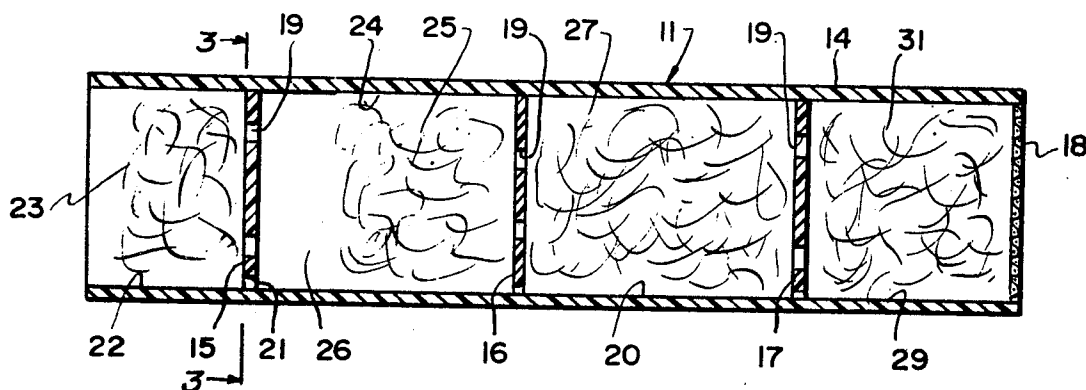
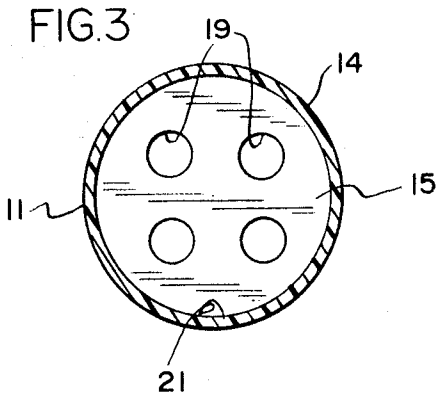
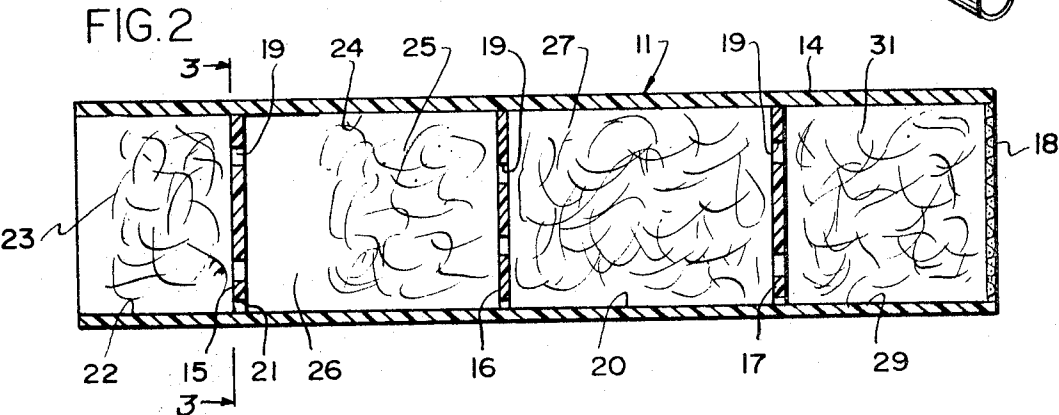
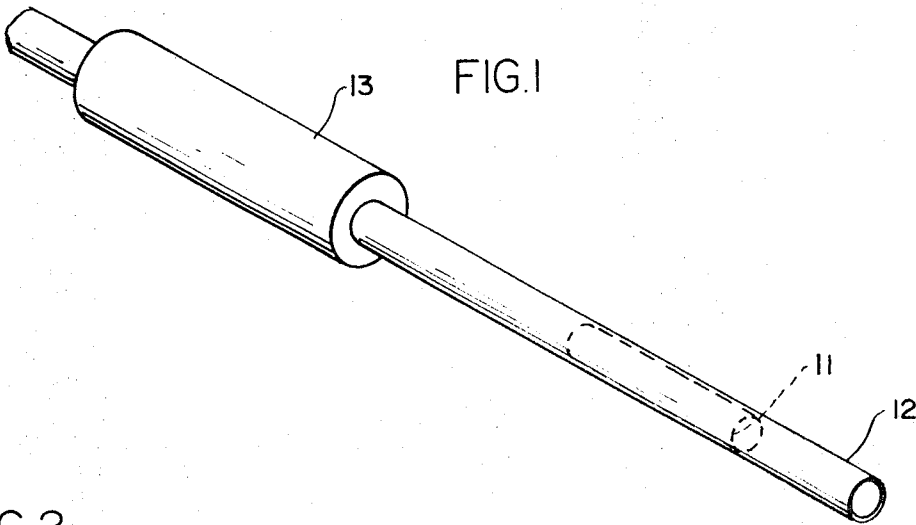


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ABSTRACT: An air pollution reduction system embodying dielectric means to induce electrostatic forces in the path of a polluted fluid stream to cause precipitation of solids in said stream in combination with particulate collecting material means to remove such solids from the fluid stream.





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FIG. 4

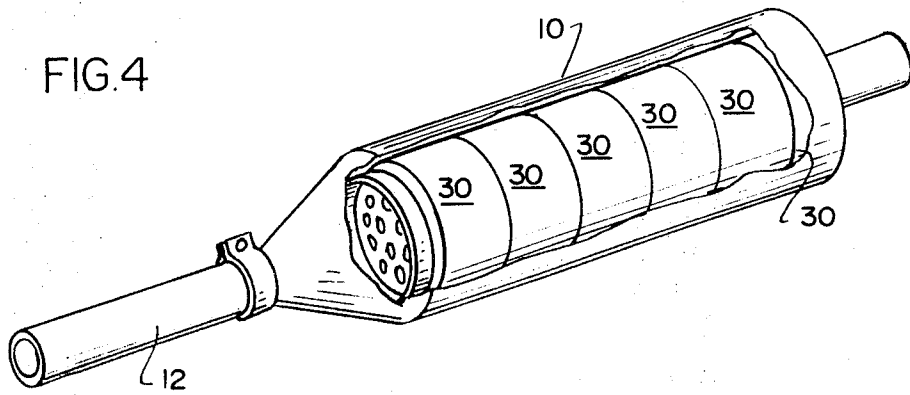
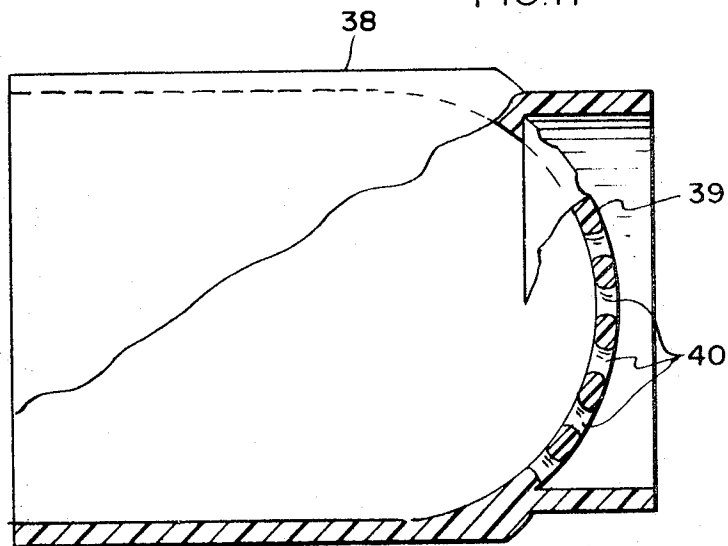


FIG. II



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FIG.5

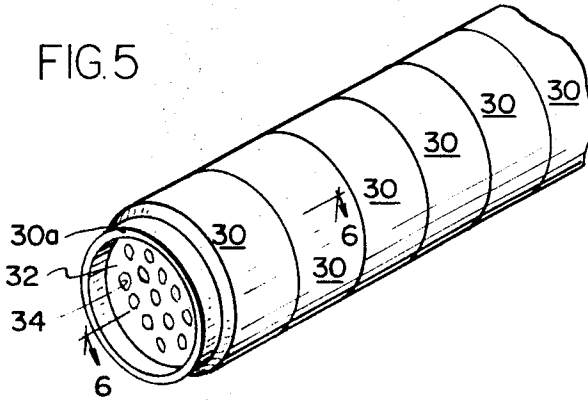


FIG.7

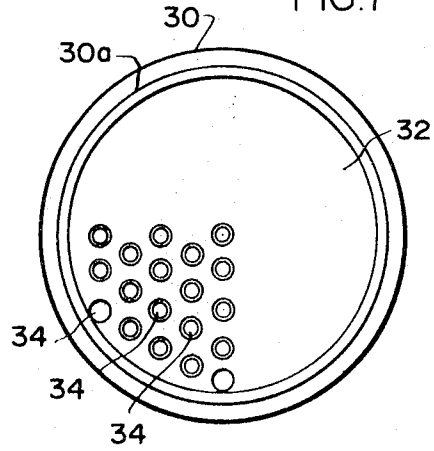


FIG.6

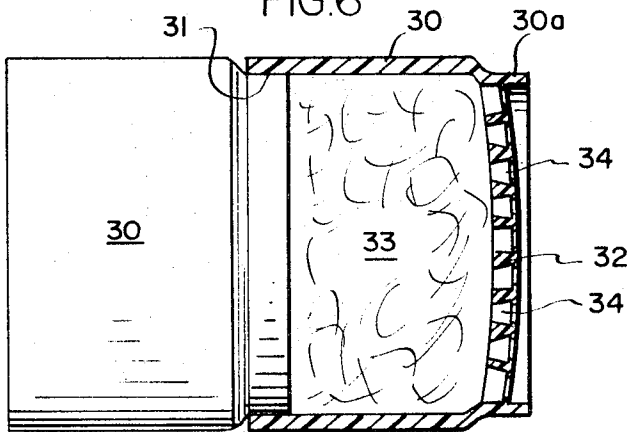


FIG.8

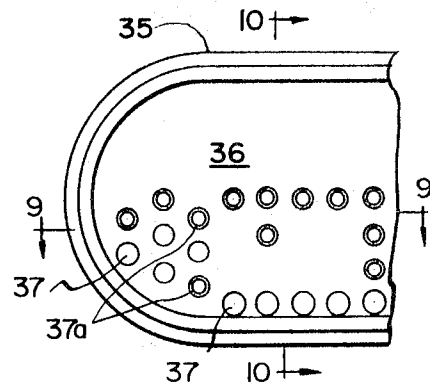


FIG.10

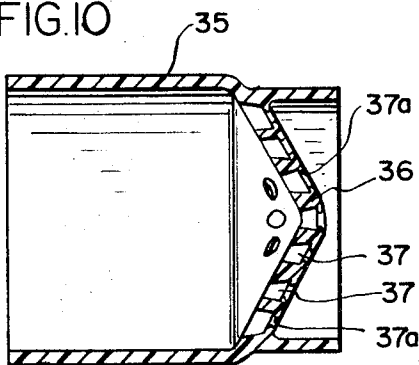
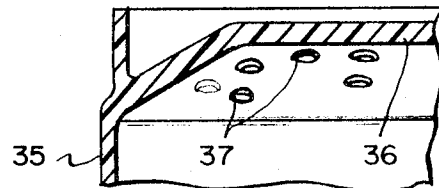


FIG.9



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AIR POLLUTION REDUCTION SYSTEM

This application is a continuation in part of my prior application Ser. No. 658,874 filed Aug. 7, 1967, (now abandoned).

The invention relates to an air pollution reduction system and is more particularly concerned with such a system wherein the removal of particulate and chemical pollutant contents of the fluid stream is obtained by the entrapment of said particulate matter after said stream has undergone precipitation of such matter through activation of an electrostatically charged field generated from a surface having dielectric properties in the path of said stream en route to said entrapment area.

It is common in former systems for separating and collecting solid and liquid contaminating particles suspended in moving gases to produce an electrical field within a chamber or enclosure through which said gases are moved and thereby effect a precipitation of said particles and thereafter collect such particles.

In one aspect, it has been found, however, that the pollutant removal efficiency of such systems can be substantially increased by promoting the growth of coalesced aggregates or bodies of such particulate material prior to the discharge of the electrostatically charged particles into an entrapment area or zone. It appears that the very fine colloid particles which are discharged from the exhaust emitted from internal combustion engines of automobiles are especially conducive to the formation of smog conditions. Accordingly coalescence of said colloids and fine particulate suspended material so as to facilitate the entrapment thereof before discharge to the atmosphere is of great significance in reducing smog-producing conditions. To this end, the present invention incorporates means whereby the colloiddally suspended pollutant particles of the pollutant-carrying fluid stream initially encounters an electrostatically charged field or zone adjacent to an electron generating or dielectric wall having a front surface facing upstream of the line of flow of said stream. The electrostatic charges applied to said particles in the fluid stream at said front surface of the dielectric retaining wall are intensified by means of openings in said wall, such as venturi openings, through which the fluid stream passes en route to an entrapment chamber or zone, said openings defining a coalescence zone to produce coalescence of the electrostatically charged particles in the stream prior to entering said entrapment zone.

It is accordingly an object of this invention to provide a new and improved method for controlling and reducing the contaminant content of a pollutant-carrying fluid stream.

Another object is to provide a self-contained air pollution reduction device for ready association with the exhaust system of an internal combustion engine or the like.

It is a further object to treat a pollutant-carrying fluid stream by subjecting said stream to an electrostatic charging zone generated by dielectric means and discharging said stream while the particles thereof are in an electrostatically charged state to a solid entrapment zone.

It is also an object of this invention to provide a system for the treatment of a pollutant-carrying fluid stream wherein a tubular unit in the path of said stream is provided with a front wall constructed of a dielectric material and having openings therein facing upstream of said fluid stream, and said dielectric front wall defines a front surface susceptible to activation by the heat generated in an automobile exhaust system to establish and maintain an electrostatically charged layer adjacent to said front surface.

A further object resides in the provision of a system for the treatment of a pollutant-carrying fluid stream wherein a tubular unit in the path of said stream is provided with a front wall constructed of dielectric material facing upstream of said fluid stream which presents a front surface susceptible, by activation by the heat generated in an automobile exhaust system, to establish and maintain an electrostatically charged field adjacent said front surface and openings in said wall are effective to coalesce particulate matter electrostatically precipitated from said stream incident to discharge of said stream to an entrapment zone in downstream relation to said wall.

A further object of this invention involves the provision of a series of like tubular units joined in staked relation in alignment with the path of a pollutant-carrying fluid stream, and each of said units is provided with a front wall constructed of dielectric material facing upstream of said fluid stream and each front dielectric wall is effective to establish and maintain an electrostatically charged field opposite the surface of said wall facing upstream of said fluid stream and each of said front walls have openings therein effective to coalesce particulate matter while said matter is en route to an area downstream of said fluid stream in relation to said front wall of each of said units.

It is also an object of this invention to provide a system which is applicable not only to the exhaust facilities of an automobile and other vehicles employing internal combustion engines but is also adapted for use in other installations such as smoke stacks and similar sources of pollutant-carrying fluid streams.

A still further object resides in the provision of a system which is relatively inexpensive to manufacture and install as well as requiring a minimum of care and maintenance.

Other objects, purposes and advantages, as well as characteristic features of this invention will in part be obvious from the accompanying drawings and in part pointed out as the description of the invention progresses.

FIG. 1 is a view of an exemplary exhaust system of an internal combustion engine having installed therewith an antipollution device according to this invention;

FIG. 2 is an enlarged longitudinal sectional view of the device;

FIG. 3 is a transverse sectional view showing one of the self-charging baffles or partitions;

FIG. 4 is a perspective view of a typical installation incorporating a pollutant-carrying fluid stream treatment multiple unit assembly in accordance with a modified form of the present invention;

FIG. 5 is a perspective view of the unit shown in FIG. 4 as it appears prior to installation;

FIG. 6 is an enlarged section taken along line 6-6 of FIG. 5; FIG. 7 is an enlarged front end view of the unit shown in FIG. 4;

FIG. 8 is an enlarged fragmentary front end view of a modified form of treatment unit in accordance with this invention;

FIG. 9 is a section taken along line 9-9 of FIG. 8;

FIG. 10 is a section taken along line 10-10 of FIG. 8;

FIG. 11 illustrates a modified form of unit incorporating the features of this invention wherein the front wall thereof is of hemispheroidal contour.

As shown in FIG. 1 of the drawings, an air pollution reduction device 11 incorporating the features of this invention is shown as occupying a position in the tailpipe 12 of a typical exhaust system having a muffler 13 to which the tailpipe 12 is joined in upstreamward relation to the device 11. Accordingly when the exhaust gases reach the device 11, much of the heat and pulse wave of such gases are absorbed during passage through the muffler 13, which allows for miniaturizing the overall size of the device 11 as compared with one that would be required under conditions where the gases entered the device 11 at close to sonic velocities and maximum temperatures, with consequent loss in the operating efficiency of the device 11.

As shown, the device comprises a cylindrical body 14 open at both ends. Preferably the body 14 is made of high heat resistant plastic which affords electrical resistance to the components therein contained and to be described.

The body 14 is divided into several compartments by plastic plates or baffle members 15, 16 and 17, and a screen 18 is arranged over the discharge end thereof. Each plate has a plurality of apertures 19 therein and is formed with an opening in the form of a notch 21 to permit condensate to return to the inlet end. The size of these apertures is not critical but may be varied to suit the needs of the pulsing gas stream so as to minimize back pressure.

The compartment 22 at the inlet end of body 14 is substantially filled with a mass of material, for collecting carbon or other smog-producing solids, such as spun fiberglass 23. The compartment 24 is partially filled with a mass of particulate collecting material such, for example, as shredded aluminum 25 arranged to leave an unfilled space 26 adjacent baffle 15. It is preferred that a mass of particulate collecting shredded fiberglass 27 fills the compartment 28 and that the compartment 29 is filled with shredded aluminum 31. Although applicant is hereinabove specifying preferred material which fills each of the compartments as most efficient, it is to be understood that the specifics may be varied and fiberglass substituted for aluminum and vice versa; or, these elements substituted for by other metal or mineral fibers such as steel or copper wool, asbestos, and catalyst treated fibers, all of which are capable of collecting precipitate. The presence of the open space 26 in compartment 24 is for the purpose of creating a maximum precipitation collection space or area adjacent to the inlet end of the device.

The function of the device is that an electrostatic force is generated in the baffles 15, 16 and 17 during the flow of exhaust gases through the device. This electrostatic force is effective to cause precipitation of the pollutants (solids) which are collected in the filter masses 23, 25, 27 and 31. Otherwise stated, the products of combustion pass through areas of voltage change and coalesce according to their colloidal properties. As a result, the gases leaving the discharge end of the device are free from pollutants.

Because the device is removed from the usual muffler it is not subjected to the sonic heat and pressures of the initial exhaust. Further, it is not subjected to the high pulsing shock wave of initial exhaust as most of this is neutralized in passage through the muffler.

In one experiment conducted by applicant using a 1966 Imperial engine, the exhaust tailpipe temperature was initially found to be close to 120° C. After idling for about 30 minutes, the exhaust temperature at the tailpipe was about 84° C. This temperature was adequate to volatilize and expel most of the moisture and raw gasoline within 1 minute. It is thus apparent that the use of this device will not be impaired by the presence of moisture or raw gasoline and that the operating temperature is sufficiently low to permit the use of high temperature plastics having a melting point of about 200° C. The discharge gases, flowing out of the tailpipe equipped with the present device, contained practically no carbon or other pollutant material.

This reduction in pollutant material results from the precipitation of carbon, etc., in the masses of filter material 23, 25, 27 and 31 resulting from the electrostatic charge generated in the partitions 15, 16 and 17 by the passage of exhaust gases therethrough and without the introduction of an outside electric charge.

In a modified form of the present invention as shown in FIGS. 4, 5, 6 and 7 a series of like tubular units 30 of suitable size and shape are joined to form a rigid stacked assembly along a line extending lengthwise of the line of travel of the fluid stream with which it is to be operatively associated. While thus joined in rigid stacked assembly, the units 30 are contained in a metallic sleeve or housing 10 suitably secured to the exhaust pipe 12 in downstreamward relation to the muffler associated with said pipe 12 so as to occupy a position in relation to the muffler corresponding to that occupied by the device 11 in FIG. 1. Each unit 30 is preferably a molded body of high temperature resistant synthetic resinous composition such as phenolic resins or acrylic polymers. The front end of each unit 30 is of reduced transverse dimension so as to provide an inwardly offset neck 30^a about which the open rear end of each unit 30 rearward thereof has external telescopic fit. The units 30 are securely fastened in rigid stacked assembly by a cemented joint between each neck 30^a and the portion of the adjacent unit enclosing said neck, or by other suitable connecting means. Thus the exposed outer walls of each unit 30 forms a smooth continuation of the corresponding wall of the other units. The number of such units 30 may

be varied to suit the requirements of the installation to which the system of this invention is to be applied.

The entrance end of each unit 30 is provided with a front wall 32 preferably formed of molded high temperature resistant synthetic resinous dielectric material such as phenolic or acrylic polymer materials. The dielectric material used must have a high electrical surface resistance so that its electrical retentive ability is sufficient to maintain an electrostatic field adjacent thereto while the fluid stream passes through the field. An entrapment area or zone containing suitable shredded or porous material 33 such as shredded aluminum, copper, steel or fiberglass occupies the interior of each unit 30 behind the wall 32. Combined with such shredded material 33 may be a suitable catalytic material such as fine dust vanadium oxide or the like for the purpose of aiding the action of the shredded material in the removal of pollutant particles from the stream entering said entrapment zone. Copper chromate or several other oxides could also be used to provide suitable catalytic material as a substitute for the vanadium oxide. Entrance to the entrapment zone containing the shredded material 33 is obtained via openings 34 provided in the wall 32.

It is to be observed that as an incident to the flow of a heated gaseous stream, such for example as the exhaust fumes from an internal combustion engine, in a path obstructed by the wall 32 of each unit 30, the heat of such fumes acting on the dielectric wall 32 appears to cause an electrostatically charged field or layer to be generated adjacent to and transversely across the front face of the wall 32 and about the mouths of the openings 34. Under these conditions the particles of contaminant material in the fluid stream encountering said electrostatically conditioned field at the front face of the wall 32 become charged so as to coalesce the colloidal particles and render the same susceptible to entrapment in the shredded material 33 after passage through the openings 34 in the wall 32.

In order to intensify the electrostatic activation of the particles while en route to said entrapment zone, it is a feature of this invention to utilize openings 34 which act in the form of a venturi orifice. Due to the squeezing action thus applied at the constricted space or neck between the flared ends of said openings 34, the fluid stream undergoes such pressure changes as to enhance coalescence of the particles in the stream thereby aiding the growth of clusters of such particles which in turn are more assured of capture while undergoing movement into the entrapment zone.

As the fluid stream thus moves from unit 30 to unit 30 rearward thereof, the colloidal effluent remaining in the fluid stream discharging from one unit into another unit will undergo further action of the succeeding unit with the result that the fine particle size at the output end of the most downstream positioned unit 30 will produce a very substantial agglomeration of the particles in relation to the condition of such particles at the most upstream positioned unit 30.

In the structure shown in FIGS. 8, 9 and 10, the shell designated by reference numeral 35, is of somewhat different cross-sectional contour than the unit 30 shown in FIGS. 5, 6 and 7, in that the unit 35 has upper and lower parallel planar surfaces or walls which are joined at the sides by convexly curved circular walls. The front dielectric wall 36 at the entrance to the unit 35 has uniformly forwardly converging areas which meet in a line of convergence midway between the upper and lower planar walls of the unit. Openings 37 provided in the front dielectric wall 36 intersect the front surface of the wall 36 to define an abrupt ridge 37^a at the mouth of each opening 37. The effect of thus constricting the mouth portion of each of said openings 37 is to produce a coalescent action on the pollutant particles in the fluid stream when said stream passes from the electrostatically charged field encountered by said stream adjacent the front face of the wall 36, in the same manner as the venturi action is obtained in the openings 34 of the unit 30. The ridge 37^a is preferably inset from the front surface of the wall 36 in order also to exert a concentrating action on the electrostatic field.

In FIG. 11, a unit 38 representing a further modification of pollutant-reducing system embodying the present invention, is provided with a front dielectric wall 39 of hemispheroidal shape. Venturi openings 40 provided in the wall 39 are bounded by surfaces in symmetry with lines projected radially of a sphere conforming to the shape of front wall 39. Accordingly, the flow of a contaminated fluid stream therethrough is not only subjected to venturi action but in addition is subjected to added constricting action due to the angularity of the surfaces of the openings 40 in relation to the line of flow of the stream en route to said openings.

While the electrostatic charged field opposite the front face of the front dielectric wall of each of the units 11, 30, 35 and 38 is maintained in the exhaust system of an automobile internal combustion engine on the basis of the heat effects of such exhaust system effluent applied to the front dielectric wall of each of said units, it is to be understood that such units are equally efficient in connection with installations, as for example in the confines of a smoke stack. In such installations, facilities providing a source of initiation of the electrostatic field, such as auxiliary heating devices, would occupy a position at a suitable distance upstream of the area occupied by the pollutant reduction unit forming the subject of this invention.

It will be appreciated that by utilizing a relatively thin layer or coating of suitable synthetic resinous dielectric material on the front face of the wall 32 of the unit 30, or the front face of the front dielectric walls of the other units described herein, relatively high resistive surface conditions capable of easy activation in the generation of an electrostatic field may be obtained while using a relatively cheaper and less resistive character material as the material of construction of the body of the unit as well as the dielectric wall of said unit. The use of such a coating thus provides a unit which is more economical to produce, without sacrificing the efficiency of the unit in the activation of the required electrostatic field, as indicated.

I claim:

1. An air pollution reduction device for placement in the path of a pollutant-loaded stream of hot gases comprising in combination, a tubular body having an open gas inlet end and an open gas outlet end, a first baffle disposed within said tubular body and spaced from said gas inlet end thereby to form a first compartment between said gas inlet end and said first baffle, a second baffle disposed within said tubular body and spaced longitudinally from said first baffle thereby to form a second compartment between said first and second baffles respectively, a third baffle disposed within said tubular body and spaced longitudinally from said second baffle thereby to form a third compartment between said second baffle and said third baffle, each of said baffles being formed of a dielectric plastic material and having a melting point of about 200° C. and each baffle being further provided with a plurality of perforations disposed therethrough for the passage of gases and a cutout to permit the passage of condensate, a screen member mounted on said tubular body and extending across said gas outlet end thereby to form a fourth compartment between said third baffle and said screen member, said first compartment being provided with a first filter mass formed of spun fiberglass substantially filling said first compartment, said second compartment being provided with a second filter mass formed of shredded aluminum arranged to partially fill second compartment whereby no part of said second filter mass con-

tacts said first baffle, said third compartment being provided with a third filter mass formed of shredded fiberglass substantially filling said third compartment, and said fourth compartment being provided with a fourth filter mass formed of shredded aluminum substantially filling said fourth compartment whereby gases containing pollutants pass through said baffles of said tubular body generating electrostatic charges therein upon passage therethrough, resulting in the precipitation of carbon and other pollutants, which pollutants are collected in the various filter masses provided in said compartments thereby to remove said pollutants from the exhaust gases prior to passage into the outer atmosphere.

2. An air pollution reduction device for placement in the path of a pollutant-loaded stream of hot gases comprising in combination, a tubular body having an open gas inlet end and an open gas outlet end, a first baffle disposed within said tubular body and spaced from said gas inlet end to form a first compartment between said inlet end and said first baffle, a second baffle disposed within said tubular body and spaced longitudinally from said first baffle to form a second compartment between said first and second baffles, a third baffle disposed within said body and spaced longitudinally from the second baffle to form a third compartment between said second and third baffles, each of said baffles being formed of a dielectric plastic material and each being provided with a plurality of perforations for the passage of gases, a fourth compartment rearwardly of the third baffle, a particulate collecting material arranged in each of said compartments, whereby gases containing pollutants pass through the baffles generating electrostatic charges therein upon passage therethrough resulting in precipitation of pollutants which pollutants are collected in the various collecting material provided in each of the compartments thereby to remove said pollutants from the exhaust gases prior to passage to the outer atmosphere.

3. The device recited in claim 2, in which each baffle has a perimeter cutout to permit the passage of condensate.

4. The device recited in claim 2, in which the particulate collecting material in the second compartment only partially fills said compartment.

5. The device recited in claim 2, in which the particulate collecting material comprises shredded aluminum.

6. The device recited in claim 2, in which the particulate collecting material comprises shredded fiberglass.

7. The device recited in claim 2, in which at least the baffles are formed of a plastic material having a melting point of about 200° C.

8. The device recited in claim 2, in which the baffles are flat discs.

9. The device recited in claim 2, in which the tubular body is comprised of stacked tube sections each including a baffle.

10. The device recited in claim 9, in which the baffles have a hemispheroidal contour.

11. The device recited in claim 9, in which the baffle openings terminate in an abrupt ridge inwardly of the ends thereof facing downstream of the flow of gasses therethrough.

12. The device recited in claim 2, in which the upstream facing surface of each baffle has a dielectric surface effective to establish and maintain an electrostatically charged field adjacent thereto.

13. The device recited in claim 2, in which each opening is a venturi-type opening.