PATENT SPECIFICATION

699,735

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COMPLETE SPECIFICATION.

Means for the Uniform Distribution of Gas over Individual Catalyst Tubes

We, RUHRCHEMIE AKTIENGESELLSCHAFT, of Oberhausen-Holten, Germany, a German Joint-Stock Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to means for providing uniform or substantially uniform distribution of a gas over the catalyst contained in several tubes in a reactor and is particularly applicable to reactors of the type used in the catalytic hydrogenation of carbon monoxide.

In carrying out the catalytic hydrogenation of carbon monoxide and other similar conversions of a gaseous mixture, use is made of reactors provided with a large number of vertical tubes in which the catalyst is contained. The gas or gaseous mixture to be converted is passed downwardly or upwardly through the vertical tubes containing the catalyst. A cooling medium, which may be water under pressure, is provided to flow around the outer surface of each of the vertical tubes so as to remove heat evolved during the conversion of the gas. To improve the cooling effect, it is known to provide each vertical tube with an inner co-axial tube through which the cooling medium also flows, the catalyst being contained in the annular space between the inner and outer tubes.

The degree to which the catalyst in the individual tubes permits the passage of the gas, varies greatly in the majority of the tubes used. This fact may be easily understood if it is borne in mind that a modern reactor for the hydrogenation of carbon monoxide may contain from 2,000 to 3,000 individual tubes for the catalyst; it is practically impossible to charge the catalyst into the tubes in such manner that the resistance to the flow of the synthesis gas is the same in every tube and the same throughout the length of each tube. The tubes in which the catalyst offers but slight resistance to the flow of the gases, pass relatively large quantities of gas. In consequence, the catalyst in such tubes is overloaded and the conversion of the synthesis gas deteriorates as compared with the conversion with normal or optimum loading of the catalyst. For this reason synthesis reactors in large scale operation are always less efficient than single synthesis tubes such as are used, for example, in experimental operations.

It is an object of the invention to provide means whereby the gas entering the reactor may be distributed uniformly over the several tubes so that the catalyst may be contacted with the gas more uniformly throughout the reactor.

According to the invention, means for distributing a gas uniformly over a catalyst contained in tubes in a reactor comprise a sealing cap mounted at the end of each tube, each sealing cap having one or more small openings in its wall to provide the only entry for the gas into the tubes, the resistance of each sealing cap to the flow of gas being substantially the same and being at least equal to the greatest resistance to the flow of gas provided by the catalyst in any of the tubes.

The resistance of a sealing cap to the flow of the gas is preferably appreciably greater than the resistance of any one of the catalyst-filled tubes to the flow of the gas.

As the resistances of the sealing caps to the flow of gas are equal one to another, the synthesis gas passed into the reactor is divided into a number of equal streams. If these streams of the gas encounter uneven resistances within the catalyst-filled tubes through which they pass, the rate of flow in the individual tubes can only be but slightly affected.

Sealing caps according to the invention

[Price 2/8]

are diagrammatically illustrated by way of example in Figs. 1 to 4 of the accompanying drawings. The sealing caps are shown mounted on the tubes, and in vertical section.

In the drawings, 1 is an outer tube provided with an inner co-axial tube 2 through which the cooling medium may be circulated.

The granulated catalyst is provided in the cylindrical annular chamber 3 between the tubes 1 and 2. By reason of the relatively small thickness of the annular chamber 3, the catalyst, in this arrangement, is effectively cooled by two surfaces. On the mouth of the tube 1, illustrated in Fig. 1, there is seated a metal sealing cap consisting of a base 4 and a projecting body portion 5, the portion 5 being shaped slightly conically and adapted to be inserted as a medium force fit into the tube 1 so that a firm seal is obtained. A capillary opening 6 is provided in the wall of the metal sealing cap, which opening 6 provides the only path by which the synthesis gas can enter the tube 1. The capillary opening 6 is of the same diameter in each cap; more than one opening 6 may be present in each cap.

The sealing caps illustrated in Figs. 2 and 3 are constructed as stamped or pressed sheet metal bodies, each having a projecting, circumferential ring 7 or 8 which is adapted to bear resiliently against the inner surface of tube 1. The synthesis gas can only enter the tubes 1 through capillary openings 9 or 10 provided in the walls of the sealing caps.

The sealing caps may also be provided with a circular washer 11 (Fig. 4) of asbestos, ceramic material or glass wool as sealing means, so as to ensure that the gas only enters the tubes 1 through the openings in the walls of the sealing caps. Instead of being sealed by circular washers, the mounted caps may also be sealed by substances such as wax or tar introduced into the groove running round the joint.

The sealing caps according to the invention, instead of being formed of sheet metal, may be formed of ceramic material or heat-resistant synthetic resins. Porous materials can also be used in the form of caps or plugs, the pores of which permit the passage of gas, as for example ceramic masses, sintered or fritted from powdery material.

What we claim is:—

1. Means for distributing a gas uniformly over a catalyst contained in tubes in a reactor, comprising a sealing cap mounted at the end of each of the tubes, each sealing cap having one or more small openings in its wall to provide the only entry for the gas into each of the tubes, the resistance presented by each sealing cap to the flow of gas being substantially the same and being at least equal to the greatest resistance to the flow of gas provided by the catalyst contained in any of the tubes.

2. Means according to Claim 1, in which a portion of each sealing cap is adapted to be inserted into the mouth of a tube to bear resiliently against the inner surface of the tube.

3. Means according to Claim 1 or Claim 2, in which the sealing cap is made of metal.

4. Means according to Claim 1, in which the sealing cap is formed of porous material, preferably of sintered or fritted material.

5. Means according to any one of Claims 1 to 4, in which washers of asbestos, ceramic material or glass wool are provided between a sealing cap and the tube on which it is mounted.

6. Means according to any one of Claims 1 to 4, in which a seal of tar or wax is provided between a sealing cap and the tube on which it is mounted.

7. Means adapted to distribute a gas uniformly over a catalyst contained in tubes in a reactor, substantially as hereinbefore described with reference to any one of Figs. 1 to 4.

8. Means for distributing a gas uniformly over a catalyst contained in tubes in a reactor, substantially as hereinbefore described.

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699,735 COMPLETE SPECIFICATION
1 SHEET

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

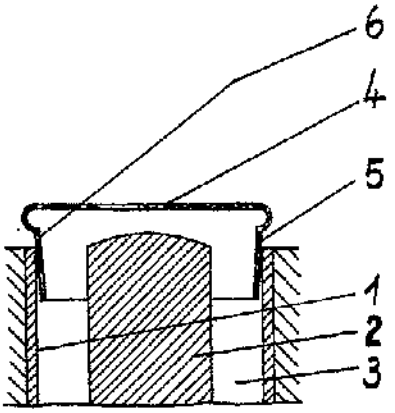

Fig. 1

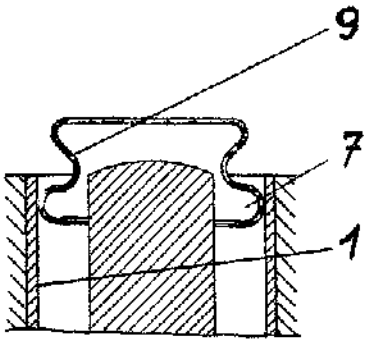

Fig. 2

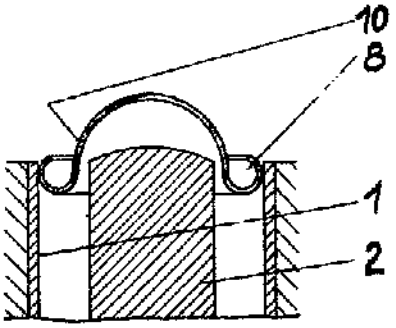

Fig. 3

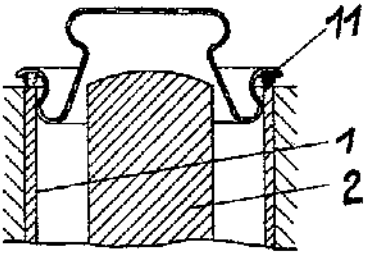

Fig. 4