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LUBRICANT COMPOSITION

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This invention has to do with the condensation or normal alpha mono-olefins, certain conjugated hydrocarbons and sulfur, 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 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. In no known instance, however, have alpha-normal mono-olefins been condensed with conjugated hydrocarbons, of the character defined hereinbelow, and sulfur.

It has now been discovered that normal alpha mono-olefins condense with certain conjugated hydrocarbons and sulfur, under conditions hereinafter defined, with the formation of 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. Further, 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 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 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

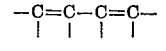
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foregoing examples that an alpha olefin may also be referred to as a 1-olefin.

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 containing a major proportion of a 1-olefin or of 1-olefins. Rrepresentative of such mixtures are those obtained by the cracking of paraffin waxes and other paraffin products; those obtained from the Fischer-Tripsch and related processes.

These hydrocrabon 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, butadiene and styrene have 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: 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 sulfur. 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-chlorobutadiene), 1-bromo butadiene and p-chlorostyrene; 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 alpha-mono-olefin and sulfur. 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 sulfur. 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 those having only one conjugated grouping

with particular preference being given to styrene and butadiene.

As indicated above, sulfur is condensed with the alpha mono-olefins and conjugated reactants defined above. Also contemplated herein for such condensation in place of sulfur are selenium and tellurium. The latter may replace sulfur in part or in entirety, and mixtures of two or all three of said substances may be used. In view of the availability and low cost of sulfur, and in view of the outstanding character of the oils obtained therewith, sulfur is particularly preferred herein. It is on this basis that the following discussion and illustrative examples are directed to condensations involving sulfur.

REACTION CONDITIONS

Condensation of the aforesaid reactants is affected at elevated temperatures. It appears that temperatures as low as 300° F. and as high as 900° F. can be used in some instances; however, temperatures of the order of about 400° F. to about 750° F. are most satisfactory. The preferred temperature range is from about 600° F. to about 650° F.

Condensation is generally complete in from 1 to 10 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.

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.

Proportions of reactants can be varied considerably. With one molar proportion of an alpha mono-olefin as the basis, from about 0.01 to about 1 molar proportion of conjugated reactant and from about 0.001 to about 1 molar proportion of sulfur, provide satisfactory products. Preferred proportions, however, are from about 0.05 to about 0.5 molar proportion of conjugated reactant and from about 0.01 to about 0.5 molar proportion of sulfur, with one molar proportion of alpha mono-olefin.

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. At the reaction conditions, the reactants are mutually soluble and homogeneity is easily attained.

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 distilled to remove unreacted materials. 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 distilled 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 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

Condensation of olefins with sulfur and conjugated hydrocarbons

Run	1	2	3	4	5	6	7
Olefin	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1.
Grams	280	280	280	280	840	280	280.
Moles	2.0	2.0	2.0	2.0	6.0	2.0	2.0.
Conjugated Hydrocarbon	Butadiene.	Styrene	Styrene	Styrene	Styrene	Styrene	Styrene.
Grams	28	26	26	26	78	26	26.
Moles	0.52	0.25	0.25	0.25	0.75	0.25	0.25.
Sulfur:							
Grams	4		1	4		0.25	1.0.
Moles	0.125		0.03	0.125		0.0078	0.03.
Temp., °F	600	410	400	500	600	597	610.
Time, Hours	10¼	10	10½	10	10¼	10½	9¼.
Max. Pressure, p. s. i. g.	200	100	<100	<100	400	200	125.
Distillation of Reaction Product:							
Max. vapor temp., °C	200 [1]	104	190	200	160	170	180.
Pressure, mm. Hg	5	6	23.5	3	12	2.8	7.6.
Residual Oils:							
Grams	72	21	27	43	493	107 [2]	123.
Cloudy at Room Temp. (22° C.)	No		No	No	Yes	No	No.
Vis., S. U. at 210° F	41.98	Resin	70.89	43.02	41.98	45.15	38.46.
V. I.	129.9		75.6	104.8	137.3	127.3	128.3.
Pour, °F	−60		−10	<−30	−25	<−35	−20.
Br. Addn	45.7		32.7	39.9	19.2	19.2	28.7.
Refractive Index			1.5307	Too Dark	1.4760	1.4802	
Specific Gravity	0.8686		0.9503	0.9071	0.8514	0.8602	0.8576.
NN	0.2		0.3	0.4	0.1	0.3	0.5.
Percent S	2.57		3.26	3.30		0.23	0.85.
Distillate, Br. No.	87.5		109.3	108.7	95.7	87.6	99.3.
Percent S	0.93					0.059	0.12.

Run	8	9	10	11	12	13
Olefin	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1	Decene-1.
Grams	8,683	280	280	280	280	17,366.
Moles	62	2.0	2.0	2.0	2.0	124.
Conjugated Hydrocarbon	Styrene	Styrene	Styrene	Styrene	Styrene	Styrene.
Grams	806	26	13	52	52	1,612.
Moles	7.75	0.25	0.125	0.5	0.5	15.5.
Sulfur:						
Grams	62	4.0	4.0	16	4	124.
Moles	1.94	0.125	0.125	0.5	0.125	3.88
Temp., °F	605	600	600	600	730	650.
Time, Hours	10	10	11	10	5	10.
Max. Pressure, p. s. i. g.	2,500	400	300	250	2,825	800.
Distillation of Reaction Product:						
Max. vapor temp., °C	260	193	195	199	183	238.
Pressure, mm. Hg	11.0	2	5	5.3	4	20.6.
Residual Oils:						
Grams	2,838	95	87 [2]	62	51	5,958 [4].
Cloudy at Room Temp. (22° C.)	No	No	No	No	No	No.
Vis., S. U. at 210° F	44.95	38.49	35.93	43.40	37.44	41.30.
V. I.	126	125.3	115.8	93.5	52	120.9.
Pour, °F	−30	−25	−10	<−50	−25	−20.
Br. Addn	24.2	33.4	42.9	50.7	13.8	19.6.
Refractive Index	1.4830		1.4740		Too Dark	
Specific Gravity	0.8686	0.8597	0.8524	0.9315	0.9123	0.8628.
NN	0.5	0.2	0.1	2.2	0.75	0.2.
Percent S	0.81	1.79	3.28	6.54	0.73	0.62.
Distillate, Br. No.	74.9	81.8	78.3	69.6	17.7	
Percent S	0.188	0.44				

[1] 292 g. reaction product from bomb first heated at atmospheric pressure to maximum liquid temperature of 180° C., no distillate.
[2] Some reaction product lost from bomb.
[3] Adsorbent clay used to improve color, with large loss.
[4] Color (Lovibond) = 45; carbon residue (Ramsbottom) = 0.1.

As can be seen from the data set forth in Table I, above, the omission of sulfur in run-2 resulted in the formation of a resin, and in run 5 resulted in the formation of a product that was cloudy at room temperature (22° C.). In the latter case, the cloud point was actually +60° F., in contrast to cloud points of less than −34° F. for the comparable products of run-6 and run-8.

Evidence that styrene condensed with decene-1 and sulfur in run-8 is shown by infra-red analysis of the residual oil. Such analysis clearly indicated the presence of aromatic rings in the residual oil. Additional evidence is shown by chemical analysis of the residual oil, the latter containing 0.81 per cent sulfur, 85.99 per cent carbon and 13.11 per cent hydrogen. This analysis indicates that the residual oil is composed of 0.81% sulfur, 16.3% reacted styrene (as compared with 8.4% monomer in the charge mixture) and 82.9% reacted decene-1 (as compared with 90.9% monomer in the charge mixture).

A number of well known tests were made on the residual oils shown in Table I, above, to determine their characteristics and usefulness. For example, the residual oil from run-8 was subjected to the copper strip test, which is a standard test for lubricants. The purpose of the copper-strip test is to detect free sulfur and corrosive sulfur, the latter often being present as "loosely-bound" sulfur in an oil. In this test, 50 mls. of the oil to be tested are placed in a 100 mls. beaker along with a polished copper strip, about ½ inch by 2 inches. The copper strip is bent into a V and so placed in the beaker that the flat surface thereof does not touch the bottom or sides of the beaker. The oil sample in the beaker completely covers the copper strip. The beaker, containing oil sample and copper strip, is placed in an electric oven for the required period of time. Thereafter, the beaker is removed from the oven and the copper strip is removed from the beaker. The strip is washed with petroleum ether and then is examined for

corrosion. After 26 hours at 100° C., the copper strip subjected to the residual oil from run-13 was only slightly stained and the oil had only slightly darkened. There was no sludge in the oil sample. This test, then, demonstrates that the sulfur present in the oil is firmly bound and that no free sulfur is present in the oil. It will be noted in Table I, above, that the residual oil from run-13 contains 0.62 percent sulfur.

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 $\frac{1}{8}$ inch lead sheet ($\frac{1}{8}$ 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.

respect. It will further be noted that the residual oil of R–1 is obtained from butadiene, demonstrating that butadiene, like styrene, is a suitable conjugated hydrocarbon reactant. The residual oil of R–5 is unsatisfactory in view of its action upon the lead sheet; however, it will be recalled that R–5 is obtained by condensing decene-1 with styrene in the absence of sulfur, and is therefore not contemplated herein.

To further demonstrate the character of the residual oils of this invention, the residual oil obtained in run-13, of Table I, above, was subjected to a Lauson oxidation stability test. In this test, a Lauson single cylinder, four-cycle gasoline engine is used. The engine has splash lubrication and a copper-lead bearing. It is operated with an oil temperature of 270° F. and a jacket temperature of 212° F., and a speed of 1825 revolutions per minute (R. P. M.). In the test, the engine is run at one-half throttle, with a 13.0–1 air-fuel ratio. The engine is inspected every 20 hours, with bearing weight loss, engine cleanliness and used oil analyses being reported.

The results of the aforesaid Lauson test are presented in Table III below. In this table, a comparison is shown of R–13 residual oil and of a blank, an SAE–20 grade Pennsylvania mineral oil which is predominantly paraffinic in character.

TABLE III

Lauson OS–2 engine test on synthetic oil from decene–1, styrene and sulfur

Oil	Hours	N. N.	Viscosity @ 210° F., cs.	Insol. in A. S. T. M. Naphtha	Insol. in Chloroform	Bearing Weight Loss, g.		Rating	
						Top	Bottom	Overall Cleanliness	Detergency
Blank	20	2.2	9.74			0.071	0.085	86	78
	40	4.1	11.06						
	60	5.2	11.76			0.434	0.347	82	73
	80	5.3	12.13						
	100	5.2	12.00			0.540	0.443	78	69
R–13	0	0.2	[1] 4.60						
	20	1.0	4.90	0.18	0.17	0.011	0.013	83	76
	40	1.9	5.11	0.32	0.21				
	60	2.3	5.25	0.48	0.34	0.039	0.047	80	71
	80	2.6	5.38	0.48	0.46				
	100	2.5	[2] 5.45	0.46	0.34	0.081	0.088	68	60

[1] Viscosity index=120.9, pour point=—20° F.
[2] Viscosity index=120.3, pour point=—25° F.

It will be noted from review of the results in Table III, above, that the bearing loss is much

TABLE II

Catalytic oxidation test

Run	1	5	6	7	8	9	10	11
Time, Hours	40	40	40	40	40	40	40	40.
Analyses of Oil:								
NN	2.4	8.8	2.8	3.3	2.0	2.2	2.3	1.8.
K.V. at 210° F	5.47	9.44	6.31	3.87	4.02	3.18	6.23	3.79.
Percent Vis. Increase	13.7	96.2	8.9	4.5	8.3	9	15.6	12.4.
Sludge Tube	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Medium.
Copper Coil	Bright Cu.	Dull Cu.	Dark Brown.	Medium Brown.	Dull Brass.	Dull Brass.	Black	Black.
Lead Loss, Mgm	30.1	238.3	64.9	10.0	12	41.1	5.9	1.0.
Rated Against	Penna. SAE 10.	Penna. SAE 10.	Penna. SAE 10.	Penna. SAE 10.	Penna. SAE 10.	Penna. SAE 10.	Penna. SAE. 10.	Penna. SAE 10.
NN	Better	Equal	Better	Better	Better	Better	Better	Better.
Vis. Increase	do	Worse	do	do	do	do	do	Do.
Sludge	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Medium.
Pb Loss	Equal	Worse [1]	Equal	Better	Better	Equal	Better	Better.

[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 in every instance the new synthetic oils are equal to or better than SAE–10 Pennsylvania motor oil in every

less for the residual oil, R–13, than for the blank oil. The average loss for the top and bottom sections of the bearing in contact with the blank oil is 0.491 gram, as compared with only 0.085 gram

when the oil is R–13 residual oil. Consistent with this comparison is the large differences in N.N. values for the two oils. While the engine cleanliness rating for R–13 residual oil is somewhat lower than the rating for the blank oil, it is of the same order as the blank oil when the latter contains a small amount of a conventional antioxidant (which tends to make for lowered cleanliness rating). The blank oil requires such an antioxidant to prevent bearing loss and thus meet present day lubricant requirements. It will also be noted that the viscosity change of R–13 residual oil over the 100 hour period is only 18 per cent, as against a 23 per cent change for the blank oil. Finally, it should be noted that R–13 residual oil has a low initial pour point, —20° F., and at the end of the test still has a low pour point, —25° F. This demonstrates that the oil does not undergo "reversion" of pour point, which is a serious problem today with oils of the type of the blank, particularly when the latter contains certain of the commercially available pour point depressants.

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 1 to 10 per cent, the synthetic oils improve the stability of mineral oils, such as SAE 10 and 20 Pennsylvania type oils.

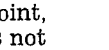
One or more of the individual properties of the synthetic lubricants of this invention may be further improved by incorporating therewith a small, but effective amount, of an addition agent such as a detergent, an extreme pressure agent, a foam suppressor, a viscosity index (V. I.) improver, etc. Typical 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 nonlimiting and serve to illustrate the invention, which is to be broadly construed in the light of the language of the appended claims.

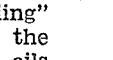
We claim:

1. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from 5 to 18 carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of a substance selected from the group consisting of sulfur, selenium and tellurium; said conjugated hydrocarbon being characterized by at least one



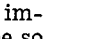
grouping and being selected from the group consisting of conjugated hydrocarbons and substituted conjugated hydrocarbons wherein a substituent is one which is substantially inert in said condensation.

2. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



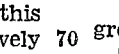
grouping and consisting essentially of the elements carbon and hydrogen.

3. The method of preparation of a viscous oil, which comprises: condensing at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a substituted conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and having a halogen substituent.

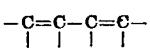
4. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400 °F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a substituted conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and having an alkoxy substituent.

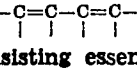
5. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a

straight chain, alpha mono-olefin having from eight to twelve carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



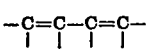
grouping and consisting essentially of the elements carbon and hydrogen.

6. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by one



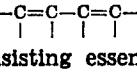
grouping and consisting essentially of the elements carbon and hydrogen.

7. The method of preparation of a viscous oil, which comprises: condensing at a temperature between about 600° F. and about 650° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



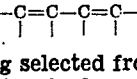
grouping and consisting essentially of the elements carbon and hydrogen.

8. The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.05 to about 0.5 molar proportion of a conjuagated hydrocarbon, and from about 0.01 to about 0.5 molar proportion of sulfur; said conjugated hydrocarbon being characterized by one



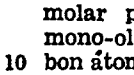
grouping and consisting essentially of the elements carbon and hydrogen.

9. A condensation product obtained by: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of a substance selected from the group consisting of sulfur, selenium and tellurium; 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 condensation product obtained by: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and consisting essentially of the elements carbon and hydrogen.

11. A condensation product obtained by: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from eight to twelve carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and consisting essentially of the elements carbon and hydrogen.

12. A condensation product obtained by: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by one



grouping and consisting essentially of the elements carbon and hydrogen.

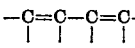
13. A condensation product obtained by: condensing, at a temperature between about 600° F. and about 650° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and consisting essentially of the elements carbon and hydrogen.

14. A viscous oil composition comprising a mineral oil of lubricating viscosity in major proportion and a minor proportion, from about one to about ten per cent, of a condensation product; said condensation product being obtained by: condensing, at a temperature between about 400° F. and about 750° F. for a period of time from about ten hours to about one hour, respectively, one molar proportion of a straight chain, alpha mono-olefin having from five to eighteen carbon atoms per molecule, from about 0.01 to about one molar

proportion of a conjugated hydrocarbon and from about 0.001 to about one molar proportion of sulfur; said conjugated hydrocarbon being characterized by at least one



grouping and consisting essentially of the elements carbon and hydrogen.

15. A condensation product of lubricating viscosity obtained by: condensing, at a temperature of about 610° F. for about nine hours and with a pressure of about 125 pounds per square inch, about 32 molar proportions of decene-1, about four molar proportions of styrene and one molar proportion of sulfur.

16. A condensation product of lubricating viscosity obtained by: condensing, at a temperature of about 600° F. for about ten hours and with a pressure of about 250 pounds per square inch, about four molar proportions of decene-1, about one molar proportion of styrene and one molar proportion of sulfur.

17. A condensation product of lubricating viscosity obtained by: condensing, at a temperature of about 600° F. for about ten hours and with a pressure of about 200 pounds per square inch, about sixteen molar proportions of decene-1, about four molar proportions of butadiene and one molar proportion of sulfur.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,213,423	Wiezevich	Sept. 3, 1940
2,337,473	Knowles	Dec. 21, 1943
2,439,610	Morris et al.	Apr. 13, 1948
2,442,644	Elwell	June 1, 1948