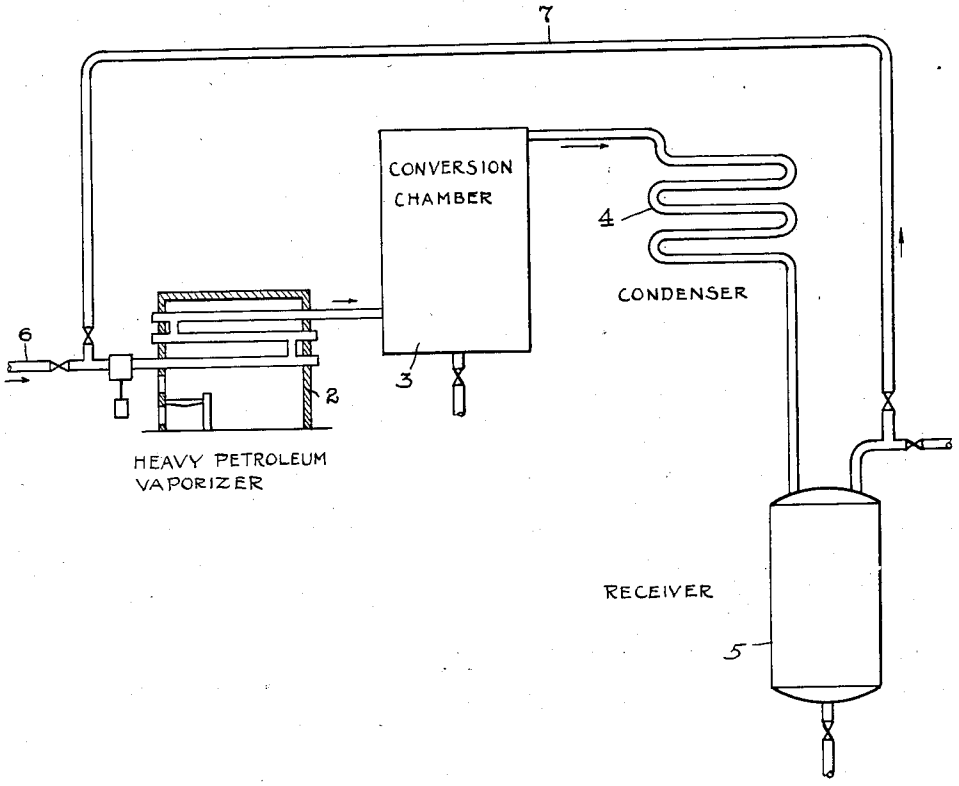
June 19, 1934. R. E. BURK 1,963,517

CONVERSION OF HYDROCARBONS

Filed July 12, 1930



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Patented June 19, 1934 1,963,517

UNITED STATES PATENT OFFICE

1,963,517

CONVERSION OF HYDROCARBONS

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Application July 12, 1930, Serial No. 467,621

5 Claims. (Cl. 196—53)

This invention relates to the conversion of hydrocarbon materials into hydrocarbon products of different boiling point, and more particularly the conversion of hydrocarbon materials which are of low value to products of utility for motor fuels and chemical application.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain embodiments of the invention, these being illustrative however of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:—

The sole figure is a diagrammatic elevational view of apparatus such as may be employed for carrying out the invention.

In proceeding in accordance with the invention, hydrocarbon material is subjected to heat at temperatures above those which have been heretofore usual in cracking operations. The raw material so employed may be of gaseous or vaporous character, as hydrocarbons heavier than the customary motor fuel range, and particularly such materials as are resultant from refinery operations, for instance tars from cracking operations, residual materials, gas, etc. Such materials in other words as can be brought into vaporous or gaseous state, and while the process is applicable with hydrocarbons such as gas oil and similar cuts, from an economic standpoint, it is more advantageous with hydrocarbons of the general category of cracking-coil tars, residual tars, wastes, and gas.

The oil or tar to be utilized is brought into a vaporous condition in any suitable manner, and in some instances, it is advantageous to assist vaporization by the passage of refinery or light gas or hydrogen through the oil, particularly where the type of vaporization employed involves the heating of a body of oil, as contrasted with a spray or flash type of vaporization. Even in the latter however, an atomization by means of gas may be desirable in instances. With the heavy hydrocarbon material brought into vaporous form, as in vaporizer 2, it is subjected to heat at a temperature of 1600–2100° F. in conversion chamber 3. Where the operation is carried on at temperatures of about 1600° F. or somewhat lower, the product involves considerable quantities of unsaturated aliphatics. With higher temperatures, the aromatics are more predominant, and with temperatures for instance of 1800–1850° F., important proportions of such aromatics as toluene, xylene, besides benzene, occur. With a still higher temperature, the naphthalene and anthracene become more important. Thus typically, products of aromatic character may be had, and with utility for motor fuels and naphthalene and anthracene, etc. yield as well. The products from conversion chamber 3 thence proceed to a condenser 4 and receiver 5.

In subjecting the hydrocarbons to heat, it is desirable to avoid contact with iron surfaces, and I employ by preference equipment in which the surfaces presented are for instance sillimanite or similar non-metallic surfaces, or if a metallic surface be desired, chromium, or a non-ferrous alloy of chromium or a high chromium steel in some instances.

In a general sense, the temperature factor and the time of subjection to heating are reciprocals, in regard to feasible production without undue coking. Desirably, the vapors of the tar or the like are forwarded with refinery gas, residual gas from cracking installations, or the like. In general, the heating time desirable may range from an exposure for instance of 1.5 seconds where operating at the lower temperatures of the range indicated, to 0.05 second where operating at the higher temperatures of the range indicated. The amount of gas fed with the vapor of a heavy hydrocarbon may be varied in accordance with the throughput desired, and the temperature and the conditions generally. For instance, a feasible range of operating ratios may involve 0.4 to 2.5 cu. ft. of gas to an amount of tar vaporized from 0 to 50 c. c.

The gas contributes a quota in the products ultimately obtained, and it particularly however has a utility in facilitating throughput. Excessive gas feed above such point of advantage is economically undesirable because using heat unproductively in such heating as is involved for the excess bulk of gas. As previously indicated, refinery or like gas, or hydrogen, may be satisfactorily employed in the process. Since such gas will ordinarily be a hydrocarbon gas this last-named term, it will be understood, is used herein to designate any such suitable gas, including hydrogen by itself, as an equivalent. As indicated in the drawing, the gas may be introduced at 6, from any suitable source, or it may in whole or in part be obtained by recycling through connection 7 from the end of the condenser system.

Preferably also, as the vaporous material passes from the heating zone, it is subjected to

the action of a catalyst before proceeding to the condensers. For instance, the vaporous material while still at a temperature of about 1350–1625° F. is passed through a zone in which a catalyst is exposed. An example of an advantageous catalyst is zinc, and an especially thorough contact with the hydrocarbons may be had with both in the vaporous state.

As pointed out, the liquid hydrocarbon material employed may be if desired a gas oil, but more advantageously will be a mixture of heavy materials on the order of cracking-coil tars or residual materials of low value. Gas oil or the like may where desired be employed in mixture with these.

Coke is removed without shutting down the apparatus by first blowing steam through and then air. This is followed by steam again, after which the hydrocarbon materials are again introduced.

As an example, employing a cracking-coil tar, preferably a fifty per cent. cut therefrom presenting an initial boiling point around 300° F. and an end point around 700° F., such material is vaporized, as by spraying into a heated chamber, and vapors are forwarded with tail gas from a condenser system, through heated tubes of nonferrous surface. With a feed ratio of 12.17 c. c. of tar vaporized to each 0.44 cu. ft. of gas, and a heating temperature of 1517° F., with exposure 0.675 sec., a condensate is obtained showing for instance 22.5 per cent. off at 440° F., of freezing point —5° F. and freezing point —42° F. when mixed with 20 per cent. aviation gasoline.

As another example: With a feed rate of 12.3 c. c. of such cracking coil tar vaporized to each 0.44 cu. ft. of gas, and a temperature of 1619° F., and heating time 0.64 sec., a condensate may be obained showing 20 per cent. off at 403° F., of freezing point —5° F., and freezing point —42° F. when mixed with 20 per cent. aviation gasoline.

As another example: Such cracking coil tar vaporized and fed at the rate of 15.35 c. c. per each 0.85 cu. ft. of gas, and a temperature of 1828° F., and heating time 0.3116 sec., a condensate may be obtained showing 32.5 per cent. off at 402° F., of freezing point 10° F. and —8° F. when mixed with 20 per cent. aviation gasoline.

As another example: Such cracking coil tar vaporized and fed at the rate of 14 c. c. per each 1.3 cu. ft. of gas, and heated at 1900° F. for 0.207 sec., a condensate may be had showing 34.4 per cent. off at 391° F., freezing point 13° F., and —3° F. when mixed with 20 per cent. aviation gasoline.

As another example: With such cracking coil tar vaporized and fed at the rate of 14 c. c. per each 2.15 cu. ft. of gas, and heated at 1940° F. for 0.126 sec., a condensate may be had showing 34.75 per cent. off at 393° F., with freezing point 18° F., and 0° F. when mixed with 20 per cent. aviation gasoline.

As another example: With such cracking coil tar vaporized and fed at the rate of 14.15 c. c. per each 2.6 cu. ft. of gas, and heated at 1967° F. for 0.096 sec., a condensate may be had showing 33.3 per cent. off at 268° F., with freezing point 32° F., and 2° F. when mixed with 20 per cent. aviation gasoline.

The lower distillation cuts taken from the condensates produced may be employed as such are preferably in blends, for motor fuel. From the higher fractions, naphthalene, anthracene and the like may be obtained, and finally a resinous product utilizable for insulative and moulding purposes.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. A process of converting hydrocarbons to products of different boiling point, which comprises vaporizing a petroleum cracking-residuum tar by a hydrocarbon gas and heating to a temperature from about 1600° to not over 2100° F., subjecting to the action of zinc vapor while still at an elevated temperature, and cooling and condensing the products.

2. A process of converting hydrocarbons to products of different boiling point, which comprises vaporizing a petroleum cracking-residuum tar, subjecting such vapors with a hydrocarbon gas, in the feed proportion of 0.5–3 cubic feet of gas per 10–50 cc. of tar vaporized, to a temperature of about 1825° F. for a heating time of 0.05–1.5 sec., subjecting to the action of zinc vapor while still at an elevated temperature, and cooling and condensing the product.

3. A process of converting hydrocarbons to products of different boiling point, which comprises intermingling a stream of preformed hydrocarbon gas added from an external source with a tarry petroleum residuum while heating the same sufficiently, vaporizing the residuum thereby, heating the mixture to a temperature of about 1600° to not over 2100° F. for a heating time of 0.09–1.5 sec., and while still at an elevated temperature subjecting to the action of a catalyst which is a vapor at such temperature, and cooling and condensing the products.

4. A process of converting hydrocarbons to products of different boiling point, which comprises intermingling a stream of preformed hydrocarbon gas added from an external source with a tarry petroleum residuum while heating the same sufficiently, vaporizing the residuum thereby, heating the mixture to a temperature of about 1600° to not over 2100° F., for a heating time of 0.09–1.5 sec., and cooling and condensing the products.

5. A process of converting hydrocarbons to products of different boiling point, which comprises intermingling a stream of preformed hydrocarbon gas from an external source with a tarry petroleum residuum while heating the same sufficiently, vaporizing the residuum thereby, heating the mixture to a temperature of about 1600° to not over 2100° F., for a heating time of 0.09–1.5 sec., subjecting to the action of zinc vapor while still at an elevated temperature, and cooling and condensing the products.

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