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Kearsley

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[54] **CATALYTIC CONVERTER**

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[52] **U.S. Cl.** ..... **23/288 FC;** 252/477 R

[51] **Int. Cl.**[2] **B01J 35/04;** F01N 3/15; B01J 8/00

[58] **Field of Search** ..... 23/288 F, 288 FC; 252/477 R

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Assistant Examiner—Michael S. Marcus

[57] **ABSTRACT**

A catalytic converter having an improved suspension system for carrying a fragile catalyst housing. The housing is retained within a surrounding casing by a resilient support media which restricts transverse movement of the housing relative to the casing. Destructive longitudinal housing movement is also prevented by the support media in conjunction with the respective shapes of the housing and casing. In a preferred embodiment the casing is strengthened by tapering from a larger cross-section at the middle to a smaller one at the ends, while the housing is of uniform cross-section throughout. Various other combinations of housing and casing shapes are possible which similarly retard housing movement.

2 Claims, 6 Drawing Figures

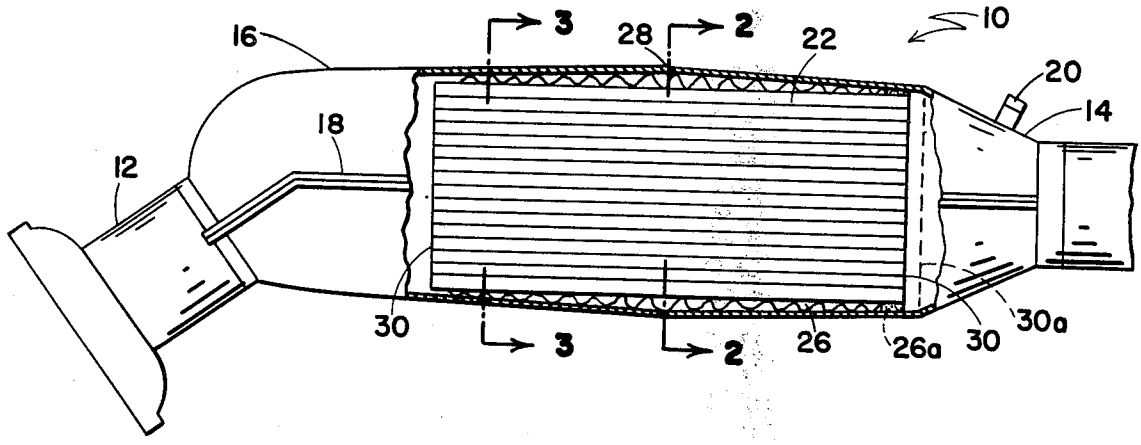
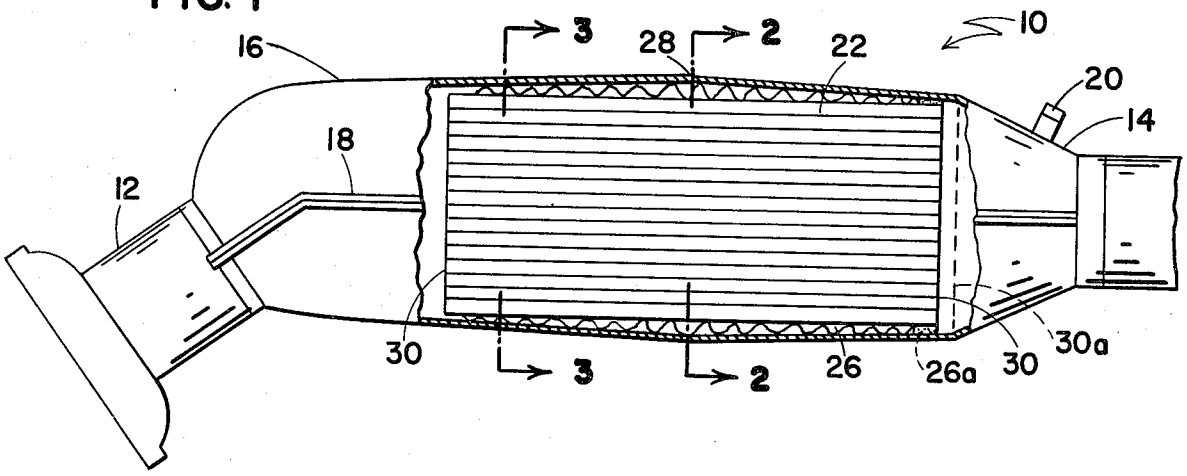


FIG. 1



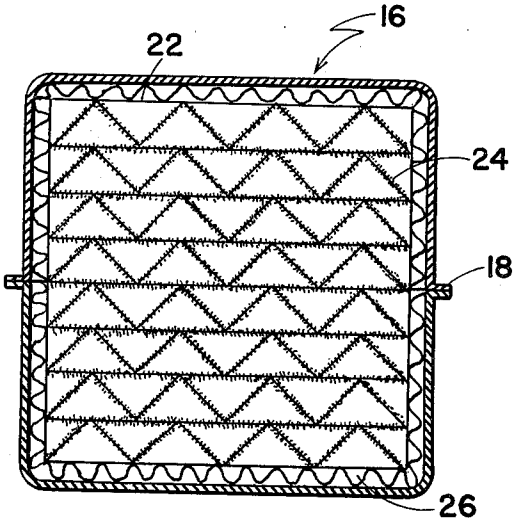


FIG. 2

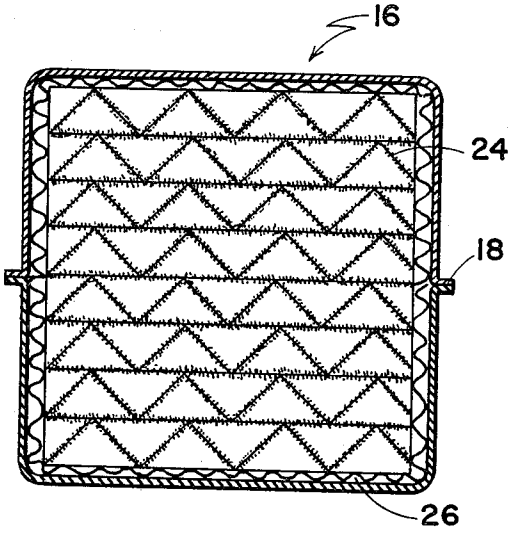


FIG. 3

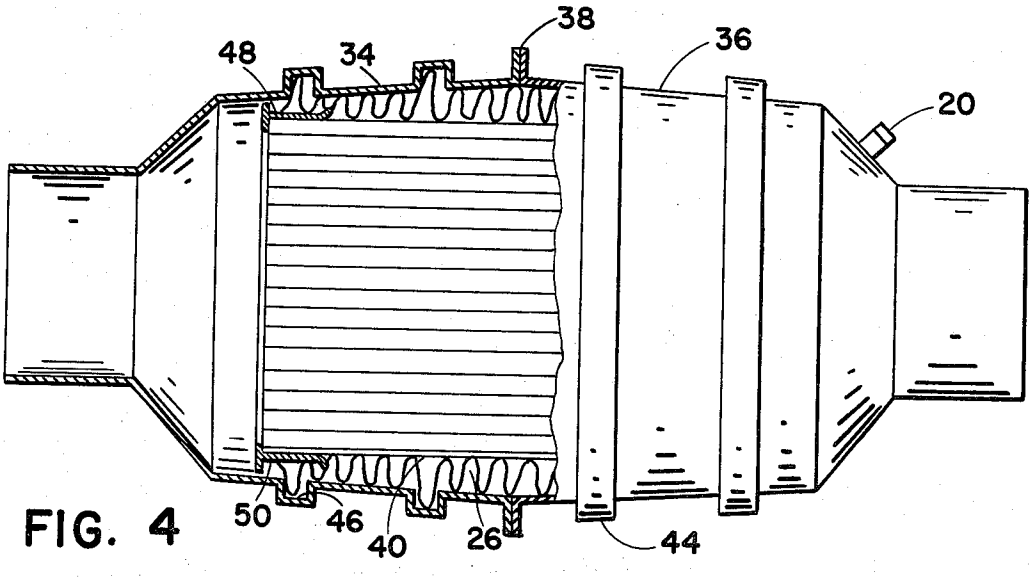


FIG. 4

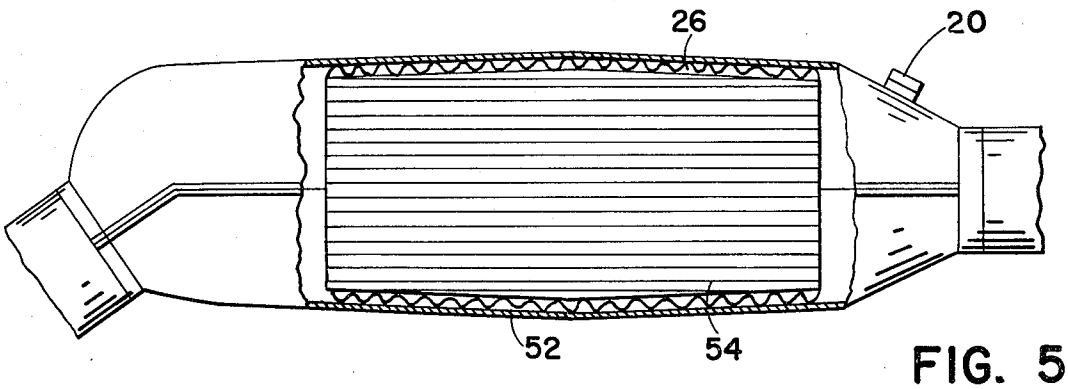


FIG. 5

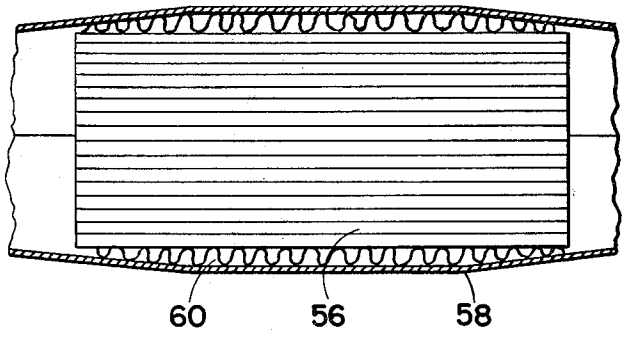


FIG. 6

CATALYTIC CONVERTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the catalytic purification of exhaust gases from an internal combustion engine, and more particularly to apparatus for supporting within a casing a fragile housing for catalyst material against destructive vibrations both longitudinal and transverse.

2. Description of the Prior Art

The attainment of more complete combustion of products fed to an internal combustion engine in order to purify the exhaust gases delivered therefrom has been an object of great interest, particularly with regard to automotive vehicles. The problem of air pollution caused by incomplete combustion is well known. To this end catalytic converters have been developed to consume incompletely oxidized gases exhausted from the engine. Typically employing a fragile ceramic housing for the catalyst material, the converter is held in a metallic casing and installed in the line of exhaust gas flow downstream from the engine. Gases flow through the catalyst material and are oxidized. To prevent untreated gases from escaping into the gap between the housing and casing, sealing rings or the like are used at either end of the housing. The rings are also designed to bear against the ends of the housing to prevent longitudinal motion.

A flexible mesh support has been used around the periphery of the catalyst housing to protect it from vibrating against the hard casing surface during operation. This is especially important at the high temperatures necessary to completely burn the exhaust gases, at which the casing expands transversely away from the catalyst housing. An effective solution to transverse vibration is thus provided, but the usefulness of the system has been considerably limited because longitudinal vibration can still develop.

While the mesh support also provides some resistence to longitudinal housing motion, it will not prevent the housing from vibrating across any small gap that might exist between it and the sealing rings. If such a gap should be formed, a destructive sequence may be initiated when the automobile is operated; the ceramic housing vibrates against the sealing rings and begins to crumble at the points of contact. The gap widens accordingly, leading to greater vibrations and more housing crumbling, until the mesh support itself wears the housing. Rapid failure of the converter follows.

The aforementioned high operating temperatures contribute seriously to the formation of such gaps since the outer casing undergoes a greater thermal expansion than does the catalyst housing, moving the sealing rings away from the housing even if a close fit had been achieved initially. In addition, this movement also admits exhaust gases into the space between the casing and housing, bypassing the catalyst material. Lack of adequate means to prevent longitudinal movement is particularly troublesome, as the ceramic housings are stronger in transverse compression than in longitudinal compression applied at the ends.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a new and improved catalytic converter that will avoid harmful longitudinal vibrations of the catalyst housing, even under sustained operation at high temperatures. It is a further object to provide a new and improved catalytic converter with a shaped housing for catalyst material and a shaped outer casing, designed to hold a resilient support media therebetween in such a way as to arrest both longitudinal and transverse motion of the housing relative to the casing.

In the accomplishment of these objects the housing and casing in a catalytic converter of the type described are shaped such that an annular opening is formed therebetween, at least one of said housing and said casing having non-uniform transverse dimensions in longitudinal cross-section. Any longitudinal movement of the housing away from an equilibrium position causes a compression of a portion of the surrounding support media. The compression is translated into a distributed generally transverse force acting upon the housing surface that dampens longitudinal vibrations and restores the housing to equilibrium. In a preferred embodiment the casing is tapered from a larger cross-section in the middle to smaller cross-sections at each end, while the catalyst housing is of uniform cross-sectional dimensions throughout. The support media is compressed into mirror-image generally wedge shapes, of which one wedge is narrowed and compressed by any longitudinal housing displacement and tends to restore the housing to its original position. If the casing is rectangular, its side walls may be left untapered, the taper at the top and bottom generally being adequate to prevent undesired motion. The tapered walls are easy to manufacture and provide greater strength than the prior art straight walls.

Other gradual constrictions in the gap between casing and housing may likewise create an area of greater compression in the support media that will resist longitudinal movement of the housing. Either the casing alone or both casing and housing may be tapered either outwardly or inwardly, or other areas of compression may be provided. In general, V-shaped shells are preferred for strength, ease of manufacture, and effectiveness. If the support media is compressed sufficiently at its ends, exhaust gases will be unable to enter the gap and the need for sealing rings or gas flow deflectors eliminated.

Another object can thus be seen to be the provision of a catalytic converter that can operate under heavy vibrational loading without destruction of the catalyst housing.

Still another object is the provision of a catalytic converter with a strengthened casing that eliminates the need for sealing rings at the catalyst housing. A related object is the provision of a catalytic converter that can be used with sealing rings without destructive longitudinal vibrations against the rings.

Other objects, features and advantages of this invention will occur to those skilled in the art from the following detailed description of preferred embodiments thereof taken together with the accompanying drawings in which,

FIG. 1 is a side elevation, partly in section, showing a tapered casing and straight housing for a catalytic converter in accordance with the invention;

FIGS. 2 and 3 are sectional views taken respectively along the lines 2—2 and 3—3 of FIG. 1;

FIG. 4 is a side elevation, partly in section, showing a cylindrical embodiment of the invention with a strengthened casing and sealing rings;

FIGS. 5 and 6 are views similar to FIG. 1 showing variations in the casing and housing shapes.

Detailed Description

In FIGS. 1, 2 and 3 is shown a preferred embodiment of a catalytic converter **10**, according to the invention, having an exhaust gas inlet port **12** to receive the exhaust from an internal combustion engine, an outlet **14** leading towards a tail-pipe, and a central metallic casing portion **16**. The casing **16** is generally rectangular in cross-section with 1/16 walls, formed from upper and lower sections welded together at flanges **18** running longitudinally along its sides. A boss **20** may be placed along the upper side for securing the converter to the vehicle or machine. An open-ended ceramic housing **22** is located inside and spaced from the inner walls of casing **16** by a resilient support media **26**. Catalyst material is mounted on the exposed surfaces of a longitudinally channeled ceramic honeycomb **24**, each channel having a gas inlet and outlet. Exhaust gas enters the converter through inlet port **12** and is purified during transit through the channels by contact with the catalyst material contained therein.

The support media **26** is a shock absorbant material, capable of withstanding elevated temperature conditions, and is held under compression in non-sliding contact with the exterior housing **22** walls. It may be a corrugated, knitted mesh metallic fabric such as stainless steel that is knitted into a sock and then flattened and crimped at the ends. To prevent slippage relative to the housing **22** the strands of wire mesh dig into the ceramic housing surface, which may also be roughened or corrugated for even greater contact. Spring plates may also be used for the support media **26**, with small barbs extending into the ceramic. While it is not necessary that the support media **26** extend all the way around the housing **22**, full wrap around facilitates manufacture.

In the preferred embodiment shown, designed for use on automobiles, the housing **22** extends beyond the support media **26** by approximately ¼" at each end. The casing **16** tapers away from the center at top and bottom at an inward angle of approximately 5°,while the housing **22** has straight upper and lower surfaces. A gap approximately 0.2" wide, into which the support media **26** fits, separates the casing **16** from the housing **22** at the middle **28** thereof; the gap is narrowed to approximately 0.1" at each casing end **30**. The support media **26** is thereby subjected to a lesser compression at the middle and to increasing compression as the extremeties are approached. It in turn exerts a corresponding pressure upon the housing **22**.

The support media **26** is squeezed into mirror image wedge-like shapes, wide at the middle **28** and narrow at each end, and shields the fragile housing **22** from contact with the metallic casing **16** under transverse vibrations. The housing **22**, however, is particularly susceptible to damage if it is allowed to vibrate freely in a longitudinal direction, the ends **30** breaking easily when struck against a hard object. This problem was most acute in previous devices when sealing rings were used to fix a housing in longitudinal position and block exhaust gases from entering the gap between housing and casing. Thermal expansion during operation opened a space across which the housing ends could vibrate onto the sealing rings, ultimately leading to mechanical failure.

The operation of the present invention in arresting destructive gross longitudinal movement of the ceramic housing **22**, best illustrated with reference to FIG. **1**, is as follows:

Assume the ceramic housing **22** has vibrated slightly to the right during operation, so that its right end is at the position indicated by the dotted line **30***a*. The support media **26** is also moved partially to the right to **26***a*, and forced further into the wedge described by the adjacent walls of housing **22** and casing **16**. The end of support media **26** is now encased in a smaller gap and is hence subjected to a greater degree of compression. A corresponding increase in pressure is felt at every point in the support media that is moved further into the wedge. Frictional and shear forces are set up between the support media **26** and the inner wall of casing **16**, and reflected into increased shear forces distributed over the entire right hand surface of the housing **22**, tending to pull it back into balanced symmetry within the casing **16**. In effect, what prior devices would have experienced as a sharp blow against the housing end **30** in a longitudinal direction in translated into a distributed transverse pressure that can be handled by the housing **22** without damage. Even a slight movement is met by a corresponding retaining force exerted by the support media **26**. The pressure continually grows as the movement increases, permitting a rapid response to more severe vibrations and limiting longitudinal movement of the housing **22** to small amounts even under heavy vibrational loading.

In the above described embodiment a taper was provided only on the upper and lower walls of the casing **16**. As this will normally be sufficient to prevent damaging vibrations, the casing side walls may be manufactured straight across without any taper as shown in FIGS. **2** and **3**. The gap between the casing **16** and housing **22** along the sides is preferably a size between that of the smallest and largest gaps provided at the top and bottom. An added benefit of the tapered casing configuration of this invention is a strengthening of the catalytic converter under applied vibrations or load. Extra strength is provided for a casing of given wall thickness against a commonly encountered phenomona known as "oil canning," a situation in which a flat steel sheet buckles under vibration or load.

Other embodiments of a catalytic converter in which a support media is compressed by varying amounts along the surface of the catalyst housing and holds it against longitudinal vibration may now occur to those skilled in the art. FIGS. **4–6** illustrate a few of them. In FIG. **4** a tapered cylindrical configuration is shown in which a left hand cylinder **34** is welded to a right hand cylinder **36** along flanges **38** at the end of each cylinder. The two cylinders may also be joined by an overlapping arrangement to provide a casing. A cylindrical housing **40** for catalytic material is located inside the casing and protected by support media **26**. The casing is tapered as before, with the exception that the tapering extends all the way around. A plurality of hollow strengthening ribs **44** are provided on the surface on the casing **16** to enhance structural durability and provide recesses **46** which carry portions of the support media **26** and further engage it to the casing. If sealing rings **48** are desired they may conveniently be provided adjacent the annular opening at each end of the housing **40**, with arms **50** extending orthogonally from the

rings and cemented between the housing **40** and the support media **26.**

FIG. **5** shows another variation in which both a casing **52** and a housing **54** are provided with similarly tapered walls forming a V-shaped annular gap of substantially constant thickness for support media **26.** The compression on the housing **54** is essentially constant along its length, and increases uniformly when the housing is moved to the left or right. While this arrangement provides the most widely distributed transverse force, the housing **54** shown is somewhat more difficult to manufacture than one of uniform thickness throughout.

In FIG. **6** another embodiment is shown in which a straight housing **56** is surrounded by a casing **58** that is also straight at its mid-section and tapered only at the ends. Because it extends over a lesser distance, the angle of taper is somewhat greater and assists against slippage between the casing **58** and support media **60.**

A further advantage is found in those embodiments in which the support media is compressed by a constriction in the gap near the ends of a catalyst housing. The support media may be compressed to a degree sufficient to prevent the entrance of exhaust gases between the casing and housing, thus permitting the converter to be operated with no sealing rings at all; exhaust gases will all flow through the catalyst housing to be treated. If sealing rings are desired, they may be provided as shown in FIG. **4.**

Other embodiments of this invention will occur to those skilled in the art, from the foregoing nonlimiting description of preferred embodiments thereof.

What is claimed is:

1. In a catalytic converter for exhaust gases of the type having a casing with an internal wall surface and gas inlet and outlet openings at its respective ends, a fragile housing interior to said casing in the line of exhaust gas flow having exhaust gas passages extending longitudinally between and in communication with said inlet and outlet openings and containing catalyst material, said housing having an exterior longitudinal wall surface and being longitudinally movable with respect to said casing, a resilient support media between and engaging the exterior longitudinal wall surface of said housing and the interior wall surface of said casing to support said housing within said casing and limit relative movement therebetween, the improvement comprising the exterior wall surface of said housing and the opposing interior wall surface of said casing sloping relative to each other in one direction along one longitudinal portion of said converter, and in the opposite direction along another portion of said converter to form therebetween an annular opening having oppositely tapered portions, said support media being lodged in compression in said annular opening, between and in contact with said sloping interior and exterior wall surfaces, said relatively sloping walls and said tapered opening therebetween extending along a substantial longitudinal portion of said housing, whereby a portion of said support media is subjected to increased compression when said housing is moved in a longitudinal direction relative to said casing, thereby tending to arrest longitudinal movement of said housing relative to said casing.

2. In a catalytic converter for exhaust gases of the type having a casing with an internal wall surface and gas inlet and outlet openings at its respective ends, a fragile housing interior to said casing in the line of exhaust gas flow having exhaust gas passages extending longitudinally between and in communication with said inlet and outlet openings and containing catalyst material, said housing having an exterior longitudinal wall surface and being longitudinally movable with respect to said casing, a resilient support media between and engaging the exterior longitudinal wall surface of said housing and the interior wall surface of said casing to support said housing within said casing and limit relative movement therebetween, the improvement comprising the exterior wall surface of said housing and the opposing interior wall surface of said casing sloping parallel to each other in one direction along one longitudinal portion of said converter and in the opposite direction along another longitudinal portion of said converter to form therebetween an annular opening with oppositely sloping longitudinal portions, said support media being lodged in compression in said annular opening, between and in contact with said sloping interior and exterior wall surfaces, whereby a portion of said support media is subjected to increased compression when said housing is moved in a longitudinal direction relative to said casing, thereby tending to arrest longitudinal movement of said housing relative to said casing.

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