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2,231,248

LUBRICANT

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7 Claims. (Cl. 252—52)

This invention relates to the lubrication of sliding metal surfaces.

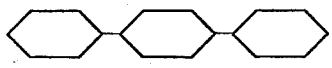
It has been found that organic compounds of the type $R_1—R_2—R_3 \ldots R_n$, in which R_1, R_2, $R_3 \ldots R_n$ represent substituted or non-substituted cyclic radicles coupled mutually with at most two other radicles either indirectly—preferably by means of aliphatic radicles or inorganic atoms or groups of atoms—, or directly—but only by means of one nuclear atom—and in which n is at least 3, are excellent lubricants and are also very suitable for improving lubricating properties of the known lubricating oils and lubricating greases. This is especially the case when into the nuclei or into the aliphatic radicles, or into the inorganic groups of atoms, those atoms, groups of atoms or radicles have been introduced which have the property of being able to adhere physically or chemically to the metal surface to be lubricated. Such adhesive groups or atoms are, for example, S, P, halogen, OH, COOH, CHO, CH_3, CH, NH, NC and NO_2.

It has been found that, especially at high temperatures, the above substances have a low coefficient of friction; they further have the valuable property of checking corrosion of the metal parts to be lubricated. Many of these substances are also valuable high-pressure lubricants, i. e. they are suitable—either as such or as additions to known lubricants—for lubrication at high pressures, elevated temperatures and great speeds.

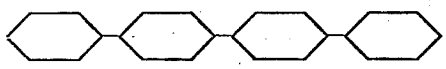
The rings may be either isocarbocyclic or heterocyclic, either aromatic or hydroaromatic.

The majority of these substances are solid at ordinary temperature. They may be used as solid lubricants as such, or mixed with known lubricating greases. When added as dopes to lubricating oil, they should be suspended therein in finely divided form, whilst it may be desirable to add emulsifiers or stabilizers, which promotes suspension and prevents settling of the suspended substances. They may also be added to the lubricating oil while dissolved in a suitable solvent, e. g. methyl cyclohexanol oxalate or dimethyl cyclohexanol adipate.

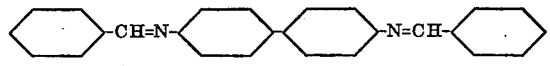
Examples of the substances in question are:



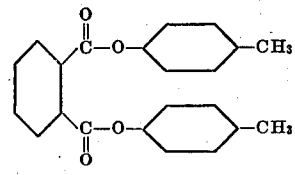
Diphenyl benzene



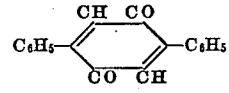
Bis-(diphenyl)



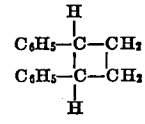
Di-benzilidene benzidine



Sextol phthalate



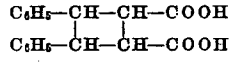
Di-phenyl quinone



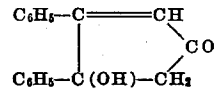
Di-phenyl tetramethylene

$C_6H_5—CH_2—C_6H_5—CH_2—C_6H_5$

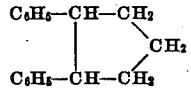
Di-benzyl benzene



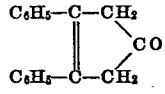
Truxillic acid



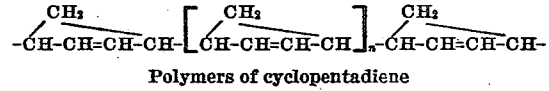
2.3.di-phenyl-3-oxy-5-keto-cyclopentene



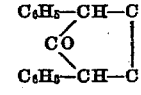
1.2.di-phenyl pentamethylene



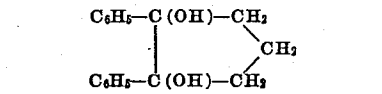
1.2.di-phenyl-4-keto-cyclopentene



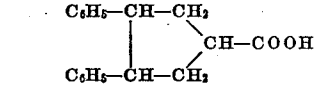
Polymers of cyclopentadiene



1.3 di-phenyl-2.4.5-tri-keto-pentamethylene



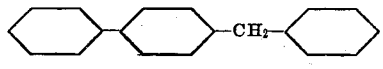
1.2.di-phenyl-1.2.dioxy-pentamethylene



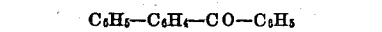
1.2.di-phenyl pentamethylene carboxylic acid



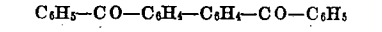
Di-benzoyl benzene



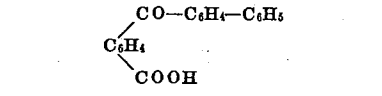
Benzyl diphenyl



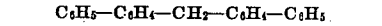
Phenyl benzophenone



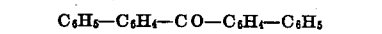
Di-benzoyl diphenyl



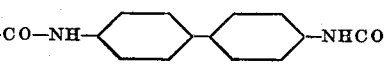
Phenylobenzoyl benzoic acid



Bis-(diphenyl) methane



Di-phenyl benzophenone



Di-benzoyl benzidine

The following experiments carried out with lubricants according to the invention give an idea of the results obtainable in respect of friction and wear at normal and at elevated temperatures when lubricating with the said substances. The friction was determined with a device and in the manner described in "Proceedings of the Royal Society of London, Series A, No. 883, vol. 154, pp. 640–656, May 1936."

The surface wear was investigated microscopically. The normal pressure between the surfaces amounted to 500 g. weight, whilst the sliding speed was about 80 cm/sec. (50 revolutions per minute). The diameter of the cylinder was 2 mm. The steel surfaces were ground flat on lead laps using 320 carborundum. They were cleaned with rouge and washed in strong caustic soda followed by water. They were then cleaned and dried with pure acetone. The lubricant was wiped over the surface so as to form a thin film.

I. Mineral Oil

(a) *Friction*

With a mineral oil the average coefficient of kinetic friction was 0.16. The surfaces ran noisily and unsteadily and there were violent fluctuations in the friction.

(b) *Surface wear*

A marked scoring wear and abrasion of the surfaces had occurred. Heavily scored parallel tracks of the slider could be clearly seen.

(c) *Effect of heating*

The steel surface with the oil film on it was heated to 250° C. for 30 minutes. The oil darkened and the friction became very unsteady. The wear and abrasion of the surfaces was increased.

II. Di-Benzylidene Benzidine

(1) 10% of di-benzylidene benzidine was dissolved in methyl cyclohexanol oxalate (a liquid).

(a) *Coefficient of friction*

The average coefficient of friction was 0.08.

(b) *Surface wear*

The surface wear was barely perceptible. There were no visible abrasion marks on the surface.

(2) 2% di-benzylidene benzidine was suspended in the same mineral oil as used in Experiment I.

(a) *Coefficient of friction*

Average coefficient of friction was 0.08. The surfaces ran steadily and quietly.

(b) *Surface wear*

Again the surface wear was barely visible under the microscope. The surface looked very similar to that of the preceding experiment.

(c) *Effect of heating*

After heating the surfaces continued to run quietly and there was a slight wearing of the surfaces. The surfaces were stained rather than worn. This wear was certainly very much less than that observed with the pure mineral oil.

III. Sextol Phthalate

(1) Pure Sextol phthalate.

(a) *Friction*

Average friction was 0.1 to 0.12.

(b) *Wear*

The surfaces ran steadily. Little or no wear was observed. After heating there was a slight wearing of the surfaces.

(2) 10% Sextol phthalate was mixed with the same mineral oil as used in Experiment I.

(a) *Friction*

Average coefficient of friction was 0.1

(b) *Wear*

Little or no wear was observed.

IV. Bis-Diphenyl

1% bis-diphenyl was suspended in the same mineral oil as used in Experiment I.

(a) *Friction*

Coefficient of friction was 0.09.

(b) *Wear*

Little or no wear was observed.

V. Diphenyl Benzene

1% diphenyl benzene was suspended in the same mineral oil as used in Experiment I.

(a) *Friction*

The average friction was 0.07. The surfaces ran quietly and steadily.

(b) *Wear*

Little or no wear was observed.

VI. Triphenyl Carbinol

5% triphenyl carbinol was dissolved in tricresyl phosphate.

(a) *Friction*

Average value of the friction was 0.08. The surfaces ran quietly.

(b) *Wear*

No wear was perceptible.

It will be seen that these substances used pure, dissolved in suitable solvents or dissolved or suspended in mineral oil, will diminish the friction and decrease the wear of sliding steel surfaces. They are also more resistant against high temperatures than is the mineral oil by itself.

These values for the coefficient of friction were obtained at a comparatively low sliding speed. At higher speeds the coefficient of friction given by these substances is also low. For example the friction obtained with a sliding speed of about 10 metres per sec. was as follows:

Lubricant	Average coefficient of friction	Effect on surface
About 1% dibenzylidene in mineral oil (as used in Experiment I)	0.06	Little effect.
About 1% diphenyl benzene in mineral oil (as used in Experiment I)	0.07	Do.
About 2% triphenyl carbinol in mineral oil (as used in Experiment I)	0.065	Do.
Pure mineral oil	0.14	Surface badly torn and scratched.

Some of these substances also have valuable properties in that they do not form carbon or sticky gums in a working engine to the same extent as a mineral oil, and thus do not give rise to ring-sticking, etc. For example, a crosshead engine, 600 R. P. M., was run for 16 hours with pure Sextol phthalate as lubricant. The amount of carbon on the piston crown at the end of the run was less than 0.01 g. The amount of deposit from a standard mineral oil under the same conditions was 0.11 g.

The local surface temperature at the sliding points of contact was considerably lower when using these substances (e. g. di-benzylidene benzidine) than in the case of mineral oil.

I claim:

1. An improved lubricant having a low coefficient of friction comprising an organic compound which comprises not less than 3 serially arranged single rings, each of said rings being coupled mutually with not more than 2 other rings, at least 2 of said rings being aromatic rings which are connected with each other through a keto linkage.

2. An improved lubricant having a low coefficient of friction comprising an organic liquid suitable for lubrication of metal surfaces and an organic compound which comprises not less than 3 serially arranged single rings, each of said rings being coupled mutually with not more than 2 other rings, at least 2 of said rings being aromatic rings which are connected with each other through a keto linkage.

3. The lubricant of claim 2 in which the organic compound is stably suspended in said liquid.

4. An improved lubricant having a low coefficient of friction comprising a mineral lubricating oil and an organic compound which comprises not less than 3 serially arranged single rings, each of said rings being coupled mutually with not more than 2 other rings, at least 2 of said rings being aromatic rings which are connected with each other through a keto linkage.

5. An improved lubricant having a low coefficient of friction comprising a mineral lubricating oil and phenyl benzophenone.

6. An improved lubricant having a low coefficient of friction comprising a mineral lubricating oil and dibenzoyl diphenyl.

7. An improved lubricant having a low coefficient of friction comprising a mineral lubricating oil and phenyl benzoyl benzoic acid.

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