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Poitras

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[54] **RELEASE MECHANISM FOR PRESSURIZED VESSELS**

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[52] **U.S. Cl.** ..... **169/20,** 137/72, 169/9, 169/26, 169/31 R, 169/42

[51] **Int. Cl.** **A62c 37/02**

[58] **Field of Search** ..... 169/9, 26, 42, 2 R, 5, 169/31 R, 20, 22; 137/72, 74; 220/89 B

[56] **References Cited**

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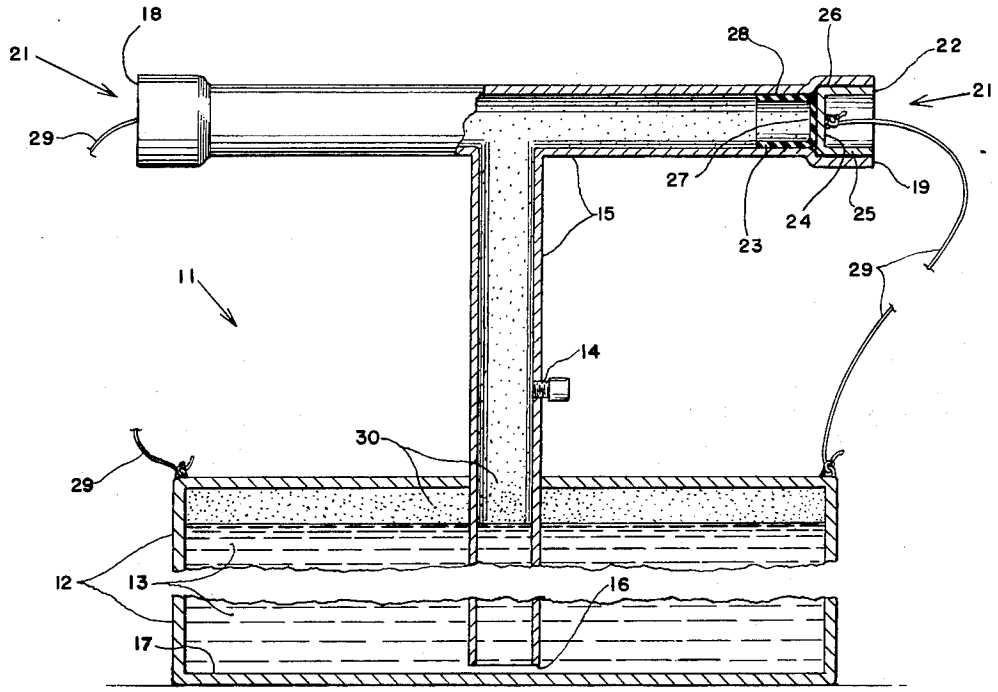
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Assistant Examiner—Andres Kashnikow
Attorney, Agent, or Firm—John E. Toupal

[57] **ABSTRACT**

Disclosed is a fluid pressure release mechanism including a primary seal hermetically sealed in a fluid outlet by a eutectic material, and an auxiliary seal isolating the eutectic material from the fluid pressure and opened thereby upon melting of the eutectic material.

17 Claims, 2 Drawing Figures



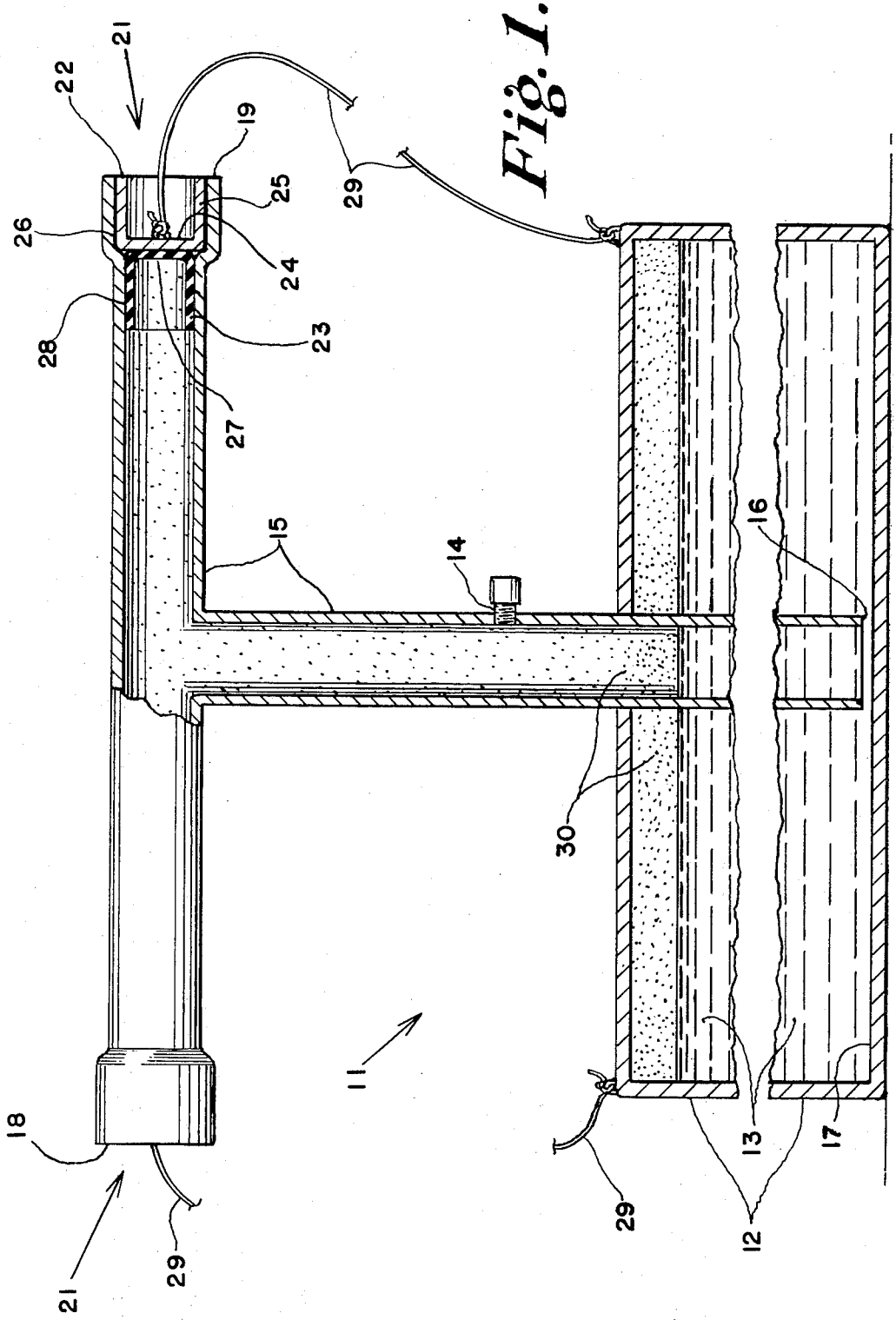


Fig. 1.

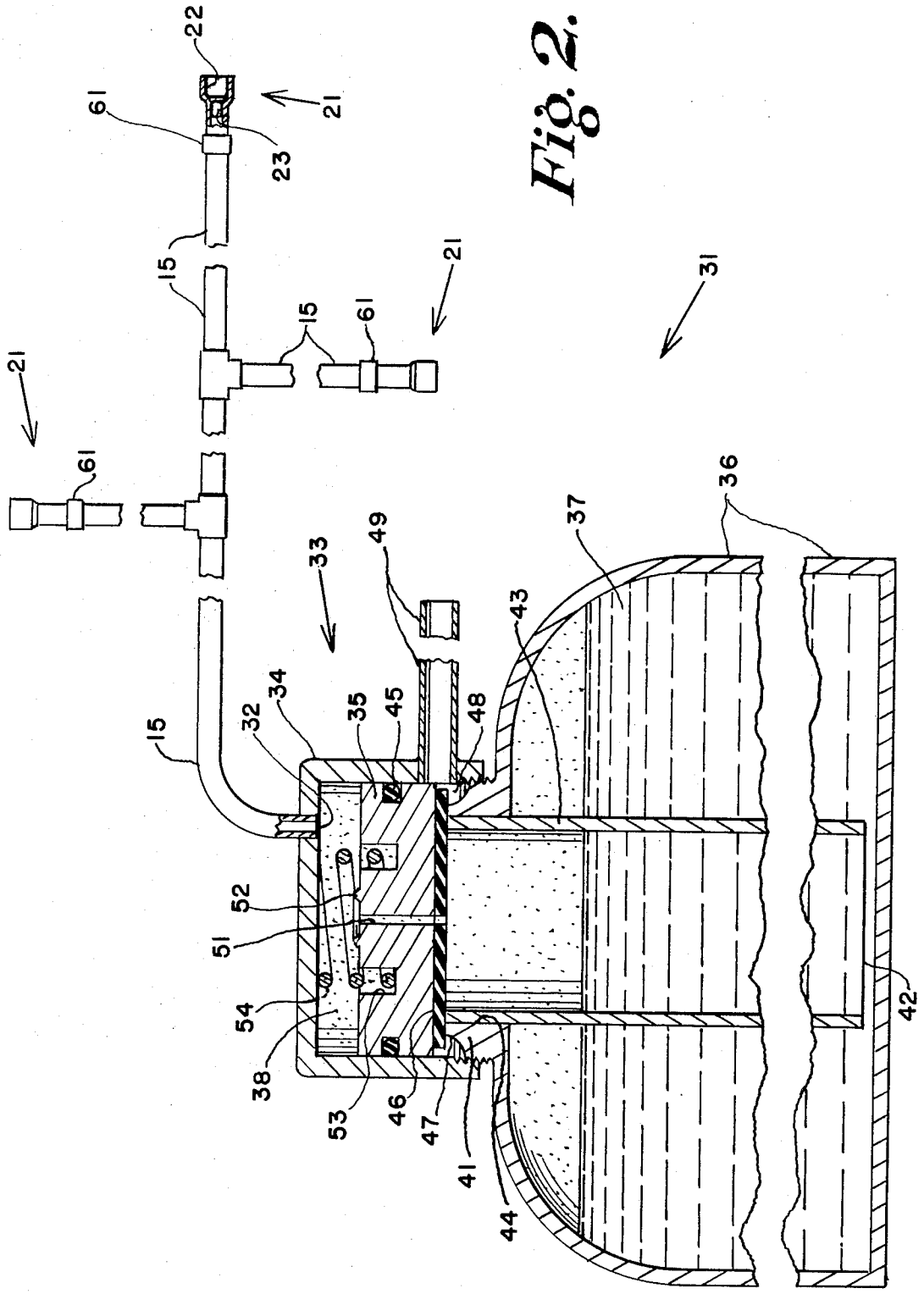

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Fig. 2.

RELEASE MECHANISM FOR PRESSURIZED VESSELS

BACKGROUND OF THE INVENTION

This invention relates generally to a fluid pressure release mechanism and relates, more particularly, to a device for automatically releasing a pressurized fire extinguishing medium in response to the detection of an elevated temperature indicative of either the presence or danger of fire.

A well known type of fire and explosion suppressor utilizes a vessel filled under pressure with a suitable fire extinguishing fluid and having a sealed discharge opening that is automatically opened in response to detection of fire. In many such devices the discharge port is closed by a frangible wall portion that is ruptured by detonation of an explosive squib disposed within the vessel. Generally, the internal explosive squib is detonated in response to an electrical signal produced by a suitable fire detector. Examples of detectors of this type are disclosed in U.S. Pats. Nos. 2,742,094 and 3,523,583. Other devices of this nature have discharge ports closed either by valves or sealed diaphragms. Devices of this latter type utilize various types of actuators including solenoids, pressure operated valves, etc. to open their discharge ports. Also well known are fire sprinkler heads with toggle valves that are released in response to fusing of an eutectic material.

Although many of the known suppressors of this type are generally quite reliable, they do exhibit certain disadvantages in particular fields of desired use. For example, the cost of automatically actuated highly reliable suppressor units limits their use to applications involving high risk of loss to either personnel or equipment. Also some kinds of actuators such as the explosive squib are objectionable in certain environments.

The object of this invention, therefore, is to provide for pressurized containers an improved automatic release mechanism that is highly reliable and of relative low cost.

SUMMARY OF THE INVENTION

The invention is characterized by the provision in a pressurized fluid filled container of an outlet hermetically sealed by a release mechanism including both a temperature responsive eutectic material and an auxiliary seal that isolates the eutectic material from the pressurized fluid. The auxiliary seal prevents the escape of fluid through isolated paths created in the eutectic material while it is being melted in response to an increase in ambient temperature. Such an escape of fluid would induce cooling of the eutectic material and thereby inhibit complete melting thereof at a predetermined and desired release temperature. In the present invention, the auxiliary seal insures complete melting of the eutectic material after which the auxiliary seal is automatically opened by the pressure within the container thereby permitting release of the fluid through the outlet.

In a featured embodiment of the invention, the outlet comprises a discharge orifice formed by the open end of a tube communicating with the interior of the container. Closing the open end of the tube is a sealing plug formed by a metallic cup-shaped member having cylindrical walls hermetically sealed to the internal walls of the tube by a fusible metallic alloy. The auxiliary seal

is formed by an oppositely oriented resilient cup-shaped member disposed within the tube between the sealing plug and the interior of the container. Upon initial creation of a leak path through the alloy, the fluid pressure within the container forces the cylindrical side wall of the auxiliary seal into sealing contact with the tube while the fluid pressure exerted on the end wall of the auxiliary seal member is retained by the oppositely disposed end wall of the metallic plug. However, after complete fusing of the eutectic material to release the metal plug, the internal pressure of the container acts to dislodge both seal members from the tube allowing a full release of its fluid content. In this embodiment the outlet can encompass a plurality of strategically oriented discharge openings each sealed by a separate release mechanism.

According to another embodiment of the invention, the above described release mechanism is utilized to operate a pilot valve that controls discharge of a pressurized fluid from a supply reservoir. The release mechanism communicates with a pilot volume separated from the reservoir by a piston type valve. A leak path through the valve establishes equal pressures on either side thereof thereby maintaining the valve in a position that seals a primary discharge orifice. The conductance of the leak path between the reservoir and the pilot volume is less than that provided by the tube retaining the release mechanism. Consequently, upon actuation of the release mechanism the pressure in the pilot volume falls producing across the piston valve a differential pressure that actuates the valve and opens the primary discharge orifice. In this embodiment a plurality of release mechanisms can be strategically distributed throughout a protected region and all connected for communication with the pilot volume. Actuation of any individual release mechanism will produce release of fluid from the supply reservoir.

DESCRIPTION OF THE DRAWINGS

These and other features and objects of the present invention will become more apparent upon a perusal of the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic drawing, partly in cross-section, illustrating one preferred embodiment of the invention; and

FIG. 2 is a schematic drawing, also partly in cross-section, illustrating another preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 there is shown a first embodiment **11** of the invention including an hermetically sealed container **12** filled with a pressurized fluid agent **13.** In a preferred fire suppressor embodiment of the invention, the pressurized fluid **13** can be, for example only, methyl bromide or similar halogen suppressant. The suppressant **13** enters the container **12** through an inlet valve **14** positioned in a discharge tube **15** communicating with the interior of the container **12.** The valve **14** can be, for example, of the type used in tubes for tires and prevents vaporization and escape of the liquid suppressant **13.** One open end **16** of the tube **15** terminates near the bottom **17** of the container **12** while the other end is bifureated to form a pair of discharge orifices **18** and **19.**

Disposed within each of the discharge orifices **18** and **19** is a release mechanism **21** only one of which is shown in detail, it being understood that the two are identical. The release mechanism **21** comprises a cup-shaped sealing plug **22** and an oppositely oriented cup-shaped auxiliary seal element **23.** The plug **22** possesses an end wall **24** that closes the discharge orifice **19** and a cylindrical side wall **25,** the outer surface of which is hermetically sealed to the inner surface of tube **15** by a eutectic material **26** such as a fusible metallic alloy. The auxiliary seal element **23,** preferably made of a resilient elastomeric material, similarly includes an end wall **27** in contact with the end wall **24** of plug **22** and a cylindrical side wall **28** the outer surface of which engages the inner surface of the tube **15.** Extending between and secured to both the seal plug **22** and the container **12** is a retaining cord **29** made of a strong material such as nylon.

During typical use of embodiment **11,** the container **12** is suitably mounted with the discharge orifice **19** directed toward a region in which fire protection is desired. For example only, the container **12** could be mounted on a cabinet housing (not shown) electrical equipment such as an electrostatic copying machine. In that case the tube **15** would extend through an opening in the cabinet with the orifice **19** pointed toward the equipment to be protected. It will be apparent that a single discharge orifice might suffice for many applications in which case a tube **15** with only one outlet could be used. The embodiment shown, however, is particularly useful for protecting compartmented volumes separated by partitions of some kind. Under those circumstances a single container **12** can be used to protect multiple areas each of which is occupied by a different discharge orifice.

In response to either a fire or an excessive heat condition that could result in fire, the ambient temperature in the protected volume rises to above the fusing temperature of the material **26** which accordingly begins to melt. Typically, this melting process is not uniform because of localized variations in the temperature to which the material **26** is subjected and also due to some non-uniformity in the temperature response of the material itself. For these reasons, isolated leaks are generally created through the annularly distributed eutectic material **26** before it is completely melted to release the plug **22.** The premature flow through these leak paths of pressurized suppressant vapor **30** is prevented by the auxiliary seal member **23.** Accordingly, localized cooling of the eutectic material **26** by escaping vapor is prevented and the entire body of material **26** is quickly melted to release the plug **22.** This melting process is further enhanced by the cup-shape of the plug **22** which minimizes the thermal mass in contact with the eutectic material **26.** Correspondingly, the shape and resiliency of the auxiliary seal **23** enhances its sealing function. The pressure of vapor **30** within the tube **15** forces the resilient outer surface of the side wall **28** against the internal surface of the tube **15** thereby providing a substantial fluid seal therebetween. However, upon complete melting of the eutectic material **26,** the internal pressure exerted by the vapor **30** against the end wall **27** forces both the auxiliary seal member **23** and the plug **22** out of the discharge orifice **19.** The internal vapor pressure within the container **12** then rapidly forces the extinguishing liquid **13** up through the open end **16** of the tube **15** and out of the discharge orifice **19** into the protected region. Damage of the protected equipment by the expelled plug **22** is prevented by the retaining cord **29.**

Referring now to FIG. **2** there is shown another embodiment **31** of the invention in which components identical to those utilized in embodiment **11** have been given the same reference numerals used therefor in FIG. **1.** As above, a plurality of release mechanisms **21** each including a sealing plug **22** and auxiliary seal number member **23,** hermetically seal discharge orifices formed by open ends of a tube **15.** An opposite open end **32** of the tube **15** communicates with a container **33** formed by a cap member **34** and a piston valve member **35.**

A vessel **36** serves as a reservoir for a fluid **37** which again comprises a pressurized liquid fire extinguishing agent. In this embodiment, the container **33** provides a pilot volume **38** for the valve **35** which is controlled by the difference between the pressure in the pilot volume **38** and that within the vessel **36.** A neck portion **41** on the vessel **36** has external threads that receive the cap **34.** Extending to near the bottom of the vessel **36** is an open end **42** of a dip tube **43** that is accommodated by the inner surface **44** of the neck portion **41.**

The outer surface of the piston member **35** possesses an annular groove that receives an O-ring gasket **45** that provides a seal with the interior surface of the cylindrical cap **34.** Fixed to the bottom of the piston **35** is a circular gasket **46** that seals against the top edges of the neck portion **41** and the dip tube **43.** A recessed portion **47** in the neck **41** forms with the cap **34** an annular space **48** that is in fluid communication with a primary discharge tube **49** that is accommodated by an opening in the cap **34.** Extending through both the piston member **35** and the gasket **46** is an orifice **51** that provides a leak path between the pilot volume **38** and the interior of the vessel **36.** The top surface of the piston member **35** possesses a small annular ridge **52** encircling the orifice **51** and an annular groove **53** that retains a spring member **54.**

During installation of the embodiment **31,** the release mechanisms **21** are distributed throughout an area to be protected and interconnected with the tubing **15.** To facilitate this operation, the release mechanisms **21** are preferably connected to the tubing **15** with threaded couplings **61.** Typically, the release mechanisms would be located near the ceiling of a room for which protection is desired. Next, the tubing **15** is connected to the vessel **36** which has been mounted in a convenient location and with the primary discharge tube **49** opening into the protected zone. The vessel **36** is filled by coupling a suppressant supply tank to the primary discharge tube **49** after removing at least one of the release mechanisms **21** to create atomospheric pressure in the tubing **15** and accordingly in the pilot volume **38.** Pressure created by suppressant flow into the annular region **48** overcomes the bias force of the spring member **54** and forces the piston **35** upward. This opens the tube **43** to allow suppressant flow into the vessel **36.** The resultant high pressure exerted on the surface of gasket **46** forces the annular ridge **52** into contact with the cap **34** and establishes therewith a relatively good seal because of high unit loading provided by the limited surface area of the ridge. Upon completion of the filling process, the primary outlet **49** is closed by a suitable valve (not shown) on the supply tank (not shown) and all release mechanisms **21** are mounted to seal the

tubing **15**. In a short period, molecular leakage through the orifice **51** and the limited seal created by the annular ridge **52** establishes within the tubing **15** and the pilot volume **38** a pressure substantially equal to that within the vessel **36**. Consequently, the pressure induced forces on both sides of the piston **35** are equalized and the additional force provided by the spring member **54** causes the piston to move into the position shown in FIG. **2**. An extremely tight seal between the gasket **46** and the vessel **36** is insured by the larger surface area that is exposed to fluid pressure on the top of the piston **35**.

In response to a predetermined ambient temperature at any of the release mechanisms **21** produced, for example, by a fire within the protected region the above described discharge of the cup-shaped plugs **22** and **23** will occur. This will result in an immediate reduction of pressure within the pilot volume **38** in that the fluid conductance to atmosphere provided by the opened tubing **15** is substantially greater than that provided to the pressurized vessel **36** by the orifice **51**. Accordingly, the piston **35** is forced upward to open the vessel **36** and allow pressurized discharge of the suppressant **37** through the primary discharge tube **49**.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. For example, the primary outlet **49** can comprise a plurality of strategically located discharge outlets. Also, the release mechanisms **21** can be used to control the release of pressurized fluids other than the fire suppressants specifically described herein. It is to be understood, therefore, that the invention can be practiced otherwise than as specifically described.

What is claimed is:

1. Pressurized fluid release apparatus comprising:
a pressure sealed container means for retaining under pressure a fluid medium;
outlet means defining a discharge orifice for accommodating release of the fluid medium from said container means;
temperature responsive hermetic seal means sealing said discharge orifice, said hermetic seal means comprising an eutectic material adapted to melt at a predetermined temperature; and
auxiliary seal means isolating said eutectic material from the fluid medium in said container, and adapted in an unbroken state to prevent fluid discharge out of said hermetic seal means, said auxiliary seal means comprising a pressure responsive portion adapted to be automatically opened by the fluid pressure in said container means in response to opening of said hermetic seal means, and wherein said pressure responsive portion is engaged and retained in sealing position by said hermetic seal means.

2. Pressurized fluid release apparatus according to claim **1** wherein said container means is filled with a pressurized fire extinguishing medium.

3. Pressurized fluid release apparatus according to claim **1** wherein said eutectic material comprises a fusible metallic alloy.

4. Pressurized fluid release apparatus according to claim **1** wherein said hermetic seal means further comprises a plug having a periphery hermetically sealed to said outlet means by said eutectic material.

5. Pressurized fluid release apparatus according to claim **1** wherein said outlet means comprises a tube with an open end forming said discharge orifice, and said hermetic seal means further comprises a cup-shaped plug disposed in said tube and having a cylindrical wall hermetically sealed thereto by said eutectic material.

6. Pressurized fluid release apparatus according to claim **1** wherein said outlet means comprises a tube with an open end forming said discharge orifice, said auxiliary seal means comprises a resilient cup having a cylindrical side wall portion engaging an internal wall of said tube and an end wall forming said pressure responsive portion.

7. Pressurized fluid release apparatus according to claim **4** including retainer means for retaining said plug after melting of said eutectic material.

8. Pressurized fluid release apparatus according to claim **6** wherein said hermetic seal means further comprises a cup-shaped plug disposed in said tube and having an end wall engaging said resilient cup end wall and a cylindrical side wall hermetically sealed to said internal wall of said tube by said eutectic material.

9. Pressurized fluid release apparatus according to claim **8** wherein said cylindrical side wall portion of said resilient cup is no greater in height than about the diameter of said pressure responsive end wall thereof.

10. Pressurized fluid release apparatus comprising:
a pressure sealed container means for retaining under pressure a fluid medium;
outlet means defining a discharge orifice for accommodating release of the fluid medium from said container means;
temperature responsive hermetic seal means sealing said discharge orifice, said hermetic seal means comprising an eutectic material adapted to melt at a predetermined temperature;
auxiliary seal means isolating said eutectic material from the fluid medium in said container, and adapted in an unbroken state to prevent fluid discharge out of said hermetic seal means;
a reservoir means for retaining under pressure a fluid medium;
second outlet means defining a primary release orifice for accommodating release of the fluid medium from said reservoir means; and
valve means for controlling fluid flow through said primary release orifice in response to the differential fluid pressure retained by said pressure sealed container means and said reservoir means.

11. Pressurized fluid release apparatus according to claim **10** including means defining a fluid leak path between said pressure container means and said reservoir means.

12. Pressurized fluid release apparatus according to claim **11** wherein said auxiliary seal means comprises a pressure responsive portion adapted to be automatically opened by the fluid pressure in said container means in response to opening of said hermetic seal means.

13. Pressurized fluid release apparatus according to claim **12** wherein said pressure responsive portion is retained in sealing position by said hermetic seal means.

14. Pressurized fluid release apparatus according to claim **13** wherein said outlet means comprises a tube with an open and forming said discharge orifice, said auxiliary seal means comprises a resilient cup having a

cylindrical side wall portion engaging an internal wall of said tube and an end wall forming said pressure responsive portion.

15. Pressurized fluid release apparatus according to claim **14** wherein said hermetic seal means further comprises a cup-shaped plug disposed in said tube and having an end wall engaging said resilient cup end wall and a cylindrical side wall hermetically sealed to said internal wall of said tube by said eutectic material.

16. Pressurized fluid release apparatus according to claim **15** wherein said tube is dimensioned to provide substantially greater fluid conductance than that provided by said leak path.

17. Pressurized fluid release apparatus according to claim **16** including attachment means to facilitate integral mounting of said outlet means, said hermetic seal means and said auxiliary seal means to said container means.

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