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STABILIZED LUBRICANTS

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This invention relates more particularly to the use of improved inhibitors for effecting the stabilization of lubricants. The lubricants are selected from the group consisting of grease and an oil of lubricating viscosity.

In recent years, stringent requirements for lubricants in certain applications have resulted in the availability of a new class of lubricants referred to in the art as synthetic lubricants. These lubricants do not necessarily replace petroleum oils in conventional usage, but are designed for special applications where the petroleum oils do not function to a satisfactory degree. These synthetic lubricants have found particular use in winter-grade crankcase oils, turbo-engine oils, aviation instruments, automatic weapons, etc. For example, aircraft gas turbines require oils capable of providing satisfactory lubrication at temperatures ranging as low as —65° F. and as high as 400° F. during use. Temperatures up to 500° F. are encountered for intervals of from one to two hours during shut-down. Petroleum lubricants are unsatisfactory at high altitudes or in the winter season for use in machine guns and automatic cannons which frequently could not be made to fire because of congealed lubricants. Because they are used under such stringent conditions, the synthetic lubricants undergo undesirable deterioration including, for example, formation of deposits, discoloration, change of viscosity, etc. While the features of the present invention are particularly applicable to the stabilization of synthetic lubricants, it is understood that they also may be used for the stabilization of petroleum lubricants.

The synthetic lubricants are of varied types including aliphatic esters, polyalkylene oxides, silicones, esters of phosphoric and silicic acids, highly fluorine-substituted hydrocarbons, etc. Of the aliphatic esters, di-(2-ethylhexyl) sebacate is being used on a comparatively large commercial scale. Other aliphatic esters include dialkyl azelates, dialkyl suberates, dialkyl pimelates, dialkyl adipates, dialkyl glutarates, etc. Specific examples of these esters include dihexyl azelate, di-(2-ethylhexyl) azelate, bis-(1-methyl cyclohexylmethyl) sebacate, di-3,5,5-trimethylhexyl glutarate, di-3,5,5-trimethylpentyl glutarate, di-(2-ethylhexyl) pimelate, di-(2-ethylhexyl) adipate, triamyl tricarballylate, dipropylene glycol dipelargonate, 1,5-pentanediol-di-(2-ethylhexanonate), etc. The polyalkylene oxides include polyisopropylene oxide, polyisopropylene oxide diether, polyisopropyiene oxide diester, etc. The silicones include methyl silicone, methylphenyl silicone, chlorophenyl silicone, methylchlorophenyl silicone, etc., and the silicates include, for example, tetraisooctyl silicate, tetrakis-n-dodecyl silane, didodecyldioctyl silane, diphenyl-di-n-dodecyl silane, octadecyltridecyl silane, hexa-2-ethylhexoxy-disilocane, etc. The highly fluorinated hydrocarbons include fluorinated oil, perfluorohydrocarbons, etc.

Other synthetic lubricating oils proposed for use in high temperature service as, for example, jet fuel lubrication, include (1) various phosphates as tricresyl phosphate, trioctyl phosphate, trinonyl phosphate, tridecyl phosphate, tris-(chlorophenyl) phosphate, chlorophenyl phenyl phosphate, as well as mixed aryl and alkyl phosphates, (2) neopentyl glycol esters, in which the ester group contains from 3 to 12 carbon atoms or more, and particularly neopentyl glycol propionates, neopentyl glycol butyrates, neopentyl glycol caproates, neopentyl glycol caprylates, neopentyl glycol pelargonates, etc., (3) trimethylol alkanes such as trimethylol ethane, trimethylol propane, trimethylol butane, trimethylol pentane, trimethylol hexane, trimethylol heptane, trimethylol octane, trimethylol decane, trimethylol undecane, trimethylol dodecane, etc., as well as the esters thereof and particularly the triesters in which the ester portions each contain from 3 to 12 carbon atoms and may be selected from those hereinbefore specifically set forth in connection with the discussion of the neopentyl glycol esters, and (4) pentaerythritol esters including, for example, pentaerythritol tetracaproate.

The present invention also is applicable to the stabilization of greases made by compositing metallic soaps with the synthetic lubricating oils described above and are referred to herein as synthetic greases. These metal base synthetic greases may be further classified as lithium base synthetic grease, sodium base synthetic grease, calcium base synthetic grease, barium base synthetic grease, strontium base synthetic grease, aluminum base synthetic grease, etc. These greases are solid or semi-solid gels and, in general, are prepared by the addition to the synthetic lubricating oil of hydrocarbon-soluble metal soaps or salts of higher fatty acids as, for example, lithium stearate, calcium stearate, aluminum naphthenate, etc. The grease also may contain thickening agents such as silica, carbon black, metal oxides, phthalocyanines, polyacrylates, talc, bentone and organo-treated clays, etc. Alkylureas, arylureas, p-tolyl and p-chlorophenylurea derivatives of bitolylendiisocyanate, pferidines, N-n-octadecylterephthalomate and other organic thickeners are used. Another type of grease is prepared from oxidized petroleum wax, to which the saponifiable base is combined with the proper amount of the desired saponifying agent, and the resultant mixture processed to produce a grease. Other types of greases in which the features of the present invention are used include whale grease, wool grease, etc., and those made from inedible fats, tallow, butcher's waste, etc., as well as petroleum grease consisting primarily of petroleum or grease prepared by compositing metal soap or salt of higher fatty acid with petroleum lubricating oil.

It is general practice to incorporate an inhibitor in lubricants in order to improve the stability thereof. Because of the severe requirements imposed upon the synthetic lubricants, research continues to search for better inhibitors in order to further improve the lubricants and permit their use for longer periods of time in present applications, as well as to permit their use under even more severe conditions as, for example, in the engines of the future which are being developed to operate at peak efficiency at high altitudes. It is important that the lubricant is stable, retains its lubricity properties, does not undergo deposit formation, retains its desirable viscosity, etc. and, in many applications it is important that the inhibitor serves to retard and/or prevent corrosion of the metal surfaces with which the lubricant comes into contact. Generally at least a small amount of water is present, either being formed during combustion and/or entrained in the fuel supplied to the engine. The combination of water and corrosive constituents cause corrosion of the metal. Accordingly, the inhibitor serves an important function in also retarding and/or preventing such corrosion.

In addition to meeting the chemical and physical requirements hereinbefore described, the inhibitor must be of sufficiently low cost to be economically acceptable. In other words, regardless of how effective an inhibitor is, if it cannot be marketed at a reasonable price, it will not be accepted in the industry because of economic reasons. Applicant has made a detailed research investigation of extensive classes of chemical compounds which might

meet inhibitor requirements and still be marketed at a reasonable cost. As a result of this extensive investigation, applicant has found that certain diaminodiphenyl propane compounds meet these requirements provided that the diaminodiphenyl propanes themselves are selected with certain important requirements. These compounds offer advantages over the previously used metallic type inhibitors as, for example, zinc dialkyldithiophosphate or other organo-metallic compounds, because the diaminodiphenyl propanes are ashless in nature and do not introduce metallic components which may contribute to serious difficulties in engine performance such as preignition, rumble, spark plug fouling, combustion chamber deposits, etc. This problem becomes more severe as the compression ratios of engines are raised, with a parallel increase in temperature of the crankcase oil.

As hereinbefore set forth, applicant has found that certain diaminodiphenyl propane compounds, meeting the important requirements to be hereinafter set forth in detail, appear to be particularly desirable for use in the stabilization of lubricants. The use of diaminodiphenyl compounds has been proposed heretofore for use as an additive in lubricating oil and other substrates. However, the teachings of the prior art to the use of such compounds are vague and indefinite and include, on an equivalent basis, compounds having a diaminodiphenyl configuration connected by alkane groups, nitrogens, oxygens, phosphorus, aluminum, boron, antimony, sulfur, etc. In addition, the broad and vague teachings of the prior art include compounds in which these bridging groups and/or the phenyl nuclei may be substituted by aliphatic, aryl, heterocyclic, halogen or other groups. All of these are placed on an equivalent basis in the prior art teachings and require an extensive investigation, study and analysis in order to determine whether any of these classes of compounds would be suitable for use at the severe conditions required of the lubricants heretofore described. In general these prior art teachings go back many years and certainly before the development of the modern engines as, for example, turbo jet engines, turbo props, gas turbines, free piston turbines, etc. Accordingly, the old prior art was not faced with the problems entailed in the more severe requirements of modern day lubricants and were not directed towards the solution of these problems.

As a result of an extensive investigation, applicant has found that certain of the diaminodiphenyl compounds will meet these requirements, provided that they, in turn, meet other important requirements. For example, applicant has concluded that the diaminodiphenyl compounds having metallic constituents are undesired because of the possible adverse effect on engine performance as hereinbefore set forth. Applicant has ruled out the diaminodiphenyl sulfides because of the possible undesirable corrosion effect due to the use of inhibitors containing sulfur. Also, as hereinbefore set forth, it is important that the inhibitor compound is sufficiently low in cost to be economically acceptable and this in turn has ruled out the diaminodiphenyl ethers because they are more expensive to manufacture. Applicant has concluded that the diaminodiphenyl propanes appear to best meet the requirements hereinbefore set forth and furthermore that only those having the amino groups in the 4,4' positions should be used. 4,4'-diaminodiphenyl propane may be prepared at a lower cost than other diaminodiphenyl propanes in which the amino groups are arranged in different positions on the phenyl nuclei, and accordingly offers a less expensive source for preparing the desired inhibitors.

From the above discussion, it will be seen that applicant has concluded that the 4,4'-diaminodiphenyl propanes appear to meet the desired requirements. However, as further investigation by applicant has shown, the diaminodiphenyl propanes themselves also must meet certain important requirements in order to impart the desired potency to the inhibitor. Accordingly, applicant has discovered, and now is claiming as his invention, the use in lubricants of a diaminodiphenyl propane meeting all of the following requirements:

(1) The diaminodiphenyl propane must be 4,4'-diaminodiphenyl propane and must contain a substituent attached to each nitrogen atom.

(2) The substituent attached to each nitrogen atom must be selected from secondary alkyl and cyclohexyl groups.

(3) The phenyl nuclei must not contain a hydrocarbon or halogen substituent in a position ortho to the nitrogen atoms.

As hereinbefore set forth, each of the specific requirements enumerated above are essential, as will be shown by the examples appended to the present specifications. The inhibitor compounds meeting these requirements are effective inhibitors and may be manufactured at a reasonable cost, thereby offering to the industry an improved inhibitor which may be incorporated into lubricants for use under the severe conditions of modern technology.

In one embodiment the present invention relates to a method of stabilizing a lubricant which comprises incorporating therein a stabilizing concentration of an inhibitor selected from the group consisting of 4,4'-di-(sec-alkylamino)-diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane.

In a specific embodiment the present invention relates to a method of stabilizing lubricating oil and preventing corrosion of metal surfaces contacting said lubricating oil which comprises incorporating in said lubricating oil an inhibitor having antioxidant and corrosion inhibiting properties, said inhibitor being selected from the group consisting of 4,4'-di-(sec-alkylamino)-diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane, said inhibitor being devoid of alkyl and halogen substituents in the positions ortho to the nitrogen atoms.

In another embodiment the present invention relates to a lubricant containing an inhibitor as herein set forth.

Of the 4,4'-di-(sec-alkylamino)-diphenyl propanes, particularly preferred inhibitors comprise 4,4'-di-(isopropylamino)-diphenyl propane and 4,4'-di-(sec-butylamino)-diphenyl propane. In general the alkyl groups each contain from 3 to 12 carbon atoms, preferably 3 to 8 carbon atoms and more particularly 3 to 6 carbon atoms. Additional illustrative compounds in this embodiment include 4,4'-di-(sec-amylamino)-diphenyl propane, 4,4'-di-(sec-hexylamino)-diphenyl propane, 4,4'-di-(sec-heptylamino)-diphenyl propane, 4,4'-di-(sec-octylamino)-diphenyl propane, 4,4'-di-(sec-nonylamino)-diphenyl propane, 4,4'-di-(sec-decylamino)-diphenyl propane, 4,4'-di-(sec-undecylamino)-diphenyl propane and 4,4'-di-(sec-dodecylamino)-diphenyl propane. In another embodiment the inhibitor is 4,4'-di-(cyclohexylamino)-diphenyl propane.

As hereinbefore set forth, these inhibitor compounds must not contain an alkyl or halogen substituent in the positions ortho to the nitrogen atoms. This will be illustrated in the accompanying examples in which it will be shown that the substitution of methyl groups or chloro groups in the positions ortho to the nitrogen atoms destroys the effectiveness of these compounds for the intended purpose.

The inhibitors for use in the present invention may be prepared in any suitable manner. Diaminodiphenyl propane may be purchased in the open market or it may be prepared by the reaction of acetone with an excess of aniline in an acid medium or by reacting acetone and aniline first in a neutral medium and subsequently rearranging the intermediate product thus formed by heating in the presence of an acid or an acid salt of aniline. The diaminodiphenyl propane then may be reductively alkylated with the desired ketone in the presence of a suitable catalyst to produce the desired inhibitor.

Any suitable catalyst may be used in the reductive

alkylation including those containing platinum, palladium, cobalt, nickel, molybdenum, etc. Another catalyst used for this reaction is a mixture of the oxides of chromium, copper and barium. In general the reaction is effected at an elevated temperature of from about 200° to about 500° F. and a hydrogen pressure of from about 50 to about 2000 pounds per square inch or more. For example, 4,4'-di-(sec-butylamino)-diphenyl propane is prepared by the reductive alkylation of 4,4'-diaminodiphenyl propane with methylethyl ketone. When the isopropyl derivative is desired, acetone is used as the alkylating agent. 4,4'-di-(1-methylheptylamino)-diphenyl propane is prepared by the reductive alkylation of 4,4'-diaminodiphenyl propane with methylhexyl ketone. 4,4'-di-(1-ethyl-3-methylpentylamino)-diphenyl propane is prepared by the reductive alkylation of 4,4'-diaminodiphenyl propane with ethylamyl ketone.

In another method, the inhibitor is prepared by the reaction of N-sec-alkylaniline or N-cyclohexylaniline with acetone in the presence of an acid catalyst. For example, 2 moles of N-sec-butylaniline and one mole of acetone are reacted in the presence of concentrated hydrochloric acid at a temperature of about 300° F. The desired 4,4'-di-(sec-butylamino)-diphenyl propane is recovered from the reaction products. It is understood that these inhibitors may be prepared in any suitable manner.

The inhibitor will be used as an additive in the lubricant in a small but sufficient concentration to obtain the desired stabilization. In general this concentration will be within the range of from about 0.001% to about 5% and preferably of from about 0.1% to about 3% by weight of the lubricant. The inhibitor is added to the lubricant in any suitable manner and preferably with intimate mixing in order to obtain uniform distribution of the inhibitor in the lubricant. In some cases the inhibitor may be added to the lubricant during the manufacture thereof as, for example, when used in grease the inhibitor may be added to one or more of the components of the grease before final compositing thereof. When desired, the inhibitor may be prepared as a solution in a suitable solvent including, for example, aromatic hydrocarbons such as benzene, toluene, xylene, ethylbenzene, cumene, decalin, etc., or mixtures such as naphtha, kerosene, lube oil, etc.

It is understood that the inhibitor may be used along with other additives incorporated in the lubricant. For example, a metal deactivator, dye, viscosity index improver, pour point depressant, antifoaming additive, lubricity and extreme pressure additive, antiscuffing additive, detergent, etc., may be incorporated in the lubricant. When desired, the inhibitor of the present invention may be prepared as a mixture with one or more of these other additives and incorporated in this manner in the lubricant.

The following examples are introduced to illustrate further the novelty and utility of the present invention but not with the intention of unduly limiting the same.

EXAMPLE I

As hereinbefore set forth, the inhibitor for use in the present invention must (1) contain a substituent attached to each of the nitrogen atoms, (2) the substituents must be secondary alkyl or cyclohexyl groups, and (3) the compound must not contain an alkyl or halogen substituent in the positions ortho to the nitrogen atoms. The criticality of these limitations is illustrated in the present example which compares the results when using (1) unsubstituted 4,4'-diaminodiphenyl propane with (2) the 4,4'-sec-alkylamino diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane, as well as a comparison of the compounds of group (2) immediately above with corresponding compounds also containing methyl or chloro groups in the positions ortho to the nitrogen atoms.

The runs of this example were made in a synthetic lubricating oil, more particularly dioctyl sebacate, marketed under the trade name of "Plexol 201." The oil was evaluated in accordance with an oxygen stability test in which a 100 cc. sample of the lubricating oil is placed in a bath maintained at 400° F. and air is blown therethrough at a rate of 5 liters of air per hour. The sample of lubricating oil is examined periodically and the time to reach an acid number of 5 is reported. It is apparent that the longer the time required to reach an acid number of 5 the more stable is the sample of lubricating oil. In other words, it takes longer for the more stable oil to deteriorate.

The data are reported in the following table and include results obtained with the sample of the lubricating oil without additive and, as hereinbefore set forth, samples containing inhibitors comprised within the present invention and also those outside of the scope of the present invention. When employed, the additive in all cases was used in a concentration of 0.0033 mole per 100 cc. of lubricating oil. This is approximately 1% by weight thereof.

Table I

Run No.	Additive	Hours to Acid No. of 5
1	None	9
2	4,4'-diaminodiphenyl propane	11
3	4,4'-di-(n-propylamino)-diaminodiphenyl propane.	14
4	4,4'-di-(isopropylamino)-diaminodiphenyl propane.	59
5	4,4'-di-(n-butylamino)-diphenyl propane	11
6	4,4'-di-(sec-butylamino)-diphenyl propane	37
7	4,4'-di-(n-hexylamino)-diphenyl propane	16
8	4,4'-di-(cyclohexylamino)-diphenyl propane	44
9	4,4'-di-(sec-butylamino)-3,3'-di-methyl diphenyl propane.	9
10	4,4'-di-(sec-butylamino)-3,3'-di-chloro-diphenyl propane.	10

As hereinbefore set forth, the diaminodiphenyl propane must contain a substituent attached to each of the nitrogen atoms. This is illustrated by comparing run 2 with runs 4, 6 and 8. It will be noted that the compound used in run 1 was unsubstituted, whereas the compounds used in runs 4, 6 and 8 contained a substituent attached to each of the nitrogen atoms. Also, as hereinbefore set forth, the substituent must be selected from sec-alkyl or cyclohexyl groups. This is illustrated by comparing run 3 with run 4 wherein the diisopropyl derivative was very effective in stabilizing the lubricant, but the corresponding di-n-propyl derivative was of substantially no potency. This also is illustrated by comparing runs 5 and 6 in which the corresponding butyl derivatives were evaluated. Similarly, a comparison of runs 7 and 8 shows that the di-n-hexyl derivative was of only mild potency in contrast to the high potency of the dicyclohexyl derivative.

Also as hereinbefore set forth, the inhibitor must not contain methyl or chloro substituents in the positions ortho to the nitrogen atoms. This is illustrated by comparing runs 9 and 10 with run 6.

EXAMPLE II

The data reported in this example were obtained in a Lauson engine operated at high oil temperature (280° F.) and low jacket temperature (210° F.). Each test was conducted for 115 hours. A typical commercial paraffinic-solvent extracted lubricating oil was used. It has been found that the Lauson engine results correlate with the results obtained in the Chevrolet L–4 test and accordingly properly evaluate the different additives.

Each of the additives, when employed, was used in a concentration of 0.5% by weight of the lubricating oil. For comparative purposes, a sample of the oil without additive was run and the results are included in the following table. Also included in the table is a run using 4,4'-di-(sec-butylamino)-diphenyl methane. This run is included in order to show a comparison with the corresponding methane compound.

Table II

Run No.	11	12	13	14
Additive	None	4,4'-di-(sec-butylamino)-diphenyl methane	4,4'-di-(sec-butylamino)-diphenyl propane	4,4'-di-(isopropylamino)-diphenyl propane
Bearing weight loss, grams	2.0921	0.0018	0.0134	0.0062
Piston ratings [1]	8	2	3.5	4.5
Sludge:				
In crankcase [2]	10	10	10	10
In sump [2]	10	1.9	5.1	5.5
Used Oil Analyses:				
Neutralization No., mg. KOH/g	10.78	0.15	0.23	0.21
Saponification No.	25.9	0.29	1.32	1.51
Pentane insolubles, wt. percent	5.16	0.10	0.47	0.298
Viscosity:				
S.S.U. at 100° F.	742	368	371	362
S.S.U. at 210° F.	74.7	56.1	56.5	56.7

[1] 10=clean, 0—dirty.
[2] 10=no sludge.

From a comparison of the above data, it will be noted that, while 4,4'-di-(sec-butylamino)-diphenyl methane is a very effective inhibitor, it has a slight tendency towards sludge formation as indicated by the 1.9 rating of the sump sludge. In comparison, the coresponding propane derivative had a sump sludge rating of 5.1, thus indicating considerably less sludge formation. Similarly, 4,4'-di-(isopropylamino)-diphenyl propane had a sump sludge rating of 5.5. Also it will be noted that both of these inhibitors (runs 13 and 14) were very effective in stabilizing the lubricating oil.

EXAMPLE III

The synthetic lubricant of this example is trimethylol propane triester available commercially from the Celanese Corporation of America under the trade name of "Cellutherm." These esters have an average molecular weight of about 460 and therefore correspond to an average acid group in each of the esters of 7 carbon atoms and probably comprises a mixture of acids such as caproic, heptylic and caprylic acids. The acids used in forming the ester are saturated monocarboxylic acids.

The procedure used in evaluataing inhibitors in this synthetic lubricant is to store a sample thereof at 425° F. for 48 hours while passing air thereover. Periodically a portion of each sample is removed and measured for viscosity and acid number. Overhead products removed with the air from the system are collected and analyzed for acidity. The acidity is calculated as mg. of KOH.

4,4'-di-(sec-butylamino)-diphenyl propane was evaluated in the above manner. The sample of lubricant containing 2% by weight of this inhibitor had a viscosity of 17.06 centistokes and an acid number of 0.35 after 35 hours of exposure in this manner. The final acidity (as mg. of KOH) of the decomposition products was only 2.8. This is considerably below that obtained with a number of different additives evaluated in this lubricant. For example, 4,4'-di-(sec-butylamino)-diphenyl methane, when similarly evaluated, imparted to the sample of lubricant a viscosity of 17.66 and an acid number of 0.62 after 30 hours. A competitive inhibitor when so evaluated imparted to the lubricant a viscosity of 31.29 centistokes and an acid number of 3.97 after 25 hours and a final overhead acidity of 38.4. It is readily seen that the 4,4'-di-(sec-butylamino)-diphenylpropane was considerably more effective in this lubricant.

EXAMPLE IV

The lubricant used in this example is a synthetic lubricating oil available commercially and is believed to be neopentyl glycol esters. This lubricant was evaluated in substantially the same manner as described in Example I, the inhibitors being used in a concentration of 0.0033 mole per 100 cc. of the lubricant.

A control sample (not containing an additive) of the lubricant reached an acid number of 5 in 9 hours. The sample containing 4,4'-di-(isopropylamino)-diphenyl propane did not reach an acid number of 5 until 89 hours. The sample containing 4,4'-di-(sec-butylamino)-diphenyl propane did not reach an acid number of 5 until after 80 hours. In both cases the percent isooctane insolubles at 48 hours was 0.6% and the percent viscosity change at 48 hours was 6.9% and 6.7%, respectively, with the samples containing the inhibitors.

EXAMPLE V

The grease used in this example is a lithium base grease and is prepared by the following method. Approximately 92% of a commercial Mid-Continent lubricating oil having an S.A.E. viscosity of 20 is mixed with approximately 8% by weight of lithium stearate. The mixture is heated to about 450° F. with constant agitation. Subsequently the grease is cooled while agitating to 320° F. and at this temperature the inhibitor in the proper concentration is added. Agitation is continued and the mixture is allowed to cool to about 250° F. and the grease then is further cooled slowly to room temperature.

The stability of the grease is tested according to ASTM D–942 method, in which method a sample of the grease is placed in a bomb and maintained at a temperature of 210° F. Oxygen is charged to the bomb and the time required for a drop of 5 pounds' pressure is taken as the induction period.

The inhibitor used in this example is 4,4'-di-(sec-octylamino)-diphenyl propane. It is incorporated in a concentration of 1% by weight in the grease. The sample of grease containing inhibitor and the sample of grease not containing the inhibitor are evaluated in the manner set forth above. The sample of grease without inhibitor reaches the induction period in 9.5 hours. The sample of grease containing the inhibitor will not reach the induction period for over 100 hours.

EXAMPLE VI

4,4'-di-(sec-octylamino)-diphenyl propane is used as an inhibitor in motor lubricating oil of petroleum origin. The inhibitor is incorporated in a concentration of 0.75% by weight in the lubricating oil and serves to reduce bearing wieght loss, used oil neutralization and saponification numbers, and to reduce the viscosity of the used oil.

I claim as my invention:

1. Lubricant selected from the group consisting of oil of lubricating viscosity and grease consisting essentially of an oil of lubricating viscosity and an amount of thickener sufficient to thicken said oil to a grease, said lubricant containing from about 0.001% to about 5%

by weight of a compound selected from the group consisting of 4,4'-di-(sec-alkylamino)-diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane.

2. Lubricating oil containing from about 0.001% to about 5% by weight of a compound selected from the group consisting of 4,4'-di-(sec-alkylamino)-diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane.

3. Lubricating oil containing from about 0.001% to about 5% by weight of 4,4'-di-(isopropylamino)-diphenyl propane.

4. Lubricating oil containing from about 0.001% to about 5% by weight of 4,4'-di-(sec-butylamino)-diphenyl propane.

5. Lubricating oil containing from about 0.001% to about 5% by weight of 4,4'-di-(cyclohexylamino)-diphenyl propane.

6. Grease consisting essentially of an oil of lubricating viscosity and an amount of thickener sufficient to thicken said oil to a grease and containing from about 0.001% to about 5% by weight of a compound selected from the group consisting of 4,4'-di-(sec-alkylamino)-diphenyl propane and 4,4'-di-(cyclohexylamino)-diphenyl propane.

7. Grease consisting essentially of an oil of lubricating viscosity and an amount of thickener sufficient to thicken said oil to a grease and containing from about 0.001% to about 5% by weight of 4,4'-di-(isopropylamino)-diphenyl propane.

8. Grease consisting essentially of an oil of lubricating viscosity and an amount of thickener sufficient to thicken said oil to a grease and containing from about 0.001% to about 5% by weight of 4,4'-di-(sec-butylamino)-diphenyl propane.

9. Grease consisting essentially of an oil of lubricating viscosity and an amount of thickener sufficient to thicken said oil to a grease and containing from about 0.001% to about 5% by weight of 4,4'-di-(cyclohexylamino)-diphenyl propane.

10. Dioctyl sebacate containing from about 0.001% to about 5% by weight of 4,4'-di-(isopropylamino)-diphenyl propane.

11. Dioctyl sebacate containing from about 0.001% to about 5% by weight of 4,4'-di-(sec-butylamino)-diphenyl propane.

12. Dioctyl sebacate containing from about 0.001% to about 5% by weight of 4,4'-di-(cyclohexylamino)-diphenyl propane.

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