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R. D. CLARK

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AFTER-BURNER FOR INTERNAL COMBUSTION ENGINE EXHAUST GASES

Filed Sept. 8, 1959

2 Sheets-Sheet 1

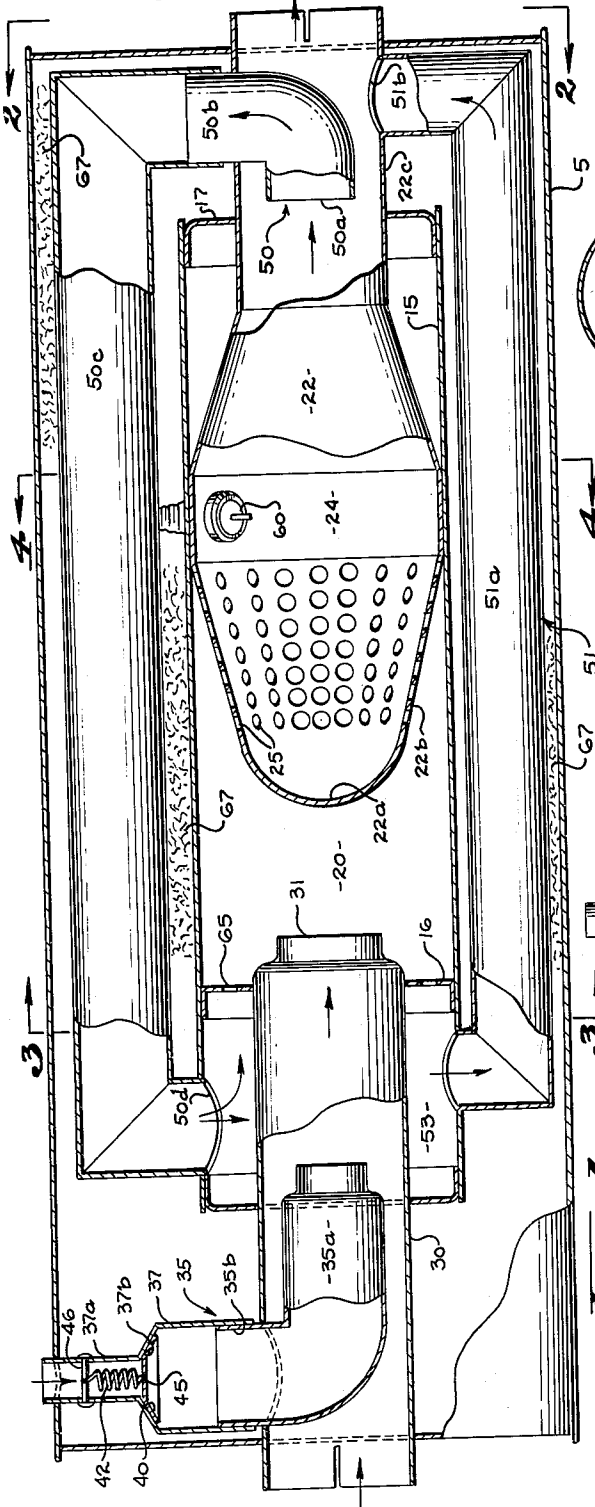


Fig. 1

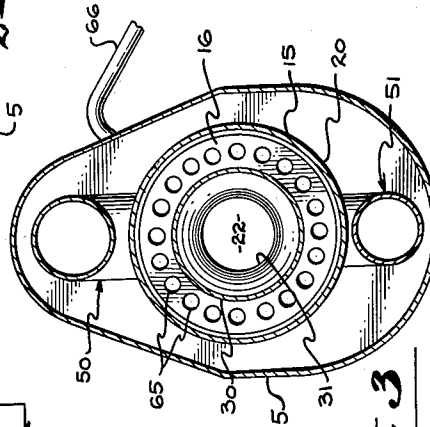


Fig. 3

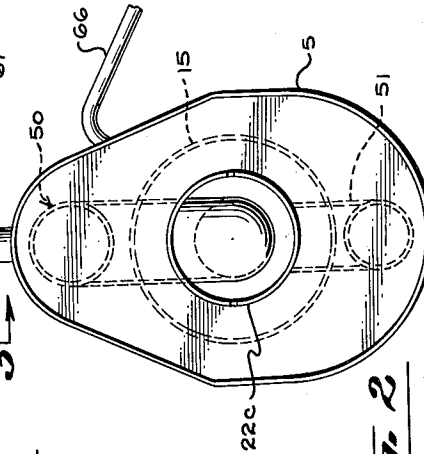


Fig. 2

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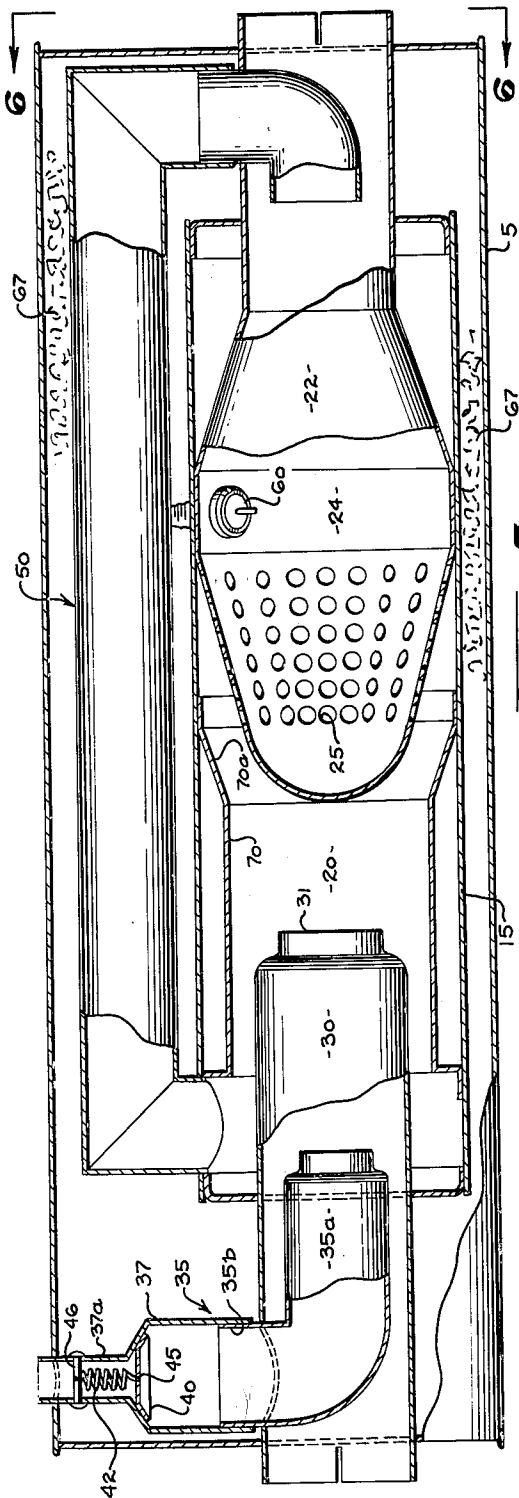


Fig. 5

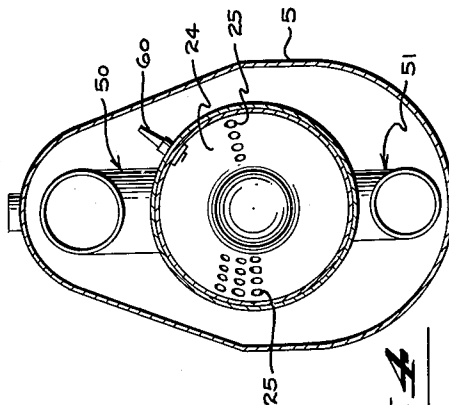


Fig. 4

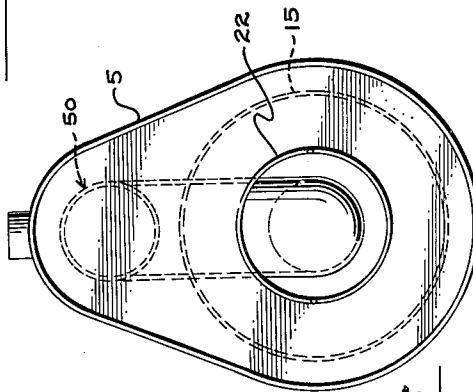


Fig. 6

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AFTER-BURNER FOR INTERNAL COMBUSTION
ENGINE EXHAUST GASES

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4 Claims. (Cl. 183—6)

This invention relates to an after-burner for removing combustible "smog" creating components from the exhaust bases of internal combustion engines.

The exhaust gases of internal combustion engines include many components which, when discharged into the atmosphere, are harmful to human beings as well as to plant life, and which constitute one of the principal elements of what has come to be commonly known as "smog," existing in many large cities. For instance such gases include partially oxidized hydrocarbons and carbon monoxide, which are injurious but which also are combustible under proper conditions. It is to the elimination of such combustible components of exhaust gases that my invention is particularly directed.

Various types of after-burners for burning such components of exhaust gases have been proposed, but none of which I am aware has been successful insofar as general use is concerned. Those devices usually include means for admixing oxygen with the automotive exhaust gases to produce a combustible mixture, and an after-burner for combusting the mixture. The following are some of the reasons why prior after-burners have not fully solved the problem of eliminating smog components from exhaust gases:

(1) The amount of combustible components in the exhaust of an internal combustion engine is normally too small to support combustion in the absence of considerable heat additional to the normal temperature of the exhaust gases as they are discharged from the engine, and additional to the heat normally present in the combustion chamber of an after-burner. Therefore, a successful after-burner must efficiently and effectively provide this substantial additional heat;

(2) The unburned hydrocarbon components should be fully broken up before an attempt is made to burn them in the after-burner;

(3) A successful after-burner must be one whose construction does not create back pressures which interfere with proper scavenging; and

(4) It is necessary that a proper control be provided of the introduction and preheating of the air required to create a mixture which will be readily combustible in the after-burner.

The after-burners of which I am aware have failed to meet those requirements.

It is an object of my invention to provide an after-burner by which I am able to overcome those shortcomings of prior devices.

More particularly, it is an object of my invention to provide an after-burner wherein the combustion chamber is maintained sufficiently heated to insure proper combustion of the combustible components of exhaust gases, and which includes novel means for effecting the heating of the combustion chamber and the introduced air by utilizing a recirculated portion of the gases of combustion.

It is also an object to provide, in a device of this character, novel means for properly mixing air with the

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exhaust gases emanating from an internal combustion engine.

A further object is to provide, in a device of this kind, novel and efficient means for insuring proper scavenging by preventing back pressures which might otherwise result from the combustion within the after-burner.

A still further object is to provide an after-burner which embodies means for subjecting a portion of the exhaust gases to multiple combustion.

Additional objects and advantages will appear hereafter.

For the purpose of enabling those skilled in the art to fully understand and practice my invention, I shall now describe, by reference to the accompanying drawing, presently preferred embodiments thereof; although I wish it understood that those specific embodiments are intended only as illustrative examples and are not to be construed as limitative of the scope of my invention except as may appear from the appended claims.

In the drawings:

Fig. 1 is a longitudinal sectional view;

Figs. 2, 3 and 4 are views taken, respectively, on lines 2—2, 3—3 and 4—4 of Fig. 1;

Fig. 5 is a longitudinal sectional view of a modified form of the invention; and

Fig. 6 is a view taken on line 6—6 of Fig. 5.

Referring now to the drawing, I show at 5 an outer casing which is somewhat ovate in cross section.

An annular member 15, having end walls 16, 17, defines a chamber 20 in which is mounted a shell 22 which defines the combustion chamber 24 of my after-burner.

Shell 22 has a curved, imperforate, inner end portion 22a, an adjoining peripheral portion 22b having perforations 25, and has a cylindrical outlet or rear end portion 22c which projects through the casing wall 5 for being connected to the conventional tail pipe of an automobile exhaust system.

An exhaust gas inlet tube 30, which also defines a mixing chamber for the incoming streams of exhaust gases and oxygen, extends through an opening in the front end wall of the casing 5 at which point it is adapted to be attached to the exhaust outlet extending from the combustion chamber of an internal combustion engine, not shown. Tube 30 has a restricted outlet end 31 discharging into the chamber 20.

An L-shaped air inlet conduit 35 has a portion 35a mounted in and coaxial with the tube 30, and has a right angular portion 35b which engages in a conduit 37 which intersects an annular neck portion 37a in a manner to provide a conical shoulder or valve seat 37b against which a valve 40 seats. The valve is normally resiliently urged against the seat by a coil spring 42 whose lower end is secured to the valve at 45 and whose top end is looped about a cross pin 46 extending transversely through the neck portion 37a. The top or inlet end of the neck portion communicates with a conventional power driven blower, not shown, or with an air scoop not shown.

To maintaining the interior of the casing, and consequently the chambers 20 and 24, heated, I provide a conduit 50 of a diameter smaller than the outlet 22c. The inlet end 50a of said conduit is centered in the outlet 22c, thence extends radially of the casing at 50b, thence extends forwardly at 50c longitudinally of the casing, and thence discharges at 50d into a chamber 53 formed by member 15 around the tubular member 30. A second conduit 51 communicates at its inlet end with chamber 53, thence extends, at 51a, longitudinally rearwardly of the casing, and thence, at 51b, discharges into the outlet 22c behind the point at which the conduit 50 communicates with said outlet.

A conventional electric sparkplug 60 is mounted in the combustion chamber of the after-burner and preferably is conductively connected into the ignition system of the internal combustion engine to which my after-burner is attached, preferably in such a way that the plug 60 is energized in timed relation to the ignition of the engine.

The annular end wall 16 of the casing has perforations 65 providing communication between chambers 53 and 20.

Electrical wiring for energizing the spark plug 60 extends into the casing through a conduit 66.

Suitable heat insulation, such as mineral wool 67 (Fig. 1), may be provided against the inner surface of casing wall 5. In operation the seating pressure on the valve 45 will be relieved between explosions occurring in the combustion chamber of the engine, thus permitting the blower air pressure entering through neck portion 37a momentarily to unseat the valve admitting a blast of air into the tube 30 where it is preheated by the returned portion of the products of combustion passing through the conduit 50. While a major portion of the returned products of combustion will pass out through the conduit 51, a limited amount will pass into the chamber 20 through the perforations 65, to be eventually recombusted.

Inasmuch as, by my construction, air is only intermittently introduced into the products of combustion before they reach the combustion chamber 24, I avoid producing too lean a mixture in the combustion chamber, thus insuring efficient after-burning in said combustion chamber.

The combustible mixture of exhaust and air entering chamber 20 will enter the combustion chamber 24 through the perforations 25 where it will be after-burned by the spark produced by the plug 60, part of the products of combustion being discharged directly to atmosphere through the outlet 22c and part of the products of combustion being recirculated through conduit 50, as before described.

The passage of the exhaust gases of the engine through the perforations 25 into the combustion chamber tends to break up the combustible components for more effective combustion in chamber 24.

Since the imperforate inner end wall portion 22a of the combustion chamber forming wall 22 will take the main force of the back thrust caused by explosions in the combustion chamber, free passage of the mixture of exhaust gases and air into the chamber 20 will not be interfered with.

It will be understood, of course, that my after-burner may be used in conjunction with a catalytic converter, not shown, in which converter non-combustible components of exhaust gases may be converted into harmless gases.

In the modified form of my invention shown in Figs. 5 and 6, the parts are like those previously described except that all the recirculated portion of the products of

combustion are discharged into the chamber 20. Referring to Figs. 5 and 6, it will be seen that the return conduit 50 discharges into the chamber 20 around the tube 30, from which chamber the recirculated portion, of the combustion products are subjected to recombustion in the combustion chamber 24. After such recombustion a portion of those gases is discharged to atmosphere through outlet 22 while a portion is again recirculated through the conduit 50. Also in the embodiment of Fig. 5 I mount an annular wall 70 in the member 15 which flares at its outer end 70a about the inner end of the shell 22, to better direct the gases into the perforations 25.

I claim:

1. A device for afterburning combustible components of internal combustion engine exhaust gases comprising an outer casing, an inner casing mounted within said outer casing and defining a combustion chamber, afterburning means in said combustion chamber, an exhaust gas inlet conduit extending through the front end of said outer casing into the front end of said combustion chamber and providing an exhaust gas and oxygen mixing chamber, wall means providing a heating chamber around said mixing chamber, means for intermittently introducing oxygen to said mixing chamber, a second conduit defining an exhaust outlet from said combustion chamber and extending through the rear end of said outer casing, and a return conduit having an inlet end of relatively smaller diameter than that of said second conduit and disposed concentrically in said second conduit towards said combustion chamber; said return conduit extending longitudinally between said casings whereby to transfer heat to said inner casing and discharging into said heating chamber whereby to preheat the mixture of exhaust gases and oxygen formed in said mixing chamber.

2. The device of claim 1 which additionally includes means providing communication between said heating chamber and the front end of said combustion chamber.

3. The device of claim 1 which additionally includes a conduit communicating at its inlet end with said heating chamber and communicating at its outlet end with said second conduit adjacent the outlet end of the latter.

4. The device of claim 1 wherein said means for intermittently introducing oxygen to said mixing chamber comprises an L-shaped tube communicating at its inlet end with atmosphere through a valve controlled inlet and having a discharge end portion within and concentric with said exhaust gas inlet conduit.

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