June 27, 1961 W. H. POWERS 2,990,028

AUTOMOTIVE MUFFLER

Filed April 1, 1955 2 Sheets-Sheet 1

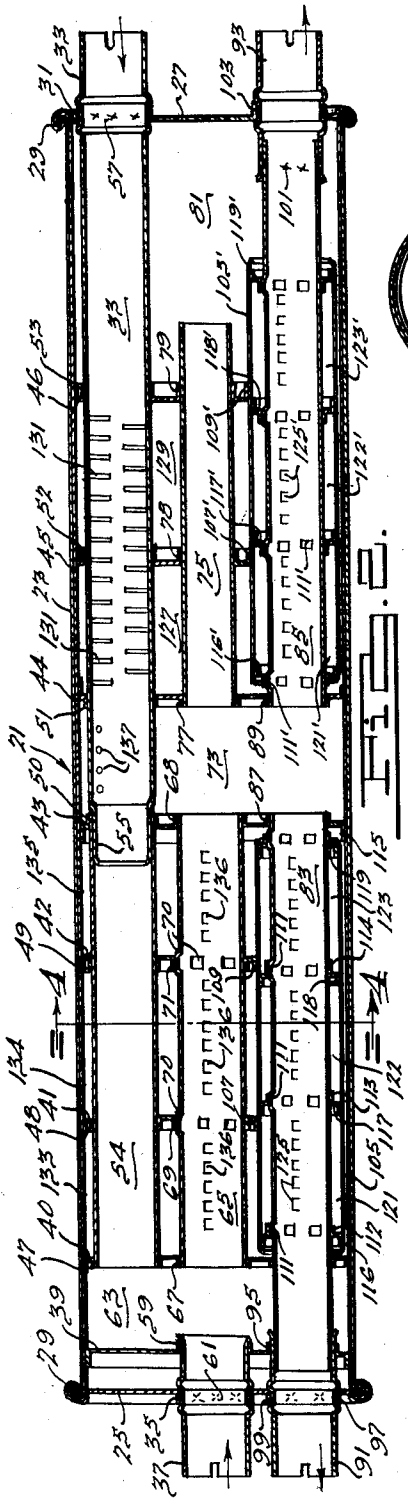


Fig. 2.

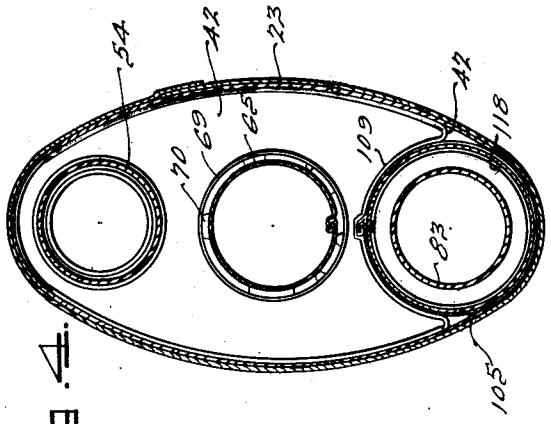


Fig. 4.

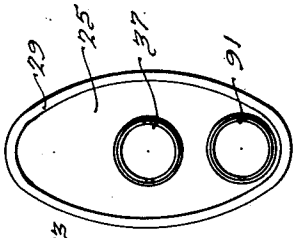


Fig. 3.

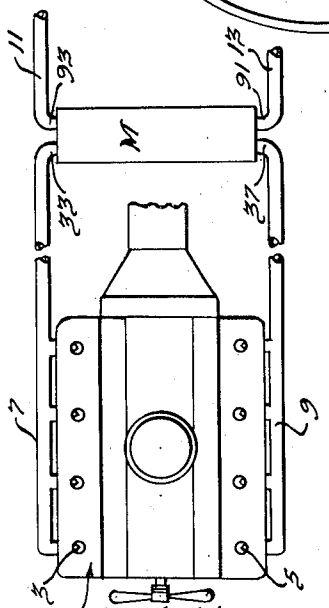


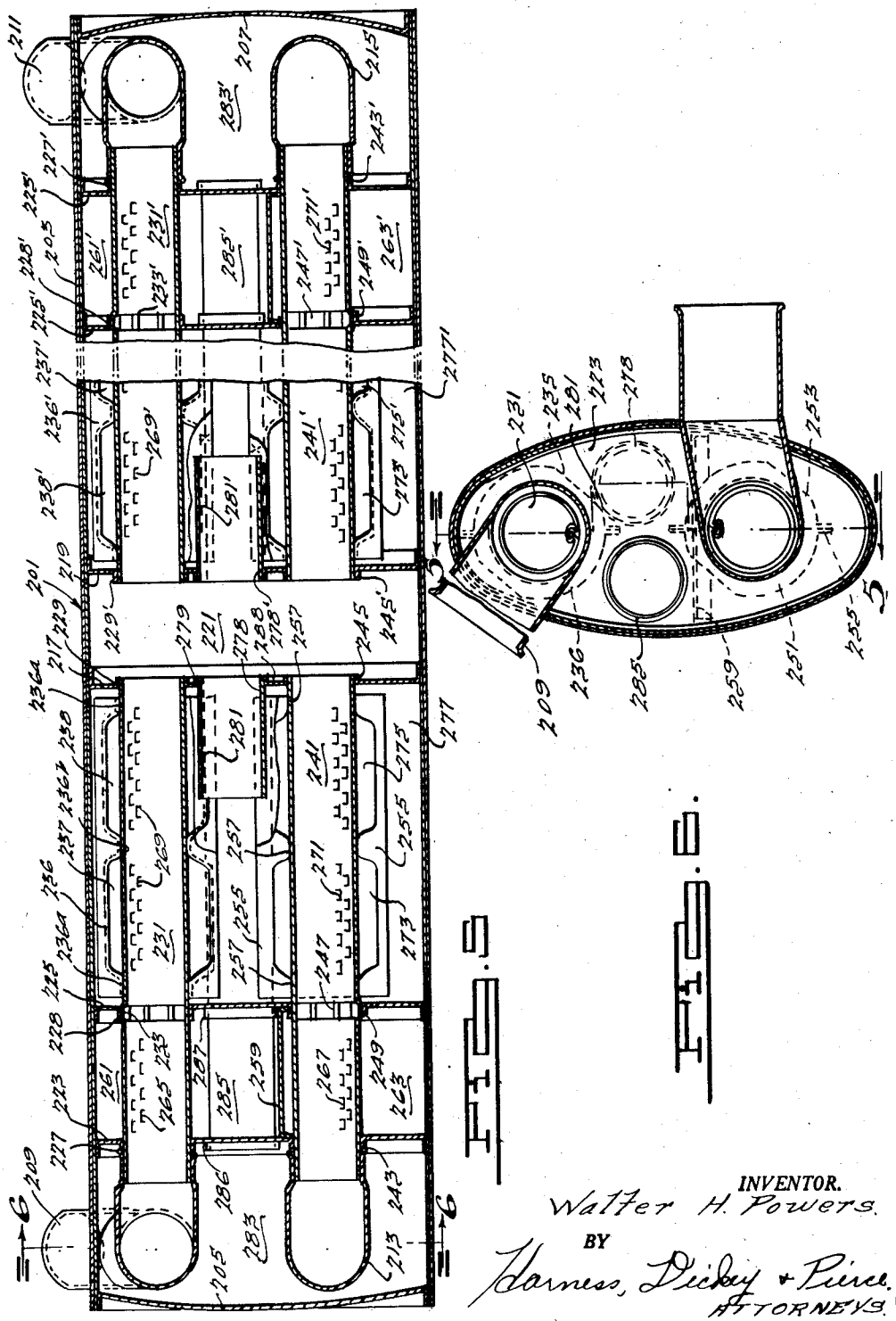
Fig. 1.

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2,990,028

AUTOMOTIVE MUFFLER

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The invention relates to mufflers and, in particular, to mufflers used to silence the exhaust stream of automotive internal combustion engines.

It is an object of this invention to provide a muffler construction of the dual flow type.

Another object of this invention is to provide a muffler that is adapted to be arranged transversely of the length of an automobile.

The invention accomplishes these and other objects by means of a muffler construction in which the opposite ends of the elongated muffler casing are each provided with an inlet and an outlet. Special silencing constructions are provided within the muffler casing and these are connected to the inlets and communicate the gas flowing from the inlets to the outlets. Preferably, the two inlets will be connected to different banks of engine cylinders so that the pulses of gas flowing therein will be out of phase with each other; and, in the mufflers shown and described herein, the silencing structure includes chambers that are common to both inlets so that the gases may intermingle and tend to level out the pulses and pressure waves.

The invention is illustrated in the accompanying drawings which show preferred embodiments thereof and in which:

FIGURE 1 is a diagrammatic representation of an exhaust system showing the present muffler arranged transversely of the length of the car;

FIG. 2 is a longitudinal cross section through one embodiment of muffler constructed in accordance with the invention;

FIG. 3 is an end view taken from the left of FIG. 2;

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

FIG. 5 is a longitudinal section on line 5—5 of FIG. 6 through a modified form of muffler embodying principles of this invention; and

FIG. 6 is a section on line 6—6 of FIG. 5.

FIGURE 1 shows diagrammatically a typical V–8 engine 1 having the twin banks of cylinders 3 and 5 which furnish exhaust to the exhaust lines 7 and 9, respectively. The lines 7 and 9 are connected to a muffler M which is transverse of the length of the automobile, as will be recognized by its position in FIG. 1. Tail pipes 11 and 13 are connected to the muffler M and exhaust gases from the muffler which have been silenced in it.

Turning now to the form of muffler M which is shown in FIGS. 2–4, the muffler 21 has an oval shape casing 23 with heads 25 and 27 (sometimes called headers) that close the opposite ends of the casing and which are interlapped at 29 with the ends of the casing to provide a leak-tight construction. The head 27 has an outwardly directed flange or neck 31 which defines an opening that receives an inlet tube 33 which is in gas-tight connection with the exhaust line 7. The end head 25 has an outwardly turned flange or neck 35 which provides an opening to receive an inlet bushing 37 that is in gas-tight communication with the exhaust line 9. Inside of the casing 23 and reading from left to right are a series of transverse partitions which have flanges bent parallel to the casing 23 and in contact with the inner wall of the casing 23. These partitions are identified, respectively, by the reference numerals 39 through 46 and all of them are securely spot welded in position to the muffler casing 23. The partitions 40–46 are provided, respectively, with flanged openings adjacent the top portion thereof, these flanged openings or necks being identified by the reference numerals 47 through 53, respectively. Fitted in the openings 47–50 of the partitions 40–43 is an imperforate tube 54 and it may be spot welded to each one of the flanged necks 47–50 as indicated. The tube 54 is in alignment with the inlet tube 33 and receives and supports a slightly turned down end section 55 of the inlet tube. The inlet tube 33 extends through the openings 51–53 of the partitions 44–46, as well as through the opening 50 of the partition 43, and may be spot welded to the necks of these partitions as shown in the drawings. At the outer end the tube 33 is expanded or increased in diameter as indicated by the beads and intermediate land 57 so that the tube will tightly fit the outwardly turned neck 31 and permit spot welding of the tube to the neck 31 after the internal parts have been assembled. It will be seen that the tube 33 acts as a force transmitting member which ties the head 27 to the internal parts of the muffler which in turn are welded to the casing so that ample support for the head 27 against blowout is provided.

At the other end of the muffler, the inlet bushing 37 fits in a flanged neck 59 of an aligned opening in partition 39 and is spot welded to the neck 59. The bushing 37 is expanded as shown at 61 into proper contact with the flange 35 of the header 25 so that the spot welding can be done after the bushing has been spot welded to the partition 39 and the internal parts assembled. With this arrangement it will be seen that the partition 39 and the header 25 are tied together in force transmitting relationship by the bushing 37 which is spot welded to each one of these members. The space between the partition 39 and the partition 40 constitutes a cross-over chamber 63. Leading away from the chamber 63 is a tube 65, the opposite ends of the tube 65 being spot welded to the outturned flanges 67 and 68 of the partitions 40 and 43, respectively. It may be noted here that the partitions 39, 40, 43, and 44 fit the periphery of the casing 23 all the way around while the intermediate partitions 41, 42, 45, and 46 fit most of the periphery but do not fit the bottom part thereof as shown by the shape of the partition 42 in FIG. 4. Returning to the construction of tube 65, the tube is provided with circumferentially spaced embossments 70 which fit in necks or flanged openings 69 and 71 in the intermediate partitions 41 and 42 and provide means for spot welding the tube to the partitions, such tubes and embossments being described in Patent 2,251,369. The tube 65 is directly in line with the inlet bushing 37 and in addition to carrying the gas from bushing 37 it also carries cross-over gas from chamber 63 into a cross chamber 73 which is provided in the casing 23 between the partitions 43 and 44. Directly in line with the tube 65 is an imperforate reduced diameter tube 75 that is mounted in and spot welded to the flanged openings 77–79, respectively, of the partitions 44, 45, and 46. The tube 75 projects into a chamber 81 defined in the casing 23 between the partition 46 and the header 27. It will be recognized that the chamber 81 constitutes a tuning or resonator chamber and that the tube 75 is the sole inlet and outlet to this chamber.

In view of the dead-end nature of the tube 75 and chamber 81, gas in the cross chamber 73 must flow either to the left or right through the tubes 83 or 85, respectively. The inside ends of the tubes 83 and 85 are supported in and spot welded to inturned flanges 87 and 89, respectively, of the partitions 43 and 44 while the outermost ends of the tubes 83 and 85 are supported in the outlet bushings 91 and 93, respectively, which in turn are connected to the tail pipes 13 and 11, respectively. The bushing 91 is spot welded to an inturned neck or

flange 95 in the partition 39 and is expanded and spot welded at 97 to an outturned neck or flange 99 on the header 25. It will be seen that the outlet bushing 91 acts in the same manner as the inlet bushing 37 to tie the head 25 and the partition 39 together. In addition, the outlet tube 83 may be spot welded to the bushing 91. The outlet tube 85 is spot welded at 101 to the outlet bushing 93 and the bushing 93 is expanded and spot welded to the outturned neck 103 of the head 27 so it will be seen that the bushing 93 acts to tie the head 27 to the internal parts and transmit load on the head to the internal parts in the same manner as described in connection with the inlet tube 33.

Surrounding the greater portion of the length of the outlet tube 83 is a cylindrical shell 105 which is spot welded to the semicircular bottom flange portions 107 and 109 of the partitions 41 and 42, respectively, and fits into the narrow bottom end of the casing, preferably in contact therewith as seen in FIG. 4. As in the case of the tube 65 the outlet tube 83 is lock seamed along its length and provided with circumferentially spaced embossments 111 (like 70) which fit in flanged necks 112–115, respectively, of partitions 116–119, respectively, which are spot welded inside of the casing 105 to provide a series of spit chambers or high frequency chambers 121, 122, and 123 surrounding the tube 83. The tube 83 is provided with louvers 125 of a type which cause the gas to swirl circumferentially around the surface of the tube 83, these louvers opening into the chambers 121, 122, and 123.

The construction of the outlet tube 85 and the spit chambers around it are identical to those described in connection with the tube 83 and the same reference numbers with a prime affixed thereto are used to identify the structure in connection with the tube 85.

Turning now to the operation of the muffler 21, inlet gas from the exhaust line 7 will enter the tube 33 and pass along its length until it reaches the cross-over chamber 63 at the end of tube 54 which is in alignment with the inlet tube 33. Between the partitions 44 and 45 is a chamber 127 and between the partitions 45 and 46 is a chamber 129, these chambers being relatively large volume spit chambers and the inlet tube 33 is provided with slots or other suitable perforations or louvers 131 so that gas can flow into the chambers 127 and 129, respectively, it being noted that the chamber 129 is somewhat larger than the chamber 127 and will therefore act on somewhat lower frequencies. Between the partitions 40, 41, 42, and 43 are a series of spit chambers 133, 134, and 135, of which the chamber 135 is the smallest and the chamber 134 is the largest in volume. The tube 65 has louvers 136 formed therein of the type adapted to cause the gases to swirl circumferentially around the outside of the tube 65 and this communicates the gas within the tube 65 with the spit chambers 133, 134, and 135, this comprising the gas that has entered the muffler at the inlet 33 and flowed along the length of the muffler as well as the gas that has entered directly from the inlet 37. Gas leaving the tube 65 flows into the cross chamber 73 and if desired the inlet tube 33 may be provided with a series of apertures 137 within the chamber 73 to permit some bypass of gas from the tube 33 directly into the chamber 73. Some of the gas reaching the chamber 73 will flow directly along the length of the tube 75 into the resonator chamber 81 and it will be recognized that this design is such as to control the heavy and sustained power notes. Gas and sound waves are mixed up and intermingled in the chamber 73 and will flow either to the left or the right through the outlet tubes 83 and 85, and while passing through these tubes will be subjected to the high frequency tuning action of the spit chambers 121–123 and 121' to 123', from whence the gases will flow through the outlet bushings 91 and 93 into the tail pipes 13 and 11 and thence to atmosphere. It is also within the purview of the invention to provide openings in tube 54 and partition 39 so as to vary the sound attenuating characteristics of the muffler.

Turning now to the modified form of muffler shown in FIGS. 5 and 6 which is identified by the reference number 201, the muffler is provided with an oval shaped casing 203 of suitable construction and having left- and right-hand end heads 205 and 207 that are connected in a leakproof manner to the ends of the casing 203. The muffler 201 has an elbow-shaped inlet fitting 209 which connects with the exhaust line 9 and a second inlet elbow 211 at the other end which connects with the exhaust line 7. The muffler 201 has an outlet elbow 213 which connects with the exhaust tail pipe 13 and an outlet elbow 215 at the other end which connects with the tail pipe 11. It will be understood that the elbow shaped inlets and outlets 209, 211, 213, and 215 are shaped to adapt themselves to the physical requirements of a particular automobile and that they can be modified as desired without changing the effectiveness of the internal parts to be described hereafter in silencing the exhaust gases. In other words the inlet and outlet nipple and bushing construction can be modified to suit the particular job. Within the casing 203 are two flanged transverse partitions 217 and 219 which are spot welded around their flanged peripheries to the inside of the shell 203. Between the partitions 217 and 219 is a cross-over chamber 221. With one exception which will be pointed out hereinafter, the structure between the partition 217 and the head 205 is identical to the structure between the partition 219 and the head 207, hence only the structure to the left of the partition 217 will be described and the similar structure on the right of the partition 219 has the same reference number with a prime affixed thereto. Between these partitions and the end heads 205 and 207 are an additional pair of partitions 223 and 225 which are spot welded around their flanged peripheries to the inside of the shell 203. The partitions are provided with a series of aligned flanged openings or necks 227, 228, and 229, respectively, which pass the inlet tube 231. The inlet tube 231 is spot welded to the necks 227 and 229 and it may be of the lock seam construction and provided with spaced circumferential embossments 233 whereby it may also be spot welded to the flange 228 of the partition 225. Surrounding the part of the tube 231 between the partitions 225 and 217 are a pair of complemental sheet metal stampings 235 and 236 which are necked down at their opposite ends 236*a* and inner center portion 236*b* to engage the tube 231 and which have flanges that are spot welded together so that the stampings 235 and 236 define a pancake construction providing two spit chambers 237 and 238 around the tube 231.

The outlet tube arrangement is substantially identical to the inlet tube arrangement and may include the outlet tube proper 241 which is spot welded to the neck 243 of the partition 223 and the neck 245 of the partition 217. The tube 241 may also be of the lock seam construction and be formed with spaced circumferential embossments 247 whereby the tube may be readily spot welded to the neck 249 around an opening in partition 225. A pancake construction comprising complemental semicircular flanged shells 251 and 253 surrounds that portion of the tube 241 which is between the partitions 225 and 217, the flanges 255 of the shells 251 and 253 being spot welded together and the shells being necked down at 257 to engage and be mounted upon the tube 241. A partition 259 divides th space between the transverse partitions 223 and 225 into a pair of spit chambers 261 and 263 communicating respectively through suitable slots, louvers, or other openings 265 and 267 with the inlet tube 231 and the outlet tube 241. The inlet tube 231 has suitable slots, louvers, or openings 269 formed therein which open into the spit chambers 237 and 238 while the outlet tube has suitable slots, louvers, or apertures 271 formed therein which open into the spit cham-

bers 273 and 275 formed by the pancakes 251 and 253. The space between the partitions 225 and 217 constitutes a relatively large closed volume resonator chamber 277 and the gases and sound waves reach it from the cross-over chamber 221 through a tuning tube 278 which is spot welded to a flanged opening or neck 279 in the partition 217 and also spot welded at a point 281 to the pancake 235. The space between the partition 223 and the end head 205 (or 207) constitutes a second and somewhat smaller volume resonator chamber 283. The cross-over chamber 221 is connected to the chamber 283 by a tube 285 that is supported in and spot welded to flanged openings 286, 287, and 288 in the partitions 223, 225, and 217. The tube 285 is imperforate and it will be noted that the tube 285' is somewhat smaller in diameter than the tube 285, this constituting the sole difference between the left-hand muffling structure and the right-hand muffling structure with respect to the cross-over chamber 221.

In operation the gases enter the inlet elbows 209 and 211 and since these elbows are connected to opposite banks of cylinders the pulses will be somewhat out of phase and will tend to equalize and even out when they meet in the central chamber 221. The gases pass through the inlet tubes 231 and 231' and some of the higher frequency noises are taken out by the spit chambers 261, 237, and 238. The gases that have entered the central chamber 221 are free to leave through either the outlet passage 241 or the outlet passage 241' and thence pass through the outlet elbows 213 and 215 to the tail pipes 13 and 11, respectively. In passing through the outlet tube 241 (and of course the outlet tube 241') the gas and sound waves will be subjected to the action of the high frequency or spit chambers 275, 273, and 263. The heavier notes of lower frequency will pass through the tubes 278 or 285 into the resonator chambers 277 and 283 (and 277' and 283'). It will be seen that the construction of the silencing arrangement within the muffler 201 provides four big and eight small spit chambers as well as four resonator or tuning chambers which could, if desired, be tuned to four different notes. The muffler is therefore capable of treating a wide range of frequencies and noises and therefore of giving a very effective job of removing noise from the exhaust streams.

It will now be realized that the invention has provided a transverse muffler construction which is adapted to be placed in a strategic position underneath an automobile especially adjacent the rear end thereof where more space is available for such a construction. It is also adapted to receive gas in a dual flow arrangement and to intermingle out of phase pulses so as to tend to even out the gas flow. It will be apparent that modifications can be made in the structure that has been selected for illustration herein without departing from the principles and scope of the invention.

I claim:

1. An exhaust system for an internal combustion engine having twin banks of cylinders comprising, an exhaust line connected to and leading gases away from one bank of cylinders and a second exhaust line connected to and leading exhaust gases away from said second bank of cylinders, said exhaust lines being of substantially equal length and running parallel to each other, a muffler extending transversely to said exhaust lines and having inlet means at opposite ends connected respectively to said first and said second exhaust lines, said muffler having a common mixing chamber located centrally thereof, inlet pipes of substantially equal length within said muffler connected respectively to said two inlet means and extending between said inlet means and said mixing chamber and emptying into said mixing chamber whereby the distance of gas travel from each of said banks into said chamber is substantially equal, and outlet means for conducting the exhaust gases away from said muffler.

2. In a muffler construction, an elongated hollow casing having heads at each end sealing off the ends of the casing, each of said heads having an inlet therein, each of said heads having an outlet therein, and gas passage and silencing means within said casing connecting each of said inlets to both of said outlets, said last named means including a common chamber located centrally within said casing, means providing two resonator chambers within said casing on opposite sides of said chamber, and four tubes connecting said common chamber to said resonator chambers, said gas passage means extending through and being imperforate in said resonator chambers, there being no inlet and outlet to said resonator chambers except as provided by said four tubes.

3. In a muffler, an elongated sheet metal casing, heads at opposite ends of said casing and rigidly secured thereto, each of said heads having an inlet tube therein, said inlet tubes being spot welded to said heads, each of said heads having an outlet tube therein, each of said outlet tubes being spot welded to said heads, internal partitions and tubes within said casing and rigidly secured by spot welding to said casing, the inside ends of both said inlet tubes and both said outlet tubes being spot welded to said internal partitions.

4. In a dual inlet-dual outlet muffler construction, an elongated sheet metal casing having closed ends, an inlet located at each end of said casing, an outlet located at each end of said casing, a pair of longitudinally spaced transversely extending partitions centrally located at a medial position within said casing and defining between them a common cross chamber, axially aligned inlet tubes connecting each of said inlets to said cross chamber, axially aligned outlet tubes connecting said cross chamber to each of said outlets, a pair of axially spaced partitions located between each of said central partitions and the adjacent ends of the casing to define a chamber between one of said partitions and the end of the casing, a second chamber between one of said partitions and said medial partition, and a third chamber between said two partitions constituting said pair, said first and second chambers constituting resonator chambers and said third chamber constituting a spit chamber, means connecting said inlet and outlet tubes to said spit chamber, and means individually connecting said first and third resonator chambers to said cross chambers.

5. The invention set forth in claim 4 including pancake structures mounted around the inlet and outlet tubes in said second chamber and defining with said tubes a pair of spit chambers.

6. The invention set forth in claim 5 including longitudinal partition means in said third chamber dividing it into a spit chamber for the inlet tube and a spit chamber for the outlet tube.

7. In a muffler construction having a pair of inlets and a pair of outlets, an elongated sheet metal casing closed at opposite ends, means within said casing defining a medially located cross chamber, tubes connecting each of said inlets to said cross chamber, means providing a series of spit chambers around the tubes which connect said inlets to said cross chamber, means defining a pair of resonator chambers on opposite sides of said cross chamber, tubes of different lengths connecting said cross chamber to said resonator chambers, outlet tubes connecting said cross chamber to said outlets, and means providing a series of spit chambers around said outlet tubes.

8. The invention set forth in claim 7 wherein certain of said spit chambers around said tubes are provided by pancake constructions, certain of said tubes connecting said cross chamber to said resonator chambers being spot welded for support to said pancake construction.

9. A muffler construction comprising an elongated hollow casing having closed ends, a pair of longitudinally spaced partitions extending transversely across the interior of said casing and respectively forming with said closed ends end chambers at each end of the casing, inlet and outlet conduits in said casing and extending to the out-

side thereof, each of said end chambers having a said conduit extending through it, a second pair of longitudinally separated partitions extending transversely across the interior of said casing and located between said first mentioned partitions and forming with said first mentioned partitions a pair of intermediate chambers and a central chamber, gas passage means supported on said partitions and connecting said inlet conduits to said central chamber but terminating outside of said central chamber so that there is gas flow through the volume of said central chamber, gas passage means supported on said partitions connecting the central chamber with said outlet conduits, and means providing for admission of sound and gas to said intermediate chambers.

10. A muffler construction comprising an elongated casing having closed ends, a pair of partitions extending transversely across the interior of said casing and located respectively adjacent closed ends thereof and defining with said closed ends closed resonator chambers, an inlet and an outlet conduit at each end of the casing extending through said closed chambers and each being rigidly secured to the adjacent said partitions, said conduits each being imperforate within said closed chambers, and gas passage and silencing means within the casing between said partitions interconnecting said inlet conduits and said outlet conduits and providing for flow and silencing of gas through the casing, and tuning necks provided in said partitions.

11. In a muffler construction having a pair of inlets and a pair of outlets, an elongated sheet metal casing closed at opposite ends, means within said casing defining a medially located cross chamber, tubes connecting each of said inlets to said cross chamber, means defining a pair of resonator chambers located respectively on opposite sides of said cross chamber, tubes of different lengths connecting said cross chamber to said respective resonator chambers, and outlet tubes connecting said cross chamber to said outlets.

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