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METHOD OF OPERATING SPARK-IGNITION COMBUSTION ENGINE

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This invention relates to spark ignition internal combustion engine operation, particularly operation at substantially constant crank case level.

The present application is a continuation in part of application No. 507,118 filed May 9, 1955, and now abandoned.

Maximum efficiency in the lubrication of the moving parts of a spark ignition internal combustion engine using gasoline fuel requires a substantially constant level of lubricating oil in the crank case of the engine. The lubricating oil is decomposed in the cylinders; some is lost by evaporation and some is lost by leakage. Normally the oil level gradually decreases until the level reaches a point where it is necessary to replenish the supply to obtain the desired level in the crank case. Engine design must take into account this decrease in the amount of lubricating oil available in the crank case during the operation of the engine and also consider the combustion chamber deposit formation. Operation at a substantially constant amount of lubricating oil in the crank case is both beneficial to engine operation and to design. Any reduction in the amount of combustion chamber deposits is helpful in reducing the octane requirement of the engine and also permits better lubrication of the cylinder walls.

An object of the invention is a method of operating a spark ignition internal combustion engine to maintain a substantially constant level of lubricating oil in the crank case. Other objects will become apparent in the course of the detailed description.

The term "spark ignition internal combustion engine" is intended to include any internal combustion engine utilizing gasoline fuel and spark plug ignition in a cylinder provided with a piston. This engine may be such as is used in automobiles, tractors, trucks, or airplanes. The gasoline fuel may be any hydrocarbon boiling in the gasoline range, i.e., between about 100° and 425° F. The gasoline may contain any or all of the additives commonly introduced into gasolines such as tetraethyllead, oxidation inhibitors, antirust agents, etc.

The lubricating oil utilized in the spark ignition internal combustion engine in the method of the invention is a synethetic oil such as, an alkyleneoxide-glycol reaction product or arylethers of polypropylene glycols. These synthetic lubricating oils may be utilized without additives but are more commonly used in combination with bearing corrosion additives and oxidation inhibitors.

The gasoline used in the method of operating a spark ignition internal combustion engine, contains the reaction product of an aliphatic dihydroxy alcohol and a mixture consisting of ethylene oxide and 1,2-propylene oxide wherein the weight ratio of ethylene oxide to propylene oxide is between about 50:50 to 10:90, which reaction product is suitable for use as a lubricating oil in spark ignition internal combustion engines. It is to be understood that the reaction product may need the addition of corrosion inhibitors and/or oxidation inhibitors to make it suitable for lubricating oil use. The primary requirements for lubricating oil use are lubricity, viscosity and viscosity index. The alcohols which may be used in the preparation of the reaction product are ethylene glycol, 1,2-propylene glycol, 1,3-propylene glycol, butylene glycol, diethylene glycol, dipropylene glycol, triethylene

glycol, tripropylene glycol, as well as other such aliphatic dihydroxy alcohols. The reaction product which is a polyoxyalkylene diol is not described in detail herein because the materials are described in detail, as well as methods of preparation, in U.S. 2,425,845. Examples 7 through 17 of this patent are of particular interest in the description of the preparation of various of these polyoxyalkylene diols which are suitable for lubricating oil usages. In general, the preferred reaction products, i.e., polyoxyalkylene diols, have a molecular weight between about 500 and 3000.

The gasoline may contain an arylether of a polypropylene glycol having a molecular weight between about 500 and 3000; e.g. phenylether of polypropylene glycol, said glycol portion having a molecular weight of about 1000, and phenylbenzylether of polypropylene glycol, said glycol portion having a molecular weight of about 1000.

It appears that the diol is passed, in large part, out of the combustion chamber as blow-by material which dissolves in the lubricating oil present in the crank case; the remainder is decomposed and/or discharged from the cylinder through the exhaust. It is preferred to operate the engine with a synthetic lubricating oil of the same type as the diol added to the gasoline, whereby the characteristics of the lubricating oil in the crank case remain substantially constant during operation of the engine.

The presence of any additive diol in the gasoline fuel decreases the apparent loss of lubricating oil. For operation with a substantially constant level of lubricating oil in the engine, the amount of diol in the gasoline fuel is adjusted so that the blow-by counteracts the loss of lubricating oil. Substantially constant oil level is generally obtainable by operating with a gasoline fuel containing between about 0.1 and 3.0 percent of additive diol; more usually between about 0.3 and 1.0 percent.

Substantially constant crank case levels are attained with Prestone Motor Oil of about 800 molecular weight using about 0.3 percent oil in the gasoline; with phenylbenzylether of polypropylene glycol (glycol of about 1000 molecular weight) using about 0.5 percent in the gasoline; and with phenylether of polypropylene glycol (glycol of about 1000 molecular weight) using about 0.7 percent in the gasoline.

The results obtainable by the method of this invention are illustrated by operation in a test engine.

The engine test procedure is an adaptation of the Ethyl Corporation Cycling Procedure using Standard CFR overhead valve test cylinder. Typical test conditions are as follows:

Compression Ratio	7.5 to 1.
Spark advance	3° BTDC.
Air to fuel ratio:	
Full load (900 r.p.m.)	13.0.
Idle (600 r.p.m.)	11.0.
Full load brake horsepower	4.0.
Air intake temperature	110–115° F.
Oil temperature	155–160° F.
Cooling water temperature	175–180° F.
Run length	48 hours.

The 900 r.p.m. full load, full throttle portion of the cycling operation is of 150-second duration while the 600 r.p.m. no load closed throttle portion is of 100-second duration. The air-fuel ratios are determined by Orsat gas analysis. The test duration in each run was approximately 48 hours.

The engine was then dismantled and the parts washed with isooctane, dried, scraped, and cleaned to determine the weights of deposits. Oil consumption data are obtained by measuring the volume of lubricant originally placed in the crank case and the volume of the lubricant which is recovered at the conclusion of the test. The dif-

ferences in thse volums was taken as the amount of lubricant consumed.

The synthetic motor oil used in these tests was a polyoxyalkylene diol sold as Prestone Motor Oil. This Prestone Motor Oil contains a phenylalphanaphthylamine oxidation inhibitor, succinic anhydride rust inhibitor and mercaptobenzothioazole corrosion inhibitor.

The characteristics of the Prestone Motor Oil used in the tests are set out in Table I.

Table I

Kinematic viscosity (centistokes/sec.):	
100° F.	64.7
130° F.	34.8
210° F.	10.8
300° F.	6.0
Viscosity index	140
Specific gravity, 25° C.	0.9893
Refractive index, 25° C.	1.4518
Molecular weight	843
Ramsbottom carbon (wt. percent)	0.03
Acid number	4.3
Saponification number	11.4
Water (wt. percent)	0.15
Sulfated ash (wt. percent)	0.01
Approximate boiling range by molecular distillation at 1 micron Hg:	
IBP ° F.	775
50% ° F.	1,050
80% ° F.	1,140

The gasoline used in these tests was a premium quality gasoline boiling over the range of 100 to 395° F., having a research octane number of about 93 and no tetraethyllead. The results of the tests are set out in Table II.

Table II

Run No.	1	2
Gasoline	Unleaded	Unleaded.[a]
Lubricant	P.M.O.	P.M.O.
Deposits, g	0.90	0.41.
Gasoline Consumed, Gal.	19.61	18.27.
Lubricant Volume Change, ml.	−115	+271.

[a] Contained 2.5 weight percent of Prestone Motor Oil (P.M.O.).

In run 2 the gasoline fuel contained 2.5 percent of the Prestone Motor Oil. These runs show that a very large increase in lubricating oil volume occurred during run No. 2. These runs show that too much P.M.O. was present in the gasoline fuel in run No. 2. However, these runs make it quite clear that by the use of the defined gasoline fuel it is possible to operate at substantially constant lubricating oil volume in the crank case of the engine.

Thus having described the invention, what is claimed is:

1. A method of operating a spark-ignition internal combustion engine whereby a substantially constant volume of synthetic lubricating oil is maintained in the crank case of the engine which method consists of charging as the fuel to the combustion zone of said engine a gasoline containing a synthetic lubricating oil in an amount between about 0.1 and 3 volume percent and having in the crank case of said engine as the lubricating oil a synthetic lubricating oil selected from the class consisting of (i) a polyoxyalkylene diol having a molecular weight between 500 and 3000 which is the diol reaction product of an aliphatic dihydroxy alcohol and a mixture consisting of ethylene oxide and 1,2-propylene oxide, the weight ratio of ethylene oxide to propylene oxide being from 50:50 to 10:90 and (ii) arylethers of polypropylene glycols, which glycol has a molecular weight between 500 and 3000, said synthetic lubricating oil in said gasoline and said synthetic lubricating oil charged to said crank case being essentially identical compounds.

2. The method of claim 1 wherein said oil has a molecular weight of about 800 and is present in said fuel mixture in an amount of about 0.3 percent.

3. The method of claim 1 wherein said oil is phenylether of polypropylene glycol which glycol has a molecular weight of about 1000 and is present in said fuel in an amount of about 0.7 weight percent.

4. The method of claim 1 wherein said oil is phenylbenzylether of polypropylene glycol which glycol has a molecular weight of about 1000 and is present in said fuel in an amount of about 0.5 weight percent.

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