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(54) **COMPACT COULOMB DAMPER**

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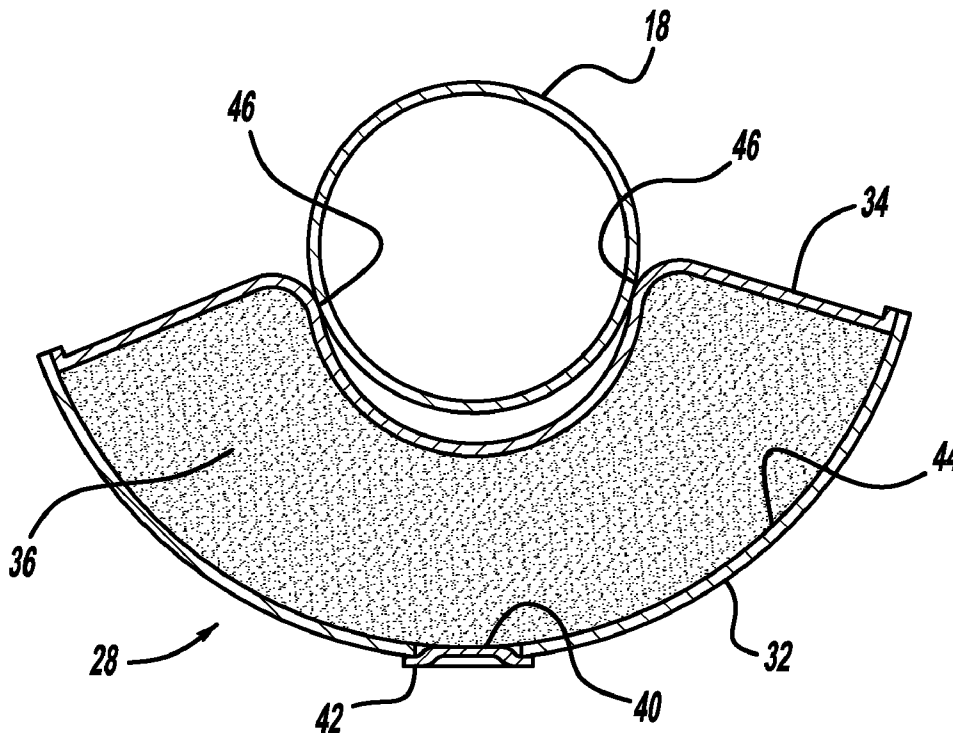
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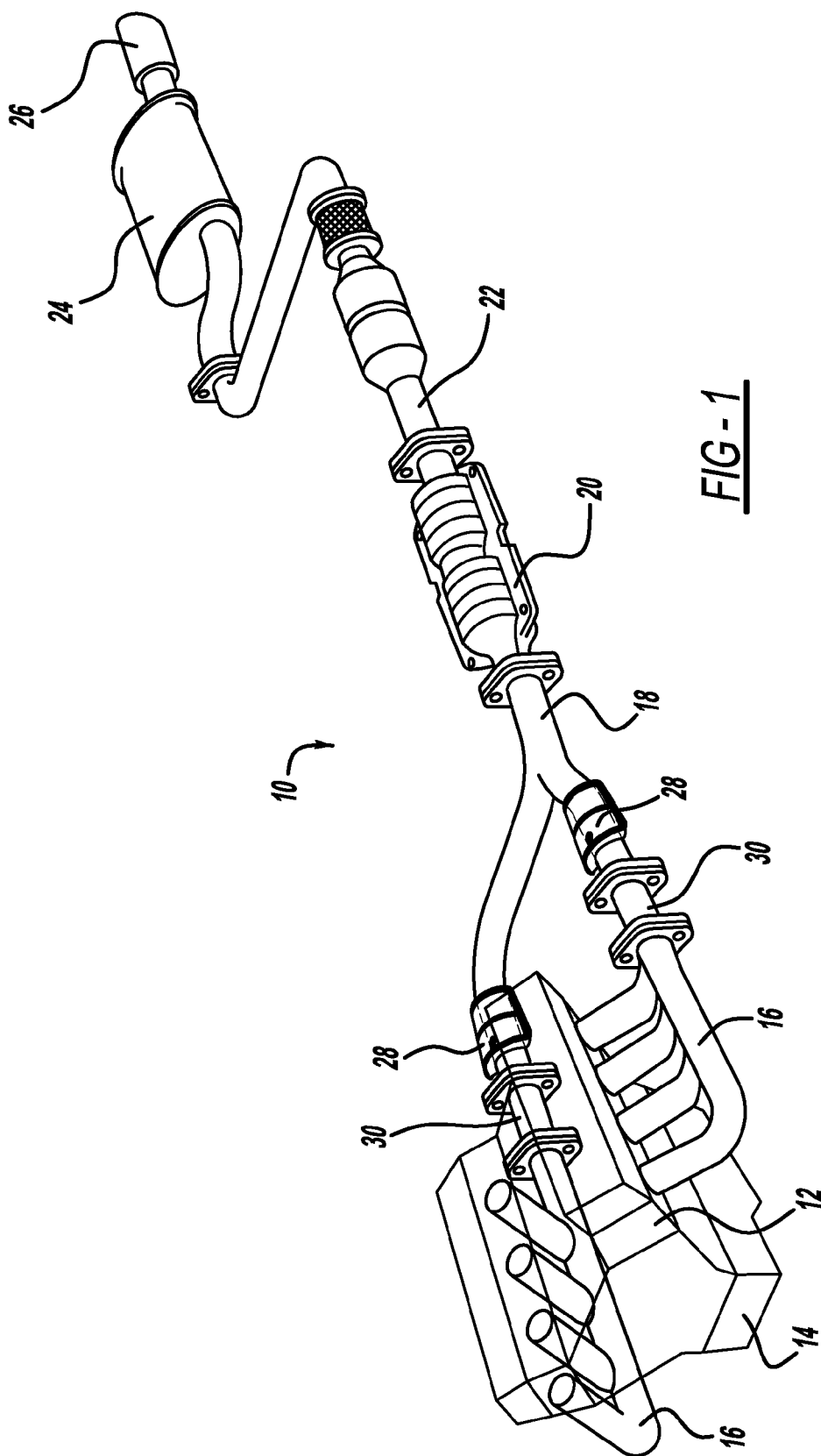
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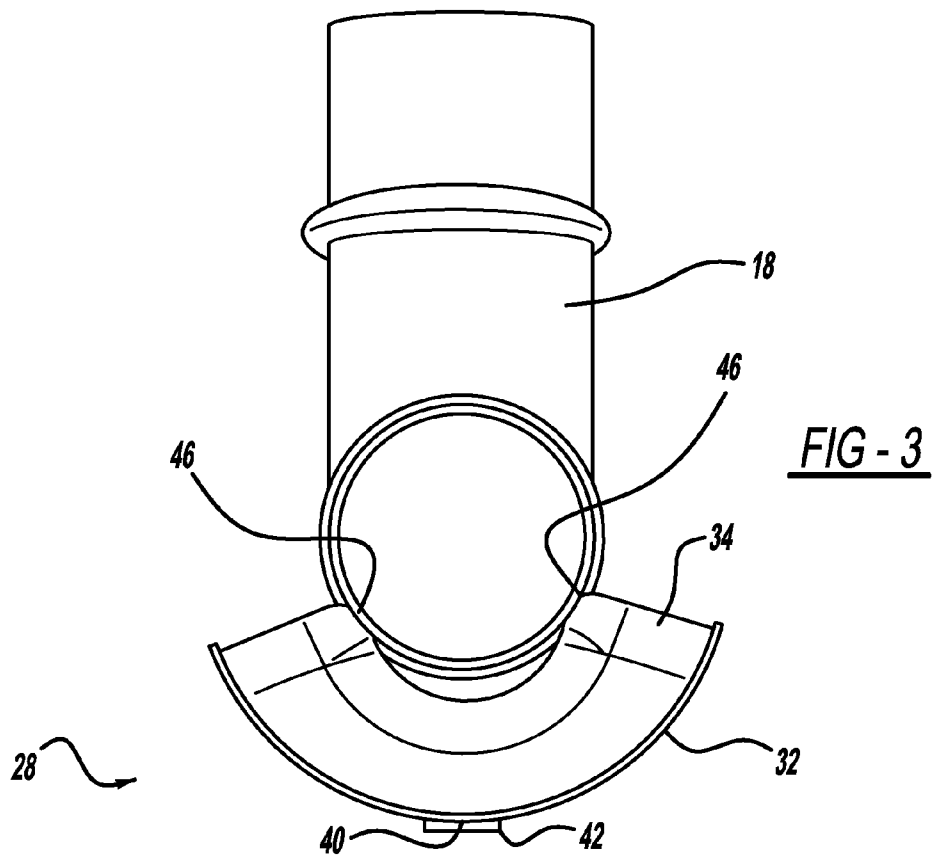
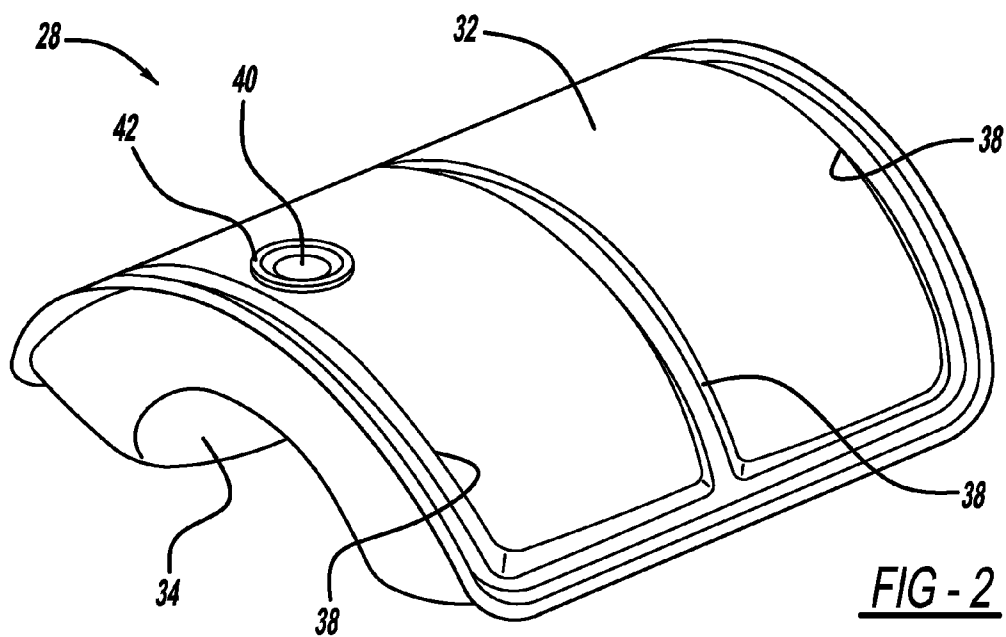
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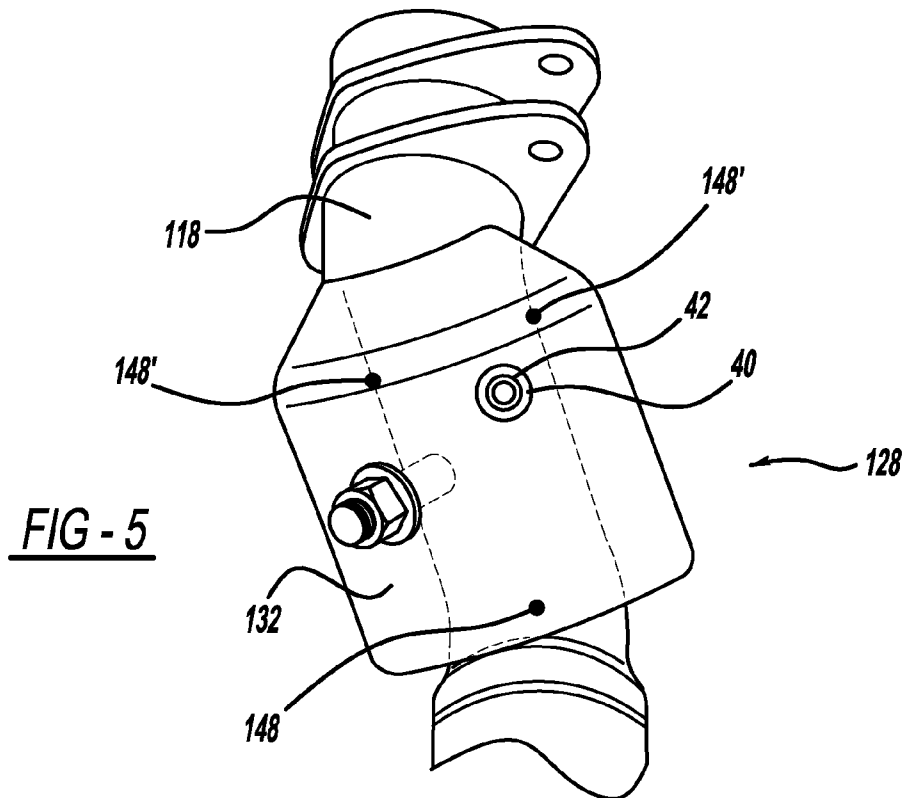
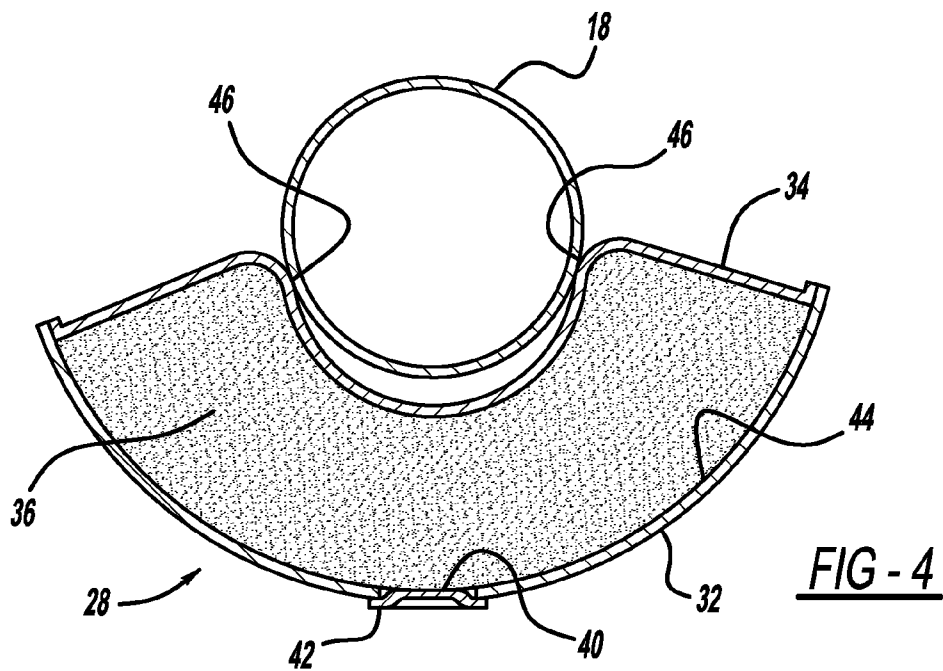
(57) **ABSTRACT**

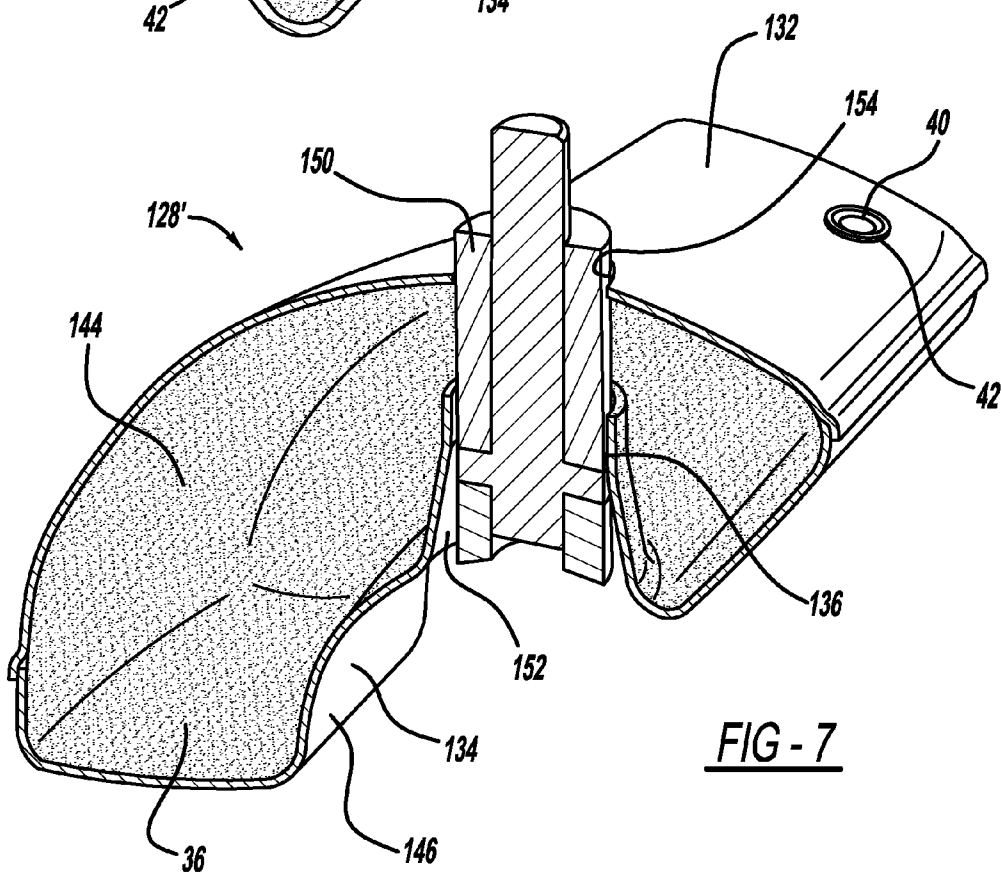
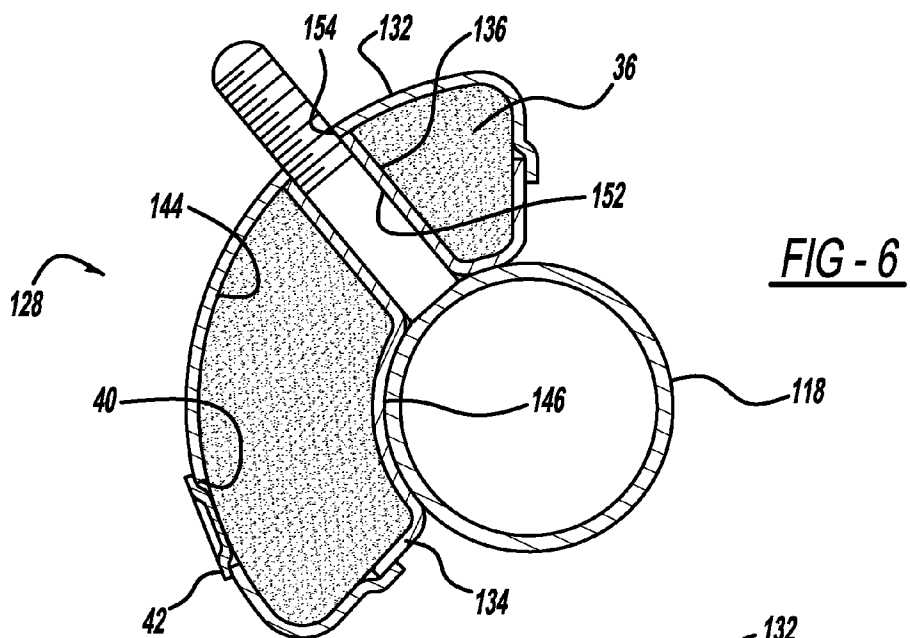
A coulomb damper is attached to a component of an exhaust system. The inner surface of the coulomb damper is in intimate contact with the outer surface of the component of the exhaust system. The intimate contact is defined by a pair of weld lines extending along an axial length of the coulomb damper in one embodiment. In another embodiment, the intimate contact is defined by at least a three point contact between the coulomb damper and the component of the exhaust system. In another embodiment a coulomb damper includes an outer member press fit over an inner member. A chamber is defined between the inner and outer member. In one embodiment, the inner member and the outer member are coaxial and the chamber is an annular chamber having a constant radial width. In another embodiment, the chamber is eccentric in relation to the inner member and has a variable radial width.

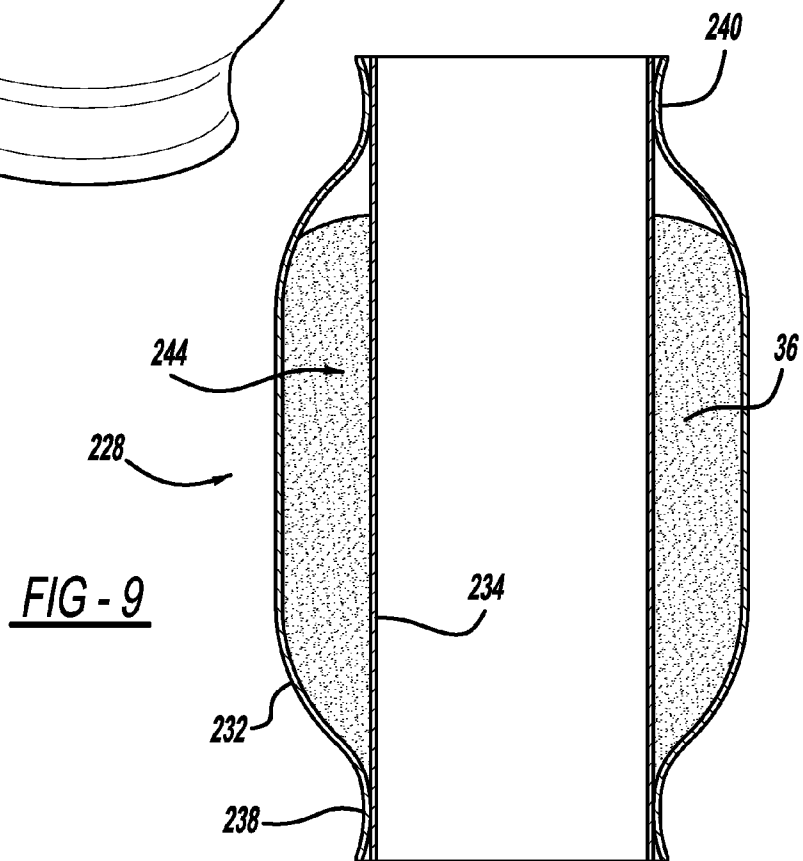
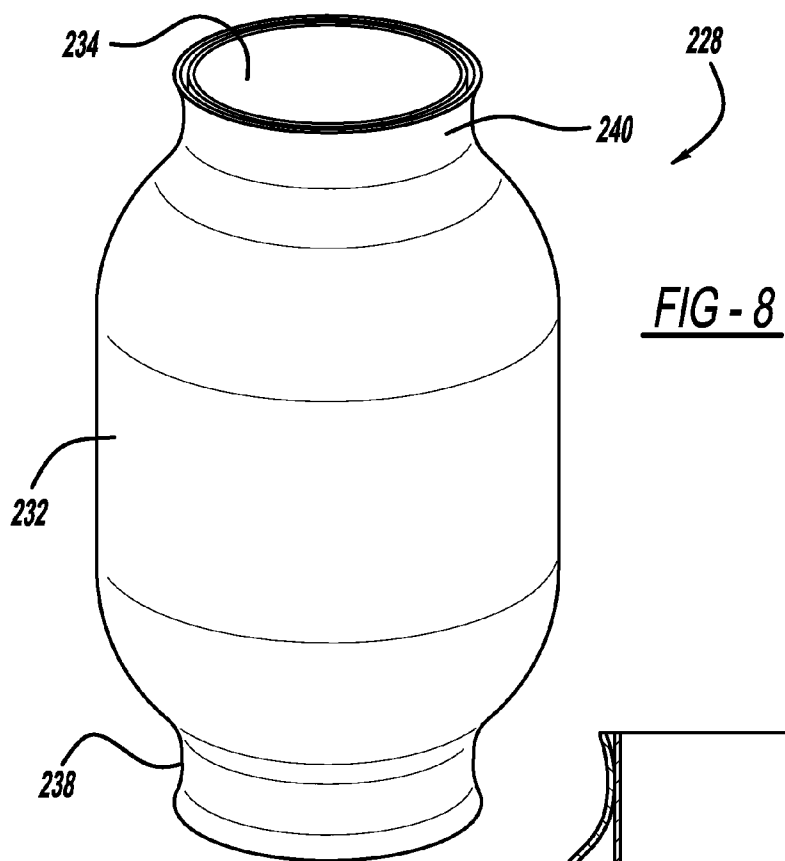


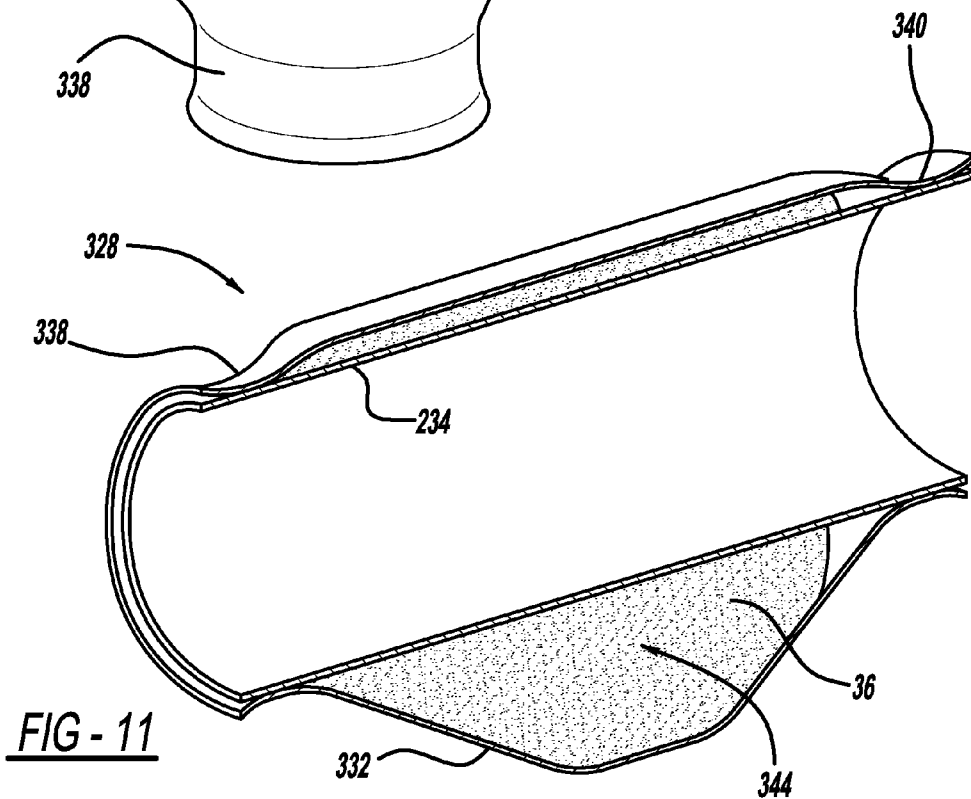
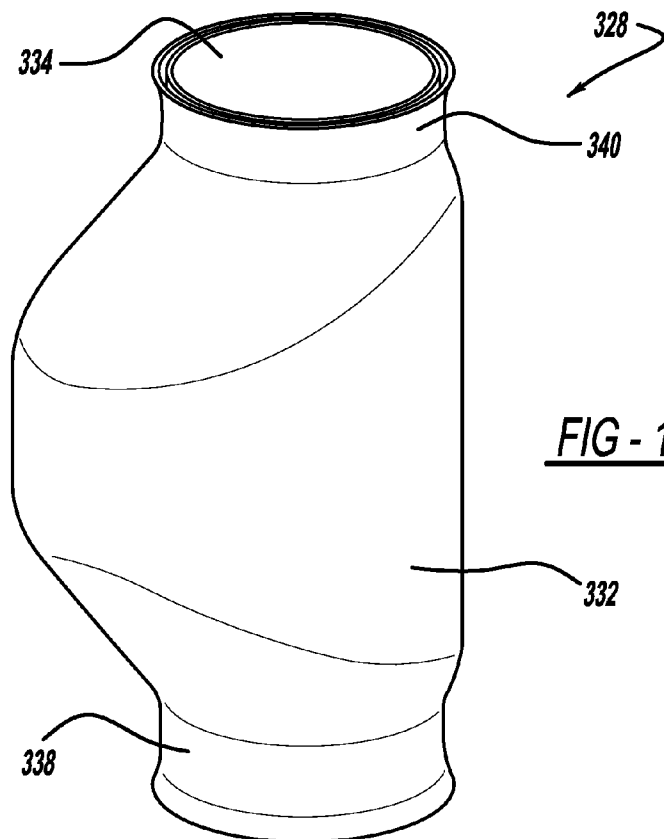












COMPACT COULOMB DAMPER

SUMMARY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 13/209,613 filed on Aug. 15, 2011 which is a continuation-in-part of U.S. patent application Ser. No. 13/050,032 filed Mar. 17, 2011. This application claims the benefit of U.S. Provisional Application No. 61/379,491, filed on Sep. 2, 2010. The entire disclosures of the above applications are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to a coulomb damper for an automotive/truck exhaust system. More particularly, the present disclosure relates to a compact coulomb damper which is intimately attached directly to an exhaust pipe of the automotive/truck exhaust system.

BACKGROUND

[0003] This section provides background information related to the present disclosure which is not necessarily prior art.

[0004] Typically, automotive vehicles including cars and trucks have an internal combustion engine (gasoline or diesel) which is coupled to at least a transmission and a differential for providing power to the driven wheels of the vehicle. An engine exhaust system which typically includes one or more exhaust pipes, one or more turbochargers, one or more catalytic converters, one or more mufflers and one or more tailpipes is attached to the engine to quiet the combustion process, to clean the exhaust gases and to route the products of combustion away from the engine. The internal combustion engine is supported in the vehicle on a set of flexible engine mounts which are positioned between a frame or other supporting structure and the engine. The exhaust system is supported by exhaust mounts which are positioned between the exhaust system and the frame or other supporting structure of the vehicle's body. In order to minimize engine vibrations from being transmitted to the vehicle's body, the exhaust mounts incorporate flexible mounting members and/or elastic suspension members.

[0005] Even with using the flexible engine mounts and the flexible exhaust mounts, the operation of the engine at the various operating conditions for the engine can cause offensive noise, vibration or harshness (NVH) issues. Various solutions to these NVH issues have been proposed. A frequency NVH issue can be addressed by adding dead mass weights to the system, adding a tuned damper and/or adding a coulomb damper.

[0006] The addition of dead mass weights to the system will simply shift the natural frequency of the system to a lower frequency. Adding a tuned damper will only address a specific frequency. The tuned damper accomplishes this by shifting the natural frequency amplitude into a lesser amplitude at a frequency above and below the original. A coulomb damper is comprised of a canister filled with impact media such as shot or sand. A coulomb damper is a broadband solution which is sensitive to the quantity, density, geometry and friction of the impact media inside the canister. In addition, the efficiency of the energy transmission from the exhaust system into the impact media of the coulomb damper is critical to the operation and effectiveness of the coulomb damper.

[0007] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0008] The present disclosure provides the art with a coulomb damper which includes a large quantity of impact media and which is intimately mounted to the exhaust system to provide excellent energy transmission into the impact media. The rigid canister which holds the impact media transmits the energy from the exhaust system into any impact media that contacts the walls of the canister. The energy transmission between the exhaust system and the coulomb damper is improved by using at least a three point mounting system where the coulomb damper is bolted directly to an exhaust pipe or the energy transmission is improved when the coulomb damper is welded directly to the exhaust pipe. This system is an improvement over a system which uses a bracket to mount a damper because the bracket impedes energy transmission.

[0009] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0010] The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0011] FIG. 1 is a perspective view of an exhaust system which includes a coulomb damper in accordance with the present disclosure;

[0012] FIG. 2 is a perspective view of one of the coulomb dampers illustrated in FIG. 1;

[0013] FIG. 3 is an end view of the coulomb damper illustrated in FIG. 2 attached to an exhaust pipe of the exhaust system illustrated in FIG. 1;

[0014] FIG. 4 is an end cross-sectional view of the coulomb damper illustrated in FIG. 1;

[0015] FIG. 5 is a perspective view of a coulomb damper in accordance with another embodiment of the present disclosure;

[0016] FIG. 6 is an end cross-sectional view of the coulomb damper illustrated in FIG. 5;

[0017] FIG. 7 is an end perspective view partially in cross-section of a coulomb damper in accordance with another embodiment of the present disclosure; and

[0018] FIG. 8 is a perspective view of a coulomb damper in accordance with another embodiment of the present disclosure;

[0019] FIG. 9 is a cross-sectional view of the coulomb damper illustrated in FIG. 8;

[0020] FIG. 10 is a perspective view of a coulomb damper in accordance with another embodiment of the present disclosure; and,

[0021] FIG. 11 is a perspective view in cross-section of the coulomb damper illustrated in FIG. 10.

[0022] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

[0023] Example embodiments will now be described more fully with reference to the accompanying drawings.

[0024] Referring now to the drawings, in which like reference numerals designate like or corresponding parts throughout the several views, there is illustrated in FIG. 1 an exhaust system in accordance with the present disclosure and which is designated by the reference numeral 10. Exhaust system 10 is attached to exhaust headers 12 of an internal combustion engine 14. Internal combustion engine 14 is designed to power one or more drive wheels of the vehicle through a transmission (not shown) and one or more differentials (not shown) as is well known in the art.

[0025] Exhaust system 10 comprises a pair of front exhaust pipes 16, a mid-pipe 18, a catalytic converter 20, a rear exhaust pipe 22, a muffler 24, a tailpipe 26, a pair of coulomb dampers 28 and one or more turbochargers 30 (shown schematically). Exhaust system 10 routes the products of combustion from internal combustion engine 14 which are collected by exhaust headers 12 to the outer periphery of the vehicle. As illustrated in FIG. 1, exhaust system 10 routes the products of combustion for internal combustion engine 14 to the rear of the vehicle. While illustrated as routing products of combustion to the rear of the vehicle, exhaust system 10 can be configured to route the products of combustion to any peripheral location of the vehicle including but not limited to the side or sides of the vehicle.

[0026] As illustrated, a pair of front exhaust pipes 16 are attached to a pair of turbochargers 30 which are attached to a single mid-pipe 18 which is attached to a single catalytic converter 20 which is attached to a single rear exhaust pipe 22 which is attached to a single muffler 24 which is attached to a single tailpipe 26. It is within the scope of the present disclosure to have a single front exhaust pipe 16 attached to a single turbocharger attached catalytic converter 20 to provide a single path exhaust system. It is also within the scope of the present disclosure to have the pair of front exhaust pipes 16 attached to the pair of turbochargers 30 attached to a pair of mid-pipes 18 which can be attached to a pair of catalytic converters 20 which can be attached to a pair of rear exhaust pipes 22 which can be attached to a pair of mufflers 24 which can be attached to a pair of tailpipes 26 to provide a dual path exhaust system. Thus, exhaust system 10 can be configured to be a single path exhaust system, a dual path exhaust system or any other configuration of exhaust system known in the art.

[0027] During the operation of the vehicle and internal combustion engine 14, vibrations generated by the internal combustion engine 14, the turbochargers 30 and the vehicle can create offensive noise, vibration or harshness (NVH) issues. Coulomb dampers 28 are intimately attached to components of exhaust system 10 to address these offensive NVH issues. While coulomb dampers 28 are illustrated as being intimately attached to mid-pipe 18, it is within the scope of the present disclosure to attach coulomb dampers 28 to any component of exhaust system 10 including but not limited to front exhaust pipes 16, mid-pipe 18, catalytic converter 20, rear exhaust pipe 22, muffler 24 and/or tailpipe 26.

[0028] Referring now to FIGS. 2-4, coulomb damper 28 is illustrated in greater detail. Coulomb damper 28 comprises a canister formed by an outer member 32, an inner member 34, and a specified volume or mass of impact media 36. Outer member 32 is an arcuate or curved shaped metal stamping that defines a plurality of stiffening ribs 38 that act as alignment features for inner member 34 as well as providing the neces-

sary stiffness or strength to coulomb damper 28. A fill port 40 extends through outer member 32 at a specified position which simplifies the addition of impact media 36 into coulomb damper 28. A button cap 42 closes fill port 40 after the addition of impact media 36. Button cap 42 is welded or otherwise attached to outer member 32 to maintain impact media 36 within a chamber 44 defined by coulomb damper 28. The longitudinal length, the curved length and the space between outer member 32 and inner member 34 are selected to provide a specific volume of impact media 36 while at the same time providing specific clearances with other components of the vehicle when exhaust system 10 is installed in the vehicle. In addition, when designing coulomb damper 28, both the clearances in the assembled position of exhaust system 10 and the clearances necessary to provide routine maintenance and/or replacement of components of the vehicle are taken into consideration.

[0029] Inner member 34 is an arcuate or curved cup shaped metal stamping that conforms to mid-pipe 18 and is welded or otherwise attached to outer member 32 to define chamber 44. Inner member 34 defines a pair of small radii 46, 5 mm in the preferred embodiment, that extend along the longitudinal length of inner member 34 and thus coulomb damper 28. As illustrated in FIGS. 3 and 4, the diameter of the arcuate or curved portion of inner member 34 is designed to be slightly smaller than the outside curve of mid-pipe 18. This feature ensures that the outer surface of inner member 34 defined by radii 46 contact mid-pipe 18 entirely along a pair of contact areas extending an entire length of inner member 34 to provide the intimate contact between mid-pipe 18 and coulomb damper 28. This feature will also minimize the required weld fillet simplifying the welding of coulomb damper 28 to mid-pipe 18.

[0030] Impact media 36 can be steel shot, sand or any other impact media known in the art. The design of coulomb damper 28 provides a large quantity of impact media 36 (25 cubic inches in the preferred embodiment) that is intimately attached (welded) to mid-pipe 18 to provide excellent energy transmissibility from mid-pipe 18 into impact media 36. The rigid design of outer and inner members 32 and 34 also transmit the energy into any impact media 36 that is in direct contact with the inner surfaces of outer and inner members 32 and 34. Coulomb damper 28 provides a large canister volume constrained in intimate contact with mid-pipe 18 which provides a compact design for any application. Coulomb damper 28 is welded to mid-pipe 18 for excellent energy transmissibility. Outer and inner members 32 and 34 are designed to provide the optimized density, geometry, quantity, air space for movement and friction for impact media 36.

[0031] Referring now to FIGS. 5-7, coulomb dampers 128 and 128' are illustrated attached to a mid-pipe 118. Mid-pipe 118 can replace mid-pipe 18 and coulomb dampers 128 and 128' can replace coulomb damper 28 in exhaust system 10. In addition, coulomb dampers 128 and 128' can be attached to any component of exhaust system 10 similar to coulomb damper 28 as discussed above. Coulomb dampers 128 and 128' comprise a canister formed by an outer member 132, an inner member 134, an inner tube 136 and impact media 36.

[0032] Outer member 132 is an arcuate or curved shaped metal stamping. While not illustrated in FIGS. 5-7, outer member 132 can include stiffening ribs 38 for alignment and stiffness increase as discussed above for outer member 32. Fill port 40 extends through outer member 132 at a specified position that simplifies the addition of impact media 36 into

coulomb dampers 128 and 128'. Button cap 42 closes fill port 40 after the addition of impact media 36. Button cap 42 is welded or otherwise attached to outer member 132 to maintain impact media 36 within a chamber 144 defined by coulomb dampers 128 and 128'. The longitudinal length, the curved length and the space between outer member 132 and inner member 134 are selected to provide a specific volume of impact media 36 while at the same time providing specific clearances with other components of the vehicle when exhaust system 10 is installed in the vehicle. In addition, when designing coulomb dampers 128 and 128', both the clearances in the installed position of exhaust system 10 and the clearances necessary to provide routine maintenance and/or replacement of components of the vehicle are taken into consideration.

[0033] Inner member 134 is an arcuate or curved cup shaped metal stamping that is welded or otherwise attached to outer member 132 to define chamber 144. Inner member 134 defines an inner curved surface 146 that extends along the longitudinal length of inner member 134 and thus coulomb dampers 128 and 128'. As illustrated in FIG. 6, the size of the inner curved surface 146 is designed to be the same as the outside diameter of mid-pipe 118. This feature provides a three point contact between coulomb dampers 128 and 128' and mid-pipe 118 as illustrated by lower points 148 and upper points 148' in FIG. 5. Coulomb dampers 128 and 128' are designed with an interference fit to a top of a pipe bend in mid-pipe 118 to create an initial primary touch point as illustrated by lower point 148 illustrated in FIG. 5. Lift off creates the second and third touch points as illustrated by the upper points 148' in FIG. 5 to create a stable tripod footing spaced from the mounting bolt. This three point contact provides the stable tripod footing spaced away from the mounting bolt creating a tensile load only on the mounting bolt. There is no cantilever loading on the mounting bolt. This three point contact and subsequent tightening of the retaining nut on the mounting bolt provides the intimate contact between mid-pipe 118 and coulomb dampers 128 and 128'. The embodiment in FIG. 7 also includes the three point contact described above.

[0034] Inner tube 136 extends between outer and inner members 132 and 134 as illustrated in FIGS. 6 and 7. In FIG. 6, inner tube 136 is designed to accept the mounting bolt that is welded or otherwise secured to mid-pipe 118. In FIG. 7, inner tube 136 is designed to accept a tubular bushing 150 which is designed to accept the mounting bolt that is welded, threaded or otherwise attached to mid-pipe 118. Inner member 134 defines a drawn hole 152 formed by inner tube 136. Outer member 132 defines an aperture 154. In the embodiment of FIG. 6, inner tube 136 extends out to outer member 132 where it is welded or otherwise secured to the portion of outer member 132 that defines aperture 154. In the embodiment of FIG. 7, tubular bushing 150 extends through inner tube 136, drawn hole 152 and aperture 154. Bushing 150 is welded or otherwise secured to inner tube 136 and welded or otherwise secured to the portion of outer member 132 that defines aperture 154. In FIG. 6, inner tube 136 and bushing 150 are designed to not withstand the proof load of the mounting bolt. Thus, excessive torque applied to the retaining nut on the mounting bolt will cause inner tube 136 and bushing 150 to collapse and will not cause the mounting bolt to fail. In the embodiment of FIG. 7, inner tube 136, bushing 150 and outer member 132 are designed to exceed the proof load of the mounting bolt. Thus, excessive torque applied to the retaining

nut on the mounting bolt will cause the mounting bolt to break. The mounting bolt in Figure 7 is easily replaced. In the embodiment of FIG. 7, inner tube 136 enlarges toward the outer portion of inner tube 136 in order to clear the welding boss for the mounting bolt.

[0035] Impact media 36 can be steel shot, sand or any other impact media known in the art. The design of coulomb dampers 128 and 128' provides a large quantity of impact media 36 (25 cubic inches in the preferred embodiment) that is intimately attached or bolted with three point contact to mid-pipe 118 to provide excellent energy transmissibility from mid-pipe 118 into impact media 36. The rigid design of outer and inner members 132 and 134 also transmit the energy into any impact media 36 that is in direct contact with the inner surfaces of outer and inner members 132 and 134. Coulomb dampers 128 and 128' provides a large canister volume constrained in intimate contact with mid-pipe 118 which provides a compact design for any application. Coulomb dampers 128 and 128' is bolted to mid-pipe 118 for excellent energy transmissibility. Outer and inner members 132 and 134 are designed to provide the optimized density, geometry, quantity, air space for movement and friction for impact media 36.

[0036] Referring now to FIGS. 8 and 9, a coulomb damper 228 in accordance with another embodiment of the present disclosure is illustrated. Coulomb damper 228 is a direct replacement for coulomb dampers 28, 128 or 128' in exhaust system 10. Coulomb damper 228 comprises a canister formed by an outer member 232, an inner member 234 and a specified volume or mass of impact media 36. Outer member 232 is a tubular shaped component that defines a first swaged end 238 and a second opposite swaged end 240. The longitudinal length and the outer diameter of outer member 232 which defines the amount of space between outer member 232 and inner member 234 are selected to provide a specific volume of impact media 36 while at the same time providing specific clearances with other components of the vehicle when exhaust system 10 is installed in the vehicle. In addition, when designing coulomb damper 228, both the clearances in the assembled position of exhaust system 10 and the clearances necessary to provide routine maintenance and/or replacement components of the vehicle are taken into consideration.

[0037] Inner member 234 is a cylindrical tube which can be an exhaust pipe which is a component of exhaust system 10 or which can be a separate component that is attached, between two components of exhaust system 10, by welding or by other methods known in the art.

[0038] As discussed above, impact media 36 can be steel shot, sand or any other impact media known in the art. The design of coulomb damper 228 provides a large quantity of impact media that is intimately attached to a component of exhaust system 10 to provide excellent energy transmissibility from the component of exhaust system 10 into impact media 36. The rigid design of outer member 232 and inner member 234 also transmit the energy into any impact media 36 that is in direct contact with the inner surfaces of outer member 232 and the outer surfaces of inner member 234. Outer member 232 and inner member 234 are positioned co-axially to provide a chamber 244 which is an annular chamber having a constant radial width. This provides optimized density, geometry, quantity, air space for movement and friction for impact media 36.

[0039] Outer member 232 is designed to have a press-fit relation with inner member 234. First and second swaged

ends **238** and **240** are designed to have an inside diameter that has a press-fit relationship to the outside diameter of inner member **234**. In the preferred embodiment, there is a minimum of 10 mm of press-fit length at both first and second swaged ends **238** and **240**.

[0040] The insertion of impact media **36** into chamber **244** can be accomplished by first assembling first swaged end **238** with inner member **234** and pressing outer member **232** over inner member **234** until the end of inner member **234** is positioned just short of the press-fit diameter of second swaged end **240**. A filler nozzle can then be inserted through inner member **234** which prohibits impact media **36** from entering inner member **234** but allowing impact media **36** to enter chamber **244** through a gap defined between inner member **234** and outer member **232**. Once the proper amount of impact media has been inserted into chamber **244**, the filler nozzle can be removed and the second swaged end **240** of outer member **232** can be press-fit over inner member **234** to complete the assembly.

[0041] Referring now to FIGS. **10** and **11**, a coulomb damper **328** in accordance with another embodiment of the present disclosure is illustrated. Coulomb damper **328** is a direct replacement for coulomb dampers **28**, **128**, **128'** and **228** in exhaust system **10**. Due to the various configurations of exhaust systems in vehicles, there could be a possibility that a symmetrical/coaxial coulomb damper such as coulomb damper **228** could have a clearance issue with other components of the vehicle. Coulomb damper **328** is designed to provide a solution to clearance issues for a coulomb damper.

[0042] Coulomb damper **328** comprises a canister formed by an outer member **332**, inner member **234** and a specified volume or mass of impact media **36**. Outer member **332** is a tubular shaped component that defines a first swaged end **338** and a second opposite swaged end **340**. The longitudinal length, the configuration and the outer diameter of outer member **332** which defines the amount of space between outer member **332** and inner member **234** are selected to provide a specific volume of impact media **36** while at the same time providing specific clearances with other components of the vehicle when exhaust system **10** is installed in the vehicle. In addition, when designing coulomb damper **328**, both the clearances in the assembled position of exhaust system **10** and the clearances necessary to provide routine maintenance and/or replacement components of the vehicle are taken into consideration.

[0043] Inner member **234** is a cylindrical tube which can be an exhaust pipe which is a component of exhaust system **10** or which can be a separate component that is attached, between two components of exhaust system **10**, by welding or by other methods known in the art.

[0044] As discussed above, impact media **36** can be steel shot, sand or any other impact media known in the art. The design of coulomb damper **328** provides a large quantity of impact media that is intimately attached to a component of exhaust system **10** to provide excellent energy transmissibility from the component of exhaust system **10** into impact media **36**. The rigid design of outer member **332** and inner member **234** also transmit the energy into any impact media **36** that is in direct contact with the inner surfaces of outer member **332** and the outer surfaces of inner member **234**. Outer member **332** is positioned over inner member **234** to provide a chamber **344** which is an annular chamber having a variable radial width. This provides optimized density, geometry, quantity, air space for movement and friction for impact

media **36**. Outer member **334** and inner member **234** define chamber **344** which is eccentric in relation to inner member **234**. The amount of eccentricity and the circumferential distance of the eccentricity are designed to provide the optimized density, geometry, quantity, air space and friction for impact media **36** while providing the needed clearances for exhaust system **10**.

[0045] Outer member **332** is designed to have a press-fit relation with inner member **234**. First and second swaged ends **338** and **340** are designed to have an inside diameter that has a press-fit relationship to the outside diameter of inner member **234**. In the preferred embodiment, there is a minimum of 10 mm of press-fit length at both first and second swaged ends **338** and **340**.

[0046] The insertion of impact media **36** into chamber **344** can be accomplished by first assembling first swaged end **338** with inner member **234** and pressing outer member **332** over inner member **234** until the end of inner member **234** is positioned just short of the press-fit diameter of second swaged end **340**. A filler nozzle can then be inserted through inner member **234** which prohibits impact media **36** from entering inner member **234** but allowing impact media **36** to enter chamber **344** through a gap defined between inner member **234** and outer member **332**. Once the proper amount of impact media has been inserted into chamber **244**, the filler nozzle can be removed and the second swaged end **340** of outer member **332** can be press-fit over inner member **234** to complete the assembly.

[0047] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

1. A coulomb damper in combination with an exhaust system, the combination comprising:
 - a canister;
 - shot disposed within said canister;
 - a component of said exhaust system, said canister being in intimate contact with said component of said exhaust system.
2. The coulomb damper in combination with an exhaust system according to claim **1**, wherein said intimate contact comprises a pair of contact areas extending along an axial length of said canister.
3. The coulomb damper in combination with an exhaust system according to claim **2**, further comprising a weld extending along each of said pair of contact areas.
4. The coulomb damper in combination with an exhaust system according to claim **2**, wherein said canister defines an inner surface having a first curved portion and said component of said exhaust system defines an outer surface having a second curved portion, said second curved portion engaging said first curved portion, a diameter of said first curved portion being smaller than a diameter of said second curved portion.
5. The coulomb damper in combination with an exhaust system according to claim **1**, wherein said canister defines an

inner surface having a first curved portion and said component of said exhaust system defines an outer surface having a second curved portion, said second curved portion engaging said first curved portion, a diameter of said first curved portion being smaller than a diameter of said second curved portion.

6. The coulomb damper in combination with an exhaust system according to claim 1, wherein said canister is curved to conform to a shape of said component of said exhaust system.

7. The coulomb damper in combination with an exhaust system according to claim 1, wherein said canister is welded to said component of said exhaust system.

8. The coulomb damper in combination with an exhaust system according to claim 1, wherein said canister is bolted to said component of said exhaust system.

9. The coulomb damper in combination with an exhaust system according to claim 1, wherein said intimate contact is at least three contact points between said canister and said component of said exhaust system.

10. The coulomb damper in combination with an exhaust system according to claim 9, wherein said canister defines an inner surface having a first curved portion and said component of said exhaust system defines an outer surface having a second curved portion, said second curved portion engaging said first curved portion, a diameter of said first curved portion being the same as a diameter of said second curved portion.

11. The coulomb damper in combination with an exhaust system according to claim 1, wherein said canister defines an inner surface having a first curved portion and said component of said exhaust system defines an outer surface having a second curved portion, said second curved portion engaging

said first curved portion, a diameter of said first curved portion being the same as a diameter of said second curved portion.

12. The coulomb damper in combination with an exhaust system according to claim 1, wherein said canister defines a bolt hole and said component of said exhaust system includes a bolt extending through said bolt hole.

13. The coulomb damper in combination with an exhaust system according to claim 1, wherein said shot is steel shot.

14. The coulomb damper in combination with an exhaust system according to claim 1, wherein:

said exhaust system defines an inner member;
said canister defines an outer member press fit to said inner member;

said shot is disposed in a chamber between said inner member and said outer member.

15. The coulomb damper in combination with an exhaust system according to claim 14, wherein said inner member defined by said exhaust system is an exhaust pipe.

16. The coulomb damper in combination with an exhaust system according to claim 14, wherein said chamber is an annular chamber.

17. The coulomb damper in combination with an exhaust system according to claim 16, wherein said annular chamber has a constant radial width.

18. The coulomb damper in combination with an exhaust system according to claim 16, wherein said annular chamber has a variable radial width.

19. The coulomb damper in combination with an exhaust system according to claim 16, wherein said annular chamber is eccentric in relation to said inner member.

20. The coulomb damper in combination with an exhaust system according to claim 16, wherein said outer member and said inner member are coaxial.

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