PATENT SPECIFICATION

751,735

Date of Application and filing Complete Specification: Aug. 12, 1953. No. 22252/53.

Application made in Italy on Aug. 13, 1952.

Complete Specification Published: July 4, 1956.

Index at acceptance:—**Classes 32,** E2; **39(1),** D(9D:10F:12A), D12B(5:6), D(12E:17A2A:18A:40F), I; **and 39(3),** H1(A:J2), H2A.

COMPLETE SPECIFICATION

Modulated Electric Arc for Chemical Reactions

I, ALBERTO BAGNULO, an Italian Citizen, of 43 via Bergamo, Rome, Italy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for carrying out chemical reactions in the presence of the voltaic arc.

It is known that all chemical reactions involve electromagnetic radiations and that the number of molecules reacting in a given time is determined by the number of molecules which surpass the value of the molecular energy in a unit of time.

For this reason, cracking and chemical synthesis are often carried out by subjecting the substances to be treated to the action of the voltaic arc. These are, however, generally rather empirical processes, in which notice is not duly taken of the particular vibrations of the arc which, according to circumstances, can help or hinder the reactions required.

It is an object of the present invention to create a sympathy in phase or synchronism between the electromagnetic vibrations which are involved in a given reaction and those which are produced in the ionizing field generated by the electric arc.

Moreover, the effect can be greatly increased by the combined utilization of sonic or supersonic vibrations which reduce the stability of the substances being treated and cause an increased dissociation of the molecules, which are thus put in a condition to be more effectively ionized.

The dissociation obtained by means of sonic vibrations is particularly effective in those reactions wherein the chemical balance is affected by the temperature required to effect the dissociation.

Cracking and new molecular associations depend not only upon the characteristics of the electric arc, but also of those of the current supplied to feed the said arc.

Moreover, the reactions must take place directly in the electric arc and the molecules which are so formed or dissociated must be immediately dispersed or concentrated, according to whether a polymerization is required or not.

According to this invention apparatus is provided for treating chemical substances so as to obtain cracking or chemical synthesis comprising two co-axial conically-shaped members forming electrodes which are electrically insulated from one another, wherein one of the members is provided at its base end with means for producing sonic or supersonic vibrations and at its apex with a pile of annular metallic elements in imperfect contact with each other and wherein the other of the members is provided with a metallic ring which is adapted to be subjected to magnetic action, said ring being located radially opposite the pile of annular elements co-axially therewith.

The invention will be more easily understood from the following detailed description taken in connection with the accompanying drawing, wherein a preferred embodiment thereof is shown by way of a non-limitative example.

In the drawing:

Fig. 1 shows schematically in section a device for the emission of electrons for carrying out analysis or synthesis of chemical products;

Fig. 2 is a device for accelerating the whirling motion of the electrons; and

Fig. 3 is a device for effecting the modulation of the voltaic arc.

Referring particularly to Fig. 1, the device comprises a central electrode 4 and an external conical electrode 5, co-axial with the central electrode 4. A device 6 of any suitable type, which is adapted to emit sonic or supersonic vibrations, is provided surround-

ing the lower part of the electrode 4; it is formed with a hole 7 to allow the passage of the substance to be treated, which passes through a tube 7*a*. A cone 15 surrounds the electrode 4, which is provided at its upper part with a mushroom head 9 which retains in position a pile of annular metallic elements 8 which are assembled one on the other in such a way as to form imperfect electrical contact with each other.

The cone 15 is surrounded by a cone 13 of dielectric material which is shaped at 12 to receive another metal cone 14, separated from cone 13 by a hollow space 16.

Over that part of its length which is directly opposite the pile of elements 8 the electrode 5 is shaped cylindrically at 17 so as to form a magnetron, which will be described hereinafter. The parts 5 and 14 and the cylindrical part 17 are divided from one another by dielectric parts 18.

The conical part 5 may be either convergent or divergent according as to whether the products of the reaction are to be concentrated or dispersed.

The conductor 10 is connected to a high tension electric supply which, in the example illustrated in the drawings, is a variable transformer 20, and to the electrode 4. A battery 21 supplying low tension current is connected to the electrode 4 by a wire 22 and to the base of the cone 15.

When the current supplied by the high tension source is alternating current, as, for instance, in the present case, it is rectified by a rectifier 24, of which the positive pole is connected to the cylinder 17 and the negative one to the electrode 4.

The installation described above, which is completed by electric components of known type such as resistors, impedances and condensers, operates as follows:—

As the low tension current supplied by the battery 21 passes through the imperfect contact elements 8 it heats them strongly, thus causing the emission of a great quantity of electrons. In turn the current supplied by the rectifier 24 generates an electric arc in the shape of a ring between the elements 8 and the magnetron anode 17. A strongly ionized region is thus established around the annular arc.

The magnetron of Fig. 1 is operated by the means illustrated in Fig. 2, it being noted that Fig. 2 shows a magnetron of the cavity type in which the part 17 forming the anode is formed with cavities 17*a*. The pile of elements 8 forms the cathode.

Current is supplied to an electromagnetic circuit 26 by a variable transformer 27, together with a rectifier 28 and a condenser 29.

If a substance, for example, fuel oil, is introduced by suction or by compression into the cone 15 through the passage 7, the substance is finely divided by the action of the supersonic waves emitted by the device 6 and is then drawn through the interstices between the elements of the pile 8, where it is under the action of the electrons existant in the zone which surrounds the pile.

Simultaneously hydrogen is introduced through tangential holes 30 in the part 14 and as the hydrogen arrives near the arc, it imparts to the whole surrounding atmosphere the whirling motion with which it is endowed, thus facilitating a perfect mixture and reaction with the fuel oil, with the result that gasoline is delivered from the conical electrode 5.

The motion of the electrons in the space between the pile 8 and the magnetron anode 17 is accelerated by the electromagnetic field produced by the device of Fig. 2.

If, while retaining the arrangement of the co-axial elements 15 and 17, electrical discharges are utilized in the form of an arc or of a flux, depending on the reaction to be produced, some of the above described elements can be removed or simplified.

For example, the arc can be modulated by means of known devices, such as, for instance, the device shown in Fig. 3. This shows a Ruhmkorff spark coil 32 to which current is supplied by a battery 33 provided with a switch 34. One of the conductors of the spark coil 32 passes through an impedance 35 and is connected to a venturi cone 36 in the narrowest portion thereof; the other passes through a double solenoid 37 to feed an electrode 38, while a shunt 39 of the same line feeds a variable condenser 40 which is connected with the narrowest portion of the cone. Any other known device can be utilized for effecting the modulation of the arc.

If the chemical process to be performed comprises a number of simultaneous or successive reactions, the installation in accordance with the present invention may comprise a number of devices as described above, which are assembled in series or in parallel, in each of which a single phase of the process takes place, until the final result is obtained.

What I claim is:—

1. Apparatus for treating chemical substances, so as to obtain cracking or chemical synthesis, comprising two co-axial conically-shaped members forming electrodes which are electrically insulated from one another, wherein one of the members is provided at its base end with means for producing sonic or supersonic vibrations and at its apex with a pile of annular metallic elements in imperfect contact with each other and wherein the other of the members is provided with a metallic ring which is adapted to be subjected to magnetic action, said ring being located radially opposite the pile of annular elements co-axially therewith.

2. Apparatus claimed in Claim 1, wherein means are provided for varying the electromagnetic field within the metallic ring in which the chemical action takes place.

3. An installation for treating chemical substances comprising a plurality of units of apparatus as claimed in Claim 1 or Claim 2, wherein the units are connected in series so that the chemical substances passing through them are subjected to a series of successive reactions.

4. An installation for treating chemical substances comprising a plurality of units of apparatus as claimed in Claim 1 or Claim 2, wherein the units are connected in parallel so that the chemical substances being treated are subjected to a number of simultaneous reactions.

5. Apparatus for treating chemical substances substantially as herein described with reference to the accompanying drawing.

Agents for the Applicant,
STANLEY, POPPLEWELL, FRANCIS & ROSS,
Chartered Patent Agents,
19, Buckingham Street, Strand,
London, W.C.2.

Printed for Her Majesty's Stationery Office by Wickes & Andrews, Ltd., E.C.4. 684/2.—1956.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

751,735 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1

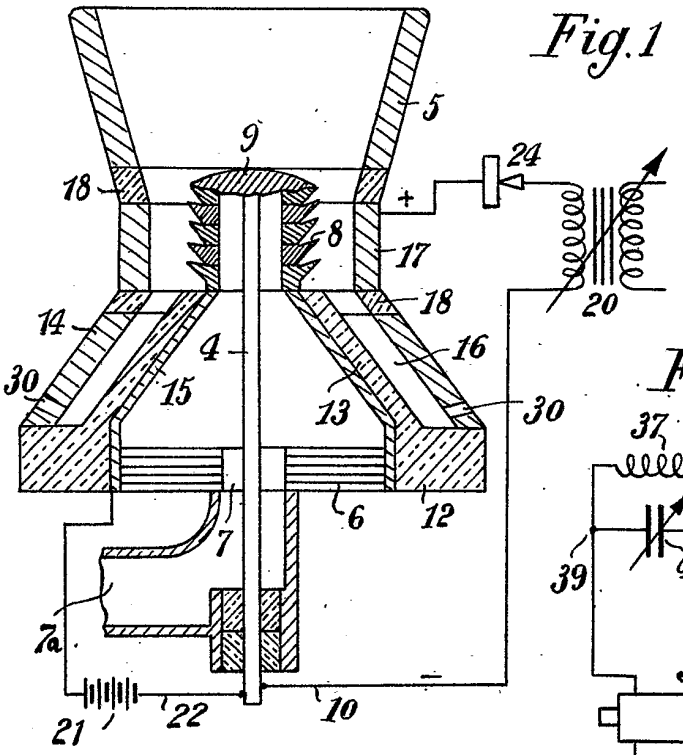
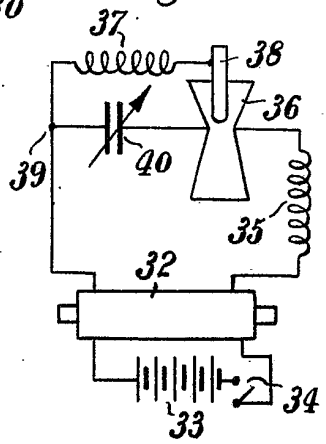


Fig. 3



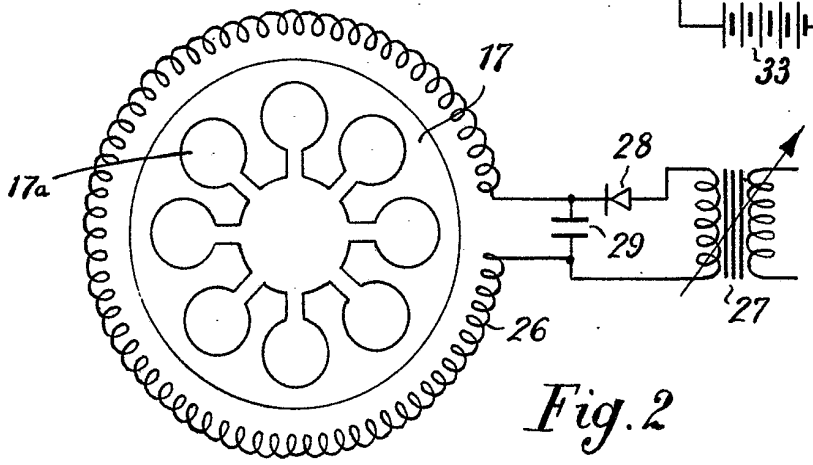


Fig. 2