

Jan. 11, 1966

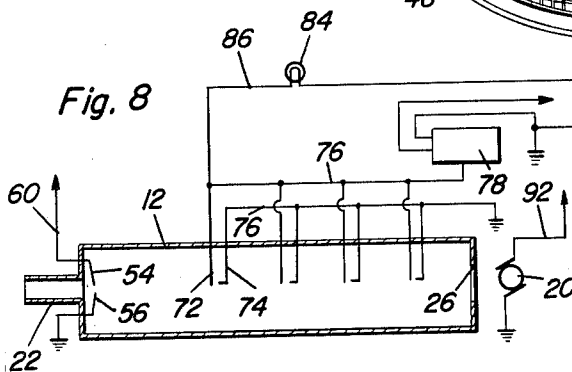
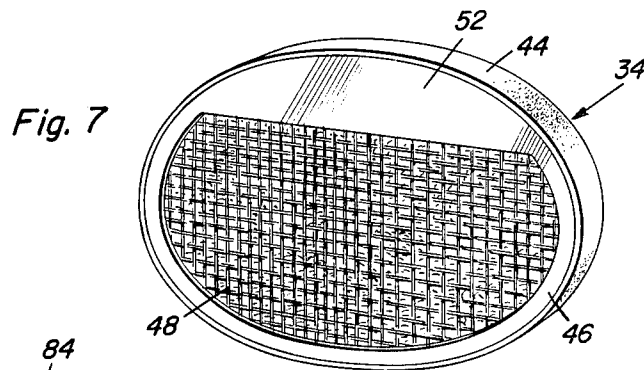
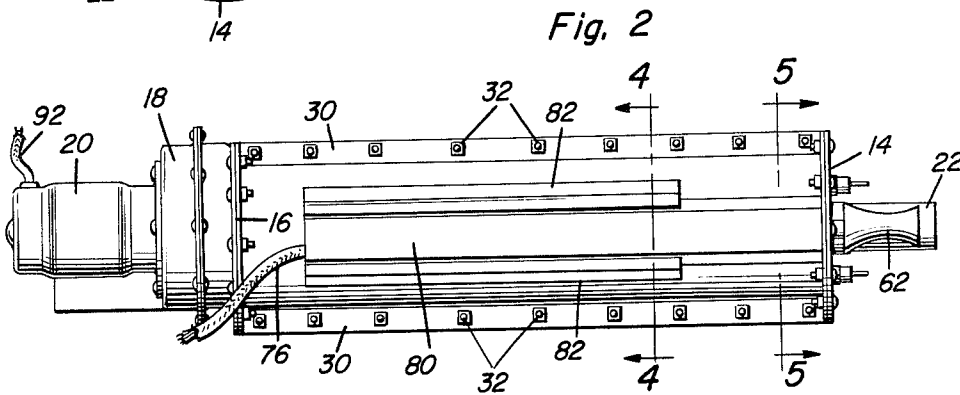
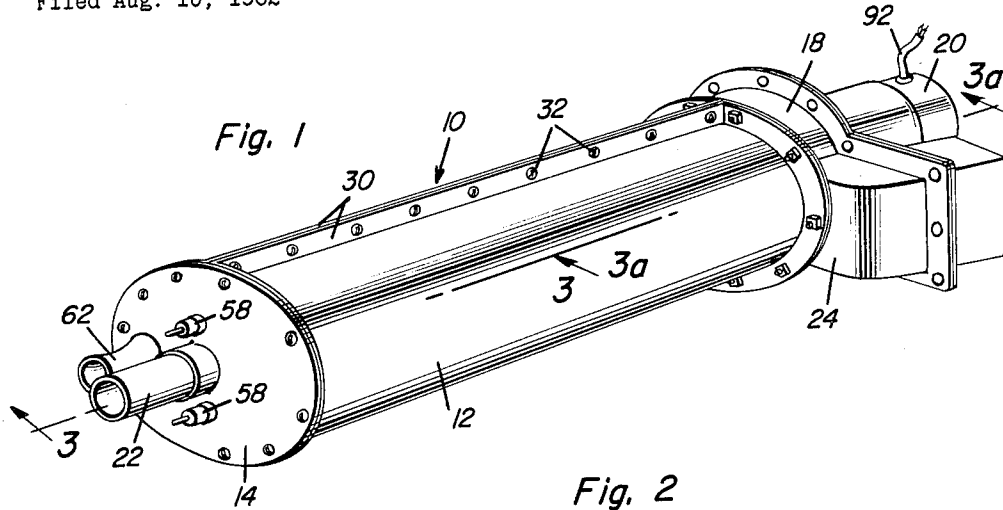
R. R. LOTTINVILLE

3,228,755

CHEMICAL MUFFLER FOR FILTERING EXHAUST

Filed Aug. 10, 1962

3 Sheets-Sheet 1



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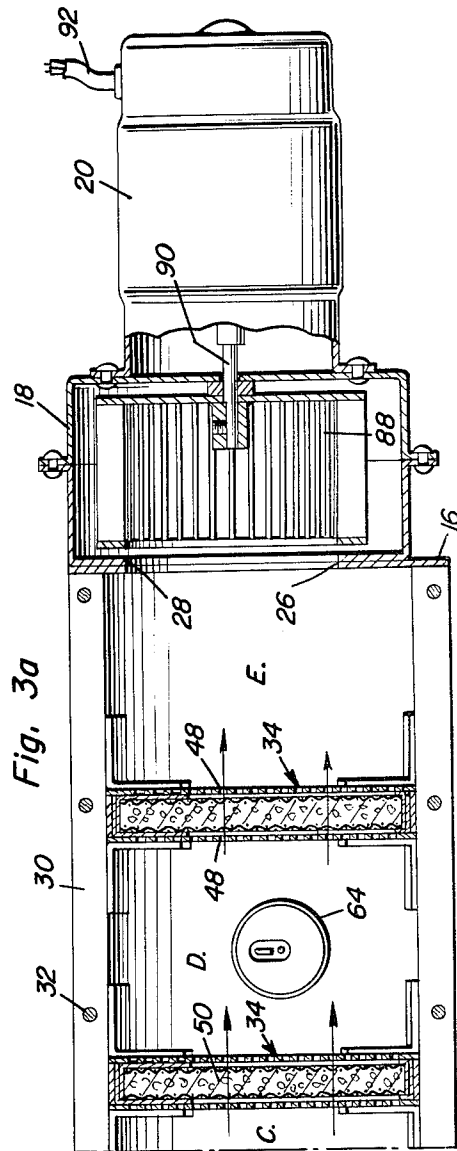
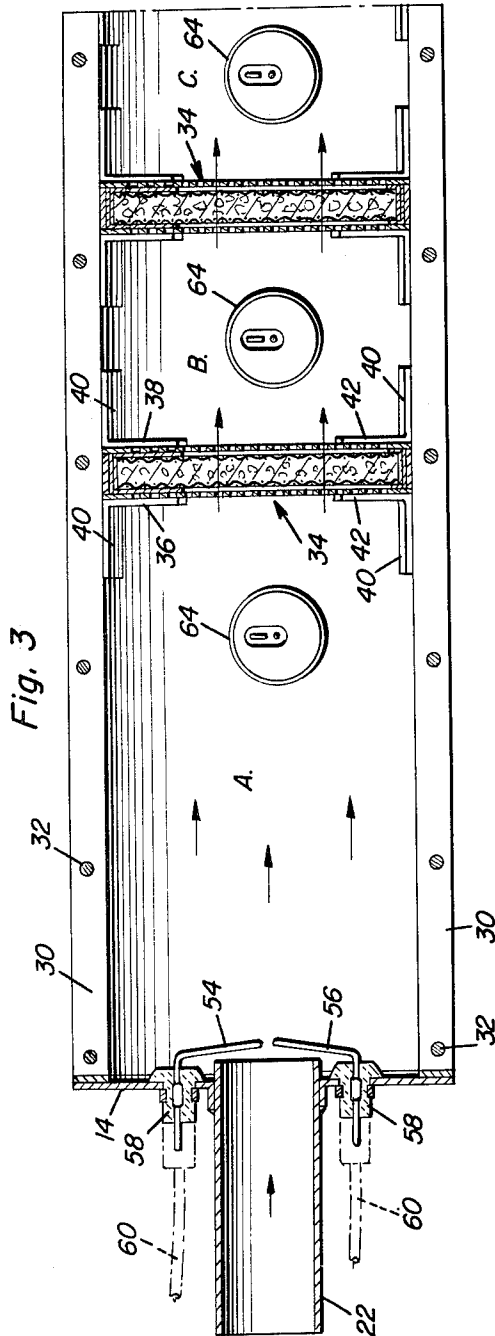
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3 Sheets-Sheet 2



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Fig. 4

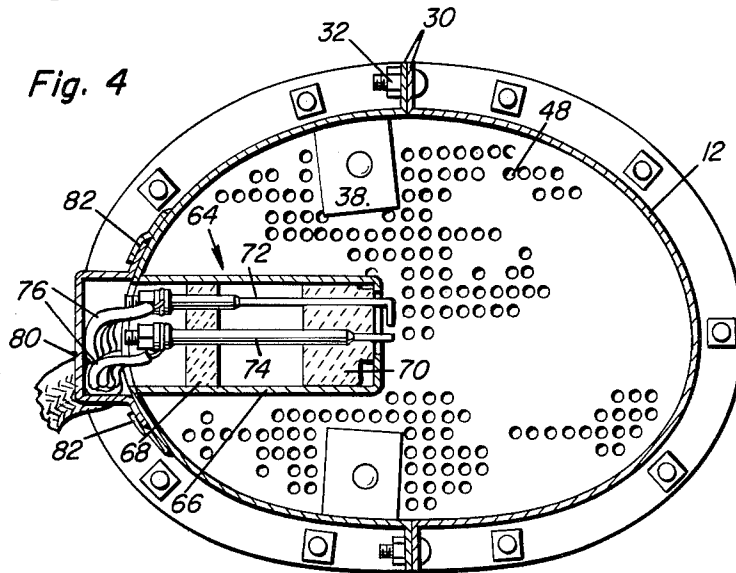


Fig. 5

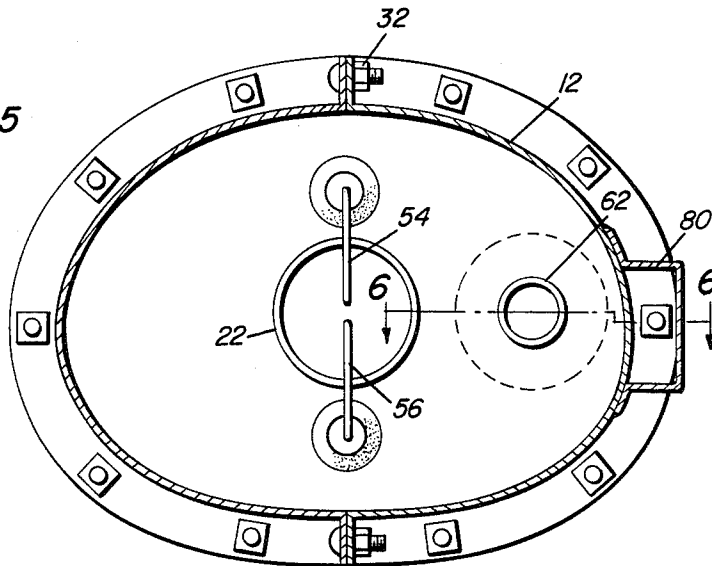
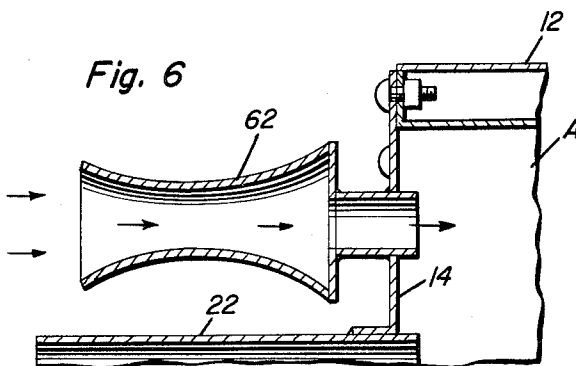


Fig. 6



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CHEMICAL MUFFLER FOR FILTERING EXHAUST

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4 Claims. (Cl. 23—277)

This invention comprises a novel and useful chemical muffler for filtering exhaust and more particularly pertains to a muffler for rendering innocuous the exhaust gases of internal combustion engines in an improved manner and with high efficiency of operation.

In certain areas of the country owing to geographical, climatic and industrial factors, there is a serious and growing problem of pollution of the atmosphere by the exhaust products of internal combustion engines. This problem has become so acute in certain areas that it presents a serious problem to the health and safety of the community. Owing to the increasing numbers of motor vehicles, the problem of air pollution by the exhaust gases of the engines tends to steadily increase.

It is therefore the primary purpose of this invention to provide a means for drastically reducing if not completely abating the pollution of the air by the exhaust gases of internal combustion engines.

It is therefore the primary purpose of this invention to provide a device which will render the exhaust products from internal combustion engines substantially innocuous and thereby greatly reduce if not substantially eliminate toxic gases and/or the smog causing compounds which are now discharged into the atmosphere from the exhaust pipes of conventional internal combustion engines.

It is a further important object of this invention to attain the foregoing objective within the structure of an exhaust muffler which may be readily applied to the exhaust systems of any hydrocarbon burning internal combustion engine whether in a vehicle or disposed in other installations, and whether the exhaust treating device is mounted upon or is mounted separately from the vehicle.

A further important object of the invention is to provide an exhaust gas treating device which shall be especially adapted to be incorporated into the exhaust discharge system of the internal combustion engine of a motor vehicle and which will effectively render innocuous all of the exhaust gases discharged through the engine exhaust system.

A still further object of the invention is to provide a device in accordance with the preceding objects which not only will not produce a back pressure upon the exhaust gases thereby detrimentally affecting the operation of the engine, but will actually increase the velocity of flow of the exhaust gases from the engine and thereby beneficially effect the volumetric efficiency of the engine.

A further important object of the invention is to provide a device in accordance with the preceding objects which will also incorporate therein the customary functions of an exhaust muffler in deadening the noise of the engine exhaust.

Still another object of the invention is to provide a device in accordance with the preceding objects which will provide and effect a substantially straight line flow of gases through the device thereby reducing to a minimum any impedance to flow of the exhaust gases and also eliminating any stagnant pockets of gas within the device.

A still further purpose of the invention is to provide a device in accordance with the preceding objects in which there is provided a succession of readily replaceable chemical exhaust gas treating units for effectively reducing or removing by chemical action and reaction the

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injurious components of exhaust gases during their passage through the device.

A still further object of the invention is to provide a device in accordance with the preceding objects which shall include the provision of an after-burner and means for effecting a complete combustion of any combustible components of the exhaust gases upon their entry into the device and prior to their passage therethrough.

An additional object of the invention is to provide a device in accordance with the preceding objects which shall further facilitate the separation of undesired components from the exhaust gases through the application of a high voltage potential to the particles of the gas passing through the device.

It is a still further object of the invention to provide a device in accordance with the preceding objects which shall incorporate therein means for positively effecting the passage of and the propelling of exhaust gases through the device to thereby reduce the back pressure of the exhaust gases upon the engine exhaust ports.

And a final object of the invention to be specifically enumerated herein resides in the provision of an indicating system in conjunction with a device of the character above set forth which will instantly warn of inefficient operation or cessation of operation of various vital portions of the device.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part thereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a perspective view of a muffler incorporating therein the principles of this invention and shown detached from the exhaust gas system of an internal combustion engine;

FIGURE 2 is a side elevational view of the device of FIGURE 1 taken from the left side thereof;

FIGURE 3 is a detail view taken upon an enlarged scale in vertical longitudinal section substantially upon the plane indicated by the section line 3—3 of FIGURE 1 and showing the forward or inlet portion of the muffler;

FIGURE 3a is a view similar to FIGURE 3 but taken substantially upon the plane indicated by the section line 3a—3a of FIGURE 1 and showing the rear or discharge end of the muffler;

FIGURE 4 is a view taken upon an enlarged scale in vertical transverse section substantially upon the plane indicated by the section line 4—4 of FIGURE 2 and showing the structure and location of one of the high voltage electrical treating units of the invention;

FIGURE 5 is a detail view in vertical transverse section taken upon an enlarged scale substantially upon the plane indicated by the section line 5—5 of FIGURE 2 and showing in particular the relative locations of the igniting device and of the combustion supporting agent inlet means into the after-burner chamber;

FIGURE 6 is a detail view taken in vertical longitudinal section substantially upon the plane indicated by the section line 6—6 of FIGURE 5 and upon an enlarged scale of the inlet end of the device and showing in particular the location of the combustible mixture supply inlet and of the exhaust gas inlet of the device;

FIGURE 7 is a perspective view of one of the partition units which also constitutes a gas porous container of an exhaust gas treating agent; and,

FIGURE 8 is a diagrammatic view of the electrical system of this invention.

In the accompanying drawings, the numeral 10 designates generally the exhaust gas purifying device in accordance with this invention, regardless of whether the

device is to be employed as a muffler upon a motor vehicle as a part of the exhaust gas discharge system thereof, or as a separate installation into which the exhaust gases of a vehicle internal combustion engine are to be discharged, or whether the device is to be utilized to treat the exhaust gases of stationarily mounted internal combustion engines or the exhaust gases from other hydrocarbon burning apparatuses.

As shown in FIGURE 1, the exhaust gas treating device 10 consists of an elongated housing having a cylindrical body portion 12 which is ovate in cross section as best seen from FIGURES 4 and 5, and which is provided with removable front and rear end or closure walls as at 14 and 16 which are removably secured as by the use of fastening bolts in cooperation with complementary mounting flanges upon the body and the end walls. Further mounted upon the rear wall 16 is a casing 18 which constitutes a housing for receiving a blower, an impeller or other means for inducing a flow of gas therethrough, while the numeral 20 indicates an electric motor attached to the rear of the casing 18 and providing a source of power for operating the gas impelling means in the casing 18.

Exhaust gas inlet and outlet means are secured to and communicate with the interior of the housing 12 through the front and rear end walls 14 and 16 respectively, the inlet means including a conduit 22 while the outlet means comprises a discharge duct 24 communicating with and preferably tangentially connecting with the impeller chamber within the casing 18. The exhaust or gas outlet means 24 may communicate and discharge directly to the atmosphere or to any other desired destination.

Referring now to FIGURE 3 it will be seen that the elongated body 12 is illustrated as being of cylindrical configuration and of a uniform cross-sectional area throughout substantially its entire length, and being of an ovate or flattened circular cross section as shown best in FIGURES 4 and 5. The front end wall 14 is provided with the gas inlet means 22 for delivering exhaust gases thereinto, which inlet means may conveniently be in the form of a pipe section secured in and extending through an opening disposed axially of the end wall and projecting into the interior of the housing. The outlet means consists of a centrally disposed discharge opening 26 disposed in the rear end wall 16 and which communicates by means of registering opening 28 to the interior of the previously mentioned casing 18. It will thus be observed that the interior of the housing consists of a straight line passage of uniform cross-sectional area throughout and which thus is devoid of pockets or cavities which might produce a zone of stagnation and for retaining exhaust gases passing through the housing. Although the housing may be constructed in various manners, it is found to be quite satisfactory to fabricate it from two semi-cylindrical sections having cooperating longitudinally extending and radially outwardly projecting mounting flanges 30 detachably secured together as by fastening bolts 32.

The interior of the housing is provided with a plurality of partitions each indicated generally by the numeral 34. Although in the interest of simplicity only four such partitions are shown in FIGURES 3 and 3a, it will be appreciated that any desired number of these partitions may be provided. The partitions are of a construction to be set forth hereinafter possessing a very high gas porosity so as to interfere as little as possible with the free flow of gas therethrough. The partitions divide the interior of the housing into longitudinally spaced compartments for a purpose which will be subsequently apparent, these compartments being indicated by the numerals A, B, C, D, and E. As will be noted, A is the compartment into which the inlet means 22 opens, while E is the compartment from which the exhaust gases after treatment are discharged into the casing 18 of the gas propelling device from whence they are discharged through the discharge duct 24.

The partitions 34 are removably located within the interior of the housing and extending transversely across the latter completely prevent the flow of gas except through the partitions themselves.

Mounting means are provided for detachably and replaceably securing the partitions within the housing. For this purpose, see also FIGURE 4, there are provided cooperating pairs of mounting brackets, the brackets of each pair being identified by the numerals 36 and 38. The brackets have their base flanges 40 fixedly secured to the internal walls of the flanged sections of the housing, while their parallel flanges 42 are in longitudinally spaced relation from each other to provide a pocket or recess in which is snugly retained the peripheral portions of the partitions 34. It will therefore be apparent that by merely separating the two housing sections, one or more of the partitions may be removed and replaced, and the device then readily reassembled.

Referring next to FIGURE 7 in conjunction with FIGURES 3 and 3a, it will be observed that each of the partitions 34 comprises a wafer-like container consisting of a peripheral surrounding rim 44 which encloses, embraces and retains the peripheral portions of or the rims 46 of a gas pervious side wall 48. Each side wall is of a material which will retain therein a granular treating agent as indicated at 50 while permitting free flow or passage of gases through the two side walls and the granular material of the wafer. Each of the side walls may be provided with an imperforate portion 52 of any suitable extent or area as for example the portion received between the mounting brackets 36 and 38.

The side walls may be of such suitable materials as wire mesh, perforated sheets of material, foraminous, vesicular or reticulated panels.

The exhaust gas treating agent 50 within the container defined by each partition is preferably of a material in granular form consisting of calcium hydroxide, sodium hydroxide and potassium hydroxide in equal proportions, together with any other chemical agent which will provide the necessary catalytic reaction desired to obtain the result of reducing or eliminating hydrocarbons, carbon monoxide or nitrous oxide. The size of the granules is preferably such that they will not pass through a screen of 9 meshes per inch.

The arrangement is such that the exhaust gases entering from the inlet means 22 will pass in succession through the entire series of partitions and thus be subjected to the effect of the treating agent contained therein.

It is to be appreciated that it is within the scope of this invention to provide various types of treating agents such as those capable of reacting with selected components of the exhaust gas in a chemical manner, or which will act as catalysts or in any other manner will contribute toward or effect the separation and removal of undesired toxic and other components of the exhaust gases.

An important feature of the invention resides in the provision of an after-burner in the device to effect complete combustion of all combustible components in the exhaust gas supplied by the inlet means 22. Thus, the compartment A may constitute an after-burner chamber. For this purpose, there is provided any suitable type of igniting device as for example the spark ignition terminals 54 and 56 which extend through dielectric insulating bushings 58 in the end wall 14 and which are supplied with electric current as by the conductors 60 connected to any suitable source of power or electric potential. As will be noted, the igniting device is preferably disposed directly across the center of the inlet passage of the incoming gas through the inlet means 22 to thus ensure immediate initiation of combustion in the after-burner chamber A. In order to promote such combustion, and further in order to supply air to the treating agent 50 in the partitions 34, there is provided an auxiliary air inlet means consisting of the venturi shaped inlet nozzle 62 which is secured to and extends through the end wall 14 as shown in FIGURE 6

and into the after-burner chamber A. Thus, any combustible component of the exhaust gas such as carbon monoxide is mixed with a combustion supporting agent such as air in the chamber A and combustion is maintained therein by the ignition means 54, 56 until all of the combustible components of the exhaust gas are consumed. Preferably this action occurs prior to the passage of the exhaust gases through the series of partitions and their treating agents.

In order to further facilitate removal of undesired components in the exhaust gases, there is provided a means for supplying an electric current of relatively high voltage to treat the gases passing through the various compartments. Thus, a plurality of high voltage discharge units each indicated by the numeral 64 is provided in the various compartments A, B, C, and D. As shown in FIGURE 4, the high voltage treating units consist of a plug-like cartridge or sleeve 66 which is removably inserted through an opening in a side wall of the housing and into the interior thereof. In this cartridge there is disposed dielectric blocks 68 and 70, fixedly secured therein, and through which extend the electric terminals 72 and 74 having their extremities exposed in the interior of the respective compartment. At their other ends, these terminals are connected to electric leads 76 which extend to any suitable source of a high voltage current. As shown in the diagrammatic view of FIGURE 8, such a source is indicated by the numeral 78, and may comprise any suitable device for producing voltages ranging between 5,000 to 30,000 volts. While the precise operation and effect of the high voltage discharge is not fully understood, it is effective to cause and accelerate the precipitation of various solid particles in the exhaust gases and cause them to more readily collect upon and within the treating agent granules 50 of the partitions 34. As shown in FIGURE 5, a longitudinally extending enclosing shield or casing 80 is removably secured as by the spring clips 82, see FIGURE 4, to that side of housing through which the units 64 project, this shield serving to enclose as suggested in FIGURE 2 the cables associated with the high voltage discharge system.

As a further means to render the operation of this apparatus more effective, there is preferably provided an electrical indicating means to visually indicate as by a signal light 84 and suitable electrical connections 86 the effectiveness or the operability of the high voltage discharge means and/or the igniting device and even the temperature extremes prevailing in the various compartments, if desired.

A further important feature of the invention resides in the provision of means for preventing the development of any back pressure upon the flow of exhaust gases into the device through the inlet means. For this purpose the casing 18 has enclosed therein a propelling means such as a blower or impeller rotor 88 which is fixedly secured to the armature shaft 90 of the previously mentioned electric motor 20. Rotation of this motor by the supplying of power from any suitable source such as by the cable 92 will produce a propulsive effect which will induce a flow of gases through the device. If desired, the operation of the motor may likewise be connected to the signal means 84 in order that the operation of the impelling means may be ascertained.

Although a motor driven impeller has been illustrated in the drawings as a means for inducing flow through the housing of the device, it will be appreciated that this is merely illustrative of the broader concept of this invention of utilizing any means for effecting a propelling of the gases through the device even including the producing of a reduced pressure below atmospheric inside the device itself. Thus, the possibility of back pressure building up in the device which would interfere with the free discharge of the exhaust gases from the internal combustion engine or other apparatus delivering such discharge gases is prevented.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A muffler for rendering innocuous the exhaust gases from internal combustion engines comprising an elongated housing having a substantially uniform internal cross-sectional area constituting a straight line flow passage therethrough, inlet and outlet means communicating with the opposite ends of said housing, a plurality of individually removable partitions of high gas porosity fixedly secured to said housing and transverse said passage and dividing the housing interior into longitudinally spaced compartments, each of said partitions comprising a container having an exhaust gas treating agent therein for removing impurities from the exhaust gas, each of said partitions covering the entire cross-sectional area of said passage affording a low flow resistance to the flow stream of gases passing through said housing, the compartment adjacent said inlet means comprising an after-burner chamber, combustion initiating means disposed entirely within said after-burner chamber and disposed directly across the center of the inlet means to insure immediate ignition of combustion, a combustion supporting agent supply means for said chamber, electrical means communicating with each of said compartments for subjecting the gases therein to a sufficiently high potential voltage to cause and accelerate the precipitation of various solid particles in the exhaust gases and cause them to more readily collect upon the treating agent within said partitions.

2. A muffler for rendering innocuous the exhaust gases from internal combustion engines comprising an elongated housing having an exhaust gas flow passage therethrough with intake and outlet means communicating with the opposite ends of said passage, a plurality of longitudinally spaced partitions each extending transversely of said passage and dividing the latter into compartments, each partition comprising a highly gas porous container filled with an exhaust gas treating agent for removing impurities from the exhaust gas flowing through said passage, said housing consisting of a pair of longitudinally extending detachably connected sections enclosing said passage, longitudinally spaced sets of circumferentially spaced supports upon the interior of said housing sections and projecting into said passage, each support of a set comprising a pair of longitudinally spaced members releasably embracing and retaining therebetween the rim portion of a partition, the compartment adjacent said inlet means comprising an after-burner chamber, a combustion supporting agent supply means communicating with said after-burner chamber, combustion initiating means disposed within said after-burner chamber and having an igniting area positioned across the center of said inlet means, electrical means communicating with and extending into each of said compartments for subjecting the gases passing therethrough to a sufficiently high potential voltage to cause and accelerate the precipitation of various solid particles in the exhaust gases and causing them to more readily collect upon the treating agent within said partitions.

3. The combination of claim 2 including an exhaust gas impelling means mounted upon the exterior of said housing adjacent said outlet means and in alignment with said passage, said impelling means having an inlet in direct communication with said housing outlet means whereby to apply sub-atmospheric pressure to the exhaust gases in said passage.

4. The combination of claim 3 including electrical indicator means including sensing elements located within

said compartments and indicating the operation of said after-burner chamber.

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