United States Patent Office 2,968,585
Patented Jan. 17, 1961

2,968,585

REMOVAL OF COMBUSTION CHAMBER DEPOSITS

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No Drawing. Filed Sept. 22, 1955, Ser. No. 536,019

3 Claims. (Cl. 134—22)

The invention relates to the removal of carbonaceous deposits from the combustion chambers of internal combustion engines. More particularly, it relates to materials capable of dissolving such deposits and to an economical method for the removal of such deposits.

It is well known that solid deposits, consisting principally of carbon and other products of combustion of the fuel mixture and lubricating oil, such as lead salts, formed from tetraethyl lead which is commonly used as an anti-knock agent in gasoline, adhere to the interior parts, such as the combustion chambers, pistons, cylinder heads and valves, of internal combustion engines. The harmful effects of these deposits have been recognized for some time. One harmful effect is the increase in octane requirement of an engine caused by the build-up of these deposits. Another is pre-ignition which is caused primarily by glowing deposit particles which ignite the fuel charge before the normal spark. These harmful effects are reflected in rough engine operation and power loss. This is particularly true in the case of the newer, high compression type engines. Other detrimental effects of these deposits are that they lower the efficiency of heat transfer from the combustion chambers to the cooling jacket and reduce the capacity of the engine to take in a full charge of air and fuel. Also, the accumulation of such deposits has been found to shorten the working life of the exhaust valves. Accordingly, some easy means of accomplishing the removal of these deposits has been sought. Such means have been provided in the prior art through the development of certain liquid materials which exert a solvent action on the combustion deposits, but which have no harmful effect on the metal parts. By the employment of such materials, which are known in the art as combustion deposit solvents, the removal of the deposits may be accomplished without dissembling the engine. Thus, by introducing the solvent into the combustion chamber and allowing it time to act on the surface deposits, the deposits are effectively loosened. The engine is then started up and the loosened deposits are blown out through the exhaust. It will be appreciated then that combustion deposit solvents are of great value to the art since they afford a most convenient and economical way of keeping an engine free of deposits and, consequently, in top operating condition. Accordingly, it is the prime object of the present invention to provide a new combustion deposit solvent. Other and further objects will appear from the description of the invention.

In accordance with the invention, it has now been found that hexamethylphosphoramide,

$$[(CH_3)_2N]_3PO$$

is a highly effective combustion deposit solvent. Accordingly, it is seen that, broadly stated, this invention provides a method for the removal of combustion deposits from the metal surfaces of internal combustion engines which comprises app'ying hexamethylphosphoramide to the adhered deposits and then removing the loosened deposits. A specific and preferred embodiment of the invention, however, involves the contacting of the deposit-coated engine parts with the hexamethylphosphoramide without dissembling the engine and then starting the engine to cause the loosened deposits to be removed and carried out through the exhaust. This particular embodiment of the invention is described more fully hereinbelow.

The ability of the hexamethylphosphoramide as a combustion deposit solvent has been demonstrated by the following tests. A sample of a typical deposit taken from the combustion chambers of a road test car was first de-oiled by extraction with normal pentane. One gram of the deposit was then soaked in 25 cc. of the hexamethylphosphoramide for one hour at room temperature and then filtered. The undissolved deposit was washed with 50 cc. of methanol, dried and weighed. The percent soluble in each of the solvents is shown below. The results of similar tests made on a material sold commercially as a combustion deposit solvent are also shown for comparison.

Solvent:	Percent deposit soluble
Hexamethylphosphoramide	39
Commercial material	17
Methanol	3

It is seen from the data that the hexamethylphosphoramide is more than twice as strong a solvent for the combustion deposits as the commercial material.

As aforementioned, the utilization of the hexamethylphosphoramide in accordance with the invention preferably involves bringing the solvent into contact with the deposit-coated engine parts without dissembling the engine. A preferred procedure is as follows. A portion of the solvent, say 25 to 100 cc., preferably about 50 cc., is either poured or sprayed into the combustion chamber through the spark plug hole. Another method of applying the hexamethylphosphoramide is to slowly introduce a suitable amount into the carburetor air-intake while the engine is idling, the rate of addition of the last portion of the dose being increased so as to cause the engine to stall. In this way a good distribution of the solvent in the combustion chambers is assured. Preferably, the solvent is introduced to the combustion chamber after the engine has been operated for a period of time so that the coated metal parts have become heated. Also, the solvent may be preheated before introducing it to the combustion chamber.

The solvent is allowed to act on the deposits for a suitable period of time, depending upon the severity of the deposit condition. In general, it has been found that from about 1 to about 6 hours is a sufficient length of time to provide excellent results. The engine is then started up and the loosened carbon and other deposit particles are blown out through the exhaust.

It will be appreciated that although the solvent of the invention is particularly advantageous in providing for the removal of combustion deposits from the engine parts without dissembling the engine, it may also be used in cleaning the coated parts of a dissembled engine. Thus, the solvent may be applied to the coated parts by some suitable method, such as spraying, painting or immersion, and after allowing time for it to act on the deposits the loosened deposits may be wiped, brushed or blown off the metal surfaces. The parts may be heated by a flame, or otherwise, to accelerate the solvent action, if desired.

Although generally speaking the hexamethylphosphoramide provides excellent results when used alone, it has been found that its effectiveness is enhanced in certain instances by using it in combination with an organic type solvent. Thus, it has been found highly effective when used with such solvents as benzene, cresols, dichloro- and trichlorobenzenes; with ketones, such as

methyl ethyl ketone; with esters, such as ethyl acetate; and with amides, such as formamide, dimethylformamide, etc. Such solvent combinations may suitably comprise from about 25% to about 75% of the hexamethylphosphoramide.

Having now fully described the invention, what is claimed is:

1. The method of removing combustion deposits from the metal parts of an internal combustion engine which comprises applying hexamethylphosphoramide to the deposits and then removing the loosened deposits.

2. The method of removing combustion deposits from the metal parts of an internal combustion engine which comprises heating the deposit-coated parts, contacting the deposits with hexamethylphosphoramide and then removing the loosened deposits.

3. The method of removing combustion deposits from the combustion chamber of an internal combustion engine which comprises contacting the deposits with hexamethylphosphoramide and then removing the loosened deposits.

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