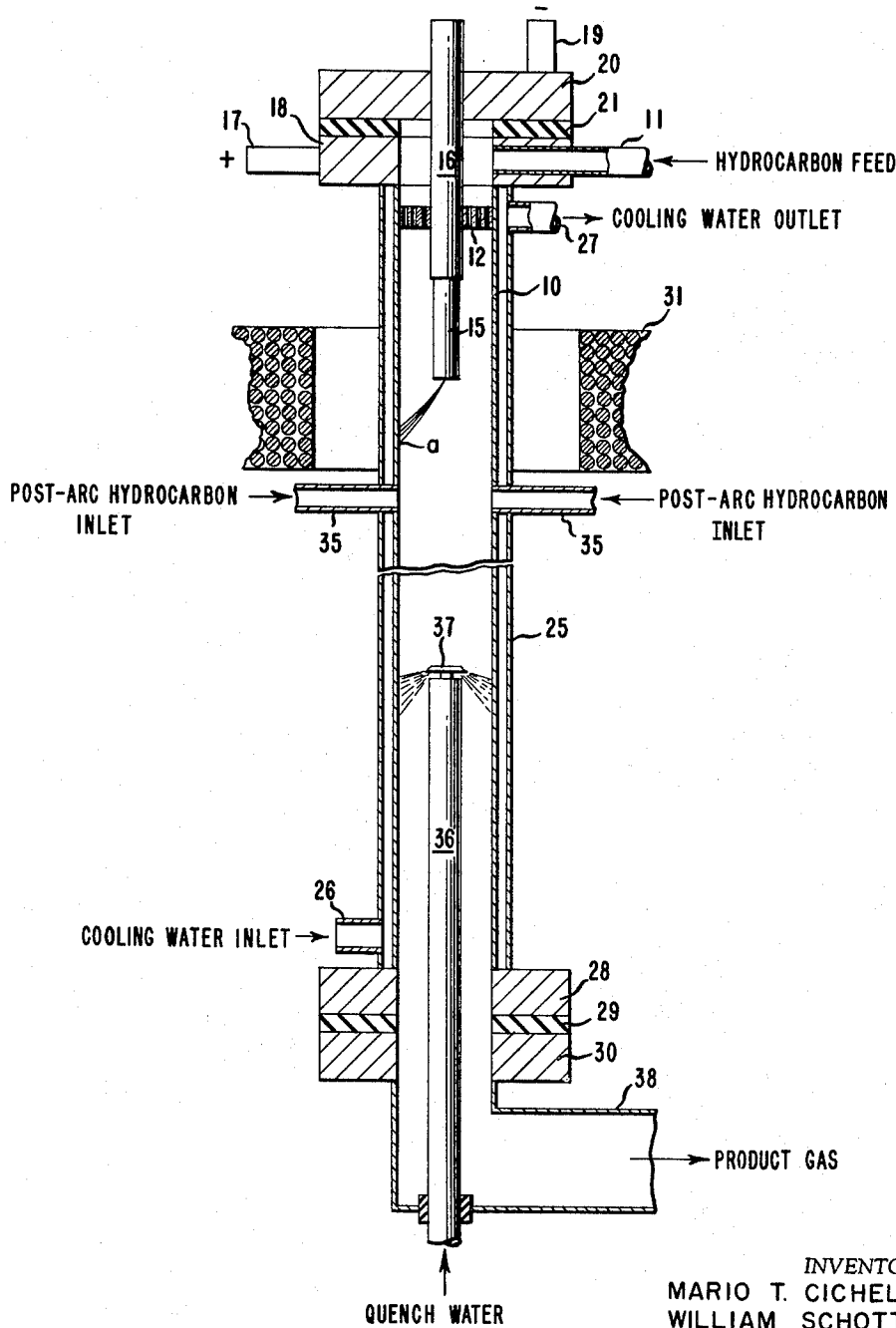


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MANUFACTURE OF ACETYLENE BY TWO STAGE PYROLYSIS
UNDER REDUCED PRESSURE WITH THE FIRST STAGE
PYROLYSIS CONDUCTED IN A ROTATING ARC
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MANUFACTURE OF ACETYLENE BY TWO STAGE PYROLYSIS UNDER REDUCED PRESSURE WITH THE FIRST STAGE PYROLYSIS CONDUCTED IN A ROTATING ARC

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This invention relates to an improved process for the manufacture of acetylene, and particularly to a two stage pyrolysis under reduced pressure in which a lower hydrocarbon is pyrolyzed to acetylene in a rotating electric arc as a first stage, and part of the heat of the hot output gases thereafter is immediately utilized to pyrolyze a hydrocarbon of higher molecular weight to acetylene by the post-arc injection of the higher hydrocarbon, followed quickly by quenching to a low temperature at which the individual integrity of the products is preserved.

The pyrolysis of hydrocarbons to form acetylene is well known in the art and there are numerous ways of accomplishing the heat transfer, such as by contact of the feed stock with combustion products, as described in U.S. Patent 2,790,838, or by the arc-heating of a carrier gas such as hydrogen, as taught in U.S. Patent 2,916,534. In both of these approaches, however, non-essential gases are present in the reaction zone, and this is objectionable because the equipment size must be increased proportionately. Moreover, operating temperatures must be very high in processes relying on thermal dissociation of gases such as hydrogen or nitrogen as the heat transfer agency, and this is accompanied by excessive heat requirements together with high thermal stressing of apparatus components. Hydrocarbon synthesis by methane pyrolysis followed by reaction within 2-8 seconds time with various hydrocarbons is taught in U.S. Patent 2,197,257; however, acetylene per se is apparently not obtainable as a product.

A primary object of this invention is to provide a process for the manufacture of acetylene which operates throughout at least one stage at a relatively low temperature and thus is conservative in heat demand. Another object of this invention is to provide a process for the manufacture of acetylene which utilizes the available heat more efficiently than has hitherto been possible. Another object of this invention is to provide a process for the manufacture of acetylene which is accompanied by a lower carbon monoxide adulteration as a result of the terminal quenching of products. The manner in which these and other objects of this invention are obtained will become clear from the following detailed description and the drawing, which shows schematically a preferred apparatus for carrying out the process of the invention.

Generally, the process of this invention comprises,

(a) Passing a feed of gaseous hydrocarbon of 1-3 carbon atoms through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature in excess of 1700° C.;

(b) Admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight higher than the molecular weight of said feed hydrocarbon but not higher than about 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1300° C.;

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(c) Maintaining the pressure in the reactor at less than 500 mm. Hg during said pyrolyses;

(d) Quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) Employing a residence time from arc to quench of less than 0.01 second.

By such process, a high conversion of feed hydrocarbon to acetylene is produced in the first stage pyrolysis by passage of the feed hydrocarbon through the rotating arc, and additional acetylene, equal to at least about 8% of the total acetylene, is formed by pyrolysis of at least part of the second hydrocarbon in the second stage, concomitant with the cooling of the arc product to an interim temperature level, followed by a quick cooling of the entire effluent to below about 300° C. to forestall intercombination or polymerization reactions involving acetylene. Due to the combination of conditions, there is obtained good conversion of the second hydrocarbon in the second stage pyrolysis to acetylene with the formation of little or no ethylene and like olefins. Thus, a significant part of the energy, required to produce the high conversions of feed hydrocarbon to acetylene in the first stage, is recovered in the production of additional amounts of acetylene in the second stage, resulting in an over-all economy in the utilization of electric power per unit weight of acetylene. Also, the combination of conditions has the further advantages of decreasing the formation of by-product CO, carbon, and losses of acetylene through side reactions and polymerization.

It is essential to good results that there be careful maintenance of a temperature above a first high level of about 1700° C., preferably at about 2000° C. to about 2800° C., adapted to pyrolyze the pre-arc hydrocarbon feed to acetylene in the first stage and above a second interim level above about 1300° C., preferably above 1600° C., in the second stage but lower than the first to effect an efficient pyrolysis of the post-arc feed to the second hydrocarbon to acetylene and to cool in large part the products of the first pyrolysis, and finally that there be rapid quenching of the full effluent to a temperature below about 300° C. Consequently, the proportion of the second hydrocarbon employed in the second stage or post-arc feed must be such that the sum of its sensible heat demand and the heat of cracking it to acetylene does not exceed that which will bring the temperature of the products from the upstream pyrolysis down to an interim temperature about 1300° C., preferably in the range of about 1600° C. to about 2000° C. Also, the amount of the hydrocarbon employed in the post-arc feed should be sufficient to bring the temperature of the pyrolysis products down by at least about 200° C. below the temperature of the gas leaving the arc, which usually will result in the production of at least about an 8% additional amount of acetylene. Preferably, the amount of post-arc hydrocarbon will be sufficient to bring the temperature down by about 400° C. to about 900° C. The amount of post-arc hydrocarbon required will vary with its temperature, the other conditions of operation, the loss of heat from the reactor, and the like. Once the reduction in temperature in the second stage pyrolysis is effected, it is necessary to bring the total product effluent to nonreactive temperatures as quickly as possible to prevent losses of acetylene by both reaction and polymerization.

It has been found that the rapid mixing afforded by the rotating electric arc, having a frequency of rotation in excess of 2000 rev./sec. (revolutions per second), is necessary to the secondary pyrolysis stage in the manufacture of acetylene according to this invention, and it is preferred to use the electromagnetically rotated arc. The arc rotates at a typical peripheral speed of 3200 ft./sec. (7000 rev./sec.) in a 1.75 inch I.D. reactor, thereby generating high

levels of turbulence which promote rapid mixing. In addition, the arc imparts a high swirling velocity, typically 200 to 400 ft./sec., to the arc gas, which further improves the mixing with the hydrocarbon added below the arc. Such rapid mixing is necessary to bring the arc-gas and post-arc feed to thermal equilibrium in a very short period of time, thereby yielding a high conversion to acetylene. Electric arcs rotated by permanent magnet assemblies, or arcs which, in effect, rotate, as in the case of the so-called polyphase "traveling arcs" which strike in sequence from one pair of electrodes to a neighboring pair, with all of the electrodes arranged in a circular pattern, are also operable and the term "rotating arc" as used in the claims is intended to encompass all of these together with their equivalents. At the same time, it is intended to exclude therefrom arcs displaced primarily by impingement of the gas streams, as these are altogether too erratic to be of use.

The pre-arc hydrocarbon feed to the rotating electric arc can be any saturated or unsaturated hydrocarbon having from one to three carbon atoms, or mixtures thereof, although methane and propane individually are particularly preferred as a matter of current economics. The second hydrocarbon, employed in the post-arc feed, is of even wider selection and, in general, includes any hydrocarbon having a higher molecular weight, a larger number of carbon atoms, than the hydrocarbon constituting the principal part of the pre-arc feed up to, and including, a molecular weight of 150, either solely or in admixture one with another. Usually, the post-arc hydrocarbon will have a molecular weight in the range of 44 to 150.

The purpose of the post-arc hydrocarbon feed is twofold, i.e., (1) to utilize part of the heat of the product leaving the arc to produce additional amounts of acetylene by pyrolysis of the hydrocarbon in the post-arc feed and (2) to cool the product gases from the arc. Both of these objectives can be attained to a high degree by employing a relatively hot post-arc feed which, advantageously, can have a temperature up to about 1100° C. In this manner, it is possible to introduce a high proportion of post-arc hydrocarbon compared to the arc effluent gas volume and, where the post-arc feed is brought to temperature by waste heat, or at least by other heating means such as oil or gas burners or the like, which are usually lower in cost than arc heating, there is realized an over-all heating economy. It will be understood that the heating of the post-arc hydrocarbon should be conducted at temperatures below those giving troublesome coke formation or uncontrolled cracking as a side reaction and this imposes a practical limit on the heat content imparted to the post-arc hydrocarbon. Under some circumstances, it is desirable to employ either a cold (room temperature) post-arc hydrocarbon or a heated hydrocarbon to which is added a portion of room temperature hydrocarbon as a means of effecting close heat control for the entire process, and this is entirely feasible and within the contemplation of this invention. In addition, there can be a preselected pattern of introductions of different post-arc hydrocarbons or mixed post-arc hydrocarbons, either at the same or different temperatures, so as to obtain a thermodynamic balance in time with respect to the progressive thermal demands of the process, as can be advantageous in going from start-up to steady state operation, or in going from one feed gas to a different feed gas, or the like.

Typical examples of suitable hydrocarbons for use in the post-arc feed include, but are not limited to, propane, butane, toluene, divinylacetylene, and natural gasoline. For economic reasons, the post-arc hydrocarbon, as well as the pre-arc hydrocarbon, should be gaseous, that is it should be in the form of a gas or vapor. Thus, if the hydrocarbon is liquid at standard conditions of temperature and pressure, it should be vaporized and fed into the reactor in vapor (gaseous) form.

The process of this invention is conducted at an absolute pressure below about 500 mm. Hg, preferably at about 100 to about 350 mm. Hg. Such low pressures produce high conversions of the hydrocarbons to acetylene, minimize carbon formation and avoid losses of acetylene through side reactions and polymerization.

Also, it is vital that the terminal quenching of the entire process effluent to temperatures below 300° C. be effected as quickly as practicable, with a residence time of gas between arc and quench of less than 0.01 second, preferably of about 0.001 to about 0.003 second. Quenching by cold water spray has proved effective and convenient; however, other methods of quenching, as by contact with solids or through the conjoint use of solids and liquids or the like, are also suitable.

Referring to the drawing, a small scale reactor utilized a 1.75" I.D. copper pipe shell 10 measuring 12" long from the top end to the upper end of quench nozzle 37, shell 10 abutting annular copper flanges 18 at the top and 28 at the bottom. The spacing of quench nozzle 37 above flange 28 was several inches; however, this distance is not critical. Companionate copper flanges 20 and 30 were provided at the top and bottom, respectively, electrically insulated from their adjacent flange elements by gaskets 21 and 29, which also sealed the interior of shell 10 against vacuum leakage, and the assembly held together by conventional means, not shown, preserving the individual electrical isolation of at least the two upper flanges.

Shell 10 was enclosed within a concentric cooling jacket 25 provided with water inlet and outlet connections 26 and 27, respectively. Cathode 15 was a graphite electrode which, in various runs, ranged from $\frac{3}{16}$ "– $\frac{1}{2}$ " in diameter carried by a water-cooled copper holder, indicated generally at 16, mounted centrally of flange 20 and coaxial of shell 10. Negative terminal 19 attached to flange 20 provided an electrical connection with holder 16 and cathode 15. Shell 10 constituted the anode, which was in electrical connection through flange 18 with positive terminal 17.

Inlet pipe 11 discharging into shell 10 radially of flange 18 constituted the feed port for hydrocarbon passed to the electric arc, the flow of which was distributed evenly throughout the full cross-section of 10 by passage through the multiple holes of distributor plate 12, fabricated from ceramic or equivalent high temperature electrical insulator.

A pair of post-arc hydrocarbon injection tubes 35 diametrically opposed one to another was provided opening into shell 10 about 1" below the locus of rotating arc termination *a*, hereinafter described. A water quencher was used, consisting simply of upstanding water supply tube 36 entering shell 10 at the lower end coaxially thereof, provided with a spray nozzle 37 located about 7" below region *a*, adapted to discharge water substantially evenly in a generally radial direction across the shell. Product gases were removed from the apparatus through connection 38 in open communication with the bottom end of shell 10 leading to conventional separation equipment, not shown, disposed downstream.

Arc rotation was effected electromagnetically to give the electric arc a frequency of about 4000 to about 8000 rev./sec. through the agency of $5\frac{1}{2}$ " inside diameter field coil 31 through which was passed a direct current. Coil 31 was disposed coaxially with respect to cathode 15 at a radial clearance of approximately $1\frac{1}{8}$ " with respect to jacket 25, in a lengthwise position such that the midpoint of the arc struck was located approximately mid-length of the coil.

In operation, using methane as the hydrocarbon feed to the arc and propane at room temperature as the post-arc feed supplied through tubes 35, the pyrolysis will be conducted at a reduced pressure within the reactor of about 150 mm. Hg absolute, which was found to give good conversions and, at the same time, minimized car-

bon formation. The apparatus hereinbefore detailed had a power consumption of about 50 kw. and the arc zone ending at region *a* measured about 1" long. The arc was struck initially by use of a starting wire, high voltage arc starter, or graphite starting rod, as is the conventional practice in the art, and thereafter maintained itself. It is preferred to effect as uniform a contacting as practicable between the arc and the hydrocarbon feed there-through, and this is facilitated by the rapid rotation of the arc circumferentially of shell 10, a typical speed being about 7000 revolutions/sec. under a field strength of coil 31 of 600 gauss. The evenness of arc contacting is an important factor in itself, since we have found that an appreciably higher acetylene yield of the order of 70-85% conversion of methane, typically, to acetylene is thereby obtained independent of other considerations.

In the case of methane, good pyrolysis is obtained at a temperature above 1700° C., whereas propane readily pyrolyzes to acetylene at temperatures above 1300° C. Accordingly, methane was projected through the rotating arc at an entering flow velocity of about 7 meters per second (measured at 150 mm. Hg pressure absolute, and 25° C.) into contact with sufficient propane to bring the over-all temperature to above about 1300° C. prior to water quenching. A limitation of the residence time between arc and water spray of 0.001 to 0.003 second gave good results. The conversion of propane to acetylene varied from 47% to 70%, which thus constituted added production resulting from utilization of the sensible heat of the products of the upstream arc pyrolysis of the methane. In addition, the two stage pyrolysis reduced the amount of carbon monoxide formed during the terminal water quenching, which was very advantageous.

A larger reactor, similar in design to that hereinbefore described, also has been used. In this larger reactor, the copper pipe shell 10 had an internal diameter (I.D.) of 3.5 inches; the post-arc injection tubes 35 were positioned about 2¼ inches below the locus of the rotating arc termination *a*; and the quencher spray nozzle 37 was located about 12 inches below region *a*; the other dimensions of the equipment being generally twice those of the smaller reactor. This larger reactor operated with field strengths of up to 1800 gauss, the frequency of rotation of the electric arc also being in the range of about 4000 to about 8000 rev./sec.

In summary, the pyrolysis of this invention realizes the following improvements: (1) a reduction of by-product CO concentrations from a level of ½% with conventional processes to about 0.5-1%, (2) an increase in acetylene concentration from the usual maximum level of 20% to about 21-22%, and (3) a reduction in power consumption of about 1 kw.-hr./lb. C₂H₂.

The following examples carried out in the apparatus detailed furnish numerical data comparative of operation with and without post-arc hydrocarbon feed:

EXAMPLE 1.—EFFECT OF POST-ARC ADDITION OF PROPANE IN 1.75-IN. I.D. REACTOR

Case 1. Without post-arc addition of propane

A flow of 11.4 lb./hr. of commercial grade methane (analyzing 94.1% CH₄, 4.4% C₂H₆, and 1.5% C₃H₈) was passed through a 51.8-kw. rotating arc (7000 rev./sec.) operated at 320 amp., 162 v., and about 600 gauss. The pressure maintained in the reactor was 143 mm. Hg absolute. The water-quenched product contained 20.2% C₂H₂, 0.2% C₂H₄, and 2.6% CO. The carbon conversion of methane to acetylene was 80% with a power consumption of 7.0 kw.-hr./lb. of C₂H₂ produced.

The net heat input to the gas was 64% of the power supplied or 33.2 kw., the remaining 18.6 kw. being lost to cooling water. The temperature of the hot gas leaving the arc was calculated to be about 2420° C. Under these conditions, the residence time of the hot gas between arc and quencher was 0.0013 second.

Case 2. With post-arc addition of propane

A flow of 12.0 lb./hr. of commercial grade methane (same analysis as above) was passed through a 58.0-kw. rotating arc operated at 325 amp., 178 v., and about 600 gauss. The pressure was 159 mm. Hg absolute. Natural grade propane (analyzing 0.3% CH₄, 8.0% C₂H₆, 90.8% C₃H₈, and 0.9% C₄H₁₀) was introduced at a rate of 3.1 lb./hr. as a room-temperature gas through two inlets disposed a distance of 1" below the arc. The product gas analyzed 22.5% C₂H₂, 0.9% C₂H₄, and 0.5% CO, corresponding to an over-all carbon conversion to acetylene for both the methane and the propane of 77.8%. If 80% conversion of methane to acetylene is assumed on the basis of operation without propane addition, the propane to acetylene conversion calculates to about 70%. The power consumption was 6.0 kw.-hr./lb. C₂H₂ as compared with 7.0 kw.-hr./lb. for Case 1.

Based on a net heat input to the methane of 64% of the power input, the temperature of the hot gas leaving the arc was calculated to be about 2800° C. The corresponding residence time between the arc and the location of the post-arc addition points was 0.0002 second. With post-arc addition of propane, the temperature of the resulting mixture of hot gaseous reaction products was calculated to be about 1930° C. A further residence time of 0.0013 second was calculated for the distance between the post-arc addition points and the quencher, giving an over-all residence time of 0.0015 second.

EXAMPLE 2.—EFFECT OF POST-ARC ADDITION OF NATURAL GASOLINE IN 3.5-IN. I.D. REACTOR

Case 3. Without post-arc addition of natural gasoline

A flow of 170 lb./hr. of natural gas (analyzing 93.2% CH₄, 3.5% C₂H₆, 0.1% C₃H₈, 0.9% C₃H₈, 0.5% C₄H₁₀, 0.8% CO₂, and 1.0% N₂) was passed through a 528-kw. rotating arc operated at 1110 amp., 476 v., and 1450 gauss. The pressure was 225 mm. Hg absolute. The water-quenched product contained 19.5% C₂H₂, 0.2% C₂H₄, and 1.4% CO. The carbon conversion of natural gas to acetylene was 73.7% with a power consumption of 5.3 kw.-hr./lb. C₂H₂.

The net heat input to the gas was 83% of the power supplied or 438 kw., the remaining 90 kw. being lost to cooling water. This corresponds to a temperature of about 2200° C. for the hot gases leaving the arc, and a residence time of 0.0011 second for the 12-in. distance between the arc and the quencher.

Case 4. With post-arc addition of natural gasoline

A flow of 170 lb./hr. of natural gas (same analysis as for Case 3) was passed through a 529-kw. rotating arc operated at 1150 amp., 460 v., and 1450 gauss. A pressure of 225 mm. Hg absolute was maintained in the reactor. Vaporized natural gasoline (corresponding to 50 mole percent C₆H₁₄ and 50 mole percent C₇H₁₆) at 500° C. was introduced at a rate of 48 lb./hr. through inlets disposed a distance of 2¼ in. below the arc. The product gas analyzed 20.8% C₂H₂, 0.4% C₂H₄, and 1.1% CO, corresponding to an overall carbon conversion to acetylene for both the natural gas and the natural gasoline of 69.4%. Assuming 73.7% conversion of natural gas to acetylene on the basis of operation essentially identical with Case 3, the natural gasoline to acetylene conversion calculates to 56%. The power consumption was 4.3 kw.-hr./lb. C₂H₂ as compared to 5.3 kw.-hr./lb. C₂H₂ for Case 3.

Based on a net heat input to the natural gas of 83% of the power input, the temperature of the hot gases leaving the arc was calculated to be about 2210° C. The corresponding residence time between the arc and location of the post-arc addition points was 0.0002 second. With post-arc addition of natural gasoline, the temperature of the resulting mixture of hot gaseous reaction products was calculated to be about 1640° C. A further

residence time of 0.001 second was calculated for the 9/4 in. distance between the post-arc addition points and the quencher, giving an over-all residence time of 0.0012 second.

From the foregoing, it will be understood that our invention can be modified extensively without departure from its essential spirit, and it is therefore intended to be limited only by the scope of the appended claims.

This application is a continuation-in-part of our co-pending application Serial Number 18,956 filed March 31, 1960, now abandoned.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon of 1-3 carbon atoms through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature in excess of 1700° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight higher than the molecular weight of said feed hydrocarbon but not higher than about 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1300° C.;

(c) maintaining the pressure in the reactor at less than 500 mm. Hg during said pyrolyses;

(d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) employing a residence time from arc to quench of less than 0.01 second.

2. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon of 1-3 carbon atoms through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight higher than the molecular weight of said feed hydrocarbon but not higher than about 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature about 400° C. to about 900° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1600° C.;

(c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;

(d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) employing a residence time from arc to quench of less than 0.01 second.

3. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon of 1-3 carbon atoms through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight higher than the molecular weight of said feed hydrocarbon but not higher than about 150 at a rate sufficient to pyrolyze said second hy-

drocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature in the range of about 1600° C. to about 2000° C. which is about 400° C. to about 900° C. below the temperature of the hot reaction gases leaving the electric arc;

(c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;

(d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) employing a residence time from arc to quench of about 0.001 to about 0.003 second.

4. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature in excess of 1700° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight in the range of 44 to 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1300° C.;

(c) maintaining the pressure in the reactor at less than 500 mm. Hg during said pyrolyses;

(d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) employing a residence time from arc to quench of less than 0.01 second.

5. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight in the range of 44 to 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1600° C.;

(c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;

(d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and

(e) employing a residence time from arc to quench of less than 0.01 second.

6. A process for the manufacture of acetylene in a reactor, which process comprises

(a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation of about 4000 to about 8000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.;

(b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which has a molecular weight in the range of 44 to 150 at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature in the range of about 1600° C. to about 2000° C. which is about 400° C. to about 900° C. below the temperature of the hot reaction gases leaving the electric arc;

- (c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;
- (d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and
- (e) employing a residence time from arc to quench of about 0.001 to about 0.003 second.
7. A process for the manufacture of acetylene in a reactor, which process comprises
- (a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature in excess of 1700° C.;
- (b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which consists essentially of propane at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1300° C.;
- (c) maintaining the pressure in the reactor at less than 500 mm. Hg during said pyrolyses;
- (d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and
- (e) employing a residence time from arc to quench of less than 0.01 second.
8. A process for the manufacture of acetylene in a reactor, which process comprises
- (a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation of about 4000 to about 8000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.
- (b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which consists essentially of propane at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1600° C.;
- (c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;
- (d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and
- (e) employing a residence time from arc to quench of about 0.001 to about 0.003 second.

9. A process for the manufacture of acetylene in a reactor, which process comprises
- (a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation in excess of 2000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature in excess of 1700° C.;
- (b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which consists essentially of natural gasoline at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1300° C.;
- (c) maintaining the pressure in the reactor at less than 500 mm. Hg during said pyrolyses;
- (d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and
- (e) employing a residence time from arc to quench of less than 0.01 second.
10. A process for the manufacture of acetylene in a reactor, which process comprises
- (a) passing a feed of gaseous hydrocarbon which consists essentially of methane through a rotating electric arc having a frequency of rotation of about 4000 to about 8000 rev./sec. at a rate sufficient to pyrolyze said hydrocarbon to acetylene and produce hot reaction gases having a temperature of about 2000° C. to about 2800° C.;
- (b) admixing with said hot reaction gases leaving said electric arc a second gaseous hydrocarbon which consists essentially of natural gasoline at a rate sufficient to pyrolyze said second hydrocarbon to acetylene and produce a mixture of hot gaseous reaction products having a temperature at least about 200° C. below the temperature of the hot reaction gases leaving the electric arc but not below 1600° C.;
- (c) maintaining the pressure in the reactor at about 100 to about 350 mm. Hg during said pyrolyses;
- (d) quenching the mixture of hot gaseous reaction products to a temperature below about 300° C.; and
- (e) employing a residence time from arc to quench of about 0.001 to about 0.003 second.

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