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## PATENT SPECIFICATION



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223,543

Application Date (in United Kingdom): Sept. 22, 1924. No. 22,322/24.

Complete Accepted: May 14, 1925.

### COMPLETE SPECIFICATION.

#### Industrial Process and Apparatus for the Synthetic Manufacture of Hydrocarbons by the Electrical Method.

We, LE PÉTROLE SYNTHÉTIQUE, of 16, Avenue de l'Opéra, Paris, France, a joint-stock company organised under French law, (Assignees of CHARLES ANDRY-BOURGEOIS, a citizen of the French Republic, residing at 20, rue Lesueur, Paris, (20E), France), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to a process for the treatment of light hydrocarbons with a view to obtaining heavier hydrocarbons.

This process is characterised by the fact that a mixture of carbon monoxide (CO) and hydrogen (H) is made to react upon the light hydrocarbons in the gaseous state and in the presence of the electric arc, in such a way as to obtain successively heavier and heavier hydrocarbons.

For the mixture of carbon monoxide and hydrogen, there can be utilised water gas obtained from producers or the like.

This process can be applied to obtaining heavy hydrocarbons, saturated, ethylenic and benzenic, starting respectively from methane, from ethylene or acetylene and from benzene, and by forming successively heavier hydrocarbons.

The annexed drawing represents diagrammatically and by way of example, an apparatus adapted to be utilised for the carrying out of this process.

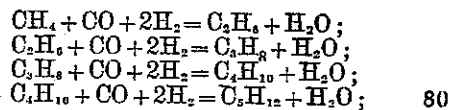
The reaction chambers 1, 2, 3, 4, . . . . . are provided with electrodes *a b—c d—e f—g h*, etc., respectively; these electrodes are hollow and the electrode *a, c, e, g, i*, . . . . ., serves to introduce into the corresponding reaction chamber the hydrocarbon to be treated therein, while the other electrode *b, d, f*,

*h*, . . . . ., serves for the removal of the hydrocarbon formed. Each reaction chamber is open on the side of the admission of the hydrocarbon and closed on the opposite side, the electrode *b, d, f, h*, serving for the removal of the hydrocarbon formed passing through the wall of this chamber so as to lead into a vessel *E, E<sup>1</sup>, E<sup>2</sup>, E<sup>3</sup>*, etc., which serves for the purification of this hydrocarbon before it is introduced into the next chamber.

The open side of each reaction chamber communicates with a device for the admission of the mixture of carbon monoxide (CO) and hydrogen (H) *a<sup>1</sup> c<sup>1</sup> e<sup>1</sup> g<sup>1</sup>*, . . . . . respectively.

The electrodes *a, c, e, g, i*, . . . . . are connected to one of the terminals of the circuit for the formation of the arcs, and the electrodes *b, d, f, h*, . . . . . to the other terminal of the latter. The extremities of these electrodes are preferably made of iron, aluminium, nickel, copper, ferro-nickel, sodium, potassium or alloys of these metals with one another, which exert a catalytic action upon the conversion of the hydrocarbons.

This apparatus can be utilised for example for the preparation of heavier and heavier saturated hydrocarbons, starting from methane, in accordance with the following equations:—



and so on.

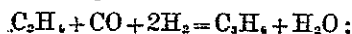
In this case the gaseous mixture (CH<sub>4</sub>) is introduced into the chamber 1 by the electrode *a*, and the mixture of carbon monoxide and hydrogen by the inlet *a<sup>1</sup>*; the hydrocarbon (C<sub>2</sub>H<sub>6</sub>) formed in the arc between the electrodes *a b*, escapes through the hollow electrode *b* into the

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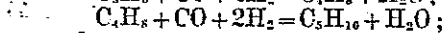
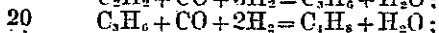
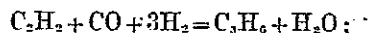
purifier E, where it is freed from water vapour.

By the electrode *c*, this hydrocarbon ( $C_2H_4$ ) enters the chamber 2, where it forms with the mixture of hydrogen and carbon monoxide introduced at  $c^1$  a heavier hydrocarbon ( $C_3H_8$ ), which escapes by the electrode *d*, is purified at  $E^1$  and is further transformed in the vessel 3 in the presence of a mixture of carbon monoxide and hydrogen introduced at  $e^1$  and so on.

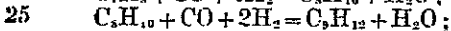
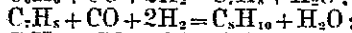
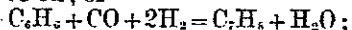
This process can likewise be applied to the preparation of ethylenic or benzenic hydrocarbons in accordance with the following equations:—



or



and so on; or



and so on up to the formation of hydrocarbons composed of the heaviest molecules.

According to the particular case, the operation may be carried out with gases maintained at the ordinary temperature,

or with gases previously raised to a temperature up to  $500^{\circ}$  C., under the ordinary pressure or under a pressure up to 30 atmospheres.

The reaction vessels may be heated, if necessary, and there may be introduced therein finely pulverized metals acting by their catalytic power to actify, to complete or to increase the yield of the reaction.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

A process for the treatment, by electrical means, of light hydrocarbons with a view to obtaining heavier hydrocarbons, characterised by the fact that a mixture of carbon monoxide (CO) and hydrogen (H) is made to act upon the light hydrocarbons, in the gaseous state and in the presence of the electric arc, in such a way as to obtain successively heavier and heavier hydrocarbons.

Dated the 22nd day of September, 1924.

For the Applicants,

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[This Drawing is a reproduction of the Original on a reduced scale]

