

March 7, 1967

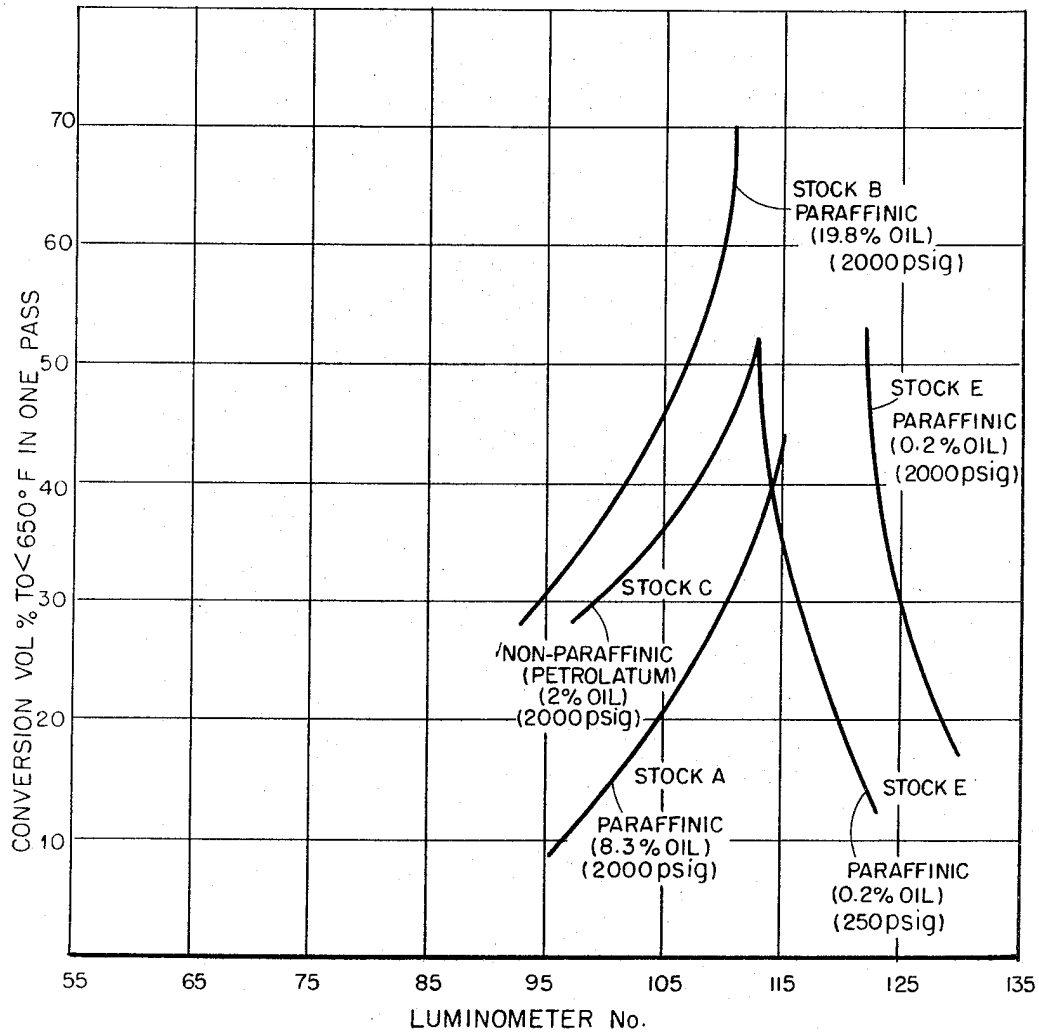
H. R. IRELAND ET AL
HIGH QUALITY LUBE OIL AND/OR JET FUEL
FROM WAXY PETROLEUM FRACTIONS

3,308,052

Filed March 4, 1964

5 Sheets-Sheet 1

FIG. I



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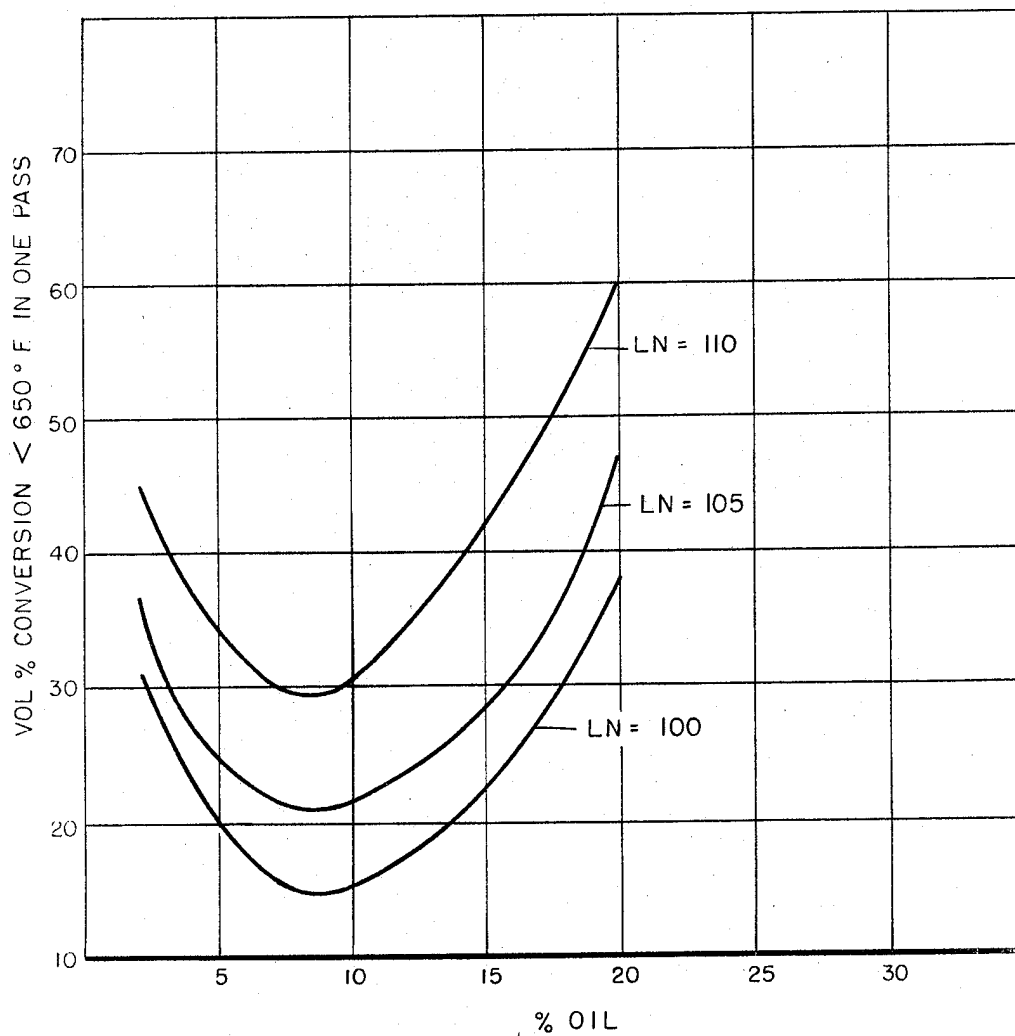
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5 Sheets-Sheet 2

FIG. II



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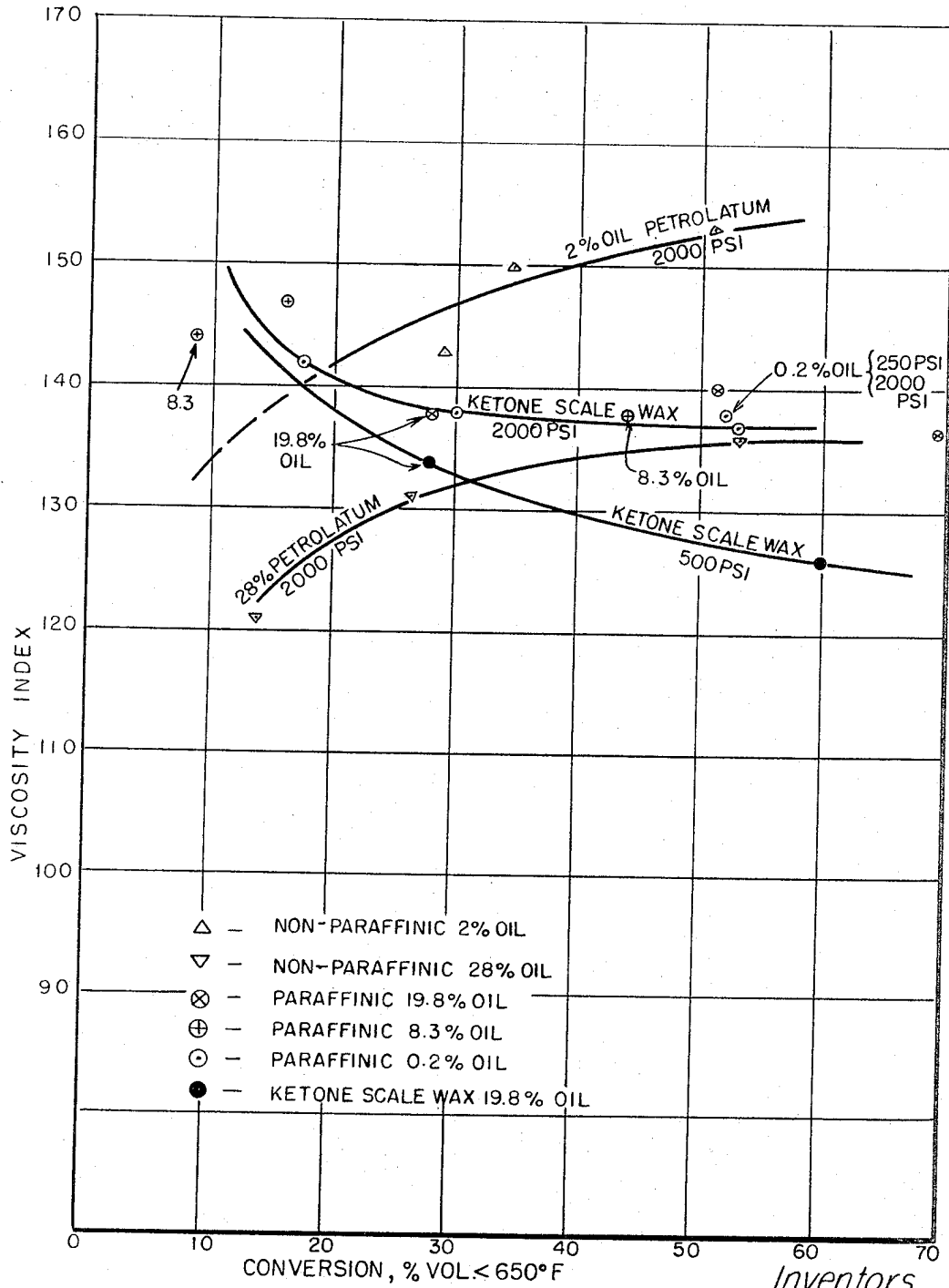


FIG. III

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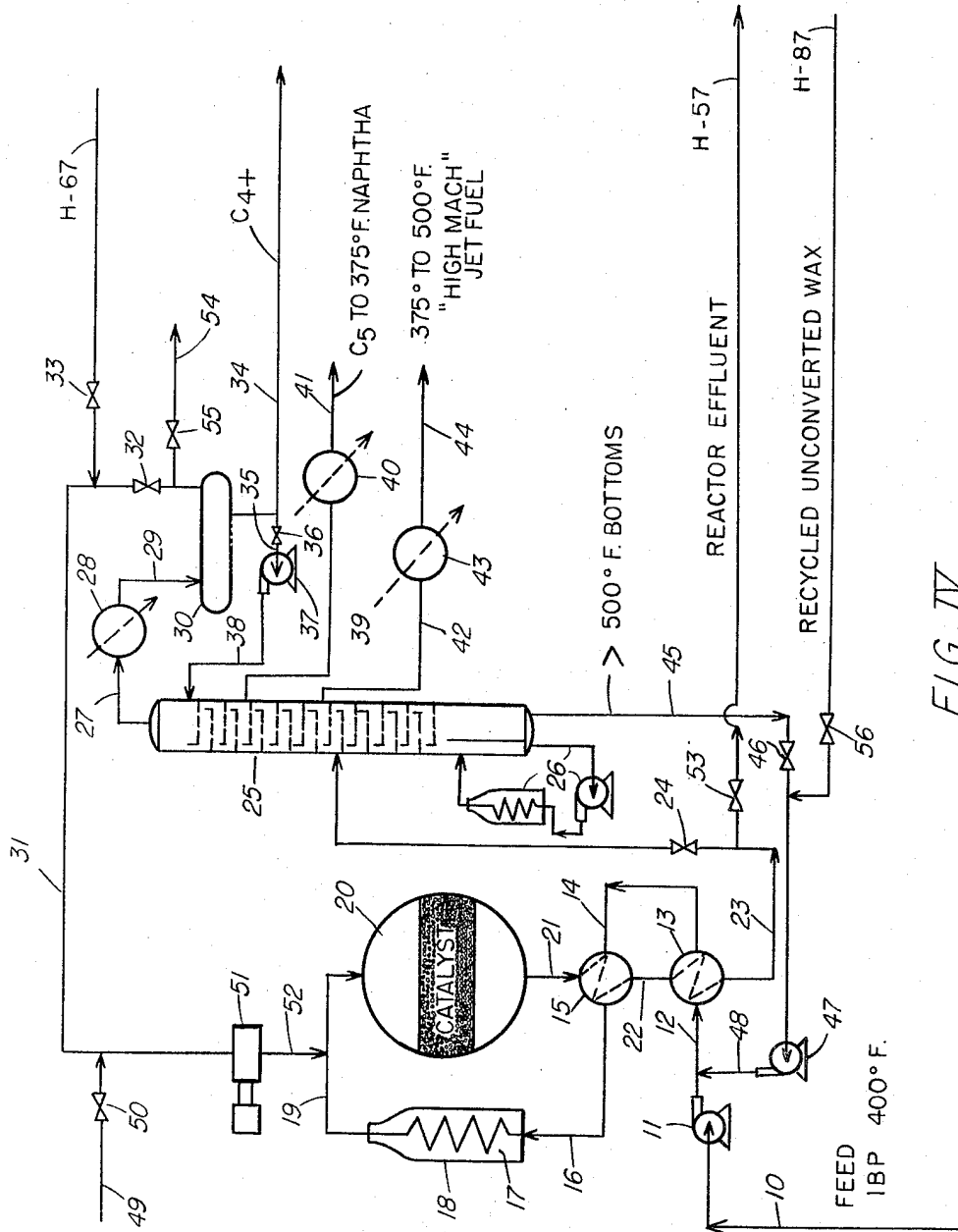


FIG. IV

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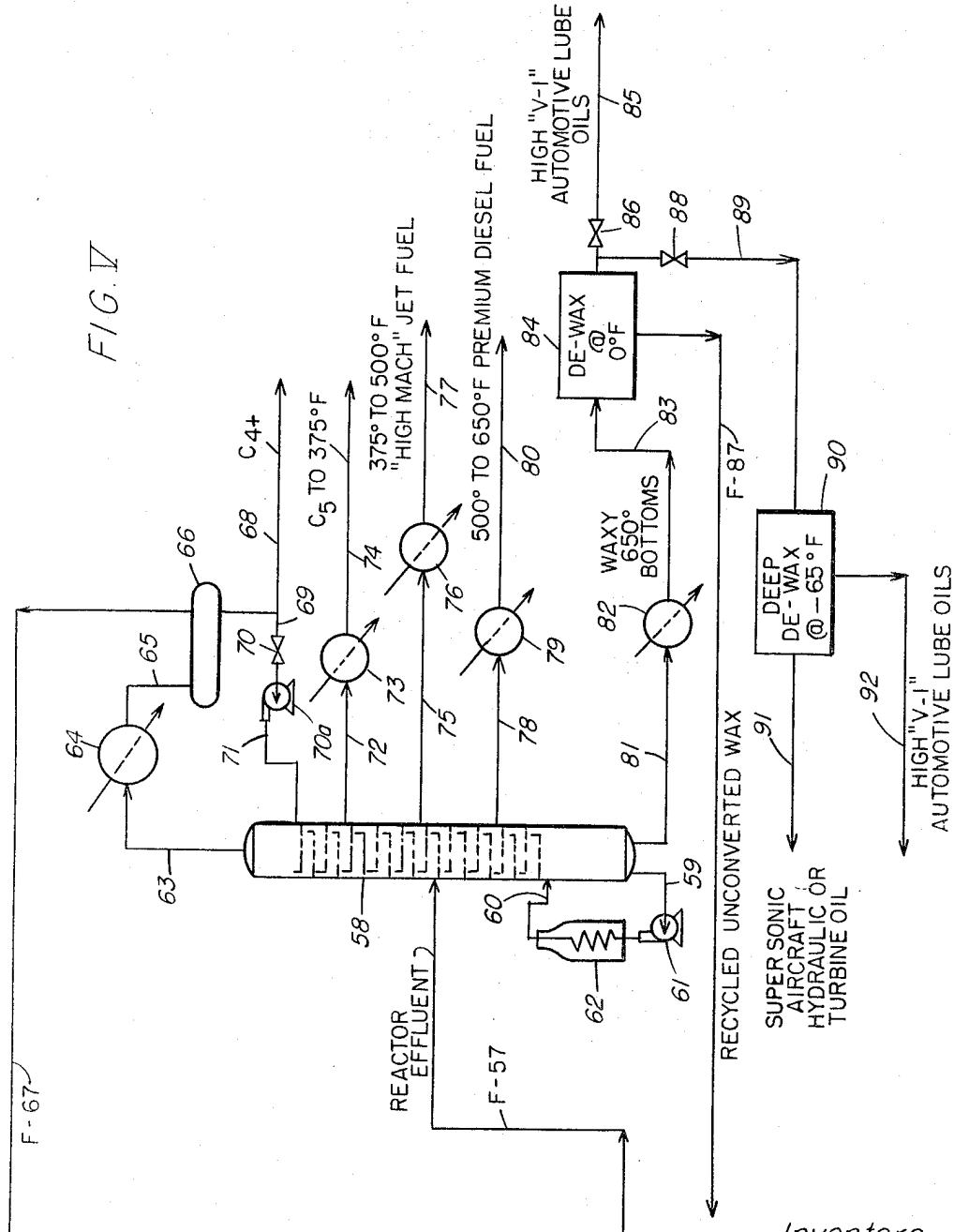
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5 Sheets-Sheet 5



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3,308,052

HIGH QUALITY LUBE OIL AND/OR JET FUEL FROM WAXY PETROLEUM FRACTIONS

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14 Claims. (Cl. 208—27)

The present invention relates to the hydroconversion of waxy petroleum fractions comprising hydrocarbons having at least twenty-one carbon atoms to lubricating oils having a viscosity index (VI) of at least 110 and/or jet fuel having a luminometer number of at least 100 and more particularly to the hydroisomerization of waxy petroleum fractions comprising hydrocarbons having at least twenty-six carbon atoms at hydroisomerization conditions dependent upon the concentration of oil in the waxy petroleum fraction.

The influx of plastic coatings into the milk carton and wrapping paper business may be expected to reduce the demand for paraffin wax and microcrystalline wax for such purposes. Of course, both paraffin wax and microcrystalline wax can be catalytically cracked into gasoline and naphtha to increase excess of supply over demand. On the other hand, the demand for "Hi-Mach" jet fuel and the demand for premium, high viscosity petroleum fractions suitable for use as base material for high viscosity index lubricating oils and premium hydraulic fluids exceeds the supply. In addition, the product value of the latter products compared to the value of the gasoline or naphtha which could be produced from the waxy fractions is in the ratio of about 2.2 to 1.

Treatment of waxy fractions of petroleum oil to produce lubricating oil from paraffin wax generally is not novel as is evident from the descriptions of such processes as is provided by the disclosures of the following patents. For example, in U.S. Patent No. 2,668,790, G. M. Good et al., describe a liquid phase process for the production of lubricating oil from paraffin wax, i.e., a waxy petroleum fraction containing little if any liquid hydrocarbons, e.g., less than 0.5 percent of liquid petroleum by weight. The Good et al. method of converting paraffin wax substantially devoid of liquid hydrocarbons, i.e., containing not more than 0.5 percent by weight of liquid hydrocarbons comprises contacting the paraffin wax in the liquid phase with at least 1 mol of hydrogen per mol of wax and with a supported platinum catalyst such as that commercially available from Baker and Company, Inc., Newark, New Jersey, as "0.5 percent platinum on alumina pellets" which comprises about 0.3 to about 0.6 percent by weight of platinum and about 0.6 to about 0.7 percent of chlorine on an alumina support. As shown in Example 1 when the conversion to cracked products having a lower molecular weight than the charge exceeds 25 percent the quality of the lube oil fraction of the product is lowered.

In U.S. Patent No. 2,668,866 issued to G. M. Good et al. a vapor phase process for the isomerization of paraffin wax, substantially devoid of liquid hydrocarbons, is described. In this method of isomerization of paraffin wax the conversion to cracked products, i.e., products having a lower molecular weight than the charged paraffin

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wax is limited to below 25 percent and preferably to less than 20 percent. For this process one catalyst described in U.S. Patent No. 2,668,790, i.e., "0.5 percent platinum on alumina pellets" made by Baker and Company, Inc., is said to be useful. Reaction temperature is in the range of 572° to 1022° F. compared to 572° to 932° F. recommended in U.S. Patent No. 2,668,790.

In U.S. Patent No. 2,817,693, J. Koome et al., describe a method of producing oil from waxes. In this process the catalyst is pretreated with hydrogen at a pressure at least 10 atmospheres (150 p.s.i.) higher than the operating pressure. Thus, a solid paraffin wax substantially devoid of liquid hydrocarbons (M.P. 129.2° F.) was contacted with a platinum-chlorine on alumina catalyst after the catalyst had been pretreated at reaction temperature (788° F.) with hydrogen at 35 atmospheres (515 p.s.i.). The wax was treated at 50 atmospheres (735 p.s.i.) for seventy hours after which the pressure was reduced to 35 atmospheres (515 p.s.i.). This treatment increased the yield of oil from 55 to 66 percent.

In U.S. Patent No. 2,779,713, E. L. Cole et al., describe a method for improving lube oil by hydrorefining in a first stage and hydrofinishing under milder conditions. The catalyst employed in the first stage is a hydrogenation catalyst comprising metals of the sixth and eighth groups of the Periodic Table, their oxides, sulfides, and mixtures thereof at a temperature in the range of 600° to 800° F. at a pressure in the range of about 500 to 10,000 p.s.i.g. at a space velocity in the range of 0.1 to 5.0. In the second or hydrofinishing stage the temperature is in the range of 400° to 650° F., and the pressure in the range of 750 to 5000 p.s.i.g. The catalysts used in the first stage are useful in the second stage. In addition, Raney nickel, platinumized charcoal, and alumina, platinum and combined halogen catalysts may be used in the second stage.

In U.S. Patent No. 2,692,224, H. Heinemann describes a hydrocracking process for heavy hydrocarbons employing a platinum-charcoal catalyst composite and hydrogen fluoride. This process is operated at a temperature in the range of 700° to 1000° F. at pressures and hydrogen to hydrocarbon ratios to provide a hydrogen partial pressure of at least 200 p.s.i. and at a space velocity in the range of 0.1 to 10. The feed stocks are light Texas gas oil or heavy hydrocarbon fraction or residuum.

M. Schreiner, Jr. et al., U.S. Patent No. 3,019,180 describes and claims a combination of processing steps for the production of gasoline and gas oil including coking, hydroprocessing and reforming wherein coker gas oil along with straight-run gas oil is hydroprocessed with reformer hydrogen and coker naphtha is combined with straight-run and hydroprocessed naphtha as feed to the reformer. A light straight-run gas oil is combined with hydroprocessed gas oil and passed to catalytic cracking for conversion to lower boiling products.

A. M. Henke et al. have described a method of preparing improved lube oil in U.S. Patent No. 3,046,218. Henke et al. treat a mixture of one of deasphalted residuum and unpressable distillate and hydrocarbon wax, the wax constituting between 12 and 80 percent of the mixture at a pressure above 1750 p.s.i., at a temperature in the range of 715° to 825° F., at a space velocity in the range of 0.2 to 4.0 in the presence of a mixture of a sulfide of a metal of Group VI and a sulfide of a metal of the iron group composited with a cracking catalyst having a cracking activity greater than 12.

In British Patent No. 364,403 there is described a method for the production of low boiling oils from higher boiling oils. In the process disclosed in this British patent the feed is crude oil, reduced crude, asphaltic residue. The operating conditions are: temperature above 850° F., pressure above 20 atmospheres (294 p.s.i.) preferably 1470 to 2940 p.s.i., to 14,700 p.s.i. Three products are obtained to wit: motor fuel, middle oil distillate, and 5 to 15 percent bottoms. The whole of the bottoms is withdrawn from the system while the middle oil distillate is recycled.

It will be observed that in the foregoing descriptions of various processes for upgrading heavy products only one description reveals that the degree of conversion affects the quality of the lube oil produced. Thus, Good et al. present data which indicates that, in the presence of paraffin wax containing substantially no liquid hydrocarbon, i.e., less than 0.5 percent, the products degrade in quality as conversion or severity is increased. That is the viscosity index (VI) for the product lube oils is lower and the luminometer number (LN) for the product fuel oil is lower as the severity or degree of conversion is increased. In direct contrast, it has now been found that the product quality of both produced lube oil and jet fuel is dependent upon (1) the type of charge stock, i.e., paraffinic charge stock from paraffinic wax and/or paraffinic distillate or non-paraffinic charge stock from microcrystalline wax, e.g., petrolatum, (2) the amount of liquid hydrocarbon in the waxy charge stock and (3) the degree of conversion to products boiling below 650° F. That is to say the greater the amount of charge stock converted to material boiling below 650° F. per pass the higher the quality of the jet fuel (BR 375° to 500° F.) and the dewaxed 650° F. lube oil. The foregoing is established by the data presented in Tables I and II.

TABLE I
[Charge stock inspection]

Stock	A	B	C	D	E
Inspections—					
Viscosity:					
KV at 210° F.	3.87	3.91	7.66	8.99	3.85
SSU at 210° F.	39	39.1	51.3	55.9	39
Color ASTM	LO.5	LO.5	3.5	3.0	LO.5
Melting Point, ° F.	127	127	154	140	132
Oil Content, percent wt.	8.3	19.8	2.0	28.2	0.2
Hydrogen, percent wt.	14.59	14.20	14.25	13.74	14.37
Vacuum Distillation:					
IBP	716	679	887	899	713
5% vol.	758	726	960	972	795
10% vol.	771	742	984	991	808
20% vol.	786	756	998	1,005	823
30% vol.	796	765	1,008	1,014	832
40% vol.	805	774	1,017	1,020	848
50% vol.	815	784	1,028	1,030	862
60% vol.	825	793	1,036	1,040	877
70% vol.	836	802	1,044	1,052	891
80% vol.	848	813	1,057	1,071	909
90% vol.	864	827	1,075	1,094	927
95% vol.	877	839	1,092	1,113	959
High Molecular Weight Mass					
Spectrometer Analysis:					
+2 paraffins, mol percent	90		74	54	96
0 monocyclic paraffins, mol percent	7.9		22	30	4.2
-2, -4, condensed cyclic paraffins, mol percent	1.3		2.1	11	
-6 alkylbenzenes, mol percent	0.8		1.7	4	
-8, -10 tetralines, indenes, mol percent	0.2		0.4	1.2	
-12 naphthalenes, mol percent				0.2	
Carbon Range, C-atoms	21-35		30-52	26-54	21-36
Average Carbon number	26		39	40	26

TABLE II.—SECTION A
[Feed stock A—paraffin wax—8.3% oil]

Run No.	A-1	A-2	A-3
5			
Pressure, p.s.i.g.	2,000	2,000	2,000
Temperature, ° F.	664	628	722
Space Velocity, v./hr./v.	2.0	0.5	2.0
H ₂ -Circulation, s.c.f./b.	2,000	2,000	2,000
Conversion, vol. percent ¹	8.7	15.9	44.1
10			
Product, percent wt. of charge:			
IBP to 375° F.	3.0	6.8	22.1
375° F. to 500° F.	2.1	3.5	10.4
500° F. to 650° F.	3.0	4.5	8.9
Conversion wt. percent ²	8.1	14.8	41.4
650° F.+ Bottoms Lube oil Fraction	33.1	30.8	30.8
Unconverted Wax Fraction	58.8	54.4	27.8
15			
Total	100.0	100.0	100.0
Inspections—			
375° to 500° F. Jet Fuel:			
Gravity, ° API	51.3	51.8	55.2
Aniline No., ° F.	176.7	178.5	175.4
Freeze Point, ° F.	<-76	<-76	<-76
Luminometer No.	95	100	115
20			
Dewaxed 650° F.+ Lube:			
Pour Point, ° F.	25		25
Viscosity, SSU at 210° F.	37.8		36.8
Viscosity Index (VI)	144		138
25			

¹ Conversion, vol. percent—percent by volume of charge stock converted to products boiling below 650° F. in one pass.

² Conversion, wt. percent—percent of charge stock to products boiling below 650° F. in one pass.

TABLE II.—SECTION B
[Feed stock B—paraffin wax—19.8% oil]

Run No.	B-1	B-2	B-3	B-4	B-5
35					
Pressure, p.s.i.g.	500	2,000	500	2,000	2,000
Temperature, ° F.	705	749	738	725	768
Space Velocity, v./hr./v.	2	2	2	2	2
H ₂ -Circulation, s.c.f./b.	2,000	2,000	2,000	2,000	2,000
Conversion, vol. percent ¹	28.2	28.0	59.9	51.5	70
40					
Product, percent wt. of Charge:					
IBP to 375° F.	10.7	9.9	26.9	26.0	38.5
375° to 500° F.	7.3	7.7	13.4	12.9	16.6
500° to 650° F.	8.6	10.0	17.4	10.0	12.7
Conversion wt. percent ²	26.6	27.6	57.7	48.9	67.8
650° F.+ Bottoms Lube Oil Fraction	44.8	55.2	33.9	30.9	25.0
Unconverted Wax Fraction	28.6	17.2	8.4	20.2	7.2
45					
Total	100.0	100.0	100.0	100.0	100.0
Inspections—					
375° to 500° F. Jet Fuel:					
Gravity, ° API	49.5	50.3	50.5	52.7	53.5
Aniline No., ° F.	160.9	172.5	164.5	176.3	177.3
Freeze Point, ° F.	<-76	<-76	<-76	<-76	<-76
Luminometer No.	62	93	69	107	111
50					
Dewaxed 650° F.+ Lube:					
Pour Point, ° F.	15	10	10	10	15
Viscosity, SSU at 210° F.	37.2	36.9	36.5	37.4	36.9
Viscosity Index (VI)	134	138	126	140	137
55					

¹ Conversion, vol. percent—percent by volume of charge stock converted to products boiling below 650° F. in one pass.

² Conversion, wt. percent—percent of charge stock converted to products boiling below 650° F. in one pass.

TABLE II.—SECTION C
[Feed stock C—petrolatum—2.0% oil]

Run No.	C-1	C-2	C-3	C-4
60				
Pressure, p.s.i.g.	2,000	2,000	2,000	2,000
Temperature, ° F.	555	545	765	784
Space Velocity, v./hr./v.	2.0	0.5	2.0	2.0
H ₂ -Circulation, s.c.f./b.	2,000	2,000	2,000	2,000
Conversion, vol. percent ¹	0.5	28.8	34.6	52.0
65				
Product, percent wt. Charge:				
IBP to 375° F.		15.7	13.0	24.1
375° F. to 500° F.		6.4	10.2	12.2
500° F. to 650° F.		4.2	9.2	13.0
Conversion Wt. percent ²	0.5	26.3	32.4	49.3
650° F.+ Bottoms Lube Oil Fraction	2.9	10.1	39.7	29.8
Unconverted Wax Fraction	96.6	63.6	27.9	20.9
70				
Total	100.0	100.0	100.0	100.0
75				

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TABLE II.—SECTION C—Continued

Run No.	C-1	C-2	C-3	C-4
Inspections—				
375° to 500° F. Jet Fuel:				
Gravity, ° API		52.9	53.5	54.8
Aniline No. ° F		174.0	176.7	174.3
Freeze Point, ° F		<-76	<-76	<-76
Luminometer No.		97X	106X	110X
Dewaxed 650° F. + Lube:				
Pour Point, ° F	65	60	30	30
Viscosity, SSU at 210° F	51.3	43.8	43.4	41.8
Viscosity Index	132	143	150	153

¹ Conversion, vol. percent—percent by volume of charge stock converted to products boiling below 650° F. in one pass.

² Conversion, wt. percent—percent of charge stock converted to products boiling below 650° F. in one pass.

TABLE II.—SECTION D
[Feed stock D—petrolatum—28.2% oil]

Run No.	D-1	D-2	D-3
Pressure, p.s.i.g.			
	2,000	2,000	2,000
Temperature, ° F			
	748	773	795
Space Velocity, v./hr./v.			
	2.0	2.0	2.0
H ₂ Circulation, s.c.f./b.			
	2,000	2,000	2,000
Conversion, vol. percent ¹			
	14.2	26.5	52.7
Product, percent wt. Charge:			
IBP to 375° F.	4.0	9.3	21.2
375° F. to 500° F.	4.2	7.9	13.9
500° F. to 650° F.	5.3	8.0	15.4
Conversion wt. Percent ²			
650° F. + Bottoms Lube Oil Fraction	13.5	25.2	50.5
Unconverted Wax Fraction	44.2	44.6	34.4
	42.3	30.2	15.1
Total	100.0	100.0	100.0
Inspections—			
375° to 500° F. Jet Fuel:			
Gravity, ° API	44.2	44.4	48.1
Aniline No. ° F	144.7	152.3	158.8
Freeze Point, ° F	<-76	<-76	<-76
Luminometer No.	55	55	56
Dewaxed 650° F. + Lube:			
Pour Point, ° F	25	20	20
Viscosity, SSU at 210° F	51.5	46.7	43.8
Viscosity Index	121	131	136

¹ Conversion, vol. percent—percent by volume of charge stock converted to products boiling below 650° F. in one pass.

² Conversion, wt. percent—percent of charge converted to liquid products boiling below 650° F. in one pass.

TABLE II.—SECTION E
[Feed stock E—paraffin wax—0.2% oil]

Run No.	E-1	E-2	E-3	E-4	E-5
Pressure, p.s.i.g.					
	250	250	250	2,000	2,000
Temperature, ° F					
	500	570	606	673	704
Space Velocity, v./hr./v.					
	2	2	2	2	2
H ₂ Circulation, s.c.f./b.					
	2,000	2,000	2,000	2,000	2,000
Conversion, vol. percent ¹					
	12.2	30.0	52.1	17.2	53.1
Product, percent wt. Charge:					
IBP to 375° F.	3.2	8.6	21.4	2.6	20.3
375° F. to 500° F.	3.5	6.6	13.9	6.1	16.0
500° F. to 650° F.	4.9	13.3	14.6	7.7	14.7
Conversion, wt. percent ²					
650° F. + Bottoms Lub Oil Fraction	11.6	28.5	49.9	16.4	51.0
Unconverted Wax Fraction	44.6	46.6	38.4	53.8	39.8
	43.8	24.9	11.7	29.8	9.2
Total	100.0	100.0	100.0	100.0	100.0
Inspections—					
375°-500° F. Jet Fuel:					
Gravity, ° API	53.7	55.0	54.4	55.0	55.1
Aniline No. ° F	183.4	178.9	180.5	182.4	180.9
Freeze Point, ° F	<-76	<-76	<-76	<-76	<-76
Luminometer No.	123	116	112	130	122
Dewaxed 650° F. + Lube Oil:					
Pour Point, ° F	20	20	20	20	20
Color, ASTM	2.5	LI.0	LI.0	LO.5	LO.5
Viscosity SSU at 210° F	37.8	37.3	37.3	37.4	37
VI	149	138	138	142	137

¹ Conversion, vol. percent—percent by volume of charge stock converted to products boiling below 650° F. in one pass.

² Conversion, wt. percent—percent of charge stock converted to products boiling below 650° F. in one pass.

The data presented in Table II, Sections A, B, C, D, and E for luminometer number have been plotted in FIGURE 1. It will be observed that, for paraffinic and non-paraffinic charge stocks containing eight percent or more of oil (as defined herein), the luminometer num-

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ber increases with increased conversion of charge stock to products boiling below 650° F. However, the data for the luminometer for charge stock D containing 28.2 percent of oil establishes that when the charge stock contains in excess of about 23 percent of oil the luminometer number of 375° to 500° F. jet fuel cannot be raised to 100. The data plotted in FIGURE 1 for charge stock containing practically no oil, i.e., 0.2 percent establishes that at a pressure of 250 p.s.i.g. or at a pressure of 2000 p.s.i.g. the more severe the reaction conditions, i.e., the greater the conversion to products boiling below 650° F., the lower the luminometer number of the 375° to 500° F. jet fuel. However, it will be observed that at a given conversion the higher the pressure the higher the luminometer number for stocks containing substantially no oil, e.g., 0.2 percent oil as defined herein.

From the curves in FIGURE 1 for charge stocks containing 2 percent to 19.8 percent of oil (as defined herein) curves have been drawn and presented in FIGURE 2 to more clearly illustrate the anomalous effect of the increasing concentration of oil. That is to say with increasing concentration of oil from 2 percent to about 8 percent the conversion must be reduced to maintain a target luminometer number.

On the other hand, as the concentration of oil in the charge stock increases from about 8 percent to about 23 percent the conversion must be increased to maintain the target luminometer number of the 375° to 500° F. jet fuel. In other words, the curves for constant luminometer number presented in FIGURE 2 establish that, while the conditions to produce jet fuel having higher luminometer number must be more severe the higher the luminometer number, to maintain a target luminometer number the severity of the hydroisomerization conditions must be reduced when the charge stock contains between about 0.2 to about 7.0 percent of oil (as defined herein) and the severity of hydroisomerization conditions increased as the concentration of oil (as defined herein) increases from about 7 percent to about 23 percent. (Severity being measured by the conversion to products boiling below 650° F.)

With a consideration of the curves for the correlation of viscosity index and percent conversion to products boiling below 650° F. presented in FIGURE 3 other controlling factors are visualized. Pressure during hydroisomerization and the character of the charge stock are recognized as effective variables.

Let us consider first a paraffinic charge stock containing 0.2 percent of oil (as defined herein). It will be observed that pressure has little, if any, effect upon the viscosity index. Thus, at a hydroisomerization pressure of 250 p.s.i. and at a hydroisomerization pressure of 2000 p.s.i. and conversions of 52 and 53 percent of the charge stock to products boiling below 650° F. the viscosity index is 137 and 138. On the other hand, while at 2000 p.s.i. the oil content in the range of 8 to 20 percent has little, if any, effect upon the viscosity index when the hydroisomerization reaction is carried out at 2000 p.s.i., at an operating pressure of 500 p.s.i. the oil content of the charge stock has a marked effect upon the viscosity index. It will also be observed that the viscosity index of the lube oil fraction of the hydroisomerization products boiling above 650° F. when the hydroisomerization operation is carried out at 2000 p.s.i. is substantially the same when a paraffinic stock containing 0.2 to 20 percent of oil is treated. This is established by the numerical values for viscosity index read from the curves of FIGURE 3.

Charge Stock Type	Oil Content, Percent	Conversion to Products Boiling, <650° F.	Viscosity Index, Lube Oil Fraction Products Boiling, >650° F.
Paraffinic	0.2	30	138
Do	19.8	29	138
Do	8.3	30	138

A paraffinic charge stock containing about 20 percent of oil illustrates the effect of operating pressure on the viscosity index of the lube oil fraction of the conversion products boiling above 650° F. as established by the data presented in the following tabulation:

Change Stock Type	Oil Content, Percent	Pressure, p.s.i.	Conversion to Products Boiling, <650° F.	Viscosity Index, Lube Oil Fraction Products Boiling, >650° F.
Paraffinic.....	19.8	2,000	28	138
Do.....	19.8	500	28	134
Do.....	19.8	2,000	60	137
Do.....	19.8	500	60	126

Now consider a non-paraffinic charge stock, e.g., petrolatum containing 2 percent of oil and a non-paraffinic charge stock, e.g., petrolatum containing 28 percent of oil. It will be observed that at an operating pressure of 2000 p.s.i. and at a conversion of about 25 percent to products boiling below 650° F. the viscosity index of the lube oil fraction of the products boiling above 650° F. the viscosity index of the lube oil fraction produced from the charge stock containing 2 percent of oil is 144.5 while that of the lube oil fraction produced from the charge stock containing 28 percent of oil is 130. At a conversion of 50 percent to products boiling below 650° F. the viscosity index of the lube oil fraction produced from the charge stock containing 2 percent of oil is 152.5 while the viscosity index of the lube oil fraction produced from charge stock containing 28 percent of oil is 135.5. These statements are summarized in the following tabulation:

Stock Type	Percent Oil	Percent Conversion	VI of Lube Oil Fraction
Non-paraffinic.....	2	25	144.5
Do.....	28	25	130.0
Do.....	2	50	152.5
Do.....	28	50	135.5

From the foregoing the following general characteristics of the effect of charge stock type and the oil content thereof can be obtained: (1) For paraffinic charge stocks containing 0.2 to about 7 percent of oil both luminometer number and viscosity index decrease with increased severity as measured by the percent of the charge stock converted to products boiling below 650° F.; (2) for paraffinic stocks containing oil in the range of about 8 to about 23 percent the luminometer number increases and the viscosity index decreases with increased severity as measured by the percent of the charge stock converted to products boiling below 650° F.; (3) for non-paraffinic charge stocks containing oil in the range of 2 to 23 percent of oil both luminometer number and viscosity index increase with increased severity (as defined hereinbefore); (4) for non-paraffinic stocks containing oil in excess of 23 percent, e.g., 28 percent the luminometer number is static while the viscosity index increases with increased severity (as defined hereinbefore); and (5) operating pressure in the range of 100 to 2000 p.s.i. has little or no effect upon the viscosity index of the lube oil fraction of conversion products boiling above 650° F. produced from paraffinic stocks containing less than about 8 percent of oil but has marked effect upon the viscosity index of the lube oil fraction of products produced from paraffinic stocks containing 8 percent or more of oil at conversions in excess of 25 percent.

From the foregoing it follows that the severity of hydroisomerization conditions must be coordinated with (1) the type of charge stock, i.e., paraffinic and non-paraffinic as hereinafter defined, (2) the quantity of oil in the charge stock, i.e., the concentration of hydrocarbon boiling above 650° F. which is liquid after solvent

dewaxing at 0° F., (3) the quality of the jet fuel, i.e., 375° to 500° F. fraction of the liquid products boiling below 650° F., and (4) the quality of the lube oil fraction, i.e., the fraction of the bottoms product (boiling above 650° F.) liquid after solvent dewaxing at 0° F. or lower, e.g., minus 65° F. or lower.

Charge stocks are characterized as paraffinic or non-paraffinic. Charge stocks A, B, and E are illustrative of paraffinic stocks while charge stocks C and D are illustrative of non-paraffinic stocks. Thus, paraffinic stocks contain at least 80 mol percent of +2 paraffins and not more than 20 mol percent of monocyclic paraffins. On the other hand, non-paraffinic charge stocks less than 80 mol percent of +2 paraffins and 20 mol percent or more of monocyclic paraffins. The hydrogen or hydrogen-containing gas can be used in a once-through manner, i.e., no recycle of the reaction products boiling below C₄ hydrocarbons. On the other hand, in many operations local conditions will require recycle of the gas comprising hydrogen and C₁ to C₃ hydrocarbons for economic industrial operation. Accordingly, the flowsheets diagrammed in FIGURES 4 and 5 provide the recycle of the C₃ and lighter hydrocarbons and hydrogen separated from the C₄ and heavier hydroisomerization products. Those skilled in the art will understand that although not illustrated in the illustrative flowsheets FIGURES 4 and 5, the C₃ and C₄ hydrocarbons present in the effluent of the hydroisomerization zone can be recovered for use as "LPG" (liquid petroleum gas) or the C₁ to C₃ hydrocarbons can be upgraded as by conversion into unsaturated hydrocarbons such as acetylene, ethylene, and propylene respectively.

The flowsheets, FIGURES 4 and 5 illustrate three embodiments of the present invention to wit: "Embodiment A" in which a charge stock containing less than 25 percent of hydrocarbon liquid after solvent dewaxing at 0° F., i.e., having a pour point of about 20° F. is converted to "Hi-Mach" i.e., luminometer number at least 100, jet fuel and naphtha having an E.B.P. (end boiling point) of about 375° F. and the bottoms boiling above about 500° F. are recycled to extinction. The feed or charge stock in Embodiment A is at least one of slack wax, petrolatum, or other waxy hydrocarbon mixtures having an I.B.P. (initial boiling point) higher than 400° F. and containing less than 25 percent of oil as defined hereinbefore. Embodiment B is illustrative of the hydroisomerization of waxy charge stock containing less than 50 percent of oil (as hereinbefore defined) having an I.B.P. of at least 650° F., e.g., slack wax petrolatum and the like to "Hi-Mach" jet fuel, premium diesel fuel, and high viscosity index (Hi-VI) automotive lubricating oils having a pour point not higher than 20° F. and a VI above presently commercially available automotive lube oils of usual quality as measured by the VI. In "Embodiment B" the wax separated from the 650° F.+bottoms in a conventional dewaxing operation at 0° F. is recycled to extinction. In "Embodiment C" waxy hydrocarbon mixtures containing less than 5 percent of oil (as defined hereinbefore), e.g. finished paraffin wax is hydroisomerized, the waxy 650° F.+bottoms is dewaxed at 0° F. and the dewaxed oil dewaxed a second time at considerably lower temperature to provide twice dewaxed oil having a pour point not higher than about minus 40° F. suitable for use as fluid in supersonic aircraft hydraulic systems and a waxy "Hi-VI" automotive lube such as defined hereinbefore.

Embodiment A (maximizing jet fuel)

A charge stock containing not more than 25 percent oil, e.g., slack wax, petrolatum, or other waxy hydrocarbon mixture having an I.B.P. above about 400° F. is drawn as shown in FIGURE 4 from a source (not shown) through pipe 10 by pump 11. Pump 11 discharges the charge stock into pipe 12 through which the charge stock flows to heat exchanger 13. When suf-

efficient charge stock has been hydroisomerized to produce distillation bottoms boiling above 500° F. the bottoms, flowing from distillation tower 25 through pipe 45 to the suction side of pump 47 (valve 46 open, valve 56 closed), is discharged by pump 47 into pipe 48 at a pressure in excess of that in pipe 12, is admixed with the charge stock at some point in pipe 12 intermediate to pump 11 and indirect heat exchanger 13 to form hydroisomerization feed. The hydroisomerization feed, hereinafter designated feed, flows through pipe 12 to indirect heat exchanger 13 where the feed is in heat transfer relation with the total effluent of the hydroisomerization reaction zone 20 flowing from indirect heat exchanger 15 through conduit 22. From indirect heat exchanger 13 the feed flows through pipe 14 to indirect heat exchanger 15 where the feed is in heat transfer relation with the total effluent of the hydroisomerization reaction zone 20 flowing therefrom through conduit 21.

From indirect heat exchanger 15 the feed flows through pipe 16 to coil 17 in heater 18. In heater 18 the feed is heated to a temperature to provide at the inlet of hydroisomerization reaction zone 20 a hydroisomerization temperature in the range of about 500° to about 900° F. From heater 18 the heated feed flows through conduit 19 to the inlet of hydroisomerization reaction zone 20. At a point in conduit 19 intermediate to heater 18 and reaction zone 20 hydrogen flowing from a source not shown through conduit 49 under control of valve 50 (valves 32 and 33 closed) to conduit 31 or hydrogen-containing gas flowing from accumulator 30 or as otherwise described hereinbefore through conduit 31 (valves 32 or 33 open, valve 50 closed) and thence to the suction side of compressor 51 and thence through conduit 52 to conduit 19 is admixed with the aforesaid feed to form charge mixture comprising about 1 to about 25 mols of hydrogen per mol of feed.

The charge mixture flows through conduit 19 to reaction zone 20. Generally, one reactor is sufficient since the hydroisomerization reaction is exothermic. However, more than one reactor can be used in a hydroisomerization reaction zone.

The conditions in the hydroisomerization zone are in the limits set forth hereinafter; the severity of the hydroisomerization conditions being regulated in accordance with the oil content and type (paraffinic or naphthenic) of the feed and the quality of the major product.

	Broad	Preferred
Hydrogen Pressure, p.s.i.	At least 100.....	200 to 2000.
Temperature, ° F.	450 to 950.....	500 to 900.
Liquid Hourly Space Velocity, v./hr./v.	0.25 to 5.0.....	1-3.
H ₂ Circulation, s.c.f./b.	300 to 10,000.....	1,000-5,000.
Catalyst*	Particle form solid hydroisomerization.	0.6 wt. percent pt., 4.5 wt. percent F., 0.36 wt. percent Cl on alumina.

*It is preferred to use platinum-group metal hydroisomerizing catalyst. Such catalysts comprise one or more of platinum, palladium, and nickel preferably on a support comprising eta alumina and especially gamma alumina or a non-alkaline base such as bentonite, barite, faujasite and the like containing chlorine and/or fluorine. Particularly preferred is the platinum group metal hydroisomerizing catalyst comprising about 0.1 to about 1.0 percent by weight of platinum, halogen in the range of about 0.1 to about 10 percent by weight on an alumina support. Halogen as used herein is limited to fluorine and chlorine and, dependent upon the method of preparation with either hydrofluoric acid or hydrochloric acid or a combination of hydrofluoric and hydrochloric acid the catalyst contains fluorine or chlorine or both in the range set forth hereinbefore.

The charge mixture flows downwardly through reaction zone 20 in contact with the particle-form solid hydroisomerization catalyst to the reaction zone outlet and conduit 21. The reaction zone effluent flows through conduit 21 to indirect heat exchanger 15, thence through conduit 22 to indirect heat exchanger 13 and thence through conduit 23 (valve 24 open, valve 53 closed) to fractionation tower 25.

As illustrated separation of the reaction zone effluent takes place at pressures in the range of 25 to 50 p.s.i.g. The reaction zone pressure is reduced to distillation pressure, i.e., 25 to 50 p.s.i.g. by pressure reducing valve 24. As those skilled in the art know, the single fractionation tower 25 can be replaced with a plurality of fractionation towers. In addition, a high-pressure separator or flash drum can be used up-stream of the distillation zone to separate C₄ and lighter hydrocarbons and hydrogen from the C₅ and heavier hydrocarbons of the reaction zone effluent, the pressure on the C₅ and heavier fraction of the reaction zone effluent reduced and only the C₅ and heavier reaction zone product introduced into the distillation zone.

As illustrated the fractionation zone comprises fractionating tower 25, a reboiler represented by pump and heater 26 and coolers and receivers. In "Embodiment A" the reaction zone effluent flows through conduit 23 from reducing valve 24 at a pressure up to about 50 p.s.i.g. and a temperature at which hydrocarbons boiling below about 500° F. at atmospheric pressure are volatile. The reaction zone effluent is fractionated into (1) hydrogen and C₁ to C₄ hydrocarbons, (2) C₅ to 375° F. E.B.P. naphtha, (3) 375° to 500° F. "Hi-Mach" jet fuel, and (4) bottoms boiling above about 500° F.

The C₄ and lighter, including hydrogen, is taken overhead through conduit 27 to cooler 28 where the overhead is cooled to a temperature at which at the existing pressure the C₄ hydrocarbons condense. The cooled overhead flows from cooler 28 through conduit 29 to accumulator 30. In accumulator 30 the uncondensed C₃ and lighter separate and flow therefrom through conduit 31 and conduit 54 (valve 32 closed; valve 55 open) to the refinery fuel system, recovery of hydrogen, or other hydro processes or with valve 55 closed and valve 32 open (valve 33 closed) to compressor 51 for recycle to reaction zone 20.

The condensed overhead C₄ and heavier flows from accumulator 30 through pipe 34 to recovery of C₄ and heavier. A portion of the C₄ and heavier flowing through pipe 34 is diverted under control of valve 36 through pipe 35 to the suction of pump 37. Pump 37 discharges the C₄ and heavier into pipe 38 through which the C₄ and heavier flows to fractionation tower 25 for use as reflux.

A fraction boiling in the range of about C₅ to about 375° F. designated hydronaphtha is taken in the usual manner with or without as illustrated, reflux through pipe 39 to cooler 40 where the C₅ to 375° F. is cooled to a temperature at which under the existing pressure the C₅ to 375° F. hydronaphtha is condensed. The condensed hydronaphtha flows from cooler 40 through pipe 41 to hydronaphtha storage.

A "Hi-Mach," i.e., luminometer number at least 100, jet fuel is taken in the usual manner (with or as illustrated without reflux) through pipe 42. The "Hi-Mach" jet fuel flows through pipe 42 to cooler 43 where the "Hi-Mach" jet fuel is condensed. The condensed "Hi-Mach" jet fuel flows from condenser 43 through pipe 44 to "Hi-Mach" jet fuel storage.

The bottoms, i.e., reaction zone effluent boiling above about 500° F. flows from fractionator 25 through pipe 45 under control of valve 46 (valve 56 closed) to the suction side of pump 47. Pump 47 discharges the unconverted waxy bottoms, i.e., recycle bottoms, into pipe 48 for admixture with the charge stock to form the hydroisomerization feed.

As those skilled in the art will recognize, "Embodiment A" of the present invention provides a means for producing "Hi-Mach" jet fuel but no lube oil with recycle of the waxy 500° F. bottoms to extinction. Consequently, there is no need to compromise on the severity of the conditions in the hydroisomerization reaction zone. The temperature and space velocity are regulated to provide the maximum yield of jet fuel having a luminometer

number of at least 100. The temperature and space velocity accordingly are regulated dependent upon the oil content of the feed and the luminometer number of the produced "Hi-Mach" jet fuel.

Embodiment B (maximize "Hi-Mach" jet fuel or maximize "Hi-VI" automotive lube oils)

As illustrated in FIGURES 4 and 5 of the combination of operations in Embodiment B are coordinated to produce (1) "Hi-Mach" jet fuel, (2) premium diesel fuel and (3) above conventional quality, "Hi-VI" automotive lubricating oil.

The charge stock is a waxy mixture of hydrocarbons containing less than 50 percent of oil, i.e., hydrocarbon liquid at 0° F. after conventional dewaxing, e.g., pour point 20° F. The charge stock flows as described in Embodiment A through the heat exchangers, heater and reaction zone at a temperature, a pressure, a space velocity and hydrogen circulation in the limits set forth hereinbefore. However, the recycle bottoms is the unconverted wax separated in a conventional manner, i.e., using methyl-ethyl ketone and benzol at 0° F. The total hydroisomerization reaction zone effluent flows from reactor 20 through conduit 21 to indirect heat exchanger 15, thence through conduit 22 to indirect heat exchanger 13 and from exchanger 13 through conduits 23 and H-57 and F-57 (valve 24 closed; valve 53 open) to fractionation tower 58.

Fractionation tower 58 and a reboiler of any suitable construction (indicated by pipes 59 and 60, pump 61, and heater 62) can be replaced by a plurality of fractionation towers and auxiliary equipment or a high-pressure separator can be interposed between heat exchanger 13 and fractionation tower or towers 58 as described hereinbefore. As illustrated the total reactor effluent at a reduced pressure in the range of 10 to 50 p.s.i.g. enters fractionator 58 at a temperature at which hydrocarbons boiling below 650° F. under normal conditions are volatile.

An overhead comprising C₄ and lighter hydrocarbons and hydrogen is taken through conduit 63. The overhead flows through conduit 63 to cooler 64. In cooler 64 the overhead is cooled to condense C₄ and heavier hydrocarbons. The cooled overhead flows from cooler 64 through conduit 65 to accumulator 66. In accumulator 66 the hydrogen and C₁ to C₃ hydrocarbons, uncondensed overhead, separate and flows therefrom through conduit F-67 and H-67 [(FIG. 4) valve 33 open; valve 32 closed] to compressor 51 (FIG. 4) for use as recycle gas. The separated C₄ and heavier flow from accumulator 66 through pipe 68 to storage. A portion of the C₄ and heavier is diverted through pipe 69 under control of valve 70 to the suction side of pump 70a. Pump 70a discharges the diverted portion of the C₄ and heavier into pipe 71 through which the aforesaid diverted portion flows to fractionator 58 for use as reflux.

In a conventional manner without reflux as illustrated or with reflux, a C₅ to about 375° F. hydronaphtha flows from fractionator 58 through pipe 72 to cooler 73 where the C₅ to about 375° F. hydronaphtha is condensed. The condensed hydronaphtha flows from cooler 73 through pipe 74 to storage.

In the usual manner without reflux as illustrated or with reflux, a "Hi-Mach" jet fuel fraction, boiling range about 375° F. to about 500° F. flows from fractionator 58 through pipe 75 to cooler 76. In cooler 76 the "Hi-Mach" jet fuel is condensed, the condensed "Hi-Mach" jet fuel flows therefrom to storage through pipe 77.

A third intermediate fraction is taken in the usual manner. The third intermediate fraction being a premium diesel fuel boiling in the range of about 500° to about 650° F. and having a cetane number in the range of 60 to 90 flows from fractionator 58 through pipe 78 to cooler 79. The premium diesel fuel is condensed in cooler 79 and flows therefrom through pipe 80 to storage.

The bottoms, i.e., a waxy mixture of hydrocarbons

boiling above about 650° F. flows from fractionator 58 through pipe 81 to means such as cooler 82 and other heat exchangers. In the heat exchanger system indicated by cooler 82 the 650° F.+bottoms is cooled to provide, when mixed with suitable dewaxing solvent, e.g., methyl-ethyl ketone-benzol mixture or methylisobutyl ketone mixture a dewaxing temperature to provide a 20° F. pour point oil for the purpose of removing unconverted wax. The cooled 650° F.+bottoms is dewaxed in a suitable manner, for example, at a temperature not higher than about 20° F. in a dewaxing unit indicated by 84. (The dewaxing operation being well-known and understood and being per se not this invention detailed description thereof is not considered necessary for full understanding of the present novel combination of operation.) Under the normal dewaxing conditions to produce a lube oil having a pour point of 20° F. or lower, "Hi-VI" lubricating oil suitable as a base for premium automotive lubricating oil flows from dewaxing unit 84 through pipe 85 (valve 86 open; valve 88 closed) to storage, and/or compounding.

The unconverted wax flows from dewaxing unit 84 through pipe F-87 and H-87 to pipe 45 (valve 56 open; valve 46 closed; FIG. 4) and thence to the suction side of pump 47 for use as recycle in the feed to the hydroisomerization reactor 20. The unconverted wax preferably is recycled to extinction.

Those skilled in the art will understand that in "Embodiment B" dependent upon local marketing conditions, the severity of the hydroisomerization conditions, i.e., oil content of the charge stock, hydrogen operating pressure, space velocity and reaction temperature as measured at the inlet of the reaction zone are regulated in the ranges given hereinbefore to maximize the production of "Hi-Mach" jet fuel depending upon the luminometer of the jet fuel produced and/or to maximize the production of "Hi-VI" automotive lube oils.

Embodiment C (maximizing premium product)

The severity of hydroisomerization conditions as measured by hydrogen pressure, space velocity and temperature in the ranges set forth hereinbefore are regulated to maximize "Hi-Mach" jet fuel or hydraulic fluid particularly for supersonic aircraft or aircraft turbine engines dependent upon the luminometer numbers, the stability in the range of minus 65° F. to 700° F. and viscosity index respectively and dependent upon the oil content (as hereinbefore defined) of the charge stock.

The feed is substantially any waxy hydrocarbon mixture containing less than 5 percent of oil, e.g., microcrystalline wax, partially refined or refined paraffin wax.

As described in conjunction with the discussion of "Embodiments A and B" hereinbefore, the charge stock flows together with unconverted wax through the heat exchangers, heater and reaction zone 20. The reaction zone effluent flows through conduit 21, heat exchanger 15, conduit 22, and heat exchanger 13 to conduit 23. With valve 24 closed and valve 53 open the total reactor effluent flows through conduit H-57 and F-57 to fractionator(s) 58 or a high pressure separator and one or more fractionators as described hereinbefore.

In "Embodiment C" as illustrated the total effluent enters the separation system at a temperature at which hydrocarbons boiling up to 650° F.+ are volatile. In other words, separation is as described in "Embodiment B" except that, after dewaxing the 650° F.+bottoms in a conventional manner to produce an oil having a pour point not higher than +20° F., the partially dewaxed oil is deep dewaxed in a suitable manner, e.g., using methyl-ethyl ketone-benzene, preferably 100 percent methylisobutyl ketone as the solvents, at a temperature not higher than about minus 65° F.

Thus, the total reactor effluent flows from heat exchanger 13 (FIG. 4) through conduits 23, H-57, F-57 to fractionator 58 (FIG. 5). In fractionator 58 an

overhead is recovered and treated as previously described in "Embodiment B." Three intermediate fractions or side streams being a C₅ to 375° F. hydronaphtha, a 375° to 500° F. "Hi-Mach" jet fuel, and a premium diesel fuel are recovered as previously described in Embodiment B.

In "Embodiment C" however, the 650° F. bottoms flowing from fractionator 58 through pipe 81 is dewaxed as stated hereinbefore to produce partially dewaxed oil and unconverted wax. The unconverted wax is recycled through pipe F-87 and H-87 (valve 56 open; valve 46 closed) to pipe 45 as described in "Embodiment B." The partially dewaxed oil flows from the dewaxing unit indicated by 84 through pipe 89 (valve 88 open; valve 86 closed) to a suitable dewaxing operation indicated by 90. In the dewaxing unit indicated by 90 the partially dewaxed oil is again dewaxed using the described solvents at a temperature not higher than about minus 65° F. Two products are obtained from this "deep" dewaxing, to wit: (1) an oil suitable for use as the fluid in the hydraulic systems of supersonic aircraft and being stable in the range of about minus 50° F. to 700° F. or for use as an aircraft turbine engine oil and (2) "high VI" automotive oils and turbine oils far superior to the presently available "Hi-VI" automotive and turbine oils as is manifest by the following comparison of the properties of the novel "Hi-VI" oils produced as herein described and conventional "Hi-VI" automotive oils.

Conventional automotive base stocks and turbine lubes:

Viscosity index -----	90-105
Present novel base stocks:	
Viscosity index -----	125-155

As in "Embodiments A and B" the severity of the hydroisomerization reaction conditions are regulated dependent upon the concentration of oil in the waxy charge and the luminometer number of the jet fuel or the VI of the fractions recovered from the 650° F. bottoms.

What is claimed is:

1. A method for the production of a liquid product comprising jet fuel which comprises selectively cracking and hydroisomerizing a waxy hydrocarbon mixture containing less than about 50 weight percent oil combined therewith in the presence of hydrogen and a catalyst composition promoting isomerization at a temperature in the range of from about 450° to about 950° F., to obtain a conversion of said waxy hydrocarbon mixture to products boiling below about 650° F. of from about 25 percent to about 70 percent, recovering a liquid product from said selective cracking step, separating said liquid product into a jet fuel boiling in the range of from about 375° to about 500° F., a diesel fuel boiling in the range of from about 500° to about 650° F. and a bottoms fraction boiling above about 650° F. and recycling said bottoms fraction to said selective cracking step.

2. A method for converting waxy constituents containing less than 50 percent weight of a distillate oil combined therewith which comprises contacting the waxy constituents with hydrogen in the presence of a halogen promoted platinum containing catalyst under temperature and pressure conditions to obtain greater than 25 percent conversion of said waxy constituents to product material boiling below about 650° F. and recycling to extinction product material boiling above about 650° F.

3. A method for upgrading a waxy hydrocarbon mixture containing less than about 50 percent of distillate oil to lower boiling products comprising jet fuels and high VI lube oils which comprises contacting the waxy material combined with a hydrogen in the presence of a hydroisomerizing catalyst under hydroisomerizing conditions to obtain a conversion of said waxy hydrocarbon to products boiling below about 650° F. of from about 25 percent to about 70 percent, separating the hydroisomerized prod-

uct under conditions to obtain a jet fuel boiling range product and a liquid product boiling above about 650° F., cooling the liquid product boiling above about 650° F. to a temperature below about 20° F. and recovering a high viscosity index lube oil from the product of the cooling step.

4. A method for converting a paraffin wax containing from about 8 to about 50 percent oil combined therewith which comprises contacting said paraffin wax with hydrogen in the presence of a halogen promoted platinum type catalyst under hydroisomerizing conditions sufficient to obtain a conversion of said combined paraffin wax and oil to products boiling below about 650° F. of from about 25 percent to about 70 percent to obtain jet fuel boiling range materials and a liquid product boiling above about 650° F. and continuously recycling the liquid product to said hydroisomerizing.

5. In the hydroisomerization of waxy hydrocarbon mixtures boiling above 400° F. selected from a member of the group consisting of petrolatum and microcrystalline wax and containing less than 50 percent of oil at a pressure in the range of 200 to 2000 p.s.i.g. in the presence of about 300 to 10,000 s.c.f. of hydrogen per barrel of said waxy hydrocarbon mixture and in the presence of catalyst composition promoting isomerization the improvement which comprises regulating the severity of reaction conditions as measured by temperature in the range of about 450° to about 950° F. and the liquid hourly space velocity in the range of .25 to 5.0 to convert said waxy hydrocarbon to products boiling below about 650° F. in an amount of between about 25 percent and about 70 percent to produce jet fuel fraction boiling in the range of about 375° to about 500° F. and having a luminometer number of at least 100.

6. The method set forth in claim 5 wherein the catalyst comprises halogen promoted platinum-group metal on alumina support.

7. The method set forth in claim 6 wherein the catalyst comprises about 0.6 weight percent of platinum, about 4.5 weight percent of fluorine, and about 0.36 weight percent of chlorine on alumina.

8. The method set forth in claim 6 wherein the catalyst comprises about 0.6 weight percent of platinum and about 5 to 6 weight percent of halogen of which at least about 90 percent is fluorine on alumina.

9. In the hydroisomerization of waxy hydrocarbon mixtures boiling above 400° F. and containing less than 50 percent of oil at a pressure in the range of 200 to 2000 p.s.i.g. in the presence of about 1000 to 5000 s.c.f. of hydrogen per barrel of said waxy hydrocarbon mixture and in the presence of catalyst composition promoting isomerization the improvement which comprises regulating the severity of reaction conditions as measured by temperature in the range of about 500 to about 900° F. and the liquid hourly space velocity in the range of 1.0 to 3.0 to produce products boiling below 650° F. in amount at least 25 percent of the feed and dependent upon the concentration of oil in the aforesaid waxy hydrocarbon mixture to produce jet fuel boiling in the range of about 375° to about 500° F. and having a luminometer number of at least 100.

10. The method set forth in claim 9 wherein the isomerization catalyst comprises about 0.6 weight percent of platinum and about 5 to 6 percent by weight of halogen of which at least 90 percent is fluorine, wherein for a jet fuel having a predetermined luminometer number of at least 100, and a feed containing in excess of 8 percent of oil, the severity of reaction conditions is increased with the increase in oil content.

11. In the hydroisomerization of waxy hydrocarbon mixtures boiling above 400° F. selected from a member of the group consisting of petrolatum and microcrystalline wax and containing less than 50 percent of oil at a pressure in the range of 200 to 2000 p.s.i.g. in the presence of about 300 to 5000 s.c.f. of hydrogen per barrel of said waxy

hydrocarbon mixture and in the presence of catalyst composition promoting isomerization the improvement which comprises regulating the severity of reaction conditions as measured by temperature in the range of about 500° to about 900° F. and the liquid hourly space velocity in the range of 0.25 to 3.0 to convert from 25 percent to 70 percent of the waxy hydrocarbon mixture to products boiling below about 650° F. to produce jet fuel fraction boiling in the range of about 375° to about 500° F. and having a luminometer number of at least 100 and a lubricating oil having a viscosity index of at least 120.

12. The method set forth in claim 11 wherein the isomerization catalyst comprises about 0.6 weight percent of platinum and about 5 to 6 weight percent of halogen of which at least about 90 percent is fluorine on alumina.

13. The method set forth in claim 11 wherein a diesel fuel boiling in the range of about 500° to about 650° F. and having a cetane number of at least 60 is produced.

14. The method set forth in claim 11 wherein (1) a jet fuel boiling in the range of about 375° to about 500° F. and having a luminometer number of at least 100, (2) a

diesel fuel boiling in the range of about 500° to about 650° F. and having a cetane number of at least 60, (3) an oil suitable for the hydraulic systems of supersonic aircraft stable in the range of 0° to 700° F. boiling above 650° F. and having a viscosity index of at least 100, and (4) an automotive lube oil boiling above 650° F. and having a viscosity index of at least 125 are produced.

References Cited by the Examiner

UNITED STATES PATENTS

3,110,661	11/1963	Franz	208—141
3,148,136	9/1964	Woodle	208—15

FOREIGN PATENTS

1,097,444	7/1955	France.
755,105	8/1956	Great Britain.

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