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(54) **Knitted wire mesh alignment separation and support ring for automotive catalytic converter systems**

(57) A profiled knitted metal mesh wire ring interposed between the end of tile fixed metal cone and the nearest face of the ceramic monolithic block containing the catalytic reagents, of such a shape and configuration that it serves to hold the said metal cone and monolithic block in correct axial alignment.

This correct axial alignment ensures the optimum flow of the hot engine exhaust gases from the metal cone into the monolithic block such that the required catalytic reactions may occur.

The flexible construction of the knitted metal mesh wire ring permits the thermal expansion of the fixed metal cone linearly towards the face of the ceramic block to be compensated for without permitting the two components to make contact and cause damage one to the other.

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Description

BACKGROUND OF THE INVENTION AND DESCRIPTION OF PRIOR ART

[0001] The current automotive catalytic converter systems are comprised of several components made from different materials having different properties but generally consisting of an external metal enclosure within which is a metal pipe carrying the hot engine exhaust gases linked to a multi-chambered ceramic monolithic block or blocks, the chambers of which contain the catalytic agents which cause the toxic exhaust fumes to undergo the various reactions required to oxidise the carbon monoxide and hydrocarbon components of the exhaust gas and reduce the oxides of nitrogen to non-toxic levels.

[0002] The metal pipe carrying the hot engine exhaust gases and the metal enclosure system are subject to large and rapid dimensional expansions during the heating up period between the initial production of hot engine exhaust gases and steady state operating temperatures being reached under normal automotive operating conditions.

[0003] In direct contrast to the metal components the ceramic monolithic block, by virtue of its composition and construction, undergoes very little dimensional change during both the heating up period or the high temperatures reached under normal automotive operating conditions.

[0004] There is therefore a need to reconcile the dimensional changes undergone by the different components due to the temperatures imposed by the generation of the hot engine exhaust gases.

[0005] In one current system this reconciliation is achieved by affixing a conical diffuser to the circular exhaust pipe, at entry to the catalytic converter assembly, such that the conical diffuser has a circular cross section at the junction with the engine exhaust pipe and changes to an oval cross section at the point of connection to the ceramic monolithic block, the shape and internal cross section of the large diameter of the metal cone being identical to that of one face of the ceramic monolithic block.

[0006] To prevent egress of the hot exhaust gases at the area of contact between the metal cone and the ceramic monolithic block a length of thin ceramic material, in the form of an adhesive tape, is applied such that it adheres equally to both the external edge of the metal cone and the ceramic monolithic block and extends around the full circumference of both components to form a complete seal.

[0007] A layer of ceramic intumescent material is then applied to the external surface of the monolithic block and wrapped around it such that the monolithic block is totally enclosed circumferentially within the intumescent material.

[0008] The length of the enclosure of the intumescent

material is such that it projects beyond one edge of the ceramic monolithic block to also enclose the adhesive ceramic tape used to provide a gas tight seal between the metal cone and the ceramic monolithic block.

[0009] The intumescent ceramic material utilised to enclose the monolithic block and joint area with the metal cone has the property of rapid dimensional expansion when subjected to temperatures above 350°C and the purpose of its use within the catalytic converter enclosure is to provide both support for the ceramic monolithic block and a sealing medium between the outer circumference of the monolithic block and the internal surface of the metal enclosure system.

[0010] Whilst this system operates with a degree of effectiveness, it suffers from several inherent disadvantages which will deleteriously affect the longer term integrity, effectiveness and operational efficiency of the catalytic converter unit.

[0011] These disadvantages are listed as follows:

1. The linear thermal expansion of the metal cone and the vibrations inherent in any automotive hot engine exhaust gas system cause the rapid deterioration of the ceramic adhesive tape applied at the junction of the metal cone and ceramic monolithic block. As a result of the deterioration of the ceramic tape high velocity, high temperature exhaust gases are able to egress through the area between the end of the metal cone and the face of the ceramic monolithic block.

These high velocity exhaust gases have temperatures in the range 800°-960°C, which is above the suitable operating temperature of the intumescent material surrounding the circumferences of the metal cone and ceramic monolithic block.

In consequence, the intumescent material layer is rapidly degraded and the effectiveness of the required support and sealing properties reduced. The result of this reduction in support to the monolithic block from the intumescent material is that the metal cone and ceramic monolithic block suffer increasing misalignment with consequent increase in the rapidity with which the process of degradation of the intumescent support material occurs and consequent increasing operational loss of efficiency of the catalytic converter system.

2. The strength of the adhesive ceramic tape utilised to joint the metal cone and ceramic monolithic block is insufficient to damp out vibrations induced in the metal cone, arising from changes in engine operating speeds, or external road surfaces. In consequence, the edges of the metal cone impinge upon the nearest face of the ceramic monolithic block causing damage to the said face.

3. The requirement to utilise a combination of low strength adhesive ceramic tape and intumescent blanket material in the assembly process for the catalytic converter unit requires a process of rela-

tively long assembly time, of the order of 40 to 60 seconds, and is no guarantee of the correct inter-component alignment required for prolonged effective operation of a catalytic converter system.

DETAILED DESCRIPTION OF THE NEW INVENTION

[0012] The present invention relates to the use of a profiled knitted metal wire mesh ring interposed between the end of the fixed metal cone and the nearest face of the ceramic monolithic block of such a shape and configuration that it serves to hold the said metal cone and monolithic block in correct axial alignment, to ensure the optimum flow of the hot engine exhaust gases from the metal cone into the monolithic block such that the correct catalytic reactions may occur, and also interposes a flexible portion of the said shape and configuration between the edge of the metal cone and the face of the ceramic monolithic block such that thermal expansion of the metal cone linearly towards the face of the ceramic block is compensated for without permitting the two components to make contact and cause damage one to the other.

[0013] By virtue of the said knitted metal wire mesh ring providing axial alignment of the monolithic ceramic block to the metal cone it also provides a means of supporting the monolithic ceramic block from the fixed metal cone.

[0014] The knitted metal wire mesh ring is formed by joining together the two ends of a length of knitted wire mesh sleeve to form an endless ring and then forming the ring into a 'Tee' shape by means of appropriate tools such that the upper cross member of the 'Tee' is both more flexible and greater in width than the shortened downward member of the 'Tee' which is thickened into square or rectangular form of greater rigidity than the mesh constituting the upper member.

[0015] The inner circumference of the flat flexible component of the 'Tee' shaped ring is such that it matches the outer circumference of both the metal cone and the ceramic monolithic block.

[0016] By virtue of the aforesaid dimensional compatibility the 'Tee' shaped knitted metal wire mesh ring may be placed into position over the largest end of the metal cone such that the thickened section of the 'Tee' shape abuts to the edge of the end of the metal cone and one portion of the more flexible upper cross member of the 'Tee' shape circumferentially overlaps and grips a short length of the end of the metallic cone so forming a recessed socket into which the ceramic monolithic block may be accurately placed.

[0017] By a reverse procedure to the above, the knitted metal wire mesh ring may firstly be located onto one face of the ceramic monolithic block and the metal cone located into the recessed socket so formed.

[0018] It is an objective of the present invention that it should not only ameliorate the disadvantages of the current system as described previously, but additionally

provide advantages by virtue of the design, configuration and properties of the knitted metal wire mesh ring.

[0019] The advantages deriving from the present invention are set out below:

1. The flexibility of the more rigid shorter member of the 'Tee' section when interposed as a barrier between the fixed metal cone and ceramic monolithic block will deform in such a way that linear thermal expansion of the fixed metal cone may be accommodated without displacement of or damage to the associated ceramic monolithic block.

2. Although there are interstices within the compressed wire mesh structure of said rigid shorter member of the 'Tee' section, the density of the shorter member is such as to minimise the egress of hot exhaust gases through it such that their erosive capabilities are reduced to a level capable of being withstood by the surrounding intumescent sealing material.

3. By virtue of the method of interposing the profiled knitted metal wire mesh ring between the rigid metal cone and ceramic monolithic block and the flexibility of the mesh construction, the wire mesh ring is capable of absorbing and nullifying the vibrations set up in the hot exhaust gas system such that there is no damage to the ceramic monolithic block or impairment to the efficiency of the catalytic reactions.

4. The effect of the overlapping of the two halves of the longer component of the 'Tee' section, both onto the end of the fixed metal cone and the nearest end of the monolithic block, is to hold the two components in the correct axial alignment such that the flow of hot engine exhaust gases from the metal cone into the catalytic chambers of the ceramic monolith are maximised and the ceramic block is adequately supported by the fixed metal cone.

5. That the ease with which the knitted metal wire mesh ring may be used to join the metal cone and ceramic monolithic block reduces the final assembly time of the catalytic converter system with consequent economic benefits.

Claims

1. It is a claim of this present invention that the use of a knitted metal wire mesh ring having a 'Tee' shaped cross sectional configuration is a very effective means of providing the requisite axial alignment and separation and support between the fixed metal cone and the ceramic monolithic catalyst block of a catalytic converter system for automotive use ameliorating the disadvantages of the current system and providing additional advantages for the operational effectiveness of said catalytic converter system as precedingly disclosed.

2. A claim as in claim 1 whereby the 'Tee' section of the knitted metal wire mesh ring has a configuration whereby the ratio of the width of the upper cross component of the said 'Tee' section to the shorter more rigid stem of the said 'Tee' section has the range of 3:1 to 7:1, but preferentially is of the order of 4.5:1. 5

3. A claim as in claims 1 and 2 whereby the shape or form of the more rigid shorter stem of the 'Tee' section may be square, rectangular, triangular, part circular, and with or without recesses, lips or edges or combinations of any of the precedingly described forms or shapes. 10

4. A claim as in claims 1-3 inclusively whereby the composition of the metal or alloy utilised in wire form for the knitting process to produce the knitted metal wire mesh ring may be any such as is available in wire form but preferentially be of those compositions made up of combinations including nickel and chrome and known variously as stainless steels. 15

5. A claim as in claims 1-4 inclusively whereby some other substances which are non-metallic may be so combined with the wire mesh as to fill any interstices within the wires constituting the more rigid shorter stem of the said 'Tee' section but preferentially be ceramic materials in fibre form. 20

6. A claim as in claims 1-5 inclusively whereby the design and construction of the two flexible wire mesh parts comprising the longer top component of the 'Tee' section may be such that they provide a gripping function more variously known as "self tightening action" to more securely align and support the two separate components which are so conjoined by the knitted metal wire mesh ring. 25

7. A claim as in claims 1-6 inclusively whereby the design and construction of the more rigid and shorter member of the 'Tee' section of the knitted metal mesh ring is such that it accommodates the linear thermal expansion of one or both components of a catalytic converter to which it is conjoined that neither component suffers any resulting operational damage or loss of operational efficiency. 30

8. A claim as in claims 1-7 inclusively whereby the design and construction of the knitted metal wire mesh ring is of sufficient flexibility as to absorb and nullify the deleterious vibrations arising in the hot exhaust gas system of an internal combustion engine such that damage to or loss of operational efficiency of any of the components in a catalytic converter system to which it is conjoined is prevented. 35

9. A claim as in claims 1-8 inclusively whereby the design and construction of the knitted metal wire mesh ring is such that its flexibility will allow components having irregular edges or surfaces to be supported and aligned without damage or loss of operational efficiency of the catalytic converter system. 40

10. A claim as in claims 1-9 inclusively whereby the design and construction of the 'Tee' shaped knitted metal wire mesh ring are such as to greatly facilitate the assembly of the components comprising a catalytic converter system with consequent economic benefits. 45

11. A claim as in claims 1-10 inclusively whereby the design and construction of the knitted metal wire mesh ring is such that it accommodates the linear thermal expansion of one or both components of a catalytic converter to which it is conjoined that neither component suffers any resulting operational damage or loss of operational efficiency. 50

12. A claim as in claims 1-11 inclusively whereby the design and construction of the knitted metal wire mesh ring is of sufficient flexibility as to absorb and nullify the deleterious vibrations arising in the hot exhaust gas system of an internal combustion engine such that damage to or loss of operational efficiency of any of the components in a catalytic converter system to which it is conjoined is prevented. 55