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COMPOSITION FOR IMPROVING AIR-FUEL RATIO DISTRIBUTION IN INTERNAL COMBUSTION ENGINES

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ABSTRACT OF THE DISCLOSURE

The distribution of the air-fuel mixture in the intake manifold of a multicylinder gasoline engine is improved by adding to the gasoline that is used as the fuel for that engine, a hydrocarbon wax that has at least 20 weight percent of normal paraffin hydrocarbons of at least 23 carbon atoms and not more than 10 weight percent of paraffinic hydrocarbons of more than about 36 carbon atoms. The concentration of the added wax in the gasoline is from about 2 to about 100 pounds per thousand barrels of gasoline, one barrel equalling 42 U.S. gallons.

BACKGROUND OF THE INVENTION

This invention concerns an improved motor fuel composition and an improved method of operating an internal combustion engine. More particularly, the invention concerns incorporating into a motor fuel, such as gasoline, one or more additives of a waxy nature which will modify the induction tract surfaces of an aspirated multicylinder internal combustion engine, including the internal surfaces of the carburetor and intake manifold in such a way as to improve the geometric and time distribution of the fuel in the induction system of that engine.

In the operation of a gasoline engine, it is necessary to supply to the cylinders a mixture of gasoline and air in proper proportions. In most instances, this is accomplished by the use of a carburetor wherein the fuel is aspirated into a stream of moving air. In an aspirated multicylinder engine the mixture of air and fuel is distributed to the various cylinders through an intake manifold. One problem that arises in such a system is that the air/fuel ratio in the mixture of air and fuel tends to vary from cylinder to cylinder. Thus, some cylinders operate with a relatively rich mixture and other cylinders operate with a relatively lean mixture. Similarly, variations in air/fuel ratio occur in each cylinder with respect to time. Both of these effects result in reduced operating efficiency of the engine, which shows up in at least two ways, one being a loss in fuel economy and another being reduced and uneven power output.

Gasolines used as motor fuels comprise a mixture of hydrocarbons of various boiling points. Thus a gasoline can have an initial boiling point somewhere in the range of about 70 to 135° F. and a final boiling point somewhere in the range of about 250 to 450° F. The mixture of gasoline and air that leaves the carburetor and passes to the various cylinders through the intake manifold tends to deposit some of the higher boiling fractions in the form of a liquid film on the walls of the intake manifold. This liquid film is the main factor in poor fuel distribution in the engine. It is thus desirable for improved efficiency to have the gasoline enter the cylinders as a vapor or spray in the air-fuel mixture rather than to run into the cylinders in liquid form.

DESCRIPTION OF THE INVENTION

In accordance with the present invention, it has been found that the distribution of the air-fuel mixture to the various cylinders of an aspirated multicylinder internal

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combustion engine can be improved by incorporating in the fuel fed to that engine a minor amount of a hydrocarbon wax, preferably a paraffin wax, having at least 20 wt. percent of normal paraffin hydrocarbons of at least 23 carbon atoms.

The paraffin waxes used in this invention will have melting points within the range of about 70° to 150° F., or more usually from about 100° to 135° F. More particularly, a paraffin wax is used that contains at least 20 wt. percent of normal paraffin hydrocarbons having at least 23 carbon atoms. Additionally the wax should not contain more than about 10 wt. percent of paraffinic hydrocarbons of more than about 36 carbon atoms.

The wax will be added to the gasoline in an amount ranging from about 2 to 100 pounds of the wax per thousand barrels of gasoline. One barrel of gasoline contains 42 U.S. gallons. Preferably, the amount of wax used should be from about 10 to about 40 pounds per thousand barrels of gasoline. A concentration of one pound per thousand barrels of gasoline is roughly about 4 parts per million; thus a range of from 10 to 40 pounds per 1000 barrels is roughly equal to a concentration of from about 0.004 to about 0.016 wt. percent.

The gasolines in which the additives of this invention are employed are conventional petroleum distillate fuels boiling in the gasoline range and intended for internal combustion engines, preferably spark igition engines. Gasoline is defined as a mixture of liquid hydrocarbons having an initial boiling point somewhere in the range of about 70 to 135° F. and a final boiling point somewhere in the range of about 250 to 450° F. Gasolines are suplied in a number of different grades, depending upon the type of service for which they are intended. The additives of the invention are particularly useful in motor and aviation gasolines. Motor gasolines include those defined by ASTM specification D–439–58T, Types A, B and C, and are composed of a mixture of various types of hydrocarbons, including aromatics, olefins, paraffins, isoparaffins, naphthenes, and occasionally, diolefins. Not all of these types of hydrocarbons will necessarily be present in any particular gasoline. These fuels are derived from petroleum crude oil by various refining processes, including fractional distillation, catalytic cracking, hydroforming, alkylation, isomerization, polymerization and solvent extraction. Motor gasolines normally have boiling ranges within the limits of about 70° F. and about 450° F., while aviation gasolines have narrower boiling ranges, within the limits of about 100° F. and 330° F. The vapor pressures of gasoline as determined by ASTM Method D–323 vary between about 5 and about 18 p.s.i. at 100° F. The properties of aviation gasolines are set forth in U.S. Military Specification MIL–F–5572 and ASTM Specification D–910–57T.

The additives employed in accordance with this invention can be used in gasolines with other additive agents conventionally used in such fuels. It is common practice to employ from about 0.5 to about 4.0 cc./gal. of alkyl lead antiknock agents, such as tetraethyl lead, tetramethyl lead, dimethyl diethyl lead, or a similar alkyl lead antiknock agent or olefinic lead antiknock agent such as tetravinyl lead, triethyl vinyl lead, and the like, or a combination thereof, in motor gasolines and in aviation gasolines, e.g. 1.0 to 3.0 cc. of a tetraethyl-lead-tetramethyl-lead combination. The lead compounds are customarily employed in conjunction with a scavenging agent such as ethylene dichloride or ethylene dibromide. Antiknock agents that can be used also include other organometallic additives containing lead, iron, nickel, lithium, manganese and the like. The effectiveness of the hydrocarbon waxes of this invention does not depend on the presence of these or other antiknock agents, however. Other additives conventionally employed in gasolines may be used in practicing the present invention. These include corrosion inhibitors, rust inhibitors, antioxidants, solvent oils, antistatic agents, octane appreciators, e.g., t-butyl acetate, auxiliary scavengers like tri-B-chloroethyl phosphate, dyes, anti-icing agents, e.g. isopropanol, hexylene glycol, and the like. There may also be included certain oil-soluble dispersants and detergents to provide significant improvement in overall engine cleanliness. This is taught, for example, by Calvino et al. in U.S. Pat. 3,223,495.

The nature of this invention and the advantages accruing from the practice thereof will be better understood when reference is made to the following examples, which include a preferred embodiment.

EXAMPLES

Gasoline blends were prepared using as the base a gasoline of 100 octane rating that had the inspections shown in Table 1:

TABLE 1

Base gasoline inspections

ASTM distillation, method D–86:	° F.
Initial boiling point	90
20% overhead	144
50% overhead	214
70% overhead	255
90% overhead	308
Final boiling point	380
FIA analysis:*	Volume percent
Saturates	54
Olefins	18
Aromatics	28
	Cc./gal.
Tetraethyl lead	2.5

*Fluorescent Indicator Absorption analysis; ASTM 1319.

Each blend was prepared by adding to the base gasoline by a simple mixing procedure a paraffin wax at the concentration of 40 pounds per thousand barrels. In one case the paraffin wax had a melting point of 108° F. and in the other case a melting point of 125° F.

The base fuel and the blend were run separately in a 1967, 6-cylinder, 175 cu.-inch Valiant engine equipped with exhaust emission controls meeting the requirements of the State of California for 1967. The Valiant car was operated on a Clayton dynamometer with acceleration weights equivalent to 4000 pounds. In each test the engine was run at idle speed, at 30 miles an hour, and at 50 miles an hour and the air/fuel ratio reaching each cylinder was determined. In order to accomplish this, sampling lines were extended into the individual exhaust valve ports of the engine, so as to permit the analysis of the combustion products from each of the six cylinders separately. The exhaust gas was filtered and cooled prior to analysis to remove solid particles and most of the water produced by combustion of the gasoline. The exhaust gas was then analyzed for hydrocarbons, carbon monoxide, carbon dioxide, nitrogen oxide and oxygen. The car was held at a constant engine r.p.m. and dynamometer speed for the period of each of the measurements, approximately 15 minutes at each speed condition. Air/fuel ratios were calculated by a material balance of the exhaust gas by well known procedures (see Lamont Eltinge, "Fuel/Air Ratio and Distribution From Exhaust Gas Compositions," SAE Paper 680114, January 1968; and R. S. Spindt, "Air Fuel Ratios From Exhaust Gas Analysis," SAE Paper 650507, May 1965). The spread between the highest and the lowest calculated air/fuel ratio at each of the testing speeds for each of the fuels is given in Table II which follows. The air/fuel ratios were in the range of about 13/1 to about 15/1 at idle, and in the range of about 14.5/1 to about 17/1 at 30 miles per hour and at 50 miles per hour.

TABLE II.—SPREAD OF AIR/FUEL RATIOS

		Base fuel plus—	
Velocity	Base fuel	108° M.P. wax	125° M.P. wax
Idle	1.95	1.00	1.15
30 m.p.h.	1.56	1.11	1.31
50 m.p.h.	1.90	1.57	1.67

The data in Table II show that in each instance the added wax improved the air/fuel distribution ratio.

As an additional example, a gasoline blend coming within the scope of this invention can also be prepared by adding to a low-lead (0.5 cc. TEL/gallon) base gasoline of about 96 octane number, having an initial ASTM boiling point of about 80° F. and a final boiling point of about 390° F., a paraffin wax of 134° F. melting point, at a concentration of 25 pounds of the wax per 1000 barrels of the gasoline.

In Table III, which follows, are given the normal paraffin hydrocarbon distribution data for representative paraffin waxes of 108°, 125° and 134° F. melting points.

TABLE III.—DESCRIPTION OF COMMERCIAL PARAFFIN WAXES

	Melting point		
	108° F.	125° F.	134° F.
Wt. percent n-paraffins by carbon number:			
17	0.15		
18	0.45		
19	3.45	0.25	
20	12.60	3.03	0.59
21	21.27	5.05	1.76
22	22.48	7.58	3.95
23	18.00	8.84	6.14
24	11.40	9.34	7.89
25	5.70	9.59	9.20
26	2.70	9.59	9.94
27	1.20	9.34	10.67
28	0.60	8.34	10.08
29		7.83	9.80
30		6.06	7.89
31		5.81	7.47
32		3.79	5.27
33		2.78	4.39
34		1.52	2.63
35		1.01	1.31
36		0.25	0.58
37			0.29
38			0.15
Wt. percent non-normal paraffins	5.90	7.10	10.50

It is to be understood that this invention is not to be limited to the specific examples herein presented by way of illustration, the scope of the invention being defined by the appended claims.

What is claimed is:

1. A gasoline composition comprising a major proportion of a gasoline into which has been incorporated from about 2 to 100 pounds, per thousand barrels of gasoline, of a hydrocarbon wax having a melting point in the range of about 70 to 150° F., said wax containing at least 20 wt. percent of normal paraffin hydrocarbons of at least 23 carbon atoms and not more than about 10 weight percent of paraffin hydrocarbons of more than about 36 carbon atoms.

2. Composition as defined by claim **1** wherein the wax concentration is from about 10 to about 40 pounds per thousand barrels of gasoline.

3. Composition as defined by claim **1** wherein the said wax is a paraffin wax having a melting point within the range of about 100° to about 135° F.

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