US008078767B2

(12) **United States Patent**
Kotani

(10) **Patent No.: US 8,078,767 B2**
(45) **Date of Patent: Dec. 13, 2011**

(54) **DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM**

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(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

(21) Appl. No.: **12/545,270**

(22) Filed: **Aug. 21, 2009**

(65) **Prior Publication Data**

US 2010/0014007 A1 Jan. 21, 2010

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2009/055831, filed on Mar. 24, 2009.

(30) **Foreign Application Priority Data**

May 29, 2008 (JP) 2008-141678

(51) **Int. Cl.**
G06F 13/10 (2006.01)

(52) **U.S. Cl.** **710/8**; 710/14; 710/15; 710/16

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Ilwoo Park

(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

When a communication connection with a device is disconnected during execution of a display based on data transmitted from the connected device, it can be controlled to continue or end the display according to a class of the device. A display apparatus **1** includes a USB connector **102** used to connect an external device so as to be able to communicate with that device. The display apparatus **1** also includes a CPU **107** which controls to make a display based on data received from the external device with which a communication connection is established via the USB connector **102**. The CPU **107** acquires class information indicating a class of the external device, the communication connection of which is established. When the communication connection with the external device is disconnected, if the acquired class information indicates a predetermined class, the CPU **107** controls to continue the display based on the received data, and if the class information does not indicate the predetermined class, the CPU **107** controls to end the display.

14 Claims, 28 Drawing Sheets

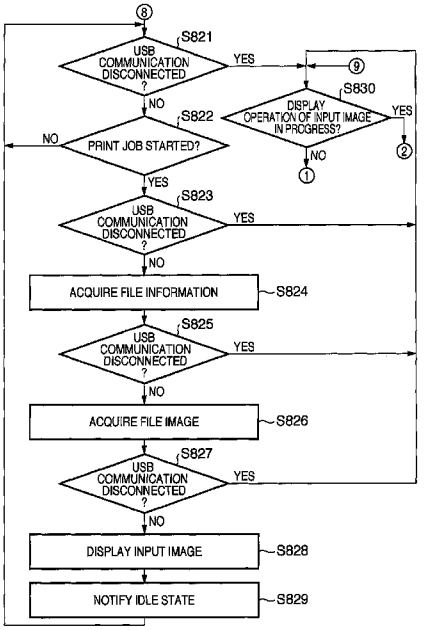


FIG. 1A

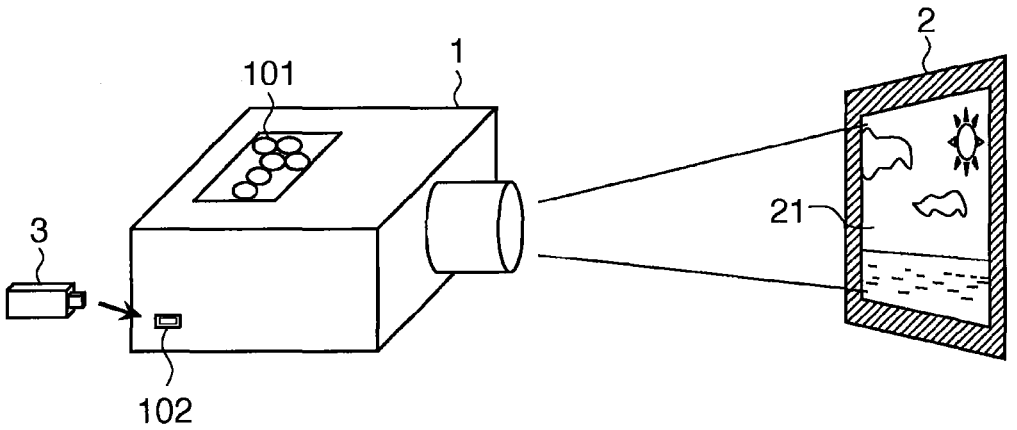


FIG. 1B

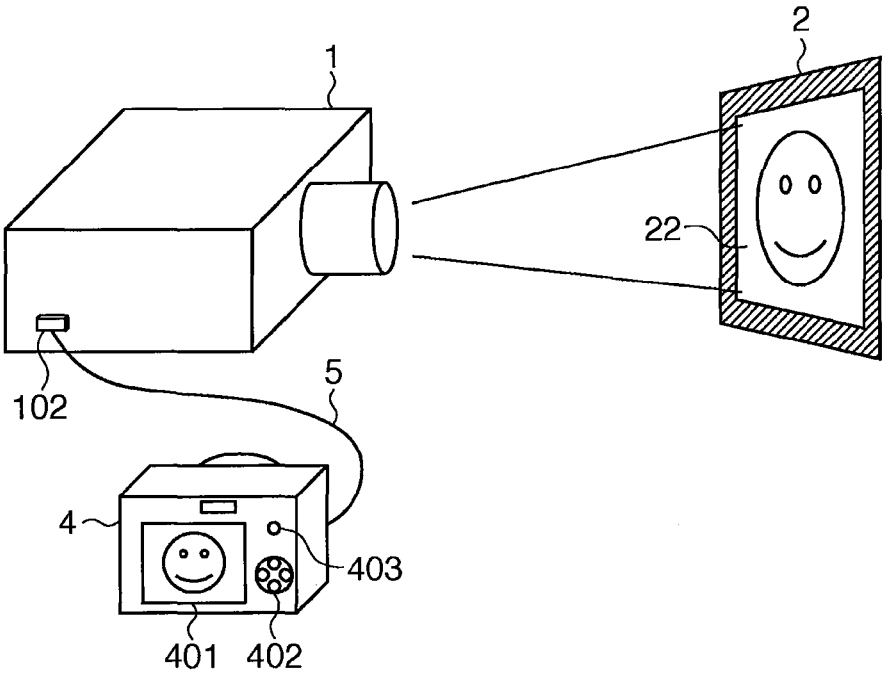


FIG. 2

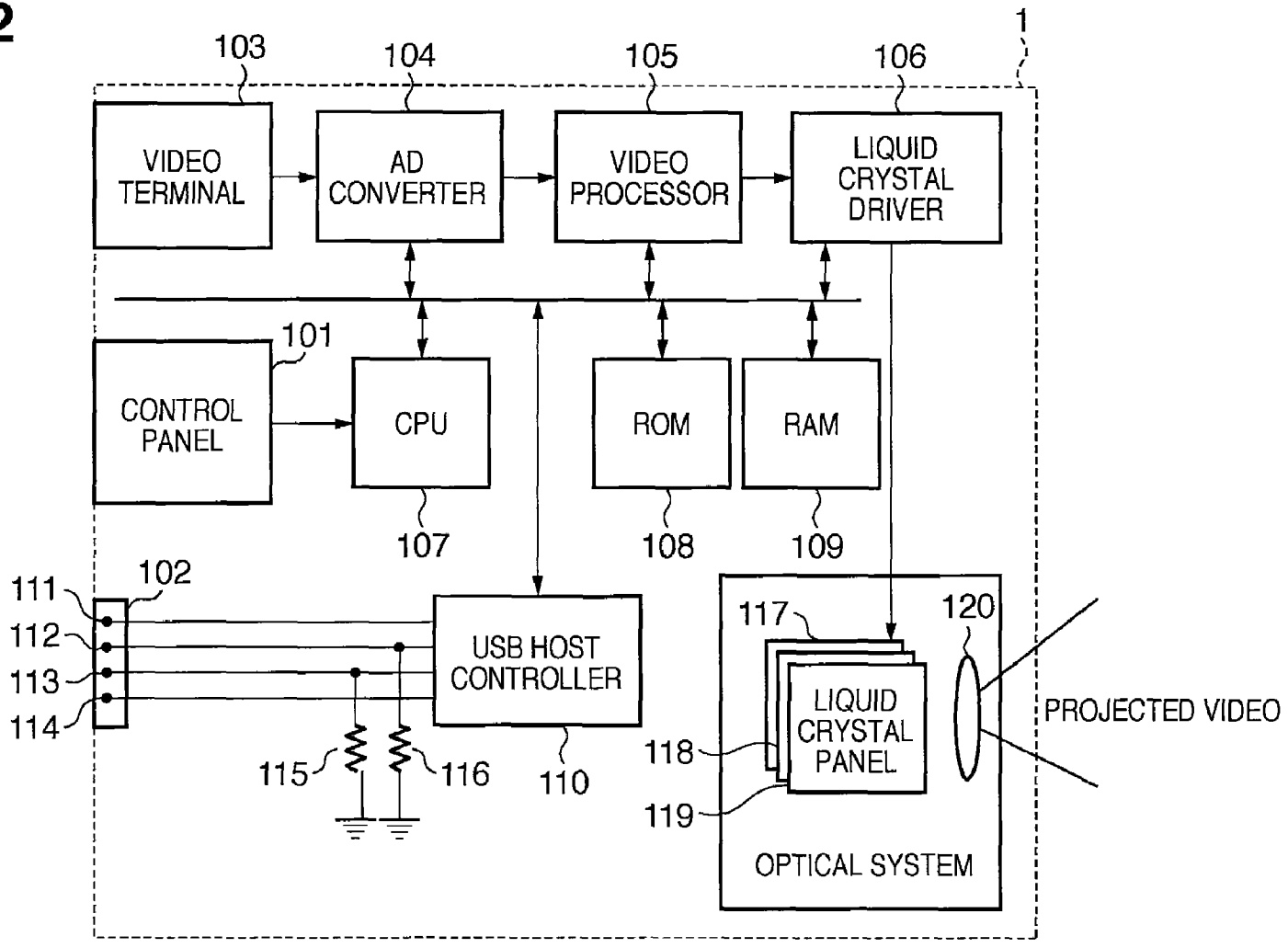

1
103
104
105
106
VIDEO TERMINAL
AD CONVERTER
VIDEO PROCESSOR
LIQUID CRYSTAL DRIVER
101
CONTROL PANEL
CPU
ROM
RAM
107
108
109
102
111
112
113
114
USB HOST CONTROLLER
115
116
110
117
120
LIQUID CRYSTAL PANEL
PROJECTED VIDEO
118
119
OPTICAL SYSTEM

FIG. 3

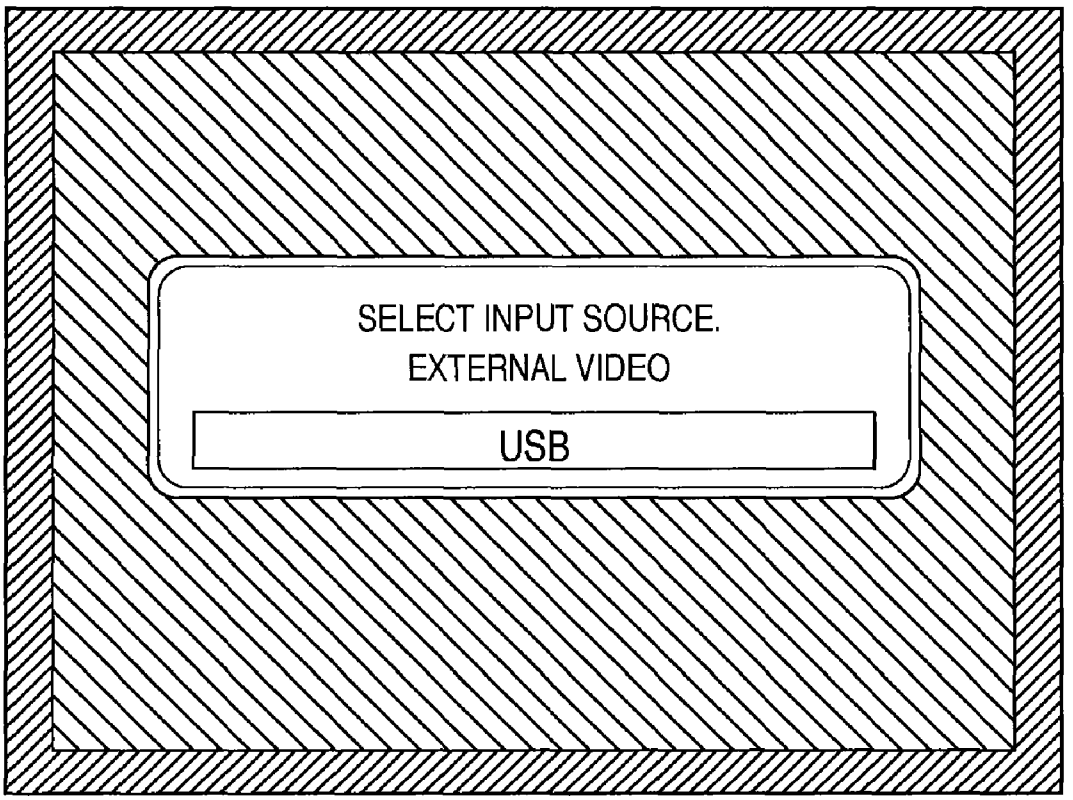


FIG. 4A

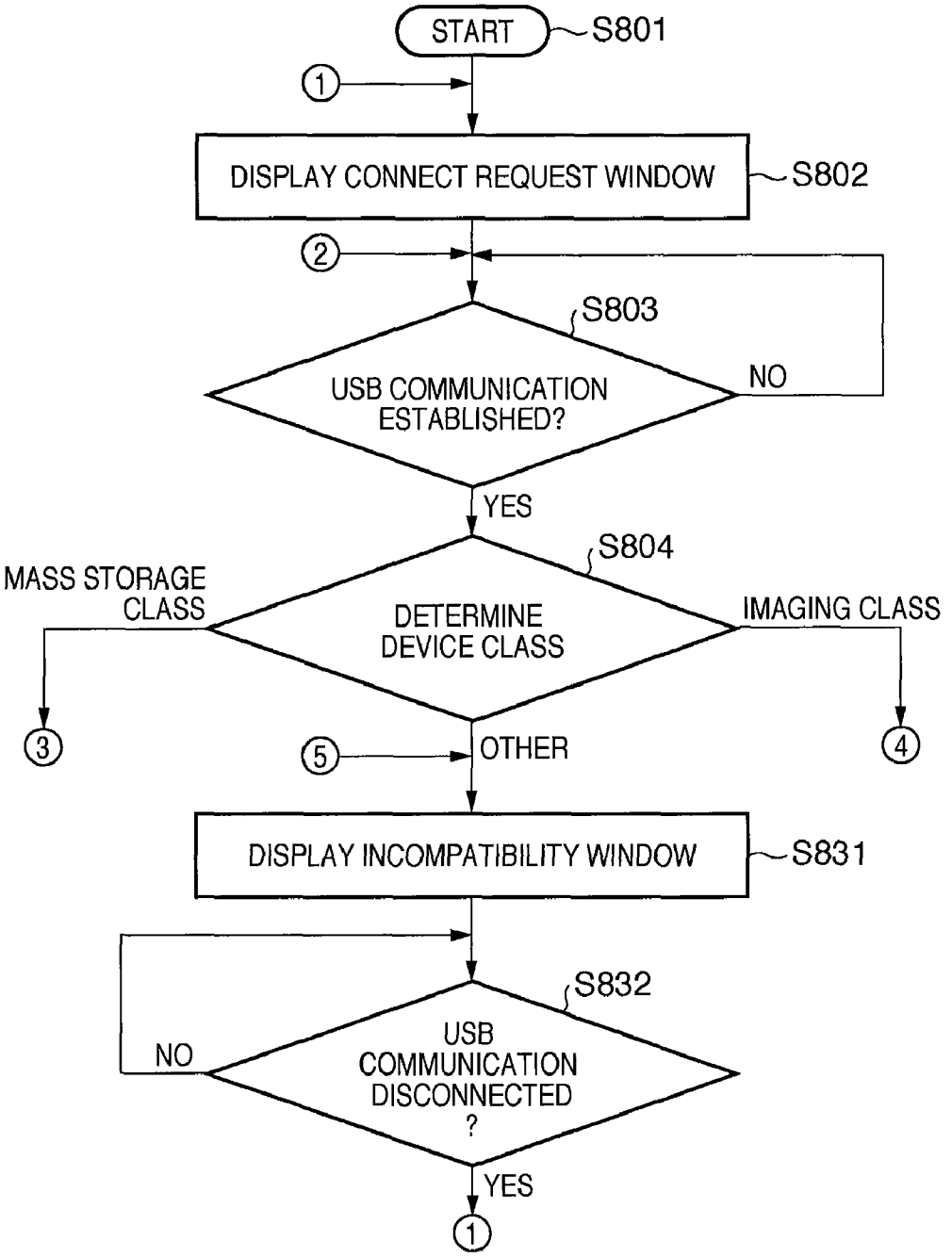

START
S801
1
DISPLAY CONNECT REQUEST WINDOW
S802
2
S803
USB COMMUNICATION ESTABLISHED?
NO
YES
S804
MASS STORAGE CLASS
DETERMINE DEVICE CLASS
IMAGING CLASS
3
5
OTHER
4
DISPLAY INCOMPATIBILITY WINDOW
S831
S832
NO
USB COMMUNICATION DISCONNECTED ?
YES
1

FIG. 4B-1

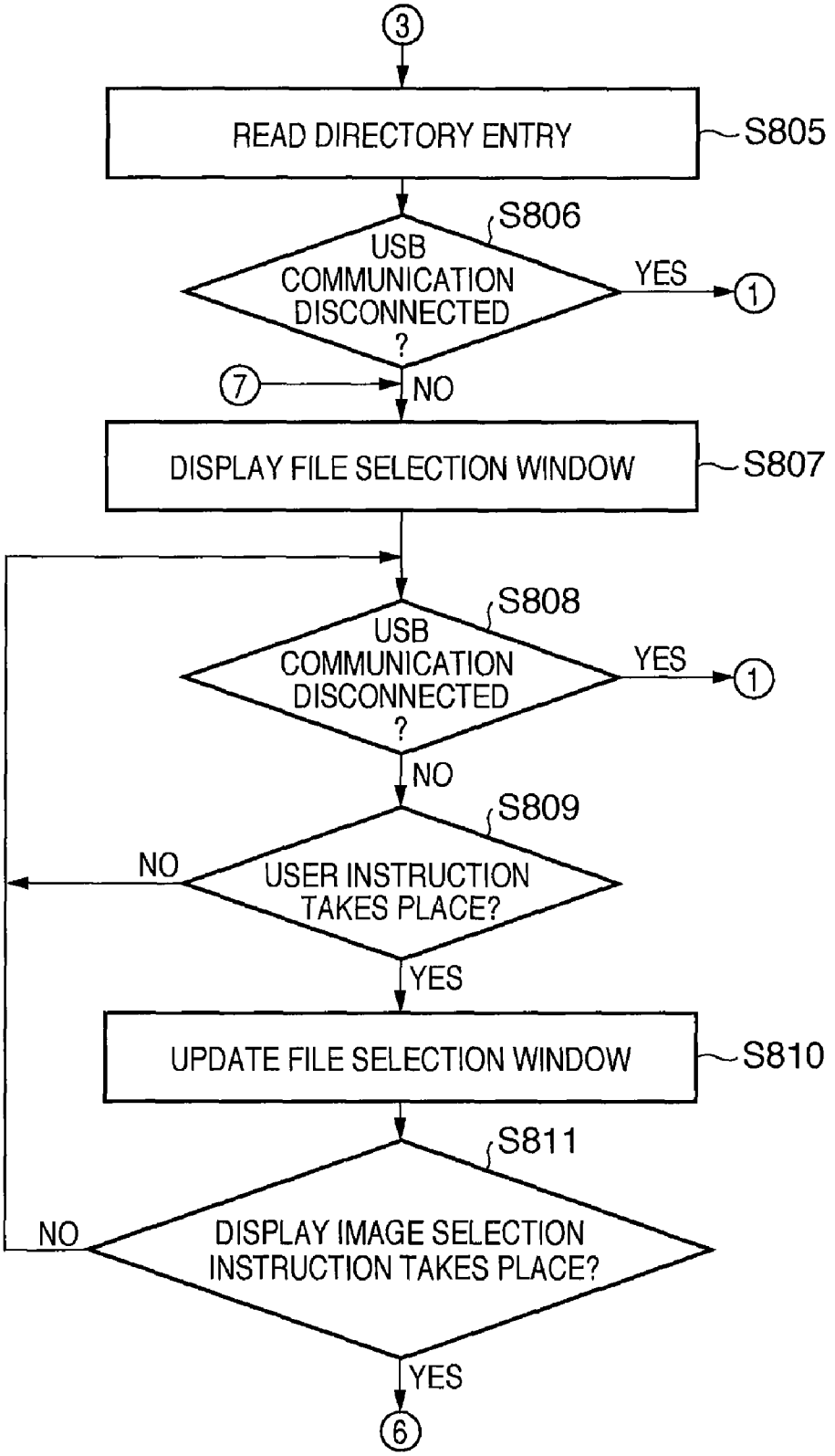

3
READ DIRECTORY ENTRY
S805
S806
USB COMMUNICATION DISCONNECTED ?
YES
1
7
NO
DISPLAY FILE SELECTION WINDOW
S807
S808
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
S809
NO
USER INSTRUCTION TAKES PLACE?
YES
UPDATE FILE SELECTION WINDOW
S810
S811
NO
DISPLAY IMAGE SELECTION INSTRUCTION TAKES PLACE?
YES
6

FIG. 4B-2

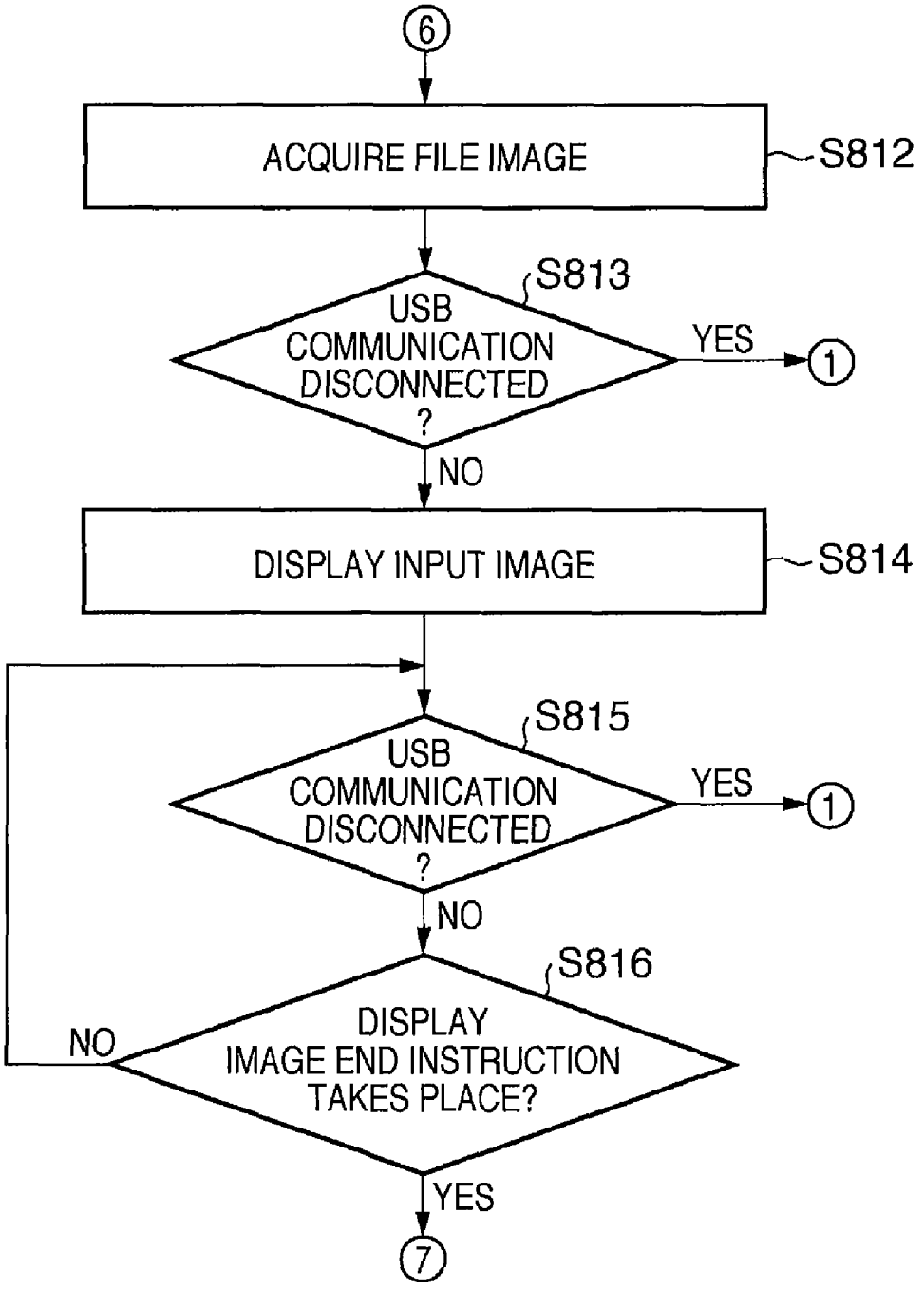

6
ACQUIRE FILE IMAGE
S812
S813
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
DISPLAY INPUT IMAGE
S814
S815
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
S816
DISPLAY IMAGE END INSTRUCTION TAKES PLACE?
NO
YES
7

FIG. 4C-1

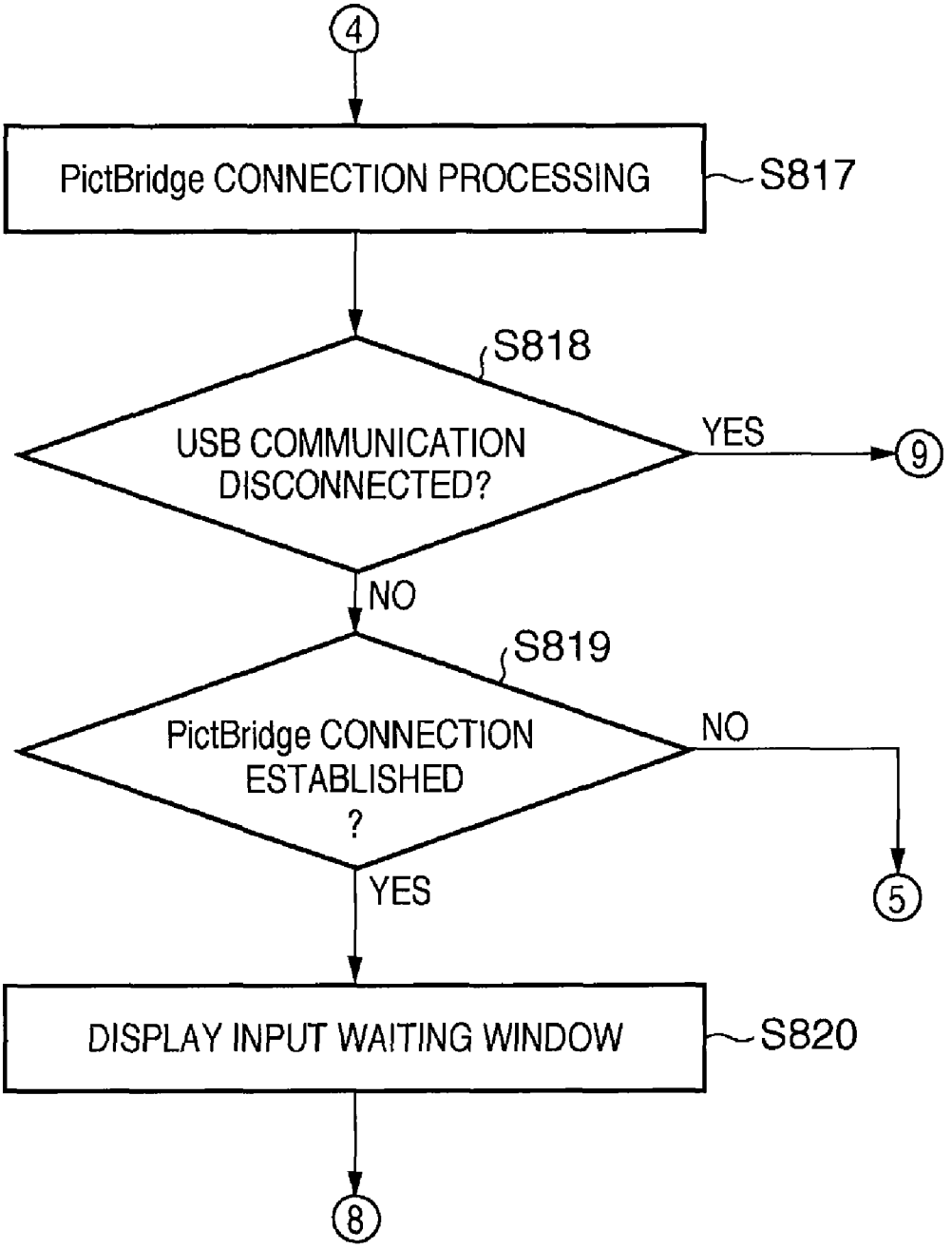

4
PictBridge CONNECTION PROCESSING
S817
S818
USB COMMUNICATION DISCONNECTED?
YES
9
NO
S819
PictBridge CONNECTION ESTABLISHED ?
NO
5
YES
DISPLAY INPUT WAITING WINDOW
S820
8

FIG. 4C-2

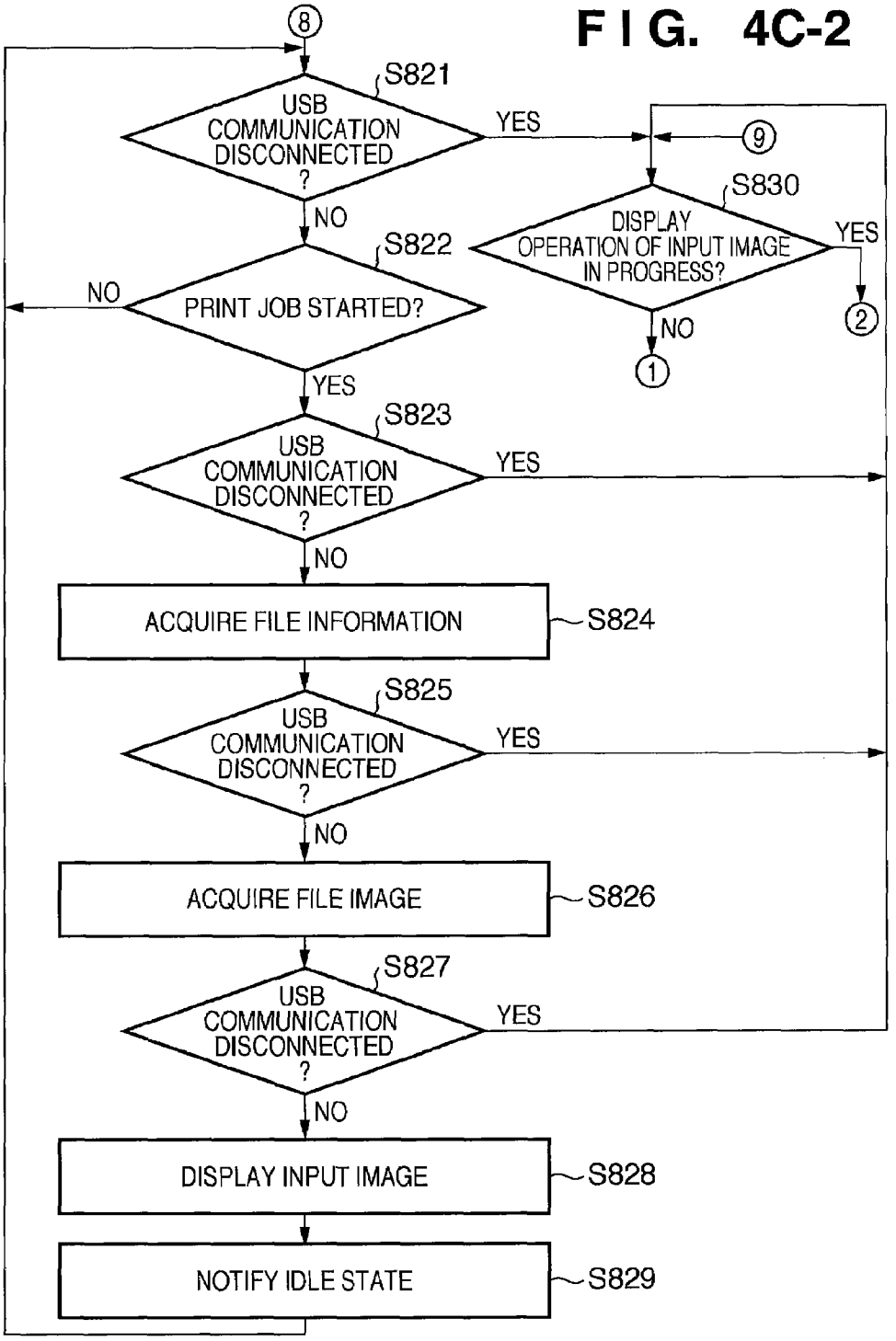

8
S821
USB COMMUNICATION DISCONNECTED ?
YES
NO
9
S830
DISPLAY OPERATION OF INPUT IMAGE IN PROGRESS?
YES
NO
2
1
S822
PRINT JOB STARTED?
NO
YES
S823
USB COMMUNICATION DISCONNECTED ?
YES
NO
ACQUIRE FILE INFORMATION
S824
S825
USB COMMUNICATION DISCONNECTED ?
YES
NO
ACQUIRE FILE IMAGE
S826
S827
USB COMMUNICATION DISCONNECTED ?
YES
NO
DISPLAY INPUT IMAGE
S828
NOTIFY IDLE STATE
S829

FIG. 5A

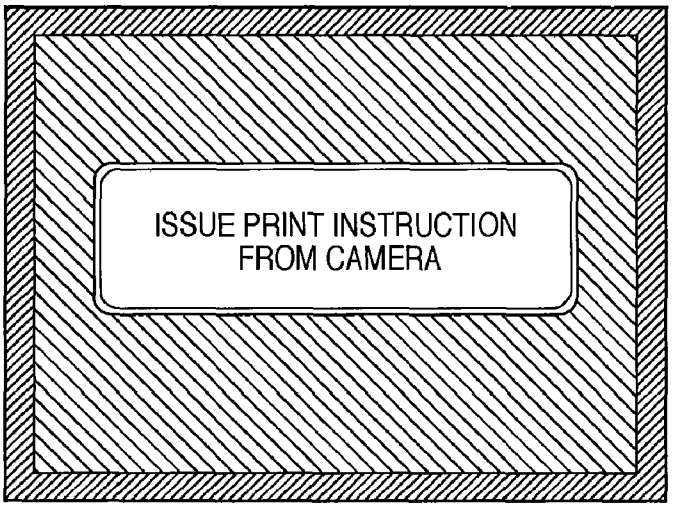


FIG. 5B

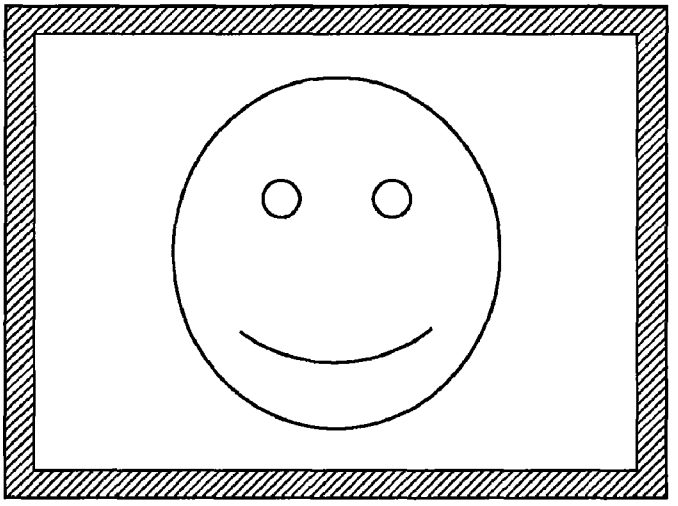


FIG. 5C

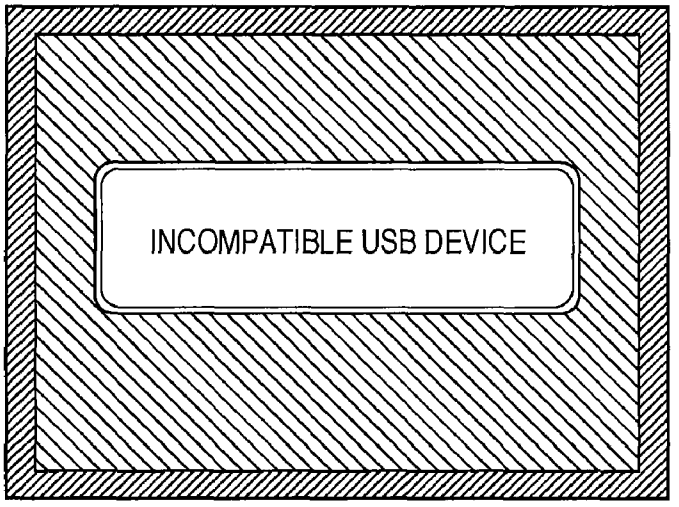


FIG. 6A

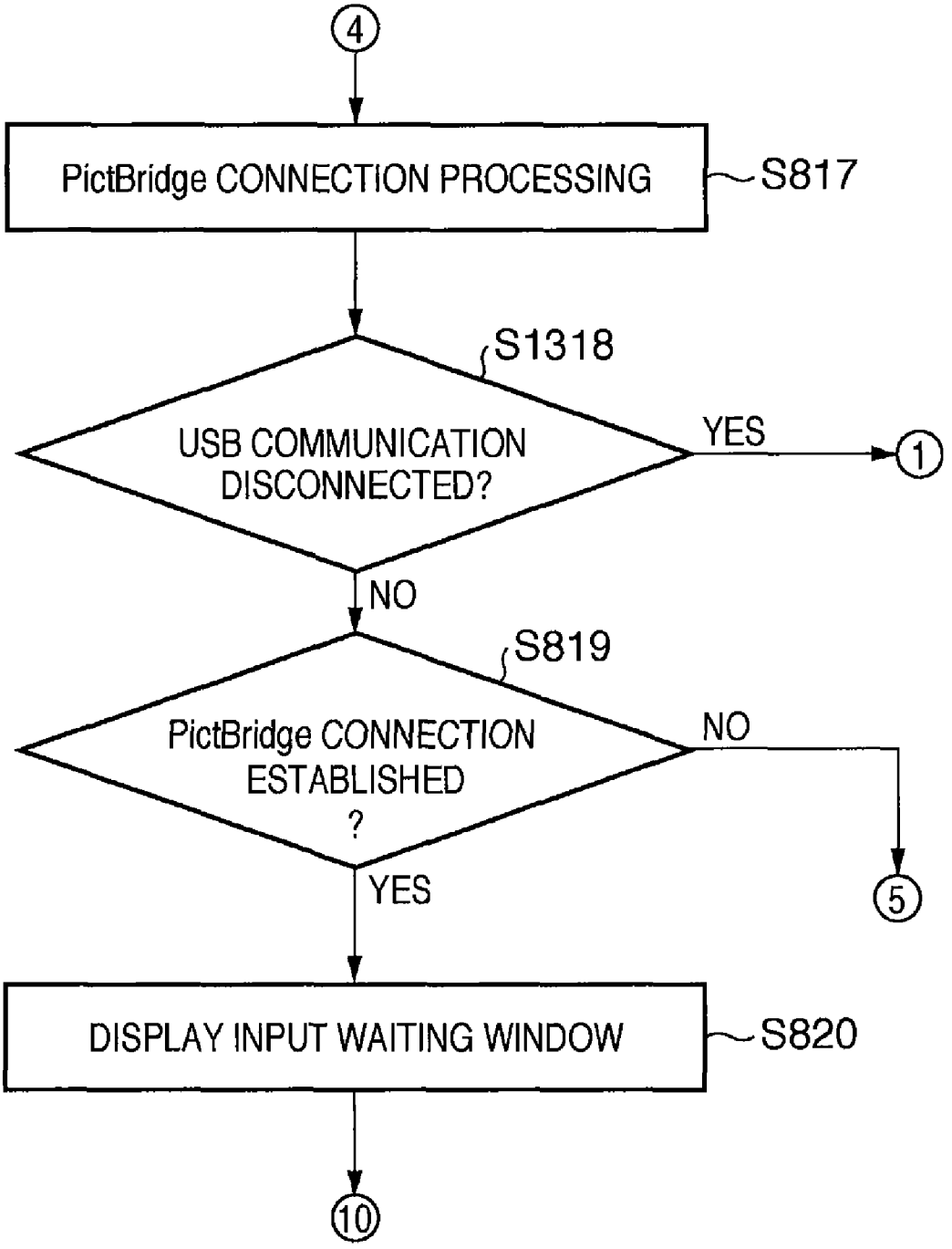

4
PictBridge CONNECTION PROCESSING
S817
S1318
USB COMMUNICATION DISCONNECTED?
YES
1
NO
S819
PictBridge CONNECTION ESTABLISHED ?
NO
5
YES
DISPLAY INPUT WAITING WINDOW
S820
10

FIG. 6B

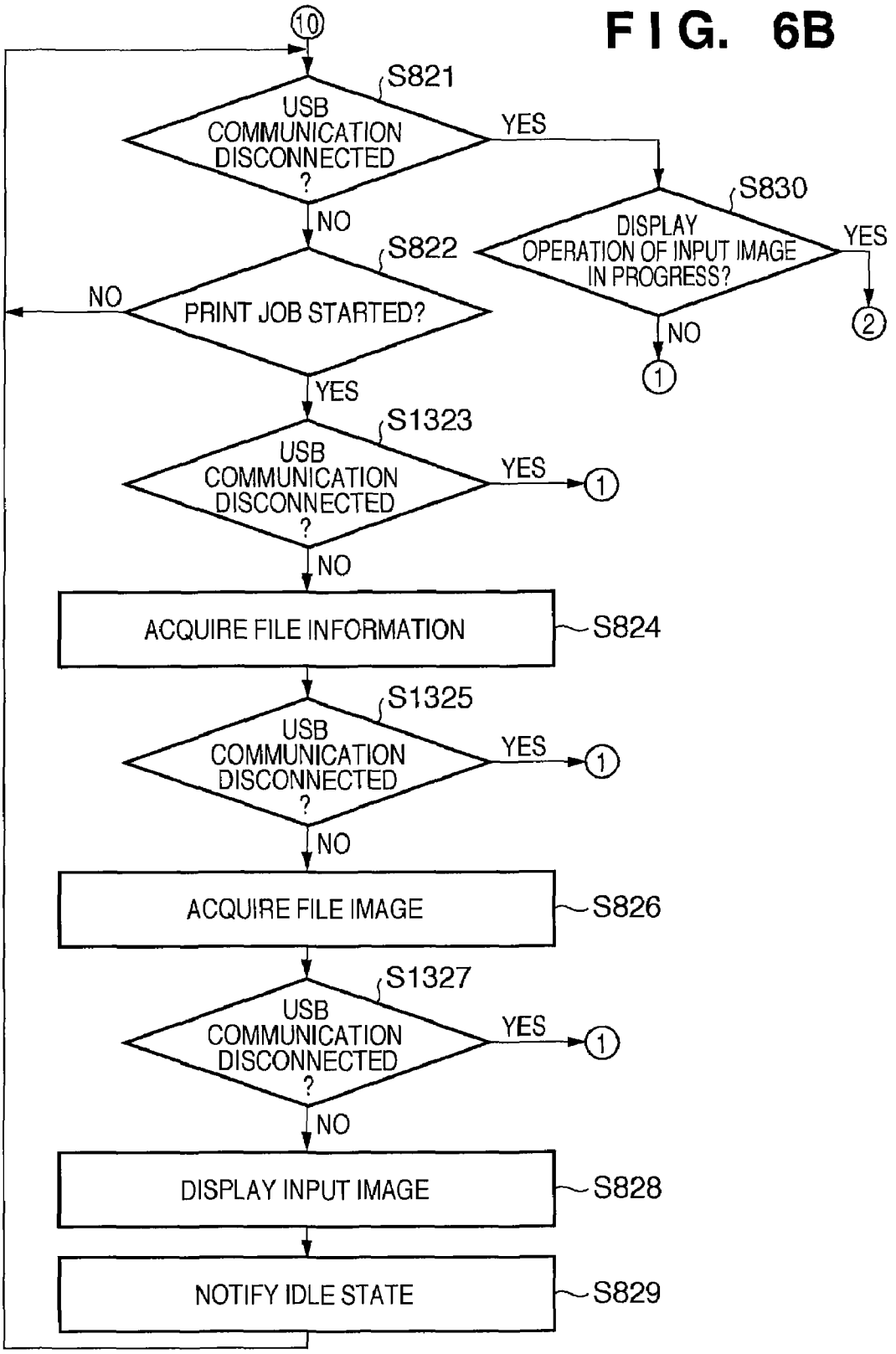

10
S821
USB COMMUNICATION DISCONNECTED ?
YES
NO
S830
DISPLAY OPERATION OF INPUT IMAGE IN PROGRESS?
YES
NO
2
1
S822
PRINT JOB STARTED?
NO
YES
S1323
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
ACQUIRE FILE INFORMATION
S824
S1325
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
ACQUIRE FILE IMAGE
S826
S1327
USB COMMUNICATION DISCONNECTED ?
YES
1
NO
DISPLAY INPUT IMAGE
S828
NOTIFY IDLE STATE
S829

FIG. 7

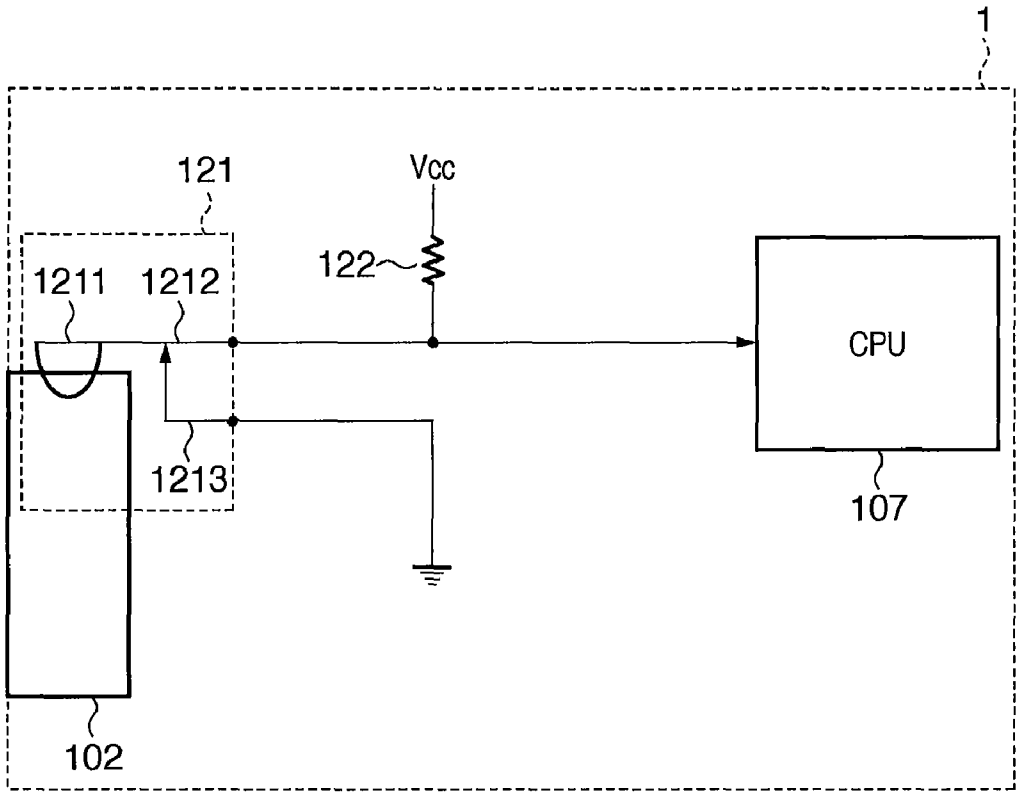


FIG. 8A

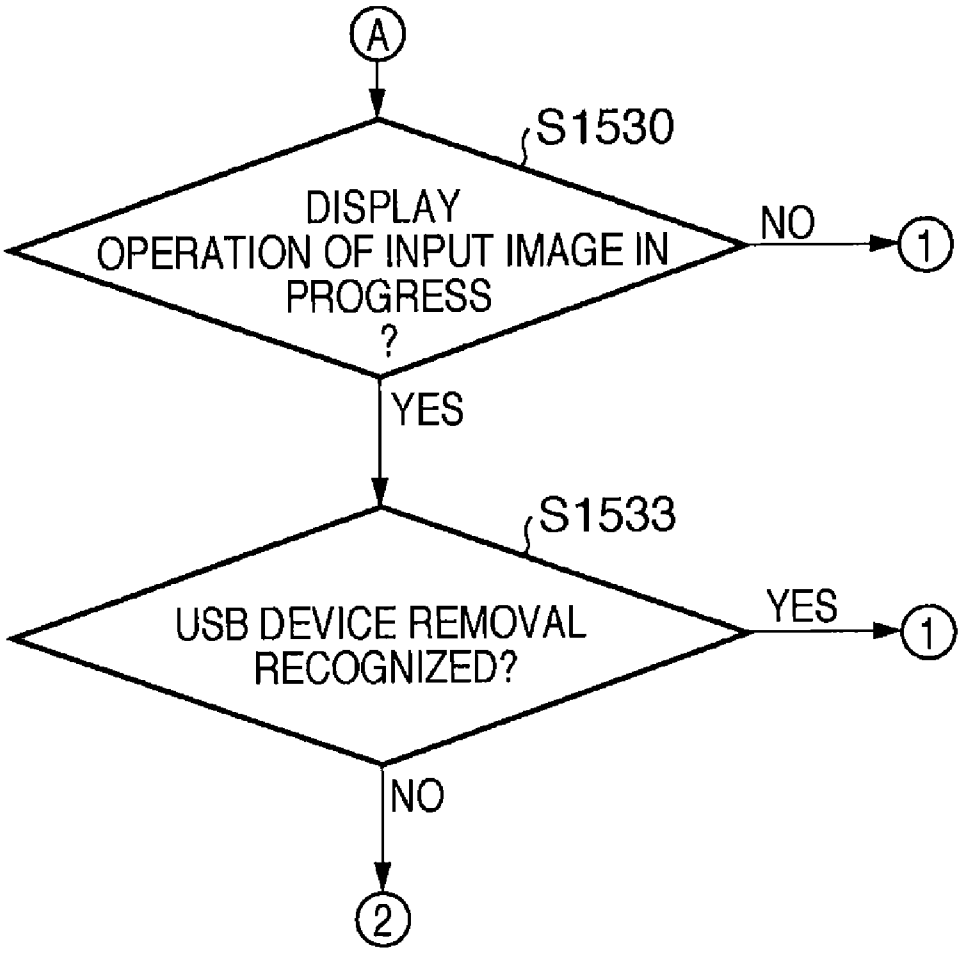

A
S1530
DISPLAY OPERATION OF INPUT IMAGE IN PROGRESS ?
NO
1
YES
S1533
USB DEVICE REMOVAL RECOGNIZED?
YES
1
NO
2

FIG. 8B-1

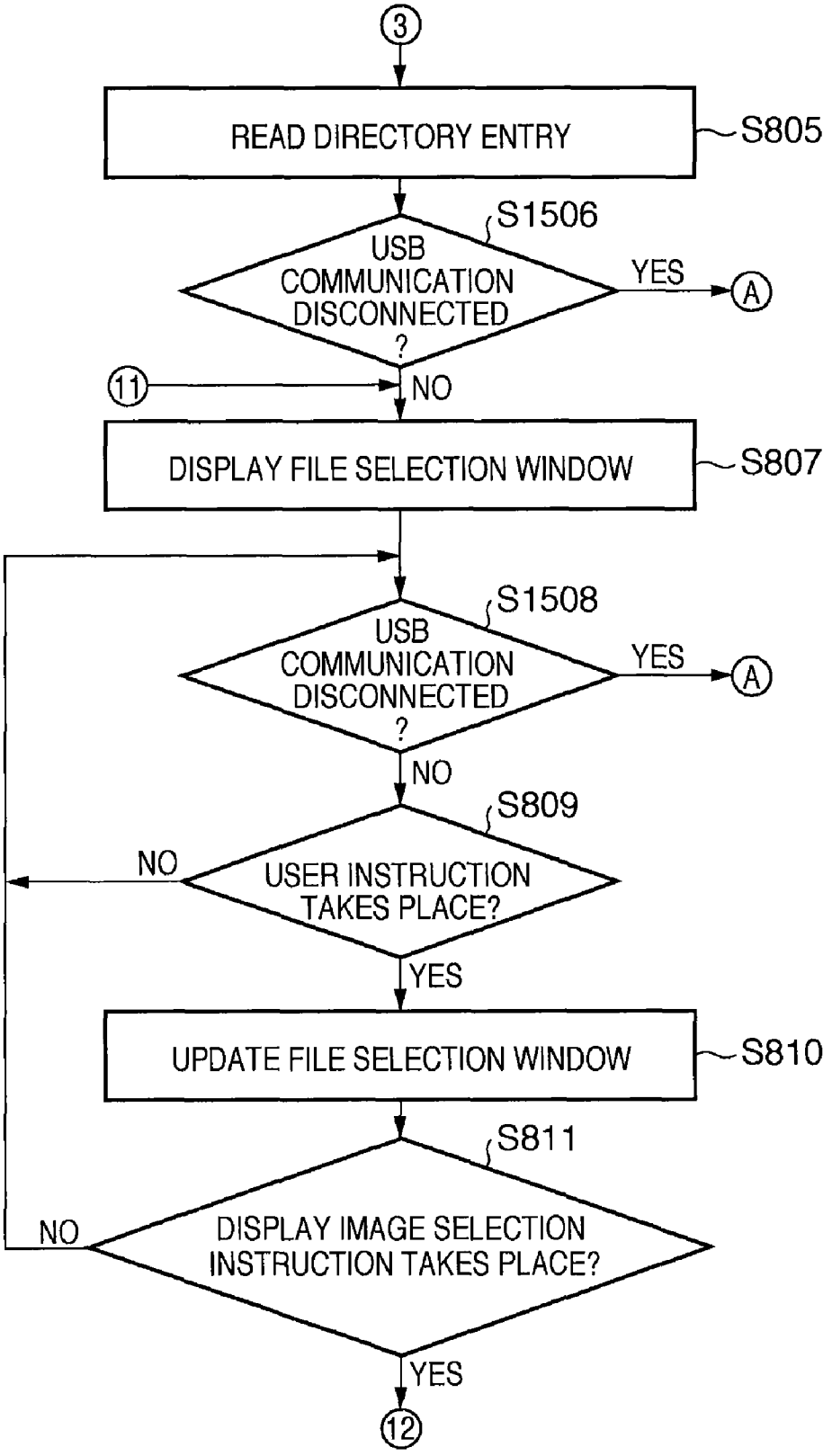

3
READ DIRECTORY ENTRY
S805
S1506
USB COMMUNICATION DISCONNECTED ?
YES
A
11
NO
DISPLAY FILE SELECTION WINDOW
S807
S1508
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
S809
NO
USER INSTRUCTION TAKES PLACE?
YES
UPDATE FILE SELECTION WINDOW
S810
S811
NO
DISPLAY IMAGE SELECTION INSTRUCTION TAKES PLACE?
YES
12

FIG. 8B-2

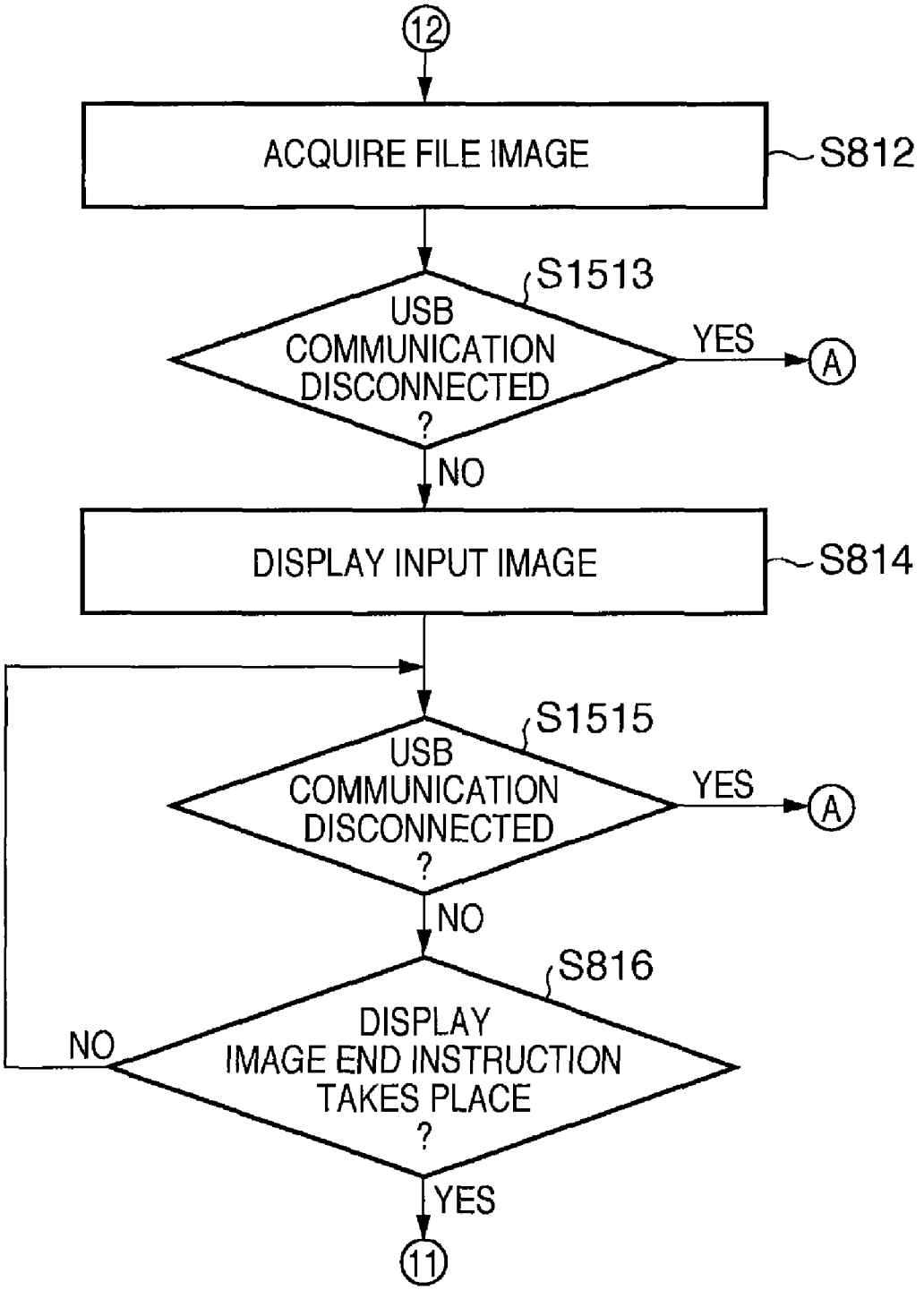

12
ACQUIRE FILE IMAGE
S812
S1513
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
DISPLAY INPUT IMAGE
S814
S1515
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
S816
DISPLAY IMAGE END INSTRUCTION TAKES PLACE ?
NO
YES
11

FIG. 8C-1

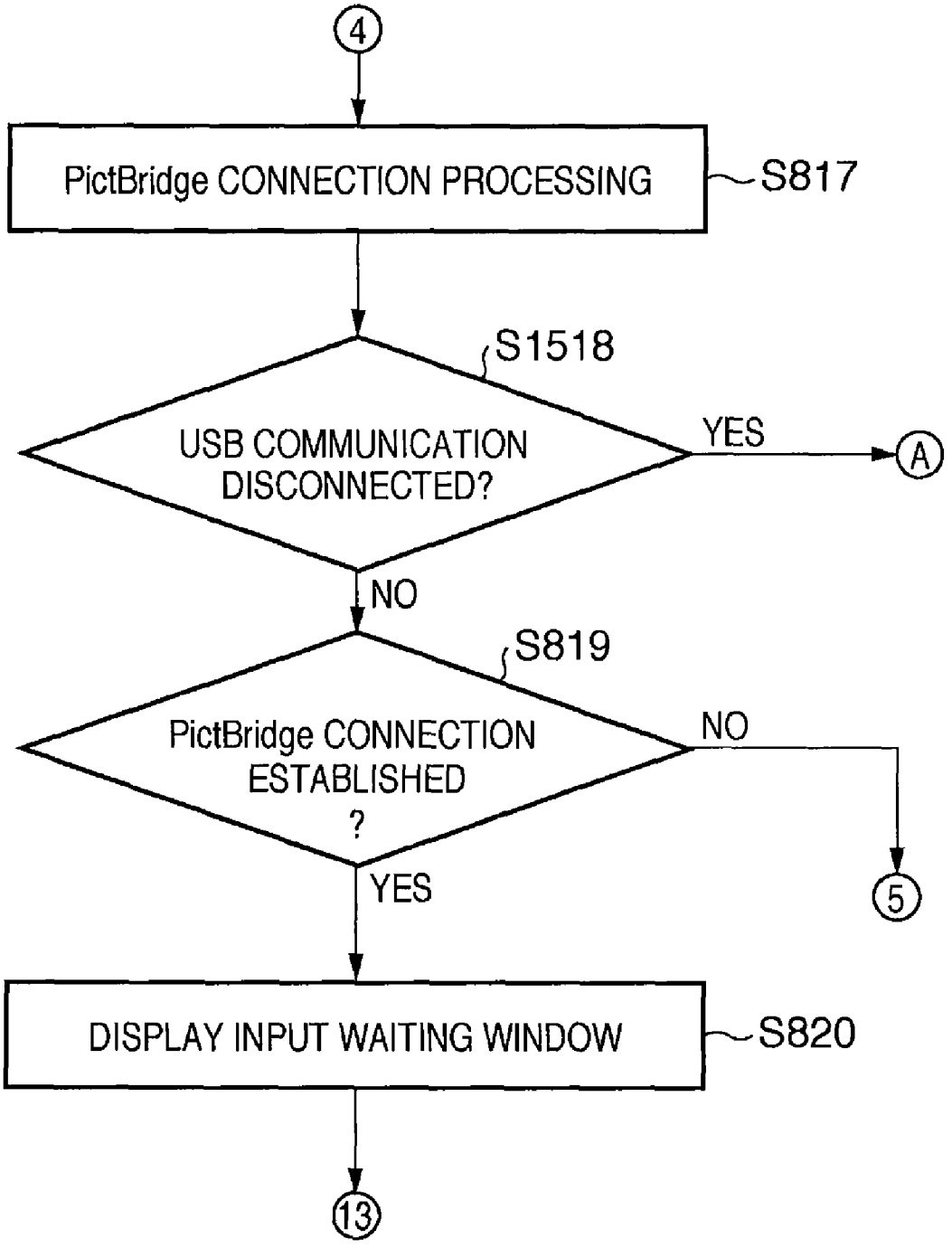

4
PictBridge CONNECTION PROCESSING
S817
S1518
USB COMMUNICATION DISCONNECTED?
YES
A
NO
S819
PictBridge CONNECTION ESTABLISHED ?
NO
5
YES
DISPLAY INPUT WAITING WINDOW
S820
13

FIG. 8C-2

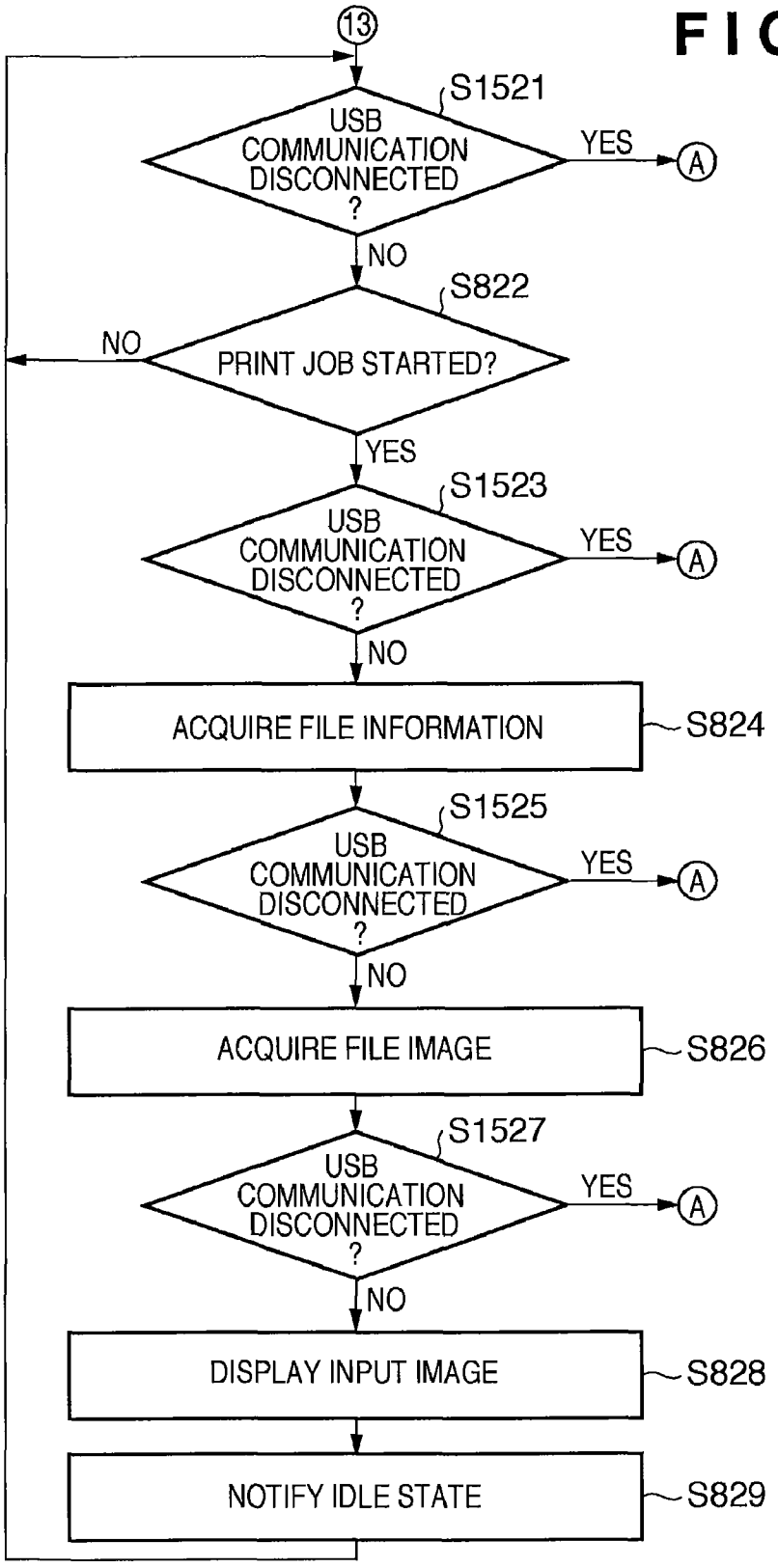
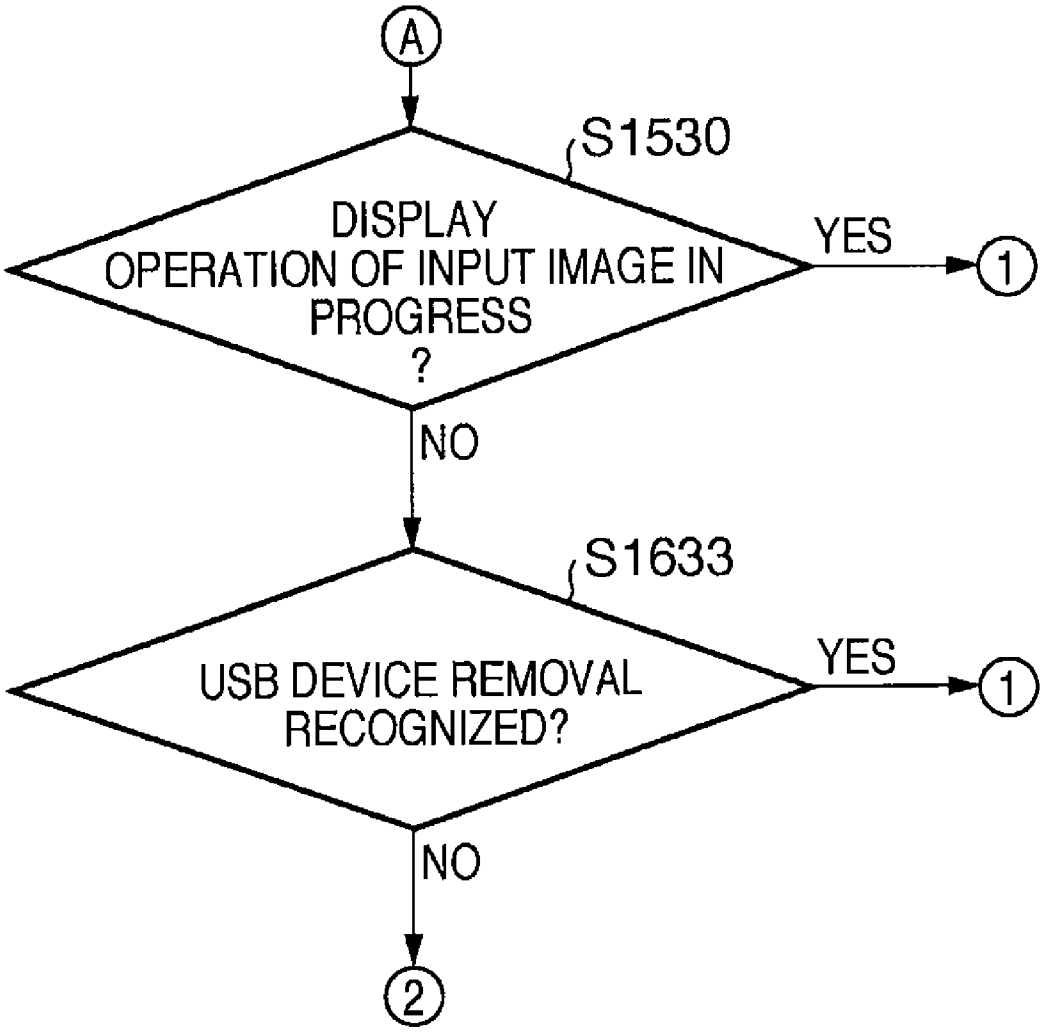

13
S1521
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
S822
PRINT JOB STARTED?
NO
YES
S1523
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
ACQUIRE FILE INFORMATION
S824
S1525
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
ACQUIRE FILE IMAGE
S826
S1527
USB COMMUNICATION DISCONNECTED ?
YES
A
NO
DISPLAY INPUT IMAGE
S828
NOTIFY IDLE STATE
S829

FIG. 9A


A
S1530
DISPLAY OPERATION OF INPUT IMAGE IN PROGRESS ?
YES
1
NO
S1633
USB DEVICE REMOVAL RECOGNIZED?
YES
1
NO
2

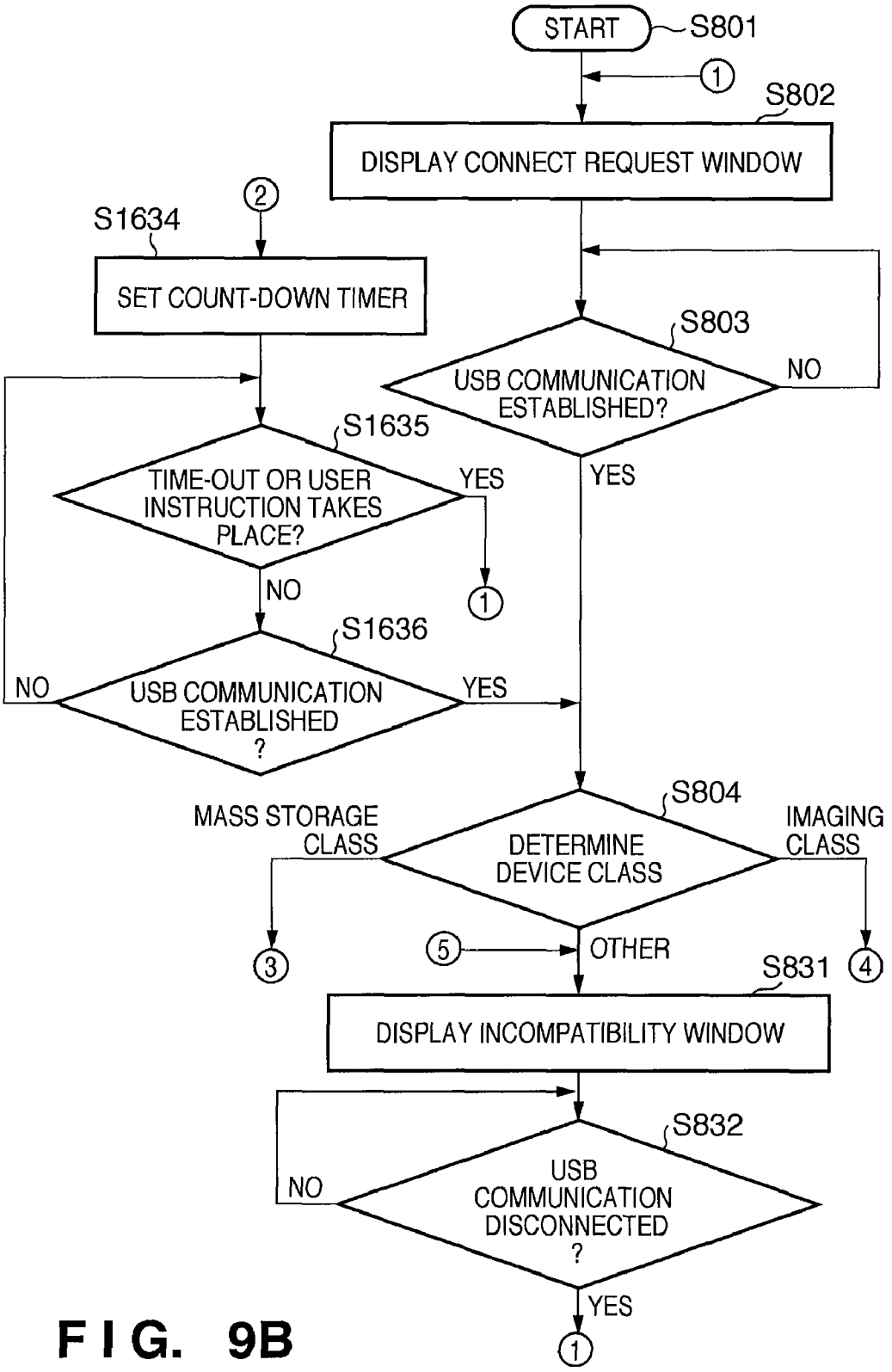
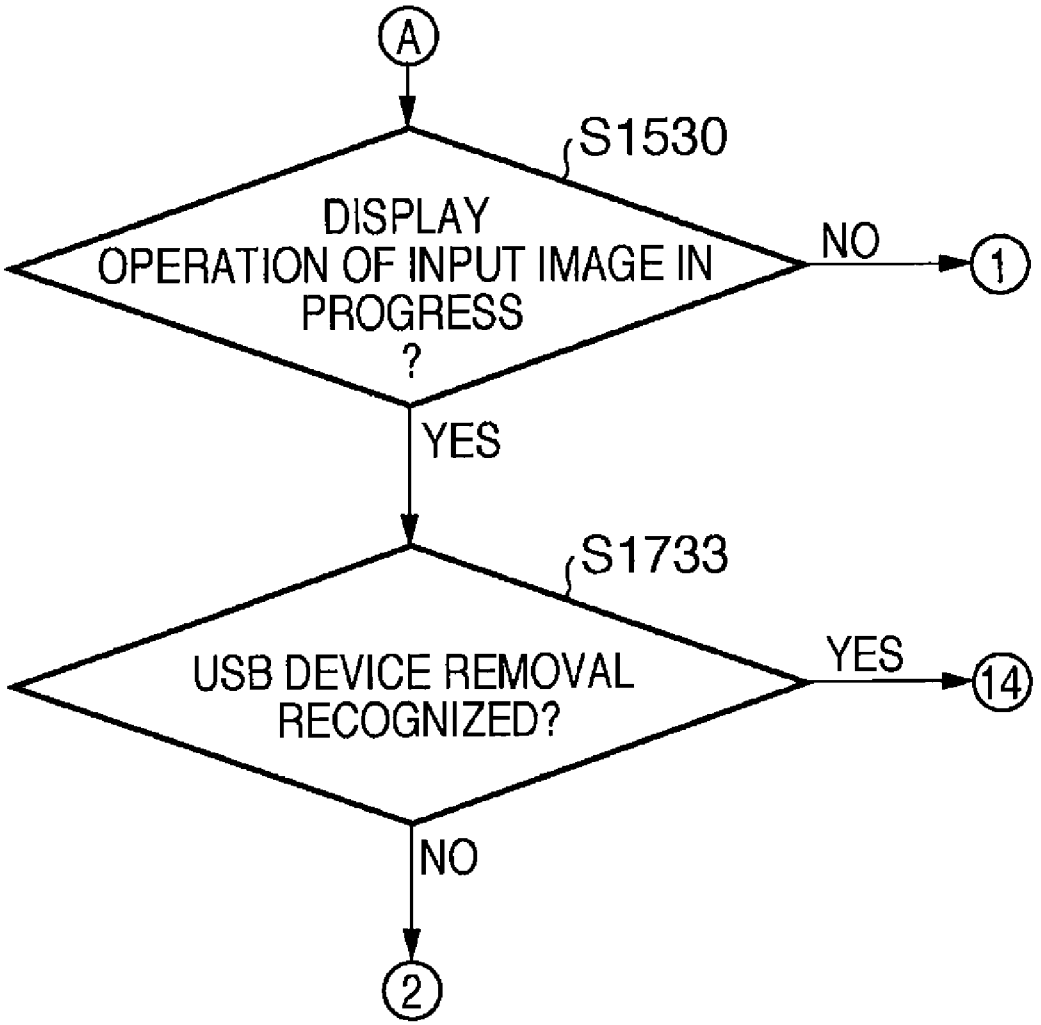

START
S801
1
S802
DISPLAY CONNECT REQUEST WINDOW
2
S1634
SET COUNT-DOWN TIMER
S803
USB COMMUNICATION ESTABLISHED?
NO
YES
S1635
TIME-OUT OR USER INSTRUCTION TAKES PLACE?
YES
NO
1
S1636
NO
USB COMMUNICATION ESTABLISHED ?
YES
S804
MASS STORAGE CLASS
DETERMINE DEVICE CLASS
IMAGING CLASS
3
5
OTHER
S831
4
DISPLAY INCOMPATIBILITY WINDOW
S832
NO
USB COMMUNICATION DISCONNECTED ?
YES
1

FIG. 9B

FIG. 10A


A
S1530
DISPLAY OPERATION OF INPUT IMAGE IN PROGRESS ?
NO
1
YES
S1733
USB DEVICE REMOVAL RECOGNIZED?
YES
14
NO
2

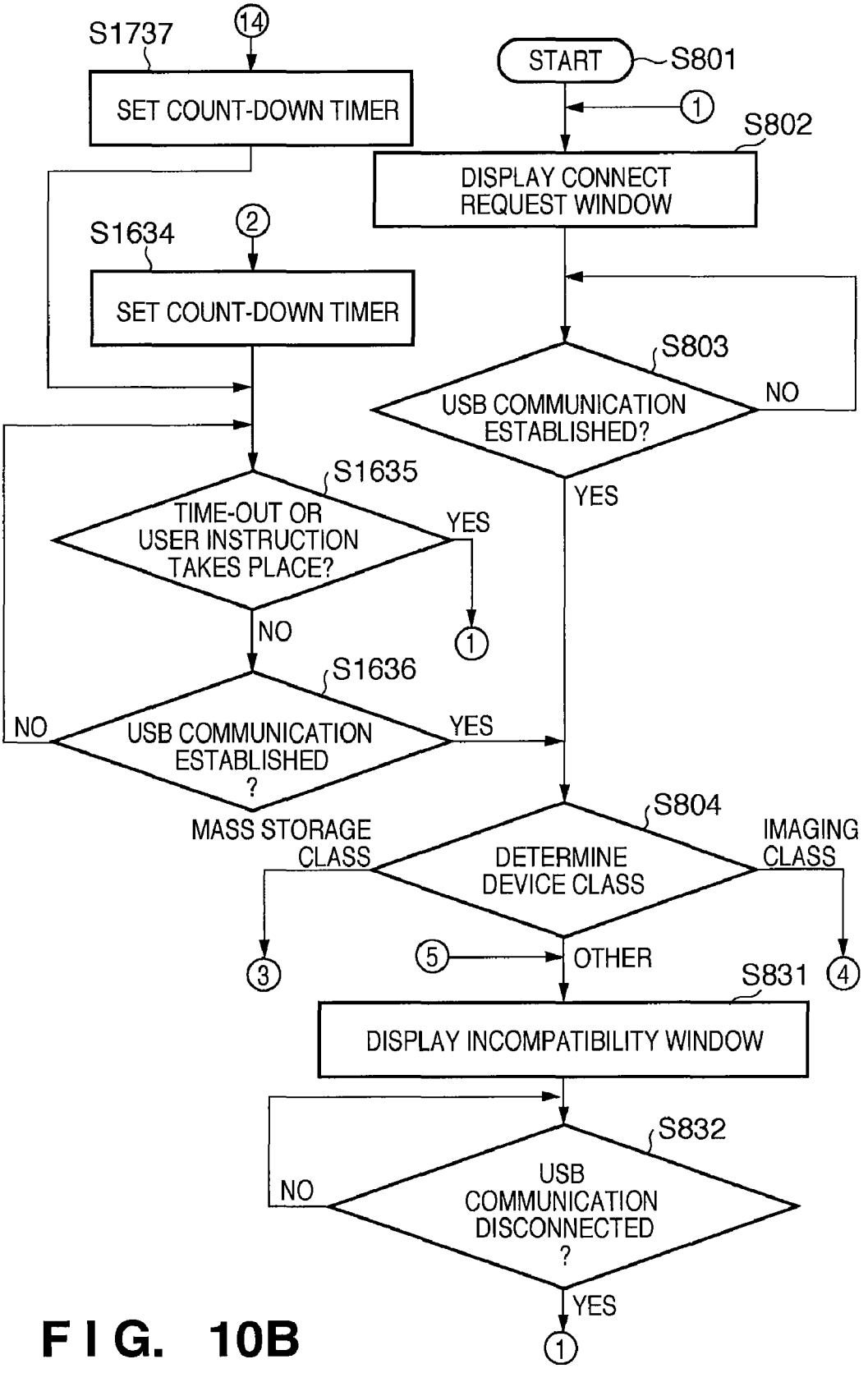

S1737
14
SET COUNT-DOWN TIMER
START
S801
1
S802
DISPLAY CONNECT REQUEST WINDOW
S1634
2
SET COUNT-DOWN TIMER
S803
USB COMMUNICATION ESTABLISHED?
NO
YES
S1635
TIME-OUT OR USER INSTRUCTION TAKES PLACE?
YES
1
NO
S1636
NO
USB COMMUNICATION ESTABLISHED ?
YES
S804
MASS STORAGE CLASS
DETERMINE DEVICE CLASS
IMAGING CLASS
3
5
OTHER
S831
4
DISPLAY INCOMPATIBILITY WINDOW
S832
NO
USB COMMUNICATION DISCONNECTED ?
YES
1

FIG. 10B

FIG. 11A

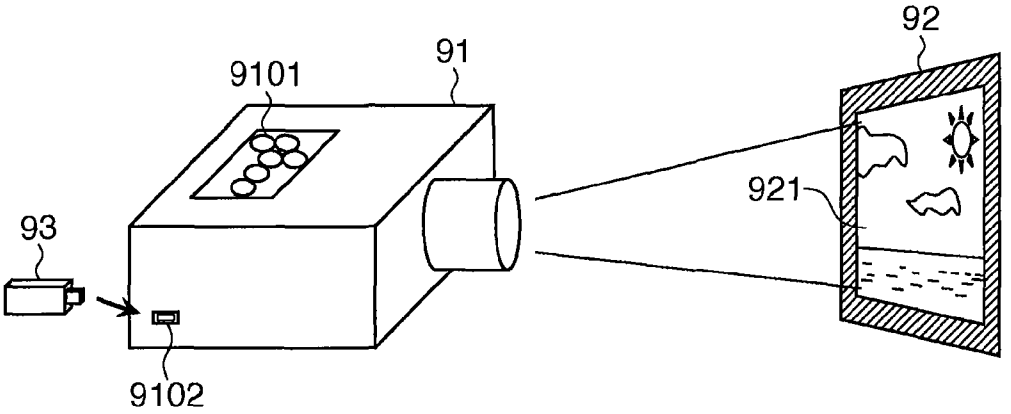


FIG. 11B

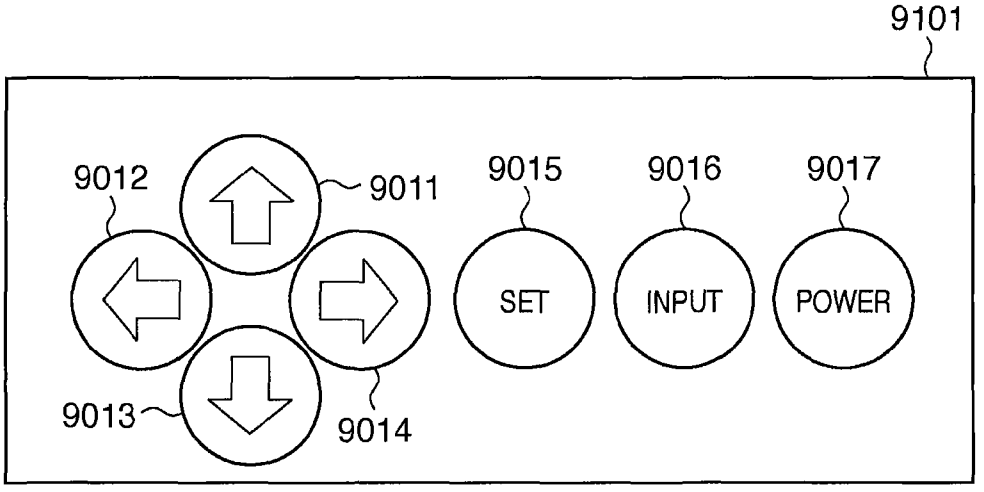


FIG. 12

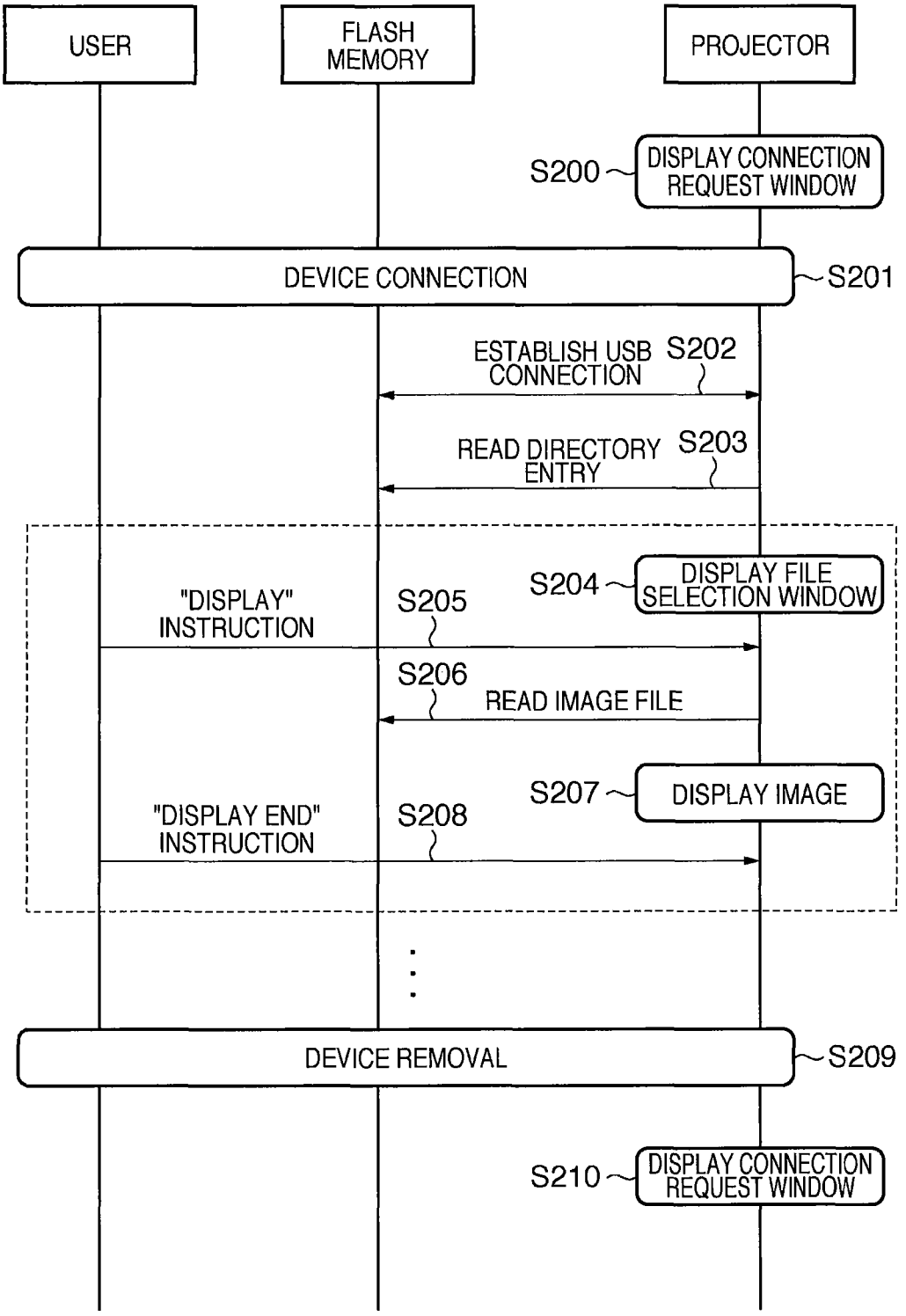

USER
FLASH MEMORY
PROJECTOR
S200
DISPLAY CONNECTION REQUEST WINDOW
DEVICE CONNECTION
S201
ESTABLISH USB CONNECTION
S202
READ DIRECTORY ENTRY
S203
S204
DISPLAY FILE SELECTION WINDOW
"DISPLAY" INSTRUCTION
S205
S206
READ IMAGE FILE
S207
DISPLAY IMAGE
"DISPLAY END" INSTRUCTION
S208
DEVICE REMOVAL
S209
S210
DISPLAY CONNECTION REQUEST WINDOW

FIG. 13A

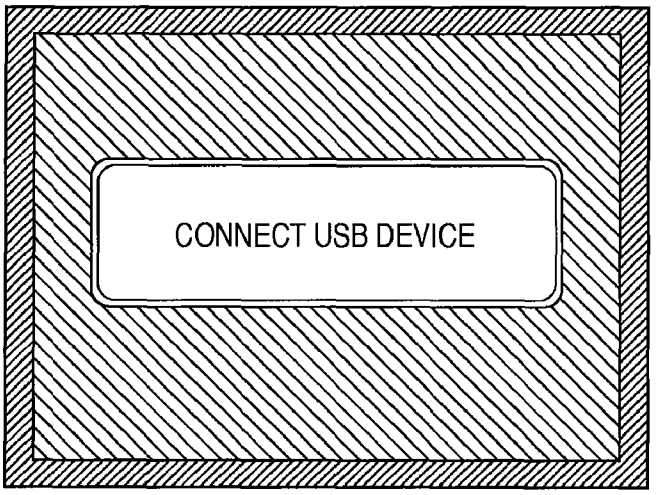


FIG. 13B

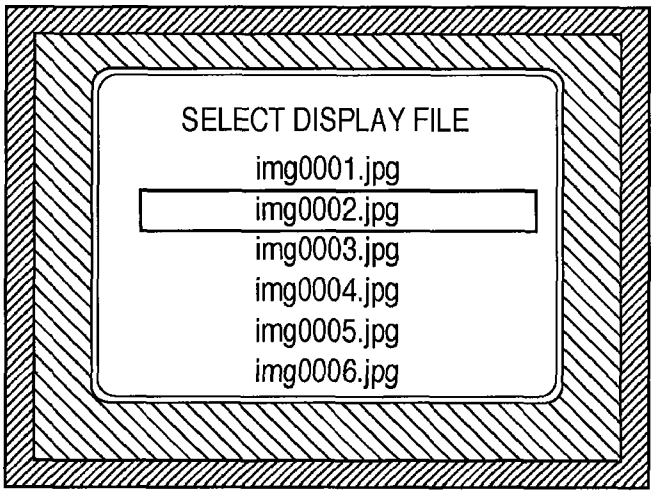


FIG. 13C

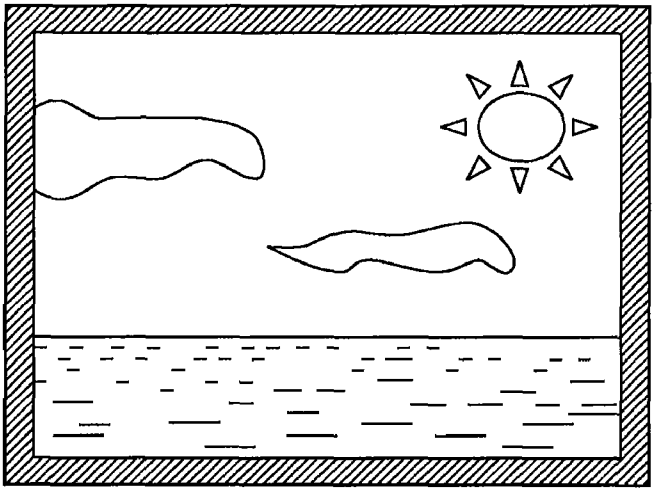


FIG. 14A

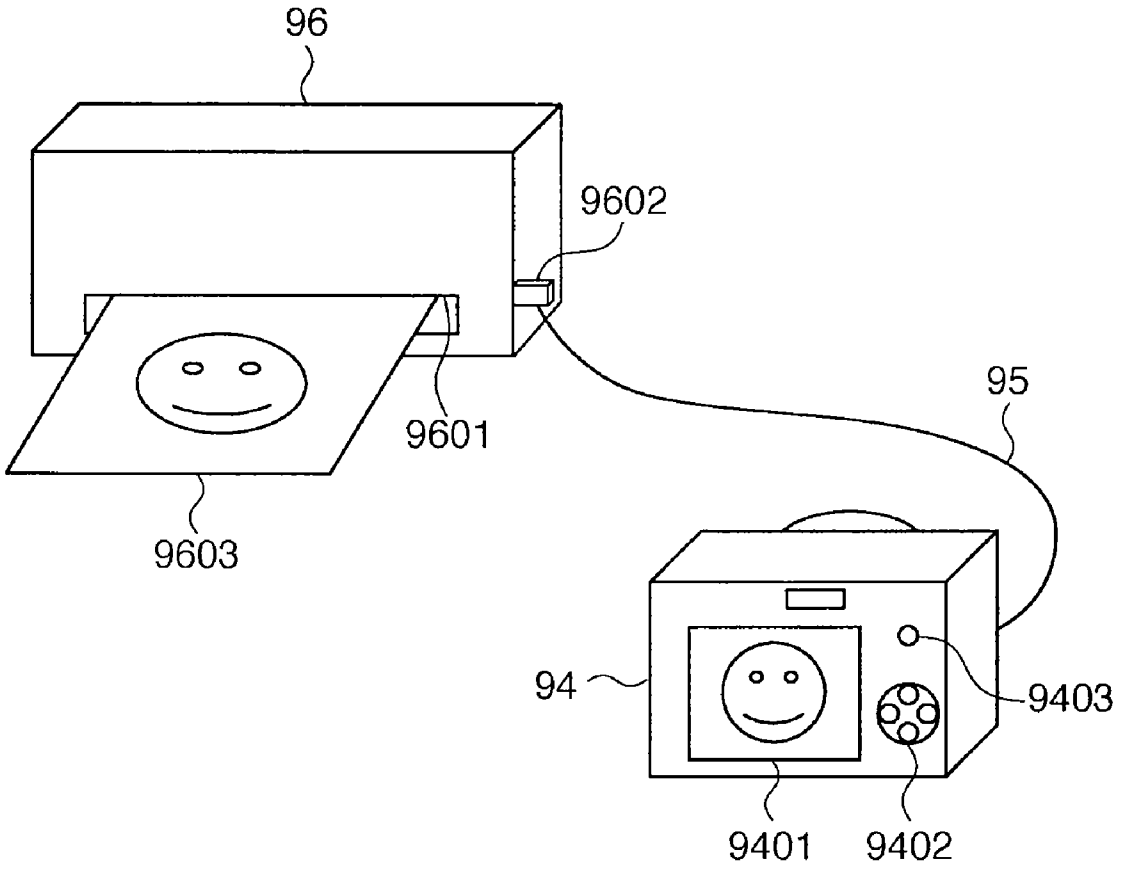


FIG. 14B

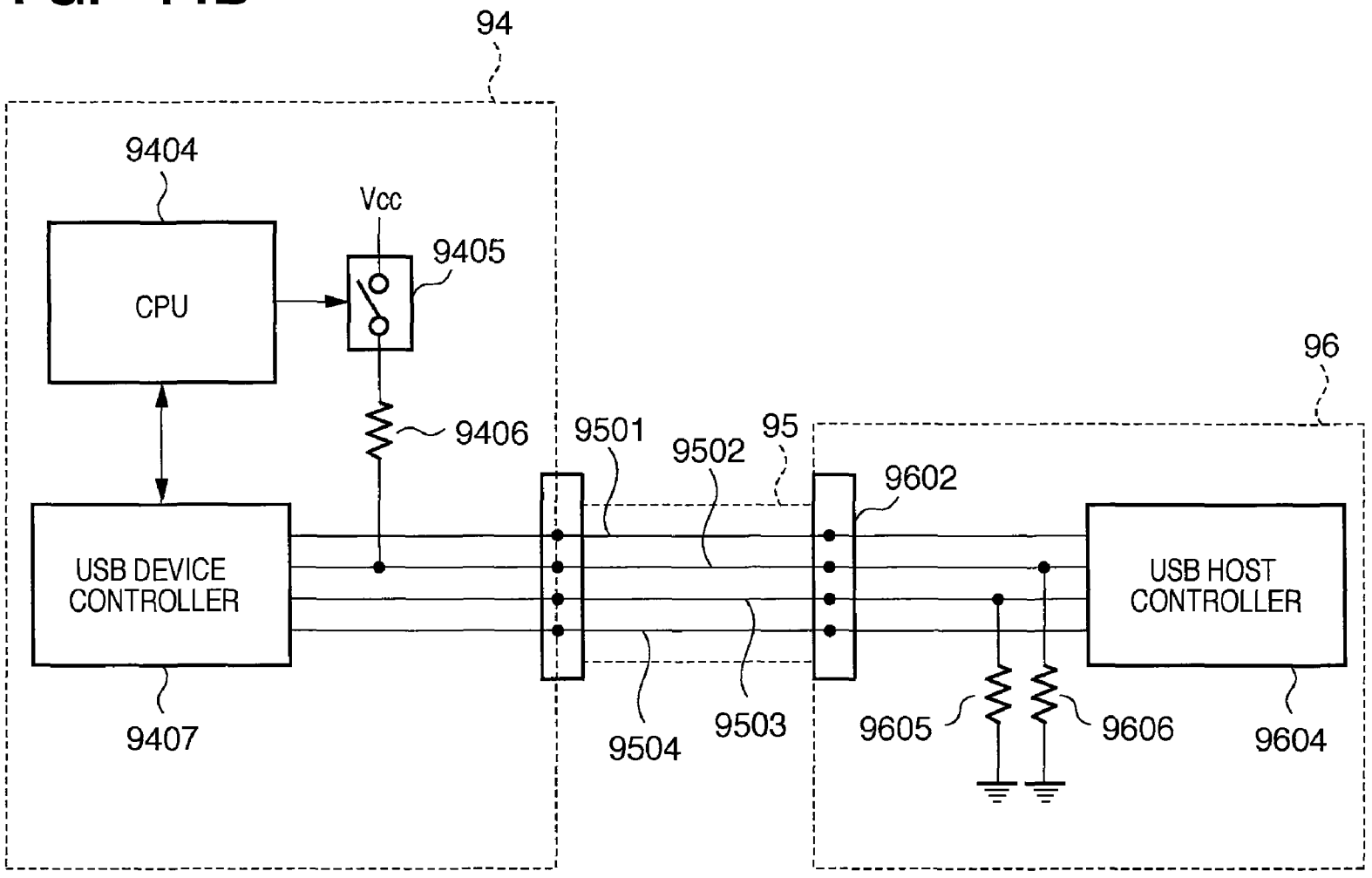

94
9404
Vcc
9405
CPU
9406
9501
9502
95
96
9602
USB DEVICE CONTROLLER
USB HOST CONTROLLER
9407
9504
9503
9605
9606
9604

FIG. 15

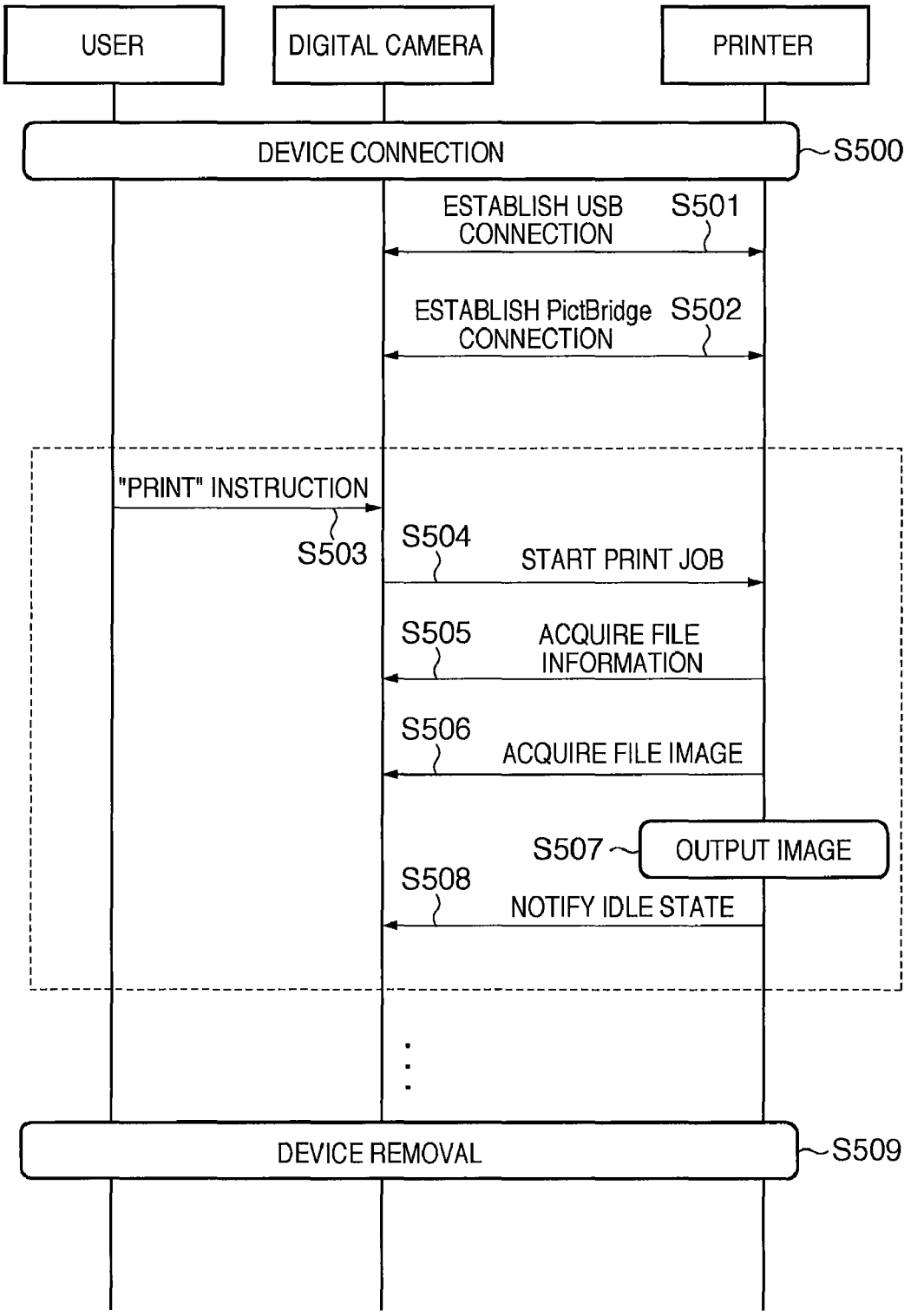
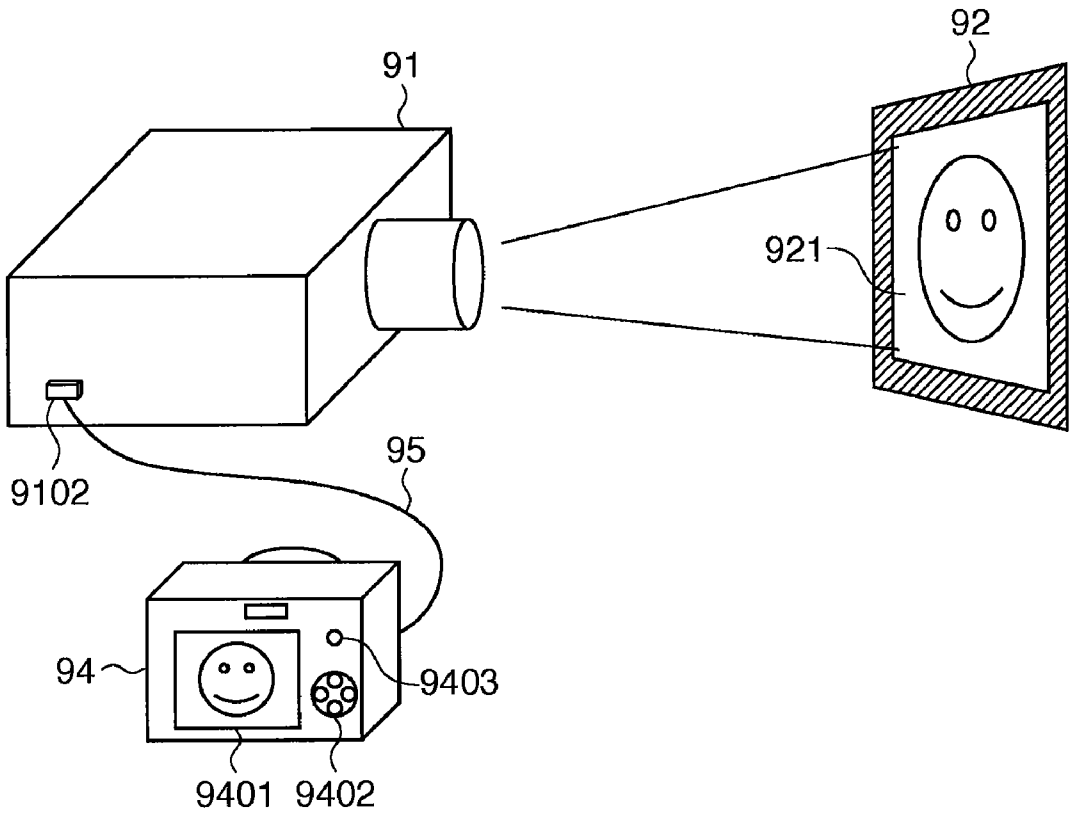

USER
DIGITAL CAMERA
PRINTER
DEVICE CONNECTION
S500
ESTABLISH USB CONNECTION
S501
ESTABLISH PictBridge CONNECTION
S502
"PRINT" INSTRUCTION
S503
S504
START PRINT JOB
S505
ACQUIRE FILE INFORMATION
S506
ACQUIRE FILE IMAGE
S507
OUTPUT IMAGE
S508
NOTIFY IDLE STATE
DEVICE REMOVAL
S509

FIG. 16



DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM

This application is a continuation of PCT Application No. PCT/JP2009/055831, filed Mar. 24, 2009.

TECHNICAL FIELD

The present invention relates to a display apparatus, a control method thereof, and a program.

BACKGROUND ART

Conventionally, a display apparatus such as a projector is connected to various devices via, for example, USB (Universal Serial Bus), and displays image data transmitted from these connected devices. Various devices connected to the display apparatus include a semiconductor memory device such as a flash memory device, a PC (Personal Computer), a digital still camera (to be referred to as a "digital camera" hereinafter), and the like.

A case will be explained first with reference to FIGS. **11**A to **13**C wherein a flash memory as a semiconductor memory device is connected to a projector as a display apparatus, and image data stored in that flash memory is displayed on the projector. FIG. **11**A is a schematic view showing an overview when a flash memory **93** is connected to a conventional projector **91** to display an image. FIG. **11**B is a schematic view showing details of a control panel **9101**. FIG. **12** is a sequence chart showing the operation sequence executed when the flash memory **93** is connected to the projector **91** to display an image. FIGS. **13**A to **13**C are schematic views exemplifying images to be projected by the projector **91** onto a screen **92**.

As shown in FIG. **11**A, the projector **91** has the control panel **9101** and a USB connector **9102**. As shown in FIG. **11**B, the control panel **9101** has an up arrow button **9011**, left arrow button **9012**, down arrow button **9013**, right arrow button **9014**, enter button **9015**, input button **9016**, and power button **9017**. The projector **91** accepts operation instructions from the user from various buttons on the control panel **9101**. The USB connector **9102** receives the flash memory **93** having a USB connection terminal. This flash memory **93** stores image data to be displayed by the projector **91**. By the user plugging the flash memory **93** into the USB connector **9102** and operating the control panel **9101**, he or she can browse image data stored in the flash memory **93** as an image **921** on the screen **92**.

The operation sequence among the user, flash memory **93**, and projector **91** will be described below. Assume that the projector **91** is powered, and the flash memory **93** is not connected to the projector **91** in an advance state. As shown in FIG. **12**, the operation sequence by the user, flash memory **93**, and projector **91** mainly include steps S**200** to S**210** which are executed in turn. In step S**200**, the projector **91** displays a connection request window that requests the user to connect the flash memory **93** to the USB connector **9102** by projecting that window on the screen **92**. The connection request window in step S**200** displays a message that prompts the user to connect the flash memory **93** as a USB device, as shown in FIG. **13**A.

In step S**201**, the user connects the flash memory **93** to the USB connector **9102**. In step S**202**, a USB communication is established based on the USB standard between the projector **91** and flash memory **93** which are physically connected via the USB connector **9102**. In this case, the projector **91** recognizes the flash memory **93** as Mass Storage Class based on the USB standard.

In step S**203**, the projector **91** reads directory entry information stored in the flash memory **93**. In step S**204**, the projector **91** displays a file selection window that prompts the user to select an image file to be displayed by projecting that window on the screen **92**. The file selection window in step S**204** is as shown in FIG. **13**B, and is a window that displays a file name list of image files stored in the flash memory **93**, and a cursor used to select them.

In step S**205**, the user who confirmed the aforementioned file selection window selects an image file to be displayed by operating the control panel **9101** and issues a display instruction to the projector **91**. For example, in step S**205** the user gives an instruction to move the cursor by pressing the up or down arrow button **9011** or **9013** on the control panel **9101**, and issues a display instruction of an image file selected by the cursor by pressing the enter button **9015**.

In step S**206**, the projector **91** reads data of the image file designated in step S**205** from the flash memory **93**. In step S**207**, the projector **91** displays an image based on the image file read in step S**206** by projecting that image on the screen **92**. As the image displayed in step S**207**, image data of a landscape or the like captured using a digital camera is stored in advance in the flash memory **93**, as shown in FIG. **13**C.

In step S**208**, the user issues a display end instruction to the projector **91** by operating the control panel **9101**. More specifically, when the user presses the enter button **9015**, a display end instruction is issued to the projector **91**. Note that the operations for accepting selection of an image file by the user and displaying the selected image file can be repeated by repeating steps S**204** to S**208** bounded by the broken line in FIG. **12**.

In step S**209**, the user removes the flash memory **93** from the USB connector **9102**. In step S**210**, the projector **91** clears a display image projected onto the screen **92** (or overwrites the image by a predetermined image such as a menu window) due to removal of the flash memory **93** in step S**209**. For example, in step S**210** the connection request window shown in FIG. **13**A is overwritten on an image displayed in steps S**204** to S**208**. As a result, the projector **91** can prompt the user to connect the next device. The user removes the flash memory **93** with the intention to end browsing of image files stored in the flash memory **93**. Therefore, since the projector **91** clears an image displayed in steps S**204** to S**208**, it can attain an image display operation according to the user's intention.

Note that patent reference 1 is known as a technique of clearing (overwriting) a display image by a predetermined image in step S**210** above. Patent reference 1 discloses a technique for clearing a display image at the end of a communication and a technique for clearing a previous display image at the beginning of a communication.

A case will be exemplified below wherein another example of various devices to be connected is a digital camera. Note that a case will be exemplified below with reference to FIGS. **14**A and **14**B, and FIG. **15** wherein a digital camera is connected to a printer, and the printer outputs an image based on image data stored in that digital camera. As a typical example in this case, the CIPA DC-001-2003 standard (to be referred to as "PictBridge" hereinafter) is available. In a method of outputting an image using this PictBridge, even a user unskilled in operations of devices such as PCs can output an image using a printer by readily operating a digital camera. An image output operation using the PictBridge will be described below.

FIG. **14**A is a schematic view showing an overview when a digital camera **94** is connected to a printer **96** to output an image. FIG. **14**B is a block diagram showing the arrangement

associated with a communication between the printer **96** and digital camera **94**. FIG. **15** is a sequence chart showing the operation sequence when the digital camera **94** is connected to the printer **96** to output an image.

As shown in FIG. **14**A, the printer **96** has a discharge port **9601** and USB connector **9602**. The discharge port **9601** discharges a paper sheet **9603** after image formation. To the USB connector **9602**, the digital camera **94** is connected via a USB cable **95**. The digital camera **94** has a liquid crystal panel screen **9401**, operation member **9402**, and PictBridge button **9403**. The liquid crystal panel screen **9401** displays a preview of an image or the like transferred via the PictBridge. The operation member **9402** accepts an image selection instruction from the user. The PictBridge button **9403** is a button which accepts an instruction to start PictBridge transfer from the user. An image based on image data stored in the digital camera **94** is output onto a paper sheet in the printer **96** in such a manner that an image output instruction is output to the printer **96** by an operation on the digital camera **94** side, and image data to be output is transmitted from the digital camera **94** to the printer **96**.

The operation sequence among the user, digital camera **94**, and printer **96** will be described below. As shown in FIG. **15**, the operation sequence by the user, digital camera **94**, and printer **96** mainly includes steps S**500** to S**509**, which are executed in turn. In step S**500**, the user connects the digital camera **94** and printer **96** via the USB cable **95**. In step S**501**, a USB communication is established based on the USB standard between the digital camera **94** and printer **96** which are physically connected via the USB cable **95**. In this case, the printer **96** recognizes the digital camera **94** as a capture device of Imaging Class based on the USB standard.

In step S**502**, a PictBridge connection is established between the digital camera **94** and printer **96**. More specifically, a connection is established in a PTP (Picture Transfer Protocol) layer, device information is exchanged, and so forth. Then, a communication state as a PictBridge sequence transits to an idle state, and the printer **96** waits for issuance of a print job by the digital camera **94**.

In step S**503**, the user issues a print instruction via the PictBridge by operating the digital camera **94**. More specifically, this print instruction in step S**503** is issued when the user presses the PictBridge button **9403**. In step S**504**, the digital camera **94** transmits a PictBridge print job to the printer **96** based on the print instruction in step S**503**, and the printer **96** starts the operation of that print job.

In step S**505**, the printer **96** requests the digital camera **94** to transmit file information to be printed in accordance with the print job in step S**504**, and acquires that file information. Likewise, in step S**506** the printer **96** requests the digital camera **94** to transmit a file image (image data) to be printed in accordance with the print job in step S**504**, and acquires that file image.

In step S**507**, the printer **96** executes decoding, scaling, print processing, and the like of an image indicated by the file acquired in steps S**505** and S**506**, and outputs the paper sheet **9603** after image formation from the discharge port **9601**. In step S**508**, the printer **96** notifies the digital camera **94** of an idle state upon completion of the print job. Note that the operations for accepting selection of an image to be printed from the user, and printing out the selected image can be repeated by repeating steps S**503** to S**508** bounded by the broken line in FIG. **15**.

In step S**509**, the user removes the USB cable **95** from the printer **96** or digital camera **94**. Note that a device, which can control a communication session and logically disconnects a communication connection like the digital camera **94**, often disconnects a communication like closing of a communication session in addition to a physical communication disconnection by, for example, removal of the USB cable **95**. For example, when the battery remaining amount lowers during the aforementioned PictBridge sequence, the digital camera **94** side may execute control for disconnecting a USB communication so as to reduce consumption power.

A communication disconnection on the digital camera **94** side will be explained below by exemplifying the arrangement associated with a communication between the digital camera **94** and printer **96**. As shown in FIG. **14**B, a USB host controller **9604** on the printer **96** side is connected to a USB device controller **9407** on the digital camera **94** side via the USB cable **95**. The USB cable **95** includes four signal lines, that is, a VBUS line **9501**, D+ line **9502**, D− line **9503**, and GND line **9504**.

The D+ line **9502** and D− line **9503** are used to transmit differential signals required to make a USB data communication, and also indicate a device connection state by a voltage in a steady state. The D+ line **9502** and D− line **9503** are respectively pulled down by resistors **9606** and **9605** on the printer **96** side, and indicate a Low voltage when no USB cable is connected. Thus, the printer **96** recognizes a USB non-connection state. On the other hand, when the printer **96** and digital camera **94** are connected, the D+ line **9502** is pulled up by a resistor **9406** via a switch **9405** on the digital camera **94** side. Then, when the switch **9405** is in a connection state, the D+ line **9502** indicates a High voltage. As a result, the printer **96** recognizes a USB connection state.

A CPU **9404** controls the switch **9405** on the digital camera **94** side. Note that the CPU **9404** executes the following processing for the purpose of, for example, reducing consumption power of the digital camera **94**. For example, in step S**508** in which the PictBridge sequence transits to an idle state upon completion of the print job, the CPU **9404** controls the switch **9405** on the digital camera **94** side to stop to pull up the D+ line **9502**. In this case, the D+ line **9502** indicates a Low voltage since it is pulled down on the printer **96** side. For this reason, the USB host controller **9604** recognizes a USB non-connection state and disconnects a USB communication, since this state is electrically equivalent to cable removal in association with the D+ line **9502**. That is, the communication session between the digital camera **94** and printer **96** is closed by the control on the digital camera **94** side for the purpose of, for example, reducing consumption power.

When a communication disconnection is made on the digital camera **94** side, as described above, the user meets the same behavior as that when the USB cable **95** is removed at the end of the print processing of the printer **96**. That is, the PictBridge sequence reaches the same state as that when the process reaches step S**509**.

Note that the PictBridge that assumes printing has been exemplified, but the PictBridge is applicable to a display on a display apparatus such as a projector or television. For example, when the digital camera **94** is connected to the projector **91** to display an image, as shown in FIG. **16**, the PictBridge allows the projector **91** to project and display an image transmitted from the digital camera **94** by a simple operation on the digital camera **94** side. Like in the case in which the printer **96** and digital camera **94** are connected, when a communication is disconnected on the digital camera **94** side, the user meets the same behavior as that when the USB cable **95** is removed. That is, the projector **91** clears an image which was transmitted from the digital camera **94** and was displayed immediately before the communication disconnection by displaying, for example, the connection request window.

As a technique for disconnecting a USB communication from the device side, patent reference 2 is known. Patent reference 2 discloses a technique for disconnecting a communication by stopping to pull up a data line on the device side based on a disconnection instruction from the host side.

Patent Reference 1: Japanese Patent Laid-Open No. 7-123379

Patent Reference 2: Japanese Patent Laid-Open No. 2006-235993

DISCLOSURE OF THE INVENTION

Problems that the Invention is to Solve

As described above, the conventional display apparatus can be connected to various devices, and can display image data stored in a connected device. However, independently of the device class to be connected, when a communication is disconnected, the display operation of an image transmitted from that device ends. For this reason, in addition to the image display end operation that the user intended by removing the flash memory or USB cable, the image display operation often ends without the intention of the user by the control on the device side that logically disconnects a communication connection.

The present invention handles at least one of such conventional problems. That is, the present invention provides a display apparatus, which can control to continue or end a display operation according to a device class when a communication connection with a device is disconnected during execution of the display operation based on data transmitted from the connected device, a control method thereof, and a program.

Means of Solving the Problems

According to the first invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the second invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the third invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is the predetermined class, and controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the fourth invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

Effects of the Invention

According to the present invention, when a communication connection with a device is disconnected during execution of a display operation based on data transmitted from the connected device, the display operation can be controlled to continue or end according to the device class.

Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings. Note that the same reference numerals denote the same or similar components throughout the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodi-

ments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1**A is a view exemplifying a use mode of a display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a flash memory to a display apparatus to display an image;

FIG. **1**B is a view exemplifying a use mode of the display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a digital camera to the display apparatus to display an image;

FIG. **2** is a block diagram illustrating the functional arrangement of the display apparatus;

FIG. **3** is a schematic view exemplifying an input selection menu window;

FIG. **4**A is a flowchart showing the processing of the display apparatus;

FIG. **4**B**1** is a flowchart showing the processing of the display apparatus when "Mass Storage Class" is determined in step S**804** in FIG. **4**A;

FIG. **4**B**2** is a flowchart showing the sequel of FIG. **4**B**1**;

FIG. **4**C**1** is a flowchart showing the processing of the display apparatus when "Imaging Class" is determined in step S**804** in FIG. **4**A;

FIG. **4**C**2** is a flowchart showing the sequel of FIG. **4**C**1**;

FIG. **5**A is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an input waiting window;

FIG. **5**B is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying a display of image data from the digital camera;

FIG. **5**C is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an incompatibility window;

FIG. **6**A is a flowchart showing processing of the first modification (corresponding to FIG. **4**C**1**) in the display apparatus;

FIG. **6**B is a flowchart showing processing of the first modification (corresponding to FIG. **4**C**2**) in the display apparatus;

FIG. **7** is a block diagram showing the peripheral arrangement of a CPU and USB connector **102** of the second modification in the display apparatus;

FIG. **8**A is a flowchart showing processing of the second modification (continued from any of FIGS. **8**B**1** to **8**C**2**) in the display apparatus;

FIG. **8**B**1** is a flowchart showing processing of the second modification (corresponding to FIG. **4**B**1**) in the display apparatus;

FIG. **8**B**2** is a flowchart showing processing of the second modification (corresponding to FIG. **4**B**2**) in the display apparatus;

FIG. **8**C**1** is a flowchart showing processing of the second modification (corresponding to FIG. **4**C**1**) in the display apparatus;

FIG. **8**C**2** is a flowchart showing processing of the second modification (corresponding to FIG. **4**C**2**) in the display apparatus;

FIG. **9**A is a flowchart showing processing of the third modification (corresponding to FIG. **8**A) in the display apparatus;

FIG. **9**B is a flowchart showing processing of the third modification (corresponding to FIG. **4**A) in the display apparatus;

FIG. **10**A is a flowchart showing processing of the fourth modification (corresponding to FIG. **9**A) in the display apparatus;

FIG. **10**B is a flowchart showing processing of the fourth modification (corresponding to FIG. **9**B) in the display apparatus;

FIG. **11**A is a schematic view showing an overview when a flash memory is connected to a conventional projector to display an image;

FIG. **11**B is a schematic view showing details of a control panel;

FIG. **12** is a sequence chart showing the operation sequence when the flash memory is connected to the projector to display an image;

FIG. **13**A is a schematic view exemplifying a connection request window projected by the projector onto a screen;

FIG. **13**B is a schematic view exemplifying a file selection window projected by the projector onto the screen;

FIG. **13**C is a schematic view exemplifying a display of image data which is stored in the flash memory, and is projected by the projector onto the screen;

FIG. **14**A is a schematic view showing an overview when a digital camera is connected to a printer to output an image;

FIG. **14**B is a block diagram showing the arrangement associated with a communication between the printer and digital camera;

FIG. **15** is a sequence chart showing the operation sequence when the digital camera is connected to the printer to output an image; and

FIG. **16** is a schematic view showing an overview when a digital camera is connected to a projector to display an image.

DESCRIPTION OF REFERENCE NUMERALS

1 . . . display apparatus
2 . . . screen
3 . . . flash memory
4 . . . digital camera
5 . . . USB cable

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be described hereinafter with reference to the drawings, but the present invention is not limited to the embodiment to be described hereinafter. The embodiment of the present invention presents one aspect of the invention, and does not limit the scope of the invention.

A use mode of a display apparatus according to the present invention will be described first with reference to FIGS. **1**A and **1**B which exemplify the use modes of a display apparatus **1**. As shown in FIG. **1**A, as a use mode of the display apparatus **1**, a flash memory **3** is connected to a USB connector **102** of the display apparatus **1**, and an image stored in the flash memory **3** is projected and displayed as an image **21** on a screen **2**. A control panel **101** includes various buttons used to accept operation instructions from the user. The user can browse image data stored in the flash memory **3** as the image **21** on the screen **2** by plugging the flash memory **3** into the USB connector **102** and operating the control panel **101**.

Also, as shown in FIG. **1**B, as another use mode, a digital camera **4** is connected to the USB connector **102** of the display apparatus **1** via a USB cable **5**, and an image stored in the digital camera **4** is projected and displayed as an image **22** on the screen **2**. The digital camera **4** has a liquid crystal panel screen **401**, operation member **402**, and operation button **403**. The liquid crystal panel screen **401** displays a preview of an image and the like to be transferred to the display apparatus **1**. The operation member **402** accepts a selection instruction of

an image from the user. The operation button **403** is a button used to accept a transfer start instruction to the display apparatus **1** from the user. A projection display operation by the display apparatus **1** based on image data stored in the digital camera **4** is attained in such a manner that an image display instruction by an operation on the digital camera **4** side is output from the digital camera **4** to the display apparatus **1**, and image data to be output is transmitted from the digital camera **4** to the display apparatus **1**.

The user who uses the display apparatus **1** can appreciate an image captured by the digital camera **4** by projecting and displaying it onto the screen or can make a presentation for other users by projecting an image which is saved in the flash memory **3** and represents briefing paper.

Details of the display apparatus **1** will be described below with reference to FIG. **2**. FIG. **2** is a block diagram illustrating the functional arrangement of the display apparatus **1**. As shown in FIG. **2**, a video signal is input to a video terminal **103** particularly via a video cable (not shown). The input video signal is converted into a digital video signal by an AD converter **104** (Analog-To-Digital) connected to the video terminal **103**. A CPU **107** (to be described later) sets sampling parameters (a frequency, phase, etc.) upon AD conversion. Note that when an input video signal is a digital video signal, the AD converter **104** is not required, and the present invention is applicable when an appropriate receiver is used as needed.

The converted digital video signal is input to a video processor **105** connected to the AD converter **104**. The video processor **105** applies video adjustment processing such as resolution conversion processing, contrast adjustment, and brightness, sharpness, and gamma corrections, and OSD image superimposing processing of a menu and the like. Note that "OSD" is an abbreviation for "On Screen Display".

The CPU **107** controls the operation of the video processor **105**. Furthermore, the video processor **105** can receive arbitrary image data from the CPU **107**. For example, when the CPU **107** transmits image data received by a USB host controller **110** to the video processor **105**, the video processor **105** can output that video as a video signal.

The video signal output from the video processor **105** is input to a liquid crystal driver **106**, and is converted into signals (e.g., RGB video signals) suited to drive liquid crystal panels **117**, **118**, and **119**. The liquid crystal panels **117**, **118**, and **119**, which respectively represent three primary colors, that is, Red, Green, and Blue, include liquid crystal pixels arranged in a matrix pattern, and form images based on input signals. The liquid crystal panels **117**, **118**, and **119** are arranged to transmit light emitted from a lamp (not shown) through them, and modulate light coming from the lamp by images formed based on the input signals.

A projection lens **120** projects and displays light modulated by the liquid crystal panels **117**, **118**, and **119** onto an external device (e.g., the screen **2**). The control panel **101** has an up arrow button, left arrow button, down arrow button, right arrow button, enter button, input button, and power button as in the control panel **9101** that has been explained with reference to FIG. **11**B. Pressing information of each button on the control panel **101** is sent to the CPU **107** as an operation instruction by the user. More specifically, that information is used to control a cursor movement, an enter operation, and the like of a menu on a display window.

The USB host controller **110** is a circuit which makes a USB communication with an external device using a VBUS line **111**, D+ line **112**, D− line **113**, and GND line **114**, which are specified in the USB standard. In the USB host controller **110**, data to be transmitted/received is input/output by the CPU **107**. The D+ line **112** and D− line **113** are USB communication lines used to make a differential communication, and are respectively pulled down by resistors **115** and **116**. The VBUS line **111**, D+ line **112**, D− line **113**, and GND line **114** are connectable to an external device via the USB connector **102** as a connection unit. The USB connector **102** serves as a USB interface which can connect a USB device as an external device. Therefore, the display apparatus **1** and USB device can communicate with each other via the USB connector **102**.

The CPU **107** (Central Processing Unit) centrally controls the display apparatus **1**. More specifically, the CPU **107** manages to start up and shut down the display apparatus **1**, and controls the respective units such as the AD converter **104**, video processor **105**, USB host controller **110**, and liquid crystal driver **106**. A ROM **108** (Read Only Memory) stores program codes and various data required to operate the CPU **107**. A CPU **107** (Random Access Memory) provides a work area required to let the RAM **109** operate.

The CPU **107** can select a video source to be displayed from the following two sources in addition to the startup processing of respective blocks after power-ON. The first video source is a video picture signal input from the video terminal **103**. The second video source is image data transmitted from a device connected via the USB connector **102**. The CPU **107** controls the video processor **105** to project an input selection menu window in response to a user's operation on the control panel **101** as a trigger. FIG. **3** is a schematic view exemplifying the input selection menu window. As shown in FIG. **3**, the input selection menu window presents a selection menu of "external video" and "USB" as a video source to be displayed to the user.

After that, the CPU **107** receives a selection instruction input by a user's operation on the control panel **101**, and executes a video source switching operation. In this video source switching operation, when "USB" is selected, and the projection display operation of image data from the flash memory **3** or digital camera **4** connected to the display apparatus **1** is to be executed, the CPU **107** sequentially executes the flowcharts including steps **S801** to **S832** exemplified in FIGS. **4**A to **4**C**2**. The processing of these flowcharts is executed until the power switch of the display apparatus **1** is turned off or until the input selection menu is displayed again, and "external video" is selected as a video source.

As shown in FIGS. **4**A to **4**C**2**, if the processing is started (**S801**), the CPU **107** controls the video processor **105** to project and display a USB device connection request window onto the screen **2** (**S802**). This connection request window is as has been described with reference to FIG. **13**A, and prompts the user to connect a USB device. The connection request window is a kind of pattern image, and is displayed based on pattern image data stored in advance in the ROM **108**.

The CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB device is communication-connected via the USB connector **102**, and a USB communication is established (**S803**). If it is determined in step **S803** that a USB communication is established, the process to be executed by the CPU **107** advances to the next step.

The CPU **107** sends an inquiry to the USB host controller **110** to determine a class of the communication-connected USB device (**S804**). This class is determined based on class information transmitted from the USB device when the USB host controller **110** establishes a USB communication with that USB device connected via the USB connector **102**. More specifically, the class information of the USB device includes USB Mass Storage Class indicating the class of a device

which is a simple storage and physically disconnects a communication connection. Also, the class information includes USB Imaging Class (often also called Imaging Device) indicating the class of a device which can execute communication control with the connected display apparatus **1** and can logically disconnect a communication connection depending on devices. Note that USB Mass Storage Class will be referred to as Mass Storage Class, and USB Imaging Class will be referred to as Imaging Class hereinafter. For example, the flash memory **3** transmits class information indicating Mass Storage Class to the display apparatus **1** at the time of connection, and the digital camera **4** transmits class information indicating Imaging Class to the display apparatus **1** at the time of connection. If the class information indicates Mass Storage Class in step S**804**, the process to be executed by the CPU **107** advances to step S**805**; if the class information indicates Imaging Class, the process advances to step S**817**; otherwise, the process advances to step S**831**.

FIG. **4**A shows "Mass Storage Class" and "Imaging Class" as the device classes, but the present invention is not limited to these classes. For example, the display apparatus **1** may store a class for which an image display operation is to be continued and a class for which the operation is to be ended (or one of these classes) at the time of disconnection of a communication.

The CPU **107** executes a sequence of steps S**805** to S**816** when the communication-connected USB device is a USB mass storage such as the flash memory **3**. In step S**805**, the CPU **107** reads out directory entry information stored in the USB device via the USB host controller **110**.

In step S**806**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S**805** in this case). If it is determined in step S**806** that the USB communication was disconnected, the process to be executed by the CPU **107** returns to step S**802**.

In step S**807**, the CPU **107** controls the video processor **105** to display a file selection window that enumerates image file names based on the readout directory entry information. This file selection window is as has been described with reference to FIG. **13**B, and is a window that displays a file name list of image files stored in the flash memory **3** and a cursor used to select them. The display apparatus **1** prompts the user to select an image file to be displayed of those stored in the flash memory **3** using this file selection window.

The CPU **107** determines in step S**808** whether or not a USB communication with the USB device was disconnected, as in step S**806**. The CPU **107** determines in step S**809** whether or not the user has made an operation on the control panel **101**. If it is determined in step S**809** that the user has not made any operation, the process to be executed by the CPU **107** returns to step S**808**.

In step S**810**, the CPU **107** updates the file selection window based on the user's operation on the control panel **101**. More specifically, when the user presses the up or down arrow button on the control panel **101**, the CPU **107** reconfigures and displays a window on which the cursor to be rendered to select a file of interest has been moved.

The CPU **107** determines in step S**811** based on a user's operation on the control panel **101** whether or not the user has made an operation to select an image file to be displayed. More specifically, when the user presses the enter button on the control panel **101**, the CPU **107** determines that an image file in a cursor line is determined as that to be displayed. If no image file selection operation is made, the process to be executed by the CPU **107** returns to step S**808**.

In step S**812**, the CPU **107** reads out a file image of the image file selected in step S**811** from the USB device via the USB host controller **110**. The CPU **107** determines in step S**813** whether or not a USB communication with the USB device was disconnected, as in step S**806**.

In step S**814**, the CPU **107** controls the video processor **105** to project and display an image based on the readout file image on the screen **2**, after the image is scaled to match the resolution of the liquid crystal panels **117**, **118**, and **119**. The image which is projected and displayed on the screen **2** is the same as that which has been described with reference to FIG. **13**C, and is based on image data stored in advance in the flash memory **3**.

The CPU **107** determines in step S**815** whether or not a USB communication with the USB device was disconnected, as in step S**806**. The CPU **107** determines in step S**816** based on a user's operation on the control panel **101** whether or not the user gives the instruction to end the image display operation. More specifically, the CPU **107** makes this determination by acquiring pressing information of the enter button on the control panel **101**. If the user does not give the instruction to end the image display operation, the process to be executed by the CPU **107** returns to step S**815**. If the user gives the instruction to end the image display operation, the process to be executed by the CPU **107** returns to step S**807**, and the file selection window is displayed again to prompt the user to select another image file.

On the other hand, the CPU **107** executes a sequence of steps S**817** to S**830** when the connected USB device corresponds to, for example, Imaging Class such as the digital camera **4** compatible to the PictBridge. Note that the PictBridge-compatible digital camera **4** will be exemplified below, and a case will be described wherein the scheme of the PictBridge is diverted, and the projection display operation of the display apparatus **1** is made using a print instruction (image output) from the digital camera **4**. In step S**817**, the CPU **107** executes PictBridge connection processing with respect to the USB device via the USB host controller **110**. Note that this processing corresponds to step S**502**, which has been explained with reference to FIG. **15**.

In step S**818**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S**817** in this case). If it is determined in step S**818** that the USB communication was disconnected, the process to be executed by the CPU **107** advances to step S**830**.

The CPU **107** determines in step S**819** whether or not the PictBridge connection processing in step S**817** has succeeded, and a PictBridge connection is established. If a PictBridge connection is not established because, for example, the USB device to be connected is incompatible to the PictBridge, the process to be executed by the CPU **107** advances to step S**831**.

In step S**820**, the CPU **107** controls the video processor **105** to project and display an input waiting window. This input waiting window is a window used to prompt the user to print an image file (or to transfer an image to a projector) by the PictBridge function from the digital camera side, as shown in FIG. **5**A. Note that this step S**820** corresponds to an idle state in which the control waits for a "print" instruction in step S**503** described with reference to FIG. **15**.

The CPU **107** determines in step S**821** whether or not a USB communication with the USB device was disconnected, as in step S**818**. The CPU **107** determines in step S**822** whether or not a print job start communication is made from the USB device via the USB host controller **110**. This communication corresponds to step S**504** which has been

explained with reference to FIG. **15**. If it is determined in step S**822** that no start instruction is issued, the process to be executed by the CPU **107** returns to step S**821**.

The CPU **107** determines in step S**823** whether or not a USB communication with the USB device was disconnected, as in step S**818**. In step S**824**, the CPU **107** acquires information of an image file to be output included in the print job from the USB device via the USB host controller **110**. This step S**824** corresponds to step S**505** which has been described with reference to FIG. **15**.

The CPU **107** determines in step S**825** whether or not a USB communication with the USB device was disconnected, as in step S**818**. In step S**826**, the CPU **107** acquires an image of the image file included in the print job from the USB device via the USB host controller **110**. This step S**826** corresponds to step S**506** which has been described with reference to FIG. **15**.

The CPU **107** determines in step S**827** whether or not a USB communication with the USB device was disconnected, as in step S**818**. In step S**828**, the CPU **107** controls the video processor **105** to project and display the acquired image on the screen **2**, after the image is scaled to match the resolution of the liquid crystal panels **117**, **118**, and **119**. The image, which is projected and displayed on the screen **2**, is an image based on image data captured by the digital camera, and is an image of a person or the like, as shown in, for example, FIG. **5**B.

In step S**829**, the CPU **107** notifies the USB device, via the USB host controller **110**, that a communication state based on the PictBridge connection transits to an idle state. This notification in step S**829** corresponds to step S**508** which has been described with reference to FIG. **15**.

If it is determined in step S**818**, S**821**, S**823**, S**825**, or S**827** that the USB communication was disconnected, the process of the CPU **107** advances to step S**830**. The CPU **107** determines in step S**830** whether or not the projection display operation of an image based on the image acquired from the USB device is in progress (i.e., whether or not the process has passed step S**828**). If the projection display operation of the image is in progress, the process of the CPU **107** returns to step S**803**; otherwise, the process of the CPU **107** returns to step S**802**.

On the other hand, if an incompatible device class is determined in step S**804**, or if it is determined in step S**819** that a PictBridge connection is not established, the process of the CPU **107** advances to step S**831**. In step S**831**, the CPU **107** controls to project and display an incompatibility window. This incompatibility window is a window used to notify the user that the connected USB device is incompatible to the display apparatus **1**, as shown in FIG. **5**C.

In step S**832**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected. This determination in step S**832** continues until the USB communication is disconnected, and if the USB communication is disconnected, the process of the CPU **107** returns to step S**802**.

As described above, when a USB communication is disconnected while the display apparatus **1** is connected to a USB device such as a flash memory device, and executes the projection display operation of image data stored in that device, the display apparatus **1** overwrites an image whose projection display operation is in progress by the connection request window (S**802**). When the class of the connected device corresponds to, for example, the flash memory device, the USB connection is disconnected mainly by removal of the device by the user. Furthermore, the user removes the device with the intention to end the projection display operation. Hence, when the USB connection is disconnected, it is preferable for the display apparatus **1** to overwrite an image, whose projection display operation is in progress, by the connection request window without continuing the projection display operation.

On the other hand, when a USB connection is disconnected while the display apparatus **1** is connected to a USB device such as a digital camera, and executes the projection display operation of image data stored in that device, the display apparatus **1** continues to display the image, whose projection display operation is in progress, without being overwritten by the connection request window (transition from step S**830** to step S**803**). When the class of the connected device corresponds to, for example, the digital camera, the USB communication may be disconnected either by removal of the device by the user or by control on the USB device side. Therefore, since the USB connection is disconnected by not only removal of the device by the user who intended to end the projection display operation, it is preferable for the display apparatus **1** to continue to display an image, whose projection display operation is in progress, when the USB connection is disconnected.

That is, when a communication is disconnected while the display apparatus **1** executes the projection display operation based on image data from the connected device, the display apparatus **1** controls whether or not to continue the display operation of the image whose projection display operation is in progress according to the class of the connected device. Therefore, the display apparatus **1** can eliminate the opportunity of a display state which is likely to occur depending on the class of the connected device and is not intended by the user. For example, the display apparatus **1** can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing. Note that, in this embodiment, the image of the connection request window is used as an overwrite image. Alternatively, for example, a solid black or blue-back pattern image may be used.

[First Modification]

As the first modification of the aforementioned embodiment, a case will be described wherein the processes of FIGS. **4**C**1** and **4**C**2** of those to be executed by the CPU **107** of the display apparatus **1** exemplified in FIGS. **4**A to **4**C**2** are modified like the flowcharts shown in FIGS. **6**A and **6**B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided.

As shown in FIGS. **6**A and **6**B, in the first modification, steps S**818**, S**823**, S**825**, and S**827** in the sequence of the CPU **107** exemplified in FIGS. **4**C**1** and **4**C**2** are respectively replaced by steps S**1318**, S**1323**, S**1325**, and S**1327**.

In step S**1318**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S**817** in this case). If it is determined in step S**1318** that the USB communication was disconnected, the process to be executed by the CPU **107** returns to step S**802**. Note that the processing contents in steps S**1323**, S**1325**, and S**1327** are the same as in step S**1318**.

In step S**821**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S**820** in this case). If it is determined in step S**821** that the USB communication was disconnected, the process to be executed by the CPU **107** advances to step S**830**. That is, when the USB communication is disconnected at the

display timing of the input waiting window, and in an idle state of the communication, since the process of the CPU **107** temporarily advances to step **S830**, an image can be prevented from being immediately overwritten by the connection request window.

As described above, in the first modification, the following processes of the display apparatus **1** executed when a communication is disconnected while the display apparatus **1** is connected to the PictBridge-compatible device and executes the projection display operation of an image stored in that device are different from the aforementioned embodiment. When the PictBridge connection is not in an idle state, that is, a communication is underway at the time of the aforementioned communication disconnection, the display apparatus **1** overwrites an image whose projection display operation is in progress by the connection request window. When the PictBridge connection is in an idle state, that is, a communication is not underway, an image whose projection display operation is in progress is continuously displayed.

When the PictBridge connection is in a non-idle state, that is, a communication is underway, a USB communication is more likely to be disconnected at that time not by control on the USB device side but by, for example, removal of the USB device by the user. Therefore, when a communication is disconnected during the USB communication, it is preferable for the display apparatus **1** to overwrite an image, whose projection display operation is in progress, by the connection request window without continuously displaying the image. When a communication is disconnected while the USB communication is in an idle state, such disconnection may be caused either by removal of the USB device by the user or by control on the USB device side. Therefore, since a USB communication in an idle state is disconnected by not only removal of the device by the user who intends to end the projection display operation, it is preferable for the display apparatus **1** to continue to display an image whose projection display operation is in progress.

[Second Modification]

The second modification of the aforementioned embodiment will be described below. In the second modification, the peripheral arrangement of the CPU **107** and USB connector **102** of the display apparatus **1** exemplified in FIG. **2** is modified, as shown in FIG. **7**. Also, in the second modification, the processes to be executed by the CPU **107** of the display apparatus **1** exemplified in FIGS. **4**B**1** to **4**C**2** are modified, as shown in the flowcharts shown in FIGS. **8**A to **8**C**2**. Note that the same reference numerals denote the same components, and a repetitive description thereof will be avoided.

As shown in FIG. **7**, the display apparatus **1** includes an insertion detector **121** which detects insertion of a USB plug in the USB connector **102**. In the insertion detector **121**, a conductive terminal **1212** having a projection **1211**, which is arranged at a position where the projection **1211** physically interferes with a USB plug, and a grounded conductive terminal **1213** are arranged in the USB connector **102** to be brought into contact with each other when a USB plug is not inserted. The conductive terminal **1212** is pulled up by a resistor **122**, and is connected to an input port of the CPU **107**.

Therefore, in the insertion detector **121**, when a USB plug is inserted into the USB connector **102**, the USB plug pushes up the conductive terminal **1212**, and the conductive terminals **1212** and **1213** are open. Hence, the CPU **107** can recognize insertion/removal of the USB plug to/from the USB connector **102**.

In the second modification, steps **S806**, **S808**, **S813**, **S815**, **S818**, **S821**, **S823**, **S825**, and **S827** shown in FIGS. **4**B**1** to **4**C**2** are changed, as shown in FIGS. **8**B**1** to **8**C**2**, and FIG. **8**A having steps **S1530** and **S1533** is added.

In step **S1506**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not a USB communication with the USB device was disconnected in the previous process (step **S805** in this case). If it is determined in step **S1506** that the USB communication was disconnected, the process to be executed by the CPU **107** advances to step **S1530**. Note that the processing contents in steps **S1508**, **S1513**, **S1515**, **S1518**, **S1521**, **S1523**, **S1525**, and **S1527** are the same as in step **S1506**.

The CPU **107** determines in step **S1530** whether or not the projection display operation of an image based on image data acquired from the USB device is in progress (that is, whether or not the process has passed step **S814** or **S828**). If the projection display operation of the image is in progress, the process of the CPU **107** advances to step **S1533**; otherwise, the process of the CPU **107** returns to step **S802**.

The CPU **107** determines in step **S1533** using the insertion detector **121** whether or not a USB plug is physically removed from the USB connector **102**. If it is determined in step **S1533** that the USB plug is physically removed, the process of the CPU **107** returns to step **S802**. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU **107** returns to step **S803**.

As described above, in the second modification, when the USB plug is physically removed and a USB communication is disconnected during the projection display operation of image data stored in the connected USB device, the display apparatus **1** overwrites the image whose projection display operation is in progress by the connection request window. Note that when a USB communication is disconnected not by physical removal of the USB plug, the display apparatus **1** does not overwrite the image whose projection display operation is in progress by the connection request window. Thus, the display apparatus **1** can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing.

[Third Modification]

The third modification, which further modifies the processing of the aforementioned second modification, will be described below with reference to the flowcharts shown in FIGS. **9**A and **9**B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. **9**A and **9**B, in the third modification, step **S1533** is replaced by step **S1633** in the sequence of the CPU **107** exemplified in FIG. **8**A (FIG. **9**A), and steps **S1634** to **S1636** are added in the sequence of the CPU **107** exemplified in FIG. **4**A (FIG. **9**B).

The CPU **107** determines in step **S1633** using the insertion detector **121** whether or not a USB plug is physically removed from the USB connector **102**. If it is determined in step **S1633** that the USB plug is physically removed, the process of the CPU **107** returns to step **S802**. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU **107** advances to step **S1634**.

In step **S1634**, the CPU **107** sets and starts a timer which performs a count-down operation for a predetermined period (second period) specified in advance in the ROM or the like. If the CPU **107** determines in step **S1635** that the timer started in step **S1634** reaches a time-out, or the user issues an instruction on the control panel **101**, the process returns to step **S802**.

In step **S1636**, the CPU **107** sends an inquiry to the USB host controller **110** to determine whether or not the USB device is connected, and a USB communication is estab-

lished. If it is determined in step **S1636** that the USB communication is established, the process of the CPU **107** advances to step **S804**. On the other hand, if it is determined that the USB communication is not established, the process of the CPU **107** returns to step **S1635**. Therefore, in steps **S1634** to **S1636**, the processing waits before the user issues an instruction or the second period set by the timer elapses until the USB communication is established.

As described above, in the third modification, when the USB plug is physically removed and the USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus **1** overwrites the image whose projection display operation is in progress by the connection request window. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period elapses or the user issues an instruction. Hence, the display apparatus **1** can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing.

[Fourth Modification]

The fourth modification that further modifies the aforementioned third modification will be described below with reference to the flowcharts shown in FIGS. **10**A and **10**B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. **10**A and **10**B, in the fourth modification, step **S1633** is replaced by step **S1733** in the sequence of the CPU **107** exemplified in FIG. **9**A (FIG. **10**A), and step **S1737** is added to the sequence of the CPU **107** exemplified in FIG. **9**B (FIG. **10**B).

The CPU **107** determines in step **S1733** using the insertion detector **121** whether or not a USB plug is physically removed from the USB connector **102**. If it is determined in step **S1733** that the USB plug is physically removed, the process of the CPU **107** advances to step **S1737**. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU **107** advances to step **S1634**.

In step **S1737**, the CPU **107** sets and starts a timer which performs a count-down operation for a predetermined period (first period) which is set in advance in the ROM or the like, and is shorter than the second period set in step **S1634**.

As described above, in the fourth modification, when the USB plug is physically removed, and a USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus **1** overwrites the image whose projection display operation is in progress by the connection request window. The connection request window is overwritten when the first period set to be shorter than the second period elapses or when the user issues an instruction. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period set to be longer than the first period elapses or the user issues an instruction.

Note that the description of the aforementioned embodiment is merely an example, and the present invention is not limited to this. The arrangement and operation in the aforementioned embodiment can be modified as needed. For example, the projector has been exemplified as the display apparatus in this embodiment, but a PDP, LCD, SED, CRT monitor, and the like may be used. Note that "PDP" is an abbreviation for "Plasma Display Panel". Also, "LCD" is an abbreviation for "Liquid Crystal Display". "SED" is an abbreviation for "Surface-Conduction Electron-emitter Display". Furthermore, "CRT" is an abbreviation for "Cathode Ray Tube".

This embodiment has exemplified the arrangement using USB, but the present invention is not particularly limited to this. For example, an SDIO (Secure Digital Input/Output) interface and other interfaces may be used. Furthermore, as an external storage device using a USB mass storage, an SD (Secure Digital) card memory, CF card, and the like may be used.

In the second, third, and fourth modifications, the insertion detector **121**, which is a mechanism for detecting a physical contact of the connector, is used as means for detecting a physical connection of the USB plug, but the detection mechanism is not particularly limited. For example, as another means for detecting a physical connection of the USB plug, a current amount that flows through the VBUS line may be measured, and if the measured current amount exceeds a predetermined value, it may be determined that the USB plug is physically connected.

Other Embodiments

The aforementioned embodiments can be implemented in a software manner by a computer (or a CPU, MPU, etc.) of a system or apparatus. Therefore, a computer program itself supplied to the computer to implement the aforementioned embodiments using the computer implements the present invention. That is, the computer program itself required to implement the functions of the aforementioned embodiments is one invention of the present invention.

Note that the form of the computer program required to implement the aforementioned embodiments is not particularly limited as long as that program is computer-readable. For example, the program may adopt the forms of an object code, a program to be executed by an interpreter, script data to be supplied to an OS, and the like, but the present invention is not limited to them. The computer program required to implement the aforementioned embodiments is supplied to the computer via a storage medium or wired/wireless communications. As the storage medium for supplying the program, for example, magnetic storage media such as a flexible disk, hard disk, and magnetic tape, optical/magneto-optical storage media such as an MO, CD, and DVD, a nonvolatile semiconductor memory, and so forth may be used.

As a computer program supply method using the wired/wireless communications, a method using a server on a computer network is available. In this case, a server stores a data file (program file) that can be a computer program which forms the present invention. The program file may be either an executable format file or source codes. Then, the program file is supplied by downloading to a client computer that has accessed the server. In this case, the program file may be segmented into a plurality of segment files, which may be allocated on different servers. That is, the server which provides the program file required to implement the aforementioned embodiments to the client computer is also one invention of the present invention.

Also, a storage medium, which stores the encrypted program required to implement the aforementioned embodiments, may be delivered, and key information required to decrypt the encrypted program may be supplied to the user who meets a predetermined condition, so as to allow that user to install the program on a computer of the user. The key information can be supplied to the user by making him or her

download it from a homepage via, for example, the Internet. The computer program required to implement the aforementioned embodiments may use the functions of an OS which already runs on the computer. Furthermore, some functions of the computer program required to implement the aforementioned embodiments may be configured by firmware which runs on an expansion board or the like attached to the computer, or may be executed by a CPU equipped on the expansion board or the like.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are appended.

This application claims the benefit of Japanese Patent Application No. 2008-141678, filed May 29, 2008, which is hereby incorporated by reference herein in its entirety.

The invention claimed is:

1. A display apparatus characterized by comprising:
a display unit;
a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control said display unit to make a display based on data received from the external device with which a communication connection is established via said connection unit,
characterized in that said control unit acquires class information indicating a class of the external device from the external device via said connection unit, controls said display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls said display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

2. The display apparatus according to claim **1**, characterized in that the predetermined class is a class of a device which logically disconnects a communication connection.

3. The display apparatus according to claim **1**, characterized in that if the class information indicates a USB mass storage class, said control unit controls to end the display.

4. The display apparatus according to claim **1**, characterized in that if the class information is class information indicating a USB imaging class, said control unit controls to continue the display.

5. The display apparatus according to claim **4**, characterized in that even if the class information is the class information indicating the USB imaging class, when the communication connection with the external device is disconnected during a communication with the external device, said control unit controls to end the display.

6. The display apparatus according to claim **1**, characterized by further comprising:
a detection unit configured to detect whether or not the external device is physically connected to said connection unit,
characterized in that if said detection unit detects that a physical connection with the external device is disconnected at the time of disconnection of the communication connection with the external device, said control unit controls to end the display irrespective of the class information.

7. The display apparatus according to claim **6**, characterized in that said control unit controls to end the display after a predetermined first period elapses.

8. The display apparatus according to claim **7**, characterized in that if said detection unit detects that a physical connection with the external device is not disconnected at the time of disconnection of the communication connection with the external device, said control unit controls to end the display irrespective of the class information after a predetermined second period elapses.

9. The display apparatus according to claim **8**, characterized in that the first period is shorter than the second period.

10. The display apparatus according to claim **1**, characterized in that when the communication connection with the external device is disconnected, and said control unit controls to end the display based on the class information, said control unit controls said display unit to display a pre-set image.

11. A control method of a display apparatus which comprises:
a display unit;
a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit,
the method characterized by comprising:
the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

12. A program for making a computer execute each step of the control method of a display apparatus according to claim **11**.

13. A display apparatus characterized by comprising:
a display unit;
a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control said display unit to make a display based on data received from the external device with which a communication connection is established via said connection unit,
characterized in that said control unit acquires class information indicating a class of the external device from the external device via said connection unit, controls said display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls said display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

14. A control method of a display apparatus which comprises:
a display unit;

a connection unit configured to connect an external device to be able to communicate with the external device; and

a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit,

the method characterized by comprising:

the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

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