

Description

Background of the Invention

5 This invention relates to heat-resistant lubricant compositions for processing synthetic fibers.

In general, a lubricant is attached to thermoplastic synthetic fibers such as polyester, polyamide and polypropylene immediately after they are melted and spun. After they are made into drawn yarns with different forms and characteristics, they are further subjected to higher-order processes to obtain final products. Recently, the trend has been to speed up these production and processing steps and, in order to
 10 improve productivity by using energy-saving means in the production and processing steps of thermoplastic synthetic fibers or by making such steps shorter, attempts are being made to produce partially oriented yarns (POY) and to carry out drawing and false twisting successively or simultaneously by using the POY to thereby produce texture yarns. Currently, there are increasing attempts to speed up these processes but, as the speed of these processes increases, there arise at the same time the needs for a new kind of
 15 lubricant which satisfy the following two conditions. One of these conditions to be satisfied is that the lubricant must be able to provide high degrees of lubricity, cohesiveness and antistatic characteristics to feed yarns for false twisting and, in particular, to feed yarns for drawing and false twisting because there is an increase not only in the speed of yarns running in contact with rollers, guides, heaters for heat treatments, disks and the like (hereinafter simply referred to as contact members) but also their contact pressure against them. The other condition to be satisfied relates to the increased amount of substances of all kinds which fall onto the heater because more yarns pass through the heater per unit time and the centrifugal force associated with the twisting of the yarns is also increased. Since both the length of the heater and its surface temperature are increased in order to supply sufficient heat to filaments for winding and securing, furthermore, these substances are degraded more easily. Such thermally degraded sub-
 25 stances (such as tar) cause fluffs, yarn breakage, and other ill-effects if they pile up on the heater surface. In view of the above, the lubricant must be able to reduce the amount of substances falling onto the heater.

In the past, many kinds of lubricant compositions containing an ionic or nonionic surfactant as antistatic agent have been used for the processing of synthetic fibers. With conventional lubricant compositions for synthetic fibers, however, the mixing ratio of the antistatic agent must be increased if a high antistatic
 30 characteristic is desired. In this case, if the ionic surfactant is sodium alkane sulfonate, potassium alkyl phosphate or the like having metallic ions as counter ions, for example, it lacks in compatibility with the lubricant composition and tends to be rejected from the lubricant system. As a result, it is easily dropped during processing and piled up, thereby increasing the contact friction between fibers and the contact members, causing an increase in the tension, damage to the fibers, fluffs and yarn breakage, and
 35 significantly affecting work efficiency and the yarn quality adversely. If the substances which fall off and piled up on the heater for heat treatment and become thermally degraded (such as when tar is generated), the situation is even worse. If the mixing ratio of ionic surfactant is reduced in order to reduce the amount of substances which fall off and become degraded, or if use is made of a nonionic surfactant which is relatively compatible with lubricant compositions, on the other hand, antistatic characteristics cannot be
 40 attained as desired and there arise problems due to generated static electricity such as disheveling of filaments, swinging motion of yarns and their wrapping around the rollers. Thus, processability and yarn quality are adversely affected.

Antistatic polymer compositions containing ionic surfactants not having metallic ions as counter ions have been disclosed, for example, in U.S. patents 4,038,258 and 4,506,070 (use of various phosphonium salts) and U.S. patent 2,837,446 (use of N substituted phosphonium salts). Especially in U.S. patent 4,038,258 conductive compositions comprising synthetic resins having a specific glass transition temperature and phosphonium salts have been disclosed. Japanese patent publication Tokkai 56-31077 has disclosed spin finish compositions containing polyether compounds for the specific purpose of improving heat resistance. U.S. Patent 4,552,671 has disclosed spin finish compositions having as base oil specific
 50 polyether compounds and containing polyoxyalkylene modified polysiloxane for ultra-high speed texturing of polyester and polyamide yarns. U.S. patent 4,561,987 has also disclosed the mixing of a polyether compound with polyoxyalkylene modified polysiloxane and an anionic surfactant such as sulfonates, sulfates, phosphates and carboxylates having an alkali metal salt or organic amine salt as counter ions. None of these prior art examples, however, can be a solution to the aforementioned problems as a whole
 55 although there are differences in degree among them.

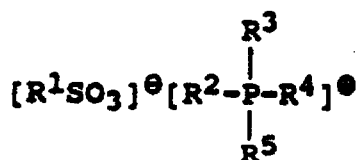
Summary of the Invention

It is therefore an object of the present invention in view of the above to solve the aforementioned problems of prior art compounds and to provide heat-resistant lubricant compounds for the processing of synthetic fibers with which severe requirements of the present day can be satisfied. In other words, the main object of the present invention is to provide heat-resistant lubricant compounds for the processing of synthetic fibers which can substantially satisfy requirements regarding not only lubricity, cohesiveness and anti-static capability but also contamination of heater.

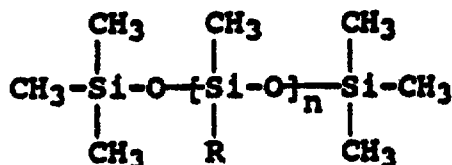
The present invention was accomplished by the present inventors as a result of their diligent studies in view of the above and other objects and is based on their discovery that lubricant compositions comprising specified amounts of a polyether compound, modified polysiloxane and phosphonium sulfonate of specified structures satisfy the desired conditions.

Detailed Description of the Invention

Heat-resistant lubricant compositions according to the present invention for processing synthetic fibers are characterized as comprising 85% or more by weight of polyether compound of molecular weight between 500 and 10000 derivable from alkylene oxide with 2-4 carbon atoms and an organic compound having at least one active hydrogen in its molecule, 0.2-5% by weight of modified polysiloxane of molecular weight 2500 or greater modified by propylene oxide and/or ethylene oxide, and 0.05-10% by weight of phosphonium sulfonate shown by the formula



where R^1 is phenyl group substituted by alkyl group with 1-12 carbon atoms or alkyl group with 12 - 18 carbon atoms, and R^2 - R^5 are same or different, each being phenyl group or alkyl group with 1-12 carbon atoms. Regarding polyether compound of the aforementioned type, examples of organic compound having active hydrogen include monohydric and polyhydric alcohols, amines, mercaptans and aliphatic acids such as butanol, ethylene glycol, trimethylol propane and ethylene diamine. Examples of modified polysiloxane of the aforementioned type include those which are obtainable by hydrosilylation reaction of Compound A and Compound B and are modified polysiloxane with a portion of its chain on the methyl side of Composition B substituted by Composition A where Composition A is a compound obtainable by alkylation of the end (ω -position) hydrogen group of an propylene oxide and/or ethylene oxide adduct of allyl alcohol and Composition B is methyl hydrogen polysiloxane with random or block positioned hydrogen atoms shown by the formula



where R is a mixture of CH_3 and random or block positioned H and n is the number of repetitions.

Phosphonium sulfonate according to the present invention may be any combination of an organic sulfonate anion and an organic phosphonium cation. Regarding the above, examples of organic sulfonate anion include aliphatic alkyl sulfonate anions such as lauryl sulfonate, stearyl sulfonate and their mixtures, as well as dodecylphenyl sulfonate anion. Examples of organic phosphonium cation include aliphatic phosphonium cations such as tetramethyl phosphonium, tetrabutyl phosphonium, trioctylmethyl phosphonium, trimethyl lauryl phosphonium and trimethyloctyl phosphonium and aromatic phosphonium cations such as triphenylmethyl phosphonium.

As stated above, heat-resistant lubricant compositions of the present invention are characterized not only as having three constituents which are a polyether compound, modified polysiloxane and phosphonium

sulfonate but also as having them within specified ranges of weight percentages, that is, a polyether compound must be contained by 85% or more by weight, modified polysiloxane must be contained by 0.2-5% by weight, and phosphonium sulfonate must be contained by 0.05-10% or preferably by 0.1-5% by weight. Only if the aforementioned three constituents are contained at a ratio within the range specified above, the lubricant composition exhibits the desired characteristics as a whole.

Heat-resistant compositions of the present invention can be applied to fiber yarns as a 5-30wt% aqueous solution or emulsion at a rate of 0.1-5wt% or preferably 0.2-3wt% (converted with respect to effective compositions). Methods of application which may be used include the roller touch method, the guide oiling method and the spraying method. In what follows, test examples of the present invention are described but they are not intended to limit the scope of the present invention.

Test Examples

Polyethylene terephthalate of intrinsic viscosity 0.68 was spun out of a capsule with 36 holes by a melting spinning method and after a 10wt% emulsion of each of the lubricant compositions described in connection with Table 1 was attached to it by a roller touch method at the rate of 0.4 ± 0.1 wt% (converted with respect to effective component), it was wound up at the speed of 3300m/min to obtain a 12kg rolled cake of 115 denier/36 filament partially oriented yarn (POY) of polyester. Next, this POY was simultaneously processed by drawing and false-twisting under the following conditions to obtain processed 75 denier/36 filament polyester yarn.

Conditions of simultaneous drawing and false-twisting

Twisting system:	Three-axis friction methods with urethane disk
Speed of winding yarns:	650m/min
Draw ratio:	1.518
Heater on twist side:	Length = 2.5m
	Surface temperature = 220 °C
Heater on untwisting side:	None
Intended number of twisting:	3200T/m

Occurrence of yarn breakage, contamination of the heater surface and static electricity generated on the yarns at the time of drawing and false twisting were evaluated as follows by a continuous operation for 72 hours. The results are shown in Table 1.

Evaluation of yarn breakage

Occurrence of yarn breakage during a continuous operation for 72 hours was evaluated as follows:

- A : No yarn breakage (Pass)
- B : Yarn breakage once
- C : Yarn breakage 2 or 3 times
- D : Yarn breakage 4 or more times

Evaluation of contamination of heater surface

Contamination of a heater surface after a continuous operation for 72 hours was evaluated as follows:

- A : Hardly any contamination (Pass)
- B : Extremely small amount of contamination
- C : Small amount of contamination
- D : Large amount of contamination

Evaluation of generated static electricity (Voltage)

Static electricity generated on the running yarns was measured by a Kasuga static electrometer immediately after the yarns passed the twisting apparatus (with a urethane disk) during the simultaneous processing of drawing and false twisting. The measured results were evaluated as follows:

- A : Less than 100V (Pass)
- B : 100V or more but less than 300V (Pass)
- C : 300V or more but less than 500V

D : 500V or more

Generated electricity was negative. Absolute values were considered in the evaluation.

Table 1 clearly shows that the present invention provides heat-resistant lubricant compositions which are superior regarding lubricity, cohesiveness and antistatic characteristics and do not contaminate the heater surface, thereby making it possible to obtain high-quality products under improved processability conditions.

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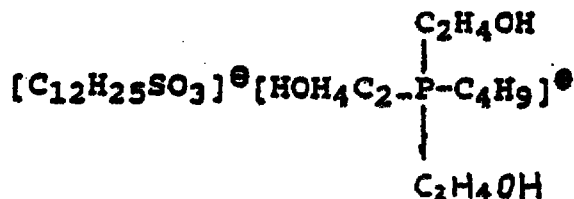
TABLE 1

<u>Test Examples</u>					<u>Comparison Examples</u>										
1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
A-1					15	11									
A-2					15	10									
A-3											94				
A-4	34	36	36	28	34	30	20	30	34	40	30		34	34	34
A-5	60	60	60	60	60		30	59	64	60	40		60	60	60
A-6												94			
B-1					20	13	5			10					
B-2					14	10				5					
C-1					6	6									4
C-2	4	2								15	4	4	4		
C-3			2	8	4										
D-1							6	2							
D-2														2	
E-1	2	2	2	4	2						2	2		2	2
E-2													2		
Breakage:															
	A	A	A	A	A	B	B	D	C	D	C	C	C	D	B
Contamination:															
	A	A	A	A	A	B	B	D	C	A	C	B	B	C	B
Voltage:															
	A	AB	AB	A	A	A	A	C	D	D	A	AB	AB	A	A

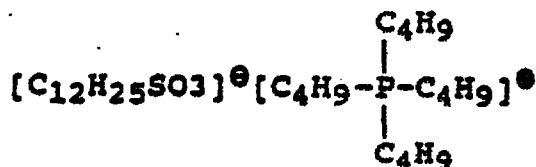
Notes:

- A-1: Octyl stearate
 A-2: POE (10 mole)-1,4-butandiol dilaurate
 A-3: Polyoxy alkylene glycol (PO/EO = 50/50, MW = 300, random)
 A-4: Polyoxy alkylene monobutylether (PO/EO = 50/50, MW = 1500, block)
 A-5: Polyoxy alkylene glycol (PO/EO = 60/40, MW = 6000, random)
 A-6: Polyoxy alkylene glycol (PO/EO = 20/80, MW = 15000, random)
 B-1: POE (10 mole) laurylether
 B-2: POE (5 mole) nonylphenylether

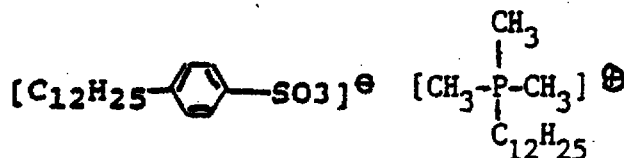
C-1:



C-2:

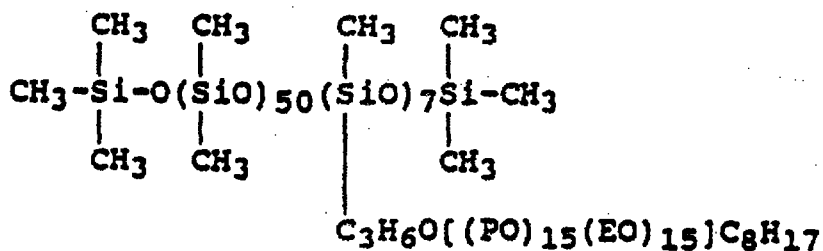
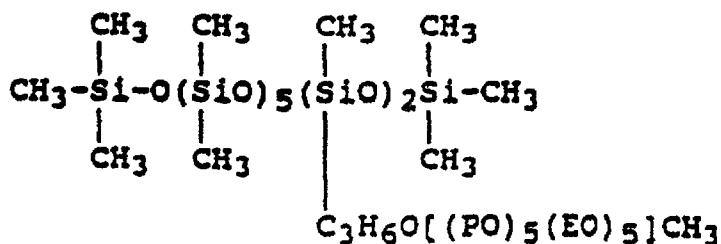


C-3:



D-1: Sodium dodecane sulfonate

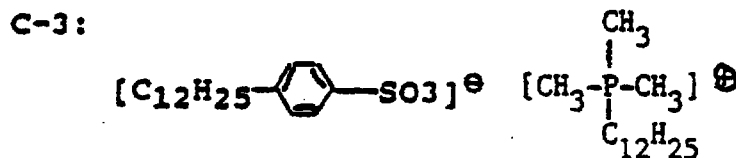
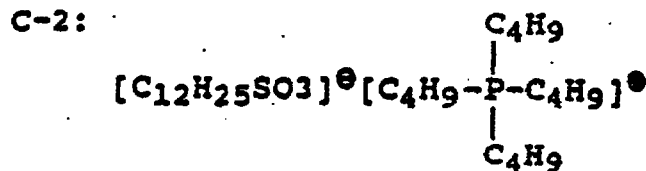
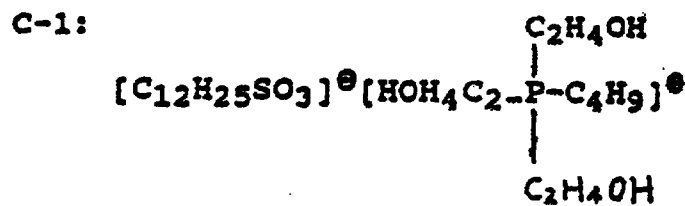
D-2: Potassium lauryl phosphate

E-1: Modified polysiloxane with MW = 16188
shown below:E-2: Modified polysiloxane with MW = 1817
shown below:

Regarding E-1 and E-2, the repetition of the poly (dimethyl siloxane) part and the poly (oxyalkylene) modified polysiloxane part and the repetition of the poly (oxypropylene = PO) part and the poly (oxyethylene = EO) part are both random.

Claims

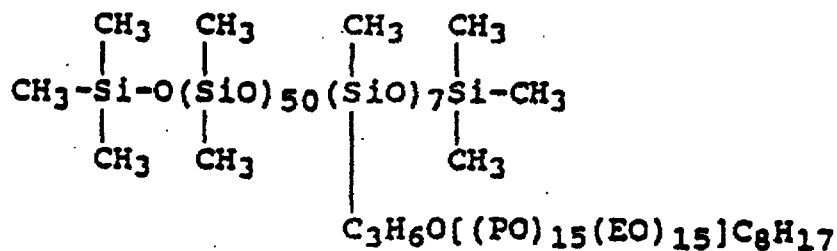
1. A heat-resistant lubricant composition for processing synthetic fibers comprising 85% or more by weight of polyether compound of molecular weight between 500 and 10000 derivable from alkylene oxide with 2-4 carbon atoms and an organic compound having at least one active hydrogen in its molecule,



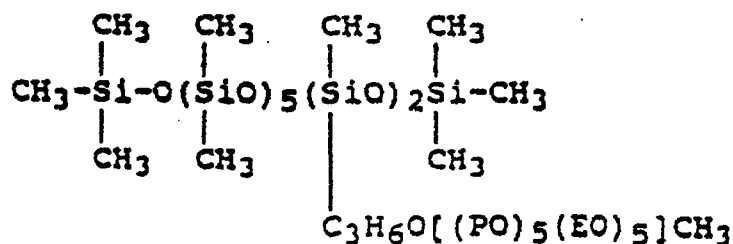
D-1: Sodium dodecane sulfonate

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shown below:



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Regarding E-1 and E-2, the repetition of the poly (dimethyl siloxane) part and the poly (oxyalkylene) modified polysiloxane part and the repetition of the poly (oxypropylene = PO) part and the poly (oxyethylene = EO) part are both random.

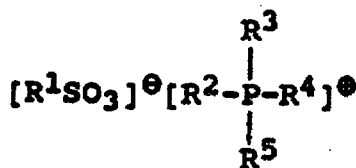
Claims

1. A heat-resistant lubricant composition for processing synthetic fibers comprising 85% or more by weight of polyether compound of molecular weight between 500 and 10000 derivable from alkylene oxide with 2-4 carbon atoms and an organic compound having at least one active hydrogen in its molecule.



0.2-5% by weight of modified polysiloxane of molecular weight 2500 or greater modified by propylene oxide and/or ethylene oxide, and

0.05-10% by weight of phosphonium sulfonate shown by the formula

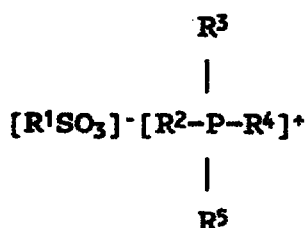


where R¹ is phenyl group substituted by alkyl group with 12 carbon atoms or alkyl group with 12 - 18 carbon atoms, and R²-R⁵ are same or different, each being phenyl group or alkyl group with 1-12 carbon atoms.

2. The composition of claim 1 wherein said phosphonium sulfonate shown by said formula is contained by 0.1-5% by weight.

Patentansprüche

1. Wärmebeständige Schmiermittelzusammensetzung zur Behandlung von Kunstfasern mit wenigstens 85 Gew.-% einer von einem Alkylenoxid mit 2 bis 4 Kohlenstoffatomen und einer organischen Verbindung mit wenigstens einem aktiven Wasserstoff im Molekül ableitbaren Polyetherverbindung mit einem Molekulargewicht zwischen 500 und 10000, mit 0,2 bis 5 Gew.-% eines modifizierten Polysiloxans mit einem Molekulargewicht von wenigstens 2500, wobei das Polysiloxan mittels Polypropylenoxid und/oder Ethylenoxid modifiziert ist, und mit 0,05 bis 10 Gew.-% eines Phosphoniumsulfonats der Formel



worin R¹ eine durch Alkylgruppen mit 12 bis 18 Kohlenstoffatomen substituierte Phenylgruppe oder eine Alkylgruppe mit 12 bis 18 Kohlenstoffatomen ist, und worin R² bis R⁵ gleich oder verschieden sind und jeweils eine Phenylgruppe oder eine Alkylgruppe mit 1 bis 12 Kohlenstoffatomen bedeuten.

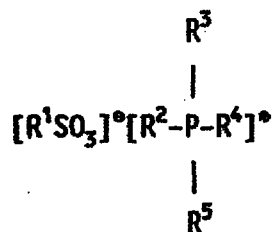
2. Zusammensetzung nach Anspruch 1, dadurch gekennzeichnet, daß sie das Phosphoniumsulfonat der angegebenen Formel in einer Menge von 0,1 bis 5 Gew.-% enthält.

Revendications

1. Composition lubrifiante résistante à la chaleur pour le traitement des fibres synthétiques comprenant:
- 85% ou plus de 85% en poids d'un composé polyéther d'un poids moléculaire compris entre 500 et 10.000 pouvant être dérivé d'un oxyde d'alkylène avec 2-4 atomes de carbone et d'un composé organique dont la molécule contient au moins un hydrogène actif,
 - de 0.2 à 5% en poids d'un polysiloxane modifié d'un poids moléculaire de 2500 ou supérieur à 2500 modifié par de l'oxyde de propylène et/ou de l'oxyde d'éthylène et



- de 0.05 à 10% en poids de sulfonate de phosphonium représenté par la formule:



dans laquelle R¹ est un groupement phényle substitué par un groupement alkyle ayant jusqu'à 12 atomes de carbone ou un groupement alkyle avec de 12 à 18 atomes de carbone et R²-R⁵ sont identiques ou différents l'un de l'autre et sont chacun un groupement phényle ou un groupement alkyle avec 1-12 atomes de carbone.

2. Composition de la revendication 1, dans laquelle ledit sulfonate de phosphonium représenté par ladite formule est présent à raison de 0.1 à 5% en poids.