PI201/36302/2014-MOM

We Claim:-

1. A cooling fan control apparatus for a radiator (54) that is used in an

internal combustion engine (1) capable of using a fuel in which gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator (54) of the internal combustion engine (1), the cooling fan control apparatus characterized by comprising:

a controller (9) that performs the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when an evaporation amount of the fuel inside a fuel tank (41) after a supply of the fuel to the fuel tank (41) is performed is less than a predetermined amount, the alcohol concentration of the fuel is taken to be higher than the predetermined concentration, and that restricts the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when the evaporation amount of the fuel inside the fuel tank (41) after the supply is performed is equal to or greater than the predetermined amount, the alcohol concentration of the fuel is taken to be equal to or lower than the predetermined concentration.

2. The cooling fan control apparatus for a radiator according to claim 1, wherein:

the predetermined concentration is an alcohol concentration of the fuel when a boiling point of the fuel that changes according to the alcohol concentration of the fuel is at a maximum value attainable by a temperature of the fuel after the internal combustion engine is stopped.

3. The cooling fan control apparatus for a radiator according to claim 41, wherein:

the internal combustion engine (1) is provided with an intake passage (2) for introducing intake air into the internal combustion engine (11, and an evaporated fuel processing device (6) that introduces an

evaporated fuel produced by evaporation of the fuel inside the fuel tank (41), into the intake passage (2), the controller (9) that calculates a purge amount integral value which is an integral value of an amount of the evaporated fuel introduced into the intake passage (2) after the supply of the fuel to the fuel tank (41) is performed, that performs the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when the purge amount integral value is less than a predetermined value, the alcohol concentration of the fuel is taken to be higher than the predetermined concentration, and that restricts the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when the purge amount integral value is equal to or higher than the predetermined value, the alcohol concentration of the fuel is taken to be equal to or lower than the predetermined concentration.

4. The cooling fan control apparatus for a radiator according to any one of

claims 1 to 3, comprising:

an estimation device (9, 95) that estimates an alcohol concentration of the fuel,

wherein when the alcohol concentration of the fuel estimated by the estimation device is equal to or lower than the predetermined concentration, the drive of the cooling fan (55) after the internal combustion engine (1) is stopped is restricted.

5. The cooling fan control apparatus for a radiator according to claim 4, wherein

the controller (9) that performs the drive of the cooling fan (55) after the internal combustion engine is stopped, when the alcohol concentration of the fuel is equal to or lower than the predetermined concentration, regardless of the evaporation amount of the fuel inside the fuel tank (41) after the supply of the fuel to the fuel tank (41).

6. A cooling fan control apparatus for a radiator (54) that is used in an internal combustion engine (1) capable of using a fuel in which gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator (54) of the internal combustion engine (1), the cooling fan control apparatus comprising:

a controller (9) that performs the drive of the cooling fan (55) after the internal combustion engine is stopped, when an evaporation amount of the alcohol in the fuel inside a fuel tank (41) after a supply of the fuel into the fuel tank (41) is performed is less than a predetermined amount, and that restricts the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when the evaporation amount of the alcohol after the supply is performed is equal to or greater than the predetermined amount.

7. A cooling fan control apparatus for a radiator (54) that is used in an internal combustion engine (1) capable of using a fuel in which gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator (54) of the internal combustion engine (1), the cooling fan control apparatus comprising:

a controller (9) that performs the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, before a predetermined period elapses from a supply of the fuel to a fuel tank (41), and that restricts the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, after the predetermined period has elapsed from the supply.

8. A cooling fan control method for a radiator (54) that is used in an internal

combustion engine (1) capable of using a fuel in which gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator (54) of the internal combustion engine (1), comprising:

driving the cooling fan (55) after the internal combustion engine (1) is stopped when an alcohol concentration of the fuel is higher than a predetermined concentration;

and

restricting the drive of the cooling fan (55) after the internal combustion engine (1) is stopped when the alcohol concentration of the fuel is equal to or lower than the predetermined concentration.

9. A cooling fan control method for a radiator (54) that is used in an internal

combustion engine (1) capable of using a fuel in which gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator of the internal combustion engine(1), comprising:

driving the cooling fan (55) after the internal combustion engine (1) is stopped when an evaporation amount of the alcohol in the fuel inside a fuel tank (41) after a supply of the fuel into the fuel tank (41) is performed is less than a predetermined amount; and

restricting the drive of the cooling fan (55) after the internal combustion engine (1) is stopped when the evaporation amount of the alcohol after the supply is performed is equal to or greater than the predetermined amount.

10. A cooling fan control method for a radiator (54) that is used in an internal combustion engine (1) capable of using a fuel in which

gasoline is mixed with an alcohol with a boiling point lower than that of the gasoline, the cooling fan control apparatus that controls drive of an electric cooling fan (55) provided in the radiator (54) of the internal combustion engine (I), comprising:

performing the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when an evaporation amount of the fuel inside a fuel tank (41) after a supply of the fuel to the fuel tank (41) is performed is less

than a predetermined amount, the alcohol concentration of the fuel is taken to be higher than the predetermined concentration:, and

restricting the drive of the cooling fan (55) after the internal combustion engine (1) is stopped, when the evaporation amount of the fuel inside the fuel tank (41) after the supply is performed is equal to or greater than the predetermined amount, the alcohol concentration of the fuel is taken to be equal to or lower than the predetermined concentration.

Dated this 11th day of March, 2014

SENTHIL KUMAR S.
OF K & S PARTNERS
AGENT FOR THE APPLICANT(S)

FIG. 1

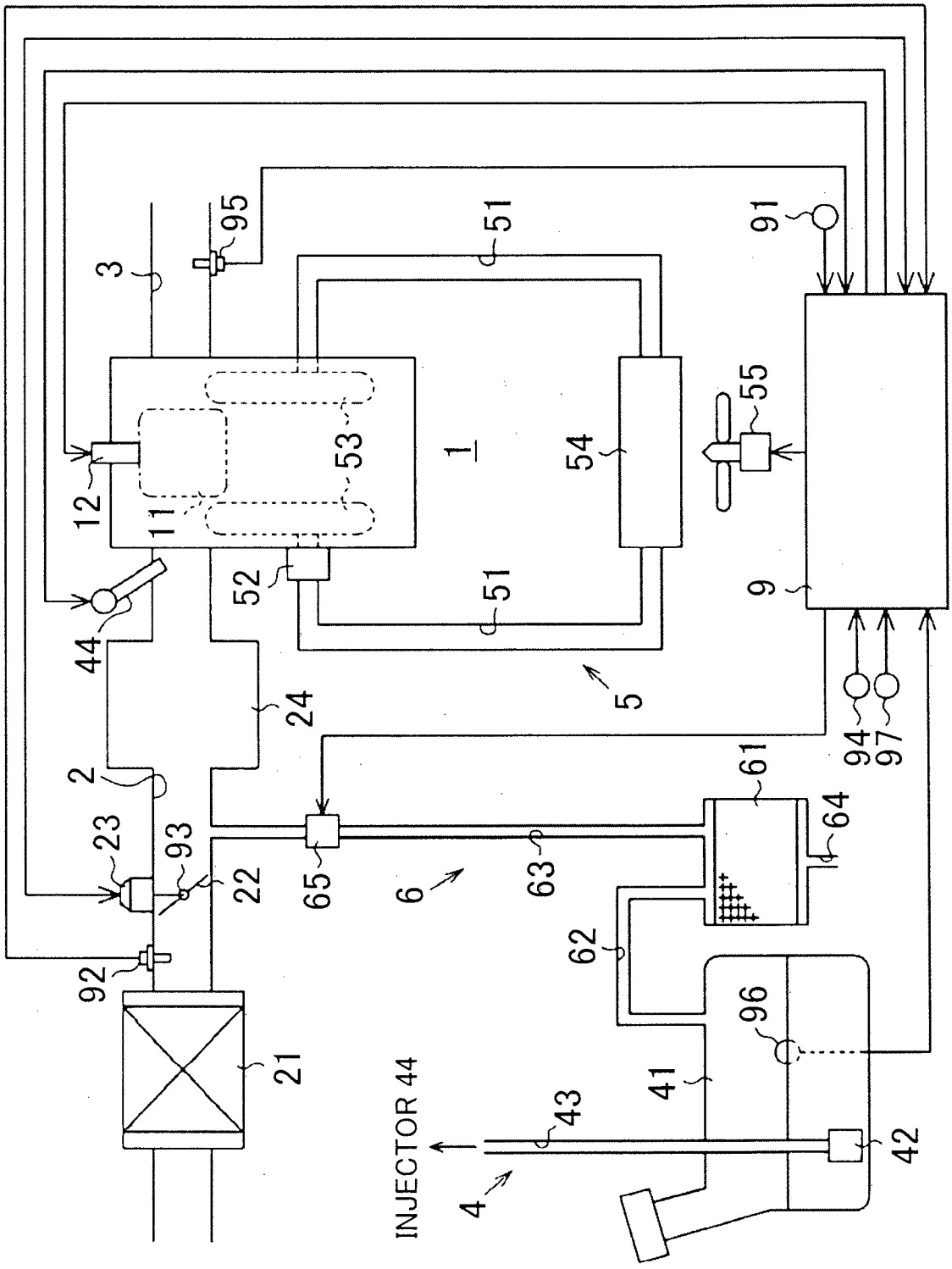

95
3
51
91
55
53
1
54
12
11
52
51
9
44
5
24
94
97
2
61
64
23
93
22
65
6
63
62
92
96
21
41
INJECTOR 44
43
42
4

FIG. 2

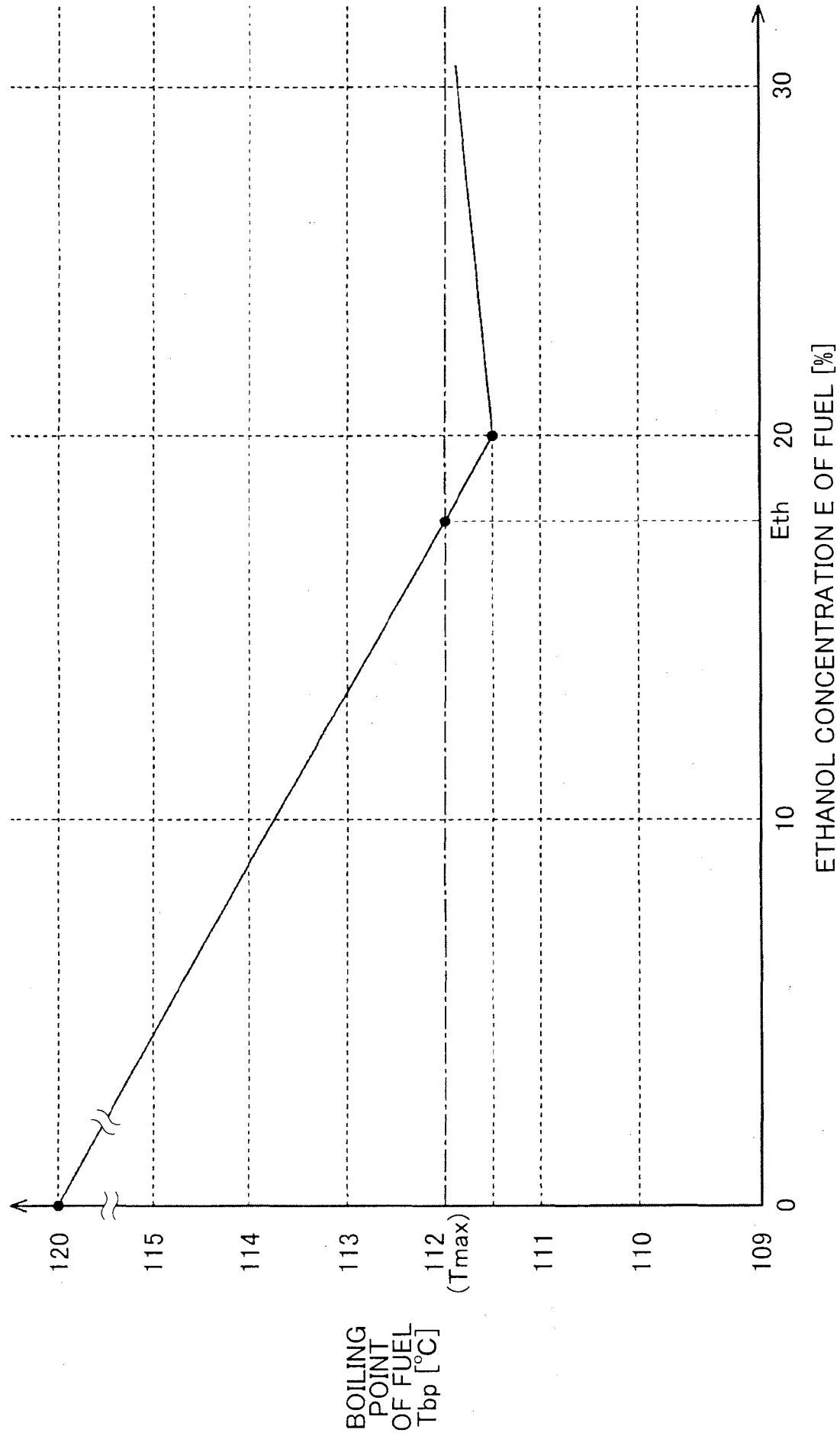

BOILING POINT OF FUEL Tbp [°C]
120
115
114
113
112 (Tmax)
111
110
109
0
10
Eth
20
30
ETHANOL CONCENTRATION E OF FUEL [%]

FIG. 3

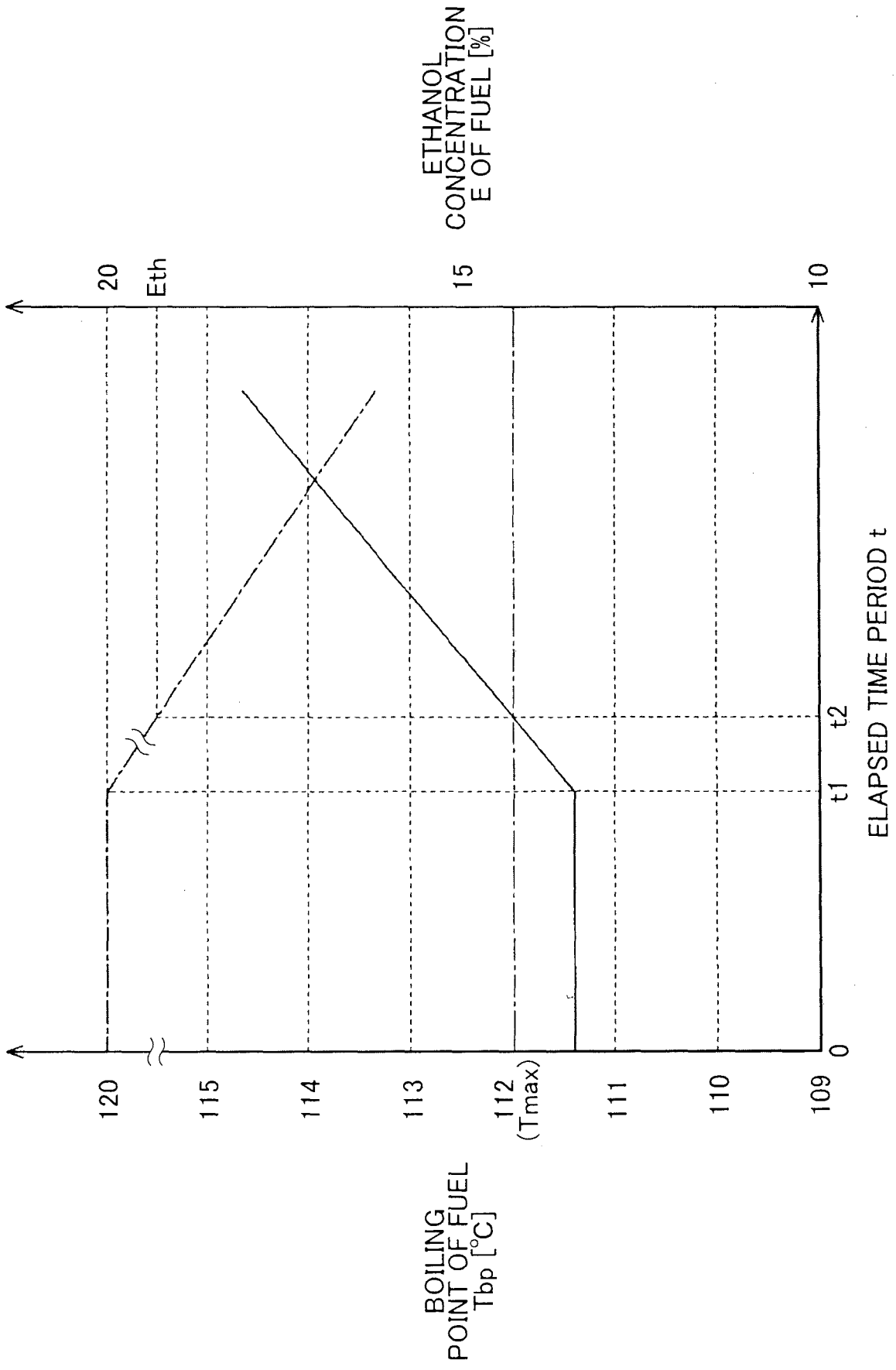

ETHANOL CONCENTRATION E OF FUEL [%]
20
Eth
15
10
BOILING POINT OF FUEL Tbp [°C]
120
115
114
113
112 (Tmax)
111
110
109
0
t1
t2
ELAPSED TIME PERIOD t

FIG. 4

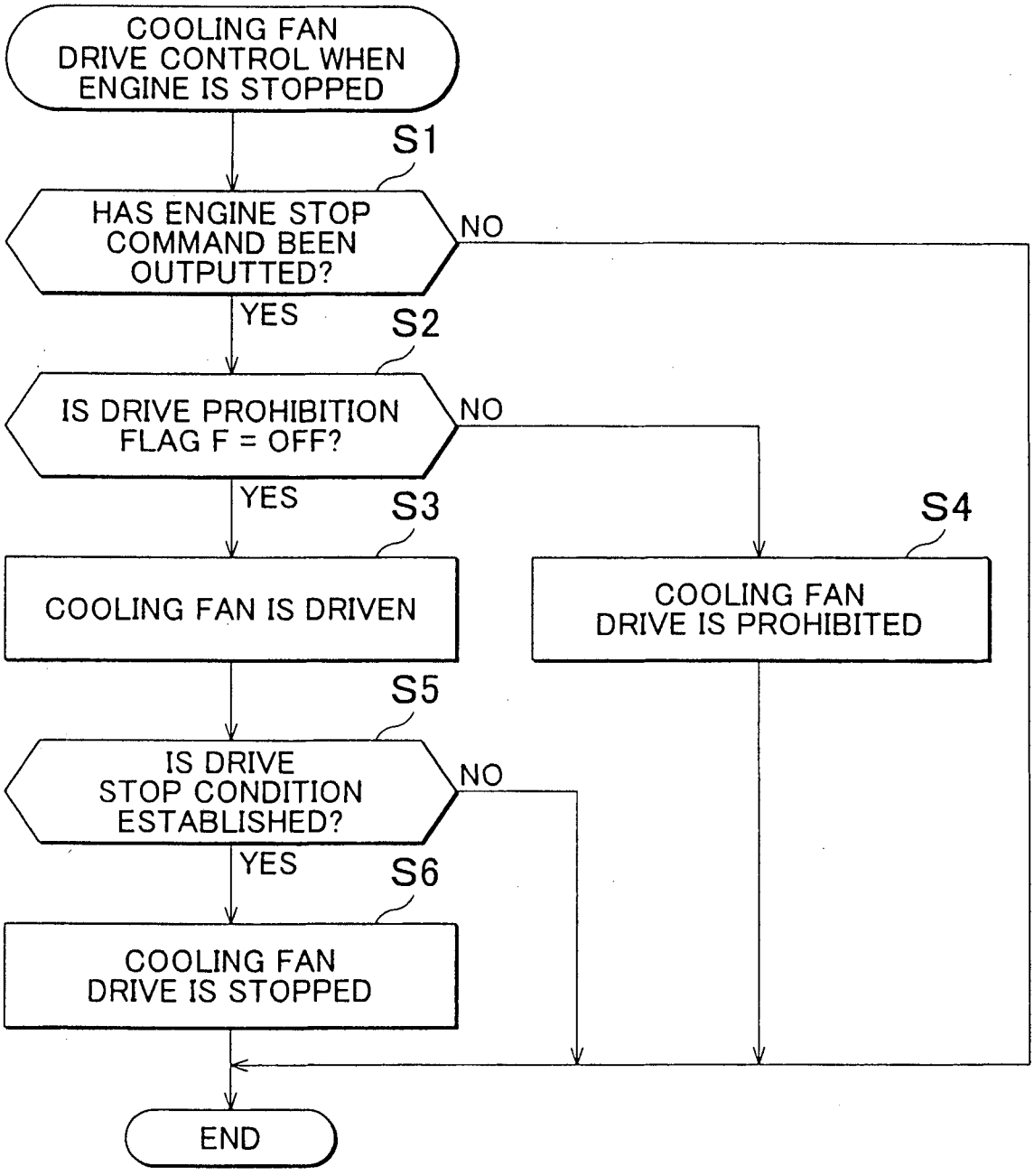

COOLING FAN DRIVE CONTROL WHEN ENGINE IS STOPPED
S1
HAS ENGINE STOP COMMAND BEEN OUTPUTTED?
NO
YES
S2
IS DRIVE PROHIBITION FLAG F = OFF?
NO
YES
S3
COOLING FAN IS DRIVEN
S4
COOLING FAN DRIVE IS PROHIBITED
S5
IS DRIVE STOP CONDITION ESTABLISHED?
NO
YES
S6
COOLING FAN DRIVE IS STOPPED
END

FIG. 5

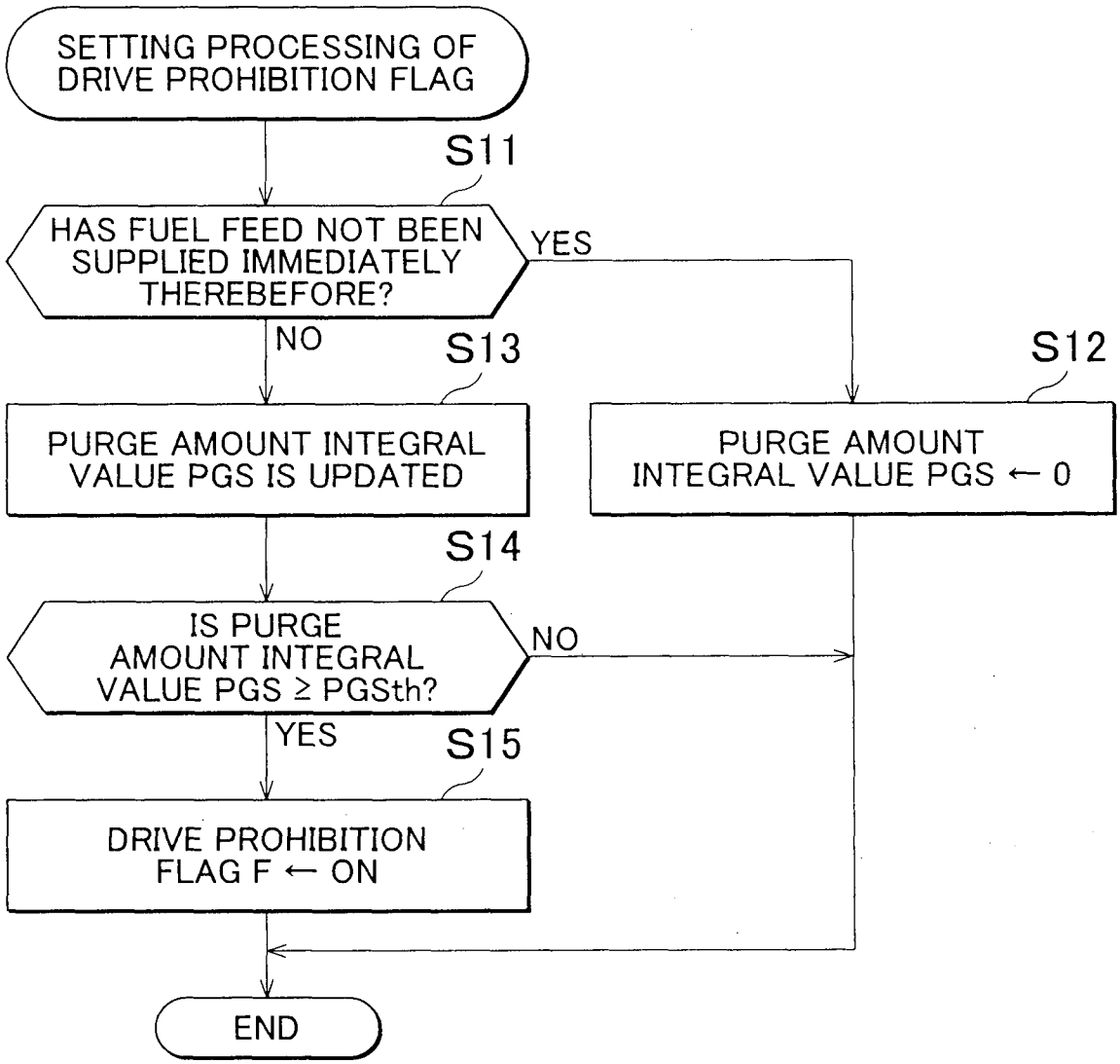

SETTING PROCESSING OF DRIVE PROHIBITION FLAG
S11
HAS FUEL FEED NOT BEEN SUPPLIED IMMEDIATELY THEREBEFORE?
YES
NO
S13
PURGE AMOUNT INTEGRAL VALUE PGS IS UPDATED
S12
PURGE AMOUNT INTEGRAL VALUE PGS ← 0
S14
IS PURGE AMOUNT INTEGRAL VALUE PGS ≥ PGSth?
NO
YES
S15
DRIVE PROHIBITION FLAG F ← ON
END

FIG. 6

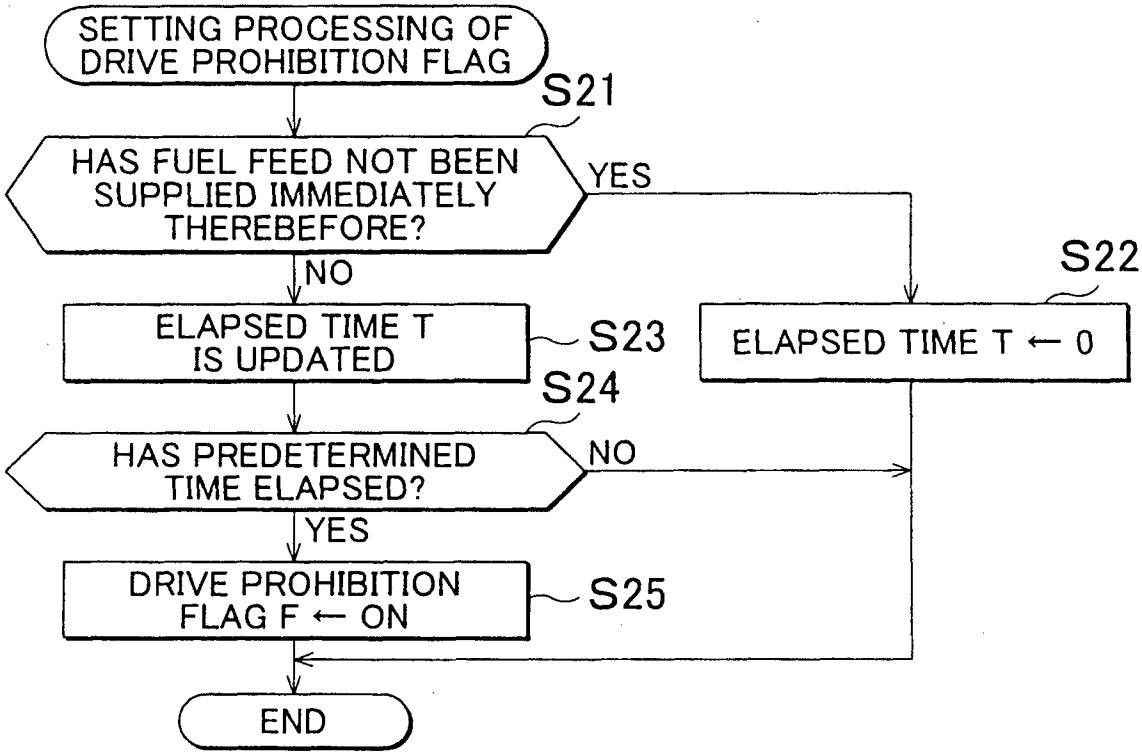
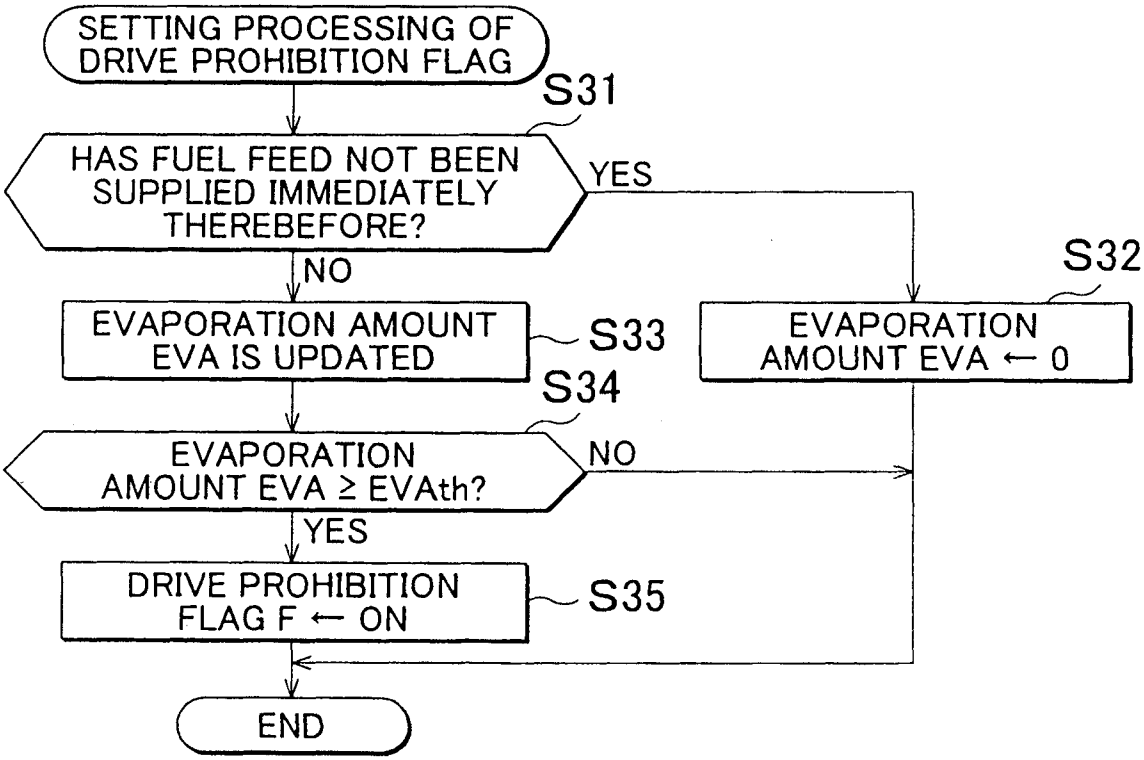

SETTING PROCESSING OF DRIVE PROHIBITION FLAG
S21
HAS FUEL FEED NOT BEEN SUPPLIED IMMEDIATELY THEREBEFORE?
YES
NO
S22
ELAPSED TIME T ← 0
ELAPSED TIME T IS UPDATED
S23
S24
HAS PREDETERMINED TIME ELAPSED?
NO
YES
DRIVE PROHIBITION FLAG F ← ON
S25
END

FIG. 7


SETTING PROCESSING OF DRIVE PROHIBITION FLAG
S31
HAS FUEL FEED NOT BEEN SUPPLIED IMMEDIATELY THEREBEFORE?
YES
NO
S32
EVAPORATION AMOUNT EVA ← 0
EVAPORATION AMOUNT EVA IS UPDATED
S33
S34
EVAPORATION AMOUNT EVA ≥ EVAth?
NO
YES
DRIVE PROHIBITION FLAG F ← ON
S35
END