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EUROPEAN PATENT APPLICATION

⑰ Application number: **86301887.5**

⑤① Int. Cl.4: **C10L 1/10**

⑰ Date of filing: **14.03.86**

④③ Date of publication of application:
23.09.87 Bulletin 87/39

⑥④ Designated Contracting States:
DE FR GB IT

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⑤④ **An additive for increasing the rate of burning of a liquid hydrocarbon material, and a method for its manufacture.**

⑤⑦ The present invention provides an additive for fuel oils such as petrol or similar liquid hydrocarbon materials, which incorporates a uniform mixture composed of an organogermanium oxide, at least one alcohol, a liquid hydrocarbon material and a surface active agent. Adding the accelerator to the fuel oil enhances the rate of burning of the fuel. Preferred amounts are 1-1000mg of organogermanium oxide, 300-900ml of a mixture of 80% v/v of ethanol and 20% v/v methanol and 50-400mg of liquid hydrocarbon material, all per litre.

EP 0 237 658 A1

AN ADDITIVE FOR INCREASING THE RATE OF BURNING OF A LIQUID HYDROCARBON MATERIAL, AND A METHOD FOR ITS MANUFACTURE

The present invention relates to an additive for increasing the rate of burning of a liquid hydrocarbon material, (such as petrol) that contributes greatly to the completeness of burning of the material and to a method of manufacturing such an additive.

Conventional technologies that help fuels such as petrol to burn efficiently include improved internal
5 combustion engines; improved carburetor nozzles; added oxidizer; or atomized water.

Internal combustion engines, or associated parts, have primarily been improved to improve the mixture ratio of the fuel and air under pressure, or to enhance the flame delivery at the time of combustion, or to minimize the quantity of the exhaust gases that may contain harmful ingredients.

As an alternative to the above solution, added oxidizer or atomized water enhances the combustion rate
10 by supplying an appropriate additional quantity of oxygen.

Specific improvements associated with mechanical parts include changes in the geometrical shape of the combustion chamber, nozzles, and inlet or outlet paths. Those changes have as an objective to provide improved burning efficiency. Since those improvements rely solely upon the combustion chamber or its associated parts for improved burning efficiency, however, they can cause a problem when the engine is
15 running at high speeds, in that the fluid becomes viscous and limits further improvement in the combustion efficiency.

For the alternative solution that deals with supplying the appropriate amount of oxygen or other additives to the fuel oil, there is also a problem, in that it is difficult to mix those additives rapidly and uniformly with the fuel oil. It is also difficult to control the quantity of those agents to be added, since they
20 can affect the ignition and timing and the compression ratio within the combustion chamber, depending upon the quantity of additives. Thus, the usage of such additives is limited.

The present invention sets out to solve the above problems by producing a uniform admixture of a solution containing an organo germanium oxide and alcohols and liquid hydrocarbon materials as well as a surface active agent.

In one aspect the invention consists in an additive for increasing the rate of burning of a liquid hydrocarbon material characterised by comprising a uniform mixture of a solution in water of an organo germanium oxide, at least one liquid alcohol, and liquid hydrocarbon material together with a surface active agent.
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The liquid hydrocarbon material can be a heating oil or a fuel for a vehicle engine e.g. marine fuel oil, aviation fuel, diesel oil of differing grades or, most especially, leaded or unleaded petrol for automobiles.
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The alcohol is preferably an alkanol, and more especially those alcohols of lower molecular weight e.g. the C₁ to C₆ alkanols, preferably methanol and ethanol. A mixture of a major volume proportion of ethanol and a minor volume proportion of methanol e.g. 80:20 is particularly valuable.

A quantity of an organo germanium 32 oxide down to 1mg/l, can be effective for the purpose of the invention. As the quantity is increased, it provides a corresponding effect. For practical purposes, however, the quantity may be increased up to 1000mg/l. The range between 50mg/l and 500mg/l is preferred in terms of cost efficiency.
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The alcohol (e.g. 20% of methyl alcohol and 80% of ethyl alcohol) are preferably present in amounts from 900ml/l to 300ml/l. This represents a preferred quantity of alcohol per liter of additive, but may
40 be increased or decreased, depending on the quantities of the other ingredients which are to be added. For the liquid hydrocarbon material the preferred quantity may range from 50ml/l to 400ml/l, and for the surface active agent from 50ml/l and to 300ml/l. The quantity of water is usually sufficient to allow the organo germanium oxide to be dissolved in the water. It may depend upon the quantity of the organic germanium, but usually ranges between 5ml/l and 20ml/l.

The alcohols are added to increase the affinity of the mixture with the organo germanium. The liquid hydrocarbon material is added to facilitate the admixture of the additive of the invention with the fuel. The surface active agent is provided to improve the diffusion of the accelerator throughout the fuel, thereby allowing it to be mixed with the fuel rapidly and uniformly. The amount of the additive actually to be used depends upon the kind or nature of the fuel. Usually the value of 100 ppm to 1000 ppm provides a satisfactory effect. For gasoline (petrol) to be used in a gasoline engine, an amount of approximately 500
50 ppm provides the desired effect.

In another respect, therefore, the invention provides a method of increasing the rate of burning leaded or unleaded petrol for an automobile characterised in that it involves the essential step of adding to the petrol from 100 to 1000 ppm of the additive as described above.

In yet another aspect the invention provides a method of manufacture of such an additive characterised in that (a) the organogermanium oxide is dissolved in the water (b) the alcohol or alcohols are added and mixed and (c) the liquid hydrocarbon material and surface active agent are added and uniformly mixed.

The organo germanium used in the present invention appears to contribute to reducing the fuel oil particles into finer particles, and thus increases the contact area between the fuel particles and oxygen. The active oxygen contained in the organo germanium appears to lower the flash or firing point of the fuel, thereby accelerating the burning rate. The additive can also improve the rates of atomizing, vaporization, and diffusion of the fuel.

The organo germanium oxide in the additive according to the present invention is easily dissolved in the water, and the resultant solution can uniformly diffuse throughout liquid hydrocarbon material without risk of segregation.

EXAMPLE

100 mg of organo germanium oxide is dissolved in 10ml of water, and 770ml of alcohol (20% v/v of methyl alcohol and 80% of ethyl alcohol) is added to the resultant solution while it is being stirred. A uniform mixture is obtained. Then, 100ml of petrol and 100ml of a surface active agent are gradually added to that uniform mixture with stirring. The result is an additive according to the present invention, in an amount of 1000ml.

When 500 ppm of the additive is added to petrol it increases the burning efficiency of 5% to 10%. Output of an internal combustion engine can be increased by about 10%.

Although it is intrinsically difficult to mix an organo germanium oxide with liquid hydrocarbon materials uniformly, the present invention provides for easy admixture. The additive incorporating the uniform mixture of the organo oxide can rapidly diffuse throughout the fuel whatever its quantity may be.

TEST CASE

Additive: 500 ppm is added.
Fuel oil: Gas oil No. 1 offered by Esso Oil.
Calorie of 10,800: specific gravity of 0.8326.
Engine: Model 6BD offered by Isuzu Motors Co.
Capacity of 5785 c.c
Output of 85ps/2100 rpm
Maximum torque of 31 kgm/1500 rpm
Test mode: conforms with JIS-D-1005

The test results are as follows:

(1) Maximum torque: 32 kgm/1500 rpm, on which additive is used
32 kgm/1500 rpm, on which additive is not used;

(2) Output: 84.8ps/2098 rpm, on which additive is used;
83 ps/2107 rpm, on which additive is used;

(3) Fuel consumption during 50 hrs continuous running:
12.88l/h, on which additive is used; 12.12l/h, on which additive is not used.

The following tables are presented to show the results of the actual testing for the particular car on which the additive of the invention is used.

Table for Recording the Exhaust Gases Test Results for Gasoline-Engine Vehicle (10 mode and idling)

Date of Testing: Oct. 28, 1985; Weather: clear; Test House: Nippon Jidousha Yuso Gijutu Kyokai

Vehicle Specifications:

5 Car Name: SUBARU Model E-AB4 Motor type:EA81 Max. Output: 100/5600 ps/rpm
 Car No.: AB4-034438 Cycles: 4 Cylinders: 4 Total Capacity: 1780 cc
 Distance Traveled: 38008 km Transmission: automatic, 3 gears
 10 Total Car Weight: 1185 kg Gear ratio: 3.77
 Car Wt. under Test: 1020 kg Fuel Oil: Leadless Regular
 Equivalent Inertia Wt.: 1000 kg
 15 Drive wheel tyre pneumatic (standard): 1.8 kg/cm²
 -ditto- (actual measurement): 2.8 kg/cm²

20 Test Equipment:

Chassi-Dynamo Meter: "BANZAI" BCD-100E
 Exhaust gas spectrometer: (idling exhaust gas testing) Horiba MEXA-8320
 25 (10 mode exhaust gas testing) Horiba MEXA-8320
 CVS device: Horiba CVS-31 (sampling: 8.18 m³/min)

30 ⊙Idling Exhaust Gas Testing:

Room Temperature: 28.0 °C; Coolant Temperature: 82°C
 Atmospheric Pressure: 783.0 mmHg; Lubricant Temperature: 94 °C

Gear Pos.	Engine Speed rpm	Suction -mmHg	Measured Value(NDIR)			Concentration Corrected	
			CO	HC	CO ₂	CO	HC
45 N	880	453	0.01 ppm %	11.7 ppm	10.8%	0.02 ppm%	18.0 ppm
50 D	550	410	0.01 ppm %	10.0 ppm	10.8%	0.02 ppm%	13.7 ppm

55 ⊙10-mode Exhaust Gas Testing:

Test Room Dry Bulb Temp: 28.0°C~28.0°C	Test Car Warmup Start Time: 9 h:50 m
Wet Bulb Temp: 18.0°C~18.0°C	Coolant Temp: 82°C~82°C
Rel. Humidity: 34 %	Lubricant Temp: 94°C~94°C
Atmos. Pressure: 763 mmHg	Engine Suction equivalent to Chassi-
10-mode Run Start Time: 10 h:20 m	Dynamo Meter Load:
Fuel Consumption: 12.1 km/l	481 mmHg (20 km/h)
KH (NOx humid. Correct Factor): 0.893	453 mmHg (40 km/h)
	414 mmHg (60 km/h)
	Exhaust Pipe Opening Static Pressure
	Difference: mmAq (40 km/h)

Ingredient	Diluted Exhaust Gas Density A	Environ. Density B	Net Density A-[BX(1-1/DF)]	Exhaust Wt.
CO(NDIR)	29.0 ppm	0.3 ppm	28.71 ppm	0.67 g/km
HC(FID)	7.49 ppmC	2.33 ppmC	5.26 ppmC	0.08 g/km
NO _x (CLD)	9.47 ppm	0.02 ppm	9.45 ppm	0.32 g/km
CO ₂ (NDIR)	0.57%	0.03%	0.54%	195 g/km

©Note: Normal Non-load rpm (N) 800 ± 50 rpm, spark timing $13^\circ \pm 3^\circ / 800 \pm 50$ BTDC/rpm

Table for Recording the Exhaust Gases Test Results for Gasoline-Engine
Vehicles (10 mode and idling)

Date of Testing: Nov. 29, 1985; Weather: clear; Test House: Nippon Jidousha

Yuso Gijutu Kyoukai

Vehicle Specifications:

Car Name: SUBARU Model E-AB4 Motor type:EA81 Max. Output: 100/5800 ps/rpm
 Car No.: AB4-034438 Cycles: 4 Cylinders: 4 Total Capacity: 1780 cc
 Distance Traveled: 38839 km Transmission: automatic, 3 gears
 Total Car Weight: 1185 kg Gear ratio: 3.77
 Car Wt under Test: 1020 kg Fuel Oil: Leadless Regular
 Equivalent Inertia Wt: 1000 kg
 Drive wheel tyre pneumatic (standard): 1.8 kg/ c m²
 -ditto- (actual measurement): 2.7 kg/ cm²

Test Equipment:

Chassi-Dynamo Meter: "BANZAI" BCD-100E
 Exhaust gas spectrometer: (idling exhaust gas testing) Horiba MEXA-8320
 (10 mode exhaust gas testing) Horiba MEXA-8320
 CVS device: Horiba CVS-31 (sampling: 8.18m³/min)

⊙Idling Exhaust Gas Testing:

Room Temperature: 27.0 °C; Coolant Temperature: 88°C
 Atmospheric Pressure: 751.7 mmHg; Lubricant Temperature: 105°C

Gear Pos.	Engine Speed rpm	Suction -mmHg	Measured Value(NDIR)			Concentration Corrected	
			CO	HC	CO ₂	CO	HC
N	750	472	0.01 ppm %	21.0 ppm	8.6%	0.01 ppm%	35.3 ppm
D	580	405	0.01 ppm %	11.0 ppm	9.2%	0.01 ppm%	17.3 ppm

⊙10-mode Exhaust Gas Testing:

Test Room Dry Bulb Temp: 27.0°C~27.0°C Test Car Warmup Start Time: 11 h:30m

Wet Bulb Temp: 15.0°C~15.0°C Coolant Temp: 86 °C~86°C

Rel.Humidity: 24% Lubricant Temp: 105°C~105 °C

Atmos. Pressure: 751.7 mmHg Engine Suction equivalent to Classi-

10-mode Run Start Time: 12 h:00 m Dynamo Meter Load:

Fuel Consumption: 12.3 km/ l 488 mmHg (20 km/h)

KH (NOx humid. Correct Factor): 0.858 458 mmHg (40 km/h)

397 mmHg (80 km/h)

Exhaust Pipe Opening Static Pressure

Difference: mmAq (40 km/h)

Ingredient	Diluted Exhaust Gas Density A	Environ. Density B	Net Density $A - [BX(1 - 1/DF)]$	Exhaust Wt.
CO(NDIR)	18.8 ppm	1.3 ppm	17.36 ppm	0.40 g/km
HC(FID)	8.35 ppmC	2.47 ppmC	5.98 ppmC	0.07 g/km
NOx(CLD)	15.10 ppm	0.09 ppm	15.01 ppm	0.48 g/km
CO ₂ (NDIR)	0.58 %	0.04 %	0.54 %	192 g/km

⊙Note: Normal Non-load rpm (N) 800±50 rpm, spark timing 13 ° ±3 ° /800±50
BTDC/rpm

The following table is presented to show the result of the actual testing
for the particular car on which the additive of the invention is

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not used.

10 Table for Recording the Exhaust Gases Test Results for Gasoline-Engine
Vehicles (10 mode and idling)

Date of Testing: Aug. 2, 1985; Weather: clear; Test House: Nippon Jidousha

15 Yuso Gijutu Kyoukai

Vehicle Specifications:

20 Car Name: SUBARU Model E-AB4 Motor type:EA81 Max. Output: 100/5600 ps/rpm
 Car No.: AB4-034436 Cycles: 4
 Cylinders: 4 Total Capacity: 1780 cc
 25 Distance Traveled: 35428 km Transmission: automatic, 3 gears
 Total Car Weight: 1185 kg Gear ratio: 3.77
 Car Wt. under Test: 1020 kg Fuel Oil: Leadless Regular
 30 Equivalent Inertia Wt.: 1000 kg
 Drive wheel tyre pneumatic (standard): 1.8 kg/ c m²
 35 -ditto- (actual measurement): 1.8 kg/ cm²

Test Equipment:

Chassi-Dynamo Meter: "BANZAI" BCD-100E
 40 Exhaust gas spectrometer: (idling exhaust gas testing) Horiba MEXA-8320
 (10 mode exhaust gas testing) Horiba MEXA-8320
 CVC device: Horiba CVS-31 (sampling: 8.18 m³/min)
 45 © Idling Exhaust Gas Testing:
 Room Temperature: 23.0 °C; Coolant Temperature: 81°C
 50 Atmospheric Pressure: 752.5 mmHg; Lubricant Temperature: 100°C

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Gear Pos.	Engine Speed rpm	Suction -mmHg	Measured Value (NDIR)			Concentration Corrected	
			CO	HC	CO ₂	CO	HC
N	730	480	0.02 ppm%	11.0 ppm	13.2%	0.03 ppm%	12.1 ppm
D	800	420	0.01 ppm%	9.8 ppm	13.2%	0.01 ppm%	10.8 ppm

© 10-mode Exhaust Gas Testing:

Test Room Dry Bulb Temp: 23.0°C~23.0°C Test Car Warmup Start Time: 14 h:00 m

Wet Bulb Temp: 18.0°C~18.0°C Coolant Temp: 81°C~81°C

Rel. Humidity: 82% Lubricant Temp: 100°C~100 °C

Atmos. Pressure: 752.5 mmHg

10-mode Run Start Time: 14 h:40 m

Fuel Consumption: 9.9 km/l

KH (NOx humid. Correct Factor): 1.008

Engine Suction equivalent to Chassi-Dynamo Meter Load:

430 mmHg (20 km/h)

435 mmHg (40 km/h)

402 mmHg (60 km/h)

Exhaust Pipe Opening Static Pressure Difference: mmAq (40 km/h)

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Ingredient	Diluted Exhaust Gas Density A	Environ. Density B	Net Density $A - [BX(1-1/DF)]$	Exhaust Wt.
CO(NDIR)	480 ppm	1.0 ppm	479.05 ppm	10.9 g/km
HC(FID)	71.8 ppmC	2.88 ppmC	69.28 ppmC	0.78 g/km
NO _x (CLD)	1.55 ppm	0.01 ppm	1.54 ppm	0.08 g/km
CO ₂ (NDIR)	0.88%	0.04%	0.82%	220 g/km

©Note: Normal Non-load rpm (N) 800 ± 50 rpm, spark timing $13^\circ \pm 3^\circ / 800 \pm 50$

BTDC/rpm

The following comparative table is presented to compare the results of the actual testing on which the additive of the invention is used with the result of the actual testing on which the additive accelerator of the invention is not used.

Comparative table of the Exhaust Gases Test Results for Gasoline-Engine Vehicles and the Fuel Consumption Test Results (10 mode)

Car Name: SUBARU Model E-AB4
 Cycles: 4
 Cylinders: 4
 Total Capacity: 1780 cc
 Max. Output: 100/5800 ps/rpm
 Transmission: automatic
 Test House: Nippon Jidousha Yuso Gijutu Kyoukai

Date of Testing		Aug. 2, 1985	Oct. 28, 1985	Nov. 29, 1985
Existence of the burning additive		not addition	addition	addition
Condition of traveling km	Distance Traveled	35428	38008	38638
	Distance Traveled after adding		2578	3211
Exhaust Wt. g/km	CO	10.90	0.87	0.40
	HC	0.78	0.06	0.07
	total Wt.	11.68	0.73	0.47
Fuel Consumption	km/ l	9.9	12.1	12.3
	Elongation percentage	100	122.22	124.24
Total Wt. of Exhaust Gas	g/ l	115.83	8.83	5.78
	Variation percentage	100	-92.36	-95.00

45 The above test results demonstrates that the additive according to the present invention is effective in terms of the maximum torque, output and fuel oil consumption. Adding the additive cleans the combustion chamber, and reduces the solid deposits there.

Although the present invention has been described with reference to the typical example, it should be understood that various changes and modifications may be made within the scope of the invention.

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Claims

55 1. Additive for increasing the rate of burning of a liquid hydrocarbon material characterised by comprising a uniform mixture of a solution in water of an organo-germanium oxide, at least one liquid alcohol, and liquid hydrocarbon material together with a surface active agent.

2. An additive as claimed in claim 1 characterised in that the liquid hydrocarbon material is leaded or unleaded petrol for an automobile.

3. An additive as claimed in claim 1 or 2 characterised in that the alcohol is at least one C₁ to C₆ alkanol.

4. An additive as claimed in claim 1, 2 or 3 characterised in that the alcohol is a mixture of a major proportion of ethanol and a minor proportion of methanol.

5 5. An additive as claimed in any one preceding claim characterised in that from 1 to 1000 mg of the organogermanium oxide is present per litre of additive.

6. An additive as claimed in claim 5 characterised in that from 50 to 500 mg of the organogermanium oxide is present per litre of additive.

7. An additive as claimed in any one preceding claim characterised in that from 300 to 900 ml of alcohol are present per litre of additive.

8. An additive as claimed in any one preceding claim characterised in that from 50 to 400 mg of liquid hydrocarbon material are present per litre of additive.

9. An additive as claimed in any one preceding claim characterised in that from 50 to 300 mg of surface active agent is present per litre of additive.

15 10. An additive as claimed in any one preceding claim characterised in that from 5 to 20 ml of water is present per litre of additive.

11. A method of increasing the rate of burning of leaded or unleaded petrol for an automobile characterised in that it involves the essential step of adding to the petrol from 100 to 1000 ppm of the additive as claimed in any one of claims 1 to 10.

20 12. A method of manufacturing an additive as claimed in claims 1 to 10 characterised in that (a) the organogermanium oxide is dissolved in the water (b) the alcohol or alcohols are added and mixed and (c) the liquid hydrocarbon material and surface active agent are added and uniformly mixed.

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	PATENTS ABSTRACTS OF JAPAN, vol. 9, no. 192 (C-296)[1915], 8th August 1985; & JP-A-60 63 288 (KITAMURA GOUKIN SEISAKUSHO K.K.) 11-04-1985	1-12	C 10 L 1/10
A	--- PATENTS ABSTRACTS OF JAPAN, vol. 5, no. 148 (C-72)[820], 18th September 1981; & JP-A-56 81 393 (NOBORU HIGASHIDE) 03-07-1981	1-12	
A	--- FR-A-2 364 260 (CIBA-GEIGY AG) * Claims 1-3,71 *	1	
A	--- GB-A-1 237 581 (MOBIL) * Claims 1,16; page 1, lines 58-65 *	1	
A	--- US-A-3 491 133 (REVUKAS) * Claim 1; abstract *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) C 10 L
A	--- US-A-3 006 142 (CARR) * Claims 1,2 *	1,3,4	
A	--- FR-A-2 241 610 (SVENSKA UTVECKLINGSAKTIEBOLAGET) * Whole document *	1	

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-10-1986	Examiner DE LA MORINERIE B.M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	