United States Patent [19]
Dunfee et al.

[11] **3,707,918**
[45] **Jan. 2, 1973**

[54] **AEROSOL DISSEMINATOR**

[75] Inventors: **Danny D. Dunfee,** Fairfax; **Robert W. Evans,** Herndon; **Richard C. Grimm,** Triangle, all of Va.

[73] Assignee: **The Susquehanna Corporation,** Fairfax County, Va.

[22] Filed: **Feb. 26, 1971**

[21] Appl. No.: **119,280**

[52] **U.S. Cl.** **102/90,** 102/6, 102/65, 102/66

[51] **Int. Cl.** **F42b 13/46**

[58] **Field of Search**............102/90, 87, 66, 6, 39, 65

[56] **References Cited**

UNITED STATES PATENTS

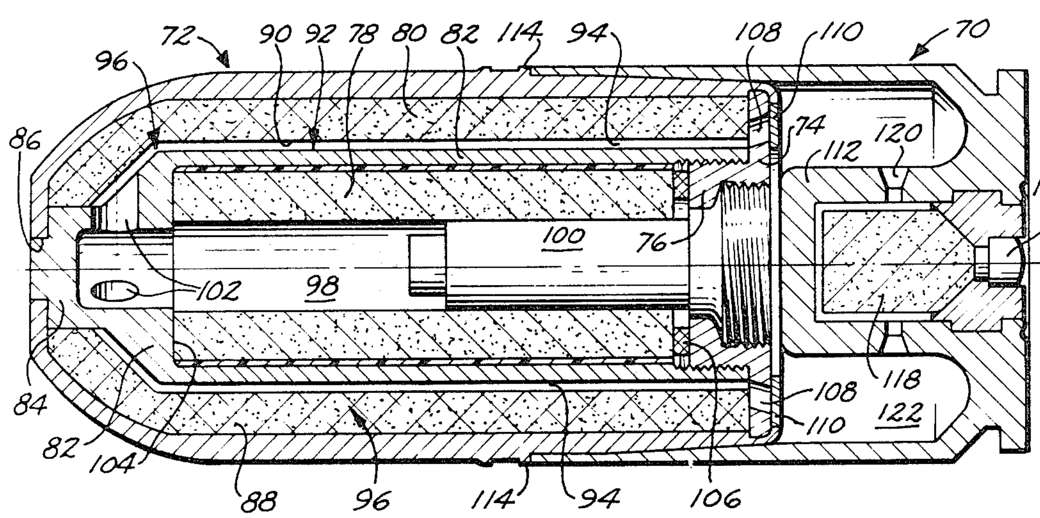
R16,841	1/1928	Bradner	43/129
3,109,821	11/1963	York et al.	252/359
3,492,944	2/1970	Reaves et al.	102/6
3,324,794	6/1967	Gahle	102/66 X
3,354,829	11/1967	Nichols	102/90

Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—H. J. Tudor
Attorney—Jacobi, Lilling & Siegel

[57] **ABSTRACT**

An embodiment of the invention disclosed herein shows a two-compartment disseminator for generating aerosols of smoke, poisons, gases, and other lethal and non-lethal agents. One disseminator compartment houses the propellant and the other compartment houses the agent. These two compartments are coaxially disposed, and a tubular bulkhead separates these two compartments. Sonic nozzles are formed in this bulkhead. The gases generated by propellant combustion are vented through these nozzles at sonic velocity into passageways formed in the solid agent. The agent is eroded, finely atomized and vaporized by the gases and expelled through exit orifices. The vaporized agent now condenses into minute particles to form with the gas an aerosol having long-term effectiveness. Close control of agent concentrations and dissemination time is also achieved. The coaxial arrangement enables higher loading ratios of agent to propellant as compared to a tandem arrangement.

11 Claims, 3 Drawing Figures



PATENTED JAN 2 1973 3,707,918

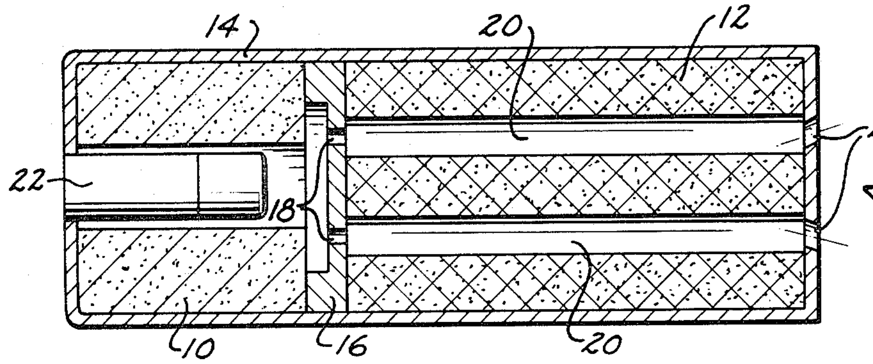


Fig. 1

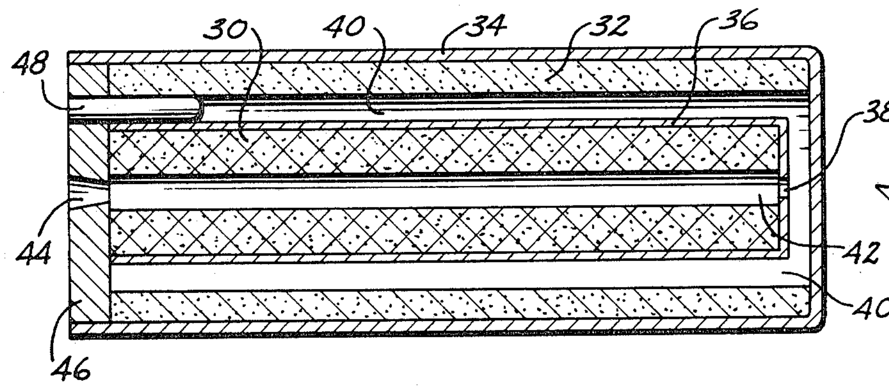
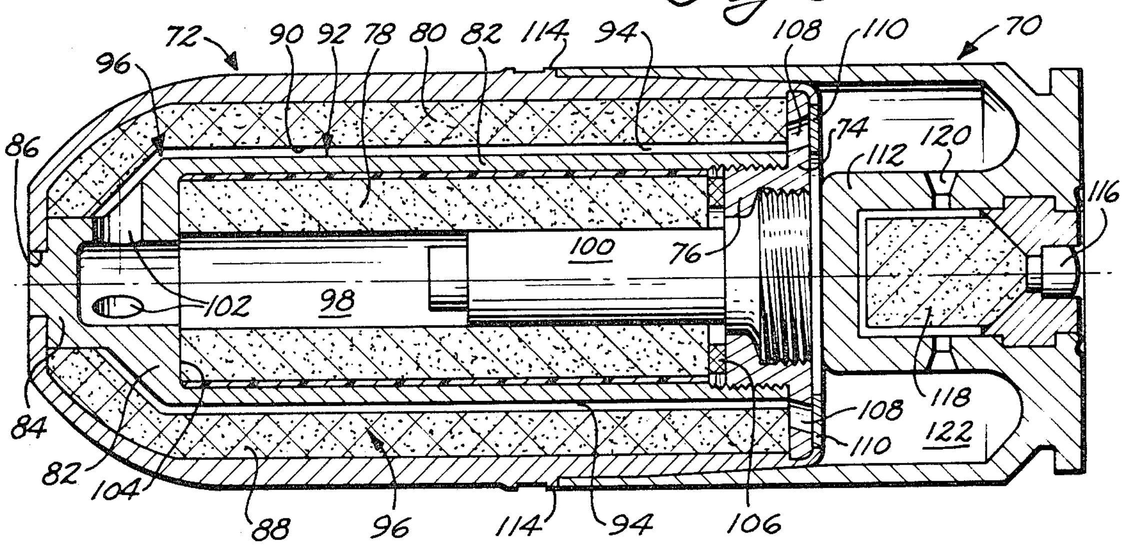


Fig. 2

Fig. 3



INVENTORS
DANNY D. DUNFEE
ROBERT W. EVANS
RICHARD C. GRIMM

BY Tipton D. Jennings
ATTORNEY

AEROSOL DISSEMINATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention is an improvement upon the invention disclosed and claimed in the Evans et al. patent application entitled: "Aerosol Disseminator," filed contemporaneously with and assigned to the assignee of the present application.

BACKGROUND OF THE INVENTION

The present invention relates to an improvement in disseminators, and more particularly to a two-compartment disseminator useful for forming aerosols of smoke, poisons, gases, and other lethal and non-lethal agents.

In the dissemination of agents of this type, it is desirable for the agent to remain suspended in the dispersing gas for sufficient time to allow the agent to perform effectively its intended function. If the particle size of the dispersed agent is too large, the rapid settling of the agent particles out of the aerosol suspension will lower the effectiveness of the aerosol as well as reduce the effective area coverage.

It can also be an important factor as regards agent effectiveness if the agent can be disseminated in a rapid and concentrated manner. Where the agent is directed against personnel, rapid dissemination eliminates the opportunity for individuals against whom the agent is directed to take protective action or to seize the disseminator and throw or launch it back in a return direction. Rapid dissemination of aerosol with long-term agent residence will also provide a relatively larger open-area coverage.

As disclosed in the aforesaid copending Evans et al. application, it has been discovered that in a two-compartment agent disseminator, the above-described advantages can be attained if there is sonic flow of the hot combustion gases from the combustion compartment or chamber into the compartment housing the agent. The sonic flow is directed along a path which causes the gases to contact the exposed surfaces of the agent, resulting in vaporization and rapid expulsion of the agent. The vaporized agent condenses into minute, solid particles which with the carrier combustion gas form an aerosol.

The flow of gases at sonic velocity causes virtually all of the agent to be vaporized. The gases cause what appears to be an erosion of the molded or tightly-pressed solid agent whereby it become liquefied and finely atomized. The atomized particles are then vaporized by the heat of the gas and carried by this high-velocity gas out of the disseminator. In the aerosol cloud which is formed, it is preferred that the condensed agent particles be predominantly of the micron-range size which will result in prolonged suspension of the agent in the aerosol. This gives an improved effectiveness to the aerosol as compared with state-of-the-art agent disseminators by providing operative agent concentrations for an extended period of time.

The rate of erosion of the agent is proportional to the mass flow of combustion gases. The use of sonic flow enables high mass-flow rates to be obtained. Thus, sonic flow provides a capability for very rapid generation of effective agent concentrations. The combination of this result with the prolonged suspension of agent particles also gives an increase in effective area coverage for the agent in open areas or increased agent concentrations in a confined area when compared with the prior art systems.

In the past, a variety of two-compartment agent disseminators have been designed; but generally these do not provide an aerosol with long-term residence of the agent particles or have a capability for high mass-flow rates to provide rapid dissemination of the agent.

For example, the U.S. Pat. to Bradner No. Re. 16,841 shows a two-compartment disseminator in which the generated gases pass through a large stack into the chamber that houses the agent and then over the agent to heat and volatize it and carry off the agent as a toxic vapor. The combustion gases are kept cool by an exchange of heat to avoid decomposition of the agent. Dissemination of the agent according to Bradner would be a relatively slow process. Furthermore, the cooling of the gases might lead to incomplete vaporization and a resulting undesired settling rate.

The U.S. Pat. to Stevenson No. 2,730,482 also shows a two-compartment disseminating device. The agent and propellant compartments are separated by a screen or perforated plate through which the hot combustion gases freely flow to contact intimately with a large free-surface area of a loosely-packed solid agent. No provision is made for sonic ejection of the combustion gases into the agent compartment to vaporize the agent to form upon condensation the small particle size desired for long residence in the aerosol. The U.S. Pat. to York et al. No. 3,109,821 discloses the use of a two-compartment disseminating device in which the heat transferred to the agent is closely controlled to avoid its decomposition. York et al. use a system in which the agent is first caused to melt and the melted agent caused to flow into an orifice where it is aspirated by the adjacent flow of combustion gases. The combustion gases are stated to be a high velocity gas stream which atomizes and vaporizes the melted agent. However, the York et al. patent fails to recognize the advantages of or even the need for sonic ejection, namely, the ability to increase the residence time of the agent in the aerosol by eroding and vaporizing essentially all of the solid agent so that it condenses to fine particles in the desired micron-size range, and the capability of having high mass flow rates. Furthermore, the York et al. system is, of necessity, more complex in design and structure by having to provide the additional means for melting and causing flow of the agent.

In the U.S. Pat. to Spragg et al. No. 3,352,238, the propellant compartment is separated from the agent compartment by a screen which limits the flame front produced by the propellant charge. The generated gases flow through holes formed in the solid agent, the holes becoming gradually enlarged as the agent is disseminated. Spragg et al. U.S. Pat. No. 3,352,238 states that the gases which are generated provide a relatively high velocity stream through the agent so that there is a limited heat exchange, and thereby a minimization of thermal decomposition of the agent. However, this patent teaches that only a minor portion of the agent is actually vaporized by the hot gases, this purportedly being an advantage of the construction and operation of the disclosed disseminator. Spragg et al. thus also fail to recognize the advantages to be secured by having sonic ejection of the combustion gases.

SUMMARY OF THE INVENTION

As taught in the aforesaid copending Evans et al. application, the disadvantages of the prior art can be overcome by the use of an aerosol disseminator in which the propellant or gas-generating composition compartment is separated from the compartment housing the agent. One or more apertures are provided in the structure separating the compartments. When the composition is ignited, the hot gases which are generated by the burning of the composition raise the pressure in the compartment to a level sufficient to cause sonic flow through the one or more apertures. The apertures are arranged to cause the sonic flow of hot gases to contact the agent so that the agent will become vaporized and discharged from the disseminator. The agent then condenses as minute particles whose size is such that they remain suspended in the carrier gas and resist settling for a period of time sufficient for the agent to be fully effective. The sonic flow of hot gases permits tailoring of the mass flow rate and burn time to provide a rapid vaporization and ejection of the agent such that a voluminous, concentrated aerosol suspension is quickly formed.

The present invention improves upon the generic invention summarized above by disposing the agent and gas-generating compartments coaxially within the disseminator housing. Again, the hot gases which are generated by the burning of the composition are ejected at sonic velocities through one or more apertures into the agent compartment. The resulting flow of hot gases through the agent compartment vaporizes the solid agent and discharges it from the disseminator to form the desired aerosol.

It has been found that this coaxial arrangement of the two components gives greater operating efficiencies and thus enables higher loading ratios of agent to gas-generating composition as compared to a disseminator in which the two components are arranged in tandem. The hot gases are injected into the agent compartment at one end of the disseminator and ejected from the agent compartment at the opposite end of the disseminator. The increase in efficiency is realized by the fact that the gases enjoy a longer residence time within the agent compartment and thus can erode and vaporize a greater volume of agent as they flow therethrough. Therefore, less propellant is needed to vaporize any given volume of agent.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-sectional view of the invention disclosed in the aforesaid Evans et al. application;

FIG. 2 is a schematic cross-sectional view of a preferred embodiment of the present invention; and

FIG. 3 shows the embodiments of FIG. 2 adapted to fit a conventional munition package.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, FIG. 1 shows a cross-sectional schematic of an embodiment of the invention shown in the aforesaid Evans et al. application. A disseminator is depicted having a gas generator 10 and agent 12 arranged in tandem fashion within an outer casing 14. Separating the interior of the disseminator into two compartments is a stationary bulkhead or plate 16 having one or more nozzle orifices 18. Each nozzle orifice is aligned with a perforation or passageway 20 formed longitudinally in agent 12. A conventional fuse/igniter assembly 22 is positioned at one end of the disseminator casing 14 and reposes within the central perforation of the gas generator 10. At the opposite end of the disseminator, exit orifices 24, which can be straight or canted as shown, are provided in communication with the passageways 20 of the agent.

In the operation of the disseminator shown in FIG. 1, the fuze/igniter combination 22 is caused to ignite by impact, time delay or in any other desired way. The gas generator 10 becomes ignited and burns. The gas generator compartment functions as a combustion chamber and the gases which are generated build the pressure in this chamber up to a level which causes sonic flow of these gases through the nozzles 18. The sonic flow or streams of these hot combustion gases are now directed through the passageways 20 and vented externally of the disseminator through exit orifices 24.

As the hot gases flow through the passageways 20, they briefly contact and erode the exposed surfaces of the agent 12. The eroded portion becomes liquefied and finely atomized by this gas flow, and then vaporized by the heat of gas; and the vaporized particles are carried by the gases through exit orifices 24. The vaporized particles now condense to minute solid particles to form with the combustion gases the desired aerosol cloud.

Sonic flow of the gas is critical. At this velocity, virtually all of the eroded agent is finely atomized and vaporized. The resulting agent particles which condense in the aerosol have been observed, in the case of dissemination of CS agent, to be primarily one micron in size; however, the particle size will vary based upon the type of agent employed, its molecular weight, and other factors. As long as the size of the particles is within the 0.1 to 3.5 micron range, undesired settling of the agent out of the aerosol should be deterred, although this range of sizes is not to be construed as limiting the scope of the present invention.

The utilization of sonic flow provides the capability to control the precisely mass flow rates of the combustion gases and the burning time of the gas-generating composition. The rate of agent erosion is proportional to mass flow rate, and agent dissemination time is, of course, essentially coincident with burning time. Thus, sonic flow permits close control of agent concentrations and agent dissemination time. It has been found that for many applications large mass flow rates and short dissemination times are preferred and the gas-generating grain and sonic nozzles can be designed accordingly.

The actual design function is facilitated by the utilization of sonic flow because recourse can now be had to conventional rocket motor internal ballistics. Such factors as nozzle sizing, burning rates, grain configuration and the like can be readily solved by the use of conventional techniques and formulas for the mass flow rate and combustion time dictated by or desired for the planned end use of the agent.

To ensure continuous sonic flow, the pressure within the combustion chamber compared to the pressure within the agent compartment must be kept at a ratio of about two-to-one or greater in accordance with standard design practice. Care must be taken during operation that the pressure in the agent compartment does not increase to a level that causes pressure fluctuations in the combustion chamber and a loss of sonic flow. To prevent this from occurring, the exit orifices **24** are preferably sized to be at least twice the cross-sectional area of the sonic nozzles **18**.

FIG. **2** shows a cross-sectional schematic view of a preferred embodiment of the present invention. The agent **30** is disposed coaxially within the gas generator **32**. These two components are maintained separated by a stationary tubular member **36** which functions as a bulkhead to divide the interior of the disseminator casing **34** into two compartments. To this end, tube **36** is shown as extending essentially the length of the disseminator. At one end of the tube **36** a nozzle orifice **38** is provided. In this embodiment, the gas generator **12** is shown as a thin tube positioned against the inner wall of casing **34** so that with the external wall of tube **36** it forms an annular combustion chamber **40**. The agent **30** is shown formed with a longitudinal perforation or passageway **42** extending substantially the interior length of the disseminator. Nozzle **38** provides communication between this passageway **42** and combustion chamber **40**. Passageway **42** terminates at exit orifice **44** formed in closure **46** at one end of the disseminator casing **34**. A conventional fuse/igniter assembly **48** is inserted through closure **46** and reposes within the combustion chamber **40** adjacent to gas generator grain **32**.

The operation of FIG. **2** is as described above with respect to FIG. **1**. The fuse/igniter assembly **48** is caused to ignite by impact, time delay, or in any other preferred way. The gas generator **32** becomes ignited and burns to evolve gases within combustion chamber **40**. The pressure in this chamber increases to a level which causes sonic flow of these gases through nozzle **38**. The sonic flow of these hot combustion gases is now directed through passageway **42** past agent **30** and vented externally of the disseminator through exit orifice **44**.

As the hot gases flow through passageway **42**, they briefly contact and erode the exposed surface of agent **30**. The eroded portion becomes liquefied and finely-atomized by this gas flow and then vaporized by the heat of the gas; and the vaporized particles are carried by the gases out through exit orifice **44**. The vaporized particles now condense to minute solid particles to form with the combustion gases the desired aerosol cloud.

The elongated compartment housing the agent **30** can, by a comparison with FIG. **1**, be seen to provide an increase in distance for the combustion gases to travel. As a result, the gases contact a greater surface area of the agent and thus can erode and vaporize a greater volume of agent while in transit. The volume of required gas generator **32** can be decreased because less mass flow of gas is now needed to vaporize the agent **30**. The space that is saved by the reduction in volume of the gas generator can be filled with additional agent, and of course such additional gas generator necessary to ensure that all the agent is vaporized and ejected during operation. The end result is a higher loading ratio of agent to gas-generating composition as compared to the tandem arrangement, such as shown in FIG. **1**.

FIG. **3** is included to illustrate how the present invention can be adapted to fit a conventional munition package. FIG. **3** shows a cross-sectional view of a military cartridge consisting of a cartridge case **70** and projectile **72**. The projectile has an external configuration in the conventional form of a cylindrical body with a truncated ogive nose. The base of the projectile **72** is crimped to retain base plate **74**. This base plate **74** closes the base of the projectile, and has at its center an inwardly-directed threaded boss **76**.

Within the projectile **72**, the gas generator **78** is here shown as disposed coaxially within the agent **80**. These two components are maintained separated by a stationary, substantially tubular member **82** which functions as a bulkhead to divide the interior of the projectile **72** into two compartments. To this end, member **82** is shown as extending the internal length of the projectile **72**, being threaded at the projectile base onto boss **76** and seated at the nose of the projectile by means of a stepped boss **84** sized to fit tightly into hole **86** centrally formed in the truncated projectile nose.

The agent **80** is shown as formed in a generally tubular shape and positioned against the inner wall of the projectile **72**. The inner surface **90** of the agent **80** is spaced from the outer surface **92** of member **82** such that an annular passageway **94** is formed substantially the entire internal length of the projectile **72**.

As stated above, tubular member **82** divides the interior of projectile **72** into two compartments. One compartment **96** contains the agent **80** and annular passageway **94**. The other compartment **98**, which functions as the combustion chamber during operation, includes gas generator **78** and the fuse/igniter assembly **100**. Communication between the two compartments is obtained by a plurality of nozzles **102** equally spaced through tubular member **82** adjacent to the projectile nose. As shown, these nozzles **102** open into passageway **94** at its far forward end so that the combustion gases vented through these nozzles during operation will contact essentially the entire exposed surface of agent **80** from the projectile nose to its base.

The gas generator **78** is shown as being a centrally perforated cylindrical grain inhibited on its outer surface and mounted at its forward face against an appropriately formed shoulder **104** of member **82**. The base of the grain is cushioned by annular pad **106** placed between the grain **78** and the top of boss **76**. The fuse/igniter assembly **100** is screw-mounted into base plate **74** and extends through boss **76** into compartment **98** and reposes within the central perforation of grain **78**. The fuse/igniter assembly **100** can be of a conventional design so that it ignites grain **78** upon impact of the projectile **72**, or after a predetermined time following firing of the projectile. If desired, the perforation of grain **78** can be coated with a starter mixture (not shown) to aid in its ignition by the fuse/igniter assembly **100**.

A plurality of exit orifices **108** are formed in the base plate **74**. These orifices **108** communicate with the annular passageway **94** in compartment **96** and vent the hot gases and vaporized agent externally of the projectile **72** during operation. Each orifice is closed by a seal

110 bonded in place but designed to be easily ruptured or blown off by the pressure developed in compartment 96 during operation.

The aft end of projectile 72 fits tightly within cartridge case 70 to a depth determined by circular flange 114 which contacts the rim of the case. The base of projectile 72 lies in close proximity to a central boss 112 projecting from the bottom of the case. Cartridge case 70 has a conventional percussion primer 116 which functions to ignite propellant charge 118. The hot combustion gases are vented through nozzles 120 and cause a rapid build-up of pressure in space 122 to launch or fire projectile 72. If a time-delay fuze is included in the fuse/igniter assembly 100, the hot gases in space 122 contact and ignite the delay charge (not shown) in this assembly.

Once the projectile 72 has been fired, then by either impact or after a predetermined time delay, the igniter portion of the fuze/igniter assembly 100 will ignite the propellant 78 causing, as described above with respect to FIGS. 1 and 2, a rapid generation of gases within compartment 98 and the sonic ejection thereof by nozzles 102 through passageway 94, thereby to erode, vaporize, and eject the agent 80 through exit orifices 108 to form the desired aerosol.

Canting of exit orifice 108 serves to increase the lateral width of the aerosol cloud by ejecting the gas and vaporized agent at an angle to the longitudinal axis of the projectile 72. The gases vented through exit orifice 108 also cause thrusting fuse/igniter skittering of projectile 72 and a resulting increase in area coverage by the aerosol that is formed.

While FIG. 3 depicts one type of munition package suitable as an aerosol disseminator, it is merely representative of munition packages which can be used. The disseminator is equally adaptable to other types of munition vehicles including, as examples, rocket warheads, artillery rounds, and prime munition vehicles. As regards the last type, the disseminator would be classed as a submunition and could be provided in large numbers or clusters for dispensing over a wide target area prior to actuation.

The use of the present disseminator is not limited solely to munitions, nor must the disseminator necessarily be thrown or launched to be effective. For example, it could by used as a stationary smoke marker or insecticide disseminator, or positioned in a bank or other building to thwart robbers by dissemination of an incapacitating agent or the like when triggered. If desired, the disseminator can serve both as the vehicle and the payload by utilizing the ejected gases and vaporized agent to launch and/or sustain the disseminator in flight. Uses for such versatile devices are readily foreseen in crop dusting and the laying of smoke screens, for example.

The external configuration of the disseminator is likewise not critical although only tubular embodiments have been illustrated herein. The end use will to some extent dictate the shape of the disseminator package but rectangular, cube and even pie-shapes are readily foreseeable. Additionally, the exit orifices which vent the combustion gases and vaporized agent to the outside can be selectively positioned to attain the desired aerosol plume pattern.

The variety of agents which can be disseminated find utility as insecticides, rescue and marker smokes, and antipersonnel toxicants, all by way of example. It is feasible to disseminate insecticides such as DDT, TEPP and Chlordane, among others; and various dye stuffs for the production of smokes such as 1-methylaminoanthraquinone; 1,4-di-toluidinoanthraquinone, among others. It is also feasible as regard antipersonnel agents to disseminate a variety of harrassing, nauseating, incapacitating and lethal agents such as CS, tear gas, mustard gas, and DM, among others. The agent is solid and can be cast or can be formed as a tightly-pressed powder, and is shaped to fit in the space provided in the disseminator device. The quantity of agent used will be based upon the volume and characteristics of the gas generator so that essentially all of the agent will be vaporized and ejected from the disseminator.

The gas-generating compositions are preferably in a cast solid form to facilitate their shaping and loading, but other types can obviously be used. The particular compositions selected are not critical provided the gases which are generated do not adversely affect the chemical structure or performance of the agent, or cause untenable environmental results as the carrier gas of the aerosol. A likely source of candidate compositions occur in the solid propellant field, the state-of-the-art of which is well defined and readily available in the published literature and issued patents.

Although several embodiments of the present invention have been particularly shown and described, it is apparent that various modifications may be made therein within the spirit and scope of the invention, and it is to be understood, therefore, that only such limitations be placed on the invention as are imposed by the prior art and set forth in the appended claims.

What is claimed is:

1. A disseminator for generating aerosols of lethal or non-lethal agents, comprising:
   a. a tubular housing with an end closure at one end thereof, said end closure having an exit orifice therethrough;
   b. a tubular bulkhead extending longitudinally within said housing and forming first and second compartments in said housing, said compartments being coaxially disposed;
   c. said first compartment including:
      1. a gas-generating composition;
   d. said second compartment including:
      1. an agent,
      2. at least one passageway for providing gas-flowing contact with said agent, said passageway being in communication with said exit orifice;
   e. means for igniting said gas-generating composition; and
   f. at least one sonic orifice formed in said bulkhead to provide communication between said first and second compartments for venting gases, generated in said first compartment, at sonic velocity into said passageway of said second compartment to contact and cause vaporization of the agent therein.

2. A disseminator as claimed in claim 1, wherein:
   a. said agent is substantially tubular in form and is positioned in said second compartment which is

formed external to said tubular bulkhead, said agent having:

1. an exposed surface; and

b. said gas-generating composition is positioned in said first compartment which is formed within said tubular bulkhead.

3. A disseminator as claimed in claim 2 further comprising:

a. a plurality of sonic orifices formed in said tubular bulkhead.

4. A disseminator as claimed in claim 3, wherein:

a. said agent is positioned in said second compartment outwardly of said tubular bulkhead and said exposed surface is the inner surface of said agent;

b. said passageway is defined as the space between the inner surface of said agent and said tubular bulkhead; and

c. each of said sonic orifices is aligned to vent generated gases into said passageway.

5. A disseminator as claimed in claim 4 further comprising:

a. a plurality of exit orifices in said end closure formed in communication with said passageway for venting the generated gases and vaporized agent externally of said disseminator, whereby an aerosol of said agent is formed.

6. A disseminator as claimed in claim 5, wherein:

a. said exit orifices are canted.

7. A disseminator as claimed in claim 1, wherein:

a. said gas-generating composition is substantially tubular in form and is positioned in said first compartment which is formed external to said tubular bulkhead, said composition having:

1. an exposed surface;

b. said agent is positioned in said second compartment which is formed within said tubular bulkhead; and

c. said passageway is formed longitudinally through said agent.

8. A disseminator as claimed in claim 7, wherein:

a. said gas-generating composition is positioned in said first compartment outwardly of said tubular bulkhead and said exposed surface is the inner surface of said gas-generating composition and;

b. said exposed inner surface of said gas-generating composition and said tubular bulkhead define a combustion chamber.

9. A disseminator as claimed in claim 8 further comprising:

a. a plurality of exit orifices formed in said end closure in communication with said passageway for venting the generated gases and vaporized agent externally of said disseminator, whereby an aerosol of said agent is formed.

10. A disseminator for generating aerosols of lethal or non-lethal agents comprising:

a. a tubular housing with an end closure at one end thereof;

b. a stationary, tubular bulkhead extending longitudinally through substantially the entire interior length of said tubular housing to divide the interior of said tubular housing into first and second compartments, said compartments being coaxially disposed within said housing;

c. said first compartment functioning as a combustion chamber and being defined by the space within said tubular bulk-head, said first compartment including;

1. a propellant grain,

2. an igniter for said grain;

d. said second compartment being defined by the space between said tubular bulkhead and the inside surface of said tubular housing, said second compartment including:

1. a tubular solid agent positioned against the inside surface of said tubular housing and having an exposed inner surface,

2. a passageway defined as the space between the inner surface of said tubular agent and the tubular member;

e. a plurality of sonic nozzles formed in said tubular bulkhead, said sonic nozzles establishing communication between said first and second compartments,

1. each of said nozzles being positioned to direct combustion gases, generated in said combustion chamber upon ignition and burning of said propellant, into said passageway at sonic velocity whereby said agent is vaporized by said combustion gases; and

f. a plurality of exit orifices formed in said end closure at one end of said tubular housing, said exit orifices being in communication with said passageway to vent the combustion gases and vaporized agent externally of said disseminator, whereby an aerosol of said agent is formed.

11. A disseminator as claimed in claim 10, wherein:

a. said exit orifices are canted.

* * * * *