May 18, 1943 DU BOIS EASTMAN ET AL 2,319,590

CATALYTIC CRACKING OF HYDROCARBON OILS

Filed Jan. 13, 1940 3 Sheets-Sheet 1

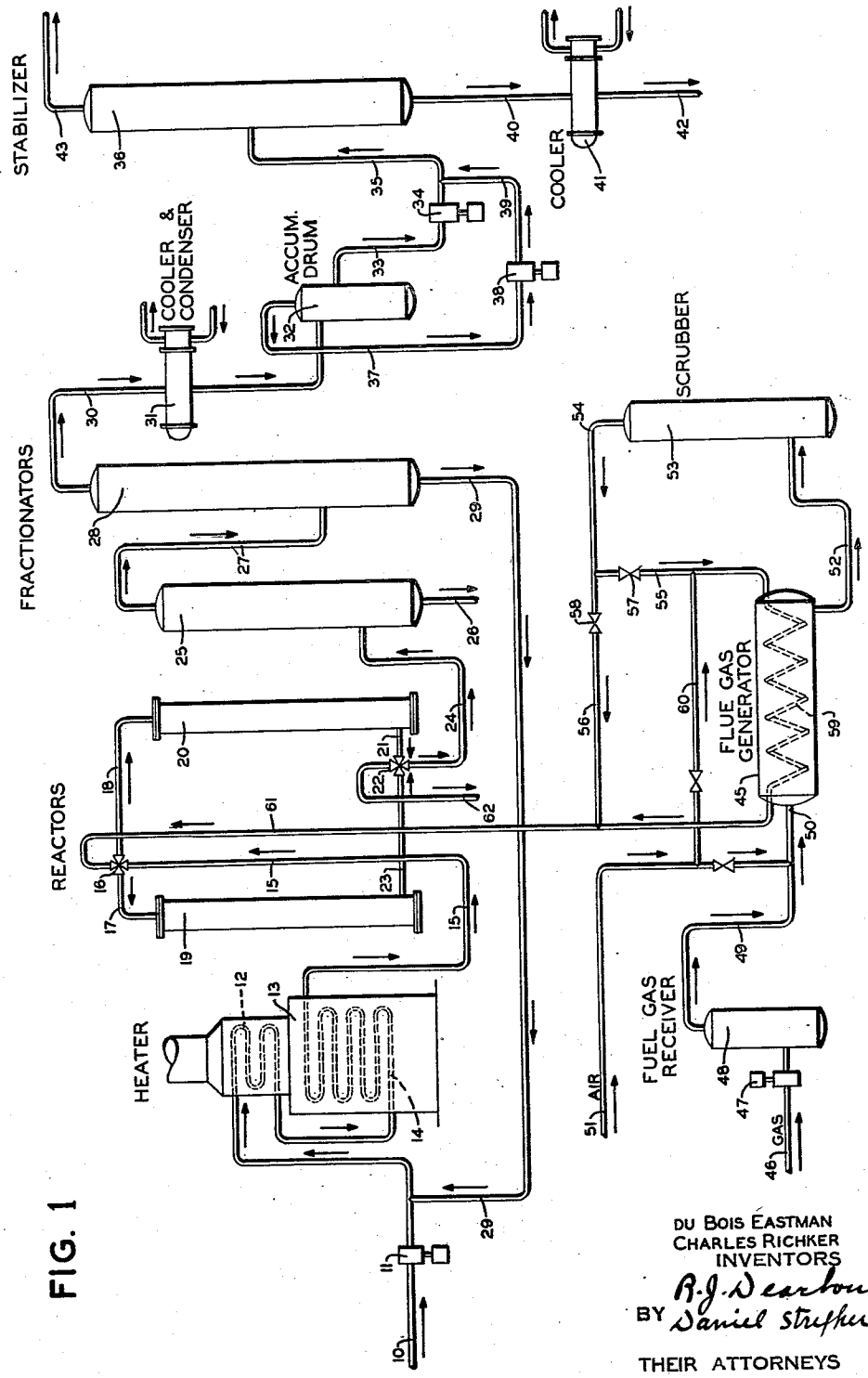


FIG. 1

DU BOIS EASTMAN
CHARLES RICHKER
INVENTORS

BY R. J. Dearborn
Daniel Strepher

THEIR ATTORNEYS

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CATALYTIC CRACKING OF HYDROCARBON OILS

Filed Jan. 13, 1940 3 Sheets-Sheet 2

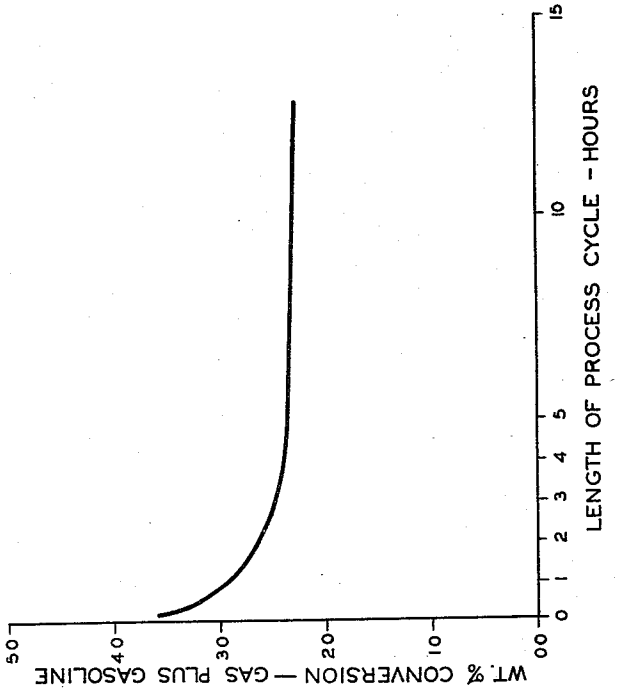


FIG. 3

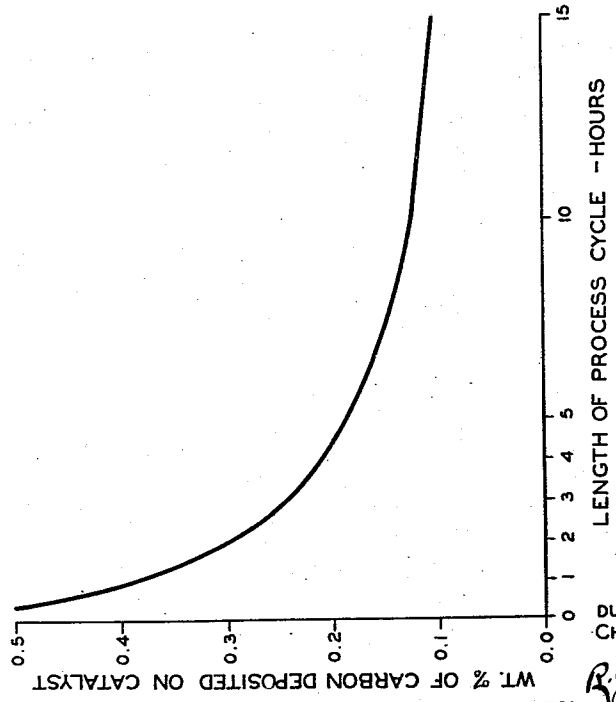


FIG. 2

DU BOIS EASTMAN
CHARLES RICHKER
INVENTORS

BY R. J. Dearborn
Daniel Stryker

THEIR ATTORNEYS

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Filed Jan. 13, 1940 3 Sheets-Sheet 3

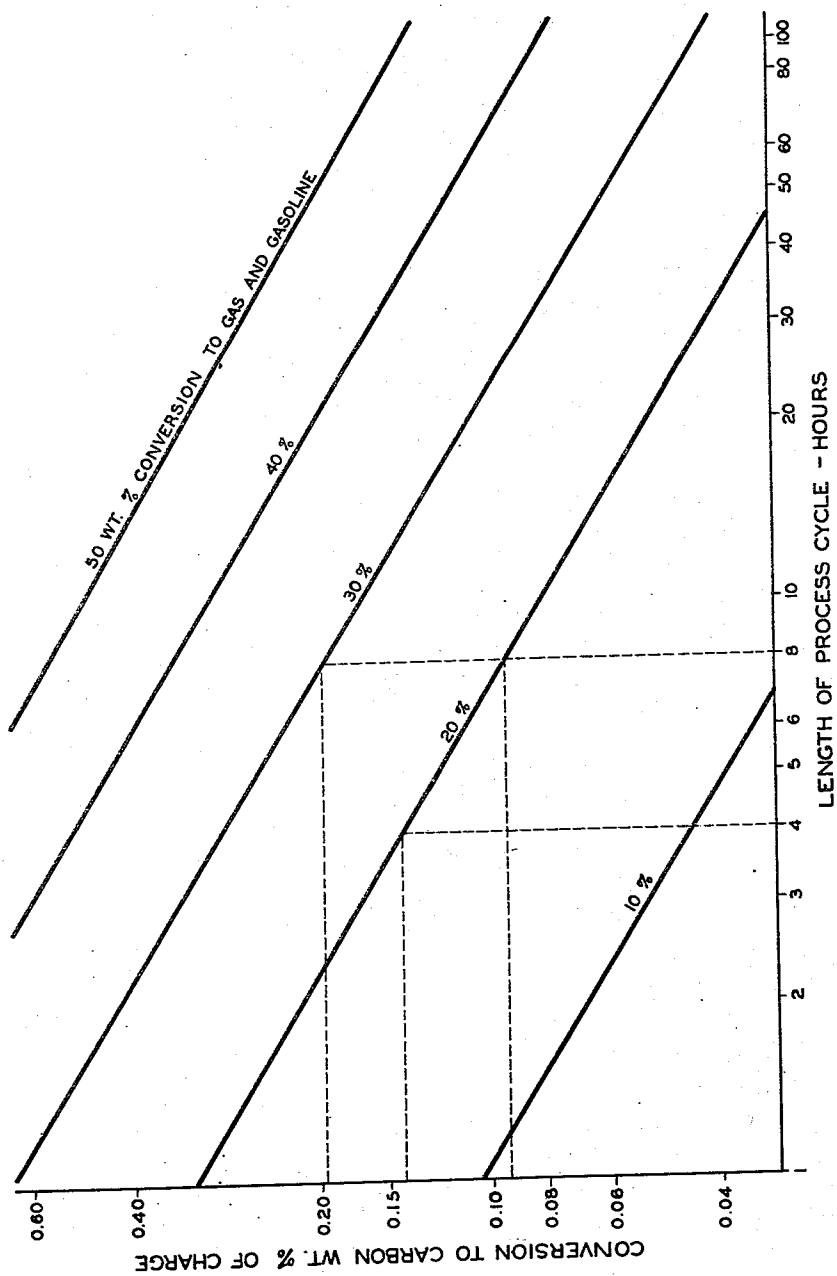


FIG. 4

DU BOIS EASTMAN
CHARLES RICHKER
INVENTORS

BY R. J. Dearborn
Daniel Stryker
THEIR ATTORNEYS

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UNITED STATES PATENT OFFICE

2,319,590

CATALYTIC CRACKING OF HYDROCARBON OILS

DuBois Eastman and Charles Richker, Port Arthur, Tex., assignors, by mesne assignments, to The Texas Company, New York, N. Y., a corporation of Delaware

Application January 13, 1940, Serial No. 313,654

11 Claims. (Cl. 196—52)

This invention relates to the catalytic cracking of heavier hydrocarbon oils to convert the same to gasoline hydrocarbons suitable for motor and aviation fuel.

One of the principal objects of the invention is to provide an improved catalytic cracking process of this character having greatly increased conversion cycle time over such processes as heretofore commercially employed, with greater throughput and capacity of the plant for lower installation and operating costs.

Another object of the invention is to provide a catalytic cracking process of this character in which the feed stock is selected to give a clean charge and the conditions of operation correlated to provide an exceedingly long time on stream or conversion cycle time before reactivation of the catalyst is necessary, to give a high conversion of gasoline plus gas per pound of carbon deposited on the catalyst, with resulting high throughput and efficiency of operation.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In catalytic cracking processes of this character as heretofore used commercially, it has been customary to pass a preheated stream of the hydrocarbon oil in substantially vaporized form through a catalyst bed maintained at an elevated temperature for a comparatively short conversion time, to convert the hydrocarbon oil to gasoline hydrocarbons with concomitant breakdown of a portion of the feed to gas and resultant deposition of coke or carbon on the catalyst. The activity of the catalyst as measured by the percentage conversion per pass to gasoline and gas drops off exceedingly rapidly as the carbon deposit builds up on the catalyst. In order to maintain a desirably high conversion, it has been customary to run with an exceedingly short conversion cycle or on-stream time, then terminate the flow of the hydrocarbon charge through the catalyst bed, and reactivate that bed by passing therethrough a highly heated gas containing air or oxygen to burn off the carbon deposits and bring the catalyst back to a high activity. The reactivation may be preceded by a purging of the catalyst bed following the on stream time, such as by passing steam or other inert gas through the bed; and a similar purging may be employed following the reactivation period. In a typical installation of the so-called Houdry type, it is customary to employ an operating cycle of ten minutes on-stream, five minutes for purging, ten minutes for reactivation, and five minutes for a final purging before the unit is again placed on-stream. This means that a catalytic cracking chamber is off-stream for twice the period of time that it is on-stream or is actually being used for the conversion operation.

It has heretofore been thought necessary to use a short intermittent cycle of this type in order to obtain commercially satisfactory results from the standpoint of conversion or gasoline yield and quality of product. Apparently previous results tended to confirm the prevalent belief in the industry that continuance of the on-stream time would give a progressive decrease in conversion, while the rate of carbon deposition on the catalyst would remain essentially constant under the given operating conditions. It had also been found that when excessive quantities of carbon were allowed to deposit on the catalyst bed, the reactivation of that catalyst could only be accomplished with exceedingly great difficulty and often without a return of the catalyst to the desired high activity. Consequently, in order to obtain the desired practical conversion per pass and the proper reactivation of the catalyst, resort has been had to the short on-stream cycles.

Contrary to expectations and the previous knowledge in this art, it has now been found that greatly improved results are secured under proper and controlled operating conditions by employing a conversion cycle time or on-stream time which is increased many times over previous practice. Further, the proper reactivation of the catalyst is effected with a reactivation cycle time which is not greater than, and is usually less than, the conversion cycle time. Greatly increased throughput and higher efficiency of operation of the plant are thereby secured. This is accomplished by first selecting a suitable charging stock which is a relatively clean oil of good color. Second, a cracking catalyst of high and sustained activity is employed. And third, the operating conditions of temperature, pressure and space velocity are correlated with the other factors to allow prolonging the conversion cycle time to a period in excess of four hours, and preferably of the order of 8–20 hours or more. Under these conditions, the catalyst with deposited carbon or coke at the termination of the on-stream time can be reactivated without difficulty with a reactivation cycle time not greater than four hours, and generally of the order of 2–3 hours.

Under these operating conditions, a further unexpected result has been obtained. This is that the conversion rate per pass drops off only a com-

paratively small amount as the conversion cycle time is prolonged to within the range set forth above, while the rate of carbon deposition on the catalyst falls off a comparatively large amount. Thus there is obtained a conversion yield in excess of fifty pounds, and generally of the order of eighty pounds or more, of gasoline plus gas per pound of carbon deposited on the catalyst. This is greatly in excess of the conversion yields per pound of carbon deposited on the catalyst heretofore obtained with the conventional short operating cycle. At the same time, the ratio of gasoline to gas produced is maintained at a desirably high figure, and the quality of the gasoline is at least as good as that produced with the short operating cycle.

In accordance with the present invention, a heavier hydrocarbon oil feed stock is selected which is of clean character and good color, as represented by a carbon residue of less than 0.2% and a color of less than 200 as measured on the Lovibond ½" scale. Various types of feed stocks having these characteristics can be employed, such as various kerosenes, gas oils, distillate lubricating oils and even topped crudes and residuals, which have been treated to bring them within the characteristics mentioned above. Either straightrun, cracked or cycle stocks or mixtures thereof, can be employed, although it is generally preferred to utilize straightrun fractions. A stock relatively free from unsaturates is preferred, and this stock may be from paraffinic, mixed base or naphthenic crudes, although the fractions from naphthenic crudes appear to give even better results. From the operating standpoint, a straightrun gas oil, either light or heavy, or a broad range fraction, representing normal plant supply, is eminently satisfactory.

The type of catalyst employed may be defined as one having high initial as well as sustained activity, such as a catalyst giving a conversion per pass in excess of 15% and preferably in excess of 25%, by weight of gasoline plus gas over a processing cycle in excess of four hours, and preferably of the order of 10–20 hours or more. Various catalysts satisfying these requirements under the present conditions of operation have been found, and the invention is applicable to any active cracking catalyst of this type. As representative of the catalysts satisfying these requirements, there may be mentioned the synthetic silica-alumina type. Various acid-treated clays such as the Super-Filtrols and metal-substituted clays, are satisfactory. Likewise, the acid-treated and metal-substituted natural or artificial zeolites, such as the artificial zeolite known as Doucil, can be used. Various metals can be substituted in the clays or zeolites, such as uranium, molybdenum, manganese, lead, zinc, zirconium, nickel and the like. Likewise, the combination of certain acid-treated active clays of the character of Filtrol, together with added proportions of alumina or silicate or both can be employed. Alumina alone may be used under certain conditions. The synthetic silica-alumina catalysts can be improved by the addition of other constituents, such as zirconium oxide or molybdenum oxide. Other catalysts which are not silica-alumina catalysts, either synthetic or prepared from natural minerals, have been found which satisfy the characteristics of the catalyst of the present invention. In general, a catalyst is employed which is stable at high temperatures of the order of 1400–1600° F., as determined by calcining in a muffle furnace at that temperature, and which is a measure or indication of the ability of the catalyst to maintain its activity under the customary temperatures of reactivation of the order of 1100–1400° F., as measured by thermocouples within the catalyst bed during the reactivation cycle. It is preferred to employ a catalyst which is substantially free from alkali and alkaline earth metals. By way of specific example, a very satisfactory catalyst is a synthetic silica-alumina-zirconia catalyst containing 100 parts by weight of SiO_2, 2 parts by weight of Al_2O_3, and 4 parts by weight of ZrO_2.

During the processing cycle, the catalyst is maintained at a temperature of 850–1050° F., and preferably of the order of 910–1000° F. Pressures of the order of atmospheric up to about 200 pounds per square inch may be employed, but it is important that the pressure be correlated with the temperature so that the pressure is below the critical or dew point of the charge stock at the temperature used, whereby the preheated and vaporized oil charge is maintained in completely vaporized form in contact with the catalyst and oil deposition or condensation on the catalyst is avoided. For example, with a temperature of 850° F., a pressure of about fifty pounds per square inch is approximately the critical pressure, and consequently somewhat lower pressures than this are generally employed at the lower temperatures. The intermediate or higher temperatures within the range specified are therefore preferred. The higher pressures of operation are preferred for thermal economy, particularly in the fractionation of the cracked products; and consequently the pressure is generally raised to approach but be below the critical pressure for the temperature employed.

The charge rate during the processing cycle is conveniently expressed in terms of space velocity, which means the total liquid volume of charge divided by the total volume of catalyst (solid volume plus voids) per hour. Expressed in these units, a space velocity of about 1–10 gives satisfactory results, and about 3–6 is preferred. In determining space velocity the liquid charge is usually regarded as liquid measured at 60° F.

During the reactivation, a mixture of flue gas and/or steam with air or oxygen is employed. This flue gas is preheated, preferably to a temperature of the order of about 800° F., and is then passed through the catalyst bed to cause a low temperature combustion of the deposited carbon on the catalyst. The temperature of the catalyst during the reactivation is maintained below a certain peak temperature as measured by thermocouples positioned within the catalyst bed, which peak temperature may be of the order of 1100–1400° F. This may be accomplished by any suitable means of cooling or extracting heat from the catalyst during the reactivation, and may be at least in part controlled by the oxygen content of the flue gas which is generally of the order of 1–5%.

In the annexed drawings, which illustrate a preferred embodiment of the invention:

Fig. 1 is a flow sheet of a catalytic cracking plant for carrying out the method of the present invention;

Fig. 2 is a diagram illustrating a typical curve of the weight percent deposit of carbon on the catalyst for various processing cycle times, based upon the weight of the charge supplied to the cracking unit;

Fig. 3 is a diagram illustrating a typical curve of weight percent conversion per pass to gaso-

line plus gas based upon the weight of the charge for various processing cycle times, and

Fig. 4 is a diagram on the logarithmic scale with weight percent conversion to carbon plotted against length of process cycle in hours for various weight percent conversions of the charge to gasoline plus gas.

Referring to the drawings, a suitable hydrocarbon oil charge stock of the character hereinbefore mentioned is introduced by line 10 and forced by pump 11 through preheating coil 12 in the stack of furnace 13 and thence through radiant heating coil 14 within the furnace and line 15 to a 4-way control valve 16. The latter controls the passage of the preheated and vaporized oil to one or the other of lines 17 and 18 leading into the top of the catalyst chambers 19 and 20 respectively. Each catalyst chamber is supplied with a suitable volume of an active cracking catalyst of the type hereinbefore mentioned, and may be equipped with any suitable means (not shown) for maintaining and controlling the temperature of the catalyst during the processing and reactivation cycles.

As shown, the valve 16 is in position to connect lines 15 and 18 so that the oil charge passes into catalyst chamber 20 and flows downwardly therethrough for the conversion operation. The oil charge is preheated to a temperature to be maintained within the catalyst bed, and may be heated to a somewhat higher temperature in order to supply additional heat thereto and make up for heat losses from the catalyst chamber. The gaseous conversion products are discharged from the base of the catalyst chamber 20 through line 21 communicating with 4-way control valve 22, which also controls communication of line 23 leading from the base of catalyst chamber 19 with a discharge line 24 which empties into a first fractionating tower 25.

Tower 25 operates to fractionate the vapors and to condense heavy bottoms or cycle fuel oil which is discharged from the base of the tower through line 26. The gaseous vapors including gas, naphtha and unconverted gas oil pass overhead through line 27 to a second fractionating tower 28 where the clean recycle stock or gas oil is condensed and withdrawn by line 29 for recycling to the charge line or other suitable disposal. Vapors of naphtha and gas pass overhead from tower 28 through line 30 to a condenser and cooler 31 and into an accumulator drum 32. From the latter, condensed liquid is withdrawn through line 33 and forced by pump 34 through line 35 into a stabilizing tower 36. Vapors separating in accumulator drum 32 are withdrawn through vapor line 37 and forced by pump 38 through line 39 which discharges into line 35, whereby the liquids and vapors from the accumulator drum are introduced together into the stabilizer 36.

Stabilizer 36 is operated to condense the naphtha therein, which may be wholly or partially debutanized but preferably retains a portion of the butane to improve volatility. This naphtha, which is suitably controlled as to end boiling point by operation of the second fractionator 28 and may for example be a 400° F. end point naphtha, is removed from the bottom of the stabilizer through line 40 through a suitable cooler 41 and line 42 to suitable tankage or other point of accumulation. The gas passing overhead from stabilizer 36 is removed by line 43 to a suitable place of accumulation or may be delivered for further processing.

Flue gas for reactivation may be obtained from any suitable source. As shown, it is produced in a flue gas generator 45. A suitable combustible gas such as natural gas or refinery gas from supply line 46 is forced by compressor 47 into fuel gas receiver 48, from whence it is led by line 49 to suitable burners 50 discharging into the combustion space within generator 45. A line 51 carrying high pressure air leads to burners 50 to supply air for combustion. The products of combustion or flue gases at high temperature and under pressure discharge from generator 45 through line 52 into a suitable scrubber 53, where the gases are purified. The clean flue gas then passes by line 54 to one of lines 55 and 56 under the control of valves 57 and 58 respectively. Line 55 contains a heating coil 59 positioned within the combustion space of generator 45. By suitable regulation of the proportions of the flue gas passed through lines 55 and 56, the temperature of the gas is controlled. Additional air from line 51 is introduced by branch line 60 into line 55 to control the oxygen content of the reactivating flue gas. This mixed gas at a temperature of about 800–900° F. is introduced by line 61 and control valve 16 into line 17 and passes downwardly through the catalyst within catalyst chamber 19 for the reactivation. The resulting gas, after passing through the catalyst bed, is discharged by line 23 through control valve 22 into line 62 which leads the gas to a stack or other suitable point of accumulation such as a gas holder, for recycling.

While in the drawings there is shown, as a matter of convenience, two catalyst chambers, it is to be understood that any suitable number may be provided, whereby one or more of the catalyst chambers can be carrying out the processing cycle while the remaining chamber or chambers can be carrying out the reactivation cycle, whereby the process is continuous. In accordance with the present invention, where a processing cycle time substantially in excess of the reactivation cycle time is obtained, it is convenient to provide a series of catalyst chambers so that one may be reactivating for a comparatively short time while the remaining ones may be on-stream in the processing cycle for a comparatively longer time. For example, in the case where a processing cycle time of 20 hours is employed with a reactivation cycle time of approximately 4 hours or somewhat less, five catalyst chambers may be used for processing while one is reactivating. At the completion of the reactivation period for this one catalyst chamber, it is then thrown back on the line for processing, while one of the other catalyst chambers which was the first of the group to be placed on-stream is then taken off the line and placed on reactivation. It is to be understood, however, that where high plant capacity is not a desideratum, a fewer number of catalyst chambers can be employed, such as the two that are shown, and wherein the reactivation of the catalyst chamber off-stream is carried out only intermittently and with a substantially shorter period than the processing cycle in the other chamber.

After a catalyst chamber is taken off-stream, it is found desirable to first flush the catalyst with flue gas comparatively free of air or oxygen for a short period. After this is accomplished, air is gradually bled into the flue gas to bring the oxygen content of the gas up to the percentage desired, and it is then held constant for the duration of the reactivation cycle. Before

the chamber is again placed on-stream, the catalyst bed is preferably purged by flushing with flue gas, the air bleed having in the meantime been cut off. During the reactivation, the temperature of the catalyst bed tends to rise due to the combustion taking place therein, and this is controlled so as to stay below a peak temperature, such as to avoid injury to the catalyst, as by cooling or absorbing heat from the catalyst bed in any suitable manner. When the reactivation is substantially complete, the temperature of the bed drops to approach the temperature of the entering flue gas, which is an indication that the catalyst chamber is again ready to be placed on-stream.

Fig. 2 is a typical curve illustrating the weight percent, based on the charge, of carbon deposited on the catalyst for various lengths of the process cycle in hours, where the conditions of operation remain otherwise uniform as to temperature, pressure, space velocity, etc. It will be noted that for short processing cycles up to approximately 4 hours, the weight percent of carbon is relatively large, and drops off on a steep curve or quite rapidly as the processing cycle is increased within that range. Beyond 4 hours processing cycle time the curve flattens out somewhat but further appreciable reduction in the carbon deposition rate takes place as the processing cycle time is increased to 15 hours or more.

Fig. 3 illustrates a typical curve for the weight percent, based on the charge, of conversion to gasoline plus gas for varying lengths of the process cycle in hours, where the conditions of operation remain otherwise uniform. As shown, the conversion falls rather rapidly for extremely short processing cycles, but begins to flatten out at about 2–3 hour cycle lengths and beyond four-hour cycle length is comparatively flat. This clearly indicates that the conversion is little affected by extending the length of the processing cycle to more than 4 hours, while at the same time the advantage of greatly reduced weight percent of carbon deposited is obtained.

Fig. 4 is a typical diagram on the logarithmic scale wherein the weight percent of carbon deposited on the catalyst is plotted against the length of the process cycle in hours for various weight percentage conversions of the charge to gasoline plus gas. It will be noted that the various weight percentage conversion curves are essentially straight lines with an appreciable slope. Obviously, the conditions of operation would have to be altered during the continuance of a run to produce a constant conversion rate of 20%, 30%, 40%, etc., throughout the run. This is not done in practice. The curves herein shown were prepared from data assembled from different runs on the same charge stock and with the same catalyst, giving at least two points on each conversion curve, which is sufficient to determine the location and slope of the straight line. This indicates the advantage of increasing the length of the process cycle for any set of operating conditions which will give the percentage conversion indicated. For example, an operation giving a 20% conversion under the conditions of this invention will give about 0.15% by weight of carbon deposited on the catalyst for a 4-hour processing cycle, and approximately 0.10% of carbon for an 8-hour processing cycle. For more rigorous operating conditions where a 30% conversion is obtained, less than 0.20% by weight of carbon will be deposited on the catalyst where the process cycle is increased to 8 hours or more.

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.

We claim:

1. In the catalytic cracking of a normally liquid heavier hydrocarbon oil charge to convert the same to gasoline hydrocarbons involving alternate periods of conversion and reactivation, the method which comprises continuously passing a preheated and vaporized stream of a selected heavier hydrocarbon oil charge stock having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½" scale through a contact mass of active cracking catalyst maintained at a temperature of about 910 to 1000° F. at a space velocity of 3 to 10 for a conversion period in the range about four to twenty hours on stream, to obtain a conversion to gasoline plus gas of not less than 50 pounds per pound of carbon deposited on the catalyst, the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more, being substantially greater than that obtaining during a period of less than 4 hours, then discontinuing the flow of the hydrocarbon charge in contact with said catalyst after substantial deposition of carbon upon the catalyst, reactivating the catalyst in situ in a period of time less than the said conversion period, and then repeating the process.

2. The method as defined in claim 1, in which the catalyst is a synthetic silica-alumina-zirconia catalyst.

3. The method as defined in claim 1, in which the conversion cycle time is in excess of eight hours, and the reactivation cycle time is less than four hours.

4. The method as defined in claim 1, in which a conversion pressure of atmospheric to 200 pounds per square inch is employed, and in which the pressure is correlated with the temperature so as to approach but be below the critical pressure for the temperature employed to maintain the charge stock completely vaporized and to avoid oil condensation on the catalyst.

5. The method as defined in claim 1, in which the charge stock is a straightrun gas oil, the conversion temperature of the catalyst is 910 to 1000° F., the pressure employed is such as to maintain complete vaporization of the charge stock in contact with the catalyst, the space velocity is about 3 to 6, the conversion cycle time is 8 to 30 hours, and the conversion is not less than 80 pounds of gasoline plus gas per pound of carbon deposited on the catalyst, such that the reactivation cycle time is not more than four hours.

6. In the catalytic cracking of a normally liquid heavier hydrocarbon oil charge to convert the same to gasoline hydrocarbons involving alternate periods of conversion and reactivation, the method which comprises continuously passing a preheated and vaporized hydrocarbon charge stock having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½" scale through a contact mass of active cracking catalyst maintained at a temperature of about 910 to 1000° F. at a space velocity of 3 to 10, continuing the flow of hydrocarbon charge under said conditions in contact with the cata-

lyst for a conversion period in the range about 4 to 20 hours on stream, to obtain a conversion to gasoline plus gas of not less than 50 pounds per pound of carbon deposited on the catalyst, the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more, being substantially greater than that obtaining during a period of less than 4 hours, thereafter discontinuing the flow of the hydrocarbon charge in contact with the catalyst after substantial deposition of carbon upon the catalyst, reactivating the catalyst in situ, and then resuming the flow of hydrocarbon charge to the reactivated catalyst under the aforesaid conditions.

7. The method according to claim 6 in which the catalyst is a synthetic silica-alumina catalyst substantially free from alkali metals.

8. In the catalytic cracking of a normally liquid heavier hydrocarbon oil charge to convert the same to gasoline hydrocarbons involving alternate periods of conversion of the oil and reactivation of the catalyst, the method which comprises continuously passing a preheated and vaporized stream of hydrocarbon oil charge stock having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½ inch scale through a mass of active cracking catalyst, maintained at a temperature of 910 to 1000° F., at a space velocity in the range 3 to 6 for a conversion period of about 4 hours onstream, to obtain a conversion to gasoline plus gas of at least about 50 pounds per pound carbon deposited on the catalyst, the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more, being substantially greater than that obtaining during a period of less than 4 hours, discontinuing the flow of the hydrocarbon charge in contact with said catalyst after substantial deposition of carbon on the catalyst, reactivating the catalyst in situ, and then repeating the process.

9. In the catalytic cracking of a normally liquid heavier hydrocarbon oil charge to convert the same to gasoline hydrocarbons involving alternate periods of conversion of the oil and reactivation of the catalyst, wherein a vaporized feed oil, having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½ inch scale, at a temperature of 910 to 1050° F. and at high space velocity in the range 3 and above, is continuously passed through an active contact mass maintained at the elevated temperature during said periods of conversion, the method comprising continuing the flow of heated charge oil through the contact mass under said conditions for a conversion period in the range about 4 to 20 hours such that the rate of carbon deposition upon the catalyst declines to a substantially constant value so that the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more is substantially greater than that obtaining during a period of less than 4 hours, obtaining a conversion yield to gasoline plus gas of at least about 50 pounds or more per pound of carbon deposited on the catalyst, said gasoline and gas being at least in the range about 20 to 30% by weight of the charge, discontinuing the flow of the hydrocarbon charge through the contact mass after substantial deposition of carbon upon the catalyst, reactivating the catalyst in situ, and then repeating the process.

10. In the catalytic cracking of a normally liquid heavier hydrocarbon oil charge to convert the same to gasoline hydrocarbons involving alternate periods of conversion of the oil and reactivation of the catalyst, wherein a vaporized feed oil, having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½ inch scale, at a temperature of 910 to 1050° F. and at high space velocity in the range 3 and above, is continuously passed through an active contact mass maintained at the elevated temperature during said periods of conversion, the method comprising continuing the flow of heated charge oil through the contact mass under said conditions for a conversion period of about 4 hours such that the rate of carbon deposition upon the catalyst declines to a substantially constant value so that the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more is substantially greater than that obtaining during a period of less than 4 hours, obtaining a conversion yield to gasoline plus gas of about at least 50 pounds per pound of carbon deposited on the catalyst, said gasoline and gas being at least in the range about 20 to 30% by weight of the charge, discontinuing the flow of the hydrocarbon charge through the contact mass after substantial deposition of carbon upon the catalyst, reactivating the catalyst in situ, and then repeating the process.

11. In the catalytic cracking of normally liquid hydrocarbon oil to convert the same to gasoline hydrocarbons involving alternate periods of conversion of the oil and reactivation of the catalyst, wherein a vaporized feed oil, having a carbon residue of less than 0.2% and a color of less than 200 on the Lovibond ½ inch scale, at a temperature in the range of about 910 to 1050° F. and at high space velocity in the range of about 3 to 10, is continuously passed through an active contact mass maintained at the elevated temperature during said periods of conversion, a method comprising continuing the flow of heated charge oil through the contact mass under said conditions for a conversion period in the range about 4 to 30 hours to obtain a conversion to gasoline plus gas of at least about 30 pounds per pound of carbon deposited on the catalyst, the ratio of gasoline plus gas to carbon being produced when the catalyst has been onstream 4 hours or more being substantially greater than that obtaining during a period of less than 4 hours, then discontinuing the flow of the hydrocarbon charge in contact with said catalyst after substantial deposition of carbon upon the catalyst, reactivating the catalyst in situ, and then repeating the process.

DU BOIS EASTMAN.
CHARLES RICHKER.