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COMPLETE SPECIFICATION.

An Improved Method of Working with Carbon Monoxide under Pressure.

We, I. G. FARBENINDUSTRIE AKTIENGESELLSCHAFT, formerly known as Badische Anilin & Soda Fabrik, of Frankfort-on-Main, Germany, a corporation organised according to German laws, 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:—

In operations in which carbon monoxide is employed under pressure and at an elevated temperature, serious difficulties are sometimes encountered. These are due on the one hand to the fact that the carbon monoxide on its way through the apparatus reacts with the iron in the walls thereof forming iron carbonyls which interfere with the desired operation, and on the other hand to certain decompositions of the carbon monoxide caused by the contact with the said iron walls. Such decompositions consist, for example, in a formation of carbon and carbon dioxide, the former of which ultimately chokes the pipings and other parts of the apparatus, or in a reaction with hydrogen if this be present, which leads to the formation of methane which may be an undesirable admixture. All of these reactions also mean a consumption of part of the carbon monoxide introduced into the apparatus. Further, some of such undesirable reactions are accompanied by a great development of heat and when once started would proceed very rapidly, and to a considerable extent, thereby developing more and more heat and raising the temperature eventually to a dangerous degree. For operations in which carbon monoxide is employed under high pressure and at an elevated temperature, the use of reaction vessels lined inside with copper has been suggested. It has also been proposed in Specifications Nos. 229,714, 229,715 and 237,030 to carry out the synthesis of methanol and the like from carbon monoxide and hydrogen by working with dry gases and excluding iron, nickel, and cobalt, from within the reaction vessel, but by this method the before-mentioned difficulties are not avoided as undesirable reactions may occur by contact of the carbon monoxide with hot iron surfaces outside the reaction vessel. In order to overcome these difficulties, it has been suggested in Specification No. 231,285 to exclude iron surfaces from all parts of apparatus used for the synthetic manufacture of methanol and other oxygenated organic compounds which come into contact with carbon monoxide whether at a high temperature or in the cold.

We have now found that the said difficulties can be overcome without the whole of the precautions recommended in Specification No. 231,285 being necessary, provided the gases are substantially dry. Under these conditions that is when working with substantially dry carbon monoxide under pressure, we have found that it is only necessary to protect the gases from coming into contact with the iron walls in such parts of the apparatus which in the course of the operation reach a temperature of 150 degrees Centigrade or more, whereas the parts of the apparatus only reaching a temperature of less than 150 degrees Centigrade may still be of iron and left unprotected. The protection of the parts of the apparatus of a temperature higher than 150 degrees Centigrade may be effected as described in the aforementioned Specification No. 231,285, by constructing those parts of copper, silver, aluminium, or their alloys, or special steels with a substantial per-

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centage of chromium, manganese, tungsten, molybdenum or vanadium, or by constructing such parts of iron or ordinary steel with a lining or coating of the beforementioned metals, or with chromium, manganese, tungsten, molybdenum or vanadium alone. Various metals or alloys or coatings thereof may be used for different parts of the apparatus and such parts of the apparatus as in the operation reach a temperature of more than 150 degrees Centigrade though not a high temperature may also be lined or coated with zinc, tin, lead, or alloys of such metals of low melting point. The gases employed for the operation may be dried in any suitable manner, as for example by means of desiccated calcium chloride. If synthetic methanol is the product to be made in the operation from a mixture of carbon monoxide and hydrogen under high pressure, the gases which are used in a circular system, are kept sufficiently dry to exclude any reaction with the iron walls up to 150 degrees Centigrade, if the said gases are washed with the methanol produced in the process. In the case of operations in which iron carbonyl would exert an obnoxious influence, as for example in the synthetic manufacture of methanol, care must be taken that the iron carbonyl contained in the original gas serving as a supply to the circular system for the gas consumed by the reaction, is removed prior to its introduction into the circular system.

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:—

A process of working with carbon monoxide under pressure which consists in passing carbon monoxide under pressure in a substantially dry condition through an apparatus or vessel, which, where not exposed to a temperature higher than 150 degrees Centigrade is made of iron without any protection, while the parts of the apparatus or vessel exposed to a higher temperature are provided with an inner surface of a metal sufficiently resistant to carbon monoxide and the temperature under the conditions of working.

Dated this 6th day of February, 1926.

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