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(54) **NON-HALOGENATED METAL CONDITIONER AND EXTREME PRESSURE LUBRICANT**

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(57) **ABSTRACT**

There are disclosed compositions for use as extreme pressure lubricants for use in general machinery as well as in the refrigerant of air conditioners, refrigerators and heat pumps. The compositions are designed to lubricate moving parts of machinery. In its broadest aspect the invention comprises a metal conditioner containing a lubricating oil and a bismuth compound. A further embodiment involves a lubricating oil, a bismuth compound and a molybdenum compound. The lubricating compounds can be added to a refrigerant gas.

NON-HALOGENATED METAL CONDITIONER AND EXTREME PRESSURE LUBRICANT

FIELD OF THE INVENTION

[0001] The herein disclosed invention finds applicability in the field of extreme pressure lubrication. Examples of areas needing this type of lubrication are machinery in general and particularly refrigeration and air-conditioning systems, heat pumps and compressors wherein the lubricant is added to circulate in the compressor system reservoir and bearing surfaces, etc.

BACKGROUND OF THE INVENTION

[0002] There is a need in industry for a lubricating and/or conditioning system for lubricating metal surfaces, especially in refrigeration and air conditioning systems. It is desirable that the lubricating system be free of chlorine, sulfur, and fluorine which have the potential of combining with hydrogen to produce hydrochloric, sulfuric, and hydrofluoric acid, respectively.

[0003] In the field of specialty lubrication, active elements such as sulfur, chlorine, fluorine, lead, etc. have been used to provide extreme pressure (EP), anti-wear, anti-friction properties. In this era of increased environmental concerns, the use of these types of elements, regardless of their ability to improve lubrication performance, adds to the hazardous waste stream and increases the cost of production if used in industry.

[0004] In some cases, chemical compound break-down can release the element to form other compounds which are corrosive, such as sulfuric acid, hydrochloric acid, etc.

[0005] Prior Art U.S. Patents

[0006] Wilkins, et al (U.S. Pat. No. 4,963,280) teaches compositions for improving the efficiency of heat pumps, refrigeration units, air condition and heating units. The patentees do this by employing a polar organic compound which is defined as being an organic compound containing sufficient polar groups to provide regions on the molecule which have regions of high electron densities and other regions which have low electron densities. The preferred polar compounds are liquid halogenated α-olefins and liquid halogenated paraffins.

[0007] Karol, et al (U.S. Pat. No. 5,576,273) teaches a synergistic mixture of a dithiocarbamate and organic bismuth compounds to have good extreme pressure properties and to be useful in lubricating compositions.

[0008] Karol et al (U.S. Pat. No. 5,631,214) teaches the preparation of bismuth dithiocarbamates for use as extreme pressure additives.

[0009] Sgarbi, et al (U.S. Pat. No. 6,276,147) teaches a polar solution for air conditioning and refrigeration containing a dithiocarbarnate and a calcium salt.

[0010] Sgarbi, et al (U.S. Pat. No. 6,286,323) teaches compositions for improving air conditioning and refrigeration systems containing a polar compound, dithiocarbamates, β-olefin (see claim 1) and other ancillary components are set forth.

[0011] Roberts (U.S. Pat. No. 6,110,877) teaches an extreme pressure lubricant composition containing amongst other ingredients bismuth compounds and a polyalphaolefin (e.g., 1-decene homopolymer).

[0012] Rowan et al (U.S. Pat. No. 4,889,647) sets forth molybdenum compounds useful in lubricants.

OBJECTS OF THE INVENTION

[0013] A principal object of this invention is to produce an active, polarized refrigerant oil additive and extreme pressure lubricant which will significantly improve heat transfer in the condenser and evaporator coils of a refrigeration system.

[0014] A further object of this invention is to produce a lubricant which efficiently functions as an extreme pressure lubricant in the compressor unit of refrigerators, chillers, freezers, heat pumps and air conditioners.

[0015] An important object of the invention is to provide an active, polarized refrigerant oil additive and extreme pressure lubricant that does not contain halogen or sulfur as the polarizing agent.

[0016] An additional object is to produce an extreme pressure lubricant which is environmentally friendly.

[0017] A main object of this invention is to produce an extreme pressure lubricant which will efficiently lubricate the metal surfaces of a compressor system.

[0018] An important object of the invention is to provide an extreme pressure lubricant for refrigerants that does not contain halogen or sulfur as the polarizing agent.

[0019] A significant object of this invention is to produce a composition when properly used will decrease energy use, boost lubricity between metal to metal contact and increase efficiency.

[0020] These and other objects of the present invention will become apparent from a reading of the following specification.

[0021] Identification and/or Source of Components of the Inventive Polarized Additive, Metal Conditioner and Extreme Pressure Lubricant are:

Component	Identification
Polyalphaolefin Base Oil	CAS: 88037-01-4
Methyl Ester Base oil	CAS: 68082-78-0
Fatty Acid Ester Base Oil	CAS: 68424-31-7
Bismuth Carboxylate	CAS: 34364-26-6 26896-20-8
Viscosity Improver (Paratone ™ 8232)	Copolymer of Ethylene & Propylene (Olefins)
Antimony Dialkyldithiocarbamate	VANLUBE ™ 73 (mixture)
Zinc Alkyldithiophosphate	LUBRIZOL ™ 5178-F (mixture)
Organomolybdenum complex of Organic Amide	MOLYVAN 855 (mixture)
Dialkyldithiocarbamate Ester with Bismuth Carboxylate	OD-9413 (mixture)
Epoxidized Triglyceride Acid Scavenger/Stabilizer	Plas-Check 775 ™

[0022] Olefin blend can be obtained as polyalphaolefin under the trade names Ethyl Flo 166, Durasyn 166 or Synfluid PAO6 (Chevron-Phillips Co.).

[0023] Examples of operative bismuth carboxylates are bismuth neo-decanoate (CAS: 34364-26-75), bismuth 2-ethylhexanoate and bismuth naphthenate or mixtures of these bismuth compounds and are available from OMG™ Cleveland, Ohio or R. T. Vanderbilt™ of Norwalk, Conn.

[0024] Polyalphaolefin is a hydrogenated synthetic hydrocarbon base fluid supplied by the Ethyl™ Corporation and has a CAS registry number of CAS: 68037-014.

[0025] Amoco™ supplies 1-decene, Homopolymer Hydrogenated and has a CAS No. 88037-01-4.

[0026] Examples of fatty acid base oils CAS: 68082-78-0, synonsym: methyl lardate, available from Ferro Corporation, Hammond, Ind.

[0027] Example of penteryiitol esters of C_5-C_{10} fatty acid are CAS: 68424-31-7.

[0028] Molybdenum compound can be obtained from R T. Vanderbilt™ under the designation Molyvan 855.

[0029] Dialkyldithiocarbamate Ester with Bismuth Carboxylate can be obtained from R. T. Vanderbilt™ under the designation OD-9413.

[0030] Epoxidized triglyceride can be obtained from Ferro™ as Plas-Check 755™.

[0031] Further examples of the active components used in the lubricant and metal conditioner of this invention are to be found in U.S. Pat. No. 6,110,877 and bismuth carboxylates are to be found in U.S. Pat. No. 5,576,273.

[0032] Exemplary of the refrigerant gas to which the lubricant metal conditioner is to be added are CFC, HCFC and HFC:C=carbon, F=fluorine, H=hydrogen). The refrigerant gases are conventional in the art, and specific examples are fluoropropane and fluorobutane. Additionally, this invention is compatible with refrigerants from the Freon series and their updated replacements, as well as the Methane series, the Ethane series, and the Propane series, Ammonia, Sulfur Dioxide and Carbon Dioxide gasses.

BRIEF SUMMARY OF THE INVENTION

[0033] In its broadest aspect the herein disclosed invention is directed to the incorporation of effective amounts of a bismuth compound into the refrigerant oil reservoir or the refrigerant gas of a cooling system such as chillers, coolers, refrigeration plants, air conditioners, refrigerators and heat pumps. Generally speaking, the bismuth compound would be added along with a lubricant to the refrigerant gas or oil. In preferred embodiments, the bismuth compound will be present at about 5 to 10 percent of the lubricating or refrigerant oil, however, the optimum effective amounts could be determined by those skilled in the art. It is expected that the addition of a polarized lubricating oil and bismuth compound to refrigerant gas will boost metal-to-metal lubricity producing a decrease in energy consumption and an increase of over-all efficiency of the cooling equipment in which the polarized bismuth compound which is non-toxic is employed. The bismuth containing lubricating composition is intended to prolong the life of compressors used in cooling equipment.

[0034] It is anticipated that dye tracers and/or bactericides may be added to the bismuth containing lubricant composition.

[0035] Broadly considered the herein disclosed non-halogenated metal conditioner and extreme pressure lubricant additive useful in refrigerant gas comprises effective amounts of:

[0036] a lubricant

[0037] bismuth carboxylate polarized extreme pressure additive,

[0038] an antimony dialkyldithiocarbarnate anti-wear additive,

[0039] a viscosity improver,

[0040] and a molybdenum compound anti-friction additive,

[0041] optionally, a dialkyldithiocarbamate ester with bismuth carboxylate,

[0042] and/or an acid scavenger/stabilizer together in the compressor gas of a cooling unit.

[0043] The lubricant may comprise:

[0044] a polyalphaolefin base oil,

[0045] a methyl ester base oil,

[0046] a fatty acid ester base oil.

[0047] The herein disclosed lubricant composition is directed to a non-halogenated (no chlorine, fluorine, bromine, iodine, or astatine) metal conditioner/extreme pressure lubricant additive system, for use in the conditioning or lubricating of metal surfaces. This formulation is unique in that it is free from chemical elements of the Halogen Group, particularly chlorine and fluorine, which are known to combine with hydrogen and form highly undesired (corrosive) hydrochloric acid and hydrofluoric acid respectively. Applications of the invention include but are not limited to use as a Polarized Refrigerant Additive Oil (PROA) in consumer, industrial, commercial, military, and federal sector refrigeration and air conditioning systems, chillers and heat pumps and compressors. Use of this additive system as a PROA provides (1) significantly improved heat transfer in the evaporator and condensing coils, and (2) increased lubricity of refrigerant oils, significantly enhancing compressor operation and efficiency. The additive system is blended into the refrigerant oil reservoir or refrigerant flow as appropriate to the equipment design. When used as a polarized refrigerant oil and lubricant additive, the composition of this invention is carried with the primary lubricant and moves throughout the system. The polar nature of the formula refers to the covalent molecular bonding which takes place between the negatively charged additive molecules and the positive charge of the metal surfaces. As each molecule attaches itself to metal surfaces within the system, it conditions these surfaces, displacing dirt, carbon deposits (coking), and lubricating oil build-up, eventually forming a thin, one molecule thick layer of the additive system. This provides the optimal conditions for efficient thermal conductivity within the heat exchanger systems of refrigeration/air conditioning equipment. Additionally, as a polar (molecular bonding) extreme pressure lubricant, it provides greatly enhanced lubrication to moving parts of refrigeration equipment.

[0048] The lubrication system may include in combination, a polyalphaolefin base oil, a methyl ester base oil, a

fatty acid ester base oil (individually or as a mixture), a bismuth carboxylate polarized extreme pressure additive, a viscosity improver, a molybdenum anti-friction additive, and optionally, an additional bismuth compound additive, and/or an acid scavenger/stabilizer. In an embodiment when in operation, the lubricant additive system is present in a minor quantity and the primary lubricating oil or refrigerant is present in a major quantity, based on weight. In a preferred embodiment, the bismuth carboxylate is selected from the group of bismuth neodecanoate, bismuth 2-ethylhexanoate, bismuth naphthenate and mixtures thereof. The polyalphaolefin base oil is from about 20 to 40 percent of said additive system and preferably from about 28 to 38 percent of the additive system. The methylester base oil is from about 15 to 35 percent of the additive system and preferably from about 24 to 33 percent of said system. The fatty acid ester base oil is from about 1 to 10 percent of said additive system and preferably from about 2 to 5 percent of the additive system. The bismuth carboxylate is present in the range from about 20 to 40 percent, and preferably from about 23 to 32 percent. About 1 to 8 percent of an olefin blend is employed in the system as a viscosity improver, preferably in the amount from about 3 to 5 percent of the additive system as a copolymer of ethylene and propylene. A molybdenum compound may be introduced from about 0.1 to 8 percent of the system. Optionally, an additional bismuth compound may be introduced from about 0.1 to 8 percent of the system. Optionally, about 1 to 3 percent of an epoxidized triglyceride may be employed in the system as an acid scavenger and/or stabilizer.

[0049] Note particularly that the lubricant composition does not contain chlorine or sulfur compounds which would adversely affect the components of the air conditioner, refrigerator or heat pump.

[0050] In a preferred embodiment of this invention, there is envisioned the following composition for addition to the refrigerant of the compressor of, for example, air conditioners, refrigerators and heat pumps in approximately the following proportions:

Component	Percent
Polyalphaolefin Base Oil	32.58
Methyl Ester Base oil	28.00
Fatty Acid Ester Base Oil	3.06
Bismuth Carboxylate	27.00
Viscosity Improver (Paratone ™ 8232).	4.00

[0051] To this preferred embodiment, optional alternative ingredients can be added to tailor the product to a particular industry, application or customer. For example, epoxidized triglycerides 1-2 percent can be added. Another component contemplated for use is an anti-microbial biocide as, for example, ionic silver.

[0052] A special embodiment of this invention includes the addition of a tracer dye, e.g., fluorescent tracer dye, to the lubricant which is to be supplied to the refrigerant of the cooling unit.

[0053] While the invention has been defined in terms of air conditioners, refrigerators or heat pumps, the invention is intended to cover like devices which involve refrigerant gases.

[0054] An elegant embodiment of this invention involves a lubricating composition for lubricating gear boxes as well as a lubricating composition for compressors. Broadly considered this elegant composition comprises effective amounts of bismuth compound, molybdenum compound and lubricating oil as for example:

Component	Percent
Lubricating oil	40–70
Bismuth compound	20–40
Molybdenum compound	1–20

[0055] In addition, a zinc compound can be added to this composition in the range of 0.1-2%. An antimony compound may be added in the range of 1-10%. The composition may also be added to a refrigerant gas and can also be accompanied by a tracer to detect leaks. Antimicrobial agents may be added as a preservative. In this latter respect, silver containing antimicrobial agents are preferred. A viscosity improver with an SAE iso-number of 32-68 would be an operative additive for the composition.

[0056] A specific preferred embodiment of the conditioner-lubricating composition involves:

Component	Percent
Bismuth compound	30
Molybdenum compound	6
Lubricating oil	64

[0057] Rowan et al (U.S. Pat. No. 4,889,647) is exemplary of molybdenum compounds useful in the herein disclosed invention and is incorporated by reference to show the same.

[0058] The amounts of the ingredients set forth herein are exemplary and could be varied somewhat as readily understood by those skilled in the art. Effective amounts of the ingredients could also be determined by those skilled in the art.

[0059] In general, any type of lubricant or lubricating oil would be appropriate. The terms lubricant and lubricating oil may be used interchangeably.

[0060] Obviously, many modifications may be made without departing from the basic spirit of the present invention. Accordingly, it will be appreciated by those skilled in the art that within the scope of the appended claims, the invention may be practiced other than has been specifically described herein.

What is claimed is:

1. A non-halogenated metal conditioner and extreme pressure lubricant additive useful in the refrigerant gas of an air conditioner, refrigerator or heat pump comprising in combination a refrigeration gas, effective amounts of a lubricant and a bismuth compound.

2. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein the lubricant comprises a polyalphaolefin base oil.

3. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein the lubricant a mixture polyalphaolefin base oil, methyl ester base oil and fatty acid ester base oil.

4. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein the bismuth compound is a bismuth carboxylate.

5. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 4 wherein the bismuth carboxylate is selected from the group of bismuth neodecanoate, bismuth 2-ethylhexanoate, bismuth naphthenate and mixtures thereof.

6. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein there is added a composition of (a) a bisdithiocarbamate and (b) a bismuth compound of carboxylates, dithiocarbamates, and phosphorodithioates.

7. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein there is added a molybdenum compound as an anti-friction additive.

8. The non-halogenated metal conditioner and extreme pressure lubricant additive of claim 1 wherein there is added a tracer dye to aid in leak detection.

9. A method for enhancing lubricity of a refrigeration unit comprising adding the composition of claim 1 to said refrigeration unit.

10. A non-halogenated metal conditioner and extreme pressure lubricant additive useful in refrigerant gas comprising effective amounts of:

a lubricating oil,

a bismuth carboxylate polarized extreme pressure additive,

a viscosity improver,

a molybdenum compound anti-friction additive,

and/or an acid scavenger/stabilizer together in the compressor gas of a cooling unit.

11. A non-halogenated metal conditioner and extreme pressure lubricant additive useful in the refrigerant gas comprising the following:

Component	Percent
Lubricating oil	64.00
Bismuth Carboxylate	27.00
Viscosity Improver	4.00
Molybdenum compound	5.00

12 The non-halogenated metal conditioner and extreme pressure lubricant additive useful in compressor refrigerant gas of claim 1 wherein the following ingredients are present on a weight basis:

lubricating oil 40 to 70 percent

bismuth carboxylate is present in the range from about 20 to 40 percent,

about 1 to 8 percent of an olefin blend is employed in the system as a viscosity improver, as a copolymer of ethylene and propylene,

a molybdenum compound may be introduced from about 0.1 to 8 percent,

optionally, about 1 to 3 percent of an epoxidized triglyceride may be employed in the system as an acid scavenger and/or stabilizer,

optionally, an additional bismuth compound may be introduced from about 0.1 to 8 percent.

13. The non-halogenated metal conditioner and extreme pressure lubricant additive useful in compressor gas of claim 1 wherein the following ingredients are present on a weight basis:

polyalphaolefin base oil is from about 28 to 38 percent,

methyl ester base oil is from about 24 to 33 percent,

fatty acid ester base oil is from about 2 to 5 percent,

bismuth carboxylate is present in the range from about 23 to 32 percent,

about 3 to 5 percent of an olefin blend is employed in the system as a viscosity improver,

as a copolymer of ethylene and propylene,

a molybdenum compound may be introduced from about 0.1 to 8 percent,

optionally, about 1 to 3 percent of an epoxidized triglyceride may be employed in the system as an acid scavenger and/or stabilizer.

14. A non-halogenated metal conditioner and extreme pressure lubricant comprising effective amounts of:

Bismuth compound.

Molybdenum compound, and

Lubricating oil.

15. The non-halogenated metal conditioner and extreme pressure lubricant of claim 14, comprising:

Component	Percent
Bismuth compound	20–40
Molybdenum compound	1–20
Lubricating oil	40–70.

16. The non-halogenated metal conditioner and extreme pressure lubricant of claim 15 comprising:

Component	Percent
Bismuth compound	30
Molybdenum compound	6
Lubricating oil	64.

17. The non-halogenated metal conditioner and extreme pressure lubricant of claim 14 further comprising a refrigerant gas.

18. In the method of operating an apparatus having a refrigerant gas circulating therein, wherein a lubricant is

added to the refrigerant gas to provide extreme pressure, anti-wear and anti-friction properties, the improvement comprising the step of adding effective amounts of bismuth compound to the lubricant in lieu of halogens or sulfur compounds as the polarizing agent, thereby substantially reducing corrosion and environmental problems while concurrently improving the efficiency, life and reliability of the apparatus.

19. In the method of claim 18 wherein the improvement further comprises the step of adding effective amounts of a molybdenum compound to the lubricant.

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