United States Patent

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[54] **ONE-PIECE TUBE AND SHELL ASSEMBLY FOR SILENCER**
12 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** ..... **181/54,** 181/35 C, 181/61, 138/115, 138/156, 29/193, 29/157, 29/514

[51] **Int. Cl.** **F01n 1/02,** F01n 7/18, B21d 53/06

[50] **Field of Search** 138/111–117, 156; 29/183, 193, 157, 455,469, 505, 514, 521; 181/35.3, 61–63, 48, 54, 59

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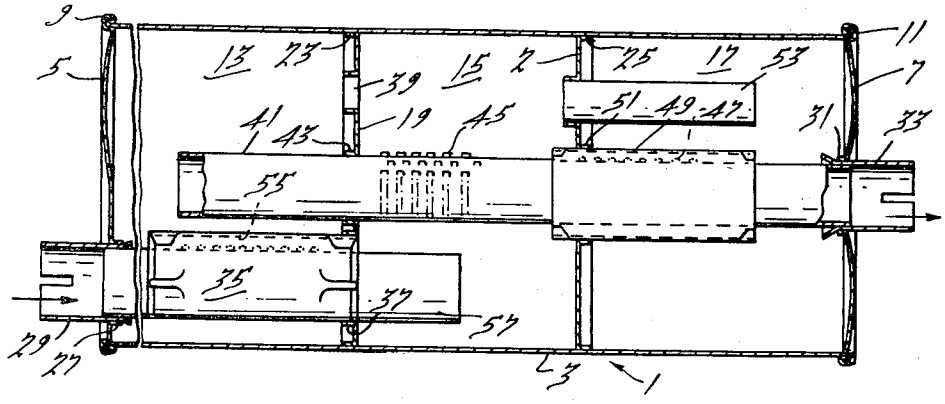
ABSTRACT: A T-shaped blank is rolled into telescoped inner and outer tubes to form a tube-and-shell assembly of a type that may be used in exhaust mufflers for internal-combustion engines as a spit chamber and gas flow tube or as a pair of tuning tubes.



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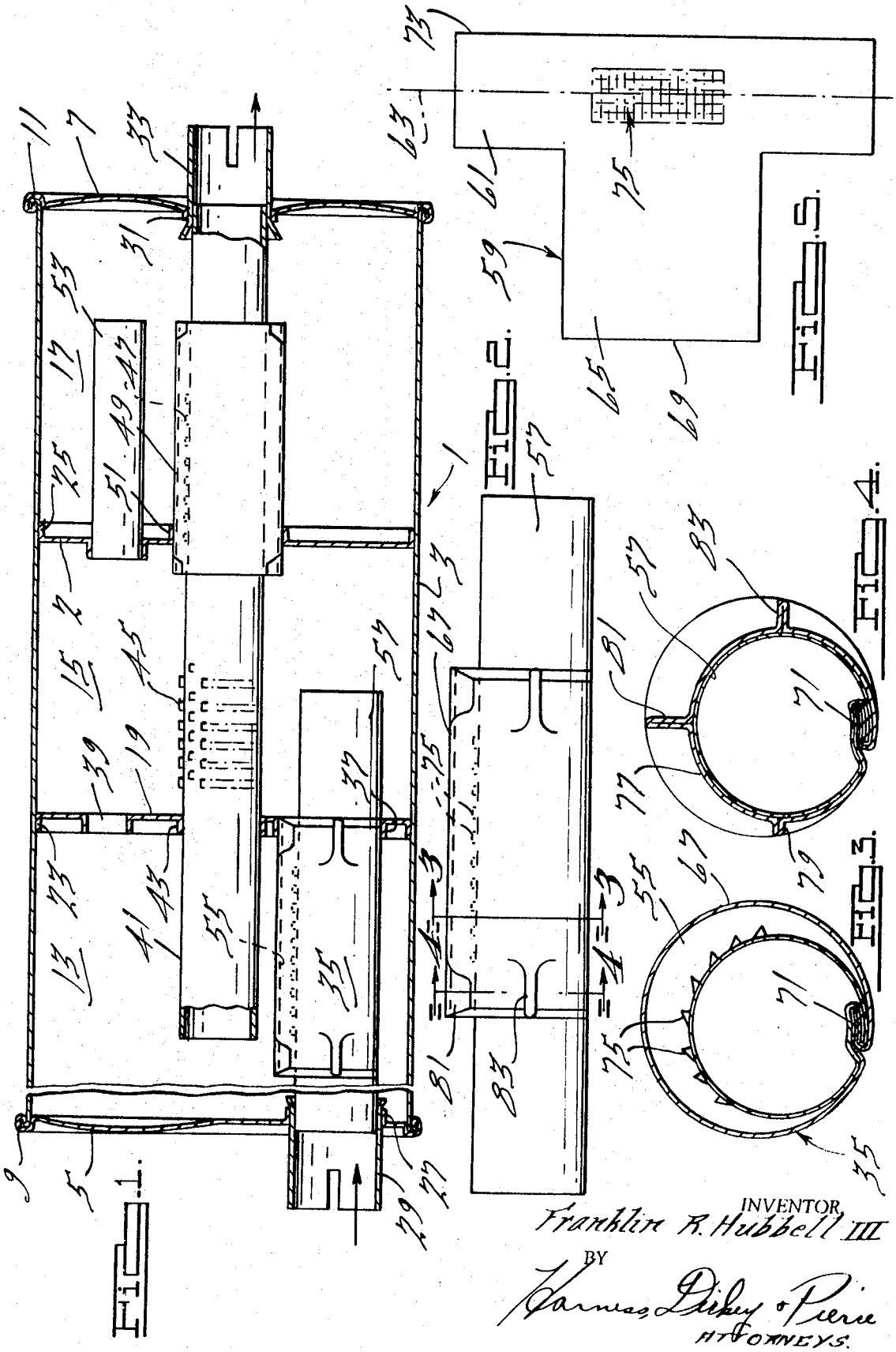

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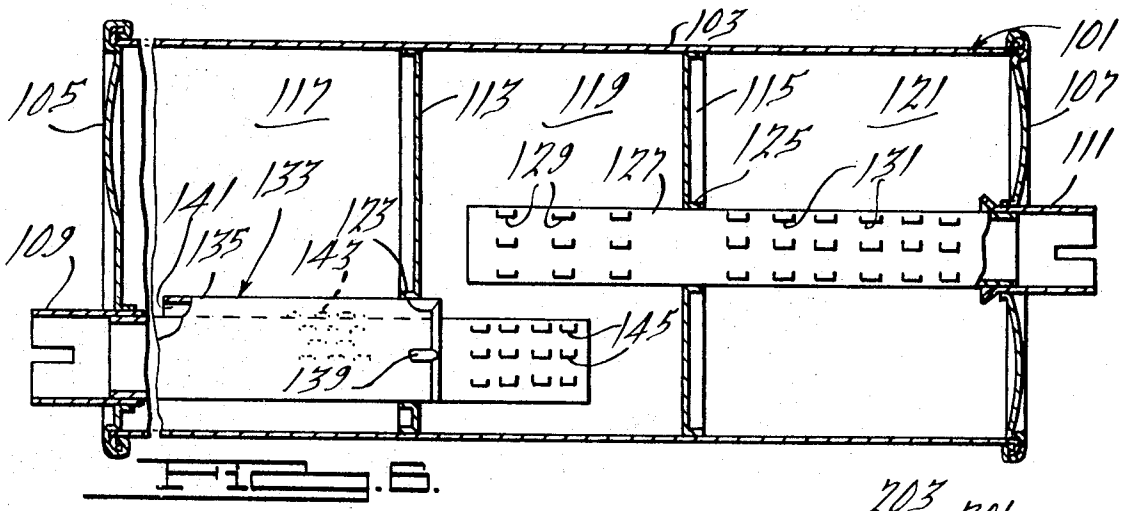

FIG. 6.

FIG. 7.

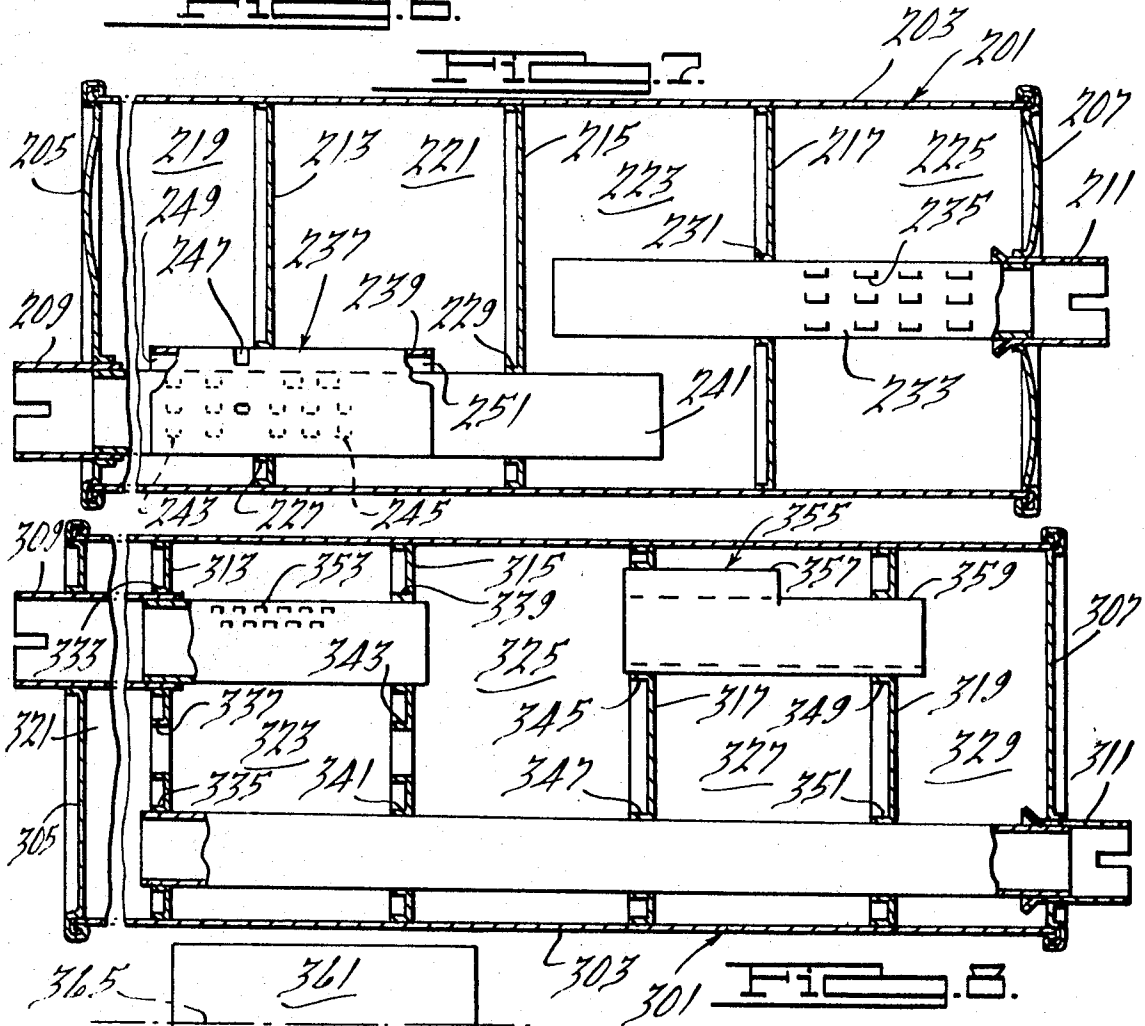

FIG. 8.

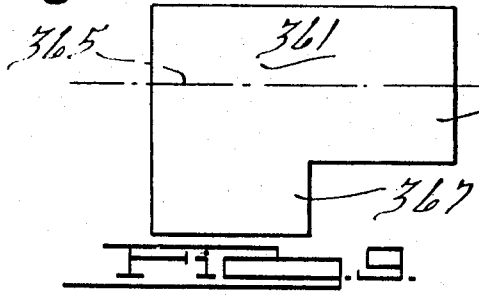

FIG. 9.

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ONE-PIECE TUBE AND SHELL ASSEMBLY FOR SILENCER

BRIEF SUMMARY OF THE INVENTION

It is the purpose of this invention to simplify and reduce the cost of manufacture of a tube-and-shell assembly of the type commonly used in exhaust mufflers for automobile-type internal-combustion engines.

The invention accomplishes this by means of a blank which has two sections, one to form the inner tube and the other to form the outer shell. If used as a spit chamber assembly, the tube section of the blank is provided with a patch of louvers or perforations. The blank is rolled into a tube with a shell around it and the top and bottom edges of the blank are interconnected.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross section through a typical muffler in which the invention may be used;

FIG. 2 is an enlarged view of a one-piece louver tube-and-shell assembly as used in the structure of FIG. 1 and as formed by the blank of FIG. 5;

FIG. 3 is a cross section along the line 3—3 of FIG. 2;

FIG. 4 is a cross section along the line 4—4 of FIG. 2;

FIG. 5 is a blank layout of the flat sheet metal prior to roll up and seaming to form the structure of FIG. 2;

FIG. 6 is a longitudinal section through a muffler containing a modified form of the invention in which the one-piece blank is rolled into a gas flow tube and a tuning tube;

FIG. 7 is a longitudinal section through a muffler containing a modified form of the invention in which the one-piece blank is rolled into a gas flow tube and two tuning tubes;

FIG. 8 is a longitudinal section through a muffler containing a modified form of the invention in which the one-piece blank is rolled into two tuning tubes; and

FIG. 9 is a plan view of the blank that may be used to form the embodiment of the invention shown in FIG. 8.

DESCRIPTION OF THE INVENTION

The muffler 1 of FIG. 1 has an outer shell 3 which is preferably oval in cross section and which is closed at its inlet end by a header 5 and at its outlet end by a header 7 and interlocked with the headers in gastight joints 9 and 11. The space inside the shell 3 is divided into three chambers 13, 15, and 17 by means of the transverse partitions 19 and 21 which have annular peripheral flanges 23 and 25 which are spotwelded to the shell 3. The inlet header 5 has an inlet opening defined by an annular flange 27 in which is supported an inlet bushing 29 and the outlet header 7 has an outlet opening which is defined by an annular flange 31 in which is supported an outlet bushing 33. Supported inside the inlet bushing 29 is the inlet end of a one-piece louver tube-and-shell assembly 35 in accordance with this invention and it carries gas from the inlet bushing 29 to the middle chamber 15, being supported in an annular flange 37 in the partition 19. The partition 19 has a flanged opening 39 which permits gas to flow in a reverse direction from chamber 15 into chamber 13 where it can enter the inlet end of an outlet gas flow tube 41 which is supported in the outlet bushing 33 and in an annular flange 43 in the partition 19. The outlet tube has a louver patch 45 opening into the chamber 15 and a louver patch 47 opening into an annular chamber around the tube provided by a shell 49 that is reduced in diameter by pinching at opposite ends whereby it is tightly attached to the tube 41 in a known manner. The shell 49 (and thus the tube 41) is supported in an annular flange 51 in the partition 21. The chamber 15 is also connected to the chamber 17 by means of a tuning tube 53 which forms the only inlet and outlet to the chamber 17 whereby that chamber and the tube 53 may be tuned in accordance with the Helmholtz formula to attenuate a desired frequency.

As will be more fully described presently, the tube-and-shell assembly 35 provides a spit chamber or high-frequency attenuating chamber 55 surrounding most of the circumference of a gas flow tube 57 whereby inlet gas and sound from the inlet tube 29 are subjected to attenuation of roughness and high-frequency noises in passing through the assembly 35 to the crossover chamber 15. In chamber 15 the exhaust gas can bypass through louvers 45 in the outlet tube 41 or reverse its flow to pass through opening 39 into chamber 13 and then into the outlet tube 41. Chamber 15 is connected by tube 13 to the resonator chamber 17 so that attenuation of a preselected relatively low frequency occurs at this point. Further attenuation occurs as gas expands into chamber 13 after passing through opening 39. As gas flows through the outlet tube 41 the louvers 45 acoustically connect it to the chamber 15 for additional sound attenuation. Further down the tube 41 the spit chamber provided by a shell 49 acts to remove relatively high frequencies just before the gas leaves the muffler through the outlet bushing 33.

Referring especially to FIGS. 2 to 5, the assembly 35 is formed from a flat metal blank 59 that is roughly T-shaped as seen in FIG. 5. It has a top or bar section 61 which is rolled up around the axis 63 to form the tube 57. It also has a stem section 65 which is curved around the tubular section 61 in a symmetrical manner to form the shell 67 which defines the chamber 55. The end edge 69 of the section 65 is joined into a common joint 71 with the end edge 73 of the blank section 61. This joint may be of the interlocked type shown in FIG. 3 or it may be of the welded or other suitable type. The joint 71 is continued into the ends of the tube 57 which project beyond the ends of the shell 67.

The blank section 61 has a patch of louvers sheared and pressed into it as seen at 75 and these open into the chamber 55 to acoustically connect the inside of the tube 57 with the space between the tube and the shell section 67. The opposite longitudinal ends of the shell section 67 are secured in gastight contact with the outer surface of the tube section 57 as seen at 77 by means of three U-shaped pinches 79, 81, and 83 which serve to reduce the diameter of the shell 65 at the opposite ends so that it can tightly grip the tube 57 and close off the ends of the chamber 55.

It is apparent that the projecting portions of the tube 57 at opposite ends of the shell section 67 as well as the extent of shell 67 can be made of varying lengths by suitable adjustment of the shape of the blank 59. Also, the diameter of the shell 67 can be adjusted by suitable control of the length of the stem section 65 of the blank.

Referring to FIG. 6, the muffler 101 has a shell 103 which is closed at opposite ends by inlet headers 105 and 107 which support inlet and outlet bushings 109 and 111, respectively. Inside the shell and suitably secured to it are transverse partitions 113 and 115 which divide the shell into chambers 117, 119, and 121. The partition 113 has a collar or annular flange 123 and the partition 115 has a collar or annular flange 125. Mounted in the flange 125 and in the outlet bushing 111 is an outlet gas flow tube 127 which may have a louver patch 129 opening into the chamber 119 and a louver patch opening into the chamber 121.

A combination gas flow tube and tuning shell assembly 133 formed from a rolled-up blank has a tuning tube or outer shell section 135 and a gas flow tube section 137, the tuning tube section being supported in the collar 123 and the inlet end of the gas flow tube 137 being supported in inlet bushing 109. The assembly 133 may be formed from a blank which is similar to the blank of FIG. 5. However, the pinched sections 139 (corresponding to pinches 79, 81, and 83) are formed at only the downstream end of the tube 135 so that the upstream end 141 is opened into the chamber 117 and forms the only means of communication between the louver patch 143 in the gas flow tube 137 and the chamber 117. If desired, a louver patch 145 may be formed in the end of the gas flow tube 137 which projects into chamber 119.

Referring to FIG. 7, a muffler 201 has a shell 203 which is closed at its ends by inlet and outlet headers 205 and 207 which contain inlet and outlet bushings 209 and 211, respectively. Transverse partitions 213, 215, and 217 extend across

the shell 203 and are suitably secured in position to it and subdivided into chambers 219, 221, 223, and 225. The partition 213 has an annular flange or collar 227; the partition 215 has an annular flange or collar 229; and the partition 217 has an annular flange or collar 231. Supported in the collar 231 and the outlet bushing 211 is an outlet gas flow tube 233 which has a louver patch opening into louver patch 235 opening into chamber 225, the tube conducting gases from chamber 223 to the outlet bushing 211.

Supported in the collars 227 and 229 is a combination gas flow tube and tuning shell assembly 237 including a shell section 239 and a gas flow tube section 249. The gas flow tube section 241 has louver patches 243 and 245 opening on opposite sides of the pinched sections 247 (corresponding to pinches 79, 81, and 83 of FIG. 4) which divide the shell 239 into different length tuning tubes 249 and 251 connecting the louver patches 243 and 245, respectively, to the chambers 219 and 221 and forming the only inlet and outlet to these chambers. The assembly 237 may be formed from a blank which is similar in principle to that shown in FIG. 5. Referring to FIGS. 8 and 9, a muffler 301 has a shell 303 which is closed by inlet headers 305 and 307 which support inlet and outlet bushings 309 and 311, respectively. Transverse partitions 313, 315, 317, and 319 are suitably supported in fixed position inside the shell 303 and divide the interior into chambers 321, 323, 325, 327, and 329. The partition 313 has flanged openings or collars 333, 335, and 337. The transverse partition 315 has flanged openings or collars 339, 341, and 343. The transverse partition 317 has flanged openings or collars 345 and 347 and the transverse partition 319 has a flanged opening 349 and 351. The inlet bushing 309 is supported in the collar 333 and in return supports the inlet end of an inlet gas flow tube which may have a louver patch 353 opening into the chamber 323, the open downstream end being supported in the collar 339 to open in the chamber 325. An outlet gas flow tube is supported at its upstream end in collar 335 and extends through collars 341, 347, 352, and is supported at its downstream end in the bushing 311 and serves to conduct gases from the chamber 321 to the outside of the muffler. Gas entering the chamber 325 from the inlet tube reverses its flow to pass through collars 333 and 337 to reach the chamber 321.

In accordance with this invention the chambers 327 and 329 are connected in a Helmholtz resonator relationship with the chamber 325 by means of the double tuning tube assembly 355 which has an outer tube or shell element 357 and an inner and longer tube element 359. The assembly 355 is formed in a manner similar to the tube-and-shell assemblies previously described though in this case the blank 361 (FIG. 9) may be of a modified T-shape or substantially L-shape. The bar section 363 is rolled around the axis 365 to form the tube 359 and the stem section 367 is rolled around the outside of the tube 359 and interconnected with it in a joint similar to the joint 71 to form the outer tube or shell section 357. The resulting double tuning tube 355 has an outer section 357 that interconnects the chambers 325 and 327 and an inner section 359 that interconnects the chambers 325 and 329. The volumes of the chambers 327 and 329 and the lengths and areas of the respective tuning tube sections may be selected and interrelated by known Helmholtz calculations so that the chambers 327 and 329 attenuate predetermined sound frequencies.

It will now be seen that the invention provides a structural technique for making muffler tube-and-shell combinations that is of substantial use in the manufacture of mufflers as well as other devices.

I claim:

1. The method of making a tube-and-shell assembly which comprises forming a substantially flat metal blank having a bar section and a stem section, rolling the bar section into a tube and the stem section into a shell around the tube, and interconnecting the top and bottom edges of the blank, after said rolling, into a joint.

2. A method as set forth in claim 1 including the step of reducing at least one portion of the shell into engagement with the outside of the tube to form a chamber between the shell

3. A method as set forth in claim 1 including forming perforations in the bar section.

4. A one-piece tube-and-shell assembly comprising a shell, a tube inside the shell, said tube and shell having a common longitudinal seam joining their individual side edges together and to each other, a portion of said shell being reduced in diameter to form a joint around the tube and a chamber adjacent the joint, said tube being perforated inside said chamber.

5. A one-piece tube-and-shell assembly comprising a shell, a tube inside the shell, said tube and shell having a common longitudinal seam joining their individual side edges together and to each other, the opposite ends of said shell being reduced in diameter to form a gastight joint with the tube at each end of the shell, said tube being perforated inside the shell.

6. A sound-attenuating muffler for flowing gas such as the exhaust gas of an internal-combustion engine which comprises a housing having an inlet and outlet, gas flow and silencing structure inside the housing connecting the inlet and outlet and including a chamber, and a one-piece tube-and-shell assembly in said structure having a shell with a tube inside and joined to the shell in a common seam, said assembly being in gas flow communication with said chamber, said assembly including perforations in that portion of the tube located inside the shell, said shell having a reduced diameter portion forming a wall extending between the shell and the tube.

7. A muffler as set forth in claim 6 wherein said wall is located intermediate the ends of the shell and said tube has perforations on both sides of the wall, the opposite ends of said shell being open.

8. A muffler as set forth in claim 6 wherein said wall is at one end of the shell, the other end of the shell being open and opening into said chamber so that the shell acts as a tuning passage connecting the chamber to the perforations.

9. A sound-attenuating muffler for flowing gas such as the exhaust gas of an internal-combustion engine which comprises a housing having an inlet and outlet, gas flow and silencing structure inside the housing connecting the inlet and outlet and including a chamber, and a one-piece tube-and-shell assembly in said structure having a shell with a tube inside and joined to the shell in a common seam, said assembly being in gas flow communication with said chamber, said structure including second and third chambers located adjacent the first mentioned chamber, said tube and shell each being open at opposite ends, one end of each of the tube and shell opening into the first chamber, the other end of the shell opening into the second chamber and the other end of the tube opening into the third chamber.

10. A muffler as set forth in claim 9 wherein the lengths and areas of the shell and tubes and the volumes of the second and third chambers are interrelated so that the second and third chambers are tuned to attenuate predetermined frequencies.

11. A sound-attenuating muffler for flowing gas such as the exhaust gas of an internal-combustion engine which comprises a housing having an inlet and outlet, gas flow and silencing structure inside the housing connecting the inlet and outlet and including a chamber, and a one-piece tube-and-shell assembly in said structure having a shell with a tube inside and joined to the shell in a common seam, said assembly being in gas flow communication with said chamber, said tube forming a part of the path for gas flow through the muffler, said shell being connected at opposite ends to said tube to form a closed chamber around said tube, said tube being perforated inside said closed chamber whereby said closed chamber comprises a high-frequency noise-attenuating chamber.

12. A sound-attenuating muffler for flowing gas such as the exhaust gas of an internal-combustion engine which comprises a housing having an inlet and outlet, gas flow and silencing structure inside the housing connecting the inlet and outlet and including a chamber, and a one-piece tube-and-shell assembly in said structure having a shell with a tube inside and joined to the shell in a common seam, said assembly being in gas flow communication with said chamber, said tube being longer than said shell, said shell and tube being formed from a blank having a bar section and a stem section.