[Second Edition.]

# PATENT SPECIFICATION

Convention Date (Germany): Jan. 20, 1926.

264,845

Application Date (in United Kingdom): Jan. 19, 1927. No. 1627 / 27.

Complete Accepted: May 21, 1928.

1216

COMPLETE SPECIFICATION.

## Improvements in and relating to the Conversion of Saturated Hydrocarbons, in Gas or Vapour Form, especially Methane, into Unsaturated Hydrocarbons.

We, I. G. FARBENINDUSTRIE AKTIENGESELLSCHAFT, of Frankfort-on-Main, Germany, a corporation organized according to German laws, 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:—

It is known that when saturated hydrocarbons in the form of gas or vapour, especially methane, are heated to high temperatures such as 900° Centigrade, or higher, unsaturated hydrocarbons, especially acetylene, are formed as the result of thermochemical breaking up or decomposition. Thus by heating the said gases, for instance, in an electric arc or incandescent tube, or by incomplete combustion, more or less high yields of unsaturated hydrocarbons, especially acetylene, can be obtained.

We have now found that a practicable and highly advantageous conversion of gaseous or vaporous saturated hydrocarbons into valuable unsaturated hydrocarbons especially acetylene may be effected by passing the former alone or diluted with nitrogen or other inert gases through a flame which more or less fills a cross sectional area of a tube, such flame being, for example, arranged like a disc which may be produced by a plurality of separate burners. The flame is generated by means of a suitable chemical reaction, preferably by the combustion of combustible gas, gaseous mixture or vapour, with a sufficient quantity of oxygen, air, or mixture of oxygen and air. Preferably care should be taken, by suitably shaping the burners, for example arranging them in the form of leads of the blowpipe type with nozzle apertures, to restrict the extent of the flame to as narrow a zone as possible in the direction of the flow of the hydrocarbons to be converted, and to attain the highest possible flame temperature.

The flame or flames through which, for example, methane is to be passed, may with advantage be fed by a portion branched off from the gas to be treated, together with oxygen or air. Hydrogen, coal gas and the like may also be used as fuel for the blow-pipe. The air or the combustion gas, or both, may be preheated, preferably by heat exchange with the effluent reaction gases.

The reaction gases containing unsaturated hydrocarbons for example, acetylene or the like may either be rapidly cooled, for the recovery of these valuable compounds, or they may be subjected directly to further operations, especially condensation into benzol hydrocarbons, for example by passing them over suitable contact masses, in which operations their sensible heat is preferably utilised to a greater or smaller extent.

Figures 1 and 2 of the accompanying drawing represent a side elevation and plan respectively of a simple apparatus suitable for carrying out the present invention in which the auxiliary flame can be generated by burning in association with air a branched off portion of the gas, for example methane, under treatment. The whole of the methane enters at E, and is divided, by means of the regulating taps F and *g* into the main portion, which flows through the pipe *p* and R, the branched off portion passing into the pipes *m* and serving to feed the flame. The feeding pipes *m* terminate in burners *i* having tapered nozzles and projecting into the reaction vessel K, the said burners being surrounded by concentric nozzle pipes *h* through which the air or oxygen is supplied. Four of these burners are shewn arranged radially in a horizontal plane. On the flames being lit by means of an ignition device (not shewn in the drawing) such as the sparks from a small induction apparatus, a highly heated zone Z, in the form of a disc, is produced by the blowpipe flames. The main portion of the methane flows through the pipe R, enters the end part of the vessel K at O and traverses the zone Z, thereby undergoing thermal breaking up. The hot effluent gases, consisting of methane, hydrogen, carbon monoxide and acetylene, preheat the fresh gas flowing through the

[*Price* 1/-]

inlet pipe R and issue from the reaction vessel at S, whereupon they are submitted to further treatment, for example, to the separation or to further chemical transformation of the acetylene.

By suitably treating the gases after the reaction product has been separated therefrom, with a view to correct their composition for example by catalytically producing methane from the carbon monoxide and hydrogen contained in the gases and introducing fresh gas in the required amount, the process hereinbefore described may also be developed into a cyclic process.

The following example will further illustrate how the said invention may be carried into practical effect but the invention is not limited to this example.

Example.

Methane or natural gas is converted in a device according to the apparatus shewn in Figures 1 and 2, by subjecting two-thirds of the gas, all of which is admitted at the rate of 300 litres per hour, to the heat treatment, whilst the remaining one-third is employed, in conjunction with a volume of a mixture of air and oxygen, in the proportion 2 : 1, sufficient for its complete combustion, to feed the heating flame. The gas mixture leaving the highly heated zone is quenched by cooling with water. It contains several units per cent. of acetylene, which is separated by suitable means, or is transformed into compounds such as acetaldehyde, benzene and the like. The residual gas is either used for heating purposes, or is wholly or partially made use of again in the process itself.

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:—

1. A process for the conversion of saturated hydrocarbons in the form of gas or vapour, especially methane, into unsaturated hydrocarbons, especially acetylene, which consists in passing the said gases, alone or diluted with nitrogen or other inert gases, through a flame, preferably a disk-like flame, of preferably high temperature, more or less completely filling the cross sectional area of a tube.

2. A modification of the process according to Claim 1; which consists in feeding the flame by the combustion of a branched off portion of the gas under treatment, with oxygen, air or a mixture of oxygen and air.

3. The process for the conversion of saturated hydrocarbons especially methane in the form of a gas or vapour into unsaturated hydrocarbons especially acetylene substantially as described in the foregoing example.

4. The improved apparatus for effecting the conversion of saturated hydrocarbons especially methane, in the form of gas or vapour, into unsaturated hydrocarbons substantially as described and shewn in the accompanying drawing.

5. Unsaturated hydrocarbons especially acetylene when prepared in accordance with the preceding claiming clauses.

Dated this 19th day of January, 1927.

JOHNSONS & WILLCOX,
47, Lincoln's Inn Fields, London,
W.C. 2,
Agents.

Abingdon: Printed for His Majesty's Stationery Office, by Burgess & Son.
[Wt. 56A—125/7/1928.]

2nd Edition

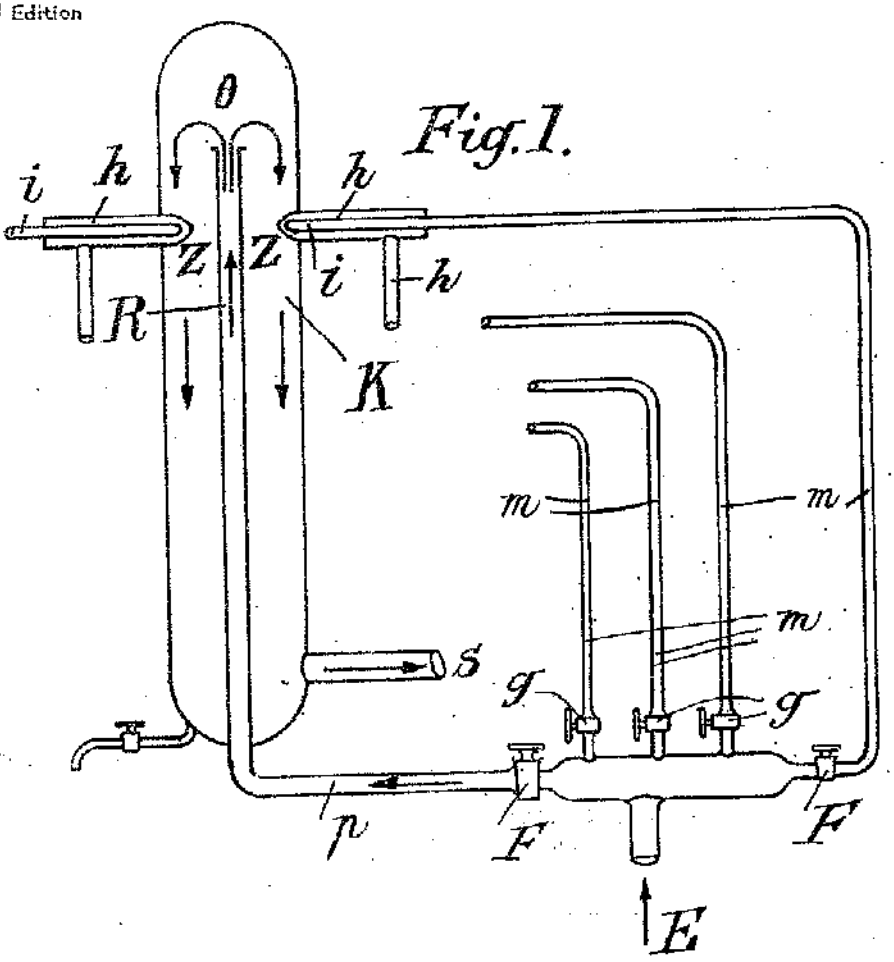


Fig. 1.

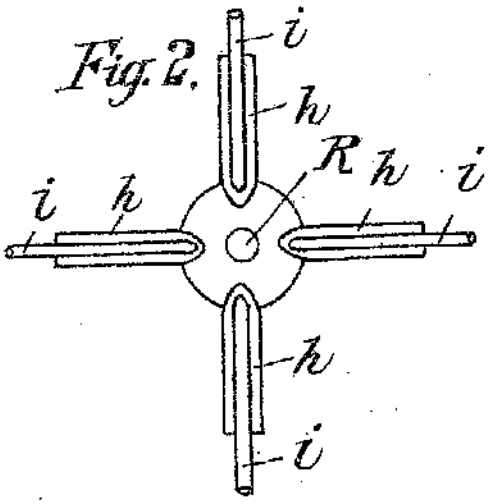


Fig. 2.

[This Drawing is a full-size reproduction of the Original.]

Charles & Read Ltd. Photo Litho