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(54) CATALYTIC GAS REACTION APPARATUS

(54) APPAREIL CATALYTIQUE A REACTIONS DE GAZ

(72)	(Country):	**OTTO ROELEN** (Not Available) **FRANZ FISCHER** (Not Available)
(73)	(Country):	**STUDIEN- UND VERWERTUNGSGESELLSCHAFT MIT BESCHRANKTER HAFTUNG**
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		Unknown

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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SPECIFICATION.

TO WHOM IT MAY CONCERN:

Be it known that we, Otto Roelen and Franz Fischer, both of 1, Kaiser Wilhelm Platz, Mülheim-Ruhr, Germany, Chemists, having invented certain new and useful "Improvements in apparatus for carrying out catalytic gas reactions" do hereby declare that the following is a full, clear and exact description of the same:-

Our invention relates to means for carrying out catalytic gas reactions and more especially to apparatus adapted to heat a gas or vapour or gas or vapour mixture travelling across a mass of catalytically active material in an absolutely uniform manner to the predetermined temperature at which the reaction, which the said gas or vapour shall undergo, proceeds in the best and most advantageous manner.

It is well known to those skilled in the art that certain reactions, in which gases or vapours are converted into products of a different chemical constitution and which are induced or furthered by bringing such gas or vapour in temporary contact with a catalytically active substance, the gas or vapour or the catalytic substance or both being heated to a predetermined temperature, are considerably affected by even minute changes of this temperature or which may be similarly affected by changes in the distribution or density or both of the catalytic substance. Certain reactions, which are particularly sensitive to the influence of temperature, such for example as the

conversion of carbon monoxide into certain hydrocarbons, can be carried out in a satisfactory manner and with the best possible yield only if the catalyst is arranged in such manner that all the particles of the catalytic substance in contact with the gas or vapour under treatment have assumed the same predetermined temperature within one or only a few grades Centigrade. This condition will be fulfilled only if the temperature is regulated and equalised in all parts of the catalytic mass traversed by the gas or vapour, the heat regulating medium being conducted through the catalytic mass by means of a great number of closely adjoining tubes extending through the mass and spaced for example 10 to 15 mms. In order to obtain the highest yield and the best results generally, the distance between two such tubes and in consequence thereof the width of the layers of catalyst enclosed between two such tubes must not differ more than a few millimetres.

In a known form of apparatus for the carrying out of changes of the chemical constitution of gases or vapours passing across a catalytically active mass cylindrical tubes have been arranged in parallel to each other in a chamber filled with the catalyst and traversed by the gases or vapours under treatment, but it has been found that in view of the irregular cross section of the space enclosed between four such cylindrical tubes it is impossible to heat the mass so enclosed in a sufficiently uniform manner by the heat of a heating medium passing through these tubes.

Our invention is based on the conception that a substantially perfect uniformity of heat regulation within a mass traversed by tubes serving for temperature regulation can be obtained only, if tubes are provided the cross sections of which are so chosen that substantially all particles of the section of the catalytically active mass, which are enclosed between these tubes, are so disposed relatively to these tubes that they are all of them brought to the exact temperature of reaction.

We have found that this can be obtained only with the aid of tubes, the cross sections of which are so chosen that adjoining tubes enclose between them layers of catalytically active material, which offer to the gas under treatment substantially uniform cross-sectional areas of passage and are imparted by the heat regulating medium flowing in the tubes an almost perfectly uniform temperature throughout.

We have found tubes having elliptical, rectangular, diamond-shaped or similar oblong cross sections, such as have for instance been suggested for use in heat exchangers, to be particularly suitable for the purpose in view.

An apparatus embodying our invention therefore comprises the combination of a chamber having a body of catalytically active material pervious to gases enclosed therein with a plurality of tubes of oblong cross section extending in parallel across the said chamber and through the said body of active material, the tubes being arranged in spaced staggered relation in such manner as to form between them layers of catalytically active

material offering to the gas under treatment at substantially all points layers of substantially uniform cross-sectional areas.

Means are further provided for fixing the tubes in their relative position, together with means for supplying the tubes with the temperature regulating medium such as an oil and for passing the gas or vapour under treatment across the body of catalytically active material, preferably at right angles to the tubes.

The means for holding the tubes in position are preferably formed by opposite walls of the chamber, in the perforations of which the tubes are fixed by forging, rolling or in some other suitable manner so as to form oil-tight joints. Preferably the ends of the tubes of oblong section are deformed into cylindrical cross section and fixed in cylindrical perforations of the walls. Intermediate walls may be provided for supporting the tubes intermediate between the end walls.

In the drawings affixed to this specification and forming part thereof several forms of apparatus embodying our invention are illustrated diagrammatically by way of example. In the drawings

Figure 1 is a vertical cross section and

Figure 2 is a perspective longitudinal section of one form.

Figures 3 and 4 are a vertical longitudinal section and a vertical cross section, respectively, of another form of apparatus.

Figures 5, 6 and 7 are cross-sectional showings, drawn to a larger scale, of tube arrangements of different sections.

Referring to the drawings and first to Figs. 1 and 2, 1 and 2 are the side walls of a contact chamber, 3 is the bottom and 4 the top of the chamber; 5 is a perforated intermediate bottom defining a collecting space 6; 7 is a pipe for supplying gas to be treated through the side wall 2 into the top part of the chamber and 8 is an exhaust pipe for the treated gas leaving the collecting chamber 6, 9 is a body of comminuted catalytically active material resting on the perforated bottom 5 and extending to a point below the top 4 and inlet pipe 7. 10 are a number of tubes extending lengthwise across the chamber in parallel to its side walls 1, 2 and surrounded by the catalytically active material. 11 and 12 are supply and exhaust chambers for heat regulating medium passed through the apparatus and 13 are the reduced cylindrical ends of the tubes, which are fixed in the inner walls of the collecting chambers 11 and 12, which may also form the end walls of the apparatus. 14 is a main and 15 are branch pipes supplying the heat regulating medium to the collectors 11 and tubes 10. In the operation of this device the heat regulating medium is supplied through the system of pipes 14, 15 to the collectors 11 and through the tubes 10, and the heat energy passing across the metal walls of the steel tubes is relied upon to bring this material to the correct temperature of reaction, the cross section, spacing and arrangement of the tubes within the body of active material being such as to cause substantially all the particles of the material to be brought to the same uniform temperature, so that the gas admitted at 7 and exhausted at 8 in passing across the body of active material is held also to this very temperature.

In the apparatus illustrated in Figs. 3 and 4, 16 is the conical bottom and 17 the conical cover, while 18 are the perforated end walls of the chamber in which the cylindrical ends 19 of the tubes 20 of substantially elliptical cross section are fixed in an oil-tight manner, 21 being a perforated plate uniting the middle portions of the tubes and providing a further support and means of fixation for them. 22 is the body of catalytically active mass and 23,24 are the collecting chambers for the oil, to which the tubes 20 are connected.

Fig. 5 illustrates tubes 25 of elliptical cross section, the ends 26 of which are widened into cylindrical shape. Fig. 6 illustrates tubes 27 of diamond section, Fig. 7 flattened tubes 28 of oblong section, one diameter of which is considerably larger than the other.

All kinds of oils either natural or artificially produced or other organic liquids and mixtures of such having a high boiling point may advantageously be used as heat regulating media, but superheated water or superheated aqueous solutions may be employed as well. We may also employ organic liquids under high pressure which may be produced either by the vapour pressure of the heated liquid or by compressed gases such as nitrogen acting on the liquid. In every case the boiling point of the circulating liquids is raised by such pressure. We may further use molten salts or molten metals of low melting point including mercury.

The ribs or lamellae 29 shown in Fig. 8 will act toward distributing heat from the tubes into the spaces intermediate the tubes. This figure illustrates with particular clearness the favourable effect obtained by

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employing tubes of oblong cross section arranged in staggered relation, whereby substantially uniform cross-sectional areas of passage for the gas are formed in the body of catalytically active substance.

We have found that in apparatus of the kind here described the varying conditions to be observed in the reacting of different gases and vapours can be obtained in a particularly satisfactory manner. Our apparatus has been found to be particularly suitable for the reaction between carbon monoxide and hydrogen to form benzine and other low boiling hydrocarbons.

We wish it to be understood that we do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

In the claims affixed to this specification no selection of any particular modification of the invention is intended to the exclusion of other modifications thereof and the right to subsequently make claim in the present application to any modification not covered by these claims is expressly reserved.

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We claim:-

1. In apparatus for the catalytic heat treatment of gases and vapours in combination, a chamber, a body of solid catalytically active material in said chamber, a plurality of tubes extending across said chamber and said body of material and into opposite walls of said chamber, means for passing a temperature regulating medium through said tubes and means for passing a gas or vapour across said body of catalyst and in a direction transverse to the said tubes, said tubes being formed with oblong cross sections and so spaced in parallel staggered relation that all layers of the catalytic material enclosed between two such tubes offer to the gas or vapour substantially equal and uniform cross-sectional areas of passage.

2. The apparatus of claim 1 in which the variation of the distance between any two adjoining tubes does not exceed a few millimetres.

3. The apparatus of claim 1 in which any two adjoining tubes are spaced from 10 to 15 millimetres.

4. The apparatus of claim 1 in which the longer axes of the cross sections of said tubes extend in the direction in which the gas or vapour passes across the body of catalyst.

~~(Signed) Dr. Otto Roelen.~~

~~(Signed) Professor Dr. Franz Fischer.~~

~~Oberhausen - Rhld. Germany.~~
~~2nd January 1935.~~

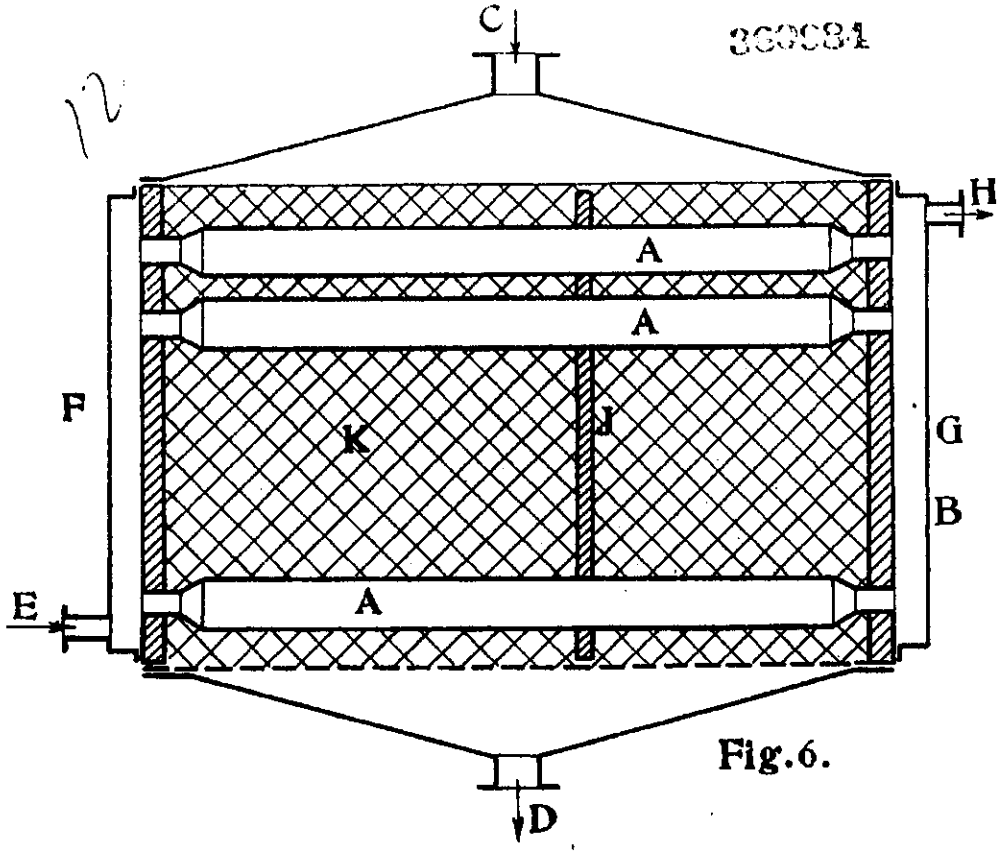

Fig.6.

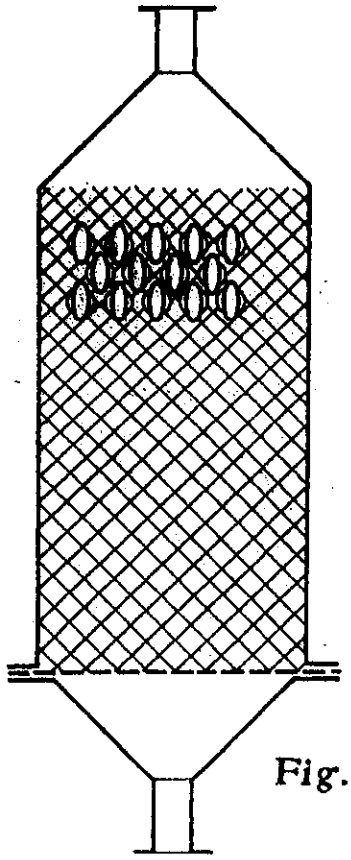

Fig.7.

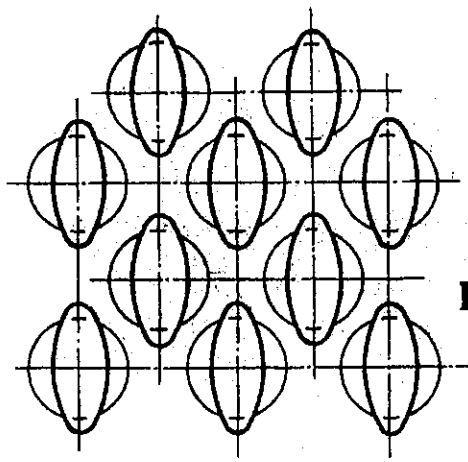

Fig.1.

Certified to be the drawings referred to in the specification hereunto annexed.

London, England, this 16th day of January, 1935.

Otto Roelen and Franz Fischer

By W. L. Emmet

Attorney

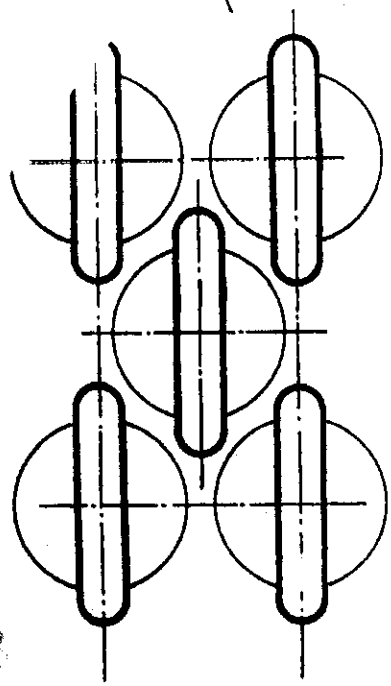

Fig.3.

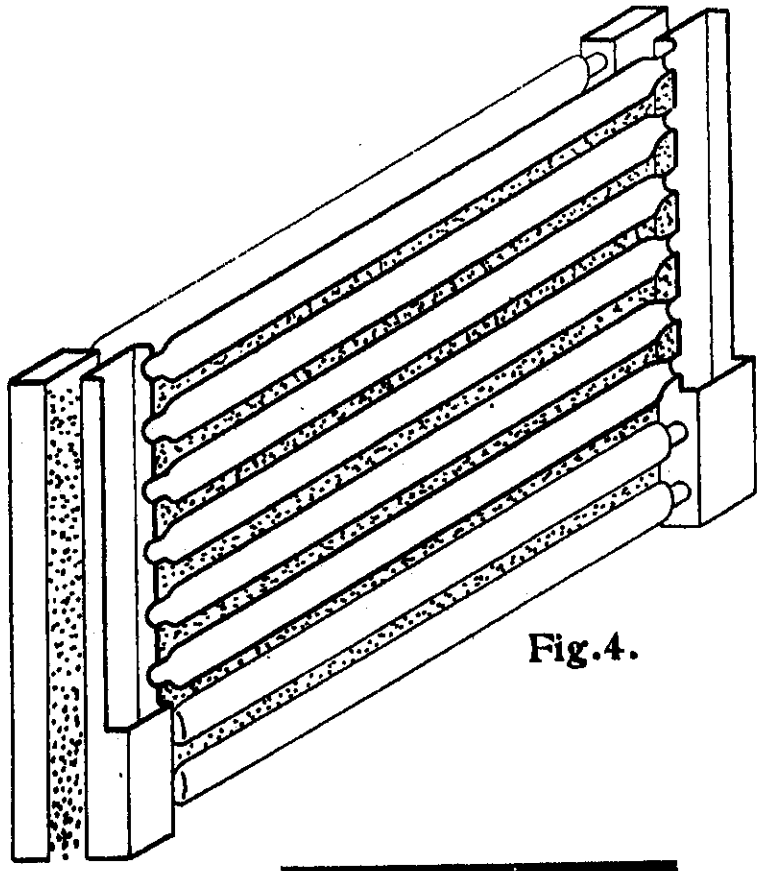

Fig.4.

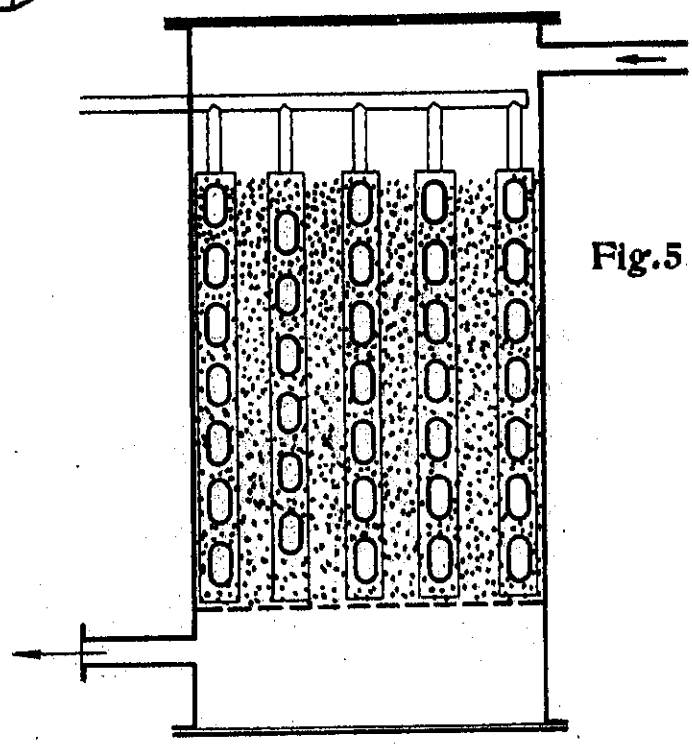

Fig.5

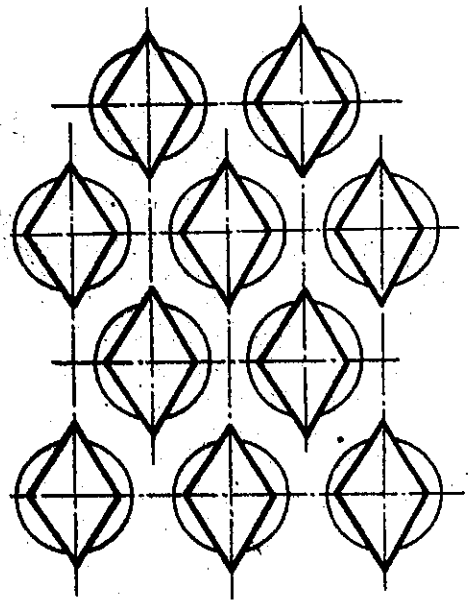

Fig.2.

Certified to be the drawings referred to in the specification hereunto annexed.

London, England, this 16th day of January, 1935.

Otto Roelen and Franz Fischer

By C. S. [illegible]

Attorney