

Aug. 1, 1972

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3,681,232

COMBINED HYDROCRACKING AND CATALYTIC DEWAXING PROCESS

Filed Nov. 27, 1970

3 Sheets-Sheet 1

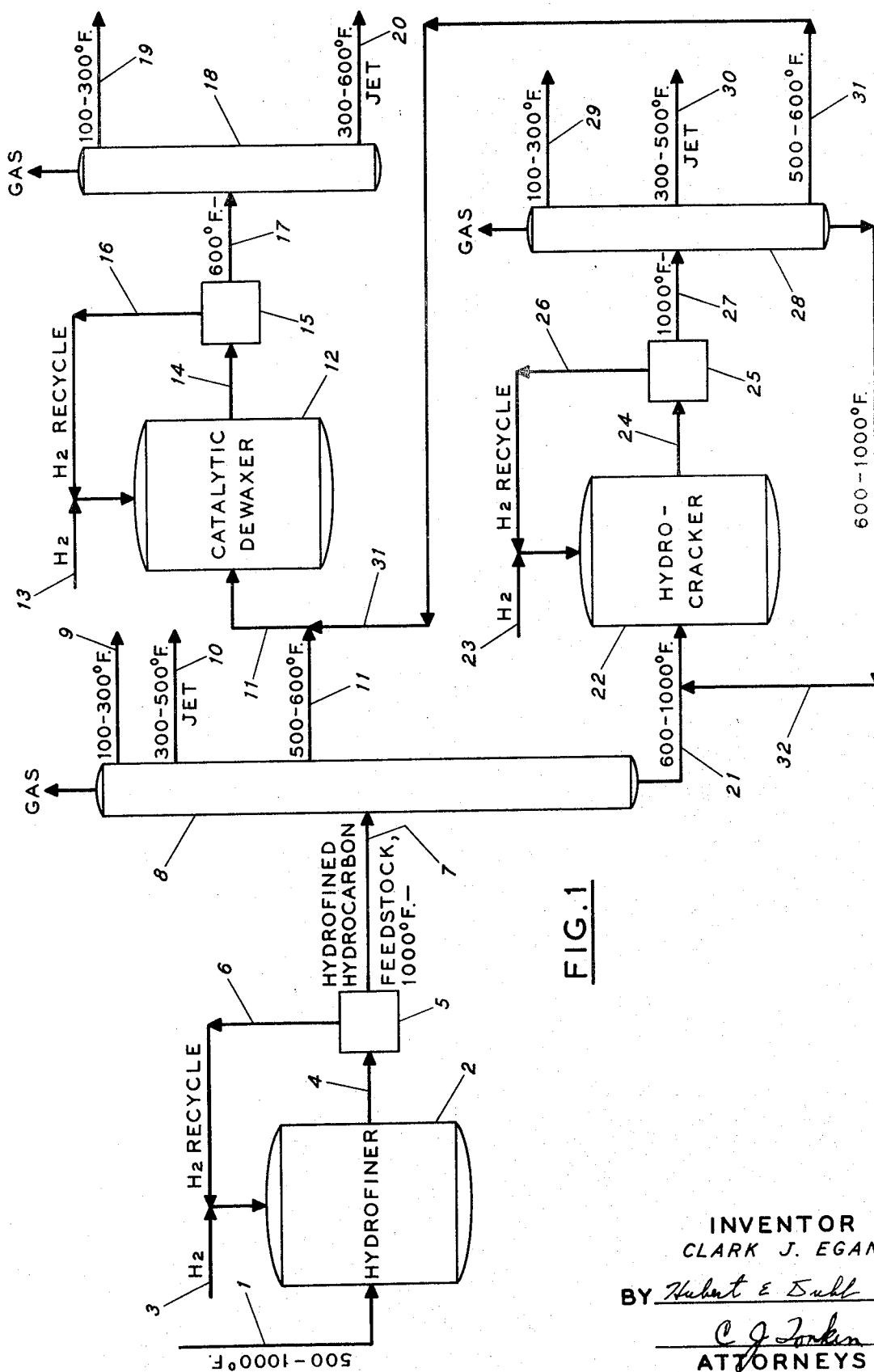


FIG. 1

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3 Sheets-Sheet 2

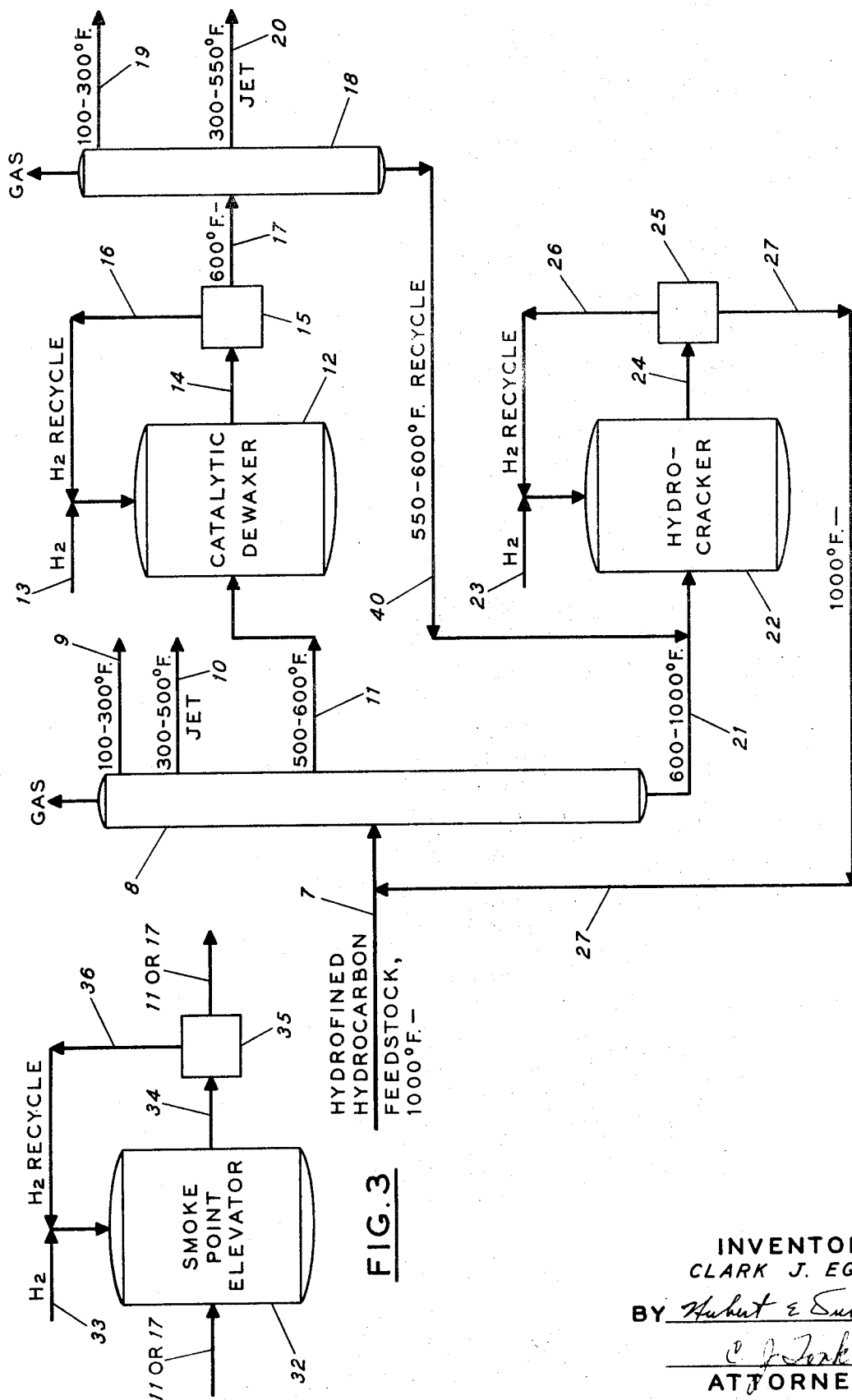


FIG. 2

FIG. 3

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3 Sheets-Sheet 3

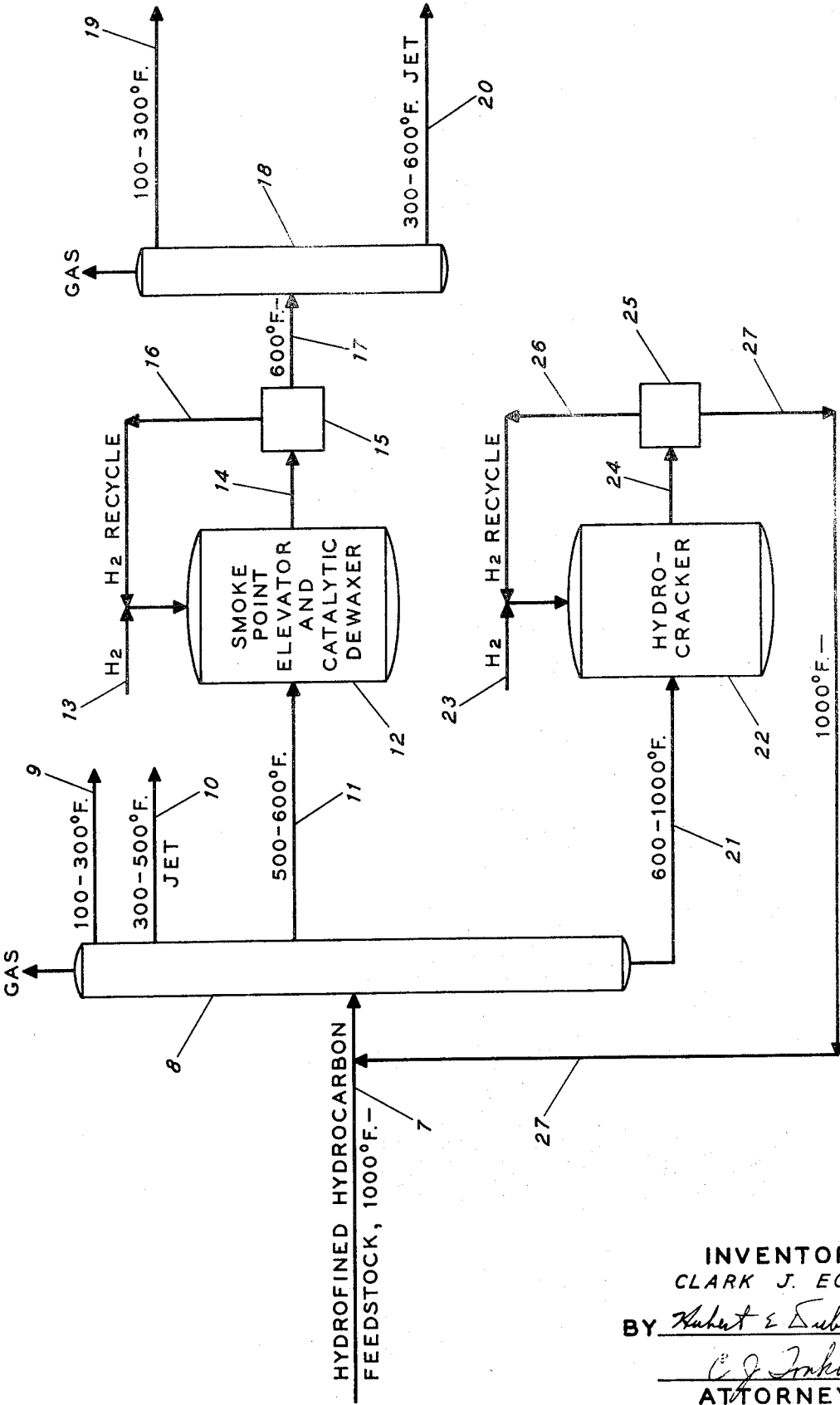


FIG. 4

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3,681,232

COMBINED HYDROCRACKING AND CATALYTIC DEWAXING PROCESS

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U.S. Cl. 208—80

12 Claims

ABSTRACT OF THE DISCLOSURE

A process for producing jet fuel from a hydrocarbon feedstock boiling substantially below about 1000° F. comprising separating the feedstock into a first 500° F.—600° F. fraction and a 600° F.—1000° F. fraction; contacting the 600° F.—1000° F. fraction with hydrogen and a hydrocracking catalyst in a hydrocracking zone at hydrocracking conditions; separating the hydrocrackate into a 100° F.—300° F. fraction, a 300° F.—500° F. fraction, and a second 500° F.—600° F. fraction; contacting the 500° F.—600° F. fractions with hydrogen and a catalyst comprising mordenite in hydrogen form and at least one hydrogenating component in a catalytic dewaxing zone at catalytic dewaxing conditions; and separating the catalytic dewaxate into a second 100° F.—300° F. fraction and a 300° F.—600° F. jet fuel. The hydrocarbon feedstock is preferably a hydrofined hydrocarbon feedstock.

BACKGROUND OF THE INVENTION

This invention is concerned with producing low freeze point jet fuel in high yield from hydrocarbon feedstocks boiling above about 500° F.

The world demand for jet fuel has been increasing steadily. This increased demand can be expected to continue and probably even accelerate in the future. Maximization of the yield of jet fuel from a hydrocarbon feedstock is accordingly becoming economically more attractive. This specification discloses and claims a novel combined hydrocracking and catalytic dewaxing process which provides low freeze point jet fuel in significantly increased yield.

SUMMARY OF THE INVENTION

A process has now been discovered which permits the production of exceptionally high yields of low freeze point jet fuel. The process comprises separating a hydrofined hydrocarbon feedstock boiling below about 1000° F., and preferably obtained by hydrofining a hydrocarbon feedstock boiling within the range from about 500° F. to about 1000° F., into a first 500° F.—600° F. fraction, and a 600° F.—1000° F. fraction. The 600° F.—1000° F. fraction is then conducted to a hydrocracking zone where it is contacted with hydrogen and a hydrocracking catalyst at hydrocracking conditions. The hydrocrackate from the hydrocracking zone is then separated in a separation zone into a 100° F.—300° F. fraction, a 300° F.—500° F. fraction and a second 500° F.—600° F. fraction. The separation of the hydrocrackate may, if desired, be performed in the same separation zone as is the separation of the hydrofined hydrocarbon feedstock boiling below about 1000° F. In this case, instead of their being a first 500° F.—600° F. fraction and a second 500° F.—600° F. fraction, there will be only a single 500° F.—600° F. fraction. The first and second 500° F.—600° F. fractions or the single 500° F.—600° F. fraction if a single separation zone is used as discussed above, are contacted with hydrogen and a catalyst comprising mordenite in hydrogen form and a hydrogenation component in a catalytic dewaxing zone

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at catalytic dewaxing conditions. The catalytic dewaxate from the catalytic dewaxing zone is then separated into a 100° F.—300° F. fraction and a 300° F.—600° F. jet fuel. Since jet fuel specifications generally require the jet fuel to boil within a 300° F.—550° F. range, it will usually be desirable to separate the catalytic dewaxate into a 100° F.—300° F. fraction, a 300° F.—550° F. jet fuel, and a 550° F.—600° F. fraction. The 550° F.—600° F. fraction may then desirably be recycled to the hydrocracking zone.

The necessity for jet fuels to be characterized by low freeze points is well known, and is reflected in all military and commercial jet fuel specifications. Many patents have been issued directed to various processes for producing low freeze point jet fuels, for example, U.S. Pat. 3,110,662. Said patent also indicates that it is known to hydrocrack hydrocarbon feedstocks containing materials boiling above the jet fuel boiling range, to produce jet fuels.

Catalytic dewaxing of hydrocarbon oils is well known in the art and refers to the reduction of the normal paraffin content of the oils by catalytic conversion of normal paraffins rather than by mere physical removal of normal paraffins without conversion thereof.

U.S. Patent 3,539,495 to Egan, adequately discusses the reasons for catalytic dewaxing of hydrocarbon oils, including reasons why continuing efforts are being made in the petroleum industry to find improved dewaxing catalysts and processes.

A recent development in the area of catalytic dewaxing is provided by accomplishing catalytic dewaxing with a catalyst comprising a crystalline aluminosilicate zeolite in hydrogen form having uniform pore openings with a minor pore diameter as determined by crystallography of not less than 5.8 and a major pore diameter less than 8 angstroms at a temperature of at least 450° F., as disclosed in Texaco Development Corporation South Africa Pat. 67/3,685. The zeolite having the required characteristics is a mordenite-type zeolite. It is highly preferable that the mordenite be in hydrogen form; the sodium form, for example, produces inferior dewaxing results. A catalytic material, suitably a Group VIII metal, preferably a platinum group metal, preferably is associated with the zeolite. The decationized mordenite-type zeolite structures have pore sizes sufficiently large to admit not only the straight-chain hydrocarbons which it is desired to selectively convert to lower molecular weight materials, but also cyclic hydrocarbons; in contrast, the straight-chain hydrocarbons alone are selectively admitted to 5-angstrom molecular sieves, the pores of which quickly become saturated with waxy components, causing catalyst deactivation. Accordingly, the decationized mordenite zeolite structures have a greater capacity for sustained selective conversion of straight-chain components than do 5-angstrom molecular sieves. The mordenite-type zeolite has a chain-type zeolite structure in which a number of chains are linked together into a structural pattern with parallel sorption channels similar to a bundle of parallel tubes, in contrast with the three-dimensional structural lattices which are characteristic of molecular sieve zeolites such as Y-type faujasites. The mordenite-type zeolite dewaxing catalyst preferably comprises a Group VIII hydrogenating component, particularly nickel, platinum, palladium and rhodium, in an amount of 0.1 to 10 weight percent, calculated as metal. When the hydrogenating component is platinum or palladium, the recommended amount is 0.1 to 5.0 weight percent, preferably 0.5 to 2.5 weight percent. When the hydrogenating component is nickel, cobalt or iron, the recommended amount is 1 to 10 weight percent, preferably 1 to 5 weight percent. Hydrogen, in conjunction with the hydrogenating component of the catalyst, extends the life of the catalyst during catalytic dewaxing by preventing fouling of the pore openings of the cata-

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lyst. The catalyst may be preconditioned in hydrogen before use, at a temperature in the range of 450° to 1000° F.

A mordenite-type zeolite in hydrogen form that is suitable for purposes of the process of said South Africa Pat. 67/3,685 and for purposes of the present invention is the calcined synthetic "Zeolon H" mordenite sold commercially by the Norton Company.

As used herein, the terms "mordenite," "hydrogen mordenite," and "mordenite in hydrogen form" are intended to include those mordenite-type zeolites indicated by said South Africa Pat. 67/3,685 to be desirable as catalytic dewaxing catalysts or as components of catalytic dewaxing catalysts.

As used herein, the terms "hydrocrackate" and "catalytic dewaxate" mean the effluents from the hydrocracking zone and catalytic dewaxing zone, respectively.

DRAWINGS

The above and additional objects of the present invention, and the ways in which these objects are achieved, will be better understood from the following description when read in connection with the accompanying drawings, which are a diagrammatic illustration of apparatus and flow paths suitable for carrying out certain embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Feedstock

The hydrocarbon feedstock boiling substantially below about 1000° F. contains at least 5 weight percent, preferably 5 to 40 weight percent, and more preferably at least 10 weight percent, and still more preferably 10 to 30 weight percent, normal paraffins. Generally the hydrocarbon feedstock has a freeze point above -10° F. and more usually above about 0° F. The hydrocarbon feedstock can, for example, be a hydrofined hydrocarbon feedstock obtained by hydrofining a hydrocarbon feedstock boiling within the range from about 500° F. to about 1000° F. using a conventional hydrofining catalyst and conditions. Suitable hydrofining catalysts include, for example, cobalt and molybdenum or nickel and tungsten in their oxide or sulfide forms, preferably supported on a porous solid carrier, e.g., alumina, silica, titania and the like. Other oxides and/or sulfides of Group VI-B and/or Group VIII metals may alternatively be included with the catalyst. Preferably the nitrogen content of the hydrofined hydrocarbon feedstock is below about 10 p.p.m. Preferably the sulfur content of the hydrofined hydrocarbon feedstock is below about 50 p.p.m. The nitrogen and sulfur contents of the 500° F.-1000° F. hydrocarbon feedstock that is converted into the hydrofined hydrocarbon feedstock are generally above about 10 p.p.m. and 50 p.p.m. respectively.

Hydrocracking conditions and catalysts

The conditions in the hydrocracking zone preferably include a temperature within the range from 400° F. to 950° F., preferably 750° F. to 850° F., a pressure within the range from 500 p.s.i.g. to 3500 p.s.i.g., preferably 1000 p.s.i.g. to 2500 p.s.i.g., a liquid hourly space velocity within the range from 0.1 to 10 volumes of 600° F.-hydrocracker feedstock per volume of catalyst per hour, and a total hydrogen rate of 200 s.c.f. to 20,000 s.c.f., preferably 2000 s.c.f. to 8000 s.c.f. of hydrogen per barrel of said feedstock, and a per-pass cracking conversion of the 600° F.-1000° F. hydrocracker feedstock of more than 30 weight percent, preferably 40 to 80 weight percent.

The nature of the hydrocracking catalyst used for hydrocracking the 600° F.-1000° F. hydrocracker feedstock is not critical, i.e., any of the many prior art hydrocracking catalysts may be used. For example, a catalyst com-

prising a nickel component and a tin component associated with a porous acidic inorganic oxide carrier as described in U.S. Pat. 3,399,132, issued Aug. 27, 1968 to B. F. Mulaskey, a hydrocracking-isomerization catalyst comprising a crystalline zeolitic molecular sieve component, a silica-containing gel component, a Group VI hydrogenating component, and a Group VIII hydrogenating component, a catalyst comprising a layered crystalline aluminosilicate clay-type mineral as described in detail in U.S. Pat. 3,252,757, which has associated therewith a palladium component and an additional metal component, for example, a member of Group VI, Group VIII, the Lanthanide Series, the Actinide Series, rhenium, or the like. Other hydrocracking catalysts are usable as well. The preferred hydrocracking catalyst comprises a nickel component and a tin component associated with a porous acidic inorganic oxide carrier as described in the aforementioned U.S. Pat. 3,399,132.

Separating the feedstocks

It is important that the feedstocks be separated into the fractions indicated above. Well known separation techniques, for example, distillation, will serve to accomplish this.

When a temperature is specified to define a feed or a product, it is to be understood that the temperature is approximate and may be changed to a temperature within about $\pm 35^\circ$ F., but more preferably within about $\pm 15^\circ$ F. of the specified temperature without departing from the teachings of the invention disclosed herein.

Catalytic dewaxing conditions and catalyst

The catalytic dewaxing conditions preferably include a temperature within the range from 400° F. to 900° F., preferably 500° F. to 750° F., a pressure within the range from 100 p.s.i.g. to 2500 p.s.i.g., preferably 400 p.s.i.g. to 2000 p.s.i.g., a liquid hourly space velocity within the range from 0.2 to 25 volumes of 500° F.-600° F. catalytic dewaxer feedstock per volume of catalyst per hour, and a total hydrogen rate of 200 s.c.f. to 20,000 s.c.f., preferably 2000 s.c.f. to 8000 s.c.f. of hydrogen per barrel of the catalytic dewaxer feedstock.

The dewaxing catalyst must comprise mordenite in hydrogen form and at least one hydrogenating component, for example, a Group VIII hydrogenating component, preferably selected from the group consisting of platinum, palladium, iridium, ruthenium, rhodium, and nickel, and compounds of these metals more preferably palladium. The dewaxing catalyst advantageously further may comprise carbon in an amount of at least 0.5 weight percent based on the total catalyst. The carbon content of the catalyst may be obtained by contacting the catalyst with hydrogen and a heavy hydrocarbon distillate boiling within the range from 500° F. to 1100° F. at a temperature within the range from 400° F. to 900° F., a pressure within the range from 500 p.s.i.g. to 3500 p.s.i.g., and a liquid hourly space velocity within the range from 0.1 to 10, at a total hydrogen rate in the range from 200 s.c.f. to 20,000 s.c.f. of hydrogen per barrel of said distillate until the catalyst contains the desired amount of carbon. It has been found that the presence of the carbon in the catalyst makes the catalyst more selective for cracking normal paraffins, and therefore makes the catalyst a more efficient dewaxing catalyst. The amount of the hydrogenating component present in the dewaxing catalyst is discussed above.

The dewaxing catalyst in the catalytic dewaxing zone advantageously may contain a rhenium component, i.e., rhenium or a compound of rhenium, in an amount from 0.2 to 1.5 weight percent, calculated as the metal and based on the total catalyst.

Preferably, the smoke point of the 500° F.-600° F. fraction is increased by contacting it with a smoke point elevation (hydrogenation) catalyst, comprising for ex-

ample, a Group VIII noble metal component associated with a porous inorganic oxide, e.g., alumina, silica, or magnesia catalyst, in a smoke point elevation (hydrogenation) zone either before or after it is contacted with the catalyst comprising mordenite in hydrogen form and a hydrogenation component. Preferably, the porous inorganic oxide is alumina. The smoke point elevation conditions should include a temperature in the range from 350° F.-700° F., and preferably from 550° F.-650° F. The upper temperature limit (700° F.) is chosen so as to avoid significant hydrocracking. The lower limit of the temperature (350° F.) is chosen so as to assure significant smoke point elevation activity. The smoke point elevation conditions further include a pressure within the range from about 300 p.s.i.g. to about 3000 p.s.i.g., preferably 400 p.s.i.g. to 2000 p.s.i.g., a liquid hourly space velocity within the range from about 0.1 to about 10 volumes of 500° F.-600° F. catalytic dewaxer feedstock (or catalytic dewaxate) per volume of catalyst per hour, and a total hydrogen rate of 200 s.c.f. to 20,000 s.c.f., preferably 2000 s.c.f. to 8000 s.c.f. of hydrogen per barrel of the catalytic dewaxer feedstock (or catalytic dewaxate). In the smoke point elevation zone, aromatic (and olefinic) hydrocarbon are hydrogenated to form saturated hydrocarbons.

DETAILED DESCRIPTION OF THE DRAWINGS

The invention will be better understood by reference to the specific embodiments thereof illustrated in FIGS. 1-4. The embodiment illustrated in FIG. 1 may be described as follows.

A hydrocarbon feedstock boiling within the range from about 500° F. to about 1000° F. is introduced via line 1 into hydrofiner 2. Hydrogen is introduced into hydrofiner 2 via line 3. Recycle hydrogen is also added to hydrofiner 2 via line 6. Hydrofiner 2 may contain any conventional hydrofining catalyst. Hydrofined hydrocarbon feedstock and hydrogen leave hydrofiner 2 via line 4 and enter vapor-liquid separator 5 wherein hydrogen and sulfur and nitrogen impurities are separated from the hydrofined hydrocarbon feedstock which is conducted via line 7 to separator 8. Gas boiling below about 100° F. is separated from the hydrofined hydrocarbon feedstock in separator 8. A first naphtha fraction boiling within the range from about 100° F. to about 300° F. is recovered from separator 8 via line 9. A 300° F.-500° F. jet fraction is recovered from separator 8 via line 10.

A 500° F.-600° F. catalytic dewaxer feedstock is conducted from separator 8 via line 11 to catalytic dewaxer 12. Hydrogen is introduced into catalytic dewaxer 12 via line 13. The catalytic dewaxate and hydrogen are conducted from catalytic dewaxer 12 to vapor-liquid separator 15 via line 14. Recycle hydrogen is conducted from vapor-liquid separator 15 into catalytic dewaxer 12 via line 16. The catalytic dewaxate is conducted from vapor-liquid separator 15 via line 17 to separator 18. Gas boiling below about 100° F. is separated from the catalytic dewaxate in separator 18. A 100° F.-300° F. third naphtha fraction is recovered from separator 18 via line 19. A 300° F.-600° F. jet fuel fraction is recovered from separator 18 via line 20.

A 600° F.-1000° F. fraction is conducted from separator 8 via line 21 to hydrocracker 22. Hydrogen is conducted to hydrocracker 22 via line 23. The hydrocrackate and hydrogen are conducted from hydrocracker 22 to vapor-liquid separator 25 via line 24. Recycle hydrogen is conducted from vapor-liquid separator 25 to hydrocracker 22 via line 26. The hydrocrackate is conducted from vapor-liquid separator 25 via line 27 to separator 28. Gas boiling below about 100° F. is separated from the hydrocrackate in separator 28. A second 100° F.-300° F. naphtha fraction is recovered from separator 28 via line 29. A second 300° F.-500° F. jet fuel fraction is recovered from separator 28 via line 30. A second 500° F.-600° F. catalytic dewaxer feedstock is conducted from

separator 28 via line 31 to catalytic dewaxer 12. A 600° F.-1000° F. recycle fraction is conducted from separator 28 via line 32 to hydrocracker 22.

As indicated in FIG. 2, it is possible and often advantageous to conduct the hydrocrackate boiling below about 1000° F. from vapor-liquid separator 25 via line 27 to separator 8. This eliminates the necessity for separator 28. As also indicated in FIG. 2, it is possible and often advantageous to separate the catalytic dewaxate in separator 18 into a 100° F.-300° F. third naphtha fraction (line 19), a 300° F.-550° F. jet fuel (line 20), and a 500° F.-600° F. recycle fraction which is conducted via line 40 to hydrocracker 22.

As indicated in FIG. 3, it is possible and often advantageous to subject the 500° F.-600° F. catalytic dewaxer feedstock to smoke point elevation. This can be accomplished, as is diagrammatically indicated, by including a smoke point elevator 32 in line 11 or line 17. In the smoke point elevator 32, hydrogen is introduced via line 33 and hydrogen recycle is introduced via line 36. In a smoke point elevation zone the 500° F.-600° F. catalytic dewaxer feedstock (or the catalytic dewaxate) and hydrogen are contacted with a smoke point elevation catalyst. The effluent from the smoke point elevator 32 may be passed via line 34 to a vapor-liquid separator 35 wherein hydrogen is removed for recycle via line 36 and condensable gases and liquid are moved via lines 11 or 17.

Alternatively, it is not necessary to separate hydrogen from the smoke point elevation zone effluent. Thus, as illustrated in FIG. 4, for example, the smoke point elevation and catalytic dewaxing zones can be incorporated within a single reactor. This can be done by packing the top of the reactor with a smoke point elevation catalyst and the bottom of the reactor with a catalyst comprising mordenite in hydrogen form and at least one hydrogenating component, or vice versa.

Conventional heating means are, of course, included where necessary to provide reactants and/or reaction zones at desired temperatures. The heating means are not 40 illustrated since they constitute a well-known part of the prior art and their inclusion would only serve to make the drawings more difficult to comprehend.

45 The naphtha fractions obtained may, of course, be combined to form a single naphtha blending stock. Similarly, the jet fuel fractions produced may be combined to form a single jet fuel to exceptionally low freeze point and having a smoke point above about 18 mm.

The reaction conditions and catalysts within the smoke point elevation, hydrofining, and hydrocracking zones are as previously identified.

50 The invention will be better understood by reference to the illustrative example which follows.

EXAMPLE

In each of two experiments, a 500° F.-600° F. fraction from a hydrocracker said 500° F.-600° F. fraction having a freeze point of 7° F. and hydrogen were contacted in a single reactor, first with a bed of catalyst comprising 0.39 weight percent platinum, 0.35 weight percent rhenium, 0.46 weight percent fluorine and 0.18 weight percent chlorine associated with alumina and then with a catalyst bed where the catalyst comprised 1.7 weight percent palladium and mordenite in hydrogen form. In the first of the two experiments, the temperature of the alumina-based (smoke point elevation) catalyst reaction zone was maintained at 210° F. and the temperature of the mordenite (catalytic dewaxer) reaction zone was maintained at 632° F. In the second experiment, the respective temperatures were maintained at 550° F. and 615° F. As discussed earlier in the specification, the alumina-based catalyst does not cause smoke point elevation when contacted with the fraction at 210° F. (below 350° F.) but does provide smoke point elevation when the catalyst is maintained at a temperature of 550° F. Table 1 below

shows the reaction conditions used and the yields of product obtained in the above-described experiments.

TABLE 1

	Smoke point elevation zone at—	
	210° F. and catalytic dewaxing zone at 632° F.	550° F. and catalytic dewaxing zone at 615° F.
Reaction conditions:		
LHSV (smoke point elevation zone).....	1.33	1.33
LHSV (catalytic dewaxing zone).....	4.0	4.0
Pressure, p.s.i.g.....	600	600
Time onstream, hrs.....	15.7	19.2
Product description:		
C ₄ - yield, wt. percent.....	3.7	3.7
C ₅ to 300° F. yield, wt. percent.....	2.6	2.9
300° F. plus yield, wt. percent.....	93.6	93.4
Freeze point, ° F.....	-31	-40
Smoke point, mm.....	18	21

The data in the table show that a low freeze point product is obtained by the method of the invention using both reaction conditions wherein smoke point elevation is obtained and conditions wherein smoke point elevation is not obtained. The data in the table further show that the smoke point of the 300° F.+ product is well above 20 mm. when the smoke point elevation zone is maintained at a temperature wherein effective smoke point elevation occurs.

The process of the present invention leads to the production of a jet fuel having a freeze point below about 0° F. and preferably below about -20° F. The freeze point of the jet fuel produced is lower than the freeze point of the hydrofined hydrocarbon feedstock by at least 10° F., more usually, by at least 20° F., and still more usually, by at least 30° F. The smoke point of the jet fuel, when a smoke point elevation step is not included with the process of the invention, is generally about 18 mm. or higher. When a smoke point elevation step is included, the smoke point of the jet fuel is generally about 20 mm. or higher. While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention and the limits of the appended claims.

The invention is hereby claimed as follows:

1. A process for producing jet fuel from a hydrocarbon feedstock boiling substantially below about 1000° F., the jet fuel having a freeze point below about 0° F. comprising:

- (1) separating the hydrocarbon feedstock into a first 500° F.-600° F. fraction and a 600° F.-1000° F. fraction;
- (2) contacting the 600° F.-1000° F. fraction with hydrogen and a hydrocracking catalyst in a hydrocracking zone at hydrocracking conditions;
- (3) separating the hydrocrackate into a first 100° F.-300° F. fraction, a 300° F.-500° F. jet fraction, and a second 500° F.-600° F. fraction;
- (4) contacting the first 500° F.-600° F. fraction, the second 500° F.-600° F. fraction and hydrogen with a catalyst comprising mordenite in hydrogen form and at least one hydrogenation component in a catalytic dewaxing zone at catalytic dewaxing conditions; and

(5) separating the catalytic dewaxate into a second 100° F.-300° F. fraction and a 300° F.-600° F. jet fuel.

2. A process as in claim 1, wherein a single separation zone is used to separate the hydrocarbon feedstock and the hydrocrackate, and the first and second 500° F.-600° F. fractions are separated together as a single 500° F.-600° F. fraction.

3. A process as in claim 1, including, as an added step: combining the first 100° F.-300° F. fraction and the second 100° F.-300° F. fraction.

4. A process as in claim 1, including, as an added step: combining the 300° F.-500° F. jet fraction and the 300° F.-600° F. jet fuel.

5. A process as in claim 1, wherein the hydrocracking catalyst comprises silica-alumina, nickel, and tin.

6. A process as in claim 1, including providing the hydrocarbon feedstock by the step comprising:

contacting a hydrocarbon feedstock having above about 10 p.p.m. nitrogen and above about 50 p.p.m. sulfur and boiling within the range from about 500° F. to about 1000° F. with hydrogen and a hydrofining catalyst in a hydrofining zone at hydrofining conditions.

7. A process as in claim 1, including as an added step: contacting the first and second 500° F.-600° F. fractions with hydrogen and a smoke point elevation catalyst in a smoke point elevation zone at smoke point elevation conditions, including a temperature from 350° F. to 700° F.

8. A process as in claim 1, including as an added step: contacting the catalytic dewaxate with hydrogen and a smoke point elevation catalyst in a smoke point elevation zone at smoke point elevation conditions, including a temperature from 350° F. to 700° F.

9. A process as in claim 1, wherein the catalytic dewaxing conditions fall within about the following ranges: temperature, 400° F. to 900° F.; pressure, 100 p.s.i.g. to 2500 p.s.i.g.; liquid hourly space velocity, 0.2 to 25; and total hydrogen rate, 200 s.c.f. to 20,000 s.c.f. hydrogen per barrel of the first and second 500° F.-600° F. fractions.

10. A process as in claim 1, wherein the hydrocracking conditions fall within about the following ranges: temperature, 400° F. to 950° F.; pressure, 500 p.s.i.g. to 3500 p.s.i.g.; liquid hourly space velocity, 0.1 to 10; and total hydrogen rate, 200 s.c.f. to 20,000 s.c.f. hydrogen per barrel of the 600° F.-1000° F. fraction.

11. A process as in claim 1, including, as added steps: separating the 300° F.-600° F. jet fuel into a 300° F.-550° F. jet fuel and a 550°-600° F. recycle fraction; and conducting the 550° F.-600° F. recycle fraction to the hydrocracking zone.

12. A process for producing jet fuel having a freeze point below about 0° F. and a smoke point above about 18 mm., comprising:

- separating a hydrofined hydrocarbon feedstock boiling below about 1000° F. into a first naphtha fraction boiling within the range from about 100° F. to about 300° F., a first jet fuel fraction boiling within the range from about 300° F. to about 500° F., a first dewaxer feedstock boiling within the range from about 500° F. to about 600° F., and a hydrocracker feedstock boiling from about 600° F. to 1000° F.; conducting the hydrocracker feedstock to a hydrocracking zone;
- contacting the hydrocracker feedstock with hydrogen and a hydrocracking catalyst in the hydrocracking zone at hydrocracking conditions;
- conducting a hydrocrackate from the hydrocracking zone to a separation zone;
- separating in the separation zone a second naphtha fraction boiling within the range from about 100° F. to

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about 300° F., a second jet fuel fraction boiling within the range from about 300° F. to about 500° F., and a second dewaxer feedstock boiling within the range from about 500° F. to about 600° F.;

conducting the first dewaxer feedstock and the second dewaxer feedstock to a catalytic dewaxing zone;

contacting the first dewaxer feedstock, the second dewaxer feedstock, and hydrogen with a catalyst comprising mordenite in the hydrogen form and a hydrogenation component in the catalytic dewaxing zone at catalytic dewaxing conditions;

conducting a catalytic dewaxate from the catalytic dewaxing zone to a separating zone; and

separating the catalytic dewaxate into a third naphtha fraction boiling from about 100° F. to about 300° F. and a jet fuel boiling within the range from about 300° F. to about 600° F.

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U.S. Cl. X.R.

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