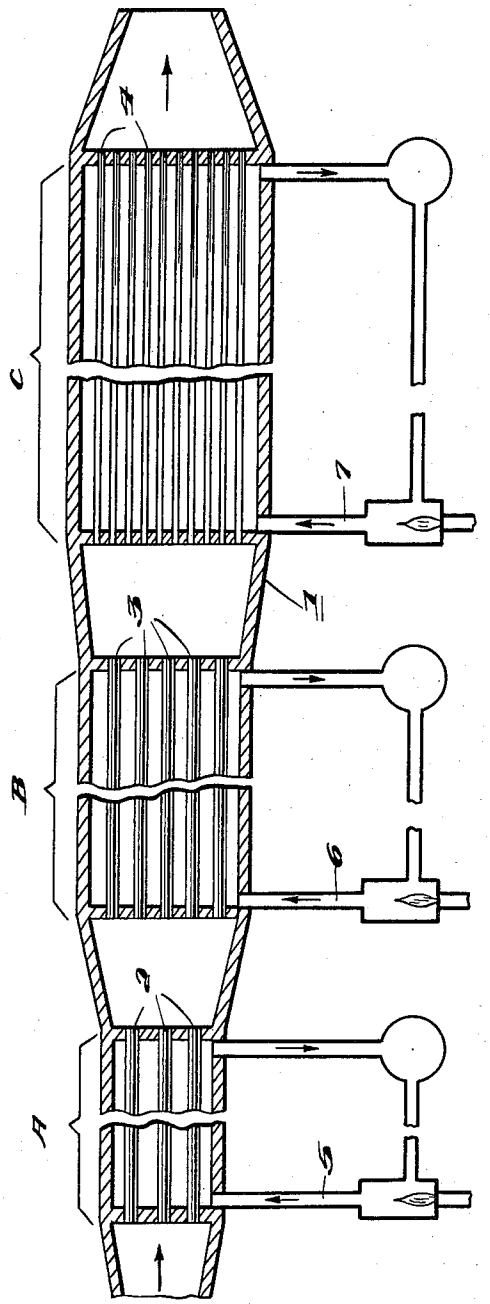
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METHOD OF PRODUCING HYDROCYANIC ACID FROM FORMAMIDE

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INVENTORS

ERICH ASENDORF

FRIEDRICH BITTNER

BY Bailey, Stephens & Huettig

ATTORNEYS

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METHOD OF PRODUCING HYDROCYANIC ACID FROM FORMAMIDE

Erich Asendorf, Bad Homburg vor der Hohe, and Friedrich Bittner, Mainz, Germany, assignors to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler, Frankfurt, Germany

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5 Claims. (Cl. 23—151)

The present invention relates to an improved process and apparatus for the continuous production of hydrocyanic acid from formamide.

It is known that hydrocyanic acid can be produced by decomposing formamide at elevated temperatures on catalytically active surfaces, particularly metal surfaces. In such process, formamide is vaporized and the vapor passed through an apparatus constructed of iron or iron alloys or copper or copper alloys. The decomposition of the formamide is represented by the following equation: $HCO.NH_2=HCN+H_2O$.

According to the invention it was found that the best throughputs and yields could be obtained in such process when the formamide vapor is passed through a catalytic apparatus, the inner free cross-section of which increases from the inlet side to the outlet side. Such increase in inner free cross-section can either be continuous or stepwise. It was also found that a further increase in throughput could be obtained by simultaneously also increasing the surface area of the catalytic surface from the inlet to the outlet side of the apparatus. Preferably, the apparatus is so arranged that the rate of increase in catalytic surface area is greater than that of the inner free cross-section.

The desired increase in inner cross-section and increase in catalytic surface area in the apparatus according to the invention can be achieved in a number of ways. For example, the apparatus can be constructed of plain-parallel plates. However, it has been found expedient to employ a plurality of serially connected bundles of tubes, preferably two or three, which advantageously are of iron. The number of tubes in the bundles increases from the inlet end of the apparatus and, if desired, their length also increases and, on the other hand, the cross-section of the tubes decreases from bundle to bundle so that the increasing catalytic surface area is provided along with the increased inner free cross-section. For example, in a two step apparatus according to the invention, a bundle of 45 iron tubes 3 meters long, each tube having an inner diameter of 50 mm., can be provided for the first step and a bundle of 215 iron tubes 3 meters long having an inner diameter of 30 mm. can be provided for the second step. The inner surface areas of the first and second bundles are 21 $m.^2$ and 61 $m.^2$, respectively. In a three step apparatus according to the invention, the first tube bundle can consist of 20 iron tubes 1.5 meters long having an inner diameter of 50 mm., the second tube bundle can consist of 65 iron tubes 2 meters long having an inner diameter 38 mm. and the third bundle can consist of 240 iron tubes 3 meters long having an inner diameter of 20 mm. The inner catalytic surface areas provided by each of the bundles are 4.7 $m.^2$, 15.5 $m.^2$ and 45.2 $m.^2$.

It has been found desirable to provide baffles or guiding elements in each of the tubes in order to obtain a turbulent flow in such tubes. It has been been found desirable to employ spiralled sheet metal strips for this purpose as they only provide a relatively low resistance to the flow of the vapor.

Gas heating has proved very suitable for heating the catalytic chambers according to the invention. Preferably, recycled gas heating is employed in which the heating gases are passed parallelly along the catalyst element, advantageously, concurrent to the formamide vapors.

In many instances it was found desirable, when apparatus is employed which is subdivided into a number of sections, to heat the individual sections or tube bundles to different temperatures. The best yields are obtained when the heating temperatures at the outlet end are maintained higher than at the inlet end.

An apparatus according to the invention renders it possible to maintain the same average velocity of flow of the vapors and the active catalytic surface increases as the formamide decomposes so that the average decomposition of the formamide per liter unit of the apparatus remains about the same.

The accompanying drawing schematically shows an apparatus according to the invention.

In such drawing, the decomposition chamber is subdivided into three sections A, B and C. Section A contains a bundle of 20 iron tubes **2**, each of which is 1.5 meters long and has an inner diameter of 50 mm. Section B contains a bundle of 65 iron tubes **3**, 2 meters long and having an inner diameter of 38 mm. Section C contains a bundle of 240 iron tubes **4**, 3 meters long having an inner diameter of 20 mm. The tubes in sections A, B and C are respectively heated exteriorly with the aid of recycling gas heaters **5**, **6** and **7**.

The following example will serve to illustrate the manner in which the process according to the invention is carried out:

Example

431 kg. per hour of formamide vapor was supplied to the apparatus described with reference to the drawing while maintaining a temperature of 340–360° C. in section A, a temperature of 360–390° C. in section B and a temperature of 410° C. in section C. The vapors leaving section C contained 235 kg. of hydrocyanic acid per hour and 30 kg. per hour of undecomposed formamide. The vapors were then worked up in the customary manner for the recovery of pure hydrocyanic acid.

When the process was repeated, but with a lower quantity of formamide vapor, namely, a supply of 300 kg. per hour, about 98 to 99.1% of the formamide was decomposed in the desired manner, that is, to form $HCN+H_2O$.

We claim:

1. In a method for the continuous production of hydrocyanic acid by the decomposition of formamide on catalytically active surfaces at elevated temperatures between 340° C. and 410° C., the step which comprises passing formamide vapors through a catalytic decomposition chamber having catalytically active inner surfaces heated to temperatures between 340° C. and 410° C., the free inner cross-section of which increases from inlet end to outlet end and the area of the catalytically active inner surfaces of which also increases from inlet end to outlet end.

2. The process of claim 1 in which the rate of increase in area of the catalytic surfaces is greater than that of the inner free cross-section of the catalytic decomposition chamber.

3. The process of claim 1 in which the temperature within the catalytic chamber also increases from inlet to outlet end.

4. In a method for the continuous production of hydrocyanic acid by the decomposition of formamide on

catalytically active surfaces at elevated temperatures between 340° C. and 410° C., the step which comprises passing formamide vapors through a series of bundles of catalytic tubes heated to temperatures between 340° C. and 410° C., the free inner cross-section and the inner surface area in each succeeding bundle increasing.

5. The process of claim 4 in which said catalytic tubes

are iron and the temperature of each succeeding bundle of tubes is increased.

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