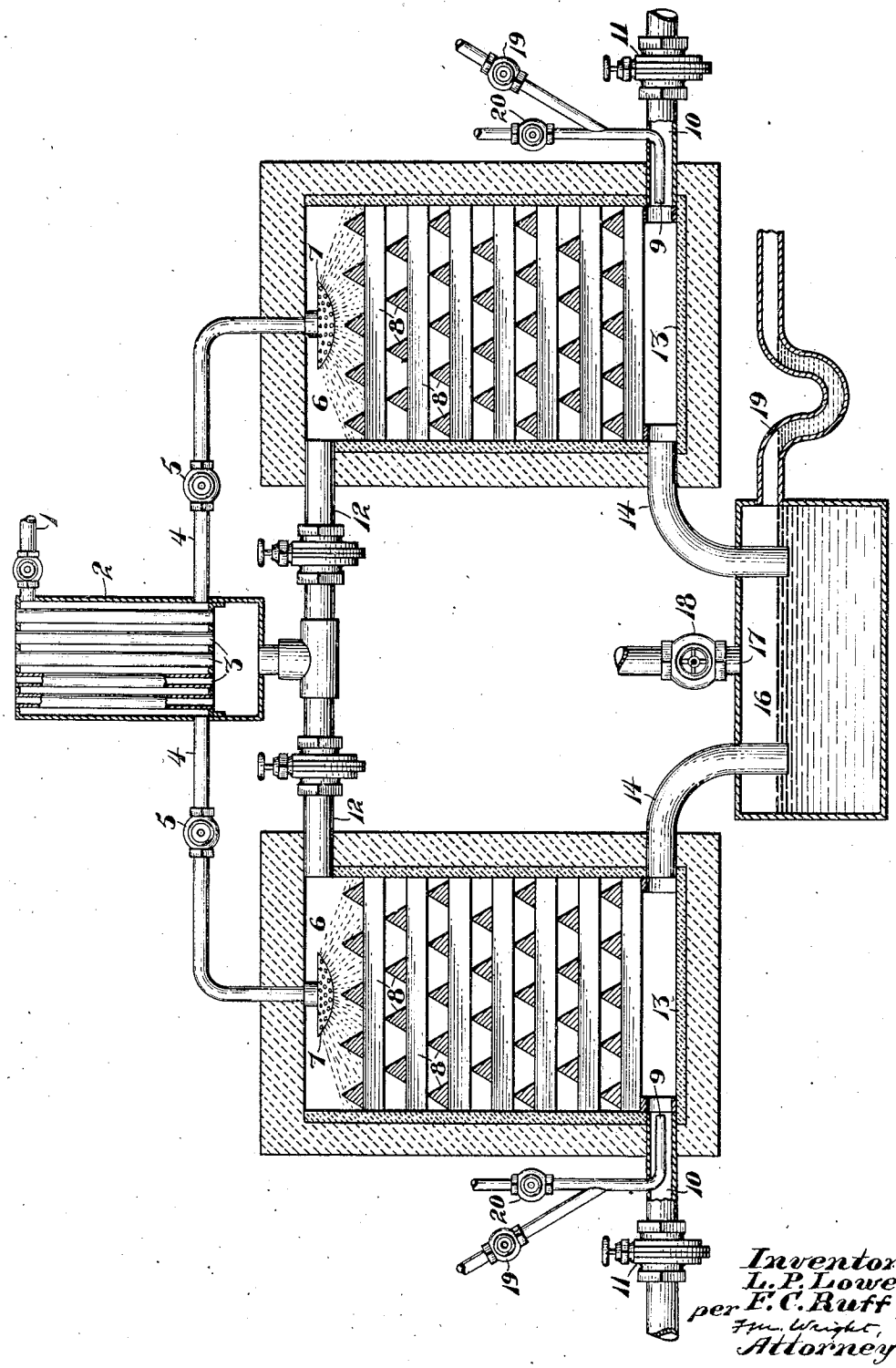
L. P. LOWE AND F. C. RUFF.

PROCESS OF CRACKING PETROLEUM.

APPLICATION FILED JAN. 15, 1917.

1,351,859. Patented Sept. 7, 1920.



Inventors.
L. P. Lowe
per F. C. Ruff
Fm. Wright,
Attorney

UNITED STATES PATENT OFFICE.

LEON P. LOWE, OF SAN FRANCISCO, AND FREDERICK C. RUFF, OF LOS ANGELES, CALIFORNIA, ASSIGNORS TO BY-PRODUCTS MANUFACTURING COMPANY, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

PROCESS OF CRACKING PETROLEUM.

1,351,859. Specification of Letters Patent. Patented Sept. 7, 1920.

Application filed January 15, 1917. Serial No. 142,560.

To all whom it may concern:

Be it known that we, LEON P. LOWE and FREDERICK C. RUFF, respectively a citizen of the United States and a subject of the Emperor of Germany, and residing at the city and county of San Francisco, State of California, and the city and county of Los Angeles, State of California, have invented new and useful Improvements in Processes of Cracking Petroleum, of which the following is a specification.

It has long been known that if petroleum is heated to a certain temperature, about 1100° F. and is brought into contact with any one of certain catalyzing substances, as iron or nickel, it is cracked into free carbon, heavy oils, the condensible hydrocarbons, gasolene and aromatic oils, and fixed gases.

However, a difficulty has been experienced in the practical application of this knowledge to the production of the aromatic oils and gasolene. The principal obstacle encountered has been the deposition of the carbon on the inner surfaces of the iron pipe or other chamber in which the oil is heated, which has not only rendered it increasingly difficult to transmit external heat through the walls of said pipe or chamber to the interior, but has eventually clogged up the oil passages and rendered the apparatus inoperative.

It is the object of the present invention to to provide a process of cracking petroleum and fractions thereof, such as distillate, which shall be free from the above difficulty and objections, and which, moreover, will be thoroughly practical and economical.

In the accompanying drawing, the figure is a longitudinal vertical section of the apparatus.

Referring to the drawing, a pipe 1 for conducting the petroleum to be cracked leads into a preheater 2 around flues 3 therein, from opposite sides of which preheater, near the bottom, pipes 4 controlled by valves 5 lead respectively into cracking chambers 6 through their tops and terminate in sprayers 7 in the upper portions of said chambers. By said sprayers the oil is finely divided and distributed on to the surface openwork, catalytic material such as tops of vertical series of horizontal rows of superposed iron checker bars 8 in said chambers 6, successive rows of the series being laid cross-wise of each other to act as baffles, in the same manner as the checker brick-work of gas generators. These bars are preferably of a material having a catalytic effect, that is, in some manner not understood, assisting in cracking the petroleum, when sufficiently heated, into free carbon, heavy oils, condensible hydrocarbons and fixed gases.

By means of fluid fuel burners 9 discharging into the lower portions of said cracking chambers, and supplied with air by conduits 10 controlled by gates 11, said bars are heated to a suitable temperature, and the petroleum, either in the presence of a catalyzer or not, is cracked, as above explained, care being taken not to raise the temperature so high as to completely gasify the constituents of the petroleum, as is done in the manufacture of gas from oil. The hot products of combustion escape by conduits 12 leading from the cracking chambers near the top, discharging into a lower portion of the preheater 2, and passing out through said flues 3. It will thus be seen that the residuum of the heat used for heating the catalyzers and cracking chambers is utilized to preheat the oil to be treated. By properly manipulating the valves 5, care is taken that the temperature of the oil in the preheater 2 does not rise to, or above, that at which the oil is cracked, in the presence of the catalyzer, for in such cases the carbon would be deposited on the exterior of the flues 3 or in the interior of the pipes 4.

While the interior of one of the cracking chambers is thus being heated, oil which has been heated in the preheater is being sprayed on to the top of the series of catalyzing bars in the other cracking chamber, which bars have already been raised above the cracking temperature. This cracking takes place as the lighter constituents of the oil in the form of vapor pass through the interstices between the checker bars and are raised to the cracking temperature in the presence of the catalyzer. The cracking chambers are lined with refractory material 13, preferably of a catalyzing nature.

Some of the free carbon thus liberated is deposited on the catalyzing agent, but the rest passes with the gasolene, aromatic oils, heavy oils and fixed gases through pipes 14

into a washing vessel 16 from which leads an outlet pipe 17, the size of the opening through which can be regulated by a valve 18 so as to vary the pressure in the washing vessel 16 and in the cracking chamber in which the oil is being cracked, the gate 11 of said cracking chamber being closed. The pipes 14 open sufficiently near to the bottom of the washing vessel 16 so that the gases and the vapors of the gasolene and aromatic oils are compelled to pass beneath the level of the heavy oils contained in said vessel, and are thereby washed from the free particles of carbon retained thereby. Said heavy oils flow off through an overflow pipe 19.

When the cracking chamber is undergoing the preheating step, an excess of air is admitted to said chamber, thereby burning up any carbon which may have been collected on the surface of the catalyzer, and utilizing the heat of combustion of the carbon to heat the interior of the cracking chamber, and also the preheater.

By this process and apparatus, the difficulties heretofore encountered when cracking the petroleum in pipes are avoided. Such pipes were heated externally, and consequently the inner surface of the pipe was the hottest portion of the interior. The carbon abstracted from the petroleum was deposited on the interior surfaces of the pipe, and was difficult to remove and tended to clog up the pipe. In the present construction the deposited carbon can easily be burnt off, and in any case the loose bars of catalyzing material can easily be removed and others substituted therefor.

From the above description the successive steps of the above process will have been apprehended. One of the cracking chambers, as, for instance, that on the left, is first heated by the combustion of fluid fuel admitted through the burner 9, the products of combustion passing out through the conduit 12 and flues 3. The heating is continued until the temperature of the catalyzing bars is raised to over 1100° F., if it be desired to produce principally aromatic hydrocarbons, and the gate on the left-hand side and the rate of flow of the oil around the flues 3 are so regulated that the oil in the preheater is heated to a temperature of 500 to 600° F. If found necessary the fluid fuel burner may be shut off and the air supply continued to equalize the temperature in the cracking chamber by reducing that in its lower portion and raising that in its upper portion. The valve 11 on the left is now closed as well as the burner valves 19 and 20 and those on the right are open and the valve 5 on the left is open and that on the right is closed. The heated oil then flows through the pipe 14 on the left and into the sprayer, by which it is sprayed on the top of the catalyzer bars, so that, by the time that it reaches the bottom of the vertical series of catalyzing bars, it is cracked into condensible hydrocarbons, fixed gases, carbon and heavy oils. Part of the carbon is deposited upon the catalyzing bars and on the walls of the chamber and the rest is carried forward into the washing chamber in which the heavy oils and carbon are retained, the latter being washed from the condensible hydrocarbons and fixed gases by being compelled to pass under the surface of the heavy oils, the condensible hydrocarbons and fixed gases passing out through the pipe 19, the condensible hydrocarbons being separated from the fixed gases by condensation.

In the meantime, the cracking chamber on the right is being heated in precisely the same manner as described in regard to the cracking chamber on the left. Thus the process, though intermittent for each cracking chamber, is continuous for the production of condensible hydrocarbons.

It will be observed that the liquid in the washing vessel is too hot to condense the vapors of aromatic hydrocarbons and gasolene, and thereby the carbon is eliminated without the necessity of employing the two steps of first heating and then cooling to get rid of the carbon.

It is evident that the general steps of the above process are applicable to the recovery of either gasolene or aromatic hydrocarbons, the cracking temperatures and the rate of supply of the petroleum being varied accordingly, the cracking temperatures being in general higher for aromatic hydrocarbons than for gasolene, and the rate of supply being slower.

The process can be carried out with the pressure in the cracking chambers 6 equal to the atmospheric pressure, but the yield at such pressure would be comparatively small. At a higher pressure the yield is greater and the product more uniform.

For the sake of brevity the word "petroleum" in the claims is to be understood as including fractions thereof, such as ordinary distillate.

What is claimed is:—

1. The process of cracking petroleum, which consists in passing products of combustion through a cracking chamber and into contact with openwork material therein to raise the temperature of said material above that at which petroleum is cracked with a production of carbon and condensible hydrocarbons, but less than that to which it is heated in the generation of gas from petroleum, then passing petroleum therethrough, thereby cracking the petroleum, then arresting the passage of the petroleum through the openwork material, and then burning the carbon deposited upon said sur-

face by the cracking of the petroleum, to assist in heating said surface in a repetition of the process.

2. The process of cracking petroleum, which consists in passing hot products of combustion alternately through two cracking chambers containing openwork material to heat the material in each of said chambers alternately to a temperature above that at which petroleum is cracked with a production of carbon and condensible hydrocarbons, and less than that used to convert petroleum substantially completely into permanent gas and simultaneously passing petroleum through the other cracking chamber.

L. P. LOWE.
FREDERICK C. RUFF.