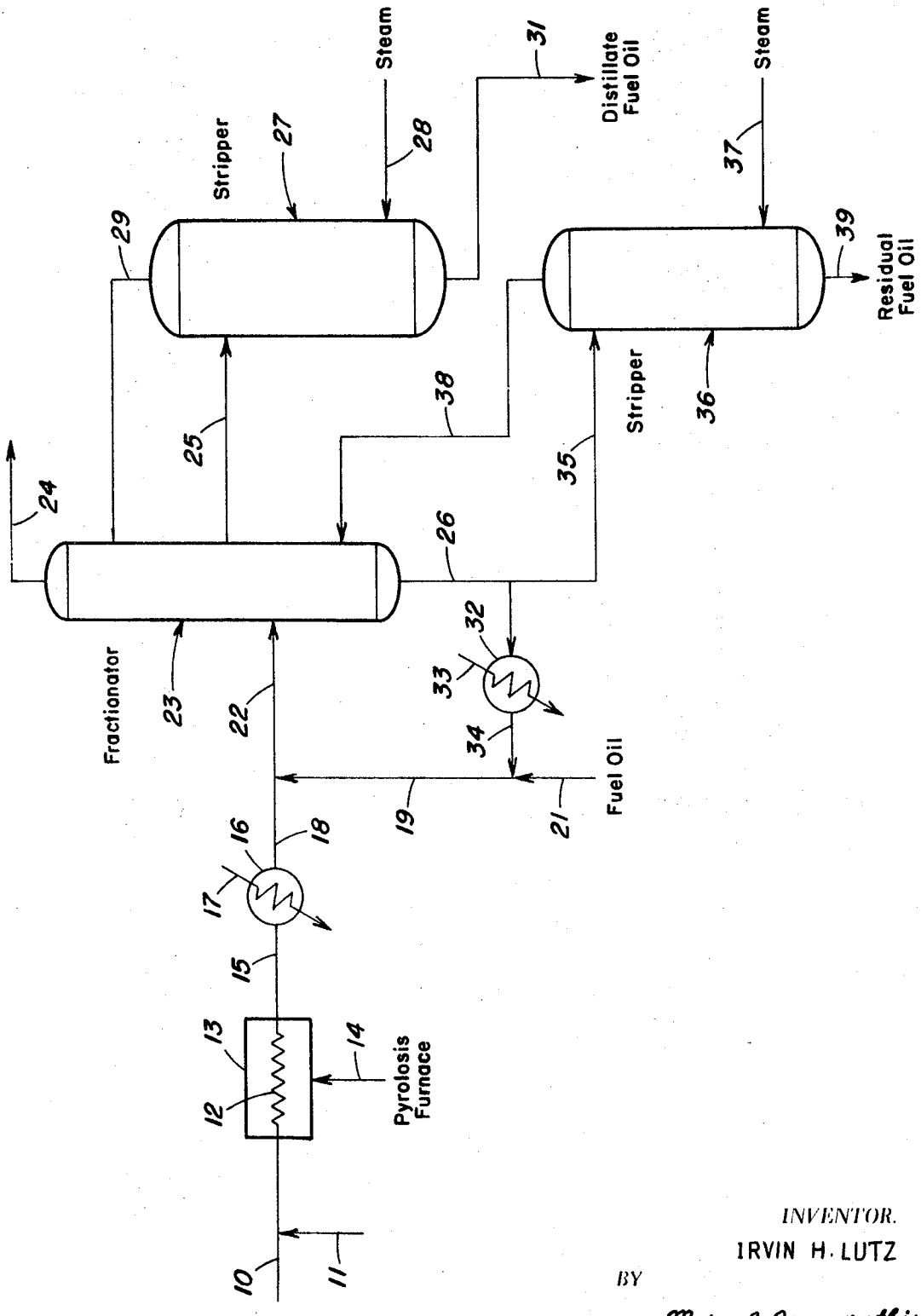
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HYDROCARBON PYROLYSIS PROCESS

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# HYDROCARBON PYROLYSIS PROCESS

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## ABSTRACT OF THE DISCLOSURE

Improved process for cracking a hydrocarbon feed in a pyrolysis furnace wherein the sensible heat of the effluent is employed to fractionate a fuel oil into a distillate and residual fraction. A fuel oil is added to the pyrolysis effluent, along with recovered quench oil, to effect quenching thereof and the mixture introduced into a gasoline fractionator to recover a distillate sidestream. The distillate sidestream, containing distillate fractions from both the effluent and residual fuel, may be employed to meet fuel requirements for the pyrolysis furnace. In addition, the residual recovered as fractionator bottoms is employed to provide quench oil and meet other fuel requirements for the pyrolysis plant or an extraneous operation.

The present invention is related to hydrocarbon pyrolysis and more particularly to a new and improved process for meeting the fuel requirements therefor.

In the cracking of a hydrocarbon feed, such as a naphtha, to produce unsaturated hydrocarbons, the feed and steam is introduced into the pyrolysis coil of a furnace which is heated by gas firing. The effluent from the pyrolysis operation is then immediately quenched to cool the effluent and prevent side reactions. The cooled effluent is then passed to a separation and recovery zone to effect recovery of the various effluent products.

An object of this invention is to provide a process for effectively utilizing the sensible heat contained in a pyrolysis gas effluent.

Another object of this invention is to provide a process for recovering lighter fractions from a fuel oil.

Still another object of this invention is to provide a process for supplying fuel for the pyrolysis heaters within the pyrolysis process.

A further object of this invention is to recover lighter fractions from a fuel oil by employing processing equipment within the pyrolysis plant.

These and other objects of the invention should be more readily apparent from the following detailed description thereof when read with reference to the accompanying drawing wherein:

The drawing is a simplified schematic flow diagram of an embodiment of the process of the invention.

The objects of this invention are broadly accomplished by adding a fuel oil to a hydrocarbon pyrolysis effluent quench system. The distillate fraction and the heavier fraction of the fuel oil and the pyrolysis effluent are then recovered within the quench system and such fractions may be employed for meeting fuel requirements of the pyrolysis process.

The invention will be described in more detail with reference to an embodiment thereof illustrated in the accompanying drawing but it is to be understood that the scope of the invention is not to be limited thereby.

Referring now to the drawing, a hydrocarbon feed, such as, a naphtha, in line **10** and steam in line **11** are introduced into a pyrolysis coil **12** of a pyrolysis furnace schematically indicated as **13**. The pyrolysis coil is heated by a plurality of burners (not shown) which are supplied with gas fuel through line **14**. The pyrolysis is effected under conditions generally known in the art; e.g.,



temperatures between about 1450° F. and about 1650° F., pressures of between about 10 and about 30 p.s.i.g and residence times of less than 1.0 second. The pyrolysis of hydrocarbon feeds, such as naphtha, is generally known in the art and consequently no further description thereof is necessary for understanding of the invention.

A pyrolysis effluent, containing unsaturated hydrocarbons including ethylene, is withdrawn from pyrolysis coil **12** through line **15** and passed through a heat exchanger **16**, supplied with a suitable coolant through line **17**, to cool the effluent to a temperature no lower than about 700° F. The cooled effluent from heat exchanger **16** in line **18** is mixed with a quench liquid in line **19** to effect further cooling thereof to a temperature below about 600° F., generally to a temperature between about 450° F. and about 550° F.

The quench liquid in line **19** is comprised of a fuel oil such as, an atmosphere or vacuum reduced crude, No. 6 Fuel Oil, Bunker C Fuel Oil, a mixture of straight run and a compatible cracked residue, and the like, obtained from storage through line **21** and a portion of the cooled bottoms from a gasoline fractionation, as hereinafter described.

The further cooled pyrolysis effluent, now containing gasoline fractionator bottoms and fuel oil, in line **22** is introduced into a gasoline fractionator to effect recovery of the various fractions. The fractionator **23** is operated in a manner to recover a distillate fraction sidestream which has an initial boiling point and an end point which both fall somewhere within the range from about 390° F. to about 850° F., with the initial boiling point of the distillate fraction generally falling within the temperature range of from about 390° F. to about 525° F. and the end point thereof generally falling within the temperature range from about 700° F. to about 850° F. In general, fractionator **23** is operated at an overhead temperature from about 200° F. to about 230° F., a bottoms temperature from about 450° F. to about 600° F. and a pressure from about 10 p.s.i.g. to about 15 p.s.i.g. A gaseous overhead comprised of lower boiling components is withdrawn from fractionator **23** through line **24** for further processing as known in the art; the distillate fraction through line **25**; and the higher boiling residual is withdrawn as bottoms through line **26**.

The distillate fraction in line **25** is introduced into a steam stripping zone **27**, supplied with steam through line **28**, to strip lower boiling components therefrom which are recycled to fractionator **23** through line **29**. The distillate fraction having an initial boiling point and an end point, as hereinabove described, is withdrawn from stripper **27** through line **31** and all or a portion thereof may be employed to provide all or a portion of the fuel requirements for either the pyrolysis heater **13** through line **14** or an extraneous process.

The residual from fractionator **23** in line **26** is divided into two portions with one portion thereof being passed through heat exchanger **32**, provided with a suitable coolant through line **33**, to effect cooling thereof. The cooled residual from heat exchanger **32** in line **34** is mixed with the fuel oil for combination with the pyrolysis effluent in line **18**, as hereinabove described.

The remaining portion of the fractionator bottoms is passed through line **35** to a steam stripping zone, supplied with steam through line **37**, to strip lower boiling components therefrom, which are recycled to the fractionator **23** through line **38**. The residual fuel oil, withdrawn through **39**, which has an initial boiling point higher than the end point of the recovered distillate fraction may be employed to meet other fuel requirements for either the pyrolysis plant; e.g., in boilers or in the naphtha steam superheater, or an extraneous process.

The invention is further illustrated by the following processing conditions for effecting an operation in accordance with the present invention, but the scope of the invention is not to be limited thereby:

EXAMPLE

A naphtha having a specific gravity of 0.7 is employed as feed to the pyrolysis furnace **12** and the fuel oil employed in line **21** has a specific gravity of 0.95 and an ASTM Boiling Range of 590° F.–1050° F.

The fractionator **23** is operated at a pressure of 10 p.s.i.g., an overhead temperature of 220° F. and a bottoms temperature of 550° F. The stripper 27 is operated at a bottoms temperature of 350° F. and a pressure of 11 p.s.i.g. and the stripper **30** is operated at a bottoms temperature of 525° F. and a pressure of 12 p.s.i.g.

The remaining conditions are as follows:

| Line | Temp., ° F. | Pressure, p.s.i.g. |
|---|---|---|
| 18 | 707 | 14 |
| 19 | 410 | 60 |
| 22 | 545 | 12 |

The above operation results in the recovery of a distillate fraction in line **31** having an initial boiling point (ASTM) of 400° F. and a residual in line **39** having an initial boiling point (ASTM) of 700° F.

The process of the invention is extremely advantageous in that the sensible heat of the pyrolysis effluent is effectively employed to fractionate a fuel oil into distillate and residual fractions. As a further advantage, the fuel requirements for the pyrolysis process may be provided by the use of existing equipment within the pyrolysis operation.

Numerous modifications and variations of the present invention are possible in light of the above teachings and therefore the process of the invention may be practiced otherwise than as particularly described.

What is claimed is:

**1.** In a process for pyrolyzing a hydrocarbon feed in a pyrolysis furnace to produce unsaturated hydrocarbons, wherein the pyrolysis effluent is quenched by contact with a guench liquid from an extraneous source and recovered quench liquid, the resulting mixture is introduced into a quench liquid fractionator to recover quench liquid and recovered quenched liquid is cooled and recycled to the quenching, the improvement comprising: employing a fuel oil as the quench liquid from an extraneous source; recovering from said quench liquid fractionator an overhead, a sidestream and a bottoms stream, the sidestream being comprised of the distillate fraction of the fuel oil and the like components of the pyrolysis effluent and the bottoms stream being comprised of the residual portion of the fuel oil and like components of the pyrolysis effluent; and employing a portion of the bottoms stream as the recovered quench liquid recycled, after cooling, to the quenching.

**2.** The process as defined in claim **1** wherein the sidestream has an initial boiling point and an end point which both fall within the range from about 390° F. to about 850° F.

**3.** The process as defined in claim **2** wherein the sidestream has an initial boiling point within the range from about 390° F. to about 525° F. and an end point within the range from about 700° F. to about 850° F.

**4.** The process as defined in claim **1** wherein at least a portion of the sidestream is employed to meet fuel requirements for the pyrolysis furnace.

**5.** The process as defined in claim **3** wherein the fuel oil is selected from the group consisting of a reduced crude, No. 6 Fuel Oil and Bunker C Fuel Oil.

**6.** The process as defined in claim **5** wherein the hydrocarbon feed pyrolyzed in the pyrolysis zone is a naphtha.

**7.** The process as defined in claim **3** and further comprising: introducing the sidestream from the fractionator into a steam stripping zone to separate lower boiling components therefrom and recycling the separated lower boiling components to the fractionator.

**8.** The process as defined in claim **7** and further comprising: introducing another portion of the bottoms from the fractionator into another steam stripping zone to separate lower boiling components therefrom and recycling the separated lower boiling components to the fractionator.


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