

UNITED STATES PATENT OFFICE

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LUBRICATING COMPOSITION

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6 Claims. (Cl. 252-48)

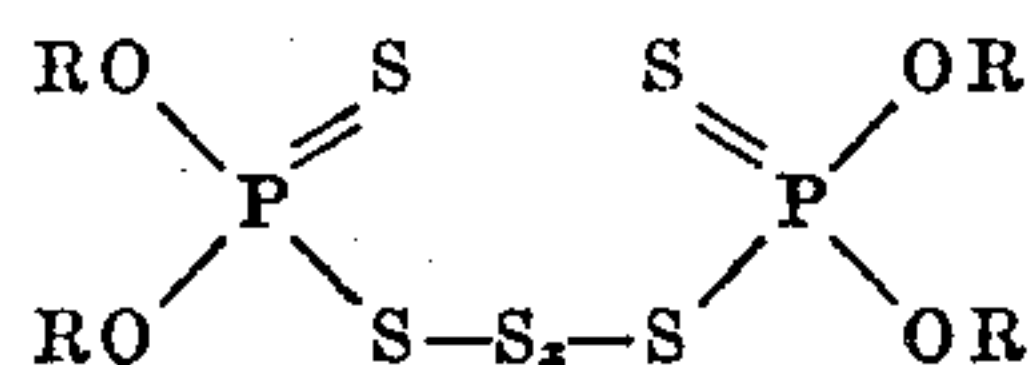
This invention relates to extreme pressure lubricating compositions, and more particularly to the use of dialkyl and diaryl dithiophosphoric acid derivatives as extreme pressure lubricant bases.

The standard lubricants for heavy duty service, for example in gear transmissions with high tooth pressures as in hypoid gears, are mostly hydrocarbon oils. These mineral oils when properly refined are very stable under heat but they are deficient in oiliness and in the strength of the oil film which is formed between metal surfaces in bearings or at other points where lubrication takes place. Insufficient film strength will result in metal to metal contact even when an adequate quantity of lubricant is supplied to the bearing and insufficient oiliness will prevent retention of an oil film in the bearing when for any reason the lubricant supply becomes insufficient. Thus, both deficient oiliness and deficient film strength result in metal to metal contact and consequently higher wear and rapid development of heat.

In the past various substances have been incorporated with extreme pressure lubricants in an attempt to solve the problem outlined above. Some of these substances have resulted in slightly increased oiliness and/or film strength; only a few have achieved commercial success and none of these has been entirely satisfactory due to still deficient oiliness properties and/or film strength.

I have found that reaction products of dialkyl and diaryl dithiophosphoric acids or their alkali metal or ammonium salts with chlorine compounds or oxidizers such as air capable of chemically removing hydrogen from a dithiophosphoric acid make excellent extreme pressure lubricant bases. The reaction products, which are the subject of Romieux and Ashley Reissue Patent No. 20,411, are preferably prepared as set out in that patent.

Dialkyl and diaryl dithiophosphate polysulfides having the following general formula are preferred:



in which R is alkyl or aryl and x is zero or a small whole number. The invention, however, is not intended to be limited to this specific embodiment.

Lubricating compositions containing small amounts of these dialkyl and diaryl dithiophosphoric acid derivatives form very tenacious oil

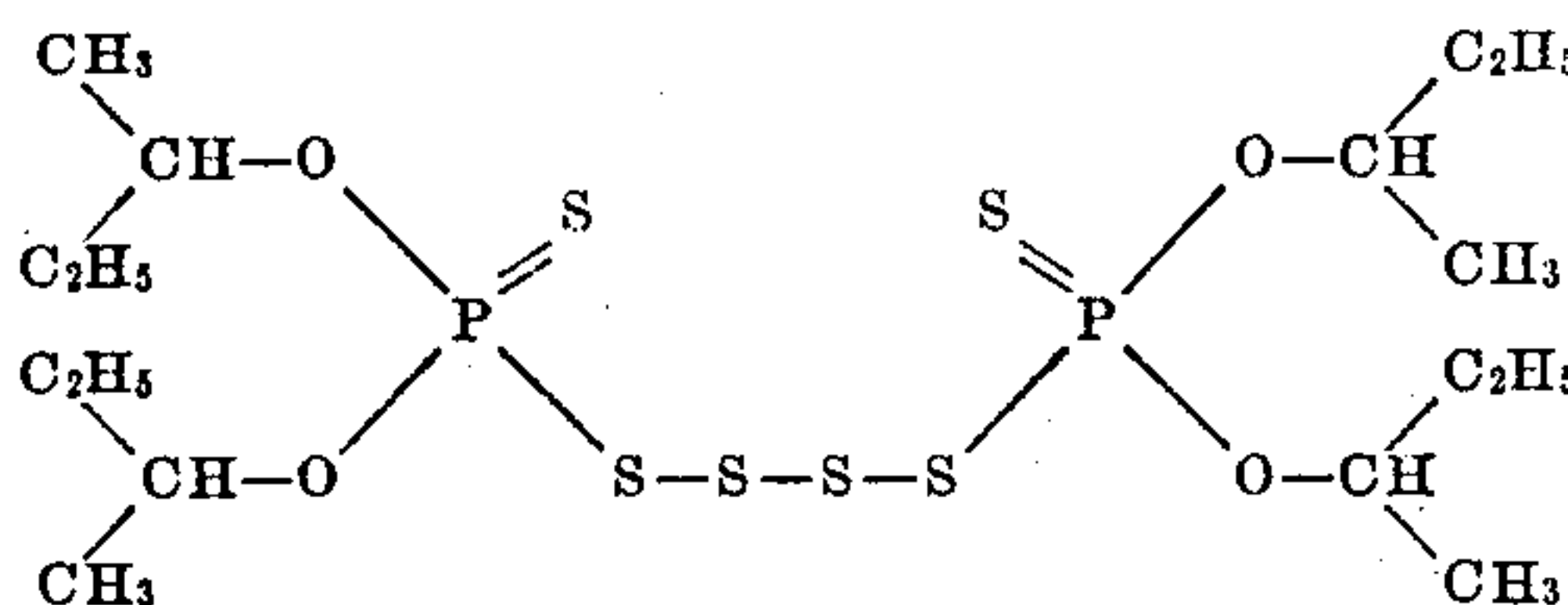
films on metal surfaces and, at the same time, have satisfactory oiliness properties. They are therefore superior extreme pressure lubricants for use in hypoid gears, particularly since the running temperature of hypoid gears rarely exceeds about 100° C. and therefore no corrosion problem arises due to decomposition of the lubricant base to form corrosive acids. Although the lubricating compositions of the present invention are best suited for use in hypoid gears, they are not limited to this application and may also be used in high compression ratio automobile engines and other internal combustion engines.

While the invention is not limited to lubricating compositions containing any definite amount or proportion of the dithiophosphoric acid derivatives, I have found that excellent lubricating results are obtained when about 10% lubricant base is used.

The following specific examples demonstrate the excellent results obtained by the use of the extreme pressure lubricating compositions of the present invention.

Example 1

10% of di-secondary-butyl dithiophosphate tetrasulfide having the following formula:

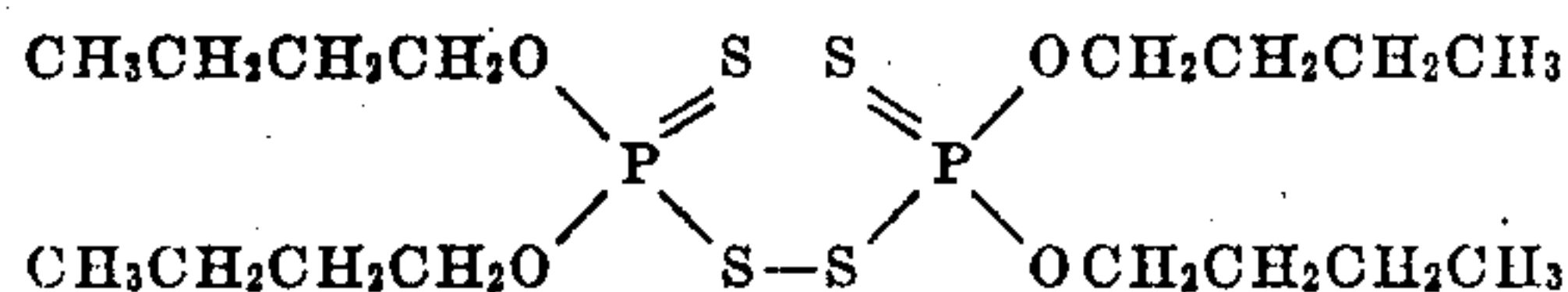


was tested on a S. A. E. machine. The lubricant carried the full load of the machine, i. e., 600 lbs., at a rubbing speed of 1000 R. P. M.

The di-secondary-butyl dithiophosphate tetrasulfide was prepared by reacting di-secondary-butyl dithiophosphoric acid with sulfur monochloride.

Example 2

A test similar to that of Example 1 was made of a lubricating composition containing 10% of di-n-butyl dithiophosphate disulfide having the following formula:



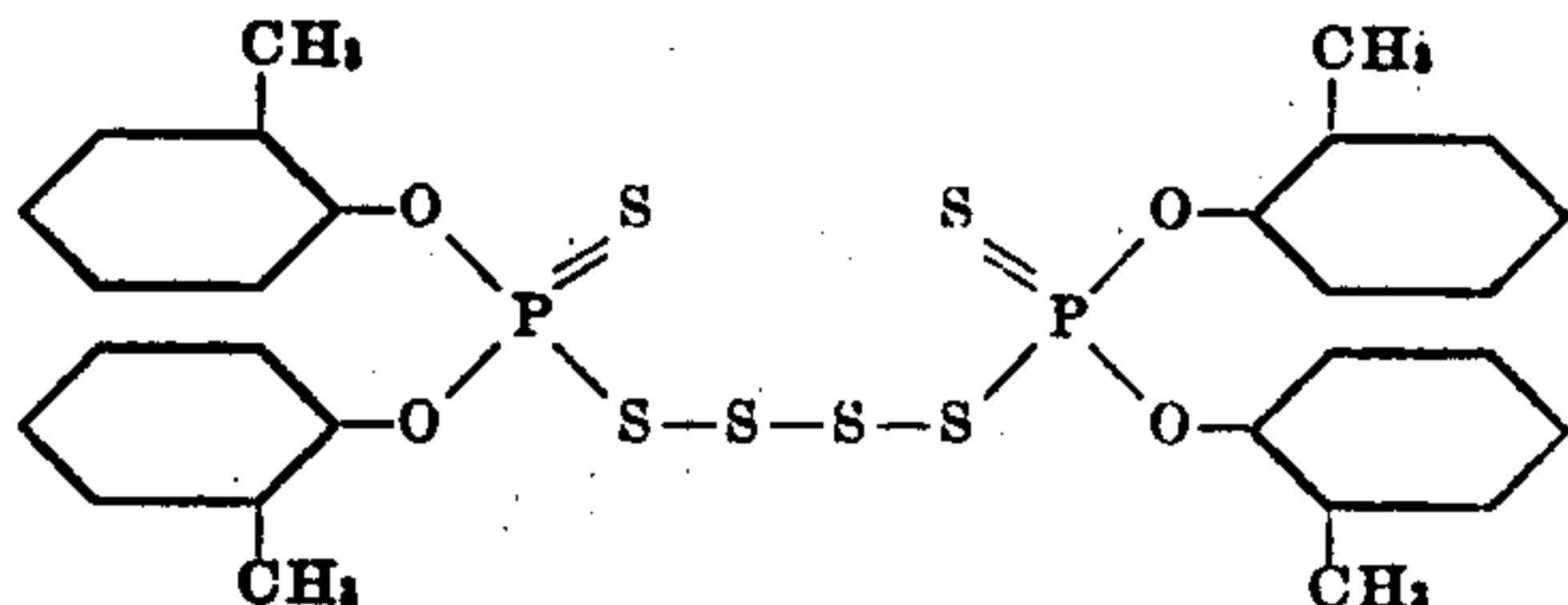
The lubricating composition carried the full load of 600 lbs. at a rubbing speed of 1000 R. P. M.

The di-n-butyl dithiophosphate disulfide was

prepared by reacting an ethylene chloride solution of di-n-butyl dithiophosphoric acid with chlorine.

Example 3

A test similar to that of Example 1 was made of a lubricating composition containing 10% of di-o-cresyl dithiophosphate tetrasulfide having the following formula:



The lubricating composition carried the full load of 600 lbs. at a rubbing speed of 1000 R. P. M.

The di-o-cresyl dithiophosphate tetrasulfide was prepared by reacting di-o-cresyl dithiophosphoric acid and sulfur monochloride in carbon disulfide solution.

The invention is of course not limited to the details of the foregoing examples. Dialkyl and diaryl dithiophosphoric acids and alkali metal and ammonium salts thereof may be used interchangeably in the preparation of the extreme pressure lubricant bases. These dithiophosphoric acids and salts may be reacted with sulfur dichloride, ethyl chlorcarbonate, aryl chlorides, phosgene, and the like, as well as with the chlorine and sulfur monochloride of the examples. The resulting polysulfides make substantially equally effective extreme pressure lubricant bases.

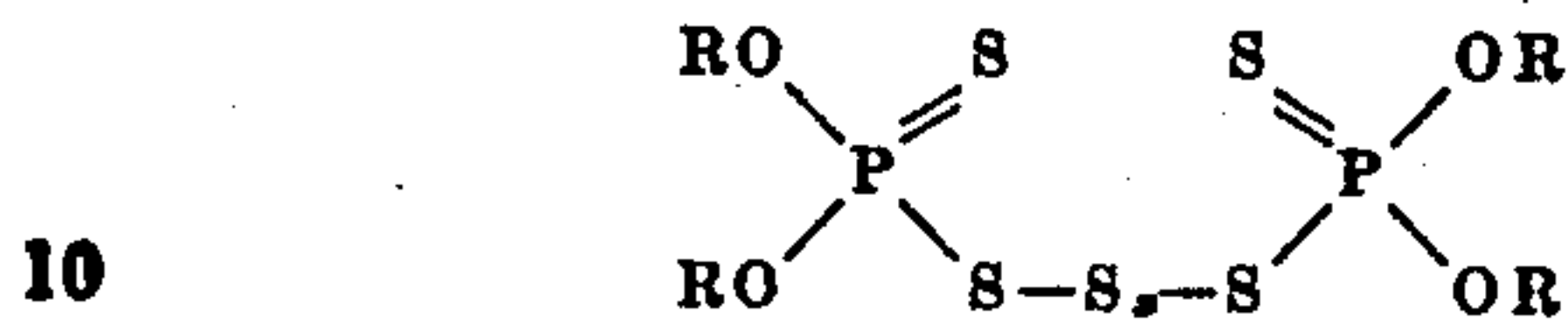
What I claim is:

1. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of the reaction product of a dithiophosphoric acid derivative and a chlorine containing compound capable of chemically removing hydrogen from a dithiophosphoric acid.

2. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of the reaction product of a member of the group consisting of dialkyl and diaryl dithiophosphoric acids and alkali metal and ammonium dialkyl

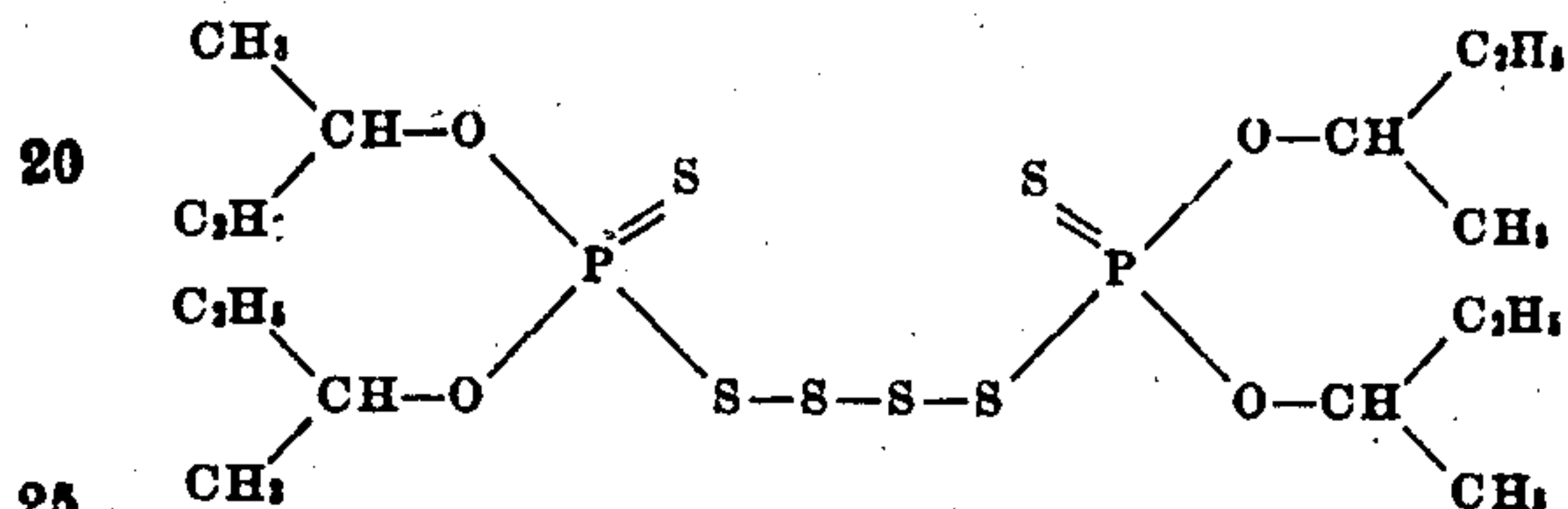
and diaryl dithiophosphates, and a chlorine containing compound capable of chemically removing hydrogen from a dithiophosphoric acid.

3. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of a compound having the following general formula:

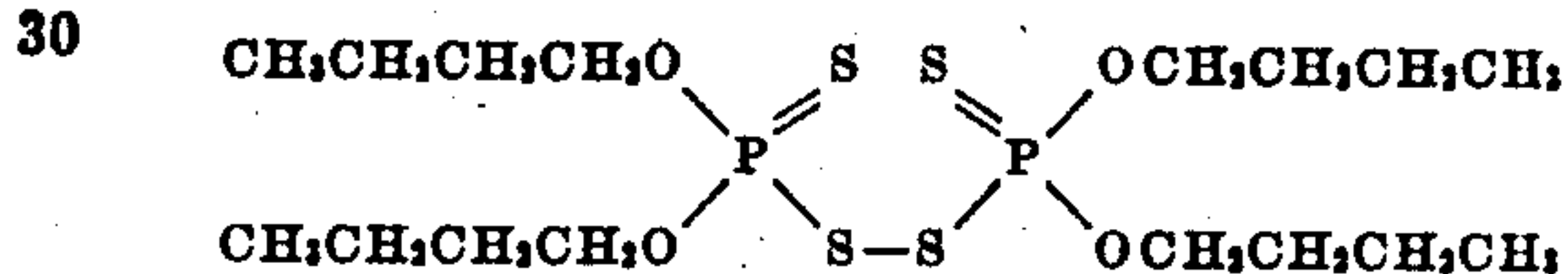


in which R is a member of the group consisting of alkyl and aryl radicals and x is zero or a small whole number.

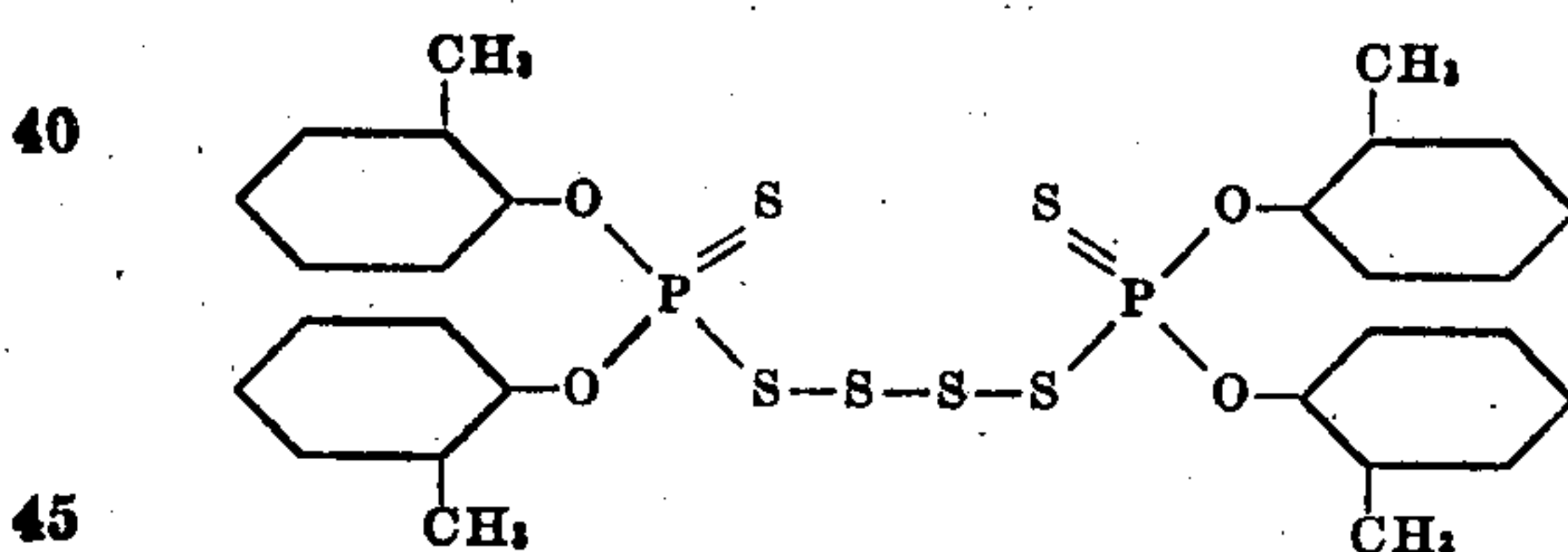
4. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of di-secondary-butyl dithiophosphoric acid tetrasulfide having the formula:



5. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of di-n-butyl dithiophosphoric acid disulfide having the formula:



6. An extreme pressure lubricant comprising a mineral lubricating oil and a small amount of di-o-cresyl dithiophosphoric acid tetrasulfide having the formula:



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