Patented July 13, 1937

2,086,589

UNITED STATES PATENT OFFICE

2,086,589

MOTOR FUEL

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No Drawing. Application April 20, 1933, Serial No. 667,039

10 Claims. (Cl. 44—9)

This invention relates to improved motor fuels and methods of making same and more particularly to motor fuels containing addition agents adapted to reduce or prevent gum troubles in the motor while simultaneously lubricating the moving parts in the upper part of the motor.

Broadly, the invention comprises adding to a motor fuel a small amount of high-boiling oxygenated compound having a superior solvent action on the gummy matter usually deposited by the gasoline in a motor and also having a gum-fluxing property, by which is meant the property of inhibiting the deposition of such gum from the gasoline or at least preventing its deposition in a hard, glazy form.

In the past, various oxygenated solvents have been added to gasoline in an effort to dissolve the gum which is deposited on the valves, valve stems, rings, pistons, and other interior surfaces of the upper part of the motor. However, I have found that these materials used heretofore as gum solvents are relatively ineffective and unsatisfactory, the chief reasons being that their boiling points are too low or that they have an excessive vapor pressure at the temperatures involved in the operation of a motor and consequently that they volatilize without accomplishing the desired effect.

According to the present invention, oxygenated organic compounds are used which have a boiling point approximately between the limits of 400 or 500 and 800° F. under atmospheric pressure, or approximately 250 to 450° F. at 1 to 3 mm. pressure. Regardless of actual boiling point, the vapor pressure at high temperature should be relatively low. Also, the melting point should not be too high. One particularly suitable class of oxygenated compounds comprises the high boiling esters such as amyl, hexyl, and heptyl stearate. Other suitable compounds will be discussed below.

In carrying out the invention, a small amount of the desired oxygenated compound is either added to the motor fuel itself or is injected into the motor in any desired manner in order to contact with the gum-coated surfaces. If added to the motor fuel several functions are accomplished simultaneously, that is, not only is already-deposited gum removed but also the deposition of more gum during subsequent operation of the motor is inhibited. On the other hand, if a motor is already in a badly gummed condition, for example, with valves and piston rings stuck, it may be impossible to operate the motor and even if possible it would take an inconveniently long time to dissolve all of the gum in the motor by merely using a small amount of the oxygenated compound in the gasoline. Therefore, in such a case the oxygenated compound may be used alone or together with a small amount of additional solvent or carrier medium and injected directly into the motor and preferably allowed to stand for a short length of time. Generally, from a few minutes to half an hour will be sufficient. Small coated parts may be removed from the engine and immersed in a vessel containing the treating liquid.

In addition to serving as a combined preventive and cure for gum troubles in the motor, the gum-fluxing oxygenated compounds used according to the invention also serve to lubricate the moving parts of the motor which are exposed to the hottest temperature. This is an important feature in preventing abrasion of these piston rings, scoring of the cylinder walls and irregular wearing of the valves. The compounds used are fairly viscous and adherent and therefore are not as easily removed from the contacting surfaces as many of the materials used heretofore. They are also relatively stable against oxidation so that they do not tend to decompose with the formation of products which might in themselves be harmful to the motor.

The amount of oxygenated compound to be used may vary over a wide range depending upon various factors such as the type of motor fuel being used, the type of engine and the potency of the oxygenated compound itself. Ordinarily from 0.1 to 5.0% of addition agent will be sufficient and preferably the amount used will be between 0.5 and 2.0%. A large number of tests have been carried out which indicate that, in general, 1.0% of the preferred oxygenated compounds is sufficient when added to the gasoline. It will be understood, of course, that with a gasoline normally having relatively low gum depositing tendency a smaller addition of gum flux is required whereas with gasolines having unusually great tendency to deposit gum a larger amount of gum flux may be used. It is therefore apparent that the invention is particularly applicable to gasolines which have been manufactured by cracking petroleum distillates.

The invention is also of specific advantage in auto-ignition engines such as the Diesel engine, where certain moving parts are exposed to friction under high pressure and high temperature, as described in co-pending application of G. M. Maverick, Serial No. 679,891, filed July 11, 1933. In such a case a larger amount of gum-fluxing lubricant may be desired than for ordinary (low compression) motors.

Instead of using the esters of stearic acid as mentioned above, other aliphatic or aromatic or mixed or substituted esters may be used. The esters of oleic and other higher fatty acids may be used such as the higher acids produced by the oxidation of the higher molecular weight petroleum hydrocarbons including paraffin wax and the like. Specific examples of suitable high boiling esters are the normal amyl stearate, secondary amyl stearate, normal amyl oleate, secondary amyl-, hexyl-, and heptyl-esters of wax oxidation acids, stearyl valeriate, amyl cinnamate (B. Pt. 572° F.), and secondary amyl ester of mono toluene stearic acid (B. Pt. between 700–800° F.). Also, any stable high-boiling ketones and other oxygenated organic compounds having good solvent power and relatively low vapor pressure may be used. They should preferably be soluble in gasoline so they can be added directly thereto.

These high-boiling oxygenated compounds may be prepared in any suitable manner, as there are various methods known to the art.

In addition to these pure or synthetic esters, it is possible to use impure ones or mixtures such as occur in nature although a great number of the natural ones possess certain disadvantages such as too low a boiling point, excessive vapor pressure at the high temperatures involved in the operation of the motor, insufficient solubility in the motor fuel, insufficient solvent or gum-flexing action and insufficient lubricating quality at high temperature. However, those which do have the necessary qualifications may be used. Also, it is possible to treat a number of the natural esters, which in themselves are not satisfactory, in such a way as to make them satisfactory. For example, castor oil which is relatively insoluble in gasoline and possesses a relatively low solvent power, probably due to the hydroxyl groups in its structure, may be esterified as with acetic acid or a higher fatty acid and it is found that the resultant modified ester not only is soluble in the gasoline but possesses the desirable gum-fluxing and lubricating properties.

In addition to using these preferred oxygenated compounds alone or as sole addition agents in the motor fuel, it may be at times desirable to add a relatively low boiling solvent such as tetralin, chloroform, etc. to aid solvency and facilitate the distribution of the oxygenated compound in the fuel or on the gum-coated surfaces; or it may also be desirable to incorporate with the esters, etc. a small amount of a hydrocarbon gum-fluxing agent such as the type described and claimed in the co-pending application of Sloane and Wasson, Serial No. 658,153, filed February 23, 1933.

The improved gum-fluxing or inhibitory property of the preferred oxygenated compounds may be observed from the following example which shows the amount of gum deposited in the standard dish gum test for gasoline:

Inhibitory action of esters

	Mg. gum/100 cc.
Gasoline alone	1345
Gasoline + .3% n-amyl stearate	425
Gasoline + .5% n-amyl stearate	345
Gasoline +1.0% n-amyl stearate	260

These weights are corrected for the ester added. A blank dish containing ester alone was run to get an approximate volatility value for the ester. This value was used as a correction also. (About 20 mg.)

The kauri butanol test is frequently used as an index of the solvent power. This test is described in Circular 378 of February 1931 by the American Paint and Varnish Manufacturers Association and the results obtained therewith give, in comparison to benzol as 100, the amount of liquid being tested which can be mixed with a standard butanol solution of kauri gum without causing turbidity due to insolubility. However, this test is not entirely satisfactory for comparing the various preferred oxygenated compounds such as esters and the like because a large majority of the most suitable ones are practically mutually soluble with butanol-gum solution in all proportions and hence have an infinitely high kauri butanol value. This kauri butanol value should in all cases be above 15, and preferably over 25 and still better over 100.

Another way, of course, to test the value of the gum-fluxing agents is to actually use them in an internal combustion engine. It is found that in such a test under practical operating conditions the preferred oxygenated compounds not only will loosen existing gum deposits but will also inhibit further deposits of gum and will allow the motor to continue in operation for long periods of time without requiring to be shut down for repairs due to gum troubles.

The type of motor fuel to which the invention may be applied is immaterial except as hereinbefore noted; ordinary gasoline may be used or blends of gasoline with benzol or alcohol, etc., as well as fuel containing metallo organic anti-knock agents such as lead tetraethyl and the like. It is likewise applicable to the heavier types of fuel used in auto-ignition engines such as the Diesel engine.

It is not desired to be limited by any of the specific examples given nor by any theories advanced as to the operation of the invention but it is intended to claim all inherent novelty in the invention as broadly as the prior art permits.

I claim:

1. A motor fuel consisting essentially of light liquid petroleum hydrocarbons and normally tending to deposit at least a small amount of gum when used for fueling an internal combustion engine, to which has been added about 0.1 to 5.0% of an oxygenated organic compound adapted to serve as a gum flux, liquid at atmospheric temperatures, adapted to soften, loosen and dislodge and/or prevent the deposition of hard carbonaceous gummy deposits on the walls, valves, rings, and other interior parts of an internal combustion engine, said material having a kauri butanol solvent value above about 25 and having a vapor pressure at the high temperature of an internal combustion engine during use at least about as low as that of normal amyl stearate.

2. A motor fuel according to claim 1 in which the gum flux used is selected from the class consisting of esters of mono-hydroxy aliphatic alcohols having at least five carbon atoms.

3. A motor fuel according to claim 1 in which the gum flux used is selected from the class consisting of esters of mono-hydroxy aliphatic alcohols having at least five carbon atoms and having a boiling point above about 500° F.

4. A motor fuel according to claim 1 in which the gum flux used is selected from the class consisting of normal or secondary amyl stearate and oleate, hexyl and heptyl esters of wax oxidation

acids, stearyl valeriate, amyl cinnamate and secondary amyl ester of mono-toluene stearic acid.

5. A motor fuel according to claim 1 containing about 0.5 to 2.0% of amyl stearate.

6. A motor fuel according to claim 1 containing about 0.5 to 2.0% of the normal or secondary hexyl ester of the higher molecular weight acids produced by the oxidation of paraffin wax.

7. The method of preparing motor fuel which comprises adding to light liquid petroleum hydrocarbons normally tending to deposit at least a small amount of gum when used for fueling an internal combustion engine, about 0.1 to 5.0% of an oxygenated organic compound adapted to serve as a gum flux, liquid at atmospheric temperatures, adapted to soften, loosen and dislodge and/or prevent the deposition of hard carbonaceous gummy deposits on the walls, valves, rings, and other interior parts of an internal combustion engine, said material having a kauri butanol solvent value above about 25 and having a vapor pressure at the high temperature of an internal combustion engine during use at least about as low as that of normal amyl stearate.

8. A method of loosening parts of an internal combustion engine which are stuck by reason of gum deposits, which comprises contacting said gum-coated stuck surfaces with an oxygenated organic compound adapted to serve as a gum flux, liquid at atmospheric temperatures, adapted to soften, loosen and dislodge and/or prevent the deposition of hard carbonaceous gummy deposits on the walls, valves, rings, and other interior parts of an internal combustion engine, said material having a kauri butanol solvent value above about 25 and having a vapor pressure at the high temperature of an internal combustion engine during use at least about as low as that of normal amyl stearate and having a boiling point above about 500° F.

9. The method according to claim 8 which comprises injecting into the interior of the motor a small amount of amyl stearate alone or in admixture with a solvent having a lower boiling point.

10. The method according to claim 8 carried out while the motor is hot.

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