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2 Sheets-Sheet 1

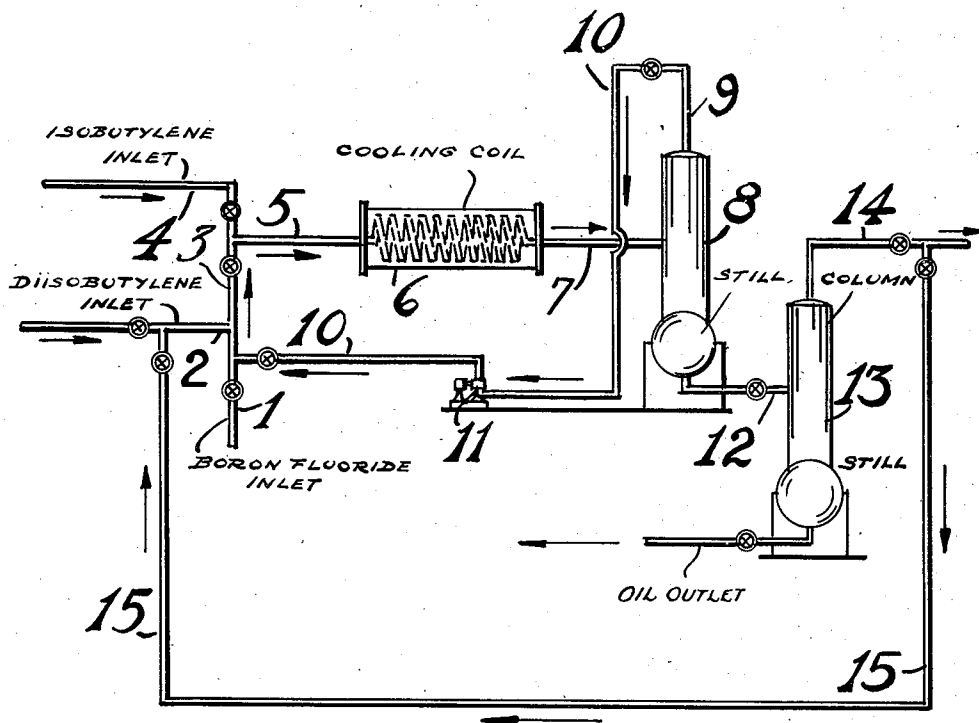


Fig.-1

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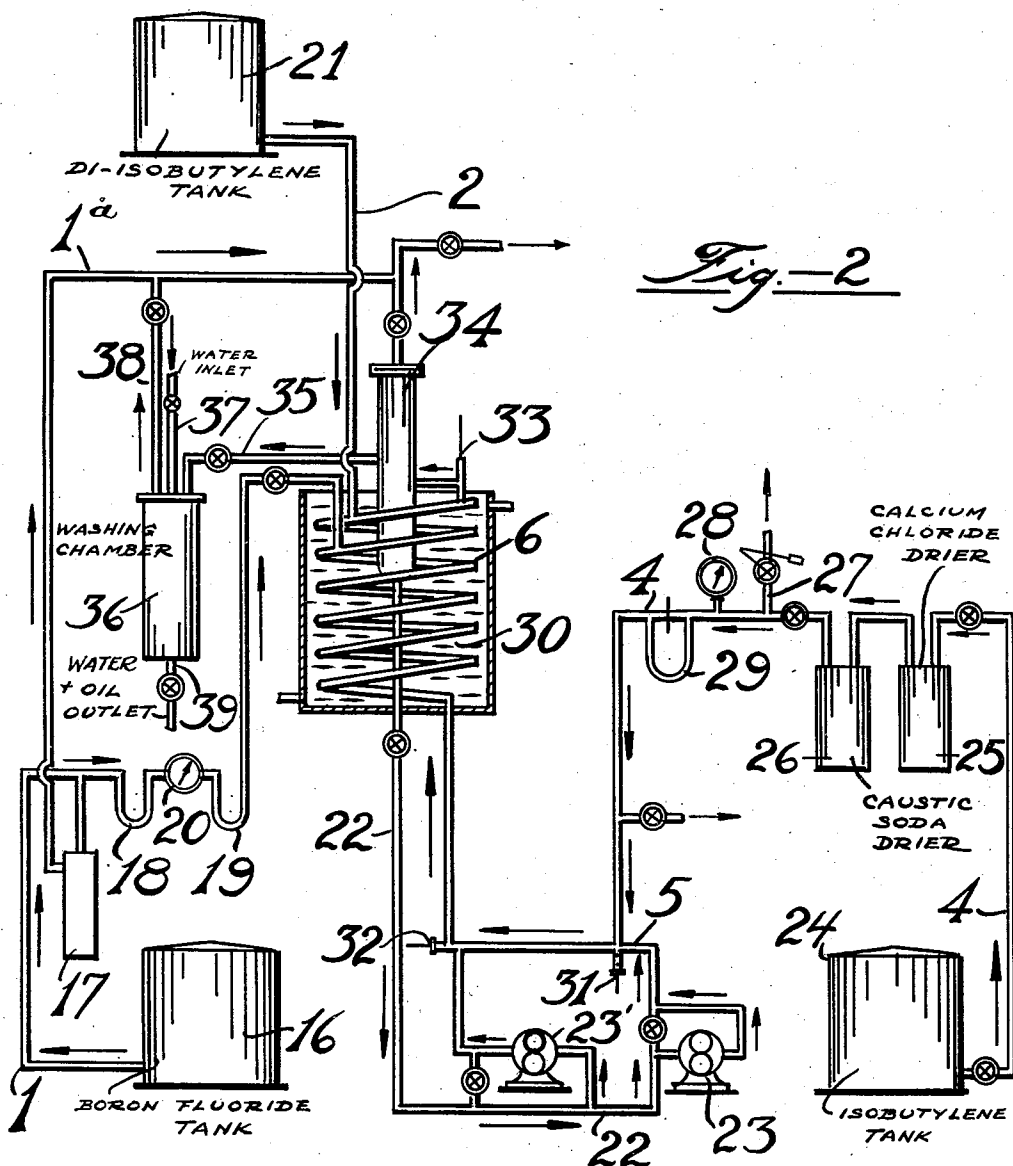
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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LUBRICATING OILS AND METHOD OF PRODUCING SAME

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8 Claims. (Cl. 196—10)

This invention relates to novel lubricating oils and novel methods of preparing same.

Broadly the invention comprises preparing lubricating oils by feeding a normally gaseous olefin, particularly isobutylene, into a normally liquid reactive hydrocarbon diluent particularly of the olefinic type, having from 6 to 24 carbon atoms, into which liquid a Friedel-Crafts type catalyst, such as boron fluoride or aluminum chloride, has been dispersed as uniformly as possible, i. e. by solution or suspension, the reaction being carried out at approximately 0–150° F., preferably 40–80° F., whereby a substantial proportion of the normally gaseous olefin polymerizes while another substantial proportion thereof reacts or condenses with the normally reactive hydrocarbon diluent to produce large yields of lubricating oil having high viscosity index (low change of viscosity with change in temperature) and having a Saybolt viscosity of from about 40 seconds to 400 seconds at 210° F. and preferably from 40 to 200 seconds at 210° F.

Heretofore many processes have been proposed for polymerization of olefins or for reacting olefins with other materials to make various types of products and also many processes have been proposed specifically for making lubricating oils. However, most of these prior art processes have either been attended with various operating difficulties or have not been practical from an economical point of view or do not produce the desired type of lubricating oil. For instance, it is known that isobutylene, for example, can be polymerized at very low temperature, e. g. from –10° C. to –50° C. or lower, to substantially solid polymers having a molecular weight greater than 1000 or 2000 and possibly as high as 100,000 or more, using boron fluoride as catalyst; and it is also known that isobutylene can be readily polymerized to dimer, trimer and other low molecular weight polymers by reacting at somewhat elevated temperatures, e. g. 100–300 or 400° F. (about 40–200° C.). It is also known that lubricating oils are produced by passing olefins such as ethylene, propylene, butylenes and amylenes into a hydrocarbon liquid such as petroleum ether containing aluminum chloride suspended therein.

Compared to the last mentioned process, the present invention has a great advantage in producing a substantially larger yield of product of the desired viscosity range and besides makes an oil having substantially improved properties. For instance, by feeding isobutylene into a solution of boron fluoride in di-isobutylene at temperatures between about 30 and 70° F. according to

the present invention, oils are produced having Saybolt viscosity limits between about 35 or 40 up to 200 or 300 seconds at 210° F., whereas by using the same temperature range but reversing the order of adding ingredients, namely by feeding boron fluoride into a solution of isobutylene in di-isobutylene, products are made which have an extremely wide range of viscosity, some of the products averaging a Saybolt viscosity of 600 or 700 seconds at 210° F., some averaging 3000 seconds at 210° F., and some covering limits as wide as 42 seconds for the lowest boiling constituents and 14,000 seconds at 210° F. for the highest boiling fractions.

The preferred procedure of the present invention has the advantage that in order to produce an oil having a certain desired viscosity at 210° F. and a certain desired viscosity index, an oil is produced having a higher flash than is obtained when the process is carried out under conditions resulting in the product having a wide range of viscosity. In other words, the products having a relatively narrow viscosity range as produced by the preferred process of the present invention, have higher flash points than the wide viscosity range oils produced by other processes.

In carrying out the reaction (polymerization and/or condensation) of olefins such as isobutylene with a reactive liquid hydrocarbon diluent such as di-isobutylene in the presence of a catalyst such as boron fluoride, a primary feature of the invention is the particular order of combining the raw materials because it has been found, for example, that feeding isobutylene into a solution of boron fluoride in di-isobutylene gives surprisingly better results than feeding boron fluoride into a solution of isobutylene in di-isobutylene even though substantially the same reaction conditions and proportions of materials are used in both cases. A still further advantage of this process lies in the ease of controlling the reaction as compared to the considerable fluctuations in temperatures when the catalyst is added to the solution of isobutylene in di-isobutylene.

The normally gaseous olefin which is the primary reactant according to the present invention is preferably isobutylene although other olefins such as ethylene, propylene, normal butylenes and amylenes may be used. Iso-olefins such as isobutylene or iso-amylenes apparently are peculiarly adapted to produce the desired combination of polymerization and co-polymerization. They lead to larger yields and superior products than are obtained with other normally gaseous olefins. Although from an economical point of view it may

be preferred to use the isobutylene (or other normally gaseous olefins) in the gaseous state, it is possible to use them also in a liquid state by using a sufficient amount of pressure under the temperature of operation. Also, instead of using any particular single olefin, it is possible to use mixtures of several normally gaseous olefins or one or more of these olefins mixed with an inert diluent such as one or more of the normally gaseous paraffins having from 1 to 5 carbon atoms, such as methane, butane, etc. or other inert gases such as nitrogen or hydrogen.

It is preferred to use di-isobutylene, tri-isobutylene or other polymers thereof up through the hexamer, because they are apparently peculiarly adapted to react with the isobutylene or other normally gaseous olefin used and are more susceptible to polymerization by themselves or co-polymerization with the normally gaseous olefin being treated. However, if desired, other normally liquid reactive hydrocarbon diluents may be used, for instance, low molecular weight polymers of normally gaseous olefins other than isobutylene such as trimers, tetramers, etc. of ethylene, propylene, etc. Although the theory of the mechanism of the reactions involved in the present invention is not entirely understood, it is believed that having the catalyst such as boron fluoride dissolved or suspended in this reactive hydrocarbon liquid diluent before adding the isobutylene, accomplishes simultaneously several advantageous results including that it permits close temperature control and thereby makes possible the production of an oil having a relatively narrow viscosity spread, and it facilitates the desired polymerization of the iso-butylene to the lubricating oil type of product rather than to either low polymers such as dimer and trimer or the very much higher substantially solid polymers such as those having molecular weights from several thousand up to 100,000. It also permits carrying out the reaction at temperatures such as 60° F. without the use of pressure (if, on the other hand, boron fluoride were to be fed into a solution of isobutylene in di-isobutylene at 60° F., the reaction chamber would have to be kept under a sufficient pressure to keep the isobutylene in the liquid phase). The lower polymers, especially dimer, trimer, etc. of isobutylene have been found to be especially good solvents for boron fluoride, approximately 1.0% by weight being soluble as compared to about 0.1% by weight soluble in a saturated hydrocarbon such as iso-octane at atmospheric pressure.

Boron fluoride is the preferred catalyst for the reactions involved in the present invention because it actually dissolves to a suitable extent in the di-isobutylene or other reaction liquid being used as diluent, instead of merely being suspended therein in a finely divided solid condition. However, other Friedel-Crafts type catalysts may be used such as aluminum chloride, titanium tetrachloride or modified catalysts such as boron fluoride dissolved in water or in acids such as sulfuric, phosphoric, etc.

The process may be carried out in separate batches but is preferably carried out in a continuous process as will be described more fully later. In any case, when the polymerization and condensation or co-polymerization have been carried out to the desired extent for which a reaction time varying from a few minutes to 4 or 10 hours may be used, the product is preferably treated first to separate the catalyst such

as by water washing or by distilling off the boron fluoride at a temperature of 200° F., or lower if partial vacuum is used, and then the product is subjected to distillation or fractionation in order to remove any light polymers or unreacted raw material having not more than 24 carbon atoms or having a molecular weight not more than about 300 or 325, or in other words, it is desired to recycle any product having a viscosity less than about 40 seconds Saybolt at 210° F. This separation may be effected by distilling or fractionating at a temperature of about 400-500° F. at atmospheric pressure with steam or by using a temperature up to about 300° F. at 5 mm. pressure.

The residual product having a viscosity greater than 40 seconds Saybolt at 210° F. may, if desired, be separated by fractionation into a light lubricating oil blending stock having a viscosity of 40 to 100 seconds Saybolt at 210° F. and a heavy lubricating oil blending stock having a viscosity of 100 to 200 seconds Saybolt at 210° F. Although even somewhat higher viscosity products such as those having a Saybolt viscosity of up to 400 to 500 seconds at 210° F. may be used in motor oils by blending them with considerably lower viscosity stocks, it is preferred to regulate the operating conditions so that relatively little product will be made outside the limits of 40 and 200 seconds Saybolt at 210° F.

In carrying out the reaction, the temperature is preferably controlled within relatively narrow limits and this may be done by several methods—one is by controlling the rate of the addition of the normally gaseous olefin and the other is by the use of cooling means, such as cooling coils (either inside or outside the reaction vessel), or the desired reaction temperature may be maintained by using some liquefied, normally gaseous material (either one of the reactants or some inert diluent) in the liquid phase by maintaining the reaction vessel under suitable elevated pressure and then releasing some of the pressure if and when desired to cool the reaction liquid, the cooling being effected by absorption of the latent heat of evaporation of the liquefied, normally gaseous material.

Various types of equipment may be used in carrying out this invention, but for the sake of illustration suitable equipment will be described for carrying out the process, either by batch or continuously.

In the accompanying drawings,

Fig. 1 is a diagrammatic sketch of suitable equipment for batch operation which may, if desired, also be used for continuous operation.

Fig. 2 illustrates an improved and more detailed layout for a continuous cyclic process.

Referring to Fig. 1, boron fluoride is fed in through inlet 1 and admixed with di-isobutylene being fed in through inlet 2 and the resulting solution passing through pipe 3 is met by isobutylene being fed in through inlet 4. The reaction takes place in the pipe 5, which is preferably provided with cooling means, such as a cooling coil 6, in order to prevent undue rise of temperature and the reaction products pass through line 7 into still 8 where the boron fluoride is distilled off overhead through discharge 9. If desired, the boron fluoride may be recirculated through line 10 and pump 11 into the original boron fluoride inlet 1. The boron fluoride may also be removed by water washing the product leaving the cooling coil 6, or traces of boron fluoride may be washed from the product leaving

still 8. The residue in still 8 which is maintained at a suitable temperature, such as about 200° F., passes through line 12 into another still or fractionating column 13 maintained at about 400° or 500° F. at atmospheric pressure or up to 300° F. under vacuum (5 mm. pressure). From here, any unreacted di-isobutylene, together with light polymers having a Saybolt viscosity less than about 40 seconds at 210° F., is taken off overhead through line 14 and, if desired, may be recirculated through line 15 into original di-isobutylene inlet 2. The bottoms taken off from still 13 constitute the lubricating oil product having a Saybolt viscosity above 40 seconds at 210° F. and, if desired, may be further fractionated by suitable equipment not shown into light and heavy lubricating oil blending stocks.

Referring to Fig. 2, which represents a continuous cyclic process in which only a portion of the product is drawn off and separated while the remaining portion of the product is recycled, boron fluoride is fed from a suitable source 16 through line 1, which is preferably provided with a suitable pressure controlling device, such as mercury seal 17, traps 18 and 19 and meter 20, into the upper part of coiled line 6 and the reactive hydrocarbon liquid diluent, such as di-isobutylene, is fed from a suitable source 21 through inlet 2 into the upper part of the same coiled line 6. The bulk of the liquid rising through the coiled line 6 descends through line 22 through pump 23 and is met by isobutylene being fed from a suitable source 24 through line 4, which is preferably provided with calcium chloride drier 25, caustic soda drier 26, safety valve 27, pressure gauge 28 and manometer 29. The isobutylene from line 4 meets the solution of boron fluoride in di-isobutylene coming through line 22 and the reaction starts in line 5, the reaction liquid then passing upward into the coiled line 6 which is being cooled by a suitable bath mixture 30 such as alcohol to which solid carbon dioxide is added. The temperature of the liquids at various stages throughout this cyclic equipment may be observed by having the thermometers 31, 32 and 33 placed at proper points in the equipment as indicated. Part of the reaction products being discharged from overflow 34 pass through line 35 into a suitable washing chamber 36 into which water is fed through line 37 and from which some boron fluoride catalyst escapes through line 38 and may be recycled into line 1a for reuse. Any excess boron fluoride that is forced through the mercury of seal 17 into line 1a, joints the recovered boron fluoride from line 38. The washed lubricating oil product is discharged through line 39 and may, if desired, be further treated, as by fractionation, etc., by suitable equipment not shown. Any low molecular weight polymers below lubricating oil in boiling range and viscosity may be recovered from the product and returned to diluent supply tank 21 and to the system through line 2.

In operating this cyclic equipment shown in Fig. 2 and described hereinabove, when the recycling is carried out at the proper rate and the raw materials are fed at the proper rate and the desired equilibrium has been established, the temperature difference between any of the three thermometers 31, 32 and 33 should not exceed about 10° or 15° F.

When carrying out the invention, the higher the temperature the lower will be the viscosity of the product, other conditions being equal.

Also the temperature to be used will vary somewhat according to the raw material being used; for example, with plant isobutylene (a crude commercial stock of isobutylene), which generally contains small amounts of normal butenes as well as a small amount of butanes, it is best to use a reaction temperature of about 40° F. whereas with a specially refractionated isobutylene, in other words, a practically pure isobutylene, the reaction temperature should be somewhat higher, e. g. about 65° F. Commercial supplies of isobutylene may be obtained by separation (by distillation or absorption, etc.) from the so-called C4 cut from petroleum refineries. The separation of it may be obtained by cracking di-isobutylene (readily prepared from a C4 cut by treating with sulfuric acid) or by dehydrating iso-butyl or tertiary butyl alcohol or may also be prepared by dehydrogenation of iso-butane.

In addition to the reactive hydrocarbon diluents mentioned previously, one may also use a cracked wax distillate boiling below the range of hydrocarbons having a Saybolt viscosity below 40 seconds at 210° F. Another suitable stock is a light polymer oil obtained by the polymerization of isobutylene up to a Saybolt viscosity of 63 seconds at 100° F. which is only slightly heavier than a mineral seal oil stock.

The proportion of the raw materials may vary considerably according to the nature of the materials used, the reaction conditions such as temperature, feed rate, etc., as well as the nature of the finished product desired. Ordinarily, however, for every one part by weight of reactive diluent such as di-isobutylene, it is preferred to use between one-tenth part and 10 parts of isobutylene and when boron fluoride is used as catalyst, generally the amount used is not more than about 1% (based on the weight of the oil produced). In the recycling process the amount used may be as low as 0.1%. It is possible under some circumstances, however, to use considerably larger amounts, e. g. up to 5 or 10% or more, particularly with some of the other less effective catalysts and when other reaction conditions are varied so as to require larger amounts of catalyst.

If the isobutylene is fed in at a high or fast rate, the yield of oil of the desired boiling range, e. g. 40 to 200 seconds Saybolt viscosity at 210° F., decreases and also the viscosity at 100° F. is increased whereas if the rate of addition of isobutylene is slow, a more uniform product is produced, i. e. having a narrower viscosity range (from the low to high boiling constituents) and the yield of oil is increased due to much greater co-polymerization. The slow rate of adding isobutylene is preferred. This means that in the continuous recycling process a high rate of circulation of the BF₃-di-isobutylene solution should be used, and a relatively small proportion of isobutylene compound to the amount of circulated material should be fed into the system.

Agitation also is a factor to be considered in that good agitation tends to cause more co-polymerization and produces a product having a narrower viscosity spread. In the continuous system this agitation is obtained by a high rate of flow through the coil.

Some examples of detailed operating conditions and products are given in the following experimental data which are submitted for illustration only and not intended to limit the invention specifically thereto.

In Table I are given the results of two tests made to compare the use of an inert diluent, namely, test 1, normal heptane, as distinguished from a reactive hydrocarbon diluent, namely, test 2, a light isobutylene polymer oil having a Saybolt viscosity of about 63 seconds at 100° F. In these tests the diluent was saturated with boron fluoride and a small excess of boron fluoride was added to the system continuously and the isobutylene was fed into the solution.

treated polymer, namely 230° F., is reduced to 120° F. in the treated polymer. Likewise, the 10%, 20% and 30% overhead points were all reduced in the treated polymer.

Apparently, in carrying out the present invention, particularly in the continuous recycling process, a number of various reactions tend to come to equilibrium and the exact nature of this equilibrium will depend upon the operating conditions, such as the temperature, proportions of

TABLE I
Comparison of inert and reactive diluents

Test No.	Diluent	Grams re-fractionated isobutylene added	Time	Temp.	Oil boiling above 450° F. with steam		
					Yield	Vis./210° F.	V. I.
1	250 gm. n-heptane	548	4	65	32	85	53
2	250 gm. 63 vis./100° F. polymer	585	4	65	48	92	53

The above Table I shows that under identical reaction conditions (e. g. time and temperature) in the same apparatus and using substantially identical proportions of materials (diluent and isobutylene), the reactive diluent, namely, the 63 vis. at 100° F. polymer, resulted in a yield of 48% of oil boiling above 450° F. with steam, which is about 50% greater yield than the 32% yield obtained with the normal heptane inert diluent. Also the reactive diluent produced an oil having slightly higher viscosity (92 seconds at 210° F. compared to 85 for the inert diluent).

It is believed that a number of different reactions are involved in the mechanism of the present invention and that these reactions cannot be summed up in any simple chemical equation involving merely the polymerization of isobutylene or co-polymerization of the isobutylene with the di-isobutylene. For instance, it is believed that some cracking of some constituents is involved because the test results shown in Table II indicate that even at a temperature as low as 40° F. boron fluoride causes a certain amount of cracking of a reactive hydrocarbon liquid diluent such as the light isobutylene polymer oil referred to above, namely, having a Saybolt viscosity of 63 seconds at 100° F. In these tests a sample of the untreated oil is compared with a sample of the same oil after treatment with boron fluoride for 3 hours at 40° F.

TABLE II

Cracking effect of BF₃ on light isobutylene polymer

	Test 3, untreated	Test 4, treated at 40° F.
Vis./100° F.	63.2	60.9
Percent overhead	Boiling range at 20 mm. Hg pressure	
	° F.	° F.
Initial	230	120
10%	302	278
20%	318	306
30%	335	330
40%	360	366
50%	398	426

The above table shows that when the light polymer oil is treated with boron fluoride at 40° F., a substantial cracking occurs as indicated by the fact that the initial boiling point of the un-

materials, rate of feed, etc. It is believed that at least the following reactions are involved simultaneously and are all interrelated:

1. Polymerization of isobutylene (or other normally gaseous olefin);

2. Polymerization of low molecular weight constituents of the reactive liquid hydrocarbon diluent to slightly higher boiling constituents but not high enough to produce the desired lubricating oils, e. g. polymerization of di-isobutylene to tetra-isobutylene;

3. Co-polymerization of isobutylene with di-isobutylene;

4. Co-polymerization of isobutylene with tetra-isobutylene;

5. Cracking of some of the constituents of the reactive hydrocarbon liquid diluent; and

6. Cracking and/or polymerization of at least some of the products of that cracking.

The data given in the following Table III show how the yield, the viscosity at 210° F., and the viscosity index vary with the feed rate of isobutylene and the reaction time. These tests were all carried out at 35-40° F., using boron fluoride as catalyst dissolved in the light isobutylene polymer oil having a Saybolt viscosity of 63 seconds at 100° F. as the reactive diluent.

TABLE III

Effect of isobutylene feed rate and reaction time on yield, viscosity and V. I.

Test No.	Isobutylene injected—gms./100 gm. diluent/hr.	Time, hours	Oil boiling above 450° F. with steam		
			Yield, percent based on isobutylene	Vis./210° F. secs. Saybolt	V. I.
5	11.6	1	283	43	59
6	19.2	1	184	45	79
7	29.2	1	98	58	81
8	67.0	1	43	77	75
9	10.8	6	124	66	78
10	18.8	6	98	(98)	78
11	31.4	6	76	79	59
12	67.0	6	51	123	63

Temperature in above runs 35-40° F.

The above Table III shows that with low isobutylene feed rate (as in tests 5 and 9) relatively high yields of oil boiling above 450° F. with steam are obtained and the yield decreases with increasing isobutylene feed rate (note the yields in tests 5, 6, 7 and 8, for example). It

is also apparent that the viscosity at 210° F. increases (from 43 to 77 in tests 5 and 8) in direct proportion to the isobutylene feed rate. On the other hand, the V. I. (viscosity index) varies from about 60-80 in these tests, the exact value apparently being dependent upon the time as well as the isobutylene feed rate, the highest V. I. values being obtained in tests 6 and 7 when the reaction time was one hour and in tests 9 and 10 when the reaction time was six hours.

The following Table IV gives the data from different tests in which the total amount of isobutylene added during each of the tests was equivalent, although the rate of addition was varied. These tests were all made under the same general conditions as those in Table III, two of them, namely tests 8 and 9, being the same data as that shown in Table III.

not vary greatly (only from 77-66) between yield of oil boiling above 450° F. with steam (from 43 to 124%) based on the weight of isobutylene used.

In both Tables III and IV the fact that some of the yields are far above 100% (of the isobutylene) shows that this high boiling oil cannot be derived simply from polymerization of isobutylene itself, but must result from co-polymerization of isobutylene and the reactive diluent used.

All of the experiments shown in Tables I to IV inclusive were batch experiments. Two other batch experiments are shown in Table V in which approximately $\frac{1}{4}$ part by weight of refracted isobutylene was passed into one part by weight of reactive diluent containing suspended aluminum chloride for three hours.

TABLE V

Tests using aluminum chloride as catalyst

Test No.	Reactive diluent		Isobutylene (gms.)	Time, hours	Temp., °F.	Yield percent based on the isobutylene	Vis./210° F.	V. I.
	Kind	Wt. (gms.)						
16.....	Di-isobutylene.....	1000	278	3	60	119	60.6	13
17.....	C ₁₈ -C ₂₀ isobutylene polymer.....	1000	287	3	20	123	50.8	62

TABLE IV

Effect of isobutylene feed rate and time when same total amount of isobutylene is used

Test No.	Isobutylene rate gm./100 gm. diluent/hr.	Time, hours	Oil boiling above 450° F. with steam		
			Yield, percent based on isobutylene	Vis./210° F. Saybolt secs.	V. I.
13.....	67.0	1	43	77	75
14.....	29.2	2	66	75	73
15.....	10.8	6	124	66	76

Temperature in above runs 35-40° F.

In test 16 the temperature was 60° F. and the diluent was di-isobutylene.

In test 17 the temperature was 20° F. and the diluent was tetra-isobutylene (C₁₆-C₂₀ polymer), containing about $\frac{1}{20}$ part of aluminum chloride suspended therein. The high yields, 119 and 123%, (based on the isobutylene used) are an indication of a large amount of co-polymerization and/or condensation.

The following Table VI shows the operating conditions used and results obtained in some tests using the continuous recycling process illustrated in Figure 2 of the drawings.

TABLE VI

Tests in continuous recycling apparatus

Test No.	Temp.	Circulation rate, liters/hr.	Isobutylene feed rate (gm./hr.)	Ratio isobutylene feed rate to circulation rate	Percent oil in product stream	Vis./210° F.	Light recycle added (gm./hr.)	Ratio light recycle to isobutylene	Yield based on isobutylene, percent
	°F.								
18.....	70	42	1000	24	7.7	46	3200	3.2	32
19.....	70	42	2000	48	9.8	53	6400	3.2	41
20.....	50	140	1325	9.5	14.7	57	4000	3.2	62
21.....	50	70	663	9.5	14.2	57	2030	3.2	60
22.....	40	140	660	4.7	9.5	55	2730	4.2	48
23.....	40	70	660	9.5	12.1	80	2730	4.2	64
24.....	40	42	660	15.4	14.2	130	2730	4.2	75

The above Table IV shows that when the same total amount of isobutylene is added but the rate of addition is varied (from 10 to 67 gms. of isobutylene per 100 gms. of diluent per hour), the V. I. remains substantially the same (between 73-76) and the viscosity at 210° F. does

In the above Table VI the circulation rate means the rate at which the fluid is pumped through at line 5 and the cooling coil 6 in Figure 2. The per cent oil in stream refers to the per cent of oil recovered from the washed oily product coming from line 39. The viscosity at

210° F. refers to the oil in the previous column in the table. The recycle added is the amount of light distillate which is recycled into the diluent feed line 2 in Figure 2 of the drawings.

5 This recycle represents dimer and other low molecular weight polymers of isobutylene which come off by the steam distillation referred to from the product obtained in line 39.

From the above Table it is noted that as the temperature is decreased from 70 to 40, the yield is progressively increased. Also, it is noted, particularly comparing tests 22, 23 and 24, that the yield and viscosity at 210° F. are both increased as the circulation rate is decreased, the amount of isobutylene and recycle being both constant.

For the sake of calling attention to the fact that the use of high temperatures generally tends to make a product having a narrower viscosity spread, more detailed data on the distillation bottoms of the oils produced in tests 18 and 22 are given herebelow in Table VII.

TABLE VII

Study of heavy bottoms from tests 18 and 22

Test	Bottoms*	Vis./100° F.	Vis./210° F.	V. I.
18.....	30% bottoms (525° F. @ 1 mm.).	2189	157.5	108
22.....	33% bottoms (530° F. @ 4 mm.).	7244	269	89

*The percentages of bottoms shown are based on the total amount of oil left after steam distillation at 450° F.

Although the lower boiling constituents of both oils had approximately the same viscosity (because both oils were free from lighter constituents) by steam distillation at 450° F., yet the bottoms obtained from test 18 had a Saybolt viscosity of only 157 seconds compared to 269 seconds at 210° F. for the bottoms obtained in test 22. Therefore, inasmuch as in practice oil having a 210° F. viscosity less than 40 seconds would be removed, then the viscosity spread of the lubricating oil produced in test 18 would be 117 (157 minus 40) whereas the corresponding lubricating oil from test 22 would have a viscosity spread of 229 (269 minus 40).

The 33% bottoms obtained in test 22 shown above as having a viscosity of 269 seconds at 210° F. had an average molecular weight of 691 whereas a fraction having a viscosity of about 40 seconds at 210° F. has a molecular weight of about 330 to 350.

By successive batch precipitations of the high molecular weight fractions from polymer oil bottoms with benzol-acetone mixtures, or by propane precipitation, fairly good yields of low viscosity oils can be made from bottoms of intermediate viscosity. 39% yield of 116 vis./210° F. oil was obtained from a 380 vis./210° F. bottoms, 66% of 99 vis./210° F. oil from a 180 vis./210° F. bottoms, and 72% of 85 vis./210° F. oil from a 134 vis./210° F. bottoms. Precipitation of 1.6% of heavy oil from the 134 vis./210°

F. bottoms lowered the viscosity to 118 vis./210° F.

It is not intended that this invention be limited to any of the specific examples given nor by any theories advanced as to the operation of the invention, but only by the appended claims in which it is intended to claim all novelty inherent in the invention as broadly as the prior art permits.

We claim:

1. The process of preparing lubricating oils which comprises dispersing a Friedel-Crafts type catalyst in a liquid consisting of a reactive aliphatic hydrocarbon liquid diluent having olefinic groups and less than 25 carbon atoms, and then contacting therewith a normally gaseous olefin at a temperature between the approximate limits of 0° and 150° F.

2. The process of preparing lubricating oils comprising dispersing a Friedel-Crafts type catalyst in an isobutylene polymer comprising 2 to 6 monomers, and then feeding thereinto isobutylene at a temperature between the approximate limits of 0° and 150° F.

3. The process of preparing lubricating oils which comprises dissolving boron fluoride in an isobutylene polymer serving as reactive catalyst solvent having from 8 to 24 carbon atoms and then feeding isobutylene into the resulting solution at a temperature between the approximate limits of 40 and 80° F.

4. The process according to claim 3 in which between about 1/8 and 10 parts by weight of isobutylene are used to one part of the isobutylene polymer feed.

5. The process according to claim 3 in which lower boiling constituents are separated from the reaction product and are recycled for use as reactive catalyst solvent.

6. Process of preparing lubricating oils which comprises dispersing a Friedel-Crafts type catalyst in a cracked wax liquid substantially free of aromatic hydrocarbons and having less than 25 carbon atoms and then feeding a normally gaseous olefin thereinto at a temperature between the approximate limits of 0° and 150° F.

7. The process of preparing lubricating oils which comprises dissolving boron fluoride into a cracked wax liquid substantially free of aromatic hydrocarbons having about 10 to 24 carbon atoms per molecule and then feeding isobutylene into the resulting solution at a temperature between the approximate limits of 0° and 150° F.

8. A hydrocarbon lubricating oil having a Saybolt viscosity above 40 seconds at 210° F. and a viscosity index above 30 obtained by dispersing a Friedel-Crafts type catalyst in a liquid consisting of a reactive aliphatic hydrocarbon diluent having olefinic groups and less than 25 carbon atoms, and then contacting therewith a normally gaseous olefin at a temperature between the approximate limits of 0° F. and 150° F.

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