

Sept. 26, 1939.

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2,174,288

PRODUCTION OF OLEFINS FROM GASEOUS OR VAPOROUS SATURATED HYDROCARBONS

Filed May 29, 1936

Fig. 1

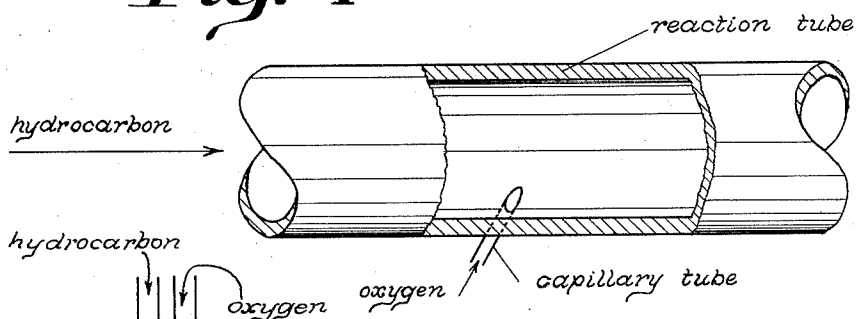


Fig. 2

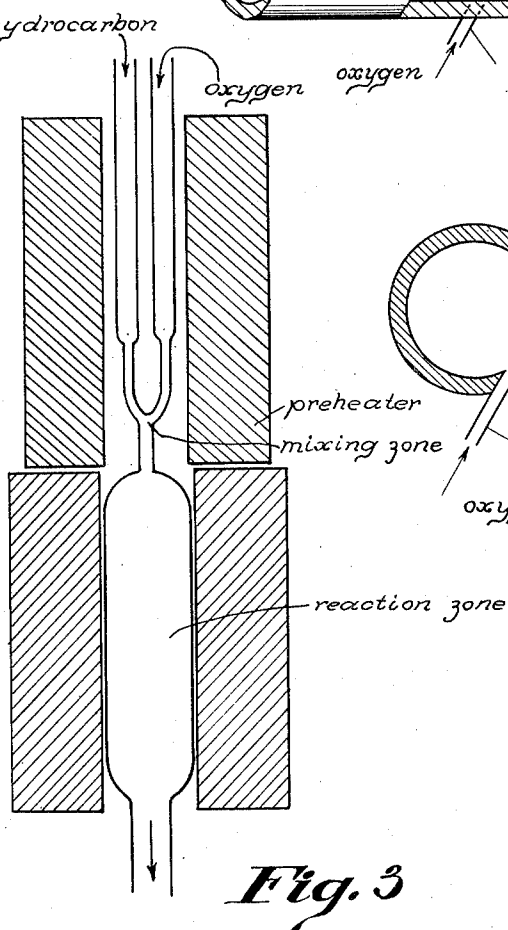
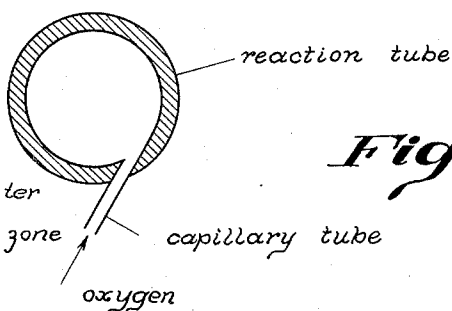


Fig. 3

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UNITED STATES PATENT OFFICE

-2,174,288

PRODUCTION OF OLEFINS FROM GASEOUS
OR VAPOROUS SATURATED HYDROCAR-
BONS

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Application May 29, 1936, Serial No. 82,448
In Germany June 7, 1935

9 Claims. (Cl. 260—683)

The present invention relates to improvements in the manufacture and production of olefins from gaseous or vaporous saturated hydrocarbons.

5 It has already been proposed to convert gaseous or vaporous (hereinafter collectively referred to as gaseous) saturated hydrocarbons into olefins by heating while supplying oxygen. The hydrocarbons and, if desired, also the oxygen were
10 in some cases preheated before entry into the reaction chamber. If this heating of the gases be carried out separately and a temperature thereby attained at which the reaction between the hydrocarbons and the oxygen takes place
15 without further external supply of heat, there is then formed when working as hitherto usual, at the place at which the hydrocarbons meet the oxygen, a flame or, when, as under certain conditions is possible, this is avoided, at least a local
20 overheating. While this formation of flame or local production of heat is desirable in the known process for the conversion of saturated hydrocarbons into acetylene, the conversion of hydrocarbons into olefins is considerably impaired
25 thereby. The yield of olefins diminishes and furthermore the formation of oil and the separation of carbon takes place.

We have now found that the said drawbacks while separately heating the hydrocarbons and oxygen, or the former alone, which is carried out for reasons of economy in heat, can be avoided if the oxygen when it meets the preheated hydrocarbons is at once so much diluted that the formation of a flame or local overheating does not
35 take place while the temperature of the mixture on account of the reaction smoothly rises to above about 700° C. This dilution of the oxygen for the purpose of avoiding its local enrichment in the gas mixture can be effected for example by providing for the most rapid possible mixing of
40 the oxygen with the initial gas. This may be effected for example by introducing the hydrocarbons, and if desired also the oxygen, into the reaction vessel with a high speed of flow. A rapid
45 mixing may also be effected by the formation of eddies at the place of mixing or by the tangential introduction of one or both gases. The supply of the gases to the mixing place may also be effected through nozzles or porous walls, it being
50 essential however that a homogeneous mixing of the two gases takes place in so short a time that strata or streaks of gas cannot be formed. In experiments with preheated industrial propane having a speed of flow of 7 metres per sec-
55 ond, when mixing it with similarly preheated

oxygen the formation of a flame took place at a mixing temperature of about 720° C. only.

Another specially suitable means of producing a sudden strong dilution of the oxygen is by mixing the hot gases under reduced pressure; it is immaterial at what pressure the preheating has been carried out. The advantages of the mixing under reduced pressure may be further enhanced by the other means above described. Thus a preheated current of propane having a speed of
10 from 17 to 18 metres per second and a pressure of 400 millimetres (mercury gauge) at the place of mixing with a similarly preheated oxygen gives no indication of any non-permissible local over-
15 heating or even formation of flame at a temperature of 750° C. at the place of mixing. The use of reduced pressure in the mixing process offers the further practical advantage that the gases to be mixed can be brought to high speeds in a very simple manner by the fall in pressure; effective formation of eddies may be produced by
20 deflecting bodies, in some cases even by ordinary filler bodies.

The dilution of the oxygen may also be effected by the supply of vapours, as for example steam, or of gases, as for example carbon dioxide, the formation of flame or local overheating thereby being avoided. These vaporous or gaseous diluting media are hereinafter collectively referred to as gaseous diluting media.

The conversion of the hydrocarbons into olefins is preferably carried out in reaction vessels of non-metallic materials such as quartz, clay or chamotte. For the heating of the hydrocarbon gases, on the contrary, metallic apparatus is more
35 suitable by reason of the better conduction of heat, as for example apparatus of iron-chromium alloys, and for the preheating of the oxygen apparatus of alloy steels which are proof against oxidation. Any impairment of the yield of olefins or troubles such as deposition of carbon (such as may occur when carrying out the reaction in metal vessels or even when heating up mixtures of hydrocarbons and oxygen), are not
40 observed when the gases are heated separately in metal apparatus and the reaction is carried out in non-metallic vessels.

The following examples when taken with the accompanying self-explanatory drawing, will serve to further illustrate the nature of this invention but the invention is not restricted to these examples. The drawing illustrates the apparatus employed in Examples 1 and 2, Figure 1 being a front elevation partly broken away of the apparatus of Example 1, and Figure 2 a
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cross section thereof, and Figure 3 an elevation partly in section of the apparatus of Example 2.

Example 1

30 litres of industrial propane preheated to 650° C. are charged per hour under a pressure of 400 millimetres (mercury gauge) through a quartz tube having a cross-section of 40 square millimetres. Into this current of gas 10 litres per hour of cold oxygen are introduced tangentially through a capillary tube having a cross-section of 2 square millimetres. The mixture attains a temperature of 880° C. in the reaction chamber without external supply of heat, 80 litres of olefins being formed from each 100 litres of propane used and also CH₄, H₂, CO, H₂O and a little CO₂.

Example 2

40.7 litres of propane per hour and 14.5 litres of oxygen per hour are heated to 700° C. under a pressure of 400 millimetres (mercury gauge) in two separate tubes, the gases then being brought to a speed of about 20 metres per second at the place of mixing by capillary restriction of the tubes to a diameter of 2 millimetres. The mixture then flows with a quiet reaction through a quartz tube widened to a diameter of 20 millimetres and charged with pieces of quartz, a maximum temperature of 870° C. being attained. The yield of olefins amounts to 79 per cent of the volume of the propane used.

Example 3

45 litres of ethane and 19.3 litres of oxygen per hour are separately preheated to 700° C. in the apparatus described in Example 2 and then mixed. In the attached reaction tube, which is widened to a diameter of 100 millimetres, a maximum temperature of 920° C. is attained. The yield of ethylene is about 64.5 per cent of the theoretical yield in spite of the high reaction temperature.

What we claim is:

1. A process for the production of olefins from gaseous saturated hydrocarbons other than methane which comprises preheating the said hydrocarbons to about 700° C. and supplying oxygen thereto while diluting it at once so as to prevent formation of strata and streaks of gas when it meets the preheated hydrocarbons, thereby producing a reaction temperature above 700° C. but

below about 1000° C., the temperature at which substantial amounts of acetylene are formed under the conditions obtaining while avoiding the formation of a flame or local overheating.

2. In the process as claimed in claim 1 the step of effecting the most rapid possible mixing of the oxygen with the initial gas.

3. In the process as claimed in claim 1 the step of effecting the most rapid possible mixing of the oxygen with the initial gas by carrying out at least one of the steps consisting of introducing at least one of the said gases into the reaction vessel with a high speed of flow, causing the formation of eddies at the place of mixing, tangentially introducing at least one of the gases into the reaction vessel and introducing at least one of the gases through nozzles at the place of mixing.

4. In the process as claimed in claim 1 the step of carrying out the most rapid possible mixing of the oxygen with the initial gas by introducing at least one of the said gases into the reaction vessel with a speed of flow of more than about 5 metres per second.

5. In the process as claimed in claim 1 the step of maintaining the reacting gases under reduced pressure.

6. In the process as claimed in claim 1 the step of maintaining the reacting gases under reduced pressure and carrying out simultaneously at least one of the steps consisting of introducing at least one of the said gases into the reaction vessel with a high speed of flow, causing the formation of eddies at the place of mixing, tangentially introducing at least one of the gases and introducing at least one of the gases through nozzles at the place of mixing.

7. In the process as claimed in claim 1, the step of producing a sudden strong dilution of the oxygen by supplying a gaseous diluting medium.

8. In the process as claimed in claim 1, the step of producing a sudden strong dilution of the oxygen by supplying steam.

9. In the process as claimed in claim 1, the step of producing a sudden strong dilution of the oxygen by supplying carbon dioxide.

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