

UNITED STATES PATENT OFFICE

2,551,643

SYNTHETIC LUBRICANTS FROM ALPHA-MONOOLEFINS AND UNSATURATED ESTERS AND METHOD FOR PRODUCING THE SAME

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9 Claims. (Cl. 260—488)

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This invention has to do with the condensation of normal, alpha mono-olefins, organic esters and organic peroxides, and particularly has to do with the new and useful compositions obtained by said condensation. More particularly, the invention relates to the preparation of synthetic lubricants of excellent quality from said olefins, esters and peroxides.

In the development of new synthetic lubricants, it has recently been found that oils having low pour points and high viscosity indices can be prepared by the thermal (non-catalytic) condensation of normal, alpha mono-olefins having from 6 to 12 carbon atoms. These oils are described in copending application Serial No. 761,716, filed July 17, 1947, now abandoned, of Francis M. Seger and Alexander N. Sachanen. As indicated in the aforesaid application, the oils so prepared generally have relatively low viscosities in the range of 30–80 Saybolt Universal seconds at 210° F., falling mainly near the SAE-10 viscosity standard. Oils of this character are particularly useful for use in automotive and aircraft crank case systems in northern latitudes. For example, the extremely low temperatures of Alaska and northern Canada make starting of automotive and aircraft engines a time consuming operation, giving rise to a need for low viscosity lubricants of low pour point and high viscosity index (V. I.). The oils described in the aforesaid application admirably meet this need. Oils of a similar character have also been described in copending application Serial No. 776,428, filed September 26, 1947, now abandoned, of said Seger and Sachanen. In the latter application the oils are shown to be prepared by heating normal, alpha mono-olefins having from 5 to 18 carbon atoms at elevated temperatures in the presence of an adsorptive-type catalyst such as silica-alumina catalyst.

A further development in the production of new synthetic lubricants involves condensation of normal, alpha mono-olefins having between about 7 and about 12 carbon atoms with organic peroxides, as described in copending application, Serial No. 673,892, filed July 1, 1946, of said Seger and Sachanen. While the synthetic oils obtained in this manner are also characterized by low pour point and high V. I., they are distinct in that they are of higher viscosity than the synthetic oils of the aforementioned applications, Serial Nos. 761,716 and 776,428. In the main, the oils obtained from the olefin-peroxide condensation are of intermediate viscosity range, particularly of the SAE 10–30 range. Oils of this nature are excellently suited for use in automotive and air-

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craft crank case systems in temperate climates.

It has now been discovered that synthetic oils of higher viscosity, also possessing the aforesaid excellent pour point and V. I. characteristics, are obtained by condensing normal, alpha mono-olefins having from 5 to 18 carbon atoms, with an unsaturated organic ester and with an organic peroxide, under the conditions hereinafter defined. The synthetic lubricants of this invention generally have viscosities of the order of 60 to more than 200 Saybolt Universal seconds at 210° F. corresponding to SAE viscosity numbers from about 30–250. Accordingly, the present invention provides a process for controlling the viscosity of the desired synthetic lubricants, which find utility, for example, as crank case, transmission and gear lubricants.

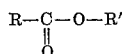
Reactants

As indicated above, the mono-olefin reactants of this invention are normal or straight chain, alpha mono-olefins and contain from 5 to 18 carbon atoms. Such mono-olefins are normally liquid at temperatures of the order of 20–25° C. Illustrative of such mono-olefins are the following: pentene-1, octene-1, decene-1, dodecene-1, octadecene-1, and the like. Preferred, however, of such olefins are those having from 8 to 12 carbon atoms, with decene-1 representing a particularly desirable olefin. It will be clear from the foregoing examples that an alpha olefin also may be referred to as a 1-olefin.

Not only may the mono-olefins of the aforesaid character be used individually in this invention, but they may also be used in admixture with each other. In addition, olefin mixtures containing a substantial proportion of such mono-olefins may be used. Preferred of such mixtures are those containing a major proportion of a 1-olefin or of 1-olefins. Representative of such mixtures are those obtained by the cracking of paraffin waxes and other paraffin products, and those obtained from the Fischer-Tropsch and related processes.

These hydrocarbon mixtures may contain, in addition to the 1-olefin or 1-olefins, such materials as: other olefins, paraffins, naphthenes and aromatics.

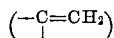
The esters used in the present invention are unsaturated organic esters represented by the general formula:



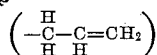
wherein R is a saturated hydrocarbon group, preferably a saturated alkyl group having from 1 to 12 carbon atoms, and more particularly, from

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1 to 10 carbon atoms; and R' is either the vinyl group



or the allyl group



Representative esters are vinyl acetate, allyl acetate, vinyl propionate, vinyl butyrate, etc. Preferred among the ester reactants, however, is vinyl acetate in view of the outstanding properties of the synthetic lubricants formed therefrom.

That the character of the unsaturated organic ester reactant is of primary importance in the formation of the desired oils is indicated by the greatly different products obtained with other unsaturated organic esters. For example, methyl methacrylate reacts with the aforesaid mono-olefins and peroxides to form gummy materials suspended in liquid. It should be noted that methyl methacrylate is an ester of an unsaturated monocarboxylic acid and a saturated alcohol, in contrast to the esters contemplated herein.

In general, any organic peroxide is suitable for our purpose. By organic peroxide we mean those organic compounds which contain an —O—O— linkage. In this connection, it must be clearly understood that when we speak of organic peroxides herein and in the claims, we have reference to organic hydroperoxides as well as simple organic peroxides. The organic peroxides utilizable in the process of the present invention may be aliphatic peroxides, aromatic peroxides, heterocyclic peroxides and alicyclic peroxides. Diethyl peroxide, tertiary butyl hydroperoxide, benzoyl peroxide, dimethylthienyl peroxide, cyclohexyl peroxide, and lauroyl peroxide may be mentioned by way of non-limiting examples of organic peroxides suitable for the process of our invention. In general, we prefer to use those organic peroxides containing the radical



wherein R is an aliphatic or aromatic radical, such as acetyl peroxide, and of these, we especially prefer to use those containing a benzene ring, such as benzoyl peroxide. The organic peroxides may be derived from any suitable source as is well understood and, advantageously, may be formed in situ, thereby obviating the necessity of using the relatively expensive commercial organic peroxides. Such a modification must be considered to be within the scope of the present invention and an important embodiment thereof.

The formation of the organic peroxides in situ may be accomplished in a number of ways. For example, they may be formed in accordance with the procedure of Price and Krebs [Organic Syntheses, 23, 65 (1943)], or by contacting oxygen or air, preferably, moist air, with a suitable organic compound such as a hydrocarbon, or an ether, which reacts therewith to form the desired organic peroxide. Ethyl benzene, cyclohexene, and tetralin which readily form peroxides on oxidation, may be mentioned by way of non-limiting examples of organic compounds utilizable for forming the organic peroxides in situ.

In general, and in accordance with our invention, the amounts of organic peroxide to be used are relatively large. In contrast to the polymerization reactions of the prior art which involve conjugated diolefinic hydrocarbons or ethylene, wherein organic peroxides function as catalysts in the widely accepted sense of the

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term, we have found that in our process, the decomposition products of organic peroxides combine with the 1-olefins and unsaturated organic esters. Accordingly, the yields and nature of the products obtained in the process of the present invention, depend upon the amounts of and reflect the type of the organic peroxides employed. For instance, when a 1-olefin and an unsaturated organic ester are reacted with benzoyl peroxide in accordance with our process, products containing benzene rings and other structural fragments of the benzoyl peroxide will be formed. Viewed in this light, our process is one involving both polymerization and the broader and more comprehensive reaction-condensation.

Hence, in our process, the amounts of organic peroxides employed determine the yield and quality of product. Such amounts are considerably in excess of catalytic amounts, and, as indicated above, must be considered reactive quantities. Good results may be obtained using between about 0.02 and about 0.20 molar proportions of organic peroxide, with between about 0.01 and about 1.0 molar proportion of unsaturated organic ester, and with one molar proportion of a normal alpha mono-olefin. Preferably, however, between about 0.05 and about 0.10 molar proportion of peroxide is used with between about 0.05 and about 0.5 molar proportion of ester and one molar proportion of 1-olefin.

For the production of oils characterized by very low pour points and high viscosity indices, a further recommendation is made with regard to the reaction proportions. The mean carbon chain length of the unsaturated organic ester and the mono-olefin should be maintained between about 6 and about 14 carbon atoms.

In carrying out the process of the present invention, the organic peroxide is added to the 1-olefin and unsaturated ester reactants, preferably in two or more portions at intervals of a few hours. If desired, however, the organic peroxide may sometimes be added in a single addition, although excessive heat of reaction may be encountered.

When the organic peroxide is formed in situ, the mixture 1-olefin, unsaturated ester, and an organic compound which forms an organic peroxide when subjected to oxidation in amounts of at least about 5%, preferably at least about 20%, based on the weight of the 1-olefin reactant, is contacted with oxygen (air for example) under the conditions of reaction to produce the organic peroxide in situ at the same time that the condensation reaction occurs. The contact with oxygen may be effected by agitation of the mixture in air, bubbling of the air through the mixture, etc. In another embodiment of this modification, an organic compound is peroxidized to a desired degree before the addition of the 1-olefin and ester reactants. Yet another modification is to use the 1-olefin per se for oxidation to the peroxide, with simultaneous or subsequent reaction to bring about the condensation of unreacted 1-olefin with that portion which has been converted to peroxide, and with the ester reactant.

Condensation conditions

In effecting the condensation of the foregoing reactants, temperatures varying between about 50° C. and about 200° C. are used, depending upon the type of organic peroxide employed. Thus, when benzoyl peroxide is used, the temperature may vary between about 50° C. and 100° C. and, preferably, between about 80° C. and about 100° C.

With hydroperoxides, however, the temperature may vary between about 100° C. and about 200° C. and preferably, is of the order of about 175° C. The pressure to be employed depends upon the temperature used and, ordinarily, a pressure sufficient to maintain the reactants in substantially the liquid phase at the temperature employed, is adequate. The time of reaction depends upon the temperature, the nature of the reactants used, the quantity of reactants used, and, to a certain extent, upon the pressure used. In general, the higher the temperature employed, the shorter the reaction time required, the criterion used being the time required at a given temperature to effect condensation, and more specifically, to assure substantially complete consumption of the organic peroxide. For example, in batch operation, we have found that at a temperature of 85° C. the time of reaction is preferably about 10 hours.

The process may be carried out as a batch, continuous or semi-continuous type of operation. Particularly when the process is carried out on a commercial scale, economic considerations make it preferable to operate in a continuous manner. For efficient operation, whether the process is carried out on a batch or continuous basis, it is essential that the 1-olefin and ester reactants be intimately contacted with the organic peroxide. This may be effected in several ways and in apparatus which is well known in the art.

Considering further the effect of the proportions of reactants used in the condensation upon the character of the products formed, it has been found that as larger quantities of ester re-

actant are used, products of increasing viscosity are formed. For example, when quantities of ester reactant at the lower end of the proportion ranges shown above are used, oils of SAE viscosity of the order of 30-50 are generally obtained. In contrast, oils of SAE 80-250 are formed by resorting to larger quantities of ester reactant, such quantities falling at the upper end of the proportion ranges indicated above.

Examples

In order to illustrate the principles of this invention, the results of a series of typical, and non-limiting, condensations are set forth in tabular form in the table below. The mono-olefin and unsaturated organic ester were reacted with about one-half of the total quantity of peroxide used for several hours at the desired temperature. Thereafter, the remainder of the peroxide was added and reaction continued at the same temperature for an additional several hours. Excess olefin was separated from the resultant reaction product by distillation, and the balance was subjected to a vacuum distillation. A vacuum distillate and an oily residue were recovered from the vacuum distillation. The oily residue is identified herein as a "residual oil," to distinguish the same from unreacted materials and products of intermediate boiling range.

All of the tests and analyses to which the residual oils in the table were subjected are well known standard tests. In this connection, it will be noted that the designation "N. N." refers to the neutralization number, which is a measure of the acidity of the oil.

Table

Run	1	2	3	4	5	6
Mono-olefin	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1
Parts by Weight	700	2,575	140	280	429	280
Molar Proportion	5	18.4	1.0	2.0	3.06	2
Ester			Vinyl Acetate	Vinyl Acetate	Allyl Acetate	Methyl Methacrylate
Parts by Weight			86	43	75	43
Molar Proportion			1.0	0.5	0.75	0.43
Peroxide		Benzoyl	Benzoyl	Benzoyl	Di-tertiary-butyl	Lauroyl
Parts by Weight		483	24	48	14	80
Molar Proportion		2.0	0.1	0.2	0.096	0.2
Temperature, °C	318	88	88	85	126	85
Time, Hrs.	20	9	9½	10	20	10¼
Residual Oils:						
Parts by Weight	464	888	120	142	102	
Per Cent Yield	68.3	29.3	48	38.2	19.7	
K. V. @100° F., Cs.	29.75	53.3		341.3	119.4	
K. V. @210° F., Cs.	5.80	7.82	198.9	25.3	14.12	
V. I.	143	119.2		103	119.5	
SAE. Vis. No.	<10	20	250	60	40	
Pour Point, °F	<-10	<-30	+55	-25	<-30	
Br. Addn. No.	15.1		3.7	7.2		
Specific Gravity	0.8568	0.8990	1.0128	0.9321	0.8978	
N. N.	Nil	0.35	0.8	0.8	0.6	
						Suspended solids.

Run	7	8	9	10	11
Mono-olefin	Octene-1	Octene-1	Octene-1	Octene-2	2-Ethyl Hexene-1
Parts by Weight	300	224	224	224	224
Molar Proportion	2.15	2.0	2.0	2.0	2.0
Ester			Vinyl Acetate	Vinyl Acetate	Vinyl Acetate
Parts by Weight			21	21	21
Molar Proportion			0.25	0.25	0.25
Peroxide		Benzoyl	Benzoyl	Benzoyl	Benzoyl
Parts by Weight		48	24	24	24
Molar Proportion		0.2	0.1	0.1	0.1
Temperature, °C	321	85-89	88	85	85
Time, Hrs.	10	9	10	10	10
Residual Oils:					
Parts by Weight	89	89.3	67	53	37
Per Cent Yield	29.6	32.7	24.9	19.7	13.8
K. V. @100° F., Cs.	28.15	66.75	131.7	90.33	716
K. V. @210° F., Cs.	5.17	8.32	12.17	8.51	18.70
V. I.	126.2	102.1	88.5	61.3	<0
SAE. Vis. No.	<10	20	40	20	50
Pour Point, °F	<-70	<-30	<-30	-35	+20
Br. Addn. No.	14.9	11.4	9.4	12.3	16.5
Specific Gravity	0.8413	0.9036	0.9340	0.9606	
N. N.	0.2	1.8	1.0	2.3	1.2

¹ Based upon combined weight of reactants.

It is apparent from the tabulation shown above that thermal and (non-catalytic) polymerization of decene-1 results in an oil of relatively low viscosity, namely, oil of SAE number below 10 (run 1). This oil and similarly characterized oils form the subject matter of the aforementioned application, Serial No. 761,716. Condensation of decene-1 with benzoyl peroxide, in the absence of an unsaturated ester, is illustrated by run No. 2, the oil obtained having an SAE number of 20. This oil and similar oils are described at length in the aforesaid application, Serial No. 673,892. Runs Nos. 3 and 4 illustrate the present invention with oil products of high viscosity being obtained by condensation of decene-1, vinyl acetate and benzoyl peroxide. It will be noted that the oil product of run No. 4 has an SAE viscosity number of 60, a V. I. of 103 and a pour point of -25°F ; the oil product of run No. 3 has an SAE viscosity number of 250, and a pour point of 55°F . Viscosity index for the oil of run No. 4 could not be calculated because the viscosity at 100°F ., being exceedingly high, was not determined.

Run No. 5 is also illustrative of the present invention. The oil product of run No. 5 is obtained for allyl acetate, di-tertiary-butyl peroxide and decene-1.

In contrast with runs 3-5, in which a suitable unsaturated ester is used, run No. 6 demonstrates that a suspension of solid materials, not an oil, is obtained with a different ester, namely, methyl methacrylate.

Run No. 7 of the foregoing tabulation is again illustrative of oils of the aforementioned application, Serial No. 761,716; the oil product has a viscosity slightly below that of SAE 10. Similarly, the oil product of run No. 8 obtained from octene-1 and benzoyl peroxide, in the absence of an unsaturated ester, is typical of the oils described in the aforementioned application, Serial No. 673,892. It will be noted that the oil product of run No. 8 has an SAE viscosity number of 20. Run No. 9 is illustrative of the process and products of the present invention, an oil product thereof being obtained by condensation of octene-1, vinyl acetate and benzoyl peroxide. The oil product of run No. 9, in contrast with the oil products of runs Nos. 7 and 8, has an SAE viscosity number of 40.

To demonstrate that a normal alpha mono-olefin is necessary for the production of the synthetic lubricants of this invention, the oil products of run Nos. 9, 10 and 11 are shown. Vinyl acetate and benzoyl peroxide were condensed with octene-1, octene-2, and 2-ethyl hexene-1, in run Nos. 9, 10 and 11, respectively, under substantially the same reaction conditions. The oil products obtained from octene-2 and 2-ethyl hexene-1 were obtained in substantially lower yields than the oil product obtained from octene-1. Further, the octene-1 product had a viscosity index (V. I.) of 88.5, in contrast to a V. I. of 61.3 for the octene-2 product and a V. I. of less than 0 for the 2-ethyl hexene-1 product. Moreover, the latter product had a pour point of $+20^{\circ}\text{F}$.

Not only are the oil products contemplated herein excellent lubricants, but certain of them have the capacity to increase the viscosity index of other oils. Representative of such oil products is the oil of run No. 3 of the table above. The mineral oil used in the following tests was a motor lubricating oil fraction having a kine-

matic viscosity of 29.97 at 100°F ., and a viscosity index of 76.2. When one percent of the oil product of run No. 3 was blended with this mineral oil, the viscosity index of the resultant oil blend was 80.6; with five percent, the oil blend had a viscosity index of 93.6.

As will be evident from the data presented above in the table, the condensation products of this invention are highly desirable lubricants per se. They are also of considerable value as blending agents for other lubricating oils. They impart desirable viscosity index (V. I.) and pour point characteristics to the oils in combination therewith, for, as indicated above, they have advantageous viscosity index and pour point properties. In short, the synthetic oils find utility in "upgrading" other lubricants. Typical oils with which the synthetic oils may be blended are mineral oils such as are normally used in the internal combustion and turbine engines. When so blended, the synthetic oils may comprise the major proportion of the final blended oil, or may even comprise a minor proportion thereof.

One or more of the individual properties of the synthetic lubricants of this invention may be further improved by incorporating therewith a small, but effective amount, of an addition agent such as an antioxidant, a detergent, an extreme pressure agent, a foam suppressor, a viscosity index (V. I.) improver, etc. Antioxidants which may be used are well-known in the art, and are generally characterized by phosphorous, sulfur, nitrogen, etc., content; representative of such materials is a phosphorous- and sulfur-containing reaction product of pinene and P_2S_5 . Typical detergents which may be so used are metal salts of alkyl-substituted aromatic sulfonic or carboxylic acids, as illustrated by diwax benzene barium sulfonate and barium phenate, barium carboxylate of a wax-substituted phenol carboxylic acid. Extreme pressure agents are well known; illustrating such materials are numerous chlorine and/or sulfur containing compositions, one such material being a chlornaphtha xanthate. Silicones, such as dimethyl silicone, may be used to illustrate foam suppressing compositions. Viscosity index improving agents which may be used are typified by polypropylenes, polyisobutylenes, polyacrylate esters and the like.

Contemplated also as within the scope of this invention is a method of lubricating relatively moving surfaces by maintaining therebetween a film consisting of any of the aforesaid oils.

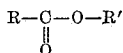
It is to be understood that the foregoing description and representative examples are non-limiting and serve to illustrate the invention, which is to be broadly construed in the light of the language of the appended claims.

We claim:

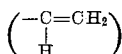
1. The process for the production of a synthetic lubricating oil by condensing a normal, alpha mono-olefin having from 8 to 12 carbon atoms, an unsaturated organic ester and an organic peroxide, which comprises: condensing, at a temperature between about 50°C . and about 200°C . for a period of time sufficient to effect condensation, one molar proportion of said mono-olefin, between about 0.01 and about one molar proportion of said ester and between about 0.02 and about 0.2 molar proportion of said peroxide, and separating from the reaction product thus formed said synthetic lubricating oil;

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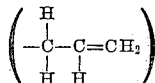
said ester being represented by the general formula:



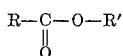
wherein R is a saturated alkyl group having from 1 to 12 carbon atoms, and wherein R' is selected from the group consisting of vinyl



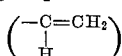
and allyl



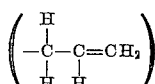
2. The process for the production of a synthetic lubricating oil by condensing a normal, alpha mono-olefin having from 8 to 12 carbon atoms, an unsaturated organic ester and an organic peroxide containing the benzene ring, which comprises: condensing, at a temperature between about 50° C. and about 100° C. for a period of time sufficient to effect condensation, one molar proportion of said mono-olefin, between about 0.01 and about one molar proportion of said ester and between about 0.02 and about 0.2 molar proportion of said peroxide, and separating from the reaction product thus formed said synthetic lubricating oil; said ester being represented by the general formula:



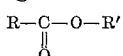
wherein R is a saturated alkyl group having from 1 to 12 carbon atoms, and wherein R' is selected from the group consisting of vinyl



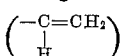
and allyl



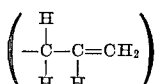
3. The process for the production of a synthetic lubricating oil by condensing n-decene-1, an unsaturated organic ester and an organic peroxide, which comprises: condensing, at a temperature between about 50° C. and about 200° C. for a period of time sufficient to effect condensation, one molar proportion of n-decene-1, between about 0.05 and about 0.5 molar proportion of said ester and between about 0.5 and about 0.1 molar proportion of said peroxide, and separating from the reaction product thus formed said synthetic lubricating oil; said ester being represented by the general formula:



wherein R is a saturated alkyl group having from 1 to 12 carbon atoms and wherein R' is selected from the group consisting of vinyl



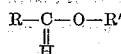
and allyl



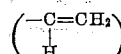
4. A synthetic lubricating oil obtained by: condensing, at a temperature between about 50° C. and about 200° C. for a period of time sufficient

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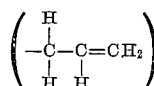
to effect condensation, one molar proportion of a normal, alpha mono-olefin having from 8 to 12 carbon atoms, between about 0.01 and about one molar proportion of an unsaturated organic ester and between about 0.02 and about 0.2 molar proportion of an organic peroxide, and separating from the reaction product thus formed said synthetic lubricating oil; said ester being represented by the general formula:



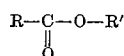
wherein R is a saturated alkyl group having from 1 to 12 carbon atoms; and wherein R' is selected from the group consisting of vinyl



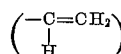
and allyl



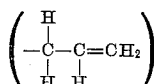
5. A synthetic lubricating oil obtained by: condensing, at a temperature between about 50° C. and about 100° C. for a period of time sufficient to effect condensation, one molar proportion of a normal, alpha mono-olefin having from 8 to 12 carbon atoms, between about 0.01 and about one molar proportion of an unsaturated organic ester and between about 0.02 and about 0.2 molar proportion of an organic peroxide containing the benzene ring, and separating from the reaction product thus formed said synthetic lubricating oil; said ester being represented by the general formula:



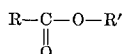
wherein R is a saturated alkyl group having from 1 to 12 carbon atoms, and wherein R' is selected from the group consisting of vinyl



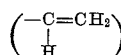
and allyl



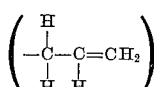
6. A synthetic lubricating oil obtained by: condensing, at a temperature between about 50° C. and about 200° C. for a period of time sufficient to effect condensation, one molar proportion of n-decene-1, between about 0.05 and about 0.5 molar proportion of an unsaturated organic ester and between about 0.05 and about 0.1 molar proportion of an organic peroxide, and separating from the reaction product thus formed said synthetic lubricating oil; said ester being represented by the general formula:



wherein R is a saturated alkyl group having from 1 to 12 carbon atoms and wherein R' is selected from the group consisting of vinyl



and allyl



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7. A synthetic lubricating oil obtained by: condensing, at about 125° C. for about twenty hours, one molar proportion of n-decene-1 with about 0.25 molar proportion of allyl acetate and with about 0.03 molar proportion of di-tertiary-butyl peroxide, and separating from the reaction product thus formed said synthetic lubricating oil.

8. A synthetic lubricating oil obtained by: condensing, at about 85° C. for about ten hours, one molar proportion of n-decene-1 with about 0.25 molar proportion of vinyl acetate and with about 0.1 molar proportion of benzoyl peroxide, and separating from the reaction product thus formed said synthetic lubricating oil.

9. A synthetic lubricating oil obtained by: condensing, at about 90° C. for about ten hours, one molar proportion of n-octene-1 with about 0.1

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molar proportion of vinyl acetate and with about 0.05 molar proportion of benzoyl peroxide, and separating from the reaction product thus formed said synthetic lubricating oil.

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The following references are of record in the file of this patent:

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