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SUBSTITUTED DIPHENYL

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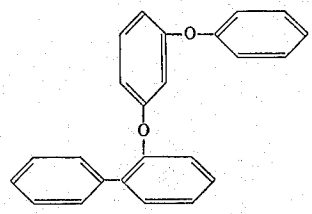
This invention relates to a novel substituted diphenyl compound useful as a heat- and oxidation-stable lubricant and to compositions containing the compound.

In general, several promising types of lubricants which are stable under the elevated temperatures of military and commercial aircraft turbine engines have been found. One important class comprises diesters of alkane dicarboxylic acids; this type of compound is typified by di-2-ethylhexyl sebacate. Another is the polyphenyl ethers which are represented by such compounds as m-bis-(phenoxy)benzene. While both of these types of compounds have worthwhile lubricating properties, both have drawbacks which interfere with their extended use. The diesters are generally too volatile to be useful at temperatures above about 500° F. and begin to decompose at around 600° F. The polyphenyl ethers, while stable and relatively non-volatile at these temperatures, have melting points so high that they are solids at or above room temperature.

It is an object of this invention to provide a novel diphenyl compound having unexpectedly superior lubricating properties coupled with an unusually low melting point. Another object of the invention is the provision of lubricant compositions containing such a diphenyl compound. Still another object of the invention is the provision of novel low-melting lubricant compositions comprising the novel diphenyl compound of the invention and polyphenyl ethers. Other objects will be apparent from the following discussion of the invention.

These objects are accomplished in the invention by o-(m-phenoxyphenoxy)diphenyl. This compound has the structure



and has a molecular weight of 306 and a melting point of 50–51° C.

To illustrate the superior high-temperature lubricating properties of the compound of the invention, the results of measurements made on this and comparable lubricants are presented in Table I below. The materials selected were those having viscosities on the order of about one centistoke at 490° F., well within the range regarded as suitable for aircraft gas turbine lubricants.

Table I

Compound	M.P., ° C.	Viscosity at 490° F., cs.	4-ball wear scar diameter [1]
Beta, beta'-binaphthyl	186	0.912	5.20
o,o'-Diphenyl-diphenyl	115–8	0.970	4.91
o,o'-Diphenyl-diphenyl oxide	118	0.909	3.37
o,p'-Diphenyl-diphenyl oxide	99–100	1.001	3.69
o-(m-Phenoxy-phenoxy) diphenyl	50–51	0.925	0.87

[1] 600+r.p.m., 500° F., 50 kg. load, one hour.

It will be seen from these data that of the compounds tested the o-(m-phenoxy-phenoxy)diphenyl had the lowest melting point coupled with the best lubricating properties at high temperature. Indeed, an important feature of this invention is the unexpectedly low melting point and excellent lubricity of the compound compared to other compounds having four phenyl rings.

The compound of the invention is also characterized by oxidation resistance superior to that of the low-melting ester lubricants. In Table II is set forth the results of an oxidation test in which the novel diphenyl was run in comparison with an inhibited Hercoflex 600 lubricant.

Table II

Lubricant	Hours to Absorb 1 Millimole O_2/g. Oil (Copper Catalyst) at 400° F.
Inhibited Hercoflex 600 (mixed esters of pentearythritol)	19
o-(m-Phenoxy-phenoxy)diphenyl	122

Because of these desirable properties, the novel diphenyl described may readily be employed both as a lubricant and in admixture with other lubricants. For example, when it is added to another higher melting lubricant, the resulting mixture is characterized by a melting point considerably lower than that of the higher melting component.

The use of such mixtures for melting point reduction has proved of particular interest with diphenyl diphenyl oxides. These compounds are those diphenyl oxides having a phenyl substituent on each of the phenyl rings attached to the oxyradical. Of these, the preferred compositions are those wherein the o-(m-phenoxy-phenoxy) diphenyl makes up at least about two-third of the total composition on a weight basis. In Table III are presented the minimum melting points of binary systems containing the novel compound of the invention with the diphenyl oxides noted.

Table III

Component A (Melting Point)	Component B (Melting Point)	Percent w. A/B	M.P., ° C.
o,o'-Diphenyl diphenyl oxide (120° C.).	o,p'-diphenyl diphenyl oxide (98° C.).	30/70	72
o,o'-diphenyl diphenyl oxide (120° C.).	o-(m-phenoxy-phenoxy) diphenyl (50° C.).	30/70	41
o,p'-diphenyl diphenyl oxide (98° C.).	o-(m-phenoxy-phenoxy) diphenyl (50° C.).	25/75	38

It will be seen from these data that the melting points of the mixtures including the compound of the invention are considerably lower than that of the higher melting component and are about 10° C. lower than the melting point of the lower melting component.

To prepare the o-(m-phenoxy-phenoxy)diphenyl, a mixture of m-methoxyphenyl, potassium hydroxide and bromobenzene was heated in the presence of copper powder. The crude reaction mixture was extracted with benzene and the benzene layer was washed with water and then fractionated under reduced pressure to yield m-methoxydiphenyl ether in 80% yield.

The m-methoxy-diphenyl ether, a liquid boiling over the range 155–167° C./13 mm., was heated in refluxing glacial acetic acid containing 48% hydrobromic acid for 48 hours. The solution was then extracted with benzene and the benzene solution washed with water and vacuum fractionated. A yield of 80% m-hydroxydiphenyl ether

was thus obtained as a light yellow oil boiling over the range of 113–155° C./0.3 mm. This compound was melted and converted to the sodium salt by reaction with metallic sodium. The sodium salt was then reacted with 2-iodiobiphenyl in the presence of a copper catalyst at atmospheric pressure and 225–315° C.

The product o-(m-phenoxy-phenoxy)diphenyl was isolated from the reaction mixture by benzene extraction followed by vacuum distillation. It was recrystallized from a hexane/isopropanol mixture to give a 34% yield of the compound having a melting point of 50–51° C.

I claim as my invention:

o-(m-Phenoxy-phenoxy)diphenyl.

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