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(54) **Composite metal mesh and ceramic fibre exhaust gas sealing and support mounting device for use with catalytic converter systems**

(57) A composite metal mesh and ceramic fibre exhaust gas sealing and support mounting device for use with catalytic converter systems, comprised of heat resistant ceramic fibres enclosed within a heat resistant knitted mesh structure in such a configuration that the ceramic fibres fill the interstices between the strands of knitted wire in such a way that when fitted to the ceramic monolith of an automotive exhaust catalytic converter system it both supports the monolith securely within the surrounding metal enclosure and acts as a seal between the exterior surface of the said monolith and interior surface of the said metal enclosure forcing the hot exhaust gases to pass through the ceramic monolith and to be reacted as desired with the catalytic agents within the monolith.

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Description

1. BACKGROUND OF THE INVENTION

[0001] The present invention relates to a catalytic converter or diesel particulate trap used to clean the exhaust gas of an internal combustion engine where the catalytic converter system is mounted in close proximity to the engine exhaust gas manifold and subjected to higher exhaust gas temperatures in the region of 800°C to 1000°C than those experienced by the conventional catalytic system mounted beneath the car body and subjected to exhaust gas temperature not exceeding 700°C.

[0002] Currently the catalytic converter systems utilised with internal combustion engines are of relatively large thermal mass and utilise support and thermal sealing systems which are not suitable for use where the engine exhaust gas temperatures exceed 700°C and are generally of the type set out and described in Patent No EU 0366484.

[0003] Whilst these are effective in general use for prolonged engine operation, they are ineffective and inoperable for short periods of engine operation as the heat from the exhaust gases is insufficient to raise the monolithic converter bodies to a temperature at which the catalytic reaction required for the oxidation of carbon monoxide and hydrocarbons and the reduction of the oxides of nitrogen in the exhaust gas will occur.

2. FIELD OF THE INVENTION

[0004] Increasingly stringent environmental legislation now requires that this defect of the current system be remedied such that catalytic oxidation and reduction of the engine exhaust gases commences virtually from the moment at which the engine is started.

[0005] This requires almost instantaneous heating of the ceramic monolith containing the catalytic reagents and a projected solution is to affix a smaller ceramic monolithic catalyst block in very close proximity to the engine exhaust manifold, and one initial term used to describe such a system is a PRE CAT CONVERTER.

[0006] Situated in such close proximity to the engine exhaust gas manifold the PRE CAT CONVERTER system will be subjected to exhaust gas temperatures in the region of 800°C - 1000°C, severe pressure pulsations and very high exhaust gas velocities.

[0007] Whilst it is anticipated that the ceramic monoliths will withstand such conditions, it is known that the intumescent mounting and sealing materials as described in EP 0366484 will not operate and their inclusion in the anticipated PRE CAT CONVERTER system is consequently not possible.

[0008] It is known that the ceramic monolithic blocks containing the catalytic reagents present an appreciable resistance to the flow of the hot engine exhaust gases and that unless the monolith is correctly supported and

sealed within the metal enclosure system the hot gases will preferentially flow around the monolithic block. The effectiveness of the catalytic reaction on the hot exhaust gases is consequently greatly dependent upon the effectiveness of the support and sealing system.

3. DESCRIPTION OF THE INVENTION

[0009] The present invention relates to a form of sealing ring which also acts as a form of support at the end of the monolithic block which combines heat resistant ceramic fibres enclosed within a heat resistant knitted wire mesh in such a configuration that the fibres fill the interstices between the strands of knitted wire and so prevent the passage of the hot exhaust gases through the combined structure forcing them to pass through the ceramic monolith and hence to react as desired with the catalytic agents within the monolith.

[0010] The heat resistant ceramic fibres may consist of any material capable of withstanding the exhaust gas temperatures in the region of 800°C - 1000°C, as for example fibres of expanded alumina, titania or silica fibres or combinations of these substances, although silica is generally preferred.

[0011] The heat resistant metals used as the knitted wire containment may be of any alloy composition which will withstand oxidation and degradation at temperatures in the region of 1000°C, but generally those alloy combinations containing nickel and chromium and known variously as stainless steels are preferred.

[0012] Various methods may be used to obtain the appropriate admixture of ceramic fibres and knitted wire mesh including the surrounding of a knitted wire sleeve of an appropriate length with a thin layer of randomly laid ceramic fibres in the form of a blanket such that when the knitted wire sleeve is rolled back on itself there is produced a tubular ring comprised of alternate layers of knitted wire mesh and ceramic fibres.

[0013] A second method which may be used with this present invention is to wind a strand composed of ceramic fibres in a spiral form around the said knitted wire sleeve at a sufficient pitch such that when the knitted wire mesh sleeve is rolled back on itself there is again produced a tubular ring comprised of alternate circular layers of knitted wire and ceramic fibres.

[0014] It is another feature of this present invention that the ceramic fibre may be combined with the wire mesh in the knitting operation whereby the fibre then forms an intimate component of the knitted mesh such that when an appropriate length of the knitted sleeve is rolled back on itself there is produced a tubular ring comprised of ceramic fibres intimately admixed with the knitted mesh.

[0015] It is a feature of this present invention that the ratio by weight of the knitted wire mesh to the ceramic fibre material may be varied by any of the above methods to be within the range of equality to 25:1 but a ratio of 7:1 is generally preferred.

[0016] It is a feature of this present invention that the tubular ring produced by rolling the combination of knitted wire mesh and ceramic fibres may be compressed or formed into any required cross sectional configuration by use of the appropriate formed tools. The cross sectional configurations so produced may include such forms as square, rectangular, part circular, triangular or any combination of such shapes, with or without edges, lips or recesses.

4. ADVANTAGES OF THE INVENTION

[0017] The advantages of the present invention over those systems utilising intumescent and other lower operating temperature materials in the PRE CAT CONVERTER system are considered to be numerous and including those listed subsequently:

i That the present invention will withstand the higher engine exhaust gas temperatures in the region of 800°C - 1000°C by virtue of the combination of both heat resistant metal alloys and ceramic fibres.

ii That the arrangement of the ceramic fibres within the knitted wire mesh, such that the said fibres fill the interstices between the wire strands effectively provides a structure capable of resisting the passage of hot exhaust gases through the said structure, thus forcing the full gas flow to pass through the ceramic monolith and be subject to catalytic reaction.

iii That the continuity of the ceramic fibre within the tubular ring eliminates any joints through which the exhaust gases may percolate.

iv That the composite tubular ring of knitted wire mesh and ceramic fibres may be compressed or formed into any required profile such that it may intimately link with other components of the PRE CAT CONVERTER system to act not only as a circumferential seal, but also as a support and lateral seal as may be required for the effective operation of the said system.

v That the compactness and density of the seal configurations may be varied to comply with varying operational requirements by adjusting the ratio by weight of the ceramic fibres and knitted wire mesh and additionally the forces applied in the forming operation used to produce the required final cross sectional configuration from the initial tubular ring.

vi That further compression of the composite knitted mesh and ceramic fibre seal ring between the ceramic monolithic block and the metal enclosure used to contain the PRE CAT CONVERTER assembly enhances the seal effect.

vii That the effectiveness of the knitted wire and ceramic fibre seal in preventing the hot engine exhaust gases from by-passing the ceramic monolith eliminates the need for the use of intumescent material in the support system of the ceramic mon-

olithic block, consequently permitting the use of simpler and more cost effective wire support configurations.

viii That by virtue of the capability of the knitted wire mesh ceramic fibre composite ring to be formed into any specified profile and to be easily located into the appropriate operating position, the assembly of the final component system is greatly facilitated with consequent economic benefits.

Claims

1. An improved sealing and support ring for use with ceramic monolithic catalyst blocks within a catalytic converter situated in close proximity to the exhaust manifold of an internal combustion engine wherein the exhaust gas temperatures are in the region of 800°C - 1000°C comprised of a knitted wire mesh structure closely combined with heat resistant ceramic fibres such that the admixture of ceramic fibres fill the interstices of the knitted mesh structure and are so supported by the knitted mesh structure that the composite sealing ring prevents the hot exhaust gases from by-passing the monolithic block thus ensuring that all the exhaust gases are subject to catalytic action to reduce their toxicity as required by legislation.
2. A claim as in claim 1 whereby the composition of the wire utilised to produce the knitted wire supporting structure may be any metal or metal alloy capable of resisting oxidation or degradation by the hot engine exhaust gases in the region of 800°C - 1000°C.
3. A claim as in claims 1 and 2 whereby the preferred heat resistant alloy for the knitted mesh is one of the nickel and chrome alloys generally known as stainless steels.
4. A claim as in claims 1-3 inclusively whereby the composition of the heat resistant ceramic fibre may be of any composition capable of withstanding degradation by the hot exhaust gases in the temperature range of 800°C - 1000°C and may include fibres of alumina, titania or silica or combinations of the said fibres.
5. A claim as in claims 1-4 inclusively whereby the preferred heat resistant ceramic fibre material is silica.
6. A claim as in claims 1-5 inclusively whereby the ceramic fibres are intimately dispersed within the knitted wire structure by including the ceramic fibres in the form of thread or yarn as one or more components of the knitting production process.

7. A claim as in claims 1-6 inclusively whereby the proportion of heat resistant wires to the heat resisting ceramic fibres may be varied by the ratio of wires to fibres in the knitting production process.

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8. A claim as in claims 1-7 inclusively whereby the ceramic fibres may be combined with the knitted structure in the form of a thin layer of randomly laid ceramic fibres applied onto the knitted wire mesh sleeve prior to rolling into a tubular ring.

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9. A claim as in claims 1-8 inclusively whereby the ceramic fibres may be combined with the knitted wire structure by helically winding the ceramic fibres in the form of thread or yarn around the knitted wire mesh sleeve prior to rolling into a tubular ring.

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10. A claim as in claims 1-9 inclusively whereby the ratio of knitted wire to ceramic fibres by weight may be varied by increasing the amount of ceramic fibre applied to the knitted wire mesh structure.

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11. A claim as in claims 1-10 inclusively whereby the ratio by weight of knitted wire to ceramic fibres may range from an equality to 25:1 but is generally preferred to be in the ratio of 7:1.

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12. A claim as in claims 1-11 inclusively whereby the tubular ring produced by rolling the knitted wire sleeve upon itself in combination with the ceramic fibres may be subsequently formed into a wide variety of cross sectional forms, shapes and configurations by the use of shaped tooling exerting a circumferential, diametrical or axial compressive force or a combination of such forces.

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13. A claim as in claims 1-12 inclusively whereby the variety of cross sectional forms, shapes and configurations into which the tubular ring may be compressively formed includes square, rectangular, triangular or part circular or any combination of such said shapes, forms and configurations with or without edges, lips or recesses.

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14. A claim as in claims 1-13 inclusively whereby the method of combining the ceramic fibre and knitted wire mesh is such as to provide a continuous ring of the ceramic fibres when the knitted wire mesh is rolled into tubular form such that there is no joint in the ceramic fibre ring through which the hot engine exhaust gases may pass.

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15. A claim as in claims 1-14 inclusively whereby the density of the sealing ring comprising of knitted wire mesh and ceramic fibres may be altered to comply with varying operational conditions by adjusting the ratio by weight of the wire and ceramic fibres, and

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additionally the compressive forces applied in the forming operation used to produce the required final cross sectional form, shape or configuration from the initial tubular ring.

16. A claim as in claims 1-15 inclusively whereby the effectiveness of the composite sealing ring in preventing passage of hot engine exhaust gases around the periphery of the monolithic block eliminates the need to use intumescent material in the support system of the ceramic monolithic block.

17. A claim as in claims 1-16 inclusively whereby the use of such composite knitted mesh and ceramic fibre sealing rings may facilitate the assembly of the PRE CAT CONVERTER system with consequent economic benefits.

18. A claim as in claims 1-17 inclusively whereby the compressive forces applied to the sealing ring by virtue of the assembly of the monolithic block and sealing ring into the metal enclosure to form the PRE CAT CONVERTER additionally enhance the density of the sealing ring and its ability to prevent the passage of hot engine exhaust gases through it.