

UNITED STATES PATENT OFFICE

2,389,227

PNEUMATIC TOOL LUBRICANT

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This invention relates to a new and improved lubricant for pneumatic tools, such as percussion type drills and similar high speed compressed air machines and steam machines. More particularly, this invention relates to a lubricating composition comprising mainly a viscous hydrocarbon oil blended with minor proportions of a non-drying thickened fatty oil and of a high molecular weight linear organic oxygen-containing polymer for providing efficient lubrication to surfaces of fast moving machine parts and to their guides, such as rapidly reciprocating pistons and their cylinder walls, the lubricant on such surfaces being exposed during the machine operation to erosive action by forceful streams of gases and condensate which accompany the use of gases like compressed air or steam.

Pneumatic tools present peculiar problems in lubrication. In general, they are rugged portable machines subjected to rough handling. Although they need constant and efficient lubrication at all times, they cannot be equipped very easily with automatic lubricant feeding systems which are delicate or which have large supply reservoirs. Added difficulties in lubricating these machines arise from the rapid jarring movements of, and high gas velocities against lubricated parts, since these mechanical actions tend to separate the lubricant from the metal surfaces. Variations of temperatures occur in different parts of these machines. Gas expansion causes intense cooling in the surrounding parts and condensation of water vapor present in the usual gaseous or pneumatic fluids, compressed air and steam, while impacts and friction cause relatively intense heating in other parts. Moisture condensed from a pneumatic fluid in the machine tends to wash away a film of lubricant non-resistant to this action, and temperature variations affect the fluidity of lubricants which have viscosities sensitive to these variations. When used outdoors and in mines, these machines are subject to environmental temperatures which intensify these temperature variations. Lubricants are undesirable if they flow too freely over the heated parts of the tool, also, if they have sufficiently high viscosity in contact with the heated parts but congeal in contact with cooler parts or in the lubricator.

Materials have been compounded in the past to make lubricants having advantageous properties in one respect or another, but lubricants with the desired combinations of qualities, particularly those of adhesiveness and moisture resistance have not been available. In my prior Patent 2,228,429, I have disclosed and claimed a pneumatic tool lubricant which satisfies the above requirements, but the present invention is a still further improvement over said prior element.

An object of the present invention is to pro-

vide a pneumatic tool lubricant with which can be achieved a high standard of lubricating efficiency and economy in a wide range of operating conditions. From careful study and experience, this object is best attained by compounding a lubricant which possesses specially combined properties of: 1, high viscosity index, 2, oxidation resistance, 3, correct viscosity for penetration between moving surfaces of finely machined parts, 4, ability to be atomized readily into the air line of a line lubricator, 5, ability to wet a metal surface in the presence of water without becoming churned to a foamy mass, 6, ability to resist moisture and adhere to metallic surfaces even when emulsified, and 7, other qualities determined by specific requirements of the service.

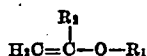
In accordance with the objects of this invention, an improved lubrication of pneumatic tools is obtained by a composition which is able to give a lubricating film protection on working parts under rapid mechanical action regardless of moisture deposition.

Broadly, this invention involves the blending of a viscous hydrocarbon oil, such as a petroleum lubricating oil fraction, with a non-drying viscous oxidized or thickened fatty oil and with a small amount of an oxygen-containing high molecular weight polymer which normally is substantially solid. By a proper selection and proportioning of these ingredients, a blend can be obtained having suitable viscosity and pour point characteristics to assure proper flowing and penetration and which protectively stays on rubbing surfaces under severe operating conditions.

Preferably, the principal ingredients of blends found to have wide adaptability for use in many kinds of air driven percussion type tools including outdoor equipment during all seasons of the year are a mineral lubricating oil having a viscosity in the range of about 100 to 925 Saybolt seconds at 100 degrees F. and a pour point below about +10° F., a non-drying thickened fatty oil, and a semi-solid to solid adhesive high molecular weight polymer. As the mineral oil ingredient, a lubricating oil fraction from a naphthenic crude, such as from a Colombian or Coastal crude, answers the purpose well, although, if desired, one may use lube oils derived from other types of crude, such as asphaltic, paraffinic, mixed base, etc., provided they are selected or treated, as by dewaxing, etc., to have a suitable low pour point. Blown rape seed oil is particularly suitable as the non-drying thickened fatty oil.

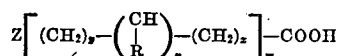
The semi-solid to solid polymer may be a high molecular weight oxygen-containing viscosity-increasing linear aliphatic polymer, preferably having a molecular weight of at least 1000. One suitable material is a high molecular weight polymer of an oxygen-containing compound having the group $-C=CH_2$ in its molecular structure.

Such additives include polymers of vinyl ethers having the general formula



in which R₁ is an unsubstituted or substituted aliphatic, aromatic, or hydroaromatic radical, and R₂ is a hydrogen atom or a substituted or unsubstituted aliphatic radical, e. g., vinyl oleyl ether, vinyl isobutenyl ether, vinyl meta-cresyl ether, vinyl cyclohexyl ether, vinyl octadecyl ether, vinyl chloroethyl ether, vinyl amino propyl ether, α-ethylvinyl isohexyl ether, α-chloromethyl vinyl lauryl ether, etc.; polymers of vinyl esters having the general formula (CH₂=CR₂-OOC)_n-R₁, in which R₁ and R₂ are as above and n is an integer having a value of 1 or more, e. g., vinyl stearate, vinyl ester of acids obtained by oxidation of paraffin wax, vinyl chloropropionate, vinyl aminopalmitate, vinyl adipate, vinyl citrate, etc.; polymers of acrylic acid esters having the general formula, R-OOC-C(X)=CH₂, in which R is an unsubstituted or substituted aliphatic, aromatic, or hydroaromatic group, preferably containing at least 10 carbon atoms, and X is a H or a halogen atom, or a CH₃ group or a C₂H₅ group, e. g., lauryl acrylate, cetyl acrylate, octadecyl acrylate, amylphenyl methacrylate, isoheptyl cyclohexyl chloroacrylate, chlorodecyl methacrylate, etc., especially such polyacrylic esters having a molecular weight of 1,000 to 10,000, although polymers having higher molecular weights such as 20,000 or even 50,000, or more may be used.

Another type of high molecular weight oxygen-containing substance which can be used for the purpose of this invention is the class of condensation products or polyesters of substituted fatty acids having the general formula



in which R is a H atom or an unsubstituted or substituted aliphatic, aromatic, or hydroaromatic group, x and y may equal 0 or any integer provided that x+y equals at least 5, and where n is 0 or an integer and m is a whole number and Z is a functional group which has one replaceable hydrogen atom, Z being capable of esterifying a carboxyl group. Some of these polyesters are described in U. S. Patent 2,147,647, and are typified by the polyester having a molecular weight of about 14,000 obtained by polyesterification of 12-hydroxy stearic acid in the presence of a small amount of adipic acid.

These various polymers range from viscous, tacky oils to tough, elastic, almost colorless, and substantially solid mass. Chemically, these oxygen-containing polymers are characterized as highly saturated in that they have an iodine number below 20, preferably below 10, and frequently below 1 or 2.

About 0.1 to 1.0% of this material is readily dissolved in the blend of hydrocarbon oil and non-drying thickened fatty oil and when thus dissolved forms a homogeneous mixture having a stable cohesiveness to be perceived in the formation of long strings or threads when the mixture is pulled apart. This cohesiveness is stable to light, air, heat and moisture.

Usually the percentage of thickened fatty oil should be in the range of about 1-15%, generally about 5-10% will be found most useful. The lubricating oil base stock will, except for possible minor amounts of addition agents such as anti-oxidants, dyes, pour depressors, etc., comprise the

balance of the composition other than the amount of high molecular weight linear oxygen-containing polymers and the thickened fatty oil mentioned above. In other words, the mineral oil base stock will comprise about 85-99% of the total composition and will usually range between the approximate limits of 90-95%.

For the sake of illustration, although not desiring to be limited thereby, examples are given herebelow of preferred ingredients and their proportions to form suitable percussion type air drill lubricants according to this invention:

	1	2	3	4
Viscosity of mineral oil (sec. Saybolt at 100° F.) percent.....	100	200	300	800
Mineral oil (naphthenic base).....	94.7	92.5	94.7	89.0
Polymerized lauryl methacrylate ¹	0.3	0.5	0.3	1.0
Blown rape seed oil.....	5.0	7.0	5.0	10.0

¹ Average molecular weight about 10,000.

Each of these blends has a very satisfactory low pour point and a high viscosity index, which is the measurement of variation in viscosity with temperature changes of the oil according to the procedure described in the article by Dean and Davis, Chemical and Metallurgical Engineering, vol. 36, 1929, page 618. These various blends are particularly suitable for lubrication of pneumatic rock drills, Examples 2 and 3 being intended primarily for use in temperate climates while Example 1 is especially adapted for use in colder climates and Example 4 in hotter climates.

Although particular compositions with specific ingredients and proportions have been described, the invention is not limited thereto. The invention can also be carried out with other fatty oils of vegetable or animal origin having qualities similar to those of blown rape seed oil. Non-drying thickened fatty oils having high viscosities may be prepared from rape seed oil, cotton seed oil, maize oil, seal oil, and sperm oil by air-blowing, or by other known methods of thickening, such as catalytic or electrical polymerization which reduce the iodine numbers of such oils to below 75. To prepare the ordinary commercial non-drying thickened fatty oils by air blowing, air is blown into a natural fatty oil with stirring for a period of about 15 to 30 hours at a temperature of about 170° F. until the desired specific gravity or viscosity of the thickened oil is reached. Rape seed oil, for example, would be treated in this manner until its specific gravity is raised from about 0.914 to between about 0.968 and 0.990 as determined at 60° F.

The proportioning of the thickened fatty oil to the mineral oil depends largely upon the viscosities of these ingredients and the desired viscosity for the blend, particularly when a pour depressant is used for ultimately reducing the pour point of the blend. The mineral oil need not be so restricted as to its source if the pour point of its blend with the fatty oil is not required to be of the order obtained in the specific examples. Lubricating oils with flash points above the flash point of a gas oil from all types of crude oils may be used. Synthetic lubricating oils with low pour points may be used. Although the mineral lubricating oils are preferably selected from naphthenic base crudes, some dewaxed paraffinic base oils may also be used. As another alternative modification of the high molecular weight oxygen-containing linear type polymer, one may use copolymers, such as described in Patent 2,125,885, made by copolymer-

izing acrylic acid esters of two different monohydric aliphatic alcohols, for instance ethyl alpha methacrylate and lauryl alpha methacrylate, or the ethyl and mono octadecyl alpha methacrylates.

In using mineral oils having relatively higher pour points, a small amount of synthetic pour point depressants may be added, particularly those containing long alkyl group branches. These alkyl groups should have preferably 10 to 30 carbon atoms in straight chains, and may be joined to other long alkyl groups or a cyclic group, preferably to a polycyclic group, e. g., a naphthyl or a naphthol group. The method of synthesizing these products is well known in the art and described in U. S. Patent No. 1,815,022, granted to G. H. B. Davis, July 14, 1931. In general, this method involves the reaction of chloroparaffins with one another or with aromatics, such as naphthalene, in the presence of a Friedel-Crafts type of catalyst. These pour point depressants in a concentration of only about 0.5 to 3% lower the pour points of compositions described in the preceding examples by more than 5° F.

The description of the aforementioned compositions as being particularly intended for use in percussion air drills, in which specific requirements may exist for low pour points, adhesiveness, and constancy of viscosity under widely varying temperature conditions, is not intended to limit the invention to such a specific use for these compositions. Blends prepared in accordance with this invention are useful for other purposes, such as jack hammers, stoppers, drifters, wagon drills, chippers, tampers, riveters, pavement breakers, and similar mechanisms having high speed reciprocating pistons activated by compressed air or steam.

The present invention has several distinct advantages over compositions prepared heretofore; one important advantage is that the high molecular weight linear type oxygen-containing polymers, particularly the polymerized acrylic acid esters, have a tendency to emulsify to a greater extent than do the simple high molecular weight hydrocarbon polymers such as polyisobutylene. Ease of emulsification permits better adherence of the lubricant to the working surfaces of pneumatic tools where emulsion-producing moisture is generally present, therefore a reduced consumption of the lubricant is effected. Another advantage of such oxygen-containing polymers is their relatively high resistance to molecular weight breakdown, and consequent decrease of adhesivity and viscosity during use.

Lubricant compositions of this invention may be applied through any of the systems of lubrication usually employed with pneumatic tools. Hand oiling is still common, but special line lubricators for injecting small quantities into the air stream at a point about ten feet from the tool are increasing. Line lubricators assure lubrication without attention over long periods. The compositions of this invention are stable and homogeneous, being even superior in these respects to the lubricants of my prior patent.

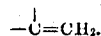
Other ingredients may be added in minor amounts, as might be desired for further improving the lubricant, but such agents as sludge dispersers, oxidation inhibitors, corrosion inhibitors and oiliness agents are in general unnecessary.

I do not desire to be limited to any given specific illustration of the invention because there may be relatively wide variation in the kinds and

proportions of the materials used without departing from the broader scope of the invention. I desire to be limited only by the following claims in which it is my intention to claim all novelty as broadly as the prior art permits.

I claim:

1. A lubricant having a viscosity in the range of about 150 to 1000 seconds Saybolt at 100° F. adapted for use in compressed air and steam motivated machines having high speed reciprocating pistons, which comprises a major proportion of a hydrocarbon lubricating oil and about 1 to 15% of a non-drying thickened fatty oil and about 0.1 to 1.0% of a linear oxygen-containing polymer which normally is plastic to solid, has an iodine number below 20 and a molecular weight of at least 1,000, said polymer being a polymer of an oxygen-containing organic compound having the group



2. A lubricant according to claim 1 in which the polymer is composed of only carbon, hydrogen and oxygen, and has a molecular weight of at least 5,000.

3. A lubricant adapted for use in pneumatic tools which comprises about 85 to 95% of a petroleum lubricating oil having a viscosity in the range of about 100 to 950 Saybolt seconds at 100° F. and a maximum pour point of +10° F., about 0.1 to 0.5% of a normally semi-solid to solid acrylic acid ester polymer having a molecular weight of at least 5,000 and a small amount of a non-drying thickened fatty oil.

4. A pneumatic tool lubricant having a stable cohesiveness, good emulsification tendencies, a maximum pour point below +10° F., a viscosity in the range of about 150 to 1000 Saybolt seconds at 100° F., and comprising in major proportion a petroleum lubricating oil having a viscosity in the range of about 100 to 950 Saybolt seconds at 100° F., about 1 to 15% of a non-drying thickened fatty oil, and about 0.1% to 1.0% of acrylic acid ester polymer having a molecular weight in the range of about 5,000 to 50,000.

5. A pneumatic percussion type drill lubricant having adhesive and moisture resistant characteristics, having a viscosity of about 400 to 600 seconds Saybolt at 100° F., a maximum pour point of about -10° F., and comprising in major proportion a hydrocarbon lubricating oil having a viscosity of about 200 to 400 seconds Saybolt at 100° F., 1 to 15% of blown rape seed oil, and 0.1% to 1.0% of acrylic acid ester polymer having a molecular weight of about 5,000 to 50,000.

6. A compressed-air driven rock drill lubricant having a viscosity in the range of about 490 to 515 Saybolt seconds at 100° F., a maximum pour point of about -25° F. and comprising about 92.1% of a naphthenic base lubricating oil having a viscosity in the range of about 300 to 315 Saybolt seconds at 100° F., about 7.0% of blown rape seed oil, and about 0.2 to 0.5% of lauryl alpha methacrylate polymer having a molecular weight in the range of about 5,000 to 50,000.

7. A lubricant having a viscosity in the range of about 150 to 1000 seconds Saybolt at 100° F. adapted for use in high speed steam motivated machines which comprises a major proportion of hydrocarbon lubricating oil and about 1 to 15% of a non-drying thickened fatty oil and about 0.1 to 1.0% of a normally semi-solid to solid acrylic acid ester polymer.

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