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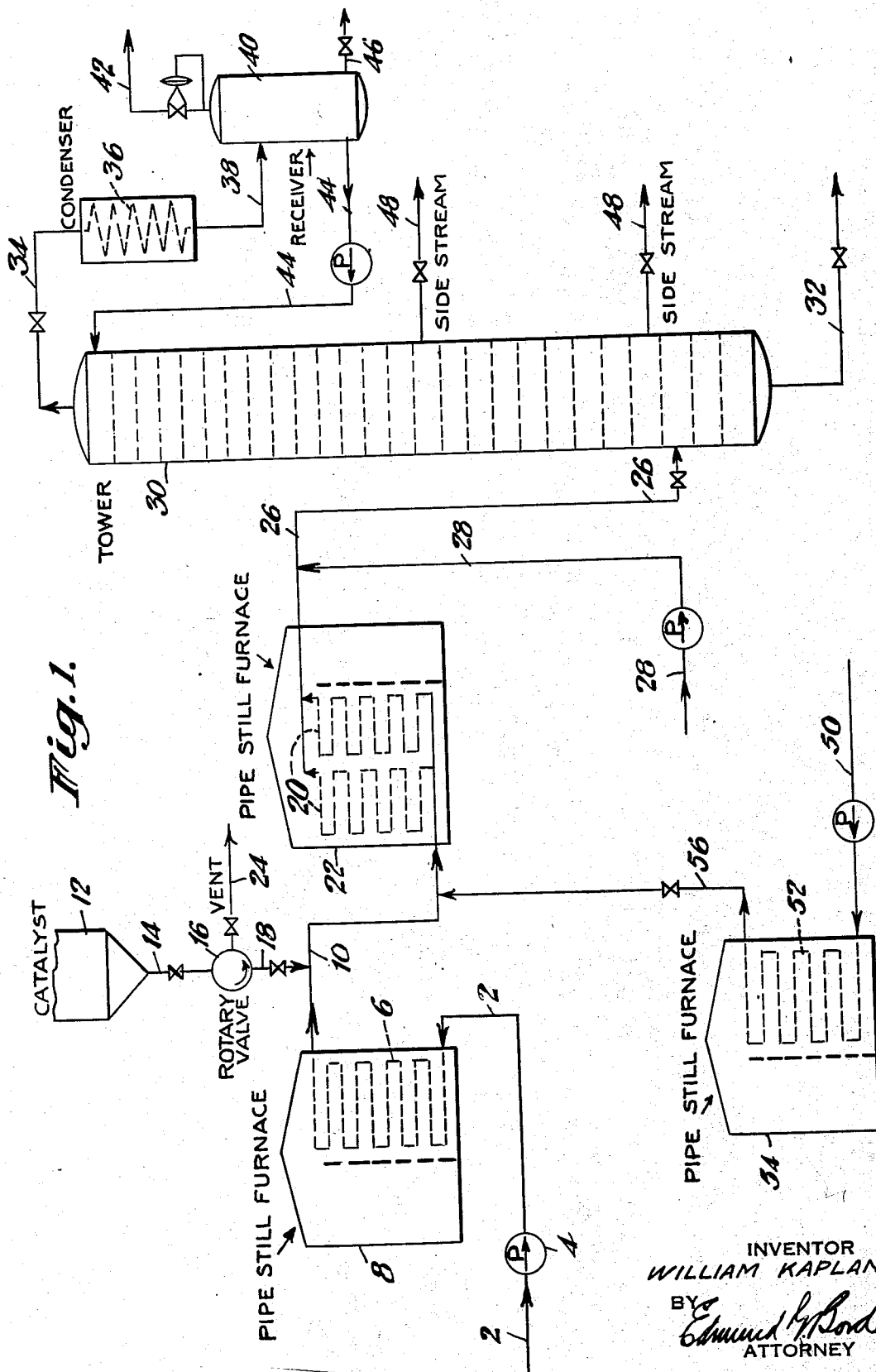
W. KAPLAN

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CATALYTIC CONVERSION OF HYDROCARBON OILS

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2 Sheets-Sheet 1



INVENTOR
WILLIAM KAPLAN
BY *Edmund P. Roder*
ATTORNEY

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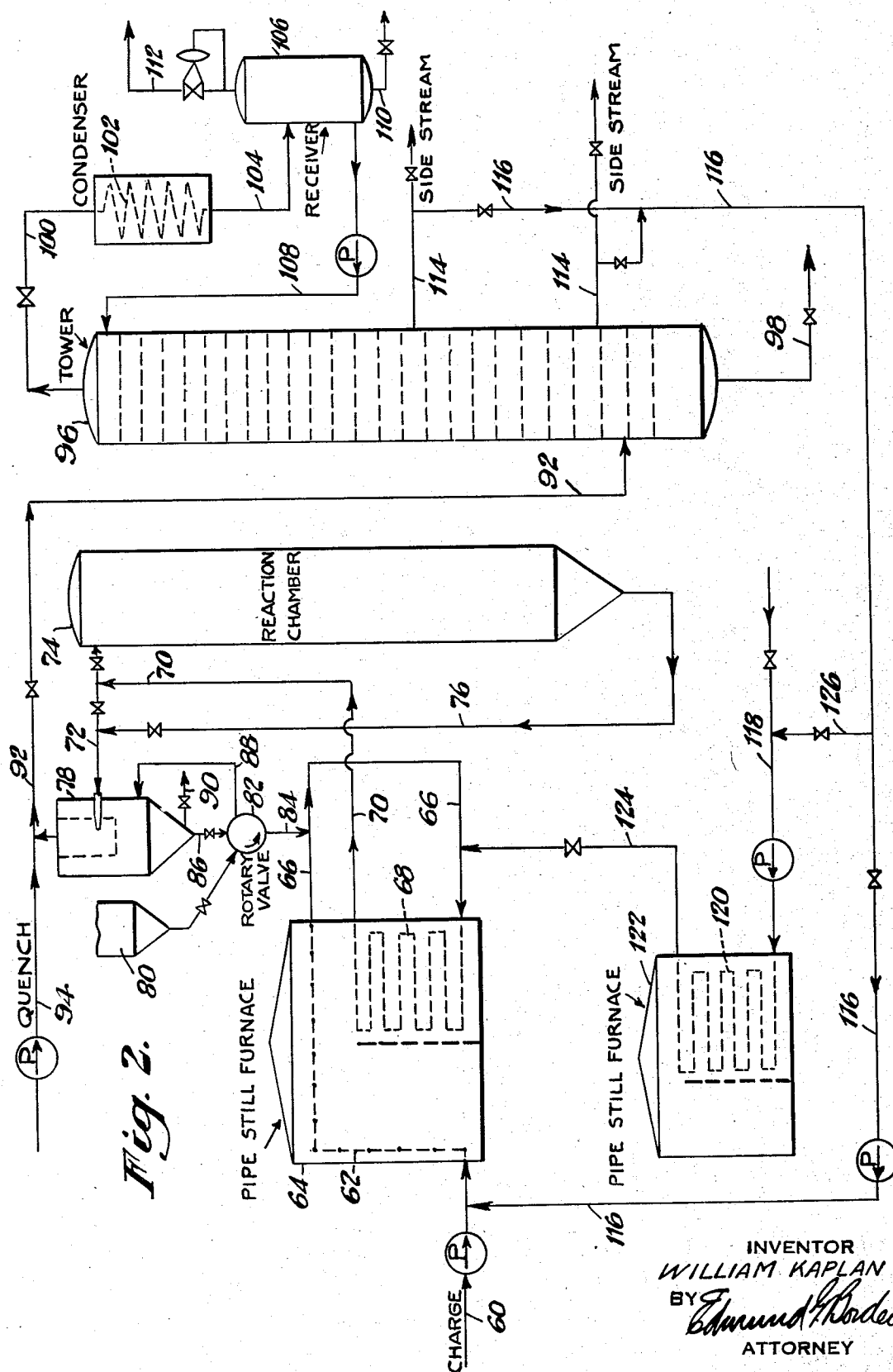
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UNITED STATES PATENT OFFICE

2,313,346

CATALYTIC CONVERSION OF HYDRO-CARBON OILS

William Kaplan, Malverne, N. Y., assignor to
Cities Service Oil Company, New York, N. Y., a
corporation of Pennsylvania

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6 Claims. (Cl. 196—52)

This invention relates to an improved process for manufacturing cyclic and aromatic hydrocarbons, and more particularly to a catalytic process for the conversion of hydrocarbon oils or gases into cyclic and aromatic hydrocarbons. The present application is a continuation-in-part of the applicant's pending application Serial No. 264,693, filed March 29, 1939, for "Manufacture of alkylated benzene hydrocarbons."

Aromatic and cyclic hydrocarbons have been manufactured from petroleum by various processes which have generally involved either; (a) operation at extremely high temperatures of the order of 1200° F. to 1400° F. or higher, or (b) operation at more moderate vapor phase temperatures (950°–1100° F.) for an extremely long period of time. In both types of operation, the production of hydrocarbons in the gasoline boiling range is very low, while the loss as fixed gas is extremely high. Although the fixed gas loss is lower in the long-time digestion type process than in the extremely high temperature processes, the loss in the former type is generally about 40% or higher. In both types of operation, the cracking must be carried substantially beyond the point of maximum gasoline recovery. In addition, the gasoline product from the former type contains sufficient olefins and diolefins to render the purification treatment very difficult or expensive by present treating processes. As a result, these types of operation have not been commercially adopted.

The present process is free of these disadvantages because a highly aromatic gasoline can be produced at moderate conversion per pass, thus obviating the necessity for going beyond the point of maximum gasoline yield. As a result, the fixed gas loss is substantially lowered. The present process also operates in the lower vapor phase temperature range so that the percentage of detrimental olefinic and diolefinic content is very low, thus assuring ease of purification with present treating processes.

When topped crude or gas oil is cracked under "mixed-phase" conditions, as practiced by many present-day commercial processes, the gasoline product is low in aromatics, ranging from 5% to 25%; varying with the type of charging stock and operating conditions. Similarly, the percentage of olefinic unsaturates will range from 15% to 35%, while the balance will consist of naphthenes and paraffins. It is generally recognized that these processes produce a gasoline of relatively low anti-knock value (60 to 70 octane number—C. F. R.) chiefly because of the deficiency in aro-

omatics, which contribute most to the anti-knock value.

In commercially used vapor phase processes, which require a vaporizable type charging oil for the heating zone, unless a separator is interposed for separating heavy asphaltic constituents, the gasoline product contains more aromatics than the "mixed-phase" gasoline product, and this is partially reflected in a higher anti-knock value. The percent aromatics will generally range from 5% to 30%, depending mainly on the type of charging stock. Generally, the gasoline will predominate in olefinic unsaturates, ranging from 40% to 70%, which is the chief reason for the increased anti-knock value. However, even when the olefinic unsaturates are in excess of 70%, the anti-knock value will rarely exceed about 80 octane number—C. F. R. These processes, which operate at moderate conversions per pass (10% to 30%), will produce a gasoline high in olefinic unsaturates when the pressure is reduced, or when the temperature is increased. For example, operating at low pressure (e. g. 30 to 75 lbs.) and high temperature (e. g. 1100 to 1150° F.), the proportion of olefinic unsaturates in the gasoline boiling range will amount to 65 to 70%, while at high pressure (200 to 500 lbs.), and lower temperature (950 to 1000° F.), the olefinic unsaturates will amount to 45 to 55%. The length of cracking or digestion has very little influence on the proportion of the various hydrocarbons contained in the gasoline when these processes are operated at moderate conversions per pass, i. e. 10% to 35% per pass, since there is an apparent equilibrium distribution of the various hydrocarbons for any given stock and set of operating conditions.

As a general average, present day vapor phase commercial processes will produce a gasoline product containing about 50 to 55% unsaturates or olefins, about 10–20% aromatics, with the balance comprising naphthenes and paraffins. The distinguishing characteristics of the present process is the production of a highly aromatic product, even when operating at moderate conversion per pass. Instead of containing a relatively large amount of olefins and a small amount of aromatics, the presence of the catalyst, activated carbon, effects a reversal of this apparent equilibrium distribution and results in the productions of a relatively large proportion of aromatics and a small proportion of olefins in the gasoline boiling range. Although the exact mechanism for this transformation is not definitely known, it is believed the presence of the activated carbon effects a cyclization of either olefins or paraffins, or

both; particularly those containing six to nine carbon atoms (whether straight chain or branched chain). As a result, the gasoline product of the present process will generally contain a small proportion of unsaturates and upwards of 40% aromatics, depending on the amount of activated carbon used.

While the production of a highly aromatic product of high anti-knock value (80 octane number—C. F. R. or higher) is the most noticeable effect of the present process; other advantages will be noted when practicing the process. For example, the cracking reaction will apparently proceed with greater ease; that is, at a given temperature, the cracking per pass will be somewhat higher. In addition, the heat required for the cracking reaction is reduced considerably so that less heat input is required in the soaking tube bank in order to maintain a given temperature, thus effecting a reduction in fuel consumption.

The primary object of this invention is therefore to provide an improved process in which petroleum hydrocarbons are catalytically converted by the action of activated carbon into cyclic and aromatic hydrocarbons, including those with side chains.

Other objects are to provide a process for producing a gasoline of high antiknock value; to provide a process for converting olefins and/or paraffins into cyclic hydrocarbons; to provide a process in which the conversion reaction is accelerated; to provide a process in which the fuel consumption is materially lowered; to provide a process in which the proportion of aromatics is increased even when operating at moderate conversion per pass; to provide a process in which aromatics can be produced from all types of petroleum hydrocarbons, including gasoline and normally gaseous hydrocarbons; to provide a process for converting olefins to aromatics; to provide a process which will produce a gasoline product which can be easily treated; and to provide a process for producing aromatic hydrocarbons in which the fixed gas loss is materially lower than usual.

Accordingly, the improved process of the present invention comprises in general the steps of passing a vaporizable petroleum distillate stock such as gas oil, or kerosene, through the heating coil of a pipe still furnace in which it is vaporized and heated to a temperature of from 950° to 975° F., intimately mingling with the vapor stream a predetermined proportion of activated carbon, digesting the mixture for a period of time sufficient to effect the desired conversion, and recovering the desired products. While gas oil and kerosene have been mentioned, the process is adapted to conversion of naphthas and straight run gasoline, as well as butane and/or propane fractions, by effecting the conversion at more elevated temperatures. In fact, the process is easily adapted to almost any type of vapor phase cracking or so-called polymerization process by making the necessary provisions for introducing the activated carbon at an appropriate point in the digesting step. The pressure may be low (30 to 75 lbs.), or elevated pressures may be used (100 to 500 lbs.), although the lower pressures will generally require higher operating temperatures for a given furnace structure. With gas oil, the pressure at the heating coil outlet is preferably from 150 to 300 lbs. per square inch, at a temperature of 950° to 975° F. Although it may be possible to effect this heat-

ing with substantially no conversion, it is preferable to obtain from 5% to 10% conversion in order to have hydrocarbons containing from six to ten carbon atoms present when the activated carbon is introduced into the hot oil products. The proportion of activated carbon introduced may be 5 lbs. to 25 lbs. per barrel of oil heated, depending on the relative proportion of aromatics desired in the final product, higher quantities causing increased proportions of aromatics. Naturally the velocity and particle size of the activated carbon should be controlled so that the catalyst will be maintained in suspension in the vapor stream. The mixture is then digested (in either a conversion coil or a reaction chamber) for a suitable period of time. Although the digestion may be controlled to effect a moderate crack per pass (20 to 30%), it may be allowed to proceed to the point of maximum gasoline formation, thus operating as a once-through process. The digestion, if done in a coil, is preferably conducted at 150 to 250 lbs. pressure with a final temperature of 1000° to 1025° F. when using about ten pounds of activated carbon per barrel. After the digestion has proceeded for a sufficient period of time, the activated carbon can be recovered in a suitable separating device, the vapor products suddenly chilled to a temperature of from 700° to 800° F., and the resulting separated vapor products subjected to a fractionation operation for the recovery of the desired hydrocarbons.

Various other features, objects, and advantages of the improved process of the present invention will be apparent to those skilled in the art from the following more detailed description thereof, taken in connection with the accompanying drawings in which:

Fig. 1 is a diagrammatic elevational view of an assembly of apparatus elements particularly adapted for carrying out the essential features of the improved process.

Fig. 2 is a view similar to Fig. 1 showing a modified form of apparatus for carrying out the improved process with certain modifications in the operation.

Referring to the apparatus shown in Fig. 1 of the drawings, the oil charging stock, such for example as a gas-oil distillate, to be converted into cyclic and aromatic hydrocarbons, is introduced into the apparatus through a line 2, and forced by means of a pump 4 mounted therein, at a pressure of from 400 to 600 lbs. per square inch, through a heating tube bank 6 mounted in a pipe still furnace 8. The oil in passing through the tube bank 6 is heated to a discharge temperature of approximately 950° F., and the tube bank is of sufficient length to permit complete vaporization of the oil and effect from 5% to 10% conversion of the oil to gasoline.

The hot oil products from the tube bank 6 are conducted through a vapor line 10 in which the activated carbon catalyst is introduced and mixed therewith. The activated carbon is conducted from a supply chamber 12 through a valved conduit 14, a rotary feed and measuring valve 16 and a valved conduit 18, into the line 10. The activated carbon catalyst is discharged into the stream of vapors in the line 10 at a controlled rate and carried into and through reaction coils or tube banks 20 mounted in a pipe still furnace 22.

The valve 16 may be of any suitable type commonly used for feeding finely divided materials, such as the activated carbon catalyst, at a con-

trolled rate. The valve may comprise a rotary plug provided with a pocket for receiving the activated carbon from the line 14. At every rotation of the plug the material deposited in the pocket from the line 14 will be discharged into the line 18. The valve is vapor-tight and preferably provided with a valved vent line 24, so that any vapor picked up by the pocket in passing the line 18 will be vented through the line 24 without disturbing the material flowing through the line 14. The rotary plug in the valve 16 may contain a number of pockets spaced around the circumference of the plug in order to assure more even distribution of the carbon in the vapor stream. The feed rate of the catalyst is controlled by the speed of rotation of the plug of the rotary valve.

The vapor stream passing through the line 10 is preferably supplied with approximately ten pounds of activated carbon catalyst per barrel of charging stock supplied to the tube bank 6, although from 3 to 25 lbs. of catalyst per barrel may be used for certain specific stocks or products desired. The mixture of vapors and catalyst passing through the tube banks 20 are raised in temperature to approximately 1010° F. as an outlet temperature. The gasoline constituents entering the tube banks 20 will normally contain approximately 50% to 60% of unsaturated olefin type hydrocarbons, a small proportion of aromatic hydrocarbons, a small proportion of naphthenes, and the remainder saturated hydrocarbons. The coils 20 are preferably of such length as to carry out the desired catalytic reactions to convert the oil constituents into cyclic and aromatic compounds.

The reaction products, including the suspended catalytic material, are discharged through a valved transfer line 26 and immediately chilled to a temperature of approximately 700° F., by the introduction of a quenching medium such as gas oil, water, or other relatively cool material, through a line 28, in which is mounted a pump. The resulting relatively cool mixture is discharged into the lower portion of a tower 30, in which the heavier ends and carbon catalyst are separated, and from which they are withdrawn through a valved line 32. The fractionating tower 30 is operated under suitable pressure and temperature conditions, so that the products boiling below approximately 450° F. are conducted in vapor form through a valved vapor line 34, the condensable constituents condensed in a condenser 36, and all overhead products conducted through a line 38 into a separator 40. The normally gaseous constituents are separated out in the separator 40 and discharged through an automatic pressure valve controlled line 42. The fractionation in the tower 30 may be controlled in part by conducting condensate from the receiver 40 through a line 44, by means of a pump mounted therein, into the upper portion of the tower 30 where it is used as reflux. The overhead condensate product is removed from the receiver 40 through a valved line 46. Various higher boiling products may also be recovered from the tower 30 and removed as side streams through the valved lines 48.

The activated carbon catalyst may be supplied to the line 10 by any means other than that described above. For example, the catalyst may be manufactured by introducing a recycle gas oil through a line 50, and forcing it at a suitable pressure by means of a pump mounted therein

through a cracking coil 52 mounted in a pipe still furnace 54. The recycle gas oil is cracked at a high temperature for a substantial period of time in the coil 52 to produce finely divided carbon which has been found to be very active. The products resulting from this cracking operation are conducted at a temperature of approximately 1100° F. through a valved transfer line 56 into the line 10 to supply and suspend the desired proportion of catalyst in the vapors passing through the line 10. Sufficient catalyst will be supplied for most operations by regulating the proportion of recycle gas oil in the line 50 so that it comprises approximately 15% of the charging stock supplied to the pipe still furnace 8 through the line 2. In providing a suspension of activated carbon in the line 10 from the furnace 54, the cracking in furnace 54 must be severe enough to form a substantial quantity of activated carbon; and the velocity must be sufficiently high in order to keep the carbon suspended in the vapor stream. Carbon produced in this manner has been found to be particularly effective in producing the desired catalytic reaction. Although it is difficult to describe the activity in precise terms, one test for determining the reactivity of the carbon is to note its reaction when in contact with air. For example, carbon produced in the above described manner, when separated, cooled, and allowed to come in contact with air in a container, will soon become red hot, glowing red below the apparent black upper surface. This heat liberation is apparently due to the extremely high adsorption of air. If the container is loosely covered, the hot zone will gradually travel from the top to the bottom of the container, although very little carbon will be burned away. If the container is not covered, the carbon will gradually disappear. Oil men, particularly those familiar with vapor phase processes, will recognize this type of carbon.

In accordance with the modified form of the process of the present invention carried out in the apparatus shown in Fig. 2, the oil stock to be converted is introduced into the apparatus through a line 60 and forced by means of a pump mounted therein through a heating coil 62 set in the combustion space and under the roof of a pipe still furnace 64. In this coil, the oil is heated under substantially the same conditions as those described for the coil 6 in Fig. 1. The hot vapor products are conducted from the coil 62 through a line 66, and therein intimately mingled with activated carbon as a catalyst. The resulting mixture is then conducted through a reaction coil 68 mounted in the convection section of the pipe still furnace 64, after which the resulting products pass through a transfer line 70 and a valved line 72, into the upper portion of an enlarged reaction chamber 74, and then through a valved line 76 and a portion of the line 72, directly into a cyclone separator 78, or the hot products may pass directly from the line 70 to the left in the line 72, and into the cyclone separator 78, without passing through the enlarged reaction chamber.

Where the entire reaction is carried out in the coil 68, this coil should be sufficiently long (from 1000 to 4000 feet depending on the vapor velocity) to give a time reaction for effecting the desired conversion of the oil to aromatic and cyclic hydrocarbons. Where the coil is used alone, the temperature conditions will be the same as those described in connection with Fig. 1 of the drawings, but where the enlarged reaction chamber

74 is used in the cycle, the coil 68 may be relatively short. When the reaction chamber 74 is employed, the temperature of the products in line 70 may range from approximately 990° F. to 1020° F. which temperatures are sufficiently high to cause the desired reaction in the chamber 74. Regardless of whether or not the reaction chamber 74 is utilized, the reaction products introduced into the cyclone separator 78 through the line 72 will contain all of the suspended activated carbon catalyst which will be separated out by the cyclone separator.

Initially, the activated carbon supplied to the line 66 is withdrawn from a supply chamber 80 through a valved conduit and fed by means of a rotary valve 82 and a line 84 to the line 66 in the manner described above in connection with Fig. 1 of the drawings. After the operation has been conducted for some time, activated carbon will be collected in the bottom of the cyclone separator 78 from which it may be fed through a valved line 86 to the rotary valve 82 and the line 66, thereby replacing the supply from the chamber 80. In the operation of the rotary valve 82 any vapor entering the valve may be readily vented into the cyclone separator through the vent line 88. The utilization of the activated carbon in carrying out the reaction does not change its activity, but for some unknown reason it appears that the high temperatures actually maintain or increase its activity. Therefore, the continuous recycling of the catalyst may be carried out almost indefinitely. If desired, however, any of the used catalyst may be removed from the cyclone separator through a valved line 90 or any deficiency may be supplied from the supply chamber 80.

The vapor products separated from the catalyst in the cyclone separator 78 are discharged into a valved line 92 and immediately quenched to a temperature of from 600° F. to 700° F. by a relatively cool fluid such as those mentioned above, introduced through a line 94. The resulting products are conducted to the lower portion of a fractionating tower 96 which is operated in the same manner as the tower 30 of Fig. 1. The heavy bottoms which in this case are substantially free of any of the carbon catalyst are discharged through a valved line 98 while the overhead vapors are conducted through a valved line 100, subjected to condensation in a condenser 102, and then conducted through a line 104 into a receiver 106. A portion of the condensate separated out in the receiver 106 may be used as reflux in the top of the tower 96 by conducting it through a line 108 by means of a pump mounted therein. The overhead condensate product is discharged from receiver 106 through a valved line 110, while the uncondensed gases are discharged therefrom through an automatic pressure valve controlled line 112. Side stream products of higher boiling point than that collected in the receiver 106 may be withdrawn from any point in the tower 96, as for example, through valved lines 114. When the side stream products, discharged for example through the valved lines 114, do not contain substantial proportions of desirable cyclic and aromatic hydrocarbons, they may be reprocessed in the operation by passing either or both of them through valved line 116 by means of a pump mounted therein, and introducing them into the charging line 60 to the coil 62.

The activated carbon catalyst to be supplied to the line 66 may be formed directly as in the

case of the operation shown in Fig. 1, by conducting a recycle stock such as recycle gas oil through a valved line 118 by means of a pump mounted therein, and passing it through a coil 120 mounted in a pipe still furnace 122 where it is heated under the same conditions as those described in Fig. 1, for the furnace 54. The resulting highly heated cracked products are then conducted through a transfer line 124 directly into the line 66 to supply the activated carbon catalyst. When the catalyst is supplied directly in this manner, the activated carbon separated out in the cyclone separator 78 may be entirely discharged through the line 90, or only a portion of it returned through the rotary valve 82. The direct supply of activated carbon as from the furnace 122 is of particular advantage where the carbon separated out in the cyclone separator and removed through the line 90 may be marketed at an advantage for use, for example, as a decolorizing agent in other industries.

The recycle gas-oil for the furnace 122 may be obtained from line 116 after the operation has been started, by conducting it through valved connecting line 126 into the line 118. In the manufacture of activated carbon by this procedure, recycle gas oil is preferred because the carbon to hydrogen ratio is much higher than that for straight run oils, and it for this reason, is more easily converted to a substantial degree into finely divided activated carbon.

The overhead distillate as well as the side stream distillates removed from the towers 30 and 96 may be fractionated into rather narrow fractions for the recovery of more or less individual aromatic hydrocarbons or fractions which are particularly suitable for various industrial purposes. The overhead product will contain primarily benzene derivatives, many of which will be side chain products suitable for use as solvents and for various other industrial uses. Some of the more complex cyclic and aromatic compounds are obtainable from the side streams and are valuable for use as intermediates in the manufacture of dyes, lubricants, and other useful products. The overhead product of course may be used as a gasoline blending agent for increasing the octane rating of relatively poor gasolines, because it contains large proportions of side chain aromatic hydrocarbons.

The results obtained from the carrying out of the process may be illustrated by reference to the conversion of a heavy gas-oil charging stock. This gas-oil was introduced into a furnace such as the furnace 8 and subjected to a temperature at the outlet of about 950° F. and an outlet pressure of 275 pounds per square inch. Sufficient cracking was accomplished in this operation so that the fraction boiling below 450° F. comprises approximately 16% of the products discharged from the furnace. Activated carbon having a fineness of approximately 150 mesh was introduced into the vapor stream at the rate of about 8 lbs. per barrel of charging stock and the resulting mixture subjected to further heating for a relatively long period of time at a temperature averaging about 980° F. at the outlet of a furnace such as the furnace 22. The outlet pressure was maintained at approximately 170 lbs. per square inch. As the products discharged from the last heating operation they were quickly chilled to a temperature of 650° F. by the introduction of gas-oil.

The products remaining in vapor state after the chilling operation, were fractionated, and an

overhead fraction boiling below approximately 450° F. was collected. This fraction was found to contain approximately 85% of aromatic hydrocarbons by the Egloff & Morrell method described in *Industrial & Engineering Chemistry*, Vol. 18 (1926) pages 354 to 356. A refractionation of the overhead distillate showed the presence of a large number of aromatic hydrocarbons such as benzol, toluol, xylol, as well as more complex side chain benzene and naphthene derivatives.

When the process of the present invention is carried out for the production of relatively high percentages of aromatic hydrocarbons in the overhead products, the side streams withdrawn through the lines 48 and 114 contain considerable proportions of cyclic and aromatic derivatives of relatively high boiling point. The fractionation of these side streams discloses the presence of naphthalene, alkyl naphthalenes, anthracene, phenanthrene, diphenyl, diphenyl methane, dibenzyl and hydronaphthalenes. Even when a moderate content of aromatic hydrocarbon compounds is obtained overhead from the tower 30 or 96, the side streams will contain some of the above compounds. Saturated cyclic hydrocarbons are also found in the products of the reaction such as alkyl cyclohexanes.

The activated carbon catalyst appears to act very effectively in the conversion of unsaturated hydrocarbons into aromatic compounds because in the example given above, the overhead distillate showed practically no unsaturated hydrocarbons of the olefin or diolefin type. The normally gaseous hydrocarbons separated out for example in a separator such as 40 was also low in olefins, particularly C₃ and C₄ olefins. The improved process therefore is particularly efficient in avoiding high gas losses which reach 40% or higher in some known processes employed for the production of aromatic hydrocarbons.

In carrying out the process of the present invention for the conversion of normally gaseous hydrocarbons such as propane, butane, corresponding olefins or mixtures containing these hydrocarbons, as well as ethane and ethylene, the charging stock either in liquid or gaseous phase is preferably heated in a stream in the coil of a pipe still furnace to a temperature of approximately 1100° F. At this point the finely divided activated carbon catalyst is intimately distributed therein in the desired proportion such as the range of proportions described above. The resulting intimate mixture is continued in the stream through a digestion zone where the intimate mixture is maintained for a period of time sufficient to effect a substantial conversion to gasoline boiling range hydrocarbons. The gasoline product under these conditions will contain at least 40% of aromatic hydrocarbons and may contain as high as 85% of aromatic hydrocarbons. Normally gaseous olefins such as butylene are satisfactorily converted to aromatic hydrocarbons at some what lower temperatures, such for example as 1050° F.

Various modifications of the improved process of the present invention may be made without departing from the spirit and scope of the invention as will appear to those skilled in the art. Such modifications are contemplated within the invention as defined by the accompanying claims.

Having thus described the invention in its preferred form, what is claimed as new is:

1. The process of manufacturing aromatic hydrocarbons from a mixture of highly heated

cracked products produced by the steps of heating a hydrocarbon distillate in a heating zone under temperature, pressure and time conditions sufficient to effect partial conversion thereof into a mixture of cracked products low in aromatic hydrocarbons containing at least approximately 50% of unsaturated olefinic hydrocarbons, which comprises intimately mixing a finely divided activated carbon catalyst with said mixture of highly heated cracked products and passing the resulting mixture through a reaction zone in which it is maintained at a temperature of from 970° to 1050° F. for a considerable period of time adapted to convert said products into a final product containing a relatively high percentage of aromatic hydrocarbons, maintaining the active carbon catalyst in intimate dispersion in the mixture in the reaction zone, and separating the desired aromatic hydrocarbon fractions from the

2. The process of manufacturing cyclic and aromatic hydrocarbons from a mixture of highly heated cracked products produced by the steps of passing a petroleum oil distillate in a confined stream of restricted cross section through a heating zone wherein the distillate is vaporized and heated to a discharge temperature of approximately 950° F., and wherein the distillate in said stream is heated for a sufficient length of time at cracking temperatures to effect partial conversion of the distillate to unsaturated olefinic constituents, which comprises mingling an activated carbon catalyst with said highly heated products and passing the resulting mixture through a reaction zone in which heat is applied to the said resulting mixture and in which the mixture is maintained at a temperature of from 970° to 1050° F. for a sufficient period of time to produce a product containing a relatively high percentage of aromatic hydrocarbons, discharging the resulting reaction products with the catalyst from said reaction zone, separating the catalyst from the reaction products and fractionating the reaction products to recover the desired aromatic hydrocarbons.

3. The process of manufacturing aromatic hydrocarbons from a mixture of highly heated cracked products produced by the steps of heating a paraffinic petroleum distillate in a heating zone under temperature, pressure and time conditions sufficient to effect partial conversion of the distillate into a mixture of cracked products containing unsaturated olefinic hydrocarbons, which comprises intimately mixing a finely divided activated carbon catalyst with said mixture of highly heated cracked products and passing the resulting mixture through a reaction zone in which it is maintained at a temperature of approximately 1000° F. for a considerable period of time adapted to convert said products into a final product containing a relatively high percentage of aromatic hydrocarbons, and separating the desired aromatic hydrocarbon fractions from the final product.

4. A process for manufacturing aromatic hydrocarbons from a mixture of highly heated cracked vapor products produced by the cracking of a paraffinic hydrocarbon distillate under cracking conditions including a cracking temperature of 950° F. adapted to form a relatively small proportion of gasoline boiling range constituents but which includes the production of a relatively high percentage of unsaturated olefinic hydrocarbons, which comprises adding to the said mixture of highly heated cracked vapor

products a relatively small proportion of a finely divided catalyst consisting of activated carbon, and subjecting the resulting mixture in a flowing stream in which the finely divided activated carbon is suspended to high temperature reaction conditions of from 970° to 1050° F. adapted to produce a final product containing a relatively high percentage of aromatic hydrocarbons.

5. The process of manufacturing cyclic and aromatic hydrocarbons, which comprises intimately mixing a finely divided activated carbon catalyst with a hydrocarbon product which is relatively low in cyclic and aromatic hydrocarbons and relatively high in olefinic hydrocarbons and which contains from about 5% to 16% of gasoline boiling range hydrocarbons, passing the resulting mixture in a confined stream of restricted cross-section and maintaining the same at a reaction temperature of about 1000° F. for a sufficient time to produce a conversion product which is relatively low in olefinic content and relatively high in cyclic and aromatic hydrocarbon content, maintaining said catalyst in intimate dispersion in said stream, separating the

carbon catalyst from the stream of conversion products and recovering the cyclic and aromatic hydrocarbons.

6. The process of manufacturing aromatic hydrocarbons from a mixture of highly heated cracked products produced by the steps of heating a petroleum distillate in a heating zone under temperature, pressure and time conditions sufficient to effect partial conversion of the distillate into a mixture of cracked products containing a substantial proportion of unsaturated olefinic hydrocarbons, which comprises intimately mixing a finely divided activated carbon catalyst with said mixture of highly heated cracked products and passing the resulting mixture through a reaction zone in which it is maintained at a temperature of from 970° to 1050° F. for a considerable period of time adapted to convert said products into a final product containing a relatively high percentage of aromatic hydrocarbons, and separating the desired aromatic hydrocarbon fractions from the final product.

WILLIAM KAPLAN.