US00RE47352E

(19) **United States**

(12) **Reissued Patent**

Sugiyama et al.

(10) **Patent Number: US RE47,352 E**

(45) **Date of Reissued Patent: Apr. 16, 2019**

(54) **ADAPTER, CAMERA SYSTEM, AND ADAPTER CONTROL PROGRAM**

(71) Applicant: **NIKON CORPORATION**, Tokyo (JP)

(72) Inventors: **Hideaki Sugiyama**, Yokohama (JP); **Fumiya Taguchi**, Tokyo (JP); **Masanori Hasuda**, Fujisawa (JP); **Masafumi Oikawa**, Tokyo (JP); **Noriaki Nakajima**, Yokohama (JP); **Shunji Nagaya**, Kamakura (JP)

(73) Assignee: **NIKON CORPORATION**, Tokyo (JP)

(21) Appl. No.: **15/184,453**

(22) Filed: **Jun. 16, 2016**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **8,755,684**
Issued: **Jun. 17, 2014**
Appl. No.: **13/553,292**
Filed: **Jul. 19, 2012**

U.S. Applications:

(60) Provisional application No. 61/589,613, filed on Jan. 23, 2012, provisional application No. 61/588,970, filed on Jan. 20, 2012.

(30) **Foreign Application Priority Data**

Jul. 22, 2011 (JP) 2011-160840
Jul. 22, 2011 (JP) 2011-160842

(51) **Int. Cl.**
G03B 7/26 (2006.01)
G03B 17/14 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G03B 17/56*** (2013.01); ***G03B 17/14*** (2013.01); ***G03B 17/565*** (2013.01); ***H04N 5/23241*** (2013.01); *G03B 2217/007* (2013.01)

(58) **Field of Classification Search**
CPC G03B 17/56; G03B 17/14; G03B 17/565; H04N 5/23241
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,758,854 A * 7/1988 Saegusa G03B 17/14 396/529
4,935,760 A * 6/1990 Kojima G03B 17/14 396/341
(Continued)

FOREIGN PATENT DOCUMENTS

CN 102111548 A 6/2011
EP 1 672 420 A1 6/2006
(Continued)

OTHER PUBLICATIONS

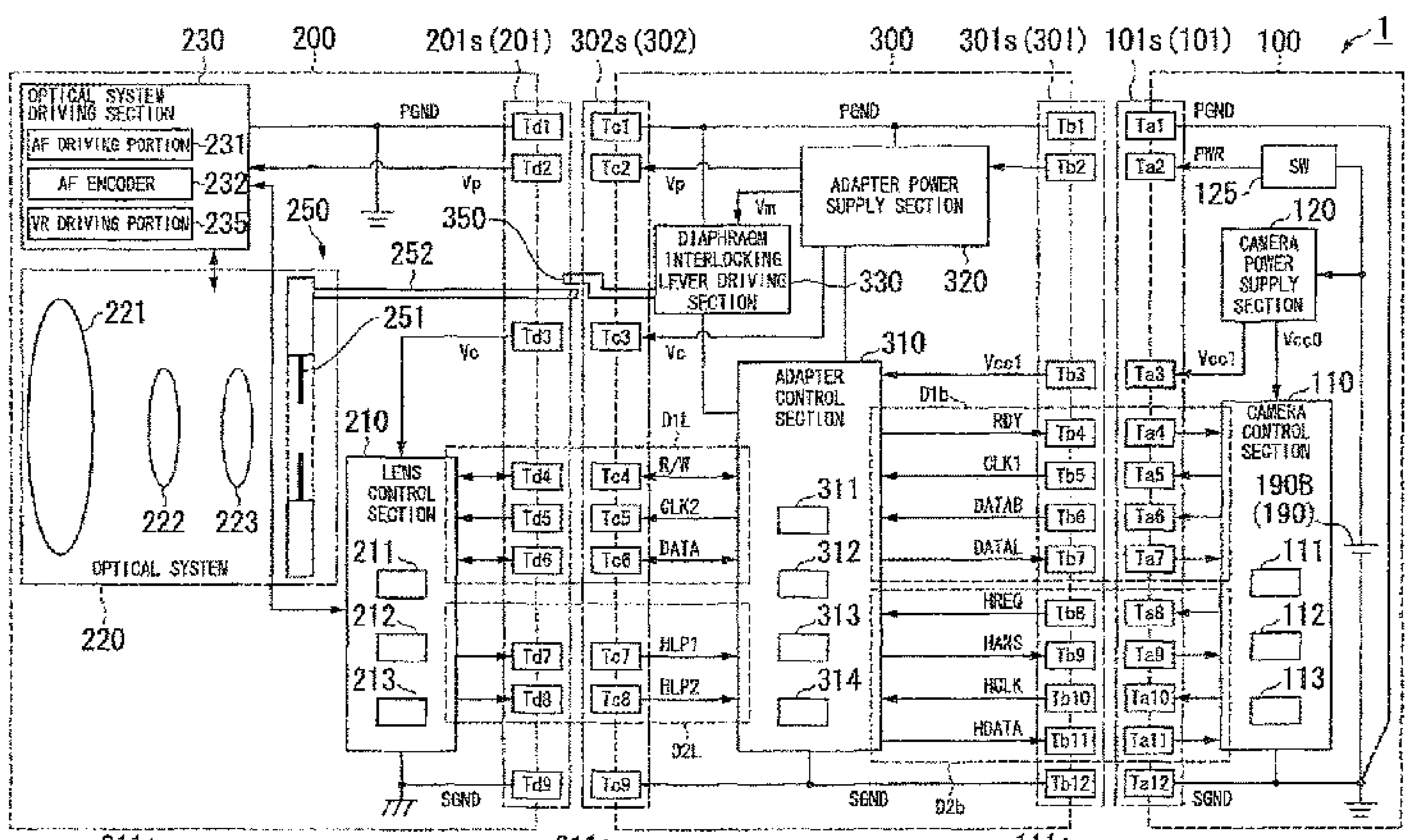
May 21, 2013 Office Action issued in Japanese Patent Application No. 2011-160840.
(Continued)

Primary Examiner — Kenneth Whittington
(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

An adapter includes: a first mount section that is detachably attached to a camera body; a second mount section that is provided separately from the first mount section and is detachably attached to an interchangeable lens; and a power supply section that generates supply voltages of a third power supply system and a fourth power supply system, which are to be fed to the interchangeable lens mounted on the second mount section, from a second power supply system between a first power supply system of the camera body, which is mounted on the first mount section, and the second power supply system which is different from the first power supply system.

52 Claims, 16 Drawing Sheets



(51) **Int. Cl.**
G03B 17/56 (2006.01)
H04N 5/232 (2006.01)

(58) **Field of Classification Search**
USPC 396/71, 529, 530, 531, 532, 541; 348/372, 373, 374, 375
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,257,058	A *	10/1993	Mabuchi	G03B 17/14	348/240.3
5,382,994	A *	1/1995	Naito et al.	G03B 7/20	396/530
5,731,920	A *	3/1998	Katsuragawa	G03B 17/14	348/383
6,041,189	A	3/2000	Izukawa		
7,522,828	B2 *	4/2009	Doi et al.	396/71	
8,545,117	B2	10/2013	Urakami et al.		
8,718,463	B2	5/2014	Kamiya et al.		
2002/0118963	A1	8/2002	Uenaka et al.		
2006/0098114	A1	5/2006	Horii		
2006/0165401	A1	7/2006	Doi et al.		
2008/0267601	A1	10/2008	Kobayashi		
2009/0269049	A1 *	10/2009	Ueda	G03B 17/14	396/529
2010/0046085	A1	2/2010	Yumiki et al.		
2010/0091175	A1	4/2010	Shintani et al.		
2011/0052185	A1	3/2011	Urakami et al.		
2011/0158629	A1	6/2011	Kamiya et al.		
2013/0077952	A1 *	3/2013	Sugiyama et al.	396/530	

FOREIGN PATENT DOCUMENTS

GB	2469332	A	10/2010
JP	A-62-187830		8/1987
JP	S62-187830	A	8/1987
JP	A-63-191136		8/1988
JP	S63-191136	A	8/1988
JP	H01-093722	A	4/1989
JP	A-05-066337		3/1993
JP	H05-66337	A	3/1993
JP	A-07-234432		9/1995
JP	H07-234432		9/1995
JP	A-07-333674		12/1995
JP	H07-333674	A	12/1995
JP	A-09-080524		3/1997
JP	H09-80524	A	3/1997
JP	A-09-230417		9/1997
JP	H09-230417	A	9/1997
JP	A-11-064957		3/1999
JP	H11-64957	A	3/1999
JP	A-11-346435		12/1999
JP	H11-346435	A	12/1999
JP	2002-258380	A	9/2002
JP	A-2002-258380		9/2002
JP	2003-195381	A	7/2003
JP	A-2003-195381		7/2003
JP	2004-117380	A	4/2004
JP	A-2004-117380		4/2004
JP	2005-031438	A	2/2005
JP	A-2005-031438		2/2005
JP	2005-115170	A	4/2005
JP	A-2005-115170		4/2005
JP	2006-135588	A	5/2006
JP	A-2006-135588		5/2006
JP	2006-215310	A	8/2006
JP	2006-319631	A	11/2006
JP	A-2006-319631		11/2006
JP	2008-092440	A	4/2008
JP	A-2008-092440		4/2008
JP	2008-216439	A	9/2008
JP	A-2008-216439		9/2008
JP	2008-233235	A	10/2008
JP	2008-275890	A	11/2008
JP	A-2008-275890		11/2008
JP	2008-294546	A	12/2008
JP	A-2008-294546		12/2008
JP	2009-093122	A	4/2009
JP	A-2009-093122		4/2009
JP	2009-186545	A	8/2009
JP	A-2009-186545		8/2009
JP	2010-050925	A	3/2010
JP	A-2010-050925		3/2010
JP	2010-226666	A	10/2010
JP	A-2010-226666		10/2010
JP	2011-053437	A	3/2011
JP	2011-107520	A	6/2011
JP	2011-112701	A	6/2011
JP	A-2011-107520		6/2011
JP	A-2011-112701		6/2011
WO	2008/099605	A1	8/2008

OTHER PUBLICATIONS

May 21, 2013 Office Action issued in Japanese Patent Application No. 2011-160842.
Oct. 22, 2013 Decision of Rejection issued in Japanese Patent Application No. 2011-160840.
Oct. 22, 2013 Decision of Rejection issued in Japanese Patent Application No. 2011-160842.
Jul. 29, 2013 Office Action issued in U.S. Appl. No. 13/553,292.
Feb. 6, 2014 Notice of Allowance issued in U.S. Appl. No. 13/553,292.
Jun. 14, 2018 Office Action issued in Indian Application No. 2277/DEL/2012.

* cited by examiner

FIG. 1

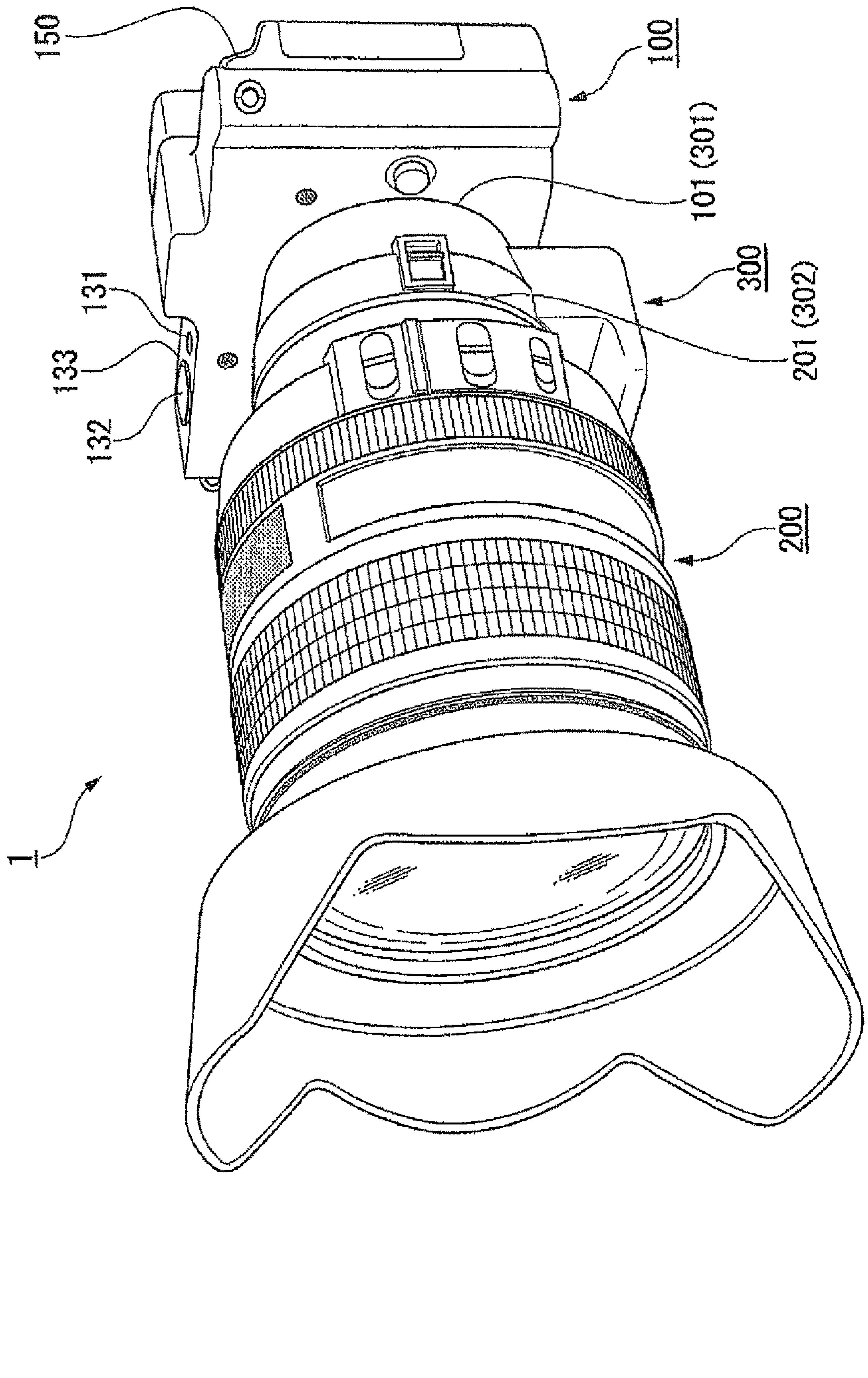


FIG. 2

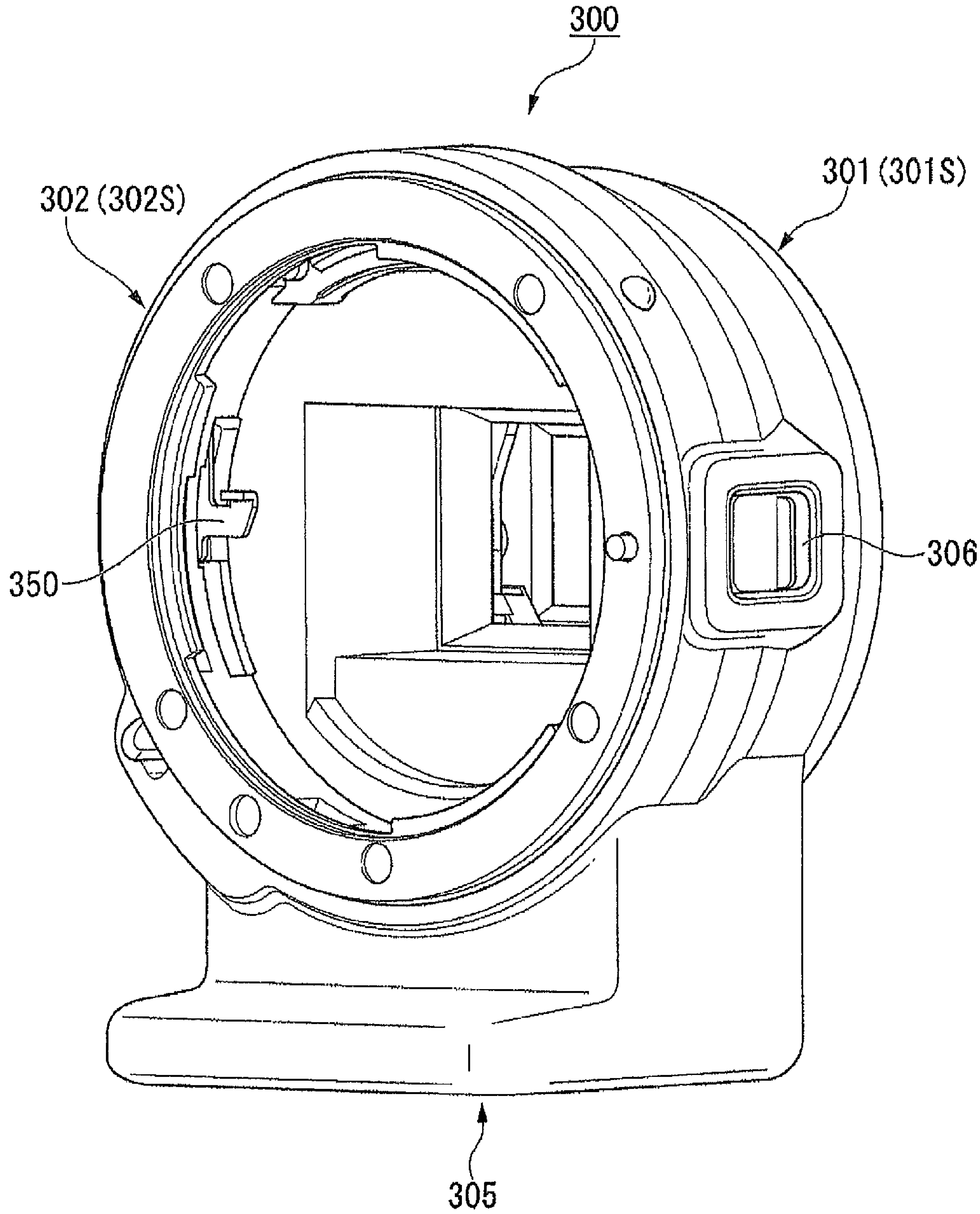
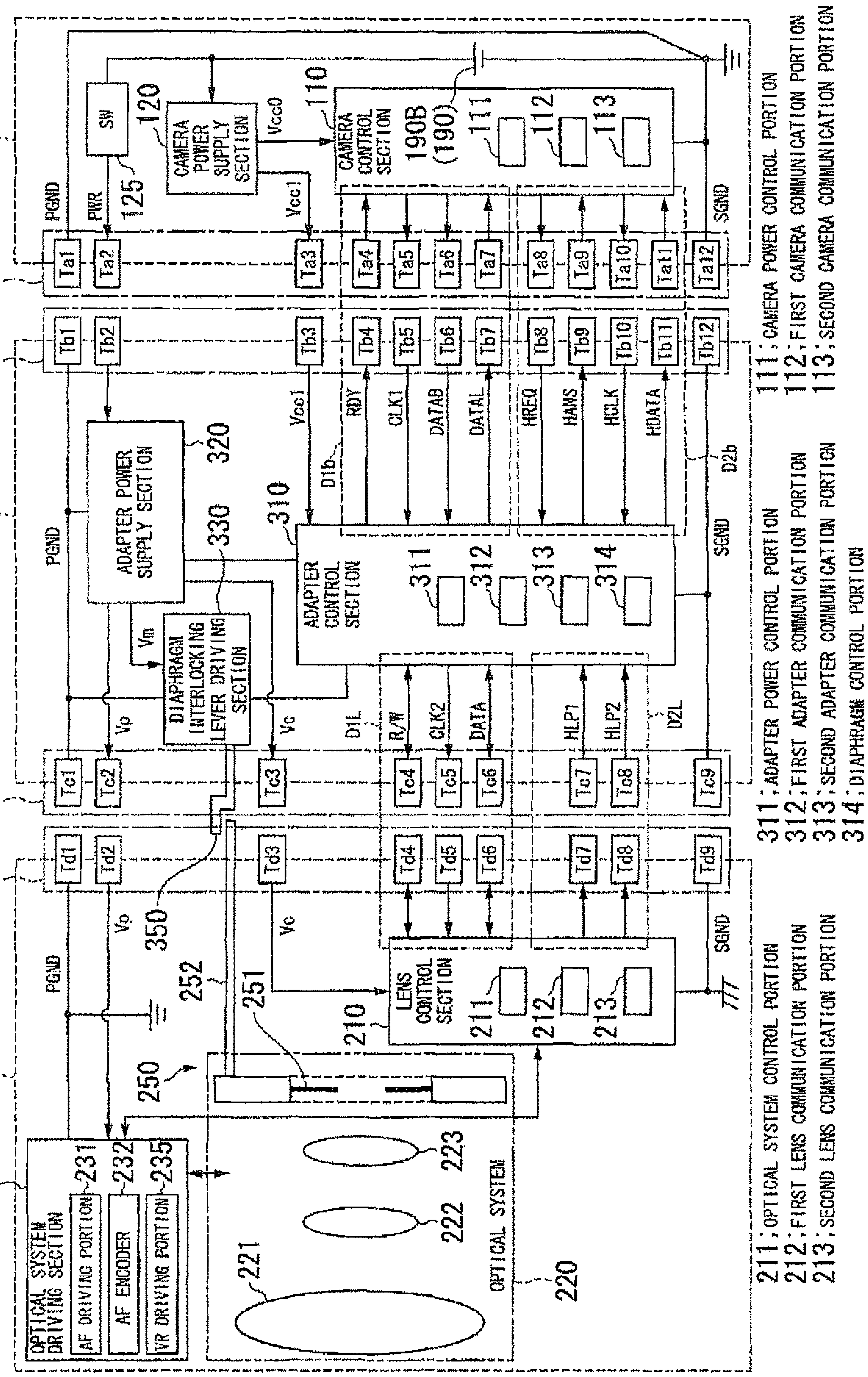


FIG. 3



1
100
101s (101)
301s (301)
300
302s (302)
201s (201)
200
230
SW
120
CAMERA POWER SUPPLY SECTION
125
PWR
PGND
Vcc0
Vcc1
110
CAMERA CONTROL SECTION
190B (190)
111
112
113
SGND
Ta1
Ta2
Ta3
Ta4
Ta5
Ta6
Ta7
Ta8
Ta9
Ta10
Ta11
Ta12
Tb1
Tb2
Tb3
Tb4
Tb5
Tb6
Tb7
Tb8
Tb9
Tb10
Tb11
Tb12
RDY
CLK1
DATAB
DATAL
HREQ
HANS
HCLK
HDATA
D1b
D2b
320
ADAPTER POWER SUPPLY SECTION
330
310
ADAPTER CONTROL SECTION
311
312
313
314
Vm
DIAPHRAGM INTERLOCKING LEVER DRIVING SECTION
Vp
Vc
D1L
R/W
CLK2
DATA
HLP1
HLP2
D2L
Tc1
Tc2
Tc3
Tc4
Tc5
Tc6
Tc7
Tc8
Tc9
Td1
Td2
Td3
Td4
Td5
Td6
Td7
Td8
Td9
350
252
251
250
210
LENS CONTROL SECTION
211
212
213
OPTICAL SYSTEM DRIVING SECTION
AF DRIVING PORTION
231
AF ENCODER
232
VR DRIVING PORTION
235
221
222
223
OPTICAL SYSTEM
220
111; CAMERA POWER CONTROL PORTION
112; FIRST CAMERA COMMUNICATION PORTION
113; SECOND CAMERA COMMUNICATION PORTION
311; ADAPTER POWER CONTROL PORTION
312; FIRST ADAPTER COMMUNICATION PORTION
313; SECOND ADAPTER COMMUNICATION PORTION
314; DIAPHRAGM CONTROL PORTION
211; OPTICAL SYSTEM CONTROL PORTION
212; FIRST LENS COMMUNICATION PORTION
213; SECOND LENS COMMUNICATION PORTION

FIG. 4

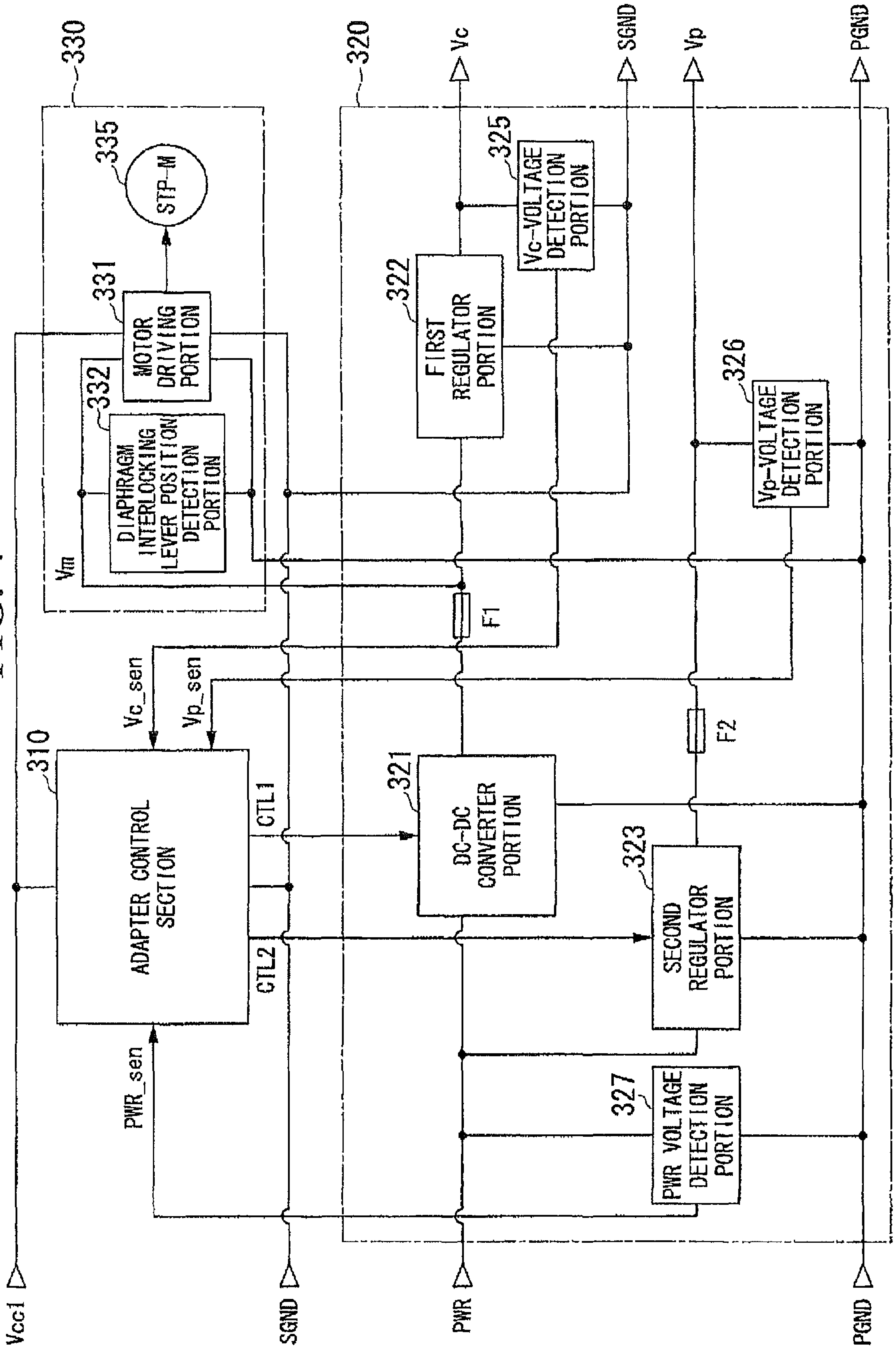

330
320
Vc
SGND
Vp
PGND
335
STP-M
325
Vc-VOLTAGE DETECTION PORTION
331
MOTOR DRIVING PORTION
322
FIRST REGULATOR PORTION
332
DIAPHRAGM INTERLOCKING LEVER POSITION DETECTION PORTION
326
Vp-VOLTAGE DETECTION PORTION
Vm
F1
Vc_sen
Vp_sen
F2
310
ADAPTER CONTROL SECTION
CTL1
CTL2
321
DC-DC CONVERTER PORTION
323
SECOND REGULATOR PORTION
PWR_sen
327
PWR VOLTAGE DETECTION PORTION
Vcc1
SGND
PWR
PGND

FIG. 5

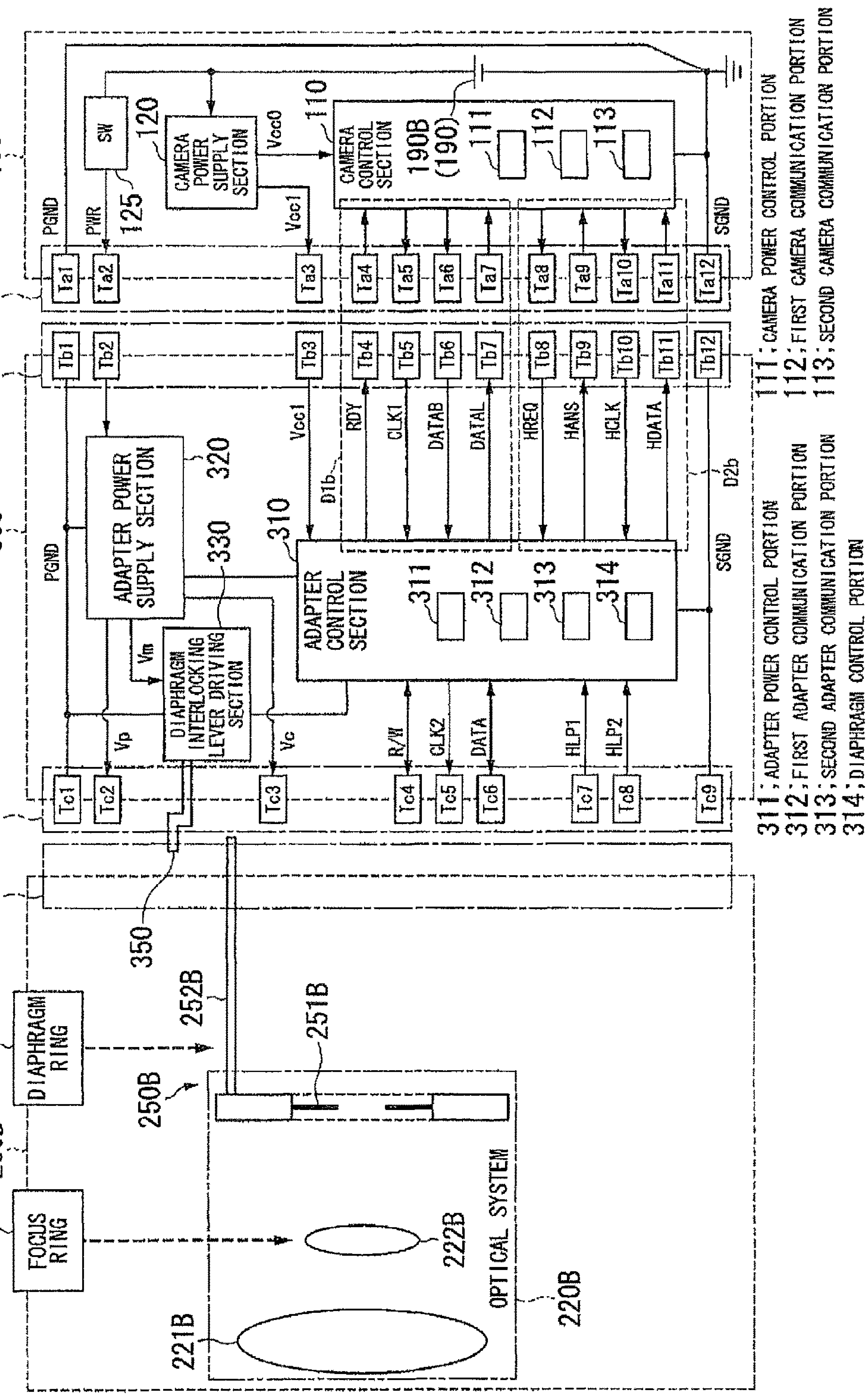
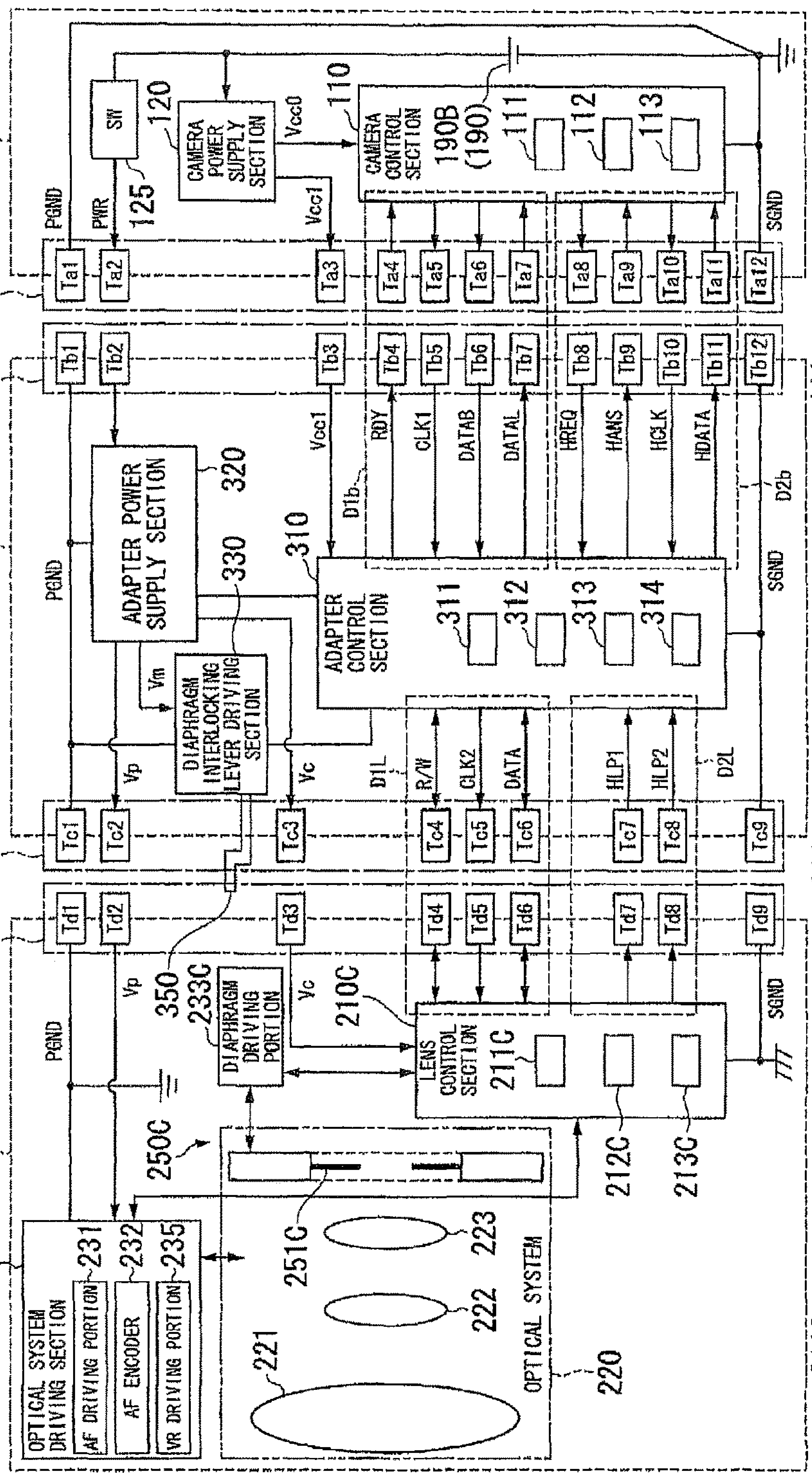

1B
100
101s (101)
301s (301)
300
302s (302)
201B
200B
260B
255B
SW
125
120
CAMERA POWER SUPPLY SECTION
Vcc0
110
CAMERA CONTROL SECTION
190B (190)
111
112
113
PGND
PWR
Vcc1
SGND
Ta1
Ta2
Ta3
Ta4
Ta5
Ta6
Ta7
Ta8
Ta9
Ta10
Ta11
Ta12
Tb1
Tb2
Tb3
Tb4
Tb5
Tb6
Tb7
Tb8
Tb9
Tb10
Tb11
Tb12
RDY
CLK1
DATAB
DATAL
HREQ
HANS
HCLK
HDATA
D1b
D2b
ADAPTER POWER SUPPLY SECTION
320
330
310
ADAPTER CONTROL SECTION
311
312
313
314
Vm
DIAPHRAGM INTERLOCKING LEVER DRIVING SECTION
Vp
Vc
R/W
CLK2
DATA
HLP1
HLP2
Tc1
Tc2
Tc3
Tc4
Tc5
Tc6
Tc7
Tc8
Tc9
350
252B
251B
250B
FOCUS RING
DIAPHRAGM RING
222B
221B
OPTICAL SYSTEM
220B
111; CAMERA POWER CONTROL PORTION
112; FIRST CAMERA COMMUNICATION PORTION
113; SECOND CAMERA COMMUNICATION PORTION
311; ADAPTER POWER CONTROL PORTION
312; FIRST ADAPTER COMMUNICATION PORTION
313; SECOND ADAPTER COMMUNICATION PORTION
314; DIAPHRAGM CONTROL PORTION

FIG. 6



111; CAMERA POWER CONTROL PORTION
112; FIRST CAMERA COMMUNICATION PORTION
113; SECOND CAMERA COMMUNICATION PORTION

311; ADAPTER POWER CONTROL PORTION
312; FIRST ADAPTER COMMUNICATION PORTION
313; SECOND ADAPTER COMMUNICATION PORTION
314; DIAPHRAGM CONTROL PORTION

211C; OPTICAL SYSTEM CONTROL PORTION
212C; FIRST LENS COMMUNICATION PORTION
213C; SECOND LENS COMMUNICATION PORTION

FIG. 7

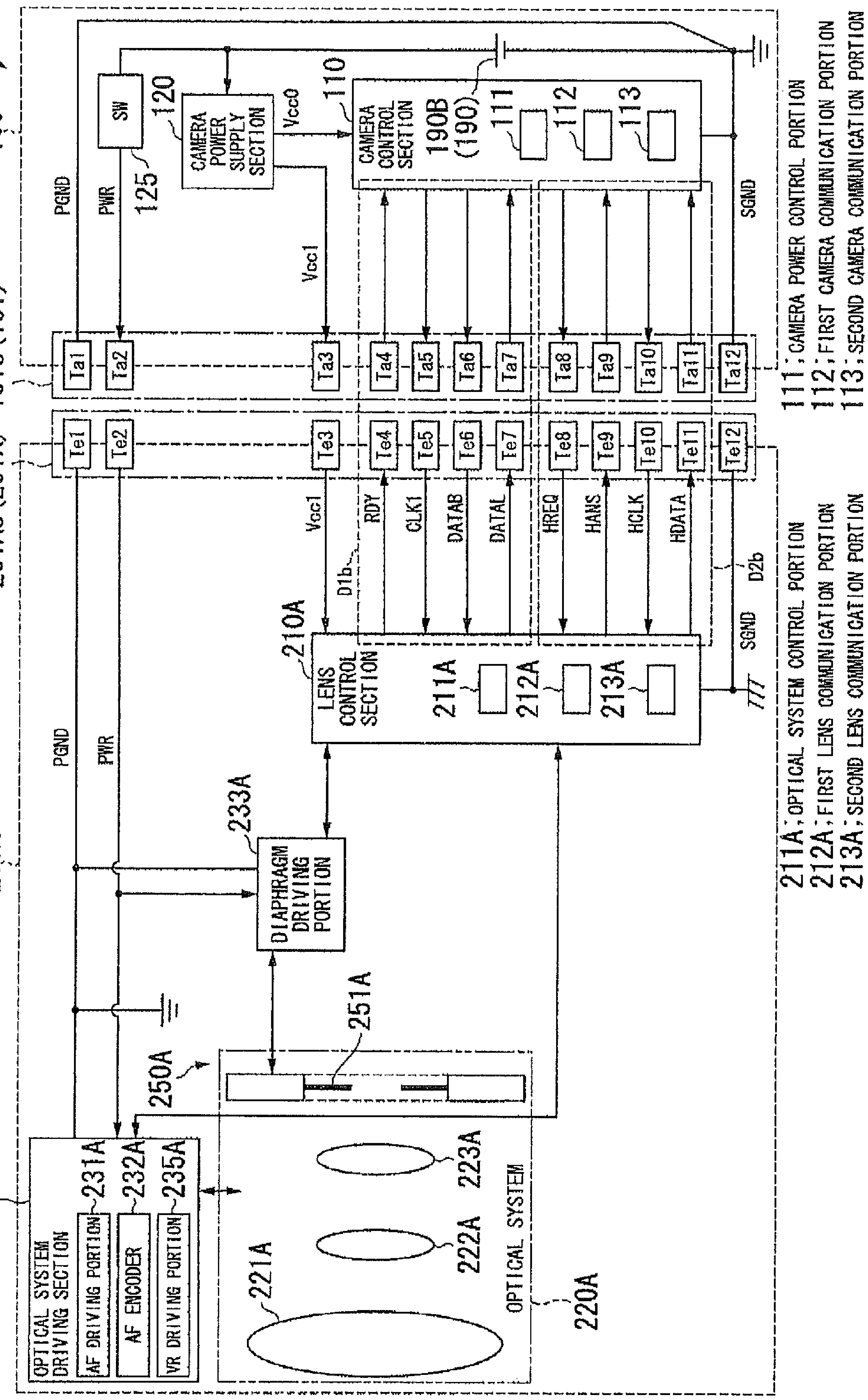

1A
100
SW
120
CAMERA POWER SUPPLY SECTION
125
PGND
PWR
Vcc0
Vcc1
110
CAMERA CONTROL SECTION
190B (190)
111
112
113
SGND
101s (101)
Ta1
Ta2
Ta3
Ta4
Ta5
Ta6
Ta7
Ta8
Ta9
Ta10
Ta11
Ta12
201As (201A)
Te1
Te2
Te3
Te4
Te5
Te6
Te7
Te8
Te9
Te10
Te11
Te12
RDY
CLK1
DATAB
DATAL
HREQ
HANS
HCLK
HDATA
D1b
D2b
210A
LENS CONTROL SECTION
211A
212A
213A
200A
233A
DIAPHRAGM DRIVING PORTION
251A
250A
230A
OPTICAL SYSTEM DRIVING SECTION
AF DRIVING PORTION
231A
AF ENCODER
232A
VR DRIVING PORTION
235A
221A
222A
223A
OPTICAL SYSTEM
220A
111; CAMERA POWER CONTROL PORTION
112; FIRST CAMERA COMMUNICATION PORTION
113; SECOND CAMERA COMMUNICATION PORTION
211A; OPTICAL SYSTEM CONTROL PORTION
212A; FIRST LENS COMMUNICATION PORTION
213A; SECOND LENS COMMUNICATION PORTION

FIG. 8

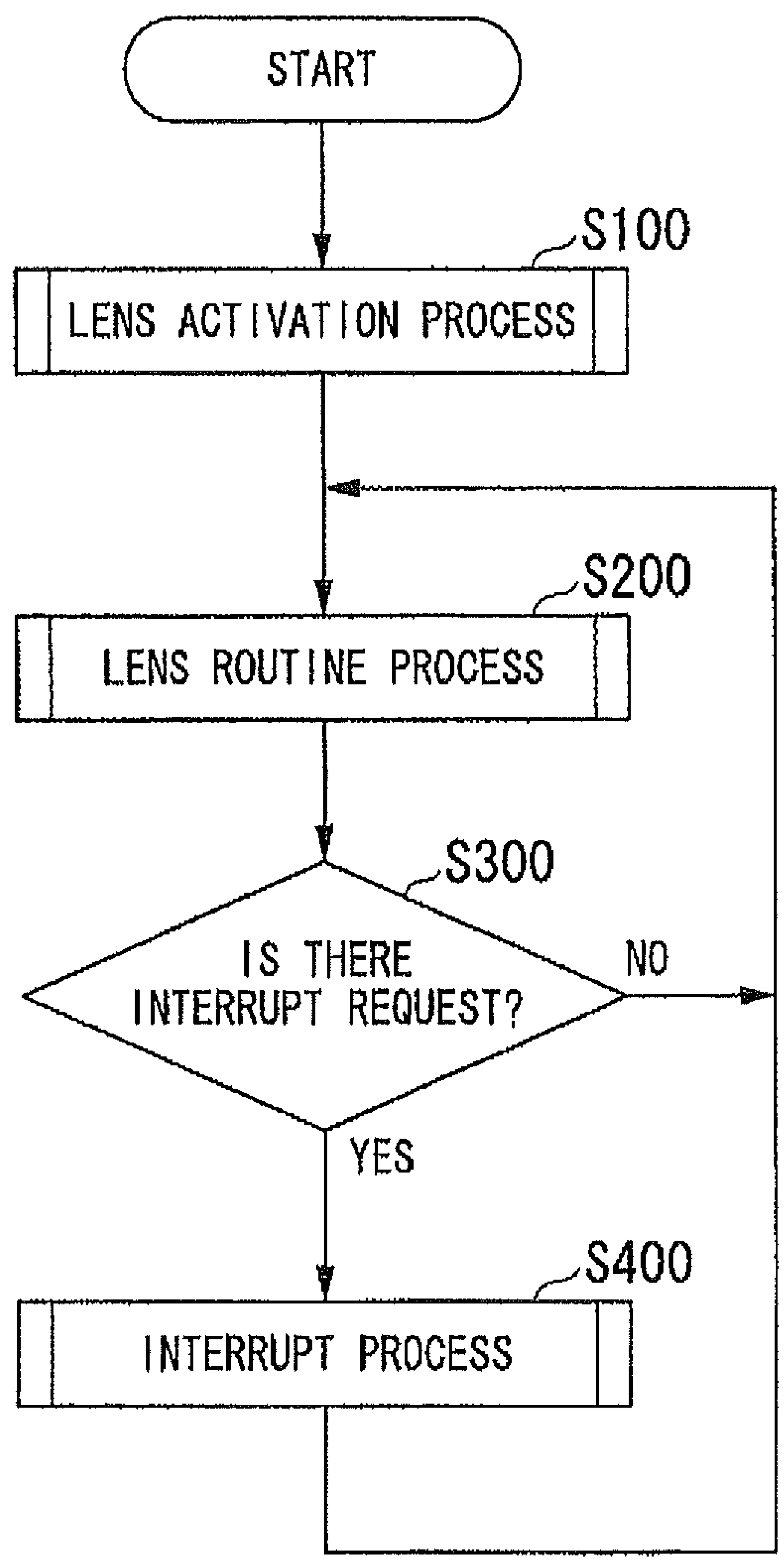

START
S100
LENS ACTIVATION PROCESS
S200
LENS ROUTINE PROCESS
S300
IS THERE INTERRUPT REQUEST?
NO
YES
S400
INTERRUPT PROCESS

FIG. 9

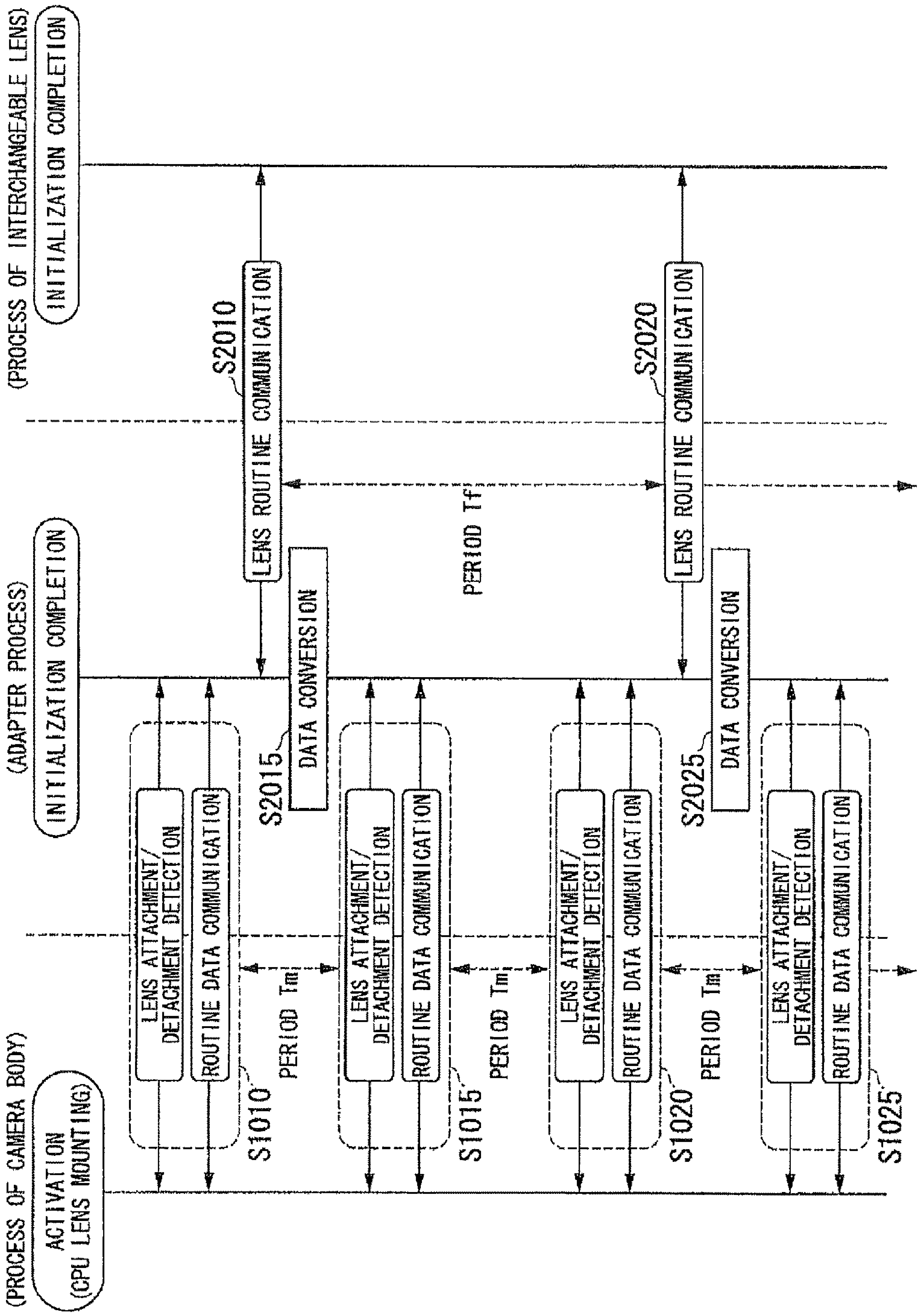

(PROCESS OF CAMERA BODY)
ACTIVATION (CPU LENS MOUNTING)
(ADAPTER PROCESS)
INITIALIZATION COMPLETION
(PROCESS OF INTERCHANGEABLE LENS)
INITIALIZATION COMPLETION
LENS ATTACHMENT/ DETACHMENT DETECTION
ROUTINE DATA COMMUNICATION
S1010
PERIOD Tm
S1015
S1020
S1025
S2010
LENS ROUTINE COMMUNICATION
S2015
DATA CONVERSION
PERIOD Tf
S2020
S2025

FIG. 10

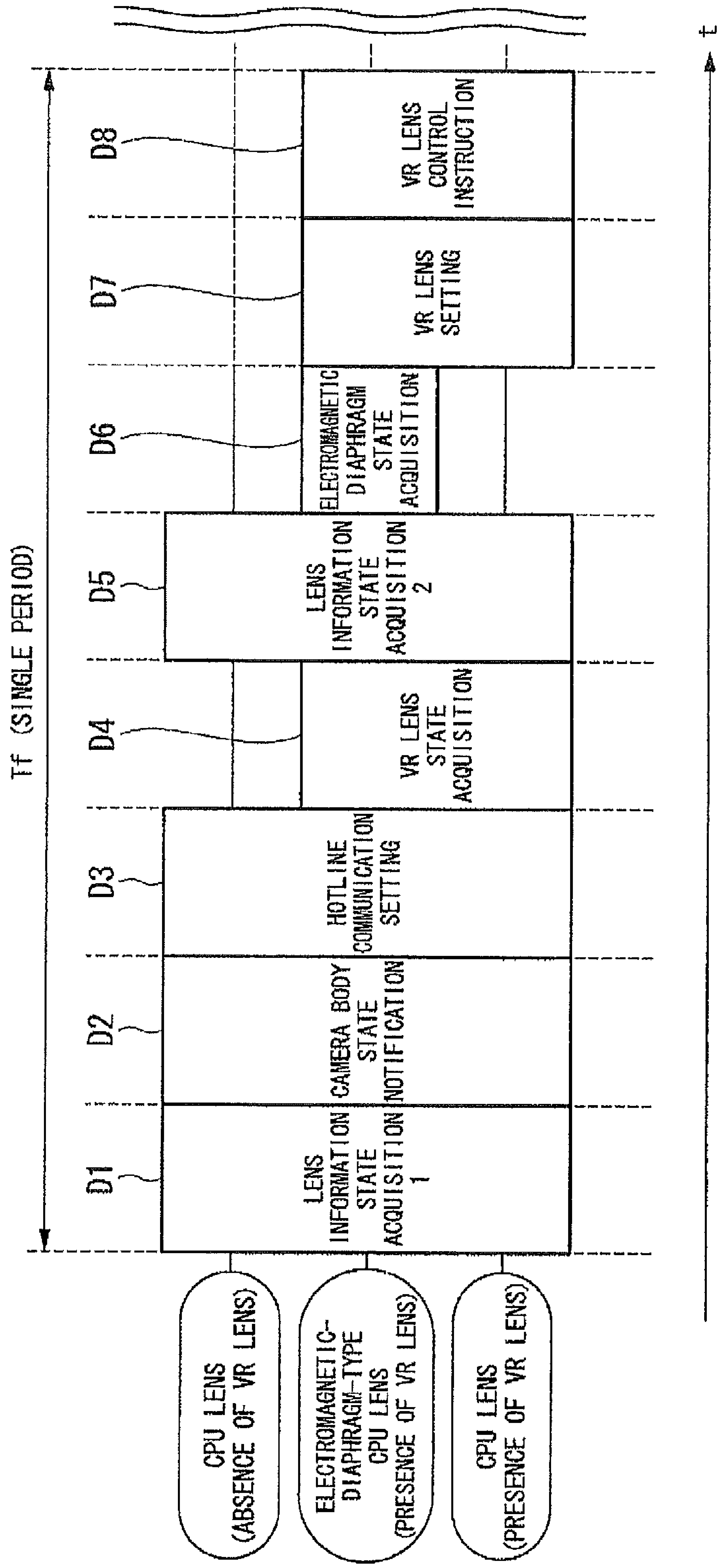

Tf (SINGLE PERIOD)
D1
D2
D3
D4
D5
D6
D7
D8
LENS INFORMATION STATE ACQUISITION 1
CAMERA BODY STATE NOTIFICATION
HOTLINE COMMUNICATION SETTING
VR LENS STATE ACQUISITION
LENS INFORMATION STATE ACQUISITION 2
ELECTROMAGNETIC DIAPHRAGM STATE ACQUISITION
VR LENS SETTING
VR LENS CONTROL INSTRUCTION
t
CPU LENS (ABSENCE OF VR LENS)
ELECTROMAGNETIC-DIAPHRAGM-TYPE CPU LENS (PRESENCE OF VR LENS)
CPU LENS (PRESENCE OF VR LENS)

FIG. 11

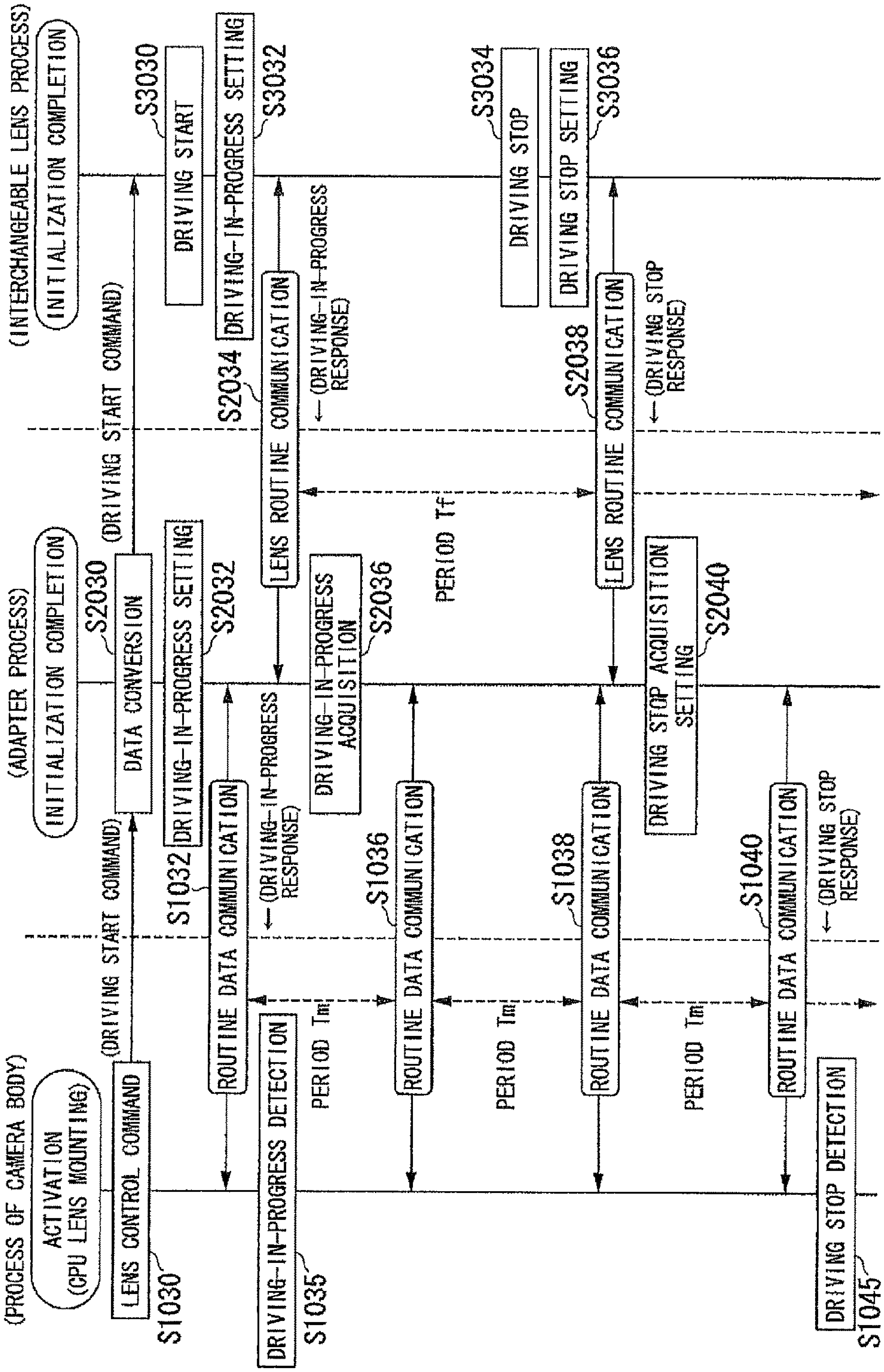

(PROCESS OF CAMERA BODY)
ACTIVATION (CPU LENS MOUNTING)
LENS CONTROL COMMAND
S1030
(DRIVING START COMMAND)
ROUTINE DATA COMMUNICATION
S1032
(DRIVING-IN-PROGRESS RESPONSE)
DRIVING-IN-PROGRESS DETECTION
S1035
PERIOD Tm
ROUTINE DATA COMMUNICATION
S1036
ROUTINE DATA COMMUNICATION
S1038
ROUTINE DATA COMMUNICATION
S1040
(DRIVING STOP RESPONSE)
DRIVING STOP DETECTION
S1045
(ADAPTER PROCESS)
INITIALIZATION COMPLETION
DATA CONVERSION
S2030
DRIVING-IN-PROGRESS SETTING
S2032
DRIVING-IN-PROGRESS ACQUISITION
S2036
LENS ROUTINE COMMUNICATION
S2034
LENS ROUTINE COMMUNICATION
S2038
PERIOD Tf
DRIVING STOP ACQUISITION SETTING
S2040
(INTERCHANGEABLE LENS PROCESS)
INITIALIZATION COMPLETION
DRIVING START
S3030
DRIVING-IN-PROGRESS SETTING
S3032
DRIVING STOP
S3034
DRIVING STOP SETTING
S3036
(DRIVING-IN-PROGRESS RESPONSE)
(DRIVING STOP RESPONSE)

FIG. 12

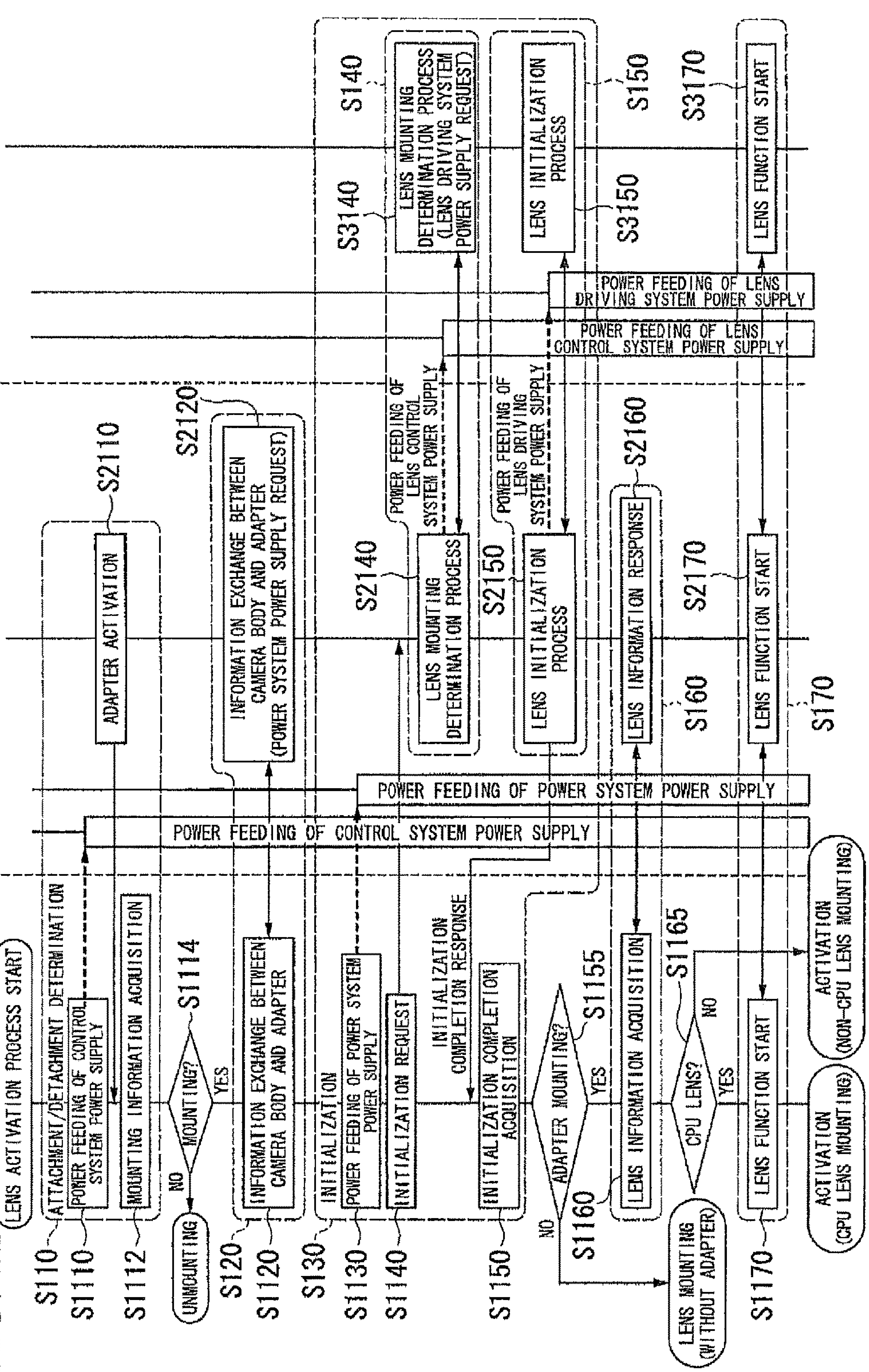
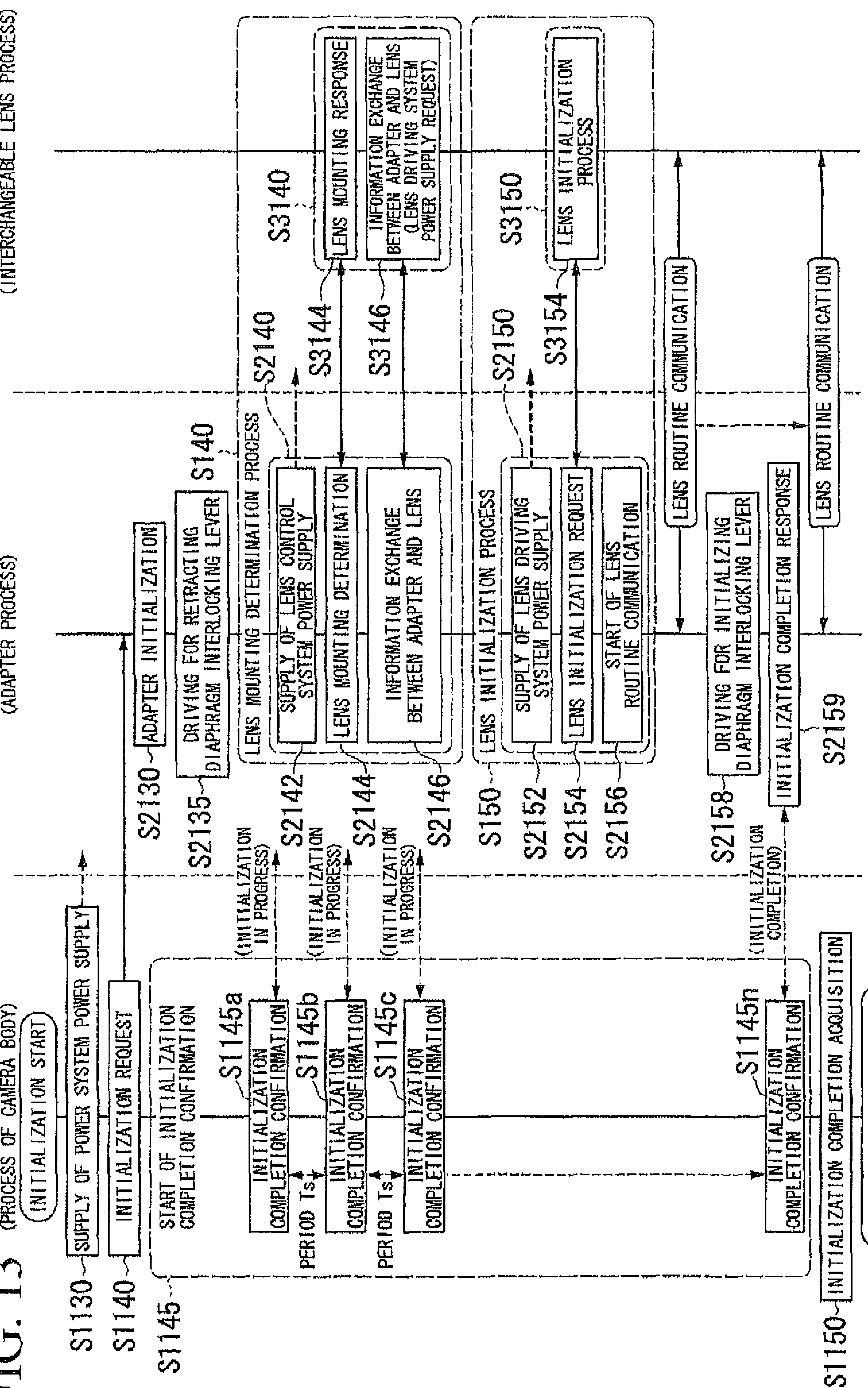

(PROCESS OF CAMERA BODY)
(ADAPTER PROCESS)
(INTERCHANGEABLE LENS PROCESS)
LENS ACTIVATION PROCESS START
S110
ATTACHMENT/DETACHMENT DETERMINATION
S1110
POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
S1112
MOUNTING INFORMATION ACQUISITION
S1114
MOUNTING?
YES
NO
UNMOUNTING
S120
S1120
INFORMATION EXCHANGE BETWEEN CAMERA BODY AND ADAPTER
S130
INITIALIZATION
S1130
POWER FEEDING OF POWER SYSTEM POWER SUPPLY
S1140
INITIALIZATION REQUEST
INITIALIZATION COMPLETION RESPONSE
S1150
INITIALIZATION COMPLETION ACQUISITION
S1155
ADAPTER MOUNTING?
S1160
LENS MOUNTING (WITHOUT ADAPTER)
LENS INFORMATION ACQUISITION
S1165
CPU LENS?
S1170
LENS FUNCTION START
ACTIVATION (CPU LENS MOUNTING)
ACTIVATION (NON-CPU LENS MOUNTING)
POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
POWER FEEDING OF POWER SYSTEM POWER SUPPLY
S2110
ADAPTER ACTIVATION
S2120
INFORMATION EXCHANGE BETWEEN CAMERA BODY AND ADAPTER (POWER SYSTEM POWER SUPPLY REQUEST)
S2140
LENS MOUNTING DETERMINATION PROCESS
POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
S2150
LENS INITIALIZATION PROCESS
POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
S2160
LENS INFORMATION RESPONSE
S160
S2170
LENS FUNCTION START
S170
POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
S140
S3140
LENS MOUNTING DETERMINATION PROCESS (LENS DRIVING SYSTEM POWER SUPPLY REQUEST)
S150
S3150
LENS INITIALIZATION PROCESS
S3170
LENS FUNCTION START

FIG. 13



(PROCESS OF CAMERA BODY)
(ADAPTER PROCESS)
(INTERCHANGEABLE LENS PROCESS)
INITIALIZATION START
S1130
SUPPLY OF POWER SYSTEM POWER SUPPLY
S1140
INITIALIZATION REQUEST
S1145
START OF INITIALIZATION COMPLETION CONFIRMATION
S1145a
S1145b
S1145c
S1145n
INITIALIZATION COMPLETION CONFIRMATION
PERIOD Ts
(INITIALIZATION IN PROGRESS)
(INITIALIZATION COMPLETION)
S1150
INITIALIZATION COMPLETION ACQUISITION
INITIALIZATION COMPLETION
S2130
ADAPTER INITIALIZATION
S2135
DRIVING FOR RETRACTING DIAPHRAGM INTERLOCKING LEVER
S140
LENS MOUNTING DETERMINATION PROCESS
S2142
SUPPLY OF LENS CONTROL SYSTEM POWER SUPPLY
S2144
LENS MOUNTING DETERMINATION
S2146
INFORMATION EXCHANGE BETWEEN ADAPTER AND LENS
S2140
S3144
S3146
S3140
LENS MOUNTING RESPONSE
INFORMATION EXCHANGE BETWEEN ADAPTER AND LENS (LENS DRIVING SYSTEM POWER SUPPLY REQUEST)
S150
LENS INITIALIZATION PROCESS
S2152
SUPPLY OF LENS DRIVING SYSTEM POWER SUPPLY
S2154
LENS INITIALIZATION REQUEST
S2156
START OF LENS ROUTINE COMMUNICATION
S2150
S3154
S3150
LENS INITIALIZATION PROCESS
LENS ROUTINE COMMUNICATION
S2158
DRIVING FOR INITIALIZING DIAPHRAGM INTERLOCKING LEVER
S2159
INITIALIZATION COMPLETION RESPONSE
LENS ROUTINE COMMUNICATION

FIG. 14A

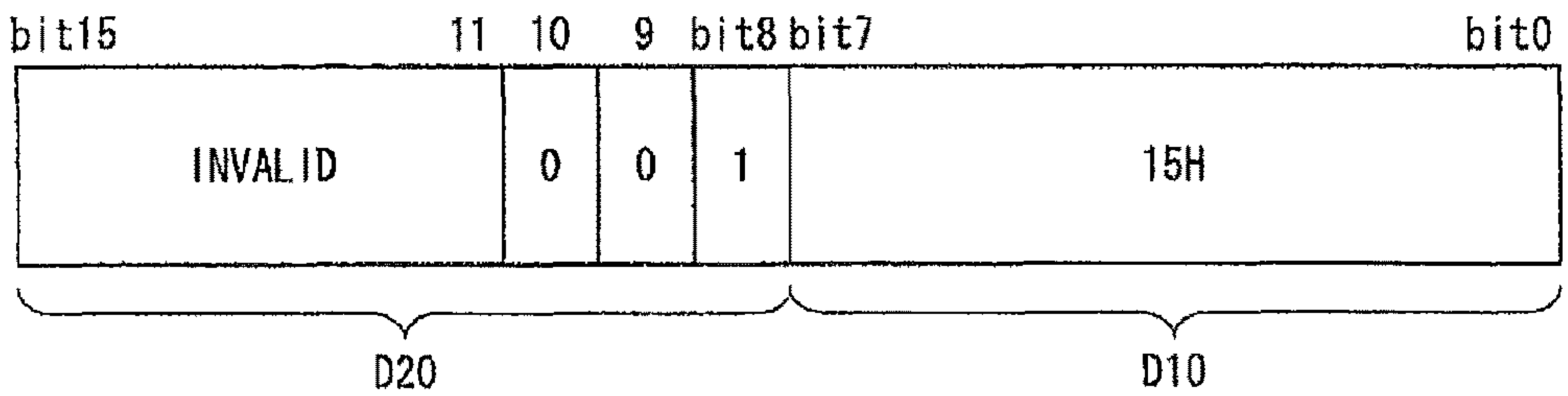


FIG. 14B

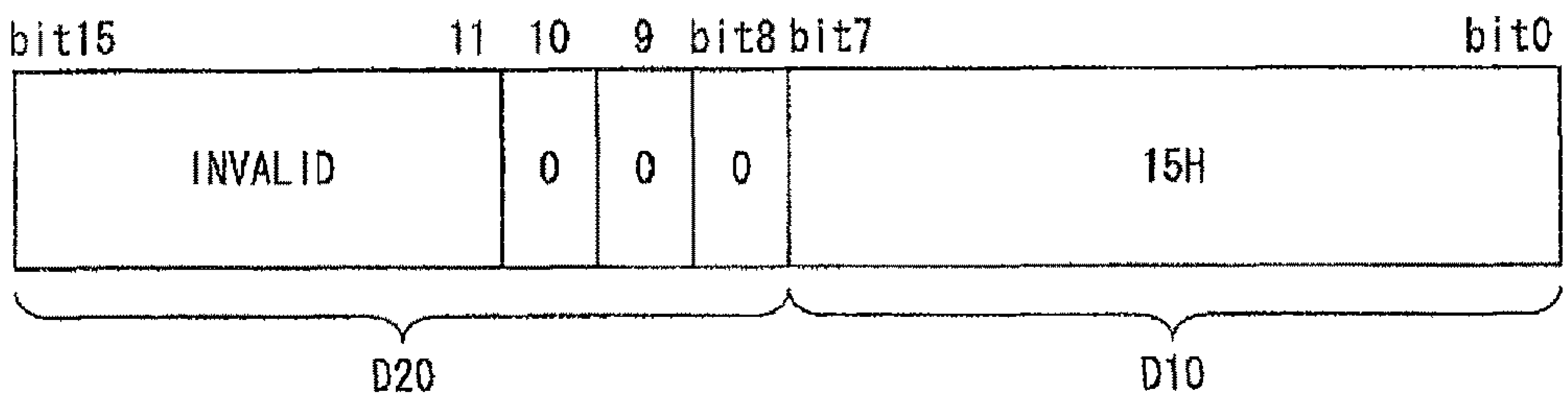


FIG. 15

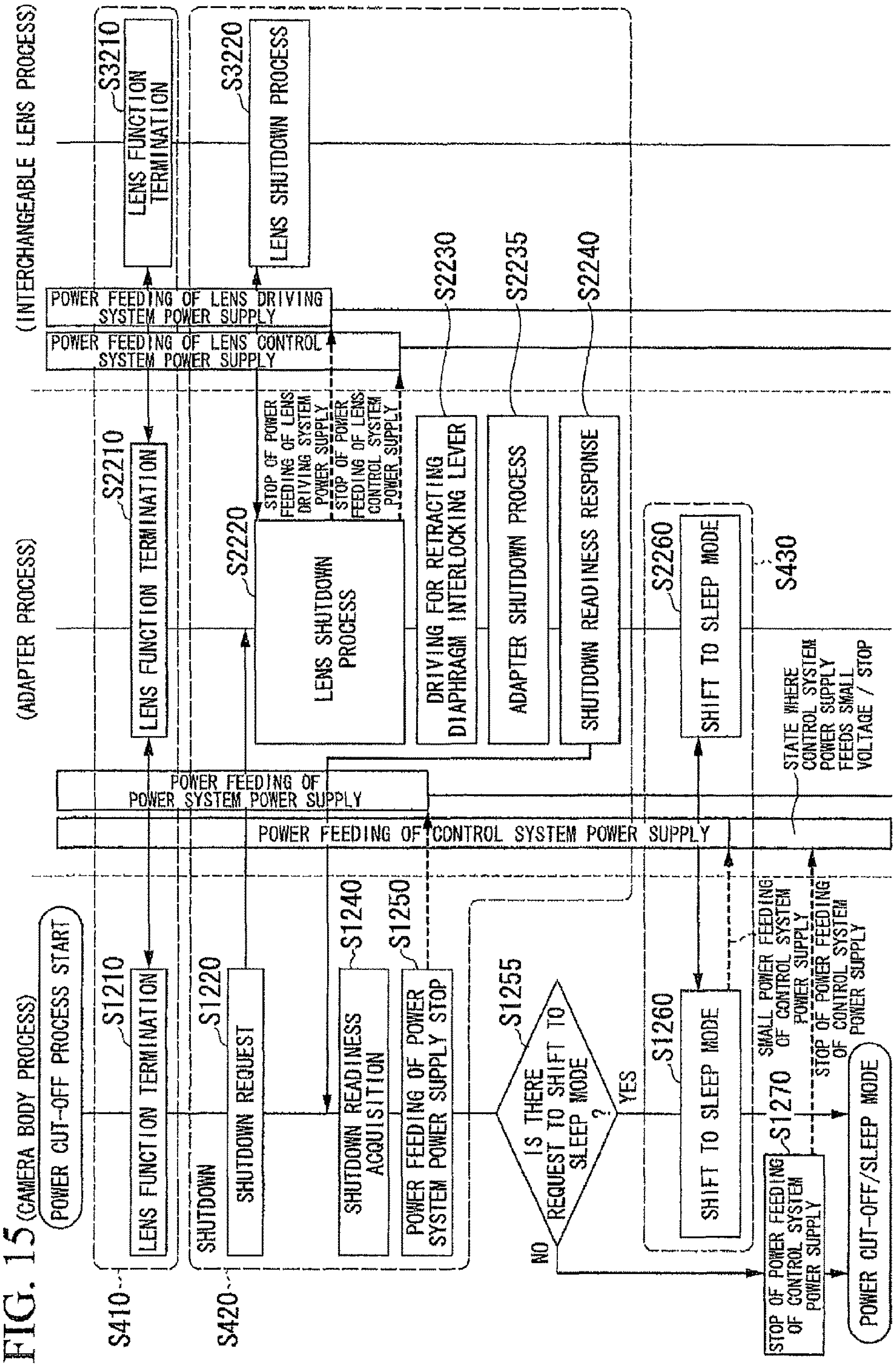
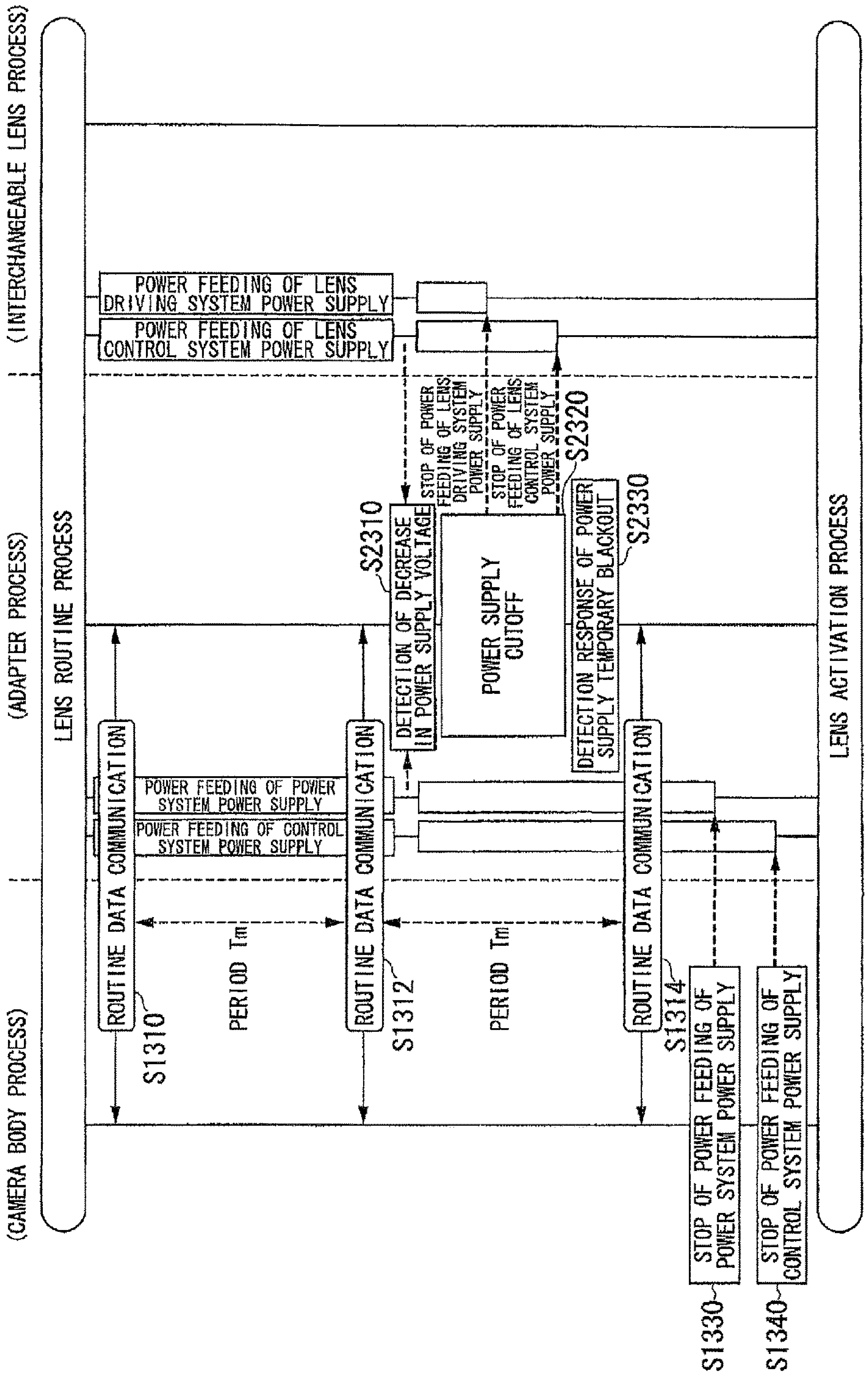

(CAMERA BODY PROCESS)
(ADAPTER PROCESS)
(INTERCHANGEABLE LENS PROCESS)
POWER CUT-OFF PROCESS START
S410
S420
SHUTDOWN
S1210
LENS FUNCTION TERMINATION
S1220
SHUTDOWN REQUEST
S1240
SHUTDOWN READINESS ACQUISITION
S1250
POWER FEEDING OF POWER SYSTEM POWER SUPPLY STOP
S1255
IS THERE REQUEST TO SHIFT TO SLEEP MODE ?
YES
NO
S1260
SHIFT TO SLEEP MODE
S1270
STOP OF POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
SMALL POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
STOP OF POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
POWER CUT-OFF/SLEEP MODE
POWER FEEDING OF POWER SYSTEM POWER SUPPLY
POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
STATE WHERE CONTROL SYSTEM POWER SUPPLY FEEDS SMALL VOLTAGE / STOP
S2210
LENS FUNCTION TERMINATION
S2220
LENS SHUTDOWN PROCESS
STOP OF POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
STOP OF POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
S2230
DRIVING FOR RETRACTING DIAPHRAGM INTERLOCKING LEVER
S2235
ADAPTER SHUTDOWN PROCESS
S2240
SHUTDOWN READINESS RESPONSE
S2260
SHIFT TO SLEEP MODE
S430
POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
S3210
LENS FUNCTION TERMINATION
S3220
LENS SHUTDOWN PROCESS

FIG. 16


(CAMERA BODY PROCESS)
(ADAPTER PROCESS)
(INTERCHANGEABLE LENS PROCESS)
LENS ROUTINE PROCESS
LENS ACTIVATION PROCESS
POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
STOP OF POWER FEEDING OF LENS DRIVING SYSTEM POWER SUPPLY
STOP OF POWER FEEDING OF LENS CONTROL SYSTEM POWER SUPPLY
S2320
DETECTION OF DECREASE IN POWER SUPPLY VOLTAGE
S2310
POWER SUPPLY CUTOFF
DETECTION RESPONSE OF POWER SUPPLY TEMPORARY BLACKOUT
S2330
ROUTINE DATA COMMUNICATION
S1310
POWER FEEDING OF POWER SYSTEM POWER SUPPLY
POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
PERIOD Tm
ROUTINE DATA COMMUNICATION
S1312
PERIOD Tm
ROUTINE DATA COMMUNICATION
S1314
STOP OF POWER FEEDING OF POWER SYSTEM POWER SUPPLY
S1330
STOP OF POWER FEEDING OF CONTROL SYSTEM POWER SUPPLY
S1340

ADAPTER, CAMERA SYSTEM, AND ADAPTER CONTROL PROGRAM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED APPLICATION

This application [is a non-provisional application claiming] *is a Reissue of U.S. Pat. No. 8,755,684, issued Jun. 17, 2014, which issued from U.S. application Ser. No. 13/553,292, filed Jul. 19, 2012, which claims* priority to the benefit of U.S. provisional application No. 61/588,970, filed on Jan. 20, 2012 and U.S. provisional application No. 61/589,613, filed on Jan. 23, 2012. [This application] *U.S. Pat. No. 8,755,684* also claims priority to Japanese Patent Application No. 2011-160840, filed on Jul. 22, 2011 and Japanese Patent Application No. 2011-160842, filed on Jul. 22, 2011. The entire contents of each of the applications identified above are incorporated herein by reference.

BACKGROUND

1. Field of the Invention

The present invention relates to an adapter, a camera system, and an adapter control program.

2. Description of Related Art

An interchangeable-lens camera system having a camera body and an interchangeable lens which is detachably attached to the camera body is known (for example, refer to Japanese Unexamined Patent Application Publication No. 2008-275890).

The interchangeable-lens camera system is able to capture an image through various types of optical systems by changing the interchangeable lens mounted on the camera body.

SUMMARY

Recently, in digital camera systems, new interchangeable-lens camera systems, of which the camera body has a smaller size than that of the related art, have been developed.

However, in some cases, interchangeable lenses of existing camera systems may not be mounted on and function in camera bodies of the new interchangeable-lens camera systems.

However, generally the existing interchangeable lenses have come into widespread use. Hence, in the new interchangeable-lens camera systems, in order to be able to capture images through various types of optical systems, it is preferable that the existing interchangeable lens be mounted on and function in these systems.

An object of aspects according to the present invention is to provide an adapter, a camera system, and an adapter control program that enable various types of optical systems to appropriately function in the interchangeable-lens camera system.

According to an aspect of the present invention, an adapter is provided including: a first mount section that is detachably attached to a camera body; a second mount section that is provided separately from the first mount section and is detachably attached to an interchangeable lens; and a power supply section that generates supply voltages of a third power supply system and a fourth power supply system, which are to be fed to the interchangeable lens mounted on the second mount section, from a second power supply system between a first power supply system of the camera body, which is mounted on the first mount section, and the second power supply system which is different from the first power supply system.

Further, according to an aspect of the present invention, a camera system is provided including: the adapter mentioned above; the camera body mounted on the first mount section; and the interchangeable lens mounted on the second mount section.

Further, according to an aspect of the present invention, an adapter control program is provided for controlling operations of an adapter control section in an adapter including a first mount section on which a camera body can be mounted and a second mount section which is provided separately from the first mount section and on which an interchangeable lens can be mounted, the adapter control program comprising steps of: generating a voltage of a lens system power supply system, which is to be fed to the interchangeable lens, from a second power supply system between a first power supply system of the camera body and the second power supply system which is different from the first power supply system; operating by feeding electric power of the first power supply system; and transmitting the second power supply system request signal, which is for requesting start of the power feeding from the second power supply system, to the camera body after the power feeding from the first power supply system is performed.

According to the aspects of the present invention, it is possible to cause various types of optical systems to appropriately function in the interchangeable-lens camera system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating a configuration of a camera system according to an embodiment of the present invention.

FIG. **2** is a perspective view illustrating an example of a configuration of an adapter according to the present embodiment.

FIG. **3** is a schematic block diagram illustrating a first example of a configuration of the camera system according to the present embodiment.

FIG. **4** is a schematic block diagram illustrating an example of a configuration of an adapter power supply section and a power supply system.

FIG. **5** is a schematic block diagram illustrating a second example of the configuration of the camera system according to the present embodiment.

FIG. **6** is a schematic block diagram illustrating a third example of the configuration of the camera system according to the present embodiment.

FIG. **7** is a schematic block diagram illustrating a fourth example of the configuration of the camera system according to the present embodiment.

FIG. **8** is a flowchart illustrating a brief overview of a state shift between processes relating to an interchangeable lens according to the present embodiment.

FIG. **9** is a diagram illustrating an example of a communication sequence of command data communication in a lens routine process.

FIG. **10** is a diagram illustrating an example of communication commands which are divisionally communicated through a plurality of communications in a single period of lens routine communication.

FIG. **11** is a diagram illustrating an example of a communication sequence for detecting a driving status of an optical system driving section.

FIG. **12** is a diagram illustrating an example of a process sequence of a lens activation process.

FIG. **13** is a diagram illustrating an example of a process sequence of an initialization process in the lens activation process.

FIG. **14**A is a diagram illustrating an example of a data structure of initialization information obtained through the command data communication.

FIG. **14**B is a diagram illustrating an example of a data structure of initialization information obtained through the command data communication.

FIG. **15** is a diagram illustrating an example of a process sequence of a power cut-off process and a sleep process.

FIG. **16** is a diagram illustrating an example of a process sequence at the time of temporary blackout of power supply.

DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments according to the present invention will be described with reference to the accompanying drawings.

FIG. **1** is a perspective view illustrating a configuration of a camera system **1** according to an embodiment of the present invention.

The camera system **1** shown in FIG. **1** is an interchangeable-lens camera system, and includes a camera body **100**, an interchangeable lens **200**, an adapter **300** which is provided between the camera body **100** and the interchangeable lens **200** and is detachably attached to the camera body **100** and the interchangeable lens **200**.

In this drawing, the adapter **300** is mounted on the camera body **100**. Further, the interchangeable lens **200** is mounted on the camera body **100** with the adapter **300** interposed therebetween.

In the camera system **1**, the specification of a camera body-side mount **101**, which is a lens mount provided in the camera body **100**, is different from the specification of a lens-side mount **201** which is a lens mount provided in the interchangeable lens **200**. For example, mount shapes and connection terminals for electrical connection of the specification of the camera body-side mount **101** and the specification of the lens-side mount **201** are different from each other. Further, communication standards of communication through the corresponding connection terminal and communication data types thereof are different from each other. Hence, it is difficult to directly mount the interchangeable lens **200** on the camera body **100**.

Therefore, the adapter **300** is formed as a mount adapter that enables the interchangeable lens **200** to be indirectly mounted on the camera body **100**. Furthermore, the adapter **300** is formed between the camera body **100** and the interchangeable lens **200** having communication standards and communication data types different from each other so as to enable them to communicate with each other without changing their communication standards and the like.

Further, the camera body **100** includes a power button **131**, a release button **132**, a rear-side operation section **133**, and a display section **150**.

The power button **131** is an operation member used to switch on and off a main power supply in the camera body **100**.

The release button **132** is an operation member used to accept instructions to start a photography process. For example, the release button **132** accepts two kinds of instructions to start the photography process based on a state where the button is pressed halfway (a half-pressed state, for example, a state for receiving focus adjustment, exposure adjustment, and the like) and a state where the button is pressed fully (a full-pressed state, for example, a state for receiving the instruction to start exposure).

The rear-side operation section **133** is provided on the rear side opposite to the side, on which the camera body-side mount **101** is provided, among the sides of the casing of the camera body **100**. The rear-side operation section **133** is configured to include an operation member such as a selection button of operation modes (for example, a mode dial) or a selection button of various setting conditions (for example, a menu button or an up-down-right-left selection button).

The display section **150** is provided on the rear side similarly to the rear-side operation section **133**, and thus displays photographed images or a menu screen for selecting various setting conditions. The display section **150** is configured to include, for example, a liquid crystal display, an organic EL (Electra-Luminescence) display, or the like.

FIG. **2** is a perspective view illustrating an example of a configuration of the adapter **300** according to the present embodiment.

The adapter **300** includes: a first mount section that is detachably attached to the camera body **100**; and a second mount section that is provided separately from the first mount section and is detachably attached to the interchangeable lens **200**.

For example, as shown in FIG. **2**, the adapter **300** includes: a first mount **301** (the first mount section) that is detachably attached to the camera body-side mount **101** provided in the camera body **100**; and a second mount **302** (the second mount section) that is detachably attached to the lens-side mount **201** provided in the interchangeable lens **200**.

In addition, in the vicinity of the first mount **301**, a plurality of electric connection terminals (mount contact points), which respectively correspond to a plurality of electric connection terminals provided in the vicinity of the camera body-side mount **101**, is provided. Thereby, when mounted on the camera body **100**, the adapter **300** is electrically connected to the camera body **100** through the plurality of connection terminals.

Further, in the vicinity of the second mount **302**, a plurality of electric connection terminals, which respectively correspond to a plurality of electric connection terminals provided in the vicinity of the lens-side mount **201**, is provided.

Thereby, when mounted on the interchangeable lens **200**, the adapter **300** is electrically connected to the interchangeable lens **200** through the plurality of connection terminals.

Further, the adapter **300** includes: a tripod mount **305** to mount the adapter **300** on a tripod; a lens attachment/detachment button **306**; and a diaphragm interlocking lever **350**.

The lens attachment/detachment button **306** is a button to release the lock of the locking mechanism which mechanically locks the adapter **300** into the interchangeable lens **200** when the lens is mounted. That is, the lens attachment/detachment button **306** is an operation member that is operated by a user when the interchangeable lens **200** mounted on the adapter **300** is detached.

A diaphragm interlocking lever **350** (the diaphragm interlocking mechanism portion) is a lever that displaces a diaphragm mechanism **251** (refer to FIG. **3**) including a plurality of diaphragm blades which change the diaphragm aperture diameter (the stopping amount of the diaphragm, the aperture size, the aperture ratio, the aperture value) by using the diaphragm of the interchangeable lens **200**, and the lever is provided in the adapter **300**. By moving the position of the diaphragm interlocking lever **350** in a direction along the inner circumference of the adapter **300**, the aperture diameter of the diaphragm of the interchangeable lens **200** is changed.

For example, the interchangeable lens **200** includes a diaphragm lever **252** (refer to FIG. **3**) that displaces the diaphragm mechanism **251**. Accordingly, the diaphragm aperture diameter of the interchangeable lens **200** is displaced by moving the position of the diaphragm lever **252**. Then, the diaphragm lever **252** is fitted to the diaphragm interlocking lever **350**, and is configured to move in conjunction with the diaphragm interlocking lever **350**. Hence, the diaphragm aperture diameter of the interchangeable lens **200** is changed by moving the position of the diaphragm interlocking lever **350**.

That is, the diaphragm interlocking lever **350** is moved to a position according to the aperture value of the diaphragm mechanism **251** (diaphragm) provided in the interchangeable lens **200**.

Description of Block Configuration of Camera System

Next, referring to FIG. **3**, the block configuration of the camera system **1** will be described.

FIG. **3** is a schematic block diagram illustrating an example of the configuration of the camera system **1** according to the present embodiment. In the drawing, the interchangeable lens **200** is mounted on the camera body **100** with the adapter **300** interposed therebetween. Further, the camera body **100**, the interchangeable lens **200**, and the adapter **300** are electrically connected to each other through the connection terminals which are respectively provided therein.

First, a brief overview of the configuration of the camera system **1** will be described.

The camera body **100** has the camera body-side mount **101** including a connection section **101**s. The adapter **300** has the first mount **301** including a connection section **301**s and the second mount **302** including a connection section **302**s. The interchangeable lens **200** has the lens-side mount **201** including a connection section **201**s.

The adapter **300** is mounted on (physically connected to) the camera body **100** through the camera body-side mount **101** and the first mount **301**, and both are electrically connected to each other through the connection section **101**s and the connection section **301**s. The connection section **101**s and the connection section **301**s are respectively provided with twelve connection terminals (terminals Ta**1** to Ta**12** and terminals Tb**1** to Tb**12**) which are electrically connected to each other, thereby feeding a voltage (supplying a voltage) and exchanging (communicating) signals between the camera body **100** and the adapter **300** through the connection terminals.

In addition, the exchange (communication) of signals is performed between a camera control section **110**, which is provided in the camera body **100**, and an adapter control section **310** which is provided in the adapter **300**.

The adapter **300** is mounted on (physically connected to) the interchangeable lens **200** through the lens-side mount **201** and the second mount **302**, and both are electrically connected to each other through the connection section **201**s and the connection section **302**s. The connection section **201**s and the connection section **302**s are respectively provided with nine connection terminals (terminals Tc**1** to Tc**9** and terminals Td**1** to Td**9**) which are electrically connected to each other, thereby feeding a voltage (supplying a voltage) and exchanging (communicating) signals between the interchangeable lens **200** and the adapter **300** through the connection terminals.

In addition, the exchange (communication) of signals is performed between a lens control section **210**, which is provided in the interchangeable lens **200**, and the adapter control section **310** which is provided in the adapter **300**.

Configuration of Camera Body

Next, a configuration of the camera body **100** will be described.

The camera body **100** includes the camera control section **110**, a camera power supply section **120**, a switch **125**, a battery section **190**B, and the connection section **101**s (terminals Ta**1** to Ta**12**).

The connection section **101**s has twelve connection terminals of the terminals

Ta**1** to Ta**12** as connection terminals which are connected to the twelve connection terminals (terminals Tb**1** to Tb**12**) of the connection section **301**s provided in the adapter **300**.

In addition, a configuration of the adapter **300** will be described in detail later.

A battery section **190**B houses a battery **190**.

The battery **190** supplies a voltage to the camera body **100**, the interchangeable lens **200**, and the adapter **300**. For example, the battery **190** is a lithium-ion secondary battery, a nickel hydride secondary battery, or the like. The battery **190** may be a primary battery such as an alkaline battery. Further, the camera body **100** is not limited to the configuration in which a voltage is supplied from the battery **190**, and the voltage may be supplied from an external direct-current power supply (such as an AC adapter that supplies a voltage by transforming an alternating-current power supply into a direct-current power supply).

The camera power supply section **120** converts the voltage, which is supplied from the battery **190**, so as to be able to supply the battery voltage to the camera body **100** or the camera accessory which is connected to the camera body **100**. For example, by converting the battery voltage, the camera power supply section **120** is divided into: a power supply Vcc**0** that supplies a voltage to control system circuits (mainly the camera control section **110**) provided in the camera body **100**; and a power supply Vcc**1** that is a first power supply system which supplies a voltage to the adapter **300** connected to the connection section **101**s. The voltage of the power supply Vcc**1** is supplied to the control system circuits (mainly adapter control section **310**) provided in the adapter **300**. Hereinafter, the power supply Vcc**1** is referred to as a control system power supply Vcc**1**.

Further, the camera power supply section **120** switches a supply state and a supply stop state of the voltage supplied by the control system power supply Vcc**1** through the control of the camera control section **110**. Furthermore, the camera power supply section **120** controls the supply of electric power (an amount of electricity, an amount of power feeding) through the control of the camera control section **110**. For example, the camera power supply section **120** switches a state (normal power feeding state), in which the electric power (the amount of electricity, the amount of power feeding) which can be supplied is large to the extent that it is possible to execute the photography process in the camera system **1**, and a state (state for feeding a small voltage) in which the electric power (the amount of electricity, the amount of power feeding) which can be supplied is small to the extent that it is difficult to execute the photography process in the camera system **1**.

In addition, the voltage of the control system power supply Vcc**1** is supplied to the adapter control section **310** through the terminal Ta**3** and the terminal Tb**3**.

Further, the terminal Ta**2** and the positive terminal of the battery **190** are connected to the battery section **190**B through the switch **125**. Thereby, separately from the power supply Vcc**1** as the above-mentioned first power supply system, a power supply PWR as a second power supply system is generated from the battery **190**, and the voltage is supplied from the power supply PWR to the adapter power supply section **320**. The voltage of the power supply PWR is supplied to the adapter power supply section **320** through the terminal Ta**2** and the terminal Tb**2**. Instead of the battery **190**, the external direct-current power supply may supply the voltage of the power supply PWR. Further, the power supply PWR is a power supply system which is able to supply a larger electric power than the control system power supply Vcc**1**. Hereinafter, the power supply PWR is referred to as a power-system power supply PWR.

Further, a power system ground POND, which is a ground (GND) corresponding to the power-system power supply PWR, is connected to the terminal Ta**1** and the respective sections to which the voltage of the power-system power supply PWR is supplied. On the other hand, a control system ground SGND, which is a ground corresponding to the control system power supply Vcc**1**, is connected to the terminal Ta**12**. Further, the power system ground PGND and the control system ground SGND are respectively grounded at an electric potential equal to the negative terminal of the battery **190** through the battery section **190**B.

In addition, the control system ground SGND is also a ground corresponding to the power supply Vcc**0**, and the control system ground SGND is connected to the ground terminal of the camera control section **110**.

The switch **125** switches the conducting state and the cut-off state (non-conducting state) through the control of the camera control section **110**. That is, the switch **125** switches whether or not to supply the voltage of the power-system power supply PWR to the terminal Ta**2** through the control of the camera control section **110**.

The camera control section **110** includes a camera power control portion **111**, a first camera communication portion **112**, and a second camera communication portion **113**. The camera control section **110** controls the respective sections which are provided in the camera body **100**, and performs two communication systems, namely, a first data communication system D**1**b and a second data communication system D**2**b, with the adapter control section **310** of the adapter **300** connected through the connection section **101**s.

The camera power control portion **111** controls the camera power supply section **120** and the switch **125**, on the basis of the state of the camera body **100** or the communication state of the first camera communication portion **112** or the second camera communication portion **113**.

In addition, the first camera communication portion **112** and the second camera communication portion **113** independently perform two communication systems, namely, the first data communication system D**1**b and the second data communication system D**2**b, respectively.

The first data communication system D**1**b is a communication system using full-duplex communication of the serial interface system. The first camera communication portion **112** exchanges (communicates) four types of signals, namely, RDY, CLK**1**, DATAB, and DATAL through the first data communication system D**1**b.

The signal RDY is a signal for notifying whether or not to perform communication to the first camera communication portion **112**. The signal RDY is transmitted (output) from a first adapter communication portion **312** to be described later to the first camera communication portion **112** through the terminal Ta**4**. The signal CLK**1** is a clock signal for serial communication. The clock signal CLK**1** is transmitted (output) from the first camera communication portion **112** to the first adapter communication portion **312** through the terminal Ta**5**. The signal DATAB is output from the first camera communication portion **112** to the first adapter communication portion **312** through the terminal Ta**6**, and is a signal of data on the camera body **100**. The signal DATAL is output from the first adapter communication portion **312** to the first camera communication portion **112**, and is a signal of data on the interchangeable lens **200**. The first camera communication portion **112** receives the signal DATAL through the terminal Ta**1**.

The second data communication system D**2**b is a serial interface system, and is a communication system using simplex communication by which the data is transmitted to the camera body **100**. The second camera communication portion **113** exchanges (communicates) four types of signals, namely, HREQ, HANS, HCLK, and HDATA.

The signal HREQ is a signal indicating a communication request from the second camera communication portion **113**, and the second camera communication portion **113** transmits (outputs) the signal to the second adapter communication portion **313** to be described later through the terminal Tb**8**. The signal HANS is a signal indicating a communication response to the second camera communication portion **113**, and is transmitted from the second adapter communication portion **313** to the second camera communication portion **113** through the terminal Tb**9**. The signal HCLK is a clock signal for serial communication. The clock signal HCLK is transmitted (output) from the second camera communication portion **113** to the second adapter communication portion **313** through the terminal Tb**10**. The signal HDATA is a lens data signal which is transmitted from the second adapter communication portion **313** to the second camera communication portion **113** through the terminal Tb**11**.

In addition, communication contents of the first data communication system D**1**b and the second data communication system D**2**b will be described in detail later.

Configuration of Interchangeable Lens

Next, a configuration of the interchangeable lens **200** will be described.

The interchangeable lens **200** includes the connection section **201**s (terminals Td**1** to Td**9**), the lens control section **210**, an optical system **220**, and an optical system driving section **230**.

The subject light (optical image), which is incident through the optical system **220**, is guided onto a light receiving surface of a well-known photography element (not shown in the drawing), which is provided in the camera body **100**, through the adapter **300**.

The optical system **220** includes a lens **221**, a lens for focus adjustment (hereinafter referred to as a focus lens) **222**, a lens for image blur correction of optical images (for vibration-proof) (hereinafter referred to as a VR (Vibration Reduction) lens) **223**, and a diaphragm section **250**.

The diaphragm section **250** includes the diaphragm mechanism **251** that includes the plurality of diaphragm blades, and the diaphragm lever **252** that mechanically operates the diaphragm mechanism **251**. Accordingly, the diaphragm aperture diameter of the interchangeable lens **200** is changed in a way that the diaphragm lever **252** mechanically operates the diaphragm mechanism **251**. Further, the interchangeable lens **200** in the camera system **1** shown in FIG. **3** is a lens in which a power supply such as an actuator which drives the diaphragm mechanism **251** is not built in, and is also a lens in which the diaphragm mechanism **251** is driven through the diaphragm lever **252** by the diaphragm interlocking lever **350** of the adapter **300**.

The optical system driving section **230** include an AF (Auto Focus) driving portion **231**, an AF encoder **232**, and a VR driving portion **235**.

The AF driving portion **231** drives the focus lens **222** through the control of the lens control section **210**. Further, the AF encoder **232** detects the position of the focus lens **222**, and supplies the detection result to the lens control section **210**.

The VR driving portion **235** drives the VR lens **223** through the control of the lens control section **210**.

The interchangeable lens **200** may include a focus ring that is manually operated by a user so as to thereby move the position of the focus lens **222**.

The connection section **201**s includes nine connection terminals Td**1** to Td**9** which are connected to nine connection terminals (terminals Tc**1** to Tc**9**) of the connection section **302**s provided in the adapter **300**.

The power supply Vp, which supplies the voltage of the optical system driving section **230**, is supplied through the terminal Td**2**.

Hereinafter, the power supply Vp is referred to as a lens driving system power supply Vp. The lens driving system power supply Vp is supplied from the power-system power supply PWR through the adapter **300**.

For example, the voltage of the lens driving system power supply Vp is supplied from the terminal Td**2** to the optical system driving section **230**, of which power consumption is large, like an actuator driving the focus lens **222** provided in the AF driving portion **231**, an actuator driving the VR lens **223**, or the like. Further, the power system ground PGND which is a ground corresponding to the lens driving system power supply Vp is connected to the terminal Td**1** and the ground terminal of the optical system driving section **230**.

The power supply Vc, which supplies the voltage of the lens control section **210**, is connected to the terminal Td**3**. Hereinafter, the power supply Vc is referred to as a lens control system power supply Vc. The lens control system power supply Vc is supplied from the power-system power supply PWR through the adapter **300**.

The voltage of the lens control system power supply Vc is supplied through the terminal Td**3** to the control system circuits and the like including the lens control section **210** of which the power consumption is smaller than that of the optical system driving section **230**. Further, the control system ground SGND, which is a ground corresponding to the lens control system power supply Vc, is connected to the terminal Td**9** and the ground terminal of the lens control section **210**.

That is, the power system ground PGND and the control system ground SGND are not connected to each other in the interchangeable lens **200**, and are divided into grounds of two systems.

The lens control section **210** includes an optical system control portion **211**, a first lens communication portion **212**, and a second lens communication portion **213**. The lens control section **210** controls the optical system driving section **230**, and controls two communication systems, namely, the first data communication system D**1**L and the second data communication system D**2**L, with the adapter control section **310** of the adapter **300** connected through the connection section **201**s.

The optical system control portion **211** controls the optical system driving section **230**. For example, the optical system control portion **211** initializes the optical system driving section **230** in accordance with the state of communication with the adapter **300**. Further, the optical system control portion **211** controls the optical system driving section **230** so as to drive a driving element such as the focus lens **222** or the VR lens **223** in accordance with the control of the camera control section **110** which is performed through the adapter **300**. Further, the optical system control portion **211** acquires information (for example, information on the position of the focus lens **222** detected by the AF encoder **232** and the like) on the optical system (driving element) **220** supplied from the optical system driving section **230**.

The first lens communication portion **212** and the second lens communication portion **213** respectively perform two communication systems, namely, the first data communication system D**1**L and the second data communication system D**2**L at independent timings.

The first data communication system D**1**L is a communication system using half-duplex communication of the serial interface system. The first lens communication portion **212** communicates three types of signals, namely, R/W, CLK**2**, and DATA through the first data communication system D**1**L.

The signal R/W is a read/write signal indicating the communication direction of the data signal to be described later, is also a signal used for performing a handshake between a lens-side and an adapter, and is transmitted and received between the first lens communication portion **212** and the first adapter communication portion **312** to be described later through the terminal Td**4**. The signal CLK**2** is a clock signal for serial communication, and is transmitted (output) from the first adapter communication portion **312** to the first lens communication portion **212** through the terminal Td**5**. The signal DATA is a data signal which is transmitted and received between the first adapter communication portion **312** and the first lens communication portion **212** through the terminal Td**6**.

The second data communication system D**2**L is a pulse communication system, and a communication system using simplex communication by which the pulse signal is output from the interchangeable lens **200**. The second lens communication portion **213** transmits two types of pulse signals, namely, HLP**1**, HLP**2** through the second data communication system D**2**L.

The signal HLP**1** is a pulse signal which is transmitted to the second adapter communication portion **313** to be described later through the terminal Td**7**. The signal HLP**2** is a pulse signal which is output from the second lens communication portion **213** to the second adapter communication portion **313** through the terminal Td**8**. Such pulse signals HLP**1** and HLP**2** are pulse signals responsive to the signal output from the AF encoder **232**.

The communication contents communicated in the first data communication system D**1**L and the second data communication system D**2**L will be described later.

Configuration of Adapter

Next, a configuration of the adapter **300** will be described.

The adapter **300** includes the adapter control section **310**, the adapter power supply section **320**, the diaphragm interlocking lever driving section **330** (diaphragm interlocking mechanism driving portion), the connection section **301**s (terminals Tb**1** to Tb**12**), the connection section **302**s (terminals Tc**1** to Tc**9**), and the diaphragm interlocking lever **350**.

The connection section **301**s includes twelve connection terminals TM to Tb**12** connected to the above-described twelve connection terminals Ta**1** to Ta**12** on the camera body **100** side. The adapter **300** and the camera body **100** are connected through the connection section **301**s and connection section **101**s, Thereby, the respective terminals of the terminals Tb**1** to Tb**12** of the connection section **301**s are electrically connected to the connection terminals respectively corresponding to the terminals Ta**1** to Ta**12** of the connection section **101**s.

Further, the connection section **302**s includes nine connection terminals Tc**1** to Tc**9** connected to the above-described nine connection terminals (terminals Td**1** to Td**9**) on the interchangeable lens **200** side. The adapter **300** and the interchangeable lens **200** are connected through the connection section **302**s and the connection section **201**s. The respective terminals of the terminals Tc**1** to Tc**9** of the connection section **302**s are connected to the connection terminals respectively corresponding to the terminals Td**1** to Td**9** of the connection section **201**s.

The terminal Tb**2** is connected to the terminal Ta**2**, and the terminal Tb**3** is connected to the terminal Ta**3**. Thereby, the voltage of the power-system power supply PWR is supplied from the camera body **100** to the terminal Tb**2** through the terminal Ta**2**, and the voltage of the control system power supply Vcc**1** is supplied to the terminal Tb**3** through the terminal Ta**3**. Thereby, the adapter power supply section **320** is supplied with the voltage of the power-system power supply PWR from the camera body **100** through the terminal Ta**2** and the terminal Tb**2**.

On the other hand, the adapter control section **310** is supplied with the voltage of the control system power supply Vcc**1** from the camera body **100** through the terminal Ta**3** and the terminal Tb**3**.

As described above, the adapter **300** is supplied with both of the voltage of the control system power supply Vcc**1** (the voltage of the first power supply system) from the camera body **100** and the voltage of the power-system power supply PWR (the voltage of the second power supply system) which is able to supply a larger electric power than the control system power supply Vcc**1**. The voltage of the power-system power supply PWR, which is supplied to the adapter power supply section **320**, can be divided (converted) into the lens driving system power supply Vp (third power supply system) and the lens control system power supply Vc (fourth power supply system) as the lens system power supply systems which supply the voltage to the interchangeable lens **200**. For example, the adapter power supply section **320** generates the supply voltages of the lens driving system power supply Vp and the lens control system power supply Vc, which feed voltages to the interchangeable lens **200**, from the power-system power supply PWR which is supplied from the camera body **100**.

The voltage, which is supplied from the lens driving system power supply Vp, is larger than the voltage which is supplied from the lens control system power supply Vc. Further, the power consumption in the load supplied from the lens driving system power supply Vp may be larger than the power consumption in the load supplied from the lens control system power supply Vc.

Furthermore, from the power-system power supply PWR supplied to the adapter power supply section **320**, separately from the above-mentioned lens driving system power supply Vp and the lens control system power supply Vc, the power supply Vm (fifth power supply system), which supplies a voltage to the diaphragm interlocking lever driving section **330**, is also generated (can be divided). Hereinafter, the power supply Vm is referred to as a diaphragm driving power supply Vm.

For example, the adapter power supply section **320** includes a voltage conversion section that converts the voltage of the power-system power supply PWR into a predetermined voltage of the diaphragm driving power supply Vm. The voltage conversion section includes, for example, a DC-DC converter. Further, the voltage conversion section converts the voltage into a voltage which is stepped up to, for example, a predetermined voltage (the predetermined voltage of the diaphragm driving power supply Vm). Then, the adapter power supply section **320** supplies the generated voltage of the diaphragm driving power supply Vm to the diaphragm interlocking lever driving section **330**.

The adapter power supply section **320** may include a first regulator portion that converts (generates) the voltage of the lens control system power supply Vc on the basis of the voltage of the diaphragm driving power supply Vm.

For example, the first regulator portion converts the voltage of the diaphragm driving power supply Vm into a voltage which is stepped down to a predetermined voltage (a predetermined voltage of the lens control system power supply Vc). Further, for example, the first regulator portion may include a first linear regulator. The voltage of the diaphragm driving power supply Vm is set to be higher than the voltage of the lens control system power supply Vc.

Further, the adapter power supply section **320** may include a second regulator portion that converts (generates) the voltage of the lens driving system power supply Vp on the basis of the voltage of the power-system power supply PWR. For example, the second regulator portion converts the voltage of the power-system power supply PWR into a voltage which is stepped down to a predetermined voltage (a predetermined voltage of the lens driving system power supply Vp). Further, for example, the second regulator portion may include a second linear regulator. In this case, the second regulator portion is configured to supply a larger electric power (the amount of power feeding is larger) than that of the first regulator portion. Further, the adapter power supply section **320** has a voltage detection portion that detects the power supply voltage, and supplies the detection result to the adapter control section **310**.

An internal configuration of the adapter power supply section **320** will be described later with reference to FIG. **4**.

The respective connections of the power supply systems converted by the adapter power supply section **320** are as follows.

The terminal Tc**2** is connected to the output terminal of the lens driving system power supply Vp (the terminal that outputs the voltage of the lens driving system power supply Vp) of the adapter power supply section **320**. Further, the terminal Tc**3** is connected to the output terminal of the lens control system power supply Vc (the terminal that outputs the voltage of the lens control system power supply Vc) of the adapter power supply section **320**. Thereby, the adapter power supply section **320** supplies the voltage of the lens driving system power supply Vp to the terminal Tc**2**, and supplies the voltage of the lens control system power supply Vc to the terminal Tc**3**.

Further, the adapter power supply section **320** supplies the voltage of the lens driving system power supply Vp to the optical system driving section **230** of the interchangeable lens **200** through the terminal Tc**2** and the terminal Td**2**.

Further, the adapter power supply section **320** supplies the voltage of the lens control system power supply Vc to the lens control section **210** of the interchangeable lens **200** through the terminal Tc**3** and the terminal Td**3**.

As described above, the adapter power supply section **320** is able to generate a voltage, which is supplied to the lens control section **210** and the optical system driving section **230** of the interchangeable lens **200**, from the voltage of the power-system power supply PWR.

Thereby, the adapter **300** does not set the voltage of the control system power supply Vcc**1**, which is supplied from the camera body **100**, as the voltage, which is supplied to the interchangeable lens **200**, but is able to set it as the voltage which is supplied to the adapter control section **310**. The camera power supply section **120** in the camera body **100** is configured to constantly supply the control system power supply Vcc**1** to the connection point at which connection is made through the terminal Ta**3** (as long as there is a "supply request" from the connection point). Hence, the adapter control section **310**, which is connected to the terminal Ta**3** through the terminal Tb**3**, can be constantly activated for example even if the power supply switch on the camera body **100** side is turned off. By constantly activating the adapter control section **310**, it is possible to store the setting state (for example, whether or not the initialization process of the diaphragm interlocking lever **350** is complete) on the adapter **300** side. Therefore, there is an advantage in that, when the power supply switch on the camera body **100** side is turned on, the unnecessary initialization process is not performed and is terminated in the adapter **300**. Further, although not described in the present embodiment, when the camera body activation switch (a switch which switches ON/OFF of the power supply on the adapter **300** side) which can be operated by a user is provided on the adapter **300** side, it is possible to constantly monitor the ON operation of the activation switch. Therefore, it is possible to configure a system which activates the camera body **100** through the operation on the adapter **300** side. (It may also be possible to adopt a system configuration which transfers the control system power supply Vcc**1** to the lens control section **210** so as to constantly activate the lens control section **210**. In this case, even when the operation switch to activate the camera body **100** is provided on the interchangeable lens **200** side, the adapter **300**, which is not in the activation state (since the power is not supplied thereto), is interposed between both of the interchangeable lens **200** and the camera body **100**, and thus it is difficult to transfer the operation of the operation switch on the interchangeable lens **200** side to the camera body **100** side. As a result, it is difficult to activate the camera body **100**.)

Furthermore, the adapter power supply section **320** supplies the voltage of the diaphragm driving power supply Vm in the adapter **300** to the diaphragm interlocking lever driving section **330**. In other words, the adapter **300** generates a voltage, which is supplied to the diaphragm interlocking lever driving section **330**, from the voltage of the power-system power supply PWR which is supplied from the camera body **100**. Since the power-system power supply PWR has a sufficiently large power feeding ability as compared with the control system power supply Vcc**1**, the power-system power supply PWR can be used in power feeding to various circuits. In addition, similarly to the present embodiment, even when a voltage for power feeding to the diaphragm interlocking lever driving section **330** is generated from the power-system power supply PWR (even when the power-system power supply PWR is used in combination), there is no adverse effect on operations of other circuits of the sections used in combination (for example, the operation of the above-mentioned lens control section **210**).

Further, the terminal Tb**1** is connected to the terminal Ta**1** of the camera body **100**. Thereby, the power system ground PGND is connected to the terminal Tb**1** through the terminal Ta**1**. Further, the terminal Tb**1** and the terminal Tc**1** are connected through the power system ground PGND in the adapter **300**. Furthermore, the terminal Tc**1** is connected to the terminal Td**1** of the interchangeable lens **200**. Thereby, the power system ground PGND is a ground corresponding to the lens driving system power supply Vp, and is connected to the terminal Td**1** through the terminal Tc**1**. In addition, the power system ground PGND is a ground corresponding to the ground of the adapter power supply section **320**, the diaphragm interlocking lever driving section **330**, and the like.

Further, the terminal Tb**12** is connected to the terminal Ta**12** of the camera body **100**. Thereby, the control system ground SGND is connected to the terminal Tb**12** through the terminal Ta**12**. Further, the terminal Tb**12** and the terminal Tc**9** are connected through the control system ground SGND in the adapter **300**. Furthermore, the terminal Tc**9** is connected to the terminal Td**9** of the interchangeable lens **200**. Thereby, the control system ground SGND is a ground corresponding to the lens control system power supply Vc, and is connected to the terminal Td**9** through the terminal Tc**9**. In addition, the control system ground SGND is a ground corresponding to the ground of the adapter control section **310**.

As described above, the power system ground POND and the control system ground SGND are not connected to each other in the adapter **300**, but are divided into the grounds of two systems.

That is, in the interchangeable lens **200** and adapter **300**, the power system ground PGND and the control system ground SGND are not connected to each other, but are divided into the grounds of two systems. However, the power system ground PGND and the control system ground SGND, which are divided into two systems, are connected in the camera body **100**, and are thus set to a ground at the same electric potential as that of the negative terminal of the battery **190**. Accordingly, the ground of the camera control section **110**, the lens control section **210**, and the adapter control section **310** is connected to the control system ground SGND, and is set to an equivalent electric potential.

Accordingly, it is possible to reduce the effect of noise, which occurs in the power system ground POND, on the control system ground SGND.

In the interchangeable lens **200**, the control system ground SGND may be connected to the conductive portion (interchangeable lens casing) of the lens-side mount **201**. Further, the terminal Td**9**, which is connected to the control system ground SGND in the interchangeable lens **200**, may be configured to be included in the conductive portion of the lens-side mount **201**. Likewise, in the adapter **300**, the control system ground SGND may be connected to the conductive portion of the second mount **302**. Further, the terminal Tc**9**, which is connected to the control system ground SGND in the adapter **300**, may be configured to be included in the conductive portion of the second mount **302**.

Furthermore, likewise, the terminal Tb**12** may be connected to the conductive portion of the first mount **301**, and the terminal Tb**12** may be configured to be included in the conductive portion of the first mount **301**. Likewise, the terminal Tall may be connected to the conductive portion of the camera body-side mount **101**, and the terminal Ta**12** may be configured to be included in the conductive portion of the camera body-side mount **101**.

The diaphragm interlocking lever driving section **330** moves the position of the diaphragm interlocking lever **350** through the control of the adapter control section **310**. By moving the diaphragm interlocking lever **350**, the diaphragm interlocking lever driving section **330** displaces the diaphragm mechanism **251** of the interchangeable lens **200** through the diaphragm lever **252**. Further, the diaphragm interlocking lever driving section **330** detects the position of the diaphragm interlocking lever **350**, and outputs the corresponding detection result to the adapter control section **310**.

For example, the diaphragm interlocking lever driving section **330** includes: a diaphragm driving actuator (for example, a stepping motor) that drives the diaphragm interlocking lever **350**; a motor driving portion that controls driving of the diaphragm driving actuator; a diaphragm interlocking lever position detection portion that detects the position of the diaphragm interlocking lever **350**; and the like. Thereby, in the diaphragm interlocking lever driving section **330**, the motor driving portion drives the diaphragm driving actuator, whereby the diaphragm driving actuator drives the diaphragm interlocking lever **350**. Further, in the diaphragm interlocking lever driving section **330**, the diaphragm interlocking lever position detection portion (for example, a photo-interrupter) detects the position of the diaphragm interlocking lever **350**, and supplies the detection result to the adapter control section **310**.

The adapter control section **310** includes an adapter power control portion **311**, the first adapter communication portion **312**, a second adapter communication portion **313**, and a diaphragm control portion **314**. Further, the adapter control section **310** is controlled by periodic communication with the camera control section **110**, controls the processes performed in the respective sections provided in the adapter **300**, and periodically communicates with the lens control section **210**. For example, the adapter control section **310** performs periodic routine communication with the camera control section **110**. Further, the adapter control section **310** also performs periodic routine communication with the lens control section **210**.

Furthermore, the adapter control section **310** controls the diaphragm interlocking lever driving section **330** on the basis of the communication for controlling the photography process from the camera control section **110**, and communicates with the lens control section **210** in order to control the optical system driving section **230** of the interchangeable lens **200**.

The adapter power control portion **311** controls the adapter power supply section **320** in accordance with the result of the communication with the camera control section **110** or the lens control section **210** or the state of the adapter **300**. For example, the adapter power control portion **311** controls the adapter power supply section **320** in accordance with the result of the communication of the camera control section **110** or the lens control section **210**, and controls whether or not to supply the voltage of the lens control system power supply Vc, the lens driving system power supply Vp, or the diaphragm driving power supply Vm.

Further, the adapter power control portion **311** monitors: the voltage (in other words, a state of the voltage supplied from the camera body **100** side to the adapter **300**) of the power supply system to which a voltage is supplied from the camera body **100**; and the voltage (in other words, a state of the voltage supplied from the adapter **300** side to the interchangeable lens **200**) of the power supply system to which a voltage is generated from the adapter **300** and supplied. The adapter power control portion **311** has a voltage detection portion that detects the voltages of the respective power supply systems, and thus monitors the voltages of the respective power supply system on the basis of the detection result obtained from the voltage detection portion, and notifies the corresponding monitoring result to the camera control section **110** as necessary. This operation will be described in detail in the "process at the time of temporary blackout of power supply" (FIG. **16**) to be described later.

The diaphragm control portion **314** controls the diaphragm interlocking lever driving section **330** in accordance with the result of communication with the camera control section **110** or the lens control section **210**.

For example, the diaphragm control portion **314** controls the diaphragm interlocking lever driving section **330**, in accordance with the result of communication with the camera control section **110**, so as to make the diaphragm aperture diameter of the diaphragm mechanism **251** equal to the diaphragm aperture diameter corresponding to the instruction of the control issued from the camera control section **110**.

Further, the diaphragm control portion **314** performs control, which moves the position of the diaphragm interlocking lever **350** to the initial position in accordance with the process, on the diaphragm interlocking lever driving section **330**. For example, the diaphragm control portion **314** controls the diaphragm interlocking lever driving section **330** so as to move the diaphragm interlocking lever **350** to the position, at which the diaphragm mechanism **251** is open, as the initial position, and the retractable position at which it does not interfere with the diaphragm lever **252** moved in accordance with the setting aperture value of the diaphragm mechanism **251**.

Further, the diaphragm control portion **314** acquires the position of the diaphragm interlocking lever **350** detected in the diaphragm interlocking lever driving section **330**.

The first adapter communication portion **312** performs communication of the first data communication system D**1**b with the first camera communication portion **112**, and performs communication of the first data communication system D**1**L with the first lens communication portion **212**.

Specifically, the first adapter communication portion **312** relays communication between the first data communication system Mb and the first data communication system D1L, which are communication standards different from each other. For example, the first adapter communication portion **312** converts data, which is received from the first camera communication portion **112** in conformity with the communication standard of the first data communication system D**1**b as the full-duplex communication of the serial interface system, into data of the communication standard of the first data communication system D**1**L as the half-duplex communication of the serial interface system, and transmits the data to the first lens communication portion **212**. On the other hand, the first adapter communication portion **312** converts data, which is received from the first lens communication portion **212** on the basis of the communication standard of the first data communication system D**1**L as the half-duplex communication of the serial interface system, into data of the communication standard of the first data communication system D**1**b as the full-duplex communication of the serial interface system, and transmits the data to the first camera communication portion **112**.

Further, the first adapter communication portion **312** relays communication between the first data communication system D1b and first data communication system D1L communicated with periods different from each other.

Furthermore, the first adapter communication portion 312 performs a conversion process to obtain consistency between the formats of the data exchanged between the first data communication system D1b and the first data communication system D1L.

In addition, the adapter control section 310 includes, for example, a storage portion (not shown in the drawing). The first adapter communication portion 312 temporarily stores the data, which is generated on the basis of the received data, the converted data, and the like, in the corresponding storage portion. In addition, the first adapter communication portion 312 reads out the generated data from the corresponding portion, and transmits the data.

The first adapter communication portion 312 and the first camera communication portion 112 perform communication of the first data communication system D1b through the signal lines for the four types of signals RDY, CLK1, DATAB, and DATAL. The terminal Tb4 is connected to the first adapter communication portion 312 through the signal line of the signal ROY. Further, the terminal Tb5 is connected to the first adapter communication portion 312 through the signal line of the signal CLK1, the terminal Tb6 is connected thereto through the signal line of the signal DATAB, and the terminal Tb7 is connected thereto through the signal line of the signal DATAL. In addition, the terminal Tb4 is connected to the terminal Ta4 of the camera body 100, the terminal Tb5 is connected to the terminal Ta5, the terminal Tb6 is connected to the terminal Tab, and the terminal Tb7 is connected to the terminal Ta7.

That is, the signal lines for the four types of the signals RDY, CLK1, DATAB, and DATAL for performing communication of the first data communication system D1b are connected between the first adapter communication portion 312 and the first camera communication portion 112 through the terminals Tb4 to Tb7 and the terminals Ta4 to Ta7.

On the other hand, the first adapter communication portion 312 and the first lens communication portion 212 perform communication of the first data communication system D1L through the signal lines for the three types of the signals R/W, CLK2, and DATA. The terminal Tc4 is connected to the first adapter communication portion 312 through the signal line of the signal R/W. Further, the terminal Tc5 is connected to the first adapter communication portion 312 through the signal line of the signal CLK2, and the terminal Tc6 is connected thereto through the signal line of the signal DATA. In addition, the terminal Tc4 is connected to the terminal Td4 of the interchangeable lens 200, the terminal Tc5 is connected to the terminal Td5, and the terminal Tc6 is connected to the terminal Td6.

That is, the signal lines for the three types of the signals R/W, CLK2, and DATA for performing communication of the first data communication system D1L are connected between the first adapter communication portion 312 and the first lens communication portion 212 through the terminals Tc4 to Tc6 and the terminals Td4 to Td6.

As described above, the communication of the first data communication system D1b and the communication of the first data communication system D1L are performed between the first camera communication portion 112 and the first lens communication portion 212 through the first adapter communication portion 312. In the communication of the first data communication system D1b and the communication of the first data communication system D1L, for example, information of the optical system 220, a request command such as a control instruction, and data of response to the request command are communicated between the first camera communication portion 112 and the first lens communication portion 212 through the first adapter communication portion 312. Here, communication in the first data communication system D1b and the first data communication system D1L is referred to as "command data communication".

In addition, the information of the optical system 220 is information indicating the type of the optical system 220 (information indicating a specification, a function, an optical characteristic of the optical system 220, and the like), information indicating the driving status of the optical system 220, or the like.

As described above, the first adapter communication portion 312 in the adapter control section 310 has: a function of receiving a camera control command, which is output from the first camera communication portion 112 of the camera control section 110 (in other words, the first reception section); a function of transmitting a lens control command, which is for controlling driving of the driving elements of the interchangeable lens 200, to the first lens communication portion 212 of the interchangeable lens 200 in accordance with contents received by the first reception section (in other words, the first transmission section); a function of receiving status information, which indicates the driving statuses of the driving elements, from the first lens communication portion 212 of the interchangeable lens 200 (in other words, the second reception section); and a function of transmitting the status information, which indicates the driving statuses of the driving elements, to the first camera communication portion 112 of the camera body 100 on the basis of contents received by the second reception section (in other words, the second transmission section).

The second adapter communication portion 313 receives a pulse signal of the second data communication system D2L from the second lens communication portion 213, and performs communication of the second data communication system D2b with the second camera communication portion 113.

Specifically, the second adapter communication portion 313 detects information which is included in the pulse signal of the second data communication system D2L, and converts the detected information in conformity with the communication standard of the second data communication system D2b. For example, the second adapter communication portion 313 converts data, which is received from the second lens communication portion 213 on the basis of the communication standard of the second data communication system D2L as the simplex communication of the pulse communication system, into data of the communication standard of the second data communication system D2b as the simplex communication of the serial interface system, and transmits the data to the second camera communication portion 113. Further, the second adapter communication portion 313 converts, through the control of the first adapter communication portion 312, information which is included in the pulse signal received by communication of the second data communication system D2L, on the basis of the communication standard of the second data communication system D2b, and transmits the information to the second camera communication portion 113.

The second adapter communication portion 313 and the second camera communication portion 113 performs communication of the second data communication system D2b through signal lines for four types of signals HREQ, HANS, HCLK, and HDATA. The terminal Tb8 is connected to the second adapter communication portion 313 through the signal line of the signal HREQ. Further, the terminal Tb**9** is connected to the second adapter communication portion **313** through the signal line of the signal HANS, the terminal Tb**10** is connected thereto through the signal line of the signal HCLK, and the terminal Tb**11** is connected thereto through the signal line of the signal HDATA. In addition, the terminal Tb**8** is connected to the terminal Ta**8** of the camera body **100**, the terminal Tb**9** is connected to the terminal Tag, the terminal Tb**10** is connected to the terminal Ta**10**, and the terminal Tb**11** is connected to the terminal Ta**11**.

That is, the signal lines for the four types of the signals HREQ, HANS, HCLK, and HDATA for performing communication of the second data communication system D**2**b are connected between the second adapter communication portion **313** and the second camera communication portion **113** through the terminals Tb**8** to Tb**11** and the terminals Ta**8** to Tall.

On the other hand, the second adapter communication portion **313** and the second lens communication portion **213** perform communication of the second data communication system D**2**L through the signal lines for the two types of the signals HLP**1** and HLP**2**. The terminal Tc**7** is connected to the second adapter communication portion **313** through the signal line of the signal HLP**1**. Further, the terminal Tc**8** is connected to the second adapter communication portion **313** through the signal line of the signal HLP**2**. In addition, the terminal Tc**7** is connected to the terminal Td**7** of the interchangeable lens **200**, and the terminal Tc**8** is connected to the terminal Td**8**.

That is, the signal lines for the two types of the signals HLP**1** and HLP**2** for performing communication of the second data communication system D**2**L are connected between the second adapter communication portion **313** and the second lens communication portion **213** through the terminals Tc**7** and Tc**8** and the terminals Td**7** and Td**8**.

As described above, the communication of the second data communication system D**2**b and the communication of the second data communication system D**2**L are performed between the second camera communication portion **113** and the second lens communication portion **213** through the second adapter communication portion **313**. In the communication of the second data communication system D**2**b and the communication of the second data communication system D**2**L, on the basis of the communication request signal of the second camera communication portion **113**, for example, data indicating the position of the focus lens **222** and the like are communicated from the second lens communication portion **213** through the second adapter communication portion **313**. Here, communication in the second data communication system D**2**b and the second data communication system D**2**L is referred to as "hotline communication".

Details of Configuration of Power Supply Section and Power Supply System of Adapter

Next, referring to FIG. **4**, details of the configuration of the adapter power supply section **320** and the power supply system in the adapter **300** will be described.

FIG. **4** is a schematic block diagram illustrating an example of the configuration of the adapter power supply section **320** and the power supply system. In the drawing, the elements corresponding to the respective sections of FIG. **3** are represented by the same reference numerals and signs, and description thereof will be omitted. Further, the adapter control section **310** shown in the drawing represents a configuration relating to the adapter power control portion **311**.

The adapter power supply section **320** includes a DC-DC converter portion **321** (voltage conversion section), a first regulator portion **322**, a second regulator portion **323**, a Vc-voltage detection portion **325** (the voltage detection portion of the fourth power supply system), a Vp-voltage detection portion **326** (the voltage detection portion of the third power supply system), a PWR voltage detection portion **327** (the voltage detection portion of the second power supply system), a fuse F**1**, and a fuse F**2**.

The DC-DC converter portion **321** is connected to the power supply line of the power-system power supply PWR, and is thus supplied with the voltage of the power-system power supply PWR. The DC-DC converter portion **321** generates the diaphragm driving power supply Von which is converted into the voltage stepped up to a predetermined voltage from the voltage of the power-system power supply PWR. The power supply line of the diaphragm driving power supply Vm, which is generated by the DC-DC converter portion **321**, is connected to the input terminal of the first regulator portion **322** and the diaphragm interlocking lever driving section **330** through the fuse F**1**, thereby supplying the voltage of the diaphragm driving power supply Yin.

The first regulator portion **322** has, for example, the first linear regulator, and thus generates the lens control system power supply Vc of which the voltage is stabilized by stepping down the voltage of the diaphragm driving power supply Vm. In addition, the power supply line of the lens control system power supply Vc is connected to the terminal Tc**3** described in FIG. **3**.

Further, the input terminal of the second regulator portion **323** is connected to the power supply line of the power-system power supply PWR, and is thus supplied with the voltage of the power-system power supply PWR. The second regulator portion **323** has, for example, the second linear regulator, and thus generates the lens driving system power supply Vp of which the voltage is stabilized by stepping down the voltage of the power-system power supply PWR. The second regulator portion **323** is a regulator which is able to supply a larger amount of power feeding than the first regulator portion **322**. In addition, the power supply line of the lens driving system power supply Vp is connected to the terminal Tc**2** described in FIG. **3** through the fuse F**2**.

The connection positions of the fuses are not limited to the connection positions of the fuse F**1** and the fuse F**2** shown in the drawing. For example, a fuse, which is connected in series to the power supply line of the diaphragm driving power supply Vm, may be configured to be connected in series to each of the power supply lines divided into the power supply line, which is connected to the diaphragm interlocking lever driving section **330**, and the power supply line, which is connected to the first regulator portion **322**. Further, a fuse may be configured to be connected in series to the power supply line of the lens control system power supply Vc. Furthermore, the fuse F**2**, which is connected in series to the power supply line of the lens driving system power supply Vp is connected in series to the second regulator portion **323** side relative to the connection point between the power supply line of the lens driving system power supply Vp and the Vp-voltage detection portion **326**. However, the fuse F**2** may be configured to be connected in series to the side of the terminal Tc**2** relative to the corresponding connection point. Further, likewise, when a fuse is connected in series to the power supply line of the lens control system power supply Vc, the fuse may also be configured to be connected in series to either one of the first regulator portion **322** side and the terminal Tc**3** side relative to the connection point between the power supply line of the lens control system power supply Vc and the Vc-voltage detection portion **325**.

The fuses protect electric circuits by cutting off current when an undesirable large current greater than or equal to the rated current flows into each power supply line.

Further, the signal line of the control signal CTL**1** is connected to the control signal output terminal of the adapter control section **310** and the DC-DC converter portion **321** (for example, the control terminal for output control provided in the DC-DC converter portion **321**). The DC-DC converter portion **321** controls the supply state of the voltage of the diaphragm driving power supply Vm on the basis of the control signal CTL**1**, which is supplied from the adapter control section **310**, so as to change the state into a power feeding state (a state in which the voltage is supplied) or a cut-off state (a state in which the voltage supply is stopped). For example, when the control signal CTL**1** is in an H (high) state, the DC-DC converter portion **321** controls the voltage of the diaphragm driving power supply Vm such that it attains the power feeding state. Further, when the control signal CTL**1** is in an L (low) state, the DC-DC converter portion **321** controls the voltage of the diaphragm driving power supply Vm such that it attains the cut-off state.

In addition, in the first regulator portion **322**, in response to the supply of the voltage of the diaphragm driving power supply Vm, the voltage of the lens control system power supply Vc is fed, and in response to the supply stop of the voltage of the diaphragm driving power supply Vm, the voltage of the lens control system power supply Vc is cut off. That is, the supply state of the voltage of the lens control system power supply Vc generated in the first regulator portion **322** is controlled on the basis of the control signal CTL**1** similarly to the supply state of the voltage of the diaphragm driving power supply Vm.

Further, the signal line of the control signal CTL**2** is connected to the control signal output terminal of the adapter control section **310**, and the second regulator portion **323** (for example, the control terminal for output control provided in the second regulator portion **323**). The second regulator portion **323** controls the supply state of the voltage of the lens driving system power supply Vp on the basis of the control signal CTL**2**, which is supplied from the adapter control section **310**, so as to change the state into a power feeding state (a state in which the voltage is supplied) or a cut-off state (a state in which the voltage supply is stopped). For example, when the control signal CTL**2** is in an H (high) state, the second regulator portion **323** controls the voltage of the lens driving system power supply Vp such that it attains the power feeding state. Further, when the control signal CTL**2** is in an L (low) state, the second regulator portion **323** controls the voltage of the lens driving system power supply Vp such that it attains the cut-off state.

The voltage detection terminal of the Vc-voltage detection portion **325** is connected to the power supply line of the lens control system power supply Vc. Thereby, the Vc-voltage detection portion **325** detects the voltage of the lens control system power supply Vc, and supplies the detection signal Vc_sen to the adapter control section **310**. For example, the signal line of the detection signal Vc_sen, which is supplied from the Vc-voltage detection portion **325** to the adapter control section **310**, is connected to the A/D conversion (analog/digital conversion) input terminal of the adapter control section **310**.

Further, the voltage detection terminal of the Vp-voltage detection portion **326** is connected to the power supply line of the lens driving system power supply Vp. Thereby, the Vp-voltage detection portion **326** detects the voltage of the lens driving system power supply Vp, and supplies the detection signal Vp_sen to the adapter control section **310**. For example, the signal line of the detection signal Vp_sen, which is supplied from the Vp-voltage detection portion **326** to the adapter control section **310**, is connected to the A/D conversion input terminal of the adapter control section **310**.

Further, the voltage detection terminal of the PWR voltage detection portion **327** is connected to the power supply line of the power-system power supply PWR. Thereby, the PWR voltage detection portion **327** detects the voltage of the power-system power supply PWR, and supplies the detection signal PWR sen to the adapter control section **310**. For example, the signal line of the detection signal PWR sen, which is supplied from the PWR voltage detection portion **327** to the adapter control section **310**, is connected to the A/D conversion input terminal of the adapter control section **310**.

The diaphragm interlocking lever driving section **330** includes a stepping motor **335** as the diaphragm driving actuator, a motor driving portion **331**, and a diaphragm interlocking lever position detection portion **332**.

The stepping motor **335** is a power source that drives the diaphragm interlocking lever **350**, and is driven by the motor driving portion **331**.

The motor driving portion **331** generates the pulse voltage and drives the stepping motor **335**, through the control of the adapter control section **310**. Further, the diaphragm interlocking lever position detection portion **332** includes, for example, a photo-interrupter, and detects the position of the diaphragm interlocking lever **350**.

The power supply line of the diaphragm driving power supply Vm, which is generated by the DC-DC converter portion **321**, is connected to the motor driving portion **331** and the diaphragm interlocking lever position detection portion **332**, and thus supplies the voltage of the diaphragm driving power supply Vm to them.

Further, the power supply line of the control system power supply Vcc**1** is connected to the adapter control section **310** and the motor driving portion **331**, and thus supplies the voltage of the control system power supply Vcc**1** to them.

The control system ground SGND is connected as a ground, which corresponds to the control system power supply Vcc**1**, to the adapter control section **310**, the motor driving portion **331**, the first regulator portion **322**, and the Vc-voltage detection portion **325**.

Further, the power system ground PGND is connected as a ground, which corresponds to the power-system power supply PWR, to the DC-DC converter portion **321**, the second regulator portion **323**, the Vp-voltage detection portion **326**, the PWR voltage detection portion **327**, the motor driving portion **331**, and the diaphragm interlocking lever position detection portion **332**.

As described above, the adapter **300** generates the voltage of the lens driving system power supply Vp and the voltage of the lens control system power supply Vc, which are supplied to the interchangeable lens **200**, from the voltage of the power-system power supply PWR, between the voltage of the control system power supply Vcc**1** and the voltage of the power-system power supply PWR which are supplied from the camera body **100**. That is, the adapter control section **310** is supplied with the voltage of the control system power supply Vcc**1** from the camera body **100**, and the lens control section **210** of the interchangeable lens **200** is supplied with the voltage of the lens control system power supply Vc which is generated from the power-system power supply PWR in the adapter **300**. Further, the optical system driving section **230** of the interchangeable lens **200** is supplied with the voltage of the lens driving system power supply Vp which is generated from the power-system power supply PWR in the adapter **300**.

Thereby, the adapter **300** is able to generate and supply a voltage for driving the interchangeable lens **200** from the power-system power supply PWR supplied from the camera body **100**. For example, in contrast with the amount of power feeding supplied to both the adapter control section **310** and the lens control section **210**, the amount of power feeding of the control system power supply Vcc**1** supplied from the camera body **100** may be insufficient. Even in this case, the adapter **300** is able to feed a voltage to both the adapter control section **310** and the lens control section **210** without a shortage of an amount of power feeding, and is able to feed a voltage to the optical system driving section **230**. Accordingly, by connecting the camera body **100** and the interchangeable lens **200** through the adapter **300**, the interchangeable lens **200** can be caused to function by driving it through the camera body **100**.

Further, the adapter **300** supplies the voltage of the lens driving system power supply Vp to the load with large power consumption in contrast with the power consumption of the load to which the voltage of the lens control system power supply Vc is supplied. That is, the adapter **300** generates the lens control system power supply Vc as a power supply system that supplies a voltage to the lens control section **210**, and generates the lens driving system power supply Vp, which is able to supply a larger amount of power feeding than the lens control system power supply Vc, as a power supply system that supplies a voltage to the optical system driving section **230**. Thereby, the adapter **300** is able to appropriately supply a voltage to the lens control section **210** and the optical system driving section **230**. Accordingly, the adapter **300** is able to appropriately supply a voltage for driving the interchangeable lens **200**.

Further, the adapter **300** generates the voltage of the diaphragm driving power supply Vm by converting the voltage of the power-system power supply PWR into a voltage which is stepped up to a predetermined voltage through the DC-DC converter portion **321**, and is thus able to supply a stabilized voltage to the diaphragm interlocking lever driving section **330**. Furthermore, the adapter **300** generates the lens control system power supply Vc of which voltage is stabilized by stepping down the voltage of the diaphragm driving power supply Vm to a predetermined voltage through the first regulator portion **322**, and is thus able to supply a voltage, which is less affected by voltage noise of the driving system, to the lens control section **210**. Further, the adapter **300** generates the voltage of the lens driving system power supply Vp by converting the voltage of the power-system power supply PWR into a voltage which is stepped down to a predetermined voltage through the second regulator portion **323**, and is thus able to supply a stabilized voltage to the optical system driving section **230**.

Other Forms of Interchangeable Lens

Next, other forms of the interchangeable lens will be described.

The lens, which can be caused to function by connecting it to the camera body **100** through the adapter **300**, is not limited to the interchangeable lens **200** described with reference to FIG. **3**. Not only the interchangeable lens **200** but also various interchangeable lenses can be caused to function by connecting them to the camera body **100** through the adapter **300**.

In addition, the interchangeable lens **200** described with reference to FIG. **3** has a lens control section **210** capable of communication. Thus, in the interchangeable lens, on the basis of the communication result, the lens control section **210** controls the optical system driving section **230**. The interchangeable lens **200** is also referred to as a CPU (Central Processing Unit) lens in the following technique.

Non-CPU Lens

On the other hand, as shown in FIG. **5**, an interchangeable lens **200**B, which does not have a lens control section capable of communication, may be caused to function by connecting it to the camera body **100** through the adapter **300**.

FIG. **5** is a schematic block diagram illustrating an example of a configuration of a camera system **1**B including the interchangeable lens **200**B which does not have the lens control section capable of communication. In the drawing, the elements corresponding to the respective sections of FIG. **3** are represented by the same reference numerals and signs, and description thereof will be omitted.

In the drawing, the interchangeable lens **200**B is mounted on the camera body **100** with the adapter **300** interposed therebetween.

For example, the interchangeable lens **200**B is a lens with specification in which the optical system is not electrically driven, and the lens includes a focus ring **260**B by which the position of the focus lens **222**B can be adjusted through user's operation, and a diaphragm ring **255**B by which the aperture degree of the diaphragm mechanism **251**B can be changed through user's operation. Further, the interchangeable lens **200**B shown in FIG. **5** is different from the interchangeable lens **200** shown in FIG. **3** in that the interchangeable lens **200**B does not include the lens control section, the optical system driving section, and the electric connection terminal.

In addition, in the interchangeable lens **200**B, a user operates the diaphragm ring **255**B, thereby changing the diaphragm aperture diameter (aperture degree, aperture value) of the diaphragm mechanism **251**B. Hence, the adapter control section **310** controls the diaphragm interlocking lever **350** so as to move it to the retractable position (a position at which the lever does not interfere with movement) as a position which does not interfere with the position of the diaphragm lever **25213** of which the position is moved by changing the diaphragm aperture diameter (aperture degree, aperture value) of the diaphragm mechanism **251**B.

Thereby, the interchangeable lens **200**B can be connected to the camera body **100** through the adapter **300**, and can be caused to function by a manual operation in accordance with the specification of the interchangeable lens **200**B.

The interchangeable lens **200**B is referred to as a Non-CPU lens in the following description.

Electromagnetic-Diaphragm-Type CPU Lens

Further, as shown in FIG. **6**, an electromagnetic-diaphragm-type interchangeable lens **200**C, which electrically drives a diaphragm mechanism **251**C, can be connected to the camera body **100** through the adapter **300**.

FIG. **6** is a schematic block diagram illustrating an example of a configuration of a camera system **1**C including the electromagnetic-diaphragm-type interchangeable lens **200**C. In the drawing, the elements corresponding to the respective sections of FIG. **3** are represented by the same reference numerals and signs, and description thereof will be omitted.

In the drawing, the interchangeable lens **200**C is mounted on the camera body **100** with the adapter **300** interposed therebetween.

The interchangeable lens **200**C shown in FIG. **6** is different from the interchangeable lens **200** shown in FIG. **3** in that the interchangeable lens **200** includes the diaphragm section **250** having the diaphragm lever **252** but the interchangeable lens **200**C includes an electromagnetic diaphragm section **250**C having a diaphragm driving portion **233**C.

For example, the interchangeable lens **200**C is a lens that includes the electromagnetic diaphragm section **250**C (EMD (Electro-magnetic Diaphragm). The electromagnetic diaphragm section **250**C has the diaphragm mechanism **251**C and the diaphragm driving portion **233**C.

The diaphragm driving portion **233**C performs electrical driving to change the aperture diameter (aperture size, size, aperture degree, aperture value) of the diaphragm of the diaphragm mechanism **251**C through the control of the optical system control portion **211**C provided in the lens control section **210**C. Further, the diaphragm driving portion **233**C is configured to include, for example, a diaphragm driving actuator.

In addition, in the configuration shown in the drawing, when the adapter **300** controls the diaphragm mechanism **251**C, the adapter control section **310** communicates with the lens control section **210**C instead of controlling the diaphragm interlocking lever driving section **330**, thereby controlling the diaphragm mechanism **251**C through the diaphragm driving portion **233**C.

Thereby, the interchangeable lens **200**C can be connected to the camera body **100** through the adapter **300**, and the camera control section **110** communicates with the lens control section **210**C through the adapter control section **310**, whereby it is possible to cause the interchangeable lens **200**C to function.

The interchangeable lens **200**C is referred to as an electromagnetic-diaphragm-type CPU lens in the following description.

Standard Compatible Lens

In addition, FIG. **7** is a schematic block diagram illustrating an example of a configuration of a camera system **1**A in the ease where a lens-side mount **201**A of an interchangeable lens **200**A and the camera body-side mount **101** of the camera body **100** are lens mounts having the same specification.

That is, the interchangeable lens **200**A is a lens appropriate for the lens mount specification and the communication standard of the camera body **100**, and is a lens which can be caused to function by directly connecting it to the camera body **100** without the adapter **300**.

In the drawing, the elements corresponding to the respective sections of FIG. **3** or **6** are represented by the same reference numerals and signs, and description thereof will be omitted.

The respective sections of an optical system **220**A and an optical system driving section **230**A of FIG. **7** have the same configuration as the respective sections of the optical system **220** and the optical system driving section **230** of FIG. **3** or **6**. Further, the respective sections of a diaphragm section **250**A have the same configuration as the respective sections of the electromagnetic diaphragm section **250**C of FIG. **6**.

The specification of the lens-side mount **201**A of the interchangeable lens **200**A is a specification which is compatible with the camera body-side mount **101** of the camera body **100** and in which the lens can be mounted on the camera body.

A connection section **201**As of the lens-side mount **201**A is connection terminals which are connected to the connection terminals of the connection section **101**s provided in the camera body **100**, and has twelve connection terminals of terminals Te**1** to Te**12**. The interchangeable lens **200**A and the camera body **100** are connected through the connection section **201**As and the connection section **101**s. Thereby, the respective terminals of the terminal Te**1** to Te**12** of the connection section **201**As are connected to the corresponding connection terminals among the respective connection terminals of the terminals Ta**1** to Ta**12** of the connection section **101**s. In addition, the connection section **201**As and the connection section **101**s are electrically connected.

The terminal Te**2** is connected to the terminal Ta**2** of the camera body **100**, and is supplied with the voltage of the power-system power supply PWR from the camera body **100**. The voltage of the power-system power supply PWR supplied to the terminal Te**2** is a voltage (a voltage corresponding to the voltage of the lens driving system power supply Vp supplied to the interchangeable lens **200**) of the lens driving system power supply supplied to the optical system driving section **230**A of the interchangeable lens **200**A.

Further, the terminal Te**3** is connected to the terminal Ta**3** of the camera body **100**, and is supplied with the voltage of the control system power supply Vcc from the camera body **100**. The voltage of the control system power supply Vcc supplied to the terminal Te**3** is a voltage (a voltage corresponding to the voltage of the lens control system power supply Vc supplied to the interchangeable lens **200**) of the lens control system power supply supplied to the lens control section **210**A of the interchangeable lens **200**A.

The lens control section **210**A includes an optical system control portion **211**A, a first lens communication portion **212**A, and a second lens communication portion **213**A. The optical system control portion **211**A controls the optical system driving section **230**A and a diaphragm driving portion **233**A of the diaphragm section **250**A.

The first lens communication portion **212**A and the first camera communication portion **112** performs communication of the first data communication system D**1**b through the signal lines for the four types of signals RDY, CLK**1**, DATAB, and DATAL. Further, the second lens communication portion **213**A and the second camera communication portion **113** performs communication of the second data communication system D**2**b through signal lines for four types of signals HREQ, HANS, HCLK, and HDATA.

As described above, the interchangeable lens **200**A is supplied with the voltage of the power-system power supply PWR as a voltage of the lens driving system power supply from the camera body **100**, and is supplied with the voltage of the control system power supply Vcc as a voltage of the lens control system power supply. Further, the first lens communication portion **212**A and the first camera communication portion **112** are based on the same communication standard, and perform command data communication. Further, the second lens communication portion **213**A and the second camera communication portion **113** are based on the same communication standard, and perform hotline communication.

Thereby, the interchangeable lens **200**A can be directly connected to the camera body **100** through the adapter **300**, and the camera control section **110** is able to cause the interchangeable lens **200**A to function by communicating with the lens control section **210**A.

The interchangeable lens **200**A is referred to as a standard compatible lens in the following description.

Description of State Shift

Next, processes of the present embodiment will be described.

First, referring to FIG. **8**, a brief overview of the state shift according to the present embodiment will be described.

FIG. **8** is a flowchart illustrating a brief overview of the state shift between the processes relating to the interchangeable lens according to the present embodiment.

First, in the camera body **100**, when the main power supply of the camera body **100** is turned on, or when the adapter **300** is mounted in a state where the main power supply of the camera body **100** is turned on, the adapter **300** executes a "lens activation process" through the control of the camera body **100** (step S**100**).

Here, the "lens activation process" includes, for example, a process of determining detachment of the camera body-side mount **101** of the camera body **100**, a process of initializing the adapter **300** and the interchangeable lens **200** mounted on the adapter **300**, a process of controlling feeding a voltage to each power supply system, and the like. Further, for example, in the lens activation process, the camera body **100** acquires information on the specification (function) and the type of the interchangeable lens **200** which is mounted on the camera body **100** with the adapter **300** interposed therebetween. The lens activation process will be described in detail in the section of the "lens activation process" (FIG. **12**) to be described later.

In step S**100**, if the lens activation process is complete, the adapter **300** shifts the process to a "lens routine process" through the control of the camera body **100** (step S**200**).

The "lens routine process" is, for example, a state where the photography process is possible after the lens activation process is complete. In the lens routine process, the camera body **100** performs, for example, "routine communication" by which detection of the mount state of the interchangeable lens **200** mounted thereon with the adapter **300** interposed therebetween and acquisition of the information of the optical system are performed with a predetermined period. The lens routine process will be described later with reference to FIGS. **9** and **10**.

Next, the camera body **100** or the adapter **300** determines whether or not an interrupt request is issued in the lens routine process (step S**300**). In step S**300**, if it is determined that the interrupt request is absent, the adapter **300** continues the lens routine process through the control of the camera body **100**. In contrast, in step S**300**, if it is determined that the interrupt request is present, the camera body **100** or the adapter **300** shifts the process to a requested interrupt process (step S**400**). Here, the interrupt process includes, for example, a process of starting photography through a release operation, a process at the time of temporary blackout of power supply, a process of advancing to a lower power consumption mode or cutting off a power supply by turning off the power supply, and the like. The processes will be described later.

In addition, in a case of directly mounting the standard compatible lens (for example, the interchangeable lens **200**A) on the camera body **100** instead of mounting the adapter **300** thereon, the process state shift is as shown in FIG. **8**.

Description of Command Data Communication in Lens Routine Process

Next, command data communication performed in the lens routine process (step S**200** of FIG. **8**) will be described.

FIG. **9** is a diagram illustrating an example of a communication sequence of the command data communication in the lens routine process.

The drawing shows an example of the command data communication using the exemplary camera system **1** in which the interchangeable lens **200** (CPU lens) and the camera body **100** are connected through the adapter **300**. The adapter control section **310** is able to routinely perform periodic communication with the camera control section **110**. By performing the periodic communication, in response to the request from the camera control section **110**, the adapter control section transmits the lens information (the information of the optical system **220** and the like), which is acquired from the lens control section **210**, to the camera control section **110**.

For example, in the "lens routine process" shown in FIG. **9**, the first adapter communication portion **312** asynchronously performs first regular communication to communicate with the lens control section **210** provided in the interchangeable lens **200** in a period Tf (first communication period), and second regular communication to communicate with the camera control section **110** provided in the camera body **100** in a period Tm (second communication period).

The first adapter communication portion **312** performs the communication of the first data communication system D**1**L (first regular communication) to communicate with the first lens communication portion **212** in the period Tf (for example, a period for each 64 msec) (steps S**2010** and S**2020**).

Here, the communication of the first data communication system D**1**L (first regular communication) in the lens routine process is referred to as "lens routine communication". Through the lens routine communication, the first adapter communication portion **312** acquires lens information (information of the optical system **220** and the like (first information)) from the first lens communication portion **212**.

Further, the first adapter communication portion **312** generates, lens information (information of the optical system **220** and the like (second information)) to be transmitted to the first camera communication portion **112** on the basis of the lens information acquired in step S**2010** (step S**2015**). For example, the first adapter communication portion **312** performs data conversion on data of the lens information (information of the optical system **220** and the like) acquired in step S**2010** so as to make it appropriate for the communication standard of the first data communication system D**1**b, and generates information to be transmitted to the first camera communication portion **112**.

Likewise, the first adapter communication portion **312** generates information to be transmitted to the first camera communication portion **112** through data conversion on the basis of the lens information (information of the optical system **220** and the like) acquired in step S**2020** (step S**2025**).

That is, the first adapter communication portion **312** generates the lens information (information of the optical system **220** and the like) to be transmitted to the first camera communication portion **112** in accordance with communication timing (communication timing of the period Tf) of the lens routine communication.

Regarding the above-mentioned communication of the first data communication system D**1**L, the first adapter communication portion **312** performs the communication of the first data communication system D**1**b (second regular communication) with the first camera communication portion **112** in the period Tm (for example, a period for each 16 msec) which is asynchronous to the communication (first regular communication) period Tf with the interchangeable lens **200** in the first data communication system D**1**L (steps S**1010**, S**1015**, S**1020**, and S**1025**). The communication period Tm is a communication period with a speed higher than that of the communication period Tf.

Here, the communication of the first data communication system D1b (second regular communication) in the lens routine process is referred to as "routine communication". The routine communication includes a lens attachment/detachment detection process (lens attachment/detachment detection) and a routine data communication process (hereinafter referred to as "routine data communication").

The lens attachment/detachment detection process of each step is a process in which the first adapter communication portion **312** responds with the detection result to the lens attachment/detachment detection instruction command issued from the first camera communication portion **112**. The first adapter communication portion **312** detects the detachment of the interchangeable lens **200** on the basis of whether or not the response of the lens routine communication from the first lens communication portion **212** is present, and transmits the detection result to the first camera communication portion **112**.

The routine data communication of each step is a communication process in which the first camera communication portion **112** acquires the lens information (information of the optical system **220** and the like) generated by the first adapter communication portion **312**. That is, in the routine data communication, the first camera communication portion **112** transmits a request command for requesting transmission of the lens information (information of the optical system **220** and the like) to the first adapter communication portion **312**, and executes a process of receiving (acquiring) the lens information (information of the optical system **220** and the like) from the interchangeable lens **200** through the adapter **300**, in accordance with the response (the transmission from the adapter to the camera side) from the first adapter communication portion **312** which receives the command. Since the request command is periodically transmitted in the routine data communication, the first camera communication portion **112** repeatedly performs the acquisition (reception) operation of the lens information whenever the routine data communication is performed. For example, the first camera communication portion **112** acquires, through the routine data communication of step **S1010**, the lens information (second information) which is generated on the basis of the lens information (information of the optical system **220** and the like; first information) acquired by the first adapter communication portion **312** before the lens routine communication of step **S2010**. Further, the first camera communication portion **112** acquires, through the routine data communication of steps **S1015** and **S1020**, the lens information (second information) which is generated on the basis of the lens information (information of the optical system **220** and the like; first information) acquired by the first adapter communication portion **312** in the lens routine communication of step **S2010**. Further, the first camera communication portion **112** acquires, through the routine data communication of step **S1025**, the lens information (second information) which is generated on the basis of the lens information (information of the optical system **220** and the like) acquired by the first adapter communication portion **312** in the lens routine communication of step **S2020**.

That is, the first adapter communication portion **312** transmits (responds with) the lens information which is generated as described above, to the first camera communication portion **112** in the period Tm of the routine data communication.

As described above, in the command data communication, the adapter control section **310** generates the lens information (second information) to be transmitted to the camera control section **110**, on the basis of the lens information (information of the optical system **220** and the like; first information) acquired from the interchangeable lens **200** by the lens routine communication of the period Tf. Further, the adapter control section **310** transmits the generated lens information (second information) to the camera control section **110** through the routine data communication of the period Tm.

Thereby, the adapter control section **310** is able to smoothly and reliably transmit, without delay, the lens information which is acquired and generated through the lens routine communication of the period Tf, to the camera control section **110** through the routine data communication of the period Tm which is asynchronous to the period Tf.

Accordingly, by communicating with the camera control section **110**, the adapter control section **310** is able to transmit the lens information which is acquired from the lens control section **210**, to the camera control section **110** without delay, in response to the request from the camera control section **110**.

In addition, referring to FIG. **9**, the description was given of the process in which the first adapter communication portion **312** generates the lens information (information of the optical system **220** and the like) to be transmitted to the first camera communication portion **112** in accordance with the communication timing (communication timing of the period Tf) of the lens routine communication, but the present invention is not limited to this. For example, the first adapter communication portion **312** may generate the lens information (information of the optical system **220** and the like) to be transmitted to the first camera communication portion **112**, in accordance with the communication timing (communication timing of the period Tm) of the routine data communication.

Thereby, the adapter control section **310** generates the lens information to be transmitted to the camera control section **110** in accordance with the timing of the period Tm, which is asynchronous to the period Tf, from the lens information (information of the optical system **220** and the like) acquired through the lens routine communication of the period Tf, and is able to transmit the generated lens information to the camera control section **110** through the routine data communication.

Further, referring to FIG. **9**, the description was given of the process in which the period Tf of the communication between the first adapter communication portion **312** and the lens control section **210** is asynchronous to the period Tm of the communication between the first adapter communication portion **312** and the camera control section **110**, but in the process, the period Tf and the period Tm may be synchronous to each other.

Description of Lens Routine Communication

Specifically, in the "lens routine communication" which is communication with the period Tf, the communication is divided into a plurality of communications (for example, eight communications; the time necessary for a single communication is about 8 ms), and the communications are performed in a single period (for example, a period of 64 ms). The plurality of communications includes: a communication which is performed in order for the first adapter communication portion **312** to acquire information from the lens control section **210**; and a communication through which information (setting instruction) is output from the first adapter communication portion **312** to the lens control section **210**.

The first adapter communication portion **312** communicates with the first lens communication portion **212** a plurality of times in the lens routine communication, thereby acquiring the (information of the optical system **220**, information of the diaphragm section **250**, and the like; first information) from the first lens communication portion **212** for each time. Further, the first adapter communication portion **312** generates lens information to be transmitted to the first camera communication portion **112** through the routine data communication, on the basis of a plurality of lens informations, which are acquired through communications different from one another, among the lens informations which are acquired through the plurality of communications. Then, the first adapter communication portion **312** transmits the generated lens information (second information) to the first camera communication portion **112**, in response to the request from the first camera communication portion **112**.

FIG. **10** is a diagram illustrating an example of communication commands which are divisionally communicated through the plurality of communications in a single period of the lens routine communication.

As shown in the drawing, in the lens routine communication, for example, communication commands D**1** to D**8** to transmit and receive the communication data are provided, and are sequentially communicated during a time period of the single period of the lens routine communication. In the example shown in the drawing, during the time period of the single period, by sequentially communicating the communication commands D**1** to D**8** of the lens routine communication, the eight communications are performed.

In addition, in the communication commands D**1** to D**8** to transmit or receive the communication data in the lens routine communication, the following commands are present: a command to cause the adapter **300** side to acquire the lens information on the interchangeable lens **200** from the interchangeable lens **200** side; and a command to send information or instruction (setting instruction) from the adapter **300** side to the interchangeable lens **200** side. As the command to acquire the information on the interchangeable lens **200**, for example, there are provided: the communication commands D**1**, D**4**, and D**5** to communicate the information of the optical system **220** and the information indicating the driving status; and the communication command D**6** to acquire the information on the electromagnetic diaphragm.

Further, as the command to send information or instruction (setting instruction) from the adapter **300** side to the interchangeable lens **200** side, there are provided: the communication command D**2** to communicate the information (for example, information indicating whether or not the release button is pressed halfway) which indicates the operation state of the camera body **100**; the communication command D**3** to communicate the setting information (setting instruction) of the hotline communication; and the communication commands D**7** and D**8** to communicate the instructions (setting instruction) for vibration-proof control (control of the VR lens **223**). In addition, the respective functions of the interchangeable lenses are different in accordance with respective specifications of the interchangeable lenses (the interchangeable lens **200** or other interchangeable lenses). Hence, the communication command, which is selected among the communication commands D**1** to D**8** in accordance with the specification (function) of the interchangeable lens (in accordance with the class or the type of the interchangeable lens), is communicated.

For example, by checking the specification (function) of the interchangeable lens such as presence or absence of the VR lens **223** (presence or absence of the vibration-proof function) or presence or absence of the electromagnetic diaphragm function, an unnecessary communication command is not communicated.

That is, the first adapter communication portion **312** acquires the information of the optical system **220** by dividing the information into a plurality of informations through the plurality of communications, and generates the information of the optical system **220** as unified information corresponding to the plurality of informations divisionally acquired.

The information which corresponds to the plurality of informations is information into which the plurality of informations is data-converted in accordance with the communication standard and the like.

The first adapter communication portion **312** sequentially communicates the eight types of the communication commands D**1** to D**8** in the single period of the lens routine communication (as described above, among them, the four types of communication commands D**2**, D**3**, D**7**, and D**8** are commands to communicate information and instructions to the interchangeable lens **200** side, and the remaining four types of the communication commands D**1**, D**4**, D**5**, and D**6** are commands to acquire the information from the interchangeable lens **200**). Thereby, the communication portion acquires (receives) the information on the optical system **220**, the information on the diaphragm section **250**, and the various kinds of the other lens information by dividing them into the four types of informations (by divisionally communicating them in four times), and divisionally transmits four types of information instructions to the interchangeable lens **200**.

Further, the first adapter communication portion **312** generates the information of the optical system **220** to be transmitted to the first camera communication portion **112**, on the basis of the information which is divisionally acquired for each of the four communications in the single period. Here, regarding the information of the lens (for example, the optical system **220**) generated by the first adapter communication portion **312** in the single period (in other words, the information to be transmitted to the first camera communication portion **112**), each information divisionally acquired is not generated for each reception of the communications and transmitted to the camera body **100**. Instead, on the basis of all the informations divisionally received in the single period (in the present embodiment, all the lens informations divisionally received in four times), the lens information to be transmitted is generated, and the generated lens information is transmitted to the camera body **100**. That is, the lens information to be transmitted to the camera body **100** is not only the respective informations, which are divisionally acquired, but also the information in which all the four types of the informations received (four times) are collected (unified in order to be transmitted to the camera body **100**) (in other words, the adapter **300** does not divisionally transmit the respective lens informations, which are divisionally received four times in the interchangeable lens **200**, to the camera body **100** through the respective four communications, but transmits them to the camera body **100** once). With such a configuration, it is possible to suppress the frequency of communications between the adapter **300** and the camera body **100**. Thus, it is possible to reduce the processing load to both control sections (the adapter control section **310** and the camera control section **110**).

In addition, the first adapter communication portion **312** generates, in a prescribed format, the lens information (information of the optical system **220**), which is to be transmitted to the first camera communication portion **112** through the "routine data communication" (refer to FIG. **9**), on the basis of the lens information (for example, the information of the optical system **220**) which is acquired through the "lens routine communication" (refer to FIG. **9**).

Here, the prescribed format is a format which is prescribed by the communication standard of the command data communication of the first data communication system D**1**b between the first adapter communication portion **312** and the first camera communication portion **112**, and is also a format in which the data configuration to transmit the information of the optical system **220** and the like are prescribed. For example, the data configuration of information indicating the type of the optical system **220**, information indicating the driving status of the focus lens **222**, information indicating the driving status of the VR lens **223**, and the like, as the information of the optical system **220**, is prescribed.

As described above, the first adapter communication portion **312** converts the lens information (information of the optical system **220**), which is acquired as the plurality of informations divided through the plurality of communications in the "lens routine communication", into the (singly unified) information in which they are unified in the prescribed format, and transmits the information through the single communication in the "routine data communication". That is, the first adapter communication portion **312** converts communication data, which is transmitted and received in the communication format of the "lens routine communication", into communication data which is transmitted and received in the communication format of the "routine data communication".

Accordingly, the adapter **300** is provided between the camera body **100** and the interchangeable lens **200** having mutually different communication standard, and is thereby able to acquire the information of the optical system **220** of the interchangeable lens **200** and transmit the information to the camera body **100**.

The embodiment described an example in which all the lens informations, which are divisionally acquired a plurality of times, are unified, and the unified information is transmitted to the camera body **100**, but not all of them may be used.

For example, by selecting some (for example, two or three) of the informations which are received a plurality of times (in the above description, four times), the selected informations may be unified and transmitted.

Further, the adapter **300** is configured to transmit the lens information which is acquired from the lens **200**, in combination with the contents to be transmitted (so as to be appropriate for the request from the camera body **100**) not only in accordance with the communication format of the "routine data communication" but also in response to the request command from the camera body **100** (on the basis of the analysis of the request command). Therefore, the adapter is compatible with various request commands from the camera body **100**.

Communication Process of Detecting Driving Status of Driving Element (or Optical System Driving Section) of Interchangeable Lens

Next, the communication process of the driving status of the driving element (the optical system **220** or the diaphragm section **250**) or the optical system driving section **230** of the interchangeable lens **200** will be described.

The adapter control section **310** receives the control command output from the camera control section **110** (for example, the first reception section of the first adapter communication portion **312** performs the reception), and transmits a lens control command, depending on the contents (the contents received by the first reception section) of the received control command, for controlling the driving of the optical system driving section **230** (in other words, the driving element such as the optical system **220** or the diaphragm section **250** in the interchangeable lens **200**), to the lens control section **210** (for example, the first transmission section of the first adapter communication portion **312** performs the transmission). Further, after transmitting the corresponding lens control command, the adapter control section **310** receives status information which indicates the driving status of the optical system driving section **230**, from the lens control section **210** (for example, the second reception section of the first adapter communication portion **312** performs the reception), and on the basis of the received contents (the contents received by the second reception section), transmits the status information which indicates the driving status of the driving element, to the camera control section **110** (for example, the second transmission section of the first adapter communication portion **312** performs the transmission).

That is, after transmitting the lens control command for the optical system driving section **230** to the lens control section **210**, the adapter control section **310** receives the status information which indicates the driving status of the optical system driving section **230**, from the lens control section **210**, and then transmits the status information to the camera control section **110**.

However, when transmitting a lens control command (first lens control command) for an instruction to start driving the driving element to the lens control section **210** (for example, when performing the transmission from the first transmission section), the adapter control section **310** transmits, regardless of the reception of the second reception section, the status information which indicates that the driving of the driving element is in progress, to the camera control section **110** (performs the transmission from the second transmission section).

For example, when receiving the lens control command to start the driving from the adapter control section **310**, the lens control section **210** drives the optical system driving section **230** in response to the instruction of the corresponding control command. Further, the lens control section **210** transmits, in response to the driving start of the optical system driving section **230**, status information which indicates that "the driving of the driving element in the interchangeable lens **200** is in progress", to the adapter control section **310**.

Here, the adapter control section **310** may be configured to wait for the reception of the status information from the lens through the lens routine communication, and then transmit the received status information to the camera control section **110** through the routine data communication. In such a configuration, regarding timing at which the driving of the optical system driving section **230** is started (that is, the driving is in progress), sometimes it may take time until the status information indicating that the driving is in progress is transmitted to the camera control section **110** (the timing of the reception by the camera control section **110** may be delayed).

The reason is that the lens routine communication and the routine data communication are asynchronous to each other and the communications are performed in mutually different periods. Further, another reason is that, in order for the adapter control section **310** to relay communication between the lens routine communication and the routine data communication as communication standards different from each other, a data conversion process is necessary.

As described above, in the adapter control section **310**, there is a time lag between the timing of the driving start of the optical system driving section **230** and the timing of the reception of the status information which indicates that "the driving is in progress", by the camera control section **110**. That is, in the camera control section **110**, even though the driving of the optical system driving section **230** is already in progress, there is a time period in which it is difficult to receive the status information which indicates that "the driving is in progress".

In order to reduce the above-mentioned time lag, the adapter control section **310** transmits the lens control command (first lens control command) to start the driving of the optical system driving section **230** to the lens control section **210** (for example, performs the transmission from the first transmission section), and then (immediately thereafter) transmits the status information (the status information which indicates the "driving-in-progress" status), which indicates that the driving is already in progress, to the camera control section **110** without waiting for the response (the response of the status information which indicates the driving status of the driving element) from the lens control section **210** (for example, without waiting for the reception by the second reception section).

In addition, the adapter control section **310** according to the present embodiment is configured to transmit the lens control command, which indicates the above-mentioned driving start, to the lens control section **210**, and then transmit the status information which indicates that "the driving is in progress", to the camera control section **110**. Regarding this sequence, for example, the operation sequence of the adapter control section **310** may be improved such that the above-mentioned lens control command is transmitted to the lens control section **210** and the "driving-in-progress" status information is transmitted to the camera control section **110**.

On the other hand, when the driving of the optical system driving section **230** is stopped, the adapter control section **310** acquires the response (status information), which indicates that the optical system driving section **230** is in a stopped state, from the lens control section **210**, and then transmits the status information which indicates the "driving stop status", to the camera control section **110**. That is, when stopping the driving of the optical system driving section **230**, the adapter control section **310** checks the actual stopped state (receives the response, which indicates the intent thereof, from the lens control section **210**), and then responds with the intent to the camera control section **110**.

FIG. **11** is a diagram illustrating an example of the communication sequence for detecting the driving status of the optical system driving section **230** (or the above-mentioned driving element).

Referring to the drawing, a description will be given of a process in which the adapter control section **310** communicates the driving status of the optical system driving section **230** (or the above-mentioned driving element).

In addition, the first camera communication portion **112** performs the routine data communication with the first adapter communication portion **312** in the period Tm (steps S**1032**, S**1036**, S**1038**, and S**1040**). Further, the first adapter communication portion **312** performs the lens routine communication with the first lens communication portion **212** in the period Tf (steps S**2034** and S**2038**).

First, when the camera control section **110** controls the optical system driving section **230** provided in the interchangeable lens **200**, the first camera communication portion **112** transmits a lens control command to control the optical system driving section **230** to the first adapter communication portion **312** (step S**1030**). For example, the first camera communication portion **112** transmits a lens control command (driving start command) to move the position of the focus lens **222** to a target position.

Next, the first adapter communication portion **312** converts the received lens control command (driving start command) into a lens control command (driving start command) to be transmitted to the first lens communication portion **212**, and transmits the converted lens control command (driving start command) to the first lens communication portion **212** (step S**2030**). Further, after transmitting the lens control command to the first lens communication portion **212**, the first adapter communication portion **312** sets the driving status to "driving in progress" without detecting the driving status of the optical system driving section **230** (step S**2032**). For example, in response to the lens control command to the position of the focus lens **222** to the target position, the first adapter communication portion **312** sets the status information which indicates the driving status of the focus lens **222**, to "driving in progress".

The first adapter communication portion **312** responds with the status information which is set to "driving in progress", to the first camera communication portion **112** through the routine data communication (step S**1032**). The first camera communication portion **112** detects that the status information is "driving in progress" through the routine data communication of step S**1032** (step S**1035**).

Further, the first lens communication portion **212** receives the lens control command which is transmitted from the first adapter communication portion **312** in step S**2030**. The optical system control portion **211** of the lens control section **210** controls the optical system driving section **230** such that it starts the driving thereof on the basis of the lens control command (driving start command) (step S**3030**). For example, in response to the lens control command to the position of the focus lens **222** to the target position, the optical system control portion **211** controls the optical system driving section **230** such that it starts driving the focus lens **222**.

Furthermore, in response to the driving start of the focus lens **222** through the control of the optical system driving section **230**, the optical system control portion **211** sets the status information provided in the interchangeable lens **200** to "driving in progress" which indicates that the driving status of the focus lens **222** is driving in progress (step S**3032**).

Next, the first lens communication portion **212** responds with the "driving-in-progress" status information which is set by the optical system control portion **211** in step S**3032** through the lens routine communication (step S**2034**). Then, the first adapter communication portion **312** acquires the "driving-in-progress" status information which is the response transmitted through the lens routine communication (step S**2036**). In addition, in step S**2036**, the first adapter communication portion **312** acquires only the "driving-in-progress" status information, and does not perform transmission to the first camera communication portion **112**.

Subsequently, when shift of the focus lens **222** to the target position is complete, the optical system control portion **211** controls the optical system driving section **230** such that it stops driving the focus lens **222** (step S**3034**). Further, in response to the stopping of the driving, the optical system control portion **211** sets the status information which is provided in the interchangeable lens **200**, to "driving stop" which indicates that the driving status of the focus lens **222** is a driving stop status (step S**3036**).

Next, the first lens communication portion **212** responds with the "driving stop" status information which is set by the optical system control portion **211** in step S**3036**, through the lens routine communication (step S**2038**). Then, the first adapter communication portion **312** acquires the "driving stop" status information which is the response transmitted through the lens routine communication (step S**2040**).

The first adapter communication portion **312** responds with the status information which is set to "driving stop", to the first camera communication portion **112** through the routine data communication (step S**1040**). The first camera communication portion **112** detects that the status information is "driving stop" through the routine data communication of step S**1040** (step S**1045**).

As described above, the first adapter communication portion **312** transmits a control command to start driving the optical system driving section **230** to the first lens communication portion **212**, then does not wait for the response from the first lens communication portion **212**, and transmits the status information (status information which indicates that the driving is in progress), which indicates the driving status, to the first camera communication portion **112**.

Further, when the driving of the optical system driving section **230** is stopped, the first adapter communication portion **312** acquires the response, which indicates that the optical system driving section **230** is in the stopped state, from the first lens communication portion **212**, and transmits the status information which indicates the driving status, to the first camera communication portion **112**.

Thereby, the first adapter communication portion **312** is able to reduce the time lag between the timing of the driving start of the optical system driving section **230** and the timing of the reception of the status information which indicates that the driving is in progress, by the first camera communication portion **112**.

Accordingly, in the first camera communication portion **112**, even though the driving of the optical system driving section **230** is in progress, it is possible to eliminate the time period in which it is difficult to receive the status information indicating that the driving is in progress. Further, when the driving of the optical system driving section **230** is stopped, the first adapter communication portion **312** detects that the driving is in the stopped state, and is then able to transmit the status information to the first camera communication portion **112**.

Lens Activation Process

Next, a lens activation process (the process of step S**100** in FIG. **8**) will be described.

First, a brief overview of the lens activation process will be given.

When the supply of the voltage of the control system power supply Vcc**1** from the camera body **100** is started (after the power feeding from the control system power supply Vcc**1** to the adapter control section **310** is started), the adapter control section **310** transmits a power-system power supply PWR request signal, which is for requesting the supply start of the voltage of the power-system power supply PWR, to the camera body **100**. That is, the adapter control section **310** is supplied with the voltage of the control system power supply Vcc**1** from the camera body **100**, and then transmits the power-system power supply PWR request signal, which is for requesting start of the power feeding from the power-system power supply PWR, to the camera body **100**.

Further, the adapter control section **310** causes the adapter power supply section **320** to generate the voltage of the lens control system power supply Vc and the voltage of the lens driving system power supply Vp for supplying a voltage to the interchangeable lens **200** from the voltage of the power-system power supply PWR which is supplied from the camera body **100** in response to the power-system power supply PWR request signal. In addition, after the power feeding from the power-system power supply PWR is started, the adapter control section **310** causes the adapter power supply section **320** to generate the voltage of the lens driving system power supply Vp and the voltage of the lens control system power supply Vc, and supplies them to the interchangeable lens **200**.

For example, after the power feeding to the adapter power supply section **320** from the power-system power supply PWR is started, the adapter control section **310** supplies the voltage of the lens control system power supply Vc from the adapter power supply section **320** to the interchangeable lens **200** (starts the power feeding from the lens control system power supply Vc). Subsequently, after the voltage of the lens control system power supply Vc is supplied from the adapter power supply section **320** to the interchangeable lens **200**, the adapter control section **310** supplies the voltage of the lens driving system power supply Vp to the interchangeable lens **200**.

Specifically, in response to the supply of the voltage of the lens control system power supply Vc to the interchangeable lens **200**, when receiving the lens driving system power supply Vp request signal which indicates the request to start the supply of the voltage of the lens driving system power supply Vp from the interchangeable lens **200**, the adapter control section **310** supplies the voltage of the lens driving system power supply Vp from the adapter power supply section **320** to the interchangeable lens **200**.

Further, after the supply of the voltage of the control system power supply Vcc**1** from the camera body **100** is started, the adapter control section **310** executes an initialization process in response to the control instruction from the camera control section **110**. For example, the adapter control section **310** executes the process of initializing the status of the interchangeable lens **200** as the initialization process (makes a request for the interchangeable lens **200**). That is, after the power feeding to the interchangeable lens **200** is performed (the power of the lens system power supply system is supplied to the interchangeable lens **200**), the adapter control section **310** executes the process of initializing the status of the interchangeable lens **200** (makes a request for the interchangeable lens **200**).

Further, the process of initializing the status of the interchangeable lens **200** includes a lens control section initialization process of initializing the lens control section **210**.

For example, by feeding a voltage to the interchangeable lens **200** through the initialization process, the adapter control section **310** detects whether or not the interchangeable lens **200** is mounted on the adapter **300**. Then, after detecting whether or not the interchangeable lens **200** is mounted on the adapter **300**, the adapter control section **310** executes the lens control section initialization process of initializing the lens control section **210**.

Next, details of the lens activation process of the camera system **1** will be described.

FIG. **12** is a diagram illustrating an example of a process sequence of the lens activation process. The drawing shows an example of the lens activation process in a case where the main power supply of the camera body **100** is turned on.

The lens activation process is performed in the order of attachment/detachment determination (step S**110**), information exchange between the camera body **100** and the adapter **300** (step S**120**), initialization (step S**130**), lens information acquisition (step S**160**), and lens function start (step S**170**). Further, in the initialization (step S**130**), as processes which are performed on the interchangeable lens **200** by the adapter **300**, a mounting determination process (step S**140**) and a lens initialization process (step S**150**) are sequentially executed.

In addition, in the activation process, communication, which is performed between the camera body **100** and the interchangeable lens **200** through the adapter **300**, is the command data communication.

First, the attachment/detachment determination (step S**110**) is a process in which the camera body **100** starts feeding a voltage of the control system power supply Vcc**1** to the adapter **300** and determines whether the adapter **300** (or the interchangeable lens **200**A) is mounted.

When the main power supply of the camera body **100** is turned on, the camera control section **110** controls the camera power supply section **120** such that it supplies (feeds) the voltage of the control system power supply Vcc**1** to the adapter **300** (step S**1110**). Thereby, the adapter control section **310** is supplied with the voltage of the control system power supply Vcc**1**. The adapter control section **310** performs the adapter activation process in response to the supply of the voltage of the control system power supply Vcc**1**, and notifies whether or not to perform communication to the first camera communication portion **112** from the first adapter communication portion **312** (step S**2110**). For example, in response to the supply of the voltage of the control system power supply Vcc**1**, the first adapter communication portion **312** controls the signal RDY such that it is set to the H (high) level, and controls the signal RDY such that it is set to the L (low) level through the adapter activation process. Then, the first camera communication portion **112** detects the falling edge of the signal level of the signal RDY, thereby acquiring mount information (step S**1112**).

Thereby, the camera control section **110** performs attachment/detachment determination as to whether or not the adapter **300** is mounted, on the basis of the mount information acquired by the first camera communication portion **112** (step S**1114**). For example, the camera control section **110** performs the attachment/detachment determination, on the basis of the mount information which indicates whether or not the falling edge of the signal level of the signal RDY is detected.

In step S**1114**, if it is determined that the adapter **300** is mounted on the camera body **100**, the camera control section **110** advances the process to the information exchange (step S**120**) between the camera body **100** and the adapter **300**.

In addition, if the standard compatible lens (for example, the interchangeable lens **200**A) is directly mounted on the camera body **100** without the adapter **300**, the camera control section **110** advances the process to step S**120** similarly to the above. In this case, the process of step S**120** is a process of exchanging information between the camera body **100** and the interchangeable lens **200**A.

Further, if it is determined that the lens is not mounted in step S**1114**, the camera control section **110** determines that the current state is an unmounted state where either one of the adapter **300** or the interchangeable lens **200**A is not mounted on the camera body **100**.

In the information exchange between the camera body **100** and the adapter **300** in step S**120**, the following process is performed.

The first camera communication portion **112** establishes communication (command data communication) with the first adapter communication portion **312**. Then, the first camera communication portion **112** and the first adapter communication portion **312** intercommunicate and acquire information such as identification IDs, names, and firmware versions of the camera body **100** and the adapter **300**. Further, the first adapter communication portion **312** transmits the power-system power supply PWR request signal, which is for requesting the supply start of the voltage of the power-system power supply PWR, to the first camera communication portion **112** (steps S**1120** and S**2120**).

Subsequently, the process of initialization (step S**130**) is performed. The process of initialization is a process of initializing the adapter **300** and the interchangeable lens **200** by supplying the voltage of the power-system power supply PWR from the camera body **100**.

First, when the first camera communication portion **112** receives the power-system power supply PWR request signal, the camera control section **110** controls a switch **125** such that it is in a conducting state, thereby supplying (feeding) the voltage of the power-system power supply PWR from the battery **190** to the adapter **300** (step S**1130**).

Next, the first camera communication portion **112** transmits an initialization execution command as an initialization request to the first adapter communication portion **312** (step S**1140**).

When the first adapter communication portion **312** receives the initialization execution command, the adapter control section **310** executes the mounting determination process (step S**140**) and the lens initialization process (step S**150**).

The mounting determination process (step S**140**) is a process of determining whether the interchangeable lens is mounted on the adapter **300**.

The adapter control section **310** causes the adapter power supply section **320** to generate the voltage of the lens control system power supply Vc and supply (feed) the voltage to the interchangeable lens **200**. Next, the first adapter communication portion **312** executes the lens mounting determination process through the communication with the first lens communication portion **212**, thereby determining whether or not the interchangeable lens is mounted. If the interchangeable lens **200** is mounted, the first lens communication portion **212** transmits the lens driving system power supply Vp request signal to the first adapter communication portion **312** (steps S**2140** and S**3140**).

Then, the adapter control section **310** advances the process to the lens initialization process (step S**150**).

The lens initialization process (step S**150**) is a process of initializing the adapter **300** and the interchangeable lens **200**.

When the first adapter communication portion **312** receives the lens driving system power supply Vp request signal, the adapter control section **310** causes the adapter power supply section **320** to generate the voltage of the lens driving system power supply Vp and supply (feed) the voltage to the interchangeable lens **200**. Next, the first adapter communication portion **312** executes the lens initialization process through the communication with the first lens communication portion **212** (steps S**2150** and S**3150**). Here, the reason why the lens driving system power supply Vp is not supplied from the adapter **300** side to the interchangeable lens **200** side is as follows. In some interchangeable lenses, it may not be necessary to supply power to the lenses (for example, manual focus lenses). When such an interchangeable lens is mounted, it is an unnecessary task for the adapter **300** to generate the lens driving system power supply Vp and perform the power supply operation. Therefore, in the present embodiment, in order for the adapter **300** not to perform the unnecessary task, the power feeding sequence of the power supply is determined.

Next, when the adapter **300** and the interchangeable lens **200** are completely initialized, as a result of the response to an initialization confirmation command, the first camera communication portion **112** receives "initialization completion" as information which indicates that the initialization is complete, from the first adapter communication portion **312**. Thereby, the camera control section **110** acquires the initialization completion information (step S**1150**).

When the initialization is complete, the camera control section **110** determines whether or not the adapter **300** is mounted, on the basis of the information acquired through the information exchange between the camera body **100** and the adapter **300** of step S**1120** (step S**1155**). In step S**1155**, if it is determined that the adapter **300** is not mounted, the camera control section **110** determines that the standard compatible lens (for example, the interchangeable lens **200**A) is directly mounted on the camera body **100** without the adapter **300**. In contrast, in step S**1155**, if it is determined that the adapter **300** is mounted, the camera control section **110** advances the process to the process of the lens information acquisition (step S**160**).

The process of the lens information acquisition (step S**160**) includes the process of determining whether the interchangeable lens is mounted on the adapter **300** and a process of acquiring information of the interchangeable lens **200** mounted on the adapter **300**. The information of the interchangeable lens **200** includes, for example, the type of the lens, presence or absence of the hotline communication function, presence or absence of the vibration-proof function, presence or absence of the electromagnetic diaphragm, the full-aperture F value, focal length information, and the like.

The first camera communication portion **112** transmits a lens information acquisition command to the first adapter communication portion **312**, and receives the response of the lens information from the first adapter communication portion **312**, thereby acquiring the information of the interchangeable lens **200** (steps S**1160** and S**2160**).

Next, the camera control section **110** determines the type (class) of the interchangeable lens **200** on the basis of the lens information which is acquired in the lens information acquisition (step S**160**) (step S**1165**). For example, the camera control section **110** determines whether or not a CPU lens is mounted on the adapter **300** on the basis of the determination result of the mounting determination process (step S**140**).

If it is determined that the CPU lens is not mounted in step S**1165**, it is determined that a non-CPU lens is mounted, activation is performed, and the process ends.

In contrast, if it is determined that the CPU lens is mounted in step S**1165**, the process advances to the lens function start (step S**170**).

Further, the camera control section **110** determines, on the basis of the acquired lens information, whether or not the lens is, for example, a lens having an AF control (processing) function, a lens having a function (vibration-proof control function) of control (processing) of the VR lens **223**, or an electromagnetic-diaphragm-type lens.

The process of the lens function start (step S**170**) is a process of starting respective functions thereof in accordance with the type (function) of the interchangeable lens on the basis of the lens information which is acquired in the process of the lens information acquisition (step S**160**). The first camera communication portion **112** communicates with the first lens communication portion **212** through the first adapter communication portion **312**, thereby performing, for example, processes of acquiring a table for lens control, setting permission of the hotline communication, setting the vibration-proof control start, and the like (steps S**1170**, S**2170**, and S**3170**).

Then, the camera control section **110** determines that the CPU lens is mounted, performs activation, and ends the process.

As described above, the adapter control section **310** performs activation in response to the supply of the voltage of the control system power supply Vcc**1** from the camera body **100**, and requests the camera body **100** to start supplying the voltage of the power-system power supply PWR. Further, the adapter control section **310** generates the voltage of the lens control system power supply Vc to be supplied to the interchangeable lens **200** from the power-system power supply PWR, in response to the supply of the voltage of the power-system power supply PWR from the camera body **100**. Furthermore, the adapter control section **310** supplies the voltage of the lens control system power supply Vc to the interchangeable lens **200**. Thereby, when the request to supply the voltage of the lens driving system power supply Vp is issued from the interchangeable lens **200**, the adapter control section generates the voltage of the lens driving system power supply Vp from the power-system power supply PWR, and supplies it to the interchangeable lens **200**.

Thereby, the adapter control section **310** is able to generate a voltage to be supplied to the interchangeable lens **200** on the basis of the voltage supplied from the camera body **100**, and appropriately control the supply start timing of the voltage of each power supply system.

Further, the adapter control section **310** determines the specification of the interchangeable lens **200** in the lens activation process, and is thereby able to supply a voltage to the interchangeable lens **200** on the basis of the determined specification. Further, the adapter control section **310** is able to stop the supply of the voltage to the interchangeable lens in the case where it is not necessary to supply a voltage to the interchangeable lens, on the basis of the determined specification of the interchangeable lens.

Details of Initialization Process in Lens Activation Process

Next, the process of initialization (step S**130**) in the lens activation process described with reference to FIG. **12** will be described in detail with reference to FIG. **13**.

FIG. **13** is a diagram illustrating an example of the process sequence of the initialization process in the lens activation process. In FIG. **13**, the processes corresponding to the respective processes of FIG. **12** will be represented by the same reference numerals and signs, and description thereof will be omitted.

The first camera communication portion **112** supplies the voltage of the power-system power supply PWR (step S**1130**), and subsequently transmits an initialization execution command as an initialization request to the first adapter communication portion **312** (step S**1140**). Thereafter, the first camera communication portion **112** repeatedly transmits an initialization completion confirmation command (steps S**1145**a, S**1145**b, S**1145**c, . . .), which is to detect completion of the process of initialization performed by the adapter **300**, to the first adapter communication portion **312**, and waits for the response of "initialization completion" from the first adapter communication portion **312** (step S**1145**).

For example, the first camera communication portion **112** repeatedly transmits the initialization completion confirmation command to the first adapter communication portion **312** in the period Ts during a period of time until the response of "initialization completion" is acquired (or a predetermined period of time to perform time-out process). The period Ts of the communication of the initialization completion confirmation command is a time interval which is shorter than that of the period Tm of the routine data communication described with reference to FIG. **9**. That is, the first adapter communication portion **312** executes a process of transmitting information (a process of responding to the initialization completion confirmation command), which indicates whether or not the initialization process is complete, on the camera control section **110** with a time interval shorter than that of the period Tm of the routine data communication. That is, the detection as to whether or not the initialization process is complete is performed with the time interval, which is shorter than that of the period Tm of the routine data communication, by the camera control section **110**. As described above, by shortening the interval (period) for detecting completion of the initialization, as a result, it is possible to start the process which is performed after completion of the initialization at an early stage. Thus, it is possible to shorten the time necessary for the rising edge of the apparatus and system.

The first adapter communication portion **312** responds with an initialization state of "initialization in progress" as information which indicates the state where the initialization is not complete, to the initialization completion confirmation command which is repeatedly transmitted from the first camera communication portion **112** until the initialization is complete.

In addition, in the drawing, the first camera communication portion **112** acquires the response of "initialization completion" on the basis of the result of the response to the initialization completion confirmation command of step S**1145**n.

Thereby, the first camera communication portion **112** is able to detect whether or not the initialization process of the adapter **300** is complete in a period with the time interval shorter than that of the period of the routine data communication.

When the first adapter communication portion **312** receives the initialization execution command, the adapter control section **310** executes a process of initializing the respective sections provided in the adapter **300** (step S**2130**). The process includes, for example, a process of resetting a memory in the adapter control section **310** of the adapter **300**. Next, the adapter control section **310** controls the diaphragm interlocking lever driving section **330** such that it moves the diaphragm interlocking lever **350** to the retractable position (step S**2135**).

Subsequently, the adapter control section **310** advances the process to the lens mounting determination process (step S**140**). In the lens mounting determination process, the adapter control section **310** firstly causes the adapter power supply section **320** to generate the voltage of the lens control system power supply Vc and supply (feed) the voltage to the interchangeable lens **200** (step S**2142**). Next, in response to the supply (power feeding) of the voltage of the lens control system power supply Vc to the interchangeable lens **200**, the first adapter communication portion **312** performs mounting determination by detecting whether or not the interchangeable lens **200** is mounted, on the basis of whether or not there is a response from the first lens communication portion **212** of the interchangeable lens **200** (steps S**2144** and S**3144**).

For example, if there is no response from the first lens communication portion **212**, it is determined that the interchangeable lens **200** is not mounted on the adapter **300** (lens unmounted state).

In contrast, if there is a response from the first lens communication portion **212**, the first adapter communication portion **312** determines that the interchangeable lens **200** is mounted on the adapter **300**, and performs communication for information exchange between the adapter **300** and the interchangeable lens **200** (steps S**2146** and S**3146**).

In the communication for information exchange between the adapter **300** and the interchangeable lens **200**, for example, the first adapter communication portion **312** and the first lens communication portion **212** indentify each other by communicating identification commands with each other, and check whether or not it is possible to perform communication normally. Further, the first adapter communication portion **312** acquires lens information which is for identifying the type of the interchangeable lens **200**, information which indicates a state of the lens switch (for example, a switch for switching between AF and MF (Manual Focus)) provided in the interchangeable lens **200**, and the like.

Further, the first lens communication portion **212** transmits the lens driving system power supply Vp request signal to the first adapter communication portion **312**. Then, the adapter control section **310** advances the process to the lens initialization process (step S**150**).

In the lens initialization process (step S**150**), first, when the first adapter communication portion **312** receives the lens driving system power supply Vp request signal, the adapter control section **310** causes the adapter power supply section **320** to generate the voltage of the lens driving system power supply Vp and supply (feed) the voltage to the interchangeable lens **200** (step S**2152**). Next, the first adapter communication portion **312** transmits the lens initialization execution command, which is to request execution of the lens initialization process, to the first lens communication portion **212** (step S**2154**). When the first lens communication portion **212** receives the lens initialization execution command, the lens control section **210** executes the lens initialization process in response to the lens initialization execution command from the first adapter communication portion **312** (step S**3154**).

The lens initialization process includes processes of initializing the lens control section **210**, the AF control (control of the focus lens **222**), the vibration-proof control (control of the VR lens **223**), and the like. In addition, in the case of the electromagnetic-diaphragm-type CPU lens, in the lens initialization process, the process of initialization of the electromagnetic diaphragm control is also executed.

In addition, after the lens initialization process is complete, the first adapter communication portion **312** starts the lens routine communication with the first lens communication portion **212** (step S**2156**).

Next, the adapter control section **310** performs initialization driving of the diaphragm interlocking lever **350** (step S**2158**). For example, the adapter control section **310** controls the diaphragm interlocking lever driving section **330**, thereby executing the process of moving the position of the diaphragm interlocking lever **350** to the prescribed position which is determined in advance. In addition, the adapter control section **310** moves, in accordance with the control condition, the position of the diaphragm interlocking lever **350** to, for example, a retractable position, an open position, or a position stored in a storage portion.

Subsequently, in response to completion of execution of the initialization driving of the diaphragm interlocking lever **350** in step S**2158**, the first adapter communication portion **312** responds with "initialization completion" as the initialization state to the initialization completion confirmation command (step S**1145**n) issued from the first camera communication portion **112** (step S**2159**). The first camera communication portion **112** acquires the response to "initialization completion" on the basis of the result of the response to the initialization completion confirmation command of step S**1145**n (step S**1150**), and ends the initialization.

As described above, in response to the initialization execution command from the first camera communication portion **112**, the adapter control section **310** is able to initialize the respective sections provided in the adapter **300**, determine whether the lens is mounted on the adapter **300**, and initialize the state of the interchangeable lens **200** mounted on the adapter **300**. Further, the first camera communication portion **112** is able to detect whether or not the initialization process of the adapter **300** is complete in the period (for example 10 msec) with the time interval shorter than that of the period (the period Tm; for example, 16 msec) of the routine data communication. Accordingly, the camera control section **110** is able to appropriately and promptly detect whether or not the initialization process is complete.

Example of Initialization Completion Response Data

In addition, as described with reference to FIG. **13**, the adapter control section **310** requests the interchangeable lens **200** to execute the process of initializing the status of the interchangeable lens **200**, and thereafter performs the initialization driving (initialization process) of the diaphragm interlocking lever **350**. Further, after the lens initialization process of initializing the status of the interchangeable lens **200** is complete, the adapter control section **310** completes the process of initialization which is performed in response to the initialization execution command transmitted by the first camera communication portion **112**. That is, before the adapter control section **310** completes the process of initialization (the process including shift of the diaphragm interlocking lever **350** to the retractable position), the lens initialization process is complete.

Thereby, after the lens initialization process is complete, the adapter control section **310** is able to respond with the initialization completion to the first camera communication portion **112**.

FIGS. **14**A and **14**B are a diagram illustrating an example of a data structure of the initialization state as a response to the initialization completion confirmation command in the command data communication.

For example, in the command data communication, the initialization state data as a response to the initialization completion confirmation command is two-byte data. In addition, among the two-byte data, the lower one byte D**10** (bits **0** to **7**) is command data which indicates the data as a response to the initialization completion confirmation command. For example, as shown in the drawing, there is provided an example in which the data of "15H" (15H in hexadecimal) as the command data for identifying the data as a response to the initialization completion confirmation command is set as the lower one byte D**10**. Further, the upper one byte D**20** (bits **8** to **15**) is initialization state data as a response. In bit **8** of the upper one byte D**20**, a flag (diaphragm interlocking lever initialization completion information), which indicates whether or not the initialization process of the diaphragm interlocking lever **350** in the adapter **300** is complete, is set. Further, in bit **9**, a flag (lens initialization completion information), which indicates whether or not the initialization process of the focus lens **222** in the interchangeable lens **200** is complete, is set. Furthermore, in bit **10**, a flag (lens initialization completion information), which indicates whether or not the initialization process of the VR lens **223** in the interchangeable lens **200** is complete, is set. In addition, bits **11** to **15** are undefined, and correspond to an invalid data area.

FIG. **14**A shows initialization state data as a response to the initialization completion confirmation command which is set in the first adapter communication portion **312**, as the first camera communication portion **112** transmits the initialization execution command as the initialization request to the first adapter communication portion **312** (data set in step S**2130** of FIG. **13**). That is, the first adapter communication portion **312** responds with data, which is shown in FIG. **14**A, as data, which indicates the initialization state where "the initialization is in progress", to the initialization completion confirmation command.

In addition, with the timing (step S**2130** of FIG. **13**), all initialization processes of the initialization process of the focus lens **222**, the initialization process of the VR lens **223**, and the initialization process of the diaphragm interlocking lever **350** are not complete (the process of initializing the status of the interchangeable lens **200** is not complete). However, the first adapter communication portion **312** sets the flag "0", which indicates that the initialization process is complete, in bits **9** and **10** which indicates the initialization state of the interchangeable lens **200** side. On the other hand, in bit **8** which indicates data of the initialization state of the diaphragm interlocking lever **350**, the flag "1", which indicates that the initialization process is not complete, is set. That is, regardless of the initialization process state (the progress state of the initialization process) of the interchangeable lens **200** side, the adapter **300** invariably sets the completion flag "0", which indicates the state where the initialization ends, in bits **9** and **10**. As described above, by setting the initialization flags within the adapter **300**, even when an interchangeable lens which is a type incapable of outputting the flag indicating the initialization completion to the adapter **300** is mounted on the camera body **100** with the adapter **300** interposed therebetween, there is an advantage in that it is possible to extending the types of compatible interchangeable lenses without stopping an operation (camera system) at the stage of the initialization process sequence mentioned above.

At the time point the lens initialization process (step S**150** of FIG. **13**) is complete, the initialization process of the diaphragm interlocking lever **350** on the adapter **300** side is not yet complete.

FIG. **14**B shows initialization state data as a response to the initialization completion confirmation command which is set when the initialization process of the initialization driving (step S**2158** of FIG. **13**) of the diaphragm interlocking lever **350** is complete. At this time point (step S**2158** of FIG. **13**), normally, the lens-side initialization process (step S**150** of FIG. **13**) is complete.

When the initialization process of the diaphragm interlocking lever **350** is complete, the first adapter communication portion **312** sets the flag "0", which indicates that the initialization process is complete, in bit **8** of the initialization state data. Thereby, the flag "0", which indicates that the initialization process is complete, is set in each of all the bits **8** to **10** of the initialization state data. That is, the first adapter communication portion **312** responds with data shown in FIG. **14**B as the initialization state data, which indicates "initialization completion", to the initialization completion confirmation command.

That is, the initialization completion information which indicates whether or not the initialization process is complete, includes: the lens initialization completion information (bits **9** and **10** in FIGS. **14**A and **14**B) which invariably indicates whether or not the lens initialization process (the process of initializing the status of the interchangeable lens **200**) is complete; and the information (diaphragm interlocking lever initialization completion information) (bit **8** of FIGS. **14**A and **14**B) which indicates whether or not the initialization process (diaphragm interlocking lever initialization process) of the diaphragm interlocking lever **350** is complete.

Then, the first adapter communication portion **312** instructs the interchangeable lens **200** to perform initialization, and sets the value of the lens initialization completion information to a value indicating that initialization is complete, and in response to completion of the diaphragm interlocking lever initialization process, the values of the diaphragm interlocking lever initialization completion information is set to a value indicating that initialization is complete.

That is, the adapter control section **310** sets the value of the lens initialization completion information to the value indicating that initialization is complete, regardless of the progress state of the process of initializing the status of the interchangeable lens **200**. Further, in response to completion of the diaphragm interlocking lever initialization process, the adapter control section **310** sets the value of the diaphragm interlocking lever initialization completion information to the value indicating that initialization is complete, and transmits the initialization completion information to the camera control section **110**.

In addition, in accordance with the timing (detection timing of the initialization process) of the initialization completion confirmation command of the camera control section **110**, the adapter control section **310** responds with (transmits) the initialization completion information to the camera control section **110**.

As described above, the adapter control section **310** updates the information (flag), which indicates whether or not the initialization is complete, at the completion timing of the initialization process of the diaphragm interlocking lever **350**, and responds with the information to the camera control section **110**.

Accordingly, at the timing at which the initialization process of the diaphragm interlocking lever **350** is complete, the adapter control section **310** responds with the initialization completion state, which indicates that entire initialization including the initialization of the interchangeable lens **200** side is complete, to the camera control section **110**.

Initialization Performed When Standard Compatible Lens Is Mounted

In addition, the embodiment described the initialization process in the case where the adapter **300** is connected to the camera body **100**, but the present invention is not limited to this. For example, in the initialization process in a case where an accessory other than the adapter **300** is connected to the camera body **100**, the camera body **100** may detect whether or not the initialization process of the accessory is complete, in the same manner as described above. For example, in the accessory detachably attached to the camera body **100**, an accessory control section provided in the accessory may be controlled by periodic communication (routine periodic communication) with the camera control section **110** provided in the camera body **100**. In this case, in the initialization process, by executing the initialization process in response to the control instruction from the camera control section **110**, the accessory control section may execute a process in which whether or not the initialization process is complete is detected by the camera control section **110** with a time interval shorter than the period of the periodic communication.

As an example, a case where the accessory detachably attached to the camera body **100** is a standard compatible lens will be described below.

The standard compatible lens (for example, the interchangeable lens **200**A) may be directly connected to the camera body **100** without the adapter **300**. In this case, in the lens routine process, for example, the first lens communication portion **212**A (the first lens communication portion **212**A is provided in the lens control section **210**A corresponding to the above-mentioned accessory control section) performs the routine data communication with the first camera communication portion **112** in the period Tm (performs the routine data communication in the period Tm which is the same as that of the routine data communication between the first adapter communication portion **312** and the first camera communication portion **112** shown in FIG. **9**).

Further, in the lens activation process, the first camera communication portion **112** transmits the initialization execution command to the first lens communication portion **212**A similarly to the initialization request process of step S**1140** shown in FIG. **13**. That is, the first camera communication portion **112** transmits the initialization execution command to the first lens communication portion **212**A instead of the first adapter communication portion **312**. Thereafter, similarly to the initialization completion confirmation process of step S**1145**, the first camera communication portion **112** repeatedly transmits the initialization completion confirmation command to the first lens communication portion **212**A in the period Ts, and waits for the response of "initialization completion" from the first lens communication portion **212**A.

Further, when the first lens communication portion **212**A receives the initialization execution command, the lens control section **210**A executes the lens initialization process of the interchangeable lens **200**A. Then, as the lens initialization process is complete by the lens control section **210**A, the first lens communication portion **212**A responds with "initialization completion".

As described above, the process from the initialization request to the initialization completion confirmation in the camera control section **110** is performed in the same manner in both cases where the interchangeable lens **200** is connected to the camera body **100** through the adapter **300** and the interchangeable lens **200**A is directly connected thereto.

That is, the first lens communication portion **212**A executes a process of transmitting information (a process of responding to the initialization completion confirmation command), which indicates whether or not the initialization process is complete, on the camera control section **110** with a time interval shorter than that of the period Tm of the routine data communication. That is, even when the interchangeable lens **200**A is directly connected to the camera body **100**, the detection as to whether or not the initialization process is complete is performed with the time interval, which is shorter than that of the period Tm of the routine data communication, by the camera control section **110**.

Thereby, the first camera communication portion **112** is able to detect whether or not the initialization process of the interchangeable lens **200**A is complete in the period with the time interval shorter than that of the period of the routine data communication. Thereby, the camera control section **110** is able to appropriately and promptly detect whether or not the initialization process is complete.

Power Cut-off Process And Low Power Consumption Process

Next, a power cut-off process and a low power consumption process will be described.

Here, the low power consumption process is a process of shifting an operation state (operation mode) of the camera body **100** to an operation mode (second operation mode/low power consumption mode/sleep mode) for reducing power consumption and incapable of performing the photography process, as compared with an operation mode (first operation mode) capable of performing the photography process.

Here, in the following technique, the low power consumption process is referred to as a sleep process, and the operation state (operation mode), which is switched by the sleep process, is referred to as a sleep mode.

For example, in response to the interrupt request issued by power off of the camera body **100**, a power cut-off process is executed. Further, for example in a case where no operation continues during a predetermined time or more, the sleep process is executed.

Further, the power cut-off process and the sleep process include a lens shutdown process of stopping (shutting down) functions of the adapter **300** and the interchangeable lens **200** and stopping (cutting off) the supply of the voltage of the power-system power supply PWR from the camera body **100**. That is, the power cut-off process and the sleep process are processes of stopping supplying a voltage to the interchangeable lens **200** and stopping (cutting off) the supply of the voltage of the power-system power supply PWR.

Further, in the case where the operation mode of the camera body **100** is shifted to the sleep mode, the supply of the voltage of the power-system power supply PWR from the camera body **100** is stopped, and the supply of the voltage of the control system power supply Vcc**1** is continued. For example, when the operation mode of the camera body **100** is shifted to the sleep mode, the camera body **100** continues the supply of the voltage of the control system power supply Vcc**1** during a predetermined time period. Here, the predetermined time period is, for example, a time period which depends on the time to return to the operation mode capable of performing the photography process by detecting the operation of the camera body **100**, a time period which depends on the time to advance to the power cut-off process of the camera body **100** when the non-operation state is further continued, or the like.

Further, the operation mode of the camera body **100** may be shifted to the sleep mode. In this case, the instruction signal (shutdown execution command), which indicates the instruction to shift to the power cut-off state or the sleep mode, is transmitted from the camera control section **110** to the adapter control section **310**. Then, in response to receiving the corresponding signal, the adapter control section **310** executes the lens shutdown process of stopping the power feeding to the interchangeable lens **200**.

Next, when the lens shutdown process ends, the adapter control section **310** transmits a permission signal (a response of shutdown readiness), which indicates a permission to shift to the power cut-off state or the sleep mode, to the camera body **100**. Subsequently, in response to the permission signal transmitted from the adapter control section **310**, the supply of the voltage of the power-system power supply PWR from the camera body **100** is stopped.

FIG. **15** is a diagram illustrating an example of a process sequence of the power cut-off process and the sleep process.

Referring to the drawing, the power cut-off process and the sleep process of the camera system **1** will be described.

The power cut-off process and the sleep process are performed in the order of lens function termination (step S**410**), shutdown (step S**420**), and shift to the sleep mode (step S**430**). In addition, in the power cut-off process and the sleep process, the communication, which is performed between the camera body **100** and the interchangeable lens **200** through the adapter **300**, is the command data communication.

When the power cut-off process or the sleep process is started, first, the process of the lens function termination (step S**410**) is performed.

The first camera communication portion **112** communicates with the first lens communication portion **212** through the first adapter communication portion **312**, thereby stopping the function operation of the interchangeable lens **200** (steps S**1210**, S**2210**, and S**3210**). Thereby, the lens control section **210** stops the function operation of the interchangeable lens **200**. For example, through the process of the lens function termination, the process of termination of the vibration-proof control of the interchangeable lens **200**, inhibition of the hotline communication, or the like.

Next, the process of shutdown (step S**420**) is performed.

The first camera communication portion **112** transmits the shutdown execution command as a shutdown request to the first adapter communication portion **312** (step S**1220**). Thereafter, the first camera communication portion **112** repeatedly transmits the shutdown completion confirmation command, and waits for the response of the shutdown readiness from the first adapter communication portion **312**.

When the first adapter communication portion **312** receives the shutdown execution command, the adapter control section **310** starts the lens shutdown process. First, the first adapter communication portion **312** transmits a command, which is to give an instruction not to permit feeing the voltage of the lens driving system power supply Vp, to the first lens communication portion **212**. As the first lens communication portion **212** receives the command, the lens control section **210** stops supplying (feeding) the voltage of the lens driving system power supply Vp in the interchangeable lens **200** (step S**3220**). Next, the first adapter communication portion **312** stops the lens routine communication with the first lens communication portion **212**. Then, the adapter control section **310** stops the simply of the voltage of the lens driving system power supply Vp from the adapter power supply section **320**, and subsequently stops the supply of the lens control system power supply Vc (step S**2220**).

Next, the adapter control section **310** moves the diaphragm interlocking lever **350** to the retractable position (step S**2230**), and executes the process of shutting down the respective sections provided in the adapter **300** (step S**2235**). Subsequently, when the shutdown process is complete, in response to the shutdown completion confirmation command received from the first camera communication portion **112**, the first adapter communication portion **312** responds with "shutdown readiness" as information which indicates that the shutdown process of the adapter **300** (the adapter **300** and the interchangeable lens **200**) is complete, to the first camera communication portion **112**. Further, the first adapter communication portion **312** responds with presence or absence of the sleep process request to the first camera communication portion **112** (step S**2240**).

As a result of the response to the shutdown completion confirmation command, the first camera communication portion **112** acquires the response of "shutdown readiness" from the first adapter communication portion **312** (step S**1240**).

When the first adapter communication portion **312** acquires the response of shutdown readiness, the camera control section **110** controls the switch **125** such that it attains the cut-off state, thereby stopping the supply of the voltage of the power-system power supply PWR (step S**1250**).

Next, the camera control section **110** determines whether or not the request to shift to the sleep mode is present on the basis of the result of the response to the shutdown completion confirmation command (step S**1255**). In step S**1255**, if it is determined that the request to shift to the sleep mode is absent, the camera control section **110** controls the camera power supply section **120** such that it stops the supply of the voltage of the control system power supply Vcc**1** (step S**1270**).

In contrast, in step S**1255**, if it is determined that the request to shift to the sleep mode is present, the process of shifting to the sleep mode (step S**430**) is performed. First, the first camera communication portion **112** transmits an instruction to shift to the sleep mode to the first adapter communication portion **312**. Thereby, the adapter control section **310** shifts to the sleep mode. For example, the first adapter communication portion **312** controls the signal RDY such that it is set to the H (high) level before the start of the process of shifting to the sleep mode, and controls the signal RDY such that it is set to the L (low) level after the process of shifting to the sleep mode is complete. The first camera communication portion **112** detects that the process of shifting to the sleep mode of the adapter **300** is complete by detecting the falling edge of the signal level of the signal RDY, and changes the state of the supply of the voltage of the control system power supply Vcc**1** to a state for feeding a small voltage (steps S**1260** and S**2260**).

Thereby, the shift to the power cut-off state or the sleep mode is performed.

As described above, when the camera body **100** is shifted to the sleep mode, the camera control section **110** stops supplying the voltage of the power-system power supply PWR to the adapter **300**, and continues supplying the voltage of the control system power supply Vcc**1**. That is, when the adapter **300** is shifted to the sleep mode, the supply of the voltage of the power-system power supply PWR from the camera body **100** is stopped, and the supply of the voltage of the control system power supply Vcc**1** is continued.

Thereby, in the sleep mode, it is possible to reduce power consumption. Further, the supply of the voltage of the control system power supply Vcc**1** is continued, and thus the process of the adapter control section **310** is not completely stopped (the adapter control section **310** is operated with the minimum electric power necessary for the return process). Hence, when returning (performing activation) from the sleep mode to a stationary state, the adapter control section **310** is able to promptly performs the return (activation) as compared with the case where the process is completely stopped.

Process at Temporary Blackout of Power Supply

For the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc, predetermined voltage ranges are prescribed respectively.

The Vc-voltage detection portion **325**, Vp-voltage detection portion **326**, and PWR voltage detection portion **327** detect the voltages of the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc, and supply the detection results to the adapter control section **310**. When any of the detected voltages of the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc are lower than the predetermined voltage ranges respectively determined for them, the adapter control section **310** supplies (notifies) the detection result to the camera body **100**.

For example, the adapter control section **310** executes the lens initialization process in order to initialize the interchangeable lens **200** (state) when any voltage (voltage value) of the voltage (voltage value) of the power-system power supply PWR fed from the camera body **100**, the voltage (voltage value) of the lens driving system power supply Vp fed from the adapter power supply section **320** to the interchangeable lens **200**, and the voltage (voltage value) of the lens control system power supply Vc fed from the adapter power supply section **320** to the interchangeable lens **200** are lower than the predetermined voltage ranges which are respectively determined for them.

Specifically, the initialization request signal, which instructs the camera control section **110** provided in the camera body **100** of the adapter control section **310** to execute the initialization process including the lens initialization process, is transmitted from the first adapter communication portion **312** to the first camera communication portion **112**, and is supplied (notified) to the camera body **100**. Further, when any of the detected voltages of the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc are lower than the predetermined voltage ranges respectively determined for them, the adapter control section **310** stops supplying the voltages of the lens driving system power supply Vp and the lens control system power supply Vc, and transmits the initialization request signal to the camera body **100**.

The initialization process is a process of stopping the supply of the voltage of the power-system power supply PWR once in response to the initialization request signal and then restarting the supply thereof. Further, the initialization process is a process of stopping the supply of the voltage of the control system power supply Vcc**1** once in response to the initialization request signal and then restarting the supply thereof.

In addition, the adapter control section **310** starts supplying the voltages of the lens driving system power supply Vp and the lens control system power supply Vc in response to the initialization process performed by the camera body **100**. That is, the adapter control section **310** initializes the lens control section **210** in response to the initialization process performed by the camera body **100**.

That is, when detecting a decrease in the power supply voltage, first, the adapter control section **310** stops supplying a voltage to the interchangeable lens **200**. Next, the adapter control section **310** transmits the initialization request signal to the camera control section **110**, and executes the process of stopping the supply of the voltage of the power supply from the camera body **100** once and thereafter restarting the supply thereof. Thereby, by executing the lens activation process again, the process of initialization is performed, and thus the adapter control section **310** supplies a voltage to the interchangeable lens **200**.

Accordingly, when any of the detected voltages of the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc are lower than the predetermined voltage ranges respectively determined for them, the adapter control section **310** is able to initialize the adapter **300** and the interchangeable lens **200**. Hence, it is possible to prevent a problem that the operation of the interchangeable lens **200** side is continued with a voltage fed unstably.

In the determination, relative merits (degrees of importance, priorities) may be given to the voltage values of the power-system power supply PWR, the lens driving system power supply Vp, and the lens control system power supply Vc. From the viewpoint of maintenance of stable power feeding, first it is highly necessary for a value of the voltage, which is fed (fed to the adapter power supply section **320**) in order to generate a supply voltage, to be within a predetermined range. Otherwise, there is a concern about fluctuation even in the voltage values subsequently generated. Accordingly, first it is determined whether or not there is an abnormality in the voltage value of the power-system power supply PWR is correct. The second important thing is that, in order for the interchangeable lens **200** side to perform correct control, it is necessary for the lens control section **210** to perform stable driving. Hence, it is determined whether or not there is an abnormality in the lens control system power supply Vc which feeds a voltage to the lens control section **210**. That is, in priority order of the power-system power supply PWR, the lens control system power supply Vc, and the lens driving system power supply Vp, determination as to whether or not there is an abnormality in each voltage value thereof may be performed. As described above, by using relative merits in the determination, for example, even when there is an abnormality in the voltage value of the lens driving system power supply Vp, if the voltage value of the lens control system power supply Vc is normal and the lens control section **210** is normally operated (may normally communicate with the adapter control section **310**), without performing the reset process (initialization process) on the interchangeable lens **200** side, it may be possible to recover the voltage value through another error processing (re-driving/retry operation of the lens-side driving element). Thereby, it is possible to prevent the hasty (unnecessary) initialization process from being performed.

Next, referring to FIG. **16**, as an example of a process which is performed when there is a decrease in the power supply voltage, the process at the time of temporary blackout of power supply will be described.

FIG. **16** is a diagram illustrating an example of a process sequence at the time of temporary blackout of power supply.

In the lens suspension state, the first camera communication portion **112** and the first adapter communication portion **312** perform the routine data communication in the period Tm (step S**1310**, S**1312**, S**1314**). The adapter power control portion **311** of the adapter control section **310** detects a state where there are temporary decreases in the voltages of the lens control system power supply Vc, the lens driving system power supply Vp, and the power-system power supply PWR, on the basis of the detection results of the Vc-voltage detection portion **325**, the Vp-voltage detection portion **326**, and the PWR voltage detection portion **327** (step S**2310**). FIG. **16** shows an exemplary case where the voltages of the lens control system power supply Vc, the lens driving system power supply Vp, and the power-system power supply PWR are temporarily decreased and then recovered (a case where there is a temporary blackout of the power supply). The adapter power control portion **311** executes a process of cutting off the power supply which supplies a voltage to the interchangeable lens **200**, in response to detecting the state where the voltage is temporarily decreased (the state where there is a temporary blackout of the power supply). For example, the adapter power control portion **311** causes the adapter power supply section **320** to perform control, which is to stop supplying voltages in order of the lens driving system power supply Vp and the lens control system power supply Vc, as the power cut-off process (step S**2320**).

Next, after the adapter power supply section **320** stops the supply of the voltages of the lens driving system power supply Vp and the lens control system power supply Vc, the first adapter communication portion **312** responds with information which indicates that the temporary blackout of the power supply is detected, through the routine data communication (step S**1314**) to the first camera communication portion **112** (step S**2330**). For example, the first adapter communication portion **312** transmits "an initialization request signal in detection of the temporary blackout of the power supply" (initialization request signal) as a signal, which indicates that the temporary blackout of the power supply is detected, to the first camera communication portion **112**.

Subsequently, as the first camera communication portion **112** receives "the initialization request signal in the detection of the temporary blackout of the power supply", the camera control section **110** controls the switch **125** such that it is set in the cut-off state, thereby stopping the supply of the voltage of the power-system power supply PWR (step S**1330**). Further, after stopping the supply of the voltage of the power-system power supply PWR, the camera control section **110** controls the camera power supply section **120** such that it stops the supply of the voltage of the control system power supply Vcc**1** (step S**1340**).

Subsequently, the camera control section **110** executes the lens activation process (step S**100** of FIG. **8**) so as to thereby feed a voltage and execute the process of initialization.

As described above, when there is a temporary blackout in the power supply supplied to the interchangeable lens **200**, the adapter control section **310** detects that the temporary blackout occurs, stops the voltage supplied to the interchangeable lens and the voltage supplied from the camera body **100** once so as to thereby attain the power cut-off state, and thereafter performs activation again so as to thereby execute the initialization process. Thereby, even when the temporary blackout of the power supply occurs, the adapter control section **310** initializes the adapter **300** and the interchangeable lens **200**, whereby it is possible to shift them to the normal operation state.

In the embodiment, the adapter power control portion **311** detects the state where there is a temporary decrease in the voltages of the lens control system power supply Vc, the lens driving system power supply Vp, and the power-system power supply PWR, on the basis of the detection results of the Vc-voltage detection portion **325**, the Vp-voltage detection portion **326**, and the PWR voltage detection portion **327**. In this case, the control portion cuts off the power supply which supplies a voltage to the interchangeable lens **200**, and thereby executes the initialization process. However, if it is determined that the voltage is decreased only in the detection result of the Vp-voltage detection portion **326** (if it is not determined that the voltage is decreased in the detection results of the Vc-voltage detection portion **325** and the PWR voltage detection portion **327**), it can be inferred that the communication itself between the adapter control section **310** and the lens control section **210** is normally performed. Therefore, the initialization process may not be executed in the interchangeable lens **200**.

The embodiment described in the example in which, as the detection result of the temporary blackout of the power supply is transmitted from the adapter control section **310** to the camera control section **110**, the camera control section **110** initializes the interchangeable lens **200** (the example in which the initialization is executed in a way that the adapter control section **310** receives an instruction from the camera control section **110**), but the present invention is not limited to this. For example, the adapter control section **310** may determine the necessity of the initialization execution by itself without receiving the instruction from the camera control section **110**, and then initialize the interchangeable lens **200**.

In addition, the present embodiment described the configuration in which all the above-mentioned three voltage detection portions **325** to **327** are provided. However, even with a configuration in which only one or two of the three voltage detection portions are provided, it is possible to obtain the same advantage as the present embodiment. In this case, the PWR voltage detection portion **327** is advantageous (prior) particularly as a portion which performs the voltage detection, and in order of priority in terms of the advantage, there are the Vc-voltage detection portion **325** and the Vp-voltage detection portion **326**.

The advantages according to the configurations are as described above.

As described above, according to the present embodiment, in the interchangeable-lens camera system, it is possible to cause various kinds of optical systems to appropriately function.

The present invention is not limited to the configuration shown in FIGS. **3**, **5**, and **6** in which the interchangeable lens **200** and the camera body **100** are connected to each other only through the adapter **300**.

For example, it may be possible to adopt a configuration in which the interchangeable lens **200** and the camera body **100** is connected to the interchangeable lens **200** through a conversion adapter (such as teleconverter) other than the adapter **300**.

Further, the adapter **300** of the embodiment is configured to not include an optical system, but may be configured to include an optical system.

The camera control section **110**, the lens control section **210**, or the adapter control section **310** in FIG. **1** may be implemented by hardware dedicated to each. Further, with a configuration using a memory and a CPU (Central Processing Unit), the respective functions of the above-mentioned camera control section **110**, lens control section **210**, and adapter control section **310** may be implemented by loading and executing programs for implementing the functions in the memory.

Further, programs for implementing the respective functions of the camera control section **110**, the lens control section **210**, and the adapter control section **310** mentioned above are recorded in a computer-readable recording medium, and the programs recorded in the recording medium are read out and executed by a computer system, whereby the above-mentioned processes of the respective section may be performed. In addition, the "computer system" described herein is defined to include OS and hardware such as peripherals.

Further, in a case of using the WWW system, the "computer system" is also defined to include the homepage provision environment (or display environment).

Further, the "computer-readable recording medium" means a portable medium such as a flexible disk, a magnetooptical disc, a ROM, or a CD-ROM or a storage device such as a hard disk built into the computer system. Furthermore, the "computer-readable recording medium" is defined to include: dynamically retaining a program during a short period of time like the communication line in the case of transmitting the program through the network such as the Internet and the communication line such as the telephone line; and retaining a program during a predetermined time like a volatile memory inside the computer system serving as a server or client in that case. Further, the program may be to implement some of the functions mentioned above, and may be implemented in combination with the program in which the above-mentioned functions are recorded in advance in the computer system.

Although the embodiments of the present invention have been described hitherto in detail with reference to the drawings, the detailed configuration is not limited to the embodiments, and may include changes in design and the like made without departing from the technical scope of the present invention.

What is claimed is:

1. An adapter comprising:

a first mount section that is *configured to be* detachably attached to a camera body *to receive a first volume from a first power supply system of the camera body mounted on the first mount section and to receive a second voltage from a second power supply system of the camera body mounted on the first mount section*;

a second mount section that is provided separately from the first mount section and is *configured to be* detachably attached to an interchangeable lens; and

a power supply section that generates supply voltages of a third power supply system and a fourth power supply system, which are to be fed to the interchangeable lens mounted on the second mount section, from [a] *the second voltage of the* second power supply system [between a first power supply system of the camera body, which is mounted on the first mount section, and the second power supply system which is different from the first power supply system].

2. The adapter according to claim **1**, wherein power consumed in a load, to which the voltage is fed from the third power supply system, is larger compared with power consumed in a load to which the voltage is fed from the fourth power supply system.

3. The adapter according to claim **1**,

wherein [the power supply section feeds] an electric power [through] *generated by the power supply section for* the third power supply system [to] *is for powering* an optical system driving section in the interchangeable lens which drives an optical system provided in the interchangeable lens, and

wherein [the power supply section feeds] an electric power [through] *generated by the power supply section for* the fourth power supply system [to] *is for powering* a lens control section in the interchangeable lens which controls the optical system driving section.

4. The adapter according to claim **1**, further comprising an adapter control section that controls processes executed in the adapter, wherein [the voltage is fed from the first power supply system to] the adapter control section *receives the first voltage from the first power supply system*.

5. The adapter according to claim **1**, wherein the power supply section has a voltage conversion portion that generates a voltage, which is obtained by converting the *second* voltage of the second power supply system into a predetermined voltage, as a voltage supplied from a fifth power supply system.

6. The adapter according to claim **5**, wherein the voltage conversion portion converts the *second* voltage of the second power supply system into a voltage which is stepped up and down to a predetermined voltage therefrom.

7. The adapter according to claim **5**, wherein the voltage conversion portion has a DC-DC converter portion.

8. The adapter according to claim **5**, further comprising:

a diaphragm interlocking mechanism section that moves to a position corresponding to an aperture value of a diaphragm provided in the interchangeable lens; and

a diaphragm interlocking mechanism driving section that moves a position of the diaphragm interlocking mechanism section,

wherein the power supply section supplies the voltage of the fifth power supply system to the diaphragm interlocking mechanism driving section.

9. The adapter according to claim **5**, wherein the power supply section has a first regulator portion that generates the voltage of the fourth power supply system on the basis of the voltage of the fifth power supply system.

10. The adapter according to claim **9**, wherein the first regulator portion converts the voltage of the fifth power supply system into a voltage which is stepped down to a predetermined voltage therefrom.

11. The adapter according to claim **9**, wherein the first regulator portion has a first linear regulator.

12. The adapter according to claim **9**,

wherein the power supply section has a second regulator portion which is capable of supplying a larger amount of the feeding voltage compared with the first regulator portion, and

wherein the second regulator portion generates the voltage of the third power supply system based on the *second* voltage of the second power supply system.

13. The adapter according to claim **12**, wherein the second regulator portion converts the *second* voltage of the second power supply system into a voltage which is stepped down to a predetermined voltage.

14. The adapter according to claim **12**, wherein the second regulator portion has a second linear regulator.

15. The adapter according to claim **3**, further comprising an adapter communication section that is able to communicate with a camera control section provided in the camera body, and communicates with the lens control section so as to thereby acquire information of the optical system provided in the interchangeable lens,

wherein [a] *the adapter communication section receives the first* voltage [is fed] from the first power supply system [to the adapter communication section].

16. The adapter according to claim **15**, wherein the adapter communication section communicates with the camera control section so as to transmit the information of the optical system, which is acquired from the lens control section, to the camera control section in response to a request from the camera control section.

17. The adapter according to claim **16**, wherein the information of the optical system is at least one of information, which indicates the type of the optical system, and information which indicates a driving state of the optical system.

18. The adapter according to claim **4**,

wherein the adapter control section is supplied with the *first* voltage from the first power supply system, and then transmits a second power supply system request signal, which is for requesting start of the power feeding from the second power supply system, to the camera body.

19. The adapter according to claim **18**, wherein the adapter control section causes the power supply section to generate the voltage of at least one of the third power supply system and the fourth power supply system from the *second* voltage of the second power supply system which is supplied from the camera body in response to the second power supply system request signal.

20. The adapter according to claim **18**, wherein after the power feeding from the second power supply system is started, the adapter control section causes the power supply section to generate the voltage of at least one of the third power supply system and the fourth power supply system, and supplies the voltage to the interchangeable lens.

21. The adapter according to claim **18**, wherein after the start of the power feeding from the second power supply system, the adapter control section starts feeding a voltage from the fourth power supply system to the interchangeable lens.

22. The adapter according to claim **18**, wherein after the supply of the voltage from the fourth power supply system to the interchangeable lens, the adapter control section supplies the voltage from the third power supply system to the interchangeable lens.

23. The adapter according to claim **18**, wherein in response to the supply of the voltage of the fourth power supply system to the interchangeable lens, when receiving a third power supply system request signal which indicates the request to start the supply of the voltage of the third power supply system from the interchangeable lens, the adapter control section supplies the voltage of the third power supply system from the power supply section to the interchangeable lens.

24. The adapter according to claim **18**, wherein after the supply of the *first* voltage of the first power supply system from the camera body is started, the adapter control section executes an initialization process in response to a control instruction from a camera control section provided in the camera body.

25. The adapter according to claim **24**, wherein the adapter control section requests the interchangeable lens to execute a process of initializing a status of the interchangeable lens as the initialization process.

26. The adapter according to claim **25**, wherein after the voltage of at least one of the third power supply system and the fourth power supply system is supplied to the interchangeable lens, the adapter control section requests the interchangeable lens to execute the process of initializing the status of the interchangeable lens.

27. The adapter according to claim **25**, further comprising:

a diaphragm interlocking mechanism section that moves to a position corresponding to an aperture value of a diaphragm provided in the interchangeable lens; and

a diaphragm interlocking mechanism driving section that moves a position of the diaphragm interlocking mechanism section, wherein the adapter control section controls the diaphragm interlocking mechanism driving section through the initialization process, thereby executing a diaphragm interlocking mechanism initialization process of moving a position of the diaphragm interlocking mechanism section to a prescribed position which is determined in advance.

28. The adapter according to claim **27**, wherein after requesting the interchangeable lens to execute the process of initializing the status of the interchangeable lens, the adapter control section executes the diaphragm interlocking mechanism initialization process.

29. The adapter according to claim **27**,

wherein initialization completion information, which indicates whether or not the initialization process is complete, includes lens initialization completion information, which indicates whether or not the process of initializing the status of the interchangeable lens is complete, and diaphragm interlocking mechanism initialization completion information which indicates whether or not the diaphragm interlocking mechanism initialization process is complete, and

wherein the adapter control section sets a value of the lens initialization completion information to a value that indicates that initialization is complete, regardless of a progress state of the process of initializing the status of the interchangeable lens.

30. The adapter according to claim **29**, wherein as the diaphragm interlocking mechanism initialization process is complete, the adapter control section sets a value of the diaphragm interlocking mechanism initialization completion information to a value that indicates that initialization is complete, and transmits the initialization completion information to the camera control section.

31. The adapter according to claim **18**,

wherein the adapter control section can receive an instruction signal, which indicates that an operation mode of the camera body is shifted from a first operation mode to a second operation mode in which power consumption is smaller compared with the first operation mode, from the camera body, and

wherein in response to receiving the corresponding instruction signal, the adapter control section executes a lens shutdown process of stopping the power feeding to the interchangeable lens.

32. The adapter according to claim **31**, wherein when the lens shutdown process is complete, the adapter control section transmits a permission signal, which indicates a permission to shill the operation mode from the first operation mode to the second operation mode, to the camera body.

33. A camera system comprising:

the adapter according to claim **1**;

the camera body mounted on the first mount section; and

the interchangeable lens mounted on the second mount section.

34. A non-transitory computer-readable storage medium storing an adapter control program for controlling operations of an adapter control section in an adapter including a first mount section on which a camera body can be mounted and a second mount section which is provided separately from the first mount section and on which an interchangeable lens can be mounted, *the adapter receiving a first voltage from a first power supply system of the camera body mounted on the first mount section and receiving a second voltage from a second power supply system of the camera body mounted on the first mount section,* the adapter control program comprising instructions to perform the steps of:

generating a voltage of a lens system power supply system, which is to be fed to the interchangeable lens *mounted to the second mount section*, from [a] *the second voltage of the* second power supply system [between a first power supply system of the camera body and the second power supply system which is different from the first power supply system];

operating by receiving a power [feeding] from *the first voltage of* the first power supply system; and

transmitting [the] *a* second power supply system request signal, which is for requesting start of the power feeding from the second power supply system, to the camera body after the power [feeding] from *the first voltage of* the first power supply system is received.

35. A camera system comprising:

the [adaptor] *adapter* according to claim **1**; and

a camera body mounted to the first mount section of the [adaptor] *adapter*, the camera body comprising:

the first power supply system;

the second power supply system; and

a power supply control section,

wherein when an operation mode of the camera body is shifted from a first operation mode to a second operation mode in which power consumption is smaller compared with the first operation mode, the power supply control section stops a power feeding from the second power supply system to the adapter and continues a power feeding from the first power supply system to the adapter during a predetermined time period.

36. The camera system according to claim **35**, wherein

in response to a permission signal transmitted from an adapter control section of the [adaptor] *adapter*, the power feeding from the second power supply system is stopped.

37. The camera system according to claim **35**, wherein

the first operation mode is an operation mode which is capable of executing a photography process, and

the second operation mode is an operation mode in which power consumption is reduced compared with the first operation mode and which is incapable of executing the photography process.

38. An adapter comprising:

a first mount that is attachable to a camera body;

a second mount that is attachable to an accessory; and

a circuit that divides a first voltage supplied from the camera body attached to the first mount into third and fourth voltages supplied to the accessory attached to the second mount.

39. A system comprising:

the adapter according to claim 38; and

the accessory, which is an interchangeable lens having an actuator and a controller, wherein

the third voltage is supplied to the actuator to move a position of an optical system of the interchangeable lens; and

the fourth voltage is supplied to the controller to control the position of the optical system of the interchangeable lens.

40. The adapter according to claim 38, wherein

the second mount has a first terminal via which the third voltage is supplied to the accessory, and a second terminal via which the fourth voltage is supplied to the accessory.

41. The adapter according to claim 38, wherein
the second mount has a ground terminal for the third voltage, and a terminal as a ground for the fourth voltage.

42. The adapter according to claim 38, wherein
a ground for the circuit is electrically connected with a ground for the third voltage.

43. The adapter according to claim 38, wherein
the first mount has a terminal via which the first voltage from the camera body is supplied.

44. The adapter according to claim 38, wherein
the first mount has a ground terminal for the first voltage.

45. The adapter according to claim 38, further comprising:
a controller to which a second voltage is supplied from the camera body when the first mount is attached to the camera body.

46. The adapter according to claim 45, wherein
a ground for the second voltage is electrically connected with a ground for the fourth voltage.

47. The adapter according to claim 45, wherein
the first mount has a terminal via which the second voltage from the camera body is supplied.

48. The adapter according to claim 45, wherein
the first mount has a ground terminal for the second voltage.

49. The adapter according to claim 38, further comprising:
a diaphragm controller that controls a diaphragm of the accessory, wherein
the circuit generates a fifth voltage supplied to the diaphragm controller.

50. The adapter according to claim 49, wherein
a ground for the circuit is electrically connected with a ground for the third voltage.

51. The adapter according to claim 38,
wherein a ground for the circuit, a ground for the first voltage, and a ground for the third voltage are electrically connected to each other.

52. An adapter that is attachable to a camera body, the adapter comprising:
a mount that is attachable to an accessory; and
a circuit that divides a first voltage supplied from the camera body into third and fourth voltages supplied to the accessory attached to the mount.

* * * * *