[Third Edition.]

PATENT SPECIFICATION

Application Date: Feb. 8, 1924. No. 3326/24. 231,285

Complete Accepted: April 2, 1925.

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COMPLETE SPECIFICATION.

Improvements in the Manufacture of Methyl Alcohol and other Oxygenated Organic Compounds.

I, JAMES YATE JOHNSON, a British subject, of 47, Lincoln's Inn Fields, in the County of London, Gentleman, do hereby declare the nature of this invention (which has been communicated to me from abroad by the Badische Anilin and Soda Fabrik, of Ludwigshafen-on-Rhine, Germany, a company incorporated according to German laws), and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It has recently been found that methyl alcohol and other oxygenated organic compounds can be produced synthetically from mixtures of carbon monoxide and hydrogen by the action of proper catalysts when working at an elevated temperature and pressure. When carrying out the said reaction in practice it has been found that the reaction of the catalyst often deteriorates more or less quickly, methane or high hydrocarbons being formed to a greater or less degree instead of alcohols or other oxygenated compounds. Even if the hot reaction vessel be lined with copper as described in my Specification No. 20,488/13 for preventing a decomposition of carbon monoxide by the iron walls with the formation of a carbon deposit, the deterioration aforementioned is not avoided.

My foreign correspondents have now found that the said drawback is due to the fact that the action of the contact mass is strongly influenced by volatile compounds of iron, nickel and cobalt, especially their carbonyls, or by deposits of the said metals formed within the reaction chamber from such carbonyl or other volatile compounds and that the deterioration of the contact mass is avoided if the hot parts of the apparatus coming into contact with the carbon monoxide, especially the reaction vessel and metallic parts arranged therein, such as supports for the catalytic mass, electric heating bodies, heat exchangers and the like, are coated or lined with, or made of a metal or metal alloy which does not form carbonyl compounds and also withstands the temperature conditions obtaining in the various parts of the apparatus (excluding in accordance therewith, iron, nickel and cobalt) and if the less hot and cold parts of the apparatus are also provided with similar means in order to prevent particles or compounds of iron, nickel or cobalt from that part of the apparatus reaching the hot zone containing the catalyst.

According to this invention the hot parts are made of, or lined or coated with, copper, silver, aluminium or their alloys, or a special steel containing a substantial amount of chromium, manganese, tungsten, molybdenum or vanadium, or coated with the last named metals. For the less hot, or for the cold parts of the apparatus, for example the high pressure piping, the same metals or alloys or coatings or linings thereof, may be employed, while metals of a lower melting point, such as zinc, tin, lead or their alloys, are also suitable for these parts, or the latter may be protected by non-metallic materials, for example they may be coated with asphalt or enamelled.

As regards the aluminium already referred to it is only suitable for use where the temperatures are not too high. The temperature up to which it may be used depends to a certain degree on the pressure, or more correctly speaking the partial pressure of the carbon monoxide, inasmuch as the temperature may be higher, the lower the pressure, or partial pressure of the carbon monoxide is. Generally speaking, the temperature limit up to which aluminium can be used is about 550 degrees Centigrade. As to the special steels, that known under

the brand "steel V2A" (of the firm of Krupp) containing 20 *per cent.* of chromium, 7 *per cent.* of nickel, 0.27 *per cent.* of carbon, 0.45 *per cent.* of silicon and 0.35 *per cent.* of manganese may be cited as an example. Such material is used with advantage for the electric heating resistance for the initial heating and, if necessary, for the further supplemental heating of the gas mixture. The coatings of chromium, tungsten, and the like mentioned above can be produced in a satisfactory manner by electro-deposition, for example electro-chroming and the like. In other respects, the working of the catalytic process is not altered by the application of the present invention.

In order to protect the walls which are exposed to the high pressure against the action of the hot compressed hydrogen, the invention may be combined with the known means for working with hydrogen under a high pressure, thus, for example, employing a copper tube surrounded with a perforated or otherwise permeable steel mantle, or an iron tube lined inside with a thin tube consisting of one of the aforesaid metals or coated with the latter, and simultaneously protected by a permeable steel mantle capable of resisting the pressure.

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

1. In the synthetic manufacture of methyl alcohol or other oxygenated organic compounds by the catalytic reduction of carbon monoxide at an elevated temperature and pressure, coating or lining the hot parts of the apparatus with, or making them of a metal or metal alloy which does not form carbonyl compounds and withstands the temperature conditions, the less hot and the cold parts of the apparatus being also similarly made, lined or coated substantially as described.

2. In the synthetic manufacture of methyl alcohol or other oxygenated organic compounds by the catalytic reduction of carbon monoxide at an elevated temperature and pressure as claimed in the preceding claiming clause, the use for the coating or lining of copper, silver, aluminium or their alloys, or a special steel containing chromium, manganese, tungsten, molybdenum or vanadium, or the use of one of the last named metals as a covering; substantially as hereinbefore described.

3. In the synthetic manufacture of methyl alcohol or other oxygenated organic compounds by the catalytic reduction of carbon monoxide at an elevated temperature and pressure, as claimed in either of the two preceding claiming clauses, the use of metals of a lower melting point such as zinc, tin, lead, or alloys thereof for the less hot or the cold parts of the apparatus, or of non-metallic materials; substantially as hereinbefore described.

4. The several improvements in the manufacture of methyl alcohol and other oxygenated organic compounds; substantially as hereinbefore described

Dated this 8th day of February, 1924.

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Abingdon: Printed for His Majesty's Stationery Office, by Burgess & Son.
[Wt. 95A.—125/3/1933.]