PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in or relating to Exothermic Catalytic Gas Reactions.

I, HANS HARTER, a German citizen, of 8, Theresienstrasse, Würzburg, 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 apparatus for carrying out exothermic catalytic gas reactions, more especially those under excessive pressures. Owing to the large quantities of heat produced, the substances forming the catalyst in such apparatus are easily overheated and their activity is impaired. Another cause for decreasing this activity is attributable to the contaminations contained in the gases to be acted upon. Consequently the concentration of the reaction products varies, and therefore the heat produced is also variable.

The object of the present invention is to provide means both for cooling the contact substance and for exactly regulating and adjusting the cooling action.

In connection with exothermic chemical reactions carried out under pressure and at a high temperature suggestions have been made previously to pass the gas which is to subsequently take part in the reaction through an annular space formed between the reaction chamber and the high pressure cylinder in which it is contained, whereupon this gas passes through a cooler then through the reaction vessel. In a modification of this arrangement an insulating cylinder has been fitted into the space between the reaction vessel and the high pressure cylinder and the gas first passed through the space between the high pressure cylinder and the insulating cylinder, then through a cooler whilst the gas for the reaction was passed into the space between the reaction vessel and the insulating cylinder and then through the reaction vessel.

According to the present invention a stream of cooling medium for the contact substance is caused to circulate continuously through the apparatus in a quantity per unit of time which is independent of the quantity of the actual reaction gas current, the control of the cooling medium being effected solely by a circulating pump, whilst an insulating cylinder for protecting the high pressure resisting wall against excessive heat is so disposed as to cause the cooling medium to pass between the cylinder and the contact surface and the reaction gas current between the cylinder and the high pressure resisting wall.

Two structural forms of the invention are illustrated in the annexed drawings of which Fig. 1 is a vertical longitudinal section of an apparatus in which the cooling gas current is detached from the main gas current, whereas Fig. 2 is a similar view of an apparatus in which the cooling medium forms a completely closed circulating system.

Referring first to Fig. 1, the apparatus consists, for instance, of a high-pressure tube *a*, a double walled cylinder *f*, the annular space of which is filled with granular heat-insulating material, a catalytic tube *b*, a circulating pump *l* and a cooler *k*.

The gases coming from the compressor (not shown) are united with the gases serving as cooling medium and circulating through the apparatus, and the united gases enter the high-pressure chamber at *c* where they are divided into two gas streams I and II forming respectively the reaction gas stream proper and the cooling gas stream. Stream I passes through the annular cylindrical space *d* formed between the high-pressure tube *a* and the double-walled cylinder *e* made of thin sheet-metal and filled with a suitable heat-insulating material. This insulating cylinder protects the high-pressure tube *a* against the heat radiating from the catalytic cylinder. The very slight quantity of heat transmitted through the insulating cylinder is absorbed by the gas stream continuously flowing with constant velocity whereby the high-pressure tube remains wholly protected against heat so that its temperature can only be increased to a very small and not injurious extent. At the lower end of the insulating cylinder short tubular pieces *h* are welded into its double wall to enable the gases I to pass into the catalytic mass. The reaction

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gases leave the catalytic tube through the tubular member *m*. The other stream II flows through the annular space *g* between the insulating cylinder *e* and the hot catalytic cylinder *b* whereby, the gas is heated.

The hot gases of stream II then leave the high-pressure tube at *i* and from here pass to the cooler *k* where they give off the absorbed heat, whereupon they are returned to the supply-pipe by means of the pump *l*. It will be understood that the cooling effect is greater the larger the quantity of cooling gases passed over the catalytic cylinder per unit of time, that is to say, the higher the speed of the pump. By accurately adjusting the speed of this pump, and using exact temperature measuring instruments, it is always possible to maintain the temperature of the catalyst within limits which ensure a smooth course of the reaction.

It will also be understood that the compressor must only supply the amount of gas corresponding to stream I. Consequently always the same quantity of cooling medium is employed for cooling purposes, its cooling action being solely determined by the speed of the pump.

In the apparatus illustrated in Fig. 2 the parts, corresponding to similar parts in Fig. 1 are designated by the same reference letters. The gas to be treated reaches the high-pressure chamber at *c* and flows through the annular space *d*, enters the catalytic tube through the short pipes *h* and leaves it through *m*. The cooling gas enters at *n*, flows through the annular space *g*, and is returned to *n* after passing through the cooler *k* and the pump *l*.

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. Process and apparatus for cooling contact substances used for high pressure exothermic catalytic gas reactions, characterised that a stream of cooling medium for the contact substance is caused to circulate continuously through the apparatus in a quantity per unit of time which is independent of the quantity of the actual reaction gas current, the control of the cooling medium being effected solely by a circulating pump, whilst an insulating cylinder for protecting the high pressure resisting wall against excessive heat is so disposed as to cause the cooling medium to pass between the cylinder and the contact substance and the reaction gas current between the cylinder and the high pressure resisting wall.

2. Process in accordance with claim 1, characterised in that gases or liquids which are kept under the same pressure as the reaction gases are employed as cooling media.

3. Process in accordance with claim 1, characterised in that gases are used for cooling which have the same composition and the same pressure as the gases employed for the catalytic process.

4. Apparatus for carrying out the process in accordance with claim 3, characterised in that the gases admitted to the reaction apparatus are divided into two partial streams, one forming the reaction gas stream (I), which flows through the annular space between the high pressure resisting wall and the insulating cylinder (*e*), and the other a cooling gas stream (II) which flows through the space between the insulating cylinder and the contact chamber, whereupon the reaction gas stream (I) is conducted to the contact mass and the cooling gas stream is returned through a tubular cooler (*k*) and a circulating pump (*l*) into the supply pipe.

5. Process and apparatus for carrying out exothermic catalytic gas reactions substantially as described in connection with the accompanying drawings.

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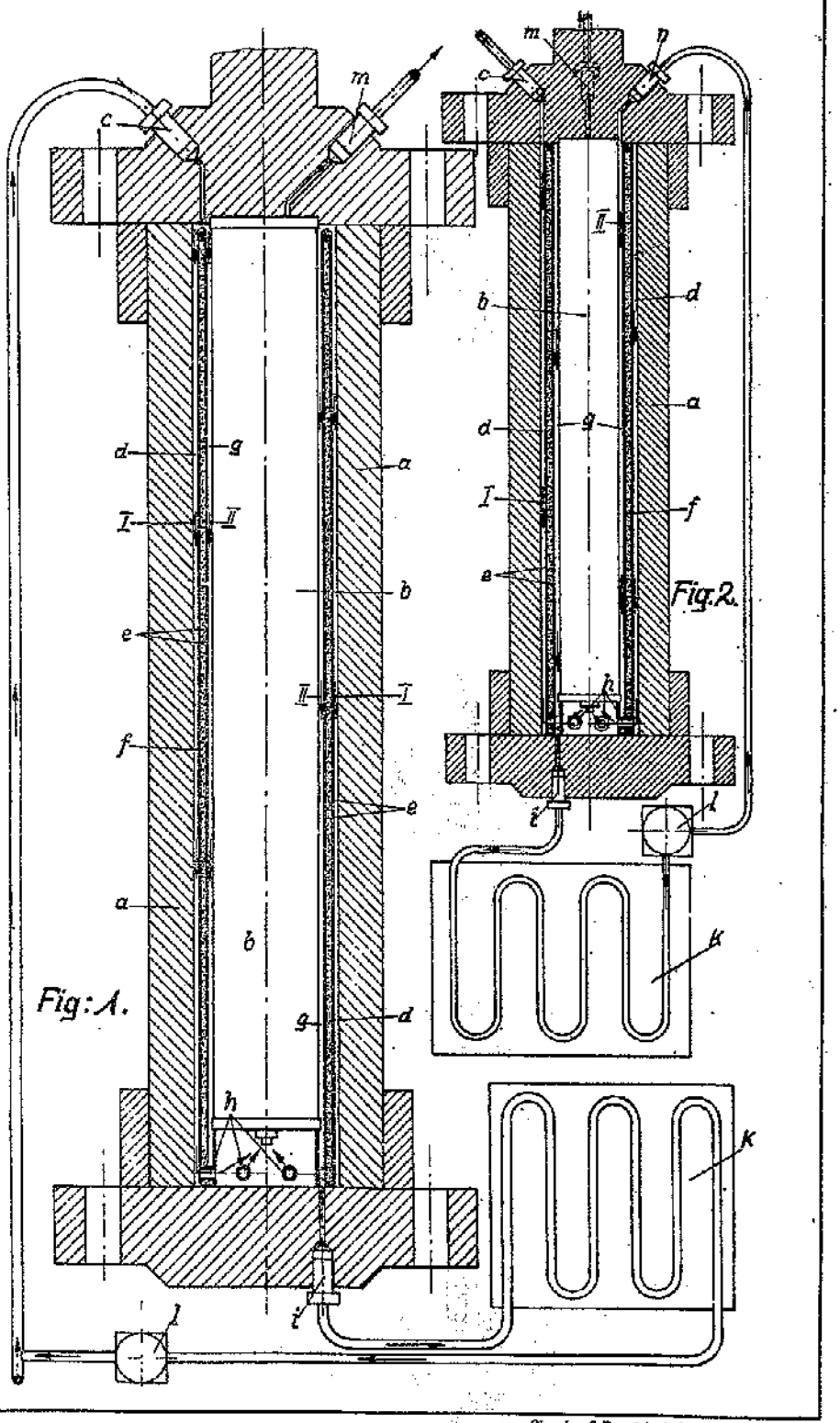

[This Drawing is a reproduction of the Original on a reduced scale.]

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