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[54] **N-SUBSTITUTED FATTY ACID AMIDE LUBRICANTS**

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[51] **Int. Cl.** **C07d 59/00**

[58] **Field of Search** ..... 260/327 E, 399

[56] **References Cited**

UNITED STATES PATENTS

3,746,644 7/1973 Magne et al. 252/47.5

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[57] **ABSTRACT**

This invention relates to N-acylmorpholines and N-mono and N,N-disubstituted fatty acid amides and to similar derivatives of epithioamides which are useful as base and extreme pressure lubricants and additives.

3 Claims, No Drawings

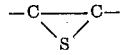
N-SUBSTITUTED FATTY ACID AMIDE LUBRICANTS

This is a division, of application Ser. No. 176,734 filed Aug. 31, 1971, now U.S. Pat. No. 3,746,644, issued July 17, 1973.

A non-exclusive, irrevocable, royalty-free license in the invention herein descrlbed, throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

This invention relates to certain compounds which are N-fatty acyl derivatives of primary and secondary amine and N-substituted acyl derivatives of primary and secondary amines which have exhibited utility as base lubricants, extreme pressure lubricants or lube additives. More particularly, this invention relates to N- and NN- disubstituted long chain aliphatic amides the acyl component of which is a normal, branched, or substituted alkenoic or alkanoic acyl group containing from 16 to 22 carbon atoms the amide nitrogen of which may be derived from an alkyl amine, dialkyl amine, alkylalkoxyalkylamine, dialkoxyalkylamine or nitrogen heteroalicylic. Typical amines are butylamines, dibutylamines, N-methyl-alkoxyethyl amine, diethoxyethyl amine, and morpholine. The acyl substituent referred to may be divalent sulfur or pentavalent phosphorus.

We have discovered that many of the simple N-alkyl and N,N-dialkyl or N-alkyl-N-alkoxyalkyl amides of the C_{16} to C_{22} alkeneoic or alkanoic fatty acids are good base lubricants. We have further discovered that the introduction of divalent sulfur into the fatty acid moiety imparts excellent extreme pressure lubricant characteristics to such compounds. In particular we have found the epithio group



to be most effective. We have also observed that the introduction of both hydroxy and alkyl phosphato groupings alpha to each other also imparts extreme pressure lubricant characteristics to the compound.

In addition it was noted that the above hydroxyphosphato compound and its mercapto analog N-[9(10)-mercapto-(9)10-dibutylphosphato]stearamide were effective antiwear compounds and additives.

Included among the specific compounds operable as base lubricants are N-methyl-N-butyloleamide, N-ethoxyethoxyethoxy propyloleamide, N-ethoxyethoxy propyloleamide, N-methoxyisopropyloleamide, N-methoxyethyloleamide. Compounds showing particular promise as extreme pressure lubricants or additives are N,N-dibutyl-9,10-epithiostearamide, N,N-dibutyl-9,10-12,13-diepithiostearamide, 9,10-epithiostearoyl morpholine, N-ethoxyethoxyethoxypropyl-9,10-epithiostearamide, N-9,10-12,13-diepithiostearoylmorpholine and N-[9(10)-hydroxy-9(10)-dibutylphosphato]stearamide.

Compounds showing particular promise as antiwear additives are N,N-dibutyl-[9(10)-hydroxy-(9)10-dibutylphosphato]stearamide and N,N-[9(10)mercapto-(9)10-dibutylphosphatostearoyl]morpholine.

EXAMPLE 1

N-Methyl-N-butyloleamide

100 grams (0.33 mole) of oleoyl chloride was added dropwise and with stirring to a mixture of 29 grams (0.33 mole) of N-methyl-N-butylamine and 27 grams (0.33 mole) of pyridine. Stirring was continued until the heat of reaction subsided. The solid pyridine hydrochloride was filtered off and the filtrate was washed successively with aqueous HCl and water until acid free. It was dried stripped, percolated through an activated alumina column, and the product removed from the percolate by stripping off the solvent. Analysis of the product: Percent C, 78.87 (theory 78.63; percent H, 13.02 (theory 12.82); percent N, 3.96 (theory 3.99).

EXAMPLE 2

N,N-dibutyloleamide

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride 42.5 grams 0.33 mole of di-n-butylamine and 27 grams (0.33 mole) pyridine. Analysis of the product: Percent C, 78.94 (theory 79.25); percent H, 13.16 (theory 13.06); percent N, 3.44 (theory 3.56) confirm the preparation.

Example 3

Ethoxyethoxyethoxy Propyloleamide

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride, 73.0 grams (0.33 mole) ethoxyethoxyethoxypropylamine and 27.0 grams (0.33 mole) pyridine. Analysis of percent C, 71,84 (theory 72.04); H, 11.80 (theory 11.80), and N, 2.96 (theory 2.90) confirm the preparation.

Example 4

Ethoxyethoxypropyloleamide

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride, 58.3 grams (0.33 mole) ethoxyethoxypropylamine and 27.0 grams (0.33 mole) of pyridine. Analyses of percent C, 71.45 (theory 73.80); percent H, 11.87 (theory 12.07); and percent N, 2.92 (theory 3.18) confirm the preparation.

Example 5

Methoxyisopropyloleamide

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride, 29.3 grams (0.33 mole) methoxyisopropylamine and 27.0 grams (0.33 mole) pyridine. Analysis of percent C, 73.15 (theory 74.99); percent H, 12.01 (theory 11.93); and percent N, 3.67 (theory 3.97) confirm the preparation.

Example 6

Methoxyethyloleamide

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride, 24.4 grams (0.33 mole) of methoxyethylamine and 27.0 grams (0.33 mole) pyridine. Analysis of percent C, 73.08 (theory 74.55); percent H, 11.98 (theory 11.83); and percent N, 3.31 (theory 4.14) confirm the preparation.

Example 7

Oleoylmorpholine

This material was prepared by the procedure of Example 1 from 100 grams (0.33 mole) of oleoyl chloride, 28.7 grams (0.33 mole) of morpholine and 27.0 grams (0.33 mole) of pyridine.

Example 8

N,N-dibutyllinoleamide

This product was prepared following the exact procedure of Example 2 except for the substitution of oleoyl chloride by linoleoyl chloride.

Example 9

N,N-dibutyl-9,10-epithiostearamide

120 grams (0.30 mole) of N,N-dibutyloleamide was epoxidized by the addition with stirring of 62.0 grams (0.36 mole) of meta-chloroperbenzoic acid in 630 ml of chloroform. Reaction was continued for 1 hour beyond final addition and the excess peracid destroyed by a small amount of a 10 percent solution of Na_2SO_3. The metachlorobenzoic acid was removed by a $NaHCO_3$ wash, followed by water washing. The $CHCl_3$ solution was then dried with anhydrous Na_2SO_4 and the $CHCl_3$ stripped off to recover the product N,N-dibutyl-9,10-epoxystearamide, oxirane content 3.45 percent (theory 3.91 percent). 100 grams (0.24 mole) of this product was added to a well stirred slurry of 55.7 g (0.73 mole) of thiourea and 89.5 g (0.73 mole) of benzoic acid in acetone. Stirring was continued for 3 hours beyond the terminal addition whereupon the benzoic acid was washed out with 38.8 g (0.36 mole) of Na_2CO_3 and the organic product extracted with hexane. The organic phase extract was dried and stripped to recover the product N,N-dibutyl-9,10-epithiostearamide containing 6.41 percent sulfur (theory 6.67 percent).

Example 10

N-(9,10-epithiostearoyl)morpholine

This product was prepared by the exact procedure described in Example 9 except for the substitution of oleoylmorpholine for the N,N-dibutyloleamide of Example 9. Analysis of product showed percent C, 71.22 (theory 69.34); percent H, 11.22 (theory 10.77); percent N, 3.66 (theory 3.68); percent S, 3.44 (theory 7.80).

Example 11

N,N-dibytl-9,10-12,13-diepithiostearamide

This product was prepared following the procedure described in Example 9 except for the replacement of the N,N-dibutyloleamide of Example 9 by N,N-dibutyllinoleamide, and a doubling of the molar ratios of all reagents. The product analyzed as follows: percent C, 69.64 (theory 68,57); percent H, 10.93 (theory 10.76; percent N, 3.10 (theory 3.07); percent S, 11.7 (theory 14.06).

Example 12

N-Ethoxyethoxyethoxypropyl-9,10-epithiostearamide

To 166 g of N-ethoxyethoxyethoxypropyl oleamide, Example 3, was added dropwise and with stirring 73.8 g of m-chloroperbenzoic acid in 800 ml of $CHCl_3$. The spent m-chloroperbenzoic acid was removed with 10 percent aqueous $NaHCO_3$ and the epoxide recovered by drying and stripping off the $CHCl_3$. 171 g of this epoxide was added dropwise to a slurry of 56 g thiourea in 1000 ml of acetone and the concurrent addition of 43.4 g of glacial acetic acid and the reaction mixture stirred for 3 hours. The glacial acetic acid was neutralized with Na_2CO_3 and the episulfide, N-ethoxyethoxyethoxypropyl-9,10-epithiostearamide, extracted with Skellysolve B and washed, dried, and stripped. Its elemental analysis was C = 67.1 (66.52), H = 11.42 (10.88), N = 2.67 (2.87), S = 2.29 (6.57).

Example 13

N-Ethoxyethoxyethoxypropyl-9(10)mercaptostearamide

173 g of N-ethoxyethoxyethoxypropyloleamide in CCl_4 was treated in the cold with a CCl_4 soltuion containing 60.9 g of bromine. Any unreacted bromine was removed by a thiosulfate wash. 140 g of the resulting dibromo compound was added dropwise to a well stirred solution of 72 g of $Na_2S \cdot 9H_2O$ in dimethylsulfoxide maintained at 80°C. Stirring was containued at 80°C for 3 hours. Water was added and the reaction product was extracted with hexane; washed, dried, and stripped. Elemental analysis of the product was C = 66.3 (66.5); H = 11.1 (10.9), N = 2.7 (2.9), S = 4.4 (6.8).

Example 14

N,N-Dibutyl-9(10)[dibutylphosphono]stearamide

100 g of N,N-dibutyloleamide, Example 2, 148 g of dibutyl phosphite, and 1.29 of benzoyl peroxide catalyst were heated at 115°C for 3½ hours. Additional units of 1.29 g of benzoyl peroxide was added after the first and second hours of reaction time. The excess dibutyl phosphite was then removed by distillation at reduced pressure, 0.45 mmHg. The stillpot contents showed strong adsorption bonds at 8, 9.3, and 9.7 microns characteristics of the phosphonate group. The elemental analysis was C = obs 71.46 (69.50), H = obs 12.42 (11.92), N = obs 2.20 (2.38), P = obs 4.24 (5.28) percent respectively.

Example 15

N-9,10-12,13-diepithiostearoylmorpholine

This product was prepared by the same procedure described in Example 9 except for the substitution of linoleoyl morpholine for the N,N-dibutyloleamide of Example 8 and the doubling of molar proportions of the m-chloroperbenzoic acid in the epoxidation step and the thiourea and benzoic acid in the "epithioation" step. The elemental analysis was C = obs 68.89 (63.92), H = obs 10.26 (9.44), N = obs 3.29 (3.38), S = obs 4.00 (15.49) percent respectively.

Example 16

N,N-Dibutyl-[9(10) -hydroxy-(9)10-dibutylphosphato]stearamide

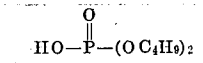
44.7 g of dibutylhydrogen phosphate was added to 182.2 g of N,N-dibutyl-9,10-epoxystearamide at 90°–95°C with stirring. Reaction conditions were continued for 3½ hours after termination of the addition. The reaction product was dissolved in commercial hexane and the unreacted dibutyl hydrogen phosphate neutralized and washed out with portions of aqueous 10 percent $NaHCO_3$ followed by several water washes. Acidulation of the hexane phase with diluted HCl followed by several water washes,

drying and stripping, yielded the product. Elemental analysis was, C= obs 66.56 (65.91), H = obs 11.04 (11.30). N = obs 2.90 (2.26), P = obs 3.04 (4.20).

Example 17

N-[9(10) mercapto-(9)10-dibutylphosphatostearoyl]-morpholine

12 g of dibutylhydrogen phosphate was added dropwise with stirring to 51.0 g of (9,10-epithiostearoyl)-morpholine, the preparation of Example 10, at 85°–90°C and the heating and stirring continued for 3 hours beyond the terminal addition. The reaction product was dissolved in commercial hexane and any excess or unreacted



was neutralized and washed out with aqueous 10 percent $NaHCO_3$. The hexane extract was washed several times with water dried and stripped. The elemental analysis of the product was C = obs 66.74 (69.36), H = obs 10.69 (11.05), N = obs 2.89 (3.32), S = obs 3.27 (2.17), P = obs 1.68 (2.10) percent respectively.

Example 18

The compounds prepared in accordance to the procedures given in Examples 1 through 7 were evaluated as base lubricants in the Shell Four-Ball Wear tests following a modified procedure of ASTM D2266-67. The resulting scar diameter on the balls after running at 600 rpm for 1 hour at 120°C and 50 kg load were compared with the scars obtained using commercial lubricants such as Aeroshell Mil-L-708 (Di-2-ethylhexyl sebacate and additive), Gulfpride, single G, MS, multiviscosity, and 100 sec. paraffin oil. The results of these tests are reported in Table 1.

TABLE I

ANTIWEAR LUBRICANT PROPERTIES OF FATTY ACID AMIDES

	COMPOUND	Avg. Wear Scar, mm		
		without additive	With 5% additive	Additive
1	N,N-Bis(2-ethoxy-ethyl)oleamide	0.597	0.735	N,N-Di-butyl-9,10-epi-thiostearamide
2	N,N-Di-n-butyl-9,10-epithiostearamide	0.842	—	none
3	Oleoylmorpholine	0.623	0.658	do.
4	N,N-Dimethyloleamide	0.797	0.987	do.
5	N,N-Di-n-propyloleamide	0.908	0.885	do.
6	N,N-Di-n-hexyloleamide	0.893	0.898	do.
7	N,N-Di-n-butylerucamide	0.758	0.798	do.
8	N,N-Di-n-butyl amide of Sel. hydrogenated cottonseed fatty acids	0.798	0.958	do.
9	N,N-Bis(2-Methoxy-ethyl)oleamide	0.626	0.725	do.
10	N,N-Dibutyloleamide	0.710	—	—
11	N-Oleoyl-4-propyl-piperidine	0.847	—	—
12	Morpholide of sel. hydrogenated cotton-seed fatty acids	0.642	—	—
13	N-Methyl-N-butyl-oleamide	0.607	—	—
14	N-Ethoxyethoxyethoxy-propyloeamide	0.503	—	—
15	N-Ethoxyethoxypropyl-oleamide	0.526	—	—
16	N-methoxylsopropyl-oleamide	0.705	—	—
17	N-Methoxyethyloleamide	0.420	—	—
18	102 sec Paraffin Oil		0.902	N-methoxyethyloleamide
19	D.O.S.		0.906	do.
20	N,N-Dibutyl-9(10)-carbobutoxyoctadecanamide	0.610		—
21	102 sec Paraffin Oil		0.818	N,N-Dibutyl-9(10)-carbobutoxyoctadecanamide
22	D.O.S.		0.945	do.
23	N-[9(10)mercapto-(9)10-dibutyl-phosphatostearoyl] morpholine	0.615		—
24	102 sec Paraffin Oil		0.552	N-[9(10)mercapto-(9)10-dibutylphosphatostearoyl]morpholine
25	D.O.S.		0.535	do.
26	N,N-Dibutyl-[9(10)-hydroxy-(9)10-di-butylphosphato] stearamide	0.498		—
27	102 sec Paraffin Oil		0.498	N,N-Dibutyl-[9(10)-hydroxy-(9)10-di-butylphosphato] stearamide
28	D.O.S.		0.498	
29	N,N-Dibutyl-9(10)-[dibutylphosphono] stearamide	0.530		—

TABLE I—Continued

ANTIWEAR LUBRICANT PROPERTIES OF FATTY ACID AMIDES

	COMPOUND	Avg. Wear Scar, mm without additive	Avg. Wear Scar, mm With 5% additive	Additive
30	N-Ethoxyethoxyethoxy-propyl-9,10-epithio-stearamide	0.707		—
31	N-Ethoxyethoxyethoxy-propyl-9(10)mercapto-stearamide	0.690		—
32	N-(9,10-12,13-diepithio-stearoyl)morpholine	0.665		—
33	Bis(2-ethylhexyl)seba-cate	0.872	—	—
34	100 sec Paraffin Oil	0.803	—	—
35	Aero Shell (Mil-7808)	0.587		
36	Gulf Pride, Single G, MS, multivis-cosity	0.447		
37	100 sec Paraffin Oil		0.813	N,N-Dibutyl-9,10-12,13-Diepithio-stearamide
38	Bis(2-ethylhexyl) sebacate		0.836	do.
39	100 sec Paraffin Oil		0.723	N-9,10-epithio-stearoyl morpholine
40	Bis(2-ethylhexyl) sebacate		0.915	do.
41	100 sec Paraffin Oil		0.917	N,N-Dibutyl-9,10-dichlorostearamide
42	Bis(2-ethylhexyl) sebacate		0.848	do.

It can be seen from the data presented that the N-alkoxyalkyl and N,N-di(alkoxyalkyl)oleamides, without the assistance of additives, exhibited wear characteristics (i.e., low scar diameters) comparable to the commercial controls Aeroshell and Gulfpride, which do contain additives to improve performance. N,N-dibutyl-[9(10)-hydroxy-(9)10-dibutylphosphato]-stearamide and N-[9(10)mercapto-(9)10-di butylphosphatostearoyl]morpholine not only exhibit low wear characteristics in themselves but also impart as additives such characteristics to paraffin oil and DOS base lubricants.

Example 19

The various amides were evaluated as extreme pressure lubricants or additives in a Shell 4-ball extreme pressure tester at 1440 RPM following ASTM Procedure D 2596–67T. Loads were increased in increments of 20 Kg to weld point and the test run for 1 minute or to weld whichever occured first. Commercial hypoid fluid SAE No. 90 was employed as the control E.P. lubricant. The performance of the amides tested is given in Tables II, III, and IV.

TABLE II

EXTREME PRESSURE TESTS (ASTM D2596-67T)

	COMPOUND	Weld Point (No additive)	Weld Point (with 5% No. 2)
1	N,N-Bis(2-ethoxyethyl) oleamide	120	170
2	N,N-Di-n-butyl-9,10-epithio-stearamide	300	—
3	Oleoylmorpholine	120	150
4	N,N-Dimethyloleamide	120	140
5	N,N-Di-n-propyloleamide	120	150
6	N,N-Di-n-hexyloleamide	120	180
7	N,N-Di-n-butylerucamide	120	200
8	N,N-Di-n-butyl amide of hydrog-enated cottonseed fatty acids	120	170
9	N,N-Bis(2-Methoxyethyl)oleamide	120	160
10	N-Methyl-N-butyloleamide	100	
11	N,N-Dibutyl-9,10-epithio-stearamide	300	
12	N,N-Dibutyl-9,10-12,13-diepi-thiostearamide	440	
13	N-Ethoxyethoxyethoxypropyole-amide	120	
14	N-Ethoxyethoxypropyloleamide	120	
15	N-Methoxyisopropyloleamide	100	
16	N-Methoxyethyloleamide	100	
17	N-9,10-epithiostearoylmorpholine	380	
18	Bis(2-ethylhexyl)sebacate	120	
19	100 sec Paraffin Oil	100	
20	SAE No. 90 Commercial hypoid fluid	280	

TABLE III

EVALUATION OF N,N-DIBUTYL-9,10-12,13-DI-EPITHIOSTEARAMIDE AS AN ADDITIVE AND AS A BASE OIL IN EXTREME PRESSURE TESTS. (ASTM D2596-67T)

BASE OIL	% ADDITIVE	LOAD, Kg	WEAR SCAR mm
100 sec Paraffin Oil	(5%)	140	1.90
do.	do.	200	2.35
do.	do.	220	2.75
do.	do.	240	Weld—5 sec.
Bis(2-ethylhexyl)sebacate	(5%)	120	1.51
do.	do.	180	1.59
do.	do.	190(I.S.)[a]	2.47
do.	do.	200	Weld—4 sec.
do.	(10%)	240	2.88
do.	do.	260	3.55
do.	do.	270	Weld—10 sec.
N,N-Dibutyl-9,10-12,13-diepithiostearamide	None	120	1.38
do.	do.	160	1.61
do.	do.	200	1.89
do.	do.	280	2.13
do.	do.	320	2.47
do.	do.	360	2.70
do.	do.	400	2.88
do.	do.	440	Weld—46 sec.

[a]Incipient seizure

EXTREME PRESSURE TESTS ON N-ETHOXYETHYOXYETHOXYPROPYL-9,10-EPITHIOSTEARAMIDE (PC-O-No. 7682)

BASE OIL	ADDITIVE	APPLIED LOAD	AVE. SCAR mm
7682	None	120	1.05
do.	do.	160	1.75
do.	do.	240	2.35
do.	do.	300	2.19
do.	do.	340	2.55
do.	do.	360	2.62
do.	do.	380	weld
102 sec Paraffin Oil	7682 (5%)	120	2.28
do.	do.	140	2.46
do.	do.	150	weld
D.O.S.	7682 (5%)	120	2.23
do.	do.	140	2.44
do.	do.	150	weld

EXTREME PRESSURE TESTS ON N-ETHOXYETHOXYETHOXYPROPYL-9(10)-MERCAPTOSTEARAMIDE (PC-O-No. 7683)

BASE OIL	ADDITIVE	APPLIED LOAD Kg	AVE. SCAR. mm
7683	None	200	1.54
do.	do.	300	2.26
do.	do.	400	2.25
do.	do.	450	2.15
do.	do.	500	2.15[a]
102 sec Paraffin Oil	7683 (5%)	120	1.97
do.	do.	140	2.35
do.	do.	150	2.54
do.	do.	160	weld
D.O.S.	7683 (5%)	120	1.68
do.	do.	140	2.18
do.	do.	160	2.59
do.	do.	170	2.72
do.	do.	180	weld

[a]Test stopped because of extreme decomposition. Did not weld.

EXTREME PRESSURE TESTS ON N-(9,10-12,13-DIEPITHIOSTEAROYL)MORPHOLINE (PC-O-No. 7684)

BASE OIL	ADDITIVE	APPLIED LOAD Kg	AVG. SCAR. mm
7684	None	200	2.21
do.	do.	260	2.38
do.	do.	340	2.43
do.	do.	400	2.75
do.	do.	460	2.90
do.	do.	500	2.98[1]
102 sec Paraffin Oil	7684 (5%)	100	2.23
do.	do.	120	2.61
do.	do.	130	2.74
do.	do.	140	weld
D.O.S	7684 (5%)	120	2.54
do.	do.	140	2.58
do.	do.	150	weld
N-Methoxyethyl oleamide	7684 (5%)	140	2.53
do.	do.	160	2.77
do.	do.	170	weld

[1]Test stopped because of extreme decomposition. Did not weld.

EXTREME PRESSURE TESTS ON N,N-DIBUTYL-9(10)-(DIBUTYLPHOSPHONO)STEARAMIDE (PC-O-No. 7685)

BASE OIL	ADDITIVE	APPLIED LOAD Kg	AVE. SCAR, mm
7685	None	120	3.05
do.	do.	140	4.50
do.	do.	150	weld

EXTREME PRESSURE TESTS ON N,N-DIBUTYL-[9(10)-HYDROXY-9(10)-DIBUTYLPHOSPHATO]STEARAMIDE (PC-O-No. 7686)

7686	None	200	0.887
do.	do.	300	2.78
do.	do.	340	4.32
do.	do.	350	4.50
do.	do.	360	weld
100 sec Paraffin Oil	7686 (5%)	120	2.28
do.	do.	140	2.80
do.	do.	150	3.01
do.	do.	160	weld
D.O.S.	7686 (5%)	120	1.95
do.	do.	140	2.85
do.	do.	150	3.03
do.	do.	160	weld

EXTREME PRESSURE TESTS ON N-[9(10)-MERCAPTO-9(10)-BUTYLPHOSPHATO-STEAROYL]MORPHOLINE (OC-O-No. 7687)

BASE OIL	ADDITIVE	APPLIED LOAD Kg	AVE. SCAR, mm
7687	None	120	0.608
do.	do.	160	1.45
do.	do.	200	1.40
do.	do.	240	1.70
do.	do.	280	3.36[1]

EXTREME PRESSURE TESTS ON N,N-DIBUTYL-9(10)-CARBOBUTYOXYOCTADECANAMIDE (PC-O-No. 7688)

7688	None	80	1.92
do.	do.	90	2.18
do.	do.	100	2.45
do.	do.	120	weld

[1]Test stopped because of extreme decomposition and noxious fumes. Did not weld.

TABLE IV

EVALUATION OF N-9,10-EPITHIOSTEAROYL MORPHOLINE AS AN ADDITIVE AND AS A BASE OIL IN EXTREME PRESSURE TESTS (ASTM D 2596-67T)

BASE OIL	% ADDITIVE	LOAD Kg	WEAR SCAR mm
100 sec Paraffin Oil	(5%)	120	2.00
do.	do.	140	2.80
do.	do.	160	3.25
do.	do.	180	weld, 10 sec.
Bis(2-ethylhexyl) sebacate	(5%)	80	1.57
do.	do.	120	2.03
do.	do.	140	2.41
do.	do.	160	2.94
do.	do.	180	3.00
Bis(2-ethylhexyl) sebacate	(5%)	200	weld, 5 sec.
N-9,10-Epithio-stearoylmorpholine	None	120	0.70
		200	2.13
		240	2.43
		300	2.68
		380	weld, 50 sec.

We claim:

1. The compound N,N-dibutyl-9,10-epithiostearamide.

2. The compound N,N-dibutyl-9,10-12,13-diepithiostearamide.

3. The compound N-(ethoxyethoxyethoxy)propyl-9,10-epithiostearamide.

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