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MOTOR FUEL ADDITIVE

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This invention relates to a motor fuel for internal combustion engines and more particularly to products that are adapted to be mixed with motor fuels to improve the efficiency of utilization of the fuel and to inhibit the deposition of carbon by the fuel during combustion, as well as to motor fuels incorporating such products.

As is well known to those skilled in the art, various compounds, commonly called additives, have been added to or blended with motor fuels to improve one or more of their characteristics. For example, lead tetraethyl has been added to motor gasolines for the purpose of improving the antiknock characteristics thereof. Also, various organic nitrates have been added to diesel fuels for the purpose of improving the burning characteristic thereof in diesel engines. It has further been suggested that suspensions of finely divided metals, such as tin, zinc, and aluminum, be used for the purpose of reducing and avoiding the deposition of carbon within the cylinders of a combustion engine. However, in spite of the many proposals that have been made, the efficiency of utilization of fuels in internal combustion engines remains relatively low and carbon deposition and sticking of valves remains a continuing problem.

It is accordingly an object of the present invention to provide for improved operation of internal combustion motors. It is another object of the invention to provide a composition which, when utilized in internal combustion engines, will resist deposit of carbon or avoid sticking and leaking valves. It is still another object of the invention to provide a composition that may be utilized in an internal combustion engine to give improved efficiency. It is a still further object of the invention to provide a product that may be added to, or blended with, a conventional motor fuel to produce a motor fuel composition having the foregoing advantages. Other objects of the invention will be in part obvious and in part pointed out hereafter.

I have discovered that when certain indium compounds are added in minor proportion to motor fuels, the resulting mixtures may be burned in an internal combustion engine with little, if any, carbon deposition, and sticking of the valves is substantially prevented. Moreover, the efficiency of the engine is significantly increased. This result is apparently not due merely to the instantaneous combustion of the fuel, but in part at least to some cumulative effect on the engine itself; since the improvement continues for some time after the composition is first added and does

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not disappear immediately but persists over a considerable time after the engine is returned to ordinary fuel containing no indium compound.

The present invention appears to be applicable to any motor fuel, such as gasoline, diesel oil and kerosene, and the like. The indium compounds used as additives are indium salts of the soap-forming acids, preferably, the indium salts of soap-forming fatty acids having from 8 to 18 carbon atoms per molecule. Typical soap-forming acids which will produce indium salts satisfactory for use in accordance with the present invention are caproic acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, and ethylhexoic acid. Of these typical acids, lauric, myristic and oleic are preferred. Ordinarily it will be most economical to use commercially available mixtures of these acids. As an example, satisfactory results may be obtained by using a commercial mixture comprising about 55% lauric acid, 25% myristic acid, 10% palmitic acid, and 10% oleic acid and having a titre of about 24–28.

The indium soaps of the present invention may be prepared by any of the methods well known in the art for the preparation of metals salts of fatty acids. For example, indium hydroxide may be caused to react with the acid directly. Also an aqueous solution of a water-soluble indium salt, such as indium trichloride, may be added to an aqueous solution of the potassium or sodium salt of a fatty acid until the indium soap is precipitated out completely, and the resulting soap may then be separated from the reaction mixture, washed and dried.

The products of the present invention may be either motor fuel compositions containing the indium soap in the final concentration that is to be used in the engine, or they may be concentrated products containing a relatively high proportion of indium soap, which concentrates are adapted to be later blended with motor fuel to produce a motor fuel composition containing the desired final concentration of the indium soap. The amount of indium soap used in these ways may vary within wide limits. Thus the motor fuel may have added thereto between about 0.001% and 10.0% by weight of the indium soap. Larger amounts may be used but ordinarily the expense could not be justified by further improvement. In preparing concentrates that are suitable for addition to a motor fuel to provide the desired indium soap-containing composition, the indium soap may be dissolved in a liquid which is miscible with the fuel and which is unobjectionable in the engine and does not break down into corrosive products or objectionable deposits in the combustion zone. This will ordinarily be a hydrocarbon fraction, e. g. lubricating oil, especially of the type now used as an additive, gasoline, diesel oil, kerosene and the like. The amount of dissolved indium soap in such an additive concentrate is preferably upward of 10% and may be an amount sufficient to form a substantially saturated solution. Such a concentrate is subsequently added to the motor fuel in amounts that will produce the desired final concentration such as previously indicated. This addition is made, preferably, shortly before its consumption.

The motor fuels and concentrates contemplated herein may contain, in addition to the motor fuel or solvent and the indium soap, other additives for the purpose of improving other characteristics of the motor fuel, such as ignition and burning characteristics, gum formation and the like.

In order to point out more fully the nature of the present invention, the following specific example is given, but it should be understood that this example is not intended to be exhaustive or limiting of the invention. On the contrary, we are giving the example as an illustration and are giving herewith explanations in order fully to acquaint others skilled in the art with our invention and the principles thereof and a suitable manner of its application in practical use, so that others skilled in the art may be enabled to modify the invention and to adapt it and apply it in numerous forms, each as may be best suited to the requirements of a particular use.

A product containing indium laurate was prepared by mixing and heating 20 grams of lauric acid and 5.5 grams of indium hydroxide at a temperature of about 160° C. to 215° C. for about 30 minutes. A solid salt was obtained which contained 16.6% indium. Approximately 0.6 gram of the resulting indium laurate was dissolved in four fluid ounces of a hydrocarbon oil fraction having a specific gravity of about 0.85 and a boiling range of 215° C. to 270° C. The solution was cooled to 4° C. for 15 minutes and remained clear.

The solution was then placed on a watch glass and the solvent permitted to evaporate in air until a jelly-like mass remained. The resulting product was still fluid and clear and could be dissolved in gasoline without any precipitate being formed.

Comparative tests were made on a test engine to determine the effectiveness af the product thus produced. In these tests a single cylinder 1¾ horsepower Briggs and Stratton gasaline engine was used, and the engine was directly connected to an air compressor which discharged into a closed receiving tank. The speed of the engine was controlled constant and the pressure in the air-receiving tank was also held at a constant value. In each test, one gallon of a commercial gasoline containing lead tetraethyl was used. In the first test (designated below as test A) no indium laurate was used, whereas in the second test (designated test B) 24 cc. of a concentrate prepared as above and containing about 0.120 gram of indium laurate was added to the gasoline. The engine cylinder head was taken off between test A and test B and the combustion chamber was thoroughly cleaned. The following results were obtained in these two tests.

	Test A	Test B
Air fuel ratio (average)	11.2	11.1.
Exhaust temperature (average)	1144° F	1104° F.
Spark plug temperature (average).	400° F	400° F. minus.
Vacuum between carburetor and engine (average).	$1\frac{11}{16}$ in	$1\frac{15}{16}$ in.
Air pressure on tank of compressor.	35 p. s. i	35 p. s. i.
Oil temperature of engine	70° F	66° F.
Speed of engine	2810 R. P. M	2810 R. P. M.
Time of run	2 hrs., 10 min	2 hrs., 20 min.

A comparison of the data obtained in test A and test B shows that when the fuel contained indium laurate the average exhaust temperature was about 40° F. lower than when no indium laurate was used, thus indicating that the presence of indium laurate improved combustion. Also the vacuum between the carburetor and engine was about one-quarter of an inch greater in test B indicating that the throttle did not have to be opened so far by the governor to maintain the constant speed in test B as in test A. Since the load was maintained the same in the two tests and the power delivered in both tests was the same, this difference in throttle position indicates that the fuel required to do a given amount of work was less in test B than in test A, and this is corroborated by the observed fact that the engine ran ten minutes longer on the same amount of fuel with the same load.

The oil temperature of the engine was 4° F. lower in test B than in test A. The increase in time of run shows that about 7.7% more available energy was released in the case of the indium laurate-containing fuel.

In a second pair of tests which may be designated C and D the same engine was operated at a somewhat heavier load, i. e. the air compressor receiving tank was maintained at a constant pressure between 45 and 50 lbs. per sq. in. In test C, the fuel comprised two gallons of gasoline without any indium soap added thereto, and the engine ran for three hours and thirty minutes. In test D, the same engine, after the carbon deposits in the combustion chamber and around the valves had been thoroughly cleaned therefrom, was run with two gallons of the same motor gasoline to which 1.6 ounces of a hydrocarbon fraction of about 0.885 specific gravity and containing 0.48 gram of indium laurate had been added. Under these conditions with the same speed and load, the engine ran for four hours which indicates an increase of 14.3% usable power over that developed in test C.

After each of the foregoing tests the cylinder head was removed and the combustion chamber carefully inspected. In the case of tests A and C, both sticky and hard carbon were found on the piston heads, in the valves, and on the walls of the combustion chamber. After tests B and D, on the other hand, there was practically no carbon deposit on the piston heads, valves or combustion chamber.

The effectiveness of the indium soaps for the purposes described above, appears to be uniquely characteristic of these soaps. This is indicated by the fact that tests made with zinc, tin, cadmium, and aluminum soaps show that these other soaps fail to give results comparable with those given by the indium soaps.

Other tests have shown that a second run with the indium soap exactly like test B will give appreciably better results than the first run with the indium soap and that a first run with no indium following a run with indium will give better results than an identical run after the engine has operated for some time without indium. Likewise, our tests have shown that an engine badly fouled with carbon deposits will be gradually cleaned out by operation with the indium soap additive in the fuel.

From the foregoing description it is apparent that the indium soaps, when incorporated in motor fuels, are capable of improving significantly the efficiency of utilization of the fuel and the economy of operation of the engine in which they are used. Moreover, the tendency of carbon to be deposited and valves to stick is materially reduced.

We claim:

1. A new composition of matter for use in internal combustion engines comprising, a motor fuel containing a small proportion of indium laurate to inhibit carbon deposition in the combustion chamber of said engine.

2. A new composition of matter for use in internal combustion engines comprising, a motor fuel containing from 0.001 to 10% by weight of indium laurate.

3. A new composition of matter for use in internal combustion engines, said composition being a product adapted to be mixed in a motor fuel to inhibit deposition of carbon in the combustion chamber of said engine, and comprising a combustible liquid having at least 10% by weight of indium laurate dissolved therein.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,916,735	MacLean	July 4, 1933
2,354,218	Murray	July 25, 1944