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METHOD AND DEVICE FOR THE PRODUCTION OF GASEOUS MIXTURES CONTAINING ACETYLENE AND ETHYLENE

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Fig. 1

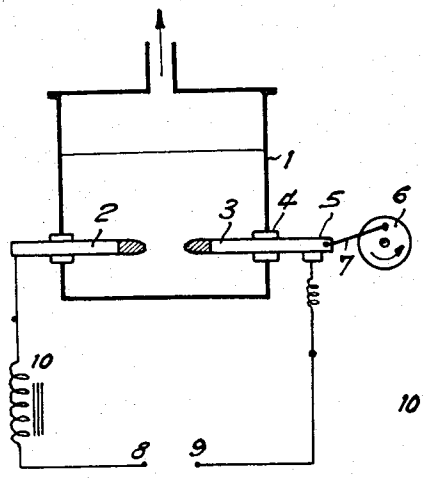


Fig. 2

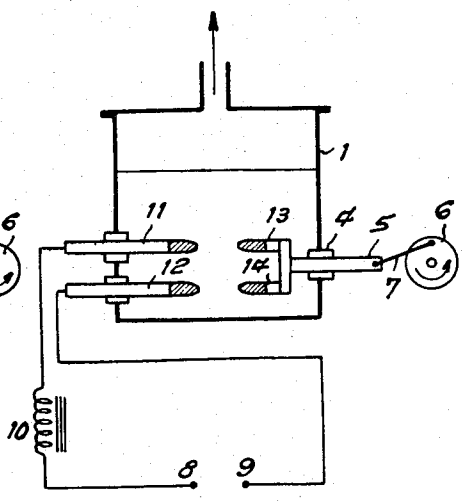
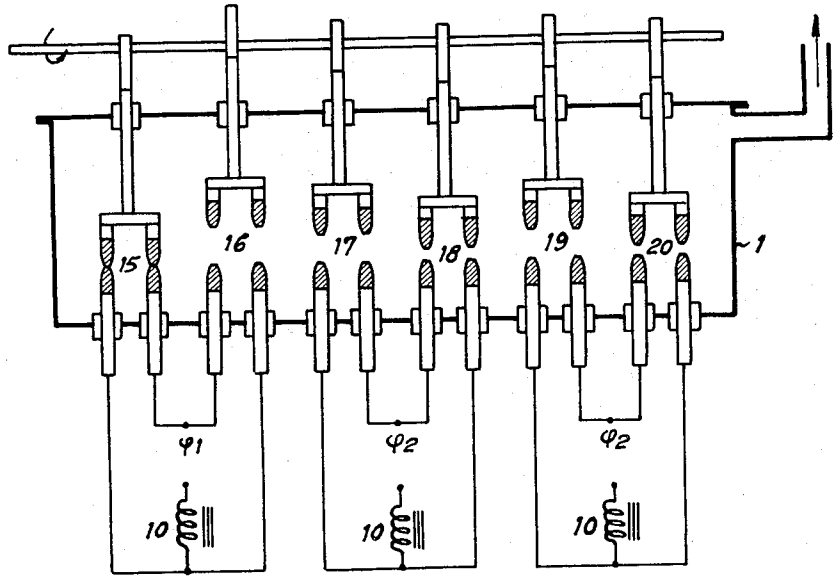


Fig. 3



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METHOD AND DEVICE FOR THE PRODUCTION OF GASEOUS MIXTURES CONTAINING ACETYLENE AND ETHYLENE

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The present invention has for its object a method of production of gaesous mixtures containing acetylene and ethylene starting from a liquid hydrocarbon in the midst of which there is produced between two electrodes an electric arc which is interrupted then restored in accordance with a pre-determined frequency by imparting to at least one of the electrodes an alternating movement which brings the said electrodes into contact for the purpose of striking the arc and draws them apart for the purpose of interrupting the arc.

Various methods and devices have already been proposed which make use of this technique. It has been found, however, that all these methods and devices inevitably produce a deposit of coked carbon on the electrodes, the progressive accumulation of this carbon deposit having the effect of rapidly putting the equipment out of service. This phenomenon, which it has not been possible to avoid up to the present time, explains the reason why it has not been feasible to carry out the industrial development of any of the known methods and devices in spite of all the advantages provided by the cracking of hydrocarbons in the liquid state.

After long researches and preliminary tests, it has been found in accordance with the invention that, by operating under well-defined conditions, it is possible to produce in the midst of a liquid hydrocarbon such as fuel oil, for example, an arc which is both stable and requires no adjustment during operation, thereby providing a means of continuously producing a gaseous mixture containing substantial proportions of acetylene and ethylene.

The present invention is based in particular on the observation that, as and when the decomposition of the liquid hydrocarbon takes place, the amount of carbon deposited on the electrodes mainly results from the temperature to which the said electrodes are liable to be heated during the operation. It has additionally been found that if the frequency of interruption and restoration of the arc is sufficiently rapid, a sufficiently moderate mean temperature of the electrodes is ensured as a result of the short time during which the electrodes are heated due to the Joule effect of the current passing through the said electrodes on the one hand and due to the transmission of the heat of the arc on the other hand, and also as a result of the cooling of the electrodes by the liquid hydrocarbon during the time of extinguishing of the arc. Accordingly, only the tips of the said elecrtodes are heated to a very high temperature and then only at the moment of striking of the arc and during the passage of the arc.

It has been determined by experiment that, for the carbon deposit to be localized exclusively at the tips of the electrodes, it was necessary to interrupt the arc after a maximum arcing time of 0.5 second, the interruption time being in turn equal to at least 0.5 second. It can be stated in a more general manner that the relative movement of the electrodes must be determined so that a complete cycle of striking and extinguishing of the arc should last approximately one second.

It follows from the foregoing that the observance of this condition nevertheless allows a localized carbon deposit to remain at the tips of the electrodes. It has

also been found in accordance with an important characteristic feature of the invention, that the accumulation of this deposit and the drawbacks which would result therefrom after a certain time of operation are prevented if the relative spacing of the two electrodes with respect to each other is so adjusted that there takes place a light mechanical impact at the moment when these two electrodes come into contact to initiate the striking of the arc; it has been revealed by experiment that such an impact is sufficient to produce excellent periodic cleaning of the electrodes.

On the basis of these different findings, the method in accordance with the invention is therefore essentially characterized in that the cycle comprising the interruption followed by the passage of the arc has a maximum time-duration of one second and that the electrodes are placed in such a position that an impact which effects the cleaning of these latter takes place at the moment of making the contact which initiates the arc.

When alternating current is employed for the practical operation of the method in accordance with the invention, it is preferable to synchronize the reciprocating motion of a movable electrode with the frequency of the current employed in such manner as to ensure that the arcing contact is made at the moment when the voltage is in the vicinity of zero value. In this form of embodiment, the limitation of the peak short-circuit arcing current accordingly requires a much smaller inductance-coil and this improves the power factor of the unit.

The method in accordance with the invention produces particularly valuable results not only by virtue of the fact that it permits continuous operation and consequently uninterrupted production of gases containing acetylene and ethylene, but in addition, the said gases produced as a result of the cracking of hydrocarbon at the temperature of the arc are generated actually in the mass of the liquid hydrocarbon; they are accordingly subjected to a very rapid cooling action, which has the effect of preventing the decomposition of the acetylene and ethylene which are formed.

In order to gain the maximum advantage from this characteristic feature, provision can be made for cooling the liquid hydrocarbon which is subjected to treatment; this cooling treatment can be effected by a circulation of hydrocarbon through a suitable cooler. It is thus possible by this means to maintain the temperature of the said hydrocarbon at a value which is as low as possible, but which is nevertheless compatible with the adequate fluidity of the hydrocarbon in such manner that this latter is capable of flowing freely.

Provision can also be made for a circulation of hydrocarbon, not only in a cooling apparatus but also in a filtering apparatus which provides a means of eliminating the small quantities of carbon inevitably produced as a result of the action of the arc on the hydrocarbon and which have become detached from the electrodes at the moment of the impacts to which these latter are subjected in accordance with the invention.

In the practical operation of this method, it has been possible to obtain acetylene contents which easily reach 25 to 35% of the gas generated and ethylene contents varying between 5 and 10%, the gas remaining being mainly constituted by hydrogen.

The measured consumption of electric power, considered in terms of the acetylene produced, is in the vicinity of 6 kilowatts-hour per kilogram of acetylene and it is possible by means of suitable electrical systems of connection to obtain a power factor of more than 85%.

The invention comprises a device for the practical application of the method as hereinbefore defined, the said device being characterized by the combination of a tank

designed to contain the liquid hydrocarbon, at least one stationary electrode and one longitudinally movable electrode which are disposed inside the said tank, a device adapted to impart a longitudinal alternating movement to the said electrode and adjustment means for positioning the electrodes in such manner that the movable electrodes strike against the stationary electrodes when they are in their position of maximum proximity.

A device of this kind can additionally comprise means for causing the hydrocarbon to flow through the tank and also, should the need arise, through a cooling device which is separate from the tank and located outside this latter, as well as through a continuous or non-continuous filter.

Further characteristic features of the invention will be brought out by the description which follows below, reference being made to the accompanying drawings which are given solely by way of example without any limitation being implied, and in which:

FIGS. 1 to 3 illustrate diagrammatically three forms of embodiment of the invention which are given by way of non-limitative example.

In the form of embodiment of FIG. 1, the reaction tank **1** is filled with light fuel oil and inside the said tank are disposed two electrodes **2** and **3** of graphite, the electrode **2** being stationary and the electrode **3** being adapted to move longitudinally and for this purpose passes through the vertical wall of the tank through a packing-gland **4**. The movement of the electrode **3** is carried out, for example, by coupling the extremity **5** of the said electrode to a plate **6** to which is imparted a movement of rotation through the intermediary of a crank **7**, but it is obvious that it is possible to make use of any other known mechanical or electromagnetic means for producing this alternating motion. The frequency of this motion is 1400 reciprocating movements per minute. The displacement of the movable electrode **3** and the amplitude thereof are regulated so that a light impact occurs between the two electrodes at the end of the travel of the electrode **3** towards the left hand side in the figure, the two electrodes thus separating to a maximum distance of 60 mm.

A direct current voltage of 500 volts is applied to the terminals **8** and **9** by interposing an inductance coil **10** having an appropriate impedance so that the peak current value does not exceed 300 amperes.

Under these conditions, there is obtained a constant evolution of 6 standard cubic meters per hour of cracking gas, the composition of which substantially corresponds to the following:

	Percent
C_2H_2	25.6
C_2H_4	6.3
H_2	61.8

In the alternative form of FIG. 2, there are disposed inside the same tank **1** as in the previous example two stationary electrodes **11** and **12** and two movable electrodes **13**, **14** in such manner that the two movable electrodes **13**, **14** form a bridge-connection between the two stationary electrodes between which the voltage is applied. Any need to supply current to a movable electrode as in the previous method of construction is accordingly avoided.

A rate of 3,000 reciprocating movements per minute is adopted for the system of moving electrodes, in synchronism with the frequency of industrial alternating current (50 cycles per second). Under these conditions, the arcing contact can readily be made by phase displacement at the moment when the voltage has just passed zero and has reached only 30 to 50 volts; it is accordingly possible to connect into the circuit an inductance coil of very small size.

In the case of an alternating current voltage of 500 volts, a peak current of 500 amperes and when making use of only one current alternation or half-wave (one half-wave for the arc, the other half-wave for the cooling

interruption time), there occurs a constant evolution of 25 standard cubic metres of gas corresponding to the following formula:

	Percent
C_2H_2	32.0
C_2H_4	9.3
H_2	50.0

In the same manner as in the previous form of embodiment, namely by employing bridge-connected electrodes and effecting the displacement of the movable electrodes in synchronism with industrial alternating-current frequency, it is possible to provide (as shown in FIG. 3) a system of connection with six arcs permitting full use of the alternations of three-phase current supply; the order of arcing will in that case be **15**, **20**, **17**, **16**, **19**, **18**, while the frequency of the reciprocating movements remains 3,000 per minute as in the previous example.

In the case of a three-phase voltage of 500 volts between phases and a peak current value not exceeding 500 amperes per phase, there is obtained an evolution of 150 standard cubic metres of gas having a composition similar to that of the previous example.

Moreover, the rational use of the power supply in the manner which has just been explained results in excellent electrical efficiency of the order of 6 kilowatts-hour per kilogram of acetylene produced, with a power factor in the vicinity of 95%.

What I claim is:

1. Method of production of gaseous mixtures containing acetylene and ethylene starting from a liquid hydrocarbon, which consists in producing an electric arc between two electrodes in the midst of the said liquid hydrocarbon, interrupting said arc and then restoring said electric arc at a predetermined cycle frequency by imparting to at least one of said electrodes a positive periodic alternating movement which brings said electrodes into contact for the purpose of striking said electric arc and draws said electrodes apart for the purpose of interrupting said electric arc, each of said cycles comprising a positive periodic interruption and a passage of said electric arc having a maximum time-duration of one second, and the relative movement of said electrodes being determined so that an impact occurs therebetween in each cycle at the moment when said electrodes strike said electric arc, said impact effecting the cleaning of said electrodes.

2. Method as claimed in claim **1**, in which said electric arc is supplied with alternating current and in which the frequency of said alternating movement is synchronized with the frequency of said current, in such manner that each contact made between said electrodes takes place at the moment when the voltage of said current is in the vicinity of zero.

3. Device for the production of gaseous mixtures containing acetylene and ethylene starting from a liquid hydrocarbon, said device comprising in combination a tank designed to contain said liquid hydrocarbon, at least one electrode fixed with respect to said tank and at least one movable electrode disposed in oppositely facing relation inside said tank, means for supplying said electrodes with electric current, means for imparting a positive periodic longitudinal reciprocating movement to each movable electrode and thus drawing said movable electrode into contact with and then away from the corresponding fixed electrode in such manner as to produce then to interrupt an electric arc between said electrodes, and means for regulating the relative movement of said electrodes in such manner that each of said movable electrodes strikes against the corresponding fixed electrode to produce an impact when said electrodes are in their position of maximum proximity.

4. The method set forth in claim **1**, in which said electric arc is supplied with alternating current and in which each cycle of arcing and interruption is synchronized with the frequency of said alternating curent.

5. Method of production of gaseous mixtures containing acetylene and ethylene starting from a liquid hydrocarbon, which consists in producing an electric arc between two electrodes in the midst of the said liquid hydrocarbon, interrupting said arc and then restoring said electric arc at a predetermined cycle frequency by imparting to at least one of said electrodes a positive periodic alternating movement which brings said electrodes into contact for the purpose of striking said electric arc and draws said electrodes apart for the purpose of interrupting said electric arc, each of said cycles comprising an interruption and a passage of said electric arc having a maximum time-duration of one second, utilizing alternating current for the making of said electric arc and synchronizing each cycle of arcing and interruption with the frequency of said current.

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