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DIESEL FUEL

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This invention relates to fuels for internal combustion engines of the Diesel or compression ignition type and is more particularly concerned with the improvement of such fuels by the addition thereto of a characterizing agent.

It is necessary for the maximum efficiency of a Diesel engine that the ignition of the fuel be essentially instantaneous. Lack of coordination between the combustion and cylinder conditions or delayed ignition is the cause of the phenomenon known as "knocking." To rectify this condition it is desirable that the ignition delay period of the fuel be short.

It is well known to those familiar with the art, however, that the ignition quality of a Diesel or compression ignition fuel can be improved by the addition thereto of small amounts of certain compounds which accelerate ignition. By such means the better grades of Diesel fuel are improved. Similarly, the ignition quality of low grade hydrocarbon mixtures may be improved sufficiently to render them available as fuels.

Some of the desirable characteristics of a Diesel fuel improving agent apart from that of increasing the cetane number of the fuel are relative insolubility in water and chemical stability in the presence of the same because of the common practice to store fuels in contact with water. It should be soluble in the fuel to the extent of 5 or 10 per cent by weight. Greater solubility is desirable if the additive is to be marketed in the form of a concentrate in fuel oil. The additive should not cause the formation of sediment or sludge-factors which might cause depreciation of the cetane number of the fuel and fouling or clogging of the injection equipment of the engine. The additive initially, as well as on combustion of the fuel, should not yield any products which are corrosive to the engine parts with which they come in contact.

Of the compounds previously proposed for use as Diesel fuel improving agents it may be said that many of them suffer from one or more undesirable characteristics, such as poor storage stability in Diesel fuel, excessively high degree of corrosivity to metals, tendency to form insoluble deposits with the fuel, etc. Characteristics such as the foregoing are important in the proper selection of a Diesel fuel improving agent and are to be avoided as much as possible. For example, although certain compounds may enhance the ignition quality of a Diesel fuel, they are generally characterized by a low degree of stability on storage in the fuel and give rise to the formation of undesirable gummy and sludge-like materials, which substantially reduce the operating efficiency of the engine. Correspondingly, other compounds may also improve the ignition quality of a Diesel fuel but they are generally so corrosive in character that the metal parts of the engine with which the fuel is in contact are seriously corroded; in this way the efficiency of the engine is also reduced.

This invention is predicated upon discovery that gem-dinitropropanes—dinitropropanes having both nitro groups attached to the same carbon atom—are highly effective in improving the ignition quality of a Diesel fuel. The improving agents of the present invention, therefore, are 1,1- and 2,2-dinitropropanes. Accordingly, the present invention contemplates Diesel fuel containing a minor proportion of such compounds for the aforesaid improvement. The present invention also contemplates the development of a method for accelerating the spontaneous ignition of liquid hydrocarbon fuels in compression ignition engines which method is characterized by the admixture of the aforesaid dinitropropanes with the fuel prior to its ignition.

While the gem-dinitroparaffins as a class are particularly effective Diesel fuel improving agents as described in copending application Serial No. 405,133, filed August 2, 1941, by one of the present inventors, John H. McCracken, it has now been found that 2,2-dinitropropane is outstanding. It is superior to other gem-dinitroparaffins in a greater enhancement of the ignition quality of a Diesel fuel and in a greater storage stability in such a fuel.

With regard to methods of preparation of the gem-dinitropropanes, the method described by v. Meyer and Locher, Ann. 180, 133 (1876) is satisfactory for the preparation of 2,2-dinitropropane, and the method proposed by ter Meer, Ann. 181, 1 (1876) is suitable for the preparation of the corresponding 1,1-compound. Other methods are well known to those familiar with the art and it is to be understood that the present invention is not concerned with or limited by the procedure by which the gem-dinitropropanes are prepared. Inasmuch as the gem-dinitropropanes and their methods of preparation are well known it is believed unnecessary to describe their preparation in this application.

The outstanding effectiveness of 2,2-dinitropropane in improving the ignition quality of a Diesel fuel is demonstrated by comparative results of a fuel blank and of typical fuel blends obtained in the following manner. A base stock commonly known as a No. 2 fuel oil which has a

flash point of 172° C., an A. P. I. gravity of 39.8, an aniline point of 160.5° C. and a cetane number of 55.0 was used in all tests. The ignition quality of the base stock and of the fuel blends was determined by comparison with a standard reference fuel in a C. F. R. engine using the ignition delay method. The value obtained in this test is expressed as the "cetane number" which is the per cent by volume of cetane in a blend of cetane and alpha methyl naphthalene having the same combustion characteristics as the sample under test. (See Proc. Am. Soc. Testing Materials, volume 36, I, 418 (1936).)

The results obtained in the foregoing test with fuel blends containing the preferred gem-dinitropropane—2,2-dinitropropane—and other representative compounds of the broad class of gem-dinitroparaffins are tabulated in the table below.

Table

Compound added	Conc., weight percent	Cetane No. of blend	Increase in cetane No.
2,2-dinitropropane	0.1	60.3	5.3
Do	0.25	61.6	6.6
Do	0.5	64.9	9.9
Dinitromethane	0.5	60	5.0
1,1-dinitroethane	0.25	59	4.0
Do	0.5	63	8.0
1,1-dinitroheptane	1.0	58	3.0

It will be apparent from the foregoing results that 2,2-dinitropropane is outstandingly effective in decreasing the ignition delay period of a Diesel fuel. It will also be apparent that 2,2-dinitropropane is substantially superior to other gem-dinitroparaffins, such as dinitromethane, 1,1-dinitroethane and 1,1-dinitroheptane. For example 0.5% by weight of 2,2-dinitropropane increased the cetane number of the fuel by 9.9 units, whereas the same amount of 1,1-dinitroethane and of dinitromethane rendered increases of only 8.0 units and 5.0 units, respectively.

The gem-dinitropropanes hereinafter claimed in this invention may be used in Diesel fuel in varying amounts. For example, to effect satisfactory improvement of the ignition quality of a Diesel fuel, as indicated by the foregoing results, amounts varying from about 0.1 per cent to about 10.0 per cent may be used. Larger amounts may be used, however, to provide Diesel fuel concentrates, which are also contemplated herein. In the latter, the amount of gem-dinitropropane may be increased beyond the aforesaid percentage range to provide such concentrates as fuels saturated with a gem-dinitropropane. It is to be further understood that when the terms "Diesel fuel" or "Diesel type fuel," etc., are used herein reference is made to any liquid hydrocarbon adapted for use in any compression ignition engine.

We claim:

1. An improved Diesel fuel having in admixture therewith a minor proportion, sufficient to decrease the ignition delay period of the fuel, of 2,2-dinitropropane.

2. An improved Diesel fuel having in admixture therewith between about 0.1 per cent and about 10.0 per cent of 2,2-dinitropropane.

3. The method of accelerating the ignition of a liquid hydrocarbon fuel in an engine where the fuel is injected into compressed air in the engine cylinder and ignites spontaneously therein, which comprises admixing with the fuel, prior to its injection into the cylinder, a minor proportion, of 2,2-dinitropropane.

4. A Diesel fuel concentrate comprising a major proportion of a liquid hydrocarbon fuel and a minor proportion of 2,2-dinitropropane.

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