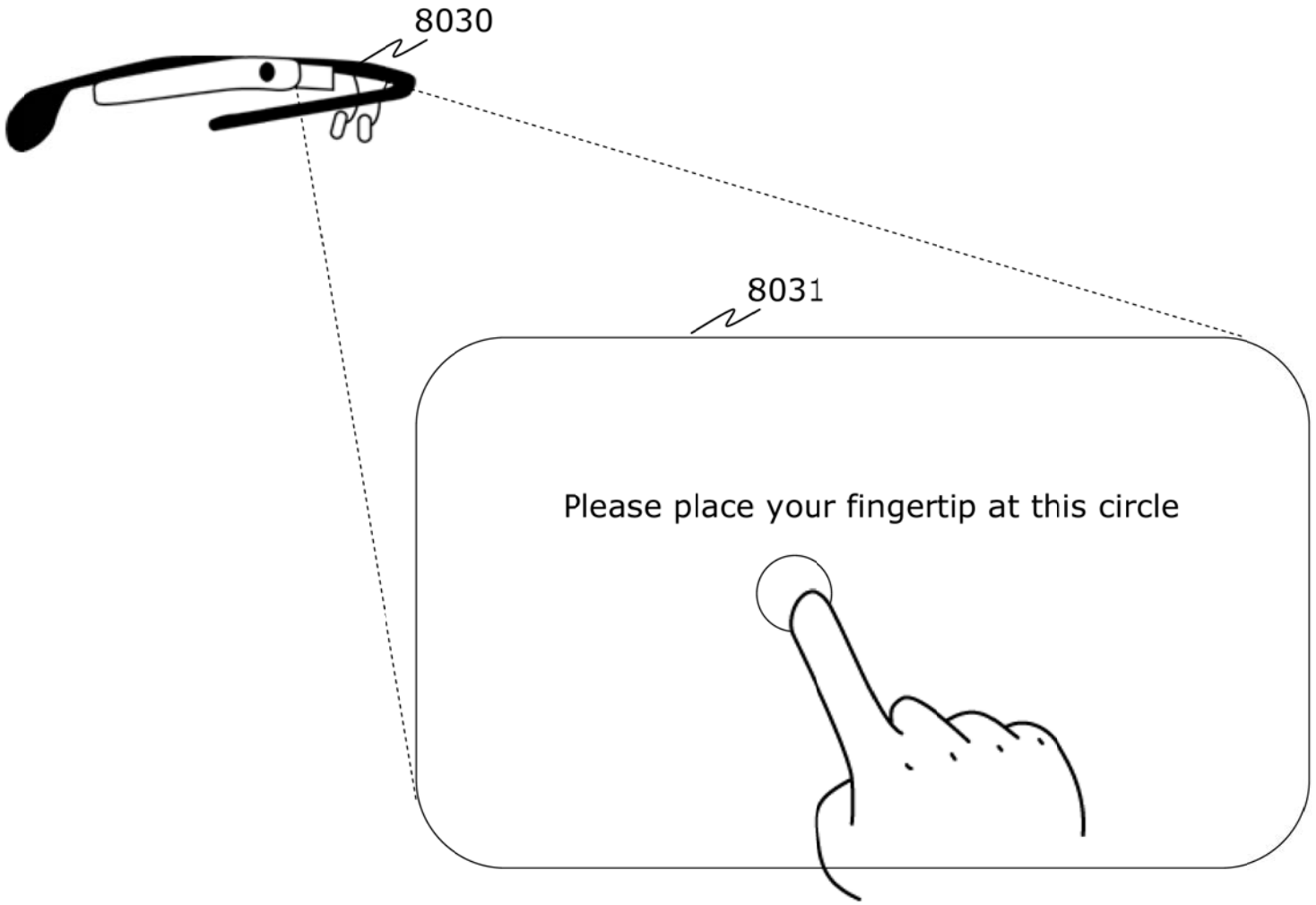


FIG. 352



Alignment of display position and imaging position

FIG. 353

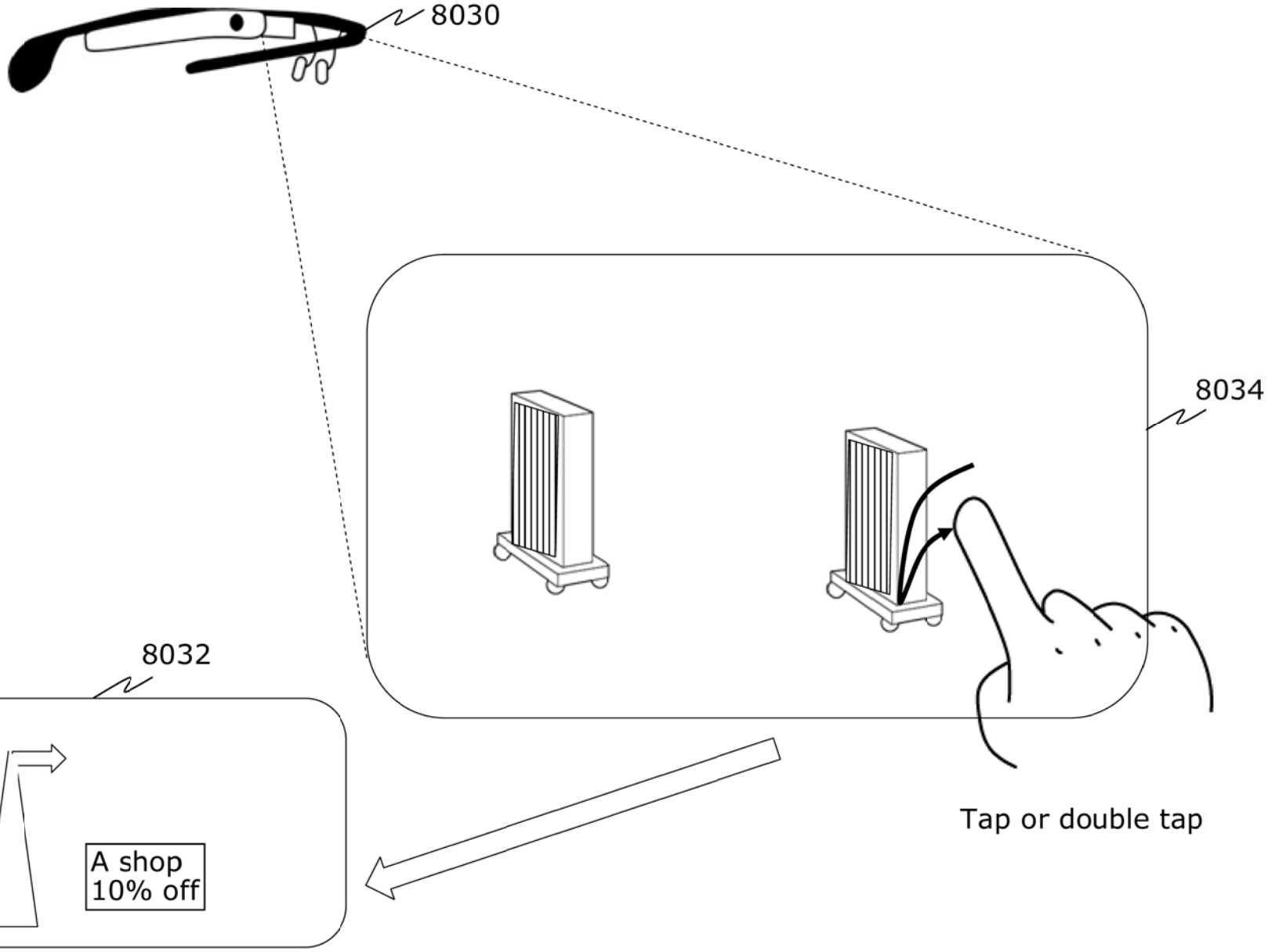


FIG. 354

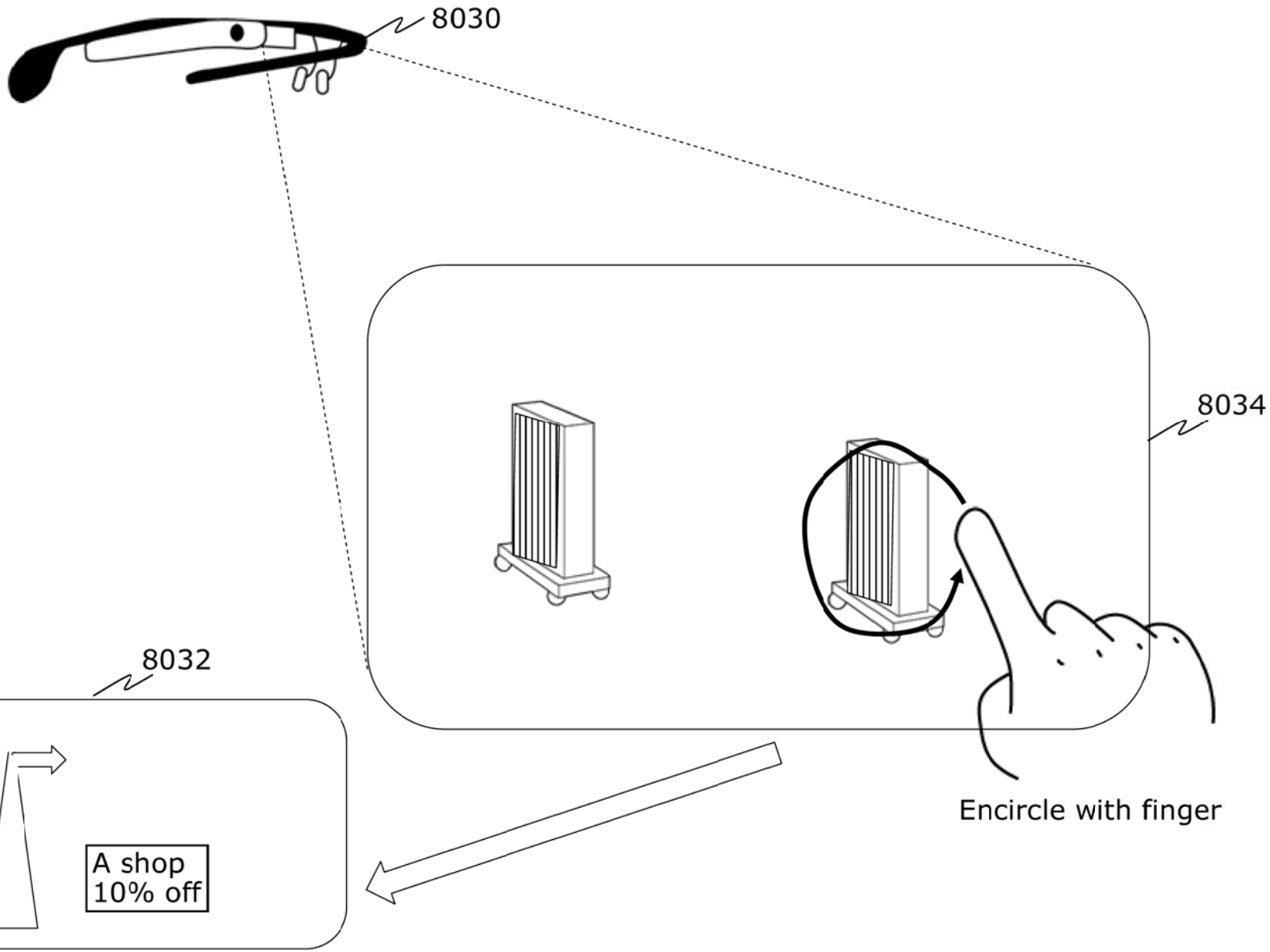


FIG. 355

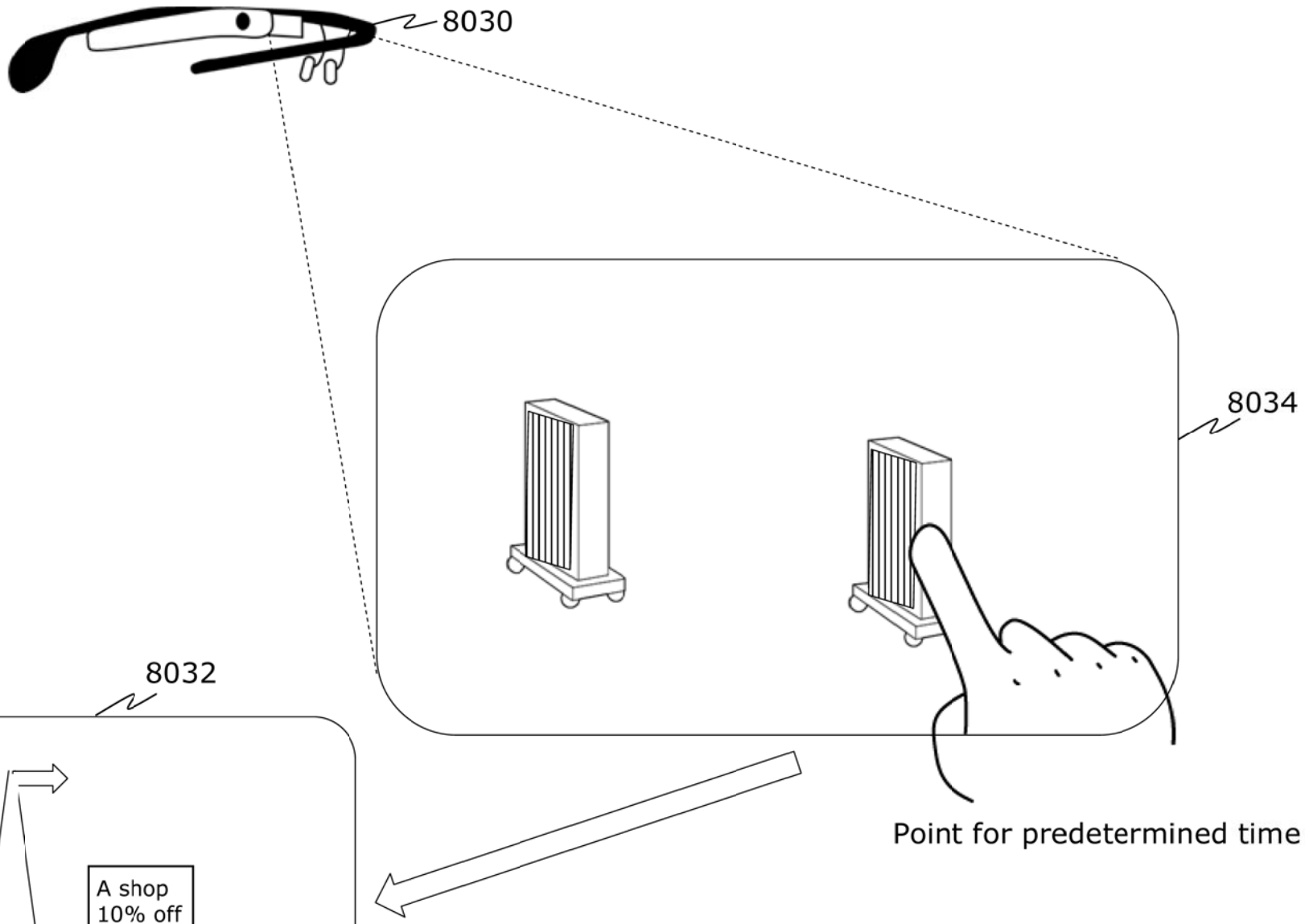


FIG. 356

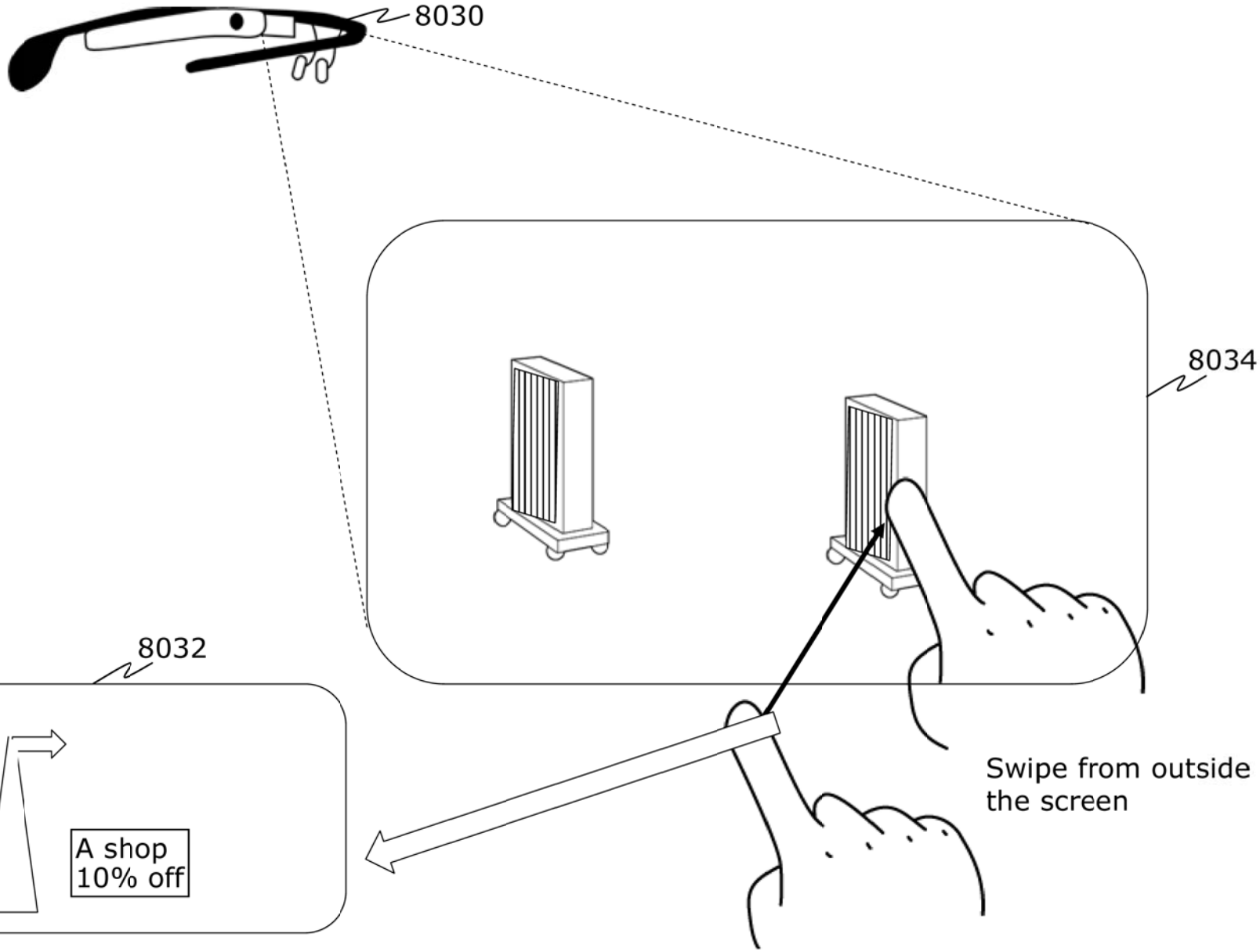


FIG. 357

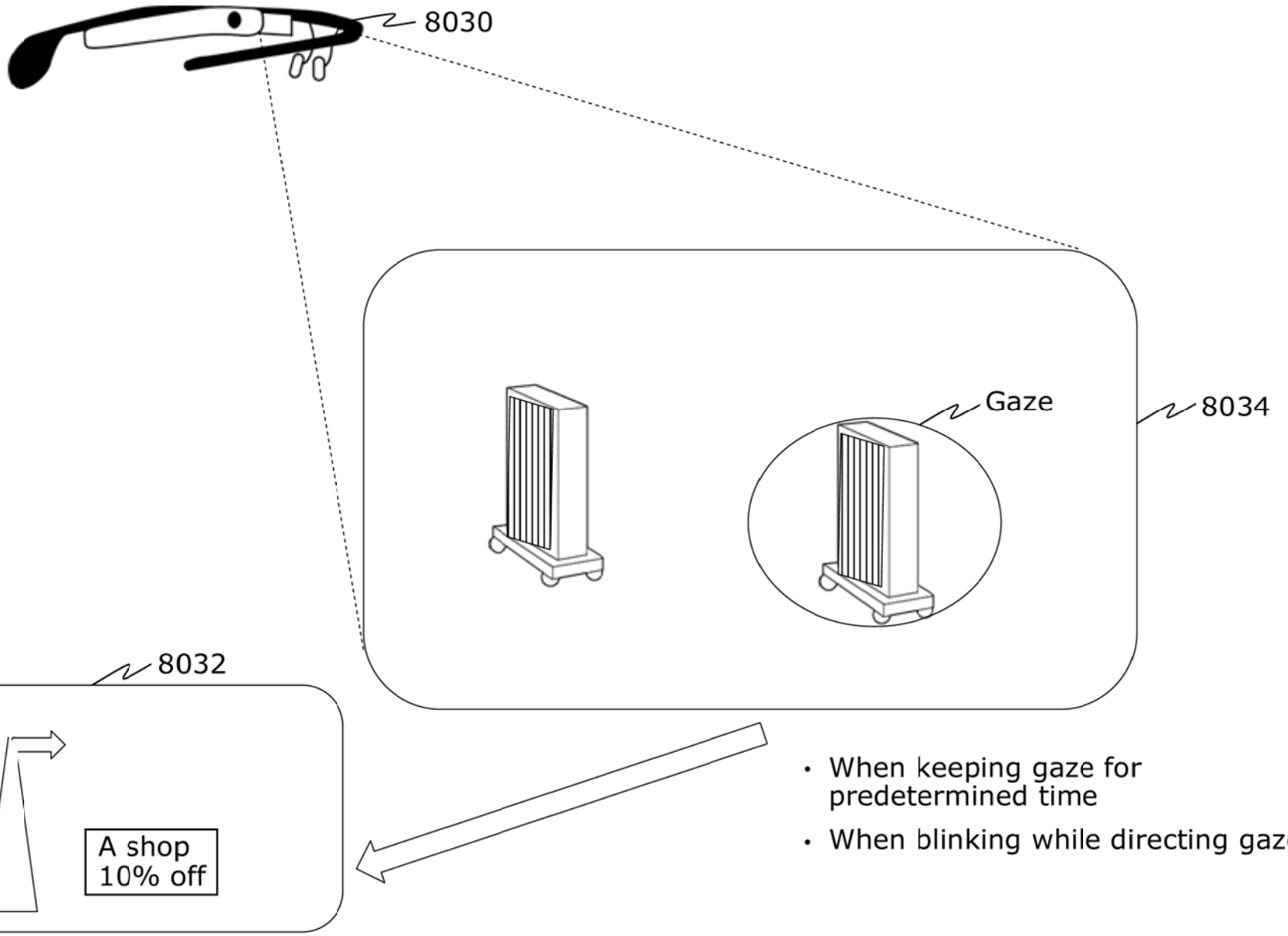

8030
Gaze
8034
8032
A shop
10% off
• When keeping gaze for predetermined time
• When blinking while directing gaze

FIG. 358

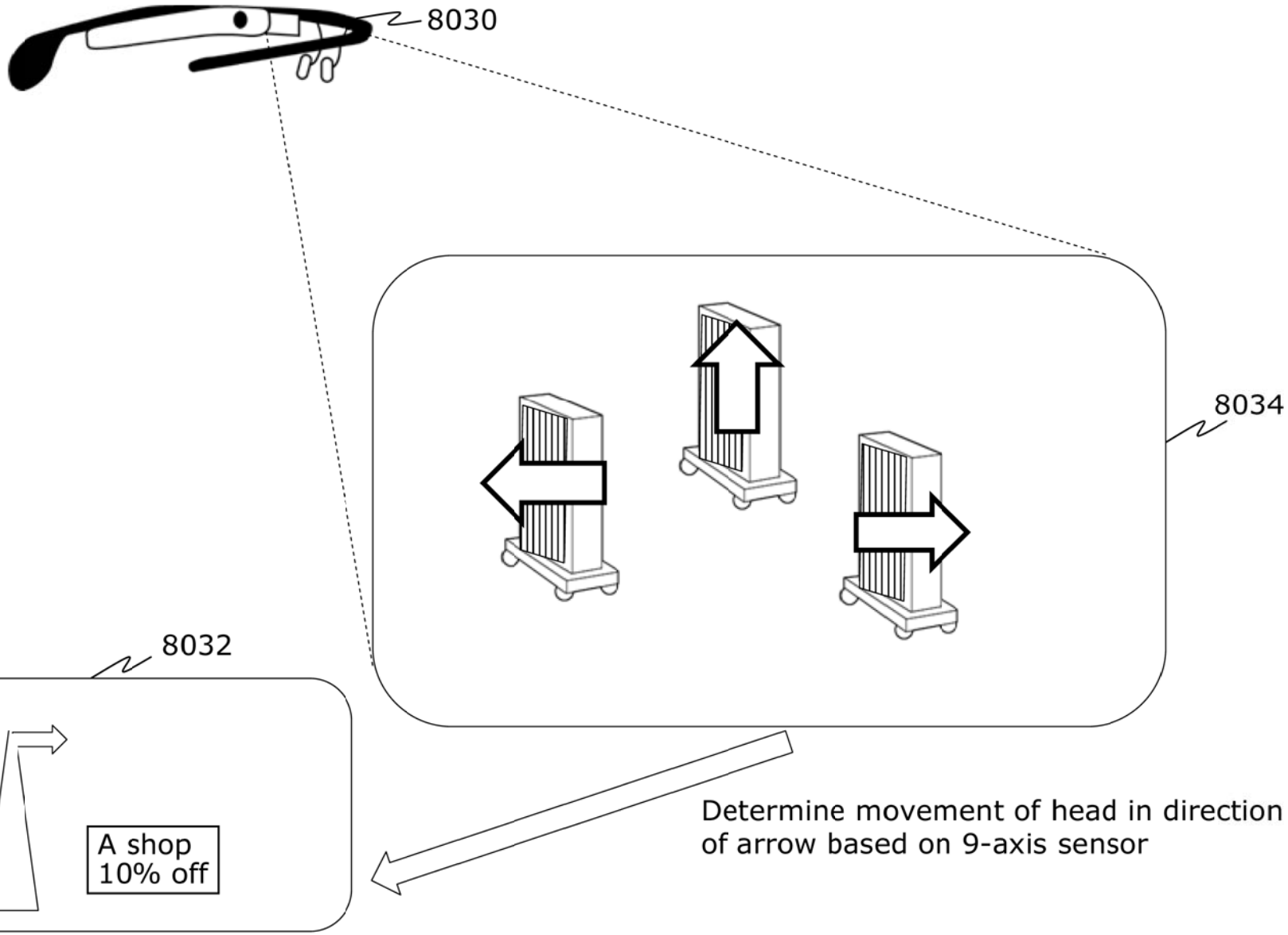

8030
8034
8032
A shop
10% off
Determine movement of head in direction
of arrow based on 9-axis sensor

FIG. 359A

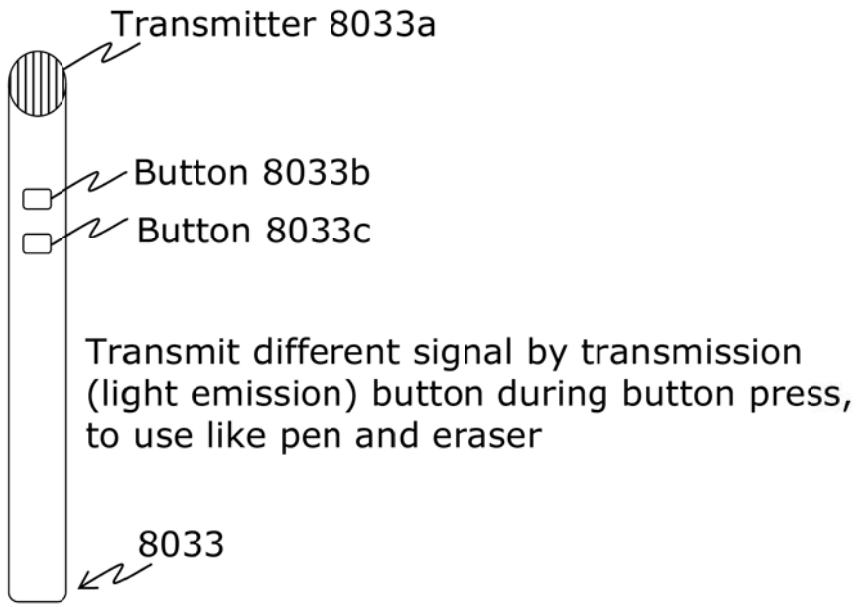

Transmitter 8033a
Button 8033b
Button 8033c
Transmit different signal by transmission (light emission) button during button press, to use like pen and eraser
8033

FIG. 359B

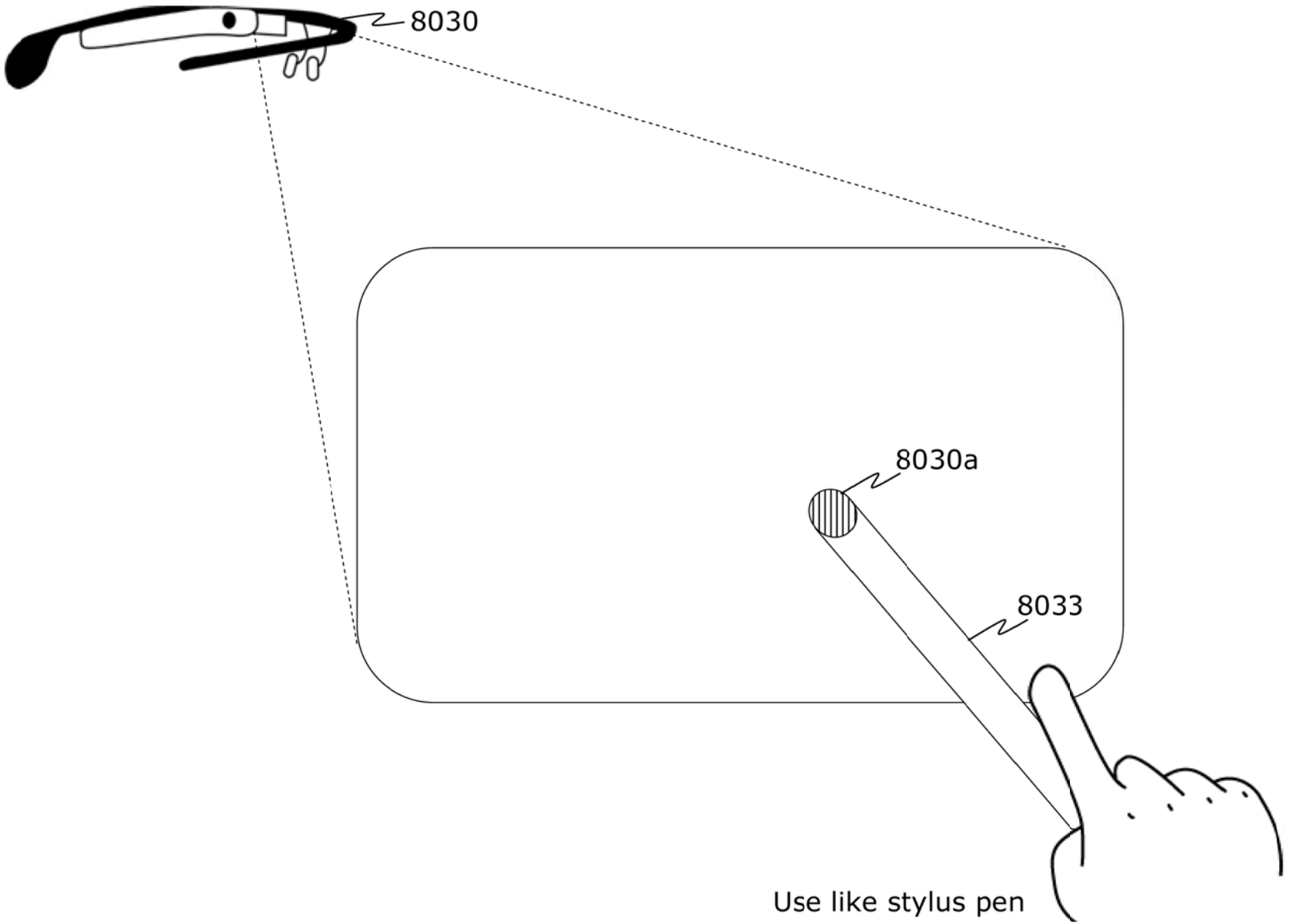


FIG. 360

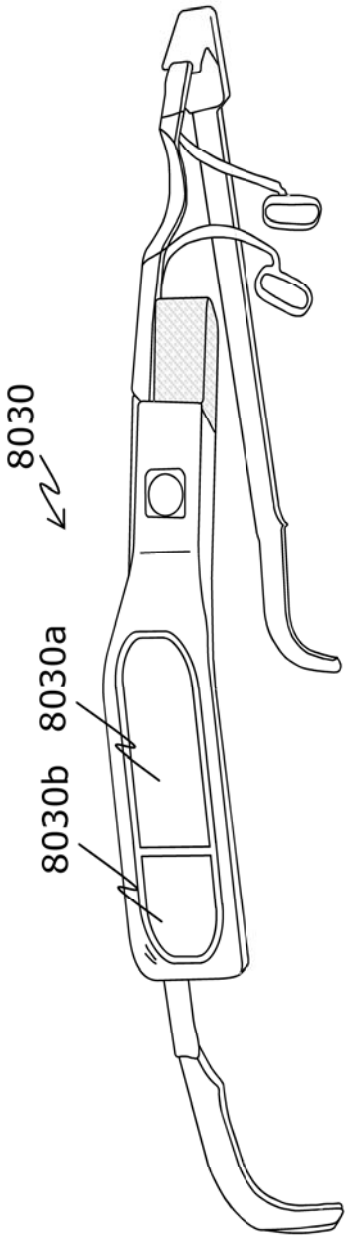


FIG. 361

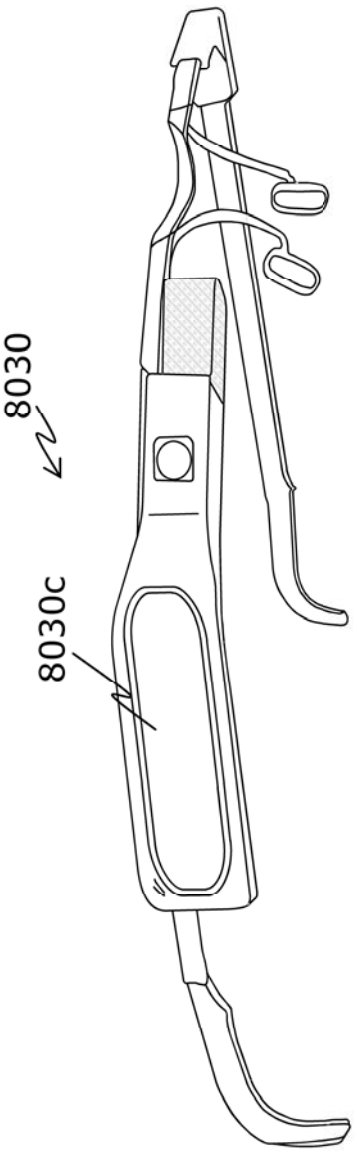


FIG. 362

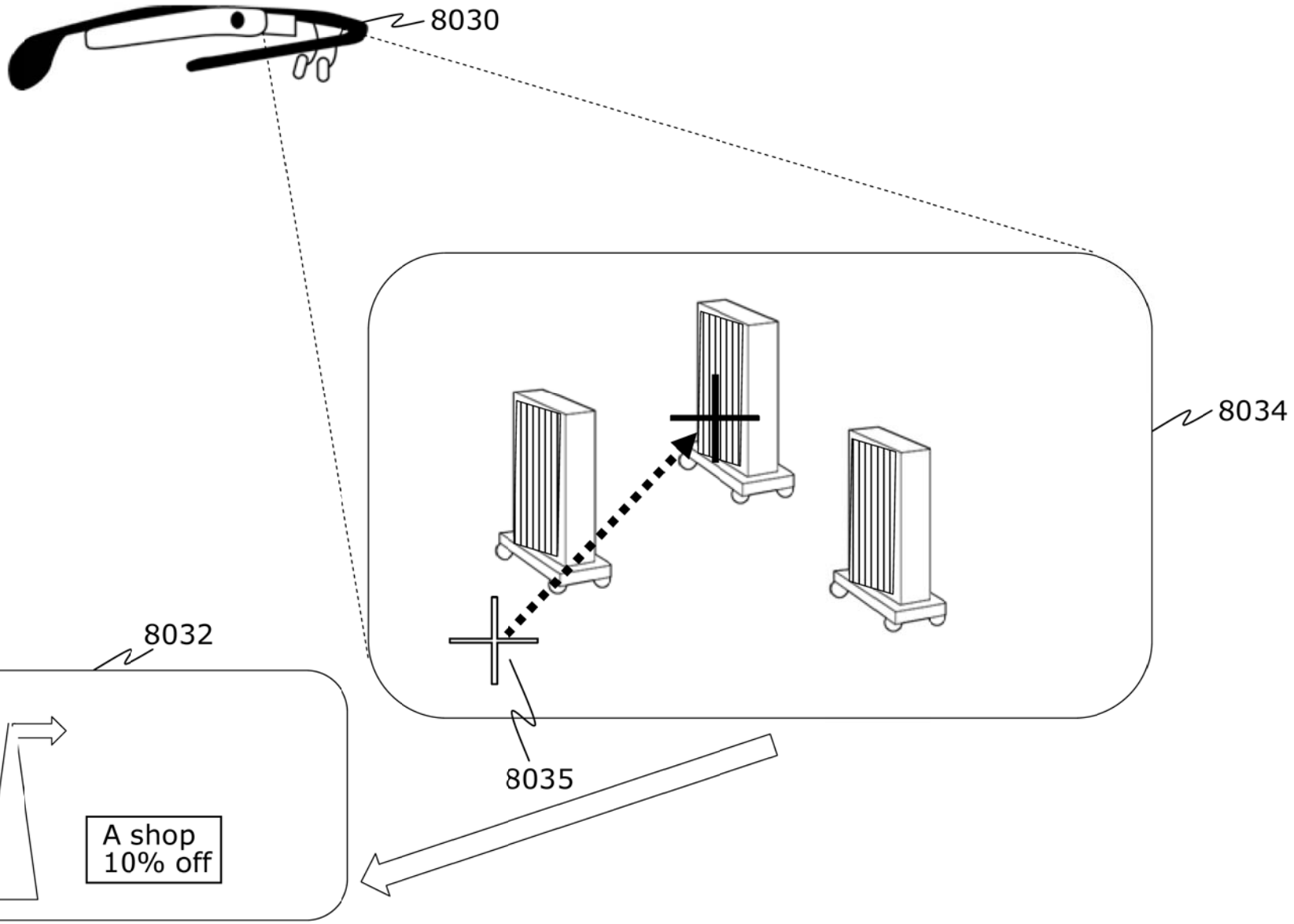


FIG. 363A

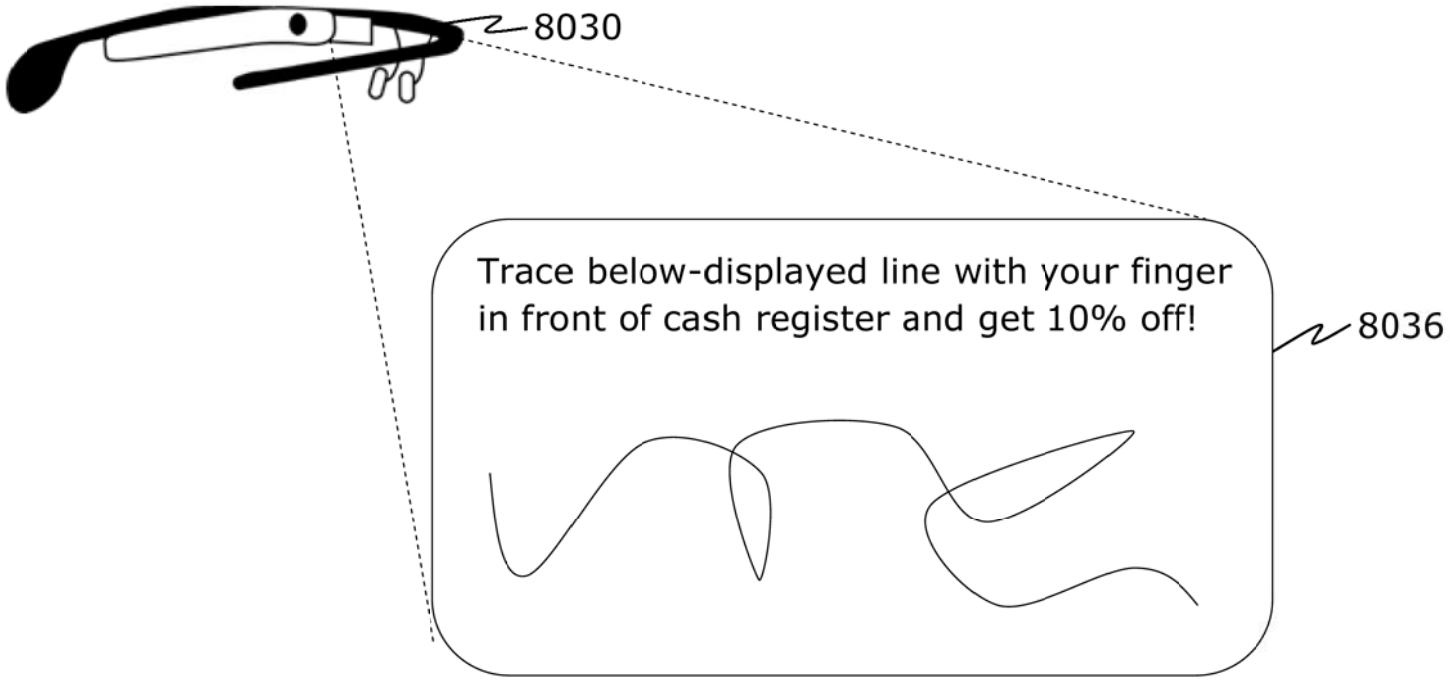


FIG. 363B

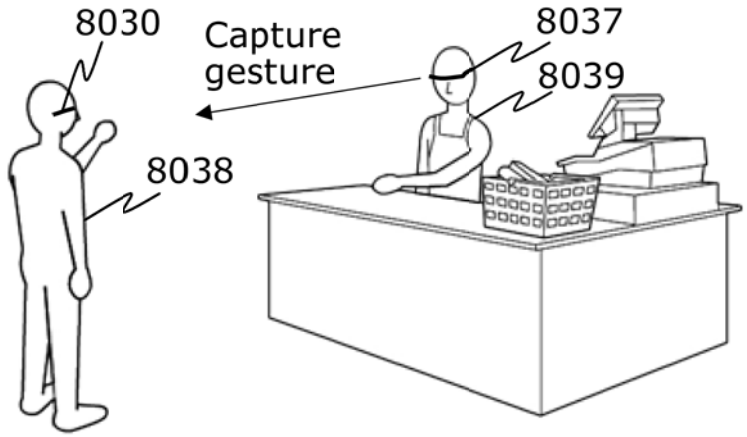


FIG. 364A

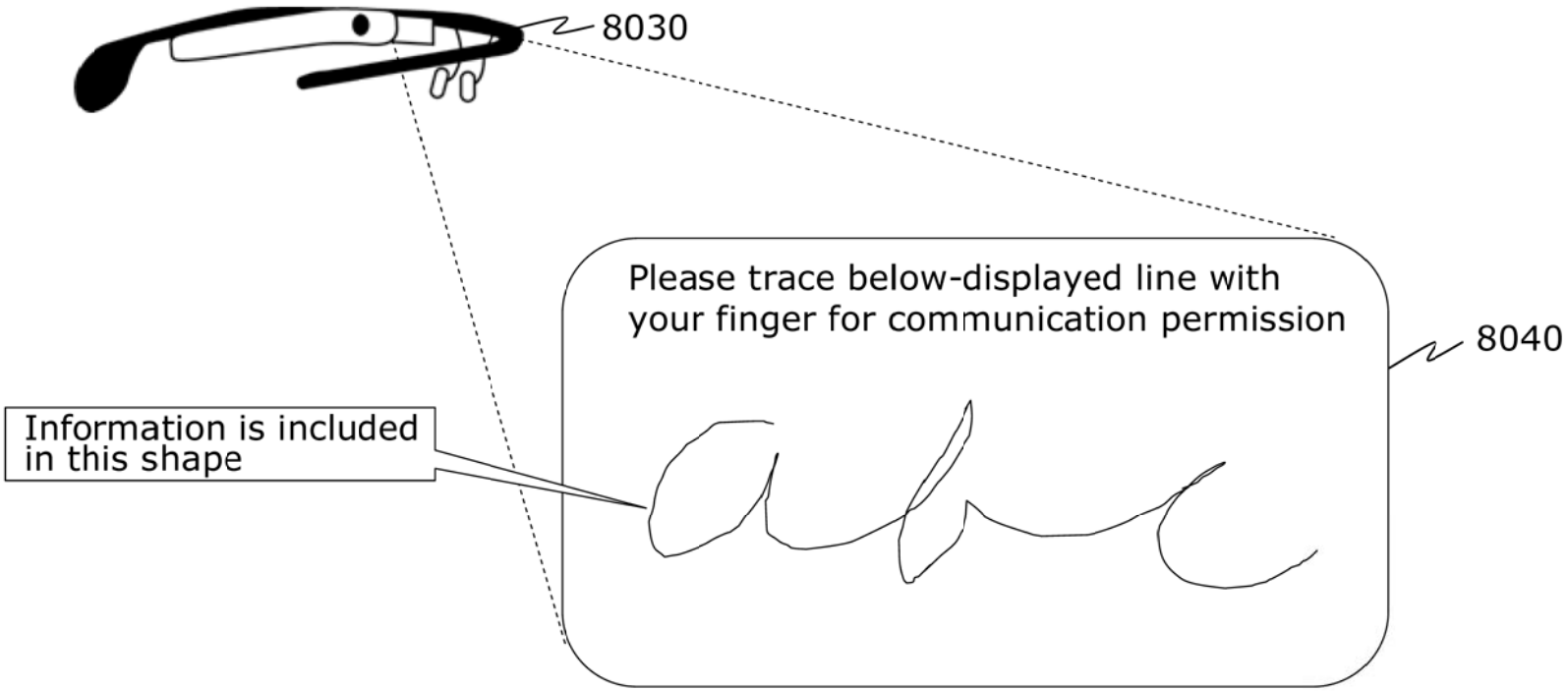


FIG. 364B

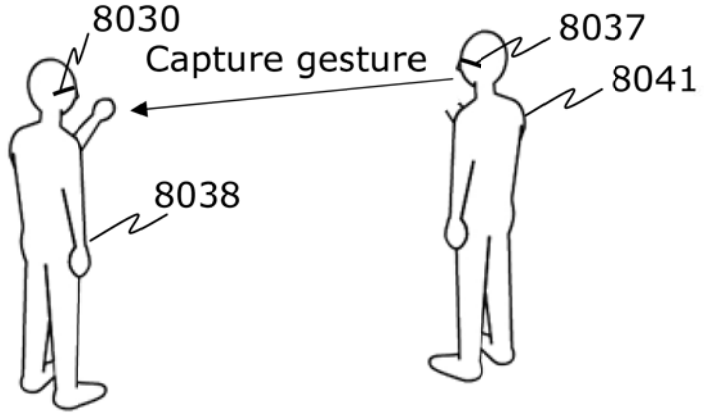
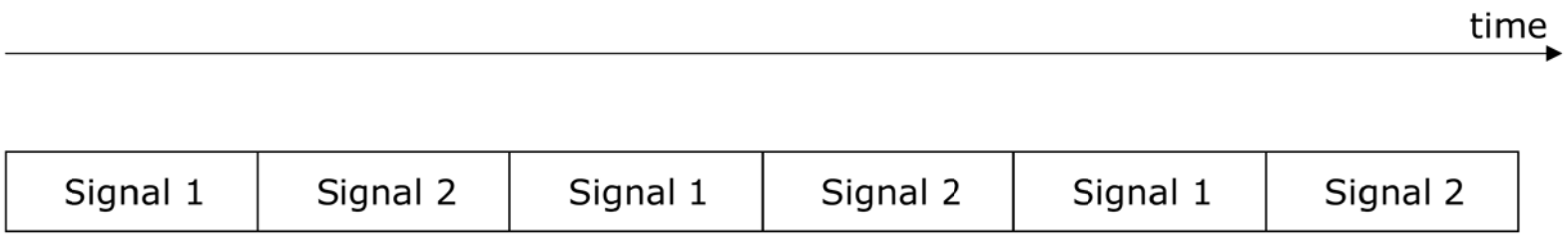


FIG. 365A



Alternately transmit signals of different types

FIG. 365B

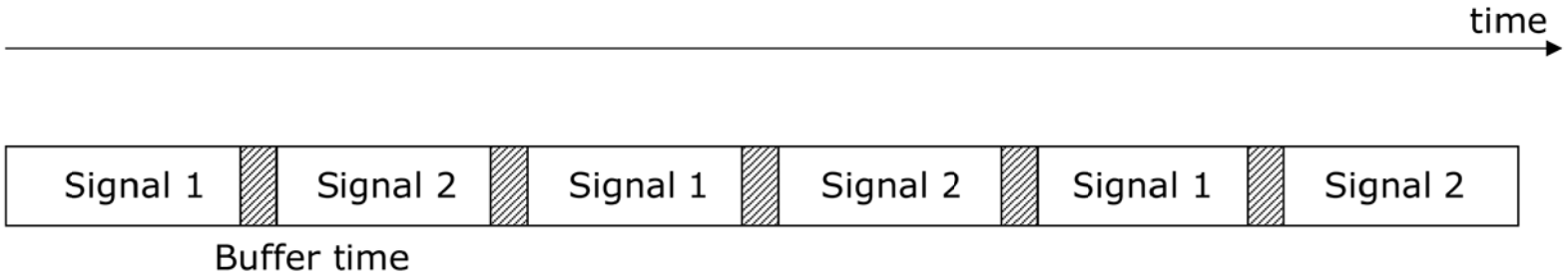


FIG. 366

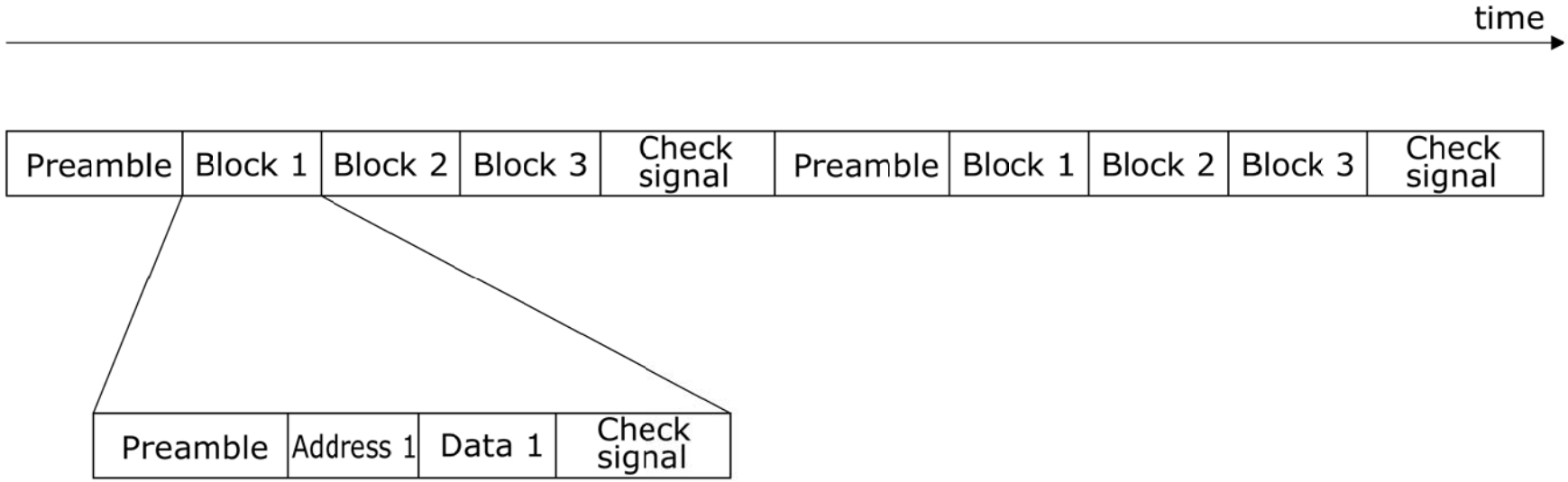

time
Preamble
Block 1
Block 2
Block 3
Check signal
Preamble
Block 1
Block 2
Block 3
Check signal
Preamble
Address 1
Data 1
Check signal

FIG. 367

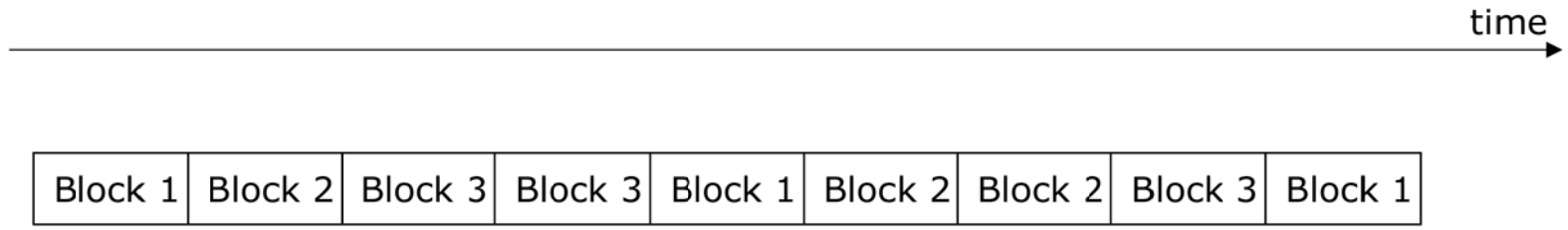
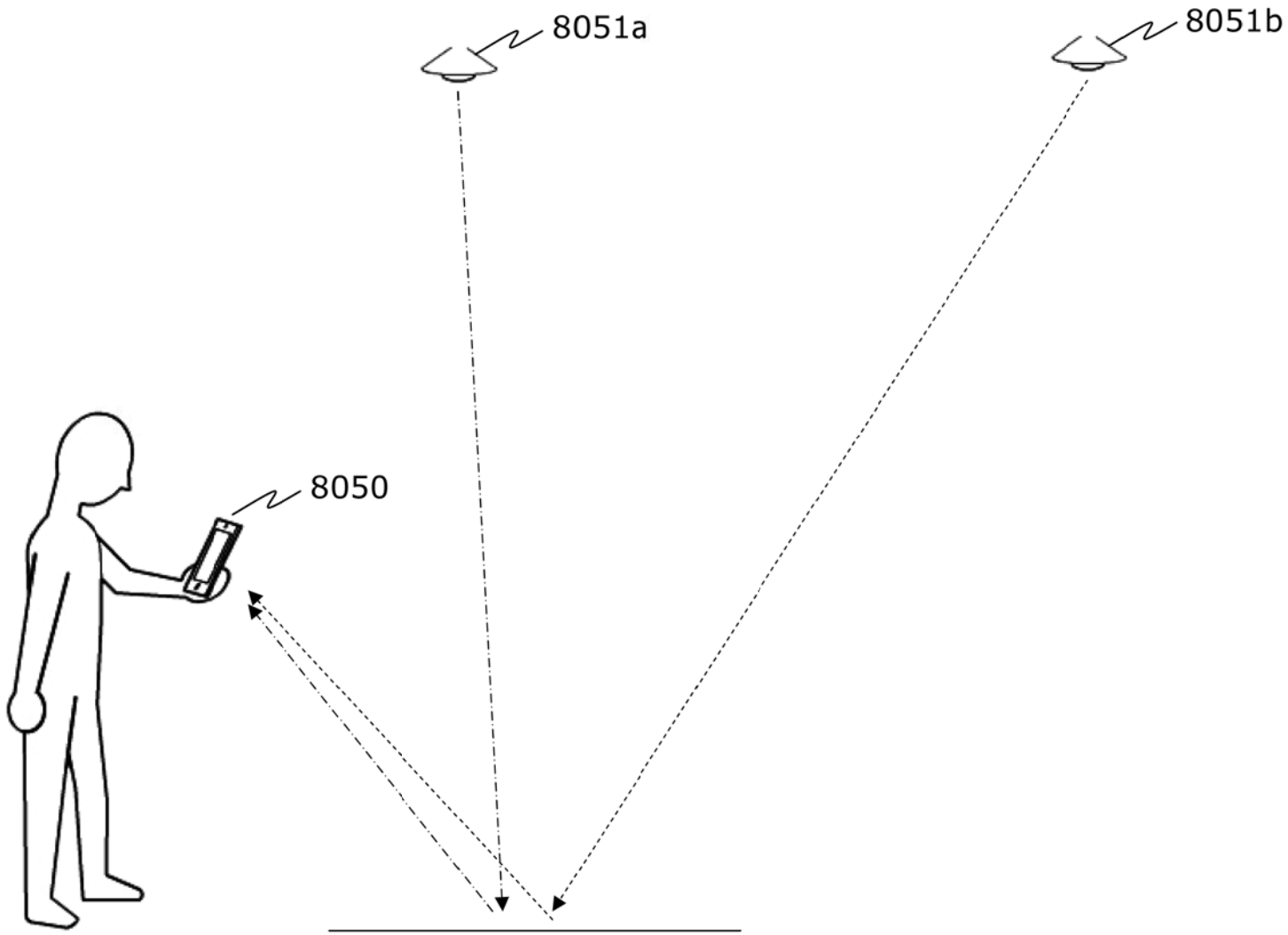
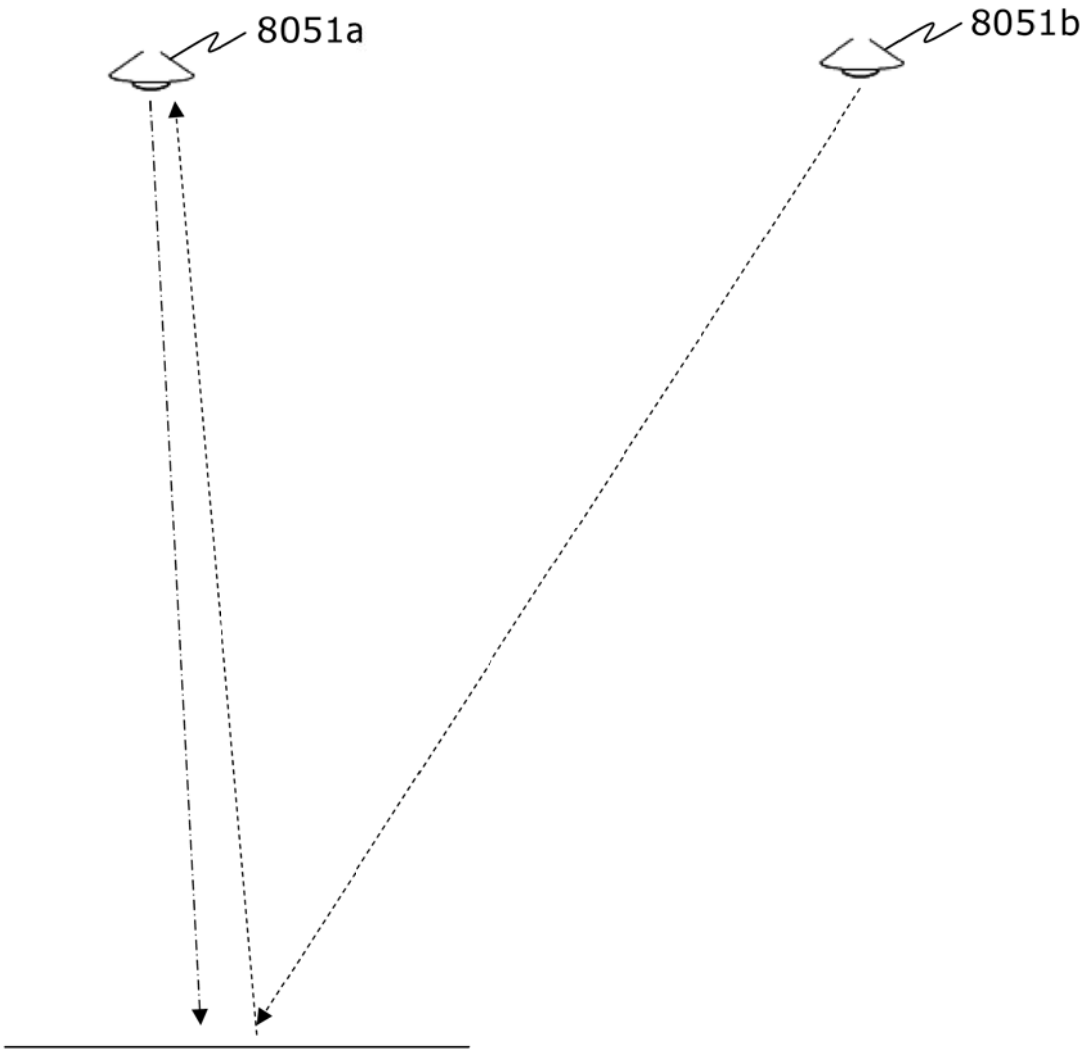

time
Block 1
Block 2
Block 3
Block 3
Block 1
Block 2
Block 2
Block 3
Block 1

FIG. 368



Nearby positioned transmitters can be received without interference by transmitting signals of different frequencies or protocols

FIG. 369



Transmitter receives signal from other transmitter, and changes transmission protocol or transmits signal in period during which other transmitter is not transmitting signal, to prevent its transmission signal from interfering with transmission signal from other transmitter

FIG. 370

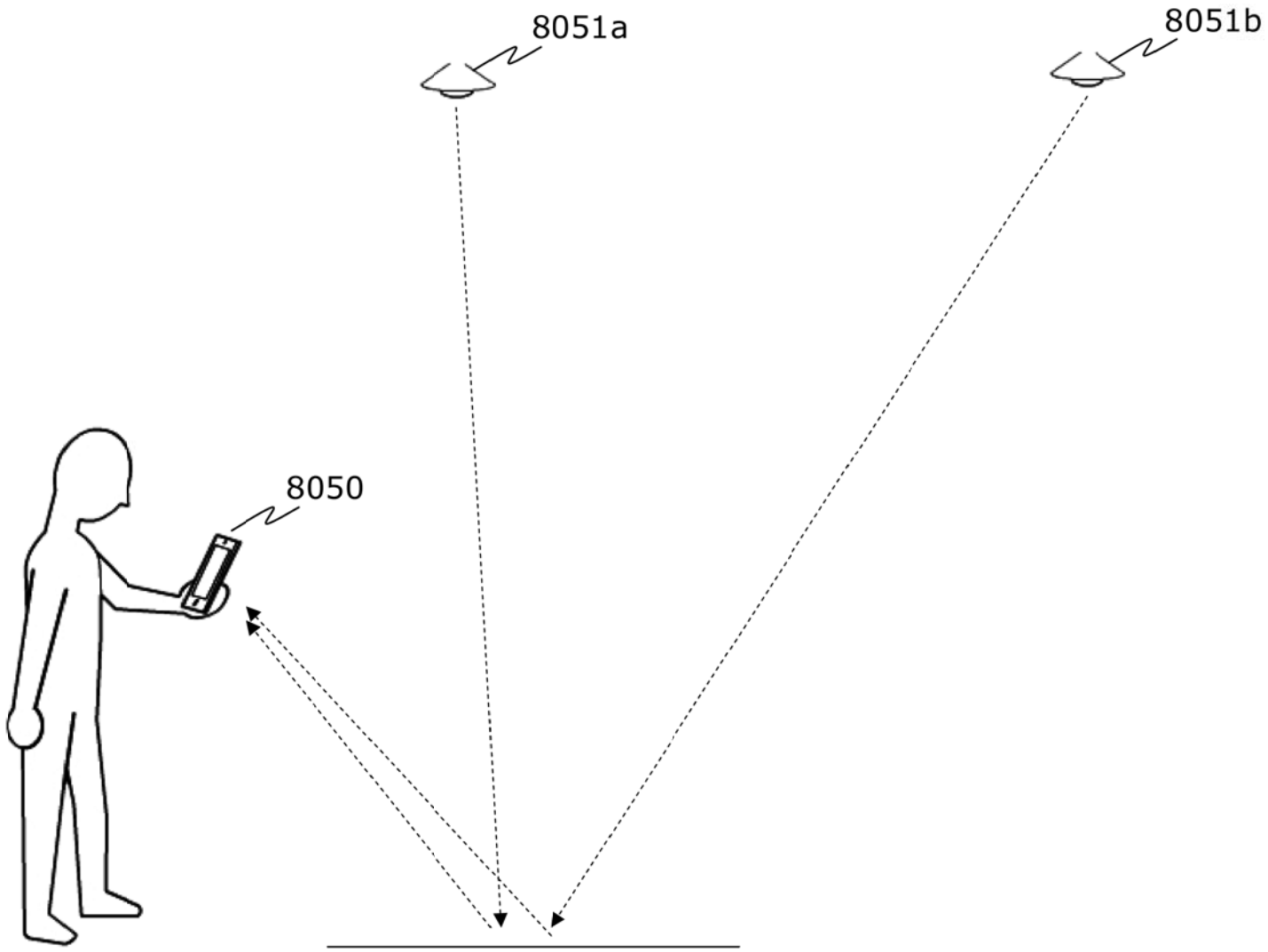

8051a
8051b
8050
Receive mixed luminance changes separately according to signal strength

FIG. 371

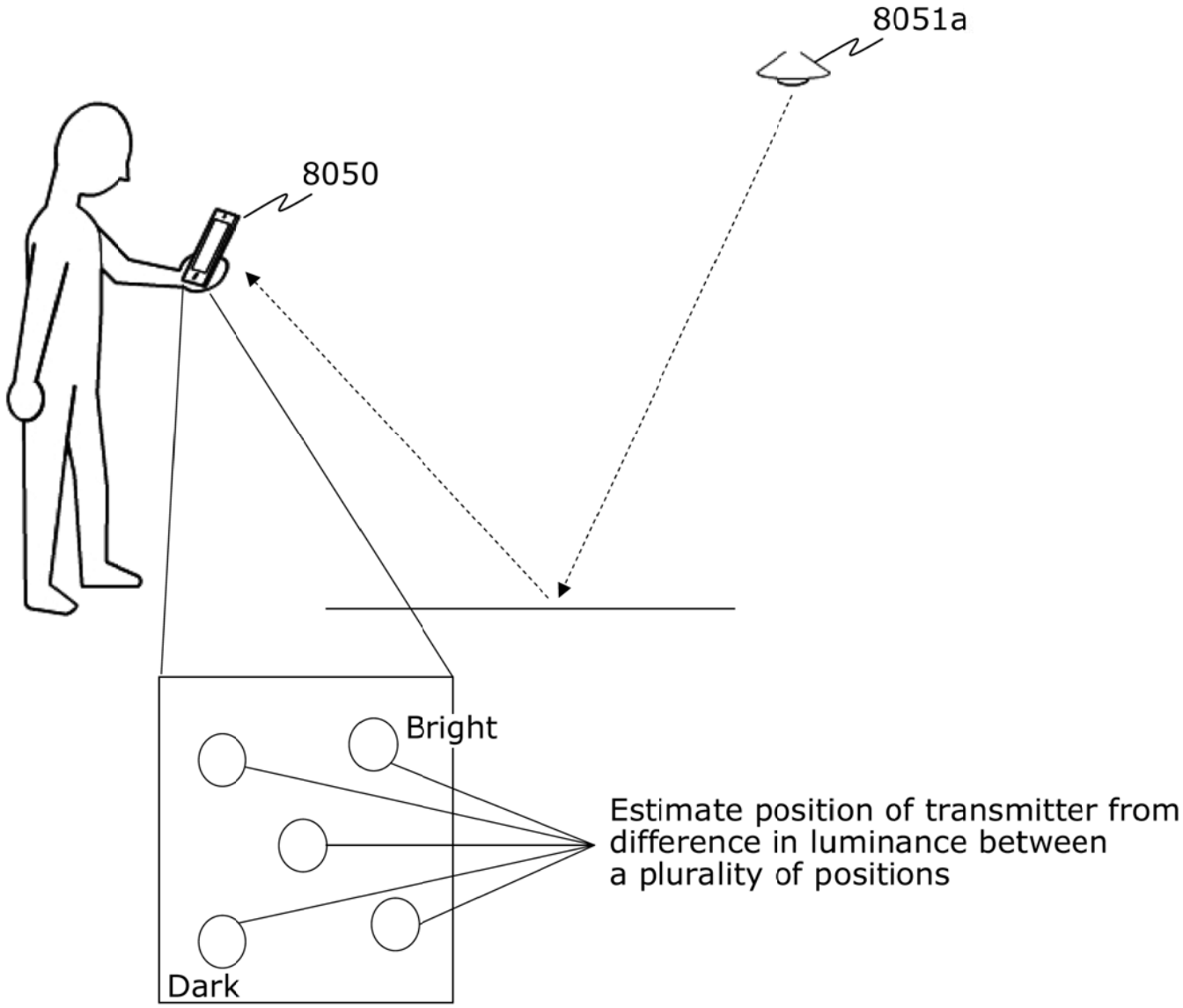

8051a
8050
Bright
Dark
Estimate position of transmitter from
difference in luminance between
a plurality of positions

FIG. 372

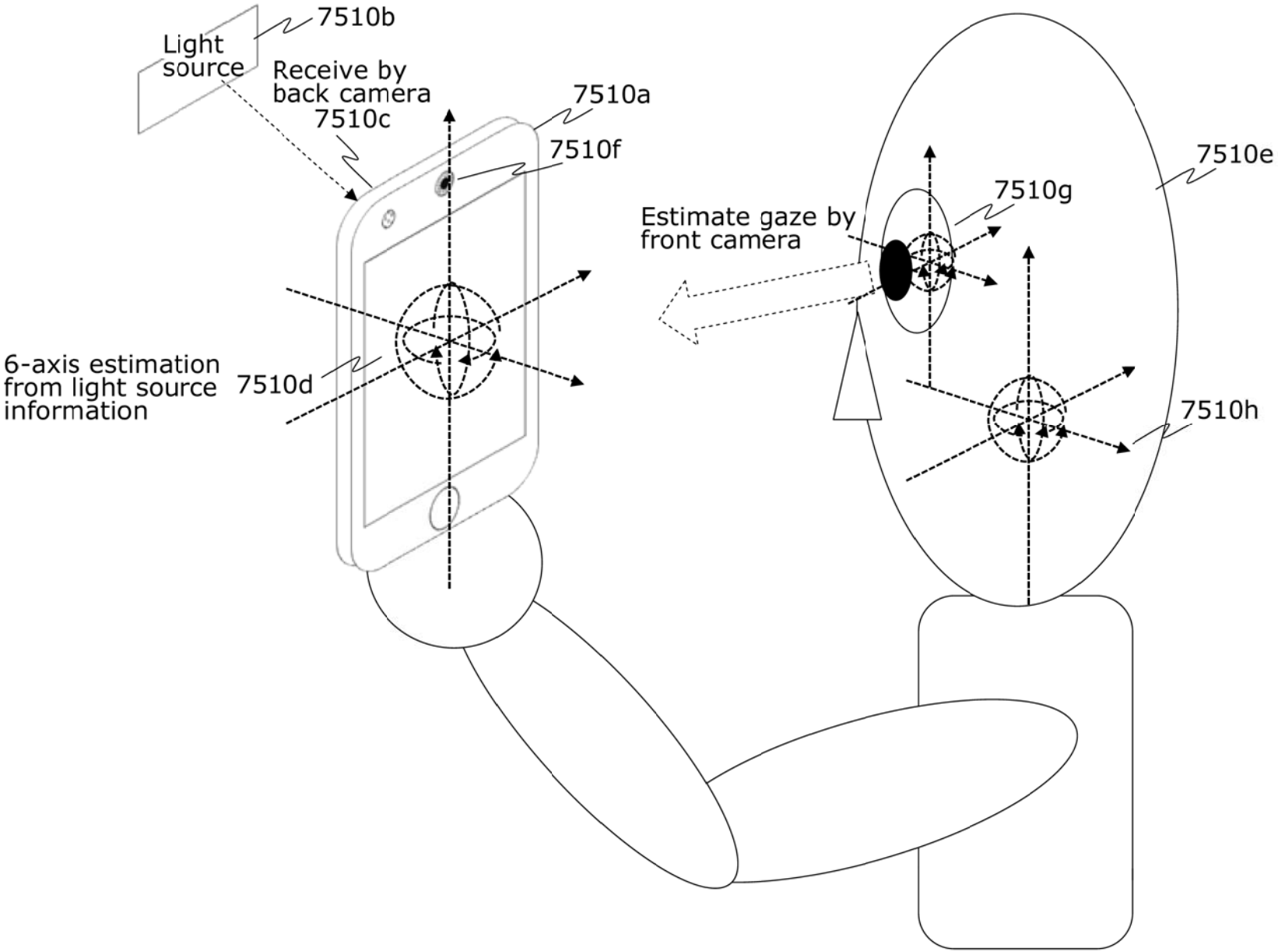

Light source
7510b
Receive by back camera
7510c
7510a
7510f
6-axis estimation from light source information
7510d
Estimate gaze by front camera
7510g
7510e
7510h

FIG. 373

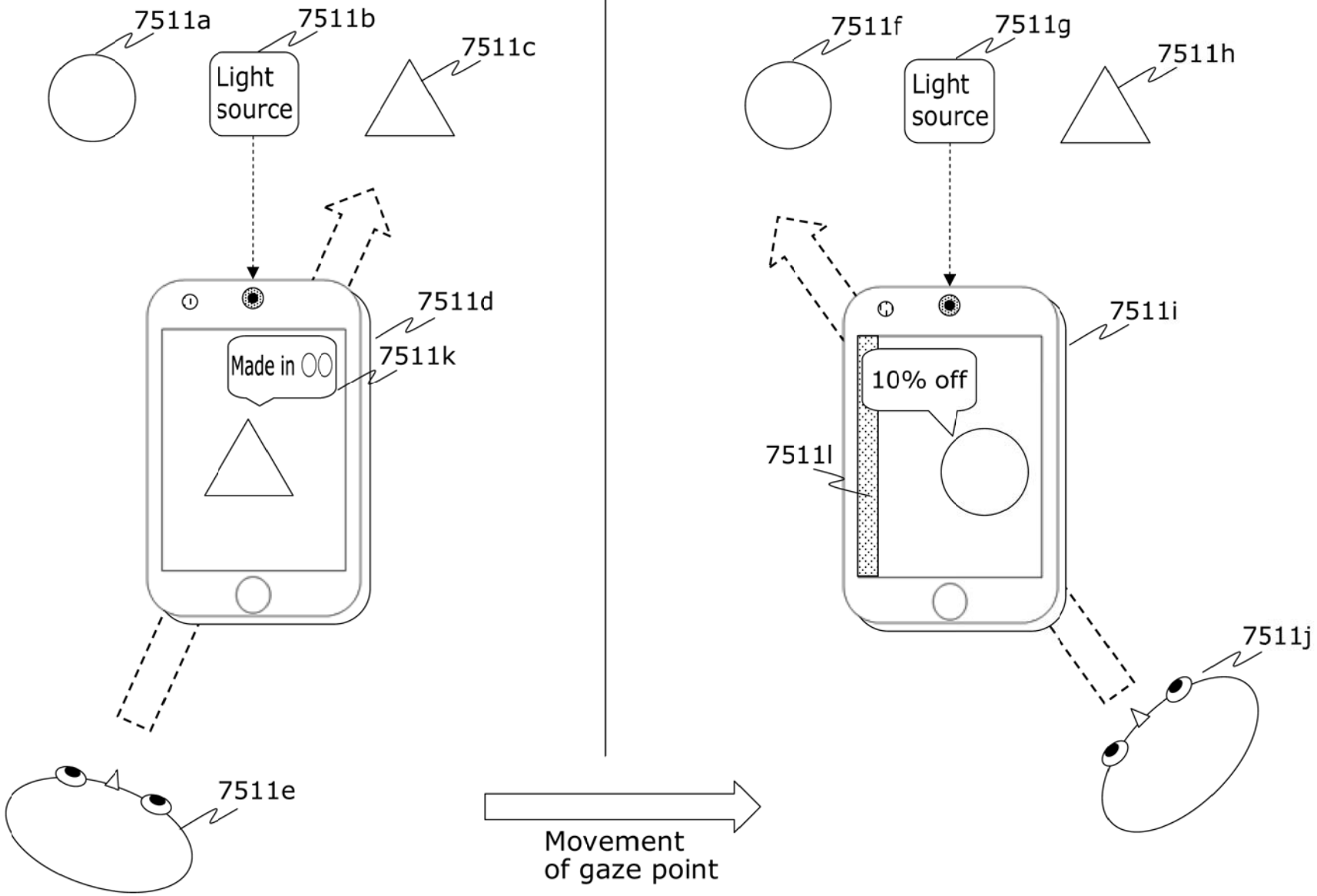

7511a
7511b
Light source
7511c
7511d
Made in
7511k
7511e
Movement of gaze point
7511f
7511g
Light source
7511h
7511i
10% off
7511l
7511j

FIG. 374

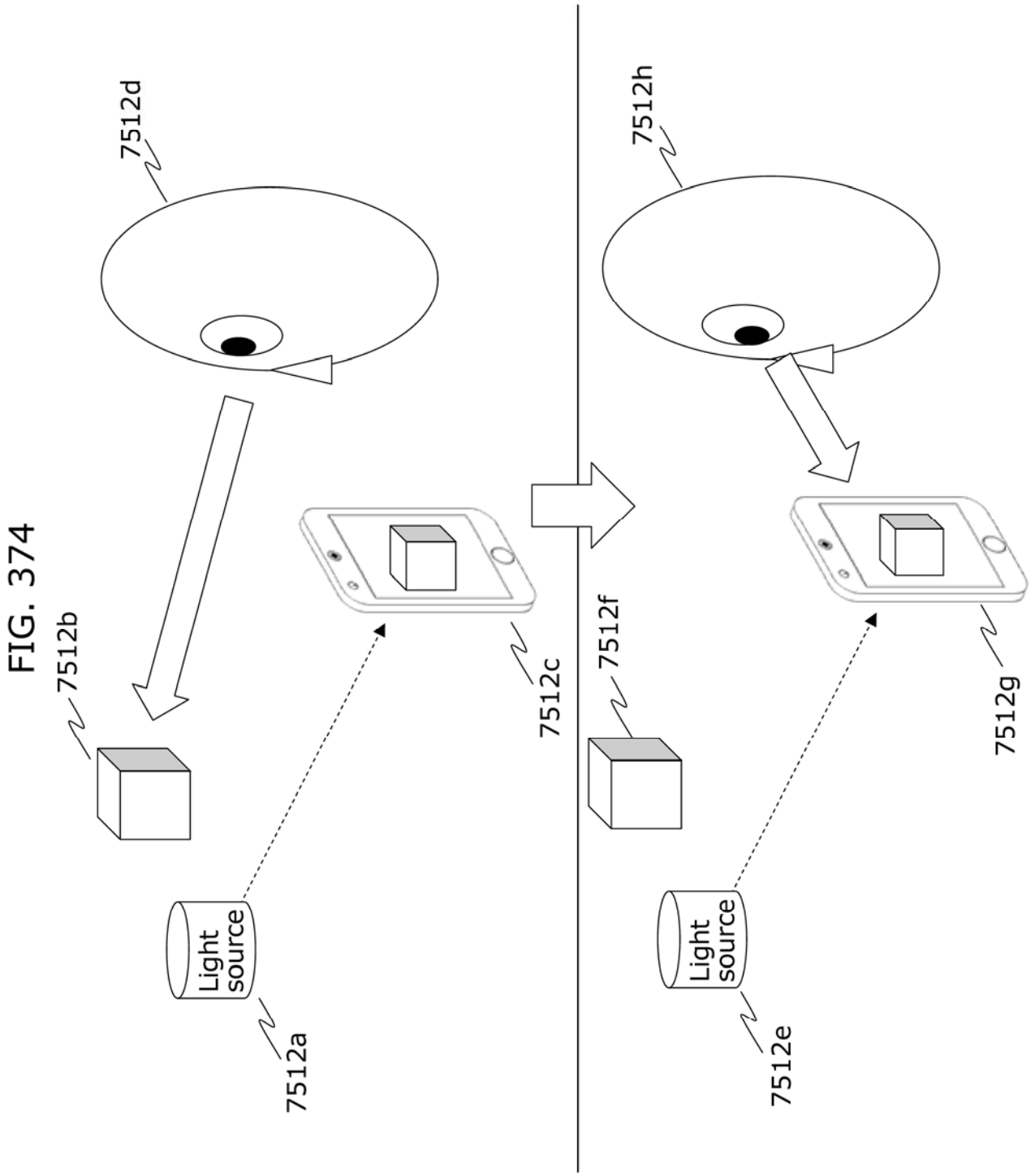

7512d
7512h
7512b
7512c
7512f
7512g
Light source
Light source
7512a
7512e

FIG. 375

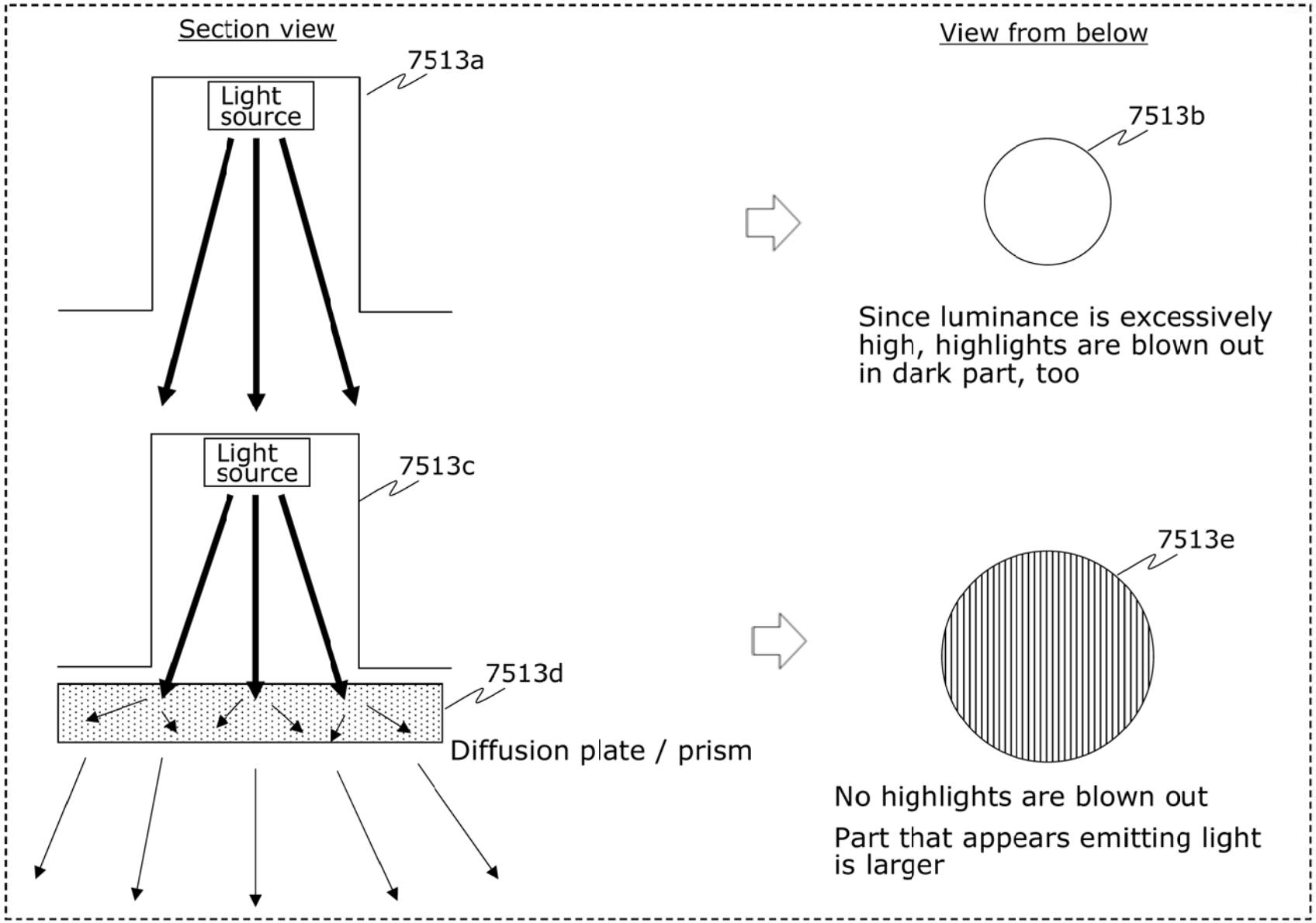

Section view
7513a
Light source
7513c
Light source
7513d
Diffusion plate / prism
View from below
7513b
Since luminance is excessively high, highlights are blown out in dark part, too
7513e
No highlights are blown out
Part that appears emitting light is larger

FIG. 376

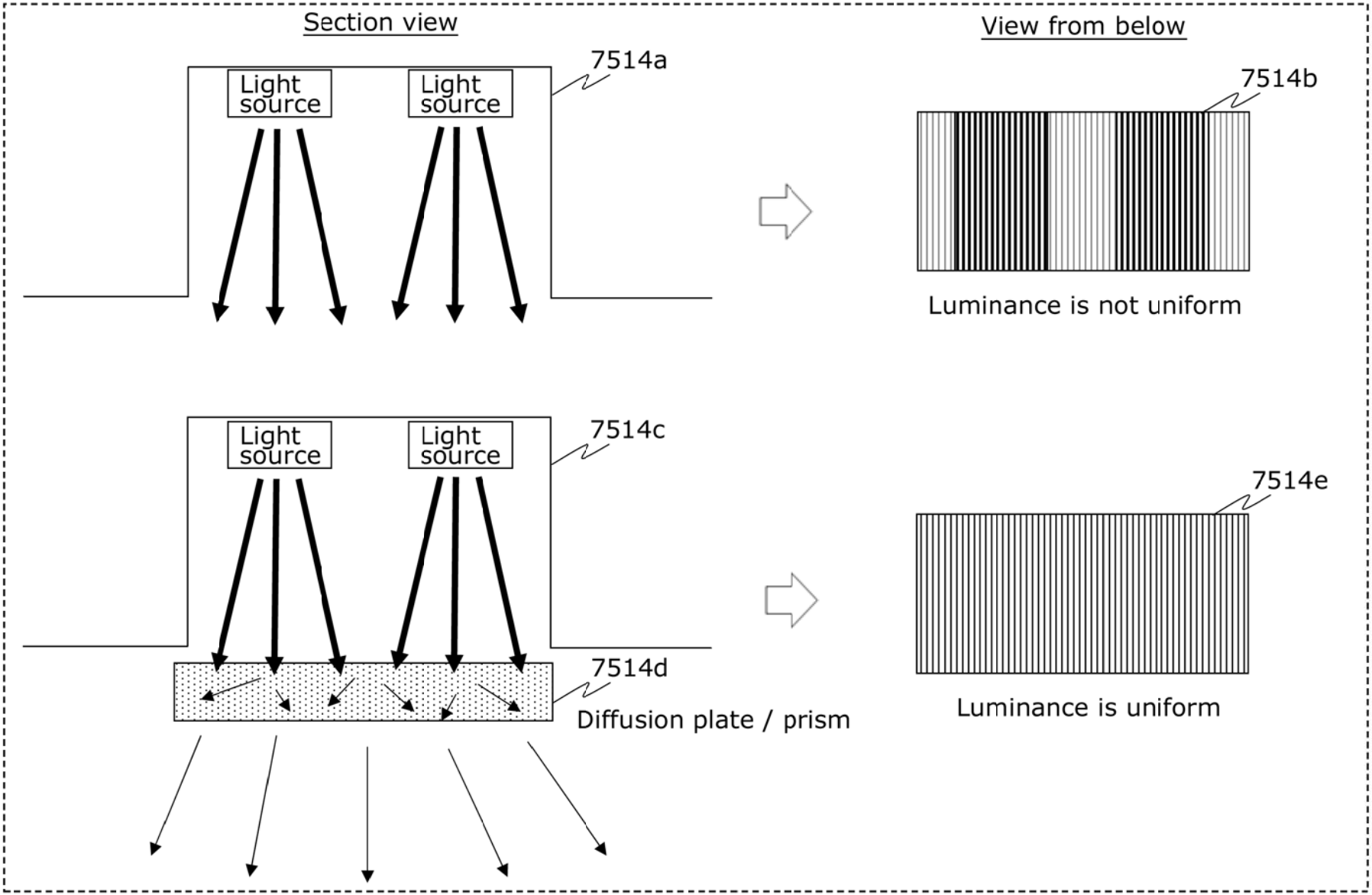

401/432
Section view
View from below
7514a
Light source
Light source
7514b
Luminance is not uniform
7514c
Light source
Light source
7514e
7514d
Diffusion plate / prism
Luminance is uniform

FIG. 377

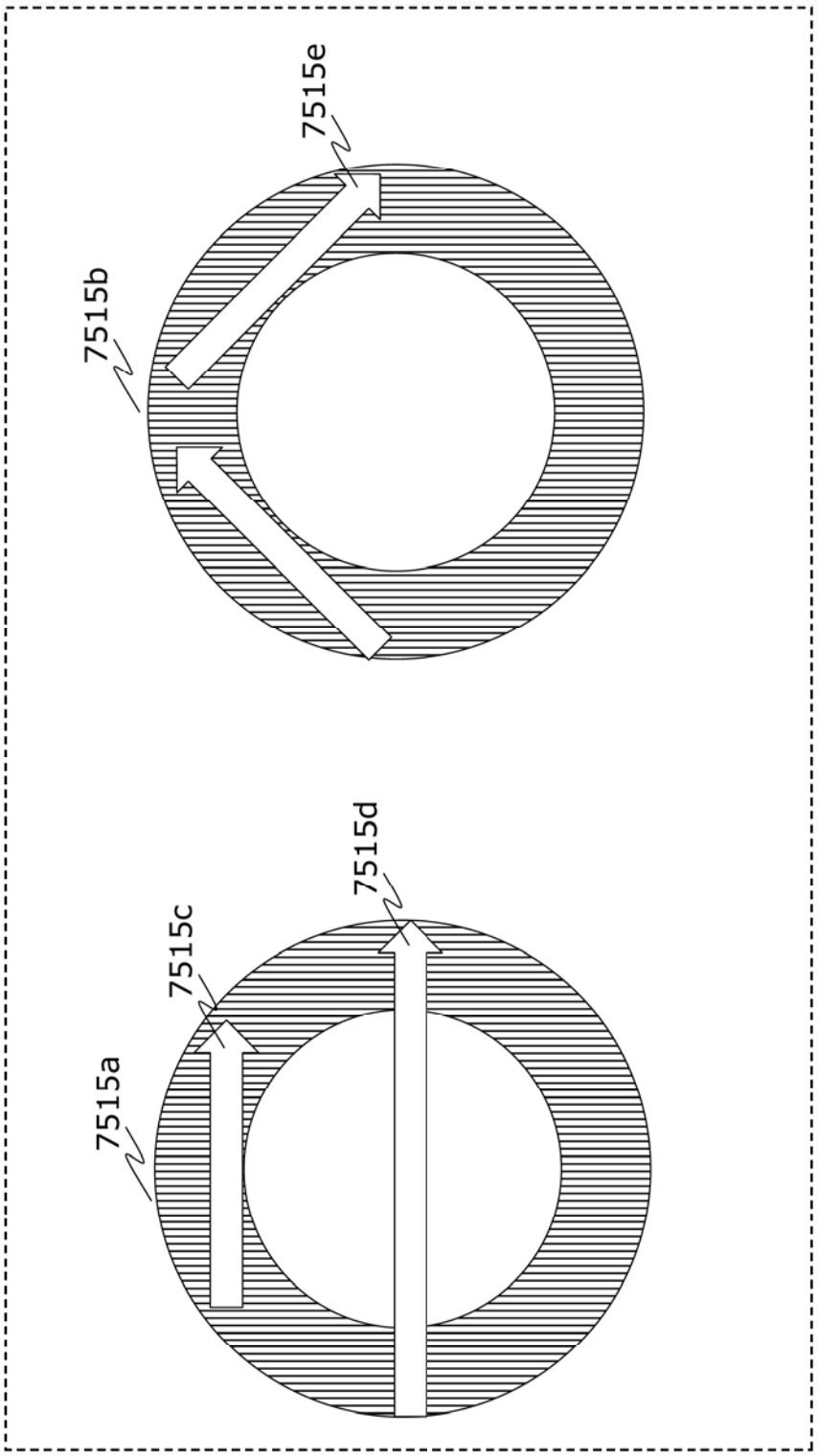


FIG. 378

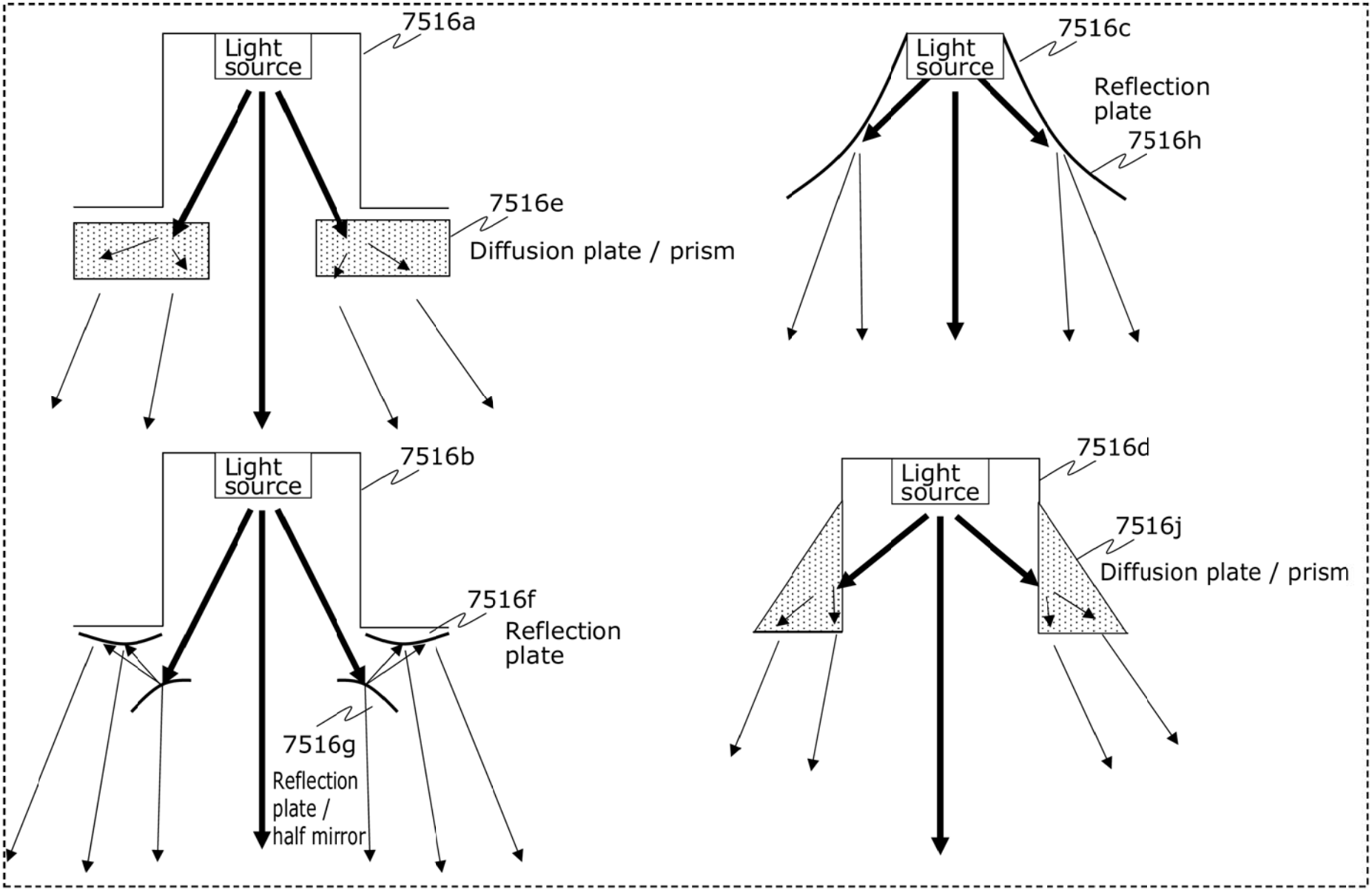

403/432
Light source
7516a
7516e
Diffusion plate / prism
Light source
7516c
Reflection plate
7516h
Light source
7516b
7516f
Reflection plate
7516g
Reflection plate / half mirror
Light source
7516d
7516j
Diffusion plate / prism

FIG. 379

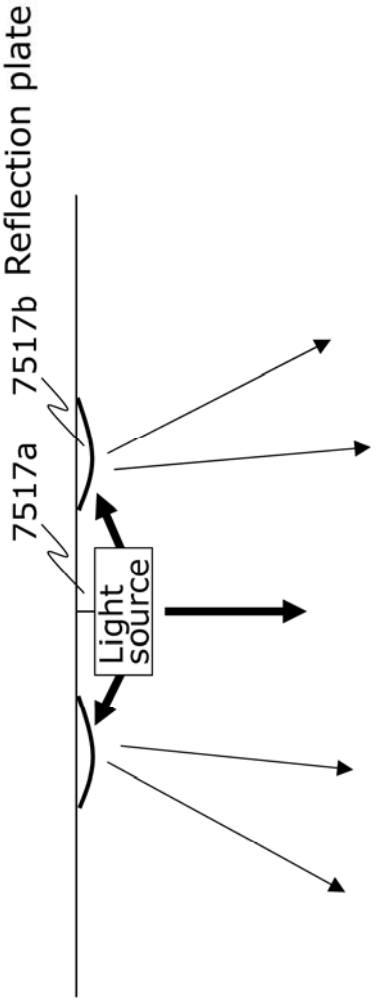


FIG. 380

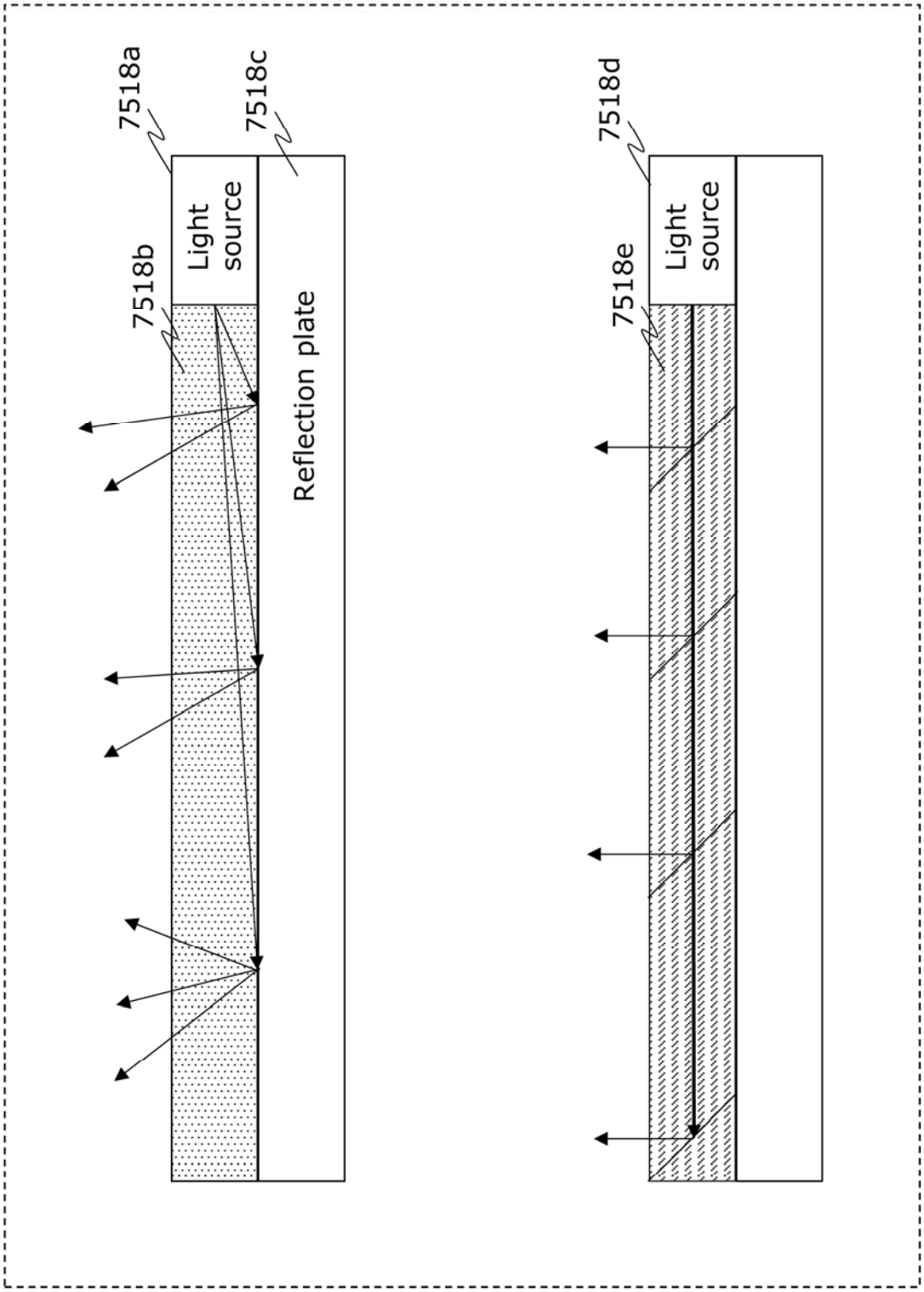
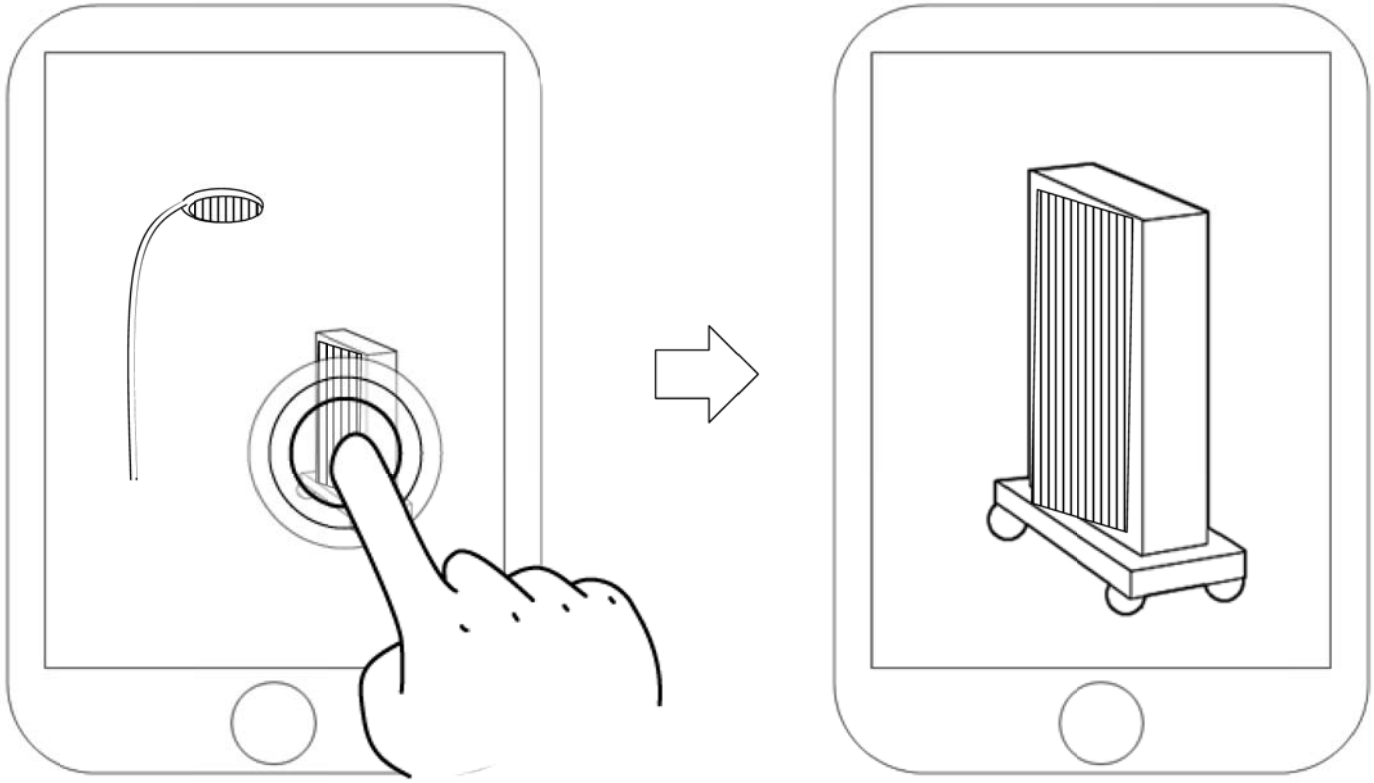
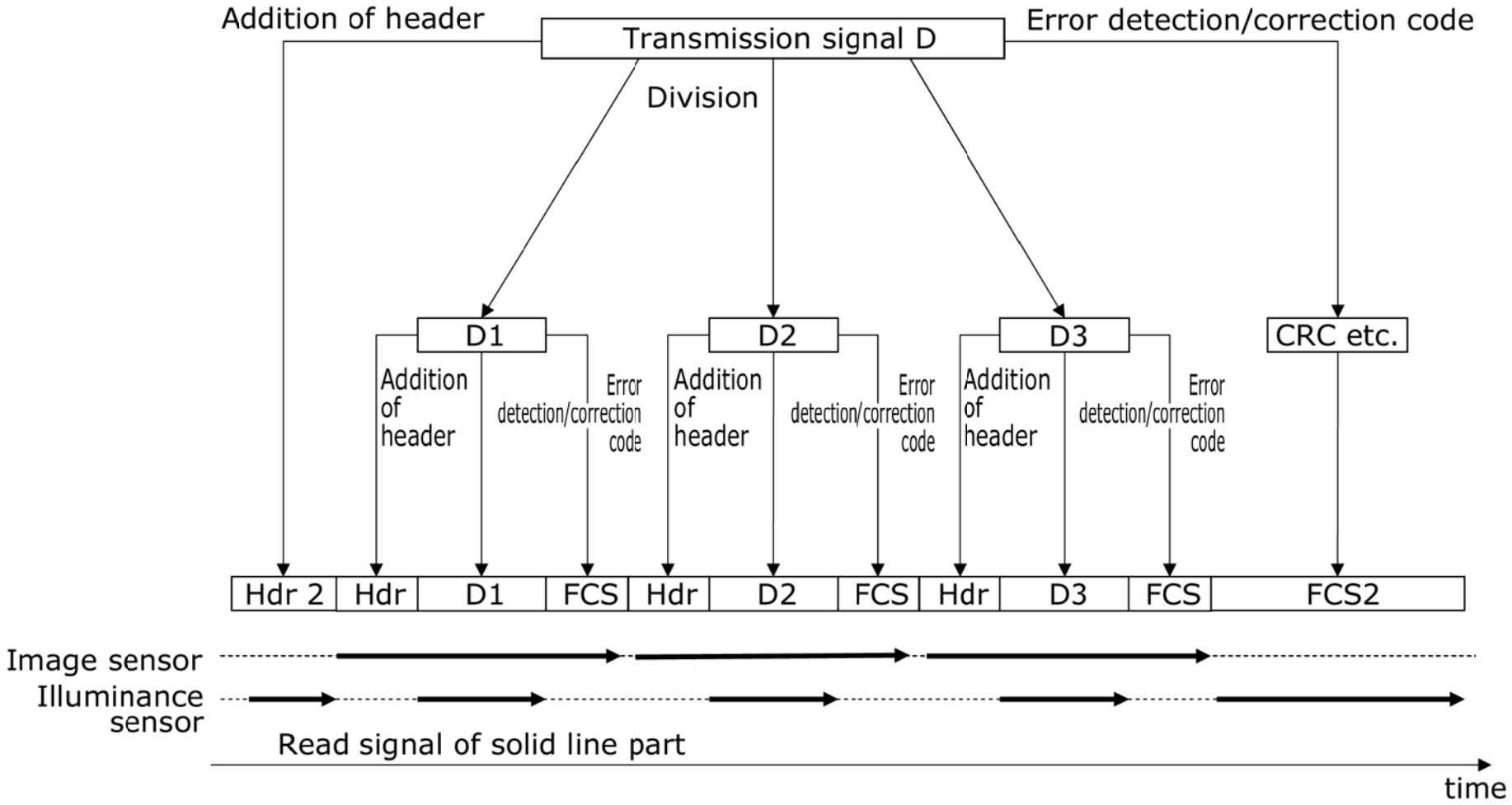

7518a
7518c
Light source
7518b
Reflection plate
7518d
Light source
7518e

FIG. 381



Zoom in and receive signal

FIG. 382



Hdr: Header
FCS: Frame check sequence

FIG. 383

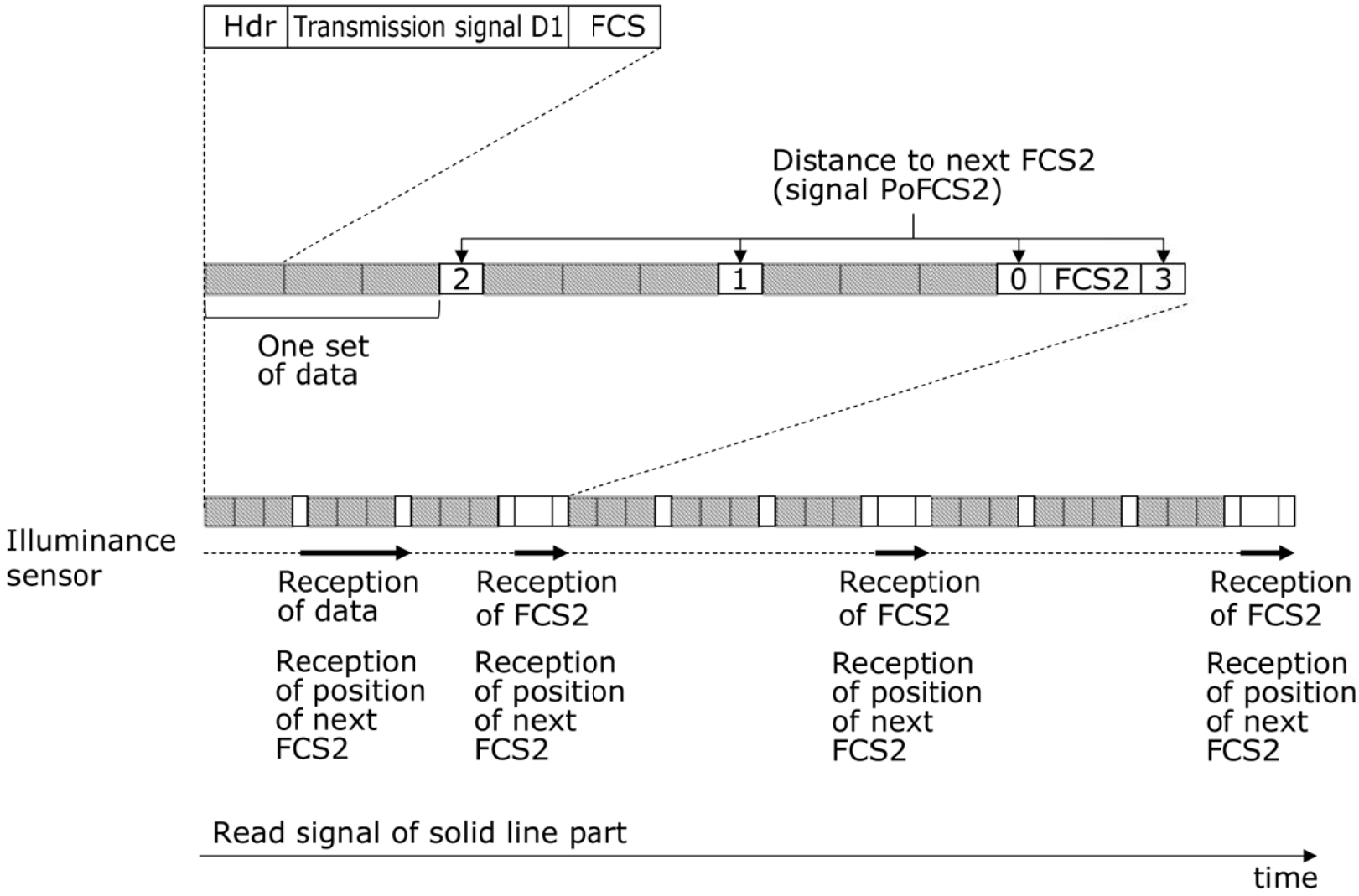

Hdr
Transmission signal D1
FCS
Distance to next FCS2
(signal PoFCS2)
2
1
0
FCS2
3
One set
of data
Illuminance
sensor
Reception
of data
Reception
of FCS2
Reception
of FCS2
Reception
of FCS2
Reception
of position
of next
FCS2
Reception
of position
of next
FCS2
Reception
of position
of next
FCS2
Reception
of position
of next
FCS2
Read signal of solid line part
time

FIG. 384A

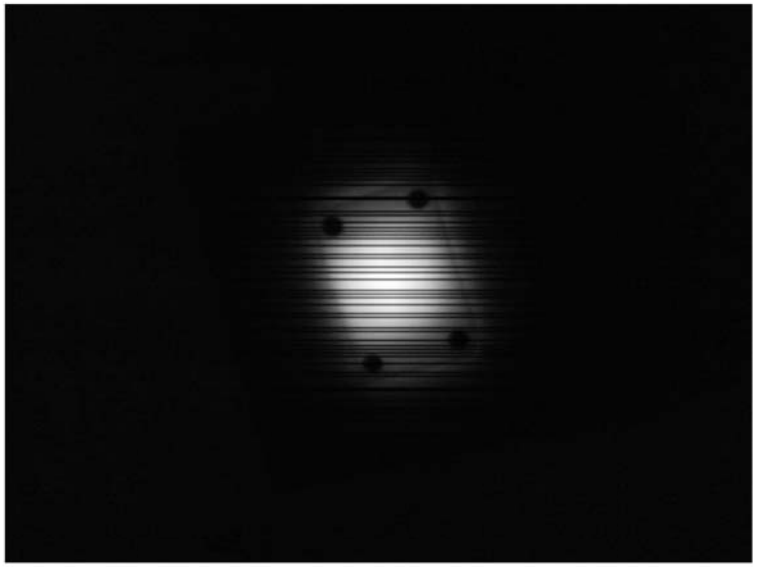


FIG. 384B

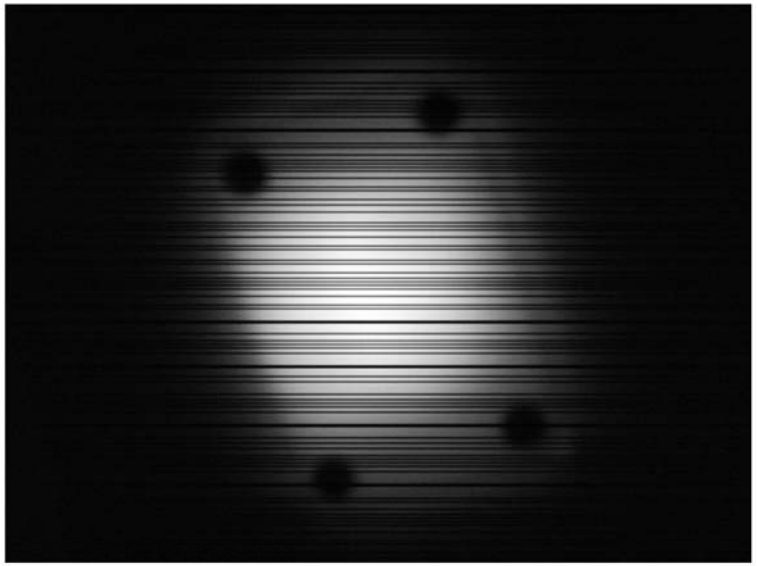


FIG. 384C

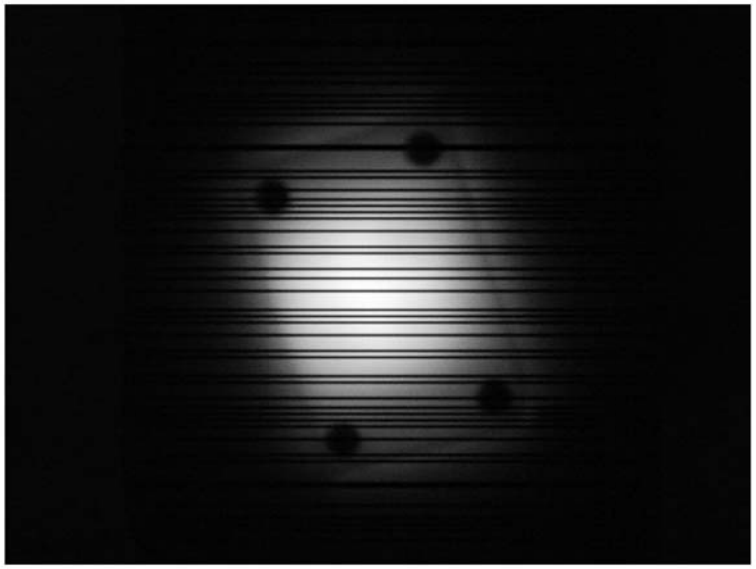


FIG. 385A

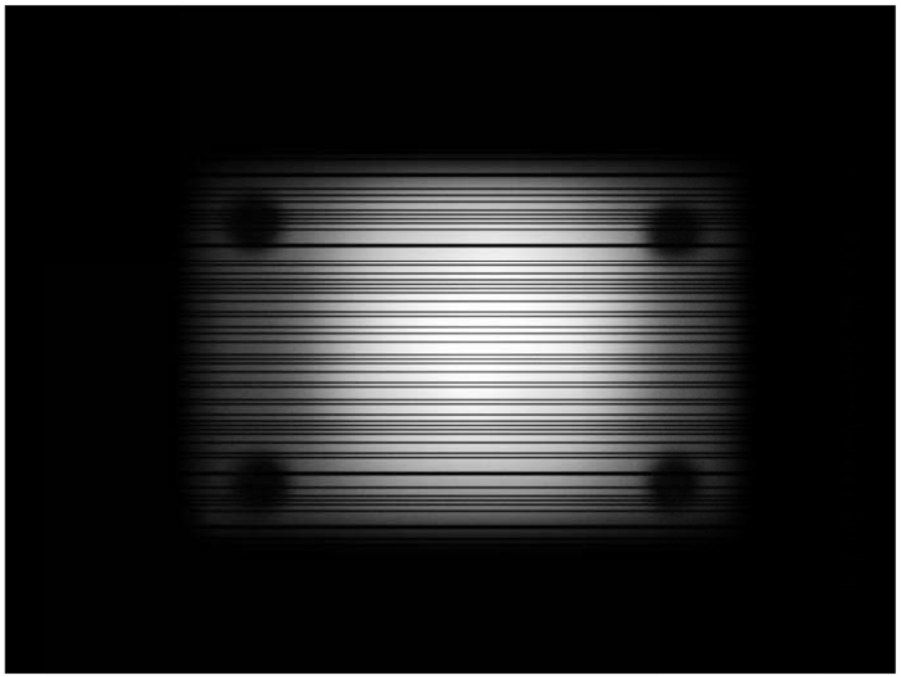


FIG. 385B

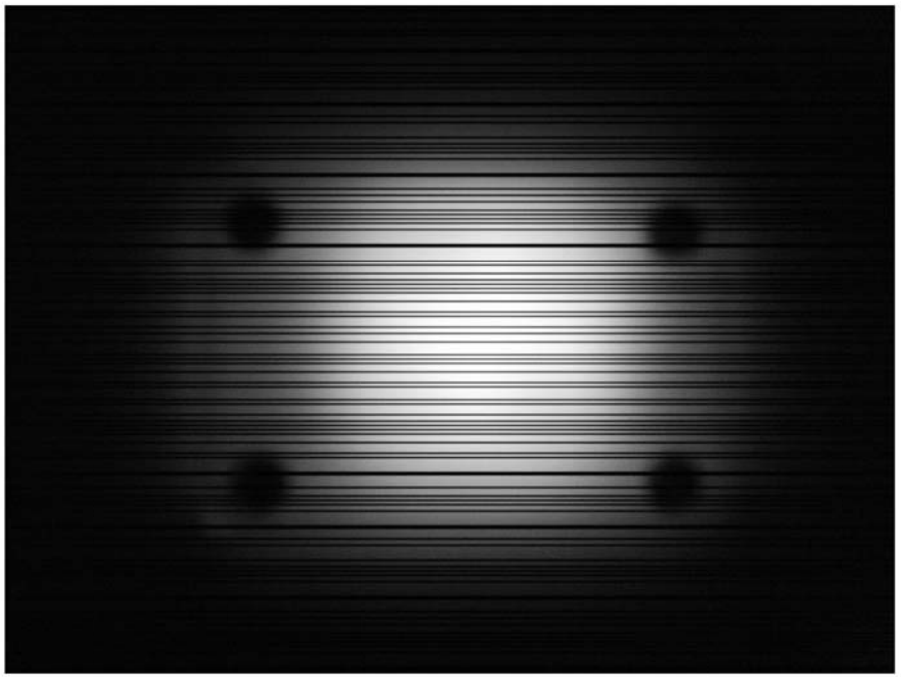


FIG. 386A



FIG. 386B



FIG. 386C

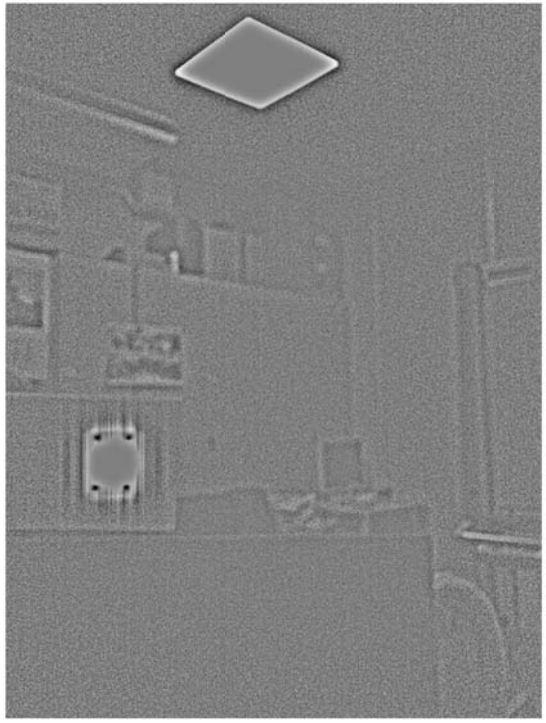


FIG. 387

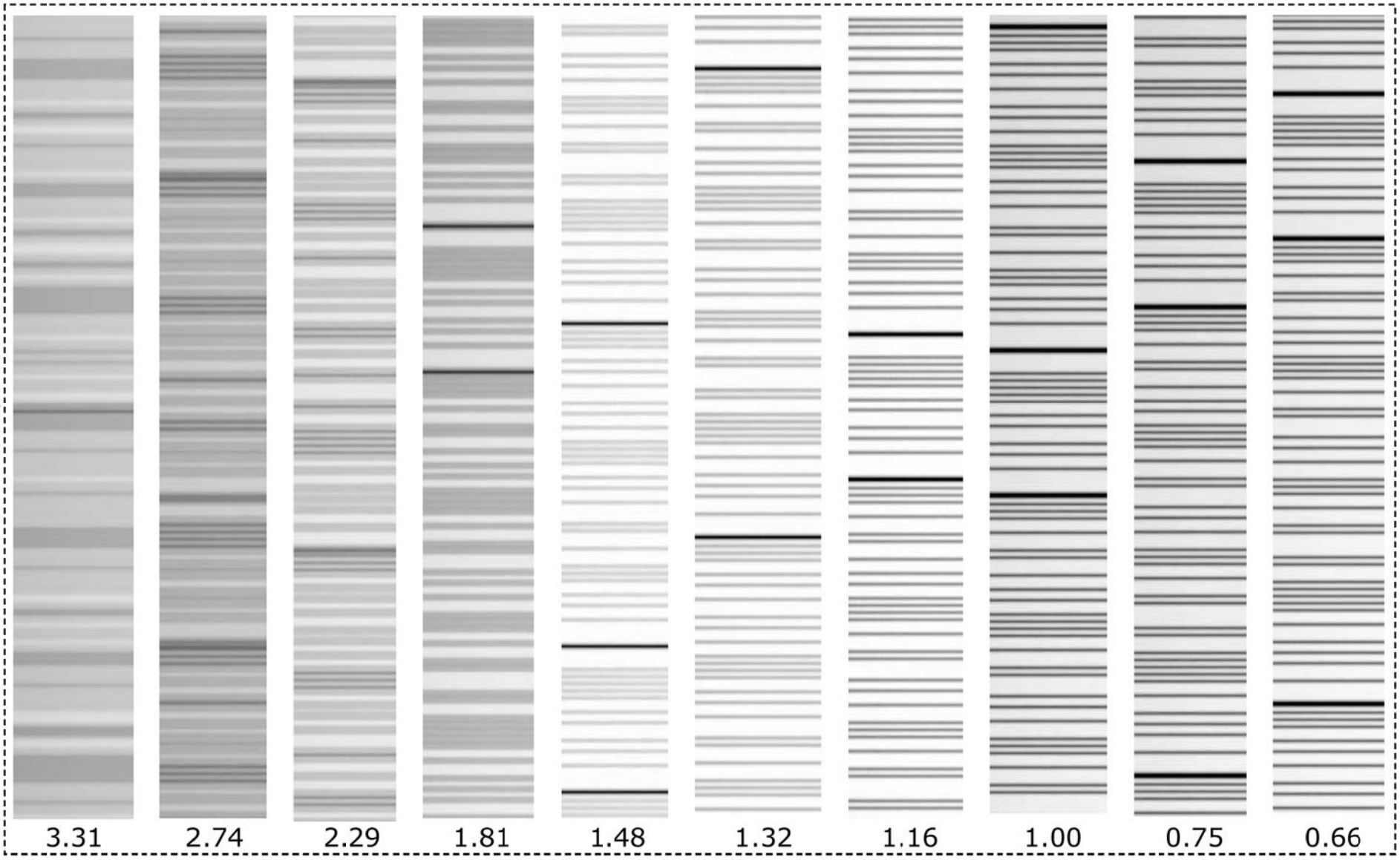

412/432
3.31
2.74
2.29
1.81
1.48
1.32
1.16
1.00
0.75
0.66
Ratio of exposure time to transmission signal period ((exposure time)/(transmission signal period))

FIG. 388

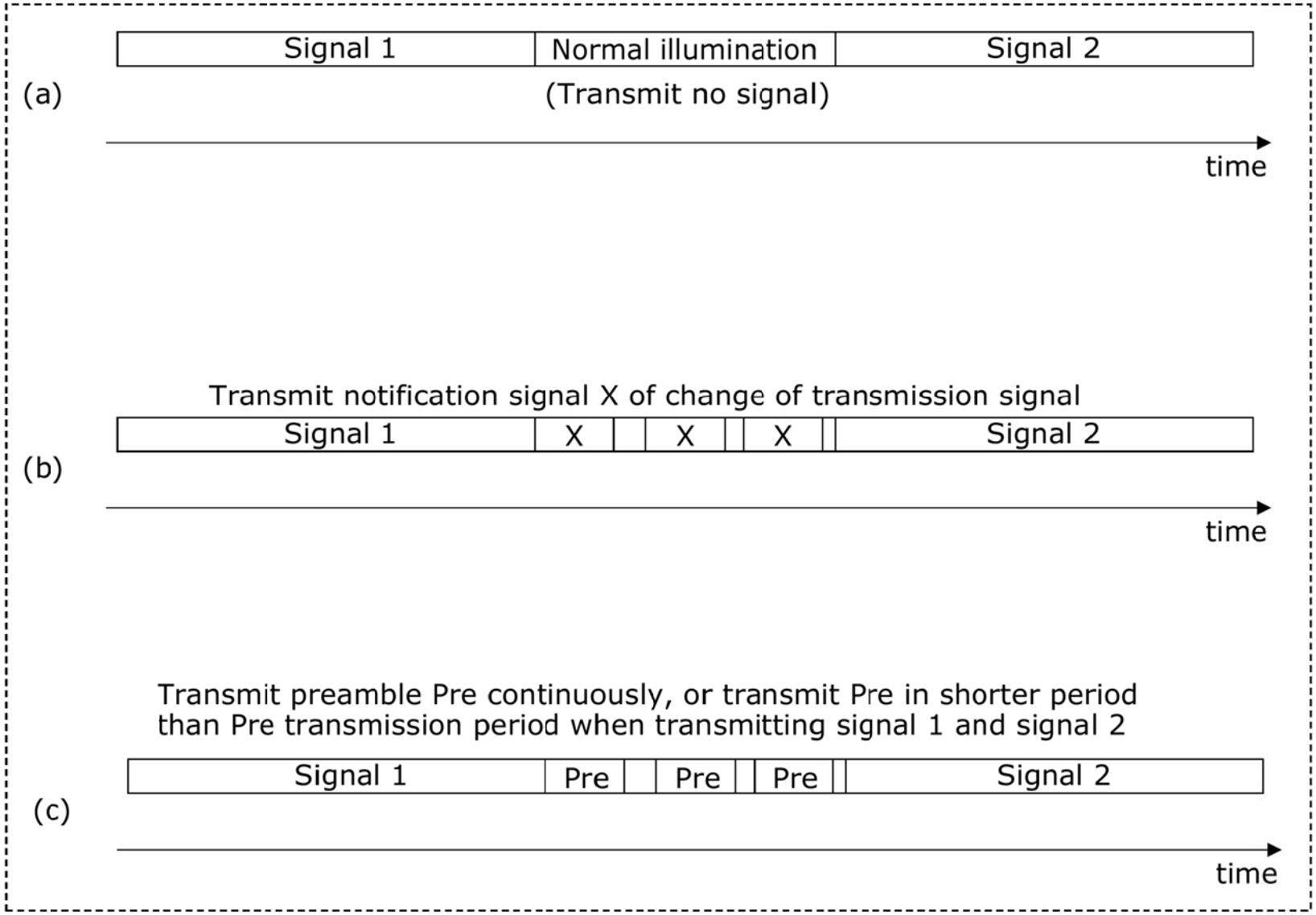

Signal 1
Normal illumination
Signal 2
(a)
(Transmit no signal)
time
Transmit notification signal X of change of transmission signal
Signal 1
X
X
X
Signal 2
(b)
time
Transmit preamble Pre continuously, or transmit Pre in shorter period than Pre transmission period when transmitting signal 1 and signal 2
Signal 1
Pre
Pre
Pre
Signal 2
(c)
time

FIG. 389

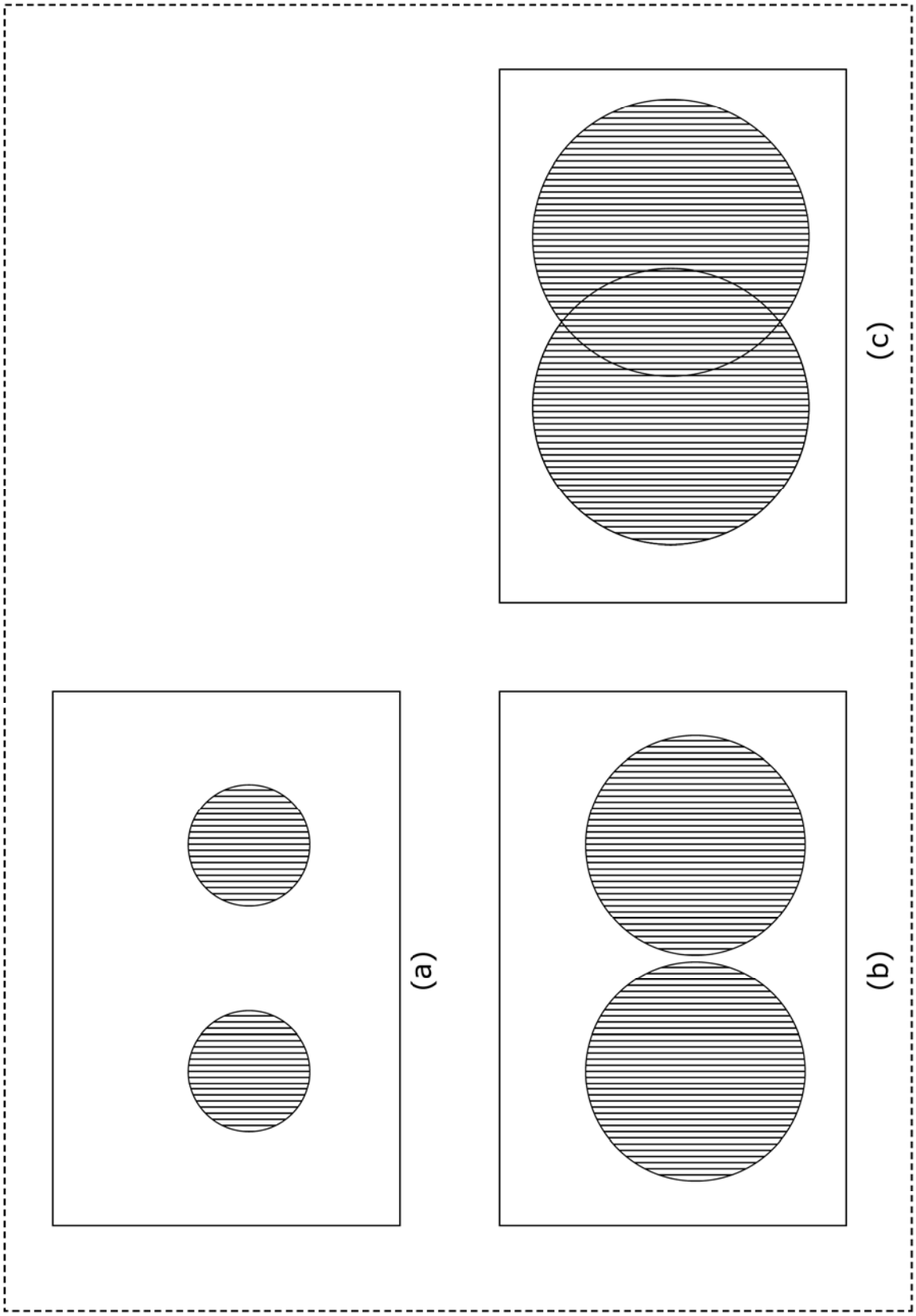


FIG. 390

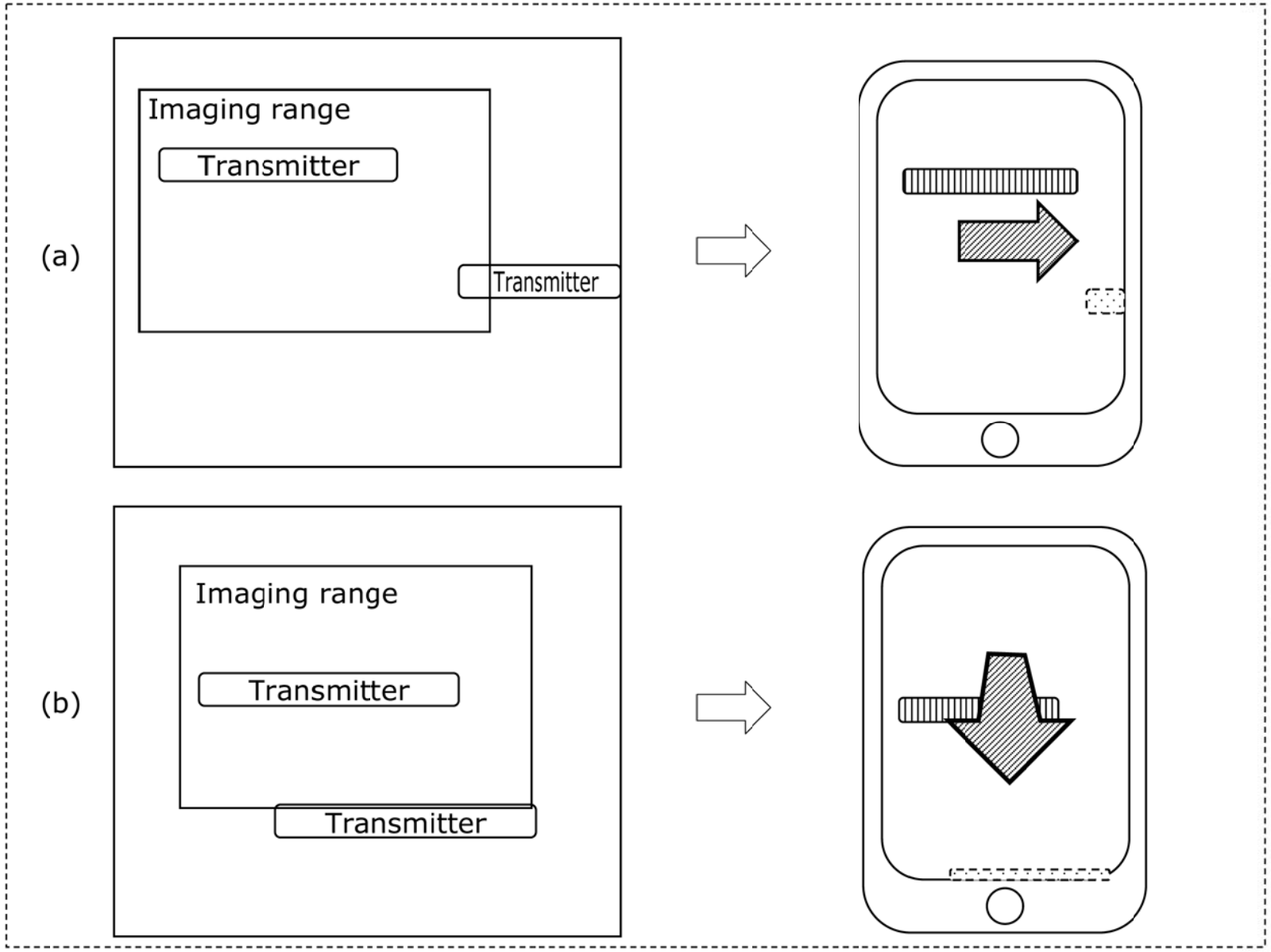

(a)
Imaging range
Transmitter
Transmitter
(b)
Imaging range
Transmitter
Transmitter

FIG. 391

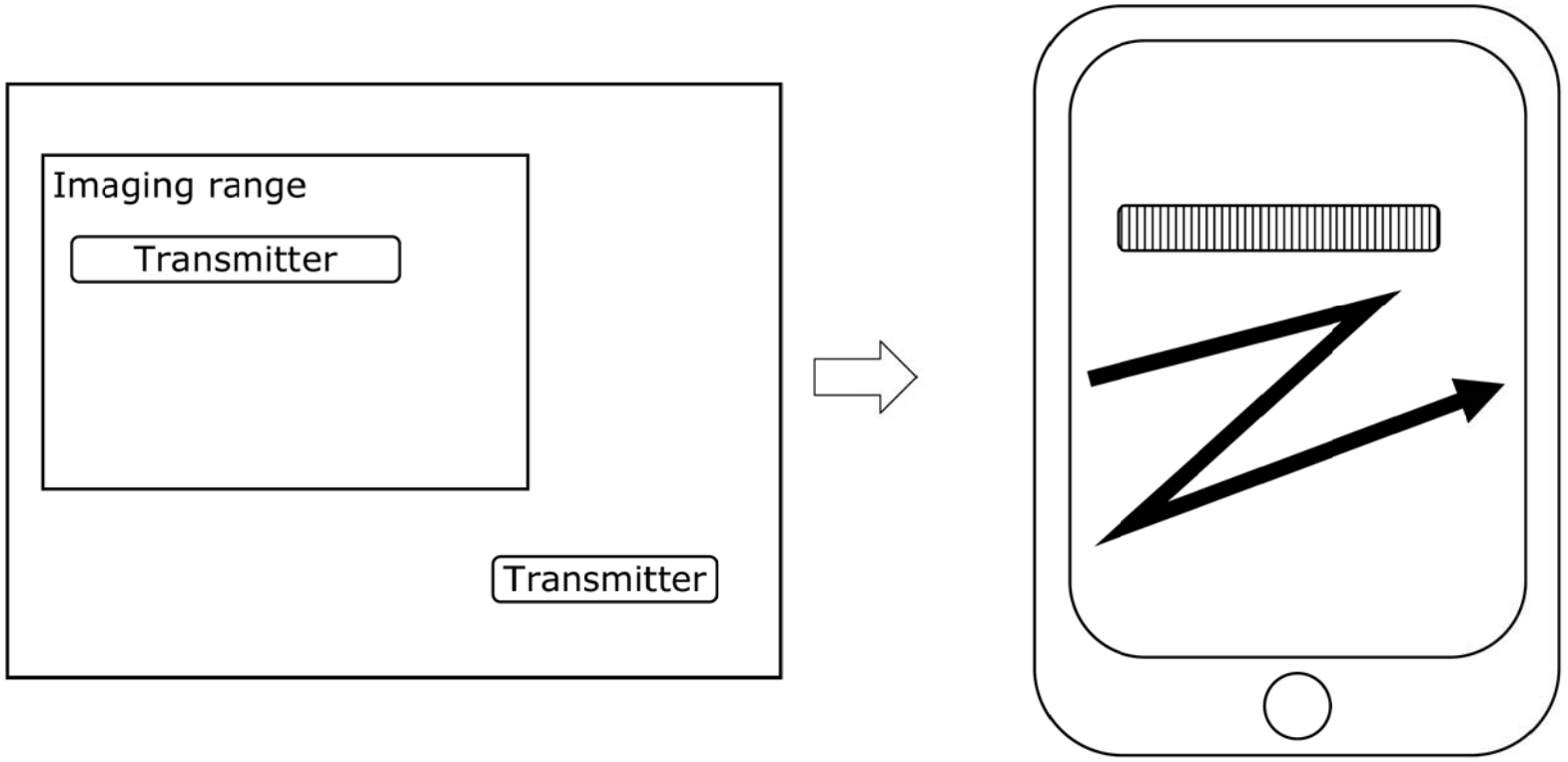


FIG. 392

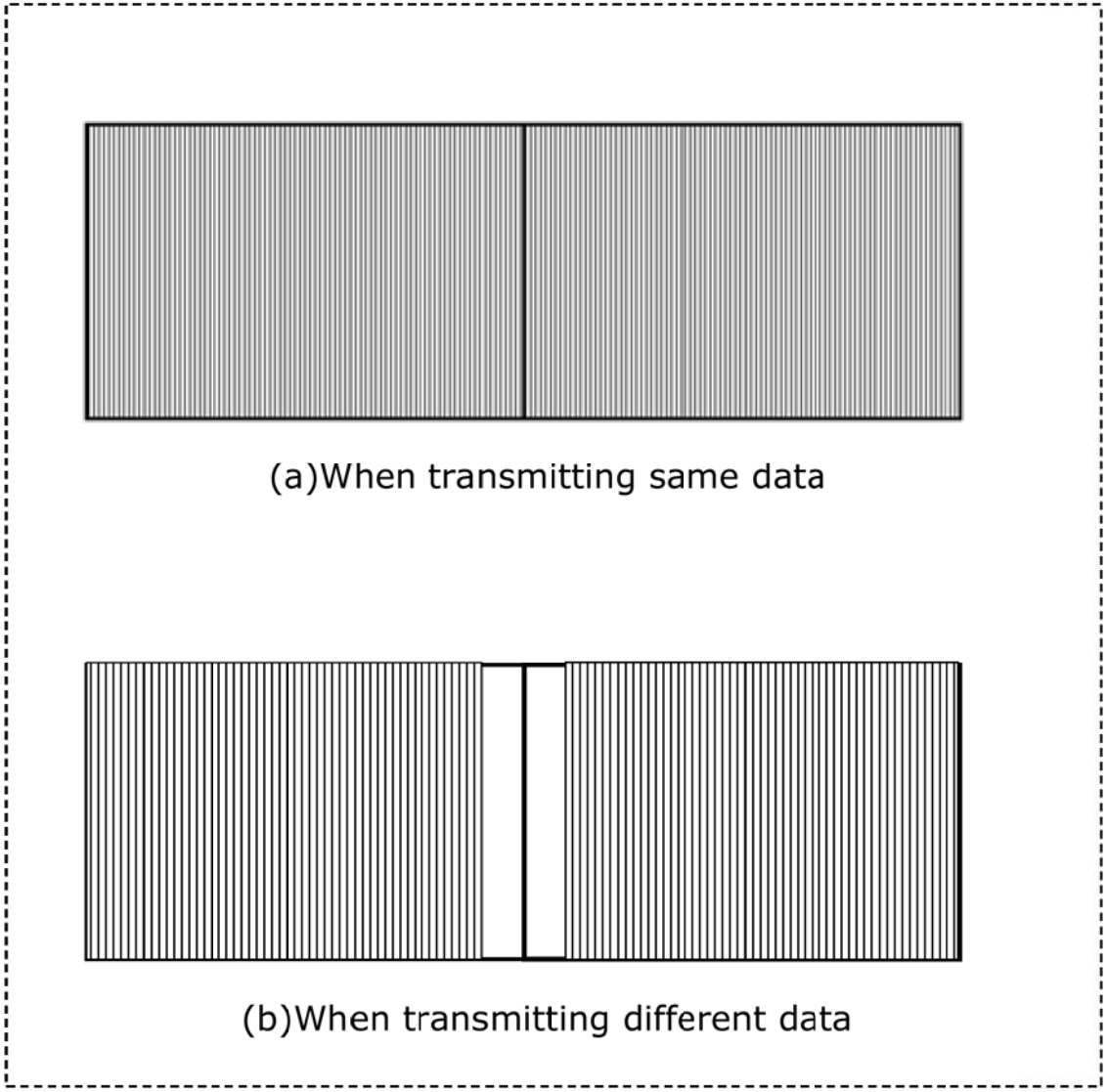

(a)When transmitting same data
(b)When transmitting different data

FIG. 393

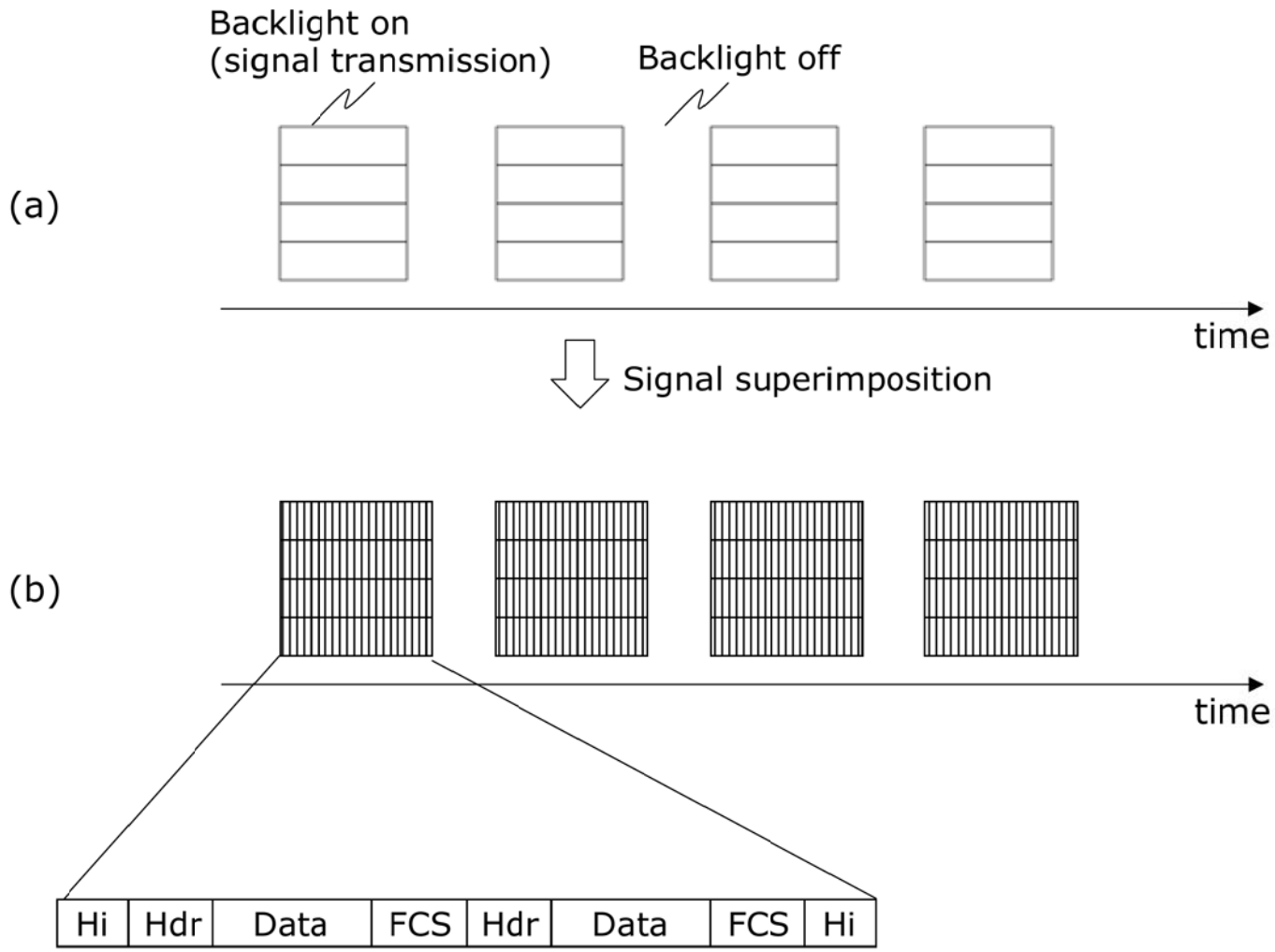

Backlight on
(signal transmission)
Backlight off
(a)
time
Signal superimposition
(b)
time
Hi
Hdr
Data
FCS
Hdr
Data
FCS
Hi

FIG. 394

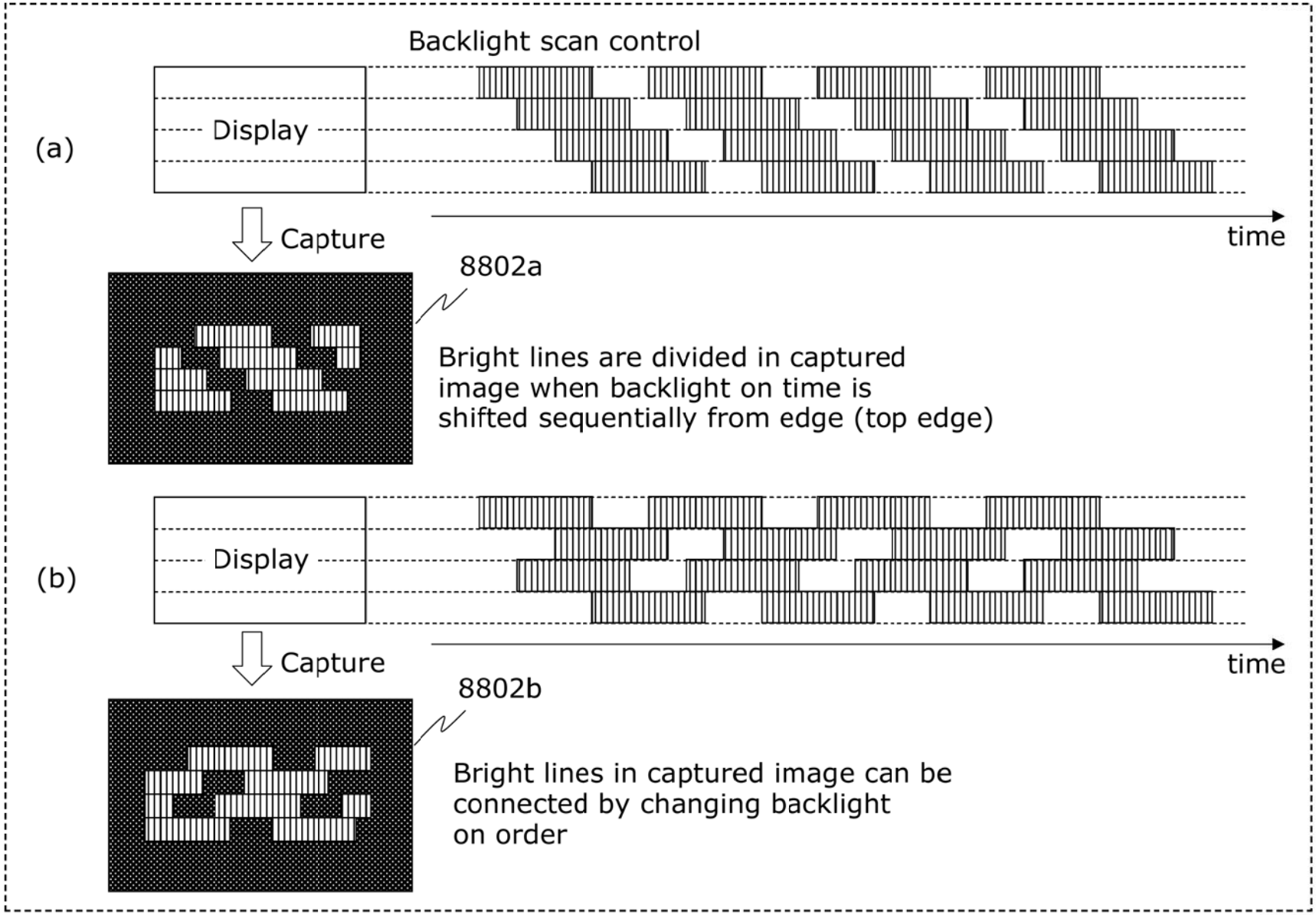

Backlight scan control
(a)
Display
Capture
time
8802a
Bright lines are divided in captured image when backlight on time is shifted sequentially from edge (top edge)
(b)
Display
Capture
time
8802b
Bright lines in captured image can be connected by changing backlight on order

FIG. 395

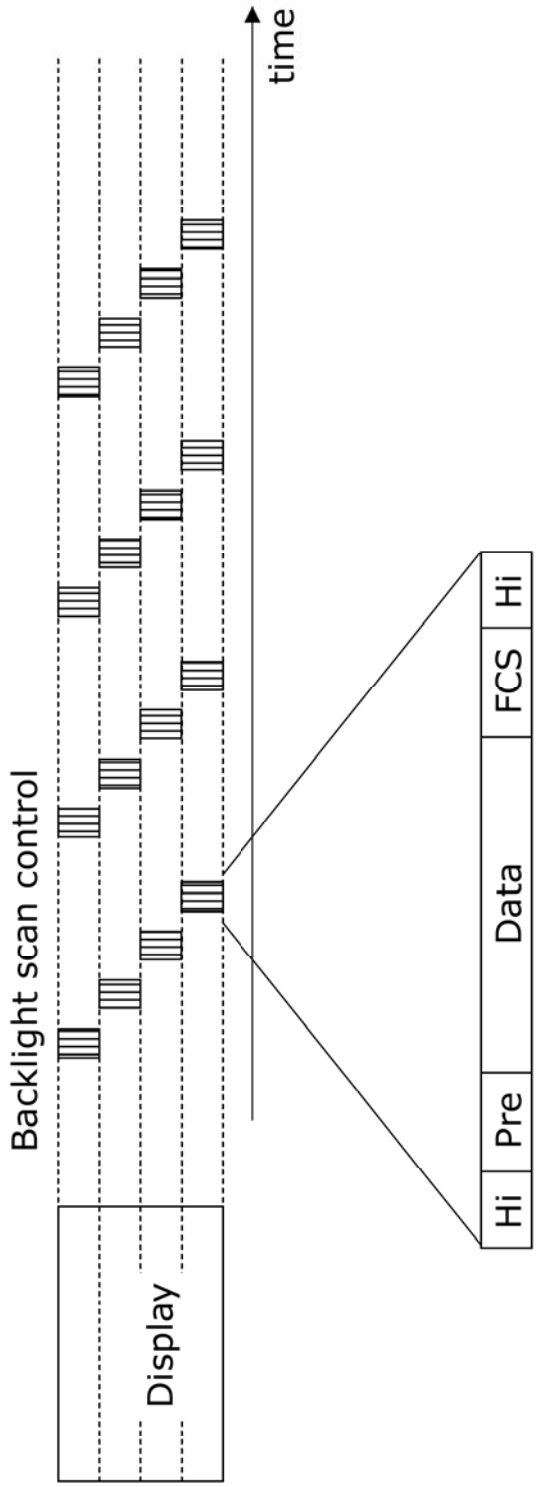


FIG. 396

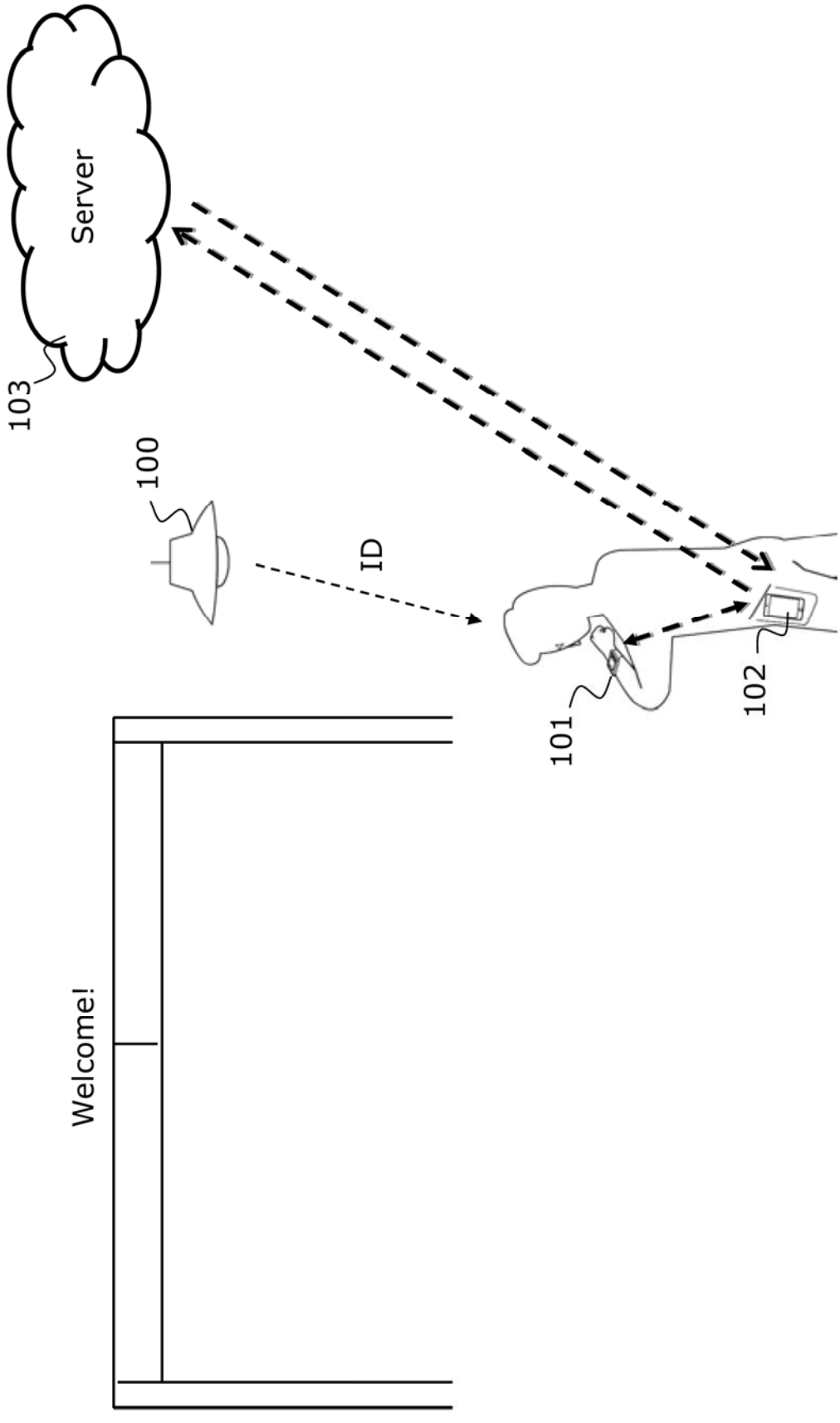


FIG. 397

Membership number	Store ID	Time	Position information
User preference information		User biological information	
User search history		User behavior history	

FIG. 398

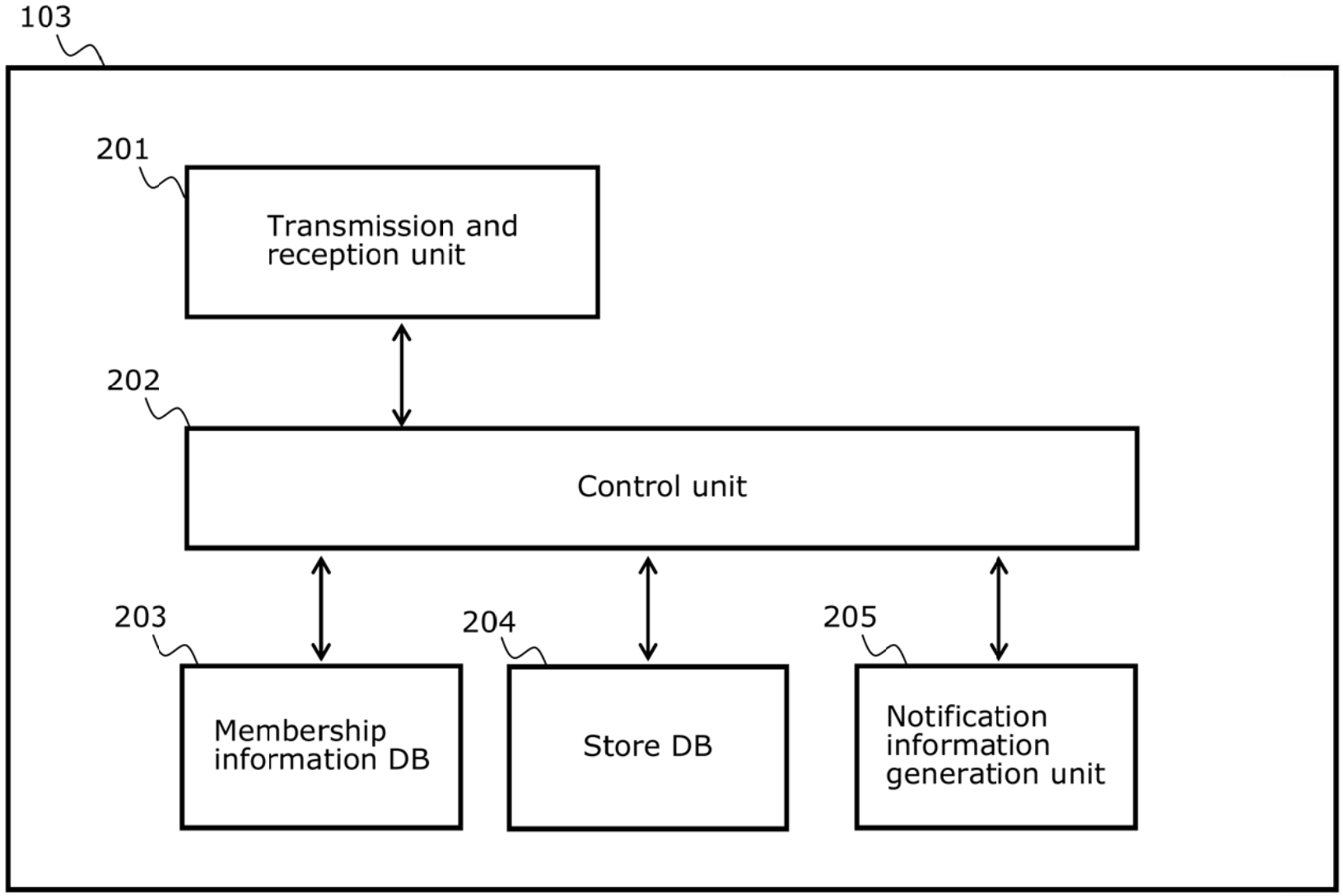

103
201
Transmission and reception unit
202
Control unit
203
Membership information DB
204
Store DB
205
Notification information generation unit

FIG. 399

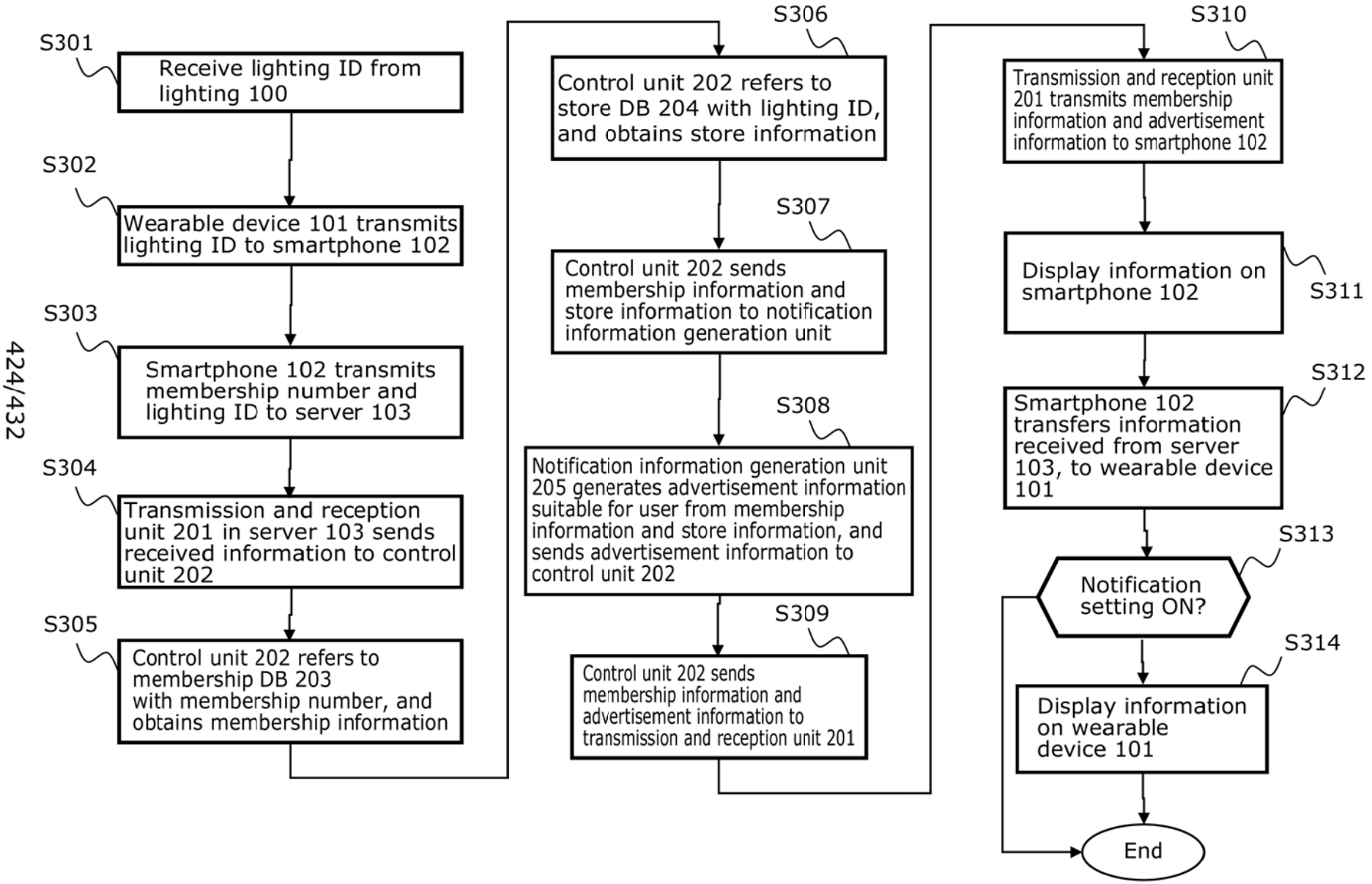

S301
Receive lighting ID from lighting 100
S302
Wearable device 101 transmits lighting ID to smartphone 102
S303
Smartphone 102 transmits membership number and lighting ID to server 103
S304
Transmission and reception unit 201 in server 103 sends received information to control unit 202
S305
Control unit 202 refers to membership DB 203 with membership number, and obtains membership information
S306
Control unit 202 refers to store DB 204 with lighting ID, and obtains store information
S307
Control unit 202 sends membership information and store information to notification information generation unit
S308
Notification information generation unit 205 generates advertisement information suitable for user from membership information and store information, and sends advertisement information to control unit 202
S309
Control unit 202 sends membership information and advertisement information to transmission and reception unit 201
S310
Transmission and reception unit 201 transmits membership information and advertisement information to smartphone 102
S311
Display information on smartphone 102
S312
Smartphone 102 transfers information received from server 103, to wearable device 101
S313
Notification setting ON?
S314
Display information on wearable device 101
End

FIG. 400

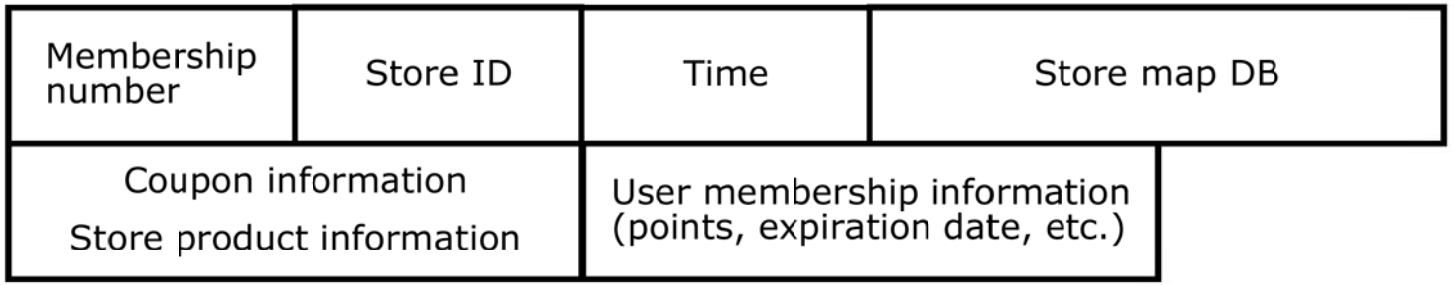

Membership number
Store ID
Time
Store map DB
Coupon information
Store product information
User membership information (points, expiration date, etc.)

FIG. 401

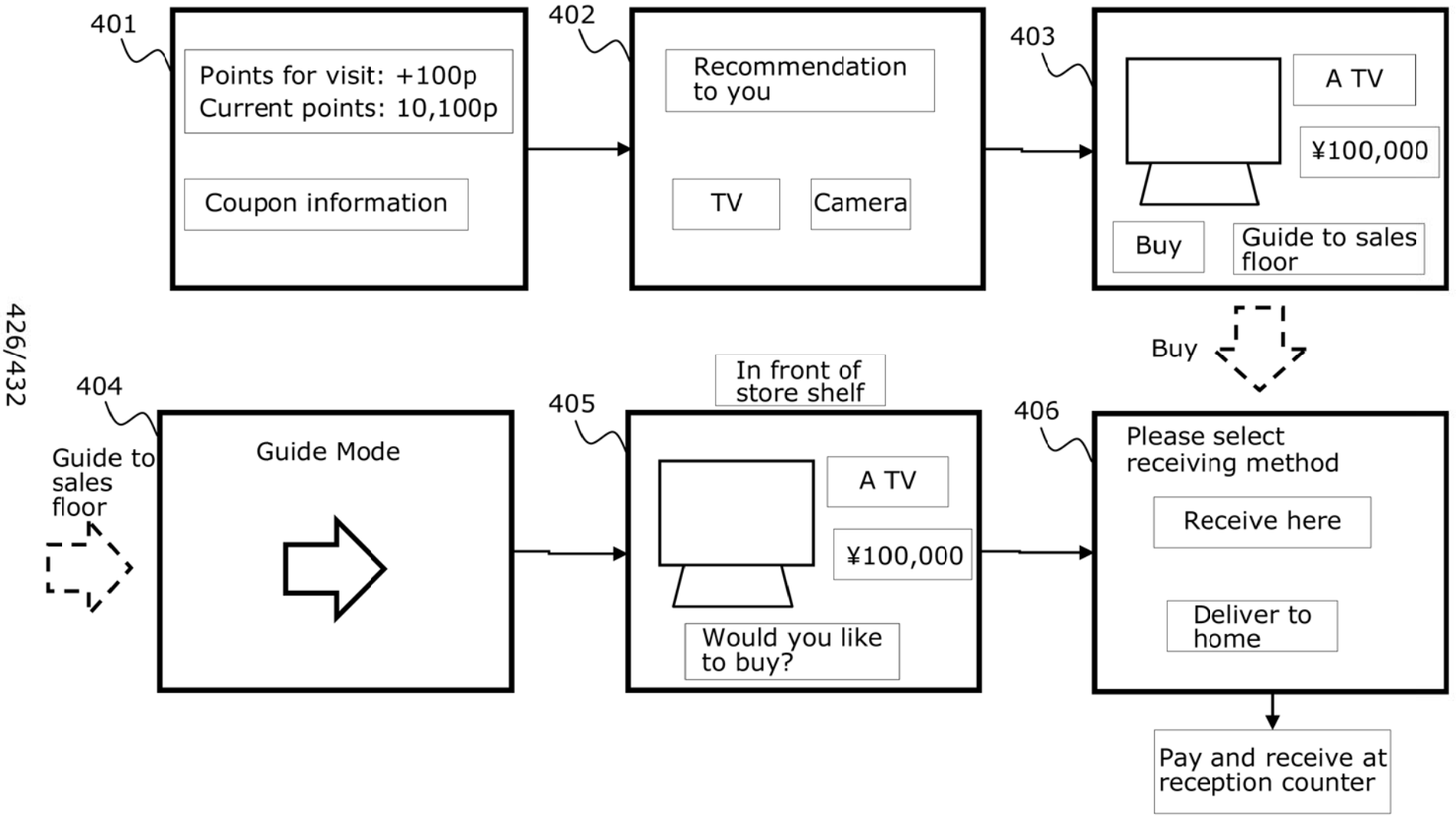

401
Points for visit: +100p
Current points: 10,100p
Coupon information
402
Recommendation to you
TV
Camera
403
A TV
¥100,000
Buy
Guide to sales floor
Buy
426/432
404
Guide to sales floor
Guide Mode
In front of store shelf
405
A TV
¥100,000
Would you like to buy?
406
Please select receiving method
Receive here
Deliver to home
Pay and receive at reception counter

FIG. 402

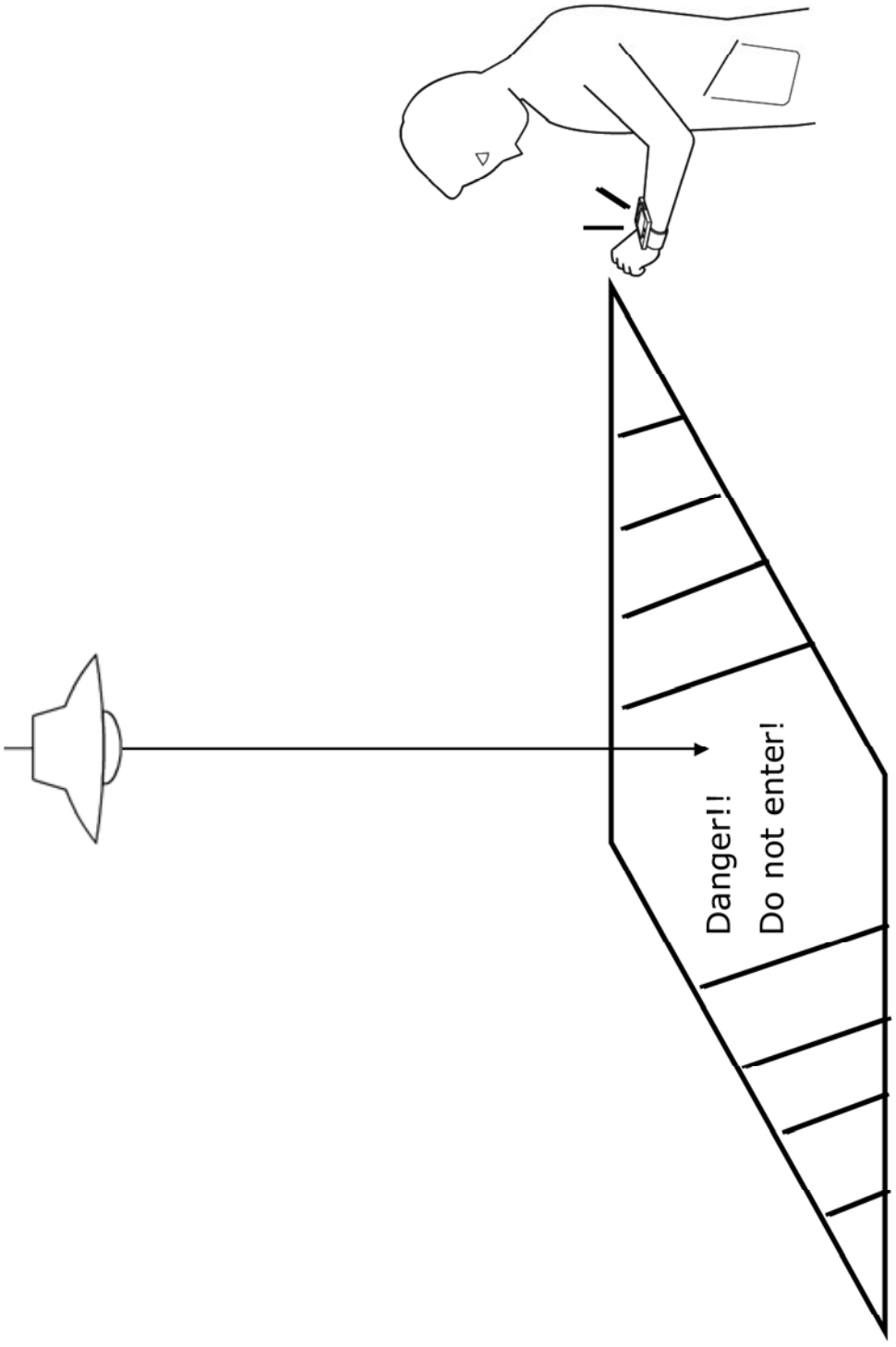


FIG. 403

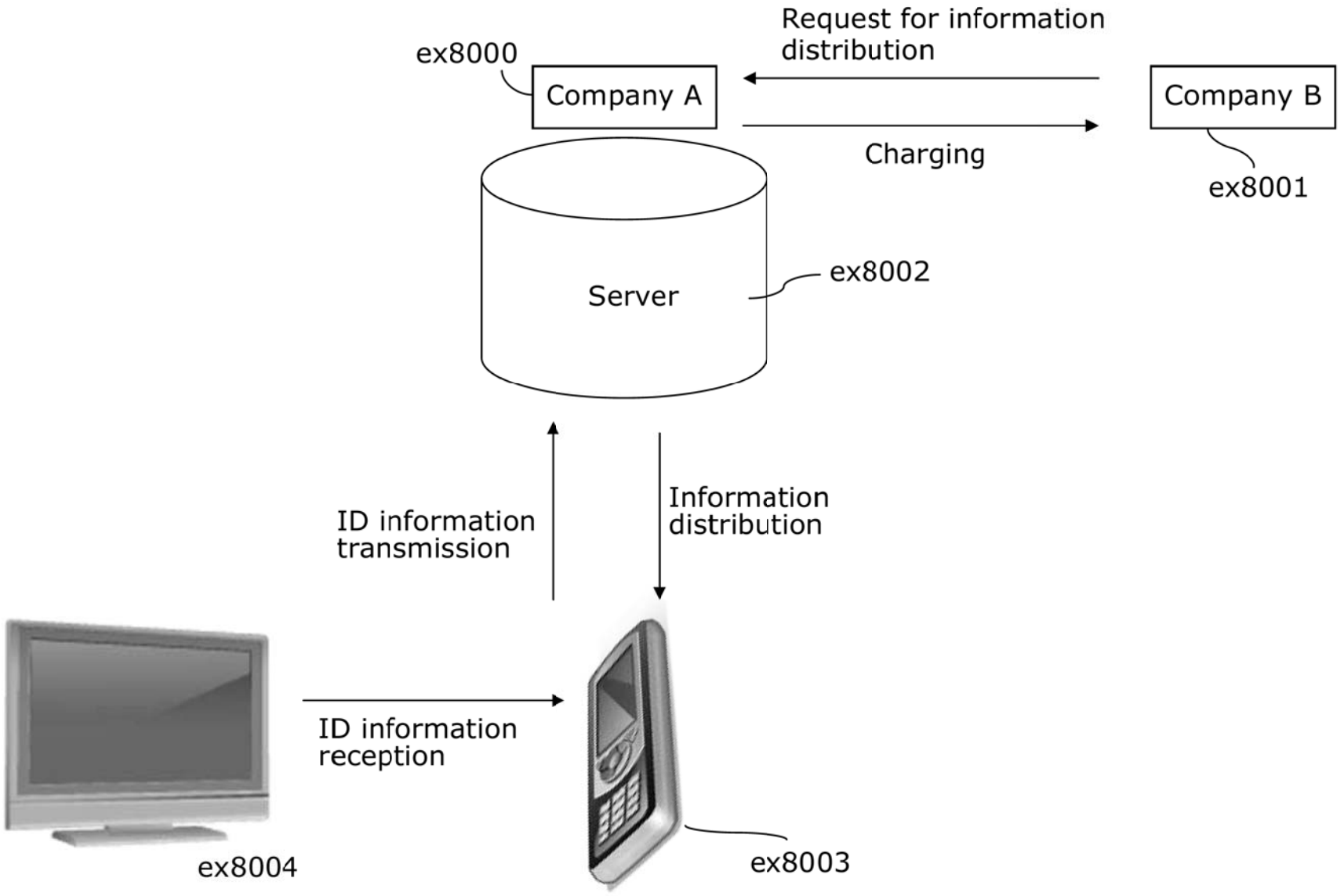

Request for information distribution
ex8000
Company A
Company B
Charging
ex8001
Server
ex8002
ID information transmission
Information distribution
ID information reception
ex8004
ex8003

FIG. 404

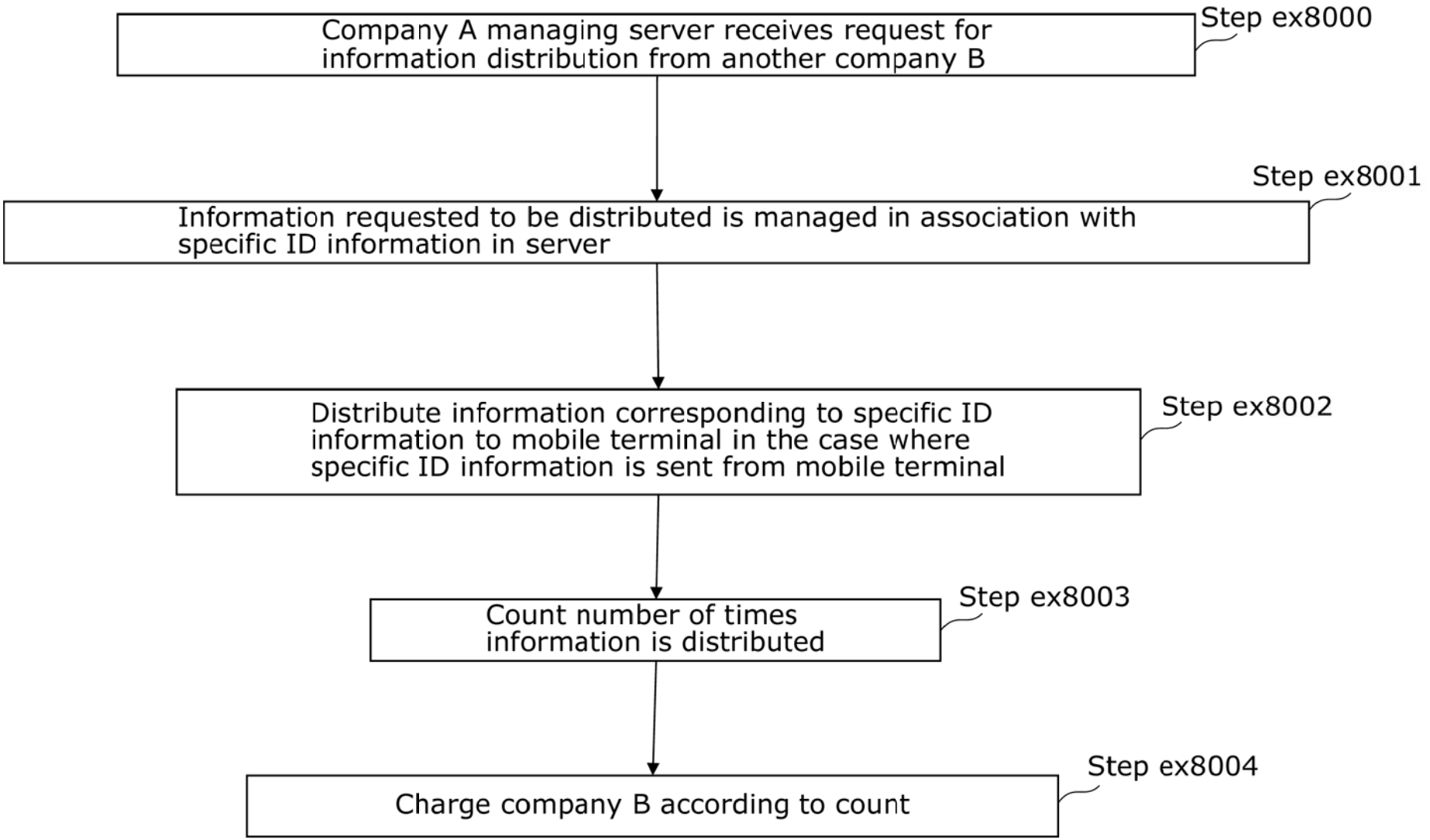

Company A managing server receives request for information distribution from another company B
Step ex8000
Information requested to be distributed is managed in association with specific ID information in server
Step ex8001
Distribute information corresponding to specific ID information to mobile terminal in the case where specific ID information is sent from mobile terminal
Step ex8002
Count number of times information is distributed
Step ex8003
Charge company B according to count
Step ex8004

FIG. 405

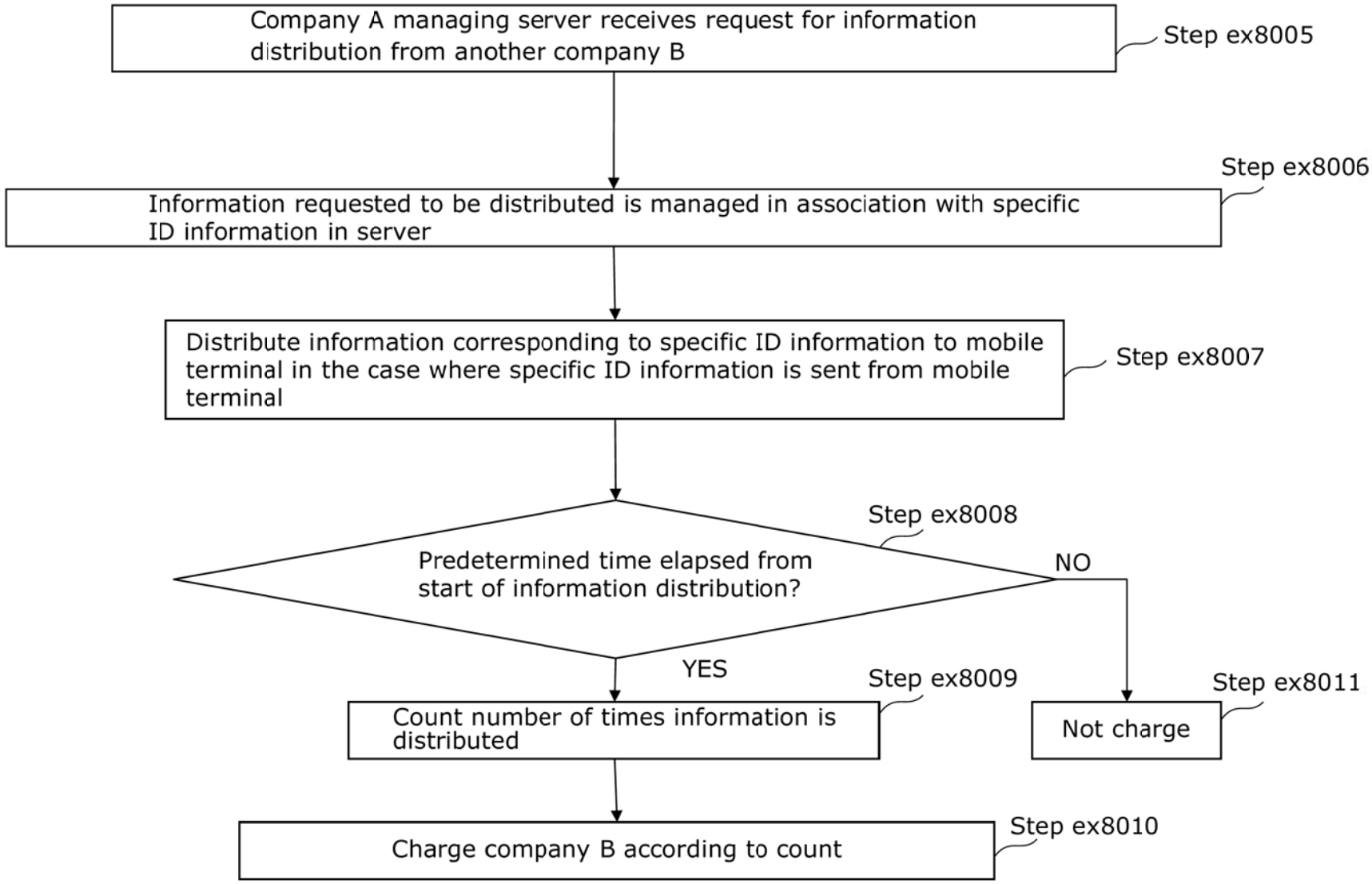

Company A managing server receives request for information distribution from another company B
Step ex8005
Information requested to be distributed is managed in association with specific ID information in server
Step ex8006
Distribute information corresponding to specific ID information to mobile terminal in the case where specific ID information is sent from mobile terminal
Step ex8007
Predetermined time elapsed from start of information distribution?
Step ex8008
NO
YES
Count number of times information is distributed
Step ex8009
Not charge
Step ex8011
Charge company B according to count
Step ex8010

FIG. 406

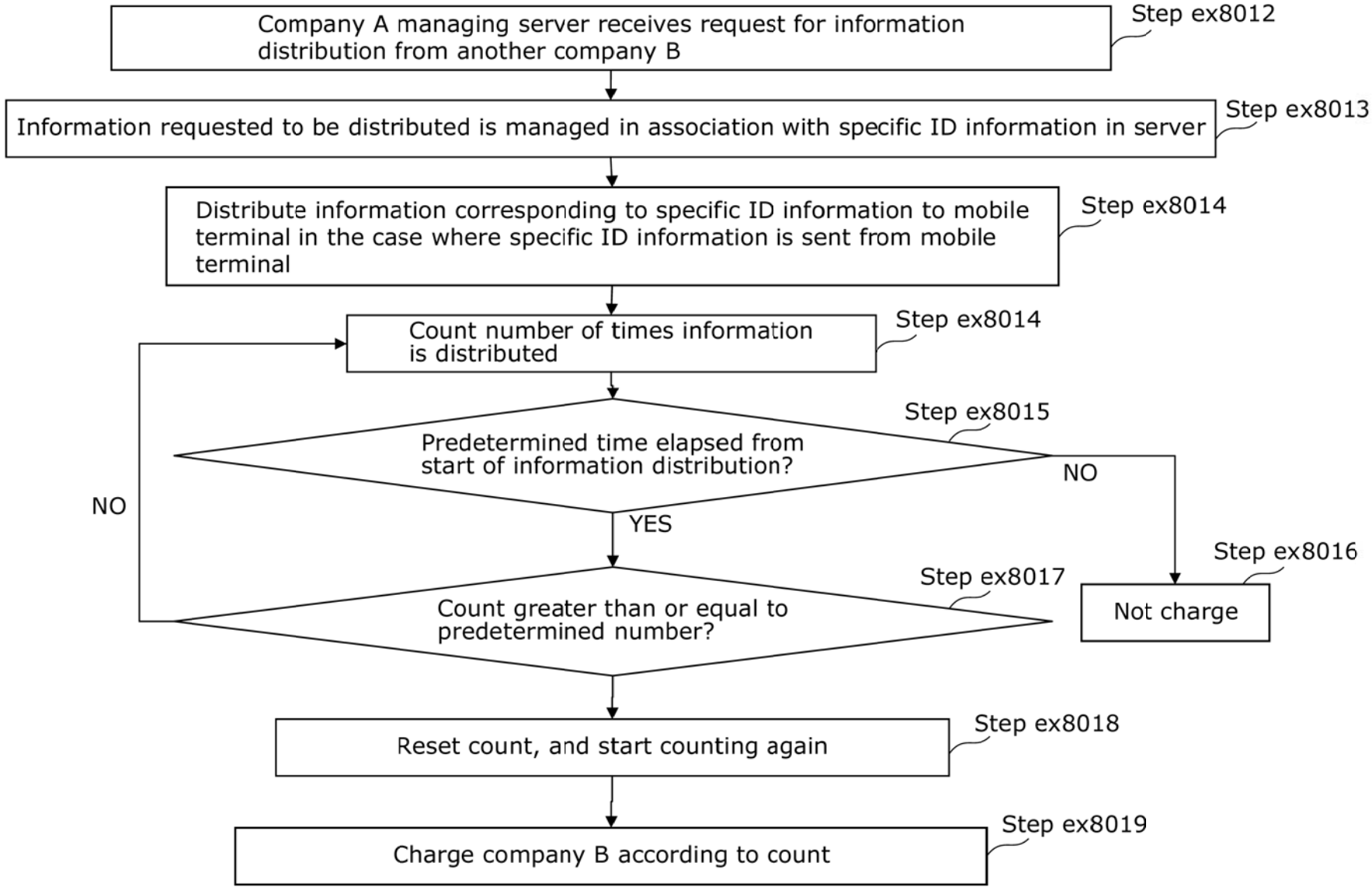

Company A managing server receives request for information distribution from another company B
Step ex8012
Information requested to be distributed is managed in association with specific ID information in server
Step ex8013
Distribute information corresponding to specific ID information to mobile terminal in the case where specific ID information is sent from mobile terminal
Step ex8014
Count number of times information is distributed
Step ex8014
Predetermined time elapsed from start of information distribution?
Step ex8015
NO
YES
NO
Count greater than or equal to predetermined number?
Step ex8017
Not charge
Step ex8016
Reset count, and start counting again
Step ex8018
Charge company B according to count
Step ex8019

FIG. 407A

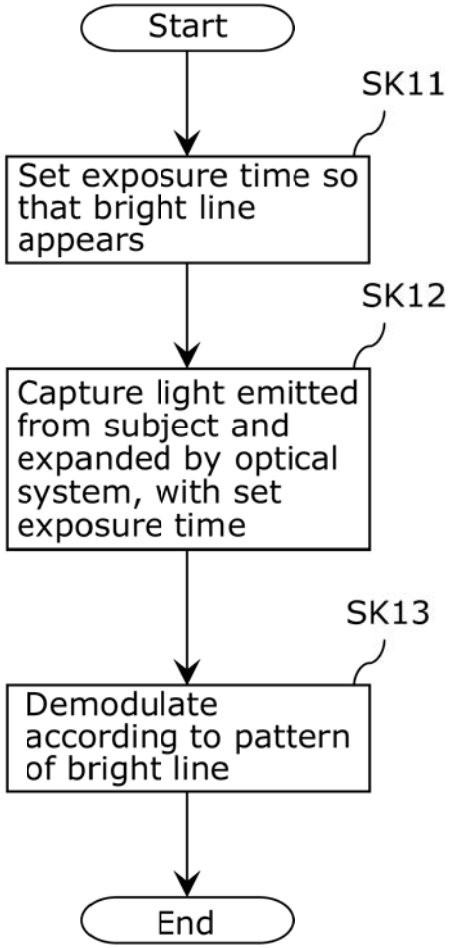


FIG. 407B

