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(54) Novel multi-purpose rust preventative and penetrant

(57) A penetrant and coating composition concentrate for metals having improved corrosion inhibiting properties. The composition concentrate includes from 2 to 5 weight percent ashless acidic rust inhibitor, from 25 to 50 weight percent neutral alkaline earth metal sulfonate corrosion inhibitor component, from 25 to 50 weight percent phosphorus-based corrosion inhibitor component, and a process oil component.

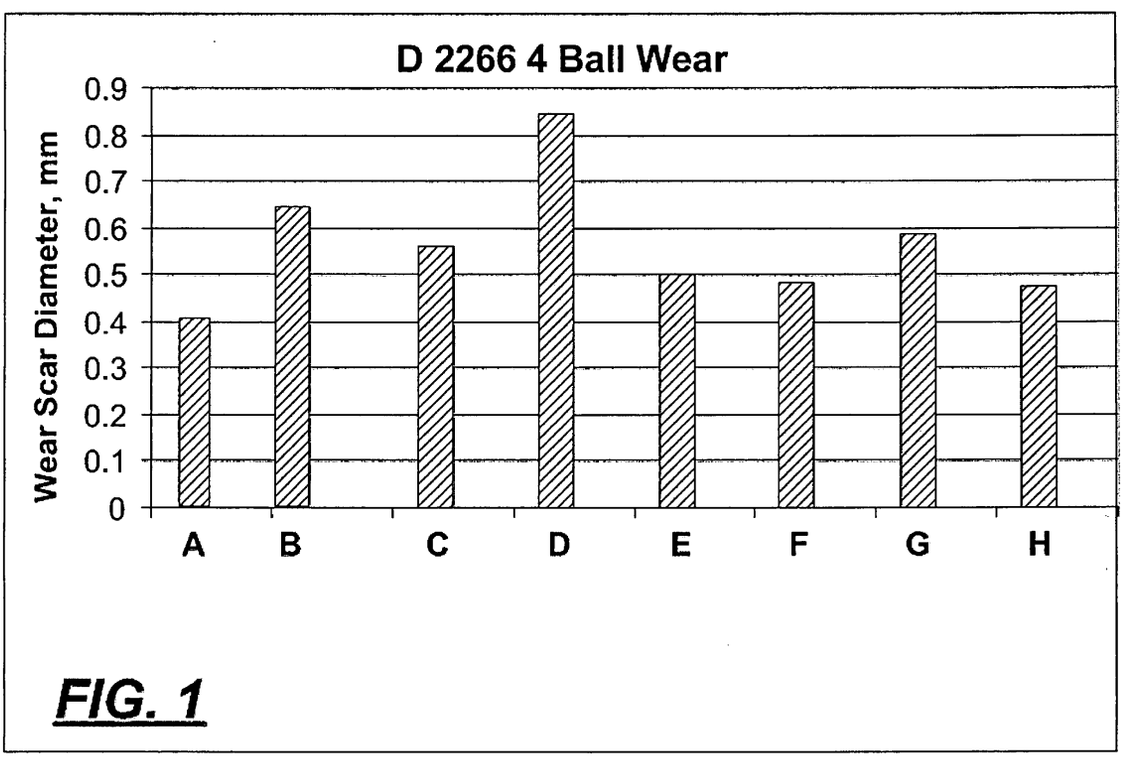


FIG. 1

EP 1 605 033 A1

Description

TECHNICAL FIELD

[0001] The following disclosure is directed to a multi-purpose rust preventative and penetrant formulation for industrial and home use applications.

BACKGROUND

[0002] Industrial and home environments often require use of a utility lubricant for a variety of purposes, such as to loosen bolts, reduce squeaks in hinges and other movable objects, remove moisture from electrical components, and the like. Such lubricants, referred to herein as "light duty lubricants" may be sprayed or otherwise applied to metal surfaces and moving parts to reduce corrosion of the parts, and to temporarily lubricate the parts. Such lubricants are effective to reduce corrosion of the parts by displacing water or moisture from the surface of the parts.

[0003] Such light duty lubricants also desirably have a surface tension that enables the lubricants to effectively coat the surface of the parts. In order for the lubricants to penetrate between closely spaced parts to loosen or lubricate the parts, the viscosity of the lubricants must be relatively low. In many cases, such lubricants have major component consisting of an oleaginous diluent having a relatively high volatility.

[0004] Unfortunately, conventional light duty lubricants that are effective to reduce corrosion of metal parts, reduce wear, and reduce squeaks must be reapplied to the parts often. While the volatility of the lubricant is desirable for some applications where relatively oil free parts are needed, the volatility is less desirable in other applications that require a lubricant to continue to work over an extended period of time.

[0005] Despite the wide variety of light duty lubricants that are commercially available, there continues to be a need for an improved light duty lubricant that has improved multi-functional properties.

SUMMARY OF THE EMBODIMENTS

[0006] With regard to the foregoing, there is presented in one embodiment of the disclosure a penetrant and coating composition concentrate for metals having improved corrosion inhibiting properties. The composition contains from 2 to 5 weight percent ashless acidic rust inhibitor component, from 25 to 50 weight percent neutral alkaline earth metal sulfonate corrosion inhibitor component, from 25 to 50 weight percent phosphorus-based corrosion inhibitor component, and a process oil component.

[0007] In another embodiment there is provided a method for inhibiting corrosion of a surface of a metal by applying a corrosion inhibiting composition to the surface of the metal. The composition includes from 0.1 to 1.0 weight percent ashless acidic rust inhibitor component, from 2 to 10 weight percent neutral alkaline earth metal sulfonate corrosion inhibitor component, from 2 to 10 weight percent phosphorus-based corrosion inhibitor component, and a process oil component.

[0008] In yet another embodiment, there is provided a method for lubricating and protecting moving parts from corrosion. The method includes applying to the moving parts a corrosion inhibiting composition containing from 0.1 to 1.0 weight percent ashless acidic rust inhibitor component, from 2 to 10 weight percent neutral alkaline earth metal sulfonate corrosion inhibitor component, from 2 to 10 weight percent phosphorus-based corrosion inhibitor component, and a process oil component.

[0009] An advantage of the embodiments described herein is that the compositions have improved corrosion prevention abilities. Another advantage of the compositions described herein is that the compositions have improved lubricity over an extended period of time. A further advantage of the compositions described herein is the compositions are miscible with light to medium weight diluent oils thereby increasing the flexibility for use of the compositions in a wider variety of applications.

BRIEF DESCRIPTION OF DRAWINGS

[0010] Further advantages of the invention will become apparent by reference to the detailed description of embodiments when considered in conjunction with the following drawings, in which like reference numbers denote like elements throughout the several views, and wherein:

FIG. 1 is a graphical representation of a 4 ball wear test comparing a formulation according to the disclosure with commercially available products;

FIG. 2 is a graphical representation of an extreme pressure wear test according to procedure A comparing a formulation according to the disclosure with commercially available products;

FIG. 3 is a graphical representation of an extreme pressure wear test according to procedure B comparing a formulation according to the disclosure with commercially available products;
FIG. 4 is a graphical representation of a pin and vee block wear test comparing a formulation according to the disclosure with commercially available products;
FIG. 5 is a graphical representation of a boundary friction coefficient versus wear scar diameter test according comparing a formulation according to the disclosure with commercially available products;
FIG. 6 is a graphical representation of a lubricity versus wear scar diameter test comparing a formulation according to the disclosure with commercially available products;
FIG. 7 is a graphical representation of dielectric strengths comparing a formulation according to the disclosure with commercially available products;
FIG. 8 is a graphical representation of a nut and bolt torque test comparing a formulation according to the disclosure with commercially available products; and
FIG. 9 is a graphical representation of a creep test comparing a formulation according to the disclosure with commercially available products.

DETAILED DESCRIPTION OF THE EMBODIMENTS

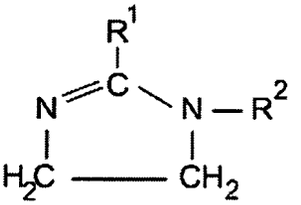
[0011] A feature of the compositions as described herein is that the compositions contain multiple corrosion or rust inhibiting components unlike conventional products. The corrosion and rust inhibiting components complement each other to provide superior corrosion inhibiting and wear properties. Another feature of the compositions described herein is that the compositions may be readily formulated for different uses. The compositions may be provided as a concentrate and blended with diluents to provide compositions having a desired viscosity. Still other compositions described herein contain tackifier components that enhance the ability of the compositions to remain on treated surfaces for extended periods of time.

[0012] For the purposes of the disclosure, the term "light duty" is intended to exclude only engine and gear train, and transmission lubricants, and lubricants intended for high speed heavy duty applications. All other lubricant applications are intended to be included in the term "light duty."

[0013] As set forth above, penetrant and coating compositions and methods describe herein include at least three rust or corrosion inhibiting components, namely an ashless acidic rust inhibitor component, a neutral alkaline earth metal sulfonate corrosion inhibitor component, and a phosphorus-based corrosion inhibitor component. The foregoing components are provided in a process oil mixture.

Ashless Acidic Rust Inhibitor Component

[0014] The ashless acidic rust inhibitor component is derived from a reaction product of a monocarboxylic acid, a polyalkylene amine having more than one nitrogen atom per molecule than there are alkylene groups in the molecule, and a succinic acid or succinic anhydride. The reaction product may be a linear or branched alkyl or alkenyl succinic acid/anhydride ester reacted with a substituted imidazoline of the formula



wherein R^1 is selected from an alkyl group containing from 1 to 12 carbon atoms or an aryl group containing from 6 to 12 carbon atoms, and R^2 is selected from H, a lower C_{1-4} alkyl group, a hydroxyalkyl group, e.g. a hydroxyethyl group, or an alkylaminoalkyl group wherein the alkyl portion contains from 1 to 4 carbon atoms. A suitable ashless acidic rust inhibitor component is available from Ethyl Corporation of Richmond, Virginia under the trade name HiTEC® 536 Performance Additive.

[0015] The ashless acidic rust inhibitor component may have a total acid number (TAN) ranging from 50 to 60 mg KOH per gram. Such reaction products are described in U.S. Patent Nos. 4,101,429 to Birke and 6,043,199 to Godici.

[0016] The amount of ashless acidic rust inhibitor component in the formulation is present in a minor amount. Accordingly, the amount of ashless acidic rust inhibitor ranges from 2 to 5 percent by weight based on a total weight of composition concentrate. The concentrate may be diluted with diluents and a tackifier to provide a finished penetrant

and coating composition containing from 0.1 to 1.0 percent by weight of the ashless acidic rust inhibitor component.

Neutral Metal Sulfonate Corrosion Inhibitor Component

[0017] The neutral metal sulfonate corrosion inhibitor component may be selected from alkaline and alkaline earth metal sulfonates. Alkaline earth metal sulfonates are derived from sulfonic acids, particularly from petroleum sulfonic acids or alkylated benzene sulfonic acids. Useful sulfonic acids from which the neutral alkaline earth metal sulfonates are prepared have a number average molecular weight of 250-1500, 400-1100, or 440-600. Examples of specific sulfonic acids include mahogany sulfonic acids, petrolatum sulfonic acids, aliphatic sulfonic acids and cycloaliphatic sulfonic acids. Sulfonic acids suitably used are alkaryl sulfonic acids such as alkylbenzene or alkylnaphthalene sulfonic acids wherein the alkyl groups contain from 10 to 30 carbon atoms or more. Higher molecular weight alkyls derived from alkylation with polyolefin (e.g. polybutenes) having molecular weights up to 2000 can be used to give hydrocarbyl sulfonic acids somewhat above the foregoing molecular weight range, but still useful. Other suitable sulfonic acids are the alkaryl sulfonic acids also referred to as alkylbenzene sulfonic acids.

[0018] Alkaryl sulfonic acids can be made by conventional methods such as by alkylating benzene, toluene or naphthalene or aromatic mixtures with olefins containing 10-30 carbon atoms or more (e.g. with polyolefin). The most suitable olefins are cracked-wax olefins, propylene trimers and tetramers and olefin mixtures derived from aluminum alkyl chain growth. Alkylation is effected using a Friedel-Crafts (e.g. AlCl3 or BF3) catalyst. The alkylaromatic mixture contains predominantly mono- and di-alkyl products. These alkyl aromatics are then sulfonated by known methods such as by reaction with sulfuric acid, oleum, sulfur trioxide and the like.

[0019] Sulfonic acids which may be used include octadecylbenzene sulfonic acid, didodecylbenzene sulfonic acid, docosylbenzene sulfonic acid, triacontylbenzene sulfonic acid, dodecyloctadecylbenzene sulfonic acid, didecylbenzene sulfonic acid, dodecylnaphthalene sulfonic acid, hexadecylnaphthalene sulfonic acid, dinonylbenzene sulfonic acid and mixtures thereof and the like.

[0020] Hydrocarbyl sulfonic acids may have a number average molecular weight of 250-1500. Suitable hydrocarbyl sulfonic acids, alkylbenzene sulfonic acids may have a number average molecular weight of, for example, 400-1100 and as a further example, 440-600.

[0021] Neutral alkaline earth metal sulfonates are produced by neutralizing the sulfonic acid with an alkaline earth metal base to form an alkaline earth metal sulfonate salt. The process provides a product having a total base number (TBN) of less than 50, for example, 0.

[0022] Neutral calcium petroleum sulfonates or alkylaryl (e.g. alkylbenzene) sulfonates may be used. Such products are prepared by neutralizing the corresponding petroleum sulfonic acid or alkylated benzene sulfonic acid with a calcium base to form a calcium sulfonate salt. Such neutral calcium sulfonates are available from Ethyl Corporation under the trade name HiTEC®614 Performance Additive.

[0023] The amount of neutral alkaline earth metal sulfonate component in the formulation ranges from 25 to 50 percent by weight based on a total weight of composition concentrate. The concentrate may be diluted with diluents and a tackifier to provide a finished penetrant and coating composition containing from 2 to 10 percent by weight of the neutral alkaline earth metal sulfonate component.

Phosphorus-based Corrosion Inhibitor Component

[0024] A third corrosion inhibiting component in the formulation is a phosphorus-based corrosion inhibitor component. Such corrosion inhibitors may be selected from aryl phosphates, alkaryl phosphates, and arylalkyl phosphates and are combined with alkyl phenols and dimer acids. Phosphates of the formula

$$(RO)_3PO$$

wherein each R is, independently, a phenyl or an alkyl-substituted phenyl group, are particularly suitable phosphates. Non-limiting examples include dimethyl (monophenyl) phosphates where the phenyl group is substituted with up to six carbon atoms as up to three lower alkyl radicals from such phenols as ortho-, meta-, or paracresol; xylenols such as 2,3-dimethyl-phenol, 3,4-dimethyl-phenol, 3,5-dimethyl-phenol, 2,6-dimethyl-phenol, 2,4-dimetllylphenol, and 2,5-dimethylphenol; mono ethyl, -propyl, isopropyl, -butyl, -amyl, or -hexyl-phenols where such straight or branched chain alkyl groups are in the ortho, meta or para position. Similarly di- and trialkyl substituted phenols such as 2,4-dimethyl-5-t-butyl-phenol, 2,4-dimethyl-6 ethyl-phenol and 2-methyl-4,5-diethyl-phenol

[0025] The phenolic component of the mixture may be provided by, for example, 2,6-di-tert-butylphenol, liquid mixtures of tertiary butylated phenols, 2,6-di-tert-butyl-4-methylphenol, 4,4'-methylenebis(2,6-di-tert-butylphenol), 2,2'-methylenebis(4-methyl-6-tert-butylphenol), mixed methylene-bridged polyalkyl phenols, and 4,4'-thiobis(2-methyl-

6-tert-butylphenol). N,N'-di-sec-butyl-p-phenylenediamine, 4-isopropylaminodiphenyl amine, phenyl-naphthyl amine, and ring-alkylated diphenylamines may also be used.

[0026] The dimer acid component of the mixture includes oil-soluble monocarboxylic acids such as 2-ethylhexanoic acid, lauric acid, myristic acid, palmitic acid, oleic acid, linoleic acid, linolenic acid, behenic acid, cerotic acid, and the like, and oil-soluble polycarboxylic acids including dimer and trimer acids, such as are produced from tall oil fatty acids, oleic acid, linoleic acid, or the like. Other suitable corrosion inhibitors include alkenylsuccinic acids in which the alkenyl group contains 10 or more carbon atoms such as, for example, tetrapropenylsuccinic acid, tetradecenylsuccinic acid, hexadecenylsuccinic acid, and the like; long-chain α,ω-dicarboxylic acids in the molecular weight range of 600 to 3000; and other similar materials. Products of this type are available from various commercial sources, such as, for example, the dimer and trimer acids sold under the HYSTRENE trademark by the Humco Chemical Division of Witco Chemical Corporation and under the EMPOL trademark by Emery Chemicals.

[0027] Such phosphorus-based corrosion inhibitor components are available from Ethyl Corporation under the trade name HiTEC® 515 Performance Additive.

[0028] The amount of phosphorus-based corrosion inhibitor component in the formulation ranges from 25 to 50 percent by weight based on a total weight of composition concentrate. The concentrate may be diluted with diluents and a tackifier to provide a finished penetrant and coating composition containing from 2 to 10 percent by weight of the phosphorus-based corrosion inhibitor component.

Optional Components

[0029] It may also be useful to include other corrosion inhibitor components in the above composition. Such components may be a single compound or a mixture of compounds having the property of inhibiting corrosion of metallic surfaces. For example, compounds such as thiazoles, triazoles, and thiadiazoles may be used in combination with the foregoing. Examples of such compounds include benzotriazole, tolytriazole, octyltriazole, decyltriazole, dodecyltriazole, 2-mercaptobenzothiazole, 2,5-dimercapto-1,3,4-thiadiazole, 2-mercapto-5-hydrocarbylthio-1,3,4-thiadiazoles, 2-mercapto-5-hydrocarbyldithio-1,3, 4-thiadiazoles, 2,5-bis(hydrocarbylthio)-1,3,4-thiadiazoles, and 2,5-(bis)hydrocarbyl-dithio),1,3,4-thiadiazoles. Such compounds are generally synthesized from hydrazine and carbon disulfide by known procedures. See for example U.S. Pat. Nos. 2,765,289; 2,749, 311; 2,760,933; 2,850,453; 2,910,439; 3,663,561; and 3,840,549. Other types of corrosion inhibitors are known and suitable for use in the foregoing compositions. Suitable corrosion inhibitors include ether amines; acid phosphates; amines; polyethoxylated compounds such as ethoxylated amines, ethoxylated and/or propoxylated phenols, and ethoxylated alcohols; imidazolines; and the like. Materials of these types are well known to those skilled in the art and a number of such materials are available as articles of commerce.

[0030] Other useful types of corrosion inhibitors include the alkenyl succinic acid and alkenyl succinic anhydride corrosion inhibitors such as, for example, tetrapropenylsuccinic acid, tetrapropenylsuccinic anhydride, tetradecenylsuccinic acid, tetradecenylsuccinic anhydride, hexadecenylsuccinic acid, hexadecenylsuccinic anhydride, and the like. Also useful are the half esters of alkenyl succinic acids having 8 to 24 carbon atoms in the alkenyl group with alcohols such as the polyglycols.

Base Oils and Diluents

[0031] The components of the penetrant and coating compositions described above are formulated in a base oil. The base oils may be provided by a combination of aromatic organic solvents from petroleum distillates, and light to medium solvent extract neutral base stocks. Suitable solvents are mineral spirits, white spirits, and Stoddard solvent (also known as VARSOL and TEXSOLVE).

[0032] Suitable diluents are very light solvent extract neutral base stocks (e.g., EC 100, EC 135 or 150SN); suitable process oils are light to medium solvent extract neutral base stocks (e.g., 100SN or 150SN). All diluents and base oils are available from ExxonMobil Oil Corporation of Fairfax, VA.

[0033] The amount of base oil and/or diluent in the formulations varies depending on whether a concentrate or a fully formulated mixture is provided. In the concentrate, the formulation may contain from 15 to 40 percent by weight process oil. A fully formulated mixture may contain from 10 to 30 percent by weight 150 neutral base stock, from 2 to 5 percent by weight process oil, and from 50 to 75 percent by weight mineral spirits.

Tackifier

[0034] A tackifier component may be included in the formulation. The tackifier provides an increased tendency of the penetrant and coating composition to remain on a treated surface. A wide variety of oil soluble tackifiers may be used including, but not limited to, olefin hydrocarbon tackifiers, tall oil rosin esters, polymerized rosin, phenolic resins,

ethylene-propylene copolymers, and the like. A suitable tackifier is an olefinic material, such as a high molecular weight olefin or polyolefin having a number average molecular weight ranging from 1,000,000 to 2,000,000. A suitable tackifier is polyisobutylene. The tackifier may be provided as a mixture in a process oil or diluent as set forth above. Such a tackifier is available from Ethyl Corporation under the trade name HiTEC® 152 Performance Additive. The amount of tackifier in a fully formulated penetrant and coating formulation ranges from 0.1 to 1.0 percent by weight of the total weight of the formulation.

[0035] The components used in formulating the compositions described herein can be blended into the base oil individually or in various sub-combinations. For example, all of the components may be blended concurrently using a component concentrate (i.e., components plus a diluent, such as a hydrocarbon solvent). The use of a component concentrate takes advantage of the mutual compatibility afforded by the combination of ingredients when in the form of a component concentrate. Also, the use of a concentrate reduces blending time and lessens the possibility of blending errors.

[0036] The formulations described herein were compared to commercially available products to determine if the formulation met or exceeded desirable properties for the formulation. Trade names of the commercially available products compared with the formulation of this disclosure include the following:

WD-40® from WD-40 Company of San Diego, California;
PB BLASTER from Blaster Chemical Companies, Inc. of Valley View, Ohio;
AEROKROIL from Kano Laboratories, Inc. of Nashville, Tennessee;
JB-80 from Justice Brothers, Inc. of Duarte, California;
MEGA POWER 120 from Mega Power, Inc. of Oldsmar, Florida;
LIQUID WRENCH® from Radiator Specialty Company of Charlotte, North Carolina; and
CRC 3-36 from C.R.C. Chemicals U.S.A. of Warminster, Pennsylvania.

[0037] The following tests were conducted on the formulation described herein and the commercially available products listed above:

Demulsification according to ASTM D 1401;
Copper Corrosion according to ASTM D-130;
Rust test according to ASTM D 665B;
Four Ball Wear scar according to ASTM D 2266;
Falex Pin & Vee Block Wear according to ASTM D 2670;
Boundary Friction Coefficient at 40°C by high frequency reciprocating rig (HFRR) test;
Lubricity according to ASTM D 6079;
Falex Extreme Pressure according to ASTM D 3233 (Procedures A and B); and
Dielectric Strength according to ASTM D 877.

[0038] Other tests were conducted for comparison purposes, including a nut and bolt torque test, a steel wool corrosion test, a standard thermogravimetric analysis, and a creep test.

[0039] The nut and bolt torque test was conducted by providing a new tempered steel nut and bolt assembly for each fluid tested. The nut was tightened onto the bolt to exactly 75 ft. lbs. torque. The torque nut and bolt were then submerged in a solution containing a synthetic sea water solution containing additional amounts of NaCl, CaCl and MgCl for two months. Next, the torque nut and bolt were exposed to the environment for two months. Each nut and bolt assembly was then sprayed with a sample of each of the products being tested and were allowed to soak for three minutes. The minimum torque used to loosen the nuts was then determined for each sample.

[0040] The steel wool test was conducted by soaking half of a steel wool sample in each of the products for ten minutes then exposing the steel wool samples to the environment for two weeks.

[0041] The creep test was conducted by soaking a portion of a metal sample in each of the products for thirty minutes whereby the product only covered a portion of each metal sample. After thirty minutes, the samples were removed from the products and the percentage increase in height of the product on the sample versus the initial height of the product on the sample was observed and recorded.

[0042] The standard thermogravimetric analysis was conducted at 210°C under a nitrogen atmosphere to determine the volatile organic content (VOC) of each of the products.

[0043] A non-limiting example of a formulation suitable for use according to the disclosure is set forth in the following table and is referred to hereinafter as HiTEC®503 Performance Additive.

Component	HiTEC® 503 Formulation	
	Concentrate (wt. %)	Fully Formulated Product (wt. %)
HiTEC® 515 (Lubricity/Cu corr.)	35.84	5.00
HiTEC® 152 (Tackifier)	----	0.50
HiTEC® 614 (Ca Sulfonate Deterg.)	35.84	5.00
HiTEC® 536 (Ashless Rust Inhib.)	3.58	0.50
150 Neutral base stock	24.74	23.45
Mineral Spirits	----	65.55
Total	100.00	100.00

[0044] The foregoing concentrate formulation had the following characteristics.

Appearance	Clear Dark Amber Liquid
Color, Neat	6.50
NTU, Neat	4.10
Nitrogen, wt.%	0.08
Phosphorus, wt. %	0.13
Sulfur, wt.%	0.90
Calcium, wt.%	0.93
Silicon, ppm	6.00
Zinc, ppm	6.00
TBN, mg KOH/gram	12.00
Flash Point, °C.	65 (minimum)
Specific Gravity @ 15.6/15.6 °C.	0.905
Viscosity @ 100 °C., (centistokes)	10 - 22

[0045] Results of the various tests conducted on the conventional samples and HiTEC® 503 are contained in the following tables and shown graphically in FIGS. 1-9. In the figures, the following legend is used:

A - HiTEC® 503 - formulation according to the disclosure
B - WD-40®
C - PB BLASTER
D - AEROKROIL
E - JB-80
F - MEGA POWER 120
G - LIQUID WRENCH®
H - CRC 3-36

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
Viscosity @ 40°C	2.58	2.18	1.66	2.11	No reading	1.89	1.63	3.01
D-5950/D97, Pour Point	>-60	-54	-60	-63	-27	----	-24	-53
D130, Copper Corrosion (Modified)								
(3 hrs. @ 100°F)	1b/1b	1b/1b	1b/1b	1b/1b	1b/1b	1b/1b	1b/1b	1b/1b
D92, Flash Point, (COC), °C	64	64	82	64	78	79	82	90
D93 Flash Point, (P-M), °C	48	50	76	60	60	62	64	90
D4052, Specific Gravity	0.8195	0.8095	0.8924	0.8641	0.8604	0.9027	0.8068	0.8161

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
@ 15.6/15.6°C								
D665 B								
Run 1	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass
Run 2	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass
D1401 @ 54°C (oil/water/emulsion)								
Initial	0/0/80	0/0/80	0/5/75	0/30/50	30/27/23	20/27/23	0/0/80	0/0/80
After 24 hrs.	0/0/80	0/0/80	15/35/30	0/35/45	40/40/0	40/37/3	0/36/44	0/15/65
After 72 hrs.	1/0/79	1/0/79	17/38/25	5/30/45	40/40/0	40/37/3	2/36/42	2/20/58
STD. TGA under N_2								
VOC % @ 210°C	67.8315	78.6774	94.6407	92.0908	No Sample	No Sample	No Sample	No Sample

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
D1748 Rust Protection Test (Run 1/Run 2)								
Temperature, °C	49/ (49)	49/ (49)	49	49	49	49	49	49
Duration, hours/ (months)	100 hrs. / (3 mos.)	100 hrs. / (3 mos.)	50	50	50	50	50	50
Number of panels used	2/(3)	2/(3)	2	2	2	2	2	2
Number of passing panels	2/ (6)	2/ (6)	2	2	2	2	2	2
Panel preparation SB = Sandblasted	SB/SB	SB/SB	SB	SB	SB	SB	SB	SB
Rating	Pass(Pass)	Pass(Pass)	Fail	Fail	Pass	Fail	Pass	Pass

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
BT-9 Humidity Corrosion Test								
(100 hours)	Pass	Pass	Fail (25 hrs.)	Fail (25 hrs.)	Pass	Fail (25 hrs.)	Fail	Pass
Mil-L-21260/p4.6.4 Salt Water Immersion								
Temperature during immersion, °C	25	25	25	25	25	25	25	25
Duration of salt water immersion, hours	20	20	20	20	20	20	20	20
Panel preparation SB= Sandblasted	SB	SB	SB	SB	SB	SB	SB	SB
Number of panels	3	3	3	3	3	3	3	3
Number of passing panels	3	3	0	0	3	3	3	3
Rating	Pass	Pass	Fail	Fail	Pass	Fail	Pass	Pass

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
FTM 4001.2M, Salt Spray Test, 24 Hours								
Rating, % (Panel 1 /Panel 2/ Panel 3)	35/30/40	15/10/10	95/95/95	95/95/95	25/30/25	90/90/90	0/0/0	2/1/2001
D2266 4 Ball Wear – FIG. 1 (1200 rpm; 40kg; 90°F; 15 min.)								
Wear scar diameter, mm	0.402	0.642	0.560	0.846	0.502	0.483	0.586	0.475
Dana Wet Bronze Corrosion Test @ 190 Hours								
Visual Rating of Oxidation Tube after 24-	D	D	Not Run	Not Run	Not Run	C	B	D

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
hr. Drain								
Metal Strips Weight Loss (Bronze), mg	0.0014	0.1008	"	"	"	1.1664	0.3230	0.0473
Metal Strips Weight Loss (Iron), mg	3.1009	0.3655	"	"	"	0.0198	0.0002	2.9400
Metal Strip Residue Weight (Bronze), mg	0.5021	0.0163	"	"	"	1.2476	0.0008	0.5087
Metal Strip Residue Weight (Iron), mg	0.0001	0.2335	"	"	"	0.0208	0.0002	0.0755
D3233 Falex EP, Procedure A – FIG. 2								
Actual Load, lbs. (2 run average)	1500	775	448	350	450	Fail @ Break-in	Fail @ Break-in	450
True Load, lbs. (2 run	1213	558	299	234	300			300

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
average)								
D3233 Falex EP, Procedure B – FIG. 3								
Actual Load, lbs. (2 run avg.)	1275	690	450	450	450	Fail @ Break-in	Fail @ Break-in	450
True Load, lbs. (2 run avg.)	1000	500	300	300	300	Fail @ Break-in	Fail @ Break-in	300
D2670 Falex Pin & Vee Block Wear – FIG. 4								
Total Teeth Wear	36	41	40	350	350	60	20	50
D1331A Surface Tension								
Dynes/cm	23.0	24.9	27.8	27.3	27.7	17.4	---	5.1
D1331B Interfacial Tension								

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
Dynes/cm	4.6	4.2	Undetectable tension	1.8	2.5	17.4	----	3.6
D971 Interfacial Tension of Oil Against Water by Ring Method								
Dynes/cm	26.1	24.5	Undetectable tension	1.1	4.4	18.8	2.4	0.7
Film Thickness @ 30°C and 1 m/s (nm)	17	14	18	12	24	24	6	22
Boundary Friction Coeff. By HFRR @ 40°C – FIG. 5	0.082	0.129	0.151	0.162	0.135	0.124	0.111	0.109

	HiTEC® 503 Finished Formulation	WD-40®	PB-BLASTER	AEROKROIL	JB-80	MEGA POWER 120	LIQUID WRENCH	CRC 3-36
D6079 Lubricity by HFRR @ 60°C, 75 min. – FIG. 6								
Wear scar diameter, mm	0.175	0.195	0.250	0.425	0.360	0.180	0.180	0.215
D877 Dielectric Strength – FIG. 7								
Max. Kv	40	32	53	17	No reading	14	40	26
Nut & Bolt Torque – FIG. 8								
Initial Torque, ft-lbs	75	75	75	75	75	75	75	75
Final Torque, ft-lbs	75	80	80	75	120	80	75	90

[0046] As shown by the foregoing table and attached figures, the formulation according to the disclosure has physical properties comparable to commercially available products. For example, the rust protection test (D 1748) and the salt water immersion test provided passing results for the formulation according to the disclosure, as well as the WD-40® lubricant, the JB-80 product, the LIQUID WRENCH® product and the CRC 3-36 product. The other products tested failed the test.

[0047] The D 1748 Rust Protection Test is normally run for 50 hours. As shown in the foregoing table, the formulation according to the disclosure is comparable to WD-40® lubricant and superior to all the other products tested with respect to this test. The formulation according to the disclosure and WD-40® lubricant gave passing results after being tested for 3 months. The other products that passed this test only lasted for the standard 50 hours. The remaining fluids failed the test at 50 hours.

[0048] The D 1401 oil/water/emulsion test was used to show the emulsibility characteristics for each fluid. The formulation according to this disclosure provided a total emulsion that lasted over time which helped to keep water from shedding onto metal parts and causing rust. The WD-40® lubricant was the only other product that was able to achieve this result. All the other products separated immediately into oil, water, and/or emulsion fractions.

[0049] In the humidity corrosion test (BT-9), the formulation according to the disclosure passed along with the WD-40® lubricant, the JB-80 product, and the CRC 3-36 product.

[0050] The lubricity properties of a formulation according to the disclosure are superior to many of the other available products as shown in the table and in FIGS. 1-6. In FIG. 1, the formulation (A) according to the disclosure had the lowest wear scar diameter of the products tested determined by a four ball wear test. In FIGS. 2 and 3, the formulation (A) according to the disclosure had the highest loads according to the Falex extreme pressure tests (procedures A and B). The formulation (A) according to the disclosure had one of the lowest total wear according to the Falex pin and vee block wear test of the products testes (FIG. 4). The formulation (A) according to the disclosure had the lowest wear scar diameter of the products tested by a HFRR (FIG. 5) and one of the lowest wear scar diameters by method D 6079 (FIG. 6). The nut and bolt torque test indicated that the formulation (A) according to the disclosure had comparable, if not superior ability to loosen a rusted nut and bolt (FIG. 8). The creep test (FIG. 8) illustrated that the formulation (A) according to the disclosure had superior ability to penetrate and coat a metal surface.

[0051] At numerous places throughout this specification, reference has been made to a number of U.S. Patents. All such cited documents are expressly incorporated in full into this disclosure as if fully set forth herein.

[0052] The foregoing embodiments are susceptible to considerable variation in its practice. Accordingly, the embodiments are not intended to be limited to the specific exemplifications set forth hereinabove. Rather, the foregoing embodiments are within the spirit and scope of the appended claims, including the equivalents thereof available as a matter of law.

[0053] The patentees do not intend to dedicate any disclosed embodiments to the public, and to the extent any disclosed modifications or alterations may not literally fall within the scope of the claims, they are considered to be part hereof under the doctrine of equivalents.

Claims

1. A composition concentrate for treating metals, said composition having wear-reducing and/or improved corrosion inhibiting properties, the concentrate including from 2 to 5 weight percent ashless acidic rust inhibitor component, from 25 to 50 weight percent neutral alkaline earth metal sulfonate corrosion inhibitor component, from 25 to 50 weight percent phosphorus-based corrosion inhibitor component, and a process oil component, all weights being based on the total weight of the concentrate.

2. The composition of claim 1, wherein the concentrate includes from 20-30 weight percent of the process oil component, based on the total weight of the concentrate.

3. The composition of any one of claims 1-2, wherein the ashless acidic rust inhibitor component includes a reaction product of linear or branched alkyl or alkenyl substituted succinic anhydrides with imidazolines.

4. The composition of any one of claims 1-3, wherein the ashless acidic rust inhibitor component has a total acid number (TAN) ranging from 50 to 60 mgKOH/gram.

5. The composition of any one of claims 1-4, wherein the phosphorus-based corrosion inhibitor component includes a reaction product of phosphorus with dimer-acids.

6. A light duty lubricant composition containing the concentrate of any one of claims 1-5.

7. The light duty lubricant composition of claim 6, wherein the lubricant contains from 10 to 20 percent by weight of the concentrate.

8. The light duty lubricant composition of claim 6, wherein the lubricant contains from 10 to 15 percent by weight of the concentrate.

9. The light duty lubricant composition of any one of claims 6-8, wherein the lubricant further includes a polyolefin tackifier component having a number average molecular weight ranging from 1,000,000 to 2,000,000 grams/mol.

10. The light duty lubricant composition of claim 9, wherein the tackifier component is present in the lubricant in an amount ranging from 0.1 to 1.0 weight percent, based on the total weight of the lubricant.

11. The light duty lubricant composition of any one of claims 6-10, including 0.1-1.0% by weight of the ashless acidic rust inhibitor component, based on the total weight of the light duty lubricant composition.

12. The light duty lubricant composition of any one of claims 6-11, including 2-10% by weight of the neutral alkaline earth metal sulfonate corrosion inhibitor component, based on the total weight of the light duty lubricant composition.

13. The light duty lubricant composition of any one of claims 6-12, including 2-10% by weight of the phosphorous-based corrosion inhibitor component, based on the total weight of the light duty lubricant composition.

14. An aerosol spray package including the light duty lubricant composition of any one of claims 3-13, and an aerosol component.

15. A mist spray package including the light duty lubricant composition of any one of claims 3-13.

16. A method for inhibiting corrosion of a surface of a metal or displacing moisture or water from a surface of a metal to reduce corrosion of the metal, said method including the step of applying a light duty lubricant composition as claimed in any one of claims 6-15 to the surface of the metal.

17. A method for lubricating and protecting moving parts from corrosion including the step of applying to the moving parts, a light duty lubricant composition as claimed in any one of claims 6-15.

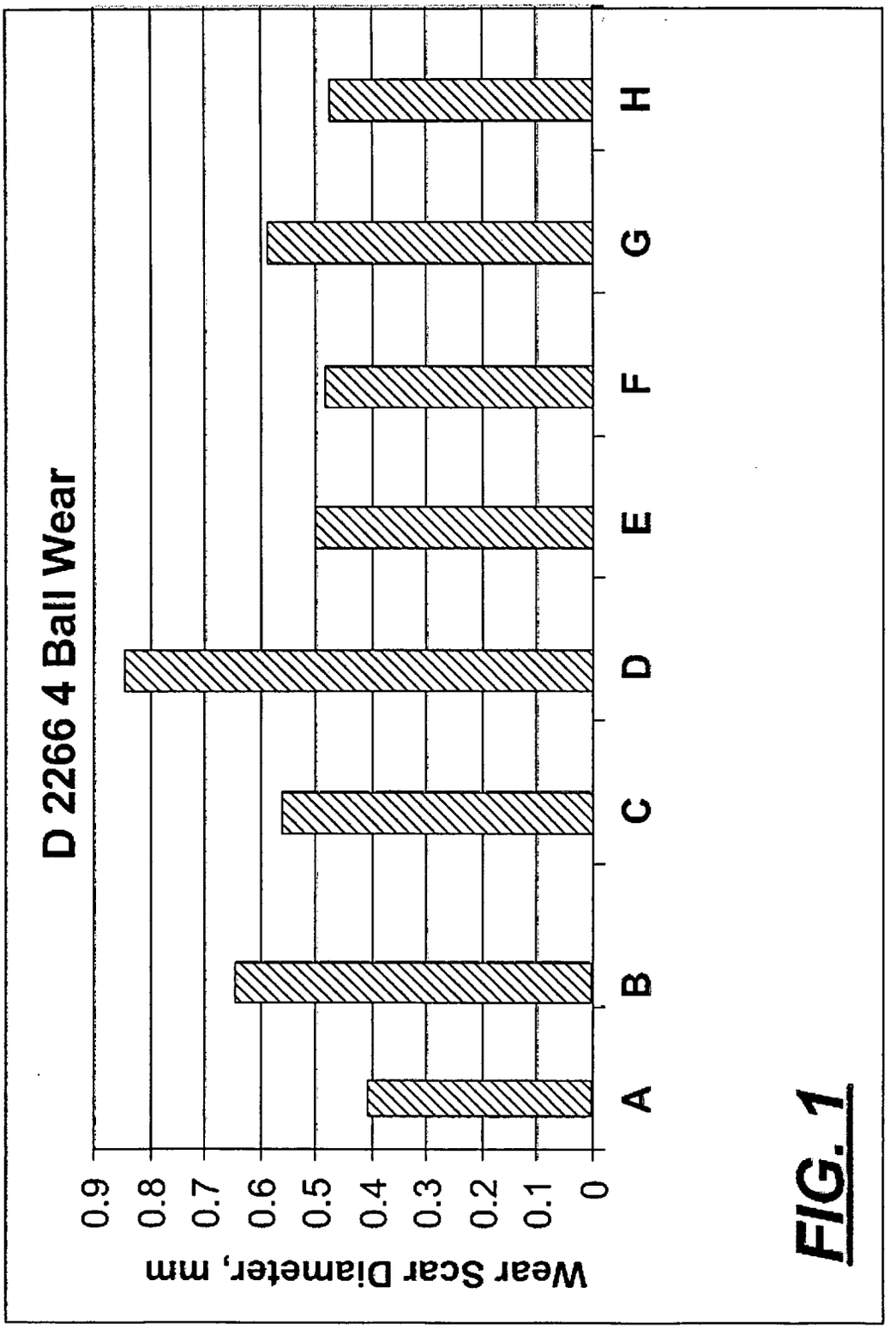

D 2266 4 Ball Wear
Wear Scar Diameter, mm
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
A
B
C
D
E
F
G
H

FIG. 1

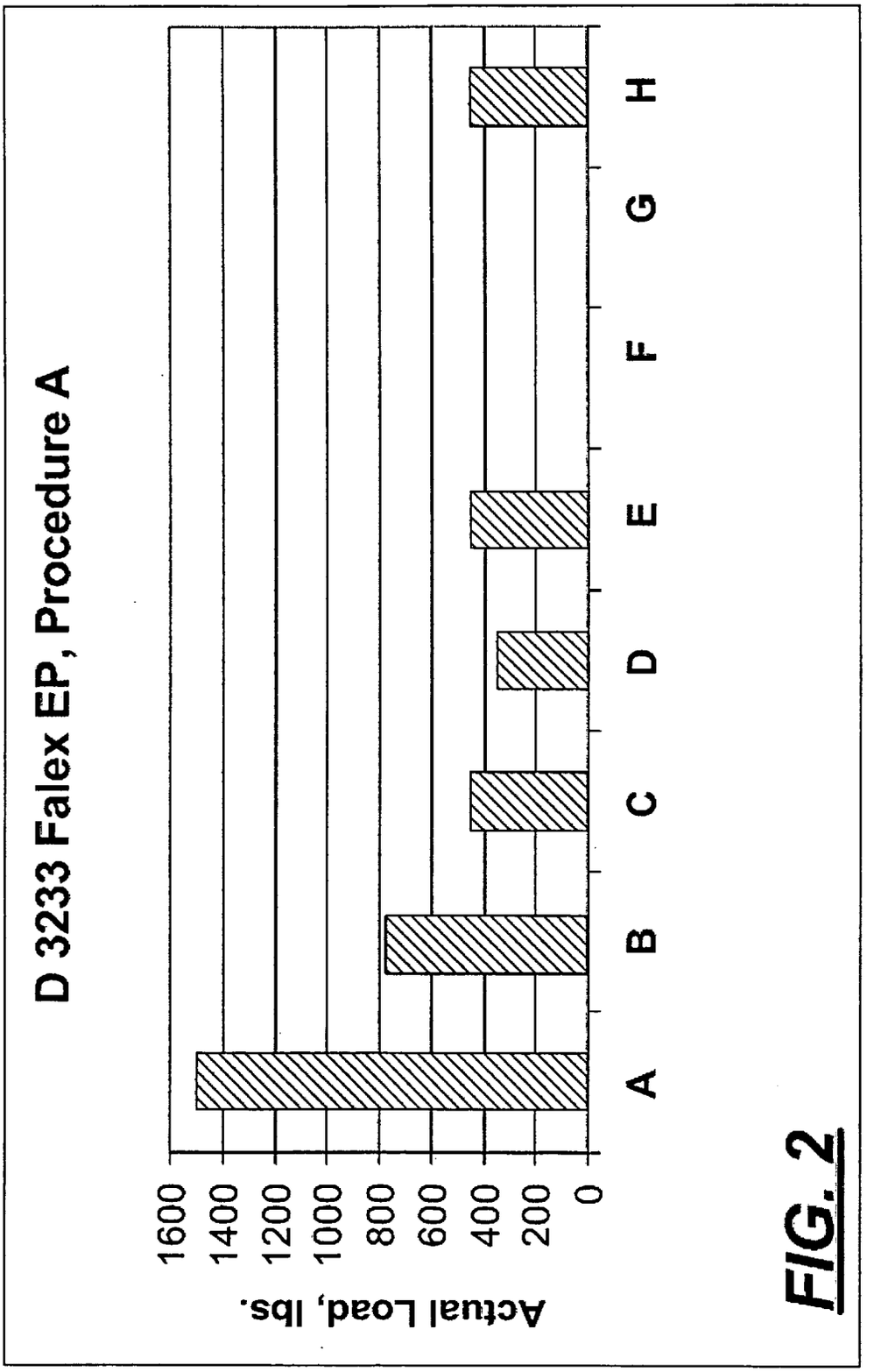

D 3233 Falex EP, Procedure A
Actual Load, lbs.
0
200
400
600
800
1000
1200
1400
1600
A
B
C
D
E
F
G
H

FIG. 2

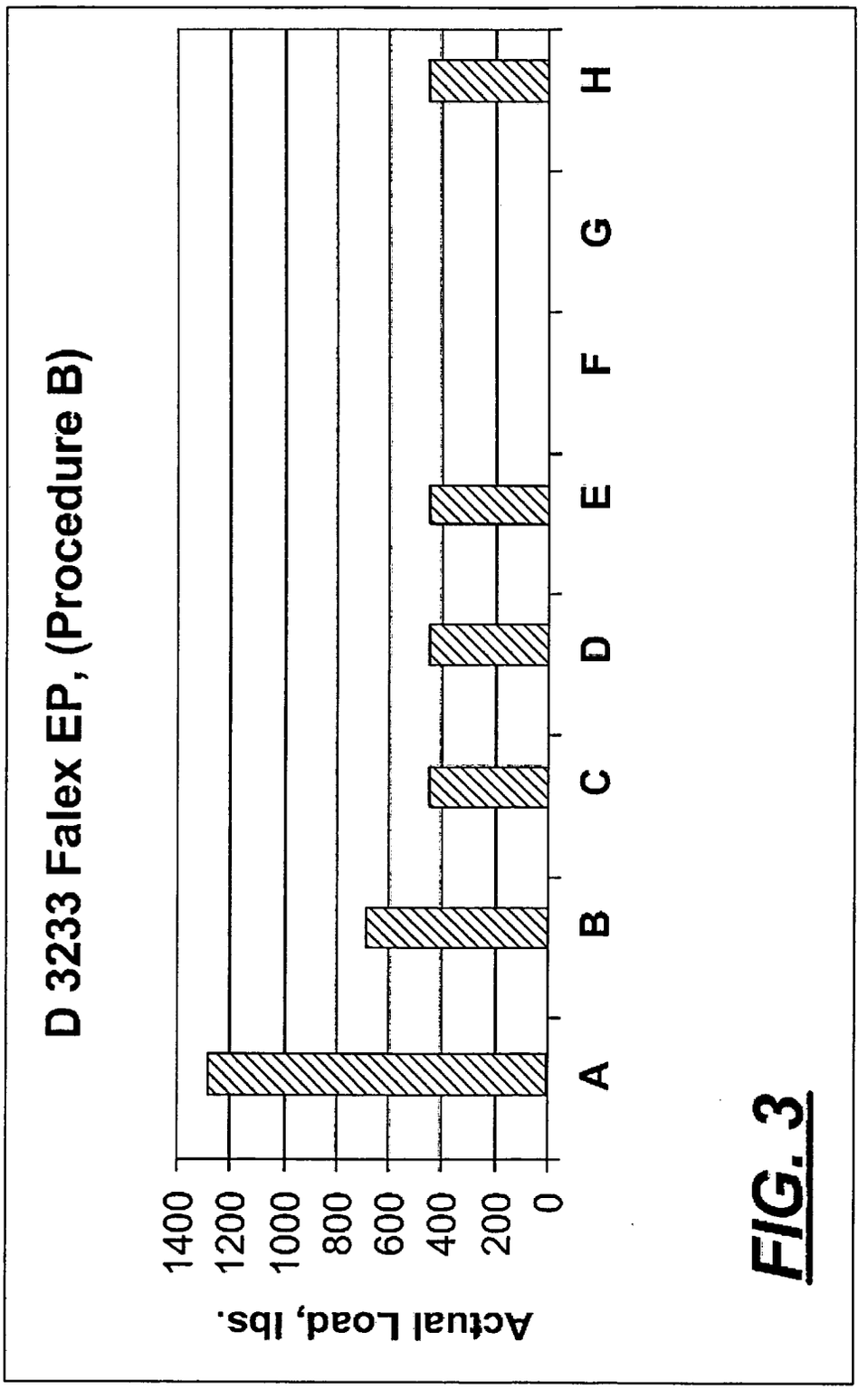

D 3233 Falex EP, (Procedure B)
Actual Load, lbs.
1400
1200
1000
800
600
400
200
0
A
B
C
D
E
F
G
H

FIG. 3

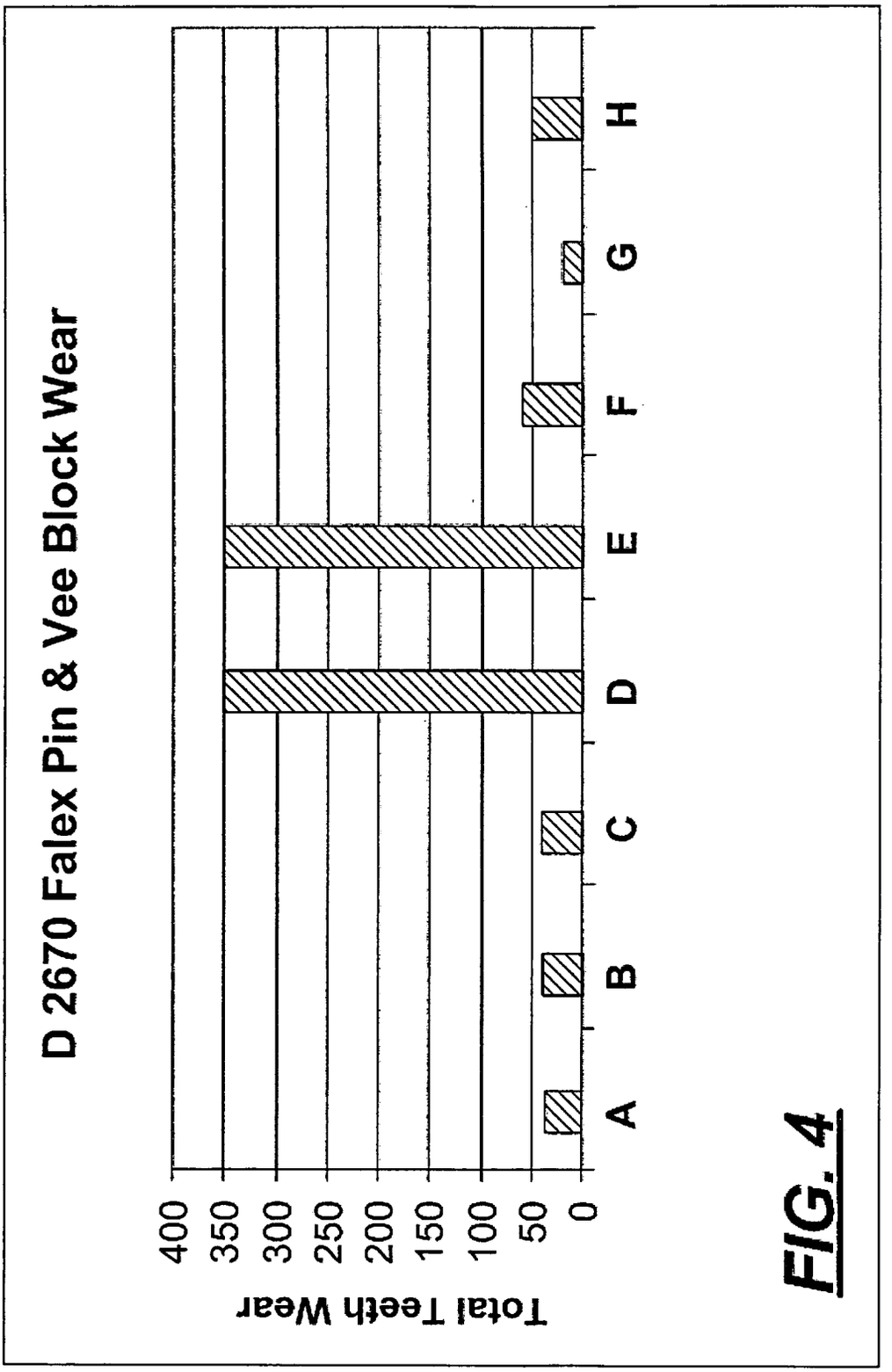

D 2670 Falex Pin & Vee Block Wear
Total Teeth Wear
400
350
300
250
200
150
100
50
0
A
B
C
D
E
F
G
H

FIG. 4

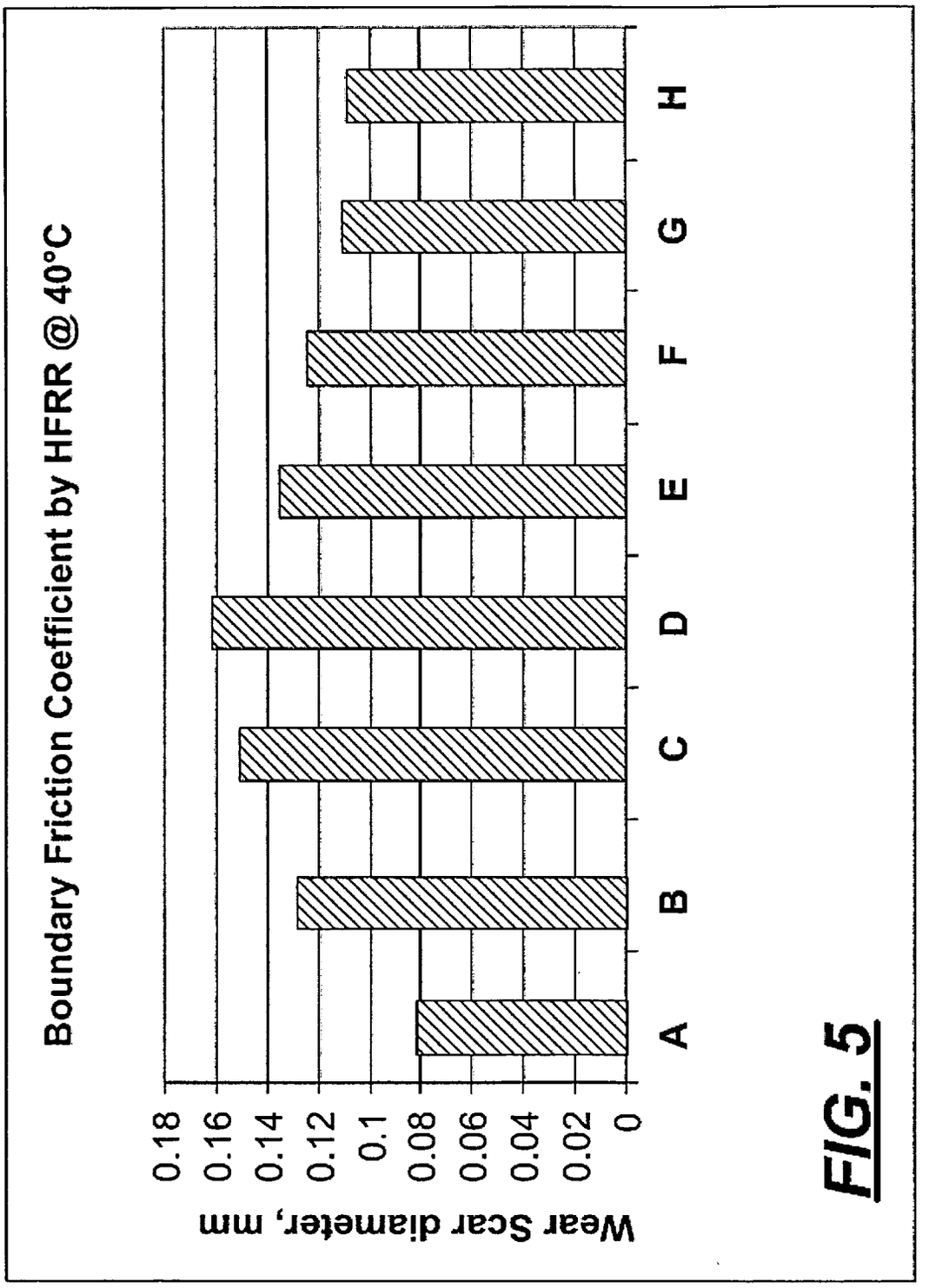

Boundary Friction Coefficient by HFRR @ 40°C
Wear Scar diameter, mm
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
A
B
C
D
E
F
G
H

FIG. 5

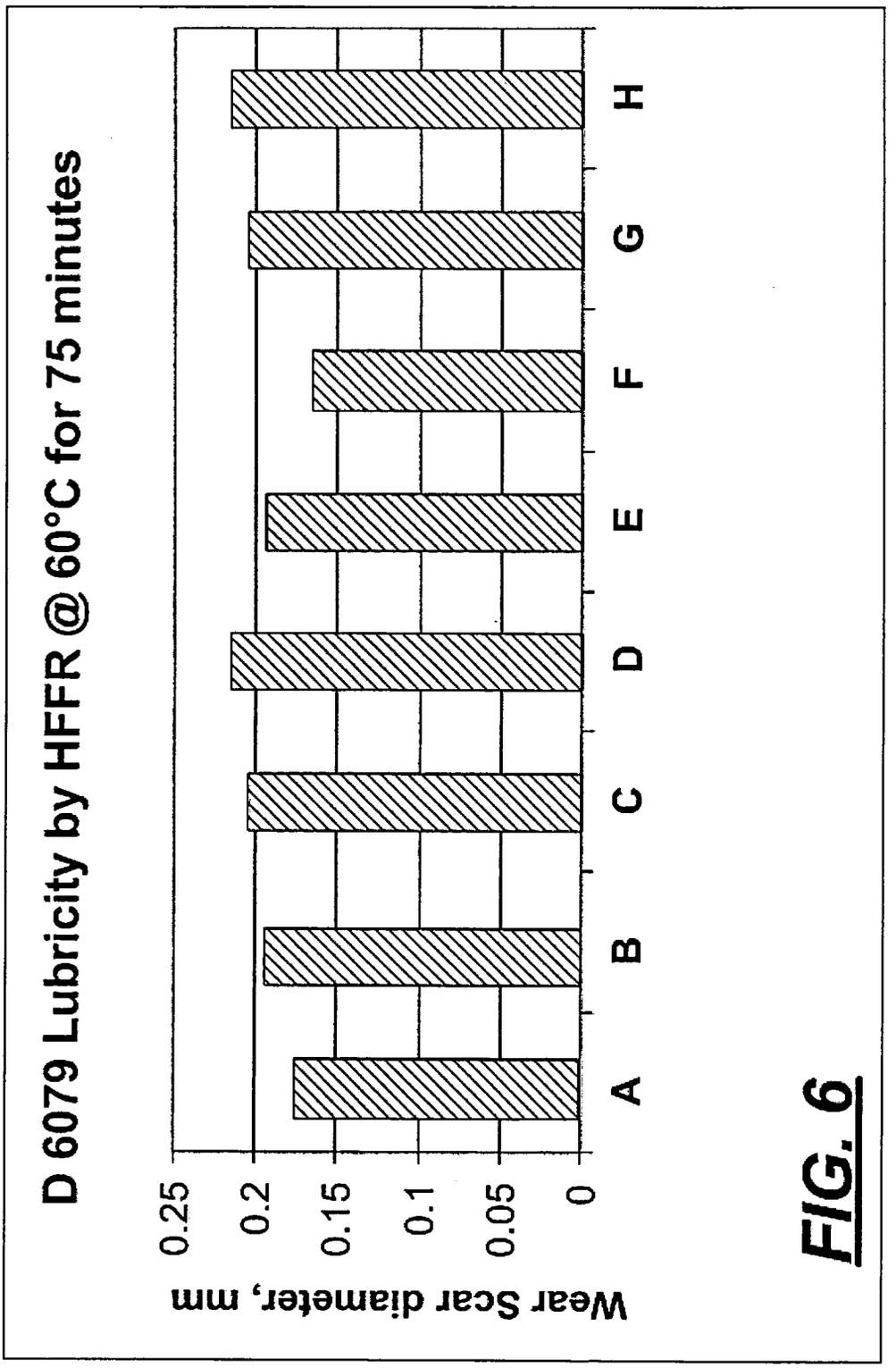

D 6079 Lubricity by HFFR @ 60°C for 75 minutes
Wear Scar diameter, mm
0.25
0.2
0.15
0.1
0.05
0
A
B
C
D
E
F
G
H

FIG. 6

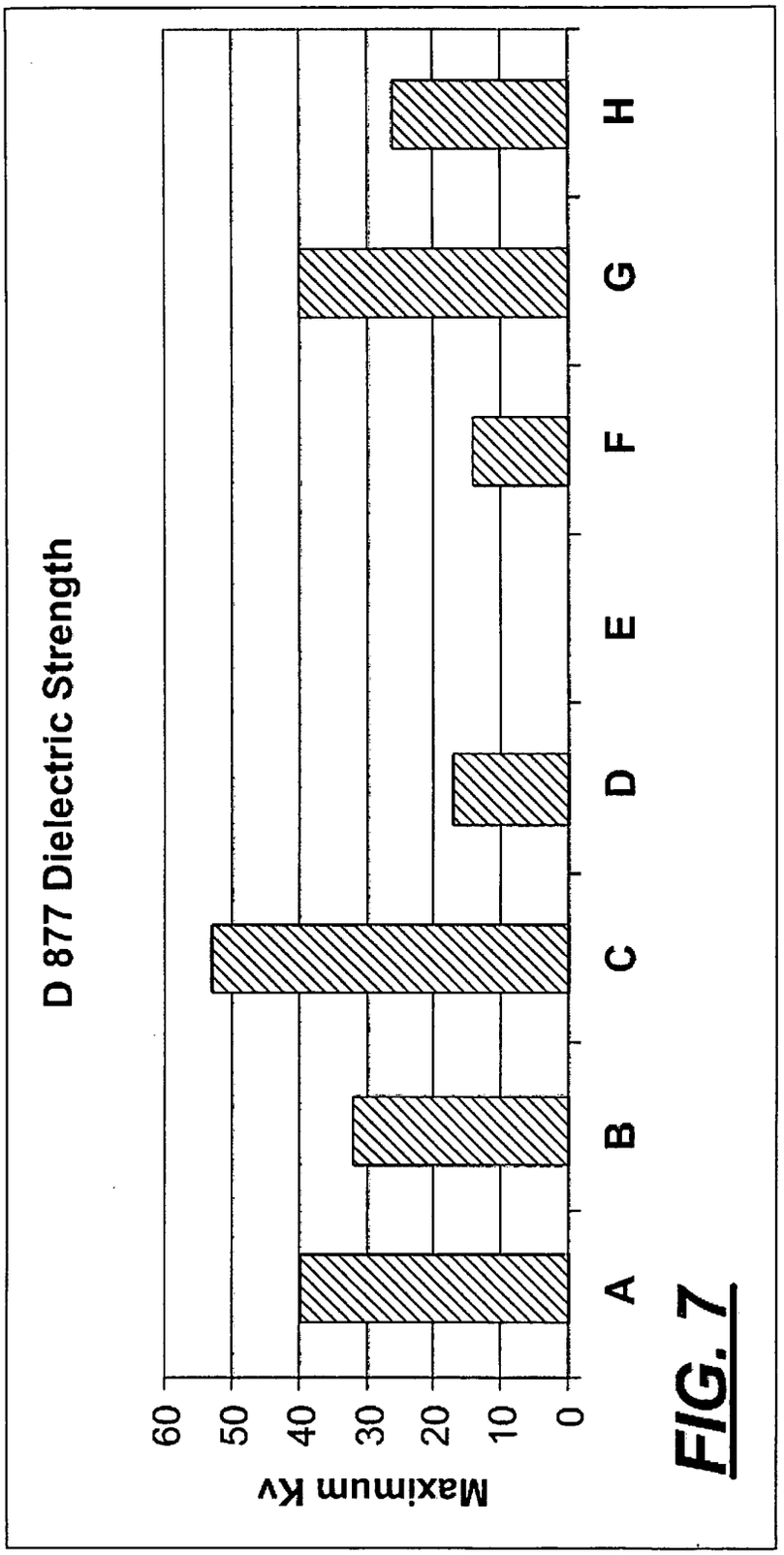

D 877 Dielectric Strength
Maximum kV
60
50
40
30
20
10
0
A
B
C
D
E
F
G
H

FIG. 7

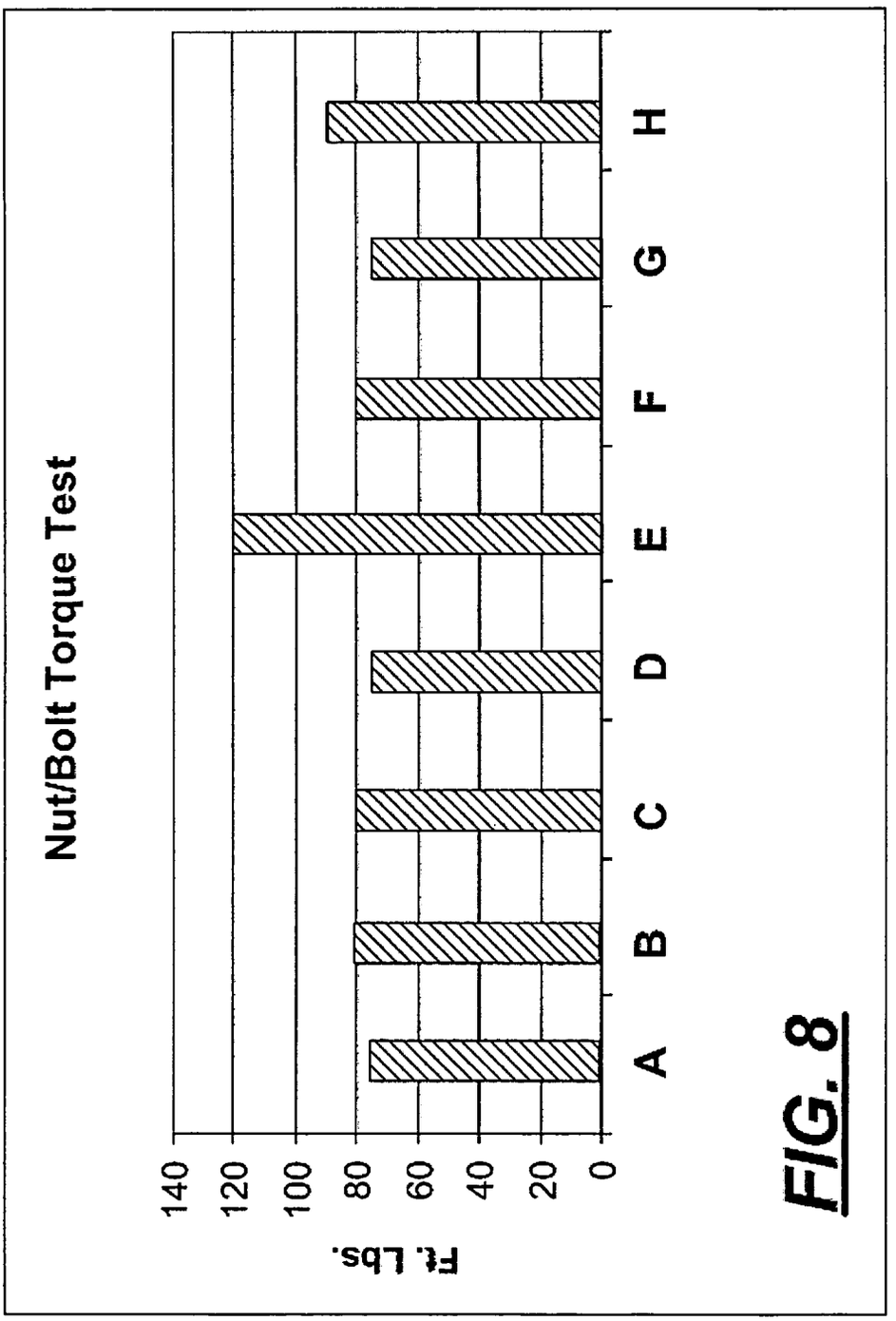


FIG. 8

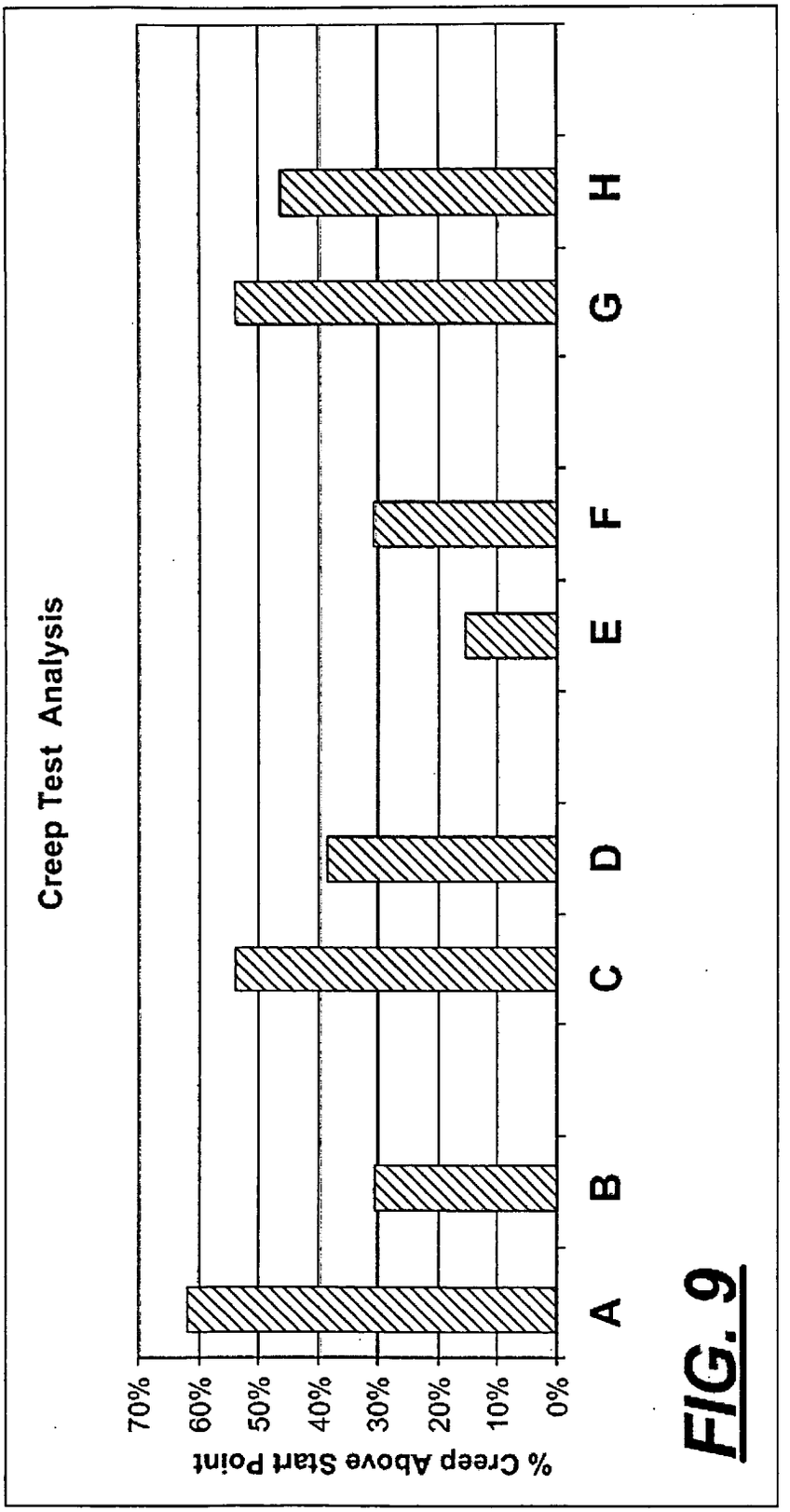

Creep Test Analysis
% Creep Above Start Point
70%
60%
50%
40%
30%
20%
10%
0%
A
B
C
D
E
F
G
H

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 01 1543

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 2 908 649 A (CUNNINGHAM ELIJAH P ET AL) 13 October 1959 (1959-10-13) * column 12, line 49 - column 14, line 23; examples A,X *	1-17	C10M141/10
Y	US 2 693 448 A (LANDIS PHILLIP S ET AL) 2 November 1954 (1954-11-02) * column 1, lines 1-55 *	1-17	
Y	US 3 623 983 A (WARREN C. PATTENDEN ET AL) 30 November 1971 (1971-11-30) * the whole document *	1-17	
A	EP 0 699 741 A (AMWAY CORPORATION) 6 March 1996 (1996-03-06) * page 3, lines 12-23; table 1 *	1-17	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

C10M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 October 2005	Kazemi, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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EPO FORM 1503 03.82 (P04C01)

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17-10-2005

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		US 5534173 A	09-07-1996

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