United States Patent

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[33] **France**
[31] **95,254**

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[54] **CATALYTIC WALL**
9 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **431/328,** 23/288, 252/477
[51] **Int. Cl.** **F23d 13/12**
[50] **Field of Search** ..... 431/326, 328, 329, 7; 252/477; 23/288, 288.91, 288.92, 288.3 F

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ABSTRACT: A catalytic wall adapted to be cross through by a gaseous flow from an internal face to an external face in order to facilitate the reaction between said gaseous flow and a gaseous medium bathing the external face, comprising an asbestos based fabric support carrying on the input face a quantity of catalyst smaller than the one provided on the face bathing in said gaseous medium. Such a wall can be used in a catalytic heater apparatus.

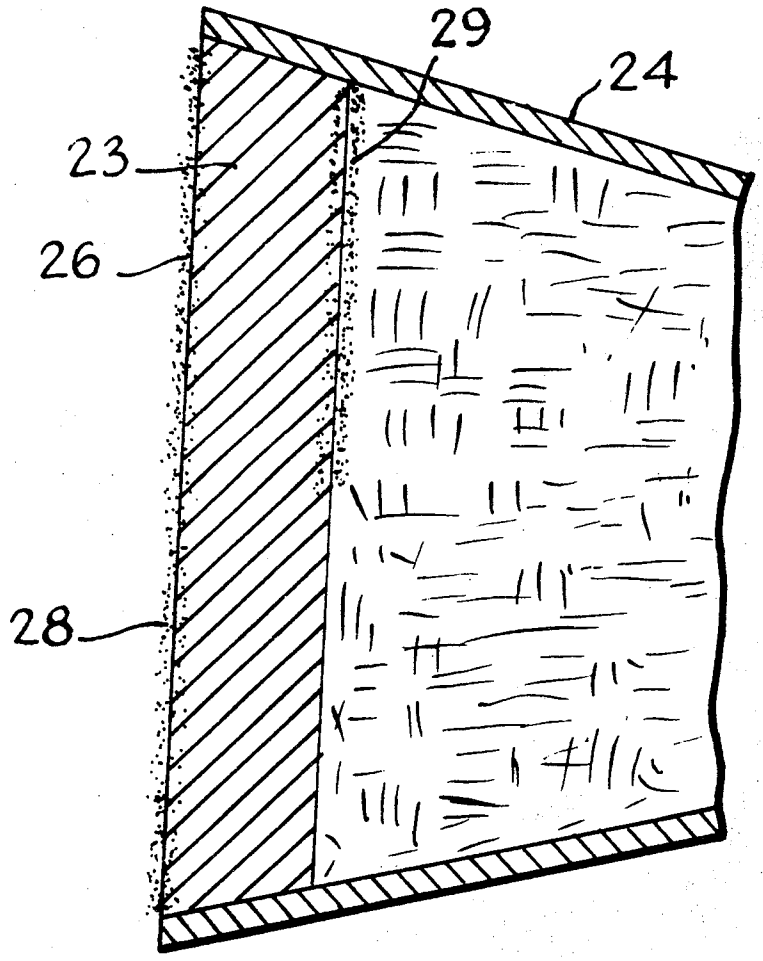

Fig. 1

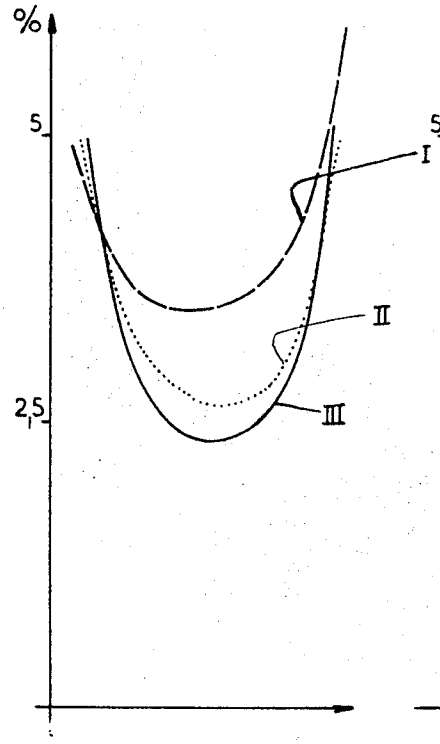

Fig. 2

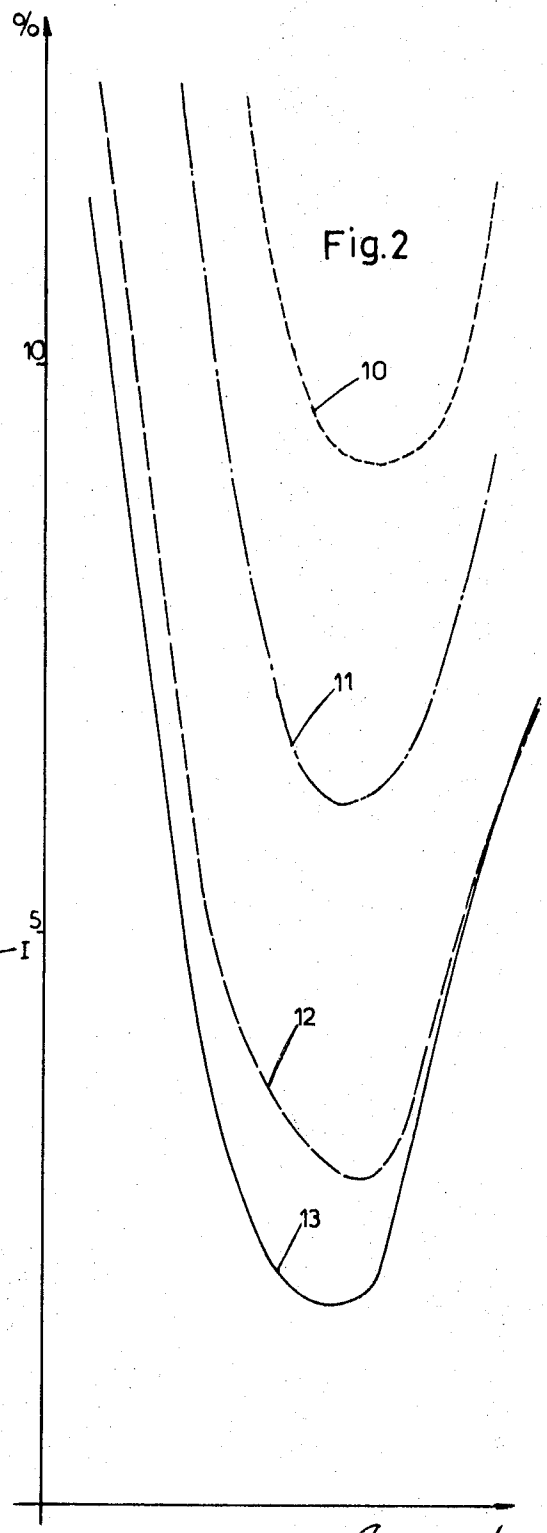

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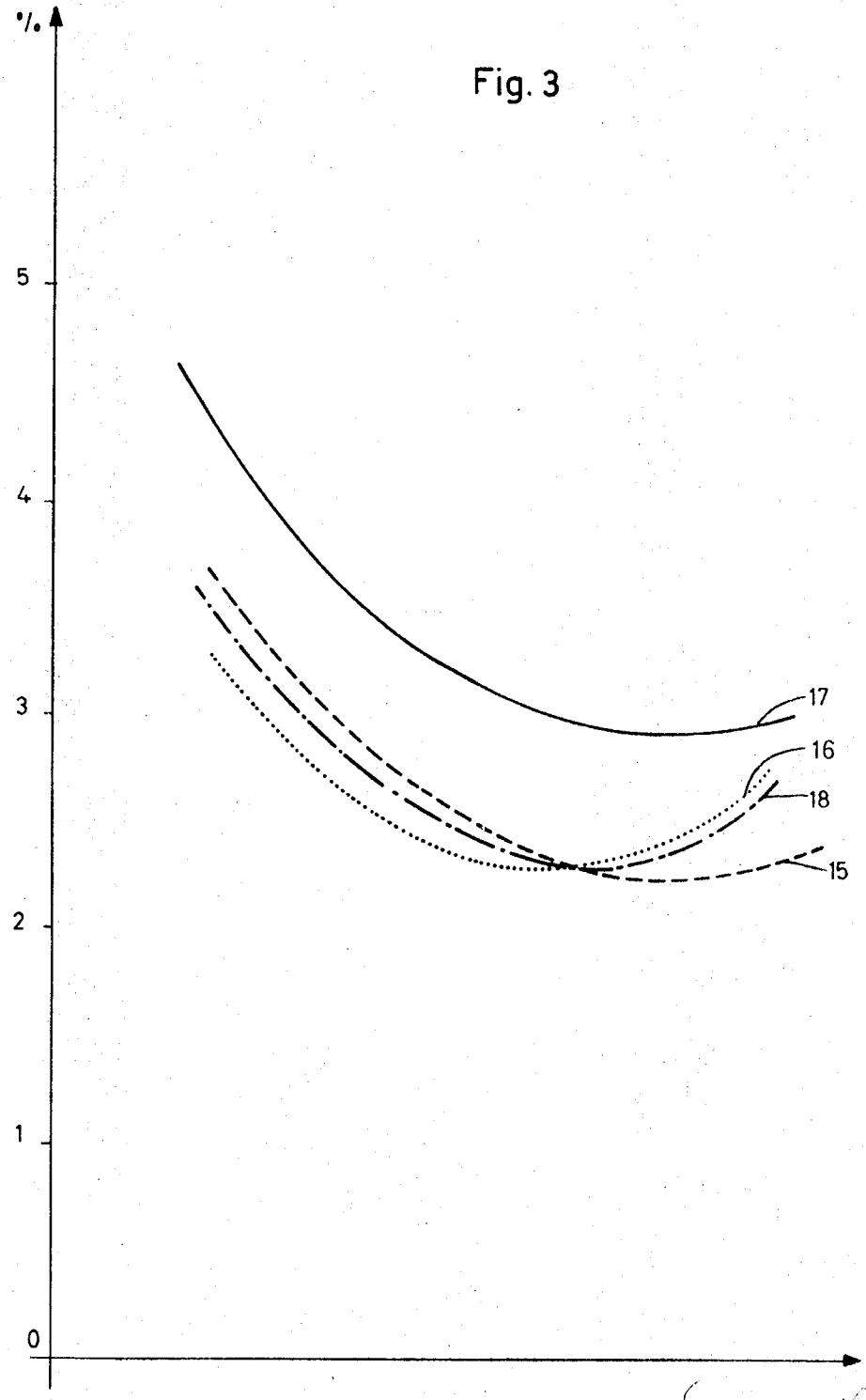
Fig. 3



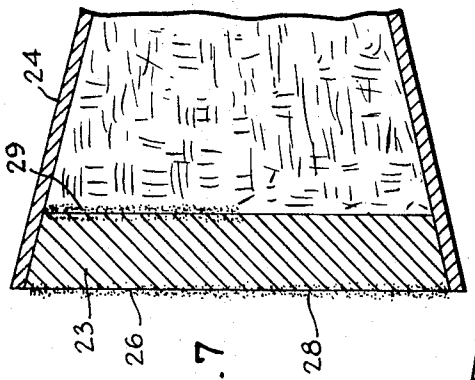


Fig. 7

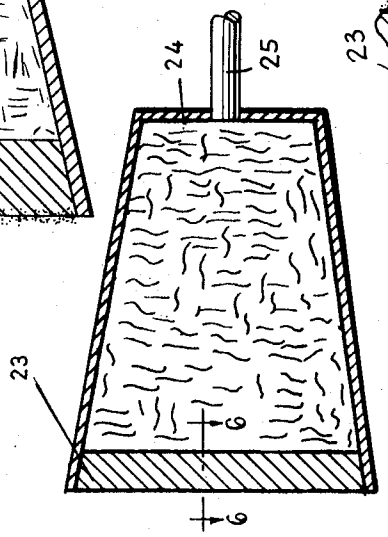


Fig. 5

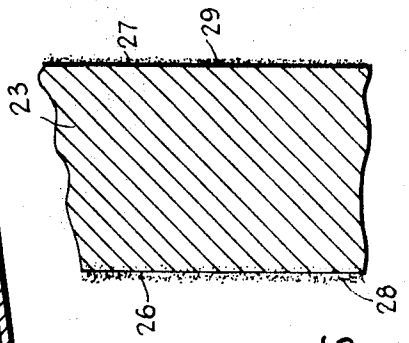


Fig. 6

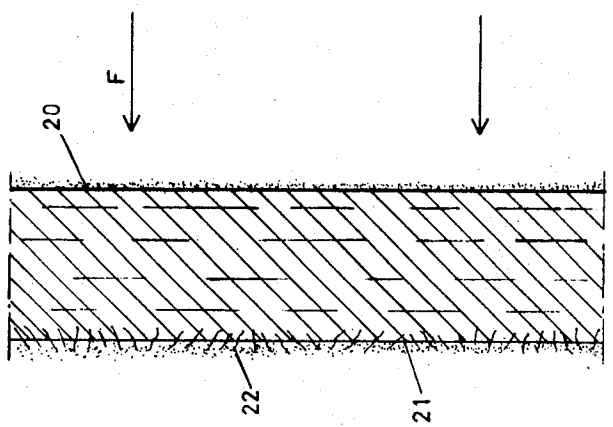


Fig. 4

CATALYTIC WALL

This invention relates to improvements in catalyst supports designed for increasing the efficiency of heterogeneous catalytic reactions.

This invention is applicable in general to the construction of catalytic apparatus of the type comprising an enclosure for distributing the reagents, and a catalyst carried by a corresponding support which may be a wall or be an integral part of, a wall or partition.

The invention is applicable, more particularly, to heating appliances of the catalytic type which comprise a chamber (containing for example mineral wool or the like) for distributing the reagent or reagents, this chamber being limited by a pervious wall or partition (asbestos fabric or the like) which is the support of the combustion catalyst, and through which at least one of the reagents is caused to flow.

It is known to use such supports, wherein the catalyst is uniformly distributed over the two faces, so that the support can be disposed in one or the other way.

The present invention is thus concerned with apparatus for the catalytic combustion of gas, and mainly catalytic stoves comprising in contact with the atmospheric air, a catalytic wall or partition through which the gas is caused to flow to make the desired combustion.

The conditions to be met in the manufacture of these apparatuses, in order to ensure their satisfactory operation, are multifarious and sometimes contradictory.

It is an object of this invention to provide a catalytic wall structure pervious to a gaseous flow which permits the manufacture of catalytic apparatuses operating better than hitherto known apparatuses of this type, and are easy and economical to manufacture.

It is another object of this invention to provide a catalytic wall structure requiring for its manufacture a moderate amount of catalytic product and therefore of an acceptable cost.

It is a further object of this invention to provide a catalytic wall structure, particularly in fabric made basically of asbestos, which, when fitted in a catalytic apparatus, particularly a catalytic stove, ensures an operation of the apparatus such that, all other parameters being equal, the proportion of unburnt gas is lower than that observed in other known apparatus of the same type.

It is also an object of this invention to provide a catalytic wall structure permitting the construction of an apparatus having an adjustment range greater than that of known apparatuses.

In conventional catalytic stoves the wall or partition crossed through by the gas and wherein the combustion is effected, usually receives the catalytic product on both faces.

Comparative tests, carried out with a catalytic stove equipped successively with walls carrying on one face increasing amounts of catalytic product, proved that beyond a certain value of the weight of catalytic product per specific surface unit of the wall, the efficiency of the catalytic reaction will not improve.

Quite unexpectedly, the applicant found that if starting from a wall on which has been sprayed, on the face in contact with the atmosphere, the quantity of catalytic product beyond which no increment in the catalytic reaction takes place the catalytic property of this wall can be considerably improved by applying catalytic product to the opposite face of the wall but in a smaller quantity than that applied to the first face.

A catalytic wall according to the invention, pervious to gaseous reagents and comprising a support for the catalytic product, particularly in a fabric made basically of asbestos, is characterized in that the quantity of catalytic product is smaller on the gas inlet face of the wall than on the gas outlet face thereof.

The quantity of catalytic product applied per surface unit to the gas inlet face of the wall according to this invention ranges from about 25 percent to about 80 percent of the quantity of catalytic product applied per surface unit to the gas outlet face of the wall. This percentage is advantageously of the order of 50 percent.

According to a specific embodiment of the invention the catalytic product is present in a substantially uniform manner on the inner face, in smaller amount than on the outer face.

The invention also contemplates an embodiment wherein the catalytic product is present only on certain zones of the inner face, at the most on about 80 percent of its surface and advantageously at the most on 50 percent.

In this respect, the invention contemplates a specific embodiment characterized in that the quantity of catalytic product present per surface unit on the inner face is greater in the zones where the fuel gas output is smaller.

In the case of a catalytic stove operating on hydrocarbon gas heavier than air, such as butane or propane, and comprising a substantially vertical wall, the catalytic product is applied only to the upper portion of the inner face of the wall pervious to the gaseous reagents.

This invention is particularly advantageous when applied to a wall in a fabric made basically of asbestos treated by brushing its outer face for bristling up the fibers thereof.

It is thought that, in this manner, the catalyst is better distributed on the fibers swept by the gaseous stream.

Particularly good results are obtained if the catalytic product is applied by spraying catalytically active substances in suspension in an alcohol medium.

Other features and advantages of this invention will appear as the following description proceeds with reference to the appended drawing, wherein:

FIG. 1 to 3 show explanatory diagrams;

FIGS. 4 and 5 show, respectively, in a schematic way, a catalytic wall and a catalytic apparatus.

FIG. 6 is a section on the line 6–6 of FIG. 5 and shows a catalytic wall having different quantities of catalytic product on opposite sides thereof.

FIG. 7 is an enlarged fragmentary section of a modified form of catalytic apparatus.

Example

A plurality of catalytic walls have been constructed which differed from each other only by the distribution or arrangement of the catalytic product.

The fabric is an asbestos fabric (warp = 27, single weft = 30).

This asbestos fabric was brushed on one face, to bristle up the fibers thereof.

To all the walls, the catalytic product, consisting of a platinum base substance was applied by spraying a suspension in an alcohol medium.

Three walls, after a heating step for reducing the catalytic product into a catalyst, are mounted in succession in a stove so that their brushed or outer face contacts the atmospheric air.

The curves defining the proportion of unburnt products as a function of the gas feed per surface unit of the wall were thus plotted.

Curve I (FIG. 1) relates to a wall the outer face of which was sprayed with a quantity of catalytic product, per surface unit, which was arbitrarily selected as being equal to 1, this quantity representing the value beyond which the addition of a complementary quantity of catalytic product per surface unit does not increase the catalytic action of the wall; no catalytic product was sprayed onto the inner face of this wall.

If the characteristics of a wall (as far as the catalytic product applied thereto are concerned) are denoted by the expression $a \times b/c\ d$, wherein a designates the external surface, b the quantity of catalytic product applied per surface unit to the external face, c the internal surface and d the quantity of catalytic product applied per surface unit to this internal surface, then the characteristics of the first wall, as concerns the applied catalytic product, can be expressed as $1 \times 1/1 \times 0$ in other

words, the entire external face has received per surface unit a quantity of catalytic product equal to 1, and no product has been applied to the internal face.

With a wall 1×1/1×1, i.e. a wall having received twice as much catalytic product, sprayed by equal amounts over its entire external surface and over its entire internal surface, the resulting curve is line II (FIG. 1).

With a wall having the characteristic 1×1/1×0.5, i.e. a wall having received throughout its inner face a quantity of catalytic product per surface unit which is half that received by the preceding wall, the resulting curve is marked III. In a surprising way, in its useful area this wall has a higher efficiency, from all points of view, than the 1×1/1×1 wall, although the latter carries a greater amount of catalytic product.

By using similar walls also prepared from the same asbestos fabric as the preceding ones, with one face brushed up and disposed externally, and equipping therewith a stove of different construction the following results have been obtained:

with a 1×0.5/1×0.5 wall, curve **10** (FIG. 2),

with a 1×0.75/1×0.5 wall, curve **11**,

with a 1×1/1×0 wall, curve **12**,

with a 1×1/1×0.5 wall, curve **13**.

These curves (FIG. 2) prove the interest of the 1×1/1×0.5 wall, notably in connection with the possibility of a low-output setting without abnormally increasing the proportion of unburnt products.

In another series of tests an asbestos fabric wall was used and a quantity of catalytic product was applied by spraying the whole of its outer, brushed face, with a quantity corresponding, per surface unit, to the above-defined value 1.

During a first test, in a butane gas stove having a substantially vertical catalytic wall, this wall was used and a quantity of catalytic product equal to that sprayed onto its external face was also sprayed onto its inner face.

In another test, a similar wall was used but its inner face was sprayed with only one-half of the quantity sprayed onto the external face, the sprayed area being limited on the inner face to the upper half thereof. Quite unexpectedly, it was discovered that the result obtained during this second test was as good as that obtained during the first test.

In still another series of tests, an asbestos fabric wall was used and catalytic product corresponding to the above-defined value 1 was sprayed onto the entire brushed external face of this wall.

During a first test in a butane gas stove having a substantially vertical catalytic wall, such a wall was used, but having a quantity of catalytic product sprayed onto the upper part of its internal face, per surface unit, half that sprayed onto the other, external face. With this wall of characteristics 1×1/0.5×0.5 the curve **15** (FIG. 3) was obtained.

During a second test such a wall was also used and the quantity of catalytic product sprayed per surface unit onto the whole of its inner face was half that applied to the external face. With this wall, of characteristics 1×1/1×0.5 the curve **16** was obtained.

During a third test, such a wall was also used and the same quantity of catalytic product per surface unit as that sprayed onto the external face was sprayed onto one-half of the internal face. With this wall, of characteristics 1×1/0.5×1, the curve **17** was obtained.

As shown in FIG. 3, the wall corresponding to curve **15** is the most advantageous since it gave practically equivalent results from the point of view of the percentage of unburnt products (in ordinates) by using a lesser amount of catalytic product.

This wall is by far superior to the one corresponding to curve **17** since not only it requires a smaller amount of catalytic product but also leads to better results.

In another test a wall was used which had a brushed external face sprayed with catalytic product up to an amount corresponding to 1.5 per surface unit; a quantity of catalytic product corresponding to 0.5 per surface unit had been sprayed onto the upper half of the internal face of this wall. Thus, with a wall of characteristics 1×0.5/0.5×0.5, a curve **18** was obtained which clearly proves, by comparison with curve **15**, that adding catalytic product in excess of 1 will not improve the efficiency of the catalytic reaction.

Referring now to FIG. 4, there is shown schematically a catalytic wall according to the invention with an inner face **20** and an outer face **21** presenting bristled fibers **22**. The direction of flow of the gaseous reagents is indicated by arrow F.

FIG. 5 illustrates schematically a catalytic stove according to the invention with a catalytic wall **23** adjacent to the distribution chamber **24** to which is connected a gas feeding pipe **25**.

FIG. 6 shows an enlarged section of the catalytic wall **23** having outer and inner surfaces **26** and **27**, respectively. A first deposit **28** of a reaction catalyst is sprayed on or otherwise applied to the outer surface **26** and a smaller second deposit **29** of a reaction catalyst is sprayed on or otherwise applied to the inner surface **27**.

FIG. 7 illustrates a modified form of catalytic apparatus in which the wall **23** is provided with a first deposit **28** of a reaction catalyst applied to the outer surface **26** and a second deposit **29** applied to the upper portion only of the inner surface **27**.

I claim:

1. A catalytic wall to improve the reaction between at least one component of a gaseous flow which crosses said wall from an internal face to an external face and a gaseous medium bathing the external face of the wall, comprising an asbestos based fabric, a first deposit of platinum carried on the face of the wall bathed by said gaseous medium substantially according to a quantity such that the catalytic action does not increase with the increase of the platinum quantity and a second deposit of platinum on the opposite face of the wall, said second deposit being from 25 to 80 percent of the quantity of platinum of said first deposit.

2. A catalytic wall according to claim **1**, wherein said quantity of platinum of said second deposit is about 50 percent of the quantity of platinum of said first deposit.

3. A catalytic wall according to claim **1**, wherein said first deposit covers the entire face of the wall bathed by said gaseous medium, and said second deposit covers no more than 80 percent of the opposite face of the wall.

4. A catalytic wall according to claim **3**, wherein said second deposit covers about 50 percent of the face of the wall opposed to the one bathed by said gaseous medium.

5. A catalytic wall according to claim **1**, wherein the quantity of platinum of said second deposit is greater in the zones where the gaseous flow is relatively smaller than in the other zones.

6. A catalytic wall according to claim **5**, wherein said second deposit covers the upper portion of the face of the wall opposite to the one bathed by said gaseous medium.

7. A catalytic wall according to claim **1**, wherein said face of the wall bathed by said gaseous medium is brushed for bristling up its fibers before the application of said first deposit.

8. A catalytic wall according to claim **1** said wall being arranged in a substantially vertical position and wherein said gaseous flow is a gas heavier than air and wherein the platinum of said second deposit is applied on the face opposed to that bathed by said gaseous medium only at the upper portion of said substantially vertical wall.

9. A catalytic wall for improving the reaction between a combustible gas and atmospheric air in a catalytic heater means, said wall comprising a gas pervious fabric having inner and outer surfaces, a first deposit of platinum saturating said outer surface so that additional platinum does not increase the catalytic action, a second deposit of platinum on said inner surface, said second deposit being smaller than said first deposit so that said combustible gas flows through said wall from said inner surface to said outer surface and reacts with the air at said outer surface.