

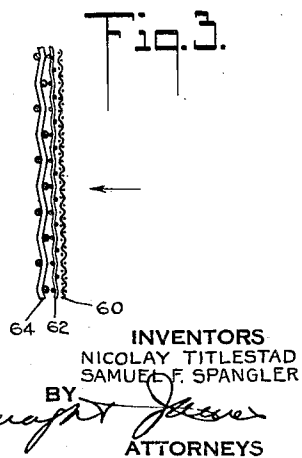
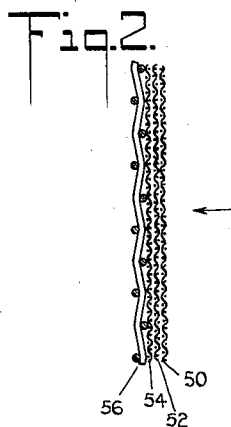
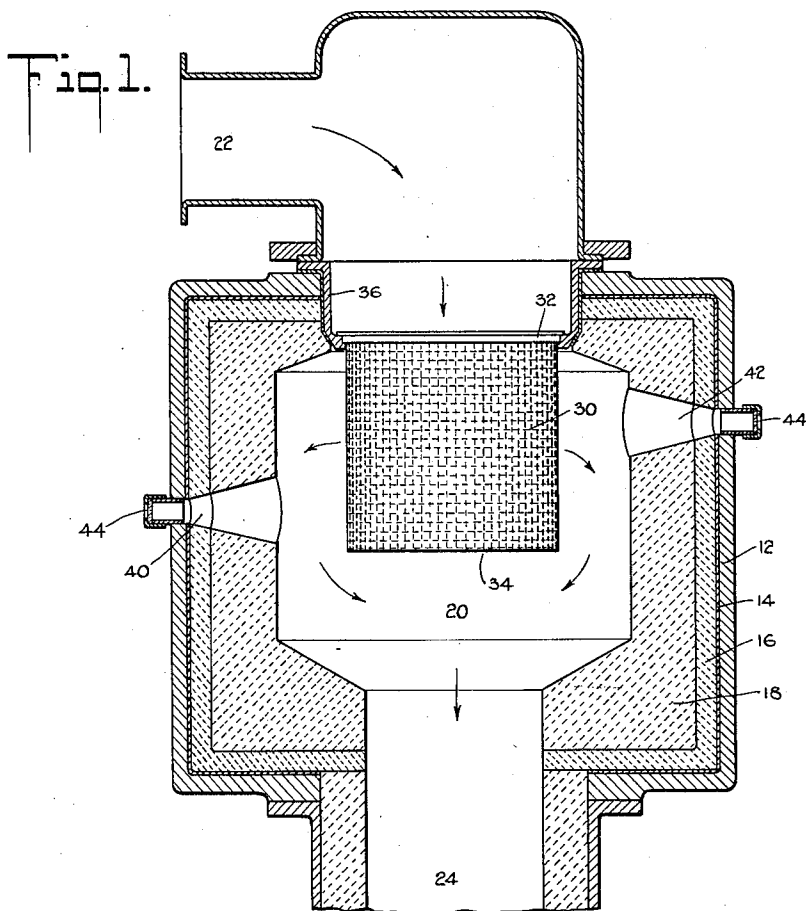
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N. TITLESTAD ET AL

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CATALYST

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UNITED STATES PATENT OFFICE

1,927,508

CATALYST

Nicolay Titlestad, Charlotte, N. C., and Samuel F. Spangler, Philadelphia, Pa., assignors, by mesne assignments, to Chemical Construction Corporation, Charlotte, N. C., a corporation of Delaware

Application January 13, 1930. Serial No. 420,409

9 Claims. (Cl. 23—234)

This invention relates to the catalyst used for catalytic conversion, and more particularly to the multi-layer platinum gauze employed in the catalytic oxidation of ammonia.

5 In the oxidation of ammonia and other chemical reactions which are aided by the presence of a metallic catalyst, such as platinum or various alloys thereof, it is customary to utilize the catalyst in the form of a wire gauze of fine
10 mesh. It has been the practice to use a gauze made of fine mesh and light wire in order to obtain as large a surface as possible with a minimum total weight and cost of material. In order to insure a maximum conversion of the reacting
15 gases caused to flow through the gauze it has been found of advantage to employ a plurality of layers of gauze. Four such layers are frequently employed on the basis that three are needed for maximum conversion, while the
20 fourth is added in order to obtain a margin of safety.

It is found that the useful life of such a catalyst is unnecessarily limited by the fact that the platinum wire becomes porous and brittle
25 and loses its mechanical strength, so that the pressure of the reacting gases causes the gauze to break before the catalytic life of the gauze has been used up, considering the problem strictly from a chemical standpoint.

30 The primary object of the present invention is to overcome the foregoing difficulty and to lengthen the useful life of such catalysts. This is accomplished generally by making the inner and outer layers of gauze different from one another, the inner layers of gauze being selected with a view to maximum conversion efficiency,
35 and at least the outermost layer of gauze being selected for mechanical strength. The flow of reacting gases being from the inner toward the
40 outer layer, the latter strengthens and supports the inner layers against breakage.

One manner in which the outer layer may be strengthened is by the use of a heavier or thicker wire in its construction. However, this greatly
45 increases the cost of such a layer of gauze. Accordingly, another object of the present invention is to obtain the desired increase in strength without an accompanying increase in cost. We have found that an outer layer of relatively
50 coarse mesh may be employed without appreciable reduction in the total conversion efficiency of the catalyst. In other words, the outer layer may consist of a coarse mesh heavy wire gauze in which the relation between the mesh and
55 weight of wire is such that the total weight of

the layer of gauze is approximately equal to the weight of the layers of fine mesh light wire gauze.

The desired selection of outer and inner layers of gauze may be made by a consideration of material as well as of mechanical construction. For example, in the case of platinum catalyst for ammonia oxidation, it has been found that an alloy consisting of 90% platinum and 10% rhodium is especially efficient. However, this alloy is particularly liable to lose its mechanical strength and to break before the catalytic life thereof has been exhausted. On the other hand, commercially pure platinum or an alloy of platinum containing from 0.1% to 0.8% of iridium, while slightly less efficient than the platinum rhodium alloy, is far greater in mechanical strength. By utilizing a multi-layer gauze catalyst consisting of platinum rhodium alloy for the inner layers and platinum iridium alloy for the outer layers the over-all conversion cost, by which we mean the cost of catalyst per ton of acid manufactured thereby, may be reduced.

To the accomplishment of the foregoing and such other objects as will hereinafter appear, our invention consists in the elements and their relation one to the other, as hereinafter more particularly described and sought to be defined in the claims; reference being had to the accompanying drawing which shows the preferred embodiments of our invention, and in which:

Fig. 1 is a section taken in elevation through a converter;

Fig. 2 is a detail section through one type of multi-layer catalyst; and

Fig. 3 is a detail section through a modified catalyst.

Referring to Fig. 1 of the drawing, the converter consists generally of a cast iron converter shell 12 lined with a layer of sheet asbestos 14, a refractory lining 16, such as Sil-O-Cel brick, and finally a jointless refractory lining 18 made of fire clay. The resulting converter chamber 20 is fed with reaction gases through an inlet 22, and the converted gases are discharged from the converter chamber 20 through an outlet 24.

The catalyst is preferably, though not necessarily, of the basket type consisting of cylindrical layers of wire gauze 30 held in shape by a ring 32 at the top thereof, and a silica disk 34 at the bottom thereof.

The converter is preferably provided with a plurality of sight holes 40 and 42, each having a sight glass 44 made of a heat resistant glass material such as pyrex. A number of these sight

windows may be provided around the periphery of the converter, and they are preferably located at different levels, as shown, in order to expose various portions of the gauze basket 30 to view.

As is obvious from the drawing, the gases preferably flow into the gauze basket 30, then through the mesh thereof, and finally out of the discharge opening 24. The pressure of the gases is therefore from the inside toward the outside of the basket. In practice it is found that the fine mesh light wire gauze which is employed for the basket frequently becomes porous and brittle and loses mechanical strength, so that it gives way under the gas pressure before the catalytic life of the material of the catalyst has been exhausted. In accordance with the present invention, the multi-layer catalyst is arranged somewhat as is illustrated in Fig. 2. The multi-layer catalyst consists of three layers of fine mesh light wire gauze numbered 50, 52 and 54, respectively, and a final or outside layer of gauze 56 consisting of coarse mesh heavy wire gauze. In order to avoid increased cost of the catalyst the relation of the mesh and weight of wire in the gauze layer 56 is preferably so selected that the total weight of material in the outside layer 56 is approximately equal to that in any of the fine mesh light wire layers of gauze 50, 52 or 54.

More specifically, the gauze layers 50, 52 and 54 may be 80 mesh using 0.003 inch wire, while the gauze layer 56 may be 20 mesh utilizing 0.008 inch wire. However, these figures are given solely by way of illustration and not limitation. For example, the wire used in the outer layer may range from 0.005 to 0.015 inches, and the mesh may be selected for the desired total weight of wire. The mesh of the inner layers is preferably 60 or greater, while that of the outer layer should be less than 60, say from 15 to 50.

The inner layers 50, 52 and 54 may be commercially pure platinum or may be a platinum iridium alloy having 0.1% iridium, but is most preferably a platinum rhodium alloy consisting of 90% platinum and 10% rhodium. The latter alloy is found to have a slightly better conversion efficiency than the former but is mechanically weak. The outer gauze layer 56 may be made of commercially pure platinum or a platinum iridium alloy containing from 0.1 to 0.8% iridium. The iridium content seems to increase the mechanical strength but it is not desirable to further increase the iridium content because the iridium then tends to volatilize.

In Fig. 3 there is illustrated an alternative form of multi-layer gauze consisting of three layers 60, 62 and 64 of progressively increasing coarseness of mesh and progressively increasing weight of wire. With this construction also the mesh and weight of wire in each layer of gauze may be selected with the object of avoiding an increase in weight and cost of catalyst. In this case also the catalyst material should be selected having in mind the function thereof.

It will be understood that our invention is applicable to multi-layer gauze catalysts used in a flat state as well as in a cylindrical or basket type of catalyzer. It will further be understood that metals other than platinum and the platinum alloys heretofore mentioned may be employed, it being understood that in accordance with our invention the multi-layer catalyst is designed with distinct consideration of the direction of flow of the reaction gas therethrough, and the inner catalyst layers are especially selected and designed with a view to obtaining a maximum

conversion efficiency, while the outer catalyst layers are designed and selected with a view to mechanical strength, but the complete combination is designed for greatest conversion efficiency at minimum cost. By the use of our invention the effective or useful life of the gauze may be prolonged considerably with no or only a negligible decrease in efficiency, and with a final overall reduction in catalyst cost per unit of material converted.

We shall use the term "platinum gauze" in the claims appended hereto in a general sense, intending it to include commercial platinum and also platinum alloys such as platinum iridium and platinum rhodium and the like. The expression is not to be restricted to mean chemically pure platinum.

It will be apparent that while we have shown and described our invention in the preferred forms, many changes and modifications may be made in the structures disclosed without departing from the spirit of the invention, defined in the following claims.

We claim:

1. A multi-layer platinum gauze for use in catalytic converters comprising a plurality of layers of mesh gauze catalyst which increase in thickness of wire from the inner to the outer layers of gauze, the gauze of thickest wire constituting the outermost layer of the multi-layer gauze, and acting to support the inner layer against the pressure of gas flowing from the inner toward the outer layer.

2. A multi-layer platinum gauze for use in catalytic converters comprising a plurality of layers of mesh gauze catalyst which increase in coarseness of mesh and thickness of wire from the inner to the outer layers of gauze, the gauze of coarsest mesh and thickest wire constituting the outermost layer of the multi-layer gauze, and acting to support the inner layer against the pressure of gas flowing from the inner toward the outer layer.

3. A multi-layer platinum gauze for use in catalytic converters comprising a plurality of layers of mesh gauze catalyst which increase in coarseness of mesh and thickness of wire from the inner to the outer layers of gauze, the total weights of the layers of gauze remaining substantially constant, the gauze of coarsest mesh and thickest wire constituting the outermost layer of the multi-layer gauze, and acting to support the inner layer against the pressure of gas flowing from the inner toward the outer layer.

4. A multi-layer gauze for use in catalytic converters comprising an inner layer of wire mesh gauze made of a catalyst material characterized by maximum conversion efficiency, and an outer layer of wire mesh gauze made of a catalyst material characterized by strength, the outer layer being made with a coarser mesh and of thicker wire than the inner layer, and constituting the outermost layer of the multi-layer gauze, and acting to support the inner layer against the pressure of gas flowing from the inner toward the outer layer.

5. A multi-layer platinum gauze for use in catalytic converters comprising an inner layer of wire mesh gauze made of a platinum rhodium alloy selected for maximum conversion efficiency, and an outer layer of wire mesh gauze made of a platinum iridium alloy selected for strength.

6. A multi-layer platinum gauze for use in catalytic converters comprising an inner layer of wire mesh gauze made of a platinum rhodium alloy

selected for maximum conversion efficiency, and an outer layer of wire mesh gauze made of a platinum iridium alloy selected for strength, the outer layer being made with a coarser mesh and of thicker wire than the inner layer.

7. A multi-layer platinum gauze for use in catalytic converters comprising a plurality of inner layers of wire mesh gauze made of a platinum rhodium alloy selected for maximum conversion efficiency, and an outer layer of wire mesh gauze made of a platinum iridium alloy selected for strength, the outer layer being made with a coarser mesh and of heavier wire strands than the inner layers, and the ratio of mesh and weight of wire strands being so selected that the total weight of the layers of gauze is substantially constant.

8. A multi-layer platinum gauze for use in catalytic converters comprising one or more inner catalyst gauze layers having a mesh finer than 60, and an outer catalyst gauze layer having a mesh coarser than 60, the coarser mesh being made of thicker wire.

9. A multi-layer platinum gauze for use in catalytic converters comprising one or more inner catalyst gauze layers having a mesh of 60 or finer, and an outer catalyst gauze layer having a mesh between 15 and 50, the coarser mesh gauze being made of heavier wire strands so related to the mesh that the weight of the layers are substantially equal.

NICOLAY TITLESTAD. 90
SAMUEL F. SPANGLER.

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