

[54] COMBINATION AFTERBURNER AND
AUXILIARY MUFFLER

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abandoned.

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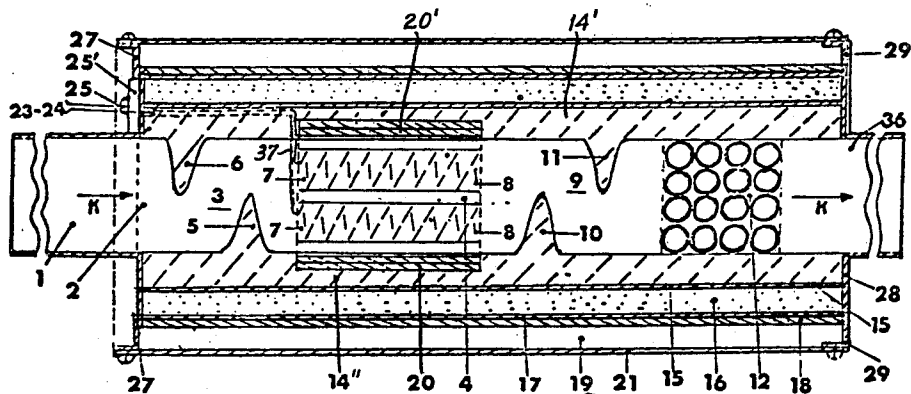
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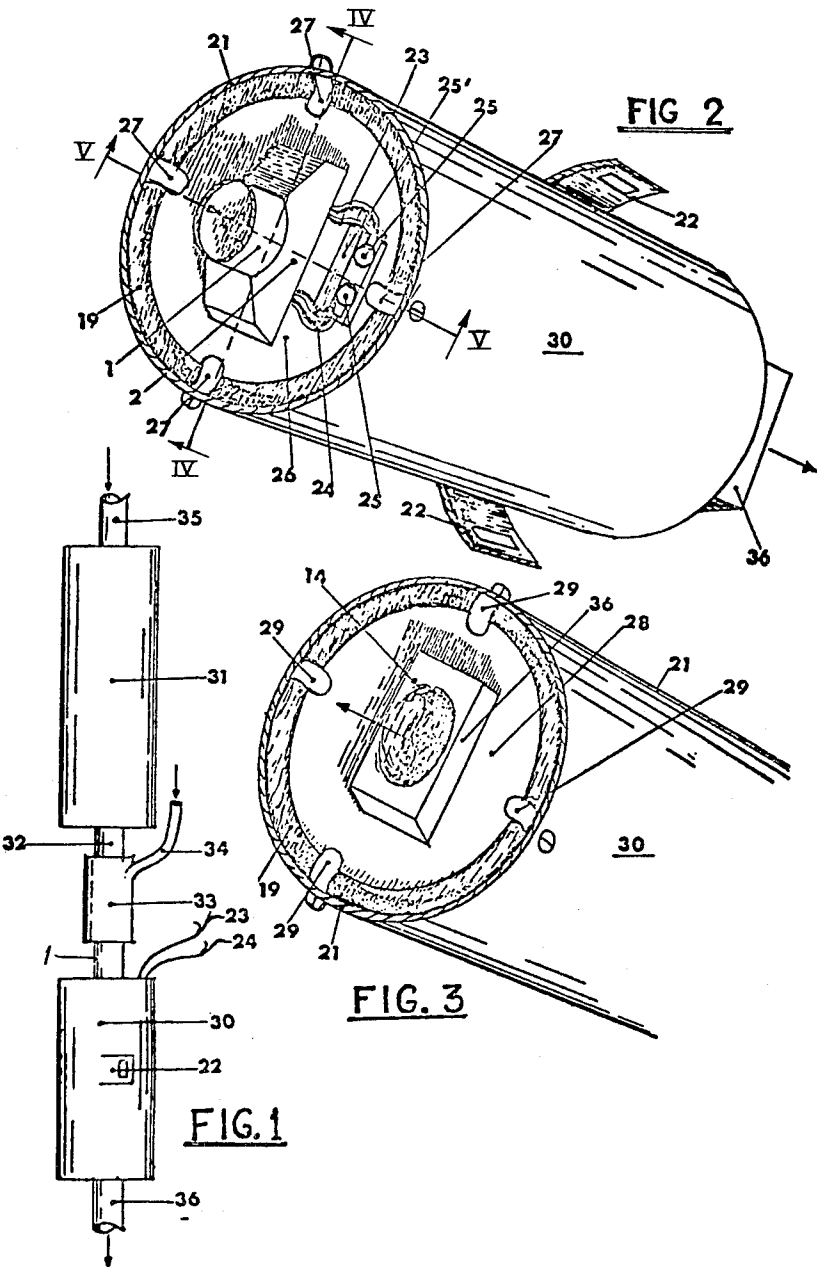
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[57] ABSTRACT

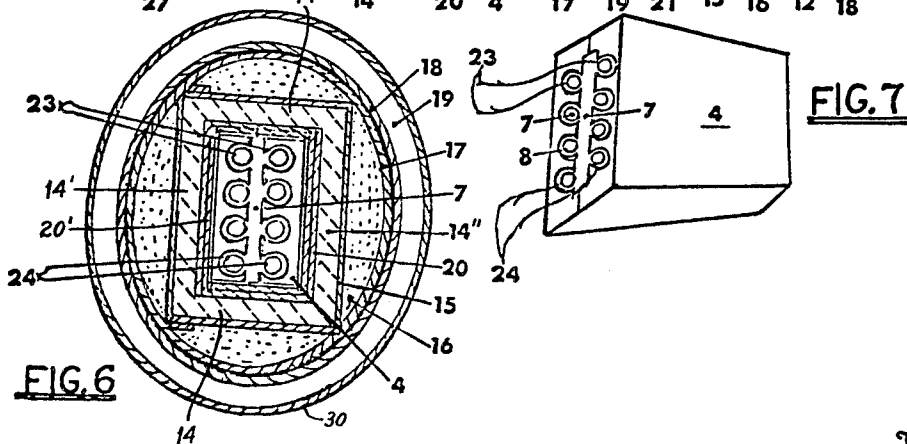
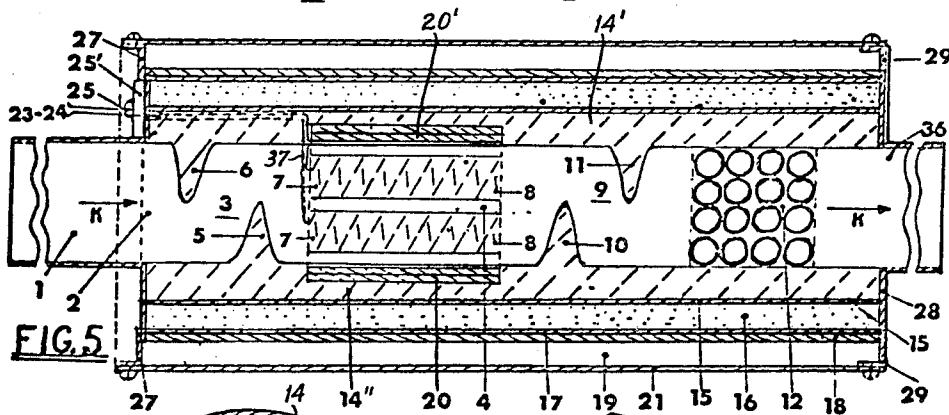
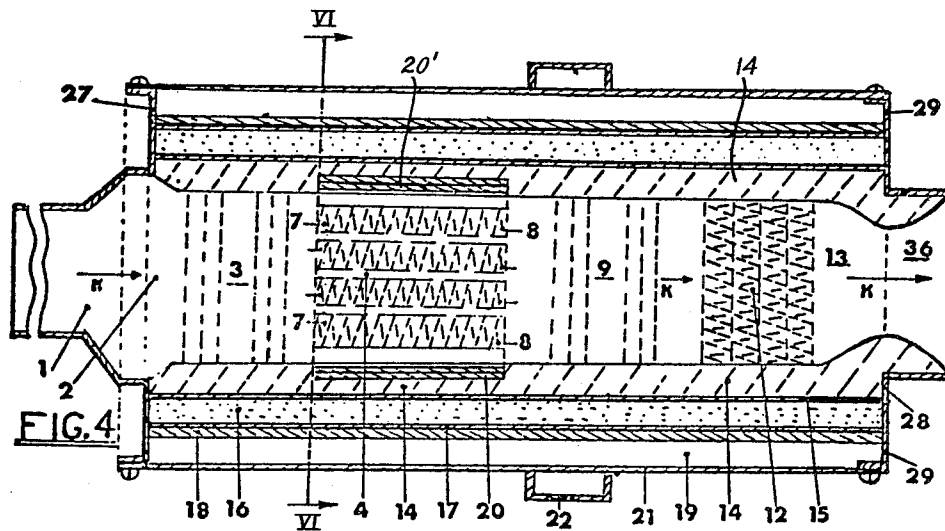
The device of the present invention may be coupled to a source of exhaust gases and compressed air. The device comprises a tubular casing with a lining of refractory material defining a passage for the mixture of exhaust gases and compressed air. An electrical heating unit and a heat sink unit are mounted in said passage, and baffles are located on the upstream side of the heating unit and intermediate the heating unit and the heat sink unit to deflect the gases from a straight line path to a path in the form of the letter "S," i.e., a reverse curve. The heater is provided with a body of refractory material affording a restricted passage section for the mixture of gases. The electrical resistance heating elements of the heater are disposed in said restricted passage.

6 Claims, 7 Drawing Figures





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COMBINATION AFTERBURNER AND AUXILIARY MUFFLER

This application is a continuation of my copending application, Ser. No. 768,070, filed Oct. 16, 1968 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to devices for reducing air pollution from automobile engine exhaust and is particularly directed to a combination afterburner and auxiliary muffler.

2. Description of the Prior Art

Many devices have been developed for reducing harmful exhaust emissions from the engines of automobiles, trucks and buses. Such devices may be broadly classified as either thermal combustion systems or catalytic oxidation systems. A device embodying this invention is of the former type, which includes such apparatus as a flame-type afterburner and means for injecting air into the exhaust manifold at a point proximate the exhaust valve ports. Known thermal combustion systems suffer from the disadvantage that they are not structured for significantly contributing to muffling of the attendant exhaust noise.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide an afterburner with an electric resistance heating unit, a heat sink and baffles arranged in a novel manner and effective to destroy noxious exhaust gases emitted from the engine of an automotive vehicle.

Another object is to provide such an afterburner which, in addition, effectively serves as an auxiliary muffler.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a diagrammatic view showing a combination afterburner and auxiliary muffler constructed in accordance with the present invention coupled to the muffler of an automotive engine;

FIG. 2 is a perspective view of the afterburner alone, looking at the upstream end thereof;

FIG. 3 is a perspective view of the afterburner alone, looking at the downstream end thereof;

FIG. 4 is a vertical longitudinal section through the afterburner, as indicated by line IV—IV in FIG. 2;

FIG. 5 is a horizontal longitudinal section through the afterburner, as indicated by line V—V in FIG. 2;

FIG. 6 is an enlarged transverse section through the afterburner, on line VI—VI in FIG. 4; and

FIG. 7 is a perspective view of the electrical furnace or electrical resistance heating unit shown alone.

Referring particularly to FIG. 1, the exhaust pipe 35 from an engine (not shown) is connected to the intake end of a conventional muffler 31. The discharge end of the muffler is connected by a pipe 32, coupler 33 and pipe 1 to the intake end of the afterburner 30. The discharge from the afterburner is through a pipe 36. Connecting into the coupler 33 is the discharge end of a compressed air line 34. Electric current is supplied to the afterburner through the leads 23 and 24, and the afterburner is mounted on a suitable frame or stationary base (not shown) by means of brackets 22.

Now referring particularly to FIGS. 2-7, the casing of the afterburner 30 comprises an inner tubular member 15 rectangular (but not square) in transverse section, an intermediate tubular member 17 oval in transverse section and of a length corresponding to that of member 15, and an outer tubular member 21 oval in transverse section and of a length somewhat greater than that of members 15 and 17. The member 15 is disposed within the member 17 with the four corners thereof engaging the inner surface of the member 17. The member 17 is disposed within the member 21, being of a size to provide a space 19 extending about the member 17.

Covering the ends of the members 15 and 17 at the intake end of the afterburner is a plate 26 carried by the outer casing member 21 by means of four brackets 27, and covering the

ends of the members 15 and 17 at the discharge end of the afterburner is a plate 28 carried by the outer casing 21 by means of four brackets 29. The crescent-shaped spaces between the members 15 and 17 are filled with thermal insulation material, for example, glass wool, designated 16, and the member 17 is wrapped in a sheet of asbestos, designated 18. The intake pipe 1 of the afterburner is connected to the cover plate 26 by an antechamber 2 rectangular in transverse section, as shown. The discharge pipe 36 of the afterburner is rectangular in transverse section and is connected to cover plate 28.

Referring particularly to FIGS. 4, 5 and 6, the opposite sides of the tubular member 15 are lined respectively with sections 14' and 14'' of a lining made of refractory material, and the top and bottom of the tubular member 15 are lined respectively with sections 14 of the lining, the arrangement being such as to provide an open passage through the member 15, as shown. An electric furnace or electric resistance heating unit 4 is disposed in the passage.

Referring particularly to FIG. 7, the heating unit comprises a block or body of refractory material, preferably made in two sections, placed in abutting side-by-side relation and conjointly providing a rectangular restricted passage 7 extending therethrough. The opposed faces of the restricted passage 7 are provided with a number of recesses respectively accommodating the several electric resistance coils 8 of the heating unit. The block of refractory material is wrapped in a metallic sheet 20', such as aluminum, with its bright side or surface turned inward, and around the metallic sheet is a sheet of asbestos 20. The block, wrapped in the metallic and asbestos sheets, is suitably nested in recesses formed in the sections 14, 14' and 14'' lining the member 15, as shown. Secured to the cover plate 26 is a Bakelite plate 25' mounting binding posts 25. The leads 23, 24 are connected to the posts 25 and extensions thereof from the posts 25 are passed therefrom through the plate 26 and an asbestos sleeve 37 to the electrical resistance heating coils 8 of the heating unit 4, being arranged as required for energization of the heating unit.

Referring particularly to FIGS. 4 and 5, also disposed in the passage is a netting assembly or heat sink unit 12, which consists of a bundle of spiral coils of the type with which the heating unit is provided. The several coils are arranged transversely of the path of the exhaust gases, i.e., transversely of the passage, as shown.

On the upstream side of the heating unit 4 are a pair of baffles 5 and 6, and on the downstream side of the heating unit, between the heating unit and the heat sink unit, are a pair of baffles 10 and 11. The baffles are formed integral with the sections 14' and 14'' lining the member 15, as shown, and are spaced apart longitudinally of the passage whereby to deflect the exhaust gases from a straight line path to a path in the form of the letter "S," i.e., a reverse curve.

Between the antechamber 2 and the heating unit 4 is a chamber 3 in which the baffles 5 and 6 are located, and between the heating unit 4 and the heat sink unit 12 is a chamber 9 in which the baffles 10 and 11 are located. On the downstream side of the heat sink 12 is a chamber 13 with upper and lower walls which converge towards the end of the passage and then flare out and extend beyond the ends of the members 15, 17 and 21 to avoid creation of spinning and turbulence of the gases as they pass therethrough.

The exhaust gases discharged from the muffler 31 through the pipe 32 are admixed in the coupling 33 with compressed air supplied through pipe 34. Then they enter the afterburner 30 through the pipe 1, flowing in the direction indicated by the arrows K,K. Next they enter the antechambers 2 and 3 and pass through the restricted passage 7 of the heating unit 4. The restricted passage 7 is heated by the electrical resistance heating coils 8 to a temperature of 400° C.—850° C., as a consequence of which the exhaust gases are ignited. The flames issuing from the restricted passage 7 impinge upon the baffles 10 and 11, which check the downstream reach thereof. However, the heat is sufficient to cause the heat sink to glow. As

the exhaust gases pass through the open network of coils which afford the heat sink they are burned out and are then discharged through the chamber 13 and pipe 36 as harmless gases. An automobile passes through many driving modes very quickly, and some of these modes have substantial hydrocarbon and carbon monoxide contents and at such times the oxidation causes immediate and marked temperature rise. By utilizing the heat sink, this heat is stored to assist in oxidation of hydrocarbons and carbon monoxide during other driving modes in which the concentrations of hydrocarbons and carbon monoxide is relatively low and consequently more difficult to combust. The overall efficiency of the apparatus is consequently improved by including the heat sink.

It will be understood, of course, that the size of the apparatus will vary with the volume, flow, quantity and source of the exhaust gases to be treated. It will be noted that at every point along the path of the exhaust gases the passage is of an area in transverse section at least equal to that of the pipe 35. Thus it will be appreciated that the apparatus does not prevent the regular and normal functioning of the engine, that is, it does not brake it.

It will be noted that after exhaust gases pass between baffles 5 and 6 and around the baffle 5, they impinge upon the body of the heating unit 4, as a consequence of which they are directed into the restricted passage 7, where they come into intimate contact with the electric resistance heating coils 8 before being ignited and discharge from the restricted passage 7 into the firing chamber 9. Thus the body of the heating unit 4 functions as a baffle and coacts with the baffles 10 and 11 to effectively contribute to reduction of exhaust noise from operation of the engine. Accordingly, the device 30 functions not only as an afterburner but also as an auxiliary muffler.

In view of the glass wool 16 disposed between the members 15 and 17 and the sheet of asbestos 18 wrapped around the member 17, the afterburner 30 is provided with adequate thermal insulation, but additional thermal insulation is afforded by the space between the members 17 and 21, which is open at each end of the afterburner for circulation of atmospheric air.

Changes in the driving mode of the engine and fluctuations in the electric current supplied to the electric heating unit 4 do not detract from the effectiveness of the apparatus, and the pressure of the exhaust gases does not effect the heat generated by the electric heating unit.

Means synchronized with the volume and velocity of the exhaust gases to be treated may be provided to automatically vary the volume of compressed air supplied through the pipe 34, and suitable thermostatic or other means may be provided for controlling temperature of the heating unit whereby to avoid exceeding the highest useful temperature.

The afterburner 30 may be located in any part of the system. However, the most convenient location thereof is on the downstream side of the muffler 31, as shown.

Although this invention has been described with respect to a specific embodiment thereof, it will be appreciated by one skilled in the art that the invention is broad enough to encompass all equivalent embodiments thereof without departing from the spirit and scope of the invention as set forth in the foregoing specification and the appended claims. For example, referring particularly to FIG. 6, the member 15 is rectangular, but not square, in transverse section, and the members 17 and 21 are oval in transverse section. However, the member 15 could be made square in transverse section, and the members 17 and 21 could be made circular in transverse section without departing from the spirit and scope of the invention as set forth in the foregoing specification and the appended claims.

What is claimed is:

1. In a combination afterburner and auxiliary muffler, the combination comprising:
 - a. a casing including an elongated tubular member,
 - b. a refractory lining of tubular conformation within said casing and extending longitudinally thereof, forming a longitudinal passage through which exhaust gases pass,

- c. a heating unit within said tubular refractory lining intermediate the length thereof, for igniting the exhaust gases,
 - d. baffles extending inwardly from opposed sides of said lining and positioned intermediate one end thereof and said heating unit upstream of the exhaust gases, whereby the exhaust gases follow a tortuous path in moving towards said heating unit,
 - e. a heat sink within said tubular refractory lining downstream of said heating unit, and
 - f. baffles extending inwardly from opposed sides of said lining between said heating unit and said heat sink to check the downstream reach of the gas ignited by the heating unit.
2. The combination of claim 1 with the addition of:
 - a. a source of compressed air in communication with the longitudinal passage formed by the refractory lining upstream of said heating unit.
 3. The combination of claim 1 wherein:
 - a. said heating unit comprises a body of refractory material mounted within said tubular refractory lining,
 - b. said body being provided with a restricted longitudinal passageway, and
 - c. a plurality of electrical resistance coils in said body adjacent the restricted passageway for igniting the gases passing through the longitudinal passageway.
 4. The combination of claim 1 wherein:
 - a. each of said sets of baffles includes a pair of baffles which are spaced apart longitudinally of the passage, each baffle extending inwardly to a point proximate the longitudinal axis of the passage.
 5. The combination of claim 1 wherein:
 - a. said heat sink comprises a plurality of spiral coils arranged transversely of the passage and in the path of the exhaust gases, whereby the spiral coils are heated by the exhaust gases and burn out the gases passing through the coils, following which they are discharged as harmless gases.
 6. In a combination afterburner and auxiliary muffler, the combination comprising:
 - a. a casing including an elongated tubular member,
 - b. a refractory lining of tubular conformation within said casing extending longitudinally thereof, forming a longitudinal passage through which exhaust gases pass,
 - c. a heating unit within said tubular refractory lining intermediate the length thereof, for igniting the exhaust gases,
 - d. said heating unit comprising a body of refractory material mounted within said tubular refractory lining,
 - e. said body being provided with a restricted longitudinal passageway,
 - f. a plurality of electrical resistance coils in said body adjacent the restricted passageway for igniting the gases passing through the longitudinal passageway,
 - g. a source of compressed air in communication with the longitudinal passage formed by the refractory lining, upstream of said heating unit,
 - h. baffles extending inwardly from opposed sides of said lining and positioned intermediate one end thereof in said heating unit, upstream of the exhaust gases, whereby the exhaust gases follow a tortuous path in moving toward said heating unit,
 - i. said baffles being spaced longitudinally of the passage and extending to a point proximate the longitudinal axis thereof,
 - j. a heat sink within said tubular refractory lining downstream of said heat unit,
 - k. said heat sink comprising a plurality of spiral coils arranged transversely of the passage and in the path of the exhaust gases, whereby the spiral coils are heated by the exhaust gases and burn out the gases passing through the coils, following which they are discharged as harmless gases, and
 - l. baffles extending inwardly from opposed sides of said lining between said heating unit and said heat sink to check the downstream reach of the gas ignited by the heating unit,

m. said baffles being spaced longitudinally of the passage and extending to a point proximate the longitudinal axis of the passage.

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