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Chapman

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[54] **DUAL CROSS-FLOW CANISTER AND PROCESS**

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[52] **U.S. Cl.** ..... **23/288 FB;** 23/288 FC; 60/299; 423/212; 252/477 R

[51] **Int. Cl.²** **B01J 35/04;** F01N 3/15

[58] **Field of Search** ..... 23/288 F, 288 FB, 288 FC; 60/287, 289, 290, 295, 301, 307; 423/212, 213.2, 213.7; 165/180; 220/5 A

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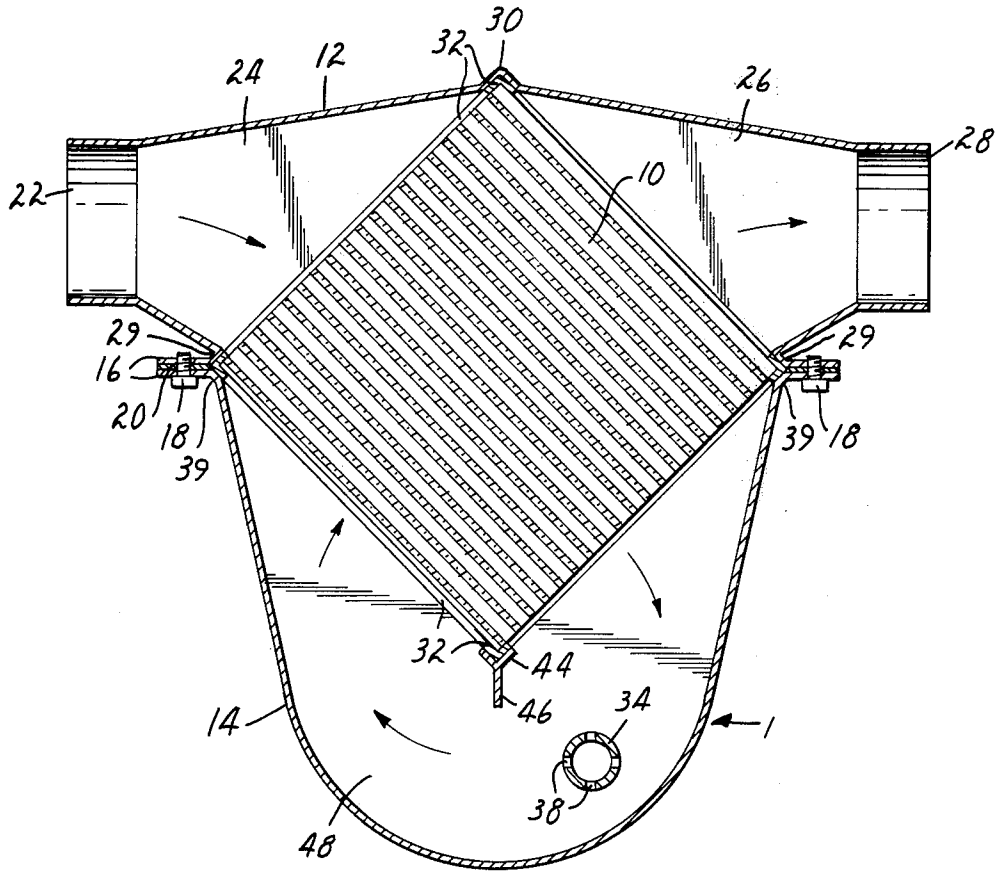
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[57] **ABSTRACT**

A process is provided for the facial mounting of a dual cross-flow supported catalyst and a canister is provided wherein manifolding inlet and outlet means bring exhaust gases to and away from the supported catalyst at an angle of about 45° to the direction and in the plane of flow through the catalyst support. The frame of the canister provides surfaces for rigid positioning of the catalyst support around the peripheries of at least two of its four active faces. Means are provided for addition of air between two catalytic stages.

2 Claims, 5 Drawing Figures



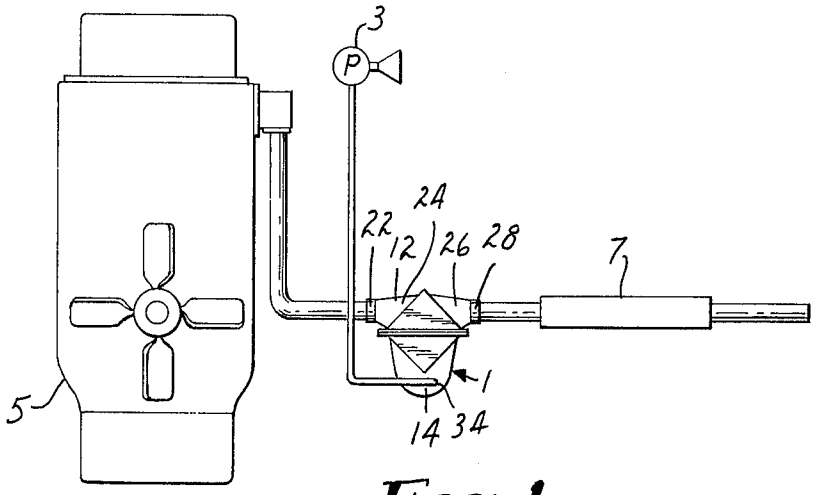


FIG. 1

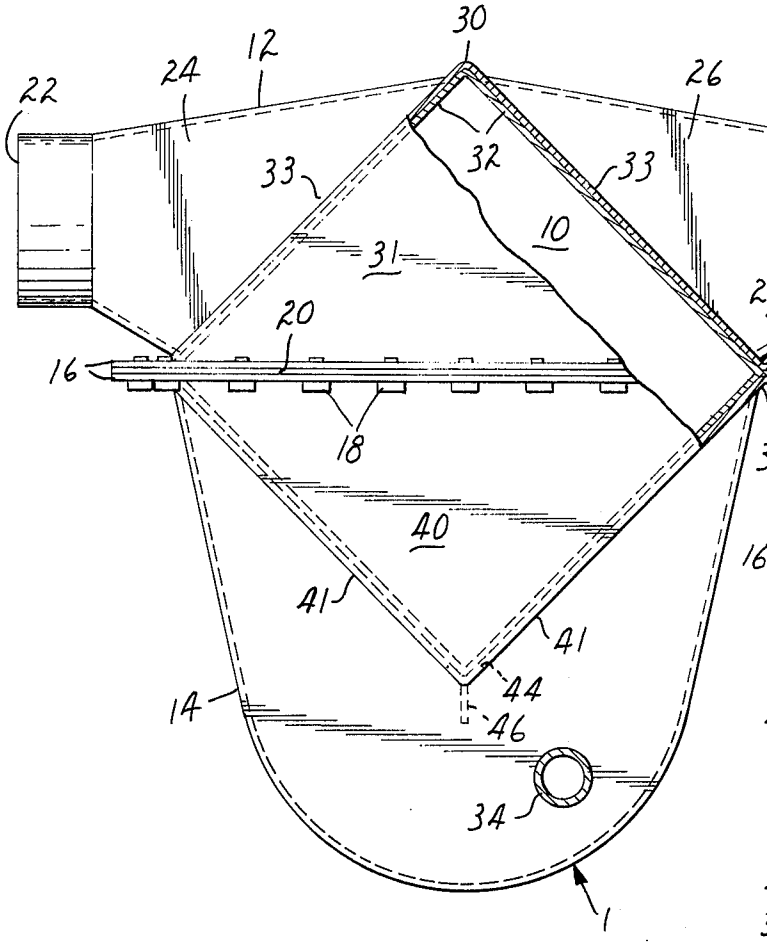


FIG. 2

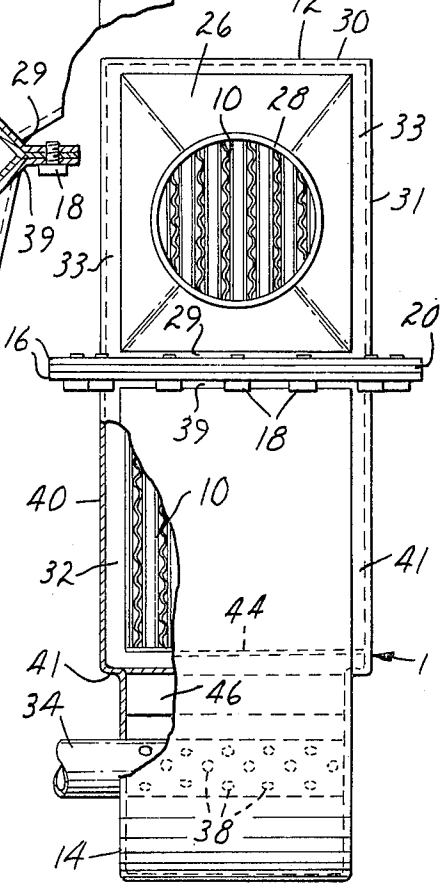


FIG. 3

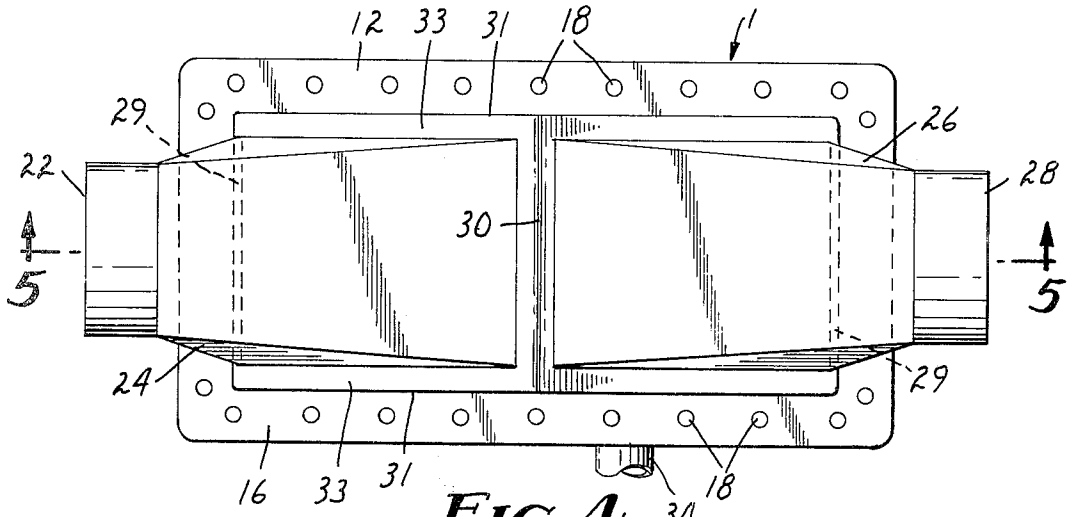

12
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FIG. 4

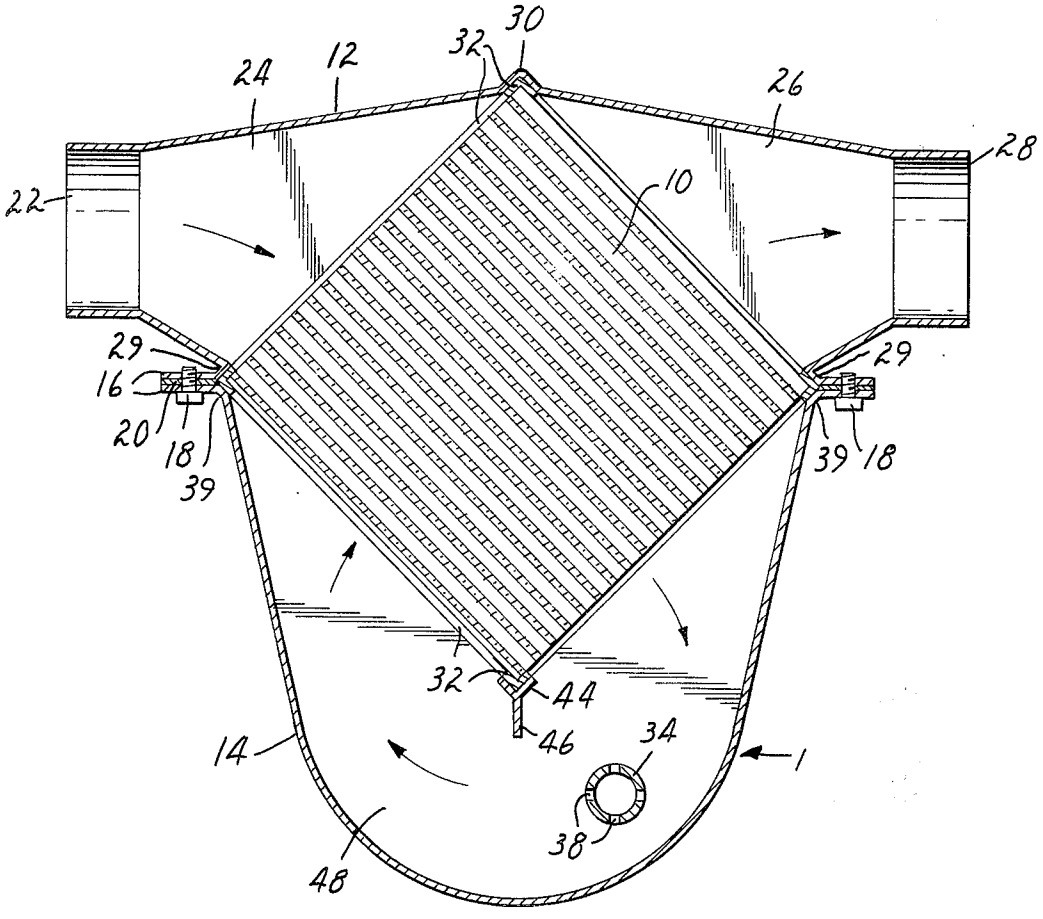

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FIG. 5

DUAL CROSS-FLOW CANISTER AND PROCESS

This invention relates to a canister for the mounting of a dual cross-flow supported catalyst and particularly to a canister in which means are provided so that direction of gas flow entering and leaving the catalyst is changed in the same plane by about 45° from the direction of flow and the frame of the canister provides rigid positioning of the catalyst support around the margins of the active faces. This invention further relates to the process for the facial mounting of a dual cross-flow catalyst support.

In the co-pending application of James R. Johnson, Ser. No. 321,021, filed Jan. 4, 1973, now U.S. Pat. No. 3,860,535, are described dual cross-flow supported catalyst systems which permit simultaneously effecting two reactions, one of which is endothermic or requires elevated temperatures and one of which is exothermic, in a single supported catalyst structure. These structures are intended particularly for use in automobile exhaust systems to render pollutants innocuous and are suitably composed of a refractory ceramic such as cordierite, zircon-mullite, alumina, etc. depending on the catalyst. Inasmuch as dwell time is very short and catalytic effects can only be expected for those molecules of the gas stream which contact the catalyst, it is especially necessary to provide a canister system for the supported catalyst which permits introduction of exhaust from the engine with thorough mixing and turbulence. Additional air is normally required to be thoroughly mixed into the gases for oxidation of carbon monoxide and hydrocarbons.

It is an object of this invention to provide a process for the mounting of a dual cross-flow catalyst support. A further object is to provide a canister in which there is good turbulence for a dual cross-flow catalyst support of square cross-section and further to provide a canister for positioning such a catalyst support. Other objects will become evident hereinafter.

In accordance with these and other objects of the invention, a process is provided in which a dual cross-flow catalyst support is mounted using resilient material around the margins or peripheries of at least the face into which gases are introduced and the face from which the gases finally leave the support. The resilient mounting material is compressed sufficiently to prevent blowby between these faces and to effect a good seal. This method of mounting is referred to as facial mounting.

Still further, a canister is provided having manifolding means permitting introduction of waste gases or exhaust gases such as from an internal combustion engine so that all changes of direction are in one plane starting with a change of 45° on entering the catalyst and ending with a change of 45° on leaving the catalyst. Changes in direction of the stream from entry to exit total about 360°. The canister of the invention is further provided with an air inlet.

A particular feature of the canister is that the catalyst support is positioned rigidly by cooperation of frame structure of parts of the canister so that force and sealing is applied around the margins or peripheries of the active faces, that is, the faces through which gases enter or leave the support. In particular, sealing is provided between the inlet face and the face through which the gases finally leave the support by use of resilient sealing material in accordance with the process of the invention.

This invention will become more readily understood by reference to the accompanying drawings wherein:

FIG. **1** is a diagrammatic representation of the method by which a canister of the invention is employed;

FIG. **2** is a side view of a canister of the invention partly broken away;

FIG. **3** is an end view of a canister of the invention partly broken away;

FIG. **4** is a top elevation of a canister of the invention.

FIG. **5** is a section at **5**—**5** of the canister of FIG. **4**.

Referring to FIG. **1**, it will be seen that a canister of the invention **1** is connected between an engine **5** and muffler **7** and attached to it is pump **3** which may be provided with automatic control devices (not shown).

In FIGS. **2**, **3** and **5**, it will be seen that a canister of the invention in which a dual cross-flow catalyst support **10** of generally parallelepipedal form with longitudinal axis and square cross-section is mounted, consists of an upper part or cover **12** and lower part or base **14** meeting at peripherally flanged rectangular openings and joined at flanges **16** by screws or bolts **18** with gasketing means **20.** If desired, other fastening means, such as welding, may be employed. Suitably, the canister is constructed from mild or non-corrosive steel about 1.5 mm thick (16 gauge; 0.060 inches). The dual cross-flow refractory ceramic catalyst support has all its passageways at right angles to its longitudinal axis and in two directions which are mutually at right angles to each other. The catalyst support has catalyst on it and is positioned within the casing as more fully described below.

Upper part **12** is provided with inlet port **22** and inlet manifold **24** and outlet port **28** and outlet manifold **26** attached to an open faced frame having a peak **30,** cross rail **29,** triangular end pieces **31** and having side rails **33.** The arrangement of inlet and outlet manifolds in the instant apparatus is particularly useful because it reduces directional changes of gas flow to a relatively low value and thereby also reduces back-pressure which could tend to increase as the rate of gas flow increases. After assembly of the canister, two rectangular faces of the catalyst support fitted with insulating and packing material **32** fit into the two rectangular open-faced congruent frames formed from peak **30** cross-rails **29** and two side rails **33** of the frame of the upper part, that is, they are facially mounted and are held so securely that there is no blow-by from inlet manifold to outlet manifold and gases must go through catalyst support **10.** The cover or support **12** has right-triangular ends mating with triangular support frames on the paraboloid end members of the base, a ridge or peak **30** connecting the right angles of said right triangular ends, cross-rails **29** connecting the acute angles of the triangular ends and side rails **33** along the sides of the triangular ends between the ridge and the cross-rails. Inlet manifold **24** is connected to the ridge, side rails and the cross-rail at one side of the ridge and to inlet port **22** for inlet of a stream of exhaust gases. Outlet manifold **26** is connected to the ridge, side rails and the cross rail at the other side of the ridge and to the outlet port for release of exhaust stream. The inlet and outlet ports face in opposite directions but on substantially the same centerline.

Any packing material may be employed which provides adequate support and tightness after repeated

thermal cycling, but one having resiliency is preferred. An especially preferred resilient type of packing is described in an application of others filed of even date herewith (Ser. No. 393,587) and comprises vermiculite which expands in situ when heated. Lower part **14** is of an approximately paraboloid cross-section as seen in FIGS. **2** and **5**, and has a rounded bottom with approximately paraboloid end members and extended side walls diverging towards a first pair of opposite sides of the rectangular opening of the base. The paraboloid end members have right-triangular support frames thereon with right angles at the base and equal sides forming side rails **41** and the hypotenuses at the edge of the end members forming the second pair of opposite sides of the rectangular opening of the base. The frame of lower part **14** is composed of lower cross-rails **39**, lower side rails **41** connected by lower end piece **40** and suitably but not necessarily channel or angle support member **44** connecting the lower points of end pieces **40**. Together, the rails and channel form the frame for receiving the lower part of catalyst support **10** which may also employ packing **32** as employed for upper part **12**, but this is not necessary for operation of the process of the invention. A vane **46** is attached to the lower edge of channel **44** to increase turbulence of gases passing through plenum **48** or, if channel **44** be omitted, vane **46** is free-standing close to the bottom edge of support **10** but may provide no support. In that instance, lower cross rails **39** and lower side rails **41** provide sufficient support for catalyst support **10**, either with or without packing. Air is admitted into plenum **48** by air inlet **34** having holes **38**.

The catalyst support is positioned within the casing with its square ends resting in the triangular support frames of the paraboloid end members of the base with its longitudinal axis parallel to the side walls of the base, a first longitudinal edge being positioned above the vane connecting the end members of the casing, being supported if an angle support member is provided between the triangular support frames of the end members. Two opposite longitudinal edges of the catalyst support are supported at the sides of the base and the fourth longitudinal edge is engaged and urged into position by the ridge, side rails and cross rails of the cover. Inlet and outlet manifolds are securely positioned above adjacent faces of the catalyst or support. It will be noted that packing need not be employed between end pieces **31** or **40** and catalyst support **10** and that some play or slack is thus provided for differential thermal expansion.

It will be seen that gas entering inlet port **22** and inlet manifold **24** (the converse of FIG. **3**) is precluded from passing around the edges of catalyst support **10** by packing **32** around the edges and when it strikes the exposed face of catalyst support **10** at an angle of about 45°, it passes through the support in a first direction where nitrogen oxides are reduced to nitrogen by reaction with part of the carbon monoxide. The gas enters plenum **48** and then after mixing with air in whatever amount may be needed passes out through catalyst support **10** in the cross-flow direction, where hydrocarbons and carbon monoxide are oxidized, into outlet manifold **26** and finally leaves by outlet port **28**.

Although this canister is particularly adapted for use with dual cross-flow catalyst supports having height considerably less than one side of the square cross-section, it may be used with such supports which are cubic or even prismatic, i.e., higher than a single side. The relative efficiency of the apparatus depends particularly on the catalyst support and its parameters as well as the catalyst employed. For example, a catalyst support suitably enclosed in the instant canister could be 3⅜in. (8.5 cm) high and 5.5 in. (14 cm) square composed of zircon mullite or cordierite. Allowing for about ¼ inch (6.2 mm) packing around the edges, the effective face area would be 14.4 in^2 (95 cm^2). The effective catalytic volume would then be 79.2 in^3 (1330 cm^3). The effectiveness depends on the surface area of catalyst provided.

I claim:

1. A container or canister for connection into the exhaust stream of an engine and for positioning a catalyst support in said stream comprising, in combination,

I. a casing containing and holding a catalyst support, said casing having two parts, a cover and a base, said cover and said base mating and being joined at peripherally flanged rectangular openings,

A. said base having

1. a rounded bottom, approximately paraboloid end members and extended side walls, said side walls diverging toward a first pair of opposite sides of the rectangular opening of said base,
2. said approximately paraboloid end members comprising right-triangular support frames, said triangular support frames having equal sides meeting at a right angle, said right angle being located near the rounded bottom of the base, the hypotenuses of said triangular support frames forming the top edges of said end members which hypotenuses also form the second pair of opposite sides of the rectangular opening of said base and the equal sides of said support frames forming side rails, and said end members, said rounded bottom and said side walls forming a plenum space,
3. a vane between said end members below the right angles of the triangular support frames,
4. said base further having an air inlet inserted through one said end member below the triangular support frame into the said plenum space.

B. said cover having

1. right-triangular end pieces having the right angle at the apex, the hypotenuses of said triangular end pieces mating with the triangular support frames of the said paraboloid end members of said base,
2. a ridge connecting the right angles of said right-triangular end pieces and forming an internal angle therebetween;
3. cross-rails connecting the acute angles of said triangular end pieces and
4. side rails along the sides of said triangular end pieces between said ridge and said cross rails,
5. an inlet manifold connecting to said ridge, side rails and cross rail at one side of said ridge and inlet port for inlet of said exhaust stream in said inlet manifold,
6. outlet manifold connecting to said ridge, side rails and cross rail at the other side of said ridge and outlet port in said outlet manifold for release of said exhaust stream from said outlet manifold with outlet port facing in the opposite direction to said inlet port and the two said ports being on substantially the same centerline,

II. said container or canister further comprising a dual cross-flow refractory ceramic catalyst support of parallelepipedal form with longitudinal axis and square cross-section having all passageways at right angles to the said longitudinal axis, said passageways being in two directions mutually at right angles to each other, said catalyst support having catalyst thereon and being positioned within said casing with its square ends resting in the triangular support frames of said paraboloid end members of said base, its longitudinal axis parallel to the side walls of said base, a first longitudinal edge being positioned above said vane connecting said end members of said casing, two opposite longitudinal edges being supported at the sides of said base and the fourth longitudinal edge and the ends being engaged and urged into position by said ridge, said side rails and said cross rails of said cover with inlet and outlet manifolds securely positioned above adjacent faces of said catalyst support, and

III. said container or canister further comprising resilient mounting material between said catalyst support and the said ridge, said cross rails and said side rails of said cover of said canister at all lines of contact therebetween thereby preventing blowby of gases in said exhaust stream.

2. A container or canister according to claim **1** additionally having an angle support member connecting the right angles of the triangular support frames and supporting the said first longitudinal edge of the catalyst support.

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