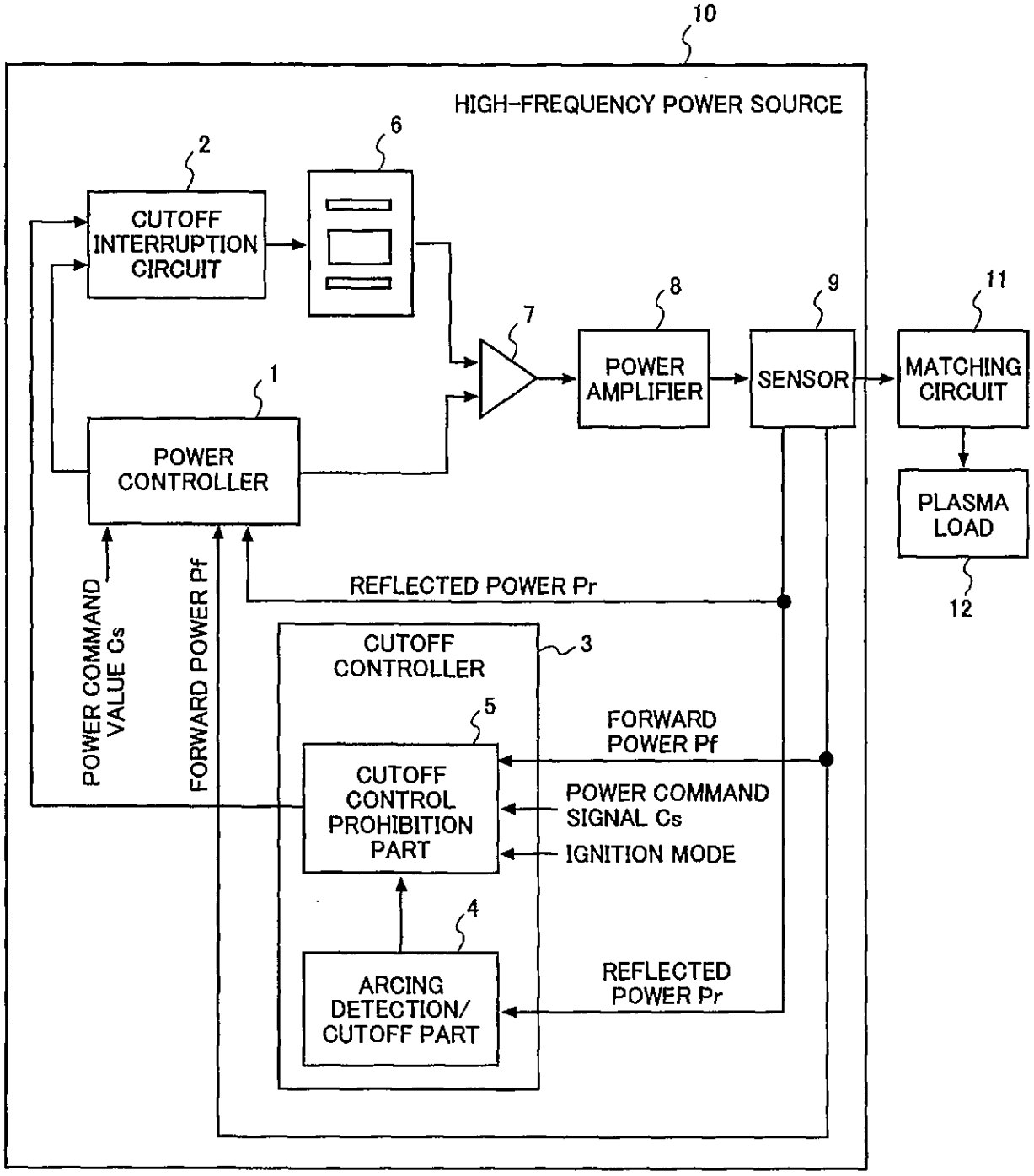

10
HIGH-FREQUENCY POWER SOURCE
2
CUTOFF INTERRUPTION CIRCUIT
6
7
8
POWER AMPLIFIER
9
SENSOR
11
MATCHING CIRCUIT
1
POWER CONTROLLER
PLASMA LOAD
12
POWER COMMAND VALUE Cs
FORWARD POWER Pf
REFLECTED POWER Pr
CUTOFF CONTROLLER
3
5
FORWARD POWER Pf
CUTOFF CONTROL PROHIBITION PART
POWER COMMAND SIGNAL Cs
IGNITION MODE
4
ARCING DETECTION/ CUTOFF PART
REFLECTED POWER Pr

FIG. 1

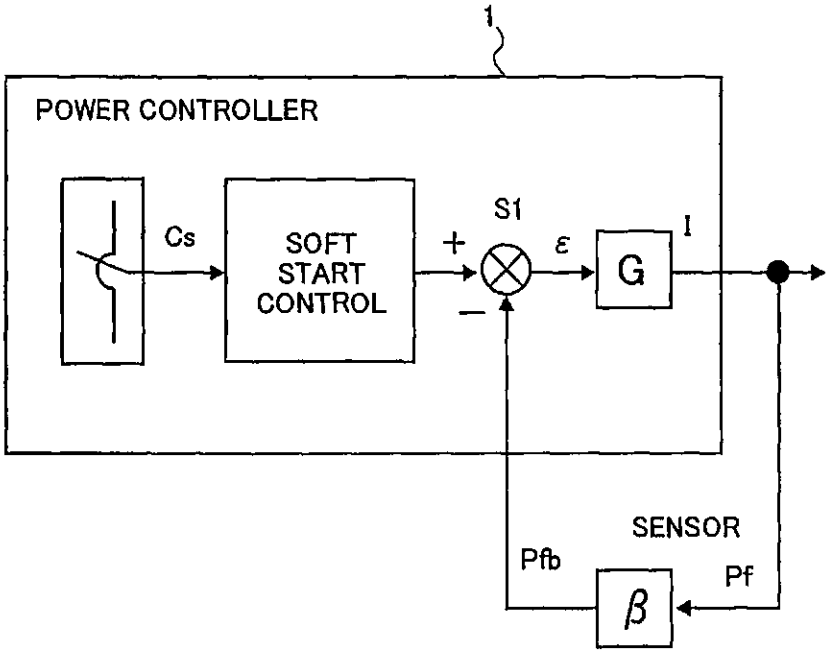

1
POWER CONTROLLER
Cs
SOFT
START
CONTROL
S1
+
−
ε
G
I
SENSOR
Pfb
Pf
β

FIG. 2

FIG. 3A

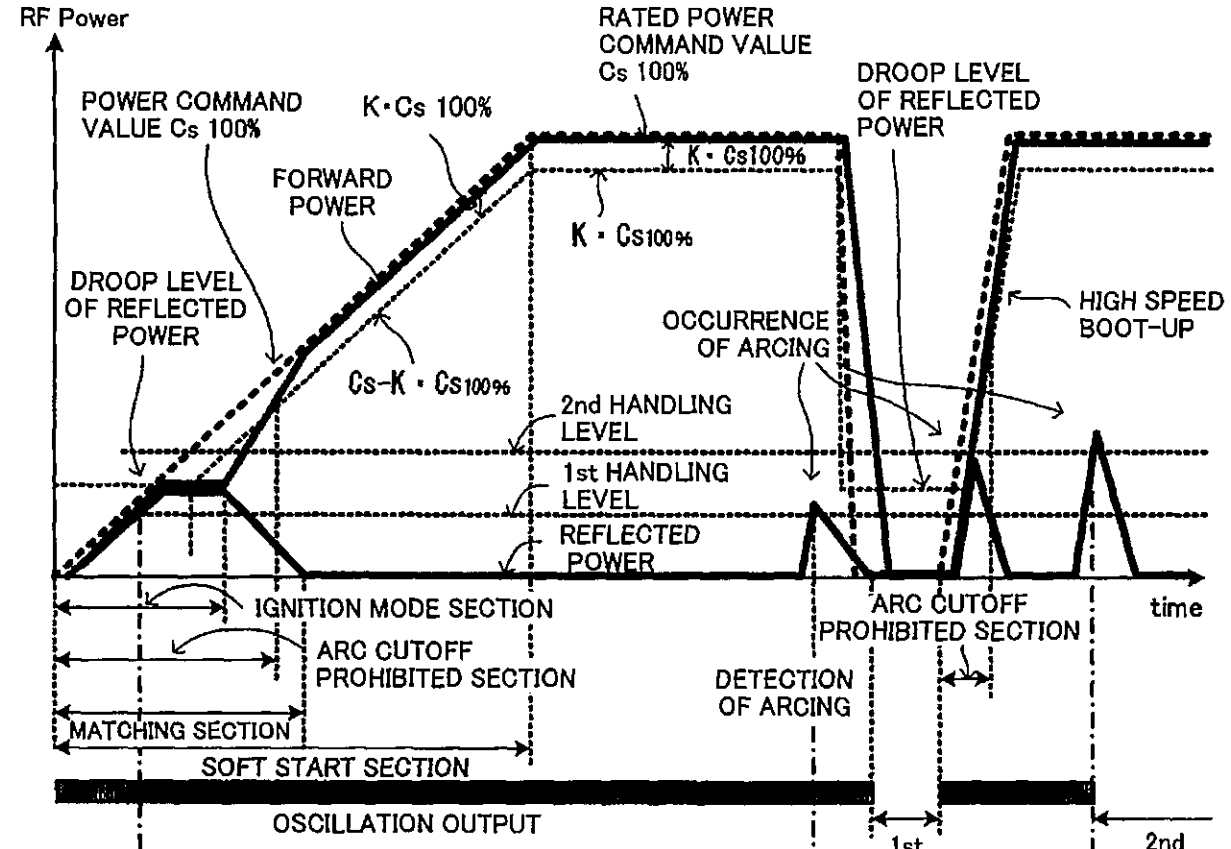


FIG. 3B ARC CUTOFF PROHIBITED SECTION

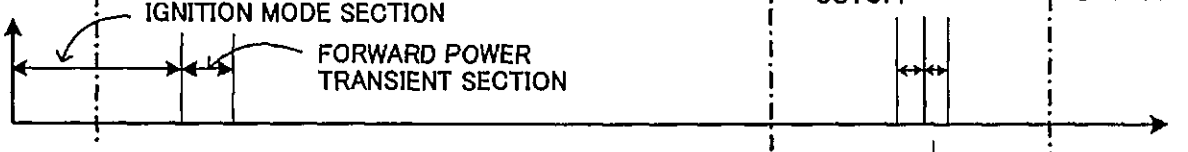


FIG. 3C DETECTION BY 1st HANDLING

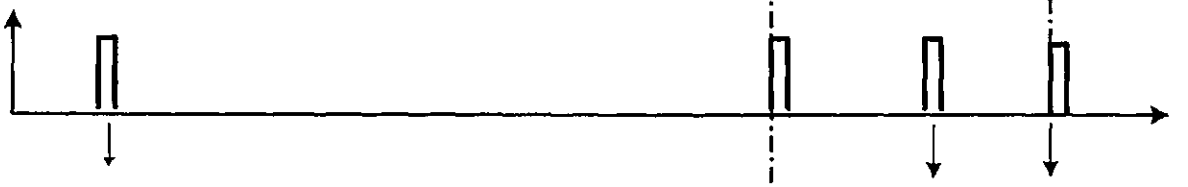


FIG. 3D CUTOFF BY 1st HANDLING

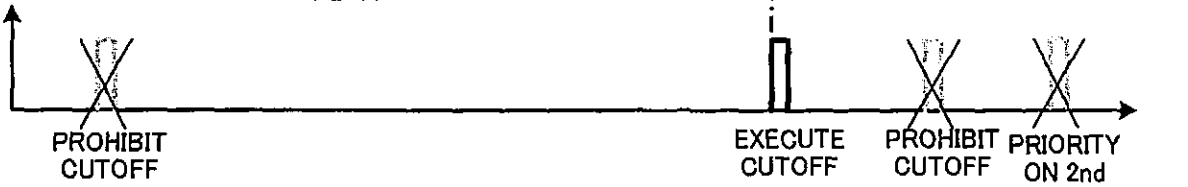


FIG. 3E DETECTION AND CUTOFF BY 2nd HANDLING

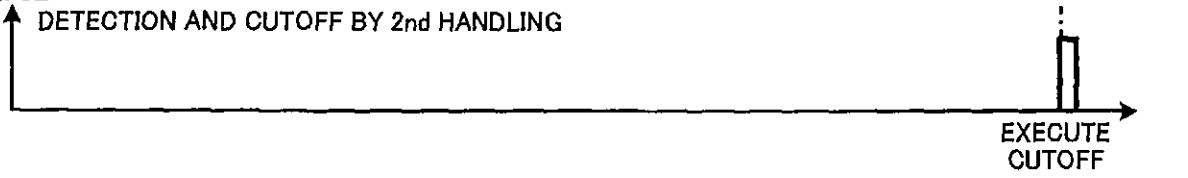


FIG. 4A

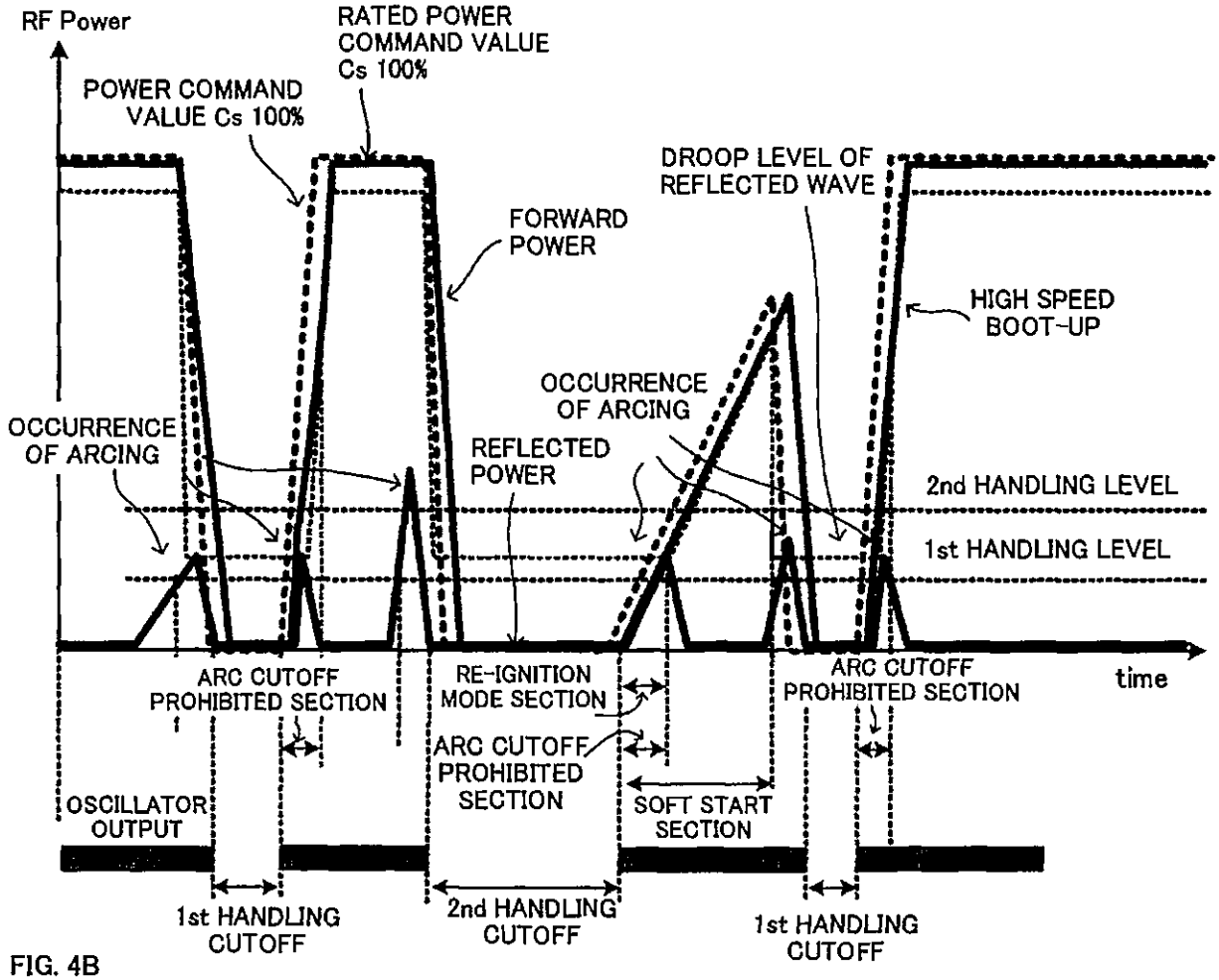


FIG. 4B

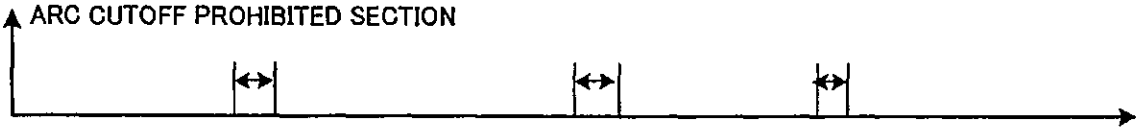


FIG. 4C DETECTION BY 1st HANDLING

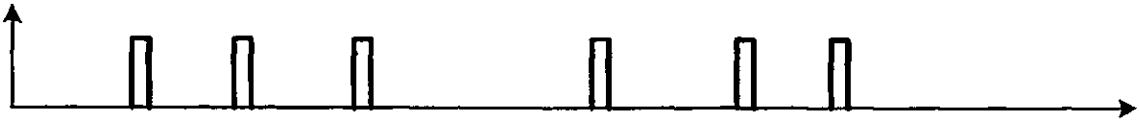


FIG. 4D CUTOFF BY 1st HANDLING

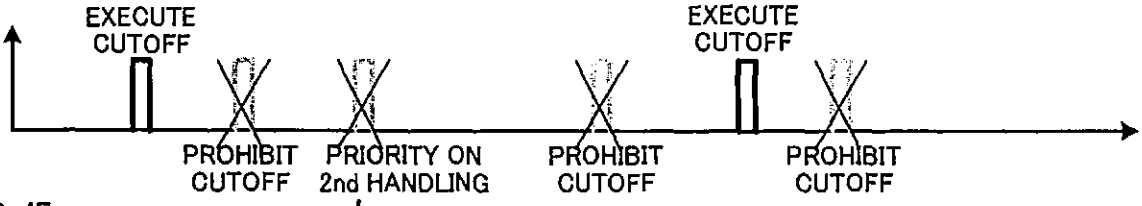
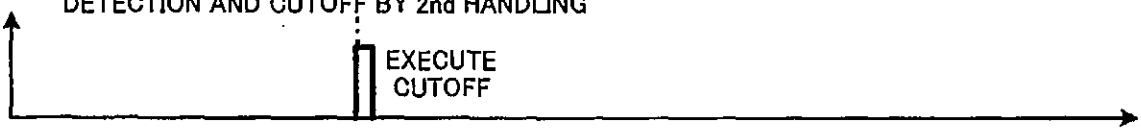


FIG. 4E DETECTION AND CUTOFF BY 2nd HANDLING



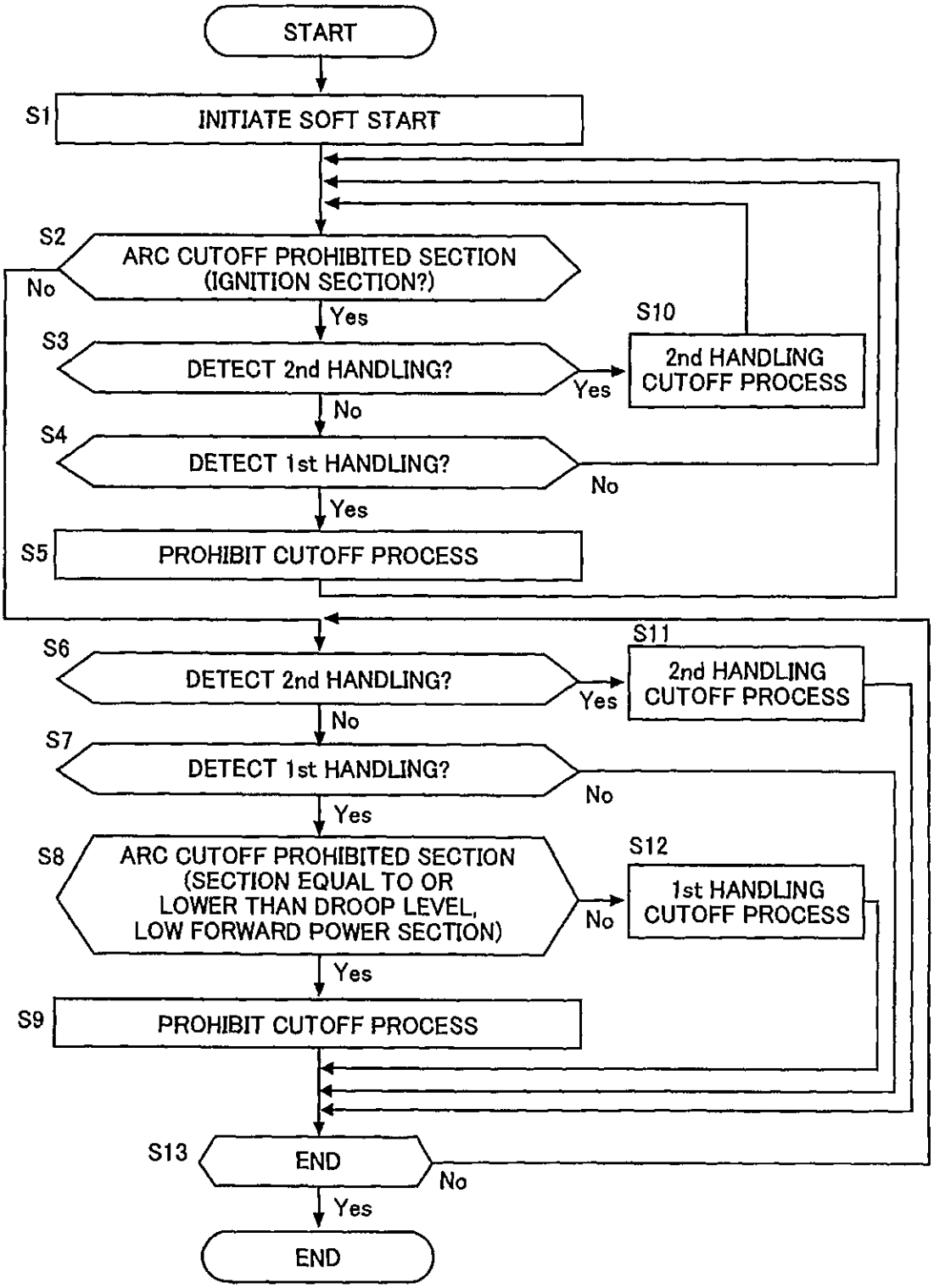

START
S1
INITIATE SOFT START
S2
ARC CUTOFF PROHIBITED SECTION (IGNITION SECTION?)
No
Yes
S3
DETECT 2nd HANDLING?
Yes
S10
2nd HANDLING CUTOFF PROCESS
No
S4
DETECT 1st HANDLING?
No
Yes
S5
PROHIBIT CUTOFF PROCESS
S6
DETECT 2nd HANDLING?
Yes
S11
2nd HANDLING CUTOFF PROCESS
No
S7
DETECT 1st HANDLING?
No
Yes
S8
ARC CUTOFF PROHIBITED SECTION (SECTION EQUAL TO OR LOWER THAN DROOP LEVEL, LOW FORWARD POWER SECTION)
No
S12
1st HANDLING CUTOFF PROCESS
Yes
S9
PROHIBIT CUTOFF PROCESS
S13
END
No
Yes
END

FIG. 5

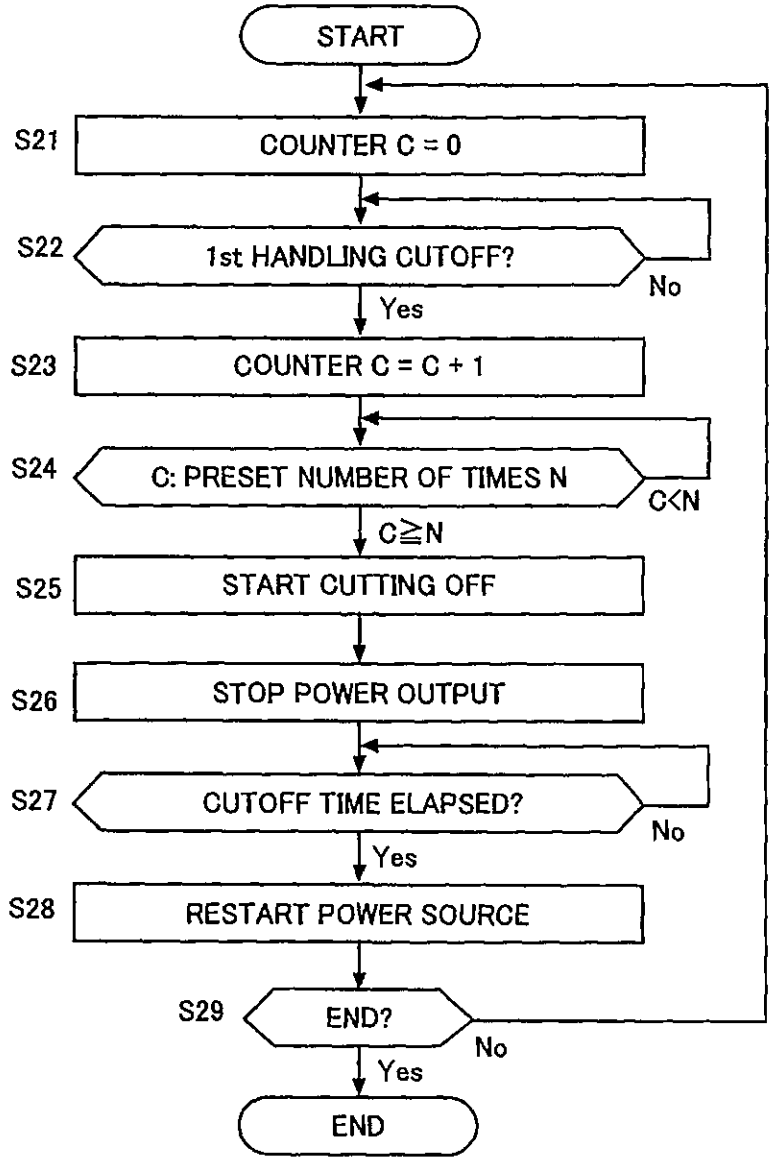

START
S21
COUNTER C = 0
S22
1st HANDLING CUTOFF?
No
Yes
S23
COUNTER C = C + 1
S24
C: PRESET NUMBER OF TIMES N
C<N
C≧N
S25
START CUTTING OFF
S26
STOP POWER OUTPUT
S27
CUTOFF TIME ELAPSED?
No
Yes
S28
RESTART POWER SOURCE
S29
END?
No
Yes
END

FIG. 6

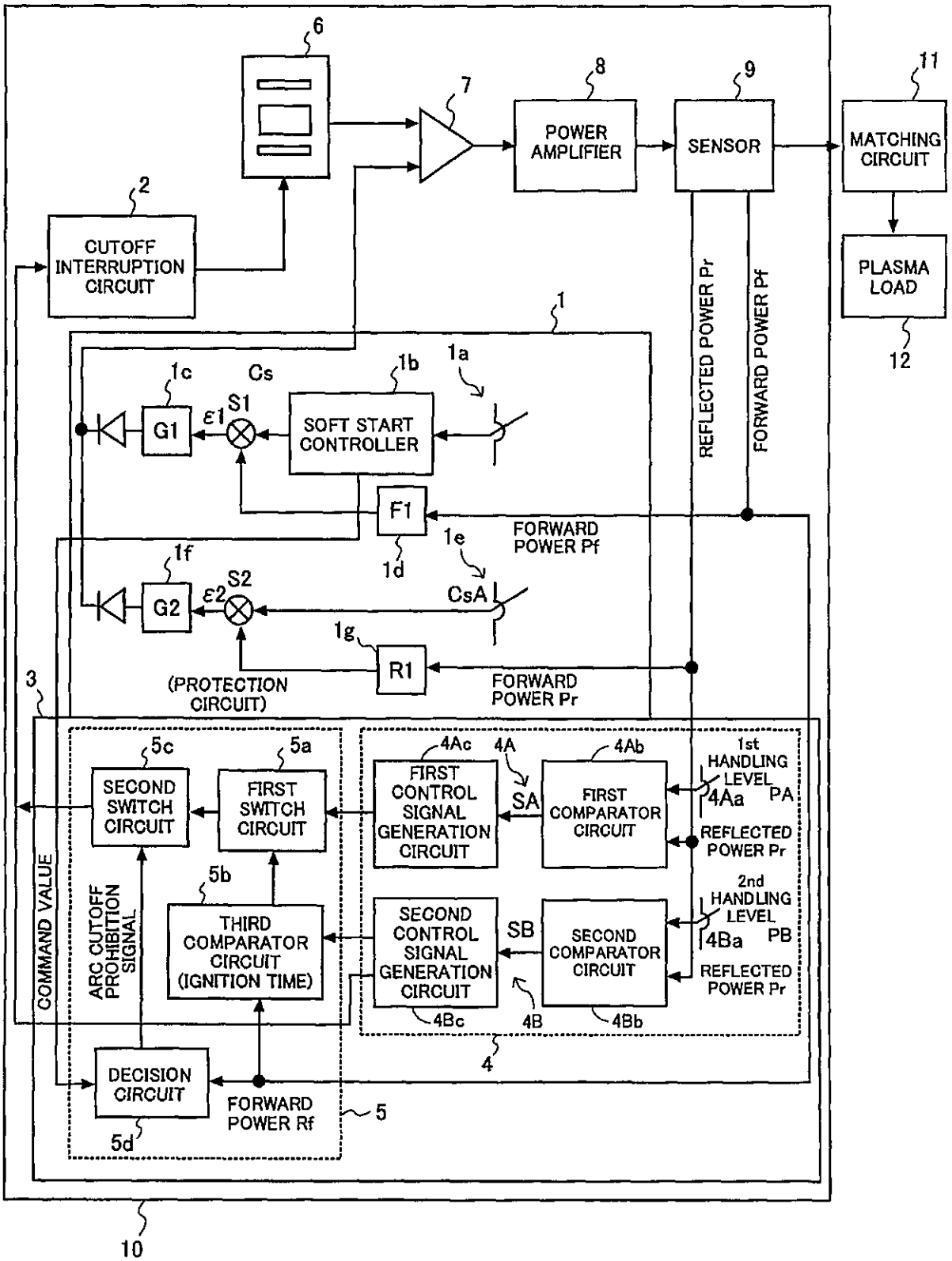

6
7
8
9
11
POWER AMPLIFIER
SENSOR
MATCHING CIRCUIT
2
CUTOFF INTERRUPTION CIRCUIT
PLASMA LOAD
12
1
REFLECTED POWER Pr
FORWARD POWER Pf
1c
Cs
1b
1a
G1
ε1
S1
SOFT START CONTROLLER
F1
1d
FORWARD POWER Pf
1e
1f
G2
ε2
S2
CsA
1g
R1
(PROTECTION CIRCUIT)
FORWARD POWER Pr
3
5c
5a
4Ac
4A
4Ab
1st HANDLING LEVEL
SECOND SWITCH CIRCUIT
FIRST SWITCH CIRCUIT
FIRST CONTROL SIGNAL GENERATION CIRCUIT
SA
FIRST COMPARATOR CIRCUIT
4Aa
PA
REFLECTED POWER Pr
COMMAND VALUE
ARC CUTOFF PROHIBITION SIGNAL
5b
THIRD COMPARATOR CIRCUIT (IGNITION TIME)
SECOND CONTROL SIGNAL GENERATION CIRCUIT
SB
SECOND COMPARATOR CIRCUIT
2nd HANDLING LEVEL
4Ba
PB
REFLECTED POWER Pr
4Bc
4B
4Bb
4
DECISION CIRCUIT
FORWARD POWER Rf
5
5d
10

FIG. 7

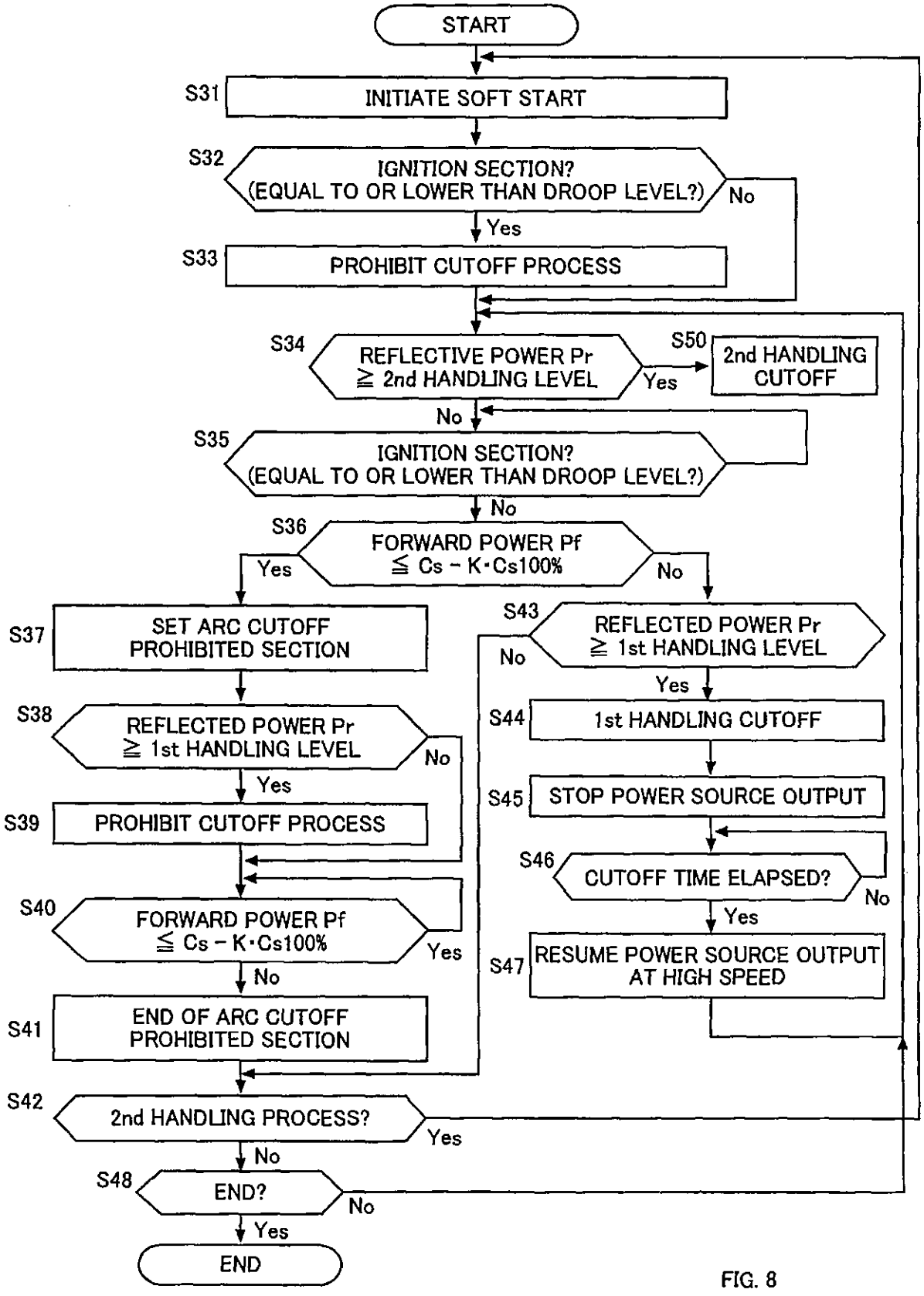

START
S31
INITIATE SOFT START
S32
IGNITION SECTION?
(EQUAL TO OR LOWER THAN DROOP LEVEL?)
No
Yes
S33
PROHIBIT CUTOFF PROCESS
S34
REFLECTIVE POWER Pr
≧ 2nd HANDLING LEVEL
Yes
S50
2nd HANDLING CUTOFF
No
S35
IGNITION SECTION?
(EQUAL TO OR LOWER THAN DROOP LEVEL?)
No
S36
FORWARD POWER Pf
≦ Cs - K·Cs100%
Yes
No
S37
SET ARC CUTOFF PROHIBITED SECTION
S38
REFLECTED POWER Pr
≧ 1st HANDLING LEVEL
No
Yes
S39
PROHIBIT CUTOFF PROCESS
S40
FORWARD POWER Pf
≦ Cs - K·Cs100%
Yes
No
S41
END OF ARC CUTOFF PROHIBITED SECTION
S43
REFLECTED POWER Pr
≧ 1st HANDLING LEVEL
No
Yes
S44
1st HANDLING CUTOFF
S45
STOP POWER SOURCE OUTPUT
S46
CUTOFF TIME ELAPSED?
No
Yes
S47
RESUME POWER SOURCE OUTPUT AT HIGH SPEED
S42
2nd HANDLING PROCESS?
Yes
No
S48
END?
No
Yes
END

FIG. 8

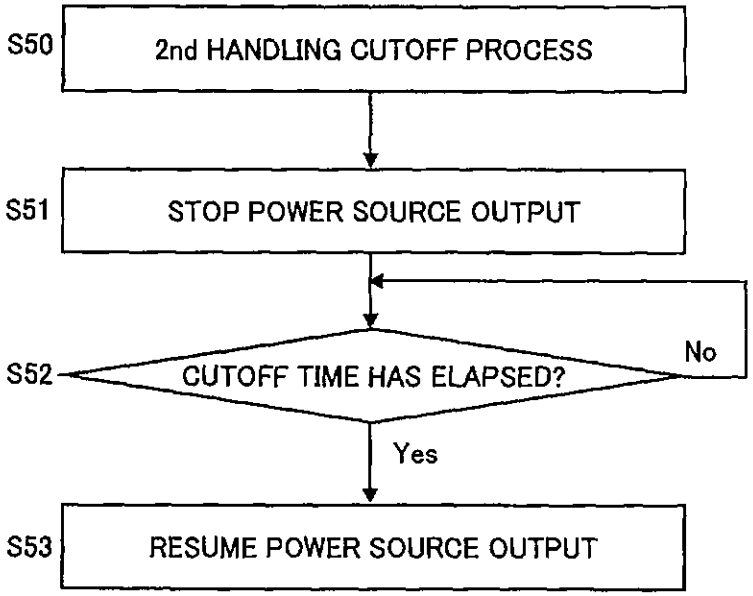

S50
2nd HANDLING CUTOFF PROCESS
S51
STOP POWER SOURCE OUTPUT
S52
CUTOFF TIME HAS ELAPSED?
No
Yes
S53
RESUME POWER SOURCE OUTPUT

FIG. 9

FIG. 10A

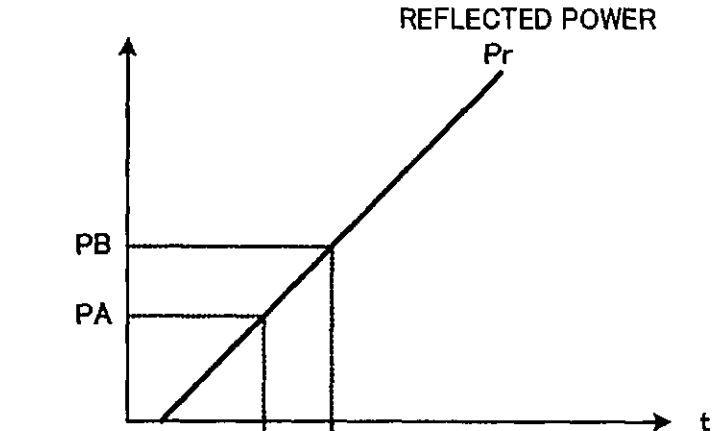


FIG. 10B



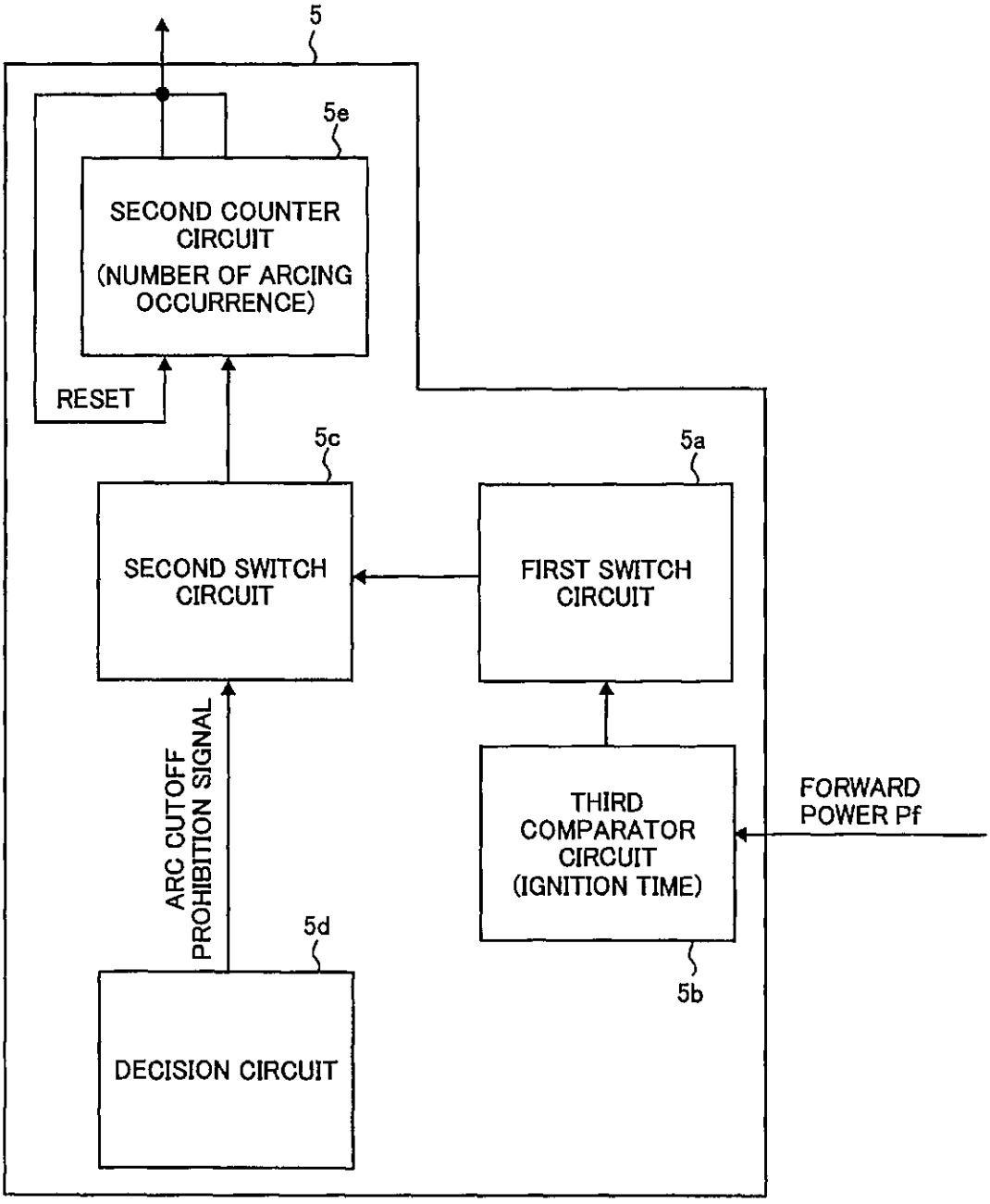

5
5e
SECOND COUNTER CIRCUIT
(NUMBER OF ARCING OCCURRENCE)
RESET
5c
5a
SECOND SWITCH CIRCUIT
FIRST SWITCH CIRCUIT
ARC CUTOFF PROHIBITION SIGNAL
THIRD COMPARATOR CIRCUIT
(IGNITION TIME)
FORWARD POWER Pf
5d
5b
DECISION CIRCUIT

FIG. 11

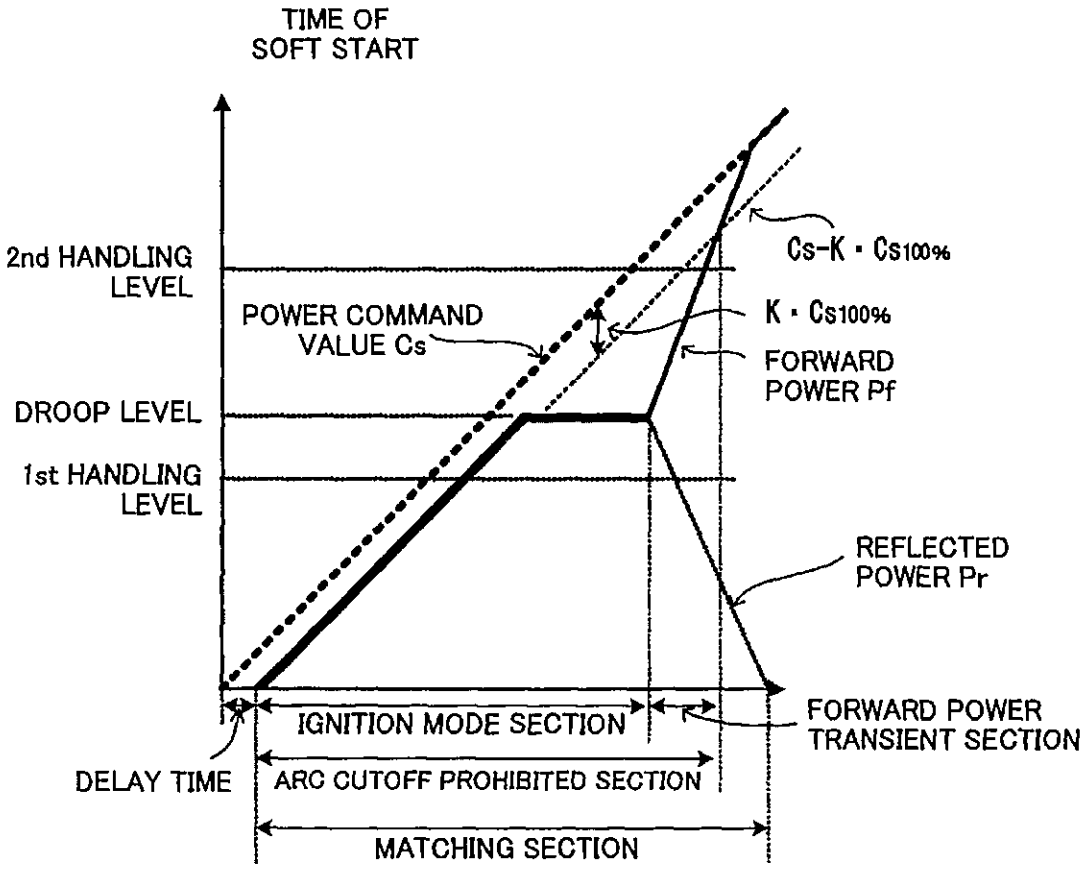

TIME OF
SOFT START
2nd HANDLING
LEVEL
DROOP LEVEL
1st HANDLING
LEVEL
POWER COMMAND
VALUE Cs
Cs-K · Cs100%
K · Cs100%
FORWARD
POWER Pf
REFLECTED
POWER Pr
IGNITION MODE SECTION
FORWARD POWER
TRANSIENT SECTION
DELAY TIME
ARC CUTOFF PROHIBITED SECTION
MATCHING SECTION

FIG. 12

TIME OF HIGH SPEED BOOT-UP AFTER 1st HANDLING

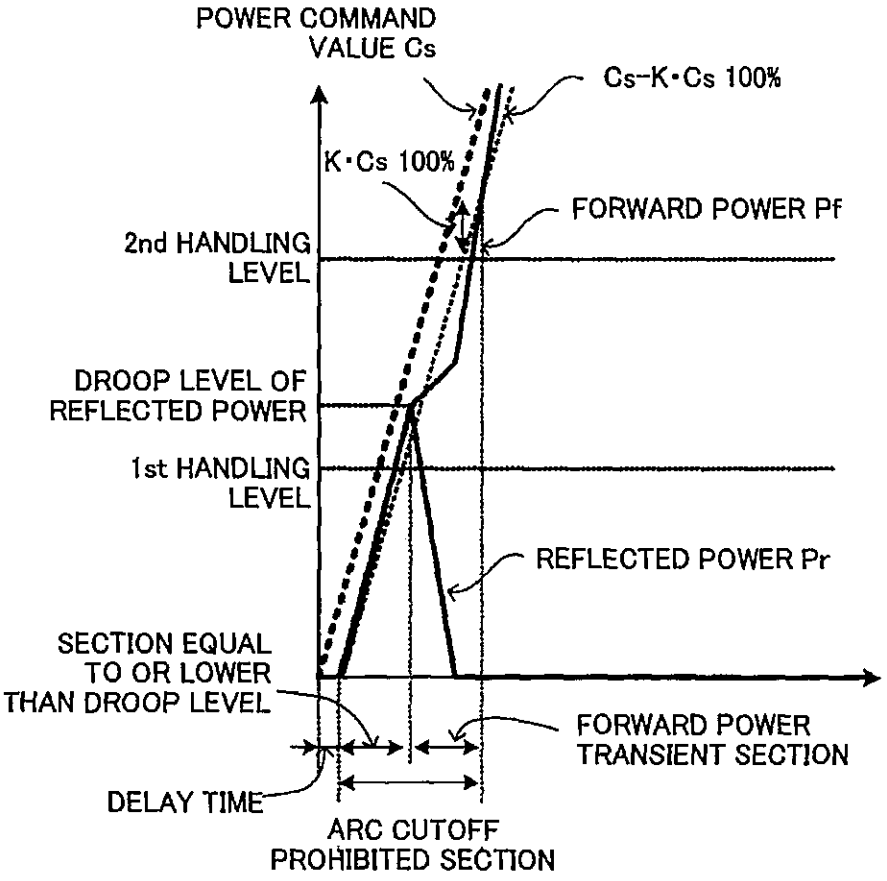


FIG. 13

TIME OF SOFT START AFTER 2nd HANDLING

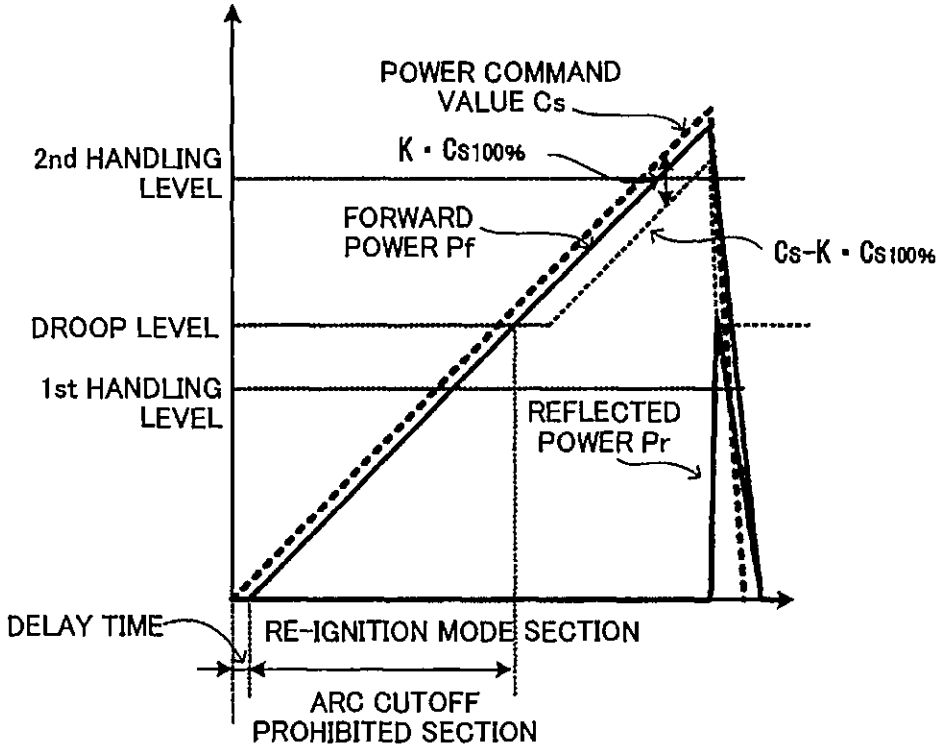


FIG. 14