Feb. 2, 1960 B. E. DEL MAR 2,923,930

SMOKE SIGNAL DEVICE

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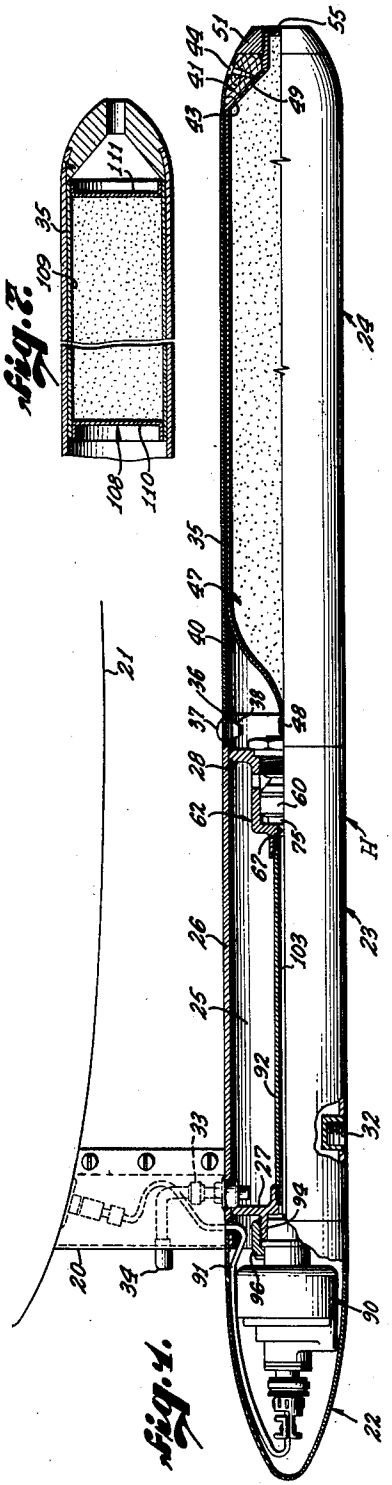

Fig. 1.

Fig. 4.

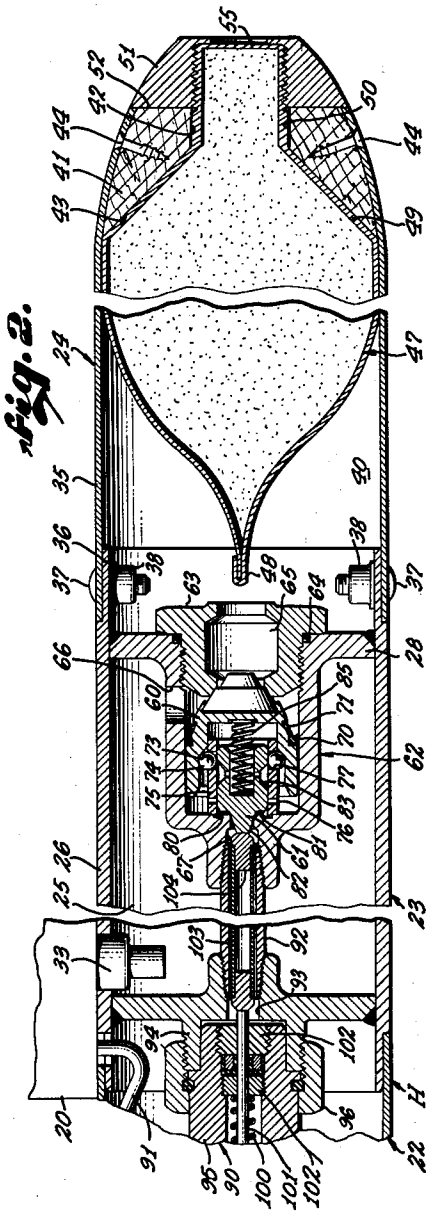

Fig. 2.

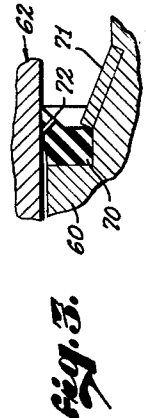

Fig. 3.

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Fig. 4.

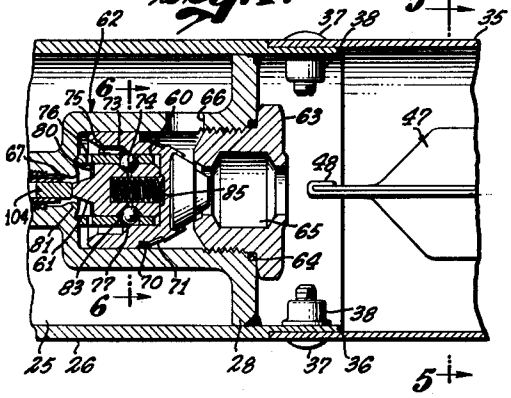


Fig. 5.

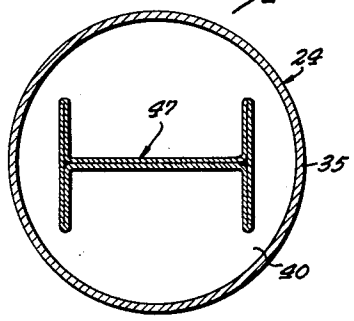


Fig. 11.

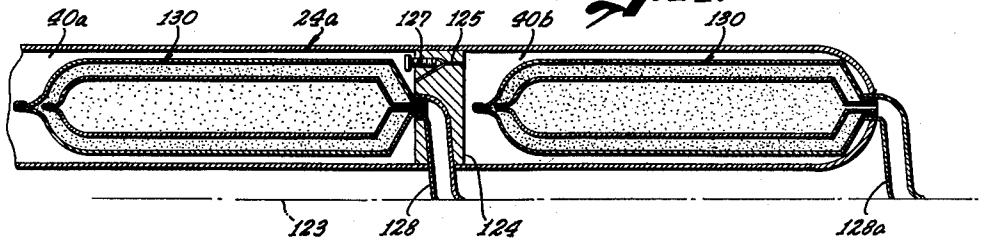


Fig. 8.

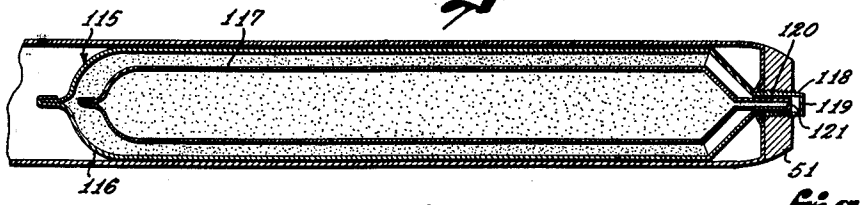


Fig. 6.

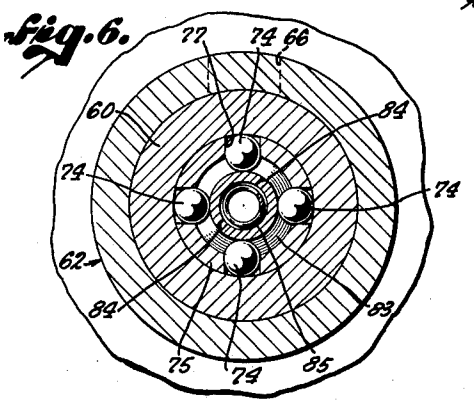


Fig. 10.

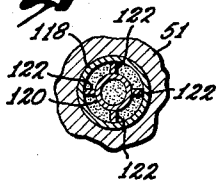
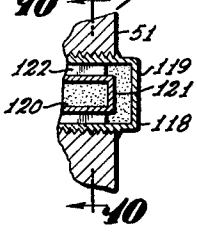


Fig. 9.



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2,923,930

SMOKE SIGNAL DEVICE

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Application February 15, 1954, Serial No. 410,392

6 Claims. (Cl. 340—366)

This invention relates to a device for producing smoke signals, with special reference to the production of smoke signals to aid in the spotting and tracking of air-borne vehicles such as manned aircraft, robot aircraft, towed aerial targets, and guided missiles.

The invention contemplates the provision of a suitable housing which, if desired, may be used inside an air-borne vehicle but preferably is of suitably elongated configuration for mounting in the air stream outside the air-borne vehicle. An important feature of the invention is the concept of using such a housing in combination with a replaceable container mounted therein, which container encloses smoke-producing material. Such a combination has the advantage of being highly versatile, since it is possible to use various kinds of smoke-producing containers interchangeably. Thus, the housing may be loaded with various types of smoke-producing charges to meet various requirements with respect to color and other characteristics of smoke signals.

The preferred practice of the invention provides for at least three different kinds of smoke-producing charges. One form of charge, for example, may be a chemical that reacts with the moisture in the atmosphere to produce the required smoke. Another form of charge may comprise two separate chemicals which are isolated from each other but are discharged in such manner as to intermix and react to create the desired smoke signal. A third form of charge may comprise a fine inert powder of any desired color. With such a range of choice, the invention is usable in a universal manner in the sense that it may be used at low altitudes or at high altitudes, at low temperatures or at high temperatures, and in atmospheres containing various degrees of humidity.

A basic feature of the invention is the concept of using fluid under pressure to compress the container inside the housing for the purpose of forcing the smoke-producing content of the container out through a discharge opening or nozzle of the housing. For this action, the container is constructed with at least one wall that is movable inward to contract the volume of the container. Preferably, the container has an outlet that is normally closed but opens in response to internal pressure.

The use of fluid under pressure in this manner makes possible a discharge operation that is simple and requires a minimum number of working parts. The procedure is also advantageous in affording a desirable degree of control in the range of choice of pressures that may be used. Further exercise of control is afforded in the selection of the size of the discharge nozzle for a particular flight at a given airspeed, and, of course, further control is afforded in the selection of the composition of the smoke-producing material.

The use of fluid under pressure in this manner makes it possible to use a container of inexpensive construction to be discarded after a single use. The container walls need not be strong since they are subjected to external pressure only and are intended to yield to the external pressure. A further advantage of using pressurized

fluid in this manner to empty a yieldable container of smoke-producing material is that the pressurized fluid itself may be of a character to produce a smoke signal when released into the atmosphere after the container is emptied.

In one practice of the invention, the container for the smoke-producing material is a collapsible tube having walls of suitably pliable material. Another practice of the invention is characterized by the concept of using two collapsible tubes, one inside the other, the two tubes both having nozzles which communicate with the discharge port or discharge nozzle of the surrounding housing. In a third practice of the invention especially suitable for the use of inert powder, the collapsible container is a shell having an end wall slidably mounted therein for inward movement in response to the applied fluid pressure.

Any suitable means, including means to generate a gas, may be provided to supply the required fluid under pressure and to control the application of the fluid to the collapsible container. In the preferred practice of the invention, the housing in which the collapsible container is mounted is adapted to confine a body of gaseous fluid, for example a body of air, under high pressure. The pressure, for example, may be as high as 600 p.s.i. or higher.

A suitable valve is adapted for operation by remote control to release the confined high pressure gaseous fluid for action against the collapsible container. In this regard, a feature of the invention is the concept of employing a pilot-operated valve in combination with a solenoid for actuation by remote control. A main valve member is adapted to open in response to differential pressure exerted by the confined fluid but is normally held closed by a pilot arrangement. Preferably the main valve member is also normally urged to its closed position by differential fluid pressure and, in addition, is mechanically locked in closed position by a latch mechanism that includes a pilot valve. Energization of the solenoid by remote control unlatches the closed main valve member and simultaneously operates the pilot valve to reverse the pressure differential for opening actuation of the main valve. Thus, the potential energy of the compressed fluid not only supplies power for forcible discharge of the smoke-producing material but also provides substantially all of the power required for actuating the valve mechanism, the electrically controlled solenoid being required merely to trigger the application of fluid pressure to actuate the valve.

One advantage of such an arrangement is that since the open valve is responsive to the pressure of the confined fluid it stays open throughout the discharge operation. A further advantage is that it is merely necessary to add a relatively light spring to cause the valve to close automatically when the fluid pressure is dissipated at the end of the smoke-signal operation.

A still further practice of the invention provides a cascade operation of a plurality of smoke-producing charges. This further practice is based on the concept of providing a series of chambers with restricted communication between the chambers in the series. The compressed gaseous fluid is released into the first chamber of the series to collapse a container of smoke-producing material therein and during the collapse of the container, the high pressure fluid bleeds into the next adjacent chamber to build up an operative pressure therein in a gradual manner. Thus an operating pressure is reached in each successive chamber with suitable time delay to cause discharge of the smoke-producing material from the chambers or compartments of the series in timed sequence.

The various features and advantages of the invention

may be understood from the following detailed description considered with the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

Figure 1 is a view of a selected embodiment of the invention mounted on the underside of an air-borne vehicle, the view being partly in section and partly in side elevation;

Figure 2 is a fragmentary longitudinal sectional view showing details of construction of this first embodiment of the invention;

Figure 3 is a greatly enlarged detail of Figure 2;

Figure 4 is a fragmentary sectional view showing the valve mechanism of Figure 2 in open position during the operation of discharging smoke-producing material;

Figure 5 is a transverse section taken as indicated by the line 5—5 of Figure 4;

Figure 6 is a greatly enlarged transverse section taken along the line 6—6 of Figure 4;

Figure 7 is a longitudinal sectional view of a collapsible container for inert powder that may be used interchangeably in the first embodiment of the invention;

Figure 8 is a fragmentary longitudinal sectional view of a portion of the first embodiment of the invention illustrating how a dual collapsible container may be used interchangeably therein;

Figure 9 is an enlarged detail of Figure 8;

Figure 10 is a transverse section taken as indicated by the line 10—10 of Figure 9; and

Figure 11 is a fragmentary longitudinal sectional view of another embodiment of the invention.

The housing for enclosing interchangeable collapsible containers of smoke-producing material may be of various constructions in various practices of the invention, but preferably is of an elongated cylindrical configuration streamlined for mounting in the air stream outside an air-borne vehicle. By way of example, Figure 1 shows a streamlined cylindrical housing, generally designated H, mounted by means of a pylon 20 on the underside of an air-borne vehicle 21. The vehicle 21 may be, for example, an aircraft or a guided missile. In a typical embodiment of the invention, the housing H may have a diameter on the order of 3 inches and over-all length on the order of 3 feet.

In this particular embodiment of the invention, the housing H is made in three sections comprising a nose section generally designated by numeral 22, an intermediate section generally designated by numeral 23, and a rear section generally designated by numeral 24. The intermediate section 23 forms a longitudinal cylindrical chamber 25 for the confinement of a gaseous fluid under high pressure and, therefore, has a relatively heavy cylindrical outer wall 26 and two relatively heavy end walls 27 and 28. This intermediate housing section 23 is directly connected to the vehicle 21 by the pylon 20.

In the present practice of the invention, the intermediate housing section 23 confines a body of compressed air having a pressure on the order of 600 lbs. per square foot and the housing section is provided with a suitable blow-out plug 32 which is added for safety and is designed to yield whatever the interior of the chamber 25 is subjected to pressure substantially in excess of a predetermined magnitude. Other gaseous fluids may be substituted for the compressed air. To permit replenishment of the charge of compressed air in the chamber 25, a suitable intake pipe 33 is mounted in the pylon 20 in communication with the chamber, the intake pipe terminating in a forwardly directed check valve 34.

The nose section 22 of the housing H is in the form of a sheet metal shell of generally conical configuration mounted on the front end of the intermediate housing section 23 and the rear housing section 24 which is designed to enclose the interchangeable collapsible container is of cylindrical construction. As best shown in Figure 2, the cylindrical sheet metal shell 35 of the rear housing section 24 telescopes onto a skirt 36 formed by removing material peripherally from the rear end of the intermediate housing section 23, the shell being secured to the skirt by suitable screws 37 threaded into internal anchor nuts 38. It is apparent that the screws 37 may be removed to permit the rear housing section 24 to be dismounted from the intermediate housing section 23 for full access into the rear housing section as required for inserting or removing the interchangeable collapsible containers.

It is contemplated that the chamber 40 formed by the rear housing section 24 will be provided with a suitable discharge port or nozzle. In the construction shown the trailing end of the sheet metal shell 35 is formed with a rounded taper and confines an annular body 41 of like taper which forms a discharge port 42 and provides an internal conical wall surface 43 converging to the discharge port. The annular body 41 may be made of wood and may be anchored in assembled position by suitable wood screws 44.

In the practice of the invention illustrated by Figures 1 to 6, one form of collapsible container that may be used interchangeably in the chamber 40 of the rear housing section 24, comprises a cylindrical collapsible tube, generally designated by numeral 47, having a pinched end 48. The other end of the collapsible tube 47 has a conical wall 49 to nest against the conical wall surface 43 and has a tubular nozzle 50 dimensioned to extend through the discharge port 42. In the construction shown, the nozzle 50 of the collapsible tube is externally threaded for engagement by a tapered bushing 51 which abuts the face 52 of the annular body 41 to cooperate therewith for the purpose of holding the tubular nozzle in the discharge port 42.

The nozzle 50 of the collapsible tube 47 may be normally closed by any means that will yield to a substantial rise in pressure inside the tube. In this instance, for example, the end of the tubular nozzle 50 is closed by a web 55 of frangible material. The collapsible tube 47 and the frangible web 55 may be made of the same material which may, for example, be a suitable non-metallic plastic material or may be made of a soft metal alloy.

Any suitable valve arrangement may be employed for release by remote control of the high pressure fluid from the chamber 25 into the chamber 40 to cause collapse of the tube 47 containing the smoke-producing material. As heretofore indicated, preferably a pilot-operated valve provided for this purpose is adapted for actuation by a suitable solenoid.

In the present construction, a main valve member 60 and a pilot valve member 61 are mounted in a cylindrical valve casing 62 that is integral with the end wall 28 of the intermediate casing housing 23, the valve casing being surrounded by the pressurized gaseous fluid in the chamber 25. The rear end of the valve casing 62 carries a threaded bushing 63 provided with a sealing ring 64, which bushing forms an outlet port 65 in communication with the chamber 40. The main valve member 60 has a conical nose which normally seats in the threaded bushing 63 to close the outlet port 65 as shown in Fig. 2. The cylindrical valve casing 62 has a peripheral inlet port 66 at the same end as the discharge port 65 to admit high pressure fluid from the chamber 25 and at the other end has an axial relief port 67 for communication with the atmosphere. Thus, when the main valve member 60 is retracted out of its normal seat in the bushing 63 the gaseous fluid confined under pressure in the chamber 25 may pass through the peripheral inlet port 66 into the valve casing 62 and out of the valve casing through the outlet port 65 into the chamber 40 containing the collapsible tube 47. The main valve member 60 is surrounded by a suitable sealing ring 70 held in place by a tapered

split retaining ring 71. It is contemplated that a suitable bleeder passage will be provided for equalizing the pressure in the valve casing 62 on the opposite sides of the main valve member 60. For this purpose, the sealing ring 70 may be provided with a small bleeder bore 72 as indicated in Figure 3.

The main valve member 60 is of hollow cylindrical construction and is formed with an inner conical shoulder 73 to cooperate with a circumferential series of four balls 74 that are best shown in Figure 6. Telescoped into the main sealing member 60 is a fixed sleeve 75 in which the pilot valve member 61 is slidingly mounted. The fixed sleeve 75 has small vent bores 76 and is formed with circumferentially spaced apertures 77 to retain the four balls 74.

The pilot valve member 61 carries a resilient ring 80 to seat against an annular rib 81 at the closed position of the valve mechanism to seal off the previously mentioned relief port 67 that communicates with the atmosphere. As shown in Figure 2, the pilot valve member 61 has an axial projection 82 which extends into the relief port 67 at its closed position. The pilot valve member 61 is preferably of hollow construction and is formed with a circumferential groove 83 for cooperation with the four balls 74. Suitable vent bores 84 may be provided in the bottom of the circumferential groove 83, as best shown in Figure 6. Preferably a suitable coil spring 85 has one end extending into the pilot valve member 61 with the other end in compression against the main valve member 60 to provide a relatively light force that will constantly urge both valve members to their closed positions.

In the normal closed position of the valve mechanism shown in Figure 2 with the main valve member 60 closing the outlet port 65 and the pilot valve member 61 closing the relief port 67, the high pressure fluid confined in the chamber 25 is in communication with the interior of the valve casing 62 through the peripheral inlet port 66 and the fluid pressure in the valve casing 62 on the opposite faces of the main valve member 60 is equalized by virtue of the bleeder bore 72 in the sealing ring 70. Since the nose of the main valve member 60 extending into the outlet port 65 is not exposed to this high pressure, the main valve member is subject to a pressure differential that holds the main valve member in closed position. In like manner, since a portion of the pilot valve member 61 in the area of the relief port 67 is cut off from the high fluid pressure, the pilot valve member is subject to a similar pressure differential that holds the pilot valve member in closed position. This last pressure differential is of relatively low magnitude, however, because of the smaller areas involved. Thus, only a relatively light mechanical pressure is required to move the pilot valve member 61 open in opposition to the pressure differential and in opposition to the relatively light spring 85.

In addition to a pressure differential to urge the main valve member 60 to closed position, the described arrangement provides a latch to lock the main valve member in closed position. The latch mechanism includes the four balls 74, the inner conical shoulder 73 of the main valve member, the fixed sleeve 75 and the circumferential groove 83 around the pilot valve member 61. When the main valve member 60 and the pilot valve member 61 are in their closed positions shown in Figure 2, the circumferential groove 83 of the pilot valve is out of registry with the four apertures 77 in the fixed sleeve 75 in which the four balls 74 are mounted. When the parts are in these positions, opening movement of the main valve member 60 is prevented in a positive manner by abutment of the inner conical shoulder 73 of the main valve member against the balls 74 and by abutment of the balls 74 against the fixed sleeve 75 inside the four apertures 77. The inner conical shoulder 73 tends to shift the four balls 74 radially inward, but such inward movement of the balls is blocked by the peripheral surface of the pilot valve member 81.

If the pilot valve member 61 is moved by mechanical force to its open position shown in Figure 4, the main valve member 60 will be unlatched and simultaneously the pressure differential against the main valve member will be reversed to move the main valve member to its open position. The reversal of the pressure differential to cause opening movement of the main valve member 60 occurs because the opening of the relief port 67 by the pilot valve member 61 releases one face of the main valve member from the high pressure. Unlatching of the main valve member 60 occurs because the opening movement of the pilot valve member 61 places the circumferential groove 83 of the pilot valve member in registry with the apertures 77 in the fixed sleeve 75 to permit the four balls to be cammed radially inward into the circumferential groove 83 by the inner conical shoulder 73 of the main valve member 60, thus freeing the main valve member for opening movement. Since one side of the main valve member 60 is under only atmospheric pressure, the main valve member will remain open as long as any substantial fluid pressure exists in the region of its nose. When the compressed gaseous fluid is completely discharged, however, the relatively light coil spring 85 will return the main valve member to its closed position and will also return the pilot valve member 61 to its closed position, thus again latching the main valve member.

In various practices of the invention, various provisions may be made for applying mechanical pressure to open the pilot valve member 61 under remote control. In this instance, the pilot valve member 61 is opened by a suitable solenoid 90 that is housed in the nose section 22 of the housing and is controlled by a suitable circuit including a cable 91 that extends into the air-borne vehicle 21 through the pylon 20. In a well known manner, the circuit includes suitable means to energize the solenoid and a suitable control switch which need not be described.

As shown in Figure 2, preferably a tube in the form of threaded pipe 92 connects the relief port 67 of the valve casing 62 with an axial port 93 in the end wall 27 of the intermediate housing section 23. The outer side of the end wall 27 is formed with a threaded cylindrical skirt 94 to receive a cylindrical extension 95 of the solenoid 90 for the purpose of supporting the solenoid. The solenoid which is of a construction to provide communication with the atmosphere is held in place by a suitable bushing 96 that threads onto the cylindrical skirt 94. The electrically responsive core or armature (not shown) of the solenoid 90 is normally maintained in retracted position by a suitable spring 100 and is operatively connected with the pilot valve member 61 by a push rod assembly that includes a push rod 101. The push rod 101 slidingly extends through a pair of bushings 102 in the cylindrical extension 95 of the solenoid and is connected to a tubular member 103 that slidingly extends through the tube or pipe 92. The tubular member 103, in turn, terminates in a plug or nose member 104 that abuts the axial projection 82 of the pilot valve member 61. It is apparent that normally the spring 100 will hold the push rod assembly in retracted position to permit the pilot valve member 61 to remain in closed position, but that energization of the solenoid 90 will cause the push rod assembly to shift the pilot valve member 61 from the closed position shown in Figure 2 to the open position shown in Figure 4, thus causing the main valve member 60 to open in the manner heretofore described.

The operation of the practice of the invention exemplified by Figures 1 to 6 may be readily understood from the foregoing description. The collapsible tube 47 may contain, for example, titanium tetrachloride for reaction with the moisture in the air, it being contemplated that the smoke signal will be produced at a sufficiently low altitude for the surrounding atmosphere to have the required water content. In general, the atmosphere at all altitude below 40,000 ft. has sufficient moisture to react

with the titanium tetrachloride for creation of the desired smoke signal.

In preparation for the flight, the rear housing section **24** is dismantled temporarily by removal of the screws **37** to permit the collapsible tube **47** to be inserted. The tapered bushing **51** is then threaded onto the tubular nozzle **50** of the collapsible tube to anchor the collapsible tube in place. A suitable source of compressed air is connected with the intake pipe **33** to charge the pressure chamber **25**.

When the solenoid **90** is energized in the course of flight, the push rod assembly including the push rod **101** is actuated to unseat the pilot valve member **61**. This action unlatches the main valve member **60** and simultaneously causes reversal of the pressure differential to cause the opening movement of the main valve member. The high pressure gaseous fluid released from the chamber **25** into the chamber **40** by the opening of the main valve member **60** causes sufficient external fluid pressure to be applied to the periphery of the tube container **47** to cause the tube to collapse. The tube collapses to the general configuration shown in Figures 4 and 5, the walls folding to the cross-sectional configuration of letter H as shown in Figure 5. This collapse of the tube **47**, which occurs progressively, initially causes rupture of the frangible web **55** across the nozzle **50** and then progressively discharges the titanium tetrachloride into the atmosphere over a suitable prolonged period of time to cause generation of the desired smoke signal. The main valve member **60** remains open during this discharge operation but is closed by the spring **85** automatically when the operation terminates.

Figure 7 shows a container, generally designated by numeral **108** that may be used in the described apparatus interchangeably with the collapsible tube **47**. The container **108** is used for the creation of a smoke signal by the discharge of a suitable inert powder, for example, chrome yellow. The container **108** which may be made entirely of cardboard, has a cylindrical shell **109** closed at each end by suitable wals in the form of flanged cardboard discs **110** and **111**. The container **108** is of substantially the same diameter as the inside of the rear housing section **24** and is dimensioned to abut the annular body **41**. The tapered threaded bushing **51** is, of course, left off as unnecessary when this type of container is used.

When the solenoid **90** is energized to open the main valve member **60** for release of the high pressure fluid from the chamber **25** into the chamber **40**, the fluid pressure causes the flanged end wall **110** to slide inward and this collapsing action causes the second end wall member **111** to be displaced outward and to be ruptured for release of the powdered content into the atmosphere. Since the creation of such a smoke signal does not depend upon the presence of moisture in the atmosphere, the smoke signal may be created at any elevation.

To produce a smoke signal by chemical reaction at altitudes above 40,000 feet, a dual container may be used such as the container generally designated by numeral **115** in Figure 8. The dual container **115** comprises an outer collapsible tube **116** of the same construction as the previously described collapsible tube **47** and, in addition, includes a substantially smaller similar collapsible tube **117** enclosed by the outer collapsible tube. The outer collapsible tube **116** has a threaded nozzle **118** closed by a frangible web **119** and the dual container is held in mounted position by the tapered threaded bushing **51** as heretofore described. The inner collapsible tube **117** has a similar plain nozzle **120** closed by a frangible web **121** and is held concentrically inside the outer nozzle **118** by means of four relatively thin radial spacer members **122**.

When the high pressure fluid is released from the chamber **25** into the chamber **40**, to cause collapse of the outer collapsible tube **116**, the inner tube **117** is thereby subjected simultaneously to collapsing pressure so that the two frangible webs **119** and **121** immediately rupture to permit simultaneous discharge of the contents of the two collapsible tubes. In this practice of the invention, for example, the inner collapsible tube **117** may contain titanium tetrachloride which is surrounded by ammonia hydroxide in the outer collapsible tube **116**. In the absence of moisture in the atmosphere the discharged titanium tetrachloride reacts with the ammonia hydroxide to produce the required smoke signal.

Figure 11 illustrates a practice of the invention in which a plurality of smoke producing charges are positioned in a corresponding plurality of chambers for what may be termed a cascade operation in which a series of charges are released in sequence. In this practice of the invention, the smoke producing device is mounted inside an air-borne vehicle the under-surface of which is indicated by the broken line **123**. The rear housing section **24*a*** that is substituted for the previously described rear housing section **24**, is divided by a relatively thick wall **124** into a forward chamber **40*a*** and a rearward chamber **40*b***. This wall **124** is provided with a restricted passage **125** to permit fluid flow from chamber **40*a*** into chamber **40*b*** at a suitably retarded rate. Preferably a needle valve **127** is provided for adjustment of the rate of flow through the restricted passage **125**. A suitable discharge tube **128** mounted in the wall **124** has its inlet end positioned axially in the forward chamber **40*a*** and its discharge end terminating at the under surface **123** of the air-borne vehicle. In like manner, a discharge tube **128*a*** has its inlet end positioned axially at the end of the second chamber **40*b*** and has its discharge end terminating at the under-surface **123** of the vehicle. Mounted inside each of the two compartments **40*a*** and **40*b*** is a dual container **130** which may have the same construction and the same content as the previously described dual container **115**.

When the highly compressed gaseous fluid is released into the forward compartment **40*a***, it causes collapse of the dual container **130** to discharge the smoke producing content progressively through the discharge tube **128**. In the course of this initial discharge operation, the high pressure fluid bleeds into the second chamber **40*b*** through the restricted passage **125** to build up fluid pressure in the second chamber **40*b*** progressively. It is contemplated that the pressure in the second chamber **40*b*** will initiate collapse of the dual container therein with a suitable time delay to cause the discharge through the second discharge tube **128*a*** to follow in timed sequence the initial discharge through the forward discharge tube **128**.

My description in specific detail of preferred practices of the invention will suggest to those skilled in the art various changes, substitutions and other departures from my disclosure that properly lie within the spirit and scope of the appended claims.

I claim:

1. In a device of the character described for producing smoke signals, the combination of: a first chamber for smoke-producing material, at least a portion of the wall of said container adapted to open upon increased pressure in said chamber and said chamber adapted to house a container having a discharge port; a second chamber to confine a body of gaseous fluid under pressure for release into said first chamber to cause a collapse of said container and a discharge of said material through said portion of the wall of said container and through said discharge port; a cylindrical valve casing having at one end a first relief port for communication with a low pressure zone and having at the other end a second outlet port for communication with said first chamber and a third open inlet port in communication with said second chamber; a main valve member slidably mounted in said valve casing for fluid-pressure actuated movement from a normal position closing said outlet port to a retracted open position permitting fluid flow from said second chamber through said inlet valve port and said outlet

port into said first chamber, there being a bleeder passage for equalization of pressure in the valve casing on opposite sides of the main valve member; a pilot valve member movably mounted inside said valve casing and normally closing said relief port to permit equalization of fluid pressure on the opposite sides of said main valve member thereby to cause pressure differentials on the main valve member and the pilot valve member respectively in directions to urge the two valve members to their closed positions; and remotely controlled means to unseat said pilot valve member for opening of said relief port thereby to destroy the pressure equalization and to create a reverse pressure differential on the main valve member to move the main valve member to open position and cause the gaseous fluid to be released from said second chamber to said first chamber.

2. A device as set forth in claim 1 in which said remotely controlled means includes a solenoid to unseat said pilot valve member to open said relief port.

3. A device as set forth in claim 1 which includes relatively weak spring means to urge said main valve member to its closed position thereby to cause the main valve member to close automatically when the high pressure fluid is dissipated.

4. A device as set forth in claim 3 in which said spring means is a coil spring mounted in compression between said two valve members to urge both of the valve members to their closed positions.

5. A device as set forth in claim 1 in which said two chambers are longitudinal compartments in an elongated housing and which includes a tube extending from said relief port of the valve casing through said second chamber for communication with the atmosphere; and in which means to open said pilot valve member extends through said tube.

6. A device as set forth in claim 1 in which said pilot valve member is a working part of a mechanism to latch said main valve in closed position, said latch mechanism being releasable by opening movement of the valve member.

References Cited in the file of this patent

UNITED STATES PATENTS

922,709	Means	May 25, 1909
1,207,393	Gammeter	Dec. 5, 1916
1,823,304	Weller	Sept. 14, 1931
2,148,438	Crain	Feb. 28, 1939
2,177,032	Baumgardner	Oct. 24, 1939
2,282,268	Thommen	May 5, 1942
2,334,552	Hammond	Nov. 16, 1943
2,399,265	Sinton et al.	Apr. 30, 1946
2,426,065	Stevens et al.	Aug. 19, 1947
2,476,171	Williams	July 12, 1949
2,557,162	Wetzel et al.	June 19, 1951
2,663,319	Marinelli	Dec. 22, 1953
2,666,451	Ray	Jan. 19, 1954

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,923,930 February 2, 1960

Bruce E. Del Mar

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, lines 60 and 61, strike out "adapted to house a container" and insert the same after "chamber" in line 57, same column.

Signed and sealed this 16th day of August 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

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