This invention relates to a combination exhaust gas muffler and after burner.

In recent years and with the ever-increasing number of motor vehicles, pollution of the air with unburned hydrocarbons carried by the exhaust gases of motor vehicles has been steadily increasing and in several locales has reached a critical point.

As a result of air pollution by motor vehicle exhausts, legislation has been passed in California and similar legislation is expected to be passed in other states which will require all motor vehicles to be equipped with means for reducing the quantity of unburned hydrocarbons in auto exhaust gases before it is discharged into the atmosphere.

To date many efforts have been made to develop such a means, but each has been wanting for one or more reasons. Some have not been efficient enough, others are of a nature which requires frequent and costly servicing, still others are too large and/or are too costly to manufacture.

An object of the present invention is to provide a novel combination auto exhaust muffler and after burner.

Another object of the present invention is to provide a device of the character referred to which is substantially the same size and shape as a conventional auto muffler and can be substituted for conventional mufflers, in existing autos, without requiring rebuilding or modifications of the auto or any of the components thereof.

Still another object of my invention is to provide a device of the character referred to having an elongate, tubular body, a ceramic liner extending through the body and through which exhaust gases are conducted, an electric heating and igniting means within the liner and a plurality of longitudinally spaced baffle screens in the body and cooperatively related to the heating and igniting means.

A further object of the invention is to provide valving means at the discharge end of a device of the character referred to, to control the flow of gases and to create a back pressure in the device to increase the heat therein and supplement the heating means in order to initiate ignition of the unburned gases.

It is an object of the present invention to provide a device of the character referred to wherein the baffle screens serve to dampen and muffle the sound of the exhaust and also serve to hold a flame once the previously unburned hydrocarbons are ignited.

Another object of this invention is to provide a device of the character referred to which, once ignition of the unburned gases has taken place, will sustain a flame and ignition of the gases subsequently introduced into it.

It is an object of the present invention to provide a device of the character referred to which is easy and economical to manufacture and which is both highly effective and dependable in operation.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a perspective view of the device provided by the present invention.

Fig. 2 is a longitudinal detailed sectional view of my invention.

Fig. 3 is an enlarged transverse sectional view taken as indicated by line 3—3 on Fig. 2.

Fig. 4 is an enlarged detailed sectional view taken as indicated by line 4—4 on Fig. 2.

Fig. 5 is a perspective view of the heating and baffle assembly that I provide.

The device A provided by the present invention is a combination muffler and after burner for motor vehicles and serves to muffle the sound of the exhaust and to ignite and burn unburned hydrocarbons discharged by the automobile engine to which it is related.

The device A that I provide is an elongate unitary structure and is adapted to be engaged with and extend between the opposing ends of the header pipe 10 and the tail pipe 11 of a conventional automotive exhaust system and in place of the conventional muffler.

The device A provided and illustrated throughout the drawings, includes generally, an elongate, tubular body B, closure C at the opposite ends of the body, one having an inlet tube 12 and the other an outlet tube 13 related thereto, an elongate, tubular, ceramic liner L arranged within the body to extend longitudinally thereof, a tubular filler F of insulating material between the liner L and the body B, a heat element H with baffle screens S related thereto and arranged within the liner L, electrical terminal units T carried by and extending through the sides of the body and connected with the opposite ends of the heating element H and valve means V in the outlet tube 13.

The body B that I provide is a simple, elongate tubular sheet metal member, round in cross-section and open at its opposite ends.

The closures C are simple, disc-shaped sheet metal parts having mounting flanges 14 about their peripheries and central openings 15 to cooperatively receive the inlet and outlet tubes 12 and 13 related thereto.

The closures C are slidably engaged in the opposite open ends of the body and are secured in fixed position therein by means of a plurality of circumferentially spaced sheet metal screw fasteners engaged through the wall of the body and the mounting flanges 14, as clearly illustrated in the drawings.

The inlet tube 12 is a simple, straight, tubular part corresponding in outside diameter with the inside diameter of the header pipe 10 of the auto exhaust system and has an inner end slidably engaged in the opening 15 of the adjacent closure C and is secured in fixed sealed engagement therewith as by welding.

The outer free end of the inlet tube 12 is slidably engaged in the open end of the header pipe 10 and is, in the case illustrated, fixed therein by means of a conventional clamp ring 17.

The outlet tube 13 is, like the inlet tube 12, a straight, tubular part corresponding in outside diameter with the inside diameter of the tail pipe 11 of the auto exhaust system and has an inner end engaged and fixed in the opening 15 in the closure C at the other end of the body.

The outer free end of the outlet pipe 13 is slidably engaged in the open end of the tail pipe 11 and is held tight therein by means of a conventional clamp ring 18.

The liner L provided by the present invention is a simple, straight, tubular, ceramic element corresponding in longitudinal extent with the space between the closures C and of lesser outside diametric extent than the inside diameter of the body B. The liner L is arranged within...
the body concentric therewith and between the closures C. In practice, the liner L is preferably formed of porous ceramic material which will absorb heat and which will maintain a glow in a flame.

The filler F that I provide is a simple, preformed sleeve of a suitable non-combustible heat insulating material, as for instance, asbestos or expanded vermiculite held together. It is to be understood that in practice, the filler F corresponds in longitudinal extent with the liner L and is arranged to occur in the annulus between the liner and the body.

The filler F serves to support the liner L in the body B and also serves to retain the heat in the device so that high temperatures can be generated and maintained therein.

In practice, the diametrical extent of the body and the diametric extent and wall thickness of the liner L and the filler F can be varied widely as circumstances require.

The heating element H provided by the present invention is an elongate, fabricated, cage-like structure formed of resistance wire or rod and includes a pair of longitudinally spaced, concentric end rings 20, a plurality of circumferentially spaced, longitudinally disposed rods 21 arranged in and extending between the rings and a bifurcated contact prong 22 fixed to and projecting longitudinally outwardly from each ring 20.

The element H is of lesser diametrical and longitudinal extent than the liner L and is adapted to be supported wholly within and clear of the liner L.

The baffle S provided by the present invention can vary widely in structure and in material.

In the case illustrated, I have shown two types of baffles S, one a simple disc-shaped body of metal fabric screening material 30 and the other a perforated disc-shaped body 31 of non-conductive, non-inflammable material, such as asbestos or ceramic.

The screen baffles 30 are formed or woven of resistance wire and are equal in diametrical extent with the interior of the liner L.

The perforated baffles 31 are, like the baffles 30, equal in diametrical extent with the interior of the liner L.

The baffles 30 and 31 are arranged in longitudinal spaced relationship on the rods 21 of the heating element H and can be alternated, that is, so that every other baffle is a screen-type baffle 30 and the intermediate baffles are perforated baffles 31, as shown.

The baffles 30 and 31 are engaged on the rods 21 of the heating element H when the said element is fabricated and so that the said element and baffles become a unitary assembly.

When the structure is assembled, the baffles S slidably engage in the liner L and serve to support the heating element concentric with the liner L.

In practice, the screen type baffles 30 serve as heating grids and become a part of the heating means. Further, when combustion is started in the construction the screens serve to hold the flame.

In practice, the number of baffles 30 and 31 and their arrangement can be varied widely as circumstances require, for instance, there can be one or more baffles 30 and one or more baffles 31 and their aggregate number can vary from two or three on upward.

In practice, it is necessary to provide at least one and possibly two baffles 31 to provide support for the heater and baffle assembly since the screen baffles 30, when heated and glowing, are subject to becoming soft and incapable of providing sufficient support by themselves.

The terminal units T that I provide are adapted to connect with the prongs 22 of the heater element H and with a suitable power supply line 35 and a suitable ground line 36. The units T are alike and each is shown as including an elongate post 37 carried by an insulated ferrule-like coupler 38 engaged in an opening in the side of the body B. The post 37 extends radially of the body and has an inner end projecting into confines of the liner L where it is engaged in the prong 22 at the adjacent end of the element H, and an outer end projecting radially outwardly from the body and connected with the supply line 35 or the ground line 36.

The inner end portion of the post is threaded and carries a pair of nuts 39 which serve to hold the prong 22 related thereto in tight clamping engagement. The outer end of the post is threaded and carries a nut 40 which serves to hold the lines 35 and 36, whichever is related thereto, or a suitable coupling fitting 41 provided on the ends of said lines, in tight clamped engagement on the terminal unit and in contact with the post.

In practice, the terminal units T, and particularly the ferrule-type coupling 38 serving to hold the post 37 in the body, can vary widely in form and construction without affecting the novelty of the invention. Since the details of construction of the terminal units T do not affect the novelty of the invention, I will not burden this application with further unnecessary detailed description of the particular terminal construction shown.

The power supply line 35 is connected with the vehicle's electrical system or can be connected with another special power source if desired, or as circumstances require.

The valve means V provided by the present invention involves a butterfly type valve arranged in the outlet tube 13. The valve consists of a butterfly plate 40 arranged in the tube 13 and carried on a shaft 41, the ends of which are rotatably supported in suitable bearing blocks 42 fixed at diametrically opposite sides of the tube. One end of the shaft 41 projects through its related bearing block and is provided at its outer end with a lever arm 43, which arm connects with a suitable operating rod or cable 44.

The rod or cable 44 extends to a station or point where the operator of the vehicle can advantageously engage it to selectively open or close the valve.

The valve plate 40 in the preferred carrying out of the invention and as illustrated in the drawings, is provided with one or more ports 46, which ports serve to bleed a portion of the exhaust gases out when the valve is closed and so that excessive back pressures, which would cause the engine to stall, will not be generated.

In operation, when the engine is initially started, the valve V is closed and current is supplied to the heater element H and baffles 30. Closing of the valve V causes an increase in pressure and resulting increase in temperature in the device and also causes the gases with the unburned hydrocarbons to build up and concentrate in the device.

The heater element, being energized heats up and glows, heating the screen baffles 30 and the several chambers formed by the baffles and the liner.

When the temperature in the device reaches the ignition point of the more combustible hydrocarbons, those hydrocarbons start to burn.

When ignition of the more combustible hydrocarbons is initiated, the internal heat in the device is further increased and until the temperature reaches the ignition point of the least combustible hydrocarbons and they ignite and burn.

Once the device reaches its maximum temperature, the screen baffles and the liner are glowing hot and will sustain ignition of the gases subsequently introduced into the device and without the aid of heating elements and without requiring the back pressure created by closing the valve to be maintained. At this point, the current to the heater element can be shut off and the valve V can be opened.
It will be apparent that the several longitudinally spaced screen baffles each becomes heated and each tends to hold a flame, with the result that those unburned hydrocarbons which pass the first screen baffle without being ignited, are burned in the flame downstream of that baffle and are not burned and at one of the subsequent screen baffles.

As the gases advance through the device and past each successive screen baffle maintaining a flame, their temperature is increased and until they are super heated to a point where all of the hydrocarbons are burned.

As a result of the above and due to the successive stepping up of the temperature in the device, which is maintained by the gases burning therein, the temperature at the downstream end of the device is greater than that at the upstream end thereof.

The insulation insert F serves to retain the heat in the device and also prevent the body from becoming excessively hot.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any modifications or variations that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, a plurality of longitudinally spaced baffle screens in the body, an elongate heater element of resistance rod extending through and supported by the baffle screens and electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related.

2. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, a plurality of longitudinally spaced baffle screens in the body, an elongate heater element of resistance rod extending through and supported by the baffle screens and electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related, and manually operable valve means in the outlet tube to selectively restrict the flow of gases through the structure.

3. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate ceramic liner in the body, a plurality of longitudinally spaced baffle screens in the liner, an elongate heater element of resistance rod extending through and supported by the baffle screens and electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related.

4. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closure at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate ceramic liner in the body, a plurality of longitudinally spaced baffle screens in the liner, an elongate heater element of resistance rod extending through and supported by the baffle screens, electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related, and manually operable valve means in the outlet tube to selectively restrict the flow of gases through the structure.

5. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, a sleeve of insulation in the body, an elongate ceramic liner in the sleeve, a plurality of longitudinally spaced baffle screens in the body, an elongate heater element of resistance rod extending through and supported by the baffle screens and electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related.

6. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate ceramic liner in the body, a plurality of longitudinally spaced baffle screens in the body, an elongate heater element of resistance rod extending through and supported by the baffle screens, electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related.

7. A combined auto exhaust muffler and after burner structure, including, an elongate, tubular body, closures at the ends of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate ceramic liner in the body, a plurality of longitudinally spaced baffle screens in the body, an elongate heater element of resistance rod extending through and supported by the baffle screens, electrical contact posts supported on the body and having inner ends connected with the heater element and outer ends connected with the electrical system of the auto to which the structure is related, and manually operable valve means in the outlet tube to selectively restrict the flow of gases through the structure.

8. A combined auto exhaust muffler and after burner structure, including, an elongate tubular body, a closure at each end of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate ceramic liner in the body, a plurality of longitudinally spaced baffle screens in the liner, an elongate heater element of resistance rod carried by the baffles and extending longitudinally along the body and concentric therewith, a pair of longitudinally spaced, electrical contact posts carried by the body and having inner ends connected with the heating elements and outer ends connected with the electrical system of the auto to which the structure is related and manually operable valve means in the outlet tube to selectively restrict the flow of gases through the construction, said baffles including alternating wire screen baffles and perforated asbestos baffles.
9. A combined auto exhaust muffler and after burner structure, including, an elongate tubular body, a closure at each end of the body and inlet and outlet tubes carried by the closures and adapted to engage with the header and tail pipes of an auto exhaust system, an elongate insulating sleeve in the body, an elongate, tubular ceramic liner in and carried by the insulating sleeve, a plurality of longitudinally spaced, disc-shaped baffles in and carried by the liner, an elongate heater element of resistance rod carried by the baffles and extending longitudinally of the liner and concentric therewith, a pair of longitudinally spaced, electrical contact posts carried by the body and having inner ends connected with the heater elements and outer ends connected with the electrical system of the auto to which the structure is related and manually operable valve means in the outlet tube to selectively restrict the flow of gases through the structure, said baffles including alternating wire screen baffles and perforated asbestos baffles, said heater element including a pair of longitudinally spaced rings, a plurality of elongate rods fixed to and extending between the rings and engaged through and supported by the baffles, and a longitudinally outwardly projecting contact prong on each ring and engaged with the terminal post related thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,843,999</td>
<td>White</td>
<td>Feb. 9, 1932</td>
</tr>
<tr>
<td>1,985,713</td>
<td>Bartlett</td>
<td>Dec. 25, 1934</td>
</tr>
<tr>
<td>2,038,567</td>
<td>Ittner</td>
<td>Apr. 28, 1936</td>
</tr>
<tr>
<td>2,880,079</td>
<td>Cornelius</td>
<td>Mar. 31, 1959</td>
</tr>
</tbody>
</table>