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(54) PARAFFINIC JET FUEL BY HYDROCRACKING WAX

(54)

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1 This invention is directed to fuels utilizable in jet
2 combustion devices. It is more particularly concerned with an
3 improved process whereby there are produced jet fuels from par-
4 affin waxes found in petroleum.

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

18 Various processes have been proposed for the treatment
19 of conversion of paraffin wax. Those processes resulting in a
20 hydrocarbon product generally involve a refining operation which
21 produces a normally solid wax of improved characteristics, or a
22 more drastic conversion treatment which results in the produc-
23 tion of a liquid product. The former usually comprises such
24 steps as solvent extraction, fractional crystallization, clay
25 treatment and the like, in which the structure of the hydrocar-
26 bons is unaltered. The latter involves a step in which the hy-
27 drocarbons are decomposed or split to give a wide range of prod-
28 ucts comprising normally gaseous and normally liquid products,
29 most of which are of relatively low value. It would be most ad-
30 vantageous to have a practical process whereby paraffin wax
31 could be converted into more valuable hydrocarbon products. One
32 possibility lies in its conversion to fuels utilizable in jet



1 combustion devices.

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

18 One of the problems encountered in the employment of
19 fuels in jet combustion devices is their tendency to form car-
20 bon upon combustion. The carbon thus formed creates noxious
21 exhaust smoke which is highly undesirable. The combustion-
22 formed carbon is also deposited inside the combustion zone where
23 it interferes with the operation of the device and may also con-
24 tribute to the warping of parts in the zone by causing uneven
25 heating.

26 A standard indication of the carbon-forming tendency
27 of a fuel is its luminosity number. As this standard is direct-
28 ly related to the burning qualities desired in a jet fuel, it
29 is apparent why such standard is an important factor in jet fuel
30 specifications. The normal commercial kerosene fraction has a
31 luminosity number that is relatively low and, therefore, requires
32 extensive improvement prior to use as a jet fuel. It is highly

1 desirable, therefore, to produce a jet fuel having a high lumi-
2 nosity number, and especially desirable to produce such a jet
3 fuel from the paraffin wax mentioned above.

4 It is an object of this invention, therefore, to pro-
5 vide an improved jet combustion fuel. Another object is to pro-
6 vide a simple process for producing an improved lower boiling
7 range jet fuel from paraffin wax stocks. Another object is to
8 provide a jet fuel of improved properties, that is, obtained by
9 hydrocracking paraffin wax in the presence of hydrogen and of a
10 suitable hydrocracking catalyst. Still another object is to
11 provide a process for producing improved jet combustion fuels
12 having high luminosity numbers from undesirable paraffin wax
13 stocks that involves cracking such paraffin wax stocks in the
14 presence of hydrogen and a hydrocracking catalyst. Another ob-
15 ject is to provide jet combustion fuels having high luminosity
16 numbers which are produced by such process.

17 Other objects and advantages of the present invention
18 will become apparent to those skilled in the art from the fol-
19 lowing detailed description considered in conjunction with the
20 drawings which shows schematic arrangements of typical embodi-
21 ments for carrying out the process of this invention.

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

28 In general, the present invention provides a method
29 for producing a jet combustion fuel which comprises contacting
30 a paraffin wax charge stock with a hydrocracking catalyst in
31 the presence of hydrogen in amounts of from about 2000 to 20,000
32 SCF of hydrogen per barrel of wax charge stock to convert at

1 least a portion of the hydrocarbon charge into a jet fuel boil-
2 ing within the range varying between about 50°F. and about 550°
3 F. Broadly, the operating conditions utilized in said contact-
4 ing are temperatures of from about 300 to 900°F., pressures of
5 from about 500 to 3000 psig. and flow rates within the range of
6 about 0.1 to 10 V/V/Hr. Suitable catalysts include supported
7 platinum metal series, e.g., platinum, palladium or nickel cat-
8 alysts as well as other sulfur insensitive hydrocracking catalyst
9 of the copper, cobalt and iron salts of the oxy and thio acids
10 of chromium, molybdenum, and/or tungsten. The sulfided forms of
11 the foregoing are found to be effective. Generally any one or
12 a combination of the above active components may be used either
13 alone, i.e. unsupported, or together with supports such as alu-
14 mina, alumino-silicate zeolites, diatomaceous earth, treated
15 clay, activated carbon or the like. In addition, the use of the
16 zinc, magnesium, calcium, strontium, or hydrogen form of syn-
17 thetic faujasite as a catalyst support may be desirable.

18 Within the narrower limits of the broad range of con-
19 ditions listed above, the conditions are not independently vari-
20 able. It is, therefore, necessary to select conditions from
21 within the ranges specified to accomplish the desired hydrocrack-
22 ing of the wax stock as evidenced by the formation of the high
23 quality paraffinic jet fuel and produce but small amounts of
24 aromatics. The interdependence of these variables will be more
25 clearly understood by reference to the discussion following and
26 to the accompanying illustrative examples.

27 The process of this invention is applicable for the
28 hydrocracking of any normally solid hydrocarbon wax, that is,
29 any hydrocarbon wax having a boiling point of 650°F. or over.
30 The wax will usually be derived from natural mineral sources
31 such as petroleum, oil shale, oil from tar sands, gilsonite,
32 ozokerite, or the like, but synthetic wax produced by the Fischer-

1 Tropsch synthesis or as a by-product of other processes may also
2 be utilized. The process may be applied for the hydrocracking
3 of crude so-called slack wax; or to refined waxes of various
4 melting points or to so-called residue wax. While the various
5 waxes differ somewhat in properties, i.e., melting point and
6 hardness, they are all composed of hydrocarbons containing long
7 paraffin chains. In some paraffin waxes the chains may be
8 slightly branched and in some the chains may be attached to
9 naphthenic or aromatic groups. Olefinic groups are rarely pres-
10 ent; when present they do not affect the operation of the proc-
11 ess.

12 The process is particularly applicable to high molecu-
13 lar weight wax, recovered from residual crude oil fractions,
14 boiling above about 650°F., preferably above about 1000°F., and
15 up to about 1300°F., which are known as microcrystalline wax or
16 as soft microwax petrolatum. This feed is a black to brown col-
17 ored, gelatinous, oily, translucent, semi-solid, amorphous mass
18 whose consistency varies with the temperature. It is obtained
19 by dewaxing a residual crude oil fraction boiling above about
20 1000°F. In simplest terms, it is a microwax obtained from a de-
21 waxing operation which has not been deoiled and therefore con-
22 tains from about 10 to 50 wt. percent oil, preferably about 20
23 percent oil.

24 In accordance with the present invention there is em-
25 ployed as an outstanding hydrocracking catalyst a composition
26 comprising a metal or compound of the platinum group deposited
27 on, composited with, or incorporated within, a crystalline sil-
28 ica-alumina anionic network which has uniform size pore openings
29 between about 6 and 15 Angstrom units. The crystalline nature
30 of the catalyst is important, as the particular crystalline
31 structure will then control the uniformity of the pore openings,
32 and so distinguish it from other crystalline and non-crystalline

1 zeolitic materials and from amorphous silica-alumina gel cata-
2 lysts and aluminas. In this regard, then, the actual chemical
3 composition of the support becomes of secondary value compared
4 to the size of the pore openings. By this is meant that the
5 relative amounts of silica and alumina are not of primary im-
6 portance though these do play a role in both catalyst stability
7 and activity.

8 In a crystalline alumino-silicate zeolite the actual
9 structure comprises an anionic network with cations interspersed
10 to allow electrical neutrality. Normally, as prepared, these
11 cations are sodium. In the structure, the amount of sodium
12 present has the same atom content as the aluminum because the
13 aluminum atom being trivalent needs an additional charge to be
14 present to compensate for its deficiency in relation to the
15 quadrivalent silicon atoms. Thus, for the purposes of the pres-
16 ent invention the catalyst support is derived from a crystalline
17 zeolite having a nominal anhydrous composition of $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot x$
18 SiO_2 where the relative silica content may vary at will, pro-
19 viding the pore size opening of the crystalline material remains
20 in the 6 to 15 Angstrom unit region. Nominally, for a good hy-
21 drocracking process catalyst support, the soda content is too
22 high, but it can be reduced to an acceptable level by base ex-
23 changing with a more acceptable cation, such as ammonium or hy-
24 drogen ions. This does not preclude the use of other metal
25 cations in this base exchange operation which could serve as
26 catalytic agents in their own right as well as improving the
27 properties of the alumino-silicate crystals as a support. Vari-
28 ous methods of preparing the catalysts utilizable in the present
29 invention have been set forth in the scientific literature and
30 patent literature, such as, for example, in British Patent
31 985,583, Italian Patent 671,928 and French Patent ^{1,371,163} ~~1371/63~~.

32 As heretofore mentioned, the catalyst of the present

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

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

24 Also suitable for use as catalysts in the instant
25 invention are the unsupported catalysts. Thus, unsupported
26 metals of the platinum group of oxides and sulfides or mixtures
27 thereof may be employed for the process of this invention. In
28 this regard, it is found that molybdenum sulfide, nickel sul-
29 fide, or mixtures thereof are preferred for use as a catalyst.

30 Having generally described the nature of the inven-
31 tion as well as the paraffinic wax charge stock and catalyst
32 employed therein, attention is now directed toward a detailed

1 discussion of the invention. In order to aid in this discus-
2 sion, reference is made to the attached Figures 1 and 2 which
3 illustrate diagrammatically a process flow plan of the manner
4 in which the present hydrocracking reaction is preferably
5 employed to produce highly desirable jet fuels.

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

19 The reactor 16 can be a single reactor or comprise
20 a plurality of reaction beds. In the reactor 16 there is
21 contained a bed or plurality of beds of a suitable hydrocrack-
22 ing catalyst, such as palladium on hydrogen form faujasite
23 support or nickel sulfide on silica/alumina support as herein-
24 before described. The mixture of hydrogen and paraffin wax
25 charge is contacted with the catalyst in the reactor 16 under
26 suitable conditions to effect at least partial conversion of
27 the paraffin wax charge into a lower boiling range jet fuel.
28 Suitable operating conditions include:

29 Temperatures of from 300 to 900°F., preferably 500
30 to 750°F.

31 Pressures of from 500 to 3000 psig., preferably 1000
32 to 2000 psig.

1 Flow rates of from 0.1 to 10 V/V/Hr., preferably 0.5
2 to 2 V/V/Hr.

3 Hydrogen feed rates of from 2000 to 20,000 SCF H₂/
4 Bbl., preferably 3000 to 10,000 SCF H₂/Bbl.

5 According to the present invention, hydrocracking of
6 paraffinic wax charge stock with consequent improvement in
7 burning qualities, i.e., higher luminosity number, can be
8 accomplished by contacting such charge stock with the cata-
9 lysts and at the operating conditions as hereinbefore set
10 forth. Generally speaking, improvement in burning qualities,
11 i.e., higher luminosity number, can be obtained by operating
12 at relatively higher hydrogen feed rates, higher pressures and
13 relatively milder temperatures to give a luminosity number of
14 at least 65. Accordingly, the degree of conversion used will
15 depend upon the amount of jet fuel desired in a specific opera-
16 tion.

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

30 In the fractionator 29, the liquid products are
31 separated into suitable fractions. C₄ and lighter fractions,
32 i.e., for example, butane and dry gas are removed through pipe

1 30 and can be sent to the gas processing plant. In accordance
2 with the invention, a high quality jet fuel boiling in a
3 range between about 50 to 480°F. is removed through pipe 31.
4 The material boiling at temperatures higher than about 480°F.
5 is removed through pipes 32 and 33. If desired, this material
6 can be recycled through the process via pipes 34 and 10.

7 Figure 2 illustrates an alternate method of producing
8 jet fuels in accordance with this invention, but which involves
9 the use of two reactors. According to this embodiment, a suit-
10 able paraffinic wax charge is introduced through a pipe 40 and
11 pumped by means of a suitable pumping device 41 through a pipe
12 42 into a heater 43. In the heater 43 the charge is heated to
13 reactor temperature of from 400 to 900°F., preferably 500 to
14 750°F. The thus heated charge is then passed through pipes
15 44 and 45 into a first reactor 46. Simultaneously, hydrogen
16 gas, or a gas rich in hydrogen, is introduced into pipe 47
17 and pumped and compressed by means of a compressor 48. The
18 compressed hydrogen passes through a pipe 49 into a heat ex-
19 changer or heating device 50 wherein it is heated to the above
20 reactor temperature. The heated hydrogen is then co-mingled
21 with the wax charge in pipe 45 and the mixture then passes
22 into the first reactor 46.

23 In the reactor 46 there is contained a bed or plural-
24 ity of beds of a suitable hydrocracking catalyst and in this
25 embodiment palladium on hydrogen form of faujasite support as
26 hereinbefore described the mixture of hydrogen and paraffin wax
27 charge is contacted with the catalyst in the reactor 46 under
28 suitable conditions to effect at least partial conversion of
29 the paraffin wax charge into a lower boiling range jet fuel.
30 Suitable operating conditions in this embodiment include:

31 Temperatures of from 400 to 800°F., preferably 550 to
32 750°F.

1 Pressures of from 500 to 5000 psig., preferably 1000
2 to 3000 psig.

3 Flow rates of from 0.2 to 20 V/V/Hr., preferably 0.5
4 to 2 V/V/Hr.

5 Hydrogen feed rates of from 2000 to 20,000 SCF H₂/
6 Bbl., preferably 3000 to 10,000 SCF H₂/Bbl.

7 The total effluent from the reactor 46 is removed
8 through a pipe 51 and passed into a heat exchanger or suit-
9 able cooling device 52. In the heat exchanger 52, the effluent
10 is cooled to temperatures at which gaseous hydrogen can be
11 separated from liquid phase, i.e., temperatures below 150°F.
12 The thus cooled effluent is passed through a pipe 53 into a
13 high pressure separator 54. In the high pressure separator
14 54, there are a liquid phase and a gaseous phase. The gaseous
15 phase containing substantial amounts of hydrogen is removed
16 through a pipe 55 and can be recycled to the process through
17 pipe 49. A liquid product from the high pressure separator 54
18 is removed through a pipe 56, passed through a depressuring
19 zone 57, and then through a pipe 58 into a suitable fractionat-
20 ing device 59.

21 In the fractionator 59, the liquid products are
22 separated into suitable fractions. C₄ and lighter fractions
23 are removed through pipe 60; the high quality jet fuel boil-
24 ing in a range between about 50 to 480°F. is removed via pipe
25 61; and a portion of the material boiling at temperatures
26 higher than about 480°F. is removed via pipes 62 and 63.

27 In accordance with this embodiment, at least a por-
28 tion of material boiling at temperatures higher than about
29 480°F. is pumped by means of pumping device 64 through pipe 65
30 to heater 66. In the heater this charge is heated to a tempera-
31 ture of from about 450 to 800°F., preferably 550 to 750°F. The
32 heated stock is then passed via pipes 67 and 68 into a second

1 reactor 69. At the same time, hydrogen is introduced into
2 pipe 70 and is pumped and compressed by means of compressor
3 71. The compressed hydrogen is passed via line 72 into
4 heating device 73 where it is heated to reactor temperature.
5 The thus heated hydrogen is co-mingled with the high boiling
6 material in pipe 67 and the mixture passes into the second
7 reactor via line 68.

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

21 The following examples are presented to better illus-
22 trate the effects of the several process variables upon the
23 quality of the jet fuel product produced. These examples will
24 further serve as a demonstration of the unexpected results,
25 e.g., luminosity number, obtained when hydrocracking the paraf-
26 fin wax feed under the operating conditions of this invention.

27 EXAMPLE 1

28 This example serves as a comparison of operating con-
29 ditions and their effect on the quality of jet fuel produced
30 by hydrocracking. In the example, a micro wax feed having the
31 following inspections was employed.

<u>Micro Wax Feed Inspections</u>		
2	Gravity, °API	32.8
3	SSU @ 210°F.	104
4	Melt Point, °F.	177
5	Oil Content, Wt. %	2
6	Initial Boiling Point, °F.	>950

7 This wax feed was hydrocracked (Run No. 1) in accordance with the process conditions of this invention. A similar
8 feed was also hydrocracked, but instead employing lower pressures,
9 higher temperatures, lower flow rate, etc. (Run No. 2). The
10 process conditions utilized the product distribution and resulting
11 inspections are set forth below in tabular form.
12

TABLE I

14	Feed	-----Micro Wax-----	
15	Catalyst	Pd on Hydrogen-Form Faujasite	
16	<u>Operating Conditions</u>	<u>Run No. 1</u>	<u>Run No. 2</u>
17	Temperature, °F.	600	675
18	V/V/Hr.	1	0.5
19	Pressure, psi.	1000	100
20	H ₂ SCF/Bbl.	6000	400
21	<u>Product Distribution, Vol. %</u>		
22	C ₃ and Lighter	13.0	7.2
23	C ₄	15.5	10.2
24	C ₅ -470	38.6	17.6
25	470°F.+	32.9	65.0
26	<u>Jet Fuel Inspections (C₅-470°F.)</u>		
27	Gravity, °API	68-69	69.5
28	Freezing Point, °F.	<-88	<-88
29	Luminometer No.	>:95	70-75
30	<u>Composition, Vol. %</u>		
31	Aromatics	2	10-12
32	Naphthenes	20	16-18
33	Paraffins	78	65-70

34 It is readily apparent from the above data that when
35 operating at low pressure, high temperature, etc. with palladium
36 on hydrogen form faujasite as a catalyst, a lower conversion
37 to poorer quality jet fuel is realized. This is surprising
38 since much of the art on wax conversion using other catalyst

1 preferred low pressure and higher temperature for operating
2 conditions. The purpose of the art, however, was to convert
3 wax to low boiling lube oil through isomerization and there-
4 fore a different catalyst at more severe operating conditions
5 was employed.

6 EXAMPLE 2

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

TABLE II

	1	2	3	4
Wax		Heavy Virgin Gas Oil	Light Catalytic Cycle Oil	Heavy Catalytic Cycle Oil
600	748	656	706	
6000	8000	1000	4000	8000
15.5	60	79	52	
54.1	50.3	41.4	43.1	
<-88	<-76	<-76	<-76	
10	21	26	40	
25	54	60	42	
65	25	14	18	

1	Run No.
2	Feed
3	Operating Conditions
4	Temperature, °F.
5	V/V/Hr.
6	Pressure, psi.
7	H ₂ SCF/Bbl.
8	Yield of 200/470°F.
9	Fraction, Vol. %
10	Quality of 200/475°F.
11	Fraction
12	Gravity, °API
13	Freeze Point, °F.
14	Composition, Vol. %
15	Aromatics
16	Naphthenes
17	Paraffins
18	
19	

1 Data given in Table II on feedstocks show wax feed
2 to be superior to virgin and catalytic fractions, although
3 these feeds contain some wax components. However, the aro-
4 matics and naphthenes concentration in these feeds contribute
5 to the formation of a more aromatic jet fuel, while hydrocrack-
6 ing of the wax feed over palladium on hydrogen form faujasite
7 catalyst at low conversion gives low aromatic jet fuel fraction
8 compared to the processing virgin and catalytic gas oils.

9 EXAMPLE 3

10 The following example illustrates the marked dif-
11 ference in various catalysts utilized in the hydrocracking
12 operation. The wax feed analyzed had inspections similar to
13 that employed in Example 1. Resulting data from four typical
14 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
<u>Operating Conditions</u>				
Temperature, °F.	600	750	750	750
V/V/Hr.				
Pressure, psi.				
H ₂ SCF/Bbl.	6000	10,000	10,000	10,000
Yield of C ₄ -470°F. Fraction, Vol. %	38.6	34.8	1.0	2.0
<u>Jet Fuel Inspections</u>				
Gravity, °API	68	64		
Freezing Point, °F.	<-88	<-88		
Luminometer No.	>#95	90-95		
Composition, Vol. %				Insufficient Product
Aromatics	2	3		
Naphthenes	20	25		
Paraffins	78	72		

21 (1) Sulfided the catalyst prior to operation.

829281

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

8 EXAMPLE 4

9 This example is a comparison of conventional jet
10 fuels produced from hydrocracking wax and from fractions ob-
11 tained by the distillation of virgin Louisiana crudes.

TABLE IV

	Hydrocracking Max		Distillation of Virgin Ia. Crudes
1	2	3	4
Feed Source	Palladium on Hydrogen Raujasite	Nickel Sulfide on Silica Alumina	
2	C ₅ -470°F.	C ₅ -470°F. 200-470°F.	C ₅ -470°F. 200-470°F.
3			
4			
5			
6			
7			
8	<u>Jet Fuel Inspections</u>		
9	68	55.2	52-53
10	<-88	<-87	-50 to -60
11	>95	66	40-45
12			
	<u>Composition, Vol. %</u>		
13	2	5	10-15
14	20	30	35-40
15	78	65	45-50

1 Jet fuel fractions from hydrocracking wax over the
2 above-identified catalysts at the conditions employed gave
3 improved quality over that obtained by conventional distilla-
4 tion of premium quality Louisiana crudes.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

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
5 650°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 psig., 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.
10 H₂/bbl. of said paraffinic wax.

2. The process of claim 1 in which the hydrocracking catalyst comprises palladium supported on a crystalline aluminosilicate 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
5 point in excess of about 650°F. with a palladium catalyst composited with a crystalline aluminosilicate 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
10 admixture with hydrogen fed in amounts within the range from 1000

to 20,000 s.c.f. H₂/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
15 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 ad-
20 mixture with hydrogen fed in amounts within the range of from 1000 to 20,000 s.c.f. H₂/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
5 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
10 to 10,000 s.c.f. H₂/bbl. of said paraffinic wax.

7. The process of claim 6 in which the hydrocracking catalyst comprises palladium supported on a crystalline aluminosilicate 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
5 an initial boiling point above about 650°F. with a palladium catalyst composited with a crystalline aluminosilicate 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.
10 while in admixture with hydrogen fed in amounts within the range from 3000 to 10,000 s.c.f. H₂/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,
15 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 2v./v./hr. while in
20 admixture with hydrogen fed in amounts within the range of from 3000 to 10,000 s.c.f. H₂/bbl. and mixing the product resulting from said second reaction zone with the product from said first reaction zone.



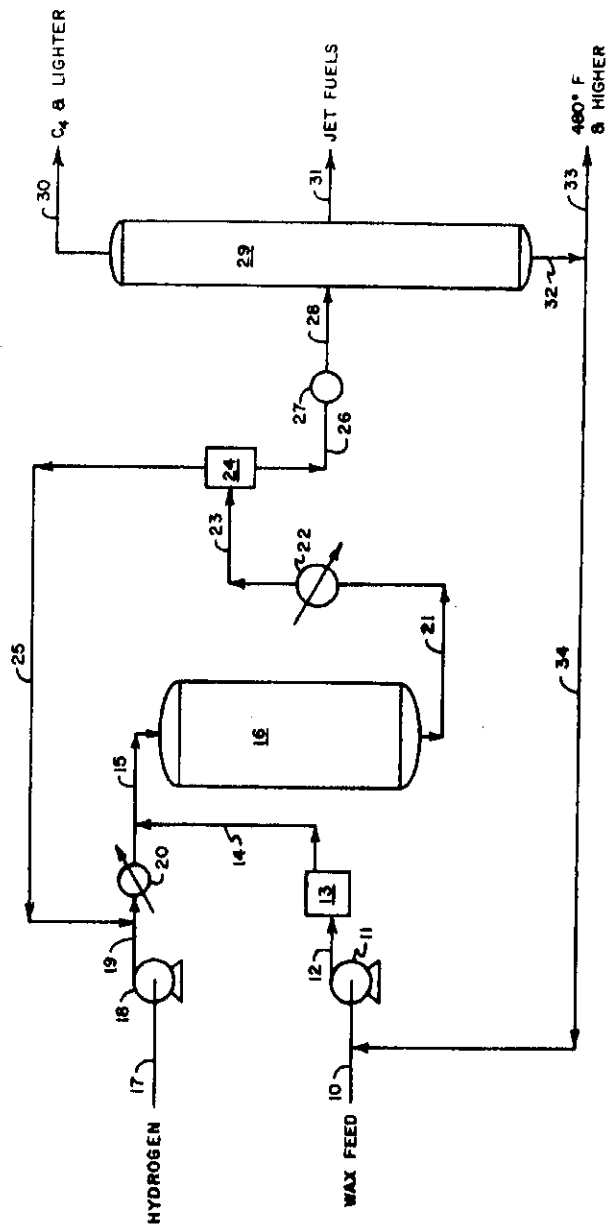


FIG. 1

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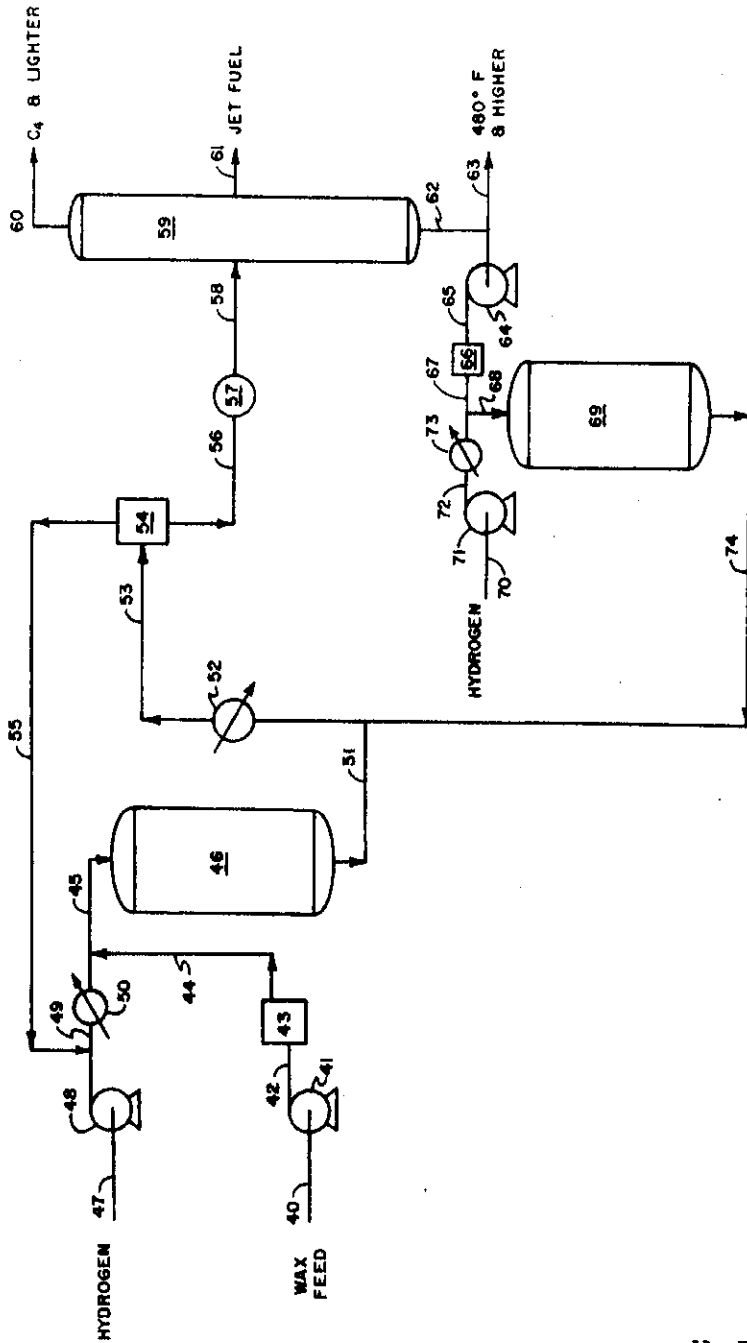


FIG. 2

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