

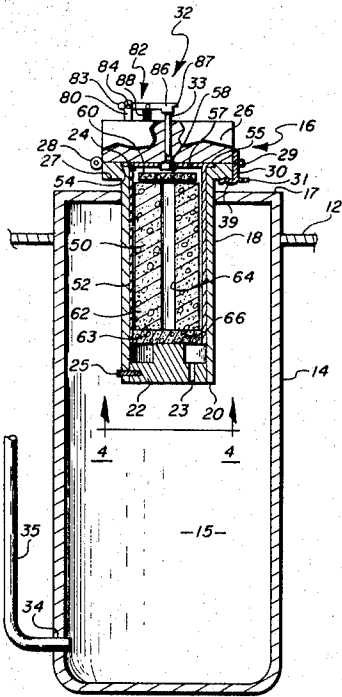
[54] **GAS GENERATOR FOR LIQUID SPRAYERS**
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[73] Assignee: **North American Rockwell Corporation**
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[52] U.S. Cl. **222/396**
[51] Int. Cl. **B65d 83/00**
[58] Field of Search.....222/389, 396, 399, 3, 5, 190;
9/321, 322; 23/281

[56]		References Cited	
UNITED STATES PATENTS			
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Primary Examiner—Stanley H. Tollberg
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[57] **ABSTRACT**
A source of regulated gas pressure is directed within a liquid sprayer tank provided by a small gas generator package adjacent the tank which, upon ignition, dissipates its energy into a hog gas plenum and thence into the tank, thereby providing sufficient pressure, upon demand, to expel liquid therefrom.

9 Claims, 7 Drawing Figures



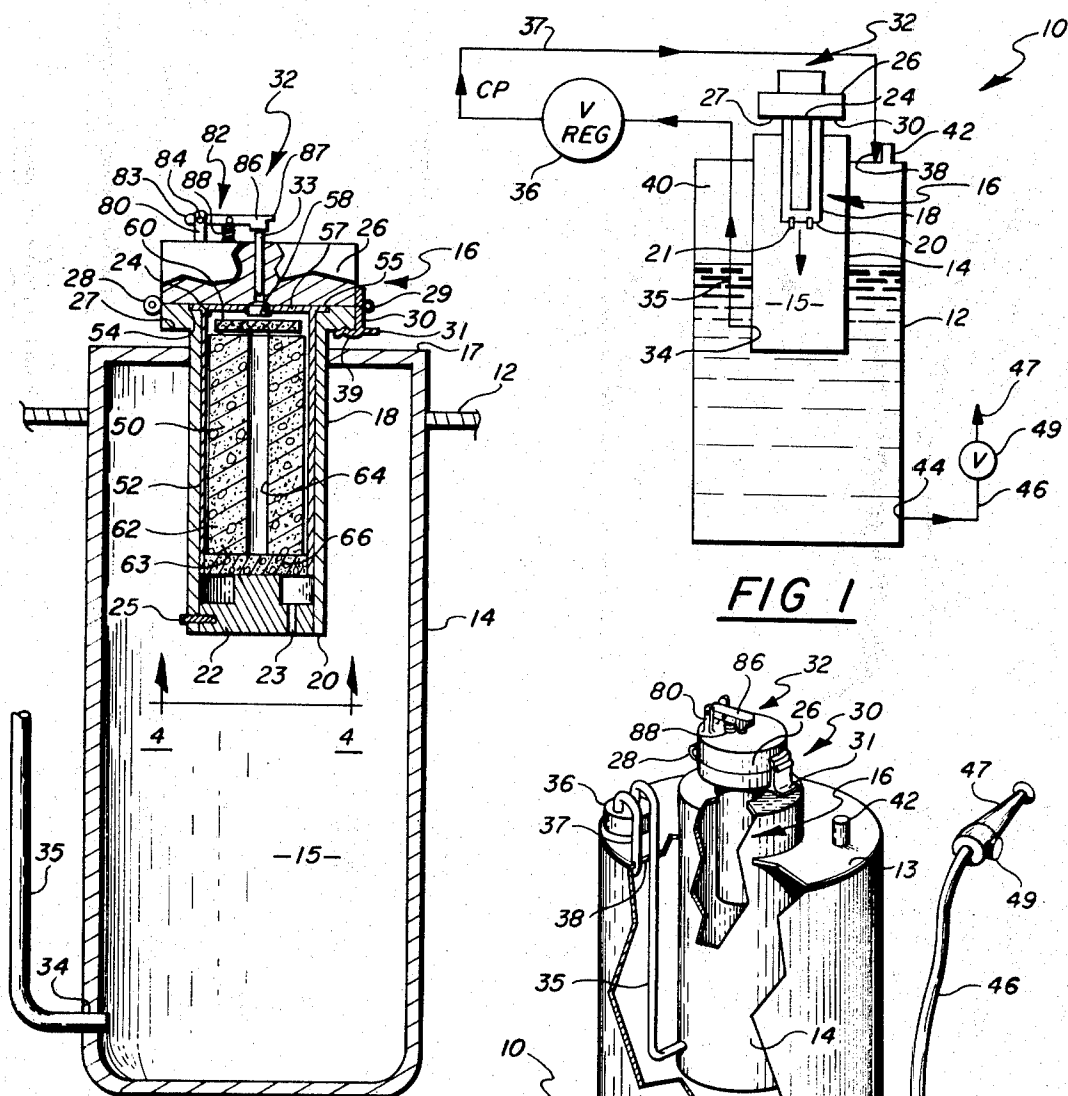


FIG. 1

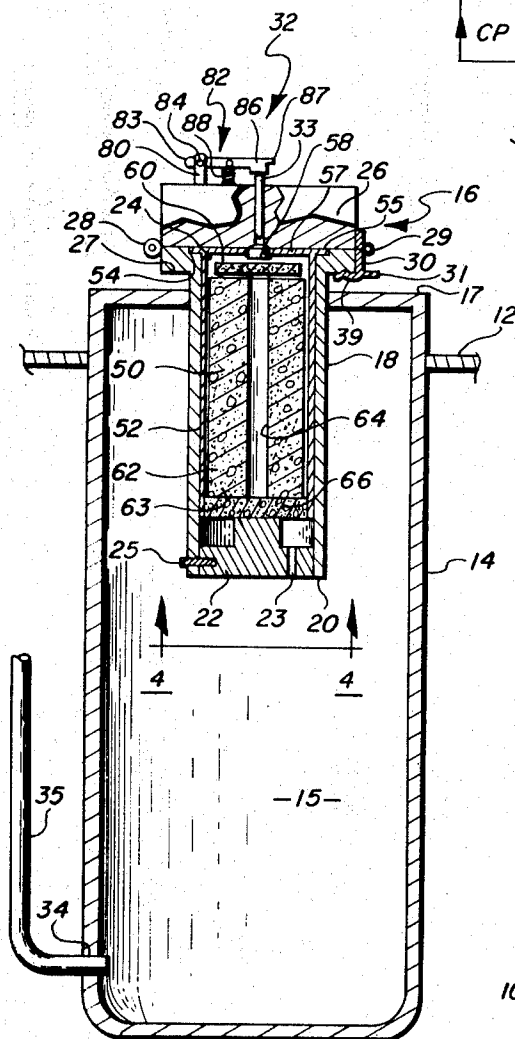


FIG. 3

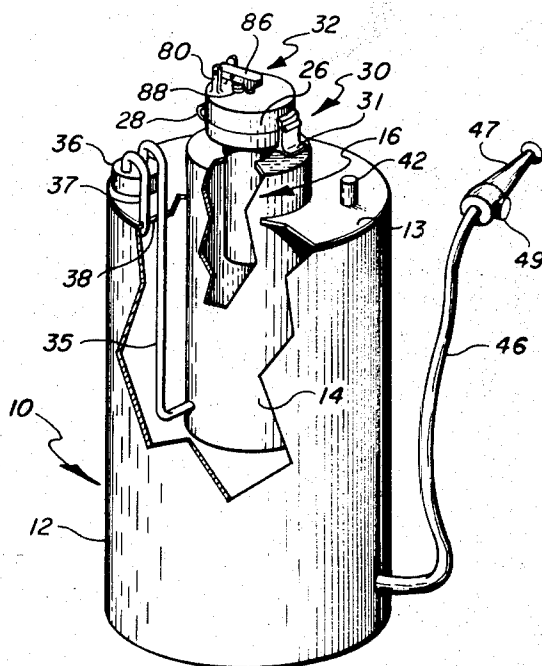


FIG. 2

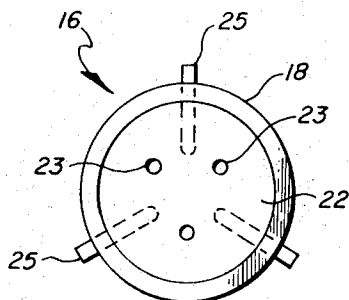


FIG. 4

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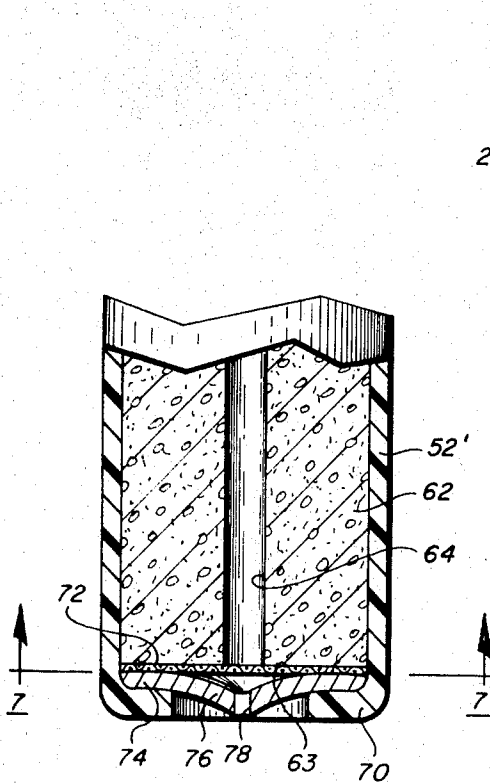


FIG. 6

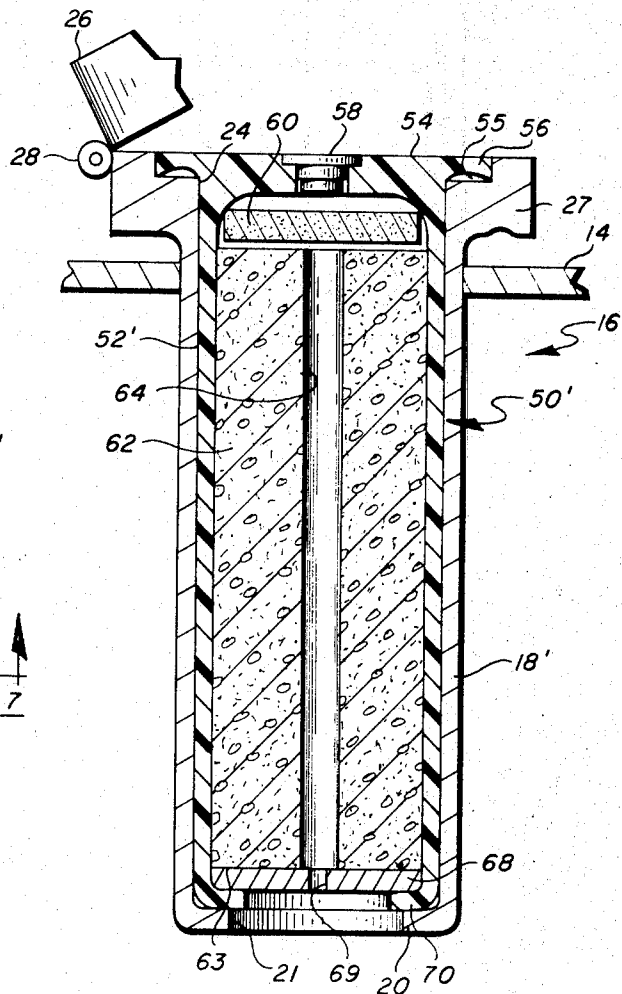


FIG. 5

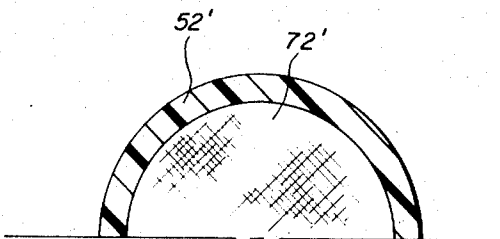


FIG. 7

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GAS GENERATOR FOR LIQUID SPRAYERS

BACKGROUND OF THE INVENTION

A number of liquid dispensing and gas pressurizing devices are shown in the prior art. A need exists for a safe, reliable and easily operable source of pressure to dispense liquid compositions from a sprayer tank, particularly in agricultural areas where these devices are widely used.

The device covered by U.S. Pat. No. 3,404,810 utilizes a small solid propellant charge to explosively drive a piston down a container wall, thereby quickly expelling a powder or liquid from the tank.

U.S. Pat. No. 3,252,622 discloses a liquid dispensing apparatus which essentially uses a charge of CO₂ for a high pressure gas source that is regulated into the interior of a low pressure chamber, the low pressure gas being subsequently used to expel the liquid from the tank.

U.S. Pat. No. 3,325,053 is another liquid dispensing device which utilizes a regulated CO₂ charge to pressurize the liquid contained within a tank.

A disadvantage of the first mentioned powder dispensing device is the lack of control of the energy upon detonation of the solid propellant charge.

The CO₂ liquid dispensers just described are disadvantaged by the relatively low volume of liquid they are capable of discharging. In addition, the cartridges have a tendency to clog the feed lines to the attending pressure regulators when the CO₂ cartridges are punctured.

Accordingly, it is an object of this invention to utilize a solid propellant cartridge to provide a regulated source of pressure within a liquid-containing tank.

More specifically, it is an object of this invention to provide a gas generator device utilizing a solid propellant charge which will provide sufficient gas pressure to dispel a relatively large quantity of liquid over a fairly long period of time. The solid propellant charge, being in the form of a "shotgun shell" cartridge, is replaceable within a breech assembly after its energy is expended.

SUMMARY OF THE INVENTION

A solid propellant gas generator in the form of a "shotgun shell" is utilized to provide sufficient regulated gas pressure to expel liquid from a tank. The shell consists of a percussion primer cap, a booster charge adjacent the primer cap, and a solid propellant charge in juxtaposition to the booster charge. The solid propellant charge is encapsulated in a plastic or paper cartridge case in much the same manner as a shotgun shell is configured. The cartridge is then insertable into a breech assembly, the breech being closable by a cap which contains a firing mechanism. The breech assembly can, for example, include a nozzle or injector assembly at the bottom end of the breech, the whole assembly being, for example, mounted within a high pressure plenum chamber housing. The plenum chamber may then be mountable within a larger liquid container having a liquid dispensing nozzle attached thereto.

When a cartridge case is inserted within the breech assembly and the cap or closure means is secured over the end of the cartridge case, the sprayer is ready for operation. Upon actuation of the firing mechanism, a solid propellant charge generates a gas under high pressure that is directed into the interior of a high pressure

plenum chamber. The gas under high pressure is accumulated in the plenum chamber and is subsequently metered through a regulator or valve, thus providing a constant pressure source to the interior of the liquid-containing tank to expel a liquid therefrom upon demand. A constant pressure in the range of 20-25 lbs psi is desirable to provide enough pressure to spray liquid from the tank. The solid propellant charge is configured to maintain a pressure within the plenum chamber of between 350 to 400 psig after the generated gas has cooled to 40° F, thus providing sufficient pressure within the chamber to provide approximately 20 psi of regulated pressure within ullage space of the liquid-containing tank, for example to dispense approximately 3 gallons of liquid.

An advantage over the prior art is realized in that an inexpensive source of high gas pressure is available through the use of a solid propellant cartridge, thereby providing a regulated source of pressure to force liquid out of a tank.

Another advantage is the throwaway aspects of the spent cartridge, thereby providing the capability to reuse the sprayer tank by inserting a new cartridge and refilling the tank with liquid.

Still another advantage is the ease of maintenance and simplicity of operation of the replaceable cartridge within the sprayer unit.

DESCRIPTION OF THE DRAWINGS

The above noted objects and further advantages of the present invention will be more fully understood upon the study of the following detailed description in conjunction with the detailed drawings in which:

FIG. 1 is a schematic view of the overall device;

FIG. 2 is a perspective view of the overall device showing a partial cutaway of the interior components of the device;

FIG. 3 is a cross-sectional view of the breech assembly within the plenum chamber, including the cartridge, closure cap, and firing mechanism;

FIG. 4 is a view along lines 4-4 of FIG. 3, illustrating the injector face forming gas injection holes therein;

FIG. 5 is a cross-sectional view of another embodiment of the present invention utilizing an injector plate as an integral part of the cartridge case;

FIG. 6 is still another embodiment of the present invention utilizing a fixed injector plate as part of the propellant cartridge case having a protruding throat; and

FIG. 7 is a view taken along lines 7-7 of FIG. 6, clearly illustrating a filter screen that is juxtaposed between the fixed injector plate and the propellant charge.

Referring now to FIG. 1, the spray device generally designated as 10 comprises a tank 12 which contains a high pressure plenum chamber housing 14 within one end of the tank. Within the plenum chamber housing is attached a breech assembly generally designated as 16 which includes a cartridge housing 18. The base 20 of housing 18 can include an injector face assembly 22 (FIG. 3) which may have any number of apertures 23 which communicate between the interior of the breech assembly and the volume 15 of housing 14. At the opposite end of breech assembly 18 is a breech block or

breech closure cap 26 which seats on support rim 27, the cap containing an ignition or firing mechanism generally designated as 32. Cap 26 closes off access opening 24 formed by base 27. The breech cap has a hinge 28 at one side and a latch, breech block retainer means 30 on the opposite side which locks a cartridge case generally designated as 52 within the breech assembly 16 prior to firing the cartridge.

Retainer means or latch 30 consists, for example, of a hinge 29, lever 31, and detent catch 39 which forcibly snaps or locks cap 26 in place over rim 27 prior to ignition of the device. An aperture 34 is located near the bottom of the plenum chamber housing 14. A conduit 35 leads from the aperture 34 into a regulator valve 36. A conduit 37 exits from the regulator valve and enters the top surface of tank 12 through tank inlet means 38.

High pressure gas generated when the cartridge 50 is fired is accumulated within volume 15 of the high pressure gas plenum chamber 14. The gas under pressure enters conduit 35 leading into regulator valve 36. The regulated gas then passes into conduit 37 through opening 38 into ullage space 40 of tank 12. The regulated pressure acts upon the liquid contained within the tank 12, expelling the fluid from the tank. An overpressure safety vent 42 in surface 13 communicates within the ullage space 40. Liquid is forced out of tank 12 through opening 44 into conduit 46 and out through nozzle 47 when regulated gas pressure generated by the cartridge 50 is directed into the tank and a demand valve 49 on the nozzle is opened.

Turning now to FIG. 2, the perspective view illustrates the various components within the liquid spray unit 10. It can be seen that the plenum chamber housing 14 is concentrically mounted within tank 12 through top surface 13. Mounted in the top of the plenum housing is breech assembly 16. Adjacent the top surface of the breech assembly is the breech closure block 26 with the firing mechanism 32 mounted within the block or cap assembly. The hinge 28 and closure clasp 30 connected to cap 26 are more clearly illustrated in this view. Conduits 35 leading from the accumulator tank or plenum chamber 14 exit out of surface 13 into regulator valve 36 and the conduit 37 exits from the regulator valve back into and through top surface 13, thereby communicating with the ullage space between the liquid and the top of the tank. The safety vent valve 42 acts to relieve any overpressures in tank 12. A liquid spray hose 46 with nozzle means 47 attached thereto can be seen leading from the bottom of the tank 12.

Referring now to FIG. 3, a more detailed view illustrates the various components and their interrelationships. The plenum chamber housing 14 provides a mount for the breech assembly 18 which is metallurgically bonded or otherwise affixed to the top 17 of the accumulator plenum housing 14. Breech block 26 is open to admit a cartridge 50. The cartridge case 52 has affixed at its one end a flange 54 which fits within recess 55 in breech block base 27. A cartridge 50 is inserted through access opening 24 in the breech assembly. The cartridge comprises a primer percussion cap 58 centrally located within end 57 of the cartridge case 52. Adjacent the percussion cap 58 is a booster charge 60. Juxtaposed to the booster charge 60 is a solid propellant charge 62 which extends down to the

opposite end of the cartridge case 52. At the base 63 of propellant charge 62 is a foam seal cap 66 which is interposed between the base 63 and the injector assembly 22. An axially aligned aperture 64 traverses the center of the propellant charge 62. The reasons for the aperture is to increase the burning rate by increasing the burning surface of the propellant upon ignition and to permit propellant gas to flow toward injector plate 22. A series of apertures 23 are oriented axially with the cartridge case 52 to pass hot gas into annulus 15 within housing 14. A series of pins 25 are equidistantly spaced about the periphery of the injector 22, thereby securing it to the end of breech assembly 18.

The firing mechanism generally designated as 32 comprises a pair of vertically extending supports 80 attached to breech closure block 26. A cross-arm 82, pivotable at one end 83 by pivot pin 84 suspended between supports 80, is urged against a firing pin 33 at end 86. Spring 88 maintains the cross-arm against one end of the firing pin. To actuate the firing mechanism, the operator lifts end 86 by an extended tab 87 and snaps the cross-arm against the firing pin 33. Suitable safety devices (not shown) may be incorporated to prevent accidental firing of a "live" cartridge within the breech.

When the firing mechanism 32 initiates firing pin 33, striking percussion cap 58, the resultant detonation ignites booster charge 60 which, in turn, ignites the charge of propellant 62. The burning propellant 62 quickly consumes the foam seal cap 66, thereby allowing hot gases to pass through apertures 23 of injector 22. The high pressure gas is accumulated within volume 15 of housing 14 and is directed through aperture 34 into conduit 35 and thence to regulator valve 36 (FIG. 1). The regulated gas then is directed to the ullage space within the tank 12, as hereinabove described.

The cartridge case 52 may be comprised of several materials. For example, if the propellant within the cartridge 50 is consumed within 100 milliseconds, a paraffin wax impregnated cardboard case similar to a shotgun shell case may be utilized; however, when slower burning propellants are used, then a polyethylene or more preferably a polycarbonate-based material should be employed. The primer percussion cap 58, for example, is a cup containing a lead styphnate substance detonatable upon impact. The booster charge 60 is a fast-burning substance comprised of, for example, a mixture of polybutadiene/acrylic acid and an oxidizer of ammonium perchlorate, or it may be a quantity of pellets comprised of boron with potassium nitrate as an oxidizer. The solid propellant charge 62, for example, is a mixture of butadiene/methylvinylpyridine 90/10 and ammonium nitrate with a trace of magnesium oxide. There are a number of solid propellant charges that could be utilized. Any propellant charge exhibiting, upon ignition, a low flame temperature, low water content and clean-burning attributes would be desirable candidates for the main ingredient of the gas generators typified in this invention.

FIG. 4 illustrates a view looking up into the base 20 of breech assembly 18, illustrating the injector 22 and the gas injection apertures 23 contained therein. It can be clearly seen that the pins 25 retain the injector within the assembly 18.

FIG. 5 is an alternative embodiment of the present invention wherein the cartridge 50 comprises a cartridge case 52 made of a polycarbonate material having a flange portion 54 which nests within recess 55 of breech block base 27. A crushable lip 56, made of the polycarbonate material, is formed on flange 54 to act as a gas-tight seal within recess 55 when breech block 26 is anchored to the base 27. The cartridge case 52' differs from the previously described cartridge case 52 in that at the base of the propellant charge 62, designated as 63, is located a metal plate 68 that is transverse to the axis of the propellant charge 62 and coaxial with propellant interbore 64, having a gas injection orifice 69 centrally located therein. The orifice 69 now forms the injector throat which takes the place of the injector assembly 22 indicated in FIGS. 1—3. The injector plate 68 is an integral part of the cartridge case 52' in that the base of the cartridge case is crimped over the peripheral edge of the injector plate 68 at the end 70, thereby assuring that the injector forms a part of the cartridge case. An enlarged opening 21 is located at the base 20' of breech housing 18' to clear the gas exiting from the cartridge case 52' through orifice 69 when the cartridge 50' is ignited.

The modified cartridge case eliminates the necessity for a separate injector plate forming an integral part of the breech assembly 16. The injector plate being a part of the cartridge case therefore simplifies the sprayer assembly 10 in that each cartridge case has its own injector plate, thus eliminating any possibility of residue clogging the orifices 23 in injector plate 22, as depicted in FIGS. 3 and 4. Since each cartridge now has an integral injector assembly, the cartridge and injector are discarded, thus a fresh cartridge with integral injector is inserted each time that the sprayer unit is recharged.

Still another embodiment is depicted in FIG. 6, whereby an injector plate 74 is preformed around orifice 78 so as to better direct the gases out of the cartridge case. A fine mesh metallized screen 72, the mesh size being in the range of 10 to 100 microns, is juxtaposed between the injector plate and the base 63 of the propellant charge 62. The screen 72 serves to trap any charged particles generated by the burning propellant so as to prevent the residue from entering the chamber space 15 of plenum chamber 14, thus preventing any possibility of clogging the orifice 34 at the bottom of the chamber or other downstream orifices.

FIG. 7 is a view looking up into the screen 72 juxtaposed between the propellant charge 62 and the injector plate 76. The screen need not be fixed to the casing 52'. It may nest between the propellant charge and the injector plate. The spent cartridge, containing the injector plate and the screen, is then discarded and replaced with a similar cartridge prior to recharging of the sprayer device 10.

Each of the preceding embodiments illustrated in FIGS. 5 and 6, while they are somewhat more expensive, are more desirable than the first embodiments described in FIGS. 1 through 4 in that there is less chance for contamination of the overall system. The embodiment described in FIGS. 1 through 4 having the integral or fixed injector 22 may be prone to contamination caused by the charred residue from the solid propellant grains after they are consumed. Proper

propellant selection would minimize the problem. While the cartridge case is discarded, the residue from the case remains within the breech assembly 16 which includes the injector holes 23. The charred residue must be flushed from the system from time to time cartridge prevent damage to the device and to prevent a possible catastrophic failure of the sprayer unit due to clogged orifices, etc. The cartridges having the integral injector plates are more reliable since each firing of the system would be through a non-contaminated injector orifice which is an integral part of the cartridge. The addition of a screen within the cartridge case is a further assurance that the plenum chamber 15 within housing 14 remains relatively clean, thus insuring proper operation of the system.

We claim:

1. A gas generator device for pressurizing a liquid-containing container comprising;
 - a solid propellant charge capable of generating a source of high pressure gas upon ignition,
 - a breech means to contain said solid propellant charge,
 - a plenum chamber housing to contain said gas, said breech means being mounted within said plenum chamber housing, and
 - a regulator means communicating with said housing and a liquid-containing container to provide a constant pressure to the interior of said container.
2. A gas generator device for pressurizing a container comprising;
 - a plenum chamber housing,
 - a cartridge breech means extending into said housing, said breech means forming an opening at a first end thereof, said breech means having attached thereto a breech block to close off said opening, said breech block being hinged on one side to said first end of said breech means, the breech block having a clasp mechanism on the other side of said block so as to latch onto a flange adjacent said first end of said breech means, thereby latching said breech block to said breech means, said breech means forming at its other end at least one aperture that communicates with the interior of said plenum chamber,
 - a cartridge case insertable through said first end of said cartridge breech means, said cartridge case having a solid propellant charge disposed therein, the cartridge case having a first end containing a percussion cap and a second nozzle-containing end communicating with the interior of said plenum chamber through said other end of said cartridge breech means, and
 - a firing mechanism means adjacent said percussion cap for igniting said propellant charge when said cartridge case is enclosed within said breech means.
3. The invention as set forth in claim 2, wherein said breech block further includes a firing mechanism suspended by at least one support arm extending from said breech block, said mechanism comprising a hammer arm swivelably hinged to said support at one end and juxtaposed to a centrally located firing pin extending through said breech block at its other end, said arm being biased by a spring means against said firing pin.

4. A solid propellant cartridge case insertable in a cartridge breech mechanism comprising;
- a cylindrical housing, said housing having at a first end a wall transverse to the axis of the cartridge case, the edges of said case protruding beyond the circumference of the cylinder forming a shoulder portion thereby, said shoulder having a raised lip circumferentially positioned around the outer edge of said shoulder, said lip being deformable, effecting a seal for said breech mechanism when said cartridge case is encapsulated within said breech,
 - a primer cap means affixed to and centrally located within said end wall,
 - a booster charge means adjacent said primer cap positioned between a solid propellant charge, said solid propellant forming a central orifice longitudinally extending through the propellant within said housing,
 - a metal nozzle plate transverse to the axis of said cylindrical housing, forming a central orifice therein, being juxtaposed to the end of said propellant charge, and
 - a retention means for retaining said booster charge, said propellant charge and said nozzle plate within said cylindrical housing, said retention means being an extension of said housing forming a second end thereof, said extension being crimped over the edge of said nozzle plate, thereby completing the assembly of said cartridge case.
5. The invention as set forth in claim 4, wherein said nozzle plate is formed with a centrally located protrusion surrounding said opening in said plate so as to more directly guide the exhaust gases out of said orifice when said propellant charge is ignited.
6. The invention as set forth in claim 4, further including a fine mesh screen between the end of said propellant charge and said nozzle plate so as to control the amount of residue leaving said cartridge case after said propellant charge is ignited.
7. A gas generator device for pressurizing a container comprising::
- a plenum chamber housing,
 - a cartridge breech means extending into said housing said breech means forming an opening at a first end thereof, said breech means having attached thereto a breech block to close off said opening, said breech means forming at its other end at least one aperture that communicates with the interior of said plenum chamber,
 - a cartridge case insertable through said first end of said cartridge breech means, said cartridge case having a solid propellant charge disposed therein, the cartridge case having a first end containing a percussion cap and a second nozzle-containing end, said nozzle-containing end is a metal plate transverse to the axis to said cartridge case, said metal plate having an orifice formed thereby for directing exhaust gases therethrough, said plate forming an integral part of said cartridge case, said nozzle communicating with the interior of said

- plenum chamber through said other end of said cartridge breech means, and
 - a firing mechanism means adjacent said percussion cap for igniting said propellant charge when said cartridge case is enclosed within said breech means.
8. A gas generator device for pressurizing a container comprising;
- a plenum chamber housing,
 - a cartridge breech means extending into said housing, said breech means forming an opening at a first end thereof, said breech means having attached thereto a breech block to close off said opening, said breech means forming at its other end at least one aperture that communicates with the interior of said plenum chamber, and
 - a cartridge case insertable through said first end of said cartridge breech means, said cartridge case having a solid propellant charge disposed therein, the cartridge case having a first end containing a percussion cap and a second nozzle-containing end, said nozzle-containing end includes a metal plate transverse to the axis of said cartridge case, said metal plate having a protruding center portion forming an orifice thereby for directing exhaust gases therethrough, said plate forming an integral part of said cartridge case, said nozzle communicating with the interior of said plenum chamber through said other end of said cartridge breech means, and
 - a firing mechanism means adjacent said percussion cap for igniting said propellant charge when said cartridge case is enclosed within said breech means.
9. A gas generator device for pressurizing a container comprising;
- a plenum chamber housing,
 - a cartridge breech means extending into said housing, said breech means forming an opening at a first end thereof, said breech means having attached thereto a breech block to close off said opening, said breech means forming at its other end at least one aperture that communicates with the interior of said plenum chamber,
 - a cartridge case insertable through said first end of said cartridge breech means, said cartridge case having a solid propellant charge disposed therein, the cartridge case having a first end containing a percussion cap and a second nozzle-containing end communicating with the interior of said plenum chamber through said other end of said cartridge breech means,
 - a firing mechanism means adjacent said percussion cap for igniting said propellant charge when said cartridge case is enclosed within said breech means, and
 - a fine mesh screen juxtaposed between said solid propellant charge and said nozzle-containing end, said screen serving to block the residue from burning propellant when said propellant charge is ignited.

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