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SYNTHETIC LUBRICANTS

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15 Claims. (Cl. 260—139)

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This invention has to do with the condensation of normal, alpha mono-olefins, certain conjugated hydrocarbons and phosphorus sulfides, and particularly has to do with the new and useful compositions obtained by said condensation.

As is well known to those familiar with the art, olefins have previously been polymerized. So also have conjugated hydrocarbons. Each of these unsaturated materials has previously been reacted individually with sulfur and with phosphorus sulfides. Olefin polymers and olefin-conjugated diolefin copolymers have also been reacted with phosphorus sulfides. Olefins and conjugated hydrocarbons have previously been reacted together. In the latter instance, copolymerization is generally incomplete. For example, when decene-1 and styrene are copolymerized at 600° F., an oil containing a polystyrene cloud at room temperature (20–25° C.) is formed.

As described in our copending application Serial No. 33,438, filed June 16, 1948, of which this application is a continuation-in-part, it has been found that normal alpha mono-olefins condense with certain conjugated hydrocarbons and sulfur to form highly desirable viscous oils. The oils so formed are free from the shortcomings of olefin-conjugated hydrocarbon copolymers, as illustrated by the styrene-decene-1 copolymer referred to above. It has now been discovered that similarly characterized viscous oils are obtained by condensing normal, alpha mono-olefins, and conjugated hydrocarbons with phosphorus sulfides and/or with elemental phosphorus and sulfur, under the conditions of operation described below. The viscous oils of this invention are unusually stable. Catalytic oxidation stability tests demonstrate them to be superior to condensation products of decene-1 alone, and superior to condensation products of decene-1 and styrene. The characteristics of the new

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oils are such as to make them outstanding synthetic lubricating oils, for use alone or blended with other lubricants.

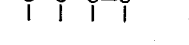
REACTANTS

As indicated above, the mono-olefin reactants of this invention are normal or straight chain alpha mono-olefins and contain from six to fourteen 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: hexene-1, octene-1, decene-1, dodecene-1, tetradecene-1, and the like. Preferred, however, of such olefins are those having from eight to twelve carbon atoms, with decene-1 representing a particularly desirable olefin. It will be clear from the foregoing examples that an alpha olefin may also 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 contaning 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 conjugated reactants contemplated herein are conjugated hydrocarbons and derivatives thereof, wherein the conjugated system is represented by the grouping:



Of such conjugated hydrocarbons, styrene has been found to be particularly desirable for the purposes of this invention. These conjugated hydrocarbons are characterized by at least one vinyl group,

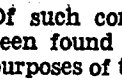
in a 1:3 conjugated relationship with another double bond. Further examples of such conjugated hydrocarbons are: butadiene, isoprene (2-methyl butadiene), 1-phenyl butadiene, divinyl benzene, vinyl naphthalene, and the like. Inasmuch as other conjugated hydrocarbons form polymeric materials, as illustrated by cyclopentadiene, methyl isoprene, and the like, such hydrocarbons may also be used to form satisfactory products with the aforesaid 1-mono-olefin and a phosphorus sulfide. It will be noted that all of the foregoing conjugated materials are hydrocarbons.

Derivatives of the conjugated hydrocarbons, or substituted conjugated hydrocarbons, which typify those contemplated herein are: halogen-substituted materials such as chloroprene (2-chloro-butadiene), 1-bromo butadiene and p-chloro-styrene; alkoxy-substituted materials such as p-methoxy styrene; etc. As will be noted from the character of the foregoing typical substituted conjugated hydrocarbons, substituent groups which may be present are those which do not interfere with the course of the condensation of the conjugated system with the aforesaid 1-olefin and phosphorus sulfide. In other words, a substituent group which may be present on the conjugated hydrocarbon is one which is substantially inert or unreactive in the condensation. The substituent group, however, generally modifies the character of the oil product; yet, in all cases, the products are characterized by unusual stability and are useful as lubricants. For example, when chloroprene or p-chloro styrene is used, the synthetic lubricant formed is also characterized by extreme pressure properties.

In connection with divinyl benzene, which may be used as a conjugated reactant, it should be noted that this reactant is characterized by a high degree of reactivity in view of the two vinyl groups. For most satisfactory results with divinyl benzene, a relatively small quantity should be used with a 1-mono-olefin and a phosphorus sulfide. Accordingly, in the discussion of reaction proportions hereinafter, it should be recognized that the quantity of divinyl benzene used will generally be at the lower end of the conjugated reactant proportion range.

It will be understood, of course, that mixtures of the aforesaid conjugated hydrocarbons, and their aforesaid derivatives, may be used in place of the individual reactant. Similarly, mixtures containing substantial, and preferably major, proportions of one or more of said conjugated reactants may be used. Examples of such mixtures are: a crude styrene containing ethyl benzene, a crude butadiene containing butenes, and coal tar light oils which contain dicyclopentadiene, indene, coumarone, and aromatics.

As will be evident from the foregoing discussion of the conjugated reactant, benzene is not considered herein as a conjugated hydrocarbon, despite its alternate double bond character. In contrast with benzene, the conjugated reactants, as aforesaid, are characterized by at least one vinyl group,



in a 1:3 conjugated relationship with another double bond.

Preferred of the conjugated reactants are vinyl aromatic hydrocarbons, with particular preference being given to styrene.

The phosphorus and sulfur reactant may be in the form of elemental phosphorus and elemental sulfur or in the form of a phosphorus sulfide. All of the phosphorus sulfides are contemplated herewith, included among which are: P_3S_6 (or PS_2), P_4S_6 (or P_2S_3), P_4S_3, P_2S_5, P_4S_7, P_4S_{10}, etc. Particularly advantageous in providing outstanding synthetic oils is P_2S_5, which represents the preferred reactant. When elemental phosphorus and elemental sulfur are used under the conditions of operation described below, it is quite possible that phosphorus sulfide or phosphorus sulfides are formed in situ. It will be understood that elemental phosphorus and/or elemental sulfur may be used with one or more of the phosphorus sulfides in the preparation of a synthetic oil.

REACTION CONDITIONS

Condensation of the aforesaid reactants is effected at elevated temperatures. It appears that temperatures as low as 400° F. and as high as 800° F. can be used in some instances; however, temperatures of the order of about 500° F. to about 750° F. are most satisfactory. The preferred temperature range is fom about 600° F. to about 700° F.

Condensation is generally complete in from one to twenty hours, with the higher reaction temperatures being used for the shorter reaction periods, and with the lower reaction temperatures being used for the longer reaction periods. However, the reaction period will also be influenced by the nature of the reactants and the quantity of reactant used.

Pressures ranging from atmospheric to 4000 pounds per square inch may be used. In general, it is desirable to use sufficient pressure to maintain the reactants in liquid state.

For synthetic lubricants of very high viscosity index, higher temperatures than about 750° F. are to be avoided, inasmuch as it has been observed that the V. I. decreases with increase of temperature.

The proportion of reactants used is a critical factor in preparing the synthetic lubricants contemplated herein. With one molar proportion of a normal, alpha mono-olefin as the basis, from about 0.01 to about 1.0 molar proportion of conjugated reactant and from about 0.01 to about 10 per cent, by weight of total olefins, of phosphorus sulfide provide satisfactory products. Preferred proportions, however, are from about 0.05 to about 0.5 molar proportion of conjugated reactant and from about 0.05 to about 1 per cent, by weight of total olefins, of phosphorus sulfide, with one molar proportion of normal, alpha mono-olefin. The preference for the latter range of proportions is influenced by the outstanding character of the lubricants obtained by selecting proportions within this range. Generally, synthetic lubricants obtained while operating within the preferred range are characterized by higher viscosity indices, lower acidity as measured by neutralization numbers (N. N.) and lower phosphorus and sulfur contents. When elemental

phosphorus and elemental sulfur are used, in place of a phosphorus sulfide, the combined quantity of phosphorus and sulfur will correspond to the quantities recited above for a phosphorus sulfide, namely 0.01–10 per cent and preferably 0.05–1 per cent, by weight of total olefins (conjugated reactant and mono-olefin). The ratio of phosphorus to sulfur used is preferably 2 parts phosphorus to 5 parts sulfur.

In all cases, however, whenever elemental phosphorus and elemental sulfur are used in the absence of a phosphorus sulfide or either or both are used with such sulfide, the combined quantity should not exceed the maximum recited above for a phosphorus sulfide, namely, 10 per cent by weight of total olefins.

It will be understood, of course, that the condensation is aided by providing mixing of the reactants. This may be provided by using various agitating means which are well known in the art.

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 Table I below. These condensations were carried out in a rocking-type bomb (American Instrument Co.). The reactants were charged to the bomb, which was then heated to the desired temperature for the desired length of time. Thereafter, the bomb was cooled, and discharged. The contents of the bomb were vacuum topped to remove unreacted hydrocarbons and materials of low molecular weight. It should be noted that the reaction times, recited as "Time, hours" in Table I, represent the time intervals during which the bomb was maintained at the desired temperature, and do not include the time intervals necessary to heat the bomb and its contents to the desired temperature, and do not include the time intervals necessary to cool the bomb after heat to the bomb has been discontinued.

The condensation products discharged from the bomb, or other reaction vessel, were topped and filtered, as in the runs shown in Table I. To distinguish the condensation products from the distillate fractions thereof, the refined oils are identified as "residual oils." The latter term identifies the oils from which unreacted materials and products of intermediate boiling range have been separated.

All of the tests and analyses to which the residual oils in Table I 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.

Styrene used in these condensations contained a fraction of one per cent of p-tertiary-butyl catechol, the latter acting as a stabilizer or polymerization inhibitor. This styrene material is the commercial product now available.

Table I

Run No.	1	2	3	4	5	6	7	8	9
Olefin	Decene-1	Decene-1	(2)	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1.
Parts by Weight	280	280		840	264	280	280	280	280.
Molar Proportion	2.0	2.0		6.0	1.9	2.0	2.0	2.0	2.0.
Conjugated System			Styrene	Styrene	Styrene	Styrene	Styrene	Styrene	Styrene.
Parts by Weight			104	78	25	26	26	26	26.
Molar Proportion			1.0	0.75	0.24	0.25	0.25	0.25	0.25.
Phosphorus Sulfide	P_2S_5	P_2S_5	P_2S_5		P_2S_5	P_2S_5	P_2S_5	P_2S_5	P_2S_5.
Parts by Weight	0.15	6.0	4.0		0.24	0.25	0.25	1.0	1.0.
Molar Proportion	0.00067	0.027	0.018		0.0011	0.0011	0.0011	0.0045	0.0045.
Wt. Per Cent of Total Olefins	0.05	2.1	3.8		0.08	0.08	0.08	0.33	0.33.
Phosphorus									
Parts by Weight									
Molar Proportion									
Wt. Per Cent of Total Olefins									
Sulfur									
Parts by Weight									
Molar Proportion									
Wt. Per Cent of Total Olefins									
Temperature, °F.	600	605	590	600	500	595	700	600	700.
Time, Hrs.	10	10	11	10½	10	9	5	5	5.
Max. Pressure, p. s. i. g.	100	100	100	400	<100	<100	100	150	100.
Topping of Reaction Product:									
Max. Vapor Temp., °C.	190	205	159	160	185	190	170	175	164.
Pressure, mms. Hg	1.0	3.0	5.0	12.0	0.5	1.0	1.0	3.0	1.8.
Residual Oil:									
Parts by Weight	10	20	49	493	33	96	79	81	34.
Yield, Per Cent 1	3.6	7.0	45.3	53.7	11.4	31.3	25.8	26.4	11.1.
K. V. @ 100° F., Cs.	17.94	69.6		24.0	45.93	29.09	23.88	24.25	43.58.
K. V. @ 210° F., Cs.	3.93	8.37		4.80	6.38	5.25	4.47	4.57	5.81.
V. I.	133	97.6		137.3	95	124.3	110.3	116	75.3.
Pour Point, °F.	<35	<−30	Dark resin.	−25	<−30	<−30	−30	−40	<−30.
Br. Addn. No.	25.7	92.5		19.2	23.5	20.6	16.3	30.2	25.4.
Specific Gravity		0.9291		0.8514	0.9123	0.8692	0.8639	0.8767	0.9030.
N. N.	2.5	14.5		0.1	0.8	0.3	0.4	1.6	17.9.
Color (Lovibond)					250	45	260		
Per Cent P.		3.84			0.031	0.01	0.021	0.35	0.70.
Per Cent S.		6.34			0.53	0.20	0.08	1.13	0.42.
Cloud Point, °F.3				+60	<−34		<−34	<−34	

Table I—Continued

Run No.	10	11	12	13	14	15	16	17	18
Olefin	Decene-1	Decene-1	Decene-1	Decene-1	Octene-1	Octene-2	2-Ethyl Hexene-1	Decene-1	Decene-1.
Parts by Weight	280	280	280	280	336	336	336	700	350.
Molar Proportion	2.0	2.0	2.0	2.0	3	3	3	5	2.5.
Conjugated System	Styrene	Styrene	Butadiene	Butadiene	Styrene	Styrene	Styrene	Styrene	Styrene.
Parts by Weight	26	26	37	31	26	26	26	65	33.
Molar Proportion	0.25	0.25	0.685	0.57	0.25	0.25	0.25	0.625	0.317.
Phosphorus Sulfide	P_2S_5	P_2S_5	P_2S_5	P_2S_5	P_2S_5	P_2S_5	P_2S_5		
Parts by Weight	6.0	24.0	1	6	1	1	1		
Molar Proportion	0.025	0.11	0.0045	0.027	0.0045	0.0045	0.0045		
Wt. Per Cent of Total Olefins.	1.96	7.9	0.31	1.93	0.28	0.28	0.28		
Phosphorus								Red	Red.
Parts by Weight								1	1.
Molar Proportion								0.032	0.032.
Wt. Per Cent of Total Olefins.								0.13	0.26.
Sulfur								Flowers	Flowers.
Parts by Weight								3	3.
Molar Proportion								0.094	0.094.
Wt. Per Cent of Total Olefins.								0.39	0.78.
Temperature, °F	603	604	600	600	600	598	600	625	625.
Time, Hrs.	10	10	10½	10	10	10	10	10	10.
Max. Pressure, p. s. i. g.	200	100	100	150	100	300	450	360	800.
Topping of Reaction Product:									
Max. Vapor Temp., °C.	185	181	183	196	181	138	155	179	150.
Pressure, mms. Hg	3.0	3.0	5	4	6	2.5	6	2.0	1.0.
Residual Oil:									
Parts by Weight	55	85	27	27	69	38	16	404	85.
Yield, Per Cent [1]	17.5	25.8	8.5	8.5	19	10.5	4.4	52.6	22.
K. V. @ 100° F., Cs.	37.32	99.49	117.4	141.5	21.45	20.81	40.58	19.79	20.46.
K. V. @ 210° F., Cs.	5.62	9.35	11.61	12.48	4.12	3.63	4.59	4.38	4.10.
V. I.	96.5	70.7	93.6	84.4	101.9	35	<0	152	114.1.
Pour Point, °F.	<−30	<−30	<−30	<−30	<−30	<−30	−10	−5	<−30.
Br. Addn. No.	52.0	93.6		56.4				21.1	31.6.
Specific Gravity	0.9076	0.9659			0.8844			0.8333	0.8767.
N. N.	13.0	18.8	1.7	40.8	0.1			0.2	0.4.
Color (Lovibond)		700			14			13	7.3.
Per Cent P	2.09	3.34	0.075	2.90	0.003			Nil	0.042.
Per Cent S	3.26	8.85	0.15	3.65	0.41			0.04	1.84.
Cloud Point, °F.[3]								−4	10.

[1] Based upon combined weight of reactants.
[2] Benzene, 200 ccs., used as a diluent.
[3] Oils filtered through super-filtrol (clay) to improve color before cloud point determination.

From the results set forth in Table I, above, it will be noted, that when decene-1 is reacted with P_2S_5, in the absence of a conjugated hydrocarbon, the yield of oil product is low (run Numbers 1 and 2). Further, run No. 2 also indicates that with a relatively large amount of phosphorus sulfide reactant, the viscosity index of the oil product decreases and the acidity of the oil product increases markedly. Run No. 3 shows an oil product obtained by reaction of a conjugated hydrocarbon, namely, styrene with P_2S_5 in the absence of a normal, alpha mono-olefin; in this instance, a dark resin is obtained, rather than a viscous oil. Run No. 4 shows the condensation of decene-1 with styrene in the absence of a phosphorus sulfide. While the oil product of run No. 4 has an excellent V. I. and pour point, it has an undesirably high cloud point (+60° F.).

Run Numbers 5 to 13 illustrate the present invention. Run Numbers 5 and 6 demonstrate the effect of temperature upon the character of the oil products. For example, greater yields are obtained at 600° F. than at 500° F.; the viscosity indices of the oil products are higher when the condensation is carried out at 600° F., as opposed to a reaction temperature of 500° F. Less sulfur and phosphorus are found in the oil products obtained at 600° F. as compared with those formed at 500° F. In each run, the cloud points are desirably low, as evidenced by the determination for run No. 5.

The effect of increasing the proportion of P_2S_5 is demonstrated with run Numbers 7 and 9. With larger quantities of P_2S_5, lower yields of oil product are obtained and the viscosity indices of the products are lower. In addition, oil products formed with larger quantities of P_2S_5 are characterized by higher degrees of unsaturation, higher specific gravities, higher acidity, and higher phosphorus and sulfur contents.

Evidence that styrene condensed with decene-1 and P_2S_5 is shown by infra-red analyses of the residual oil of run No. 8. Such analyses clearly indicated the presence of aromatic rings in the residual oil.

Runs No. 7, 10 and 11 are comparable and also demonstrate the influence of increased amounts of P_2S_5 upon the reaction products. As the amount of P_2S_5 is increased, viscosity indices of the synthetic lubricants decreases and acidity thereof increases.

Runs No. 12 and 13 show synthetic lubricants obtained from butadiene, rather than styrene.

The effect of the structure of the mono-olefin reactant is demonstrated by runs No. 14, 15 and 16. Octene-1, octene-2 and 2-ethylhexene-1, respectively, are shown in runs No. 14, 15 and 16. It is clear that the yield is higher when octene-

1 and a normal, alpha mono-olefin is used. Further, the viscosity index of the oil obtained from octene-1 is materially higher than that characterizing the oils from octene-2 and 2-ethylhexene-1. The oils from the latter two olefins are only 35 and below 0, respectively.

The use of elemental phosphorus and elemental sulfur, in combination, in place of a phosphorus sulfide, is illustrated by runs No. 17 and 18. When a relatively large amount of phosphorus and sulfur is used, as in run 18, a lower yield of oil product is realized; in addition, the V. I. of the oil is lower.

The synthetic oils contemplated herein, and illustrated above by runs No. 5–14, 17 and 18, have molecular weights of the order of 1000 or less.

The stability of the oils of this invention is revealed by the results of a catalytic oxidation test, to which were subjected several of the residual oils shown in Table I, above. In this test 6.5 feet of No. 14 (Brown and Sharpe gauge) iron wire (15.6 square inch), 6.2 inches of No. 18 (B. & S.) copper wire (0.78 square inch), 3.33 inches of No. 12 (B. & S.) aluminum wire (0.87 square inch), a ¼ inch square of $\frac{1}{16}$ inch lead sheet ($\frac{1}{16}$ square inch), and 25 ccs. of the test oil were placed in a glass test tube, heated to 260° F. and air blown therethrough at the rate of 10 liters per hour for 40 hours.

Changes in the characteristics of the oil, sludge formed, and effects of oil on the copper coil and on the lead sheet were reported. On the basis of these changes, the residual oils were rated as compared with a SAE–10 solvent refined Pennsylvania motor oil subjected to the same test. The results of these tests and of the comparisons with SAE–10 Pennsylvania motor oil are reported in Table II below.

Table II

Run	Penna. SAE 10-W Oil	4	8	14	18
Time, Hours	40	40	40	40	40.
Analyses of Oil:					
N. N	16	8.8	2.5	3.8	1.5.
K. V. @ 210° F	12.91	9.44	5.19	5.08	4.44.
Percent Viscosity Increase	125	96.2	13.5	22.5	8.2.
Sludge, Tube	Nil	Nil	Nil	Nil	Nil.
Copper Coil	Dull Copper	Dull Copper	Black	Dark Brown	Brown.
Lead Loss, Mgm	235	238.3	114.9	73.5	58.
Rating:					
N. N	Poor	Fair	Good	Good	Good.
Viscosity Increase	do	Poor	do	do	Do.
Sludge	Good	Good	do	do	Do.
Pb. Loss	Very Poor [1]	Very Poor [1]	Poor	Fair	Fair.

[1] Indicates oil is very bad in this factor and would probably fail in an engine test.

From inspection of the results shown above in Table II, it will be seen that the new synthetic oils are better than SAE–10 Pennsylvania motor oil in almost all respects. It will be further noted that the residual oil of run No. 4 is obtained by condensation of decene-1 with styrene, in the absence of a phosphorus sulfide, and that the oil product therefrom is inferior to the oil products of runs No. 8, 14 and 18, which are oils contemplated herein. The viscosity increase of the oil product of run No. 4 is materially greater than the viscosity increase of the latter oils.

To further demonstrate the stability characteristics of the oils of this invention, 3% of the oil product of run 10 was incorporated in a Pennsylvania type lubricating oil and subjected to the catalytic oxidation test described above. In this test the blended oil was compared with the Pennsylvania lubricating oil alone. The results of these tests are reported in Table III below.

Table III

Oil	N. N. Initial	N. N. Final	K. V. @ 210° F. Initial	K. V. @ 210° F. Final	Per Cent Viscosity Increase	PB Loss, Mg.	Sludge	Appearance		
								Fe	Cu	Pb
Oil+3% Run No. 10	0.9	0.8	5.70	5.80	1.7	22.4	Nil	No Change	Gray	No Change.
Oil Blank	0.1	16	5.72	12.91	125	235	Nil	do	Dull Cu	Do.

The results shown in Table III above, reveal that the synthetic oil of run 10 imparts stability to the Pennsylvania type lubricating oil. For example, the viscosity increase of the oil blend is extremely slight, compared with the considerable and undesirable viscosity increase of the oil blank. Moreover, the lead loss obtained with the oil blank is appreciably reduced by the stabilizing influence of the synthetic oil.

As will be evident from the data presented above in Tables I, II and III, 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. In view of the inherent stability of the synthetic oils, they impart stability to the oils with which they are blended. So also, 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 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. For example, although used only in the amounts of the order of one to ten per cent, the synthetic oils improve the stability of mineral oils, such as SAE–10 and 20 Pennsylvania type oils.

One or more of the individual properties of the synthetic lubricants of this invention may be further improved by incorporating therewith

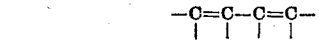
a small, but effective amount, of an addition agent such as an antioxidant, a detergent, an extreme pressure agent, a foam suppressor, a viscosity index (V. I.) improver, etc. Antioxidants which may be used are well-known in the art, and are generally characterized by phosphorus, sulfur, nitrogen, etc. content; representative of such materials is a phosphorus- 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 chlor-naphtha 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 nonlimiting and serve to illustrate the invention, which is to be broadly construed in the light of the language of the appended claims.

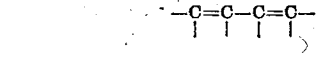
We claim:

1. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



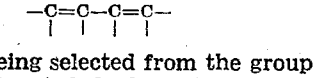
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

2. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 600° F. and about 700° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



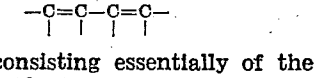
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

3. The method of preparation of a viscous oil, which comprises: condensing at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from eight to twelve carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

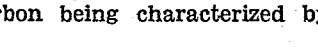
4. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



grouping and consisting essentially of the elements carbon and hydrogen.

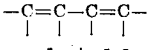
5. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a vinyl-substituted aromatic hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof.

6. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of phosphorus pentasulfide; said conjugated hydrocarbon being characterized by at least one



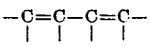
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

7. A new composition of matter comprising a condensation product obtained by: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



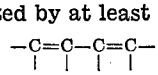
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

8. A new composition of matter comprising a condensation product obtained by: condensing, at a temperature between about 600° F. and about 700° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

9. A new composition of matter comprising a condensation product obtained by: condensing at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from eight to twelve carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one



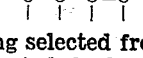
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

10. A new composition of matter comprising a condensation product obtained by: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof; said conjugated hydrocarbon being characterized by at least one

grouping and consisting essentially of the elements carbon and hydrogen.

11. A new composition of matter comprising a condensation product obtained by: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a vinyl-substituted aromatic hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of a material selected from the group consisting of a phosphorus sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof.

12. A new composition of matter comprising, a condensation product obtained by: condensing, at a temperature between about 500° F. and about 750° F. for a period of time sufficient to effect condensation, one molar proportion of a straight chain, alpha mono-olefin having from six to fourteen carbon atoms, from about 0.01 to about 1.0 molar proportion of a conjugated hydrocarbon and from about 0.01 to about 10 per cent, by weight of total olefins, of phosphorus pentasulfide; said conjugated hydrocarbon being characterized by at least one



grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

13. A viscous oil, obtained by: condensing at about 600° F. for about nine hours, one molar proportion of decene-1 with about 0.12 molar proportion of styrene and about 0.0005 molar proportion of phosphorus pentasulfide.

14. A viscous oil, obtained by: condensing at about 600° F. for about nine hours, one molar proportion of decene-1 with about 0.12 molar proportion of styrene and about 0.002 molar proportion of phosphorus pentasulfide.

15. A viscous oil, obtained by: condensing at about 625° F. for about ten hours, one molar proportion of decene-1 with about 0.12 molar proportion of styrene, about 0.006 molar proportion of phosphorus and about 0.02 molar proportion of sulfur.

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