Nov. 8, 1966

K. K. KERNS ETAL

3,283,847

CERAMIC COATED MUFFLER

Filed Jan. 11, 1961

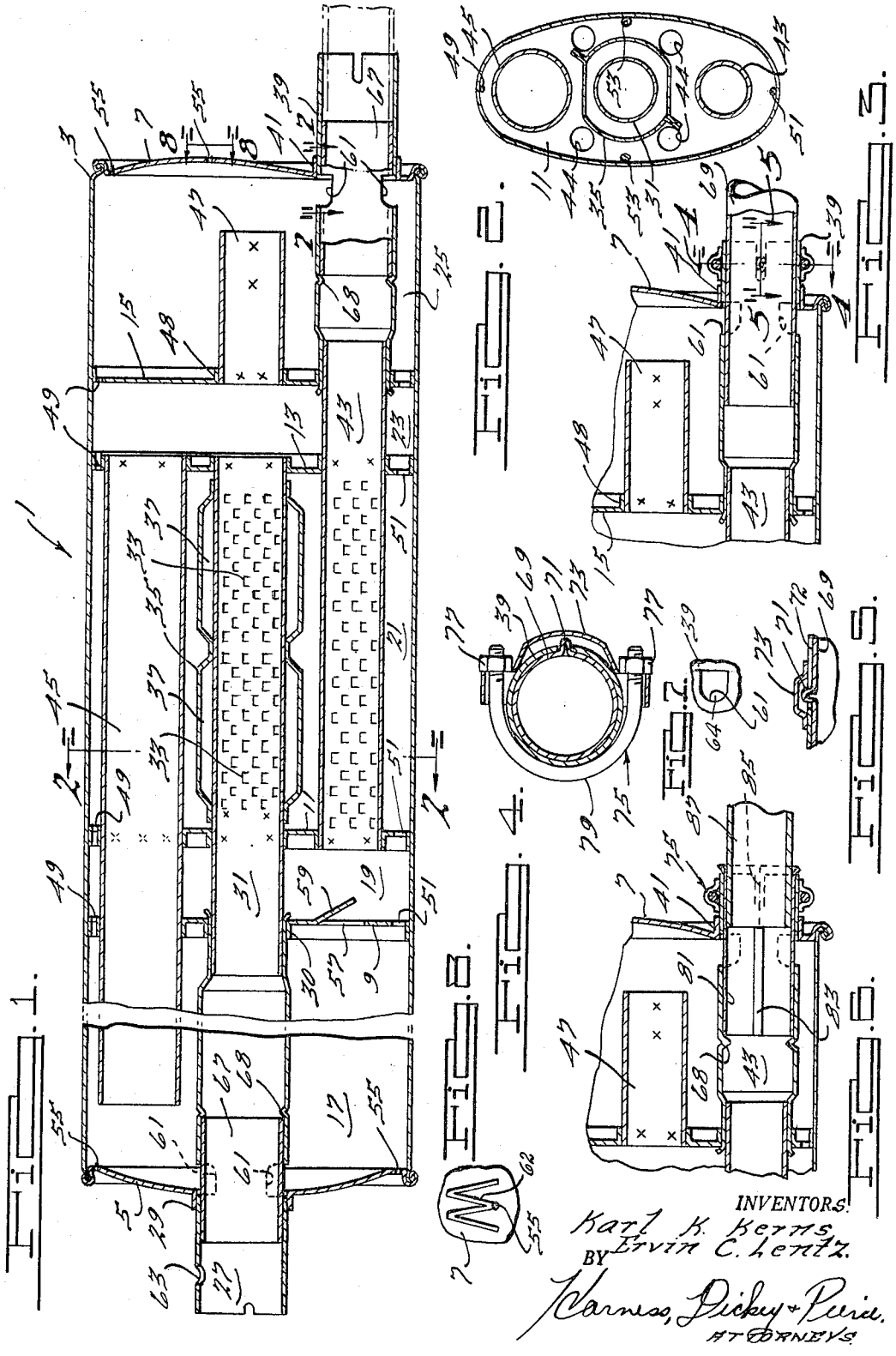

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

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United States Patent Office

3,283,847

Patented Nov. 8, 1966

3,283,847

CERAMIC COATED MUFFLER

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Filed Jan. 11, 1961, Ser. No. 82,030

20 Claims. (Cl. 181—61)

This invention relates to mufflers and in particular to improvements designed to facilitate the ceramic coating of mufflers or similar articles.

As pointed out in U.S. Patent No. 3,082,841 based upon a copending application Serial No. 65,767, filed October 28, 1960, of Walter H. Powers, assigned to the assignee of the present application, it is necessary to make provision for the internal and external drainage of various fluids employed in the coating of a muffler with an anti-corrosive ceramic material. The present invention provides an improved means for draining the fluid from the interior to the exterior of the muffler and utilizes the inlet and the outlet conduits for this purpose. We also provide certain features to facilitate drainage within the various internal chambers of the muffler itself.

The invention is illustrated in the accompanying drawings in which:

FIGURE 1 is a longitudinal cross-section through a typical exhaust muffler embodying the invention;

FIG. 2 is a cross-section along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged view similar to the right hand end of FIG. 1 but showing a modification;

FIG. 4 is a cross-section on line 4—4 of FIG. 3;

FIG. 5 is a cross-section on line 5—5 of FIG. 3;

FIG. 6 is a view similar to FIG. 3 of another modification;

FIG. 7 is a developed plan view of a D-shaped drainage hole 61; and

FIG. 8 is a view along line 8—8 of FIG. 1 showing a W-shaped trough and a drainage hole in a header.

Except for plugging of various small holes, the muffler 1 shown in the drawings is shown as it would appear immediately after the ceramic coating procedure is completed. Prior to actual usage it is likely that the manufacturer would prefer to wrap around the outer shell 3 of the muffler additional layers of asbestos or metal for acoustic purposes. Preferably these are omitted during the coating operations and hence are not shown in the present drawings.

The muffler shell 3 is closed by inlet and outlet headers 5 and 7, respectively, at opposite ends. Within the shell 3 are a series of transverse partitions 9, 11, 13, and 15 which divide the internal volume of the shell 3 into chambers 17, 19, 21, 23, and 25. The inlet conduit is provided by an inlet bushing 27 which is spot-welded to a flanged neck 29 in the inlet header 5 and which extends through and is supported in a flanged neck 30 in the partition 9. Slidably supported in the reduced end of the inlet bushing 27 is an inlet tube 31 which extends through and is spot-welded in outwardly extending flanged necks in the partition 11 and 13. The tube 31 has two sets of louvers 33 and these are surrounded by a pancake assembly 35 which forms a pair of annular spit chambers 37 around the sets of louvers 33. The outlet conduit comprises an outlet bushing 39 that extends through and is spot-welded to a flanged neck 41 on the header 7 and which has a reduced end that extends through and is spot-welded in a flanged neck in the partition 15. Slidably supported in the inner end of the outlet bushing 39 is an outlet tube 43 and this extends through and is spot-welded in the flanged necks and partitions 11 and 13. The outlet tube 43 has a series of louvers formed in it to communicate the interior of the tube with the chamber 21.

Gas leaving the end of the inlet tube 31 will enter the chamber 23. From the chamber 23 it flows back toward the front of the muffler by passing through large, non-restrictive openings (not shown) in the partition 13 and through the chamber 21 and then out of similar large, non-restrictive openings 44 in the partition 11 to enter the chamber 19. From the chamber 19 the gas can flow out of the muffler through the outlet tube 43 and the outlet bushing 39.

A long tuning tube 45 has one end opening into the chamber 23 and the other end emptying into the chamber 17, the tube 45 extending through and being supported in flanged necks in the partitions 9, 11, and 13. A tuning tube 47 considerably shorter in length is seated in a flanged opening 48 in partition 15, the flange of the opening extending toward the outlet header 7, and this connects the cross-over chamber 23 with the smaller tuning chamber 25. It will be apparent that the chamber 17 and the long tuning tube 45 will act to silence the low frequency notes whereas the chamber 25 and the shorter tuning tube 47 will act to silence somewhat higher notes. The spit chamber 37 will act to remove high frequency sounds and roughness.

Turning now from the functioning of the muffler 1 as an acoustic element to the problem of providing all of the sheet steel surfaces illustrated and described with an anti-corrosive layer of ceramic, it is necessary to provide both internal and external drainage means in order to obtain a proper coating. The reasons for this are pointed out in detail in the aforementioned copending Powers application. Internal drainage and ventilation is needed to permit fluids to flow from one chamber to the other inside the muffler. For this purpose, we use holes 49 and 51 in each of the partitions 9, 11, 13, and 15 located at opposite ends of the major axis and holes 53 in each of said partitions located at opposite ends of the minor axis. Hole 49 is preferably 1/16 inch in diameter, hole 51 is preferably 5/16 inch, and holes 53 are preferably 1/4 inch in diameter. (The holes 53 will lie on a more or less vertical line when the muffler is in use and those along the bottom of the muffler will permit condensate to flow to the hotter chambers and be vaporized thus eliminating the principal cause of muffler corrosion.) When dipped in the ceramic slip and the other various fluids and liquids involved in the coating process, the muffler is suspended by a wire or hook extending through hole 63 in inlet bushing 27. The hole 63 is offset from the central axis of the muffler and the center of gravity of the muffler is located such that the muffler will be suspended in an inclined position, instead of a vertically upright position, with the partitions positioned in vertically inclined planes. The suspension means is arranged so that small hole 49 will be on the high side to permit ventilation and air flow inside the muffler; the other holes, especially low side hole 51 permitting flow of liquids.

Flow between the inside and outside of spit chambers 37 is provided by extending the louver banks 33 to the extreme ends of their respective chamber 37 thus permitting flow through the louvers at opposite ends of each chamber 37. If needed, the louvers are enlarged or their ramp angles decreased to facilitate such flow, particularly flow of the more viscous ceramic slip.

As another internal drainage expedient, the partitition 9 may be provided with a relatively large opening 57 which is formed by shearing three sides of a rectangular opening and bending the flap outwardly as seen at 59. The opening 57 is large enough that fluid within the chamber 17 can quickly enter or leave through it in addition to the openings 49, 51, and 53.

For the purpose of external drainage, that is flow between the inside and the outside of the muffler, we provide

the bushings **27** and **39** with relatively large openings **61**. These are preferably located as shown in the drawings, that is on the upper and lower sides of the bushings and as close as possible to and preferably slightly overlapping the headers **5** and **7** to avoid the formation of pockets that might retain fluid during draining. These openings are sufficiently large, as can be seen, that fluid, including the relatively viscous ceramic slip, can drain readily through them and into the respective bushings **27** or **39** and thus out of the muffler. Similarly, when the muffler **1** is immersed in a bath the liquids can enter through the bushing **27** or **39** and flow outwardly through the openings **61** into the chambers **25** or **17**, as well as along the length of the inlet or outlet tubes **43** and **31**. Additional drainage holes to prevent the formation or accumulation of puddles or bubbles may be provided in the form of 1/16 inch or 3/32 inch holes **55** at opposite ends of the major axis of the inlet header **5** and near the center and one side of the major axis of end header **7** as shown. As seen in FIG. 8 an outwardly pressed W-shaped trough **62** can be formed by grooves in header **7** to facilitate drainage to one hole **55** as well as provide a trademark symbol.

After the muffler has been coated and the coating has been hardened, as is done in the case of a ceramic coating by firing in a furnace at around 1565° F., it is necessary to close the opening **57** and the four openings **61**. Openings **49** and **55** will be closed by bridging of the ceramic. In the case of the opening **57** this is accomplished by inserting a long mallet or rod with a rubber head through the outlet bushing **39** and outlet pipe **43** which are aligned with the opening **57**. An axial force applied to such a rod or mallet can be used to force the flap **59** back into the plane of the transverse partition **9** to effectively close the opening **57**.

Three methods of closing the openings **61** are illustrated. In FIG. 1 we have inserted an imperforate corrosion-proof sleeve **67** inserted in each bushing **27** and **39** until it engages a rib or dimple **68** formed in the bushing at which point the sleeve **67** covers the openings **61** and, in effect, forms a part of the inlet tube **27** or the outlet tube **39**. As indicated by dash lines in FIG. 1 the conduit connected to the bushing will help to hold the sleeve **67** in place. Inasmuch as all the other parts of the muffler are coated with an anti-corrosive material, the sleeve **67** is preferably formed of stainless steel or other metal that will not rust or corrode. As seen best in FIG. 7 the innermost ends of the holes are rounded as indicated at **64**. This, in effect, provides a taper action to prevent the edge of the inserted sleeve **67** from being caught on the edge of the hole **61** as it is being inserted. The holes **61** are preferably 1 inch wide and 7/8 inch long, with the curved inner ends being semi-circles formed on a 1/2 inch radius.

In FIGS. 3–5 we illustrate the use of the tailpipe **69** in place of the sleeve **67** to cover the openings **61**. It is contemplated, of course, that the tailpipe **69** will also be coated with an anti-corrosive ceramic or given a suitable anti-corrosive treatment. At the inlet end of the muffler it is understood that the exhaust pipe will be inserted to replace the sleeve **67** in a manner similar to the insertion of the tailpipe **69**. The tailpipe is provided with a radial nib **71** which fits in slot **72** in bushing **39** to prevent relative angular movement. The nib **71** also fits in hat section **73** of clamp **75**. The section **73** is clamped tightly against the bushing by tightening of nuts **77** on the ends of a U-bolt **79** (FIG. 4) so that the clamp holds the parts tightly together (this structure being shown in copending application Serial No. 55,011 filed September 9, 1960, of Vlasak and Powers assigned to the assignee hereof). Relative axial movement is prevented by the nib **1** inside of the hat section **73**.

A third method of covering openings **61** is shown in FIG. 6 where a very thin sleeve **81** is used. This is formed of metal that is preferably coated with an anti-corrosive paint or given some other treatment to minimize corrosion. It is formed from flat stock into a tube having a lock seam joint **83** running along a part of its length, the remainder being simply a butt joint **85** of no radial thickness. Thus, when the sleeve **81** is inserted against shoulder **68**, the end of lock seam **83** will act as a stop to limit the insertion of tailpipe **87**, the tailpipe also acting to hold the sleeve in place. The end of sleeve **81** is preferably flared at the end to facilitate insertion of the tailpipe. It will be understood that a sleeve **81** may also be used in the inlet end **27**.

As indicated above the various parts of the muffler are spotwelded to each other prior to ceramic coating. Because the ceramic will collect at or coat many of the joints it is possible to eliminate the spot welding and use the ceramic as a bonding material to connect the parts together. Holes or grooves in the parts at the joints will fill with ceramic and act as keys to mechanically assist in holding the parts together.

It is desirable also to reduce the thickness or gauge of the various steel parts used in the ceramic coated muffler. This can be done since the ceramic layer provides the necessary corrosion resistance and strength to compensate for the reduced thickness. By reducing the metal thickness, the speed of heat-up during the coating operation is increased and it has been found that the louvers **33** burn open better in drying after the ceramic slip has been applied if the pancakes **35** are made of thinner metal than usual.

Modifications in the specific structure illustrated can be made without departing from the spirit and scope of the invention. Reference may be made to the aforementioned Powers' application for details of the coating process.

We claim:

1. A metallic muffler comprising a shell having spaced transversely extending end wall portions, a silencing structure inside the shell, an internal conduit extending through one end wall portion of the shell, said conduit having an opening in a side wall thereof located inside and adjacent the one end portion of the shell, said opening being large enough to permit the free flow of liquid from the interior of the shell through the side wall of the conduit to enable the muffler structure on the inside of the shell to be coated, a portion of said conduit outwardly of said opening being no smaller in diameter than that portion containing said opening whereby a sleeve means may be inserted into said conduit to cover said opening, a ceramic coating on the interior of said muffler applied in part through said opening, and sleeve means mounted in said conduit and covering said opening.

2. The method of making a corrosion-resistant muffler, having a tubular casing divided into internal compartments by transverse members including end wall members, comprising the steps of forming non-acoustic openings large enough to permit the free flow of liquid through the side walls of a conduit extending into the muffler, assembling the various component parts of the muffler into an assembled muffler structure so that the non-acoustic openings in said conduit are adjacent the transverse members of the muffler inside the muffler shell, immersing the muffler structure in a bath of anti-corrosive ceramic slip and flowing slip through the interior of the muffler through the non-acoustic openings in said conduit, removing the muffler from the ceramic slip and removing slip from the interior of the muffler through the openings in said conduit, firing the muffler to harden said ceramic, and inserting a sleeve means in said conduit means to close said non-acoustic openings.

3. The method of coating a muffler, comprising a casing and internal structure including a series of tubes and partitions and a pair of end headers, by forming an opening in the internal structure by slitting a portion of the internal structure and bending the slit portion away from the adjacent internal structure to expose an opening, coating the internal structure of the muffler with a liquid that upon hardening will act as an anti-corrosive coating, flow-

ing at least part of the liquid during the coating of the internal structure through the opening, and subsequently bending the slitted portion to close said opening.

4. A metallic muffler for an automobile or the like, comprising a casing, end headers closing the ends of said casings, internal silencing structure in said casing, tube means extending through at least one of said end headers and being connected to said internal silencing structure, coating openings provided in said tube means immediately adjacent to said end headers, a ceramic coating provided on the aforementioned muffler parts, and additional tube means telescopically mounted in said first mentioned tube means and extending over and closing said coating openings.

5. A method of coating the interior surfaces of an assembled compartmented article, having an exterior casing and interior structure, comprising: forming a passageway at least part way through said article by tube means extending through said exterior casing and at least one part of said interior structure forming transverse passageways in said tube means within said article to provide a flow path to the compartments of the article, coating the interior of the article by flowing ceramic slip through the tube means and the transverse passageways, and subsequently inserting an imperforate member into said tube means to seal said transverse passageways.

6. The method of coating a muffler or the like, having exterior walls and interior partitions dividing the muffler into a plurality of compartments, comprising: forming resilient flap means in said internal silencing structure by slitting portions of the internal silencing structure, positioning said slitted portions in a deflected position relative to the adjacent internal silencing structure and thereby defining a flow passageway through said internal silencing structure, coating said muffler by flowing fluid through said muffler including said flow passageway, and thereafter deflecting said resilient flap means into a passageway closing position.

7. A muffler comprising a shell having an end, a silencing structure inside the shell, an internal conduit extending out of the shell for the passage of gases through the shell, said conduit having a sidewall with an opening therein located inside the shell and as close as possible to the end of the shell, said muffler silencing structure and conduit being coated with an anti-corrosive material, said opening being large enough to permit the free flow of liquids from the inside of the shell into said conduit to enable said structure to be coated on the inside of the shell, and an anti-corrosive sleeve means in said conduit covering said opening, said sleeve means being insertable through the end of the conduit.

8. The invention set forth in claim 7 wherein said opening has a sidewall on the inner side thereof that is rounded to prevent catching of the edge of an inserted sleeve means.

9. The invention set forth in claim 7 including a shoulder formed on said conduit inwardly of said opening, said sleeve means abutting said shoulder at one end and a pipe engaging the other end of the sleeve means.

10. The invention set forth in claim 7 wherein said sleeve means comprises a metal tube having a lock seam extending radially inwardly along a part of its length, and a pipe inserted into said tube along another part of its length and engaging the end of the lock seam to hold the tube in place inside the conduit.

11. The method of making a muffler comprising the steps of forming the various component parts of the muffler, including tubes, partitions, shell, and end headers, forming an opening in the sidewalls of those tubes which will serve as the inlet and outlet for the muffler, forming said openings in such a location that they will be adjacent the end headers when the muffler parts are assembled, assembling the component parts to form a muffler with said openings being located inside the muffler and adjacent to said end headers, immersing the muffler in a liquid that will harden and act as an anti-corrosive agent

coating all the surfaces of the muffler, removing the muffler from the liquid and hardening the anti-corrosive agent, and inserting a sleeve in each of said tubes having said openings to cover said openings and prevent fluid passage through them.

12. The method of making a corrosion-resistant muffler comprising the steps of forming non-acoustic openings large enough to permit the free flow of liquid through the sidewalls of the inlet and the outlet conduits of the muffler, assembling the various component parts of the muffler into an assembled muffler structure so that the openings are adjacent the end headers of the muffler and inside the muffler shell, immersing the muffler structure in a bath of anti-corrosive ceramic slip, removing the muffler from the ceramic slip and firing the muffler to harden said ceramic, and inserting a sleeve means in said inlet and outlet conduits to close said non-acoustic openings.

13. The method of making a muffler comprising the steps of forming a series of tubes and partitions, a shell, and a pair of end headers as component parts of the muffler, forming an opening in a partition by slitting the partition and bending the slit portion away from the partition to expose an opening, assembling the various component parts together to form a complete muffler, immersing the complete muffler in a liquid that upon hardening will act as an anti-corrosive coating, removing the muffler from the liquid, and hardening the coating and bending the slitted portion to close said opening.

14. The method set forth in claim 13 wherein said slit portion is in a partition in alignment with a tube extending out of the shell whereby a tool can be inserted in the tube to engage the slitted portion and force it back into the plane of the partition.

15. A muffler comprising a casing having an end, a header closing the end of the casing and having an opening therein, a conduit supported inside the casing for the carrying of gases and extending through the opening in the header, an opening in the conduit next to the header and providing a means for the free flow of liquid from the inside of the casing into said conduit and vice versa to enable said muffler to be coated on the inside of the shell, and a tubular member to close the opening in said conduit inserted inside said conduit, said tubular member having a radial projection, said conduit having a slot opening out of an end thereof receiving said radial projection to radially and angularly locate the tubular member relative to the outer conduit, a clamp structure extending around both said conduit and tubular member and applying radial pressure thereto to connect them together, said clamp structure having a pair of spaced shoulders transverse to the length of the conduit and said radial projection being disposed between said shoulders and serving to axially locate the conduits.

16. A muffler comprising a tubular shell, transverse partition members located in said shell and closing the ends thereof and forming chambers therein, support means temporarily holding said transverse partition members in place in said shell and a ceramic coating covering said shell and members and acting as a bond to permanently interconnect certain of said members with said shell, there being no other means permanently interconnecting said certain members and said shell.

17. A metallic muffler for an automobile or the like comprising a casing, end headers closing the ends of said casing, internal silencing structure in said casing, inlet and outlet tube means extending through said end headers and being connected to said internal silencing structure to provide a gas flow path therethrough, wall means integrally formed in said inlet and outlet tube and defining openings in said inlet and outlet tubes immediately adjacent to said end headers, a ceramic coating provided on the aforementioned muffler parts, and additional tube means telescopically mounted in said inlet and outlet tube means and extending over and closing said openings.

18. The invention as defined in claim 17 and said additional tube means being rust and corrosion resistant.

19. A metallic muffler comprising a casing, internal silencing structure mounted in said casing including transversely extending partition walls, end headers closing said casing and enclosing said internal silencing structure in said casing, inlet and outlet tube means extending through said end headers and being connected to one another through said internal silencing structure, integral resilient flap means formed in at least one of said partition walls and defining a passage therethrough and being movable between a passage opening position and a passage closing position relative to adjacent portions of said muffler separated by said partition walls, and a ceramic coating adhered to the internal surfaces of said muffler and applied in part by flowing a ceramic coating solution through said muffler with said integral flap means in the passage opening position.

20. The invention as defined in claim 19 and said integral resilient flap means being aligned with one of said inlet and outlet tubes and being located in the passage opening position between the inner end of the tube and the partition means in which it is formed.

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