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3,421,826

CATALYTIC BURNER

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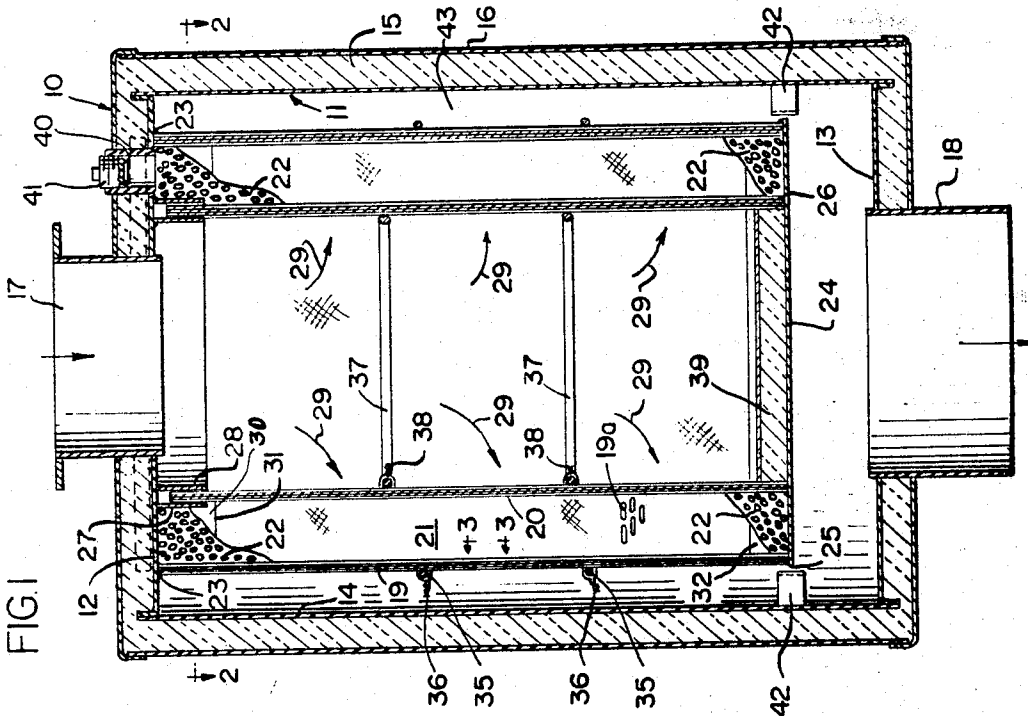


FIG. 1

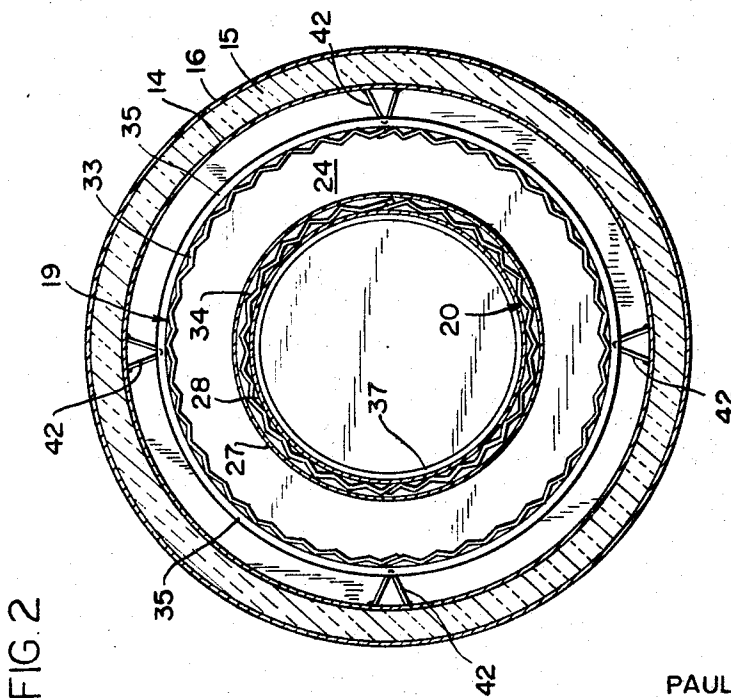


FIG. 2

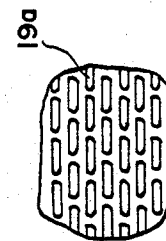


FIG. 3

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CATALYTIC BURNER

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ABSTRACT OF THE DISCLOSURE

A catalytic burner for burning a hydrogen or hydrocarbon fuel in the presence of air with the catalyst bed retained between an upright first gas pervious member and an upright second gas pervious member both surrounded by a housing with the upper end of one of the gas pervious members being fixedly held within the housing so that the first member is free to expand and contract thermally, the second gas pervious member having its lower end attached to the lower end of the first member and the upper end of the second gas member being free to expand and contract longitudinally but held against substantial sideways movement in order to maintain the spacing between the members that determines the lateral dimensions of the catalyst bed.

This invention relates to a catalytic burner for burning a hydrogen or hydrocarbon fuel in the presence of air to produce gaseous combustion products low in oxygen in which the bed of catalyst is held between two upright gas pervious members within a housing with each gas pervious member being free to expand and contract longitudinally and transversely without substantial change in over-all lateral dimensions and with the bed of catalyst being confined on all sides so as to prevent escape of the catalyst even when the generator is subject to severe agitation, and to prevent damage to the catalyst and the gas pervious members due to stresses resulting from normal or abnormal operation.

In the accompanying drawings:

FIGURE 1 is a vertical section through a catalytic burner generator embodying the invention.

FIGURE 2 is a horizontal sectional view taken substantially along line 2—2 of FIGURE 1 but with the catalyst bed omitted for clarity of illustration.

FIGURE 3 is a broken elevational view of the perforate metal member.

In the embodiment of the invention shown in the accompanying drawings the burner 10 comprises an upright generally cylindrical housing 11 having a top 12, a bottom 13 and a cylindrical side 14. The housing 11 is surrounded by heat insulation 15 which in turn is covered by a protective metal sheet 16. The burner is provided at the top with an entrance means 17 for a mixture of gaseous hydrogen or hydrocarbon fuel and air in proper proportions for burning the fuel and at the bottom with an exit means 18. The entrance 17 and exit 18 means extend through the top and bottom, respectively, of the burner 10.

Positioned within the housing 11 and spaced inwardly of the cylindrical side 14 thereof is an upright first gas pervious member 19 in the form of a perforate metal member or a screen of heat resistant wire. Positioned inwardly of the first member 19 is a second gas pervious member 20 also in the form of a perforate metal member with the two members defining a space 21 for retaining a bed of catalyst 22. Members 19 and 20 have circumferentially spaced perforations 19a which allow axial movement or

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restriction to movement without developing excessive material stresses. For clarity of illustration the bed 22 is shown in FIGURE 1 broken away intermediate the top and bottom ends of the bed.

Means are provided in the housing 11 for fixedly securing the upper end of one of the members 19 and 20 while providing substantially no restraint to thermal contraction and expansion movements of this member. In the embodiment shown in the drawings this one gas pervious member or screen is the first or outer one 19 and its upper end is fixedly attached as by welding 23 to the undersurface of the top wall 12 of the housing 11. Thus, the first or outer screen 19 hangs freely from the top wall 12 so that the screen is under substantially no restraint to thermal contraction and expansion movements caused by changes in temperature within the burner and catalyst bed 22.

The second or inner gas pervious member or screen 20 is substantially parallel and concentric to the first member 19 and has its bottom end operatively secured to the bottom end of the first screen 19. In the illustrated embodiment this operative securing is achieved by employing a circular flat metal plate 24 located at the bottoms of the screens 19 and 20 and to which the bottoms are fixedly attached as by welding 25 and 26. The circular plate 24, as shown at the bottom of FIGURE 1, also provides a bottom support for the annular catalyst bed 22 located between the screens 19 and 20.

In order to provide for maintaining the lateral spacing of the members 19 and 20 without substantial restraint to thermal contraction and expansion movements of the screen 20 there are provided a pair of spaced annular guides 27 and 28 attached to the undersurface of the top wall 12 of the housing and arranged on opposite sides of the upper end of the second screen 20. These guides 27 and 28 are preferably spaced not more than about $\frac{1}{16}$ of an inch away from its respective side of the screen 20 when the distance between screens 19 and 20 and thus the thickness of the bed 22 is about 2 inches.

In order to insure passage of all of the gas mixture entering through the entrance 17 in an outward direction through the bed in the space 21 as indicated by the arrows 29, the upper end 30 of the first or outer screen 19 is gas impervious down to below the top of the bed 22. The bottom limit of the gas impervious section 30 is indicated by the lower boundary line 31.

In order to obtain complete combustion of the fuel-air mixture which leaks around the bottom edge of catalyst bed 22 and adjacent bottom 24, the lower end of screens 19 and 20 are gas impervious as indicated at 32 in FIGURE 1 to insure sufficient contact with the hot catalyst for complete combustion.

As explained above, each of the gas pervious members or screens 19 and 20 is free to expand and contract longitudinally during temperature changes. In order to avoid excessive lateral stresses on the material and the catalyst, means are provided for permitting movement or restraint of movement of each of the members or screens laterally. In the illustrated embodiment this is accomplished by providing a series of adjacent vertical pleats, indicated at 33 and 34, in each of the screens 19 and 20 as shown in the horizontal section of FIGURE 2. In order to maintain and retain these over-all lateral dimensions of the screens, the first screen 19 is surrounded by a pair of vertically spaced metal rings 35 against the outer surface of the screen 19 and tied thereto as by wire ties 36. Similar rings 37 are provided against the inner surface of the second screen 20 and similarly tied thereto as by spaced ties 38.

In order to prevent an excessive temperature differential across bottom plate 24 an insulating barrier means 39 is provided within the confines of the second catalyst retaining screen 20. This barrier means 39 prevents warpage of the bottom plate 24.

In order to load the space 21 between the screens 19 and 20 with catalyst 22 there is provided a catalyst fill pipe 40 extending through the top of the generator and into the top of the space 21. This fill pipe 40 is normally closed by means of a threaded plug 41.

In order to provide against excessive lateral movement of the first and second screens 19 and 20 and the catalyst bed 22 therebetween spaced centering means 42 are provided attached to the cylindrical side 14 of the housing 11 opposite the outer edge of the bottom plate 24 and extending toward but short of this outer edge.

In operation a relatively cool hydrocarbon or hydrogen gas and air mixture in the usual proportions for complete combustion of the gas enters at 17 and passes outwardly into the bed 22 as indicated by the arrows 29 where low temperature combustion takes place in the bed. Such a low temperature catalytic combustion of a fuel in the presence of air is well known and widely described in the prior art. The gaseous combustion products then pass outwardly of the bed through the outer first screen 19 into the annular space 43 between the first screen 19 and the side wall 14 of the housing 11. From this space 14 the combustion products pass downwardly and outwardly through the exit means 18.

In the generator-burner of this invention the catalyst bed 22 is completely confined. The screens 19 and 20 which retain the bed in combination with the supporting rings 35 and 37 are operatively fixed to the housing 11 yet are free to expand and contract both longitudinally and transversely without substantial change in the over-all transverse dimensions of the bed. This, of course, is accomplished by anchoring only the top end of one screen, here shown as the first screen 19, while the other end of this one screen and both ends of the second screen 20 are free to change positions longitudinally under the forces of thermal expansion and contraction. Because of this arrangement, the generator-burner of this invention is ideally designed for use in environments where there is considerable movement and vibration such as in transport vehicles including trucks, railroad cars, ships and the like.

Furthermore, because of the mounting of the expanding and contracting parts of the generator these are adaptable to uneven temperatures through the generator without setting up excessive and damaging thermal stresses.

Because the upper end of the second or inner screen 20 is held loosely in an expansion joint provided by the two side retainer guides 27 and 28, this upper end and thus the assembly of screens 19 and 20 and bottom closure plate 24 are free to expand and contract longitudinally. Although some gas-air mixture may escape up through the space between the guides 27 and 28, it is forced to flow downwardly in contact with the top of the catalyst bed 22 because of the provision of the impervious section 30 that extends to substantially below the top of the bed 22.

The placement of the expansion joint defined by concentric guides 27 and 28 allows unrestricted movement of the perforate members 19 and 20 during normal and abnormal operation, while causing a minimum of damage to the catalyst in the joint area due to the relative movement between the catalyst and the joint.

Having described our invention as related to the embodiment shown in the accompanying drawings, it is our intention that the invention be not limited by any of the details of description, unless otherwise specified but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. A catalytic burner for burning a hydrogen or hydrocarbon fuel in the presence of air, comprising: an upright first gas pervious member; an upright second gas pervious member laterally spaced from said first member to provide space for retaining a bed of catalyst between said members; a housing surrounding said members; means in said housing fixedly securing the upper end of one of said members while providing substantially no restraint to thermal contraction and expansion movements of said one member; means operatively securing the lower ends of both said gas pervious members together; means for substantially maintaining said lateral spacing of said members without substantial restraint to thermal contraction and expansion movements of said other member; entrance means for conveying said fuel and air to one side of said bed space in said housing; and exit means for conveying the products of said burning from the other side of said bed space in said housing.

2. The burner of claim 1 wherein said means fixedly securing the upper end of one of said members secures said one member to an upper part of said housing.

3. The burner of claim 2 wherein said member at said other side of said bed space is gas impervious from said housing upper part to a point below the top of said bed.

4. The burner of claim 3 wherein said member at said other side is gas impervious at the bottom thereof to a point above the bottom of said bed.

5. The burner of claim 1 wherein there are provided means for permitting transverse flexing of each of said gas pervious members.

6. The burner of claim 1 wherein there are provided means for permitting longitudinal flexing of each of said gas pervious members.

7. The burner of claim 1 wherein there are provided means for permitting longitudinal and transverse flexing of each of said gas pervious members to prevent material stress potentiated by uneven heating.

8. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: an upright first gas pervious member; an upright second gas pervious member laterally spaced from said first member to provide space for retaining a bed of catalyst between said members, each of said first and second gas pervious members being of endless transverse cross section with one inside the other; a housing surrounding said members having a top and bottom, and sides spaced from said gas pervious members; means in said housing fixedly securing the upper end of one of said members to said housing top while providing substantially no restraint to thermal contraction and expansion movements of said one member; closure means operatively securing the lower ends of both said gas pervious members together and extending therebetween; means for substantially maintaining said lateral spacing of said members without substantial restraint to thermal contraction and expansion movements of said other member; entrance means for conveying said fuel and air to the interior of the innermost of said gas pervious members for passage into said bed; and exit means for conveying the products of said burning to the exterior of said housing.

9. The burner of claim 8 wherein heat insulating barrier means are provided between the interior of said innermost gas pervious member and said exit means.

10. The burner of claim 8 in which centering means are provided for retaining said gas pervious members spaced from said housing sides.

11. The burner of claim 8 wherein said gas pervious members are substantially concentric with the outer member being attached at its top to said housing top and the inner member has its top movably held in guide means for permitting longitudinal thermal expansion and contraction without substantial lateral displacement.

12. The burner of claim 11 wherein the top of said outer member is substantially gas impervious from said housing top to below the top of said bed and is gas im-

pervious at the bottom to above the bottom of said bed.
13. The burner of claim 12 wherein there are provided means including a series of longitudinal pleats for permitting flexing of each of said members while preventing substantial changes in over-all lateral dimensions.

References Cited

UNITED STATES PATENTS

3,042,499	7/1962	Williams	23—277
3,061,416	10/1962	Kazokas.	
3,233,653	2/1966	Nakamura et al.	158—99
3,291,187	12/1966	Haensel	158—116

3,362,792	1/1968	Ranum	158—99 XR
3,122,197	2/1964	Saponara et al.	

FOREIGN PATENTS

1,029,774	5/1966	Great Britain.
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