Nov. 29, 1932. I. HECHENBLEIKNER ET AL 1,889,549

CONVERTER

Filed Feb. 25, 1930

Fig. 1.

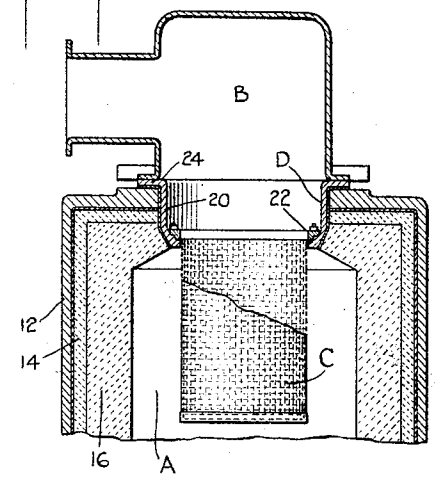


Fig. 2.

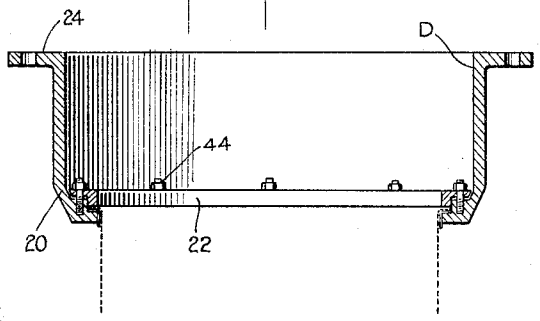


Fig. 4.

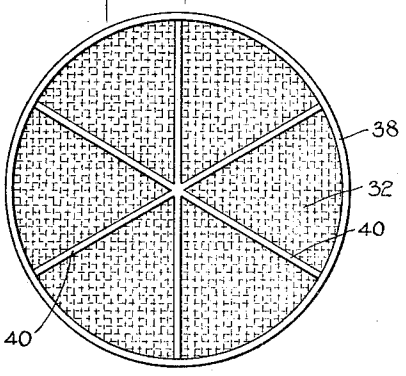


Fig. 3.

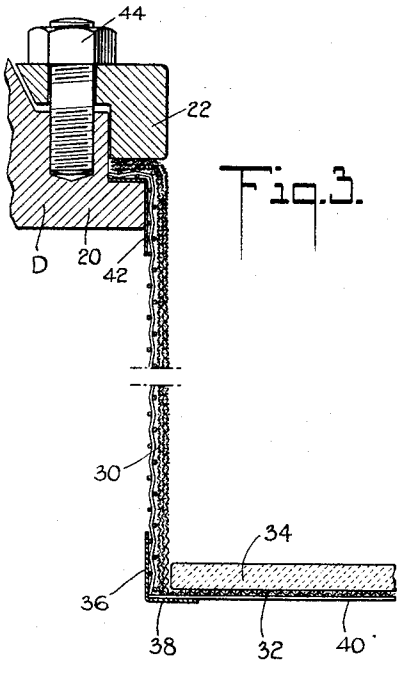
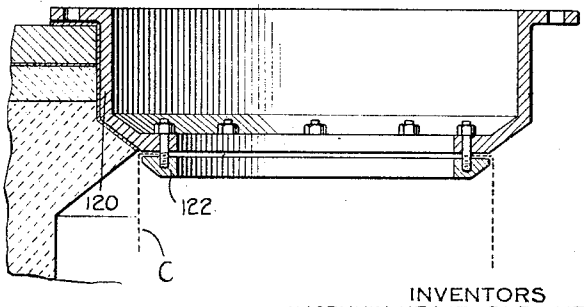


Fig. 5.



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UNITED STATES PATENT OFFICE

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CONVERTER

Application filed February 25, 1930. Serial No. 431,176.

This invention relates to converters, and more particularly to catalytic converters of the platinum gauze type.

Catalytic converters of the platinum gauze type are extensively used in chemical processes, particularly for the catalytic oxidation of ammonia in the manufacture of nitric acid. In such converters difficulty is experienced because of the tendency of leaks or holes to develop in the gauze, thereby permitting reaction gas to flow therethrough with consequent diminished conversion efficiency. Oftimes gas breaks through at important places, such as the point of anchorage or attachment of the gauze to its holder, or, in the case of gauzes of basket form, at the lower peripheral corner of the basket, resulting respectively in losing the entire gauze or the bottom of the gauze basket in the converter chamber. This breakage or blowing through of the platinum gauze ordinarily takes place before the chemical or catalytic life of the platinum is exhausted, and therefore greatly increases the catalyst cost for a given quantity of manufactured product obtained from the process. The object of the present invention, generally, is to improve the construction of platinum gauze catalysts and the mode of attachment and support thereof within the converter, with a view to preventing such leakage and breakage in order to keep up the conversion efficiency of the converter and in order to make the useful operating life of the platinum gauze approach the catalytic life thereof.

When using a gauze having a horizontal portion as, for example, the bottom of a gauze basket, it is found that the bottom of the basket blows through while the side wall thereof is still in good condition. We have found that this is caused by the accumulation at the bottom gauze of dust carried in the reaction gas flowing through the basket. This dust contains chemical impurities which deleteriously affect the platinum gauze, particularly metallic particles which alloy with the platinum and weaken it so that holes quickly develop. One object of our invention is to prevent this, which we do, generally speaking, by using only the side wall of the basket for conversion, the bottom wall being formed by an imperforate disc preferably of refractory material, such as silica.

If it is attempted to use such a disc as the sole bottom of the basket difficulty is experienced with gas leakage through the corner of the basket, it being difficult to obtain a permanent leakproof joint between the platinum gauze and the silica disc. Such leakage causes the conversion efficiency to fall and accordingly it is a further object of our invention to prevent this type of leakage. To this end we retain a gauze bottom on the basket, and place the silica disc over the gauze bottom. In this manner the gauze bottom is protected by the disc against accumulation of impurity containing dust, and meanwhile leakage is prevented. As a matter of economy we find it sufficient to use only a single layer gauze bottom even though a multi-layer gauze side wall is employed.

With the arrangement so far described the conversion efficiency is maintained and the formation of holes in the bottom of the basket is prevented, but we have found that there is a tendency for the gauze basket to weaken around the lower peripheral edge thereof permitting leakage and eventually letting the bottom of the basket fall into the conversion chamber. Another object of the present invention therefore is to overcome this difficulty and to minimize the likelihood of this attack on the corner of the basket. We first strengthen the structure of the basket at its lower peripheral edge, preferably by using a strip of platinum foil extending around, and preferably welded to, the lower peripheral edge of the basket and the lower peripheral edge of the gauze bottom thereof. In the case of baskets which are relatively large in diameter, we may additionally provide strips of platinum foil extending across the bottom and welded thereto, these strips preferably running in radial directions across the bottom of the basket. In addition to these precautions we reduce the tendency or likelihood of this corner breakage by designing the basket with a view to discouraging the accumulation of dust in the corner thereof. This may most simply

be accomplished by making the cylindrical portion of the platinum foil strip already mentioned greater in width than the thickness of the refractory disc so that the gas stream is guided upward rather than into the corner of the basket.

We further find that the platinum gauze is sensitive to breakage at its point of attachment to the holder which supports it in place in the converter. We therefore also strengthen the gauze against breakage at this point preferably by welding to the edge of the gauze a strip of platinum foil.

The design of the holder for the gauze and its relation to the gauze and the converter we have also found is important if best results are to be obtained. It is customary to make the holders of nickel and various schemes for attaching the platinum gauze thereto have been tried, such as making a groove in the nickel holder and fastening the platinum gauze thereto by means of a platinum wire or nickel rod tightened over the groove, or the use of nickel rings clamping the gauze outside of a nickel supporting member, but all of these schemes are of disadvantage because the point of attachment is exposed to the gases in the conversion chamber after they have passed through the platinum gauze. The temperature of this gas after oxidation runs about 1600 to 1700, and sometimes as high as 2000 degrees F., and this results in oxidation and destruction of the nickel parts of the holder and makes them brittle, as well as causes expansion of the fastening wires or rings, so that the entire gauze may be blown free of the holder by the gas pressure. Furthermore, the point of attachment of the platinum gauze to the holder, which is a sensitive point because of the clamping pressure needed, is directly exposed to the high temperature in the conversion chamber, which increases the possibility of breakage at this point. A further object of our invention resides in the provision of an improved holder and mode of attachment of the platinum gauze thereto with a view to exposing only the useful portion of the gauze to the high temperature in the conversion chamber. The clamping means, such as a clamping ring and bolts and, in fact, the entire nickel holder is exposed only to the reaction gas entering the converter, and this gas being relatively cool, say 300 to 400 degrees F., the life of the parts of the holder and of the platinum gauze at the point of attachment thereto is very greatly increased.

In the design of platinum gauzes of the basket type it has been found that the proportioning of the basket, particularly the ratio of the diameter to the height thereof, affects the efficiency of the converter. One of the objects of the present invention is to minimize the effect of this ratio on conversion efficiency and, generally, to increase conversion efficiency. We have found that the formation of false or eddy current flow of the gas in the converter basket is one of the factors involved in the effect of proportion on efficiency, and this effect may be reduced by reducing the likelihood of such false or eddy current gas flow. Accordingly, we so design the holder and the mode of attachment of the gauze basket thereto that the parts of the holder are located outside of the path of free flow of reaction gas into the gauze basket.

To the accomplishment of the foregoing and such other objects as will hereinafter appear, our invention consists in the converter elements and their relation one to the other as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by the drawing in which:

Fig. 1 is a sectional elevation of a converter embodying our invention;

Fig. 2 is an enlarged section through the holder used in Fig. 1;

Fig. 3 is a detail of the reinforcement employed;

Fig. 4 shows the reinforced bottom of the basket; and

Fig. 5 is a modified holder.

Referring to the drawing, and particularly to Figs. 1 through 4 thereof, the converter comprises generally a conversion chamber A, a gas inlet B therefor, and a platinum gauze catalyst C supported in the chamber A by a holder D. The converter chamber A may be of conventional construction, including an outer wall 12 lined with refractory brick 14, and an additional refractory lining 16. The reaction gas inlet B may be of metal and need not be lined, inasmuch as the incoming reaction gas is relatively cool. The platinum gauze basket C is clamped to the supporting ring 20 of the holder D by means of a clamping ring 22, and the supporting ring 20 is held in place by its flange 24, the latter being bolted between the flange of the inlet B and the casing of the converter.

Considering the platinum gauze basket C in greater detail and referring particularly to Fig. 3, the gauze is shown in basket form and comprises a cylindrical side wall 30 and a bottom gauze 32. A silica disc 34 is placed over the bottom gauze 32 and protects the latter from impurity containing dust which tends to collect on the bottom of the basket. To use the silica disc 34 alone as the bottom of the basket makes it difficult to prevent gas leakage, and consequently the gauze bottom 32 is used even though it is not operated as a useful catalytic area. Inasmuch as the bottom 32 is intended primarily to prevent leakage and is not subject to direct gas pressure, a single layer of gauze is sufficient, although more may, of course, be used.

The side wall 30 is preferably a multi-layer gauze, the particular wall here illustrated consisting of three inner layers of fine mesh gauze made of light wire, and an outer layer of coarse mesh gauze made of heavier wire, this combination being designed to obtain high conversion efficiency and maximum strength, in accordance with the teachings in the copending application of Nicolay Titlestad and Samuel F. Spangler, Ser. No. 420,409, filed January 13, 1930.

In order to strengthen the basket against breakage around the lower peripheral edge or corner thereof, permitting the bottom to fall out, we reinforce the basket at this point with a strip of platinum foil 36. This platinum foil may be welded to the platinum gauze by a slight hammering pressure at red heat. The strip of foil consists of a vertical or cylindrical portion extending around the lower edge of the wall 30, and a horizontal portion 38 extending around the lower peripheral edge of the gauze bottom 32. The portion 38 extends under the silica disc 34 and helps support the latter against its weight and the gas pressure exerted thereon. In the case of baskets which are relatively large in diameter, we additionally provide platinum foil strips 40 extending across the bottom of the basket. These are preferably made radial or diametrical, as is best shown in Fig. 4, and they extend from the marginal reinforcement across the bottom gauze 32 of the basket. Like the strip 36, these strips 40 may be fastened to the gauze by a slight welding process.

The cylindrical portion of the platinum foil strip 36 is preferably made greater in width or height than the thickness of the silica disc 34, as is clearly shown in Fig. 3 of the drawing. This construction is a simple expedient intended to fulfill another general requirement which we have found desirable, namely, that dust be discouraged from accumulating in the corner of the basket where it may weaken the same in spite of the platinum foil reinforcement used. While we are not at all certain of the theory involved, we believe that the increased length of life, which we find may be obtained in this manner, results from the fact that the wall or baffle formed by the foil strip 36 causes the reaction gas to flow upward rather than into the corner of the basket, and so lessens the tendency to supply impurities to this point.

By the various precautions and expedients so far described we strengthen the basket against loss of the bottom thereof into the conversion chamber. It is next necessary to guard against breakage and loss of the entire basket into the converter. This is accomplished by improving the holder for the basket; by exposing the basket at its point of attachment to cool rather than hot gas; and by reinforcing the gauze at the point of attachment. The reinforcement consists simply of a platinum foil strip 42 extending around and welded to the upper peripheral edge of the basket.

The reinforced upper edge is bent outwardly and clamped between the supporting ring 20 and the clamping ring 22 of the holder D by means of clamping bolts 44. It is important to notice that contrary to the usual practice, the entire clamping means is located inside of the supporting ring of the holder, and is exposed to only the relatively cool reaction gas entering the converter. Similarly, the portion of the platinum gauze which is bent and clamped within the holder is exposed to incoming rather than already converted reaction gas. It should further be noted that the smallest diameter of the clamping ring 22 is at least equal to the diameter of the basket, and that the clamping ring and bolts, as well as the entire holder as a unit, are located outside of the path of free flow of reaction gas into the platinum gauze basket. This reduces false flow or eddy currents within the basket, which increases the conversion efficiency and makes the relation between the diameter and height of the basket less critical, if not entirely inconsequent.

The relation of the holder D to the converter chamber is also important. As is obvious from the drawing, the entire outer surface of the holder, particularly the outer surface of the supporting ring 20, is surrounded by the walls and linings 12, 14, and 16 of the converter chamber A, and therefore is not exposed to the high temperature in the conversion chamber. By protecting the holder from the high temperature inside the chamber the nickle parts thereof are protected against oxidation, and are very greatly lengthened in life. In fact, we find that our type of holder may be used over and over again with successive gauze gaskets without any repair, and even in cases of misuse of the converter and consequent extreme overheating, the only repair needed, if any, is replacement of the nickel bolts.

The holder as here designed is simple and convenient to assemble, it being merely necessary to drop the gauze basket into the holder from above and to drop the holder into the converter from above in any desired order.

A modified form of holder is illustrated in Fig. 5. This holder comprises a supporting ring 120, generally similar to the supporting ring 20, already described, but differing in the arrangement of the clamping ring 122. This holder, like the preferred form of holder previously described, is protected from the high temperature of the reaction chamber, and the clamping means thereof is exposed to the flow of cool reaction gas. Unlike the preferred form of holder, the present holder exposes the point of attachment of the platinum gauze to a high tem-

perature, and interferes somewhat with the free flow of reaction gas into the gauze basket C.

The manner of constructing catalytic converters in accordance with our invention, and the many advantages thereof, should be apparent from the foregoing description. The formation of holes in the bottom of the gauze basket by the accumulation of chemical dust is prevented by the use of a silica disc, and leakage past the edges of the refractory disc is prevented by the use of a gauze bottom. Difficulty with the bottom of the basket dropping out is overcome by suitable peripheral reinforcement and, if necessary, additional reinforcement running across the bottom of the basket, this reinforcement in each case being in the form of platinum foil welded to the platinum gauze. The reinforcement at the lower peripheral edge is designed to prevent the accumulation of dust in the corner of the basket, thereby additionally guarding against weakening and breakage at this point. The loss of the entire basket in the converter is prevented by reinforcing the gauze at its upper edge where it is clamped in the holder and by exposing this portion thereof only to the relatively cool reaction gas entering the converter. The entire nickel holder is protected from exposure to high temperature, and the clamping means thereof in particular are exposed only to the entering gas. This feature not only greatly lengthens the life of the holder, but prevents release of the gauze basket by heating and expansion of the parts of the holder. In the preferred form of holder the clamping means and holder are located entirely outside of the path of free flow of reaction gas into the basket, thereby minimizing false flow and eddy currents therein, and reducing the importance of the proportioning of the gauze basket.

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 catalytic converter comprising a cylindrical platinum gauze the upper end of which is open for receiving reaction gas and the lower end of which is closed with an imperforate disc, said gauze being reinforced with a marginal band of platinum foil welded around the lower peripheral edge thereof, said band being greater in width than the thickness of the disc, in order to minimize the accumulation of solids in the corner of the basket.

2. A catalytic converter comprising a cylindrical platinum gauze the upper end of which is open for receiving reaction gas and the lower end of which is closed with an imperforate disc of refractory material, said gauze being reinforced with a marginal strip of platinum foil welded around the lower peripheral edge thereof and extending under the lower peripheral edge of the disc, the cylindrical portion of the platinum foil being greater in width than the thickness of the refractory disc.

3. A catalytic converter including a platinum gauze basket comprising a multi-layer cylindrical gauze, a single layer gauze bottom, and an imperforate disc of refractory material placed on the bottom of the basket.

4. A catalytic converter including a platinum gauze basket comprising a multi-layer cylindrical gauze, a single layer gauze bottom, an imperforate disc of refractory material on the bottom of the basket, and a reinforcing strip of platinum foil welded around the lower peripheral edge of the bottom and side walls of the basket.

5. A catalytic converter including a platinum gauze basket comprising a multi-layer cylindrical gauze, a gauze bottom, an imperforate disc of refractory material on the bottom of the basket, and a reinforcing strip of platinum foil welded around the lower peripheral edge of the bottom and side walls of the basket, the cylindrical portion of said reinforcing strip being greater in width than the thickness of the disc, so as to discourage the accumulation of dust in the corner of the basket.

6. A catalytic converter including a platinum gauze basket comprising a multi-layer cylindrical gauze, a single layer bottom gauze, an imperforate disc of refractory material on said bottom gauze, and reinforcement including a platinum foil strip extending around the lower peripheral edge of the basket and additional strips of platinum foil extending across the bottom of the basket.

7. A catalytic converter including a platinum gauze basket comprising a multi-layer cylindrical gauze, a single layer bottom gauze, and imperforate disc of refractory material on said bottom gauze, and reinforcement including a platinum foil strip extending around and welded to the lower peripheral edge of the side and bottom walls of the basket and additional strips of platinum foil extending radially across and welded to the bottom of the basket, the cylindrical portion of the platinum foil being greater in width than the thickness of the refractory disc.

8. A catalytic converter including a conversion chamber having an entrant opening and a holder located in said entrant opening outside of said chamber for supporting a platinum gauze, said holder comprising a supporting member, a clamping member, and clamping means for tightening the edge of the gauze between the clamping member

and the supporting member, the clamping member and means being so located on the holder that they are exposed only to the relatively cool reaction gas entering the converter.

9. A catalytic converter including a conversion chamber having an entrant opening and a holder located in said entrant opening outside of said chamber for supporting a platinum gauze basket, said holder being made of nickel and comprising a supporting ring, a clamping ring, and clamping bolts for tightening the edge of the gauze basket between the clamping ring and the supporting ring, the clamping ring and bolts being so located on the holder that they are exposed only to the relatively cool reaction gas entering the converter.

10. A catalytic converter including a conversion chamber having an entrant opening and a holder located in said entrant opening outside of said chamber for supporting a platinum gauze basket, said holder comprising a supporting ring, a clamping ring, and means for tightening the edge of the gauze basket between the clamping ring and the supporting ring, the clamping ring being so located on the holder that it is exposed only to the relatively cool reaction gas and is located outside of the path of free flow thereof.

11. A catalytic converter including a platinum gauze basket and a holder for supporting the same, said holder comprising a supporting ring, a clamping ring, and means for tightening the edge of the gauze basket between the clamping ring and the supporting ring, the clamping ring being so located on the holder that it is exposed only to the relatively cool reaction gas entering the converter and is located outside of the path of free flow thereof, the upper edge of the gauze basket being suitably shaped to be clamped in the holder and suitably reinforced with a strip of platinum foil welded thereto to strengthen the gauze against breakage at the point of attachment to the holder.

12. A catalytic converter comprising a converter chamber lined with a refractory material and having an entrant opening, a reaction gas inlet leading to said opening, a platinum gauze basket, and a holder for mounting said basket in the conversion chamber, said holder being located in said entrant opening outside of said chamber and being so surrounded by the walls and refractory lining of the converter that it is exposed only to the relatively cool reaction gas entering the converter.

13. A catalytic converter comprising a converter chamber lined with a refractory material and having an entrant opening, a reaction gas inlet leading to said opening, a platinum gauze basket, and a flanged holder for mounting said basket in the conversion chamber, said holder being held with its flange between the reaction gas inlet and the converter and being located in said entrant opening outside of said chamber and being so surrounded by the refractory lining of the converter that it is exposed only to the relatively cool reaction gas entering the converter.

14. A catalytic converter comprising a converter chamber lined with a refractory material and having an entrant opening, a reaction gas inlet leading to said opening, a platinum gauze basket, and a holder for mounting said basket in the conversion chamber, said holder including an outwardly flanged supporting ring of nickel the flange of which arranged to be held between the reaction gas inlet and the converter, and a clamping ring so located within the supporting ring that it is exposed only to the entering reaction gas, said supporting ring being located in the entrant opening and being so surrounded by the refractory lining of the converter that it too is exposed only to the relatively cool reaction gas entering the converter.

Signed at Charlotte in the county of Mechlenburg and State of North Carolina this 21 day of Feb., A. D. 1930.

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NICOLAY TITLESTAD.