PATENT SPECIFICATION

739,483

No. 6984/52.

Date of Application and filing Complete Specification: March 18, 1952.

Application made in Sweden on March 20, 1951.

Complete Specification Published: Nov. 2, 1955.

Index at acceptance:—Class 1(1), F3A1X, F3C(7:8).

COMPLETE SPECIFICATION

Method of carrying out Exothermic Chemical Reactions in the Gaseous Phase

I, LENNART WIKDAHL, of 13, Skirnervägen, Djursholm, Sweden, of Swedish nationality, 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 concerns a method of carrying out exothermic chemical reactions in the gaseous phase in order to transform the chemical energy liberated during the reaction into kinetic energy. Proposals have been made to expand the reaction products in a gas turbine to obtain kinetic energy.

In exothermic chemical reactions part of the chemical energy is converted to heat energy and the temperature of the reaction mixture therefore rises, with an adverse effect on the reaction efficiency. Several methods have been proposed for removing the heat generated by the reaction and to keep the reaction temperature at a value which is sufficient to ensure a suitable reaction velocity, in the presence or absence of catalysts.

All of the hitherto known methods for removing the chemical energy liberated during the reaction rely on the cooling of the reaction mixture either indirectly by means of water or the like or by means of the cold reaction mixture supplied, or directly by carrying out the reaction in a plurality of steps, for instance, diluting the partly reacted hot reaction mixture between the individual steps by one or more of the reactants at a lower temperature.

Hitherto it has not been possible to remove the reaction heat to the same extent as it is liberated and a certain temperature rise always takes place. If the exothermic reaction is strong there is a risk of the temperatures at certain points in the reaction mixture becoming so high that undesired secondary reactions occur, and the term of life and efficiency of a catalyst present may become impaired.

According to this invention the chemical reaction in the gaseous phase is carried out in a turbine device, the reactants being caused to react in the expansion space in the presence of a catalyst.

After the expansion has reached a final state it may often be of advantage to retain a certain excess pressure in order to carry out a subsequent treatment of the reaction products, such as absorption, washing, drying or the like under pressure.

The reaction may be one which yields sulphur trioxide, nitrogen compounds or chlorine compounds among the reaction products, e.g., the oxidation of inorganic compounds such as oxidation of sulphur dioxide to sulphur trioxide or the oxidation of ammonia to nitrogen oxides. The reaction may also be a hydrogenation reaction as in the Fischer-Tropsch process, synthesis of methanol or a process for the oxidation of organic compounds, such as oxidation of methanol to formaldehyde, ethyl alcohol to acetaldehyde, acetaldehyde to acetic acid, or oxidation of natural gas.

When iron pyrites are roasted to form sulphur dioxide the iron oxide obtained may serve as a catalyst for the oxidation of sulphur dioxide to sulphur trioxide according to the invention.

A practical application of the invention will now be described, by way of example only, with reference to the accompanying drawing which schematically illustrates the plant employed. The plant is used for the manufacture of sulphuric acid and the generation of electrical energy. The reactants consist of SO_2 and O_2. The sulphur dioxide is compressed in a compressor 1 to a pressure of 10 kg/cm^2 above atmospheric pressure and the temperature is raised to about 500°C. The oxygen is supplied in the form of air enriched in oxygen to a compressor 2 and is also compressed to a pressure of 10kg/cm² above atmospheric pressure and given a temperature of 500°C. The compressed gases are individually conveyed to a turbine reactor 3. Said turbine reactor consists of a gas turbine dimensioned in a suitable way and having the rotor 3b and the stator 3a faced or coated with platinum. The gases will react in the turbine reactor 3 with the liberation of SO_3. The chemical energy liberated is transformed into kinetic energy which is transformed into electric energy in a generator 4. From the turbine reactor the reaction mixture is conveyed still at a pressure of about 2 kg/cm² above atmospheric pressure to an absorption tower 5 in which the SO_3 gas is absorbed in sulphuric acid. From the absorption tower 5 the remaining gas mixture is supplied to a gas turbine 6 in which the gas mixture is allowed to expand to atmospheric pressure giving off energy via a generator 7.

A production of 10 tons of SO_3 per hour yields about 1000 kw.

The disposition of the catalyst within the gas turbine may be varied as desired. In one arrangement the catalyst is so located that the reaction is carried out in the channels between the rotor and the stator blades of the turbine and in another arrangement the catalyst is suspended in the reaction chamber or alternatively the catalyst is fixed to the wall of said chamber.

A modification of the method described above consists in supplying an inert gas to the reaction mixture so that the reaction is carried out with expansion of the reaction mixture and of a substance not taking part in the reaction.

What I claim is:—

1. A method of carrying out exothermic chemical reactions in the gaseous phase in order to transform the chemical energy liberated during the reaction into kinetic energy which comprises carrying out the chemical reaction in a turbine device and causing the reactants to react in the expansion space in the presence of a catalyst.

2. A method as claimed in Claim 1 in which the reaction is carried out in the channels between the rotor and stator blades of the turbine.

3. A method as claimed in Claim 1 in which the reaction is carried out in the presence of a catalyst suspended in the reaction chamber.

4. A method as claimed in Claim 1 in which the reactants are caused to pass a catalyst fixed to the wall of the reaction chamber.

5. A method as claimed in Claim 1 in which the reactants are compressed before they are conveyed to the turbine device.

6. A method as claimed in Claim 1 in which an inert gas is supplied to the reaction mixture

7. Method of carrying out exothermic chemical reactions substantially as hereinbefore described.

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Printed for Her Majesty's Stationery Office by Wickes & Andrews, Ltd., E.C.4. 684/2.—1955.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

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1 SHEET
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