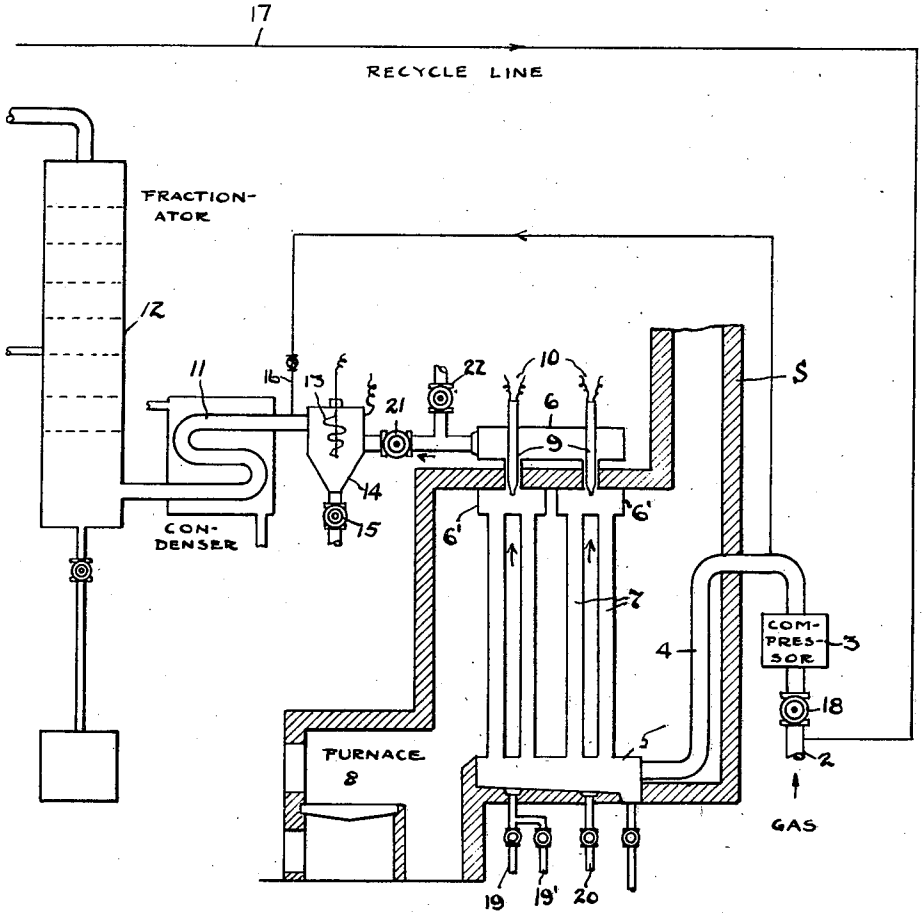
Nov. 13, 1934. R. E. BURK ET AL 1,980,380

MANUFACTURE OF MOTOR FUEL

Filed Feb. 13, 1930



INVENTORS
Robert E. Burk and
BY Herman P. Lankelma
Fay, Oberlin & Day
ATTORNEYS.

Patented Nov. 13, 1934 1,980,380

UNITED STATES PATENT OFFICE

1,980,380

MANUFACTURE OF MOTOR FUEL

Robert E. Burk and Herman P. Lankelma, Cleveland, Ohio, assignors to The Standard Oil Company, Cleveland, Ohio, a corporation of Ohio

Application February 13, 1930, Serial No. 428,133

6 Claims. (Cl. 196—110)

In the manufacture of motor fuel, it is the customary practice to obtain hydrocarbons suitable for this usage from petroleum directly by distillation or by cracking. In both instances a considerable by-product of gas is incurred. This is practically a waste product to be burned about the refinery or in nearby usage. In accordance with the present invention however, it now becomes possible to convert such waste product into useful motor fuel, etc., and in a manner readily applicable in connection with present refinery establishments.

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 semi-diagrammatic illustration of apparatus contemplated in the invention.

In the average refinery, the gas from the crude stills and that from cracking operations is generally conducted to a common point of mixing and distribution to usage. Such mixed gas, or either that from distillation or that from cracking may be employed in the practice of the present invention. A gas from distillation differs from that from a cracking operation chiefly in the lesser amounts of hydrogen, carbon monoxide, oxygen, and unsaturates; and in any case it is understood that the gas has been stripped of all condensable hydrocarbons, by approved methods of condensation, absorption, etc. For example, an analysis of a gas from a cracking coil operation may show 6.9 per cent. total unsaturates, 0.5 per cent. of oxygen, 0.4 per cent. of carbon monoxide 0.2 per cent. of carbon dioxide, 1.8 per cent. of hydrogen, and the remainder made up of methane, ethane, propane, butane, pantane, and iso-compounds.

In its general aspects, the invention contemplates operation with such a gas, from straight run or cracking equipment, or mixed, the gas being subjected to the action of heat, and conditions to synthesize higher molecular weight hydrocarbons. Analytic catalysts or contact surfaces tending to a breakdown to carbon and hydrogen are avoided.

With a source of dry gas, that is, a gas containing mixed hydrocarbons from which those condensable have been removed, a compressor may be employed if desired to bring up the pressure, this however being not strictly essential, but rather a matter of efficient throughput. The gas is then passed to a heating zone. Preferably a preheater is employed, to bring the temperature up almost to the treating temperature. For instance, a preheat of 900° or 1000° F. may be applied. The gas is then forwarded to the reaction zone. A convenient arrangement is illustrated in the drawing herewith, in which the gas stream is forwarded through a line 2 from a suitable source to a compressor 3 and a preheater 4, whence it proceeds to a header box 5 or inlet header. A bank of passageways 7 is arranged between such inlet header 5 and sub-headers 6' and outlet header 6, the passages being of tubular or other suitable form, and preferably of small diametral section, in order to increase the heating surface. In the surface material of such passages, iron should be avoided, and in fact the common metals generally. Instead, such surface material should be of a mineral composition, and preferably an oxygen-containing composition, alundum (Al_2O_3), sillimanite ($Al_2(SiO_2)_3$), silica, silicates, porcelain, etc. Such material may be made up in solid form to provide the walls, or if desired it may be employed as a lining merely. With suitable construction and provision for firing, the passages need not be long. In the illustration, heating provision is shown as a furnace 8 with the passages 7 exposed on the way to the outlet flue S.

Preferably, the outlet of the passages from the subheaders is narrow or choked by a filler element 9, which may form the mantle or cover for such pyrometers 10 as may be desired. By choking the outlet from the tubes to such extent, a drop in pressure to the outlet header is had, facilitating quick cooling by expansion.

From the outlet header the products proceed to a condenser system, including a partial condenser 11 and a fractionator 12. The partial condenser may be of any desired form, water-immersed coils or more elaborate in construction, and the fractionator may be of bell cap plate type, or the like. Desirably, the products from the outlet header are also subjected to an electric field of high voltage, for instance 10,000–50,000 volts, a multiple surface electrode 13 or a plurality of electrodes being suitably insulatively mounted in the connection between the outlet header and the partial condenser element. Such connection may take the form of a chamber 14, preferably with a drain bottom and a valve-con-

trolled lower outlet 15. In the connection between the electrode chamber 14 and condenser 11, we may also provide an inlet 16 for cold gas, and the controlled admission and admixture thereof in the products may be employed as a condensing means. It will thus be seen that the vaporous products as discharged from the reaction zone may be submitted to expansion-cooling, a high-tension electric field, and water-cooled condensation, individually or in combination. The gas discharge from the final fractionating may be returned as for instance through line 17, and be recycled through the reaction zone.

As indicated, operations may be carried on with or without pressure. If some pressure be applied a better throughput can be had however. For instance the compressor may be operated at about 100 pounds.

With a treating temperature of 1800–2000° F., preferably about 1925°, and a suitable flow rate, the actual heating time is short. For instance, with a flow rate providing a heating time of 0.1–1.0, preferably 0.2–0.5 seconds, a yield of condensate may be had in the condenser system showing an initial boiling point of 158° F., and fractionating with elimination of tarry constituents, to yield 53 per cent. in the boiling point range of motor fuel. This consists of aromatics and aliphatic compounds, benzol being in large proportion. Above the motor fuel range, a fraction of naphthalene may be had, and anthracene, besides a final polymerized mass of resinoid type, suitable for electrical insulation usages. Variation of the temperature will somewhat vary the relative amounts of the respective products, lower temperatures yielding higher proportions of aromatics, while very high temperatures largely determine yields to polymer forms. The motor fuel thus obtained may be employed as such, or preferably may be blended with customary gasoline stocks as desired.

In the event of carbon deposit in the passages of the reaction zone, the gas supply may be cut off, as by the control valve 18, and carbon dioxide may be introduced through supply pipe 19, the carbon being removed in accordance with the equation $C+CO_2=2CO$. Or preferably, steam may be introduced, as by steam supply pipe 20, the carbon then being removed by water-gas formation. Or, the temperature may be lowered and hydrogen may be introduced through supply pipe, 19', the carbon being removed as methane. For such a purging, the offtake-connection may be closed by a valve at 21, and the scavenger outlet 22 may be opened. On resumption, the scavenger outlet may be closed and the valve 21 be opened, with supply of gas from valve 18 as before.

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

We therefore particularly point out and distinctly claim as our invention:—

1. Apparatus of the character described, which comprises a heating chamber, a plurality of vertical conduits therein, inlet and outlet headers connected to the respective ends of said conduits, fixed choke means leaving a substantially annular restricted passage in the bore of the outlet header, and a condenser in communication with said outlet header.

2. Apparatus of the character described, which comprises a heating chamber, a plurality of vertical conduits therein, inlet and outlet headers connected to the respective ends of said conduits, means in common for choking the outlet of the outlet header and for indicating the temperature therein, and a condenser in communication with said outlet header.

3. Apparatus of the character described, which comprises a heating chamber, a plurality of vertical conduits therein, an inlet header at the lower end of said conduits, outlet sub-headers at the upper ends of groups of said conduits, a further outlet header connecting said sub-headers, fixed choke means, leaving a substantially annular restricted passage, between the sub-headers and said further outlet header, and a condenser in communication with said outlet header.

4. Apparatus of the character described, which comprises a heating chamber, a plurality of groups of vertical conduits therein, an inlet header at the lower end of said conduits, outlet sub-headers at the upper ends of groups of said conduits, a further outlet header connecting said sub-headers, means in common for choking the outlets of said sub-headers and for indicating the temperature therein, and a condenser in communication with said outlet header.

5. Apparatus of the character described, which comprises a heating chamber, a plurality of groups of vertical conduits therein, an inlet header at the lower end of said conduits, outlet sub-headers at the upper end of groups of said conduits, a further outlet header connecting said sub-header, choke means between the sub-headers and said further outlet header including pyrometer-covers and pyrometers therein, and a condenser in communication with said outlet header.

6. Apparatus of the character described, which comprises a heating chamber, a plurality of groups of vertical conduits therein, an inlet header at the lower end of said conduits, outlet sub-headers at the upper end of groups of said conduits, a further outlet header connecting said sub-header, choke means between the sub-headers and said further outlet header including pyrometer-covers and pyrometers therein, a connection for introducing relatively cool gas beyond said outlet header, and a condenser to receive the mingled products thereof.

ROBERT E. BURK.
HERMAN P. LANKELMA.