

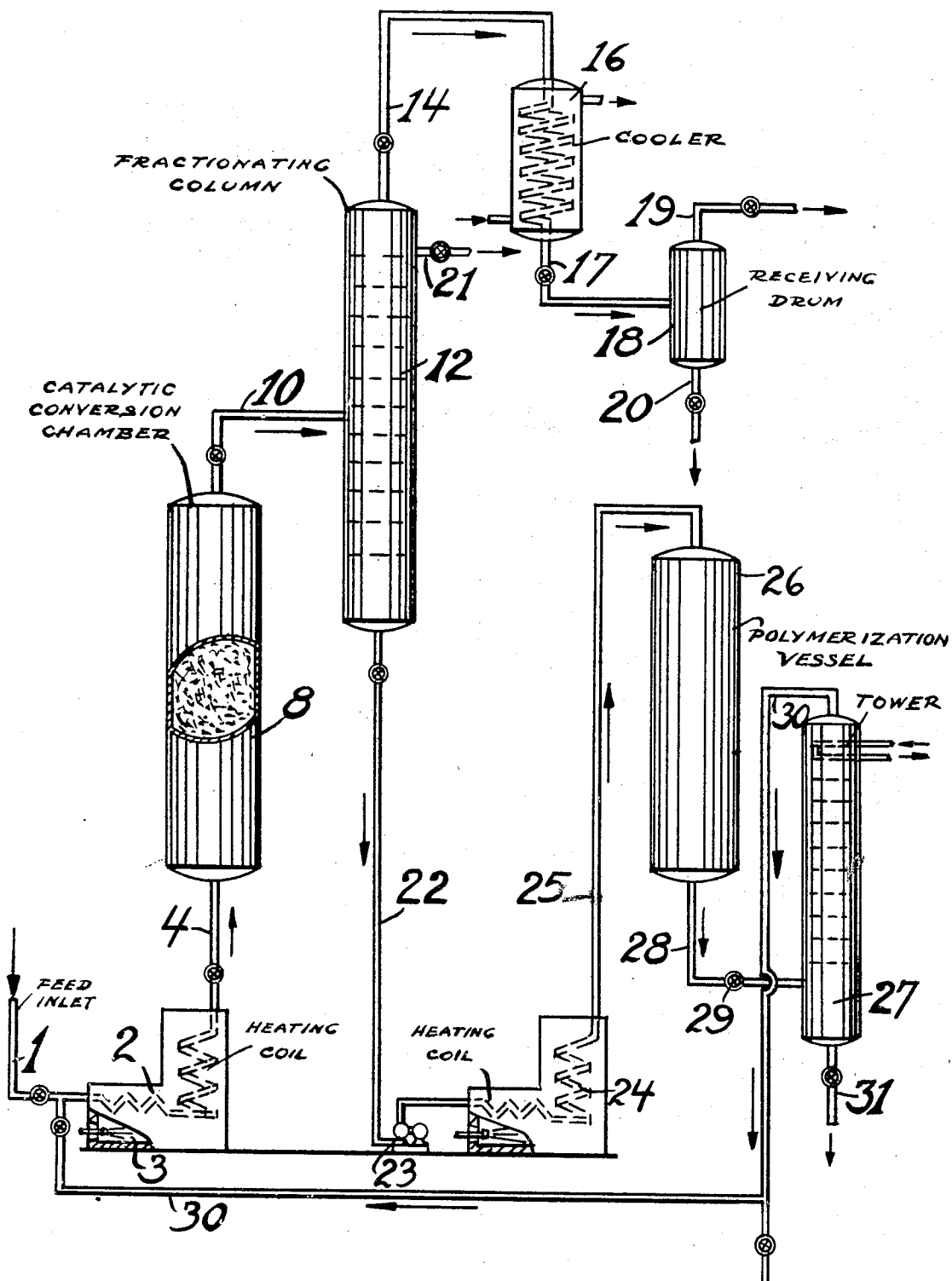
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CYCLE GAS OILS BY THERMAL TREATMENT

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CYCLE GAS OILS BY THERMAL TREATMENT

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1 Claim. (Cl. 196—48)

The present invention relates to the art of treating hydrocarbons. More particularly, the present invention relates to improvements in the catalytic treatment of relatively heavy hydrocarbons such as a gas oil to form light fractions boiling within the gasoline range in which the cycle stock, that is to say, the unconverted hydrocarbons recovered from the catalyst zone are subjected to a thermal treatment in order to improve their cracking characteristics or properties.

It is well known that in thermal cracking of hydrocarbons the charging stock should be largely paraffinic to produce the best results. It is also known that the more a charging stock is cracked thermally, the poorer it becomes as a feed stock for further cracking. Consequently, in thermal operations there comes a time when a feed stock, due to repeated cracking, must be rejected since it becomes too refractory and too prone to form excessive coke to be further cracked. On the other hand, a feed stock for a catalytic cracking operation is preferably of a naphthenic character and should also be substantially free of aromatic compounds containing more than one benzene ring in a single condensed nucleus. If a feed stock used in a catalytic cracking operation contains compounds such as naphthalene, anthracene, phenanthrene, benzanthrene, and the like, or their alkylated derivatives, these condensed ring compounds form during the cracking operation excessive quantities of coke. Furthermore, if a feed stock in a catalytic cracking operation contains substantial quantities of olefins, these latter compounds during the catalytic cracking operation tend to polymerize to form high molecular weight hydrocarbons which, during the catalytic conversion, are converted to tarry or gummy deposits or coke which deposit on the catalyst and necessitate frequent shut-downs for the purpose of removing the same to regenerate the catalyst.

I have discovered means for conditioning the cycle stock recovered from a catalytic operation wherein the cycle stock is improved as to its cracking properties and therefore may be recycled to the catalyst zone for further conversion without causing excessive formation of tarry deposits or coke on the catalyst.

It is an object of my invention, therefore, to condition an oil recovered from the catalytic process, which oil is not satisfactory from the standpoint of cracking characteristics, by subjecting the said oil to a mild viscosity breaking

or thermal treatment operation wherein the coke-forming bodies contained in the said oil are converted to relatively heavy compounds or fractions which may be removed from the said oil.

My invention will be best understood by reference to the accompanying drawing in which Fig. 1 represents in diagrammatic form an apparatus layout or flow diagram in which my process may be carried into effect.

Referring in detail to the drawing, a feed stock such as a virgin gas oil having an A. P. I. gravity of say 25° is fed to the system through line 1 and thence discharged into a coil 2 disposed in a furnace setting 3 where the hydrocarbon oil is heated to cracking temperatures, say a temperature of 825° F. The hot vapors are withdrawn through line 4 and discharged into a catalytic conversion chamber 8 where the vapors contact a catalyst, preferably an acid treated clay catalyst, and under the conditions specified the gas oil vapors are usually converted to gasoline in yields amounting to 40% to 50% based on the original feed stock. The total vapors are withdrawn from chamber 8 overhead through line 10 and passed into a fractionating column 12 from which the gasoline vapors are withdrawn through a line 14, thence discharged into a cooler or condenser 16, thence withdrawn through line 17 into a receiving drum 18, from which drum the normally gaseous products are withdrawn through line 19, while catalytically cracked gasoline is recovered through line 20. A light gas oil is withdrawn from tower 12 through line 21. This gas oil fraction may be returned to the cracking coil 2 or it may be withdrawn as a product suitable for a heating oil. Meanwhile, a heavier fraction is withdrawn from the bottom of column 12 through line 22 and discharged into a pump 23, thence into a furnace 24 where the fraction is heated to a temperature of from 400° F. to 950° F. The heated oil is withdrawn from furnace 24 through line 25 and discharged into a thermal treatment vessel 26 where it is permitted to remain for sufficient time to effect the desired conversion of unsaturated bodies and multi-ring aromatic compounds into heavy hydrocarbons. The heavy hydrocarbons formed as a result of the treatment in vessel 26 are withdrawn through line 28 and after pressure reduction in valve 29 are discharged into a fractionating tower or tar separator 27 where the tar is separated from the lighter gas oil portion, the heavy tar being removed through line 31 while the cleaned stock

from which the unsaturated compounds and the multi-ring aromatic compounds have been removed, as indicated, is withdrawn through line 30 and returned through line 1 for further catalytic treatment to produce an additional quantity of cracked motor fuel.

While the nature of the original charging stock will largely determine the operating conditions in viscosity reducing or thermal treatment vessel 26, it may be said that good results are obtained ordinarily by subjecting the oil in vessel 26 to a temperature within the range of from 400° F. to 950° F., preferably operating at about 750° F. to 850° F., and imposing a pressure of from 10 to 300 atmospheres gauge on the oil undergoing the conditioning operation with a pressure of 30 atmospheres preferred. The treatment in chamber or drum 26 is prolonged sufficiently to accomplish the desired result, and ordinarily the oil remains in the treating zone for a period of from 20 seconds to one hour or more, with best results secured by permitting the oil to remain resident in the vessel 26 for a period of about 5 minutes. As indicated previously, the principal reaction taking place in vessel 26 is one in which the mono-olefins, diolefins, and compounds of the nature of naphthalene, anthracene, and the like are converted to tarry high molecular weight compounds which are relatively poor in hydrogen content and which may be readily separated by flashing and distillation in vessel 27 after flashing through valve 29.

Although the invention has been described in terms of a stationary bed type of operation, that is to say, the catalyst in chamber 8 may be in the form of a continuous bed of catalyst or a plurality of separate layers of catalyst supported on perforated trays through which the hydrocarbon vapors undergoing treatment flow during the cracking operation, it is pointed out that my process is equally applicable to a type of operation in which a ground or powdered catalyst may be suspended in the oil vapors during the cracking operation.

As a further alternative procedure, the cycle

stock in line 30 may be discharged into the coil 2 at some point removed from the intake thereof, since the cycle oil in line 30 usually will be at a temperature of 400°-600° F. and under those conditions it need not be discharged into the feed line 1 which normally would contain cold oil. Another alternative procedure is to introduce the fresh feed in line 1 directly into furnace coil 24. In that case, and particularly where the fresh feed was a reduced crude, the overhead product from chamber 27 would be fed to the coil 2. Finally the overhead product in line 30 may not be returned to coil 2 but may be delivered to another catalytic cracking zone or thermal cracking zone where it could be subjected to higher temperatures than those prevailing in chamber 8, since the stock would be relatively free of components or constituents tending to form coke.

It is obvious that many modifications of my invention will readily occur to those skilled in this art.

What I claim is:

A process for cracking a straight run gas oil to form lower boiling hydrocarbons which comprises passing said gas oil in the absence of substantial amounts of olefin and aromatic hydrocarbons and other coke-forming constituents thru a cracking zone at a temperature above 800° F., contacting said gas oil within said cracking zone with a cracking catalyst, keeping the oil in contact with said catalyst for a period sufficient to convert a substantial portion of said oil into lower boiling hydrocarbons, separating the cracked products into a gasoline fraction, a light gas oil fraction, and a heavy gas oil fraction, condensing the gasoline and light gas oil fractions, maintaining said heavy gas oil fraction independently of said straight run gas oil at a temperature of about 750 to 850° F. and under elevated pressure for a substantial period to polymerize coke-forming constituents contained in said heavy gas oil, thereafter separating the polymerized coke-forming constituents from said heavy gas oil fraction and recycling said heavy gas oil to said catalytic cracking step.

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