

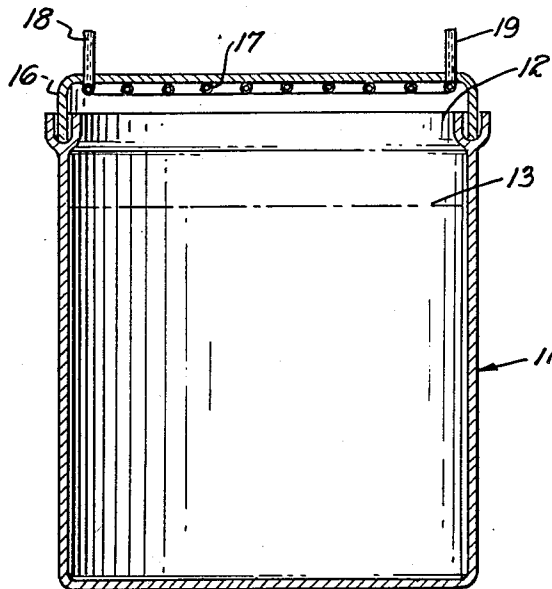
Jan. 27, 1953

A. LAZAR

2,626,879

PROCESS OF REMOVING DEPOSITS CONTAINING LEAD COMPOUNDS

Filed June 12, 1950



INVENTOR.

ARTHUR LAZAR

BY

*Arlington L. White*

ATTORNEY

# UNITED STATES PATENT OFFICE

2,626,879

## PROCESS OF REMOVING DEPOSITS CONTAINING LEAD COMPOUNDS

Arthur Lazar, San Francisco, Calif.

Application June 12, 1950, Serial No. 167,658

11 Claims. (Cl. 134—39)

1

The invention, in general, relates to prime movers of the internal combustion type. More particularly, the invention relates to a novel and useful process and apparatus for improving the performance characteristics of such prime movers.

As is perhaps well known, the anti-knock fluids hereinafter referred to merely as the ethyl-fluids, which are incorporated into gasolines for improving the octane rating thereof consist of tetra-ethyl-lead and other auxiliary agents, such as ethylene dichloride and ethylene dibromide as well as added organic dyes, the latter merely being included for purposes of differentiation or identification. During combustion of such leaded gasolines, the organic portions of the ethyl-fluids will burn whereas the lead portion is converted to inorganic lead compounds, such as lead oxide, lead chloride and lead bromide. Since there are minor proportions of organic sulfur compounds present in almost any kind of gasoline, lead sulfate is formed also during the combustion of a leaded fuel. While some of the lead-carrying reaction products of the combustion gases, evolved from the combustion of such fuels may be completely eliminated through the engine exhaust, appreciable quantities thereof are trapped in various parts of an engine and are deposited thereon. It has been found, upon inspection of an engine that has been operated with leaded fuel that a greyish sediment is deposited on the bottom of the engine crankcase or in the oil ducts of the lubrication system. On those parts of the engine which have been exposed to higher temperatures, for example, piston tops, exhaust manifold and exhaust lines, hard carbonaceous deposits of very high lead content were usually found.

The steady trend towards increasingly higher compression ratios in automotive spark ignition engines on one hand, and the high performance requirements of air-craft engines on the other hand are responsible for the steady increase in the proportion of tetra-ethyl lead fluid of premium and aviation type gasolines. It stands to reason that the higher the lead content of a fuel, the greater will be its tendency to accumulate deposits containing lead compounds in the combustion chamber and exhaust system. Therefore, the cleaning and overhauling of air-craft engines involves a particularly tedious and time consuming operation, inasmuch as the deposits containing lead compounds are so firmly baked on that the engine parts have to be cleaned by mechanical means such as scraping or sand blasting.

2

It is to be appreciated that the deposits containing lead compounds, as aforesaid, on the various parts of an engine utilizing ethyl-fluids are cumulative and, unless periodically removed, will have a deleterious effect upon the performance characteristics of the engine not only as to its efficiency but also as to development of hot spots which, in turn, causes fatigue of the metal. The present invention is directed to the provision of means for obviating the above mentioned inherent deleterious effects of the leaded fuels in the operation of combustion prime movers and, at the same time, of reducing the time and expense heretofore involved in effecting the removal of the aforementioned deposits containing lead compounds.

It should also be mentioned here, that deposits containing lead compounds are also found in the burner tubes of the heating units employed on various types of aircraft for maintaining comfortable temperatures inside the plane during high altitude flying or in cold weather. Since these deposits are likewise the result of the combustion of the same leaded fuel, which is used for feeding the aircraft engines, they resemble in composition quite closely the aforementioned deposits in the exhaust system. Consequently, these deposits, present in the heating units, can be removed just as readily by the process of this invention.

One of the primary objects of my present invention is to provide an improved method of effectively and expeditiously removing lead deposits from parts of an engine which has been operating with leaded fuels.

Another important object of the present invention is to provide a relatively simple process of the indicated nature which is additionally characterized by its appreciably low cost and the minimum of time involved in effecting the removal of deposits containing lead compounds from equipment of the hereinabove mentioned type.

A still further object of my invention is to provide an improved method of the aforementioned character which can be practiced and handled by the unskilled with the same effectiveness, dispatch and safety as any skilled person.

Other objects of the invention, together with some of its advantageous features, will appear from the following description of a preferred mode of practicing the present invention an exemplification of one type of equipment which may be employed in practicing the invention being illustrated in the accompanying drawing. It is to be understood, however, that I am not

to be limited to the precise mode of or the order of steps set forth in the description of my process, as the invention, as defined in the appended claims can be practiced in a variety and plurality of ways.

Referring to the drawing:

The single view is a sectional elevational view of an exemplification of equipment which may be employed in practicing the preferred mode of the invention.

In its preferred mode, the improved method of removing deposits containing lead compounds from internal combustion engine parts preferably comprises immersing or subjecting the parts of such an engine on which such deposits are found in or to a hot aqueous solution of ammonium acetate.

In accordance with my invention, I prepare a 30 to 40 per cent concentration of an ammonium acetate solution wherein the ammonium acetate is present in an amount, by weight, of between 30 and 40 per cent of the total solution. As indicated above, the solution is an aqueous ammonium acetate solution. In order to avoid possible chemical attack upon the part of the ammonium acetate upon the metal of the engine parts to be treated, I add a small amount of a suitable inhibitor, in order to reduce the corrosive action to an absolute minimum. It is to be observed, in this connection, that in tests that I have conducted for removing deposits containing lead compounds from engine parts of an engine that has operated with leaded fuel, there is only a negligible attack at all events on the metal parts by the ammonium acetate, but very little, if any, attack when the suitable inhibitor is introduced and utilized in the aqueous ammonium acetate, as hereinafter described.

The parts to be freed from deposits containing lead compounds may consist of a variety of metals; in most cases, they will be cast iron, steel, cast aluminum, or sheet aluminum. I have found the best all around inhibitor for ammonium acetate (de-leading) solution is provided by phosphate ion. The phosphate type inhibitor may be incorporated into the ammonium acetate solution in form of an inorganic or organic salt of phosphoric acid of a pH which matches as closely as possible that of the ammonium acetate solution itself. The pH of freshly prepared ammonium acetate solution may vary between 7.0 and 7.5. I have found that during the de-leading operation while the solution is consistently boiling under reflux, the pH may gradually decrease to as low as 6.0, due to partial dissociation of the ammonium acetate. Therefore, an occasional check up appears advisable so that, if necessary, the pH can be brought back to the normal range of 7.5 by the addition of the necessary amount of ammonia. This can be accomplished either by means of concentrated aqueous ammonium solution or by the passing of ammonia gas into the treating tank. Di-ammonium phosphate which has a pH of 7.0 is the most suitable inhibitor. It is effective when added at a ratio as low as .1%. For practical reasons I prefer to add approximately 5% of this inhibitor. Phosphates of organic amines are equally suitable provided that the pH is adjusted to that of the ammonium acetate solution itself. Depending on the basicity of the amine, the adjustment has to be made by selecting the proper ratio of amine and phosphoric acid. Of course, in metal parts consisting of stainless steel there is no attack at all even without the use of inhibitors.

It is especially to be observed that in the application of my improved method, the metal parts carrying the deposits containing lead compounds are preferably soaked in the ammonium acetate solution maintained at elevated temperature and it has been demonstrated that the hardest of such deposits will disintegrate in approximately one hour or less and will leave the metal surface bright and clean after rinsing with fresh water. It has been found that in most cases the lead compounds represent the major constituent and the carbonaceous organic binder the minor constituent of such deposits. Consequently, as the ammonium acetate solution gradually dissolves the lead constituents, the deposit as a whole readily breaks loose from the metal parts under treatment.

In order to avoid loss of chemicals during the treatment, I have found it advisable to provide a reflux cooling unit on the container or receptacle in which the treatment is carried out and to this end have devised the apparatus illustrated in the annexed drawings as an exemplification of equipment that may be employed in practicing the preferred mode of my invention. With reference to the single view, I have provided a suitable metal receptacle or tank 11 having a relatively large opening 12 in the top thereof for passing the metal parts of an engine for soaking in the aqueous ammonium acetate contained in the tank. Since the solution is preferably heated to near boiling temperature, and since such solution, under such conditions will give off water vapor as well as ammonia and acetic acid due to the dissociation of the ammonium acetate molecule, I also provide in this exemplification a reflux cooling unit and preferably mount the same on the under side of the cover or lid 16 of the tank 11 which is removably mounted thereon. The reflux cooling unit preferably employed consists of a length of stainless steel tubing 17 coiled around the underside of the lid 16 and welded or otherwise permanently secured thereto. The ends of the tubing 17, indicated at 18 and 19 in the annexed drawings, extend through or pierce the cover 16 of tank 11 and can be conveniently provided with fittings, not shown, for attaching suitable pipes, not shown, thereto whereby a coolant, such as cold water, can be continuously passed through the coil of stainless steel tubing 17 from a source, not shown, and thereby the vaporization of the heated solution 13 in the tank is kept to a minimum. Moreover, the composition of the ammonium acetate solution is thus kept fairly constant under such conditions.

In addition to causing the lead constituents of the above mentioned deposits on engine parts to enter into the aqueous ammonium acetate under the aforesaid treatment, and the breaking loose of the carbonaceous matter, my improved method of treating such lead-carrying metal parts of the aforesaid engines is efficacious in the removal of scale and rust which often occurs in the exhaust lines, ball joints and mufflers of combustion engines operating with leaded fuels. However, the scale and rust do not dissolve to any great extent in the hot ammonium acetate solution but are to be found on the bottom of the treating vessel or receptacle 11 as a brown sludge.

It will be clear from a review of the foregoing and a consideration of the annexed drawing that I have provided a relatively simple and expeditious method as well as have indicated relatively simple apparatus for effectively removing lead

5

compounds from deposits on metal parts of a combustion engine operating on leaded fuels. As indicated, the optimum concentration of the ammonium acetate solution is between approximately 30 and approximately 40 per cent, by weight. I have found that such a concentration of ammonium acetate, when heated to elevated temperature, is capable of dissolving its molecular equivalent of lead compounds and, accordingly, that a single charge of this chemical can be used for the treatment of a considerable number of engine parts. In view of the simplicity of the illustrated apparatus and the fact that the solution can be delivered to the premises where the process is to be practiced in sealed containers, it is evident that the entire process can be practiced and the apparatus utilized by unskilled persons with the same effectiveness and the same dispatch as any skilled person. There are no fire hazards involved in the use of the apparatus and the assembly thereof is relatively simple and the process of treating the lead-compound carrying metal parts likewise is relatively simple. In view of the fact that my improved method can be practiced at a relatively small expense, appreciable savings can be had in effecting the removal of the deposits containing lead compounds from engines of the type hereinabove mentioned. Moreover, the employment of such mechanical means as scrapers or sand blasters heretofore utilized for removing such deposits are eliminated.

It is to be understood that the appended claims are to be accorded a range of equivalents commensurate in scope with the advance made over the prior art.

I claim:

1. A method of removing deposits containing lead compounds from metal parts, said method comprising contacting the deposit-carrying metal parts with an aqueous solution of ammonium acetate.
2. A method of removing deposits containing lead compounds from metal parts, said method comprising contacting the deposit-carrying parts with an aqueous solution of ammonium acetate at elevated temperature.
3. A method of removing deposits containing lead compounds from metal parts, said method comprising contacting the deposit-carrying parts with an aqueous solution of ammonium acetate at elevated temperature, said solution containing an inhibitor, to prevent corrosive attack of metals.
4. A method of removing deposits containing lead compounds from metal parts, said method comprising immersing the deposit-carrying parts in a contained volume of a hot aqueous solution of ammonium acetate in the presence of phosphate ion while simultaneously cooling the container holding the solution to keep vaporization of water and dissociation of the ammonium acetate at a minimum and to maintain the composition of the solution substantially constant while the metal parts are immersed therein.

6

5. A method of removing deposits containing lead compounds from metal parts, said method comprising contacting the deposit-carrying parts with an aqueous solution of ammonium acetate at elevated temperature, said solution containing an inhibitor, to prevent corrosive attack of metals, said inhibitor consisting of a phosphoric acid salt of substantially the same pH as ammonium acetate.

6. A method of removing deposits containing lead compounds from metal parts in accordance with claim 4; keeping the pH of the solution adjusted to approximately 7.0 by the addition of ammonia in aqueous form.

7. A method of removing deposits containing lead compounds from metal parts in accordance with claim 4; keeping the pH of the solution adjusted to approximately 7.0 by the addition of ammonia in gaseous form.

8. A method of removing deposits of lead compounds and carbonaceous organic matter from metal parts of internal combustion engines utilizing ethyl-fluids as the fuel, said method comprising contacting the deposit-carrying parts with an aqueous solution of ammonium acetate to disintegrate the lead constituents and break loose the carbonaceous organic matter of the deposits.

9. A method of removing deposits of lead compounds and carbonaceous organic matter from metal parts of internal combustion engines utilizing ethyl-fluids as the fuel, said method comprising contacting the deposit-carrying parts with an aqueous solution of ammonium acetate containing a metal-protecting inhibitor to disintegrate the lead constituents and to break loose the carbonaceous organic matter of the deposits.

10. A method in accordance with claim 9; keeping the pH of the solution adjusted to approximately 7.0 by the addition of ammonia in aqueous form.

11. A method in accordance with claim 9; keeping the pH of the solution adjusted to approximately 7.0 by the addition of ammonia in gaseous form.

ARTHUR LAZAR.

#### REFERENCES CITED

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

#### UNITED STATES PATENTS

| Number    | Name         | Date           |
|-----------|--------------|----------------|
| 1,918,817 | Mantell      | July 18, 1933  |
| 2,181,553 | Hiller       | Nov. 28, 1939  |
| 2,264,766 | Mauersberger | Dec. 2, 1941   |
| 2,408,931 | Heath        | Oct. 8, 1946   |
| 2,465,228 | Hein         | Mar. 22, 1949  |
| 2,476,823 | O'Neil       | July 19, 1949  |
| 2,508,215 | Bishop       | May 16, 1950   |
| 2,523,956 | Kleist       | Sept. 26, 1950 |