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METHOD OF REMOVING CARBON DEPOSITS FROM INTERNAL-COMBUSTION ENGINES

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The present invention relates to a method of removing deposits from the combustion chambers of internal combustion engines in a simple and effective manner.

It is well known that deposits quickly accumulate in the combustion chamber of internal combustion engines such as those used in automobiles. An engine with deposits requires the use of a gasoline with a higher octane rating than does a clean engine if the engine is not to knock, and the dirty engine is said to have a higher octane demand. This becomes apparent to the driver of an old automobile by the knocking of the engine while accelerating, climbing a hill or otherwise operating the engine under greater than normal load. The deleterious effects of such accumulations of deposits is particularly noticeable in engines having a high compression ratio because the margin between the octane number of gasolines on the market and the octane demand of the engine when clean is narrower than for engines having lower compression ratios.

A great number of methods have been proposed heretofore for cleaning the combustion chambers of an internal combustion engine. One of these methods is that of introducing a liquid solvent into the carburetor while the engine is running. Although this method produces great bellows of smoke at the exhaust, it has been found, upon taking an engine so treated apart after the operation, that little of the deposits are actually removed.

Another of these methods is that of inserting particles of metal or other objects such as chains and the like into the various cylinders through the spark plug holes, replacing the spark plug, running the engine, and then removing the chains or connected particles if such were used. This method of operation, where discrete particles of metal were used, has been found entirely impracticable because (*a*) the particles either melt, due to the heat of combustion, before the engine gains sufficient speed to impart to the particles a velocity high enough to remove deposits upon impact therewith or, if the particles do not melt, they are so hard and non-crushable as to cause injury to the engine if jammed between moving parts such as a valve head; (*b*) the number of particles introduced into each cylinder at one time is either so great as to interfere seriously with the combustion and the movement of the valves and piston, or so small that the spark plug for each cylinder will have to be removed and replaced so often during a single cleansing as to make excessive the time required for the operation and the probability of injury to the spark plugs; and (*c*) many of the particles roll out through the valves before the engine gains sufficient speed to make them effective, thus resulting in a waste of particles and in an accumulation thereof in the exhaust manifold and muffler.

In view of the failure of the many proposed methods, of which the foregoing are but a few, it is still standard practice to clean an internal combustion engine by removing the head and grinding the deposits away from the tops of the pistons and valves and the recesses in the cylinder head forming the confining surfaces of the combustion chamber. This method is expensive and time consuming and renders the engine useless for at least a day.

A method for removing the deposits in the combustion chambers of an internal combustion engine has now been found that does not require a lifting of the cylinder head, is not injurious to the engine, is extremely inexpensive and requires very little time. In essence, this method involves introducing substantially continuously and uniformly, over an extended period of time, into the intake manifold for

conveyance to and substantially equally distribution among the engine cylinders while the engine is running, a plurality of discrete particles having a melting point above about 300° C. and a BHN (Brinell hardness number) between about 3 and 115.

The size of the individual particles that may be used in accordance with the method of this invention is limited only by the minimum clearance in the combustion chamber between the piston and the cylinder head when the piston is at the top of its stroke. For automobile engines it is usually desirable that the maximum dimension of any particle should not exceed about 0.125". For engines having a larger piston displacement, such as truck engines, the maximum dimension of the particles may be as high as 0.25". The minimum dimension of the particles should ordinarily not be less than about 0.05", the reason being that particles having a smaller minimum dimension tend to lose their cleansing effectiveness quickly because of more rapid melting as well as lower kinetic energy.

The particles may have any desired shape such as cubes, cylinders, ellipsoids, spheres and the like. One type of particle which has been found to be particularly effective is a flattened sphere having a maximum dimension of approximately 0.125" and minimum dimension of 0.09". Another shape that is particularly desirable from an economical point of view is the unflattened sphere. This makes it possible to use goods, such as ordinary lead shot, now available on the market.

The particles should be hard enough, under the high-temperature conditions prevailing in the combustion chamber of an internal combustion engine, to chip carbonaceous and other deposits off the walls of the combustion chamber upon impact therewith and yet be sufficiently crushable to avoid injury to the engine if jammed between two moving parts or between a stationary and a moving part. Tests have indicated generally that particles having a BHN between about 3 and 115 are satisfactory. This includes particles of metals such as aluminum, lead, magnesium, zinc, cadmium, copper and many of the alloys of said metals, as well as some very soft irons, such as malleable or ingot iron and low carbon steel as well as particles of said metals and harder metals in a sintered condition.

It has been found that particles of sintered metals are particularly effective. Such particles are made by compressing the one or more constituent metal powders followed by a heat treatment at a temperature below their melting point. This process results in particles having considerable porosity which renders them more crushable and consequently permits the use of metals that would otherwise be too hard.

The method of the invention is most effectively carried out by introducing the particles into the engine through the carburetor with the air filter removed. This is accomplished by pouring the particles in a steady stream or in fairly uniform increments into the carburetor past the butterfly valve while the engine is run at a fairly high speed. This is preferably carried out in such a manner that approximately 50 to 250 particles per cylinder are introduced within approximately 1 to 10 minutes or at an over-all rate of between about 5 and 50 particles per minutes per cylinder.

The introduction of the particles can be accomplished by means of a suitable dispenser or by the continual addition of pinches of say about 5 to 20 particles each, care being taken to avoid having more than three or four particles in each cylinder at any given time so that the operation will not become too noisy.

The advantages of this method of cleaning an internal combustion engine are numerous. The method is extremely simple and may be carried out in less time than it takes to have the oil changed. As will be brought out in the examples hereinafter, the method is effective in reducing considerably the octane demand of a dirty engine. It does not require a lifting of the cylinder head or even the removal of the spark plugs. Due to the method of introduction of the particles through the intake manifold and their cooling in the manifold by contact with the mixture of air and vaporizing fuel droplets under subatmospheric pressure, it is possible to use particles of metals that would otherwise melt within the com-

bustion chamber before they could be sufficiently agitated to remove carbonaceous deposits upon impact therewith.

Extensive tests have shown that the introduction of particles of metal into an engine in accordance with the method of this invention results in no perceptible injury to any part of the engine. The engines in two heavy-duty trucks that were subjected to periodic cleaning by the method of this invention showed, upon being taken down after 90,000 miles of travel each, no preceptible signs of damage to any of the engine parts including the valves, cylinder heads, pistons, cylinder walls, and bearings.

EXAMPLE 1

A total of six tests were carried out with three automobile engines, a Chevrolet, a Ford and a Plymouth. These engines were selected not only because they are representative of a high percentage of the automobile engines in use at the present time, but also because the intake manifolds are quite different from one another.

In each test the air filter was first removed from the carburetor and, while the engine was in operation, approximately 100 pellets per cylinder of sintered 80% copper, 20% lead, the pellets being flattened spheres having a maximum dimension of 0.125", and a minimum dimension of 0.090", were introduced within an interval of about five minutes on each side of the butterfly valve in the throat of the carburetor.

The results are tabulated immediately below:

Table I

Test No.	Engine Type	Octane Requirement		
		Before Cleaning	After Cleaning	Reduction
1	Chevrolet	84	78	6
2	do	84	77	7
3	do	77	77	0
4	Ford	88	83	5
5	Plymouth	86	82	4
6	do	86	81	5

After each test, except test No. 2, the engine was taken apart to evaluate the efficiency of the carbon removal as well as any damage to the engine parts. The carbon removal was found to be uniformly good as might have been expected from the reported reduction in octane demand of the engine as a result of the cleaning operation. It was found that in all engines parts of the pulverized pellets worked past the pistons and rings into the oil pan and that some flakes were found deposited on the bearings. Continued and extensive running revealed no damage due to the flakes on the bearings as these finally worked out and fell to the bottom of the oil pan where they were either deposited in the heavy sludge or drained away with the fluid sludge. No actual damage of any kind was observed in any test.

The third test with the Chevrolet engine was carried out immediately after the second test without taking the engine apart in the meantime. The failure, in the third test, to further reduce the octane requirement of the engine showed that the engine had been cleaned as much as it could be in the second test. The examination of the engine after the third test showed that even when an excessive number of pellets is introduced into the engine, there is little danger of damage.

The excellent results shown with the Plymouth engine in tests 5 and 6 revealed that the method of this invention is effective even in engines wherein the materials introduced into the carburetor must be carried upwardly through the intake manifold to reach the combustion chambers. In each instance overhaul of the engines subsequent to the tests revealed very good distribution and cleaning of all cylinders.

EXAMPLE 2

Two further tests were carried out with standard six-cylinder Chevrolet automobile engines. The procedure in each test was substantially the same as described in Example 1, but the composition, shape and dimensions of the particles were somewhat different. In test No. 7, the particles consisted of ⅛" clippings from an aluminum rod having a BHN of 16 and a diameter of ⅛". In test No. 8 the particles used were chilled lead shot (an alloy having a BHN of 5 to 6) having a diameter of 0.09".

The results are tabulated immediately below:

Table II

Test No.	Octane Demand			
	Clean Engine	Dirty Engine	Cleaned Engine	Reduction
7	70	81	76	5
8	70	84	75	9

It is apparent from the foregoing results that a considerable reduction in the octane demand of a dirty engine is obtained by the method of this invention. Upon dismantling the engine after test No. 7, it was found that several aluminum particles of different sizes remained, showing a progressive chipping off of the aluminum particles. Only a trace of the lead shot charge was found after test No. 8 and in neither case was there any perceptible sign of damage to the engine.

In addition to the particles specifically described in the foregoing examples, tests were also carried out with particles of commercially pure copper, a sintered bearing mix consisting of 8% tin, 4% lead and 88% copper, a sintered mix consisting of 70% copper and 30% lead and a sintered mix consisting of 60% copper and 40% lead, these particles having the shape and dimensions of the particles referred to specifically in Example 1.

It is apparent that many variations and modifications will occur to those skilled in the art upon reading the above description. All such variations and modifications are intended to be included within the scope of this invention as defined within the appended claims.

I claim:

1. A method of removing deposits from the combustion chambers of an internal combustion engine which comprises introducing, over an extended period of time, into the intake manifold for conveyance to and substantially equal distribution among the engine cylinders while the engine is running, a plurality of pellets of metal having a melting point above about 300° C. and a Brinell hardness number between about 3 and 115.

2. A method of removing deposits from the combustion chambers of an internal combustion engine which comprises introducing, over an extended period of time, into the intake manifold for conveyance to and substantially equal distribution among the engine cylinders while the engine is running, a plurality of pellets of sintered metal having a melting point above about 300 degrees C. and a Brinell hardness number between about 3 and 115.

3. A method of removing deposits from the combustion chambers of an internal combustion engine which comprises introducing, over an extended period of time, into the intake manifold for conveyance to and substantially equal distribution among the engine cylinders while the engine is running, a plurality of pellets of sintered copper and lead, said pellets having a melting point above about 300 degrees C. and a Brinell hardness number between about 3 and 115.

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