PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in or relating to Processes for Carrying Out Exothermic Chemical Reactions.

We, L'AIR LIQUIDE SOCIÉTÉ ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE, a French company, of 48, rue St. Lazare, Paris (Seine), in the Republic of France, Assignees of SOCIÉTÉ CHIMIQUE DE LA GRANDE PAROISSE (AZOTE & PRODUITS CHIMIQUES), a French company, of 13, rue des Saussaies, Paris, in the Republic of France, 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 processes for carrying out catalytic exothermic gaseous reactions, for instance the synthesis of ammonia from its elements. The principal object of the invention is to render the temperature as uniform as possible over the whole length of the catalysing material in contact with which the reaction is effected. A process and apparatus for obtaining such uniformity of temperature has been described in our prior Specification No. 268,722, and the present invention has for its object to provide another means for obtaining a similar result, which means can be used with or without the means described in our aforementioned prior specification.

According to the present invention such means depends on utilising the hot gases which have reacted and consists in transferring the hot gases immediately after they have reacted to the warmest portions of the catalysing material while avoiding during this transfer practically any loss or gain of heat by said gases and then circulating them in indirect contact with said portions so as to absorb heat therefrom and thus become heated; the gases may then leave the catalysing chamber or circulate in indirect contact with colder portions of the catalysing material to which they supply heat.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings which illustrate diagrammatically, by way of example, two constructions of apparatus embodying means for securing uniformity of temperature in the reaction chamber when carrying out the process according to the present invention.

In the apparatus shown in Figure 1 the gases which are to react enter the apparatus by the conduit A after having been heated if necessary. Inside the apparatus they then circulate in tubes B wherein they are heated or further heated while circulating in indirect contact with the catalysing material; an electrical heating device not shown in the drawing supplements if necessary the heating of the gases so that when they arrive at the ends C of the tubes B they are normally at the reaction temperature; they then come into contact with the catalysing material through which they flow while reacting. At D the gases pass into the tube E and in their passage therethrough cool the warmest region of the catalysing material, that is the region through which the gases first pass after leaving the ends C of the tubes B, and finally leave the apparatus at Y. During their travel through the tube E from the end D up to the region of the ends C of tubes B the gases must remain at practically the temperature they have when entering the tube E which latter therefore must be for instance of small diameter for imparting a great velocity to the gases or must be heat-insulated up to the region of the ends C of tubes B. It is to be noted that it may happen that the gases come into contact with the catalysing material at C at a temperature somewhat too low and that they reach the maximum temperature only after having passed through the very first portion of the catalysing material from C to I; in that case the gases coming from D which circulate in the tube E, after having absorbed heat from the zone at the highest temperature I, can give up some heat in the zone C, thereby tending to restore the normal operation.

In the apparatus shown in Figure 2 the gases which are to react enter the apparatus by the annular conduit A after having been heated if necessary, whereafter they circulate in the tubes B and

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pass through the catalysing material in the manner previously described with reference to the apparatus illustrated in Figure 1. On reaching D the gases pass into the tube E of small diameter, which is provided if necessary with heat insulating material to reduce to the minimum any transference of heat through its walls, and which brings them back into the warmest region of the catalysing material, that is the region near to C. There the gases which have been admitted to the tube E at D, and which are colder than those of the region of C but are still hot, absorb heat from the said region, and return through the external tube X in the direction opposite to that of the gases circulating in the tube E to supply heat to the zone D and finally pass out through the tube Y.

Of course there can be inserted in the catalysing material in the apparatus shown in Figure 1 several tubes such as the tube E, whilst similarly in the apparatus shown in Figure 2 a plurality of tubes such as the tubes E—X may be inserted in the catalysing material.

In the case of both the constructions of apparatus described above the excess of heat evolved by the reaction and which is not absorbed by the gases which are to react can be eliminated by any known means, for instance by external cooling of the outer receptacle H which is internally provided with an insulating material F for the purpose of protecting the walls of the receptacle H against the action of the gases and the effects due to their temperature.

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. A process for carrying out catalytic exothermic gaseous reactions which consists in transferring the hot gases immediately after they have reacted to the warmest portions of the catalysing material while avoiding during this transfer practically any loss or gain of heat by said gases and then circulating them in indirect contact with said portions so as to absorb heat therefrom and thus become heated.

2. A process as claimed in Claim 1, in which the gases which have reacted, after circulation in indirect contact with the warmest portions of the catalysing material, then circulate in indirect contact with colder portions of said catalysing material to which they supply heat.

3. A process as claimed in Claim 1, in which the gases which have reacted are passed through a tube located inside the catalysing material in the reaction chamber, said gases entering the tube at the end of the reaction chamber opposite to that at which the gases first impinge upon the catalysing material and after passing through the tube being discharged from the apparatus.

4. A process as claimed in Claim 2, in which there is provided inside the catalysing material in the reaction chamber a system of tubes comprising an inner tube and an outer tube surrounding said inner tube, the gases which have reacted entering the inner tube at the end of the reaction chamber opposite to that at which the gases first impinge upon the catalysing material and after passing through the said inner tube circulating in the opposite direction through the outer tube and being finally discharged from the apparatus.

5. A process for carrying out catalytic exothermic gaseous reactions by one or other of the methods substantially as hereinbefore described.

6. A process as claimed in any of the preceding claims adapted to the synthetic production of ammonia from its elements.

7. An apparatus for carrying out catalytic exothermic gaseous reactions having its parts constructed, arranged and adapted to operate substantially as described with reference to one or other of the constructions illustrated in the accompanying drawings.

Dated this 9th day of July, 1927.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
19—25, West 44th Street, New York, U.S.A.,
Agents for the Applicants.

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Fig. 2.

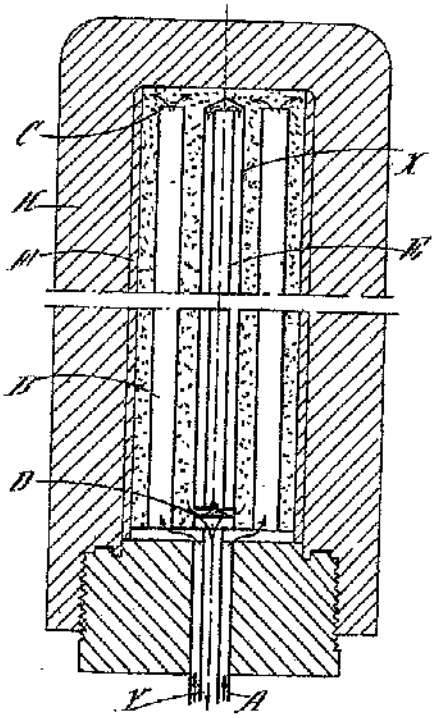
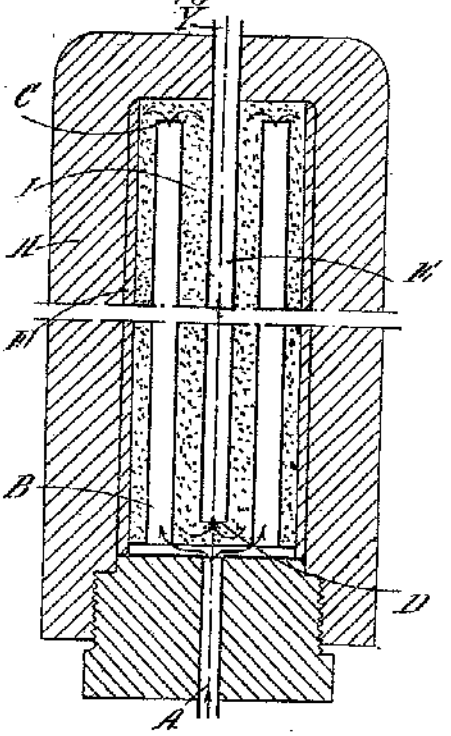


Fig. 1.



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