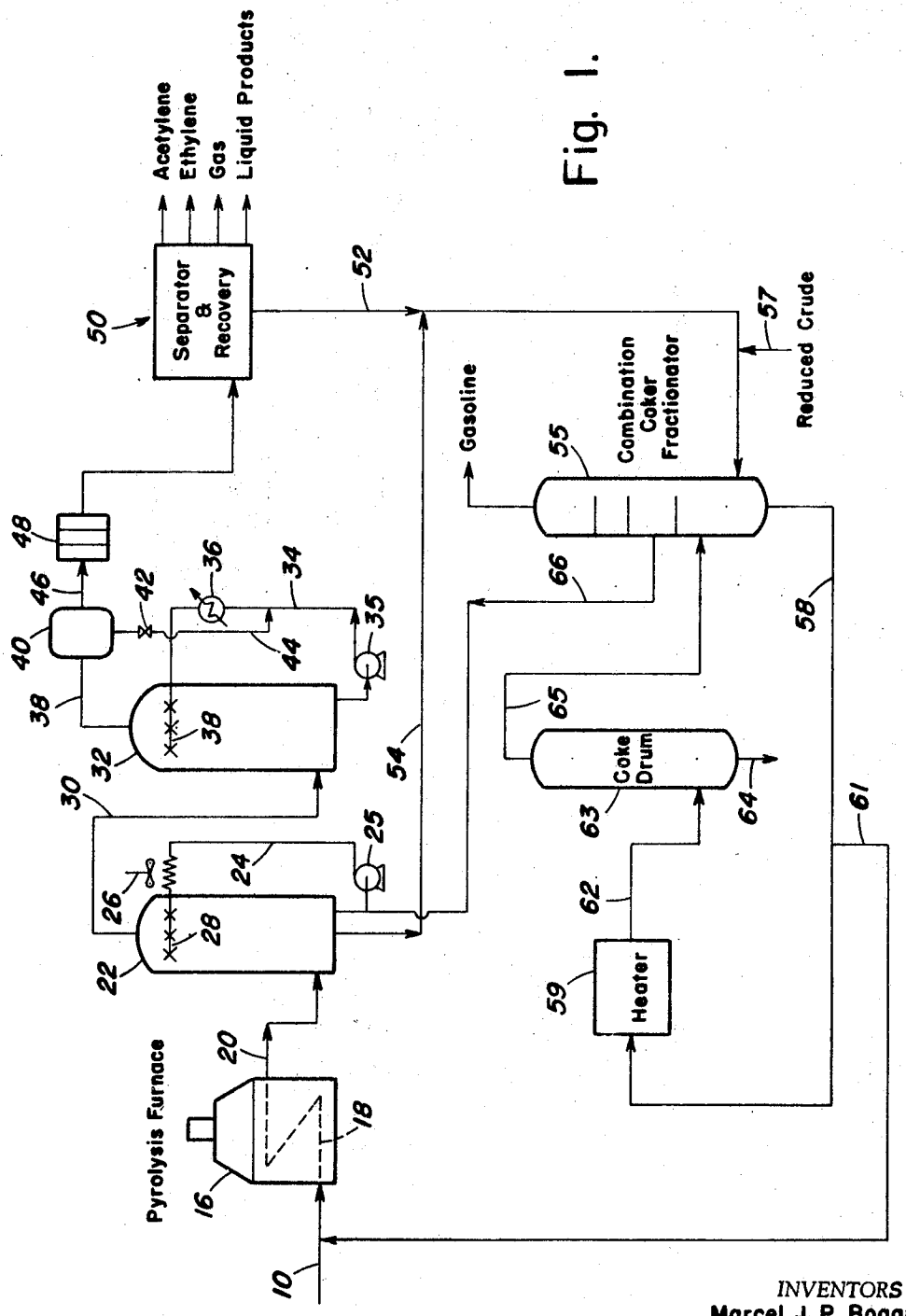
March 3, 1970 M. J. P. BOGART ET AL 3,498,906

QUENCH OIL RECOVERY SYSTEM

Filed Sept. 29, 1967 2 Sheets-Sheet 1

Fig. 1.



INVENTORS
Marcel J. P. Bogart
Hyman R. Davis

BY

Marn & Jangarathis

ATTORNEYS

March 3, 1970 M. J. P. BOGART ET AL 3,498,906

QUENCH OIL RECOVERY SYSTEM

Filed Sept. 29, 1967 2 Sheets-Sheet 2

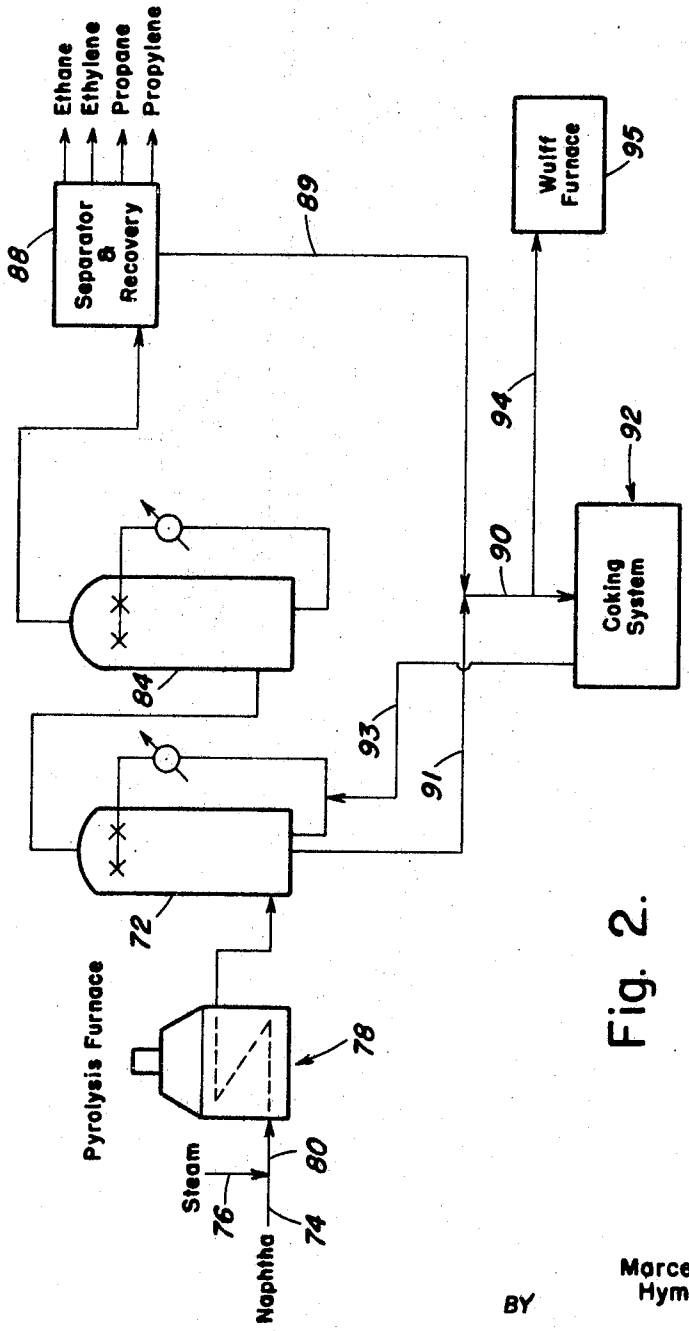


Fig. 2.

INVENTORS
Marcel J. P. Bogart
Hyman R. Davis

BY Marn & Jangarathis

ATTORNEYS

United States Patent Office 3,498,906
Patented Mar. 3, 1970

3,498,906

QUENCH OIL RECOVERY SYSTEM

Marcel J. P. Bogart, Los Angeles, Calif., and Hyman R. Davis, Glen Ridge, N.J., assignors to The Lummus Company, New York, N.Y., a corporation of Delaware

Filed Sept. 29, 1967, Ser. No. 671,828
Int. Cl. C10g 39/00
U.S. Cl. 208—50 8 Claims

ABSTRACT OF THE DISCLOSURE

A process for regenerating a dirty hydrocarbon quench oil, containing high boilers, tars, pitch, carbon fines and the like, wherein the quench oil is heated to a temperature between about 900° F. and about 1000° F., at a pressure between about 10 and about 30 p.s.i.g. to effect coking thereof. A fraction, having cut points falling somewhere within the range between about 500° F. and about 1000° F. is recovered and employed as the quench oil. The regeneration of the quench oil may be effected in a coking system simultaneously with the coking of a reduced crude and/or heavier products recovered from a hydrocarbon pyrolysis process.

This invention relates to an improved quench process for treating the products from a high temperature process and more particularly to the regeneration of dirty quench oil from a quench system. In another aspect, this invention relates to the integration of high temperature processes for treating hydrocarbons for the more effective utilization of various fractions. In still another aspect, the invention relates to an improved method which simplifies the handling of objectionable heavy material formed during a gas pyrolysis process, and for the conversion of said objectionable materials to usable materials.

In the pyrolysis of hydrocarbons to product, for example, ethylene and acetylene, the effluent from a cracking furnace is subjected to quenching operations to cool the effluent and remove undesirable components such as tars, aromatics, carbon black and condensible vapors. Following the quenching operation, the cracked gases are then compressed and dried, and the ethylene, acetylene and other valuable cracked products are recovered and purified.

A widely used method of quenching the hot gases consists in spraying as a quench a large quantity of water into the gas stream. This quench cooling operation lowers the gas temperature, and also removes a quantity of free carbon. However, the heat is not removed at a very usable temperature level, since most of it is contained in the hot water which is recovered from the quench operation as an outlet stream separate from the product gas stream. Other objections to this method include the fact that carbon must be removed from the hot water in a seperate series of operations before the water can be recycled to the quench system. This carbon removal is accomplished either by filtration or by extraction with light hydrocarbon oil. The hot water is then recycled to scrub the product gas stream in a separate operation and finally sent into the quench step. Another drawback to this process is that the product gas stream will contain a relatively large quantity of water vapor. In some cases a drying operation becomes necessary in order to remove some of this water vapor before the gas stream can be processed elsewhere. Finally, a water wash of the product gas stream has limited effectiveness due to the relative insolubility in the water of organic and carbonaceous by-products formed in the gas generator.

Another known quench method consists of using a limited amount of a high boiling hydrocarbon oil as a

quench fluid. Thus, a quench is accomplished and the heat in the product gas is transfered to the quench which can now be exchanged against another medium to effect heat recovery. However, with this method subsequent treatment is required to remove free carbon from the product gas stream from the quench cooling step. The quench oil may be sent to a carbon precipitator wherein tars, coke and other undesirable hydrocarbons are removed by precipitation.

An object of this invention is to provide an improved process for quench cooling of a hydrocarbon effluent from a high temperature process.

Another object is to provide a process for the simplified handling of, and for more efficient and complete removal and disposal of free carbon and other solid particles, tars, pitch and high boilers from an effluent from a hydrocarbon pyrolysis process.

Still another object is to provide a process for converting objectionable materials such as high boilers, tars, pitch, free carbon and other solids resulting from the pyrolysis of hydrocarbons to usable materials.

A further object is to provide a process for the regeneration of dirty oil removed from a quench oil circuit.

Another object is to provide for the availability of good wash make-up in relatively great amounts for quench cooling of hot pyrolysis gases.

Various other objects and advantages will become clear in the course of the following description of an embodiment thereof taken with reference to the accompanying drawing wherein:

FIG. 1 is a simplified schematic flow diagram of an embodiment of the invention; and

FIG. 2 is a simplified schematic flow diagram of another embodiment of the invention.

The objects of this invention are broadly accomplished in one aspect by quenching an effluent from a high temperature process for treating hydrocarbons with a hydrocarbon quench oil and subjecting a portion of the dirty quench oil to those conditions generally employed for effecting coking of a reduced crude, to produce coke and valuable by-products, including gasoline, gas and lean quench oil. In accordance with a preferred operation, the coking of the quench oil is effected simultaneously with the coking of a heavy hydrocarbon fraction; such as, a reduced crude, a lube oil extract, an asphalt extract, and the like, the heavy hydrocarbon fraction supplying additional quench oil for the system.

More particularly, a dirty hydrocarbon quench oil, containing high boilers, tars, pitch, carbon fines and the like, is heated to a temperature between about 900° F. to about 1000° F., preferably about 900° F. to about 950° F. at a pressure between about 10 p.s.i.g. to about 70 p.s.i.g., preferably between about 30 to about 60 p.s.i.g. to convert the dirty quench oil to coke, gas, gasoline, and gas oil. The coke is separated therefrom, and the remaining effluent is fractionated to recover the various components, with the fraction having upper and lower cut points falling within the range between about 500° F. and about 1000° F. being employed as quench oil.

Referring now to FIG. 1, a hydrocarbon feed; e.g., ethane, propane, cracked distillates or the like, in line **10** is introduced into a pyrolysis heater **16** (e.g., a Wulff furnace), wherein the feed is converted to a mixture containing primarily acetylene, ethylene, propylene and other light olefinic hydrocarbons, aromatic hydrocarbons, higher weight olefins, paraffins, gas and gasolines, oil, and some tars, pitch, carbon fines, etc.

The heater **16** is operated under conditions generally known in the art for producing the desired products.

An effluent, at a temperature of from about 700° F. to 1700° F., is withdrawn from the furnace **16** through

line 20 and introduced into the bottom of an oil quench tower 22 of a type known in the art wherein the hot gaseous effluent is contacted with a cool hydrocarbon oil, generally a gas oil mixture having upper and lower cut points which fall within the range between about 500° F. and about 1000° F. (converted to one atmosphere). The hydrocarbon oil preferably has cut points between about 600° and about 850° F. The residence time of the effluent in line 20 is relatively short, i.e., less than about 1/10 second, in order to minimize both decomposition of the effluent and undesirable reactions between the components thereof. The cool quench oil, e.g., at a temperature between about 80° F. and 165° F., is sprayed into the upper portion of oil quench tower 22 by means of spray device 28 and descends in countercurrent contact with the hot effluent introduced through line 20. As a result of the direct contact between the effluent and quench oil, the effluent is cooled and scrubbed of a portion of the tars, heavy olefins, aromatics, carbon particles and other undesirable components in the effluent. A portion of the quench oil is withdrawn from the bottom of oil quench tower 22 and pumped via pump 25 through line 24 to an indirect air-cooled heat exchanger 26 wherein the quench oil is cooled to the temperature between about 80° F. and 165° F. An air fin cooler is illustrated, but it is understood that other indirect heat exchangers may be employed. Another portion of the quench oil now at an elevated temperature and containing tars, heavy olefins, aromatics and other high boiling components, is withdrawn from the quench tower 22 through line 54 for cleansing thereof as hereinafter described.

The partially cooled reactor effluent is withdrawn from the top of oil quench tower 22, e.g., at a temperature between about 140° F. and 245° F., and passed through line 30 to the lower section of water quench tower 32. Water quench tower 32 operates in a manner similar to oil quench tower 22; water is withdrawn from the bottom of water quench tower 32 and pumped via pump 35 through line 34 and heat exchanger 36 wherein the water is cooled to a temperature of from about 70° F. to 120° F. by indirect heat transfer with a suitable coolant, such as water. The now cooled water is sprayed into the top of water quench tower 32 by means of spray device 38. The effluent gases move upwardly in countercurrent relation to downwardly descending quench water. The direct contact of the reactor effluent and quench water in the water quench tower 32 results in the further cooling of the effluent gases.

The quenched reactor effluent gas, at a temperature between about 95° F. and 170° F., is withdrawn from the top of water quench tower 32 and passed via line 38 to water knockout tank 40, wherein entrained water and other condensible vapors are separated from the reactor effluent gas. The separated liquids are removed from the lower portion of water knockout tank 40 under the control of valve 42, and recycled to the water quench tower system through line 44.

The gaseous overhead from water knockout tank 40 is passed through line 46 to compressor 48, wherein the gas is compressed to a pressure between about 10 and about 50 atms., and the compressed gas is introduced into a separation and recovery system schematically indicated as 50 to recover the various fractions; e.g., ethylene, acetylene, normally liquid products and gas. A residual product, containing high boilers such as aromatics, some tars, pitch, etc., is withdrawn from the recovery system 50 through line 52, combined with dirty quench oil in line 54, and the resulting mixture introduced into the combination coker fractionator 55 of a coking system of a type known in the art and generally indicated as 56. A heavy hydrocarbon fraction, such as a reduced crude may also be introduced into the coking system 56 through line 57. The fractionator 55 functions to separate both the feed introduced through line 54 and a coker overhead, as hereinafter described, into desired products and a feed for a coking heater. A bottoms, containing high boilers, tar, pitch, carbon particles, and the like is withdrawn from fractionator 55 through line 58 and introduced into a coking heater 59, operating at a temperature between about 900° and about 1000° F., and an outlet pressure between about 10 and about 70 p.s.i.g. A portion of the bottoms may be passed to the pyrolysis furnace through line 61 for further upgrading. A heated product is withdrawn from heater 59 through line 62 and introduced into coke drums 63 wherein the heavier components are converted to coke and lighter components. The coke is withdrawn from coke drum 63 through line 64 and the lighter components are passed through line 65 to the fractionator 55.

The fractionator 55 is operated to produce a gasoline overhead and a gas oil fraction, having the cut points desired for the quench liquid, e.g., upper and lower cut points falling within the range of about 500° to about 1000° F. The gas oil fraction is withdrawn from the fractionator 55 through line 66 and combined with the quench oil in line 24.

As seen from the foregoing description, the heavy oils and other high boilers, tars, pitch, free carbon and other solid particles resulting from the pyrolysis of hydrocarbons, are simply and conveniently removed from the product gas stream, and are converted to usable materials.

Referring now to FIG. 2, a crude naphtha feed in line 74 is admixed with high pressure steam in line 76 and introduced into steam cracking furnace 78 via line 80. Steam cracking furnace 78 operates with a residence time of up to about 2.5 seconds. The feed is heated to a temperature of from about 1300° F. to 1700° F. to effect pyrolysis of the feed wherein the mixture is converted to a gaseous mixture containing primarily ethane, propane, propylene, ethylene, gas, pyrolized gasoline and other light olefinic hydrocarbons, aromatic hydrocarbons, higher weight olefins, paraffins, oils, and some tars, pitch and carbon fines.

The gaseous effluent, at a temperature of from about 1300° F. to about 1700° F. is withdrawn from steam cracking furnace 78 and within one second thereafter is quenched in oil quench tower 72 as known in the art and hereinabove more fully described with reference to oil quench tower 22. A gaseous effluent from oil quench tower 72 is thereafter quenched in water quench tower 84, which quench tower operates in a manner similar to previously detailed quench tower 32.

The gaseous effluent from water quench tower 84 containing primarily gas, ethylene, propane, propylene, pyrolized gasoline, and other middle distillates, heavy oils and other high boilers, is introduced into a separation and recovery system, schematically indicated as 88 to recover the various fractions; e.g., ethane, ethylene, propane, propylene, pyrolyzed gasoline and middle distillates.

A heavy oil is withdrawn from the separation system 88 through line 89, combined with dirty quench oil withdrawn from the quench tower 72 through line 91 and the mixture passed through line 90 to a coking system 92 for treatment as described with reference to FIG. 1. A quench oil, now free of impurities, is recovered from the coking system 92, as hereinabove described, and returned to the quench tower 72 through line 93. Alternatively, a portion of the mixture in line 90 may be passed through line 94 to a Wulff furnace 95 for further upgrading.

As seen from the foregoing description, the heavy oils and other high boilers, tars, pitch free carbon and other solid particles resulting from the steam pyrolysis, are simply and conveniently removed from the product stream, and are converted to usable materials.

This process is not limited to a quench system for the

pyrolysis of hydrocarbons and is generally applicable to quenching the effluent from any of a wide variety of high temperature processes including, for example, gasification of hydrocarbons, partial oxidation of hydrocarbon gases such as methane, oxidations of hydrocarbon solids, such as powdered coals and the like.

The invention is further illustrated by the following conditions for quench oil treatment and it is to be understood that the scope of the invention is not to be limited by such conditions:

Line	Temp., ° F.	Pressure (p.s.i.a.)
54	350–600	6–20
58	600–650	20–30
62	900–1000	25–55
65	850–900	20–50
66	450–700	15–25

The quench oil fraction withdrawn through line **66** has cut points between 550 and 1000° F. (converted to one atmosphere).

It is to be understood that various changes in the details, steps, materials and arrangements of parts, which have herein been described to illustrate the invention may be made by those skilled in the art within the scope of the invention as defined in the appended claims.

What is claimed is:

1. In the quenching of a high temperature hydrocarbon stream by direct contact thereof with a hydrocarbon quench oil in a quench zone wherein a dirty hydrocarbon quench oil and a cooled hydrocarbon stream are removed from the quench zone, a process for regenerating the dirty hydrocarbon quench oil, comprising:

introducing dirty hydrocarbon quench oil into a coking zone wherein a portion thereof is heated to a temperature of from about 900° F. to about 1000° F., at a pressure from about 10 p.s.i.g. to about 70 p.s.i.g. to effect coking thereof; recovering from the coking zone a fraction having cut points falling somewhere within the range from about 500° F. to about 1000° F., converted to one atmosphere; and recycling at least a portion of the fraction to the quench zone as regenerated quench oil.

2. The process as defined in claim **1** wherein the recovered fraction has a lower cut point of about 600° F. and an upper cut point of about 850° F.

3. In the quenching of a high temperature hydrocarbon stream by direct contact thereof with a hydrocarbon quench oil in a quench zone wherein a dirty hydrocarbon quench oil and a cooled hydrocarbon stream are removed from the quench zone, a process for regenerating the dirty hydrocarbon quench oil comprising:

(a) introducing dirty quench oil into a coker combination fractionator;

(b) recovering a high boiling bottoms from the coker combination fractionator;

(c) introducing high boiling bottoms into a coking heater to effecting heating thereof to coking temperatures at coking pressures;

(d) introducing heated high boiling bottoms into a coke drum to effect coking thereof;

(e) recovering coke from the coke drum;

(f) introducing overhead from the coke drum into the coker combination fractionator;

(g) recovering a fraction having cut points falling somewhere within the range between about 500° F. and about 1000° F., converted to one atmosphere, from the coker-combination fractionator; and

(h) recycling at least a portion of the fraction to the quench zone as regenerated quench oil.

4. The process as defined in claim **3** wherein the high boiling bottoms is heated in the coking heater to a temperature from about 900° F. to about 1000° F. at an outlet pressure from about 10 to about 70 p.s.i.g.

5. The process as defined in claim **4** wherein the high temperature hydrocarbon stream is derived from the pyrolysis of a hydrocarbon in a pyrolysis zone and further comprising: recovering the various components from the cooled hydrocarbon stream, including the heavy residues of the pyrolysis effluent; and introducing at least a portion of the heavy residues into the coker combination fractionator along with dirty quench oil.

6. The process as defined in claim **5** wherein the pyrolysis is the steam cracking of naphtha and another portion of the heavy residue recovered from the pyrolysis effluent is subjected to Wulff furnace pyrolysis conditions to effect upgrading thereof.

7. The process as defined in claim **4** wherein the fraction recovered in step (g) of claim **3** has a lower cut point of about 600° F. and an upper cut point of about 850° F.

8. The process as defined in claim **5** and further comprising passing a portion of the high boiling bottoms from the coker combination fractionator to the pyrolysis zone.

References Cited

UNITED STATES PATENTS

2,656,307	10/1953	Findlay	208—50
3,347,949	10/1967	Dollinger et al.	760—683

DELBERT E. GANTZ, Primary Examiner

A. RIMENS, Assistant Examiner

U.S. Cl. X.R.

208—131; 260—683

Disclaimer

3,498,906.—*Marcel J. P. Bogart*, Los Angeles, Calif., and *Hyman R. Davis*, Glen Ridge, N.J. QUENCH OIL RECOVERY SYSTEM. Patent dated Mar. 3, 1970. Disclaimer filed Nov. 13, 1972, by the assignee, *The Lummus Company*.

Hereby enters this disclaimer to claim 3 of said patent.

[*Official Gazette January 16, 1973.*]