Aug. 23, 1966 W. F. AREY, JR., ET AL 3,268,436

PARAFFINIC JET FUEL BY HYDROCRACKING WAX

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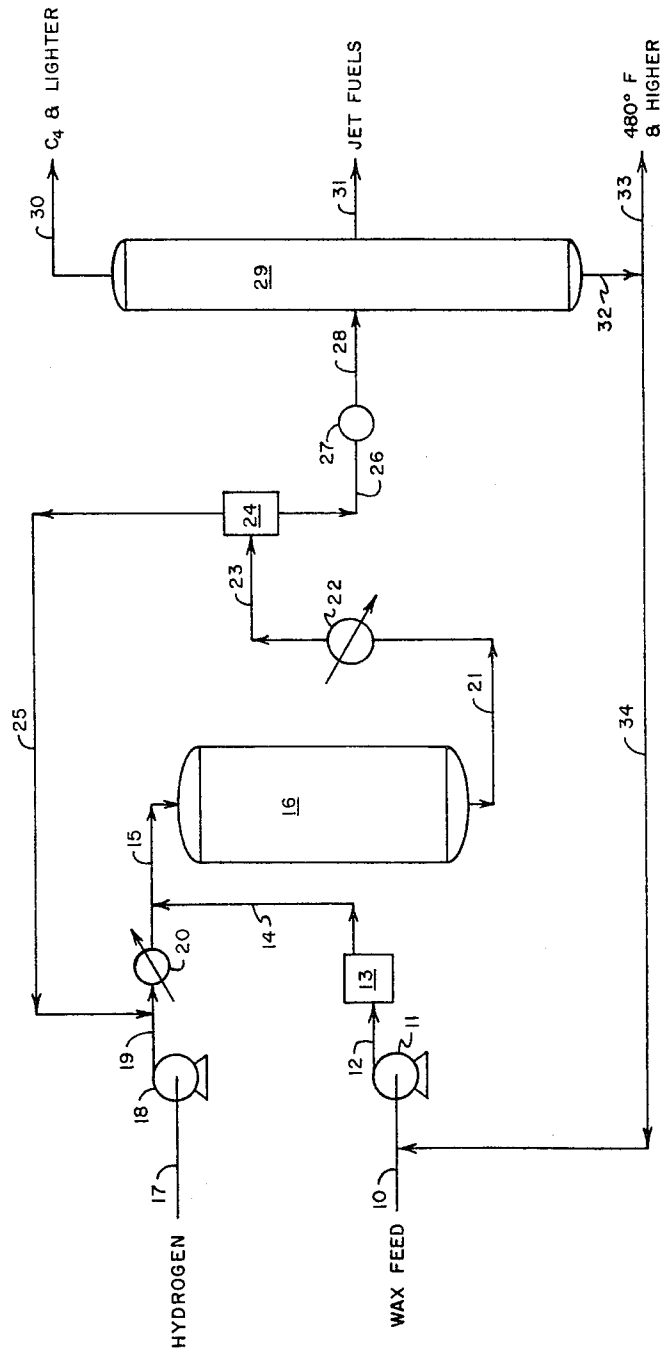


FIG. 1

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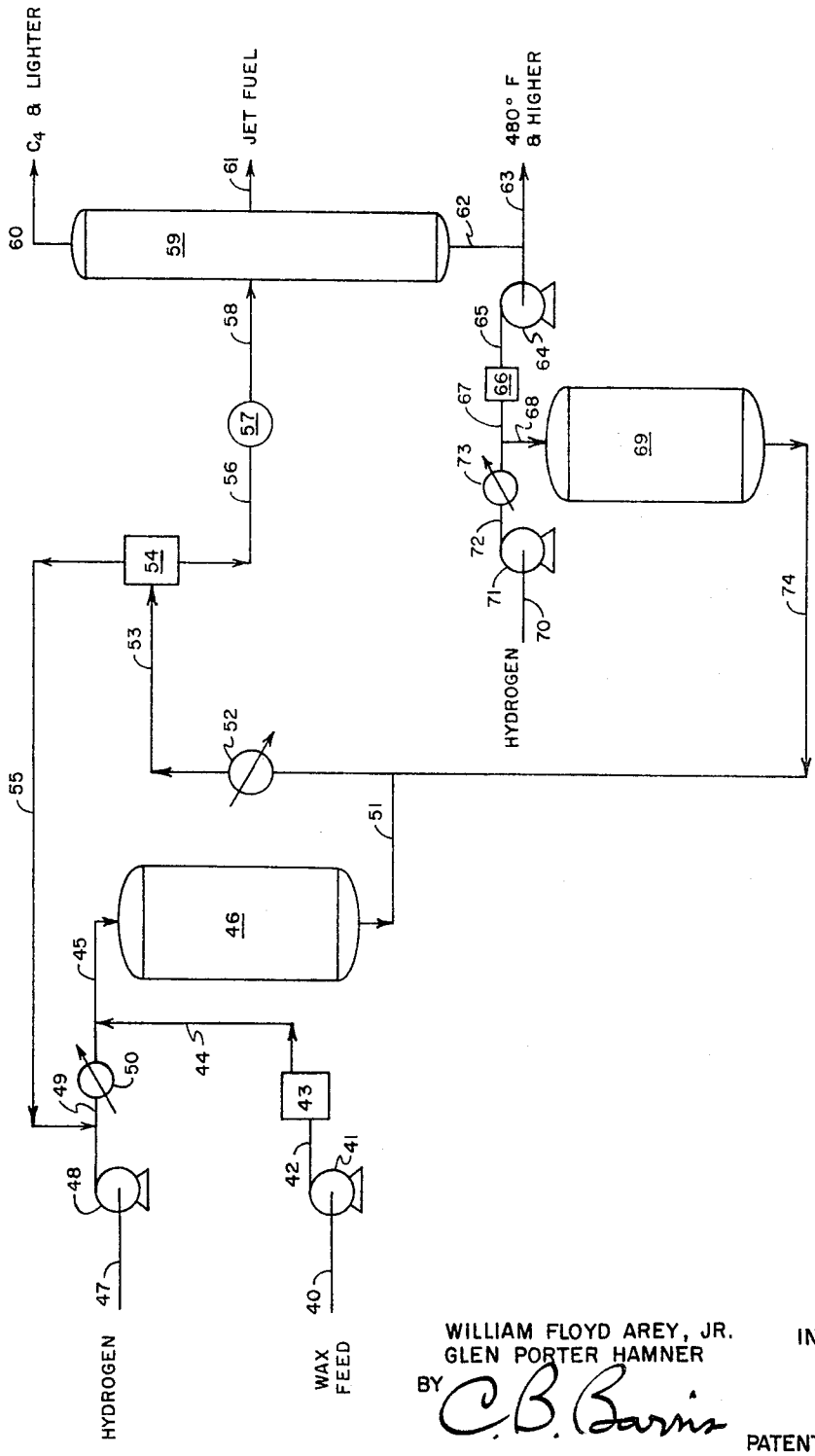


FIG. 2

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United States Patent Office 3,268,436 Patented August 23, 1966

3,268,436

PARAFFINIC JET FUEL BY HYDROCRACKING WAX

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Filed Feb. 25, 1964, Ser. No. 347,194
9 Claims. (Cl. 208—59)

This invention is directed to fuels utilizable in jet combustion devices. It is more particularly concerned with an improved process whereby there are produced jet fuels from paraffin waxes found in petroleum.

Paraffin wax is a normally solid wax-like substance composed of high molecular weight hydrocarbons. It is called paraffin wax to distinguish it from the vegetable and animal waxes which are composed largely of oxygenated compounds. It is usually obtained from the heavier fractions of petroleum such as are used for the production of lubricating oils as well as certain burning oils. In nearly every case, it is an undesired constituent in such oils and is removed by known so-called dewaxing methods during refining. While paraffin wax is useful for many purposes such as sealing containers, production of waxed paper, production of water-proofed cartons and the like, and finds a large and wide use, there is still a considerable amount of paraffin wax from which there is no ready market.

Various processes have been proposed for the treatment of conversion of paraffin wax. Those processes resulting in a hydrocarbon product generally involve a refining operation which produces a normally solid wax of improved characteristics, or a more drastic conversion treatment which results in the production of a liquid product. The former usually comprises such steps as solvent extraction, fractional crystallization, clay treatment and the like, in which the structure of the hydrocarbons is unaltered. The latter involves a step in which the hydrocarbons are decomposed or split to give a wide range of products comprising normally gaseous and normally liquid products, most of which are of relatively low value. It would be most advantageous to have a practical process whereby paraffin wax could be converted into more valuable hydrocarbon products. One possibility lies in its conversion to fuels utilizable in jet combustion devices.

As is well known in the art, the term "jet combustion," refers to a method of combustion wherein fuel is continuously introduced into and continuously burned in a confined space, for the purpose of deriving power directly from the hot products of combustion. The most complicated forms of jet engines presently proposed consist of a propulsion or jet tube, closed at one end, plus a gas turbine which extracts sufficient energy from the departing gases to drive the compressor. In present commercial forms, the compressor and turbine are assembled axially upon a common shaft, spaced far enough apart to permit a number of combustion chambers to be arranged about the shaft between the compressor and turbine, with an exhaust tube extending rearwardly from the turbine. The principal application of such engines is in powering aircraft, particularly for high-altitude operations. Therefore, the desiderata of fuels utilizable in jet combustion devices are many and varied.

One of the problems encountered in the employment

of fuels in jet combustion devices is their tendency to form carbon upon combustion. The carbon thus formed creates noxious exhaust smoke which is highly undesirable. The combustion-formed carbon is also deposited inside the combustion zone where it interferes with the operation of the device and may also contribute to the warping of parts in the zone by causing uneven heating.

A standard indication of the carbon-forming tendency of a fuel is its luminosity number. As this standard is directly related to the burning qualities desired in a jet fuel, it is apparent why such standard is an important factor in jet fuel specifications. The normal commercial kerosene fraction has a luminosity number that is relatively low and, therefore, requires extensive improvement prior to use as a jet fuel. It is highly desirable, therefore, to produce a jet fuel having a high luminosity number, and especially desirable to produce such a jet fuel from the paraffin wax mentioned above.

It is an object of this invention, therefore, to provide an improved jet combustion fuel. Another object is to provide a simple process for producing an improved lower boiling range jet fuel from paraffin wax stocks. Another object is to provide a jet fuel of improved properties, that is, obtained by hydrocracking paraffin wax in the presence of hydrogen and of a suitable hydrocracking catalyst. Still another object is to provide a process for producing improved jet combustion fuels having high luminosity numbers from undesirable paraffin wax stocks that involves cracking such paraffin wax stocks in the presence of hydrogen and a hydrocracking catalyst. Another object is to provide jet combustion fuels having high luminosity numbers which are produced by such process.

Other objects and advantages of the present invention will become apparent to those skilled in the art from the following detailed description considered in conjunction with the drawings which shows schematic arrangements of typical embodiments for carrying out the process of this invention.

It has now been found that jet fuels can be produced by hydrocracking a paraffin wax charge stock in the presence of a cracking catalyst, preferably a nickel or palladium series metal catalyst, which method is simple and economical and which simultaneously provides for the utilization of heretofore undesirable paraffin wax.

In general, the present invention provides a method for producing a jet combustion fuel which comprises contacting a paraffin wax charge stock with a hydrocracking catalyst in the presence of hydrogen in amounts of from about 2000 to 20,000 s.c.f. of hydrogen per barrel of wax charge stock to convert at least a portion of the hydrocarbon charge into a jet fuel boiling within the range varying between about 50° F. and about 550° F. Broadly, the operating conditions utilized in said contacting are temperatures of from about 300 to 900° F., pressures of from about 500 to 3000 p.s.i.g. and flow rates within the range of about 0.1 to 10 v./v./hr. Suitable catalysts include supported platinum metal series, e.g., platinum, palladium or nickel catalysts as well as other sulfur insensitive hydrocracking catalyst of the copper, cobalt and iron salts of the oxy and thio acids of chromium, molybdenum, and/or tungsten. The sulfided forms of the foregoing are found to be effective. Generally any one or a combination of the above active components may be used either alone, i.e. unsupported, or

together with supports such as alumina, alumino-silicate zeolites, diatomaceous earth, treated clay, activated carbon or the like. In addition, the use of the zinc, magnesium, calcium, strontium, or hydrogen form of synthetic faujasite as a catalyst support may be desirable.

Within the narrower limits of the broad range of conditions listed above, the conditions are not independently variable. It is, therefore, necessary to select conditions from within the ranges specified to accomplish the desired hydrocracking of the wax stock as evidenced by the formation of the high quality paraffinic jet fuel and produce but small amounts of aromatics. The interdependence of these variables will be more clearly understood by reference to the discussion following and to the accompanying illustrative examples.

The process of this invention is applicable for the hydrocracking of any normally solid hydrocarbon wax, that is, any hydrocarbon wax having a boiling point of 650° F. or over. The wax will usually be derived from natural mineral sources such as petroleum, oil shale, oil from tar sands, gilsonite, ozokerite, or the like, but synthetic wax produced by the Fischer-Tropsch synthesis or as a by-product of other processes may also be utilized. The process may be applied for the hydrocracking of crude so-called slack wax, or to refined waxes of various melting points or to so-called residue wax. While the various waxes differ somewhat in properties, i.e., melting point and hardness, they are all composed of hydrocarbons containing long paraffin chains. In some paraffin waxes the chains may be slightly branched and in some the chains may be attached to naphthenic or aromatic groups. Olefinic groups are rarely present; when present they do not affect the operation of the process.

The process is particularly applicable to high molecular weight wax, recover from residual crude oil fractions, boiling above about 650° F., preferably above about 1000° F., and up to about 1300° F., which are known as microcrystalline wax or as soft microwax petrolatum. This feed is a black to brown colored, gelatinous, oily, translucent, semi-solid, amorphous mass whose consistency varies with the temperature. It is obtained by dewaxing a residual crude oil fraction boiling above about 1000° F. In simplest terms, it is a microwax obtained from a dewaxing operation which has not been deoiled and therefore contains from about 10 to 50 wt. percent oil, preferably about 20 percent oil.

In accordance with the present invention there is employed as an outstanding hydrocracking catalyst a composition comprising a metal or compound of the platinum group deposited on, composited with, or incorporated within, a crystalline silica-alumina anionic network which has uniform size pore openings between about 6 and 15 Angstrom units. The crystalline nature of the catalyst is important, as the particular crystalline structure will then control the uniformity of the pore openings, and so distinguish it from other crystalline and non-crystalline zeolitic materials and from amorphous silica-alumina gel catalysts and aluminas. In this regard, then, the actual chemical composition of the support becomes of secondary value compared to the size of the pore openings. By this is meant that the relative amounts of silica and alumina are not of primary importance though these do play a role in both catalyst stability and activity.

In a crystalline alumino-silicate zeolite the actual structure comprises an anionic network with cations interspersed to allow electrical neutrality. Normally, as prepared, these cations are sodium. In the structure, the amount of sodium present has the same atom content as the aluminum because the aluminum atom being trivalent needs an additional charge to be present to compensate for its deficiency in relation to the quadrivalent silicon atoms. Thus, for the purposes of the present invention the catalyst support is derived from a crystalline zeolite having a nominal anhydrous composition of

$$Na_2O \cdot Al_2O_3 \cdot xSiO_2$$

where the relative silica content may vary at will, providing the port size opening of the crystalline material remains in the 6 to 15 Angstrom unit region. Nominally, for a good hydrocracking process catalyst support, the soda content is too high, but it can be reduced to an acceptable level by base exchanging with a more acceptable cation, such as ammonium or hydrogen ions. This does not preclude the use of other metal cations in this base exchange operation which could serve as catalytic agents in their own right as well as improving the properties of the alumino-silicate crystals as a support. Examples of methods of preparing the catalysts utilizable in the present invention are set forth in U.S. Serial No. 122,089, filed in the U.S. on July 6, 1961, by E. M. Gladrow and P. T. Parker.

As heretofore mentioned, the catalyst of the present invention may be subject to many variations without departing from its spirit. Though it finds its highest utility when a hydrogen ion replaces the bulk of the sodium ions in the original sodium alumino-silicate, under certain circumstances it may be desirable to replace the sodium by other elements such as cobalt, nickel, zinc, magnesium, calcium, cadmium, copper, and barium, as well as the oxides and sulfides thereof and employ the resulting crystalline compositions as a support for the platinum group metals. Such materials serve not only as the support for the platinum group metal catalyst, but also possess catalytic activity in their own right. Thus, such catalysts may serve a dual role for specific hydrocarbon conversion reactions. The other metal modifications of the adsorbent may impart greater thermal stability to the noble metal catalyst composite.

In addition to the alumino-silicate zeolite supports disclosed above, other supports advantageous for use in this invention include a number of conventional carrier materials heretofore employed. The carrier may be selected from activated alumina, activated bauxite, silica gel, diatomaceous earth, treated clay, hydrogen fluoride promoted alumina, activated carbon, and the like. Of the foregoing, alumina is the carrier material particularly preferred as a support.

Also suitable for use as catalysts in the instant invention are the unsupported catalyst. Thus, unsupported metals of the platinum group of oxides and sulfides or mixtures thereof may be empolyed for the process of this invention. In this regard, it is found that molybdenum sulfide, nickel sulfide, or mixtures thereof are preferred for use as a catalyst.

Having generally described the nature of the invention as well as the paraffinic wax charge stock and catalyst employed therein, attention is now directed toward a detailed discussion of the invention. In order to aid in this discussion, reference is made to the attached FIGURES 1 and 2 which illustrate diagrammatically a process flow plan of the manner in which the present hydrocracking reaction is preferably employed to produce highly desirable jet fuels.

Referring to FIGURE 1, a suitable paraffinic wax charge is introduced through a pipe **10** and pumped by means of a suitable pumping device **11** through a pipe **12** into a heater **13**. In the heater **13** the charge is heated to reactor temperature of from 350 to 900° F. preferably 500 to 750° F. The thus heated charge is then passed through pipes **14** and **15** into a reactor **16**. Simultaneously, hydrogen gas or a gas rich in hydrogen is introduced into pipe **17** and pumped and compressed by means of a compressor **18**. The compressed hydrogen passes through a pipe **19** into a heat exchanger or heating device **20**, wherein it is heated to the above reaction temperature. The thus heated hydrogen is then comingled with the wax charge in pipe **15** and the mixture then passes into the reactor **16**.

The reactor **16** can be a single reactor or comprise a plurality of reaction beds. In the reactor **16** there is contained a bed or plurality of beds of a suitable hydro-

cracking catalyst, such as palladium on hydrogen form faujasite support or nickel sulfide on silica/alumina support as hereinbefore described. The mixture of hydrogen and paraffin wax charge is contacted with the catalyst in the reactor **16** under suitable conditions to effect at least partial conversion of the paraffin wax charge into a lower boiling range jet fuel. Suitable operating conditions include:

Temperatures of from 300 to 900° F., preferably 500 to 750° F.
Pressures of from 500 to 3000 p.s.i.g., preferably 1000 to 2000 p.s.i.g.
Flow rates of from 0.1 to 10 v./v./hr., preferably 0.5 to 2 v./v./hr.
Hydrogen feed rates of from 2000 to 20,000 s.c.f. H_2/bbl., preferably 3000 to 10,000 s.c.f. H_2/bbl.

According to the present invention, hydrocracking of paraffinic wax charge stock with consequent improvement in burning qualities, i.e., higher luminosity number, can be accomplished by contacting such charge stock with the catalysts and at the operating conditions as hereinbefore set forth. Generally speaking, improvement in burning qualities, i.e., higher luminosity number, can be obtained by operating at relatively higher hydrogen feed rates, higher pressures and relatively milder temperatures to give a luminosity number of at least 65. Accordingly, the degree of conversion used will depend upon the amount of jet fuel desired in a specific operation.

The total effluent from the reactor **16** is removed through a pipe **21** and passed into a heat exchanger or suitable cooling device **22**. In the heat exchanger **22**, the effluent is cooled to temperatures at which gaseous hydrogen can be separated from liquid phase, i.e., temperatures below about 150° F. The thus cooled effluent is passed through a pipe **23** into a high pressure separator **24**. In the high pressure separator **24**, there are a liquid phase and a gaseous phase. The gaseous phase containing substantial amounts of hydrogen is removed through a pipe **25** and can be recycled to the process through pipe **19**. The liquid product from the high pressure separator **24** is removed through pipe **26**, passed through a depressuring zone **27**, and then through pipe **28** into a suitable fractionating device **29**.

In the fractionator **29**, the liquid products are separated into suitable fractions. C_4 and lighter fractions, i.e., for example, butanes and dry gas are removed through pipe **30** and can be sent to the gas processing plant. In accordance with the invention, a high quality jet fuel boiling in a range between about 50 to 480° F., is removed through pipe **31**. The material boiling at temperatures higher than about 480° F. is removed through pipes **32** and **33**. If desired, this material can be recycled through the process via pipes **34** and **10**.

FIGURE 2 illustrates an alternate method of producing jet fuels in accordance with this invention, but which involves the use of two reactors. According to this embodiment, a suitable paraffinic wax charge is introduced through a pipe **40** and pumped by means of a suitable pumping device **41** through a pipe **42** into a heater **43**. In the heater **43** the charge is heated to reactor temperature of from 400 to 900° F. preferably 500 to 750° F. The thus heated charge is then passed through pipes **44** and **45** into a first reactor **46**. Simultaneously, hydrogen gas, or a gas rich in hydrogen, is introduced into pipe **47** and pumped and compressed by means of a compressor **48**. The compressed hydrogen passes through a pipe **49** into a heat exchanger or heating device **50** wherein it is heated to the above reactor temperature. The heated hydrogen is then co-mingled with the wax charge in pipe **45** and the mixture then passes into the first reactor **46**.

In the reactor **46** there is contained a bed or plurality of beds of a suitable hydrocracking catalyst and in this embodiment palladium on hydrogen form of faujasite support as hereinbefore described the mixture of hydrogen and parafin wax charge is contacted with the catalyst in the reactor **46** under suitable conditions to effect at least partial conversion of the paraffin wax charge into a lower boiling range jet fuel. Suitable operating conditions in this embodiment include:

Temperatures of from 400 to 800° F., preferably 550 to 750° F.
Pressures of from 500 to 5000 p.s.i.g., preferably 1000 to 3000 p.s.i.g.
Flow rates of from 0.2 to 20 v./v./hr., preferably 0.5 to 2 v./v./hr.
Hydrogen feed rates of from 2000 to 20,000 s.c.f. H_2/bbl., preferably 3000 to 10,000 s.c.f. H_2/bbl.

The total effluent from the reactor **46** is removed through a pipe **51** and passed into a heat exchanger or suitable cooling device **52**. In the heat exchanger **52**, the effluent is cooled to temperatures at which gaseous hydrogen can be separated from liquid phase, i.e., temperatures below 150° F. The thus cooled effluent is passed through a pipe **53** into a high pressure separator **54**. In the high pressure separator **54**, there are a liquid phase and a gaseous phase. The gaseous phase containing substantial amounts of hydrogen is removed through a pipe **55** and can be recycled to the process through pipe **49**. A liquid product from the high pressure separator **54** is removed through a pipe **56**, passed through a depressuring zone **57**, and then through a pipe **58** into a suitable fractionating device **59**.

In the fractionator **59**, the liquid products are separated into suitable fractions. C_4 and lighter fractions are removed through pipe **60**; the high quality jet fuel boiling in a range between about 50 to 480° F. is removed via pipe **61**; and a portion of the material boiling at temperatures higher than about 480° F. is removed via pipes **62** and **63**.

In accordance with this embodiment, at least a portion of material boiling at temperatures higher than about 480° F. is pumped by means of pumping device **64** through pipe **65** to heater **66**. In the heater this charge is heated to a temperature of from about 450 to 800° F., preferably 550 to 750° F. The heated stock is then passed via pipes **67** and **68** into a second reactor **69**. At the same time, hydrogen is introduced into pipe **70** and is pumped and compressed by means of compressor **71**. The compressed hydrogen is passed via line **72** into heating device **73** where it is heated to reactor temperature. The thus heated hydrogen is co-mingled with the high boiling material in pipe **67** and the mixture passes into the second reactor via line **68**.

In the second reactor **69**, there is contained a bed or beds of suitable hydrocracking catalyst, preferably one different from that utilized in the first reactor **46**. Thus in this embodiment reactor **69** contains a catalyst-comprising nickel sulfide on silica/alumina support. The mixture of hydrogen and lower boiling materials is contacted with said catalyst in the second reactor **69** under operating conditions not unlike those employed in first reactor **46**. The total effluent from reactor **69** is removed through line **74** and any gaseous hydrogen contained therein is removed in the manner hereinbefore described. The remaining liquid product is passed via line **74** from where it is introduced into line **51** for further processing.

The following examples are presented to better illustrate the effects of the several process variables upon the quality of the jet fuel product produced. These examples will further serve as a demonstration of the unexpected results, e.g., luminosity number, obtained when hydro-

cracking the paraffin wax feed under the operating conditions of this invention.

EXAMPLE I

This example serves as a comparison of operating conditions and their effect on the quality of jet fuel produced by hydrocracking. In the example, a micro wax feed having the following inspections was employed.

Micro wax feed inspections

Gravity, ° API	32.8
SSU @ 210° F.	104
Melt point, ° F.	177
Oil content, wt. percent	2
Initial boiling point, ° F.	>950

This wex feed was hydrocracked (run No. 1) in accordance with the process conditions of this invention. A similar feed was also hydrocracked, but instead employing lower pressures, higher temperatures, lower flow rate, etc. (run No. 2). The process conditions utilized the product distribution and resulting inspections are set forth below in tabular form.

TABLE I

Feed / Catalyst	Micro Wax, Pd on Hydrogen-Form Faujasite	
	Run No. 1	Run No. 2
Operating Conditions:		
Temperature, ° F	600	675
V./v./hr.	1	0.5
Pressure, p.s.i.	1,000	100
H_2, s.c.f./bbl.	6,000	400
Product Distribution, vol. percent:		
C_3 and Lighter	13.0	7.2
C_4	15.5	10.2
C_5-470	33.6	17.6
470° F.+	32.9	65.0
Jet Fuel Inspections (C_5-470° F.):		
Gravity, ° API	68-69	69.5
Freezing Point, ° F.	<−88	<−88
Luminometer No.	>95	70-75
Composition, vol. percent:		
Aromatics	2	10-12
Naphthenes	20	16-18
Paraffins	78	65-70

It is readily apparent from the above data that when operating at low pressure, high temperature, etc. with palladium on hydrogen form faujasite as a catalyst, a lower conversion to poorer quality jet fuel is realized. This is surprising since much of the art on wax conversion using other catalyst preferred low pressure and higher temperatures for operating conditions. The purpose of the art, however, was to convert wax to low boiling lube oil through isomerization and therefore a different catalyst at more severe operating conditions was employed.

EXAMPLE II

The following example offers a comparison of various feedstocks and their effect on the quality of jet fuels produced therefrom. In all runs a palladium on hydrogen form faujasite catalyst was employed. The purity conditions employed and resulting data are set forth in Table II.

TABLE II

Run No.	1	2	3	4
Feed	Wax	Heavy Virgin Gas Oil	Light Catalytic Cycle Oil	Heavy Catalytic Cycle Oil
Operating Conditions:				
Temperature, ° F	600	748	656	706
V/v./hr.	1	1	1	1
Pressure, p.s.i.	1,000	1,000	1,000	1,000
H^2 s.c.f./bbl.	6,000	8,000	4,000	8,000
Yield of 200/470° F. Fraction, vol. percent	15.5	60	79	52
Quality of 200/475° F. Fraction:				
Gravity, ° API	54.1	50.3	41.4	43.1
Freeze Point, ° F.	<−88	<−76	<−76	<−76
Composition, vol. percent:				
Aromatics	10	21	26	40
Naphthenes	25	54	60	42
Paraffins	65	25	14	18

Data given in Table II on feedstocks show wax feed to be superior to virgin and catalytic fractions, although these feeds contain some wax components. However, the aromatics and naphthenes concentration in these feeds contribute to the formation of a more aromatic jet fuel, while hydrocracking of wax feed over palladium on hydrogen form faujasite catalyst at low conversion gives low aromatic jet fuel fraction compared to the processing virgin and catalytic gas oils.

EXAMPLE III

The following example illustrates the marked differences in various catalysts utilized in the hydrocracking operation. The wax feed analyzed had inspections similar to that employed in Example I. Resulting data from four typical runs are presented in Table III.

TABLE III

Run No.	1	2	3	4
Catalyst	0.5% Palladium on Hydrogen Faujasite	Nickel Sulfide on Silica Alumina [1]	Iron Faujasite	Cobalt Molybdate [1] on Alumina
Operating Conditions:				
Temperature, ° F.	600	750	750	750
V./v./hr.	1	1	1	1
Pressure, p.s.i.	1,000	1,000	1,000	1,000
H^2, s.c.f./bbl.	6,000	10,000	10,000	10,000
Yield of C^5-470° F., Fraction, vol. percent	38.6	34.8	1.0	2.0
Jet Fuel Inspections:				
Gravity, ° API	68	64	Insufficient Product	
Freezing Point, ° F.	<−88	<−88		
Luminometer No.	>95	90-95		
Composition, vol. percent:				
Aromatics	2	3		
Naphthenes	20	25		
Paraffins	78	72		

[1] Sulfided the catalyst prior to operation.

These data show excellent quality jet fuel may be produced by hydrocracking wax over palladium on hydrogen faujasite and/or nickel sulfide type catalyst. Other forms of faujasite or other zeolite based catalyst and the conventional sulfided cobalt molybdate catalyst referred to in the art, when used at the above treating conditions, are unsatisfactory for the production of jet fuel fractions from wax feed stock.

EXAMPLE IV

This example is a comparison of conventional jet fuels produced from hydrocracking wax and from fractions obtained by the distillation of virgin Louisiana crudes.

TABLE IV

Feed Source	Hydrocracking Wax			Distillation of Virgin La. Crudes	
Catalyst	Palladium on Hydrogen Faujasite	Nickel Sulfide on Silice Alumina			
Fraction	C^5-470° F.	C^5-470° F.	200-470° F.	C^5-470° F.	200-470° F.
Jet Fuel Inspections:					
Gravity, ° API	68	64	55.2	58-65	52-53
Freezing Pt., ° F	<−88	<−88	<−87	<−88	−50 to −60
Luminometer No.	>95	90-95	66	70-80	40-45
Composition, vol. percent:					
Aromatics	2	3	5	7-12	10-15
Naphthenes	20	25	30	30-35	35-40
Paraffins	78	72	65	50-65	45-50

Jet fuel fractions from hydrocracking wax over the above-identified catalysts at the conditions employed gave improved quality over that obtained by conventional distillation of premium quality Louisiana crudes.

What is claimed is:

1. A process for the production of a fuel of improved burning qualities when burned in a jet combustion device, which comprises contacting a charge stock consisting essentially of paraffinic wax having an initial boiling point greater than about 650° F. with a hydrocracking catalyst at a temperature within the range from about 300 to 900° F., a pressure within the range from about 500 to 3000 p.s.i.g., and at an hourly space velocity within the range from about 0.1 to 10 v./v./hr., while in admixture with hydrogen fed in amounts within the range from 2000 to 20,000 s.c.f. H_2/bbl. of said paraffinic wax.

2. The process of claim 1 in which the hydrocracking catalyst comprises palladium supported on a crystalline alumino-silicate zeolite having a pore size of between 6 to 15 Angstrom units.

3. The process of claim 1 in which the hydrocracking catalyst is nickel sulfide supported on silica/alumina base.

4. A process for the production of a fuel of improved burning qualities when burned in a jet combustion device, which comprises contacting in a first reaction zone a charge stock consisting essentially of a paraffinic wax having an initial boiling point in excess of about 650° F. with a palladium catalyst composited with a crystalline alumino-silicate zeolite, at a temperature within the range from about 400 to 800° F., a pressure within the range from about 500 to 5000 p.s.i.g., and at an hourly space velocity within the range of from about 0.2 to 20 v./v./hr. while in admixture with hydrogen fed in amounts within the range from 1000 to 20,000 s.c.f. H_2/bbl. of said wax, whereby a product containing a jet fuel boiling within the range of from about 50 to 480° F. and a higher boiling fraction is produced, separating at least a portion of said higher boiling fraction from said jet fuel, contacting in a second reaction zone said higher boiling fraction with a nickel sulfide catalyst on silica/alumina base at a temperature within the range from about 400 to 800° F., a pressure within the range from about 500 to 5000 p.s.i.g., and an hourly space velocity within the range from about 0.2 to 20 v./v./hr. while in admixture with hydrogen fed in amounts within the range of from 1000 to 20,000 s.c.f. H_2/bbl. and mixing the product resulting from said second reaction zone with the product from said first reaction zone.

5. The process of claim 4 in which the paraffin wax boils within the range of from 1000 to 1300° F.

6. A process for the production of a fuel of improved burning qualities when burned in a jet combustion device which comprises contacting a charge stock consisting essentially of a microcrystalline paraffinic wax having an initial boiling point above about 650° F. with a hydrocracking catalyst at a temperature within the range from about 500 to 750° F., a pressure within the range from about 1000 to 2000 p.s.i.g., and at an hourly space velocity within the range from about 0.5 to 2 v./v./hr. while in admixture with hydrogen fed in amounts within the range from 3000 to 10,000 s.c.f. H_2/bbl. of said paraffinic wax.

7. The process of claim 6 in which the hydrocracking catalyst comprises palladium supported on a crystalline alumino-silicate zeolite having a pore size of between 6 to 15 Angstrom units.

8. The process of claim 1 in which the paraffin wax has an initial boiling point in the range of from 1000 to 1300° F.

9. A process for the production of a fuel of improved burning qualities when burned in a jet combustion device, which comprises contacting in a first reaction zone a charge stock consisting essentially of a microcrystalline paraffinic wax having an initial boiling point above about 650° F. with a palladium catalyst composited with a crystalline alumino-silicate zeolite, at a temperature within the range from about 550 to 750° F., a pressure within the range from about 1000 to 2000 p.s.i.g., and at an hourly space velocity within the range of from about 0.5 to 2 v./v./hr. while in admixture with hydrogen fed in amounts within the range from 3000 to 10,000 s.c.f. H_2/bbl. of said wax, whereby a product containing a jet fuel boiling within the range of from about 50 to 480° F. and a higher boiling fraction is produced, separating at least a portion of said higher boiling fraction from said jet fuel, contacting in a second reaction zone said higher boiling fraction with a nickel sulfide catalyst on silica/alumina base at a temperature within the range from about 550 to 750° F., a pressure within the range from about 1000 to 2000 p.s.i.g., and an hourly space velocity within the range from about 0.5 to 2 v./v./hr. while in admixture with hydrogen fed in amounts within the range of from 3000 to 10,000 s.c.f. H_2/bbl. and mixing the product resulting from said second reaction zone with the product from said first reaction zone.

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