Feb. 1, 1966 W. H. POWERS 3,232,374

CERAMIC COATED MUFFLER WITH LIQUID FLOW GAPS BETWEEN PARTITIONS AND SHELL

Filed Aug. 9, 1963 4 Sheets-Sheet 1

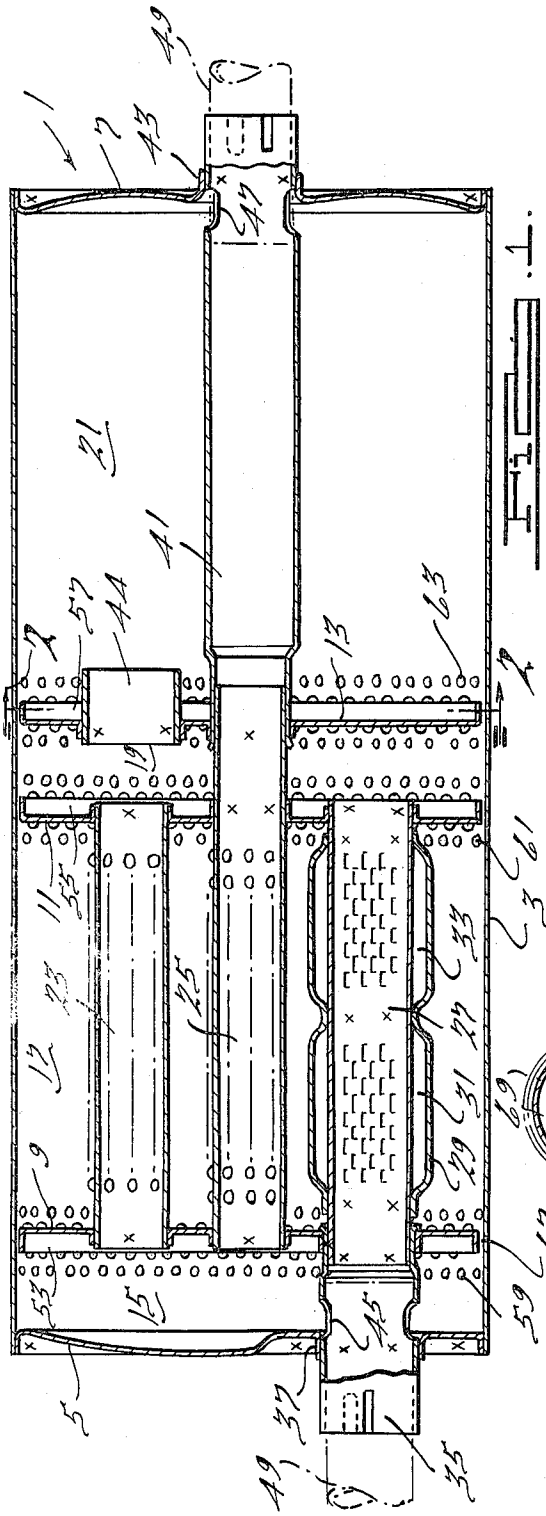

FIG. 1.

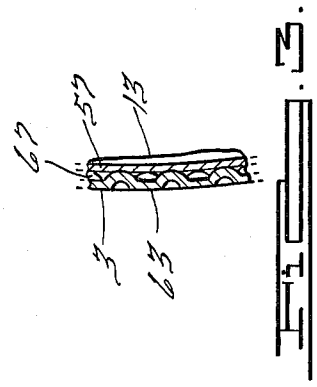

FIG. 3.

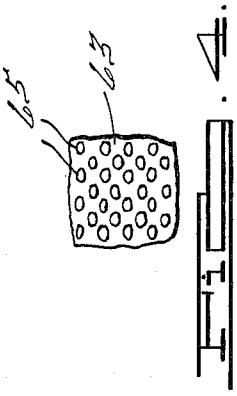

FIG. 4.

FIG. 2.

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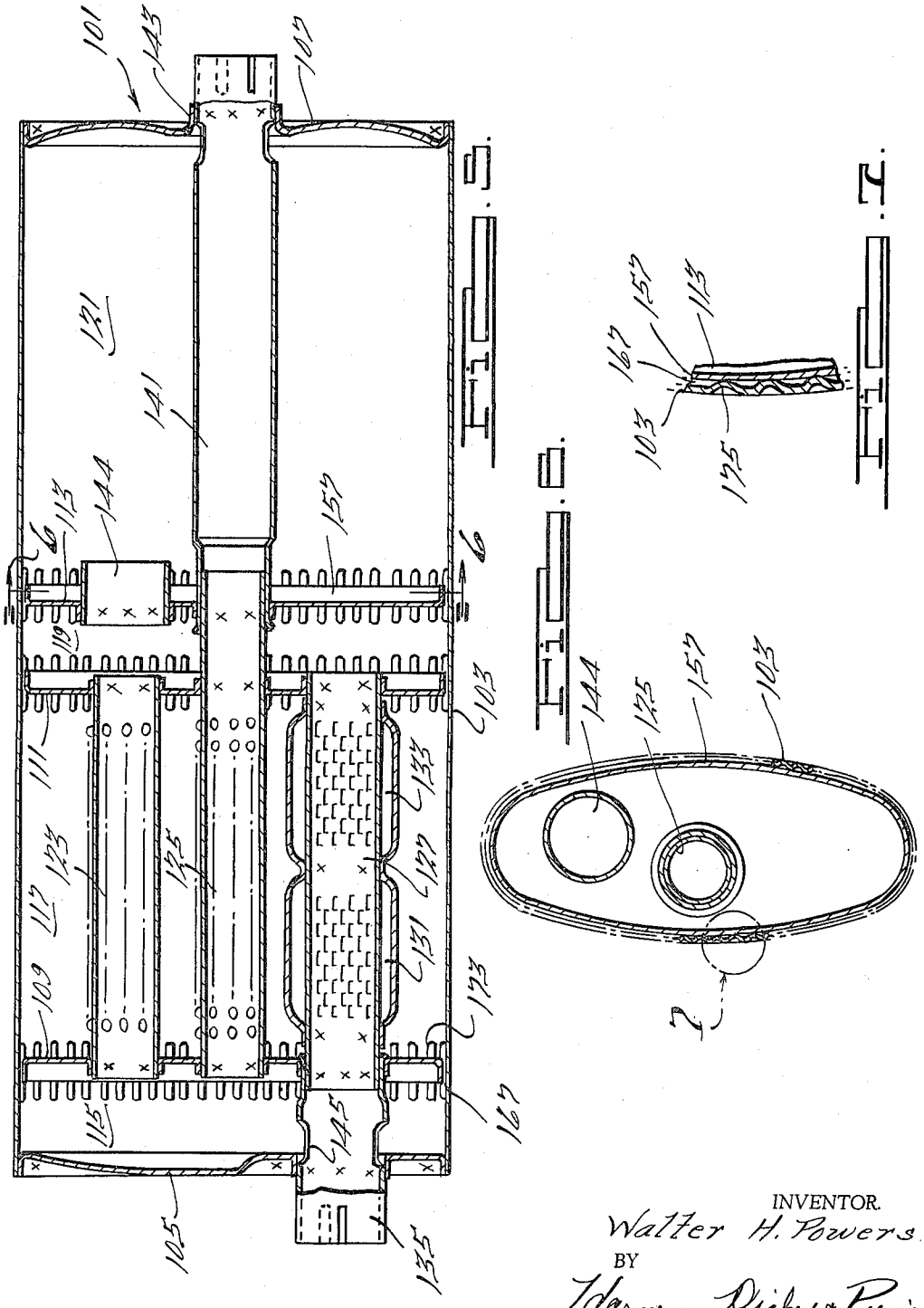

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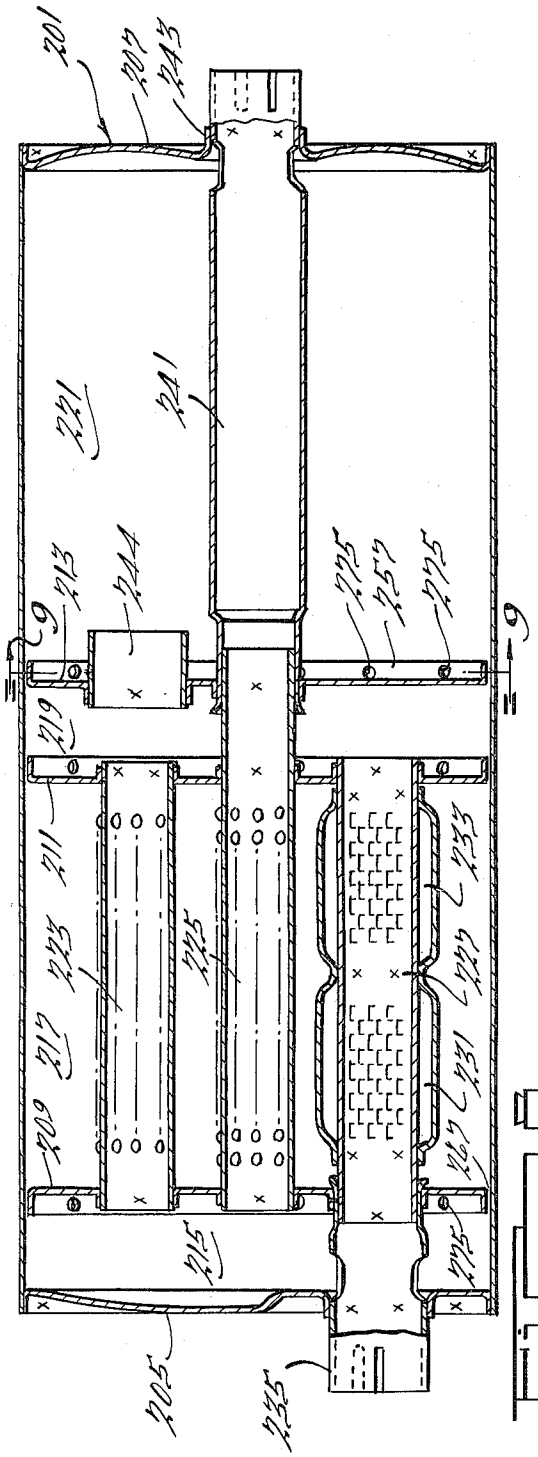
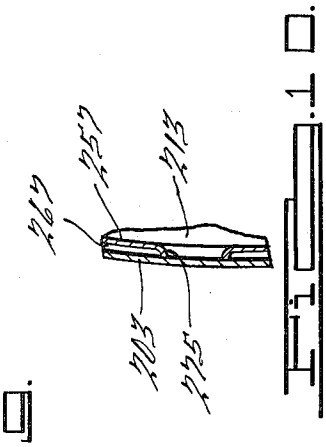
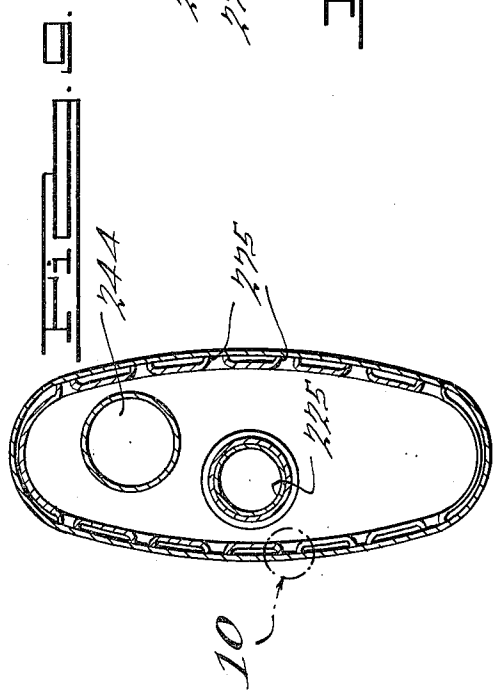
Filed Aug. 9, 1963 4 Sheets-Sheet 3







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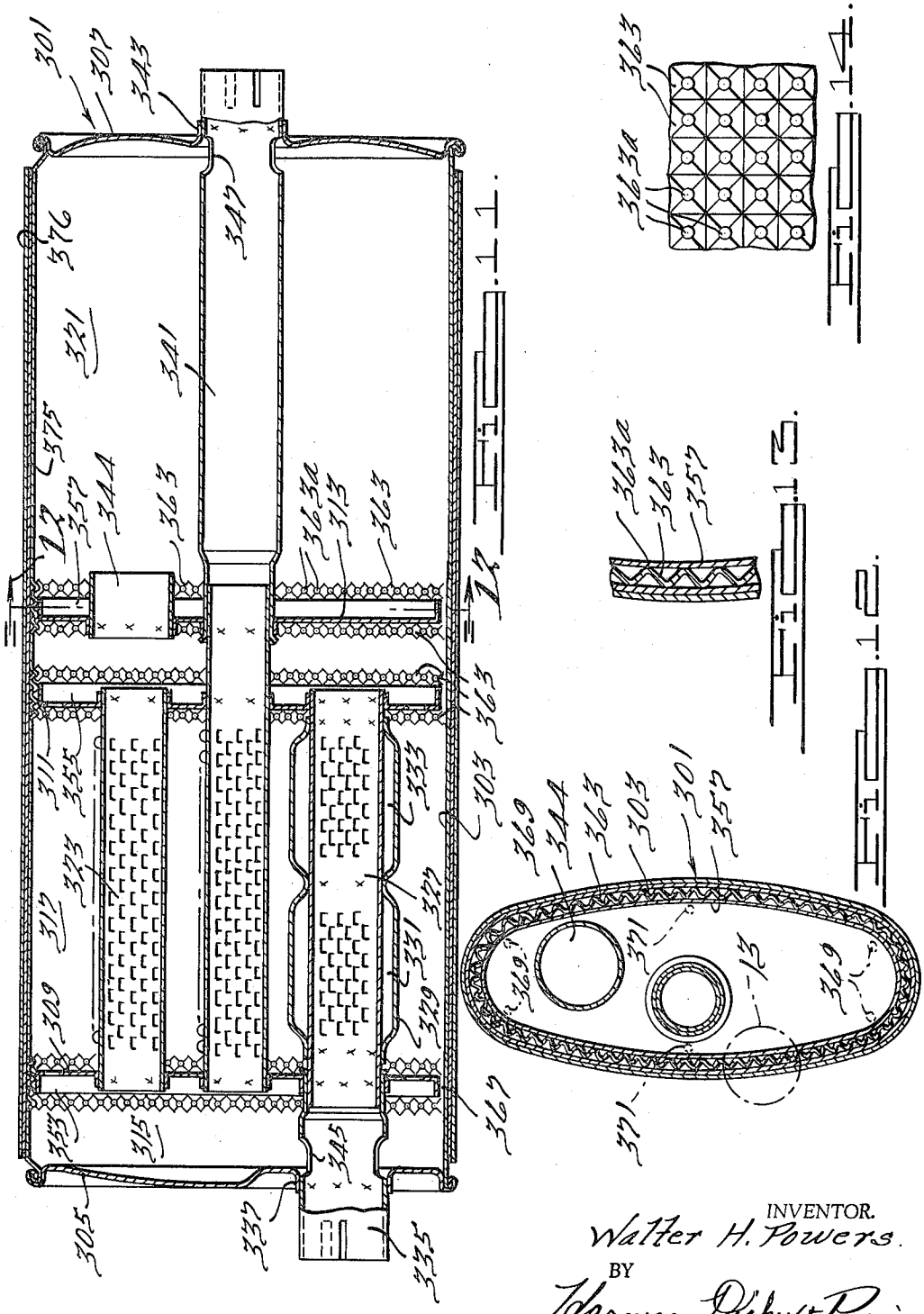

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3,232,374

CERAMIC COATED MUFFLER WITH LIQUID FLOW GAPS BETWEEN PARTITIONS AND SHELL

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Filed Aug. 9, 1963, Ser. No. 301,944
11 Claims. (Cl. 181—61)

This application is a continuation-in-part of Patent Number 3,082,841 dated March 26, 1963, and a continuation-in-part of my copending application Serial No. 266,268 filed March 19, 1963. My invention relates to the ceramic coating of closed vessels, such as automotive exhaust mufflers.

In the ordinary muffler there is an outer shell that is closed at opposite ends by end headers and inside of the housing there is a series of transverse partitions which have flanges that are spot welded to the outer shell. In the aforementioned copending application, I have disclosed a method of ceramic coating such a muffler after it has been fully assembled. Experience has shown, however, that vibration of the muffler during usage may, in some cases, cause movement of the partition flanges relative to the muffler shell and this may result in some cracking of the ceramic. Such cracking enables the corrosive condensate in the muffler to reach bare metal between the flange and shell and cause some corrosion.

It is the purpose of the present invention to overcome the above mentioned difficulty.

According to the invention, either the surface of the shell or the flange is modified so that the area of contact is materially reduced and the remaining areas of shell and flange in the joint are open and capable of being ceramic coated. The metal contact areas can be used for spot-weld connections between flange and shell.

The invention is illustrated in the accompanying drawings in which:

FIGURE 1 is a longitudinal cross section through an automotive muffler embodying the invention;

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

FIG. 3 is an enlarged view of the structure within the circle 3 of FIG. 2;

FIG. 4 is a side elevation taken from the left of FIG. 3;

FIG. 5 is a longitudinal cross section through another embodiment of the invention;

FIG. 6 is a cross sectional along the line 6—6 of FIG. 5;

FIG. 7 is an enlarged view of the structure shown in circle 7 of FIG. 6;

FIG. 8 is a longitudinal cross section to still another embodiment of the invention;

FIG. 9 is a cross sectional on the line 9—9 of FIG. 8;

FIG. 10 is an enlarged view of the structure shown in the circle 10 of FIG. 9;

FIG. 11 is a longitudinal sectional view through another form of the invention;

FIG. 12 is a sectional view taken on line 12—12 in FIG. 11;

FIG. 13 is an enlarged view of the structure within the circle 13 in FIGURE 12, and

FIG. 14 is a front elevational view of the embossments shown in FIG. 13.

In FIGS. 1–4 there is a muffler 1 of the type currently used in automotive exhaust systems. It comprises an outer shell or housing 3 which is closed at opposite ends by an inlet header 5 and an outlet header 7. These may be attached to the ends of the shell 3 by suitable means such as the spot welded connections illustrated. (Spot-weld connections throughout the drawings are indicated by the small "x's.") The space inside of the shell 3 is divided into a series of chambers by means of three interior transverse partitions 9, 11, and 13. Each of these partitions has an annular peripheral flange which is spot welded to the shell 3. The partitions divide the casing into chambers 15, 17, 19, and 21.

The partitions 9 and 11 have three pairs of aligned flanged openings in which three gas passage tubes are mounted and spot welded, these tubes being the tubes 23, 25, and 27. All of the tubes are perforated, preferably louvered, so that pressure (sound) waves in the gas passing through them can expand outwardly into the space surrounding the tubes. In the case of the tubes 23 and 25, such expansion will occur into the chamber 17 which will act as a high and medium frequency resonator and sound attenuator. In the case of the tube 27, a shell 29 surrounds the louvers and provides two spit chambers 31 and 33 which are of relatively small volume and act to attenuate high frequency sounds and roughness. The inlet header 5 has an inlet bushing 35 mounted in outwardly exending neck 37 and this fits over the inlet end of the tube 27 and inside of the flanged opening in partition 9. The middle tube 25 extends through a flanged opening in partition 13 that is aligned therewith and fits inside of a second tube 41 that is in alignment with it and extends through the neck 43 in the outlet header 7. A short tuning tube 44 is mounted in a flanged opening in the partition 13 and this may be in alignment with the tube 23. The bushing 35 and the outlet tube and bushing 41 each have a pair of D-shaped openings 45 and 47 of relatively large size located in them as close as possible to the inside face of the outlet header 5 and the outlet header 7. These provide for external drainage of the ceramic liquid and various other liquids and fluids involved in the ceramic coating of the muffler and replace the plugged opening shown in the end headers in my aforementioned copending application. Prior to usage of the muffler on an automobile, the holes 45 and 47 are closed by suitable sleeve means extending inside of the bushing 35 and the tube 41, which can either be a special sleeve or the tail pipe or exhaust pipe, as indicated in phantom lines in FIGURE 1 at 49.

In use of the muffler 1 as a component of an exhaust gas silencing system, exhaust gas will enter the inlet bushing 35 and flow along the tube 27 to the cross-over chamber 19. High frequencies and roughness are silenced in the spit chambers 31 and 33. The gas in chamber 19 can then reverse its direction of flow and pass through the tube 23 to the cross-over chamber 15. The tuning tube 44 and the chamber 21 act as a tuning means to attenuate relatively low frequencies in the gas, being in communication with the gas in chamber 19 and tube 23. High and medium frequencies in the gas flowing through tube 23 are attenuated in the chamber 17. The gas in cross-over chamber 15 reverses direction to flow towards the rear of the muffler through the tube 25 and then into the outlet tube 41, from whence it flows out the end of the muffler. In passing through tube 25, medium and high frequencies in the gas are further attenuated.

In accordance with the present invention, the flanges 53, 55, and 57 of the partitions 9, 11, and 13, respectively, are held in a spaced relationship with respect to the inside wall of the shell 3 so that there is only a minimum of actual contact between the flanges and shell 3. In FIG. 1, this is accomplished by providing knurled sections or a series of small bumps or dimples in the wall of the shell 3 in patterns located in alignment with the respective flanges. These patterns are shown a 59, 61, and 63. An illustrative size and shape of the small bumps 65 is indicated in FIGS. 2, 3, and 4. They preferably space

the partition flanges from the shell by about .080 inch. Thus, there is a gap 67 between a major part of the surface of each of the flanges 52, 55, and 57 and the surface of shell 3. When the spot welding electrodes are applied to the shell and a flange, certain of the high points or dimples 65 will be spot welded to the flange to hold the various partitions rigidly in place. During the immersion of the muffler in the ceramic coating bath, and the baths of the various other preparatory liquids and fluids, the liquid material will be able to flow through the gaps 67 and therefore coat a substantial part of the surfaces of flanges and the shell except for those portions that are actually in contact.

In FIG. 2, six internal drainage openings 69 and 71 are shown in phantom in partition 13 since the section line 2—2 was taken to the right of the opening. The openings 69 and 71 correspond to the internal drainage openings disclosed in my aforementioned copending application to provide for drainage and venting of each of the internal chambers during immersion of the muffler 1 in coating fluids. The openings are preferably about ¼ inch in diameter and may be located at the positions indicated. In dip coating, the muffler will be suspended from one end or the other so that the partitions extend at a slight angle to the horizontal, whereby the openings of one side will be slightly higher than the openings on the other side, thus permitting proper venting and draining. Since internal drainage and venting will occur to some degree through gaps 67, it is possible to reduce the size and number of holes 69, as shown in FIG. 2, and described above, if required for acoustic purposes. In some instances it may be possible to get sufficient internal venting and drainage through gaps 67 and eliminate holes 69.

FIGS. 5 to 7 show a muffler 101 embodying a modified form of the invention. The various parts of the muffler 101 are substantially identical to those disclosed in FIGS. 1 to 4 and hence they are identified by the same reference numerals plus 100. A further description of the functional structure and operation of the muffler 101 is therefore not necessary. In the case of the muffler 101, however, the knurls are replaced by patterns of longitudinal ribs 173 that are pressed in metal of the shell 103. The ribs are preferably about .080 inch in height and will therefore provide a relatively large cross sectional area of opening in the joint between the flanges of the partitions and the shell. Thus, the ceramic material will coat the bare metal exposed between the flanges and the shell.

Still another embodiment is shown in FIGS. 8–10 in a muffler 201 which structurally is substantially identical to muffler 1 and 101 so that the parts thereof are identified by the same reference numerals in the 200 series.

In this form, the actual engagement or contact area between the flanges of the partitions and the shell is held to a minimum by means of a series of holes 275 that are pierced in the partition flanges and provided with small necks around the openings which are preferably about .080 inch in length. The butt ends of the necks will be in contact with the shell and some or all of them can be spot welded to it. Thus, a tight connection between the partition and shell is provided but a maximum area of bare metal in the joints between the shell and flanges is exposed and capable of being covered with the ceramic material. The holes 275 are preferably about ½ inch in diameter.

FIGURES 11 to 13 show a muffler 301 embodying another modified form of the invention. The various parts of the muffler 301 are substantially identical to those disclosed in FIGURES 1 to 4 and hence they are identified by the same reference numerals plus 300. A further description of the functional structure and operation of the muffler 301 is therefore not necessary. However, in the muffler 301 the knurls are replaced by patterns of substantially pyramid shaped embossments 363 that are pressed in the metal of the shell 303. These embossments are preferably about .080 inch in height and will therefore provide a relatively large cross sectional area of opening in the joint between the flanges of the partitions and the shell. With this construction also the ceramic material will coat the bare metal exposed between the flanges and the shell. The apices 363*a* of the pyramid shaped embossments 363 are preferably blunted by forming the same of flat curves to provide areas for spot welding to the flanges of the partitions.

In all forms, it will be seen that each partition flange engages the shell at circumferentially spaced points. Between these points the partition flanges and shell are spaced so that bare metal on each in the joint is exposed, whereby the ceramic can coat them to minimize the possibility of subsequent cracking and corrosion.

The drainage openings 69 and 71, shown in FIG. 2, may also be used in each of the partitions in the mufflers 101, 201 and 301. It is preferable that the two drainage openings 71 at opposite ends of the minor axis be retained in all the partitions of each of the mufflers as they will provide a means whereby condensate inside the muffler can slosh back and forth from one chamber to another to be vaporized and carried off in the hotter chamber, such as 15, 17, and 19.

As shown in FIGURES 11, 13 and 14 of the drawings, it is preferred that a layer of asbestos 375 and a layer of sheet steel 376 around the asbestos be wrapped around the shell 303 to serve as additional insulation and as a means to protect the relatively brittle ceramic coating on the outside of the shell 3. This structure may be employed to advantage in all forms of construction.

While the preferred embodiment of the invention has been shown and described, it will be understood that the same is susceptible to variation, alteration and modification without departing from the spirit and scope of the invention.

I claim:

1. A protectively coated muffler or the like comprising a hollow elongated housing member, a transverse partition member inside the housing member dividing it into a plurality of interior chambers, said partition member having a peripheral section for connection to the housing member, first parts of said section being in contact with the housing member and the remaining parts of said section being spaced about 0.080 inch from the housing member to provide for liquid flow between such remaining parts and the housing member, a protective coating upon the spaced facing surfaces of such remaining parts and housing member, and means for rigidly connecting at least some of said first parts to said housing member.

2. The invention set forth in claim 1 wherein one of the members has projections extending toward and engaging the other member to provide said first parts, and the means for affixing the members together comprises spot-welds formed at the base of at least some of the projections.

3. The invention set forth in claim 2 wherein the projections are on the housing member and the partition member has a peripheral flange engaging said projections.

4. The invention set forth in claim 3 wherein the projections comprise knurls on the housing member.

5. The invention set forth in claim 2 wherein the projections comprise elongated ribs extending transverse to the partition member.

6. The invention set forth in claim 1 wherein the partition member has a peripheral flange, said flange having projections thereon engaging said housing and providing said first parts.

7. The invention set forth in claim 6 wherein said projections comprise necked openings in the flange.

8. An automotive exhaust muffler or the like comprising an elongated outer shell, end headers closing the ends of the shell, a transverse partition inside the shell, said transverse partition having an annular flange around its outer

periphery in juxtaposition to said shell, means formed at spaced locations around the periphery of said outer shell engaging said flange at spaced locations around its periphery for spacing the remaining portions of said flange from the adjacent surface of said outer shell, said last named means having a height of about 0.080 inch, means rigidly affixing said outer shell to said flange at at least some of the points of engagement between said last named means and said flange, and a protective coating upon said outer shell, said end header and said transverse partition including the spaced surfaces of said flange and said outer shell.

9. A device as described in claim **2** in which said projections are substantially pyramid shaped.

10. A device as described in claim **2** in which said projections are in the form of substantially pyramid shaped embossments with the apices of said embossments being spotwelded to the other member.

11. A device as described in claim **3** in which said projections are substantially pyramid shaped with substantially blunt apices with the apices being spotwelded to the other member.

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