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COMPOSITION FOR ENGINE DEPOSIT REMOVAL

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No Drawing. Continuation-in-part of application Ser. No. 476,172, July 30, 1965. This application Dec. 2, 1966, Ser. No. 598,595

9 Claims. (Cl. 252—170)

ABSTRACT OF THE DISCLOSURE

The present disclosure relates to a carburetor cleaner which cleans the internal and external deposits therefrom. The cleaning composition contains a cyclic carbonate inner ester as the major active component with certain solvents, namely a C_6 to C_{13} olefin, a mononuclear aromatic hydrocarbon and a polar solvent of an ester, glycol ether or mixtures thereof.

This application is a continuation-in-part of application Ser. No. 476,172, first filed July 30, 1965, by Paul E. Oberdorfer, Jr., and now abandoned.

The present invention relates to removing internal and external deposits from fuel and air intake systems and from the combustion chambers of internal combustion engines.

The formation of gummy deposits on the internal and external parts of internal combustion engine fuel and air intake systems is an important problem affecting efficient engine operation. For example, the formation of these deposits on the internal parts of a carburetor can cause sticking of the automatic choke, plugging of the air bleeds, fouling of venturi, restriction of idle air flow around the throttle blades and other conditions which adversely affect engine performance. The formation of deposits on the external parts of a carburetor cause automatic choke linkages, fast idle links and the like to behave sluggishly or to stick.

The formation of carbonaceous deposits on surfaces in the engine combustion chambers is also an important problem affecting both spark, ignition and compression ignition engines. Combustion chamber deposits cause increased engine wear, pre-ignition and engine knocking and increase the octane requirement of an engine.

A composition is shown in U.S. Patent 2,935,479 issued to Paul E. Oberdorfer, Jr., that reduces the accumulation of deposits in engine fuel and air intake systems and in engine combustion chambers. The active ingredient of this composition is a cyclic carbonate inner ester such as propylene carbonate. The cyclic carbonate inner ester loosens and dissolves engine deposits and enables the deposits to be exhausted from the engine.

The present invention maintains the desirable internal cleaning properties of the cyclic carbonate inner ester compositions but has the additional advantage of being able to remove the external deposits on fuel and air intake systems, which removal provides two benefits: (1) improved function of the system because of the freeing of external linkages and (2) renewed appearance of the cleaned system.

The previous compositions containing cyclic carbonate inner esters were not capable of removing the deposits

from the external parts. The internal and external deposits are of entirely different types. The internal deposits are essentially polar in nature whereas the external deposits are essentially non-polar in nature. Previous cyclic carbonate inner ester compositions suitable for cleaning the fuel and air intake systems in a single direct application were all polar solvents which had no effect on the external deposits.

In order to be effective for removing the polar deposits in a single application the formulation must contain at least 10 volume percent of cyclic carbonate inner esters.

The first attempt made was to dissolve the cyclic carbonate inner ester in certain hydrocarbons of the naphtha type, i.e., gasoline, since this would have the desirable non-polar solvent properties, however, it was found that the propylene carbonate was soluble in amounts up to only 1% by volume and other cyclic carbonate inner esters were soluble only in amounts up to 2% by volume. The use of gasoline per se would be unsuitable because of the danger of fire and the low solubility of the cyclic esters in gasoline, i.e., only 1 to 2%.

It was anticipated that C_6 to C_{13} saturated aliphatic hydrocarbons would be suitable solvents for the non-polar deposits, however, these hydrocarbons were found to be insoluble with the carbonate inner esters. Thus neither C_6 to C_{13} saturated aliphatic hydrocarbons nor naphtha type materials are suitable in the compositions of the present invention.

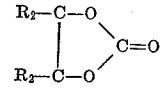
It was found that substituted mononuclear aromatics, particularly mixed xylenes, were miscible in all proportions with the range of cyclic carbonate inner esters employed, however, the aromatics alone were not good enough solvents to remove the non-polar deposits.

It was found quite surprisingly that the substituted mononuclear aromatics were capable of solubilizing the C_6 to C_{13} olefins, but not the saturated C_6 to C_{13} hydrocarbons. The C_6 to C_{13} saturated hydrocarbons could not be solubilized with the cyclic carbonate inner esters in the desired proportions of inner ester to be employed.

It was determined that suitable mononuclear aromatic hydrocarbons were those having from 1 to 4 substituents said substituents being selected from the group consisting of hydrocarbon chains having no more than 4 carbon atoms and chlorine atoms. Examples of suitable aromatic solvents include toluene, xylene, mesitylene, durene, ethylbenzene, 1,2,3,4-tetraethylbenzene, 1-ethyl-3-isopropylbenzene, chlorobenzene, chlorotoluene, 1,2,3,4-tetrachlorobenzene and the like or mixtures thereof.

Suitable C_6 to C_{13} olefins include, for example, hexenes, heptenes, 5-methyl-1-heptene, 5-methyl-1-hexene, 2,3,3,4-tetramethyl-1-pentene, 2-undecene, cyclohexene and the like or mixtures thereof.

The cyclic carbonate inner esters which are used in this invention have the formula:



wherein each R is hydrogen or a hydrocarbon group. The hydrocarbon groups can be alkyl, aryl, aralkyl and alkaryl groups preferably having about 1–6 carbon atoms per group. Cyclic carbonate esters having fewer carbon atoms

are generally more effective in reducing polar deposit accumulation than are esters having more carbon atoms. It is preferred that the total carbon atoms in the hydrocarbon substituent groups not exceed about 6. The use of propylene carbonate is especially preferred in carrying out the invention. Examples of other cyclic carbonate inner esters which are suitable are ethylene carbonate, butylene carbonates, amylene carbonates, phenyl ethylene carbonate, and the like as well as mixtures of cyclic carbonate inner esters.

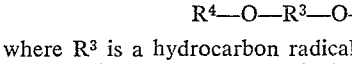
In the present invention the cyclic carbonate composition is applied directly to carburetor, internally and externally. Preferably the cleaning composition is applied from a plastic squeeze bottle or from an aerosol can using a nozzle to direct the stream of cleaner.

Cyclic carbonate inner esters are fairly viscous liquids with high surface tension. For example, propylene carbonate has a kinematic viscosity at 100° F. of 1.69 centistokes and a surface tension of 43.4 dynes per cm. at 68° F. Thus since in the practice of this invention the deposits are to be removed from relatively cool portions of the engine, e.g., from the upper portions of the carburetor air horn, it is desirable to lessen the viscosity and surface tension of the cyclic ester by mixture with less viscous polar organic solvents which improve the penetration of the cyclic ester on polar deposits. It is especially desirable to use liquids with the cyclic carbonate esters which are substantially lower boiling than the cyclic esters. These last liquids improve the penetration of the cyclic esters in the cooler parts of the engine such as the internal and external parts of the carburetor while in the hotter parts of the engine the solvents evaporate leaving the cyclic esters which are most needed on these parts. The non-polar solvents are also, for these same reasons, lower boiling than the cyclic esters.

Mixtures of one or more polar solvents with the cyclic esters, the mononuclear aromatics and olefins can be used to increase the penetration of the cyclic esters on the polar deposits. Suitable polar solvents are selected from the group consisting of (1) an ester having the structure



where R^1 is hydrogen or a hydrocarbon radical having 1 to 3 carbon atoms and R^2 is a hydrocarbon radical having 1 to 5 carbon atoms; (2) a glycol ether having the structure



where R^3 is a hydrocarbon radical having 2 to 3 carbon atoms, R^4 is hydrogen or a hydrocarbon radical having 1 to 4 carbon atoms and R^5 is a hydrocarbon radical having 1 to 4 carbon atoms; and (3) mixtures thereof. Examples of the polar solvents that may be used include esters such as methyl formate, butyl formate, methyl acetate, ethyl acetate, propyl acetate, isopropyl acetate, amyl acetate, methyl proprionate, ethyl propionate, ethyl butyrrate, isopropyl butyrate; glycol ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monopropyl ether, ethylene glycol monobutyl ether, ethylene glycol diethyl ether, ethylene glycol dibutyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, propylene glycol monobutyl ether, propylene glycol diethyl ether, propylene glycol diisopropyl ether and the like.

Suitable cleaning compositions contain by volume 10–60% of a cyclic ester, 5 to 70% of a C_6 to C_{13} olefin, 5 to 75% of a mononuclear aromatic hydrocarbon and 5 to 80% of a polar solvent selected from the group consisting of an ester, a glycol ether and mixtures thereof.

A preferred cleaning composition is one that contains by volume a cyclic ester 10–60%, a C_6 to C_{13} olefin 5–70%, a mononuclear aromatic hydrocarbon 5–75%, an ester 5–75% and a glycol ether 5–50%. The use of the glycol ethers was found (1) to increase the range of solubilities of the olefins and cyclic esters, (2) to provide a solvent of intermediate polarity between the polar cyclic esters and the non-polar olefins and to reduce the amount of aromatic hydrocarbons necessary, for obtaining miscibilities. Thus, by replacing a portion of the aromatic hydrocarbon, i.e., diminishing the relative proportion thereof, it is more rapidly diminished in total concentration by evaporation during the cleaning of the internal parts leaving essentially polar solvents which are preferred for the internal cleaning.

An example of a preferred composition is one containing propylene carbonate, propylene trimer, xylene, ethyl acetate and ethylene glycol monoethyl ether in the ranges previously mentioned.

Particularly preferred compositions according to present invention that have been found to have excellent properties for cleaning the internal and external parts of fuel and air intake systems for internal combustion engines as well as being relatively economical are those containing by volume 15 to 35% propylene carbonate, 10 to 40% propylene trimer, 5 to 23% mixed xylenes, 5 to 35% ethyl acetate, and 5 to 25% ethylene glycol monoethyl ether.

EXAMPLE I

Eight late model automobiles that had been run on various blends of gasoline were selected in order to test the cleaning ability of a composition according to the present invention.

The composition employed was

	Volume percent
Propylene carbonate	25
Propylene trimer	25
Xylene	15
Ethyl acetate	25
Ethylene glycol monoethyl ether	10

Aproximately eight ounces were employed to clean each carburetor, by means of a plastic squeeze bottle. About 75% of the formulation was used to clean the inside of the carburetor and about 25% was used to clean the external carburetor including the linkages. The air filter was removed while the engine was idling and the formulation sprayed by squeezing the plastic bottle and forcing the formulation through a nozzle having a diameter of about 1/32".

TABLE I

Automobile	Milage on Uncleaned Carburetors	Improvement	
		Appearance	Performance
'64 Tempest	6,000	Removed residual varnish and gums.	Improved engine idle.
'64 Pontiac	4,000	do	Corrected choke operation.
Do	12,000	do	Do.
'63 Chevrolet	24,000	do	Improved idle and warm-up performance.
Do		do	
'62 Plymouth	33,000	do	
'62 Corvair	62,000	do	Improved cold weather starting.
'62 Cadillac		do	

EXAMPLE II

A 1955 Oldsmobile with over 90,000 miles presented a particular problem since its carburetor was in disrepair and thoroughly covered inside and out with varnish and oil deposits. Adjustment of the idle jets produced virtually

no response in idle characteristics. The secondary venturi system (4 bbl. carburetor) was gummed up to the extent that the air bleeds were sealed shut. The automatic choke was gummed tight in the three-quarter closed position. The carburetor was cleaned with 8 ounces of the formulation of Example I using a plastic squeeze bottle and 1/32" nozzle.

The idle jet pasages were cleaned by removal of the needle assemblies and squirting the formulation through the idle passages. All external air bleeds likewise were cleaned in this fashion. The automatic choke vacuum system which had been plugged shut was cleaned by forcing a stream of the formulation through the passage while the engine was idling. The remainder of the internal air passages were cleaned by spraying a stream of the formulation on them through the carburetor throats. The external linkages were cleaned with the stream of cleaner and required about two ounces of the cleaner.

As a result of this cleaning operation, which was performed in situ, i.e., without removal or disassembly of the carburetor, a vastly improved appearance and restoration of the carburetor to nearly original performance was achieved. The only part replacement necessary was a rather inexpensive accelerator pump leather boot.

In order to determine the comparative effectiveness of the present composition with those presently available on the market two of the leading carburetor-top engine cleaners were selected. Composition A[1] was found to contain diacetone alcohol as the active ingredient, mixed xylenes as the carrier and about 1% lube oil. Composition B [2] had ethylene glycol monobutyl ether as the active ingredient, aromatic hydrocarbons as the carrier and about 10% alkyl ammonium alkyl phosphate and heavy oil. The formulation of Example I was used to demonstrate the present invention.

The following tests were performed.

Cleaning ability.—Each formulation was sprayed on adjacent portions of a Carter Ball and Ball one-barrel carburetor which had normal deposits from having been run on a regular grade of gasoline. The use of a single carburetor eliminated variations in deposits nature from carburetor to carburetor. The results of the test are recorded in terms of the visual observation of the cleaning ability of each formulation.

Volatility.—One ml. of each formulation was placed on a 1½ inch water glass and heated to 210° F. on a steam bath. The results are recorded in hours to evaporate the sample to less than 1% of original volume and hours to dryness. Measurements of percent volume remaining at 90 and 180 minutes were also made. Exceedingly fast evaporation indicates insufficient time to penetrate the deposits to rinse them away. Extremely slow evaporation allows dust and dirt to build up and recreate sluggish operation. A sticky residue is undesirable since it also recreates the deposit problem.

Kinematic viscosity.—Recorded in centistokes. Too high a viscosity (over 5) prevents easy application of the cleaner formulation to the internal and external parts of the carburetor.

Surface tension.—Measured in dynes/cm. High surface tension (over 30) also inhibits the effectiveness of the cleaner.

Oil cutting.—In this test the time required for ½ ml. of each formulation to drain ½ ml. of heavy oil from a 1 ml. necked down pipette was measured. This test is designed to show the effectivness of the present composition to dissolve non-polar type deposits.

The results of the tests are set out in Table II.

[1] Composition A—"Gumout."
[2] Composition B—"G.M. Top Engine Cleaner" Gr. 8.800, #1050002.

TABLE II

Composition	Example I	"A"	"B"
Test:			
Cleaning Ability	(1)	(2)	(3)
Volatility:			
Hours to <1% original volume	3.0	0.3	<96.0
Hours to Dryness	96.0	4 96.0	<96.0
Percent original volume at 90 min.	15	<1	25
Percent original volume at 180 min.	<1	<1	10
Kinematic Viscosity, Centistokes at 100° F.	0.9	0.9	7.9
Surface Tension, dyne/cm.	26.5	31.1	30.8
Oil Cutting, Time for ½ ml. of solvent to drain ½ ml. oil	(5)	(6)	(7)

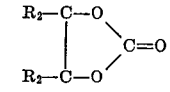
[1] Fast, effective.
[2] Fast, partially effective.
[3] Slow, partially effective.
[4] Sticky residue.
[5] 2 min., 27 sec.
[6] 3 min., 57 sec.
[7] 3 min., 44 sec.

Although compositions A and B performed in a satisfactory manner, it is readily apparent that the composition according to the present invention is superior in its cleaning ability and particularly in its ability to dissolve non-polar type materials.

The use of compositions according to the present invention not only reduces the octane requirement of internal combustion engines and results in more economical operation of such engines but will, along with proper adjustment of the engine, improve the combustion of hydrocarbon fuels and will aid in reducing atmospheric contamination resulting from such improper combustion.

I claim:

1. A solvent composition consisting essentially of by volume: about 10 to 60% of a cyclic carbonate inner ester having the formula



wherein R is selected from the group consisting of hydrogen, alkyl, aryl, aralkyl and alkaryl hydrocarbon groups having from 1 to 15 carbon atoms per group, 5 to 70% of a C_6 to C_{13} olefin, 5 to 75% of a mononuclear aromatic hydrocarbon having from 1 to 4 substituents selected from the group consisting of alkyl hydrocarbon chains having 1 to 4 carbon atoms and chlorine atoms, and 5 to 80% of a polar solvent selected from the group consisting of (1) an ester having the structure

$$R^1—C—O—R^2$$

where R^1 is hydrogen or an alkyl hydrocarbon radical having 1 to 3 carbon atoms and R^2 is an alkyl hydrocarbon radical having 1 to 5 carbon atoms; (2) a glycol ether having the structure $R^4—O—R^3—O—R^5$ where R^3 is an alkylene hydrocarbon radical having 2 to 3 carbon atoms, R^4 is hydrogen or an alkyl hydrocarbon radical having 1 to 4 carbon atoms and R^5 is an alkyl hydrocarbon radical having 1 to 4 carbon atoms; and (3) mixtures thereof.

2. A solvent composition according to claim 1 wherein the polar solvent is a mixture of 5 to 75% of the ester and 5 to 50% of the ether.

3. A solvent composition according to claim 2 wherein the cyclic carbonate inner ester is selected from the group consisting of ethylene carbonate, butylene carbonates, amylene carbonates, phenyl ethylene carbonate and mixtures thereof.

4. A solvent composition according to claim 3 wherein the C_6 to C_{13} olefin is propylene trimer.

5. A solvent composition according to claim 2 wherein the ether is ethylene glycol monoethyl ether.

6. A solvent composition according to claim 2 wherein the ether is ethylene glycol monobutyl ether.

7. A solvent composition according to claim 2 wherein the mononuclear aromatic hydrocarbon is chlorobenzene.

8. A solvent composition according to claim 2 wherein

the cyclic carbonate inner ester is propylene carbonate, the C_6 to C_{13} olefin is propylene trimer, the mononuclear aromatic hydrocarbon is xylene, the ester is ethyl acetate and the ether is ethylene glycol monoethyl ether.

9. A solvent composition according to claim 2 consisting essentially of by volume: 15 to 35% propylene carbonate, 10 to 40% propylene trimer, 5 to 35% xylene, 5 to 35% ethyl acetate and 5 to 25% ethylene glycol monoethyl ether.

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