US009270865B2

(12) **United States Patent**
Mizukura et al.

(10) **Patent No.: US 9,270,865 B2**
(45) **Date of Patent: Feb. 23, 2016**

(54) **RECORDING DEVICE AND RECORDING CONTROL METHOD, REPRODUCTION DEVICE AND REPRODUCTION CONTROL METHOD, OUTPUT DEVICE AND OUTPUT CONTROL METHOD, AND PROGRAMS**

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(73) Assignee: **Sony Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 693 days.

(21) Appl. No.: **12/436,369**

(22) Filed: **May 6, 2009**

(65) **Prior Publication Data**

US 2009/0322780 A1 Dec. 31, 2009

(30) **Foreign Application Priority Data**

Jun. 27, 2008 (JP) 2008-169153

(51) **Int. Cl.**
H04N 1/60 (2006.01)
G09G 5/02 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 1/6058*** (2013.01); ***G09G 5/02*** (2013.01); *G09G 2340/06* (2013.01)

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

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Primary Examiner — Matthew D Salvucci
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A recording device includes a color gamut conversion control unit, a color gamut conversion unit, and a recording unit. The color gamut conversion control unit controls a method of converting the color gamut of content data, on the basis of a user-specified condition specified by a user. The color gamut conversion unit converts the color gamut of the content data in accordance with the control of the color gamut conversion control unit. The recording unit records, on a recording medium, the content data, the color gamut of which has been converted by the color gamut conversion unit in accordance with the control of the color gamut conversion control unit, or the content data, the color gamut of which has not been converted by the color gamut conversion unit in accordance with the control of the color gamut conversion control unit.

12 Claims, 26 Drawing Sheets

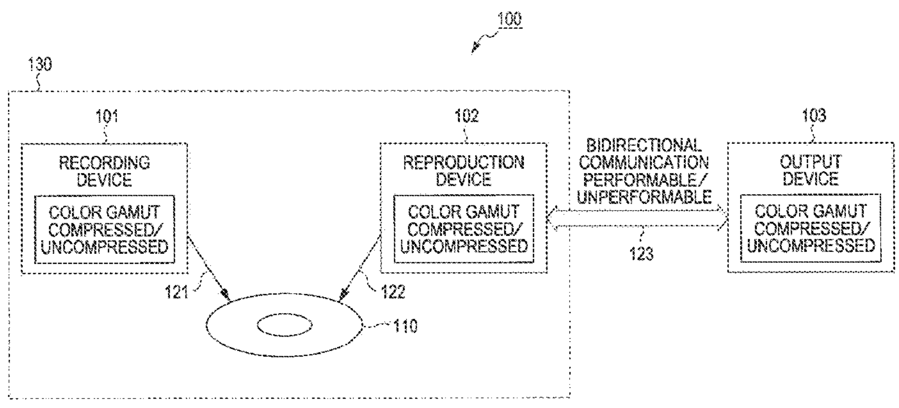


FIG. 1

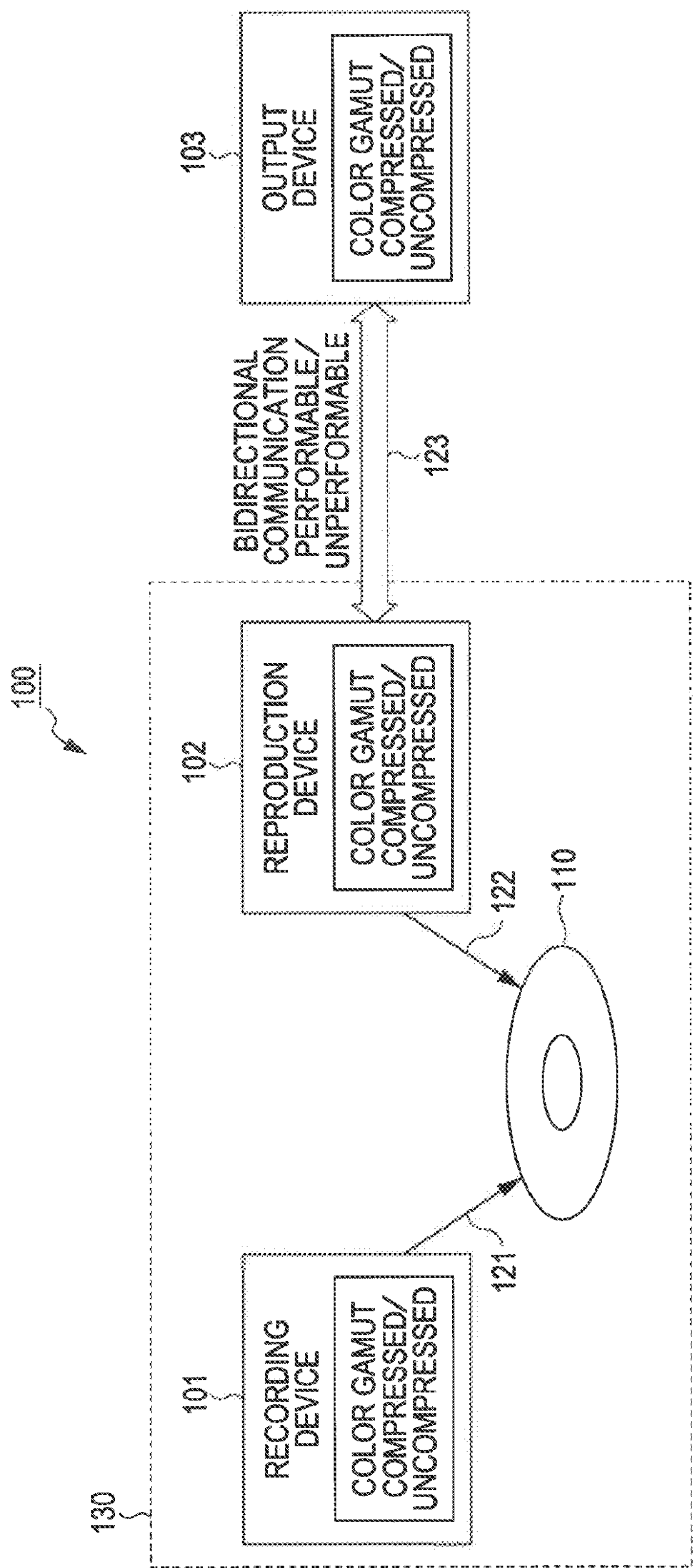

100
103
OUTPUT DEVICE
COLOR GAMUT COMPRESSED/ UNCOMPRESSED
BIDIRECTIONAL COMMUNICATION PERFORMABLE/ UNPERFORMABLE
123
102
REPRODUCTION DEVICE
COLOR GAMUT COMPRESSED/ UNCOMPRESSED
122
110
121
101
RECORDING DEVICE
COLOR GAMUT COMPRESSED/ UNCOMPRESSED
130

FIG. 2

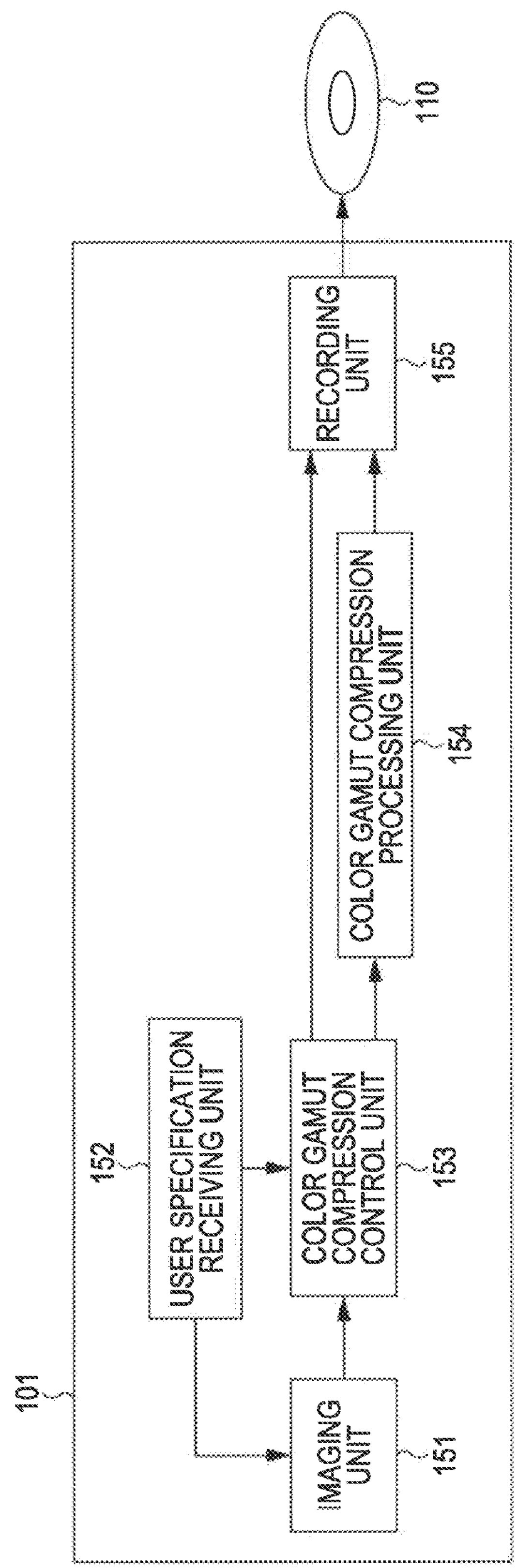

101
IMAGING UNIT
151
USER SPECIFICATION RECEIVING UNIT
152
COLOR GAMUT COMPRESSION CONTROL UNIT
153
COLOR GAMUT COMPRESSION PROCESSING UNIT
154
RECORDING UNIT
155
110

FIG. 3

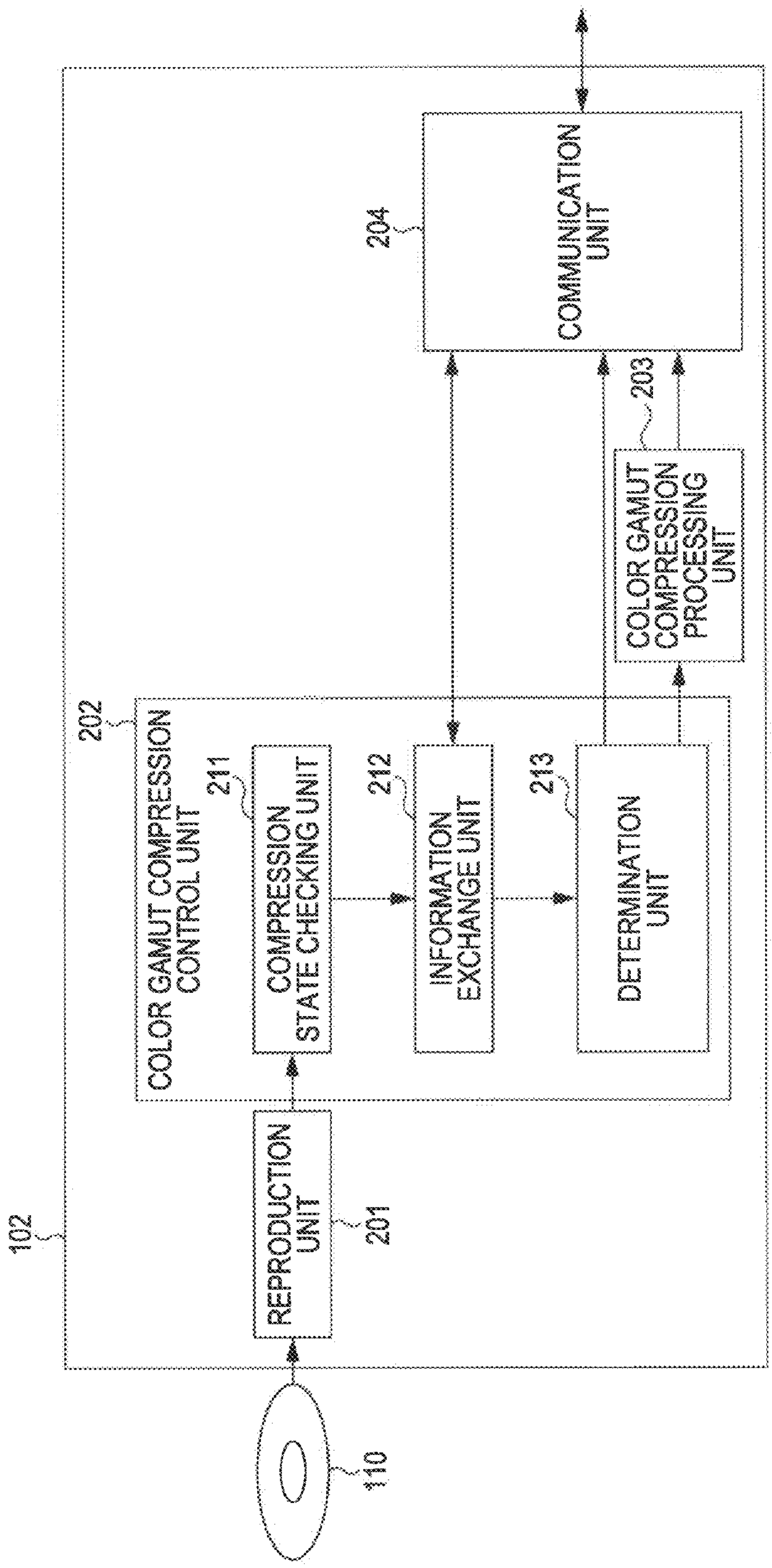

110
102
REPRODUCTION UNIT
201
202
COLOR GAMUT COMPRESSION CONTROL UNIT
211
COMPRESSION STATE CHECKING UNIT
212
INFORMATION EXCHANGE UNIT
213
DETERMINATION UNIT
203
COLOR GAMUT COMPRESSION PROCESSING UNIT
204
COMMUNICATION UNIT

FIG. 4

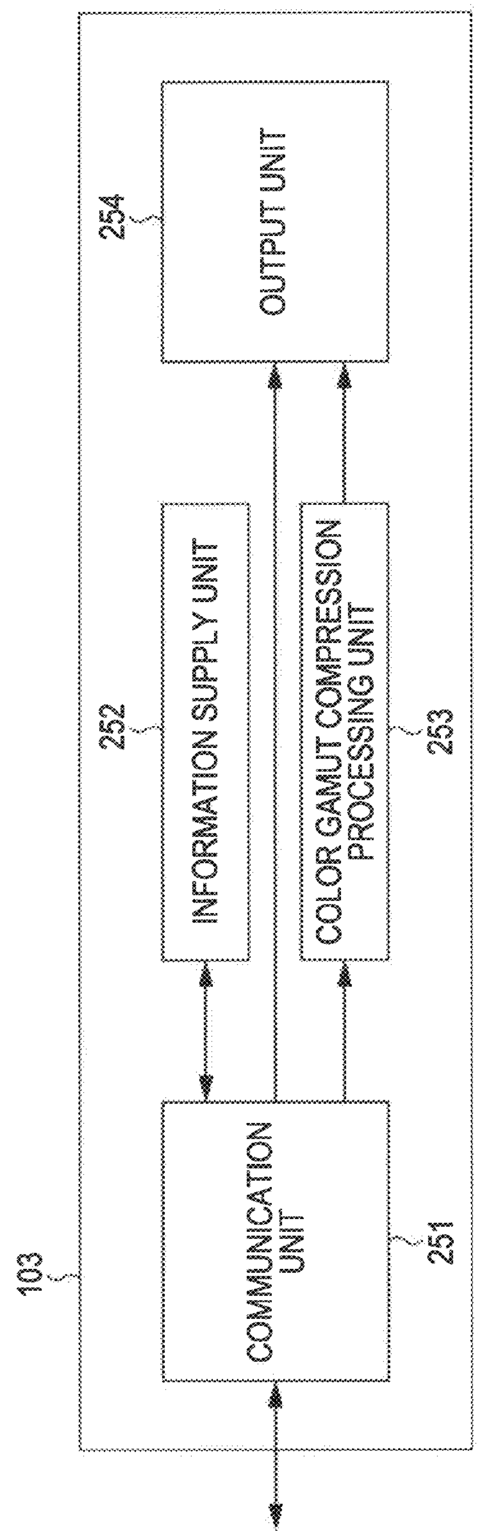
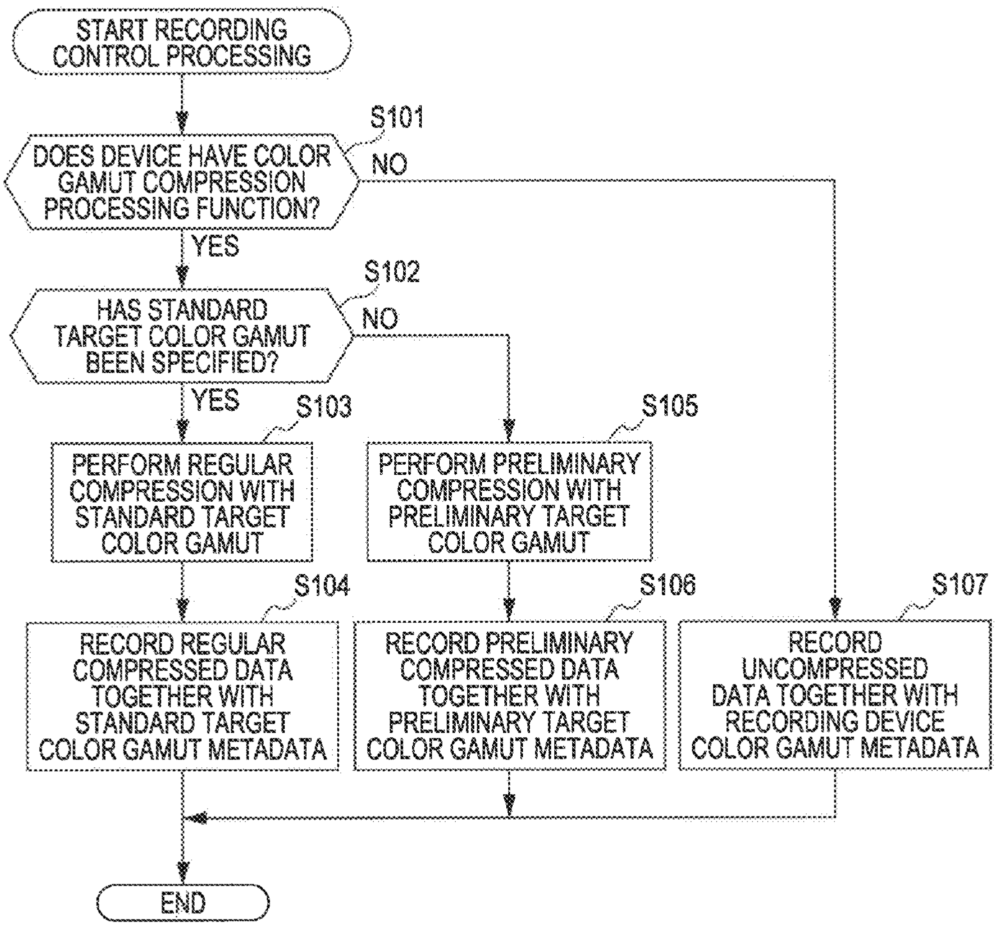

103
COMMUNICATION UNIT
251
INFORMATION SUPPLY UNIT
252
COLOR GAMUT COMPRESSION PROCESSING UNIT
253
OUTPUT UNIT
254

FIG. 5



START RECORDING CONTROL PROCESSING
S101
DOES DEVICE HAVE COLOR GAMUT COMPRESSION PROCESSING FUNCTION?
NO
YES
S102
HAS STANDARD TARGET COLOR GAMUT BEEN SPECIFIED?
NO
YES
S103
PERFORM REGULAR COMPRESSION WITH STANDARD TARGET COLOR GAMUT
S105
PERFORM PRELIMINARY COMPRESSION WITH PRELIMINARY TARGET COLOR GAMUT
S104
RECORD REGULAR COMPRESSED DATA TOGETHER WITH STANDARD TARGET COLOR GAMUT METADATA
S106
RECORD PRELIMINARY COMPRESSED DATA TOGETHER WITH PRELIMINARY TARGET COLOR GAMUT METADATA
S107
RECORD UNCOMPRESSED DATA TOGETHER WITH RECORDING DEVICE COLOR GAMUT METADATA
END

FIG. 6

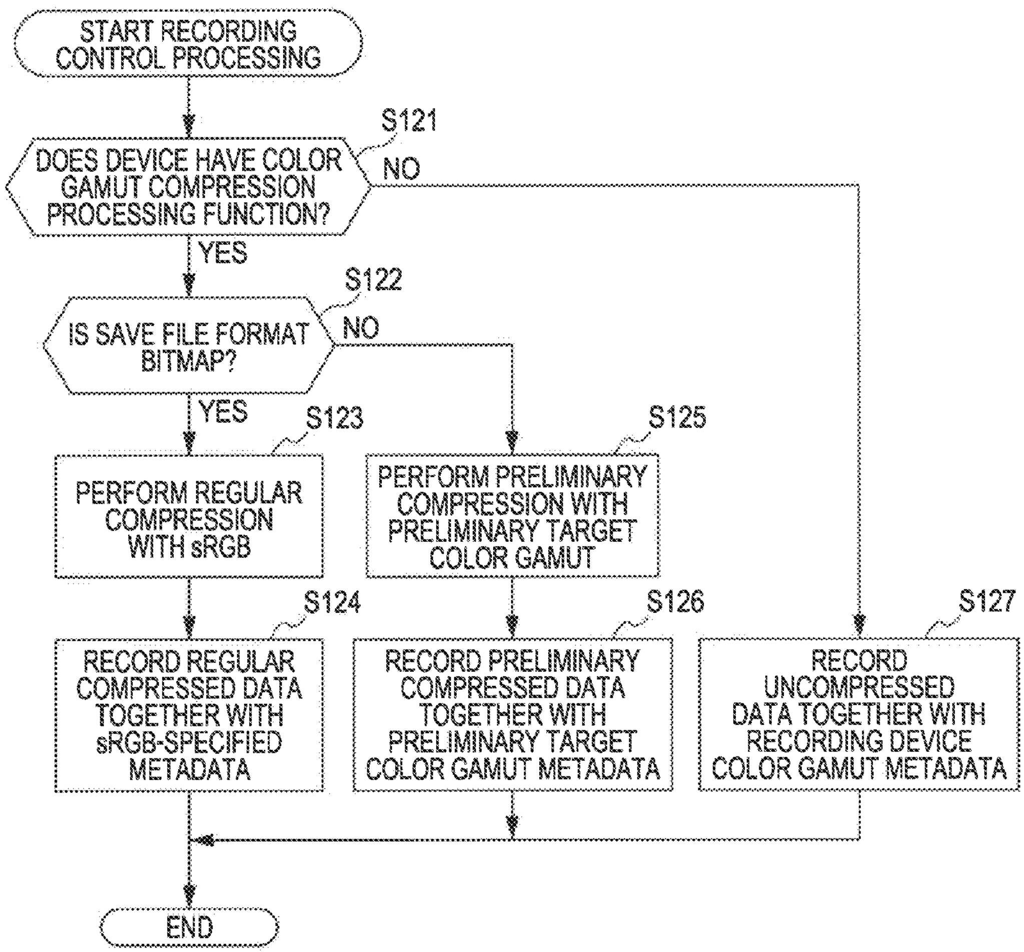

START RECORDING CONTROL PROCESSING
S121
DOES DEVICE HAVE COLOR GAMUT COMPRESSION PROCESSING FUNCTION?
NO
YES
S122
IS SAVE FILE FORMAT BITMAP?
NO
YES
S123
PERFORM REGULAR COMPRESSION WITH sRGB
S125
PERFORM PRELIMINARY COMPRESSION WITH PRELIMINARY TARGET COLOR GAMUT
S124
RECORD REGULAR COMPRESSED DATA TOGETHER WITH sRGB-SPECIFIED METADATA
S126
RECORD PRELIMINARY COMPRESSED DATA TOGETHER WITH PRELIMINARY TARGET COLOR GAMUT METADATA
S127
RECORD UNCOMPRESSED DATA TOGETHER WITH RECORDING DEVICE COLOR GAMUT METADATA
END

FIG. 7

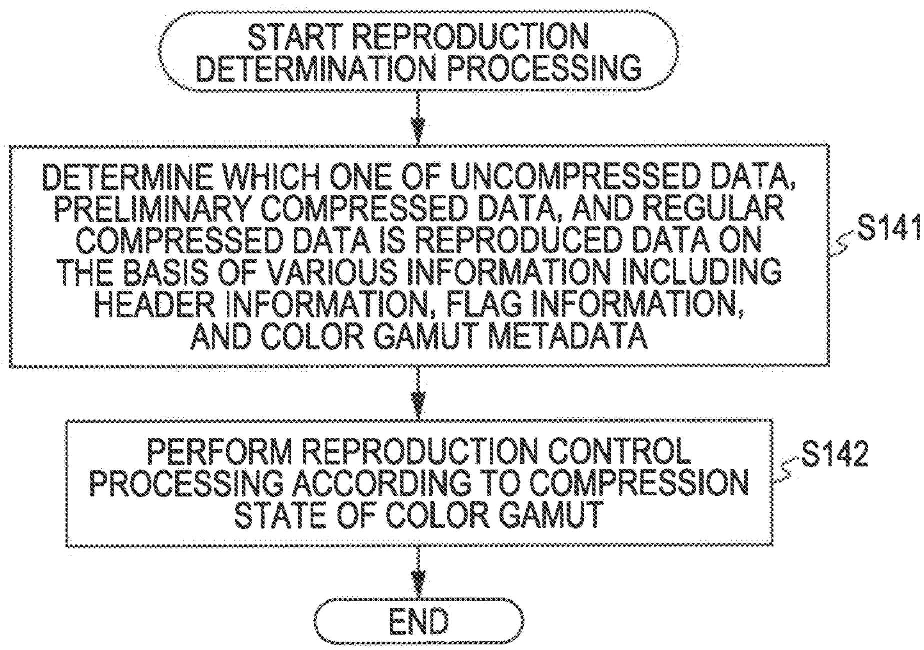

START REPRODUCTION DETERMINATION PROCESSING
DETERMINE WHICH ONE OF UNCOMPRESSED DATA, PRELIMINARY COMPRESSED DATA, AND REGULAR COMPRESSED DATA IS REPRODUCED DATA ON THE BASIS OF VARIOUS INFORMATION INCLUDING HEADER INFORMATION, FLAG INFORMATION, AND COLOR GAMUT METADATA
S141
PERFORM REPRODUCTION CONTROL PROCESSING ACCORDING TO COMPRESSION STATE OF COLOR GAMUT
S142
END

FIG. 8

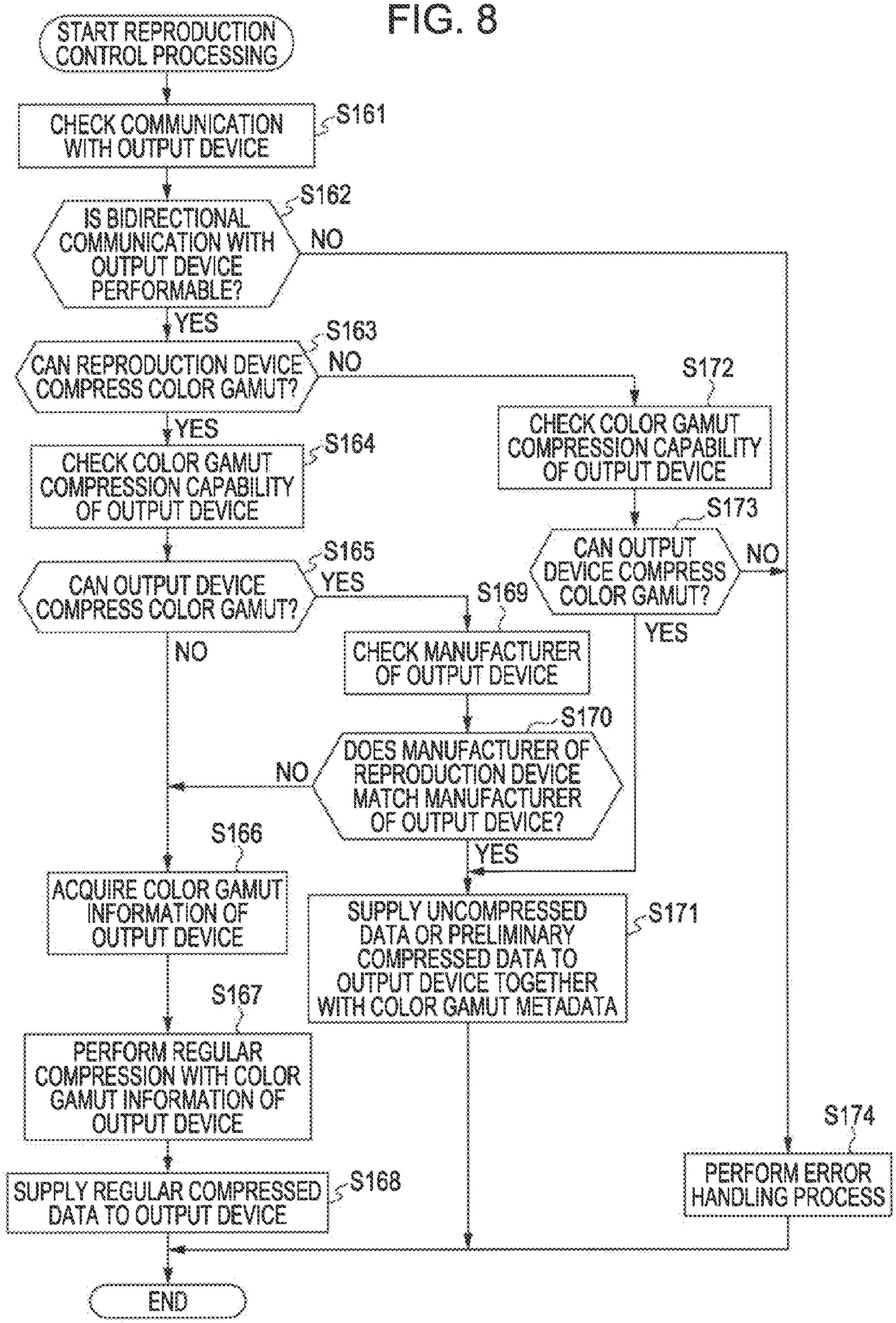

START REPRODUCTION CONTROL PROCESSING
CHECK COMMUNICATION WITH OUTPUT DEVICE
S161
IS BIDIRECTIONAL COMMUNICATION WITH OUTPUT DEVICE PERFORMABLE?
S162
NO
YES
CAN REPRODUCTION DEVICE COMPRESS COLOR GAMUT?
S163
NO
YES
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF OUTPUT DEVICE
S164
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
S165
YES
NO
S172
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF OUTPUT DEVICE
S173
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
NO
YES
S169
CHECK MANUFACTURER OF OUTPUT DEVICE
S170
DOES MANUFACTURER OF REPRODUCTION DEVICE MATCH MANUFACTURER OF OUTPUT DEVICE?
NO
YES
S166
ACQUIRE COLOR GAMUT INFORMATION OF OUTPUT DEVICE
S167
PERFORM REGULAR COMPRESSION WITH COLOR GAMUT INFORMATION OF OUTPUT DEVICE
S168
SUPPLY REGULAR COMPRESSED DATA TO OUTPUT DEVICE
S171
SUPPLY UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TO OUTPUT DEVICE TOGETHER WITH COLOR GAMUT METADATA
S174
PERFORM ERROR HANDLING PROCESS
END

FIG. 9

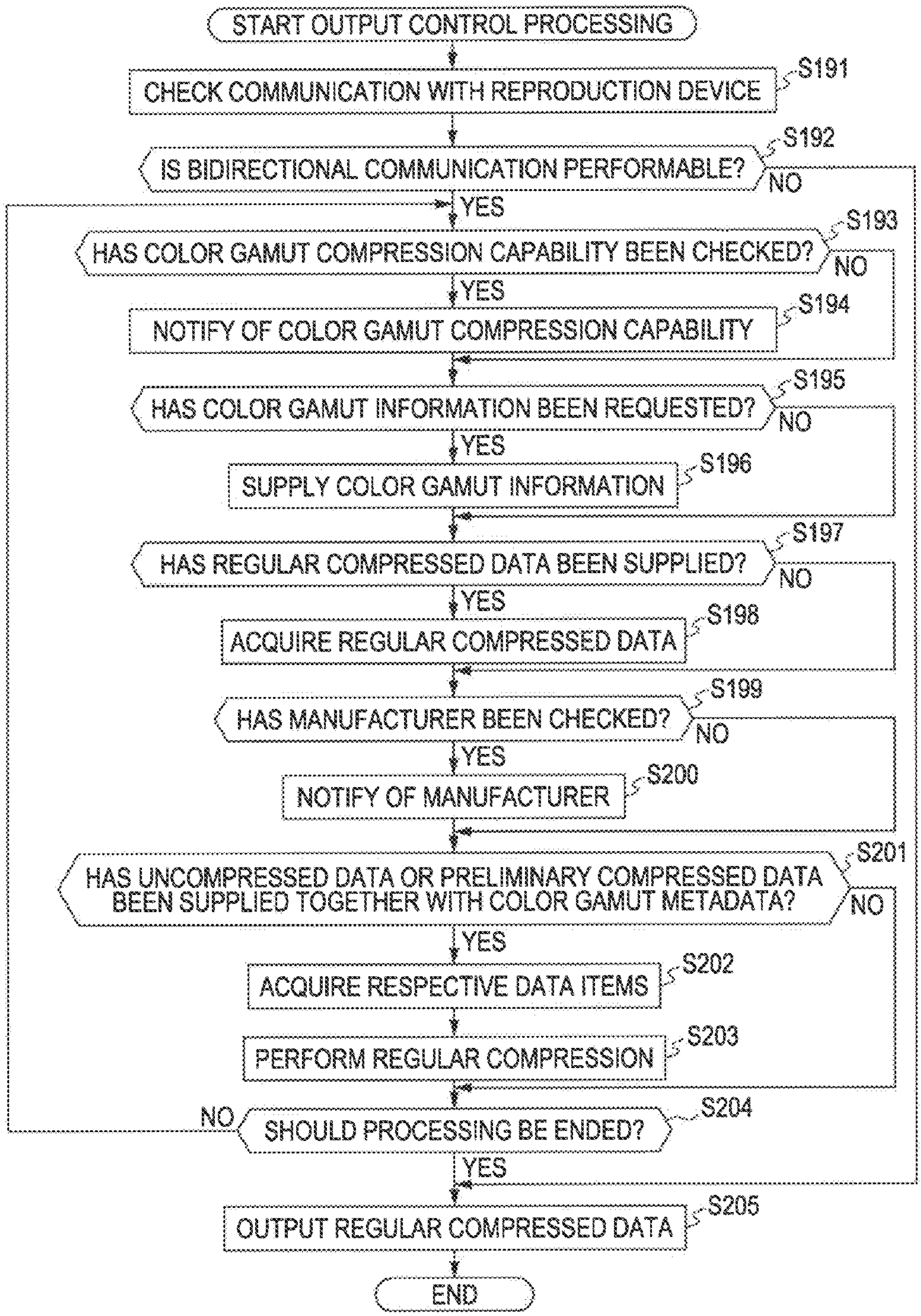

START OUTPUT CONTROL PROCESSING
CHECK COMMUNICATION WITH REPRODUCTION DEVICE
S191
IS BIDIRECTIONAL COMMUNICATION PERFORMABLE?
S192
NO
YES
HAS COLOR GAMUT COMPRESSION CAPABILITY BEEN CHECKED?
S193
NO
YES
NOTIFY OF COLOR GAMUT COMPRESSION CAPABILITY
S194
HAS COLOR GAMUT INFORMATION BEEN REQUESTED?
S195
NO
YES
SUPPLY COLOR GAMUT INFORMATION
S196
HAS REGULAR COMPRESSED DATA BEEN SUPPLIED?
S197
NO
YES
ACQUIRE REGULAR COMPRESSED DATA
S198
HAS MANUFACTURER BEEN CHECKED?
S199
NO
YES
NOTIFY OF MANUFACTURER
S200
HAS UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA BEEN SUPPLIED TOGETHER WITH COLOR GAMUT METADATA?
S201
NO
YES
ACQUIRE RESPECTIVE DATA ITEMS
S202
PERFORM REGULAR COMPRESSION
S203
NO
SHOULD PROCESSING BE ENDED?
S204
YES
OUTPUT REGULAR COMPRESSED DATA
S205
END

FIG. 10

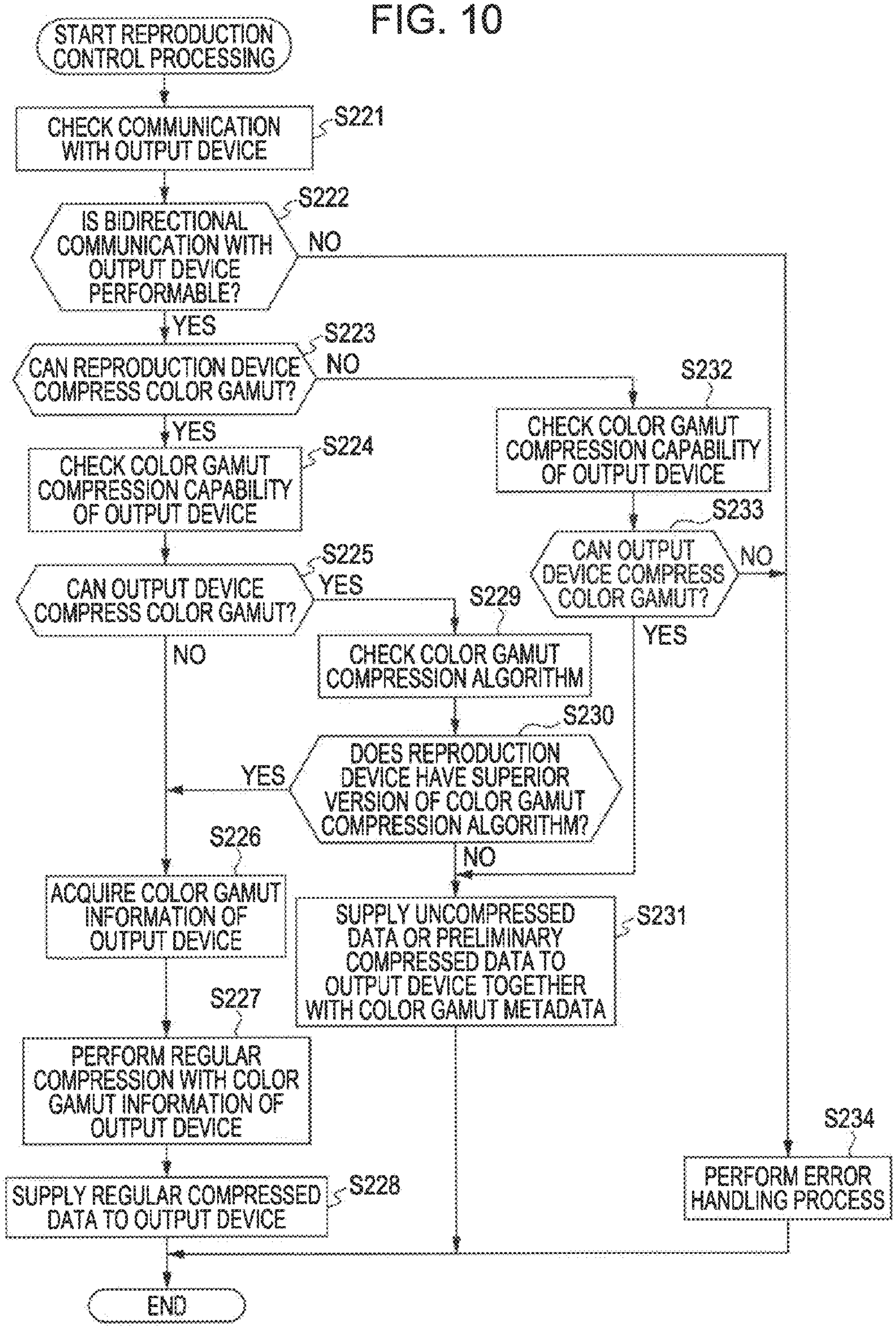

START REPRODUCTION CONTROL PROCESSING
CHECK COMMUNICATION WITH OUTPUT DEVICE
S221
IS BIDIRECTIONAL COMMUNICATION WITH OUTPUT DEVICE PERFORMABLE?
S222
NO
YES
CAN REPRODUCTION DEVICE COMPRESS COLOR GAMUT?
S223
NO
YES
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF OUTPUT DEVICE
S224
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
S225
YES
NO
S232
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF OUTPUT DEVICE
S233
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
NO
YES
S229
CHECK COLOR GAMUT COMPRESSION ALGORITHM
S230
DOES REPRODUCTION DEVICE HAVE SUPERIOR VERSION OF COLOR GAMUT COMPRESSION ALGORITHM?
YES
NO
S226
ACQUIRE COLOR GAMUT INFORMATION OF OUTPUT DEVICE
S231
SUPPLY UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TO OUTPUT DEVICE TOGETHER WITH COLOR GAMUT METADATA
S227
PERFORM REGULAR COMPRESSION WITH COLOR GAMUT INFORMATION OF OUTPUT DEVICE
S228
SUPPLY REGULAR COMPRESSED DATA TO OUTPUT DEVICE
S234
PERFORM ERROR HANDLING PROCESS
END

FIG. 11

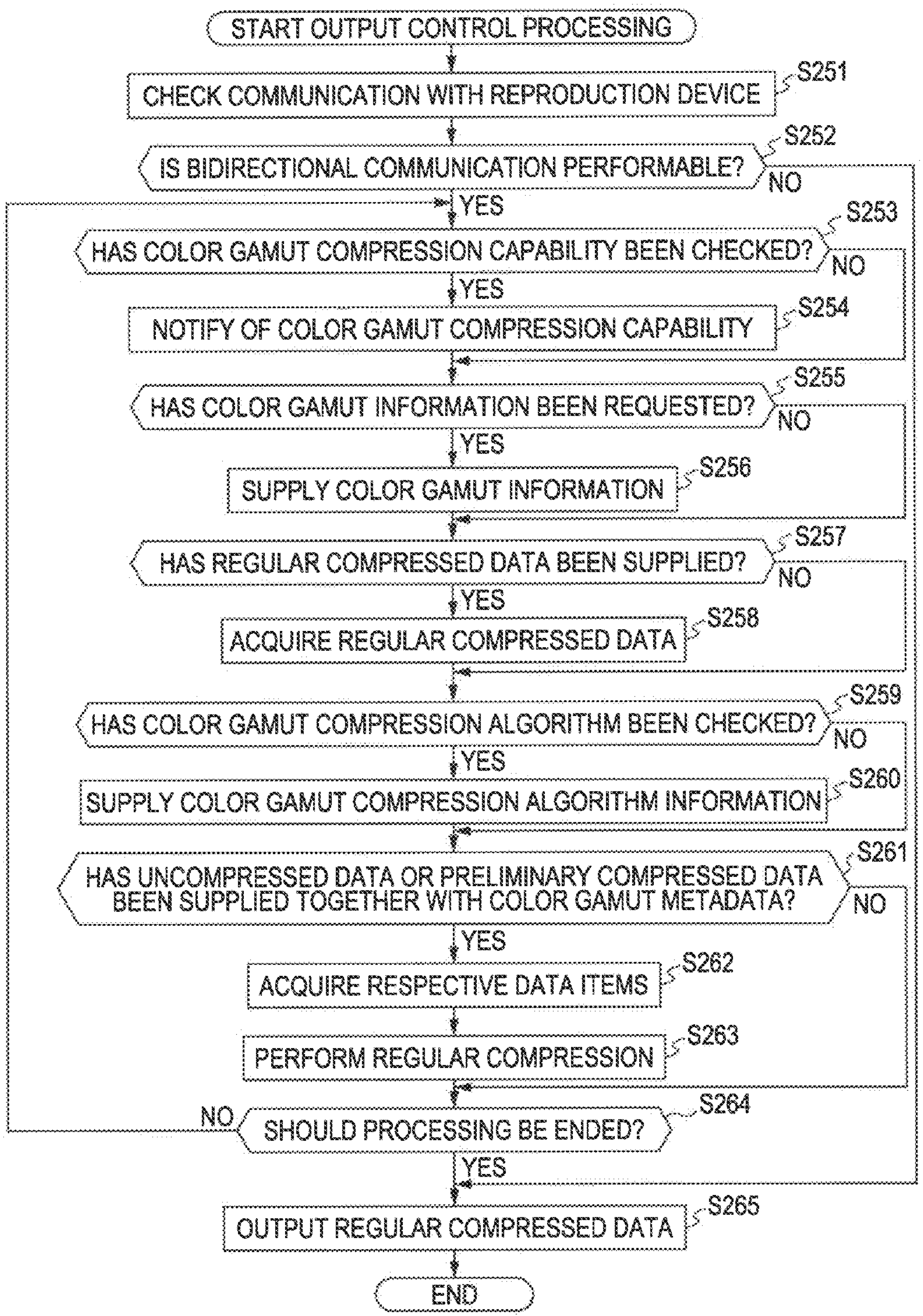

START OUTPUT CONTROL PROCESSING
CHECK COMMUNICATION WITH REPRODUCTION DEVICE
S251
IS BIDIRECTIONAL COMMUNICATION PERFORMABLE?
S252
NO
YES
HAS COLOR GAMUT COMPRESSION CAPABILITY BEEN CHECKED?
S253
NO
YES
NOTIFY OF COLOR GAMUT COMPRESSION CAPABILITY
S254
HAS COLOR GAMUT INFORMATION BEEN REQUESTED?
S255
NO
YES
SUPPLY COLOR GAMUT INFORMATION
S256
HAS REGULAR COMPRESSED DATA BEEN SUPPLIED?
S257
NO
YES
ACQUIRE REGULAR COMPRESSED DATA
S258
HAS COLOR GAMUT COMPRESSION ALGORITHM BEEN CHECKED?
S259
NO
YES
SUPPLY COLOR GAMUT COMPRESSION ALGORITHM INFORMATION
S260
HAS UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA BEEN SUPPLIED TOGETHER WITH COLOR GAMUT METADATA?
S261
NO
YES
ACQUIRE RESPECTIVE DATA ITEMS
S262
PERFORM REGULAR COMPRESSION
S263
NO
SHOULD PROCESSING BE ENDED?
S264
YES
OUTPUT REGULAR COMPRESSED DATA
S265
END

FIG. 12

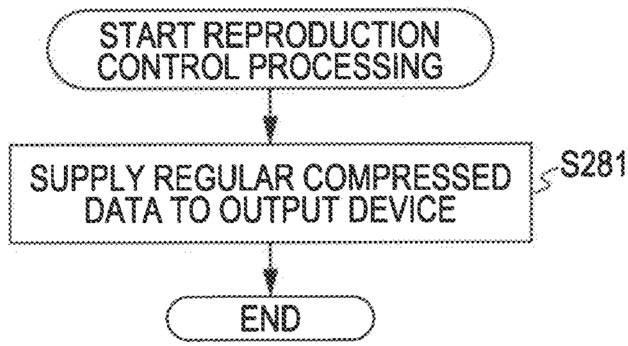

START REPRODUCTION CONTROL PROCESSING
SUPPLY REGULAR COMPRESSED DATA TO OUTPUT DEVICE
S281
END

FIG. 13

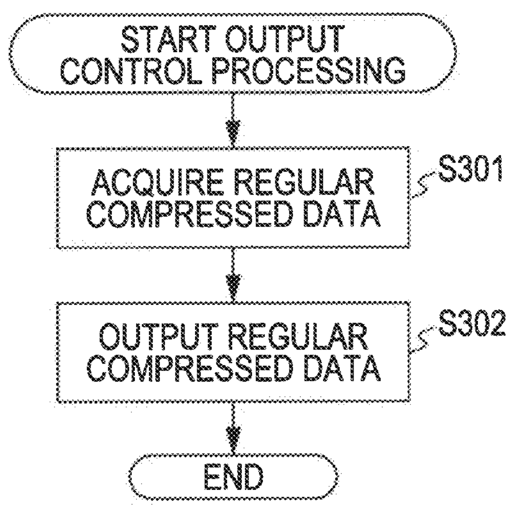
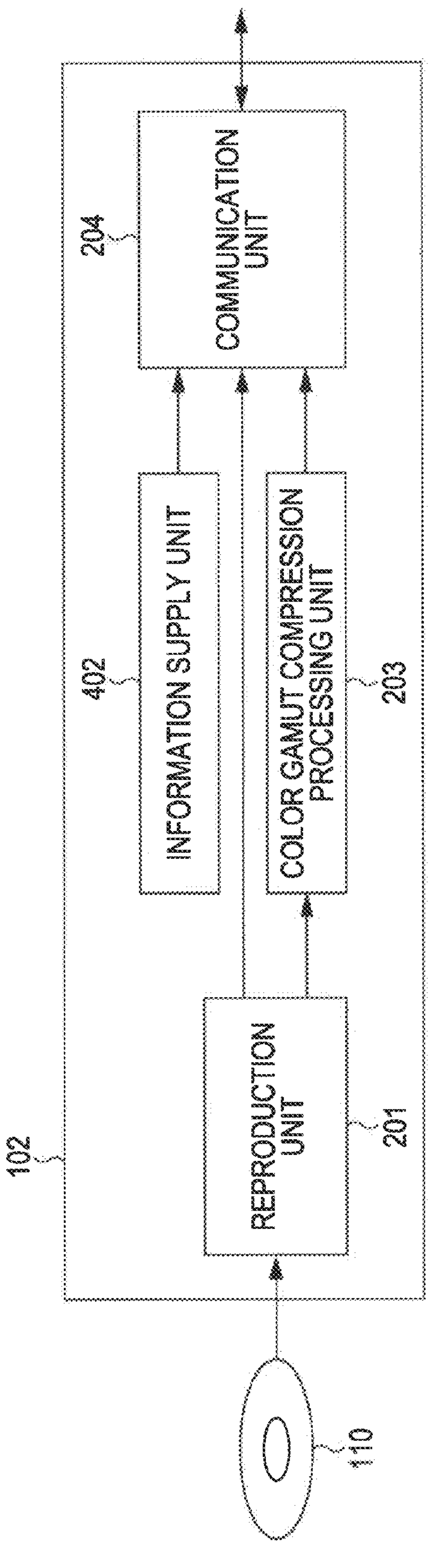

START OUTPUT CONTROL PROCESSING
ACQUIRE REGULAR COMPRESSED DATA
S301
OUTPUT REGULAR COMPRESSED DATA
S302
END

FIG. 14



102
204
COMMUNICATION UNIT
402
INFORMATION SUPPLY UNIT
COLOR GAMUT COMPRESSION PROCESSING UNIT
203
REPRODUCTION UNIT
201
110

FIG. 15

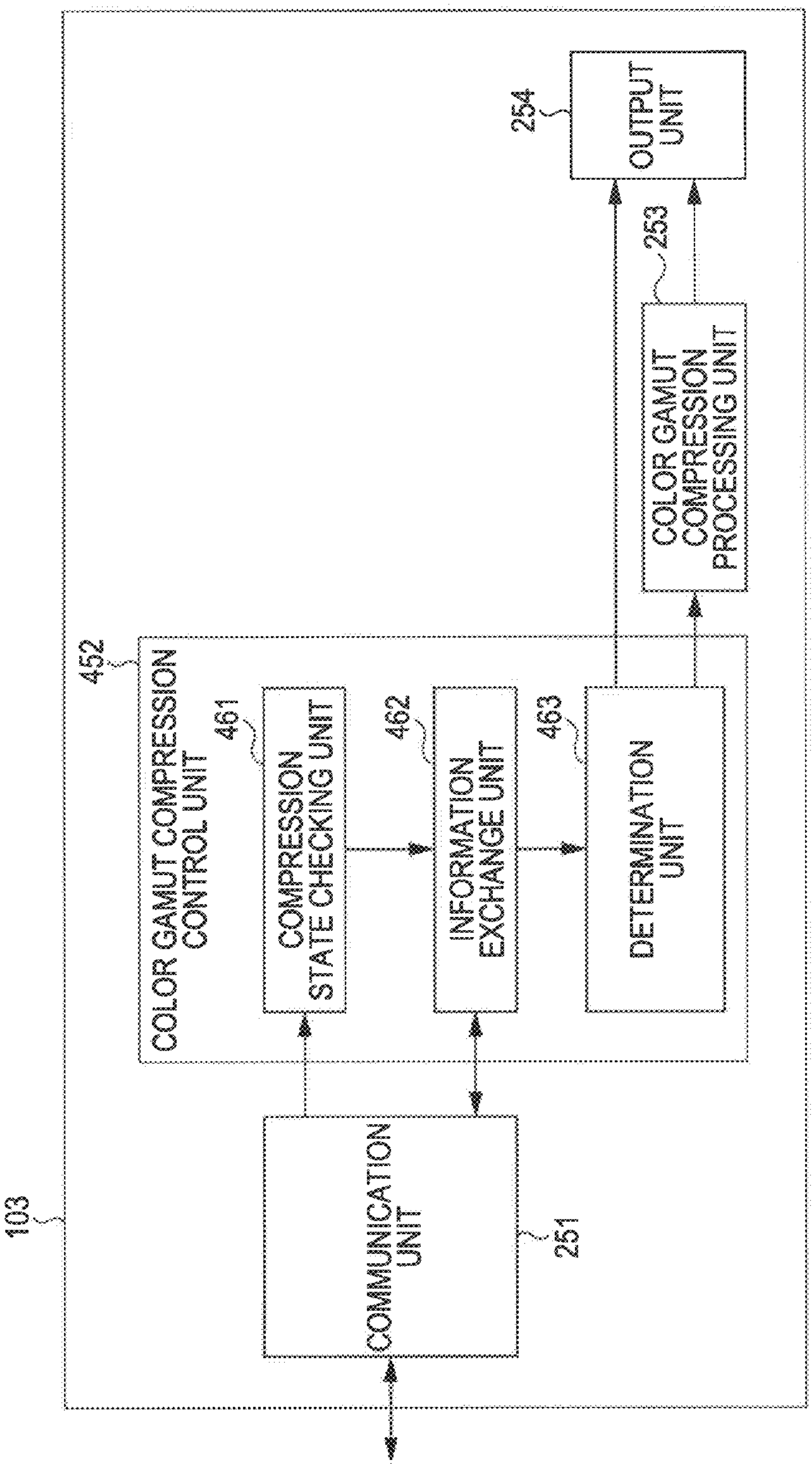

103
COMMUNICATION UNIT
251
452
COLOR GAMUT COMPRESSION CONTROL UNIT
461
COMPRESSION STATE CHECKING UNIT
462
INFORMATION EXCHANGE UNIT
463
DETERMINATION UNIT
253
COLOR GAMUT COMPRESSION PROCESSING UNIT
254
OUTPUT UNIT

FIG. 16

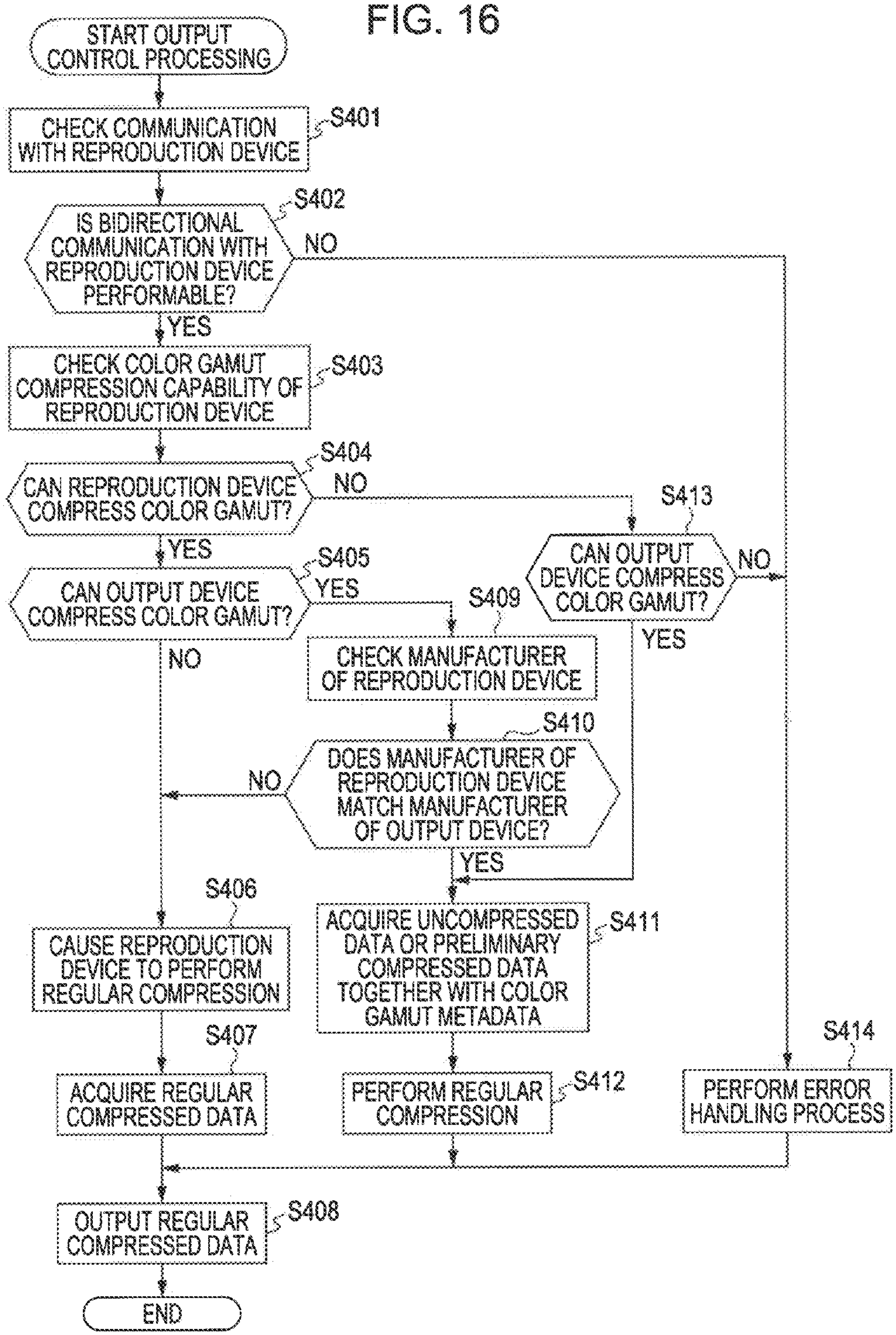

START OUTPUT CONTROL PROCESSING
CHECK COMMUNICATION WITH REPRODUCTION DEVICE
S401
IS BIDIRECTIONAL COMMUNICATION WITH REPRODUCTION DEVICE PERFORMABLE?
S402
NO
YES
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF REPRODUCTION DEVICE
S403
CAN REPRODUCTION DEVICE COMPRESS COLOR GAMUT?
S404
NO
YES
S413
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
NO
YES
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
S405
YES
NO
S409
CHECK MANUFACTURER OF REPRODUCTION DEVICE
S410
DOES MANUFACTURER OF REPRODUCTION DEVICE MATCH MANUFACTURER OF OUTPUT DEVICE?
NO
YES
S406
CAUSE REPRODUCTION DEVICE TO PERFORM REGULAR COMPRESSION
ACQUIRE UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TOGETHER WITH COLOR GAMUT METADATA
S411
S407
ACQUIRE REGULAR COMPRESSED DATA
PERFORM REGULAR COMPRESSION
S412
S414
PERFORM ERROR HANDLING PROCESS
OUTPUT REGULAR COMPRESSED DATA
S408
END

FIG. 17

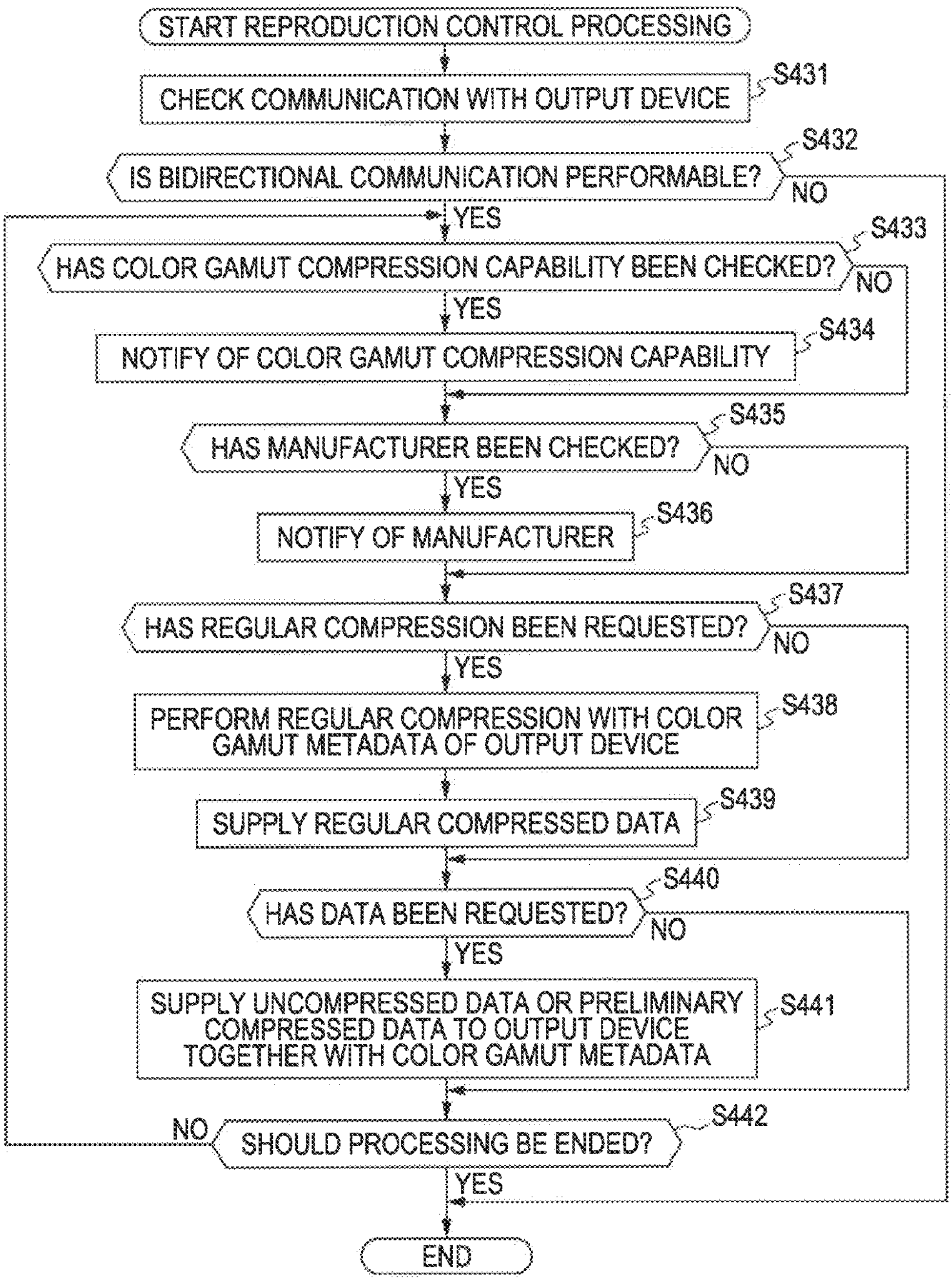

START REPRODUCTION CONTROL PROCESSING
CHECK COMMUNICATION WITH OUTPUT DEVICE
S431
IS BIDIRECTIONAL COMMUNICATION PERFORMABLE?
S432
NO
YES
HAS COLOR GAMUT COMPRESSION CAPABILITY BEEN CHECKED?
S433
NO
YES
NOTIFY OF COLOR GAMUT COMPRESSION CAPABILITY
S434
HAS MANUFACTURER BEEN CHECKED?
S435
NO
YES
NOTIFY OF MANUFACTURER
S436
HAS REGULAR COMPRESSION BEEN REQUESTED?
S437
NO
YES
PERFORM REGULAR COMPRESSION WITH COLOR GAMUT METADATA OF OUTPUT DEVICE
S438
SUPPLY REGULAR COMPRESSED DATA
S439
HAS DATA BEEN REQUESTED?
S440
NO
YES
SUPPLY UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TO OUTPUT DEVICE TOGETHER WITH COLOR GAMUT METADATA
S441
NO
SHOULD PROCESSING BE ENDED?
S442
YES
END

FIG. 18

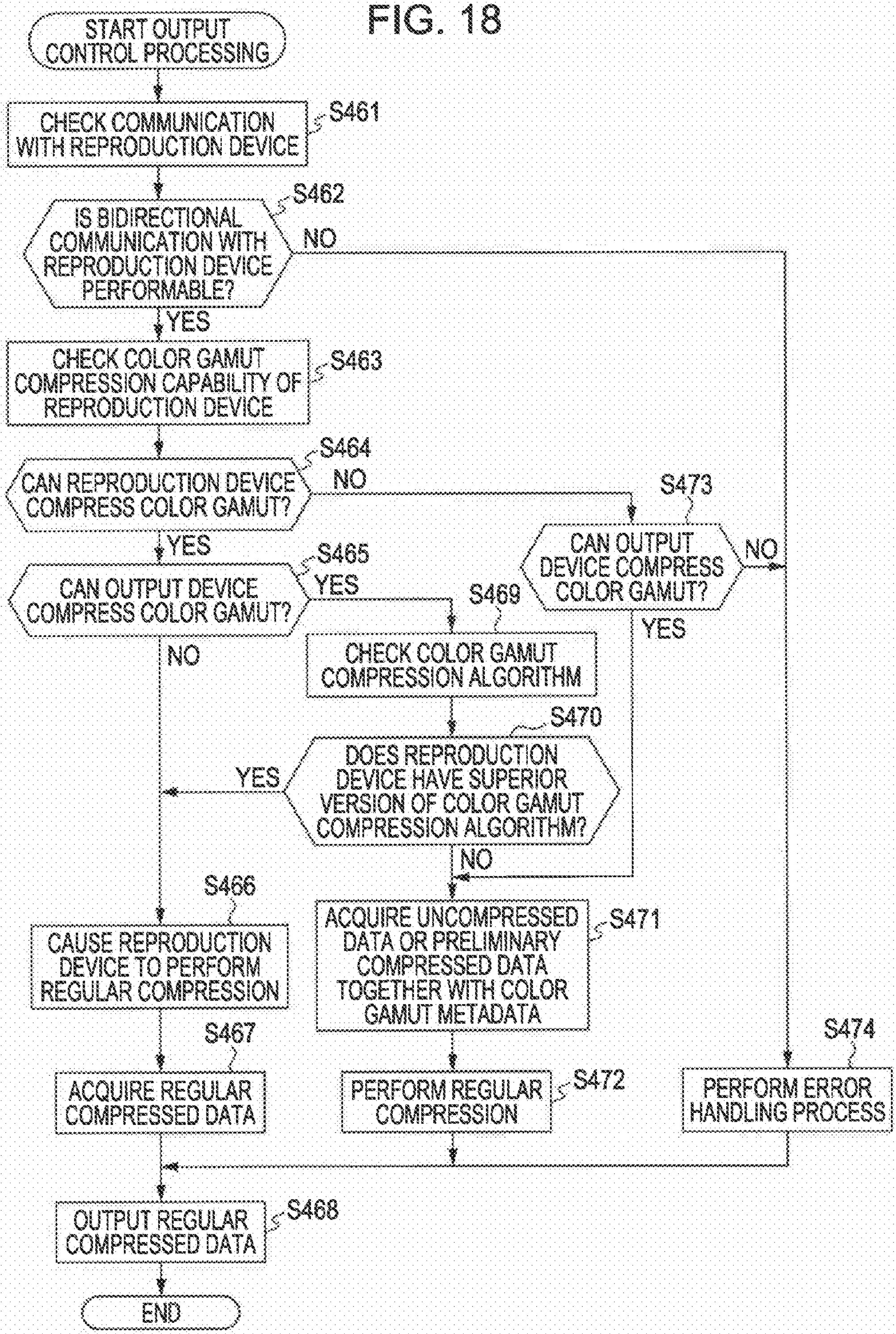

START OUTPUT CONTROL PROCESSING
CHECK COMMUNICATION WITH REPRODUCTION DEVICE
S461
IS BIDIRECTIONAL COMMUNICATION WITH REPRODUCTION DEVICE PERFORMABLE?
S462
NO
YES
CHECK COLOR GAMUT COMPRESSION CAPABILITY OF REPRODUCTION DEVICE
S463
CAN REPRODUCTION DEVICE COMPRESS COLOR GAMUT?
S464
NO
YES
S473
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
NO
YES
CAN OUTPUT DEVICE COMPRESS COLOR GAMUT?
S465
YES
NO
S469
CHECK COLOR GAMUT COMPRESSION ALGORITHM
S470
DOES REPRODUCTION DEVICE HAVE SUPERIOR VERSION OF COLOR GAMUT COMPRESSION ALGORITHM?
YES
NO
S466
CAUSE REPRODUCTION DEVICE TO PERFORM REGULAR COMPRESSION
ACQUIRE UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TOGETHER WITH COLOR GAMUT METADATA
S471
S467
ACQUIRE REGULAR COMPRESSED DATA
PERFORM REGULAR COMPRESSION
S472
S474
PERFORM ERROR HANDLING PROCESS
OUTPUT REGULAR COMPRESSED DATA
S468
END

FIG. 19

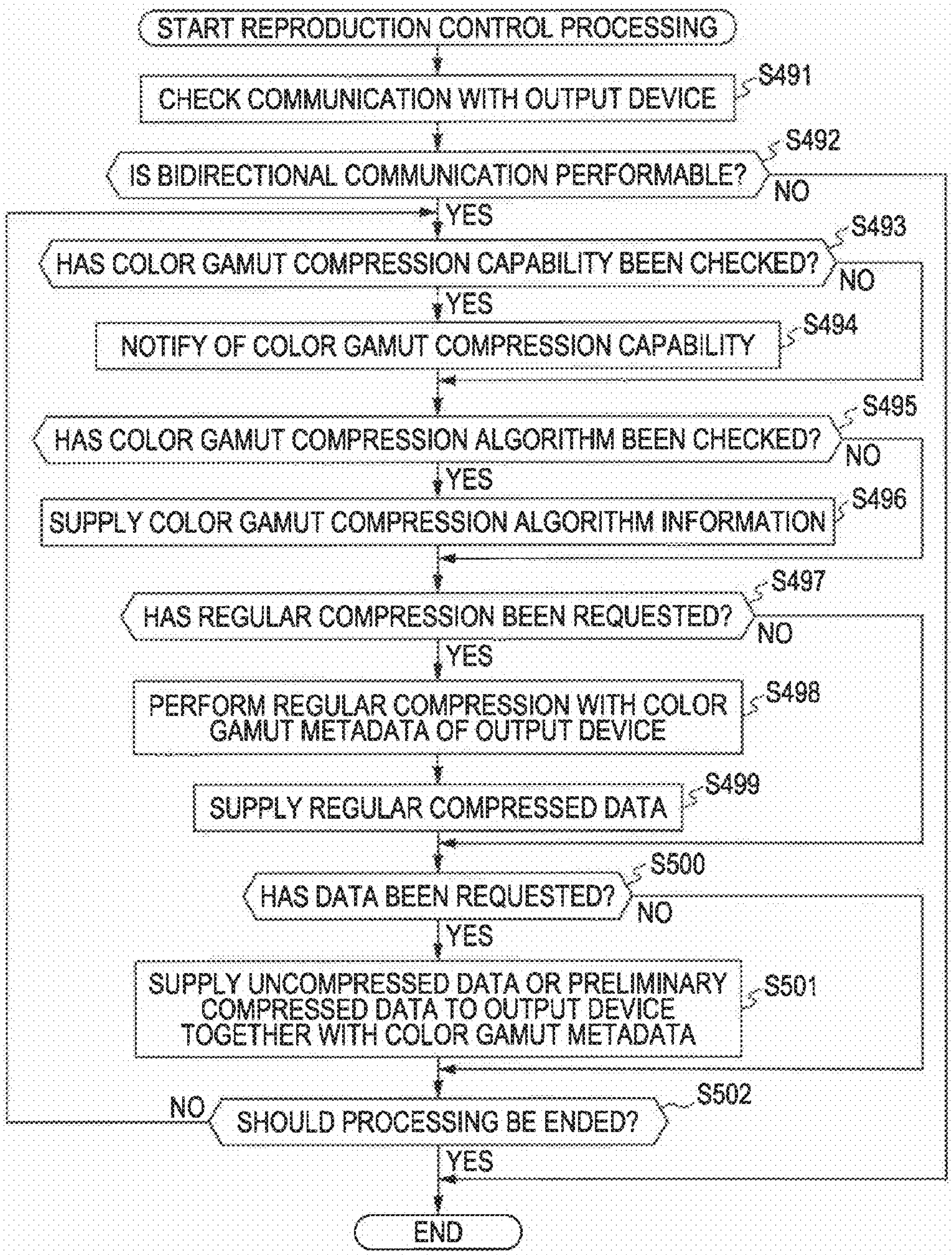

START REPRODUCTION CONTROL PROCESSING
CHECK COMMUNICATION WITH OUTPUT DEVICE
S491
IS BIDIRECTIONAL COMMUNICATION PERFORMABLE?
S492
NO
YES
HAS COLOR GAMUT COMPRESSION CAPABILITY BEEN CHECKED?
S493
NO
YES
NOTIFY OF COLOR GAMUT COMPRESSION CAPABILITY
S494
HAS COLOR GAMUT COMPRESSION ALGORITHM BEEN CHECKED?
S495
NO
YES
SUPPLY COLOR GAMUT COMPRESSION ALGORITHM INFORMATION
S496
HAS REGULAR COMPRESSION BEEN REQUESTED?
S497
NO
YES
PERFORM REGULAR COMPRESSION WITH COLOR GAMUT METADATA OF OUTPUT DEVICE
S498
SUPPLY REGULAR COMPRESSED DATA
S499
HAS DATA BEEN REQUESTED?
S500
NO
YES
SUPPLY UNCOMPRESSED DATA OR PRELIMINARY COMPRESSED DATA TO OUTPUT DEVICE TOGETHER WITH COLOR GAMUT METADATA
S501
NO
SHOULD PROCESSING BE ENDED?
S502
YES
END

FIG. 20

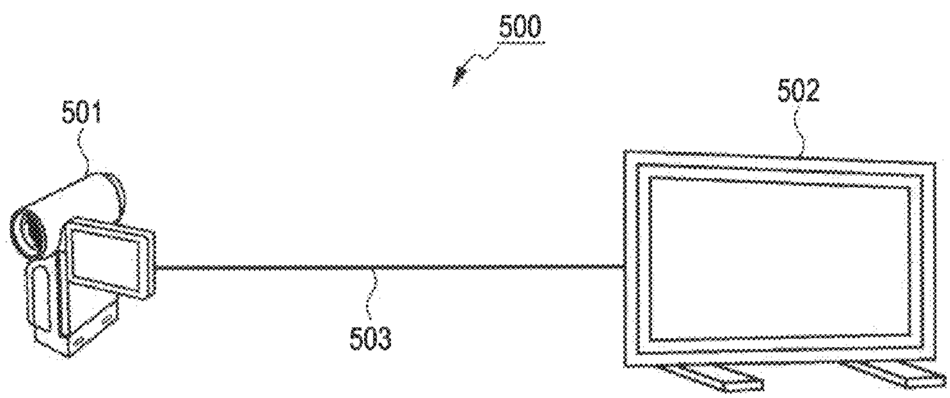


FIG. 21A

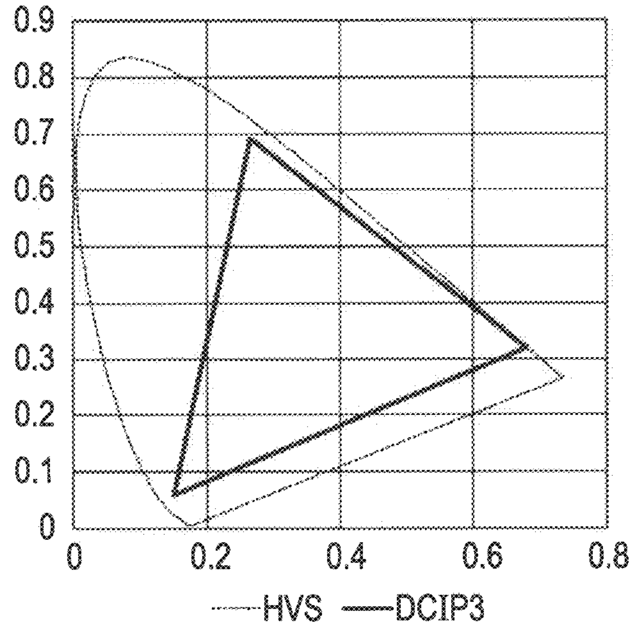


FIG. 21B

511

	x	y
RED	0.68	0.32
GREEN	0.265	0.69
BLUE	0.15	0.06
WHITE	0.314	0.351

COLOR TEMPERATURE OF WHITE POINT: 6300K

FIG. 22A

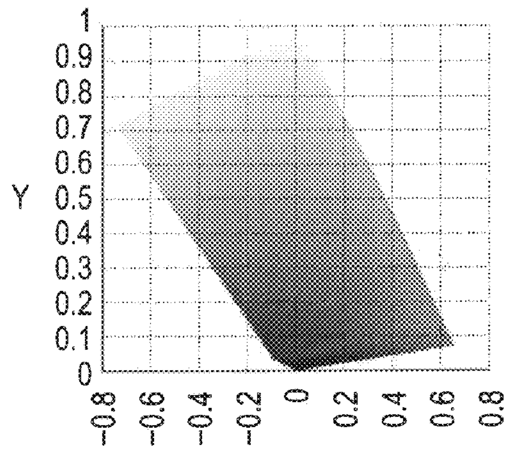


FIG. 22B

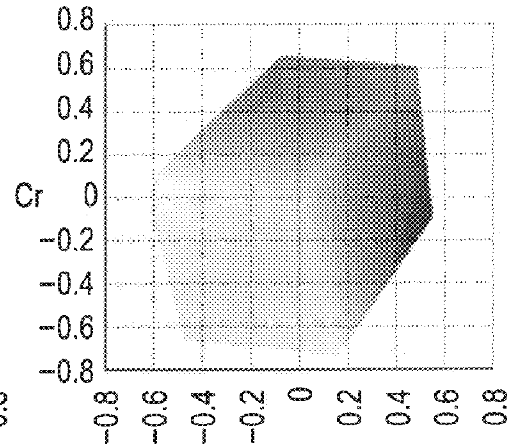


FIG. 22C

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Hue	Y	C
0	0.063168	0.52825
2	0.069205	0.525281
4	0.07484	0.523186
6	0.080099	0.521866
8	0.084935	0.521456
10	0.089435	0.521807
12	0.09356	0.52305
14	0.097358	0.525108
16	0.100839	0.527993
18	0.103971	0.531828
20	0.106786	0.536561
22	0.109235	0.542268
24	0.111327	0.549
.....	.....	.....
.....	.....	.....
350	0.031765	0.55371
352	0.037905	0.547286
354	0.044404	0.5414
356	0.050764	0.536291
358	0.057011	0.531931
360	0.063168	0.52825

FIG. 22D

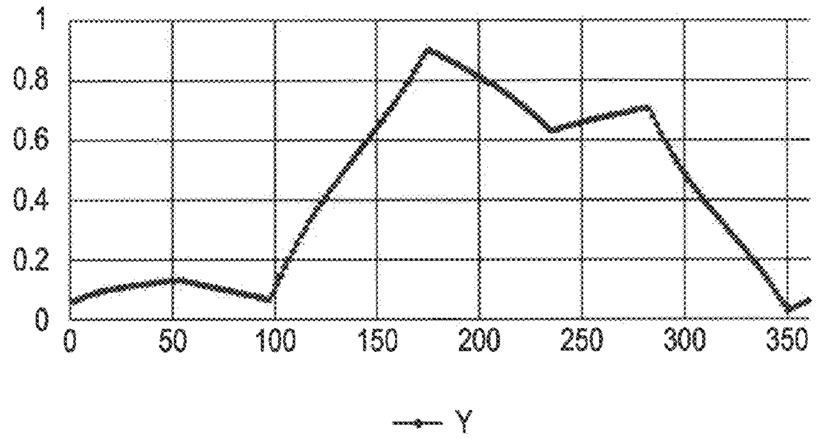

FIG. 22E

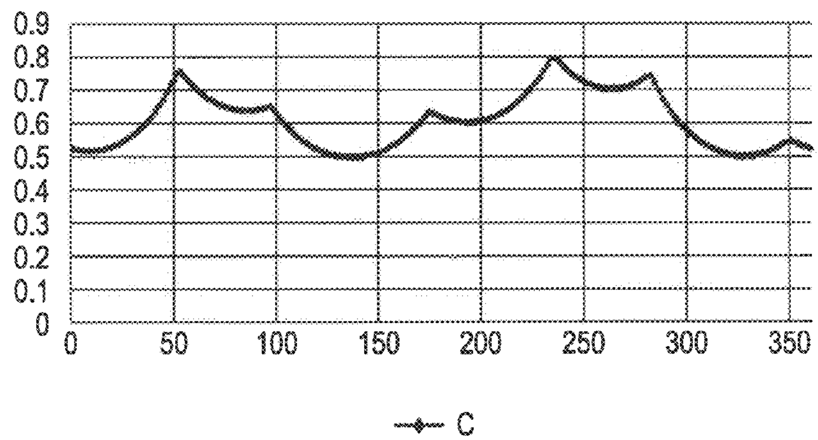

FIG. 23A

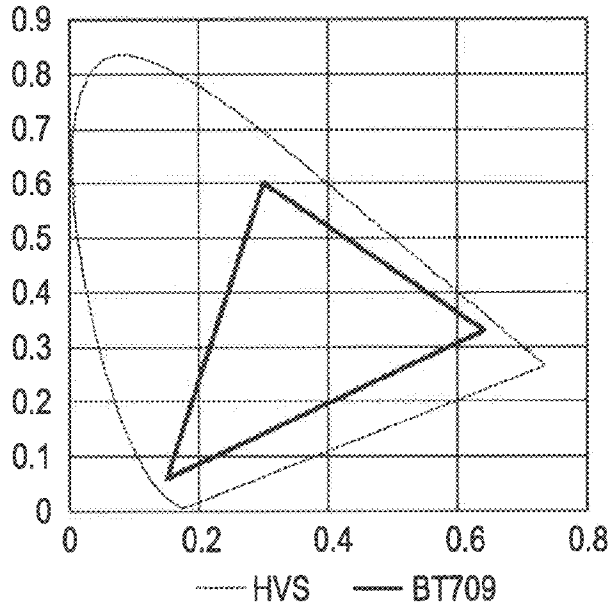

FIG. 23B

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	x	y
RED	0.64	0.33
GREEN	0.3	0.6
BLUE	0.15	0.06
WHITE	0.3127	0.329

COLOR TEMPERATURE OF WHITE POINT: 6500K

FIG. 24A

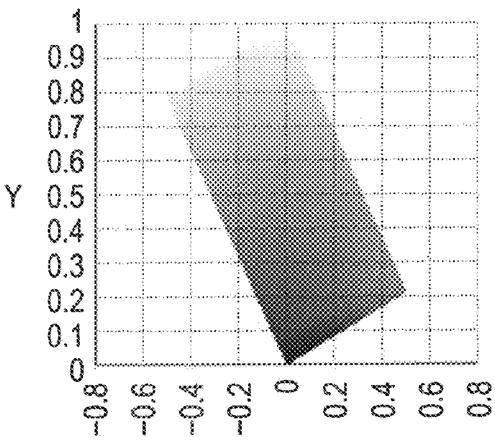


FIG. 24B

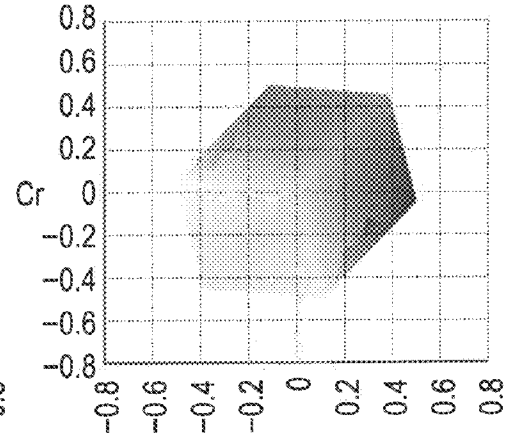


FIG. 24C

541

Hue	Y	C
0	0.089699	0.490572
2	0.096925	0.486983
4	0.104055	0.484023
6	0.111109	0.481677
8	0.118103	0.479933
10	0.125054	0.478786
12	0.131981	0.478243
14	0.138901	0.478263
16	0.14583	0.478875
18	0.152785	0.480074
20	0.159784	0.841866
22	0.166844	0.484264
24	0.173984	0.487281
.....	.....	.....
.....	.....	.....
350	0.130315	0.475916
352	0.106705	0.486145
354	0.082054	0.497418
356	0.074875	0.499778
358	0.082355	0.494837
360	0.089699	0.490572

FIG. 24D

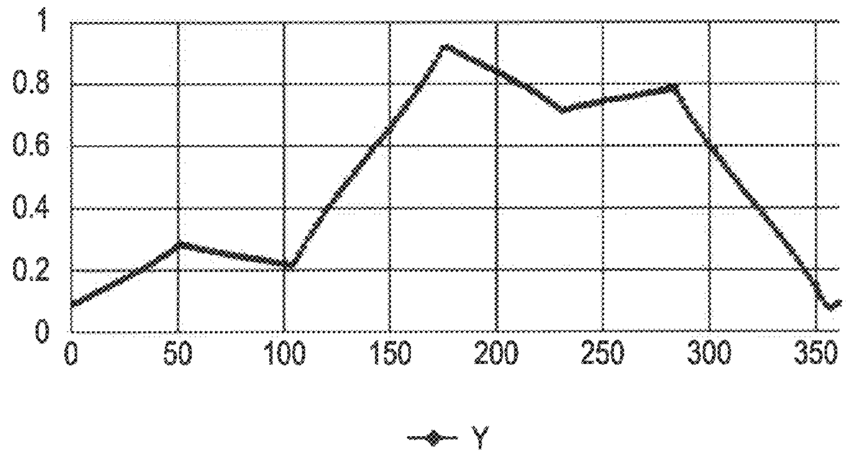


FIG. 24E

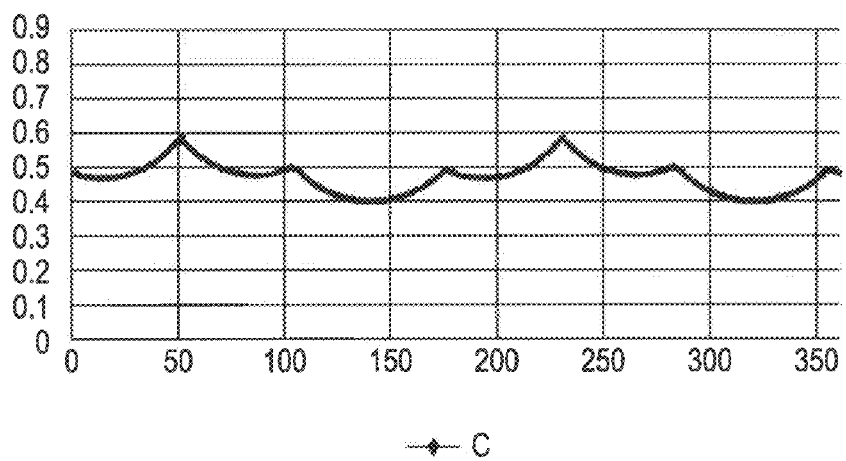
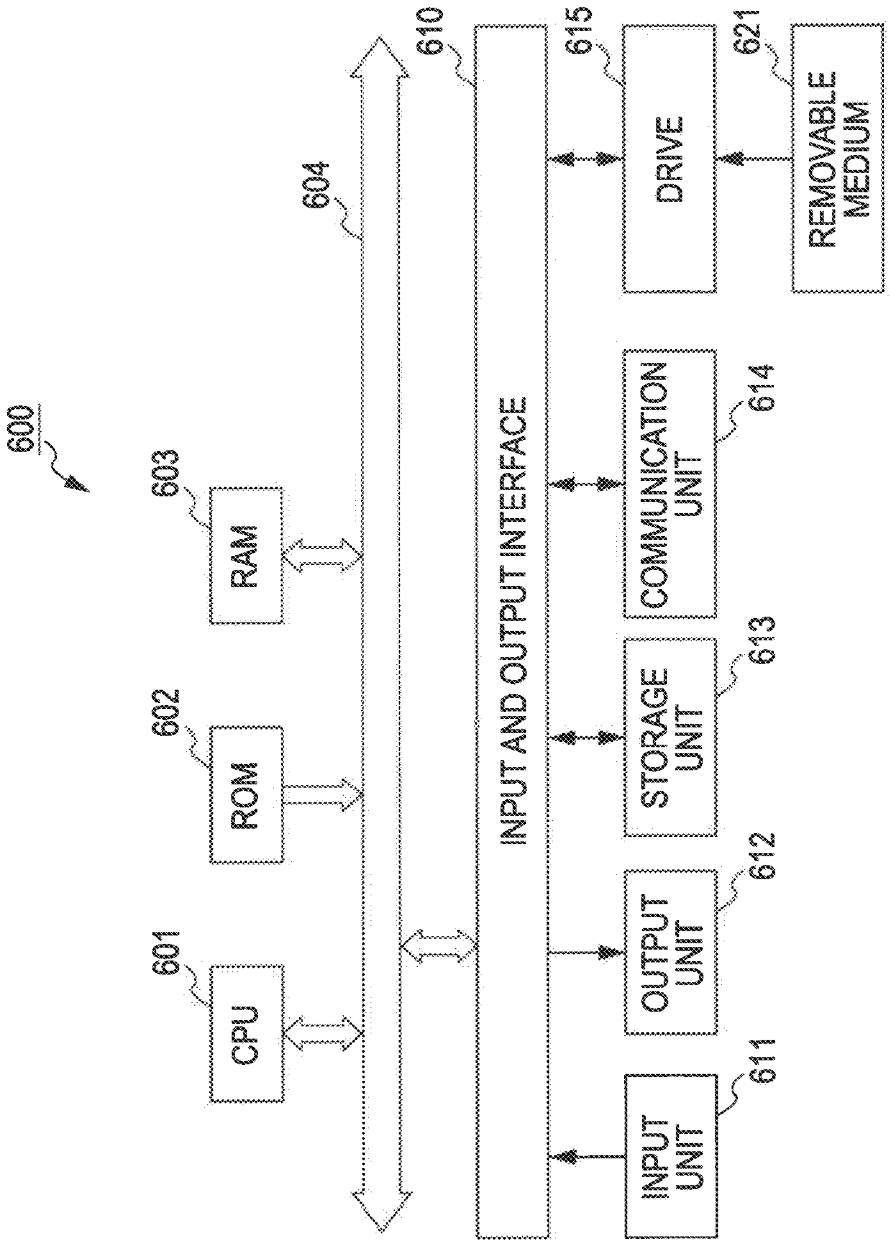


FIG. 25


600
601
CPU
602
ROM
603
RAM
604
610
INPUT AND OUTPUT INTERFACE
611
INPUT UNIT
612
OUTPUT UNIT
613
STORAGE UNIT
614
COMMUNICATION UNIT
615
DRIVE
621
REMOVABLE MEDIUM

RECORDING DEVICE AND RECORDING CONTROL METHOD, REPRODUCTION DEVICE AND REPRODUCTION CONTROL METHOD, OUTPUT DEVICE AND OUTPUT CONTROL METHOD, AND PROGRAMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a recording device and a recording control method, a reproduction device and a reproduction control method, an output device and an output control method, and programs. The present invention particularly relates to a recording device and a recording control method, a reproduction device and a reproduction control method, an output device and an output control method, and programs capable of performing more reliable and appropriate color gamut compression, even when content data is handled by a plurality of devices.

2. Description of the Related Art

In recent years, various types of digital image devices having different color expression regions have been increasing in number. Particularly in image display devices, the expansion of the color gamut is remarkable. The color gamut has been substantially expanded in the development from CRT (Cathode Ray Tube) display to plasma display, LCD (Liquid Crystal Display), and OELD (Organic Electro Luminescence Display). Further, many imaging devices, such as a digital still camera and a video camera, capable of imaging colors outside an sRGB (standard RGB) color gamut have been appearing. Therefore, a method has been sought which smoothly outputs wide color gamut image data of a captured image to devices having different color gamuts, such as a wide color gamut display, while suppressing color mismatch and hue shift occurring in a high-luminance and high-saturation color.

Major color matching methods for solving the issue of color mismatch between devices include the following three methods, for example.

The first method uses an ICC (International Color Consortium) profile. The ICC profile is a file describing the properties of an image device defined by an organization called ICC. Normally, two profiles including an input device ICC profile and an output device ICC profile are used to output one image file. The input device ICC profile is embedded in the image file in many cases. When the image of the file is output to another device via a PC (Personal Computer), an application on the PC supporting the ICC profile performs appropriate color gamut matching by using the output device ICC profile, to thereby output the image. This method is based on the assumption that image processing and conversion are performed with the use of a PC, or that an output device supports the ICC profile.

Further, there is a method using sRGB space as a system for matching colors without taking account of the difference in color gamut between devices. The sRGB is an international standard of color space formulated by the IEC (International Electrotechnical Commission) in October 1998. The color space was set to ensure color reproducibility between different environments, such as between different PC models and different devices such as a display and a printer, and was formulated on the basis of the color gamut of the CRT display. For example, if a digital camera, a PC, a display, and a printer are all compatible with the sRGB, it is possible to match color appearances without any particular processing, when a captured image is displayed on the display or printed out. As compared with a workflow based on the ICC profile, the use of a PC is unnecessary, and the processing is substantially simple and convenient. However, the sRGB is narrower in expressible color range than other color spaces. Thus, it is difficult in the sRGB to express such colors as emerald green, dark cyan, orange, light red, and yellow. Therefore, the sRGB is unsuitable for professional use wherein photographs and graphic designs are specifically handled.

Further, a movement for color matching using the Exif (Exchangeable image file format) standard is taking place mainly in the digital still camera and printer industries. The Exif is a format standard for recording an image file, and was proposed and formulated by the JEITA (Japan Electronics and Information Technology Industries Association). Most digital camera manufacturers use this format, as well as the DCF (Design rule for Camera File system) which is a file system standard. Specifically, color space can be described as the header information of an image file. By reading the header information, therefore, a printer can perform more appropriate color conversion into the printer color gamut. Particularly, with Exif Ver. 2.21, in addition to the sRGB supported by the previous versions, Adobe RGB, which is wider in color gamut than the sRGB and normally used in such business fields as the printing industry, can also be used as supported color space. Accordingly, it is now possible to express emerald green and dark cyan, which are difficult to express in the sRGB of the related art. A workflow of a printing operation using the Exif standard is called Exif Print. If a printer has a function of reading an Exif header, the Exif Print can be performed. Therefore, the use of a PC is unnecessary, and the printing operation can be performed with a memory card directly inserted in the printer. There is another standard PIM (PRINT Image Matching) similar to the Exif.

However, in a method using the ICC profile, for example, the ICC profile is embedded in an image file. Therefore, the size of the image file may be unnecessarily increased. Further, a PC application or an output device creates a CMM (Color Matching Module) for reading the ICC profile and performing appropriate processing. However, the CMM is created by respective companies, each with an idea unique thereto. Therefore, even if the color matching is guaranteed within a color gamut common to the input device and the output device, not much attention is paid to colors outside the color gamut of the devices. Therefore, in a high- or low-luminance and high-saturation color, which tends to be outside the color gamut, a hue shift often occurs due to natural clip.

The natural clip refers to a phenomenon in which, when a color of eternally supplied image data is outside the color gamut of a device, the color is forcibly expressed by a color within the color gamut of the device. For example, if only the R component of a color represented by RGB has a value greater than the maximum value of the R component of the color gamut, the R component of the color is represented by the maximum value of the R component of the color gamut (natural clip). In this case, the RGB balance of the original color is lost due to the natural clip, and the hue is changed. Such a change in hue is referred to as the hue shift. That is, the original color is expressed by a color different therefrom. Therefore, the occurrence of such hue shift is undesirable.

Further, in the method using the sRGB, for example, the assumed color gamut corresponds to the color gamut of a standard PC CRT monitor, and thus is narrow. A workflow based on the sRGB does not include a process of performing color gamut compression between devices. Thus, the natural clip occurs in a color outside the sRGB color gamut, and the hue shift occurs in a high- or low-luminance and high-saturation color. The use of the sRGB, therefore, may prevent appropriate expression of dark cyan and green colors printable by a common printer and red displayable on an LCD, the color gamut of which has been dramatically expanded in recent years.

Further, in the method using the PIM or the Exif, the output device performs processing in accordance with the image header information defined by the PIM or the Exif. Therefore, the processing load on the output device may be increased. Further, the content of the processing relies on the output device. Therefore, the color reproducibility intended by the input device may not be guaranteed.

Further, all of the methods described above are mainly for processing a still image, and thus are not suitable for color matching of a moving image, wherein the processing is performed in real time.

In view of the above, to realize a practical color reproduction technique not relying on a device, methods for performing appropriate color matching between devices have been proposed (see Japanese Unexamined Patent Application Publication Nos. 09-098298 and 07-236069, for example).

For example, according to the method described in Japanese Unexamined Patent Application Publication No. 09-098298 (corresponding to U.S. Pat. No. 5,933,253), the color reproduction region of an input system is divided into four regions on a two-dimensional plane by the use of two straight lines, and color gamut compression is performed with the compression direction changed for each of the regions.

Further, according to the method described in Japanese Unexamined Patent Application Publication No. 07-236069, for example, only the chromaticity coordinates of eight points indicating representative colors of red (R), green (G), blue (B), cyan (C), magenta (M), yellow (Y), black (K), and white (W) are exchanged. The conversion of intermediate colors between the above-listed colors is performed in accordance with the conversion results of the eight representative colors.

In addition to the above-described methods, a variety of other methods have been proposed as the algorithm for the color gamut conversion as described above.

SUMMARY OF THE INVENTION

However, there is no color gamut optimal for all devices. For example, a color gamut may be too narrow for the display capability of a device. Further, the data amount may be too large for the data transmission capability of a device, and the processing may be complicated for the processing capability of a device.

Therefore, particularly in a system in which one content data item is shared by an arbitrary plurality of devices, e.g., a system in which mutually different devices perform such operations as imaging, recording, reproduction, and display (output), the color gamut is controlled in accordance with the devices constituting the system. In general, an imaging device has a wide color gamut, while a display device has a narrow color gamut. Therefore, it is desirable to compress the color gamut of image data during a process from the imaging (generation of image data) to the display (output of an image).

If the color gamut of content data is too narrow for the capability of a device, the expression capability of image data may be unnecessarily reduced. Meanwhile, if the color gamut of content data is too wide for the capability of a device, a device failure may be caused.

Therefore, it is desired to perform reliable and appropriate color gamut control in any combination of devices. As described above, however, the appropriate color gamut is different from device to device. Therefore, it is desirable to determine the color gamut control method (color gamut compression method) in accordance with the respective configurations of the devices. However, there has not been a system satisfying such a demand.

The present invention has been proposed in view of the above circumstances. It is desirable to enable more reliable and appropriate compression of the color gamut of content data, even when the content data is handled by a plurality of devices.

A recording device according to an embodiment of the present invention includes color gamut conversion control means, color gamut conversion means, and recording means. The color gamut conversion control means controls a method of converting the color gamut of content data, on the basis of a user-specified condition specified by a user. The color gamut conversion means converts the color gamut of the content data in accordance with the control of the color gamut conversion control means. The recording means records, on a recording medium, the content data, the color gamut of which has been converted by the color gamut conversion means in accordance with the control of the color gamut conversion control means, or the content data, the color gamut of which has not been converted by the color gamut conversion means in accordance with the control of the color gamut conversion control means.

The color gamut conversion control means may perform the control such that the color gamut of the content data is converted into a color gamut specified by the user.

The color gamut conversion control means may perform the control such that the color gamut of the content data is converted into a color gamut corresponding to a file format specified by the user.

A recording control method according to an embodiment of the present invention includes the steps of: determining a method of converting the color gamut of content data, on the basis of a user-specified condition specified by a user; converting the color gamut of the content data in accordance with the determined method of converting the color gamut; and controlling the recording, on a recording medium, of the content data, the color gamut of which has been converted, or the content data, the color gamut of which has not been converted.

A program according to an embodiment of the present invention causes a computer to perform a recording control method. The recording control method includes the steps of: determining a method of converting the color gamut of content data, on the basis of a user-specified condition specified by a user; converting the color gamut of the content data in accordance with the determined method of converting the color gamut; and controlling the recording, on a recording medium, of the content data, the color gamut of which has been converted, or the content data, the color gamut of which has not been converted.

A reproduction device according to another embodiment of the present invention includes reading means, conversion state checking means, color gamut conversion control means, and color gamut conversion means. The reading means reads content data recorded on a recording medium. The conversion state checking means checks the conversion state of the color gamut of the content data read by the reading means. If it is confirmed by the conversion state checking means that the color gamut of the content data has not been converted into the color gamut of an output device at a subsequent stage, the color gamut conversion control means controls a method of converting the color gamut of the content data, on the basis of information relating to the output device. The color gamut conversion means converts the color gamut of the content data in accordance with the control of the color gamut conversion control means.

The color gamut conversion control means may control the method of converting the color gamut of the content data, in accordance with whether or not the manufacturer of the output device matches the manufacturer of the reproduction device.

The color gamut conversion control means may control the method of converting the color gamut of the content data, in accordance with whether or not a color gamut conversion algorithm version of the output device is superior to a color gamut conversion algorithm version of the reproduction device.

A reproduction control method according to another embodiment of the present invention includes the steps of: controlling the reading of content data recorded on a recording medium; checking the conversion state of the color gamut of the read content data; determining, if it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device at a subsequent stage, a method of converting the color gamut of the content data, on the basis of information relating to the output device; and converting the color gamut of the content data in accordance with the determined method of converting the color gamut.

A program according to another embodiment of the present invention causes a computer to perform a reproduction control method. The reproduction control method includes the steps of: controlling the reading of content data recorded on a recording medium; checking the conversion state of the color gamut of the read content data; determining, if it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device at a subsequent stage, a method of converting the color gamut of the content data, on the basis of information relating to the output device; and converting the color gamut of the content data in accordance with the determined method of converting the color gamut.

An output device according to still another embodiment of the present invention includes conversion state checking means, color gamut conversion control means, color gamut conversion means, and output means. The conversion state checking means checks the conversion state of the color gamut of content data. If it is confirmed by the conversion state checking means that the color gamut of the content data has not been converted into the color gamut of the output device, the color gamut conversion control means controls a method of converting the color gamut of the content data, on the basis of information relating to a reproduction device at a previous stage. The color gamut conversion means converts the color gamut of the content data into the color gamut of the output device in accordance with the control of the color gamut conversion control means. The output means outputs the content data having the color gamut of the output device.

An output control method according to still another embodiment of the present invention includes the steps of: checking the conversion state of the color gamut of content data; determining, if it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device, a method of converting the color gamut of the content data, on the basis of information relating to a reproduction device at a previous stage; converting the color gamut of the content data into the color gamut of the output device in accordance with the determined method of converting the color gamut; and controlling the output of the content data having the color gamut of the output device.

A program according to still another embodiment of the present invention causes a computer to perform an output control method. The output control method includes the steps of: checking the conversion state of the color gamut of content data; determining, if it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device, a method of converting the color gamut of the content data, on the basis of information relating to a reproduction device at a previous stage; converting the color gamut of the content data into the color gamut of the output device in accordance with the determined method of converting the color gamut; and controlling the output of the content data having the color gamut of the output device.

In an embodiment of the present invention, a method of converting the color gamut of content data is controlled on the basis of a user-specified condition specified by a user, and the color gamut of the content data is converted. Then, the content data, the color gamut of which has been converted, or the content data, the color gamut of which has not been converted, is recorded on a recording medium.

In another embodiment of the present invention, content data recorded on a recording medium is read, and the conversion state of the color gamut of the read content data is checked. If it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device at a subsequent stage, a method of converting the color gamut of the content data is controlled on the basis of information relating to the output device, and the color gamut of the content data is converted.

In still another embodiment of the present invention, the conversion state of the color gamut of content data is checked. If it is confirmed that the color gamut of the content data has not been converted into the color gamut of an output device, a method of converting the color gamut of the content data is controlled on the basis of information relating to a reproduction device at a previous stage. Then, the color gamut of the content data is converted into the color gamut of the output device, and the content data having the color gamut of the output device is output.

According to the embodiments of the present invention, the color gamut of content data can be compressed. Particularly, even when content data is handled by a plurality of device, more reliable and appropriate compression of the color gamut of the content data can be performed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a configuration example of an information processing system to which an embodiment of the present invention is applied;

FIG. **2** is a schematic diagram illustrating a detailed configuration example of a recording device;

FIG. **3** is a schematic diagram illustrating a detailed configuration example of a reproduction device;

FIG. **4** is a schematic diagram illustrating a detailed configuration example of an output device;

FIG. **5** is a flowchart for explaining an example of the flow of recording control processing;

FIG. **6** is a flowchart for explaining another example of the flow of recording control processing;

FIG. **7** is a flowchart for explaining an example of the flow of reproduction determination processing;

FIG. **8** is a flowchart for explaining an example of the flow of reproduction control processing;

FIG. **9** is a flowchart for explaining an example of the flow of output control processing;

FIG. **10** is a flowchart for explaining another example of the flow of reproduction control processing;

FIG. **11** is a flowchart for explaining another example of the flow of output control processing;

FIG. **12** is a flowchart for explaining still another example of the flow of reproduction control processing;

FIG. **13** is a flowchart for explaining still another example of the flow of output control processing;

FIG. **14** is a schematic diagram illustrating another configuration example of the reproduction device;

FIG. **15** is a schematic diagram illustrating another configuration example of the output device;

FIG. **16** is a flowchart for explaining still another example of the flow of output control processing;

FIG. **17** is a flowchart for explaining still another example of the flow of reproduction control processing;

FIG. **18** is a flowchart for explaining still another example of the flow of output control processing;

FIG. **19** is a flowchart for explaining still another example of the flow of reproduction control processing;

FIG. **20** is a block diagram illustrating a more specific example of an information processing system to which an embodiment of the present invention is applied;

FIGS. **21**A and **21**B are schematic diagrams illustrating an example of xy chromaticity information of DCI-P3;

FIGS. **22**A to **22**E are schematic diagrams illustrating an example of a Cusp table;

FIGS. **23**A and **23**B are schematic diagrams illustrating an example of xy chromaticity information of BT709;

FIGS. **24**A to **24**E are schematic diagrams illustrating an example of a Cusp table; and

FIG. **25** is a block diagram illustrating a configuration example of a personal computer to which an embodiment of the present invention is applied.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** is a block diagram illustrating a configuration example of major components of an information processing system to which an embodiment of the present invention is applied.

An information processing system **100** illustrated in FIG. **1** performs a variety of processing relating to content data (image data), such as the generation of the image data through an imaging operation (or the acquisition of the image data from outside the system), the recording on a recording medium of the image data as the content data, the reading (reproduction) of the image data from the recording medium, and the display (output) of the image of the reproduced image data. Further, along with the above processing, the information processing system **100** performs more reliable and appropriate compression of the color gamut of the image data as the content data.

For convenience of explanation, the following description will be made of an example in which the color gamut is compressed. Although the color gamut can also be expanded, of course, by a similar method, description thereof will be omitted. That is, the processing relating to the color gamut compression described below can be understood to relate to "color gamut conversion" including both color gamut compression and color gamut expansion.

The information processing system **100** includes a recording device **101**, a reproduction device **102**, and an output device **103**.

The recording device **101** records, on an optical disk **110** serving as a recording medium, the image data obtained through the imaging operation or acquired from outside the system. In this process, the recording device **101** controls, for example, whether or not the color gamut of the image data should be compressed, and if so, how the compression should be performed.

The reproduction device **102** reads the image data recorded on the optical disk **110**, and supplies the image data to the output device **103** via a bus **123**. In this process, the reproduction device **102** controls, for example, whether or not the color gamut of the image data should be compressed, and if so, which one of the reproduction device **102** and the output device **103** should perform the compression.

The output device **103** displays the image of the image data supplied by the reproduction device **102** via the bus **123**. In this process, in accordance with the control of the reproduction device **102**, the output device **103** controls, for example, whether or not the color gamut compression should be performed.

The optical disk **110** is a writable (recordable or rewritable) recording medium. Examples of the optical disk **110** include a CD-R (Compact Disc-Recordable), a CD-RW (Compact Disc-Rewritable), a DVD±R (Digital Versatile Disc±Recordable), a DVD±RW (Digital Versatile Disc±Rewritable), a DVD±RAM (Digital Versatile Disc-Random Access Memory), a BD-R (Blu-ray Disc-Recordable), and a BD-RE (Blu-ray Disc-Rewritable), for instance. Optical disks (recording media) other than the ones according to the above standards can also be used, of course, if compatible with the recording device **101** and the reproduction device **102**.

FIG. **2** is a block diagram illustrating a detailed configuration example of the recording device **101**. As illustrated in FIG. **2**, the recording device **101** includes an imaging unit **151**, a user specification receiving unit **152**, a color gamut compression control unit **153**, a color gamut compression processing unit **154**, and a recording unit **155**. The imaging unit **151** captures an image of a subject on the basis of a user specification received by the user specification receiving unit **152**, generates the image data of the image, and supplies the image data to the color gamut compression control unit **153**.

The color gamut compression control unit **153** selects the most suitable color gamut compression method on the basis of the user specification. On the basis of the control of the color gamut compression control unit **153** (in accordance with the selected method), the color gamut compression processing unit **154** compresses the color gamut of the image data, and generates color gamut metadata representing the compressed color gamut. An arrow directed from the color gamut compression control unit **153** to the recording unit **155** indicates a processing flow in a configuration example in which the recording device **101** does not include the color gamut compression processing unit **154**.

The recording unit **155** records, on the optical disk **110**, the image data (and the color gamut metadata thereof, if the color gamut metadata has been generated) supplied by the color gamut compression processing unit **154** or the image data supplied by the color gamut compression control unit **153**, as the content data.

FIG. **3** is a block diagram illustrating a detailed configuration example of the reproduction device **102**. As illustrated in FIG. **3**, the reproduction device **102** includes a reproduction unit **201**, a color gamut compression control unit **202**, a color gamut compression processing unit **203**, and a communication unit **204**. The reproduction unit **201** reads the content data (the image data, and the color gamut metadata if attached to the image data) recorded on the optical disk **110**, and supplies the content data to a compression state checking unit **211** of the color gamut compression control unit **202**.

The color gamut compression control unit **202** controls processing relating to color gamut compression of the image data (and the color gamut metadata) read by the reproduction unit **201**. For example, the color gamut compression control unit **202** selects, for example, whether or not further color gamut compression should be performed on the read image data, and if so, which one of the reproduction device **102** and the output device **103** at a subsequent stage should perform the color gamut compression. The color gamut compression control unit **202** includes the compression state checking unit **211**, an information exchange unit **212**, and a determination unit **213**. With reference to the color gamut of the image data read from the optical disk **100**, the compression state checking unit **211** checks the color gamut compression state, such as whether or not the color gamut has already been compressed. The information exchange unit **212** communicates with the output device **103** via the communication unit **204** to exchange information relating to the color gamut compression. The determination unit **213** makes a determination on the color gamut compression on the basis of the information acquired from the compression state checking unit **211** and the information exchange unit **212**.

The color gamut compression processing unit **203** performs the color gamut compression in accordance with the control of the color gamut compression control unit **202**. An arrow directed from the determination unit **213** of the color gamut compression control unit **202** to the communication unit **204** indicates a processing flow in a configuration example in which the reproduction device **102** does not include the color gamut compression processing unit **203**.

The communication unit **204** communicates with the output device **103** to exchange the information relating to the color gamut compression and supply the image data (and the color gamut metadata) to the output device **103**.

FIG. **4** is a block diagram illustrating a detailed configuration example of the output device **103**. As illustrated in FIG. **4**, the output device **103** includes a communication unit **251**, an information supply unit **252**, a color gamut compression processing unit **253**, and an output unit **254**. The communication unit **251** communicates with the reproduction device **102** to exchange the information relating to the color gamut compression and acquire the image data (and the color gamut metadata) from the reproduction device **102**.

The information supply unit **252** supplies the information relating to the color gamut compression to the reproduction device **102** via the communication unit **251**. The color gamut compression processing unit **253** compresses the color gamut of the image data supplied via the communication unit **251**. An arrow directed from the communication unit **251** to the output unit **254** indicates a processing flow in a configuration example in which the output device **103** does not include the color gamut compression processing unit **253**.

The output unit **254** is formed by an LCD, a plasma display, or the like, and displays (outputs) the image of the image data.

In the recording of the image data on the optical disk **110**, the color gamut compression control unit **153** of the recording device **101** controls the compression of the color gamut of the image data. With reference to the flowchart of FIG. **5**, an example of the flow of recording control processing will be described.

Upon start of the recording control processing, the color gamut compression control unit **153** at Step S**101** determines whether or not the recording device **101** has a color gamut compression processing function, i.e., the color gamut compression processing unit **154**. If it is determined that the recording device **101** has the color gamut compression processing function, the color gamut compression control unit **153** proceeds the processing to Step S**102**. At Step S**102**, the color gamut compression control unit **153** determines whether or not a standard target color gamut of the information processing system **100** has been specified in the user specification received by the user specification receiving unit **152**. The standard target color gamut refers to a color gamut previously set as the standard value of a target color gamut which is the final color gamut of the image data. The color gamut compression control unit **153** determines whether or not the standard target color gamut has been specified by a user as the color gamut to be obtained after the compression. If it is determined that the standard target color gamut has been specified, the color gamut compression control unit **153** proceeds the processing to Step S**103**, and controls the color gamut compression processing unit **154** to perform regular compression with the standard target color gamut.

The regular compression refers to the compression of the color gamut of the image data into the color gamut used in the output of the image, i.e., the final color gamut. For example, the color gamut of the image in the imaging operation is sufficiently wide and substantially infinite. However, it is difficult to directly use the color gamut in the reproduction device **102** and the output device **103**. Therefore, the color gamut of the image data is compressed. Herein, the compression into the color gamut used in the output of the image by the output device **103** is referred to as the regular compression. Normally, the target color gamut in the regular compression is the standard target color gamut. Further, unnecessary reduction of the color gamut is meaningless. Therefore, the target color gamut in the regular compression is generally the narrowest color gamut. That is, the narrowest one of the color gamuts used in the information processing system **100** is the standard target color gamut.

At Step S**104**, the color gamut compression control unit **153** controls the recording unit **155** to record, on the optical disk **110**, regular compressed data obtained by the regular compression together with the color gamut metadata of the data (standard target color gamut metadata). Then, the recording control processing is ended.

Meanwhile, if it is determined at Step S**102** that the standard target color gamut has not been specified, the color gamut compression control unit **153** proceeds the processing to Step S**105** to perform preliminary compression with a preliminary target color gamut specified by the user specification received by the user specification receiving unit **152**.

The preliminary compression refers to compression other than the regular compression. In the preliminary compression, the target color gamut is normally set to be wider than the target color gamut in the regular compression. For example, the recording device **101** of FIG. **1** records the image data on the optical disk **110** irrespective of the presence or absence of the output device **103**. That is, at this stage, the recording device **101** does not know the type of color gamut of the output device **103**, and thus is unable to determine the target color gamut. Therefore, the recording device **101** is prevented from performing the regular compression. However, the original color gamut of the image data in the imaging operation is too wide for the reproduction device **102** and the output device **103**. For the sake of safety (to prevent a trouble at a subsequent stage), therefore, it is desirable to compress the color gamut of the image data into some sort of target color gamut. Therefore, the color gamut compression control unit **153** sets the preliminary target color gamut on the basis of the user specification, to thereby compress the color gamut of the image data. Such compression is referred to as the preliminary compression.

Upon completion of the preliminary compression, the color gamut compression control unit **153** at Step S**106** controls the recording unit **155** to record, on the optical disk **110**, the preliminary compressed data obtained by the preliminary compression together with the color gamut metadata of the data (preliminary target color gamut metadata). Then, the recording control processing is ended.

If it is determined at Step S**101** that the recording device **101** does not have the color gamut compression processing function (i.e., the color gamut compression processing unit **154**), the color gamut compression is prevented. Therefore, the color gamut compression control unit **153** proceeds the processing to Step S**107**, and controls the recording unit **155** to record, on the optical disk **110**, uncompressed data, the color gamut of which has not been compressed, together with recording device color gamut metadata representing the color gamut of the recording device **101**. Then, the recording control processing is ended.

As described above, the color gamut compression control unit **153** can determine the target color gamut specified by the user and control the color gamut compression processing unit **154** to compress the image data into the specified color gamut. If the color gamut compression and the target color gamut are the regular compression and the standard target color gamut, respectively, and if all of the devices in the information processing system **100** already know the standard target color gamut, the recording unit **155** at Step S**104** can record only the regular compressed data on the optical disk **110**.

In the above description of the flowchart of FIG. **5**, the selection between the regular compression and the preliminary compression is made on the basis of the target color gamut specified by the user. Alternatively, the color gamut compression control unit **153** may make the selection on the basis of a condition other than the above. For example, the color gamut compression control unit **153** may make the selection on the basis of the save file format of the image data specified by the user, as illustrated in the flowchart of FIG. **6**.

The flowchart of FIG. **6**, which corresponds to the flowchart of FIG. **5**, illustrates an example of the flow of recording control processing. At Step S**122** in FIG. **6**, the color gamut compression control unit **153** determines whether or not the save file format specified by the user specification received by the user specification receiving unit **152** is bitmap.

If the save file format is bitmap, the data is constituted by RGB. Therefore, the color gamut is basically limited to sRGB (standard RGB). The sRGB is an international standard of color space formulated by the IEC (International Electrotechnical Commission) in October 1998. The color space was set to ensure color reproducibility between different environments, such as between different PC models and different devices such as a display and a printer, and was formulated on the basis of the color gamut of the CRT display. For example, if a digital camera, a PC, a display, and a printer are all compatible with the sRGB, it is possible to match color appearances without any particular processing, when a captured image is displayed on the display or printed out. As compared with a workflow based on the ICC profile, the use of a PC is unnecessary, and the processing is substantially simple and convenient. However, the sRGB is narrower in expressible color range than other color spaces. Thus, it is difficult in the sRGB to express such colors as emerald green, dark cyan, orange, light red, and yellow. Therefore, the sRGB is unsuitable for professional use wherein photographs and graphic designs are specifically handled.

Further, in the bitmap format, the header information or the like is absent. Thus, the identity of image data is unknown in many cases, and the type of color gamut of the image data is not guaranteed (unknown). For the sake of safety, therefore, it is desirable to compress the color gamut in any case to prevent a device failure and so forth.

Therefore, if bitmap is specified by the user as the save file format, the color gamut compression control unit **153** proceeds the processing to Step S**123**, and controls the color gamut compression processing unit **154** to perform the regular compression with the sRGB. Then, at Step S**124**, the color gamut compression control unit **153** controls the recording unit **155** to record, on the optical disk **110**, the regular compressed data together with sRGB-specified metadata.

The other processes are similar to the processes in FIG. **5**, and thus description thereof will be omitted.

As described above, if the recording device **101** has the color gamut compression function, the recording device **101** performs the regular compression or the preliminary compression on the color gamut of the image data on the basis of the target color gamut or the save file format specified by the user, i.e., the user-specified condition. In this case, the recording device **101** records, on the optical disk **110**, the color gamut metadata together with the image data.

The compression state checking unit **211** checks the compression state of the image data (and the color gamut metadata) read from the optical disk **110** by the reproduction unit **201** of the reproduction device **102**. The determination unit **213** performs reproduction determination processing, as illustrated in the flowchart of FIG. **7**, to make a determination on the basis of the check result.

That is, on the basis of a variety of information such as the header information, the flag information, and the color gamut metadata of the read image data (reproduced data), the determination unit **213** at Step S**141** determines which one of the uncompressed data, the preliminary compressed data, and the regular compressed data is the reproduced data. Then, at Step S**142**, reproduction control processing according to the compression state of the color gamut is performed, and the reproduction determination processing is ended.

With reference to the flowchart of FIG. **8**, description will be first made of an example of the flow of reproduction control processing performed when the reproduced data is determined to be the uncompressed data or the preliminary compressed data, i.e., when at least one more color gamut compression process should be performed before the output of the data.

At Step S**161**, the information exchange unit **212** checks the communication with the output device **103**, and determines at Step S**162** whether or not bidirectional communication with the output device **103** is performable. If the bidirectional communication is performable, the determination unit **213** at Step S**163** determines whether or not the reproduction device **102** is capable of performing the color gamut compression, i.e., whether or not the reproduction device **102** includes the color gamut compression processing unit **203**. If the reproduction device **102** is capable of performing the color gamut compression, the information exchange unit **212** at Step S**164** contacts the output device **103** to check the color gamut compression capability of the output device **103**. Then, at Step S**165**, the information exchange unit **212** determines whether or not the output device **103** is capable of performing the color gamut compression.

If the output device **103** is not capable of performing the color gamut compression, the information exchange unit **212** accesses the output device **103** to acquire the color gamut information of the output device **103**. At Step S**167**, the color gamut compression processing unit **203** is controlled by the color gamut compression control unit **202** to perform the regular compression by using the color gamut information of the output device **103**. At Step S**168**, the communication unit **204** is controlled by the color gamut compression control unit **202** to supply the output device **103** with the regular compressed data obtained by the process of Step S**167**. In this process, the communication unit **204** supplies, as appropriate, the standard target color gamut to the output device **103**, together with the regular compressed data.

Meanwhile, if it is determined at Step S**165** that the output device **103** is capable of performing the color gamut compression, the processing proceeds to Step S**169**.

At Step S**169**, the information exchange unit **212** exchanges information with the output device **103** to check the manufacturer of the output device **103**. Then, at Step S**170**, the information exchange unit **212** determines whether or not the manufacturer of the reproduction device **102** matches the manufacturer of the output device **103**. If the manufacturers match, the reproduction device **102** already knows the color gamut of the output device **103**. Further, respective compression algorithms or the like of the two devices are mutually compatible in many cases. If the manufacturer of the output device **103** matches the manufacturer of the reproduction device **102**, therefore, direct transfer of the uncompressed data or the preliminary compressed data to the output device **103** is relatively safe.

Therefore, the communication unit **204** at Step S**171** is controlled by the color gamut compression control unit **202** to supply the uncompressed data or the preliminary compressed data to the output device **103**, together with the color gamut metadata. Meanwhile, if the manufacturer of the reproduction device **102** and the manufacturer of the output device **103** do not match, direct transfer of the image data to the output device **103** is unsafe. To perform the regular compression in the reproduction device **102**, therefore, the processing is returned to Step S**166**, and the processes at the step and the subsequent steps are repeated. That is, the regular compressed data is supplied to the output device **103**.

Further, if it is determined at Step S**163** that the reproduction device **102** is not capable of performing the color gamut compression, the determination unit **213** proceeds the processing to Step S**172**. At Step S**172**, the information exchange unit **212** checks the color gamut compression capability of the output device **103**. Then, on the basis of the check result, the determination unit **213** at Step S**173** determines whether or not the output device **103** is capable of performing the color gamut compression. If the output device **103** is capable of performing the color gamut compression, the processing is returned to Step S**171** to have the output device **103** perform the regular compression. If the output device **103** is neither capable of performing the color gamut compression, the processing proceeds to Step S**174**.

Further, if it is determined at Step S**162** that the bidirectional communication with the output device **103** is unperformable, the determination unit **213** proceeds the processing to Step S**174**. At Step S**174**, the color gamut compression control unit **202** causes the respective units to perform an error handling process, and the reproduction control processing is ended. That is, in this case, the output of the image data is cancelled due to the inability of both the reproduction device **102** and the output device **103** to perform the color gamut compression or the inability of the reproduction device **102** and the output device **103** to perform the bidirectional communication therebetween (to exchange the information used in the color gamut compression).

As described above, the reproduction device **102** controls the color gamut compression performed by the reproduction device **102** and the output device **103**, on the basis of the availability or unavailability of the bidirectional communication, the presence or absence of the color gamut compression capability, the manufacturer of the devices, and so forth. In this case, the reproduction device **102** takes the initiative in performing the control. In accordance with the control, therefore, the output device **103** performs output control processing, as illustrated in the flowchart of FIG. **9**, to respond to a request from the reproduction device **102**.

That is, the communication unit **251** at Step S**191** checks the communication with the reproduction device **102**, and determines at Step S**192** whether or not bidirectional communication is performable. If it is determined that the bidirectional communication is performable, the communication unit **251** proceeds the processing to Step S**193**.

At Step S**193**, the information supply unit **252** determines whether or not the color gamut compression capability has been checked by the reproduction device **102**. If it is determined via the communication unit **251** that the color gamut compression capability has been checked, the information supply unit **252** at Step S**194** notifies, via the communication unit **251**, the reproduction device **102** of the color gamut compression capability. Meanwhile, if it is determined at Step S**193** that the color gamut compression capability has not been checked, the information supply unit **252** omits the process of Step S**194**.

At Step S**195**, the information supply unit **252** determines whether or not the color gamut information of the output device **103** has been requested by the reproduction device **102**. If it is determined that the color gamut information has been requested, the information supply unit **252** at Step S**196** supplies, via the communication unit **251**, the reproduction device **102** with the color gamut information representing the color gamut of the output device **103**. Meanwhile, if it is determined at Step S**195** that the color gamut information has not been requested, the information supply unit **252** omits the process of Step S**196**.

At Step S**197**, the communication unit **251** determines whether or not the regular compressed data has been supplied by the reproduction device **102**. If it is determined that the regular compressed data has been supplied, the communication unit **251** at Step S**198** acquires and supplies the regular compressed data to the output unit **254**. Meanwhile, if it is determined at Step S**197** that the regular compressed data has been supplied, the communication unit **251** omits the process of Step S**198**.

At Step S**199**, the information supply unit **252** determines whether or not the manufacturer has been checked by the reproduction device **102**. If it is determined via the communication unit **251** that the manufacturer has been checked, the information supply unit **252** at Step S**200** notifies, via the communication unit **251**, the reproduction device **102** of the manufacturer (maker). Meanwhile, if it is determined at Step S**199** that the manufacturer has not been checked, the information supply unit **252** omits the process of Step S**200**.

At Step S**201**, the communication unit **251** determines whether or not the uncompressed data or the preliminary compressed data has been supplied by the reproduction device **102** together with the color gamut metadata of the data. If it is determined that the uncompressed data or the preliminary compressed data has been supplied, the communication unit **251** at Step S**202** acquires the respective data items. Then, at Step S**203**, the regular compression of the image data is performed with the color gamut information of the output device **103**, and the regular compressed data is supplied to the output unit **254**. Meanwhile, if it is determined at Step S**201** that the uncompressed data or the preliminary compressed data has not been supplied, the communication unit **251** omits the processes of Steps S**202** and S**203**.

At Step S**204**, the information supply unit **252** determines whether or not the output control processing should be ended. If it is determined that the output control processing should not be ended, the processing is returned to Step S**193** to repeat the processes at the step and the subsequent steps. Meanwhile, if is determined at Step S**204** that the output control processing should be ended, the processing proceeds to Step S**205**. At Step S**205**, the output unit **254** outputs the regular compressed data (or the image thereof), and the output control processing is ended. Further, if it is determined at Step S**192** that the bidirectional communication is unperformable, the information supply unit **252** proceeds the processing to Step S**205** to output the regular compressed data, and the output control processing is ended.

As described above, with the control performed in accordance with the variety of conditions, the reproduction device **102** and the output device **103** can perform more reliable and appropriate compression of the color gamut of content data, even when the content data is handled by a plurality of devices.

In the above description, if the reproduction device **102** and the output device **103** are both capable of performing the color gamut compression, which one of the reproduction device **102** and the output device **103** should perform the color gamut compression is controlled on the basis of the respective manufacturers of the reproduction device **102** and the output device **103**. However, the configuration is not limited thereto. Thus, which one of the two devices should perform the color gamut compression may be controlled on the basis of another condition. For example, as illustrated in the flowchart of FIG. **10**, the control may be performed in accordance with the relationship between the respective color gamut compression algorithms of the devices. FIG. **10** is a flowchart corresponding to the flowchart of FIG. **8**. Therefore, the respective processes of Steps S**221** to S**234** in FIG. **10** are performed basically similarly to the respective processes of Steps S**161** to S**174** in FIG. **8**.

As illustrated in FIG. **10**, the information exchange unit **212** at Step S**229** checks the color gamut compression algorithm of the output device **103**. Then, at Step S**230**, the determination unit **213** determines whether or not the version of the color gamut compression algorithm of the reproduction device **102** is superior to (newer than) the version of the color gamut compression algorithm of the output device **103**. If it is determined that the version of the reproduction device **102** is superior, the determination unit **213** returns the processing to Step S**226** to perform the respective processes of Steps S**226** to S**228** similarly to the respective processes of Steps S**166** to S**168** (FIG. **8**). Thereby, the color gamut compression processing unit **203** is controlled to perform the regular compression of the image data in the reproduction device **102**.

Meanwhile, if it is determined at Step S**230** that the version of the output device **103** is superior, the determination unit **213** proceeds the processing to Step S**231** to supply the uncompressed data or the preliminary compressed data to the output device **103** together with the color gamut metadata of the data, similarly as in Step S**171** (FIG. **8**). Thereby, the output device **103** is caused to perform the regular compression process.

Output control processing in response to the above processing is performed as illustrated in the flowchart of FIG. **11**. FIG. **11** is a flowchart corresponding to the flowchart of FIG. **9**. Therefore, the respective processes of Steps S**251** to S**265** in FIG. **11** are performed basically similarly to the respective processes of Steps S**191** to S**205** in FIG. **9**.

However, as illustrated in FIG. **11**, the information supply unit **252** performs Steps S**259** and S**260** instead of Steps S**199** and S**200**. At Step S**259**, the information supply unit **252** determines whether or not the color gamut compression algorithm has been checked by the reproduction device **102**. If it is determined that the color gamut compression algorithm has been checked, the information supply unit **252** at Step S**260** supplies, via the communication unit **251**, color gamut compression algorithm information to the reproduction device **102**. If it is determined at Step S**259** that the color gamut compression algorithm has not been checked, the information supply unit **252** omits the process of Step S**260**.

As described above, the reproduction device **102** and the output device **103** can control which one thereof should perform the color gamut compression, on the basis of the color gamut compression algorithm version information thereof. Therefore, the reproduction device **102** and the output device **103** can perform more reliable and appropriate compression of the color gamut of content data, even when the content data is handled by a plurality of devices.

If it is determined by the determination processing of FIG. **7** that the regular compression has been performed by the recording device **101**, the reproduction device **102** and the output device **103** directly exchange the regular compressed data. That is, as illustrated in the flowchart of FIG. **12**, the color gamut compression control unit **202** controls the communication unit **204** to supply the regular compressed data to the output device **103**. In response to this processing, the communication unit **251** of the output device **103** acquires the regular compressed data at Step S**301**, as illustrated in the flowchart of FIG. **13**. Further, at Step S**302**, the output unit **254** outputs the regular compressed data.

As described above, the recording device **101**, the reproduction device **102**, and the output device **103** control the color gamut compression on the basis of the variety of conditions, and thus can perform more reliable and appropriate compression of the color gamut of content data.

In the above description, the reproduction device **102** takes the initiative in controlling the color gamut compression by the reproduction device **102** and the output device **103**. Alternatively, the output device **103** may take the initiative in performing the control. In this case, the reproduction device **102** responds to a request from the output device **103**. That is, the reproduction device **102** and the output device **103** replace each other in the configuration and the processing described above.

FIG. **14** is a block diagram illustrating a configuration example of the reproduction device **102** in this case. As illustrated in FIG. **14**, the reproduction device **102** in this case includes an information supply unit **402** in place of the color gamut compression control unit **202**. The information supply unit **402**, which is similar to the information supply unit **252** in FIG. **4**, supplies, via a communication unit (the communication unit **204** in this case), the information of a device including the information supply unit **402** (the reproduction device **102** in this case) to the other device (the output device **103** in this case) on the basis of a request from the other device (the output device **103** in this case).

FIG. **15** is a block diagram illustrating a configuration example of the output device **103** in this case. As illustrated in FIG. **15**, the output device **103** in this case includes a color gamut compression control unit **452** in place of the information supply unit **252**. The color gamut compression control unit **452** performs the color gamut compression control processing similarly to the color gamut compression control unit **202** in FIG. **3**. However, the color gamut compression control unit **452** performs the color gamut compression control processing from the side of the output device **103**. The color gamut compression control unit **452** includes a compression state checking unit **461**, an information exchange unit **462**, and a determination unit **463**, which correspond to the compression state checking unit **211**, the information exchange unit **212**, and the determination unit **213**, respectively. The color gamut compression control unit **452** and the color gamut compression control unit **202** are basically similar except that the device including the color gamut compression control unit **452** is the output device **103** while the device including the color gamut compression control unit **202** is the reproduction device **102**.

In this case, as illustrated in the flowchart of FIG. **16**, output control processing performed by the output device **103** when the regular compression has not been performed by the recording device **101** is performed similarly to the reproduction control processing described with reference to the flowchart of FIG. **8**. The present output control processing and the reproduction control processing of FIG. **8** are performed basically similarly except for the difference between the output device **103** and the reproduction device **102** as the device performing the control processing. That is, Steps S**401** to S**414** of FIG. **16** are performed similarly to Steps S**161** to S**174** of FIG. **8**.

However, if it is determined at Step **405** that the output device **103** is not capable of performing the color gamut compression, i.e., if it is determined that only the reproduction device **102** is capable of performing the color gamut compression, the information exchange unit **462** at Step S**406** supplies the color gamut information of the output device **103** to the reproduction device **102**, to thereby have the reproduction device **102** perform the regular compression. Then, at Step S**407**, the communication unit **251** acquires the regular compressed data obtained by the regular compression, and the output unit **254** at Step S**408** outputs the regular compressed data.

Further, if it is determined at Step S**410** that the manufacturer of the reproduction device **102** matches the manufacturer of the output device **103**, the communication unit **251** at Step S**411** acquires the uncompressed data or the preliminary compressed data together with the color gamut metadata of the data. Then, at Step S**412**, the color gamut compression processing unit **253** performs the regular compression.

Further, if it is determined at Step S**404** that the reproduction device **102** is not capable of performing the color gamut compression, the processing proceeds to Step S**413**, and the determination unit **463** determines whether or not the output device **103** is capable of performing the color gamut compression.

Reproduction control processing by the reproduction device **102** in response to the above processing is performed as illustrated in the flowchart of FIG. **17**. This processing is performed basically in response to a request from the output device **103**. The processing is performed basically similarly to the output control processing described with reference to the flowchart of FIG. **9** except that the device performing the processing is not the output device **103** but the reproduction device **102**. That is, the respective processes of Steps S**431** to **442** are performed similarly to the respective processes of Steps S**191** to **205**.

However, unlike the example of FIG. **9**, the output device **103** does not use the color gamut of the reproduction device **102**. Therefore, the reproduction device **102** is not requested to supply the color gamut information. Further, the reproduction device **102** does not acquire but supplies the uncompressed data or the preliminary compressed data and the color gamut metadata of the data in accordance with a request from the output device **103** (Steps S**440** and S**441**). Further, the reproduction device **102** performs the regular compression on the basis of a request from the output device **103**, and supplies the regular compressed data to the output device **103** (Steps S**437** to S**439**).

Similarly as in the example in which the reproduction device **102** takes the initiative, the color gamut compression algorithm version may, of course, be used instead of the manufacturer in the determination processing. The flow of output control processing in this case is as illustrated in the flowchart of FIG. **18**. That is, except for the processes of Steps S**469** and S**470**, the respective processes of Steps S**461** to S**474** are performed similarly to the respective processes of Steps S**401** to S**414** in FIG. **16**. Further, Steps S**469** and S**470** are performed basically similarly to Steps S**229** and S**230** in FIG. **10** except for the difference in the device performing the processing, and thus description thereof will be omitted.

FIG. **19** is a flowchart for explaining an example of the flow of reproduction control processing in response to the output control processing of FIG. **18**. As illustrated in FIG. **19**, the reproduction control processing in this case is performed basically similarly to the example of FIG. **17**. That is, the respective processes of Steps S**491** to S**502** in FIG. **19** are performed similarly to the respective processes of Steps S**431** to S**442** in FIG. **17**. In the example of FIG. **19**, however, the respective processes of Steps S**495** and S**496** are performed instead of the respective processes of Steps S**435** and S**436** in FIG. **17**. The processes of Steps S**495** and S**496** are basically similar to the processes of Steps S**259** and S**260** in FIG. **11**, and thus description thereof will be omitted.

As described above, also when the output device **103** takes the initiative in performing the control of the color gamut compression by the reproduction device **102** and the output device **103**, the recording device **101**, the reproduction device **102**, and the output device **103** control the color gamut compression on the basis of the variety of conditions, and thus can perform more reliable and appropriate compression of the color gamut of content data.

Subsequently, a more specific example of the system will be described. In recording on a tape, an information processing system **500** illustrated in FIG. **20** compresses the color gamut of a moving image captured by a video camera **501** into digital cinema color space according to the DCI (Digital Cinema Initiatives) specification. Thereafter, the video camera **501** is connected to a TV (Television) **502** by an HDMI (High-Definition Multimedia Interface) **503** to obtain the color gamut information of the TV **502**. In a reproduction process, the video camera **501** displays the moving image with the color gamut compressed into the color gamut of the TV **502**.

In this embodiment, the video camera **501** corresponds to a device **130** having the functions of both the recording device **101** and the reproduction device **102** illustrated in FIG. **1**. The TV **502** corresponds to the output device **103**. The connection state is assumed to be such that the video camera **501** and the TV **502** are connected by the HDMI **503**, as illustrated in FIG. **20**.

It is now assumed that the moving image captured by the video camera **501** is recorded in luminance and color-difference signal space called xvYCC color space. The xvYCC is color space for the recording of a moving image, which was established by the IEC (International Electrotechnical Commission) in 2006 and defined as an international standard IEC 61966-2-4 Ed. 1.0. The xvYCC enables the recording of 95% or more of colors perceivable by humans, and has a sufficient color gamut for the recording of colors detectable by a consumer video camera. In the present embodiment, the recorded picture content data corresponds to the moving image, and the recording device color gamut information corresponds to the xvYCC.

In the recording on a tape, the first color gamut compression process is performed. A preliminary output device color gamut in this compression corresponds to the color gamut of the digital cinema color space according to the DCI specification (DCI-P3). The chromaticity information of DCI-P3 is as shown in a graph of FIG. **21**A and Table **511** of FIG. **21**B. DCI is a consolidated company founded by seven major motion picture studios in Hollywood in March 2002 to determine digital cinema specifications, and is an organization determining industry-standard formats for supplying picture content data for digital cinema. Digital Cinema System Specification Ver. 1.1 (Apr. 12, 2007) published by DCI defines DCDM (Digital Cinema Distribution Master), which is a format for saving digital cinema picture content data. The DCDM, which is also called DTIM (Digital Theater Interim Master), was originally defined by SMPTE (Society of Motion Picture and Television Engineers) in US. DCI adopts the color gamut of the DCDM as the color gamut of a reference projector. The color gamut of DCI-P3 expressed in the xvYCC space can be represented by the values of Cusp table **521** in FIG. **22**C. With the use of this Cusp table as the preliminary output device color gamut information, the color gamut of the moving image is compressed into the digital cinema color space in accordance with a predetermined color gamut compression method. A picture signal representing the compression result is recorded in the DCDM format. The color space of the DCDM format can be defined as DCI-P3. Therefore, the present picture content data is practically attached with DCI-P3 color gamut metadata. The preliminary output picture content data representing the compression result is recorded on the tape in the DCDM format.

In the reproduction of the preliminary output picture content data recorded on the tape, the video camera **501** first acquires the color gamut information of the TV **502** via the HDMI **503**. In this case, in the negotiation at the time of connection, connection information using EDID (Extended Display Identification Data) is exchanged. If the information of a color gamut B, which is the color gamut information of the TV **502**, is written in the EDID in this process, the video camera **501** can acquire the color gamut information of the TV **502** at the time of connection to the TV **502**. It is now assumed that the color gamut of the TV **502** is B709. The chromaticity information of B709 is as shown in Table **531** of FIG. **23**B. With the use of the Cusp table, therefore, the color gamut of the TV **502** can be represented by Table **541** of FIG. **24**C. The data of hues at two-degree intervals shown in FIG. **24**C is written in the EDID as the output device color gamut metadata, and is transmitted to the video camera **501** via the HDMI **503**. Then, the second color gamut compression process is performed in the reproduction process. The compression is performed in accordance with a predetermined color gamut compression method and with the use of the color gamut of DCI-P3 shown in FIGS. **22**A to **22**E as the preliminary output device color gamut and the color gamut of the TV **502** shown in FIGS. **24**A to **24**E as the output device color gamut. The final output picture content data having the TV color gamut and representing the compression result is transmitted to the TV **502** via the HDMI **503**. The TV **502** displays thereon the transmitted final output picture content data.

The series of processing described above can be performed both by hardware and software. In this case, the series of processing may be configured as a personal computer illustrated in FIG. **25**, for example.

In FIG. **25**, a CPU (Central Processing Unit) **601** of a personal computer **600** performs a variety of processing in accordance with programs stored in a ROM (Read-Only Memory) **602** or loaded from a storage unit **613** onto a RAM (Random Access Memory) **603**. The RAM **603** also stores, as appropriate, data used in the variety of processing performed by the CPU **601**.

The CPU **601**, the ROM **602**, and the RAM **603** are mutually connected via a bus **604**. The bus **604** is also connected to an input and output interface **610**.

The input and output interface **610** is connected to an input unit **611** formed by a keyboard, a mouse, and so forth, an output unit **612** formed by a speaker, a display including a CRT (Cathode Ray Tube) display and an LCD (Liquid Crystal Display), and so forth, a storage unit **613** formed by a hard disk, and so forth, and a communication unit **614** formed by a modem, and so forth. The communication unit **614** performs communication processing via a network including the Internet.

The input and output interface **610** is further connected, as appropriate, to a drive **615**, into which a removable medium **621** such as a magnetic disk, an optical disk, a magneto-optical disk, and a semiconductor memory is inserted as appropriate. A computer program read from the removable medium **621** is installed, as appropriate, in the storage unit **613**.

To have the above-described series of processing performed by software, a program forming the software is installed from a network or a recording medium.

As illustrated in FIG. **25**, for example, the configuration of the recording medium is not limited to the removable medium **621**, such as a magnetic disk (including a flexible disk), an optical disk (including a CD-ROM or Compact Disc-Read Only Memory and a DVD or Digital Versatile Disc), a magneto-optical disk (including an MD or Mini Disc), and a semiconductor memory, which includes the program recorded thereon and is distributed to users separately from the device to deliver the program. The configuration of the recording medium also includes, for example, the ROM **602** or the hard disk included in the storage unit **613**, which includes the program recorded thereon and thus previously installed in the device to be distributed to users.

In the present specification, the steps describing the program recorded on the recording medium include not only processes performed chronologically in the described order but also processes not necessarily performed chronologically but performed concurrently or individually.

In the above description, the configuration described as one device may be divided and configured as a plurality of devices. Conversely, the configurations described above as a plurality of devices may be integrated and configured as one device. Further, the configuration of each of the devices may, of course, be added with a configuration other than the configurations described above. Further, a part of the configuration of one of the devices may be included in the configuration of another one of the devices, if the configuration and operation of the system as a whole is substantially unchanged. That is, the embodiments of the present invention are not limited to the embodiments described above, and thus the present invention can be modified in a variety of ways within the scope not departing from the gist of the present invention.

The present application contains subject matter related to that disclosed in Japanese Priority Patent Application JP 2008-169153 filed in the Japan Patent Office on Jun. 27, 2008, the entire content of which is hereby incorporated by reference.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A recording system comprising:

a recording device including

circuitry configured to

select a method of compressing a color gamut of content data based on a user-specified condition indicating a target color gamut, the selected method being a regular compression method requiring no further compression by a reproduction device or an output device when the user-specified condition is entered and the selected method being a preliminary compression method requiring further compression by the reproduction or the output device when the user-specified condition is not entered;

compress the color gamut of the content data in accordance with the selected method of compressing the color gamut to generate a compressed color gamut; and

record, on a recording medium, the content data and the compressed color gamut as color gamut metadata, the color gamut metadata indicating whether the color gamut of the content data was compressed with the regular compression method or the preliminary compression method, wherein

the recording device is separate from and connected to at least one of the reproduction device and the output device, and

the user-specified condition is a standard target color gamut; and the reproduction device including

circuitry configured to

read the content data and the color gamut metadata recorded on the recording medium, the color gamut metadata indicating whether the color gamut of the content data was compressed by the recording device with the regular compression method requiring no further compression by the reproduction device or the output device or the preliminary compression method requiring further compression by the reproduction device or the output device;

determine whether the content data was compressed with the preliminary compression method, and, when the content data was compressed with the preliminary compression method,

determine whether bidirectional communication with the output device is possible and, when the bidirectional communication is possible, use the bidirectional communication to determine a compression capability of the output device;

select a method of further compressing the color gamut of the content data based on the color gamut metadata and the compression capability of the output device, the selected method being one of further compressing the color gamut in the reproduction device and further compressing the color gamut in the output device; and

if the selected method is further compressing the color gamut in the reproduction device, compress the color gamut of the content data using the regular compression method, wherein

the reproduction device is separate from and connected to the output device.

2. The recording system according to claim **1**, wherein the circuitry of the recording device performs the control such that the color gamut of the content data is compressed into a color gamut specified by the user.

3. The recording system according to claim **1**, wherein the circuitry of the recording device performs the control such that the color gamut of the content data is compressed into a color gamut corresponding to a file format specified by the user.

4. A reproduction device comprising:

circuitry configured to

read content data and color gamut metadata recorded on a recording medium, the color gamut metadata indicating whether a color gamut of the content data was compressed by a recording device with a regular compression method requiring no further compression by the reproduction device or an output device or a preliminary compression method requiring further compression by the reproduction device or the output device;

determine whether the content data was compressed with the preliminary compression method, and, when the content data was compressed with the preliminary compression method,

determine whether bidirectional communication with an output device is possible and, when the bidirectional communication is possible, use the bidirectional communication to determine a compression capability of the output device;

select a method of further compressing the color gamut of the content data based on the color gamut metadata and the compression capability of the output device, the selected method being one of further compressing the color gamut in the reproduction device and further compressing the color gamut in the output device; and

if the selected method is further compressing the color gamut in the reproduction device, compress the color gamut of the content data using the regular compression method, wherein

the reproduction device is separate from and connected to the output device.

5. The reproduction device according to claim **4**, wherein the circuitry selects the method of compressing the color gamut of the content data, in accordance with whether or not a manufacturer of the output device matches a manufacturer of the reproduction device.

6. The reproduction device according to claim **4**, wherein the circuitry selects the method of compressing the color gamut of the content data, in accordance with whether or not a color gamut compressing algorithm version of the output device is superior to a color gamut compression algorithm version of the reproduction device.

7. A reproduction control method comprising:

reading content data and color gamut metadata recorded on a recording medium, the color gamut metadata indicating whether a color gamut of the content data was compressed by a recording device with a regular compression method requiring no further compression by a reproduction device or an output device or a preliminary compression method requiring further compression by the reproduction device or the output device;

determining whether the content data was compressed with the preliminary compression method, and, when the content data was compressed with the preliminary compression method, determining whether bidirectional communication with an output device is possible and, when the bidirectional communication is possible, using the bidirectional communication to determine a compression capability of the output device;

selecting a method of further compressing the color gamut of the content data based on the color gamut metadata and the compression capability of the output device, the selected method being one of further compressing the color gamut in the reproduction device and further compressing the color gamut in the output device; and

if the selected method is further compressing the color gamut in the reproduction device, further compressing the color gamut of the content data using the regular compression method, wherein

the reproduction device is separate from and connected to the output device.

8. The reproduction control method according to claim **7**, wherein the selecting is performed in accordance with whether or not a manufacturer of the output device matches a manufacturer of the reproduction device.

9. The reproduction control method according to claim **7**, wherein the selecting is performed in accordance with whether or not a color gamut compressing algorithm version of the output device is superior to a color gamut compression algorithm version of the reproduction device.

10. A non-transitory computer-readable medium encoded with computer-readable instructions thereon, the computer readable instructions when executed by a computer cause the computer to perform a reproduction control method comprising:

reading content data and color gamut metadata recorded on a recording medium, the color gamut metadata indicating whether a color gamut of the content data was compressed by a recording device with a regular compression method requiring no further compression by a reproduction device or an output device or a preliminary compression method requiring further compression by the reproduction device or the output device;

determining whether the content data was compressed with the preliminary compression method, and, when the content data was compressed with the preliminary compression method,

determining whether bidirectional communication with an output device is possible and, when the bidirectional communication is possible, using the bidirectional communication to determine a compression capability of the output device;

selecting a method of further compressing the color gamut of the content data based on the color gamut metadata and the compression capability of the output device, the selected method being one of further compressing the color gamut in the reproduction device and further compressing the color gamut in the output device; and

if the selected method is further compressing the color gamut in the reproduction device, further compressing the color gamut of the content data using the regular compression method, wherein

the reproduction device is separate from and connected to the output device.

11. The non-transitory computer-readable medium according to claim **10**, wherein the selecting is performed in accordance with whether or not a manufacturer of the output device matches a manufacturer of the reproduction device.

12. The non-transitory computer-readable medium according to claim **10**, wherein the selecting is performed in accordance with whether or not a color gamut compressing algorithm version of the output device is superior to a color gamut compression algorithm version of the reproduction device.

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