

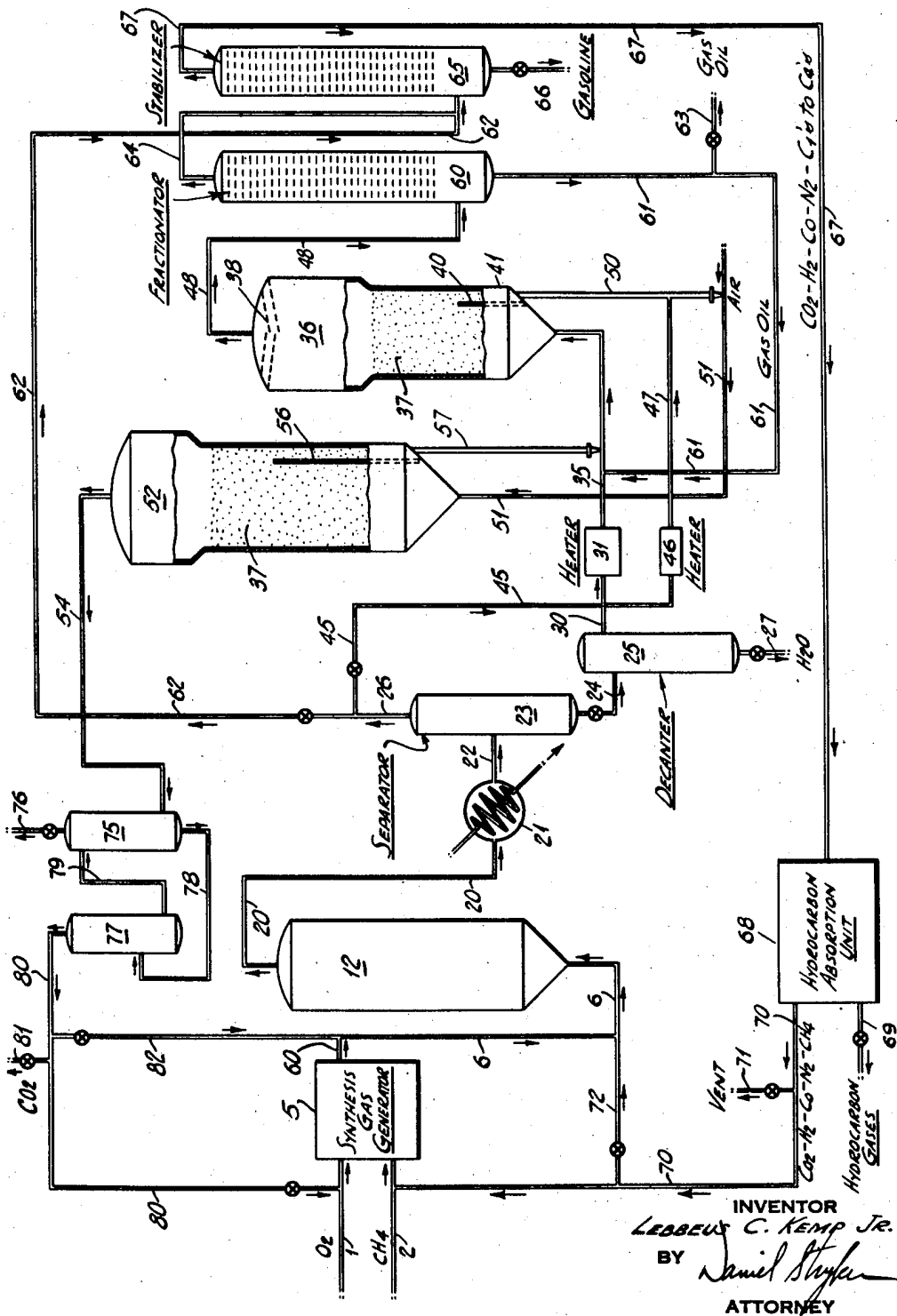
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METHOD OF MANUFACTURING MOTOR FUEL

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METHOD OF MANUFACTURING MOTOR FUEL

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This invention relates to a process for making gasoline hydrocarbons of high octane rating.

The invention involves the catalytic conversion of synthesis gas, that is, a mixture of carbon monoxide and hydrogen, under suitable conditions of temperature and pressure into hydrocarbons and hydrocarbon derivatives. The resulting hydrocarbons and hydrocarbon derivatives are converted into liquid hydrocarbons of high octane rating by treatment with a cracking catalyst at elevated temperature as will be described.

The effluent stream from a carbon monoxide hydrogenation reactor, operated to produce mainly hydrocarbons in the gasoline range, comprises gaseous hydrocarbons, liquid hydrocarbons, a small percentage of hydrocarbon waxes and oxygenated hydrocarbons, carbon dioxide, steam and nitrogen. This effluent stream is cooled to effect condensation of steam and normally liquid hydrocarbons. Water and liquid hydrocarbons are separately removed, leaving a residual gaseous fraction comprising carbon dioxide, nitrogen, C₁ up to about C₁₀ hydrocarbons and unreacted carbon monoxide and hydrogen. The substantially water-free liquid components, comprising hydrocarbons in the gasoline range, gas oil, higher boiling hydrocarbons, dissolved hydrocarbon waxes and oxygenated hydrocarbon derivatives are introduced into a catalytic cracking unit. The residual gaseous fraction is utilized to treat used catalyst from the aforesaid cracking reaction. This treatment is carried out under conditions so as to effect desorption and stripping of higher boiling hydrocarbons which are adsorbed on the cracking catalyst.

When employing a fluidized catalyst cracking system, this stripping treatment is advantageously effected within the zone of used catalyst removal from the cracking reactor. In such case the stripping gas and hydrocarbons stripped from the catalyst pass on into the cracking reaction.

Numerous advantages accrue from using the gaseous components of the effluent stream from the catalytic conversion of carbon monoxide and hydrogen for stripping the adsorbed higher boiling hydrocarbons from a fluidized cracking catalyst before its reactivation.

First, there is materially reduced the gradual deactivation of the cracking catalyst which results from the conventional use of steam to accomplish the stripping of adsorbed hydrocarbons from the catalyst in fluidized catalytic cracking operations.

Secondly, the partial pressure of the liquid hy-

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drocarbons in the fluid catalytic cracker is lowered substantially by the use of effluent gases from the hydrogenation of carbon monoxide to strip the adsorbed hydrocarbons from the catalyst since the gases issue from the stripping section into the reactor of the cracking unit. The reduction of the partial pressure of the hydrocarbons that are to be cracked results in decreased coke accumulation on the catalyst with consequent improvement in the efficiency of the cracking operation.

The invention can be better described and more fully understood by reference to the accompanying drawing wherein the method of flow of the whole operation is diagrammatically presented. Many other advantages and features of the invention will be apparent from the detailed description of the mode of operation which ensues.

The drawing shows only those operations which are essential for a complete understanding of the process of the invention; conventional heat exchangers and pumps are omitted in the interest of simplification.

Oxygen or an oxygen-rich gas, which is obtained from a source not shown, is introduced into a synthesis gas generator 5 through a feed pipe 1. This gas ordinarily contains at least 50% molecular oxygen, but it is feasible to use air for the combustion. However, in most operations, the oxidizing gas used for preparing synthesis gas contains at least 50% molecular oxygen and preferably over 75% molecular oxygen.

A hydrocarbon gas, preferably consisting mainly of methane, is introduced through a feed pipe 2 into the synthesis gas generator 5. In the diagram the oxygen-containing gas and the hydrocarbon gas are shown entering the generator 5 through separate feed lines in which there are usually inserted heaters which are not shown. The oxygen and hydrocarbon gas advantageously may be premixed before introduction into the synthesis gas generator 5 so that the whole charge to the generator may be heated at once.

In the synthesis gas generator 5, combustion occurs between oxygen and gaseous hydrocarbon to produce a mixture comprising mainly carbon monoxide and hydrogen. This generator 5 may be of the furnace type which contains either refractory material so as to permit simple surface combustion or a catalyst such as nickel deposited on a suitable carrier to catalyze the combustion. Other types of synthesis gas generators may be used, such as one employing the principles of a gas turbine to convert the heat liberated in the combustion into available mechanical

energy. The power obtained from the use of a gas turbine as a synthesis gas generator may advantageously be employed to compress and liquefy air in the preparation of oxygen.

Carbon dioxide, which is obtained from a source which will be described in detail later, is also introduced into the synthesis gas generator 5. Thereby the temperature of the highly exothermic combustion of methane with oxygen is tempered by the endothermic reaction of carbon dioxide with methane and means are provided for varying the molecular ratio of carbon monoxide to hydrogen in the synthesis gas.

The quantities of methane, oxygen and carbon dioxide introduced into the synthesis gas generator 5, are regulated so as to produce a synthesis gas containing carbon monoxide and hydrogen in the desired ratio. Usually a molecular ratio of carbon monoxide to hydrogen of 1:2 is the most advantageous. However, there are circumstances when molecular ratios of carbon monoxide to hydrogen varying from 1:1 to 1:3 are desired. In some cases it may be desirable or expedient to operate with carbon monoxide to hydrogen ratios even higher than 1:3.

It is possible to effect tempering of the highly exothermic combustion of methane with oxygen by the introduction of steam into the synthesis gas generator 5 for steam also undergoes an endothermic reaction with methane. Moreover, the introduction of steam provides means of adjusting the carbon monoxide to hydrogen ratio in the synthesis gas. The introduction of steam, as an alternative for or in conjunction with carbon dioxide, is not shown in the diagram, but such operation is included within the concept of the invention.

Synthesis gas, containing the desired molecular ratio of carbon monoxide to hydrogen, leaves the generator 5 through a pipe 6. The synthesis gas contains varying minor proportions of carbon dioxide and steam which may be removed, if desired, by conventional means, not shown, before introduction of synthesis gas into the reactor suitable for the hydrogenation of carbon monoxide. Thus, steam can be removed by conventional condensation while carbon dioxide can be removed by passage of the gases through an absorber which contains a solution of an alkaline agent such as triethanolamine.

The synthesis gas is brought to the desired temperature in a heat exchanger, also not shown, before introduction through the pipe 6 into a carbon monoxide hydrogenation reactor 12. The temperature at which the synthesis gas is introduced into the reactor 12 depends upon the catalyst and the type of operation that is employed. For example, a fixed bed operation employing a cobalt catalyst supported on a carrier at atmospheric pressure operates most effectively at a temperature of about 375° to 400° F. to produce liquid hydrocarbons in the gasoline range. A fluidized catalyst operation employing an unsupported iron catalyst at about 200 to 250 pounds pressure operates most effectively in the range of about 550° to 650° F. to produce liquid hydrocarbons in the gasoline range.

The reactor 12 can be of the fixed catalyst bed type or one of the various modifications of fluidized catalyst systems.

An iron, cobalt, nickel, ruthenium or rhenium catalyst, either supported or unsupported, may be used in the reactor 12 to effect the catalytic conversion of synthesis gas into hydrocarbons. As indicated previously, the type of catalyst em-

ployed determines the temperature at which the reactor 12 is maintained.

If a fluidized system of catalytic conversion is employed, means such as a cyclone separator are provided to remove entrained dust from the effluent stream from the reactor 12.

In the reactor 12, synthesis gas is converted into hydrocarbons by contact with the catalytic material contained therein and then issues from the reactor through the pipe 20. The effluent stream from the reactor contains unreacted carbon monoxide and hydrogen, diluent nitrogen, gaseous hydrocarbons, liquid hydrocarbons, carbon dioxide and steam, which latter two are by-products of the catalytic conversion. The effluent stream is cooled from the high temperature at which it issues from the reactor 12 in a heat exchanger 21. In the heat exchanger 21 there is effected condensation of the steam and normally liquid constituents contained in the effluent from the reactor 12.

From the heat exchanger 21, the effluent flows along a pipe 22 into a gas-liquid separator 23. Therein the effluent is separated into normally gaseous constituents and normally liquid ones. The water and normally liquid hydrocarbons leave the separator through a pipe 24 which leads to a decanter 25. The gaseous components of the effluent issue from the separator 23 through a pipe 26. The disposal of these gaseous components will be described in detail later.

In the decanter 25, water is separated from the normally liquid hydrocarbons and is removed through an exit pipe 27. The normally liquid hydrocarbons leave the decanter 25 through a pipe 30 and therethrough are introduced into a pre-heater 31.

In the pre-heater 31, the normally liquid hydrocarbons which are now at a low temperature are raised to about 650° F. As described later, the so preheated hydrocarbons are further heated by contact with hot regenerated catalyst which is being returned to the cracking reaction zone.

The hydrocarbons leave the heater 31 at the desired elevated temperature through a pipe 35 and then are introduced to a cracking unit employing a fluidized catalytic operation. In a reactor 36 of this fluidized catalytic cracking unit, the hydrocarbons contact a catalyst which is in the fluidized state such as disclosed in U. S. Patent No. 2,361,978, for example. The numeral 37 designates the catalyst whose average particle size varies from 40 to 60 microns, depending upon the type of a fluid system that is employed.

The catalyst 37 may be of the synthetic type such as silica-alumina, alumina-boria, etc., or it may be of a natural type such as natural or acid activated clays of the bentonite type; moreover, it may be promoted or unpromoted. The type of catalyst employed will determine the operating conditions that will be maintained in the reactor 36. In general, a temperature between 850 to 1050° F. is maintained and the reactor may be designed to withstand operating pressures up to and above 150 pounds per square inch.

By contact under the conditions outlined above, the hydrocarbon material, which has been introduced into the reactor 36 through the pipe 35 and which contains high boiling naphthas, gas oil, Diesel oil and other hydrocarbon material of low octane rating, are cracked to give a greater portion of hydrocarbons boiling in the gasoline range of high octane rating. During this catalytic cracking, some oil is adsorbed by the catalyst and converted into carbon which accumulates on the

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catalytic material thereby coating the active catalytic centers and decreasing the activity of the catalyst. Therefore, a portion of the fluidized catalyst is continuously removed from the reactor 36 for reactivation by removal of carbonaceous material in the regenerator section of the fluid catalytic cracking unit.

Thus a portion of the fluidized catalyst flows continuously over a baffle 40 into a stripping section 41 in the lower portion of the reactor 36. Herein there is introduced all or a portion of the gaseous components of the effluent stream from the carbon monoxide hydrogenation reactor which which have been separated from the liquid components in the separator 23. As indicated previously, these gases leave the separator 23 through the pipe 26 and then may be diverted in whole or in part along a pipe 45 to a heater 46 in which they are raised to a temperature in the range of about 300 to 500° F. The gases which comprise carbon dioxide, nitrogen, unreacted carbon monoxide and hydrogen and hydrocarbons which are mainly normally gaseous ones but some of which are of higher molecular weight up to about the C₁₀'s, leave the heater 46 through a pipe 47 and therethrough are introduced into the stripping section 41 of the reactor 36.

The catalyst particles which enter the stripping section 41 contain a considerable amount of higher boiling hydrocarbons adsorbed on their surface and condensed in their capillaries and interstices. In conventional operation, steam is employed to strip these hydrocarbons from the catalyst. The cracking catalyst suffers gradual deactivation through the use of steam to effect the removal of the adsorbed hydrocarbons from the catalyst.

In the method of this invention, desorption of the higher boiling hydrocarbons from the catalyst is effected by the introduction of the gaseous constituents of the effluent from the carbon monoxide hydrogenation reactor into the stripping section 41 at an elevated temperature. The use of these gases substantially reduces the deactivation of the catalyst which results from the use of steam for this purpose and still efficiently accomplishes the stripping of the hydrocarbons from the catalyst.

After the gases have effected the desorption of the higher boiling hydrocarbons from the catalyst, they pass around the baffle 40 into the cracking section proper of the reactor 36. The presence of these gases in the reactor 36 reduces the partial pressure of the hydrocarbons that are cracked therein. This reduction in partial pressure of crackable hydrocarbons effects decreased coke formation on the catalyst thereby increasing the efficiency of the cracking operation.

The products of the catalytic cracking and the gases which have been used to effect the desorption of the hydrocarbons from the cracking catalyst prior to its reactivation issue from the cracking reactor 36 through a pipe 48. Baffles 38 remove entrained catalytic material from the gaseous stream before it issues from the reactor 36. Cyclone separators may be used instead of the baffles 38 to effect the removal of the entrained catalytic particles from the gaseous stream. The treatment of the effluent which leaves the reactor 36 through the pipe 48 will be described more in detail later.

After the catalyst has been stripped of adsorbed hydrocarbons in the stripping section 41 of the reactor 36 through the action of the gaseous con-

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stituents of the effluent from the hydrogenation of carbon monoxide, it is continuously withdrawn from the reactor 36 through the conduit 50, and flows therethrough into the pipe 51. Air or oxygen, which is obtained from a source not shown, is pumped under pressure through the pipe 51, thereby providing means for transporting the catalyst from the reactor 36 to the regenerator 52 through the pipe 51. In the regenerator 52, the catalyst is reactivated by removal of the accumulated coke by combustion with the air or oxygen which has been introduced therein in the manner just described. Air is ordinarily used to effect this combustion. It is desirable to keep the combustion temperature in the regenerator 52 in the range of 1,000° to 1,200° F. so as to avoid deactivation of the catalyst.

The numeral 37 also designates the catalytic material which is undergoing reactivation by removal of the coke in the regenerator 52. Cyclone separators plus electrical precipitators or similar devices, not shown, are provided to remove entrained catalyst from the effluent from the regenerator 52. This effluent comprises mainly carbon dioxide, carbon monoxide, nitrogen and oxygen which has not been utilized in the combustion. The treatment of this effluent stream will be described in detail later.

A portion of the reactivated catalyst continuously flows over a baffle 56 into the lower portion of the regenerator 52 whence it is continuously returned to the reactor 36. The reactivated catalyst leaves the regenerator 52 through a conduit 57 which flows into the feed line 35 through which the hydrocarbons that are to be cracked are introduced into the reactor 36. The flow of these hydrocarbons along the pipe 35 provides means of returning the reactivated catalyst to the reactor 36. The catalyst, at an elevated temperature because of the combustion, imparts its heat to the stream of hydrocarbons that are introduced into the reactor 36 through the pipe 35.

The effluent from the reactor 36, comprising the products of the cracking operation and the gases which were used to effect the stripping of the adsorbed hydrocarbons, pass along the pipe 48 to a fractionator 60. Herein the higher boiling hydrocarbons, such as gas oil, which have not been converted into gasoline hydrocarbons in the cracking operation, are condensed and thereafter are recycled through the pipe 61 to the reactor 36 for further treatment, or led to storage through the pipe 63. The pipe 61 leads into the feed line 35 whence the recycle gas oil is returned to the reactor 36. The recycle gas oil is raised to cracking temperature by contact with the hot regenerated catalyst which flows through the conduit 57 into the feed line 35.

The lower boiling hydrocarbons, comprising gasoline and the normally gaseous components of the effluent from the reactor 36, leave the fractionator 60 through a pipe 64 and therethrough are introduced into a stabilizer 65. Herein the gaseous components of the effluent from the cracking operation, such as carbon dioxide, hydrogen, carbon monoxide, nitrogen, and C₁ to C₄ hydrocarbons, are separated from the gasoline fraction. The gasoline fraction is removed through the pipe 66 and is piped to storage, not shown.

The portion of the gaseous effluent from the hydrogenation of carbon monoxide which is not used for stripping the adsorbed hydrocarbons from the cracking catalyst in the stripping zone 41 prior to its reactivation, passes along a pipe

62 which connects with the pipe 28 through which the gaseous effluent leaves the separator 23. Through the pipe 62, this portion of the gaseous effluent from the hydrogenation of carbon monoxide enters the stabilizer 65, wherein any gasoline hydrocarbons contained therein are separated. The gasoline separated therefrom merges with the gasoline resulting from the cracking operation and is removed from the stabilizer through the pipe 66. The gaseous components, comprising carbon dioxide, nitrogen, unreacted carbon monoxide and hydrogen and C₁ to C₄ hydrocarbons, combine with the gaseous fraction of the effluent from the cracking reactor 36.

The combined gaseous fractions, comprising the components enumerated above, leave the stabilizer 65 through a pipe 67 and pass therealong to a hydrocarbon absorption unit 68 which is of the conventional type adapted to effect absorption of hydrocarbon gases. The C₁ to C₄ hydrocarbons and some methane are absorbed in the absorption unit 68 wherein an absorbing medium, such as charcoal or gas oil, is employed. The hydrocarbons which are absorbed in the absorbing medium are stripped from the absorbent in a separate section of the absorption unit 68 and are removed therefrom through a pipe 78 whence they are piped to storage, not shown.

The gas which leaves the hydrocarbon absorption unit 68 through a pipe 70 comprises carbon dioxide, nitrogen, hydrogen, carbon monoxide and methane. This gas is advantageously returned at least in part to the synthesis gas generator 5 wherein its content of methane and carbon dioxide may be utilized in the preparation of synthesis gas. The hydrogen and carbon monoxide present in this gaseous fraction may serve as diluents to moderate the highly exothermic oxidation taking place in the synthesis gas generator 5. A portion of the gas must first be vented, however, to prevent an accumulation of nitrogen in the system. This may be accomplished through the vent 71. The unvented portion of this tail gas proceeds along the pipe 70 until it is introduced into the hydrocarbon feed line 2 whence it is introduced into the generator 5.

Alternatively or simultaneously a portion of this gas comprising carbon monoxide, hydrogen, carbon dioxide, methane and nitrogen may be introduced into the synthesis reactor 12 through a pipe 72 which leads from the pipe 70 to the feed pipe 6.

The effluent from the regenerator 52 contains mostly carbon dioxide, carbon monoxide, nitrogen and oxygen which has not been utilized in the combustion. This effluent passes along the pipe 54 to a carbon dioxide absorbing tower 75. Therein the carbon dioxide portion of this effluent is absorbed in a suitable medium, such as a solution of triethanolamine. The unabsorbed components of the gas stream are vented through the vent 76. The absorbing medium is continuously passed to a carbon dioxide-stripping section 77 through a pipe 78. In the stripping section 77, the carbon dioxide is stripped from the absorbing medium and exits from the stripping section 77 through a pipe 80. The regenerated absorbing medium returns to the absorbing section 75 through a pipe 79.

The carbon dioxide passes along the pipe 80 to a vent 81 through which it may be vented in whole or in part. Advantageously, a portion of this carbon dioxide is returned to the synthesis gas generator 5, wherein it is utilized in the preparation of synthesis gas. The pipe 80 leads to the feed

line for the oxidizing gas 1, and therethrough carbon dioxide is introduced into the synthesis gas generator 5.

Alternately the carbon dioxide may be introduced into the synthesis reactor 12. This may be effected by passing the carbon dioxide along a pipe 82 which leads from the pipe 80 to the pipe 6 which is the feed line to the reactor 12. Through the pipe 6 the carbon dioxide is introduced into the reactor 12 together with the synthesis gas.

While mention is specifically made of the use of methane for the preparation of the synthesis gas, other hydrocarbon gases may be utilized in the preparation of synthesis gas. As a matter of fact, synthesis gas from any source may be used.

An additional advantage of the use of the conjunctive operation resides in the fact that in the cracking operation, the oxygenated products present in the products of the hydrocarbon synthesis are deoxygenated. The olefins so formed then undergo a double bond shift type of isomerization. The deoxygenation and isomerization result in improved products.

In the description of the invention, the hydrogenation of carbon monoxide is described as employed in conjunction with a fluidized system of catalytic cracking. However, the invention contemplates the use of a carbon monoxide hydrogenation process in conjunction with any type of catalytic cracking operation, wherein a portion of the catalyst is continuously regenerated, and wherein stripping of the adsorbed hydrocarbons prior to regeneration is necessary in order to avoid the loss of a considerable portion of hydrocarbons in the combustion which takes place in the regenerator zone.

In accordance with the invention, the hydrogenation of carbon monoxide can be employed in conjunction with a hydroforming operation. The hydrogen resulting from the hydroforming process may be used to supplement the synthesis gas in which there is sometimes a deficiency of hydrogen depending on the source of the synthesis gas.

Obviously, many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof and, therefore, only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. In a catalytic conversion of a mixture of carbon monoxide and hydrogen into liquid hydrocarbons of high octane rating, the steps which comprise preparing synthesis gas comprising hydrogen and carbon monoxide in a gas generation zone by the oxidation of carbonaceous material, converting said synthesis gas into hydrocarbons and hydrocarbon derivatives by contact with a synthesis catalyst under conversion conditions of temperature and pressure, separating the reaction products into a normally liquid fraction and a normally gaseous fraction, continuously passing the liquid fraction in contact with a mass of finely divided, solid, hydrocarbon-conversion catalyst maintained at a temperature effective for catalytically cracking hydrocarbons, continuously discharging products of cracking from the cracking zone, continuously removing from the cracking zone used catalyst, subjecting removed catalyst to contact with an oxidizing gas in a zone of reactivation to effect combustion of carbonaceous material contained in the catalyst, thereby forming a flue gas containing carbon dioxide, separating carbon dioxide from said flue gas, subjecting said used catalyst prior to said combustion to con-

tact with a stripping gas comprising a portion at least of the gaseous effluent from the catalytic conversion of carbon monoxide and hydrogen, in a stripping zone under conditions effective to strip adsorbed hydrocarbons from said catalyst, passing said stripping gas and resulting desorbed hydrocarbons from the stripping zone to said cracking zone, subjecting the combined products from the cracking zone to a separation process effective to recover normally liquid hydrocarbon products of reaction and deliver a normally gaseous stream containing the normally gaseous products from said cracking zone, supplying a substantial portion of said normally gaseous stream to said gas generation zone for the production of additional synthesis gas by the oxidation of carbonaceous materials therein, utilizing said additional synthesis gas in the production of additional hydrocarbons, and adding a second portion of said normally gaseous stream together with a portion at least of the said carbon dioxide separated from said flue gas, to the synthesis gas subjected to contact with said synthesis catalyst.

2. In the catalytic conversion of a mixture of carbon monoxide and hydrogen into liquid hydrocarbons of high octane rating, the steps which comprise preparing synthesis gas comprising hydrogen and carbon monoxide in a gas generation zone by the oxidation of carbonaceous material, converting said synthesis gas into hydrocarbons and hydrocarbon derivatives by contact with a synthesis catalyst under conversion conditions of temperature and pressure, separating the reaction products into a normally liquid fraction and a normally gaseous fraction, continuously passing the liquid fraction in contact with a mass of finely divided, solid, hydrocarbon-conversion catalyst maintained at a temperature effective for catalytically cracking hydrocarbons, continuously removing from the cracking zone used catalyst, subjecting removed catalyst to contact with an oxidizing gas in a zone of reactivation to effect combustion of carbonaceous material contained in the catalyst, thereby forming a flue gas containing carbon dioxide, separating carbon dioxide from said flue gas, subjecting said used catalyst, prior to said combustion, to contact with a stripping gas comprising a portion at least of the gaseous effluent from the catalytic conversion of carbon monoxide and hydrogen, in a stripping zone under conditions effective to strip adsorbed hydrocarbons from said catalyst, passing said stripping gas and resulting desorbed hydrocarbons from the stripping zone to said cracking zone, recovering the combined reaction effluent from said cracking zone, subjecting said effluent, including both products of reaction and products of stripping, to a separating step effective to recover normally liquid hydrocarbons and delivering a stream of normally gaseous products, recycling a portion of said last-named stream together with a portion at least of the said carbon dioxide separated from said flue gas to said synthesis gas generation zone for formation of additional synthesis gas, including said additional synthesis gas in the mixture converted to hydrocarbons and hydrocarbon derivatives, as aforesaid, and continuously admixing a second portion of said normally gaseous product stream and an additional portion of carbon dioxide separated from said flue gas, with the synthesis gas subjected to contact with the synthesis catalyst for the preparation of hydrocarbons and hydrocarbon derivatives.

3. In the catalytic synthesis of liquid hydro-

carbons in high octane rating wherein a carbonaceous material is submitted to partial combustion in a synthesis gas generation zone in the presence of molecular oxygen under exothermic conditions for the production of a synthesis gas comprising hydrogen and carbon monoxide, the synthesis gas being converted into hydrocarbons and hydrocarbon derivatives in a reaction zone by contact with a hydrocarbon synthesis catalyst under conversion conditions of temperature and pressure, the reaction products separated into a normally liquid fraction and a normally gaseous fraction, and a normally liquid fraction is continuously passed in contact with a mass of finely divided, solid particle, hydrocarbon-conversion catalyst maintained at a temperature effective for catalytically cracking said normally liquid fraction, the improvement which comprises continuously removing used catalyst from the cracking zone, subjecting said removed catalyst to contact with an oxidizing gas to effect combustion of carbonaceous material deposited on the catalyst, thereby forming a flue gas containing carbon dioxide, separating carbon dioxide from said flue gas, subjecting said used catalyst prior to combustion to contact with stripping gas comprising a portion at least of the said normally gaseous fraction derived from the catalytic reaction of carbon monoxide and hydrogen, in a stripping zone under conditions effective to strip adsorbed hydrocarbons from the catalyst, passing the said stripping gas and resulting desorbed hydrocarbons from the stripping zone to said cracking zone, recovering normally liquid hydrocarbons from the combined products of the cracking zone, thereby leaving a normally gaseous stream of products from the cracking zone, venting a portion of said normally gaseous stream, separating the remainder into at least two streams, continuously conveying one of said streams of gas into admixture with the synthesis catalyst, and continuously directing the other stream into said synthesis gas generation zone for the production of additional synthesis gas, simultaneously conducting said carbon dioxide separated from said flue gas into admixture with the synthesis catalyst.

4. In the catalytic conversion of a mixture of carbon monoxide and hydrogen into liquid hydrocarbons of high octane rating, the steps which comprise preparing synthesis gas comprising hydrogen and carbon monoxide in a gas generation zone by the oxidation of carbonaceous material, converting said synthesis gas into hydrocarbons and hydrocarbon derivatives by contact with a synthesis catalyst under conversion conditions of temperature and pressure, separating the reaction products into a normally liquid fraction and a normally gaseous fraction, continuously passing the liquid fraction in contact with a mass of finely divided solid, hydrocarbon-conversion catalyst maintained at a temperature effective for catalytically cracking hydrocarbons, continuously discharging products of cracking from the cracking zone, continuously removing from the cracking zone used catalyst, subjecting removed catalyst to contact with an oxidizing gas in a zone of reactivation to effect combustion of carbonaceous material contained in the catalyst, thereby forming a flue gas containing carbon dioxide, separating carbon dioxide from said flue gas, subjecting said used catalyst prior to said combustion to contact with a stripping gas comprising a portion at least of the gaseous effluent from the

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catalytic conversion of carbon monoxide and hydrogen, in a stripping zone under conditions effective to strip adsorbed hydrocarbons from said catalyst, passing said stripping gas and resulting desorbed hydrocarbons from the stripping zone to said cracking zone, subjecting the combined products from the cracking zone to a separation process effective to recover normally liquid hydrocarbon products of reaction and deliver a normally gaseous stream containing the normally gaseous products from said cracking zone, and continuously supplying a substantial portion at least of said normally gaseous stream together with a portion at least of said carbon dioxide separated from said flue gas to the synthesis gas subjected to contact with said synthesis catalyst for the preparation of hydrocarbon and hydrocarbon derivatives.

5. The method according to claim 1 wherein said oxidation of said carbonaceous material in the gas generation zone comprises partial combustion of said carbonaceous material in the presence of free oxygen under exothermic conditions.

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6. The method according to claim 4 wherein said oxidation of said carbonaceous material in the gas generation zone comprises partial combustion of said carbonaceous material in the presence of free oxygen under exothermic conditions.

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