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COMPLETE SPECIFICATION.

Improvements in Supplying Heat in High Pressure Reactions.

We, I. G. Farbenindustrie Aktiengesellschaft, of Frankfort-on-Main, Germany, a joint stock company, organized under the laws of Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a method of supplying heat to the reacting materials in high pressure reactions, in which readily decomposable materials containing carbon are treated at high temperatures with gases or vapours which are less liable to decomposition by the action of high temperatures and in which reaction products having a different number of carbon atoms in the molecule than that contained in the molecule of the initial materials are obtained. In such reactions the supply of the necessary amount of heat to the reacting material and the control of the most suitable temperature affords great difficulties, especially when working on a large industrial scale since it was hitherto usual to supply the greater part of the heat in such reactions through the pressure-bearing walls of the plant. The supply of heat through the pressure bearing walls, however, leads to rapid deterioration of the said walls. It has already been suggested in Specification No. 192,850 in the treatment of solid carbonaceous substances, mineral oils and heavy hydrocarbons under pressures of 100 atmospheres and at a high temperature to heat the substances participating in the reaction, before introducing them into the reaction vessel, to the temperature required for the reaction, or differing from it only to a small extent, by means of a heat carrier (for instance heating gas) the highest temperature of which is not materially higher than the temperature in the reaction vessel. An installation described as suitable for carrying out the invention shews the said heating being effected through pressure bearing pipes and is thus attended by the disadvantages before mentioned.

We have now found that the said difficulties may be overcome in a simple manner by supplying the heat required for the reaction to the materils to be treated not through the pressure resistant wall or walls of the plant but wholly or partially by a preheated non-metallic gas which is not decomposed at the temperature of preheating and which may be an inert gas or may take part in the reaction and is directly brought into contact with the materials to be treated. For example this gas is passed, before it comes into contact with the materials to be treated, over or along a heating device, for example an electrically operated heater, and thereby brought to the desired temperature, care being taken that decomposable reacting materials, or materials which would attack the heating device, do not have access to the said heating device. The said non-metallic gas must not however be preheated through the pressure-bearing walls. According to this manner of working the pressure resistant wall of the reaction vessel and of other parts of the plant is only very slightly exposed to attack by heat. Further, the heat supplied to the reacting materials is distributed much more uniformly than if the heat were supplied through the pressure resistant wall and therefore an undesirable local superheating of the materials is avoided. It is advantageous to preheat the initial materials to be treated to a temperature below that at which decomposition would occur, in any known and suitable manner.

The materials to be treated may be vapourised or atomised by the highly heated gas and are thereby heated and if desired brought into reaction with the said gas. The mixture of gas and reacting materials may also be passed over catalysts suitable for the desired reaction. When the initial materials are to be treated in the liquid state, the heat supplying gas may be employed for agitating these liquid materials. The highly heated gas may be introduced into the materials to be treated for example through porous plates or the like on which, the said materials rest in the liquid or solid state.

The heat supplying gas may be heated to temperatures exceeding the temperature

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at which the reaction is to be carried out. The degree of such superheating depends on the nature of the material to be treated and should be kept as low as practicable in order to avoid undesirable decomposition of the materials. The necessary amount of heat may be supplied with only a small excess temperature when employing a large amount of heating gas such as nitrogen, or by employing a gas of a high specific heat such as hydrogen or the like, in which latter case a smaller amount of superheated gas is sufficient. In any case any sudden development of heat which would lead to local superheating of the materials, must rapidly be equalised.

Care should be taken that those parts of the apparatus which come into contact with the hot reacting materials and gases, are made of a material resistant to the action of these substances.

The supply of heat to the heating gas may also be effected, instead of by a heating device, by an exothermic reaction; for example when working with hydrogen, oxygen may be added to burn part of the hydrogen whereby the remaining gas is strongly heated to the desired temperature.

The process according to the present invention is applicable for example in the conversion of low alcohols such as methanol or ethyl alcohol, into higher alcohols and the like by the action of carbon monoxide or water gas. The process is, however, of particular importance in the destructive hydrogenation of carbonaceous materials such as the various kinds of coal, tars, mineral oils, distillation and conversion products and residues thereof and the like, that is the treatment of the said materials with hydrogen or gases containing or giving rise to hydrogen at elevated temperatures and under pressure for the production of valuable hydrocarbons and derivatives thereof. In this treatment hydrogen or gas supplying hydrogen is preferably used as the heating gas. As already pointed out it is advantageous to employ large amounts of hydrogen in order to avoid local superheating of the reacting material; this results in the further advantage that the hydrogenating action is increased. In the case of destructive hydrogenation, the apparatus must be resistant to attacks by hydrogen, oxygen, sulphur, hydrocarbons and the like, and those parts of it which come into contact with hot hydrocarbons, should preferably not further the deposition of carbon and the formation of methane. When employing in this reaction an electric heating device, as is most suitable, the material of such device must also be resistant to the attack of the heating gas, especially of hydrogen and also of hydrogen sulphide. Suitable materials for this purpose are for example the steels V2A or WT2 of the firm of Krupp.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In high pressure reactions in which readily decomposable materials containing carbon are acted upon at high temperatures with gases or vapours which are less liable to decomposition by the action of high temperatures and in which reaction products having a different number of carbon atoms in the molecule than that contained in the molecule of the initial materials are obtained, the step of supplying the heat required for the reaction to the materials to be treated not through the pressure resistant wall or walls of the plant, but wholly or partially by means of a preheated non-metallic gas which is not decomposed at the temperature of preheating and which may be inert or may take part in the reaction which is directly brought into contact with the materials to be treated and which has not been preheated through pressure bearing walls.

2. A modification of the process claimed in the preceding claim which consists in preheating the gas serving to heat the reaction mixture by means of a heating device which is so arranged as to prevent the device from coming into contact with reacting materials which would be decomposed or which would attack the heating device.

3. A specific method of carrying out the process claimed in Claims 1 and 2 which consists in heating the gas by means of an electric heating device.

4. A modification of the process claimed in any of the preceding claims, which consists in also preheating the reacting materials, but not to a temperature at which a decomposition thereof would set in.

5. A modification of the process claimed in any of the preceding claims, which consists in employing a large amount of heating gas so as to avoid local superheating of the reacting materials.

6. The application of the process claimed in any of the preceding claims to the destructive hydrogenation of carbonaceous materials.

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