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EXTREME PRESSURE LUBRICATION THROUGH ADDITIVES

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ABSTRACT OF THE DISCLOSURE

Water insoluble organic compounds which liberate gaseous nitrogen at high temperatures and have at least one N—N single or double bond in each molecule are added to lubricants to improve lubricity and decrease corrosion while remaining readily removable from the surfaces to which they have been applied.

In the lubricating art, the demands made on the performance of lubricants are ever increasing. With todays high rate of technical progress, situations are encountered in engineering which tend to put more stress on friction-free apparatus and machinery. The present day lubrication engineer desires to have lubricants that can withstand high pressures and temperatures and at the same time have longevity of lubrication.

The larger, faster running mechanical apparatus of today have, in general, a tendency to cause friction points to be subjected to even greater stresses. If the load on the friction points is too much for the performance of the lubricant, the hydrodynamic lubrication effect is exceeded and the contact points are then subjected to conditions of mixed friction, the hydrodynamic lubricant film collapses, and very soon solid friction occurs and the rubbing surfaces seize and are damaged.

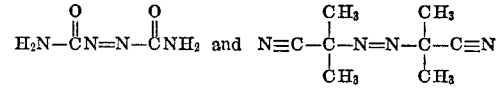
To overcome this, the load-bearing capacity of lubricants is increased by means of "extreme-pressure additives" (E.P. additives) which are chiefly organic compounds containing halogens, phosphorus or sulphur. Under the prevailing lubricating conditions, the E.P. additives react with the metal of the rubbing surfaces to form metal compounds of their hetero atoms. This process causes corrosion. The protection which E.P. additives provide against mechanical wear is, therefore, obtained at the expense of wear due to corrosion.

When solid lubricants such as molybdenum disulphide are used, there is no wear due to corrosion but the lubricant films produced adhere quite strongly and can only be removed with great difficulty. In the case of chipless metal forming, this disadvantage is not acceptable.

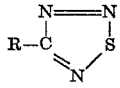
It is the object of this invention, therefore, to provide lubricants which reduce mechanical wear of rubbing surfaces and wear due to corrosion where the points of contact are heavily loaded. It is also an object of this invention to provide lubricants which are not difficult to remove from metal surfaces.

The above objects are attained by means of the invention which is characterized in that it is a lubricant preparation which contains a substantially water-insoluble organic compound which liberates gaseous nitrogen at high temperatures and said organic compound has at least one nitrogen-nitrogen single or double bond in the molecule.

Such nitrogen containing organic compounds are those that liberate nitrogen above a temperature of 80° C. Such compounds include azo compounds, more particularly,



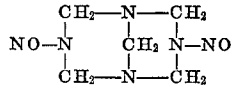
also included are thiatriazoles having the formula



where R is hydrogen, monovalent alkylradicals or monovalent aryl radicals. The organic nitrogen compound can be a hydrazide, such as sulphonic hydrazide and preferably diphenyl sulphonic 3,3'-disulphonic hydrazide

$$NH_2NHSO_2C_6H_4SO_2C_6H_4SO_2NHNH_2$$

Other compounds which liberate nitrogen include: nitroso compounds such as N,N'-dinitroso pentamethylene tetramine



diazoaminobenzene, benzene sulphonyl hydrazide

$$(C_6H_5SO_2NHNH_2)$$

and azodiformic acid ester ($RO_2C—N=N—CO_2R$) where R may be ethyl.

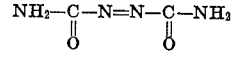
The concentration of the organic compound having at least one N—N bond, within the lubricant preparation embodying this invention, depends on the requirements which are to be satisfied. If the proportions of compound in the lubricant preparation is less than 0.1% by weight, the lubricating performance will not generally be satisfactory, and proportions containing greater than 50% by weight do not seem to further improve the lubricating performance.

Depending on the purpose for which they are intended, the lubricant preparations embodying the invention may contain other additives usually common to and well known in the art, such as viscosity improvers, detergents, anticorrosion agents, antioxidants, lubricant vehicles and thickeners.

Examples of liquid vehicles are mineral oils, esters, polyvalent alcohols and water. Water and aqueous solutions are used as liquid vehicles mainly for preparations used in the hot forming of metal. Silicic acid (hydrous silica), bentonite, methyl- and ethyl-cellulose are examples of substances which have a particularly good thickening action.

The vehicles in the lubricant preparations embodying the invention may be exclusively solid substances. The following compounds are examples of known solid lubricants: MoS_2, WS_2, ZnS, $CaCO_3$, $Ca(OH)_2$, CaO, SrO, $Sr(OH)_2$, $SrCO_3$, $Ca_3(PO_4)_2$, $AlPO_4$, $Zn_2P_2O_7$, $Fe_2P_2O_7$ and $Ca_2P_2O_7$.

One other example of a solid vehicle is pulverized mineral limonite ($2Fe_2O_3 \cdot 3H_2O$) which is mixed with the organic compound having at least one nitrogen-nitrogen bond, e.g.,



and then applied to the lubrication points in powder form. Preparations of this kind have proved particularly suitable for drop forging.

The results of tests on lubricant preparations embodied by this invention are given in the latter part of this specification. The tests show that these lubricant preparations can withstand very high stresses and are, therefore, suitable for all lubricating purposes, such as, bearings in high temperature and extreme pressure application. Fur-

ther, they are good lubricants for chipless metal forming, such as, forging, rolling, pressing and especially drop forging. They provide not only high lubricating efficiency but also the release effect which is required for this process and which must be particularly good in the case of deep reliefs.

Compared with conventional extreme-pressure additives, the preparations within this invention have (with a comparable liquid bearing capacity) the advantage that they do not attack metals and thereby cannot cause corrosion of the rubbing surfaces or points.

The present invention is illustrated in more detail by the following examples which by no means are offered to limit the invention.

EXAMPLE 1

The preparation of a typical lubricant comprises mixing 100 g. of the base oil (colorless paraffin oil) having 20,000 centistokes viscosity at 50° C. with 1% by weight of graphite. The graphite has a particle size under 50μ. The mixture is made using a Turrax® high speed agitator. Five (5) weight percent of azodicarbonamide is then stirred in using the high speed agitator while maintaining the temperature well below 80° C. After adding the azodicarbonamide, the mixture is stirred for approximately 10 minutes, after which time, a homogeneous dispersion is present.

The examples after being produced were tested on an Almen-Wieland testing apparatus. The apparatus has a pin that turns between two conforming bearing shells which are hydrolically pressed in a stepwise fashion against the pin until seizure occurs or a friction force of 360 kg. is reached. This loading will be termed "maximum loading." The machine was operated under standard conditions and the breakdown loading (seizure loading) was determined for each of the preparations.

In all of the 3 examples below a comparison of the invention is made, in that,

(1) The vehicle is tested without any other additives.
(2) A mixture of the vehicle and a known solid lubricant is tested.
(3) The preparations of this invention are tested.

EXAMPLE 2

	Maximum loading, kg.
(a) Oil base (colorless paraffin oil of viscosity 20,000 cps. at 50° C.)	250
(b) Oil base (a) + 1% graphite	300
(c) Oil base (a) + 5% azodicarbonamide	2000
(d) Oil base (a) + 5% diphenyl sulphonic 3,3'-disulphonic hydrazide	1500
(e) Oil base (a) + 5% azoisobutyric acid dinitrile	1100
(f) Oil base (a) + 5% thiatriazole	1250
(g) Oil base (a) + 1% graphite + 5% azodicarbonamide	2000

EXAMPLE 3

	Maximum loading, kg.
(a) Oil base (polypropylene glycol of viscosity 44,000 cps. at 50° C. mw.=300 gm./mole)	700
(b) Oil base (a) + 1% MoS_2	900
(c) Oil base (a) + 5% azodicarbonamide	2000
(d) Oil base (a) + 1% MoS_2 + 5% azodicarbonamide	2000

EXAMPLE 4

	Maximum loading, kg.
(a) Water	100
(b) Water + 1% zinc pyrophosphate	300
(c) Water + 5% thiatriazole	550
(d) Water + 1% zinc pyrophosphate + 5% thiatriazole	600

That which is claimed is:

1. An improved lubricant which consists of a known lubricant selected from a group consisting of mineral oil, polypropylene glycol or limonite and containing 0.1 to 50 percent by weight of azodicarbonamide.

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252—25, 27, 33, 49.5, 50, 51.5 R