SILENCER AGAINST TOXIC GASES

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Field of Search 60/303, 286, 308; 23/277 C

References Cited
UNITED STATES PATENTS
2,203,554 6/1940 Uhri 60/303
2,829,731 4/1958 Clayton 60/286
2,947,600 8/1960 Clayton 60/274
3,170,280 2/1965 Rees 60/286
3,460,916 8/1969 Aronsohn 60/286

FOREIGN PATENTS OR APPLICATIONS
2,017,447 11/1970 Germany 60/303

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Attorney, Agent, or Firm—Littlepage, Quaintance, Murphy & Dobyns

ABSTRACT
A muffler for use with an internal combustion engine having a sheath, and an exhaust tube within the sheath, terminating in a constriction creating a venturi. The exhaust tube is adapted to receive exhaust gases from the internal combustion engine. Fresh air is fed to the return, where it is mixed with exhaust gases from the engine. The air-exhaust gas mixture is burned in a combustion chamber. The muffler has features which provide for the reliable combustion of the exhaust gases; minimize the danger of backfiring, and ensure the release of only cooled gases.

2 Claims, 6 Drawing Figures
SILENCER AGAINST TOXIC GASES
CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Serial Number 225,961, filed February 14, 1972, now abandoned.

Mufflers having combustion chambers are well-known in the art and are frequently referred to as afterburners or exhaust gas burners. Their function is to reduce atmospheric pollution by burning the carbon monoxide and unburned hydrocarbons to produce harmless carbon dioxide and water vapor. Such mufflers are described in Thompson et al. U.S. Pat. No. 1,605,484, Uebi et al. U.S. Pat. No. 2,203,554, Cornelius U.S. Pat. No. 3,560,927, and Jackson et al. U.S. Pat. No. 3,188,798.

Unfortunately, prior mufflers suffer from a number of disadvantages. Many of these mufflers fail to reduce or eliminate emissions of carbon monoxide and hydrocarbons because combustion is incomplete. Others are constructed such that the pressure of the burning gases in the combustion chamber is applied against the air intake. Thus, if backfiring occurs, flames will be driven from the combustion chamber through the air intake. The ignition system in most of these prior mufflers requires the use of a sparkplug with an associated high voltage coil and a distributor or other means for making and breaking the circuit to the sparkplug. The addition of a coil and distributor to an existing vehicle is expensive and a potential source of future trouble. Furthermore, most of the prior mufflers require the ignition system to be operative at all times while the engine is operating. Still other prior mufflers have a transverse dimension that is so great that the muffler cannot be installed on existing automobiles in the place of present mufflers. As is well known, present mufflers must have a vertical cross-sectional dimension generally less than one foot in order to fit underneath the body of a vehicle and still provide sufficient clearance between the bottom of the muffler and the surface of the road. Still other prior mufflers emit hot gases or flames from their after end causing a danger to pedestrians when the vehicle is stopped. Still other prior mufflers have an air input disposed on the side of the muffler. Thus, because of a venturi effect, the pressure in the air inlet to the muffler decreases with increased vehicle speed.

It is, therefore, an object of the present invention to provide an improved muffler substantially free of one or more of the disadvantages of prior mufflers.

Another object is to provide an improved muffler which substantially eliminates emissions of carbon monoxide and hydrocarbons and causes complete combustion of the carbon monoxide and hydrocarbons present in the exhaust gas from an internal combustion engine.

A further object is to provide an improved muffler wherein the pressure of the combustion gases in the combustion chamber cannot be applied against the air intake.

A still further object is to provide an improved muffler which is substantially free of danger of backfiring.

Yet another object is to provide an improved muffler having an ignition system which does not require the use of a sparkplug or a high voltage coil or a distributor.

Still another object is to provide an improved muffler having a self-contained electrical ignition system.

Still another object is to provide a muffler which has a minimum transverse dimension such that it is readily interchangeable with mufflers of present design.

Still another object is to provide an improved muffler which does not emit flames from its after end.

Still another object is to provide an improved muffler wherein the pressure of air input to the muffler increases with increased vehicle speed.

Additional objects and advantages of the present invention will be apparent to those skilled in the art by reference to the following detailed description thereof and drawings wherein:

FIG. 1 is a sectional view of a muffler according to the present invention.

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1.

FIG. 4 is a sectional view taken along line 4—4 of FIG. 1.

FIG. 5 shows an alternative embodiment of the present invention wherein the muffler is oval rather than round. FIG. 5 corresponds to a sectional view taken through such an oval muffler corresponding to the line 4—4 on FIG. 1.

FIG. 6 is a detailed drawing of a portion of the ignition system employed in the present invention.

According to the present invention, there is provided a muffler for use with an internal combustion engine comprising a sheath, and an exhaust tube within the sheath. The exhaust tube terminates in a constriction creating a venturi. The exhaust tube is adapted to receive exhaust gases from the internal combustion engine. The muffler of the present invention is also provided with means for feeding fresh air to the venturi whereby the fresh air is mixed with the exhaust gases to form an air-exhaust gas mixture. This air-exhaust gas mixture is fed through a nozzle and discharged into a combustion chamber within the sheath. An important feature of the present invention which prevents the pressure of gases in the combustion chamber from being applied against the air inlet is a sheath having an opening, the diameter of which is substantially equal to the diameter of the nozzle. This shield is spaced axially from the nozzle such that the pressure in the combustion chamber will be shielded from the air inlet. In a preferred embodiment, the diameter of the opening of the shield is substantially equal to the diameter of the opening of the nozzle. It is preferred that the opening of the shield be spaced axially from the nozzle a distance equal to 0.7 to 1.5 times the diameter of the nozzle. Since the sheath preferably slopes outwardly and forwardly toward the sheath, it directs any gases in the combustion chamber away from the nozzle.

Another important feature of the present invention is the ignition system. This ignition system comprises a resistance heating element within the combustion chamber. When a low voltage such as 6 or 12 volts commonly employed in vehicles is impressed across the heating element, the element will become heated to the combustion temperature of the gases in the combustion chamber. In a preferred embodiment of the present invention, the muffler is provided with the temperature responsive means for electrically disconnecting the heating element when the temperature of the gases in the combustion chamber is high enough to sustain combustion. In this manner, a continual drain on the bat-
tery is eliminated. This is especially advantageous if the battery is in a low state of charge or has a low capacity due to a low temperature in cold climates.

According to another preferred embodiment of the present invention, the combustion chamber is provided with auxiliary ignition means in the form of a material which will glow when heated and ignite the gases in the combustion chamber. Such materials are commonly available and are known in the art as "glow plugs." Glow plugs made of metals such as steel and tungsten are common and conventional. See U.S. Pat. No. 3,287,914 for a preferred composition. They do not require electrical energy, but rather are maintained in a hot and glowing state by the hot gases. Should the hot gases be temporarily removed such that the combustion stops and then hot gases reapplied the glowing plug will reignite the gases.

The invention may be further understood by reference to the following detailed description of the preferred embodiment shown in the drawings.

Referring now to the drawings, and in particular to FIG. 1, there is shown a muffler 10 of the present invention. The muffler 10 comprises an elongated tubular gas-tight metal sheath 12. This sheath is adapted to be mounted on a vehicle with the forward end 14 in communication with the engine exhaust manifold (not shown). The exhaust end 16 is in communication with the vehicle tail pipe 18.

The muffler 10 has an exhaust tube 20 coaxially mounted in the forward end 14 of the tubular sheath 12 leaving an annular space 22 between the exhaust tube 20 and the sheath 12. One end of the exhaust tube 20 is adapted to receive exhaust gases from the engine which come in the direction of the arrow 24. The other end of the exhaust tube 20 terminates in a construction creating a venturi 26.

The muffler 10 is also provided with an air filter 28 in the annular opening 22. The air filter 28 comprises a first wire screen 29 which extends across the forward end of the annular opening 22, and a second wire screen 30 extending across the after end of the annular opening 22. A portion of steel wool 31 is provided between the screens 29 and 30.

The muffler 10 has a plurality of conically shaped pipes 33, 34, each having its larger end in communication with the annular space 22 and each having its smaller end adjacent to the venturi 26. By virtue of this arrangement, exhaust gases passing through the venturi 26 draw air through the conically shaped pipes 33, 34 and mix this air with exhaust gases forming an air-exhaust gas mixture.

The muffler 10 is also provided with a nozzle 36 adapted to receive the air-exhaust mixture and direct it to a combustion chamber 38.

An important feature of the present invention is a gas-impervious truncated conical shield 40 having an opening 41, the diameter a of which is substantially equal to the diameter b of the nozzle 36. The opening 41 is spaced axially from the nozzle a distance c equal to 0.7 to 1.5 times the diameter of the nozzle, i.e. c = 0.7b to 1.5b. The sides of the conical shield 40 slope outwardly and forwardly toward the sheath 12. The outer periphery 42 of the conical shield 40 is attached to the sheath 12.

The muffler 10 is also provided with an air preheating chamber 44 defined by the forward walls of the conical shield 40 and the outer walls of the conically shaped pipes 33, 34. By virtue of this arrangement, hot gases circulating in the chamber 44 add heat to the air passing through the conically shaped pipes 33, 34. Another advantage of this construction is that any explosion in the chamber 38 would create a pressure in the forward direction, which pressure would be met by the stream of gases issuing from the nozzle 36. If any of the gases from the explosion passed the opening 41 of the conical shield 40, they would harmlessly circulate in the air preheating chamber 44 and would not cause backfiring through the conical pipes 33, 34 and the annular space 22.

A dashed deflector 62 is mounted in the sheath 12 facing the nozzle 36. This deflector 46 is adapted to reverse the direction and axially disperse the gases issuing from the nozzle 36 as shown by the arrows in the chamber 38. Within the combustion chamber 38 is a resistance heating element 48. The heating element 48 is in series circuit with a temperature responsive switch 49 for the ignition switch of the vehicle 50 and the battery and/or generator 51. Referring now to FIG. 6, there is shown the details of construction of the temperature responsive switch 49. The switch 49 is provided with contacts 52, 53, one of which is connected to a bimetallic strip 54. This bimetallic strip 54 is arranged such that it opens the distance between the contacts 52, 53 when the temperature in the combustion chamber 38 is above that sufficient to sustain combustion.

Referring again to FIG. 1, there is shown a plurality of secondary ignition means 56, 57, 58. The secondary ignition means 56 is representative and comprises a sphere 59 of a material such as steel or tungsten which will glow when heated to the ignition temperature of the gases in the combustion chamber 38. The sphere 59 is mounted on a cone 60 of a conventional refractory insulating material such as a ceramic which is commonly used in spark plugs. See U.S. Pat. No. 1,296,076 for suitable spark plug material and U.S. Pat. No. 3,434,012 for a material preferred for insulators in glow plugs, which thermally insulates the sphere 59 from the walls defining the combustion chamber 38, such as the walls of the dished deflector 46. The function of the cone is to prevent dissipation of the heat of the glow sphere to the metal walls such as 46 and 42.

Aft of the combustion chamber 38 and substantially laterally coextensive therewith is a silencer section 63 provided with silencer pipes 64, 65. The rim 66 of the forward end of the silencer pipe 64 forms a gas-tight connection between the sheath 12 and the deflector 46. The silencer pipe 65 has similar structure. Within the muffler 10 is a baffle 68 having a rim 69 defining an axial opening 70. The baffle 68 extends in a gas-tight manner completely across the muffler 10 and is attached on each side to the sheath 12. An axial exhaust tube 72 has its after end forming a gas-tight connection with the rim 69 of the baffle 68. The cross-sectional area of the exhaust tube 72 is approximately equal to the total cross-sectional areas of the silencer pipes 64, 65 in order to minimize back pressure on the gases leaving the combustion chamber 38.

Thus it can be seen that the silencer pipes 64, 65, the baffle 68, and the axial exhaust tube 72 define a path whereby the gases leaving the combustion chamber 38 are caused to flow first through the silencer pipes 61, 65, then through the annular space 74, and finally through the exhaust tube 72.
The muffler 10 is provided with an outer cover 76 which is substantially parallel to the sheath 12 and covers a portion of the sheath 12 from its forward end 14 to the after end of the combustion chamber 38. The outer cover is fixed at its forward end 77 but is slideably mounted at its after end 78. By virtue of this construction the outer cover 76 and the adjacent portion of the sheath 12 can expand a different amount under the influence of heat without buckling.

The muffler 10 is also provided with fins 80, 81 to aid in cooling of the gases.

Although the invention has been described in considerable detail with reference to certain preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described above and as defined in the appended claims.

What is claimed is:

1. A muffler for use with an internal combustion engine comprising:
   A. a sheath,
   B. an exhaust tube within the sheath, the exhaust tube terminating in a constricting creating a venturi, the exhaust tube adapted to receive exhaust gases from the internal combustion engine,
   C. means for feeding fresh air to the venturi, whereby the fresh air is mixed with the exhaust gases to form an air-exhaust gas mixture,
   D. a combustion chamber within the sheath,
   E. a resistance heating element within the combustion chamber which when a low voltage potential is impressed across it will become heated to a combustion temperature of the gases in the combustion chamber and,
   F. auxiliary ignition means comprising a metallic sphere mounted on a ceramic core.

2. A muffler for use on a vehicle driven by an internal combustion engine, the muffler comprising:
   A. an elongated tubular gas-tight sheet metal sheath adapted to be mounted on a vehicle with the forward end in communication with the engine exhaust manifold and the after end in communication with the vehicle tail pipe,
   B. an exhaust tube coaxially mounted in the forward end of the tubular sheath leaving an annular space between the exhaust tube and the sheath, one end of the exhaust tube being adapted to receive exhaust gases from the engine, the other end terminating in a constricting creating a venturi,
   C. an air filter in the annular opening, the air filter comprising:
      1. a first wire screen extending across the forward end of the annular opening,
      2. a second wire screen extending across the after end of the annular opening,
      3. steel wool between the first and second wire screens,
   D. a plurality of conically shaped pipes, each having its larger end in fluid communication with the annular space between the exhaust tube and the sheath, and each having its smaller end adjacent to the venturi such that exhaust gases passing through the venturi draw air through the conically shaped pipes and mix this air with the exhaust gases forming an air-exhaust gas mixture,
   E. a nozzle adapted to receive the air-exhaust gas mixture and direct it to a combustion chamber.
   F. a gas-impervious truncated conical shield having an opening, the diameter of which is substantially equal to the diameter of the nozzle, spaced axially from the nozzle a distance equal to 0.7 to 1.5 times the diameter of the nozzle, the sides of the conical shield sloping outwardly and forwardly toward the sheath, the outer periphery of the conical shield being attached to the sheath,
   G. an air preheating chamber defined by forward walls of the conical shield and the outer walls of the conically shaped pipes, whereby hot gases circulating in this chamber add heat to the air passing through the conically shaped pipes,
   H. a dihedral deflector coaxially mounted in the sheath facing the nozzle, the deflector being adapted to reverse the direction and axially disperse the gases issuing from the nozzle,
   I. a combustion chamber defined by the inner walls of the sheath, the conical shield, and the deflector,
   J. a resistance heating element having a resistance such that its temperature will be above the ignition temperature of the gases when a low voltage is applied across it,
   K. a binomial switch in series circuit with the heating element, the binomial switch opening the series circuit when the temperature in the combustion chamber is sufficient to maintain combustion of the gases in the combustion chamber,
   L. a plurality of secondary igniter means comprising a material which will glow when heated to the ignition temperature of the gases in the combustion chamber in order to reinitiate the gases, the material being mounted on, but thermally insulated from, the walls defining the combustion chamber,
   M. a plurality of silencer pipes, the rim of the forward end of each forming a gas-tight connection between the sheath and the deflector, the pipes extending longitudinally,
   N. a gas-impervious baffle having a rim defining an axial opening therein, the baffle extending in a gas-tight manner completely across the muffler,
   O. an axial exhaust tube, the after end of which forms a gas-tight connection with the rim of the baffle, the cross-sectional area of the axial exhaust tube being approximately equal to the total cross-sectional areas of the silencer pipes, wherein the silencer pipes, the baffle, and the axial exhaust tube define a path whereby the gases leaving the combustion chamber are caused to flow first through the silencer pipes, then through the annular space between the axial exhaust tube and the silencer pipes, and then through the axial exhaust tube,
   P. an outer cover lying substantially parallel to the sheath covering a portion of the sheath from its forward end to the after end of the combustion chamber, the outer cover being fixed at one end and being slideably mounted at the other end to permit differential thermal expansion of the outer cover and the sheath without buckling either.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,921,397 Dated November 25, 1975

Inventor(s) Guarderas G. Emilio

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover page, under "United States Patent", delete "Maldonado" and insert -- Guarderas --.

Item (76) should read:
Inventor: Emilio Guarderas G.
Maldonado, No. 25551
Quito, Ecuador

Signed and Sealed this twenty-ninth Day of June 1976

[SEAL]

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks