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548,807, May 9, 1966, now abandoned,
which is a division of application Ser. No.
238,348, Nov. 19, 1962, now Patent No.
3,272,510.

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102.2; 239/412; 222/4, 192, 504, 193

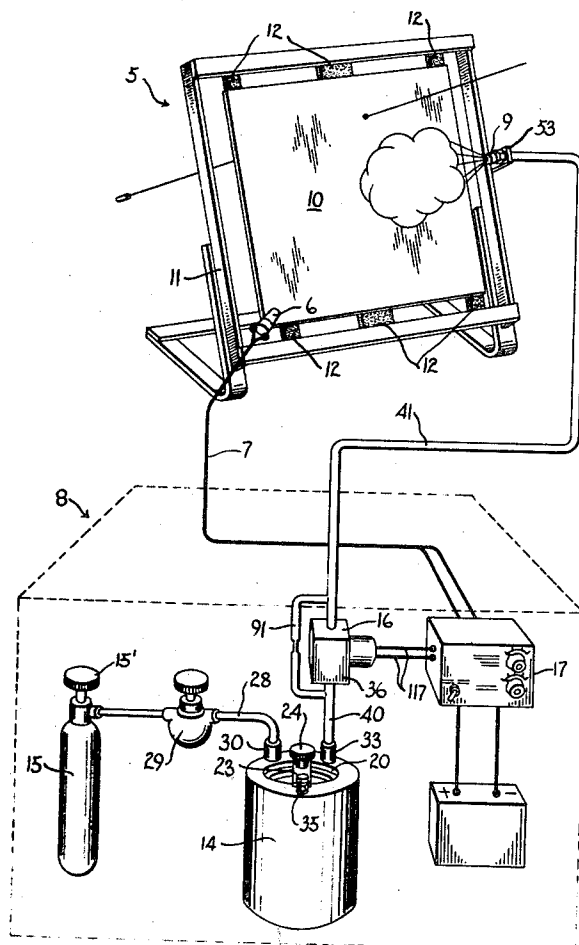
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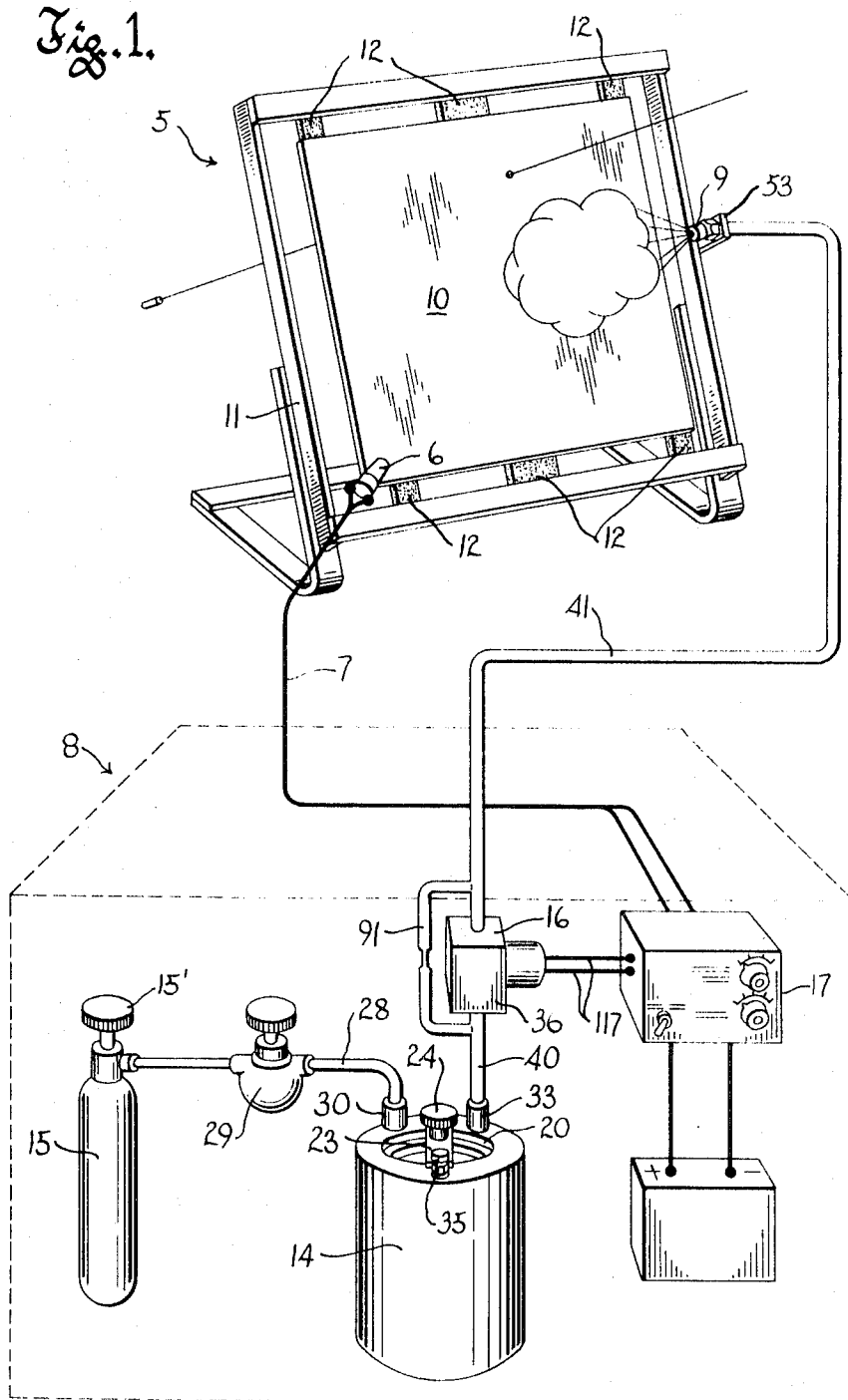
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[54] **GENERATOR OF SIMULATED SMOKE SIGNALS**
FOR GUNNERY TARGET PRACTICE
5 Claims, 3 Drawing Figs.

[52] U.S. Cl. **222/4,**
222/192, 222/193, 273/102.1

ABSTRACT: A container with powder therein has its interior continuously communicated with a pressure gas source. An outlet from the container is controlled by a valve having a remotely controllable actuator that is isolated from its valve element, to prevent the actuator from being fouled by powder.





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Fig. 2.

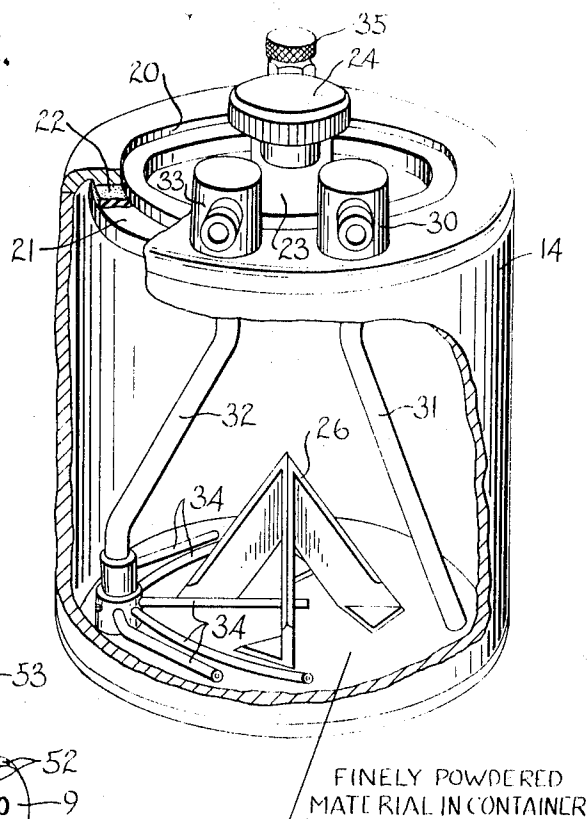
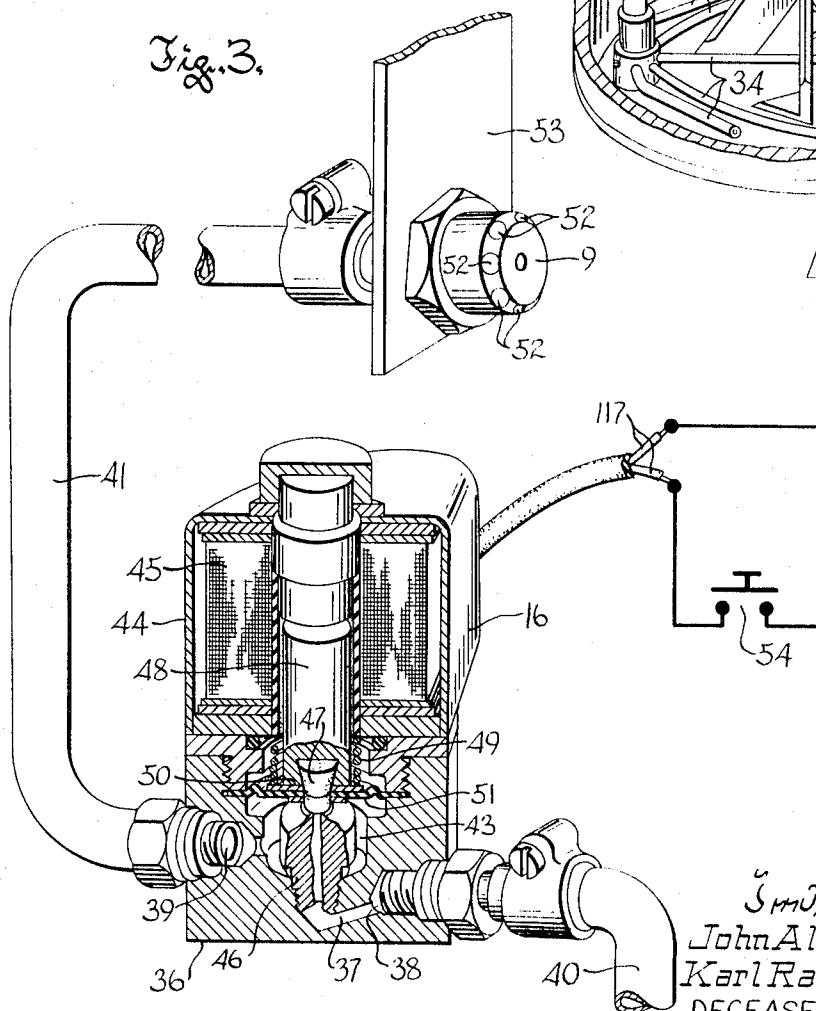


Fig. 3.



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GENERATOR OF SIMULATED SMOKE SIGNALS FOR GUNNERY TARGET PRACTICE

This application is a continuation of the copending application of John Alex Ingvar Öhlund and Karl Ragnar Andersson, Ser. No. 548,807, filed May 9, 1966 now abandoned, which was in turn a division of the copending application of the same applicants, Ser. No. 238,348, filed Nov. 19, 1962 now U.S. Pat. No. 3,272,510.

This invention relates to apparatus for gunnery target practice, and refers more particularly to means for generating a visible signal in the nature of a simulated smoke puff to indicate to a gunner engaged in practice shooting at a target that he has placed a shot in a predetermined relationship to the target.

From the stand point of training efficiency it is desirable that a gunner shooting at a target be apprised of the results that he has achieved as soon as possible after he has fired each shot and while the circumstances of the firing of the shot are still fresh in his mind. This is especially true in aerial gunnery, in which the gunner must take account of many rapidly changing variables in aiming each shot, but in which firing results can be quickly communicated to the gunner only by radio signals or by visible signals which can be seen from a substantial distance so as to be readily perceptible from the gunner's aircraft.

Radio signals are generally unsatisfactory because, among other things, they are somewhat unrealistic in that they do not simulate the conditions that would occur in actual combat firing.

With the foregoing in mind it is a principle object of the present invention to provide apparatus which produces a signal that is visible to the gunner immediately after he has successfully placed a shot in the target and which signal has the appearance of a puff of smoke and is thus readily perceptible at a distance from the target and at the same time affords a realistic simulation of the results that could be expected from successful firing under actual combat conditions.

Another object of this invention is to provide a signalling device of the character described which is particularly well adapted for aerial gunnery target practice, including air-to-air gunnery; in that it comprises means for indicating to an aerial gunner, by a readily perceptible puff simulated smoke, that he has scored a hit upon a target at which he is shooting, such signal being produced immediately after a projectile strikes the target.

A further object of this invention is to provide simulated smoke generating apparatus of the character described by which a continuous output of simulated smoke can be produced for the purpose of assisting a gunner in locating a target at which he is firing, and by which more intensive puffs of simulated smoke can be released to signify hits on the target, and which can also be employed to simulate return fire from the target.

A more specific object of the present invention is to provide apparatus for gunnery target practice by which a simulated smoke puff is produced to signify each shot that strikes the target, which apparatus comprises transducer means located at the target and which produces an electrical impulse in response to the passage of a missile in a predetermined relationship to the target, and means comprising a solenoid valve and a simulated smoke generator for releasing, through a nozzle outlet located at or near the target, a quantity of powdered material entrained in gas under pressure each time solenoid valve is opened in response to an electrical impulse from the transducer means.

It is also an object of this invention to provide a simulated smoke generator of the character described which is especially well adapted for cooperation with a target transducer device of the type described in U.S. Pat. No. 3,158,372, dated Nov. 24, 1964.

Another specific object of the present invention is to provide, in a simulated smoke generator of the character

described, a container wherein a supply of finely powdered material such as soot or talcum powder is stored in contact with gas under pressure, and means for controllably releasing such gas from the container with the powdered material entrained in the gas to simulate smoke.

A further specific object of the present invention resides in the provision, in a simulated smoke generator of the character described, of a container for finely powdered material and gas under pressure, which container can be charged with powdered material by mere insertion of a bag containing such material downwardly into the container and withdrawal of the empty bag from the container.

With these observations and objects in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings. This disclosure is intended merely to exemplify the invention. The invention is not limited to the particular structure disclosed, and changes can be made therein which lie within the scope of the appended claims without departing from the invention. The drawings illustrate one complete example of a physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a more or less diagrammatic perspective view of the apparatus of this invention associated with a target to produce a simulated smoke signal at the target when the target is struck by a projectile;

FIG. 2 is a perspective view of a powdered material container which comprises a part of the apparatus of this invention, portions of the container being cut away to show details of the interior thereof; and

FIG. 3 is a perspective view, with portions cut away and shown in section, of the solenoid and outlet nozzle of the apparatus illustrated in FIG. 1.

Referring now more particularly to the accompanying drawings the numeral 5 designates generally a target at which gunnery practice firing can be directed. When a projectile makes a hit on the target, a transducer 6 on the target produces an electrical impulse output which is transmitted, by way of conductors 7, to the simulated smoke generator of this invention, which is generally designated by 8. In response to such impulse the smoke generator discharges a puff of simulated smoke through a nozzle 9 at the target, thus providing a readily visible and very realistic indication that a hit has been scored.

In general, the target 5 and the transducer 6 attached thereto correspond to the apparatus disclosed in the aforesaid U.S. Pat. No. 3,158,372. Briefly, the target proper comprises a panel 10 of a relatively dense material such as hardboard, suspended on a frame or stand 11 by means of resilient strips 12 of rubber or the like which substantially insulate the panel from vibrations of the frame. The transducer 6 is attached to one corner of the panel and has its axis of sensitivity lying substantially in the plane of the panel and extending toward the central portion thereof so that the transducer is responsive substantially only to shock impulses that travel edgewise through the panel, such as would be caused by a projectile penetrating the panel. The transducer 6 therefore produces an electrical impulse output only in response to an accurately placed shot, and discriminates against near misses as well as vibrations and shock impulses from other sources.

The simulated smoke signal generator 8 of this invention comprises, in general, a sealed container 14 which is adapted to hold a supply of finely powdered material such as soot or talcum powder, a pressure vessel or bottle 15 for holding a supply of compressed air, carbon dioxide, or other inert gas under pressure, and which is normally in constant communication with the interior of the container 14, a solenoid valve 16 which controls discharge of powder entrained in pressurized gas from the interior of the container 14 through the nozzle 9, and an amplifier 17 connected between the transducer 6 and the solenoid valve 16.

As best seen in FIG. 2, the container 14 is preferably cylindrical and has a large opening 20 in its upper end wall that can be closed by a removable cover 21 which engages under the inner surface of the top wall, around the marginal edge portion of the 20. Preferably the opening 20 is elliptical or otherwise noncircular, and the cover has a corresponding shape so as to be readily insertable through the opening although it is larger than the opening. A gasket 22 at the underside of the top wall of the container, all around the opening 20, insures that the cover makes a good seal. The cover is drawn up into compressive engagement with the gasket by means of a cross-bar 23 which has its end portions overlying the top of the container and which is secured by a screw 24 threaded into the center of the cover.

To facilitate charging the container with powdered material it is provided with sharp-edged knife means 26 projecting upwardly from its bottom wall and which in the present case is shown as four pyramidally arranged sheet metal strips with sharp edges. It is thus possible to package the powdered material in standard bags of, e.g. plastic film. As such a bag is inserted downwardly into the container 14 through the opening 20 therein, the knife means 26 cuts open the bottom of the bag so that the bag can be emptied into the container as it is withdrawn therefrom.

Gas is normally maintained under substantially constant pressure in the interior of the container 14, in contact with the powdered material therein, and to this end the inside of the container is communicated, by way of a duct 28 that comprises a manually controllable pressure reducing valve 29, with the compressed gas vessel 15. A conventional manual valve 15' on the compressed gas bottle 15 permits the same to be cutoff from the container 14 when the apparatus is not in use or when the bottle is to be changed. The reducing valve 29 insures that the pressure of gas in the container 14 will be maintained at a substantially constant value.

The duct 28 leading from the bottle 15 is connected with an inlet fitting 30 on the container 14 from which an inlet tube 31 extends down into the interior of the container with its mouth near the bottom thereof. Gas, with powder entrained therein, is expelled from the container through an outlet duct 32 which extends downwardly into the container from an outlet fitting 33 on the top thereof and which terminates at its bottom in a plurality of branches 34 that open to different parts of the bottom portion of the container. The arrangement of the branch ducts 34 permits powdered material to be expelled from the container even when the supply of such material in the container is very low. By means of a manually controllable vent nipple 35 on the top of the container, gas can be released from the container without discharge of powder, so that the cover can be removed for recharging of the container.

As best seen in FIG. 3, the solenoid valve 16 which controls discharge from the container 14 comprises a valve body 36 through which a passage 37 extends from an inlet port 38 at one side of the body to an outlet port 39 at the other side thereof. The inlet port 38 is connected, by means of a duct 40, with the outlet fitting 33 on the container 14, while another duct 41 communicates the outlet port 39 with the discharge nozzle 9. The medial portion of the passage 37 is enlarged to provide a valve chamber 43 which opens to the top of the body 36 and which is closed by a housing 44 that is secured to the top of the body and wherein an annular winding 45 is housed. A substantially tubular sleeve member 46, threaded into the lower portion of the valve chamber, defines a valve seat in the passage 37. The valve element 47 that cooperates with this valve seat is formed on the bottom of a magnetically responsive plunger 48 which is coaxially slideable in the winding 45 and which projects down into the upper portion of the valve chamber. Also housed in the valve chamber is a coiled compression spring 49 that surrounds the lower portion of the plunger and reacts between the underside of the housing 44 and a washer 50 secured on the lower end of the plunger. The spring thus biases the plunger downwardly toward a seated position of the valve element 47 thereon, but it will be

apparent that the plunger will be drawn upwardly by magnetic attraction when the solenoid winding 45 is energized by an electric current, thus carrying the valve element 47 off of its seat to permit gas having powder entrained therein to flow out of the container 14 and to the nozzle 9 by way of the ducts 40 and 41 and the passage 37 in the solenoid valve body 36.

To keep powdered material away from the plunger 48, the spring 49 and the winding 45, a diaphragm 51 is inserted between the lower part of the plunger and the valve body.

Preferably the discharge nozzle 9 has a plurality of outlet orifices 52 therein which open in generally radially outward directions so that the simulated smoke is dispersed over the face of the target in a manner which realistically simulates the impact of a projectile. Obviously the nozzle could be made interchangeable with others that would provide for other patterns of dispersal of the simulated smoke signal. A suitable bracket 53 provides for securement of the nozzle 9 to the target frame 11.

It will be evident that the solenoid valve 16 can have suitable connections 117 with the amplifier 17, as shown in FIG. 1, or can be manually controlled by a switch 54, as illustrated in FIG. 3.

If desired a suitable bypass 91 (see FIG. 1) around the solenoid valve can be provided whereby a constant but relatively light stream of simulated smoke can be made to emanate from the target to facilitate location and identification of the target, impacts on the target then being signalled by larger outputs of smoke produced in consequence of opening of the solenoid valve for a brief period after each hit is scored.

From the foregoing description taken together with the accompanying drawings it will be apparent that this invention provides means for producing a visible signal, in the nature of a simulated smoke puff, for indicating to a gunner engaged in target practice that he has scored a hit on the target. It will also be apparent that the apparatus of this invention is capable of producing such a signal immediately after the hit is scored, and can also be employed to produce simulated smoke puffs and clouds for other purposes such as providing a smoke trace that assists a gunner in locating a target and producing an appearance of return fire from a target.

We claim:

1. Apparatus for producing a visible signal having the appearance of smoke and the production of which begins and ends in prompt response to the beginning and ending of an output from a control means, said apparatus comprising:

A. a container adapted to contain powder and having

1. a gastight closure,
2. an outlet near its bottom, and
3. an inlet for gas under pressure;

B. means providing a source of gas under substantially constant pressure;

C. means providing for uninterrupted communication between said pressure gas source means and said inlet whereby gas is maintained in the container under pressure and in contact with powder therein;

D. means comprising a valve for controlling release from the container of pressure gas with powder entrained therein, said means comprising

1. a valve body in which there is

- a. a chamber,
- b. a valve seat that faces into the chamber and provides an inlet thereto, and
- c. an outlet from said chamber, said valve body comprising a wall element that extends transversely to the axis of the valve seat and in spaced facing relation to the same,

2. means defining a duct communicated at one end with said outlet in the container and at its other end with said valve seat, the cross section area of said duct at every point spaced therealong from said valve seat being at least substantially as large as at points therealong nearer the valve seat so that gas flowing from the container outlet to the valve seat undergoes no substantial deceleration in said duct,

3. a valve element movable in said chamber to and from engagement with the valve seat in directions parallel to the axis of the valve seat,
4. remotely controllable actuator means operatively associated with the valve element and connectable with the control means, said actuator means being at the side of the wall element remote from the valve seat so as to be isolated from the chamber by the wall element and thus protected by it from fouling with powder;
- E. nozzle means through which pressure gas and powder entrained therein can be diffusingly expelled to produce the appearance of smoke; and
- F. means defining another duct, at all times communicating said chamber with the nozzle means.
2. The apparatus of claim 1, further characterized by: said wall element comprising a diaphragm.
3. The apparatus of claim 2, further characterized by: said actuator means comprising a solenoid having a winding and a plunger which are substantially concentric with one another and with the valve element, the plunger being connected with the valve element.
4. Simulated smoke signal generating apparatus of the type comprising means providing a source of pressurized gas, a container in which powdered material is adapted to be contained and which has an inlet for pressurized gas and an outlet near its bottom, and a nozzle through which pressurized gas with powder entrained therein can be expelled into the air to produce simulated smoke puffs, said apparatus being characterized by:
 - A. the inlet of the container being all times communicated with said means providing a source of pressurized gas;
 - B. means for controlling release from the container of pressurized gas with powder entrained therein, comprising

1. valve body means defining a chamber, an inlet opening to said chamber and providing a valve seat, and an outlet from said chamber, said valve body means comprising a diaphragm which provides a wall portion of said chamber that extends transversely to the axis of the valve seat and faces the same;
2. means defining a duct, one end of which comprises the outlet of the container and the other end of which comprises said inlet opening to the chamber, and which duct has a cross section area at each point remote from its said other end that is at least about as large as at points nearer said other end thereof so that gas flowing from the container outlet to the chamber inlet undergoes no substantial deceleration in the duct,
3. a valve element at the side of the diaphragm facing the valve seat, movable to and from engagement with the valve seat in directions parallel to said axis, and
4. actuator means for the valve element, connected therewith, at the opposite side of the diaphragm; and
- C. means at all times communicating the nozzle with the outlet from said chamber.
5. The simulated smoke signal generating apparatus of claim 4, further characterized by:
 - D. the axis of said valve seat being substantially vertical, and said valve seat facing upwardly; and
 - E. the valve body means defining a bosslike upward projection in said chamber that surrounds the valve seat and an annular well around said projection into which powder can fall upon seating of the valve element so that such powder cannot interfere with engagement of the valve element against the seat.

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