April 26, 1949. W. W. VOSS 2,468,385

VENTING MEANS

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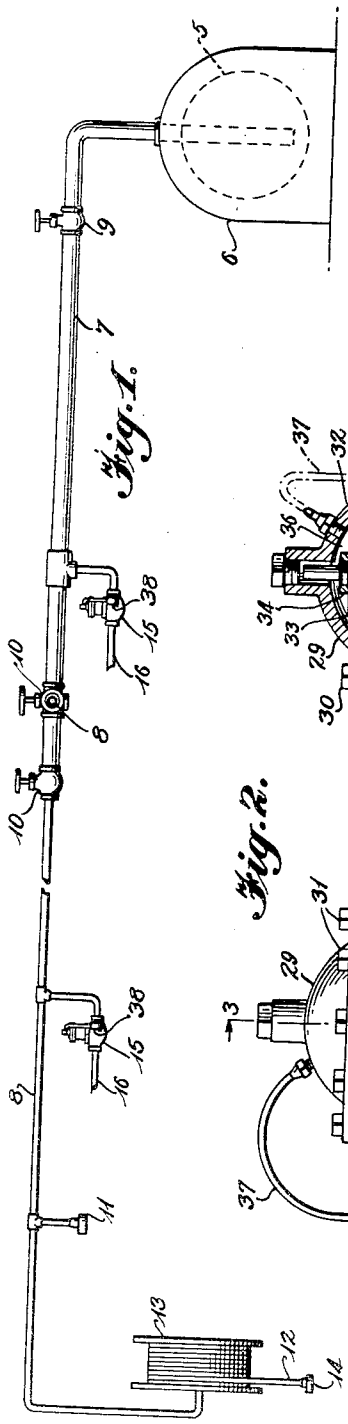


Fig. 1.

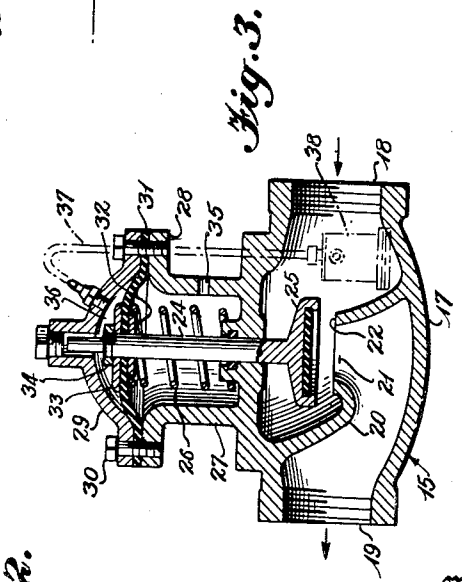


Fig. 3.

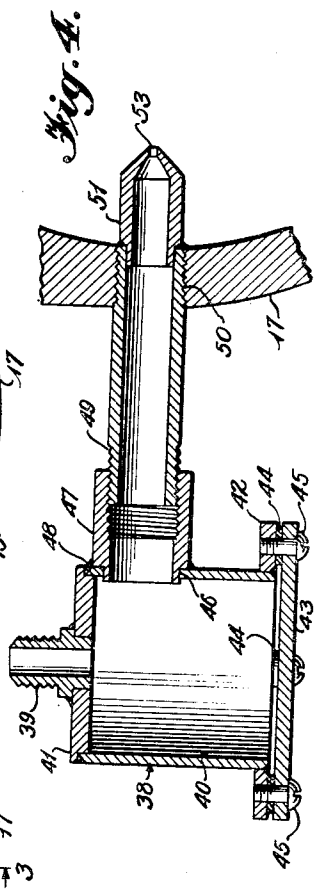


Fig. 4.

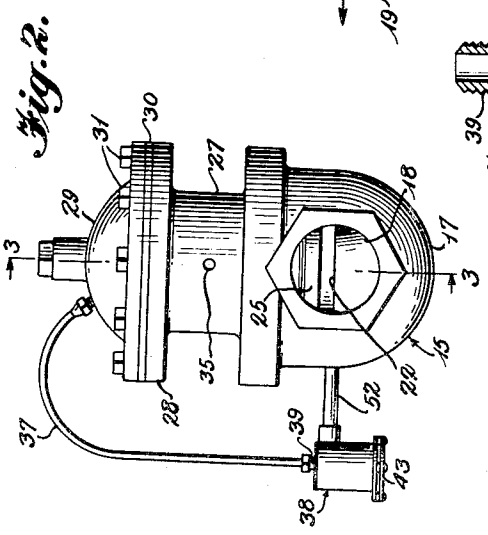


Fig. 2.

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VENTING MEANS

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22 Claims. (Cl. 62—1)

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This invention relates to new and useful improvements in venting means and relates more specifically to the venting of carbon dioxide vapor from a fire extinguishing system that employs liquid carbon dioxide as the extinguishing medium.

When carbon dioxide is employed for extinguishing a fire by the direct application of the extinguishing medium onto the burning object or material, it is essential that liquid carbon dioxide be delivered to the point or points of discharge if the most efficient extinguishing action is to be obtained. For that reason, the nozzles, or other devices, employed for effecting the discharge are designed especially for handling liquid carbon dioxide and are so positioned relative to the hazards as to make proper use of the snow and vapor type of discharge that results from the handling of liquid carbon dioxide. It will be obvious, therefore, that the delivery of carbon dioxide vapor to such discharge nozzles, or other devices, will not help to any material extent in effecting extinguishment of a fire. It further will be realized that the time required to make the liquid carbon dioxide available for discharge at the nozzles is a very important factor in effecting rapid extinguishment of the fire, after it is discovered, so that property loss will be held to a minimum.

In a fairly high percentage of fire extinguishing system installations, the layout or arrangement of the property to be protected is such that relatively long pipe lines must be provided to connect the source of supply of the liquid carbon dioxide to remotely located nozzles; or a large capacity piping header must be provided to simultaneously supply the extinguishing medium to a number of discharge nozzles protecting a given hazard or to a number of branch pipe lines leading to different hazards that may require protection at the same time.

It is the usual practice to so install carbon dioxide fire extinguishing systems that the liquid carbon dioxide is normally kept confined in a refrigerated storage tank, or in a bank of high pressure cylinders, until a fire occurs and is then admitted to the piping system. Because the long pipe lines and/or the large capacity piping headers are at atmospheric pressure and normally are warm when the liquid carbon dioxide is admitted thereto, there is considerable evaporation of the liquid carbon dioxide until a proper pressure and temperature condition develops in the piping of the system.

The carbon dioxide vapor that is thus formed in the piping system must be expelled through the nozzles before liquid carbon dioxide can reach the nozzles for being discharged therefrom. Since all nozzle sizes must be established with reference to the piping system so as to maintain a back-pressure at the nozzles that is in excess of at least eighty pounds per square inch, absolute, the carbon dioxide vapor is discharged through such nozzles at a much slower rate than the nozzles will discharge liquid carbon dioxide. Another condition that results in a very slow discharge of the carbon dioxide vapor is encountered in installations involving several hazards and including one or more small hazards which are protected by small capacity nozzles receiving their supply of carbon dioxide from large capacity piping headers. In such instances the relatively large amount of carbon dioxide vapor that is formed in initially filling the headers may require as much, or even more, time to be discharged through the said small capacity nozzles as is required to effect the actual extinguishment of the fire with liquid carbon dioxide after it becomes available at the discharge nozzles.

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It is the primary object of this invention to provide apparatus for quickly freeing a fire extinguishing piping system of its initial charge of carbon dioxide vapor so as to materially shorten the time required for liquid carbon dioxide to reach the discharge nozzles.

A further important object of the invention is to provide apparatus for quickly expelling the initial charge of carbon dioxide vapor from the portions of the fire extinguishing system piping located in advance of its liquid carbon dioxide nozzles and for automatically stopping the expelling of carbon dioxide when liquid is available in the system.

Still another object of the invention is to provide the piping of a carbon dioxide fire extinguishing system with one or more normally open venting devices which will discharge carbon dioxide vapor from the piping but will automatically close when liquid carbon dioxide reaches said devices, whereby the discharge nozzles of the system, which are called upon to effect extinguishment of a fire, will be supplied with liquid very shortly after the carbon dioxide is first released into the piping from its source of supply.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawing forming a part of this specification and in which like numerals

are employed for designating like parts throughout the same,

Figure 1 is a side elevational or schematic view of a fire extinguishing system having carbon dioxide vapor venting devices properly assembled therein,

Fig. 2 is a side elevational view of one of the vapor venting devices shown assembled in the system of Fig. 1,

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2, and

Fig. 4 is a longitudinal sectional view of an expansion chamber that is included as a part of the vapor venting device shown in the preceding figures.

In the drawing, wherein for the purpose of illustration is shown the preferred embodiment of this invention, and first particularly referring to Fig. 1, the reference character 5 designates a storage tank in which liquid carbon dioxide is to be confined at a controlled sub-ambient temperature, and its corresponding vapor pressure, by means of an automatically controlled refrigerating system. This type of bulk storage for liquid carbon dioxide is more fully illustrated in the Eric Geertz patents, No. 2,143,311, issued January 10, 1939, and No. 2,202,343, issued May 28, 1940. The storage tank 5 is suitably confined in a housing 6 and the space between the housing and the exterior of the tank 5 is filled with a suitable heat insulating material to retard absorption of heat by the liquid carbon dioxide confined in the tank.

The tank 5 has suitably connected thereto a relatively large capacity piping header 7 through which the liquid carbon dioxide is to be delivered to any desired number of smaller capacity branch lines 8. For the purpose of normally confining the liquid carbon dioxide in the storage tank 5 and for effecting its release into the header 7 when a fire occurs, a suitable valve 9 is connected in the header 7 at a desired point relatively close to the tank 5. It will be appreciated that this valve 9 may be manually controlled or automatically controlled. If it is automatically controlled, it normally will be opened in response to the automatic detection of a fire at one or more of the hazards being protected by the system.

When the system includes a plurality of branch lines, such as those designated by the reference characters 8 for separately or independently protecting different hazards, the admission of the liquid carbon dioxide from the piping header 7 into the branch pipe line 8 that leads to the involved hazard is controlled by a valve 10. In other words, one valve 10 is provided for each one of the separate branch lines 8. These valves 10, which normally are referred to as selector valves, may be either manually or automatically controlled in the same manner as referred to above in connection with the valve 9, which is normally referred to as the master valve.

Each branch line 8 may have connected therein any desired number of liquid carbon dioxide discharge nozzles, or other devices. Fig. 1 discloses one of the branch lines 8 as having connected therein a discharge nozzle 11 which will directly apply the discharge of carbon dioxide onto the particular hazard that is to be protected thereby. Additionally, this branch line 8 is illustrated as having connected thereto the hose line 12, normally wound on the reel 13 and having the discharge nozzle 14 connected to its outer end.

Because the master valve 9 is normally closed, so that the liquid carbon dioxide will be confined in the storage tank 5, the large capacity header 7 normally will be in a non-pressure condition. That is to say, the pressure prevailing in the header 7 between the master valve 9 and the selector valves 10 will correspond to that of the atmosphere. The header 7, also, will be at ambient temperature. Consequently, when the liquid carbon dioxide is admitted to the header 7, as a result of opening the master valve 9, there will be a substantial drop in pressure of the liquid carbon dioxide that is admitted to the header. Also, the low temperature liquid carbon dioxide admitted to the header will absorb a substantial amount of heat from the header until the temperature of the header is lowered to that of the carbon dioxide. Because of these two facts, or conditions, the liquid carbon dioxide first admitted to the header 7, in filling this header, will evaporate and the header will be filled with carbon dioxide vapor. These same two conditions apply to the particular branch line 8 to which the carbon dioxide is admitted, by the opening of the proper selector valve 10, to effect delivery of the extinguishing medium to the particular hazard that is being consumed by the fire. Consequently, liquid carbon dioxide first admitted to the branch line 8 that is involved will flash to vapor.

As has been pointed out above, the discharge nozzles 11 and 14 are designed for extinguishing a fire by the release of liquid carbon dioxide. These discharge nozzles, therefore, are not suitable for effecting a rapid liberation of the piping 7—8 of its initial charge of carbon dioxide vapor. Also, the discharge nozzles 11 and 14 cannot be relied upon to effectively attack a fire when carbon dioxide vapor is being discharged therefrom. Because it is very essential that liquid carbon dioxide be delivered to the discharge nozzles 11 and 14 at the earliest moment possible after a fire is discovered, it becomes imperative that the initial charge of carbon dioxide vapor be expelled from the piping at a more rapid rate than is possible with the discharge nozzles 11 and 14. For that reason, the piping of the system is provided with a suitable number of vapor venting devices which are designated by the reference character 15 in Fig. 1. It will be noted that one of these devices is provided for the large capacity piping header 7 while a second venting device is provided for the completely illustrated branch line 8. It is to be understood, however, that additional venting devices 15 may be employed and that they may be arranged in any suitable manner in the system to most efficiently effect rapid discharge of the carbon dioxide vapor from the entire length of piping between the storage tank 5 and each discharge nozzle.

Each one of the vapor venting devices 15 is illustrated in Fig. 1 as being connected in a length of piping 16 that is coupled to the header 7 or a branch line 8. These pipe lines 16 are shown as being broken off beyond the venting devices 15. This is intended to illustrate that these pipes 16 may open to the atmosphere or they may extend to a suitable point outside of the building provided with the fire extinguishing system so that the vented carbon dioxide vapor may be exhausted to the outside atmosphere.

The detail construction of each one of the carbon dioxide vapor venting devices is clearly illustrated by the disclosures of Figs. 2 to 4 inclusive and will be described in connection with these figures.

The venting device includes a suitable valve housing or body 17 that is provided with an inlet

18 and an outlet 19. Between the inlet and the outlet, the body 17 is provided with a partition 20 that is formed with an opening 21 surrounded by a valve seat 22. In line with the axis of the opening 21, the valve body 17 is provided with an opening through which passes the valve stem 24. This stem carries a valve head or member 25 that is adapted to be moved into and out of engagement with the partition seat 22 for closing and opening the flow path through the valve body.

The valve head or member 25 normally should occupy the unseated position illustrated in Fig. 3 so that the venting device will be open for the discharge of carbon dioxide vapor. A spring 26 is threaded over the valve stem 24 and is connected, in a manner to be described, to the valve stem for normally holding the valve head or member unseated.

The valve body 17 is provided with a hollow extension 27 that surrounds most of the projecting portion of the valve stem 24 and the spring 26. This hollow extension 27 is flanged at 28 for having connected thereto the cap 29 by means of the screws 30. The cap 29 and the flange 28 clamp between their opposed surfaces the peripheral edge of the flexible diaphragm 31. The central portion of this diaphragm is connected to the outer end portion of the valve stem 24 by means of the discs 32 and 33 and the nut 34. These discs and the diaphragm function to connect the outer end of the spring 26 to the valve stem 24.

The space provided within the hollow extension 27 is vented to the atmosphere by the opening 35 so that atmospheric pressure will prevail in this space. The space 36 that is formed between the diaphragm 31 and the cap 29 is sealed so as to provide a fluid pressure chamber for the application of fluid pressure to the outer surface of the diaphragm. When sufficient fluid pressure is thus applied to the diaphragm 31, it will overcome the force of the spring 26 and will move the valve head or member 25 against the seat 22 for closing off the flow path for carbon dioxide vapor that is normally provided through the valve body 17.

Figs. 2 and 3 disclose a suitable length of tubing 37 that is connected to the cap 29 at one end for communicating with the chamber 36 formed between the cap and the diaphragm 31. This tubing extends to an expansion chamber 38 and is connected to the same by the nipple 39, see Figs. 2 and 4. This chamber 38 is formed by a section of tubing 40 that is closed at one end by the welded plate 41. The remaining end of the chamber is provided with an exterior flange 42. Connected to this flange is a plate 43. The plate, however, is held in spaced relation to the flange 42 by means of the thin spacers 44 that surround the screws 45 which fasten the plate 43 to the chamber flange 42. It will be appreciated, therefore, that the interior of the chamber 38 is open to the atmosphere through the space or gap that is left between the flange 42 and plate 43.

The chamber wall 38 is provided with an opening 46 in which is fitted a nipple 47. This nipple is welded to the chamber wall at 48. A short length of tubing 49 is threadedly connected to the nipple 47 at one end and is threaded in an opening 50 formed in the wall of the valve body 17 in close proximity to the inlet 18. A tip 51 is suitably fastened to the inner end of the tube, bearing the reference numeral 52, and extends into the interior of the valve body 17. This tip is provided with an end aperture 53 for placing the pipe 52 and the interior of the chamber 38 in restricted open communication with the interior of the inlet portion of the valve body 17. It will be appreciated, therefore, that any fluid flowing through the valve body 17 will be delivered in part to the interior of the expansion chamber 38. If nothing prevents its exit, the fluid delivered to the chamber 38 will be exhausted to the atmosphere through the slot or gap that is provided between the peripheries of the chamber flange 42 and its plate 43. Also, the pressure prevailing in the chamber 38 at any given time is applied to the chamber 36 through the tubing 37.

The operation of each of the vapor venting devices 15 now will be described.

When the liquid carbon dioxide initially admitted to the system piping 7—8 flashes to vapor, this vapor will be expelled through the valve bodies 17 of the venting devices 15 and will be carried off to a desired point by the associated pipe lines 16. Some of this vapor will be delivered to the expansion chambers 38 associated with the devices 15. This vapor, however, will be exhausted from the chambers through the slots or gaps provided for this purpose. If a suitable number of vapor venting devices 15 is provided for the system, the initially formed vapor will be vented from the system in a very small number of seconds.

When the piping of the system is supplied with liquid carbon dioxide that does not flash to vapor at the location of each one of the venting devices 15, a portion of this liquid will flow into the valve body 17 and a part of this liquid will be delivered to the bore of the tip 51 through the aperture 53. Because the bore of the tip 51 is of substantially greater diameter than the diameter of the aperture 53, the liquid carbon dioxide admitted to the tip bore will expand and its pressure will drop. The bore of the pipe section 52 and the interior of the chamber 38 will permit further expansion and pressure drop of the liquid carbon dioxide passing through the tip aperture 53. This expansion of the liquid carbon dioxide will cause the pressure of the liquid to drop to a value below 75 pounds per square inch, absolute, with the result that the liquid carbon dioxide will be changed to a mixture of snow and vapor. As the snow attempts to escape from the chamber 38 through the slot or gap formed between the flange 42 and the plate 43, the snow will progressively block up this slot or gap and freeze so as to finally completely close this end of the chamber 38. Pressure will build up in the chamber 38 as the slot or gap is closed and this vapor pressure will be applied to the diaphragm chamber 36 through the tubing 37. When sufficient vapor pressure develops in the chamber 36, the diaphragm 31 will deliver this pressure to the valve head 25 through its stem 24 and the valve head will be seated to prevent further passage of carbon dioxide through the valve body 17. The valve head 25 will remain seated until the pressure in the piping drops to a value that will enable the spring 26 to again function to unseat the valve head 25. By the time the valve head 25 is unseated, the carbon dioxide snow that is formed in the expansion chamber 38 and that is blocking the exhaust slot or gap for this chamber has evaporated or sublimed. The carbon dioxide vapor venting device, therefore, is automatically returned to a condition in which it will vent vapor that is formed in the piping if

the liquid carbon dioxide is again admitted thereto.

It will be appreciated that the source of supply of liquid carbon dioxide need not be obtained from a refrigerated, bulk storage tank, such as 5, but may be obtained from a bank of high pressure cylinders. Also, the piping of the system need not include a large capacity piping header 7 to make use of vapor venting devices desirable. In other words, the system may include a long length of piping that is required to deliver the carbon dioxide from its source of supply to a remotely located hazard. It further will be appreciated that the pressure chamber 38 need not be placed in communication with the interior of the valve body 17 adjacent its inlet 18 but may be connected to any portion of the valve body and the piping 7, 8, or 16 from which liquid carbon dioxide can be obtained.

It is to be understood that the form of this invention herewith shown and described is to be taken as the preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of subjoined claims.

Having thus described the invention, I claim:

1. The combination with a fire extinguishing system comprising a source of supply of liquid carbon dioxide, piping extending from said source of supply to the point or points of discharge, liquid carbon dioxide discharge means connected to the piping at the points of discharge, and valve means in the piping adjacent the source of supply for admitting carbon dioxide into the piping, of a plurality of normally open carbon dioxide vapor venting valves connected in the piping at spaced intervals between the said valve means and the discharge means, pressure fluid operated means for closing each vapor venting valve, and means associated with each pressure fluid operated means and responsive to the formation of carbon dioxide snow and vapor resulting from the sudden expansion of liquid carbon dioxide to apply vapor pressure to said last mentioned means to cause said means to close its vapor venting device.

2. The combination with a fire extinguishing system comprising a source of supply of liquid carbon dioxide, piping extending from said source of supply to the point or points of discharge, liquid carbon dioxide discharge means connected to the piping at the points of discharge, and valve means in the piping adjacent the source of supply for admitting carbon dioxide into the piping, of a plurality of normally open carbon dioxide vapor venting valves connected in the piping at spaced intervals between the said valve means and the discharge means, pressure fluid operated means for closing each vapor venting valve, and chamber means connected to each pressure fluid operated means and responsive to the formation of carbon dioxide snow and vapor resulting from the sudden expansion of liquid carbon dioxide to apply vapor pressure to said last mentioned means to cause said means to close its vapor venting valve.

3. The combination with a fire extinguishing system comprising a source of supply of liquid carbon dioxide, piping extending from said source of supply to the point or points of discharge, liquid carbon dioxide discharge means connected to the piping at the points of discharge, and valve means in the piping adjacent the source of supply for admitting carbon dioxide into the piping, of a plurality of normally open carbon dioxide vapor venting valves connected in the piping at spaced intervals between the said valve means and the discharge means, pressure fluid operated means for closing each vapor venting valve, and a chamber communicating with each pressure fluid operated means and with the piping at the location of the vapor venting valve for said means, said chamber having a restricted outlet opening through which carbon dioxide vapor will discharge to the atmosphere but which will be sufficiently blocked by carbon dioxide snow formed in the chamber when liquid carbon dioxide expands therein to thereby bring about the application of vapor pressure to the pressure fluid operated means to cause said means to close its vapor venting valve.

4. The combination with a fire extinguishing system comprising a source of supply of liquid carbon dioxide, piping extending from said source of supply to the point or points of discharge, liquid carbon dioxide discharge means connected to the piping at the points of discharge, and valve means in the piping adjacent the source of supply for admitting carbon dioxide into the piping, of a plurality of normally open carbon dioxide vapor venting valves connected in the piping at spaced intervals between the said valve means and the discharge means, pressure fluid operated means for closing each vapor venting valve, and means, having a restricted opening to the atmosphere, providing communication between each pressure fluid operated means and the piping at the location of the vapor venting valve for said pressure fluid operated means, said restricted opening allowing carbon dioxide vapor to discharge therethrough when said vapor fills the piping at its location but blocking up with snow when liquid carbon dioxide reaches the piping at its location.

5. In combination, a source of liquid carbon dioxide, a pipe line, having a device for discharging liquid carbon dioxide, connected to said source, means for controlling the admission of carbon dioxide into the pipe line from said source, a carbon dioxide vapor venting valve connected to the pipe line and normally open to the atmosphere, and means for closing said vapor venting valve operative in response to the formation of snow resulting from the expansion of liquid carbon dioxide obtained from the pipe line.

6. In combination, a source of liquid carbon dioxide, a pipe line, having a device for discharging liquid carbon dioxide, connected to said source, means for controlling the admission of carbon dioxide into the pipe line from said source, a fluid pressure closed carbon dioxide vapor venting valve connected to the pipe line and normally open to the atmosphere, and means operative in response to the formation of snow resulting from the expansion of liquid carbon dioxide obtained from the pipe line, for applying vapor pressure to the venting valve to close same.

7. The combination with a pipe line into which liquid carbon dioxide is released when required at a point of use served by said pipe line, of normally open means for venting from the pipe line the vapor that is formed therein when the liquid carbon dioxide is first released into the pipe line, said venting means comprising normally open valve, and means for closing the valve operative in response to a change in phase of the carbon dioxide from liquid to solid.

8. The combination with a pipe line into which liquid carbon dioxide is released when required at a point of use served by said pipe line, of nor-

mally open means for venting from the pipe line the vapor that is formed therein when the liquid carbon dioxide is first released into the pipe line, and means to close the venting means responsive to a change in phase of carbon dioxide from liquid to solid when liquid carbon dioxide is in the pipe line at the venting means.

9. Carbon dioxide vapor venting means, comprising a valve body having a flow path therethrough, a valve member in the body movable between two positions for opening and closing said flow path, yieldable means normally holding said valve member in its open position, pressure fluid operated means for moving said valve to its closed position, and means for applying carbon dioxide vapor pressure to said pressure fluid operated means operative in response to a change in phase of carbon dioxide from liquid to solid when liquid carbon dioxide passes through the flow path of the valve body.

10. Carbon dioxide vapor venting means, comprising a valve body having a flow path therethrough, a valve member in the body movable between two positions for opening and closing said flow path, yieldable means normally holding said valve member in its open position, pressure fluid operated means for moving said valve to its closed position, and means for applying carbon dioxide vapor pressure to said pressure fluid operated means to move the valve member to its closed position when liquid carbon dioxide is passing through the flow path of the valve body, said last mentioned means comprising a chamber having a restricted outlet opening through which carbon dioxide vapor will discharge to the atmosphere but which will be blocked by carbon dioxide snow formed in the chamber when liquid carbon dioxide expands therein, and piping means connecting the chamber to the valve body flow path and to the pressure fluid operated means.

11. Carbon dioxide vapor venting means comprising means forming a path through which carbon dioxide vapor will be permitted to flow, and carbon dioxide pressure operated means for closing said path when liquid carbon dioxide starts to flow through the path, said last mentioned means being responsive to the pressure developed when the phase of the carbon dioxide changes from liquid to solid.

12. Carbon dioxide vapor venting means, comprising means forming a path through which carbon dioxide vapor will be permitted to flow, carbon dioxide pressure operated means for closing said path, and means for applying carbon dioxide vapor pressure to said pressure operated means operative in response to a change in phase of carbon dioxide from liquid to solid when liquid carbon dioxide passes through said path.

13. Carbon dioxide vapor venting means, comprising a valve having a normally open flow path therethrough, carbon dioxide pressure operated means for closing said valve, and means for applying carbon dioxide vapor pressure to said pressure operated means operative in response to a change in phase of carbon dioxide in said pressure applying means from liquid to solid.

14. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising means forming a flow path through which carbon dioxide will be permitted to flow, means for closing said flow path, pressure fluid operated means for actuating said flow path closing means to close said path, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said flow path, and means connected in said by-pass line to delay the actuation of said pressure fluid operated means.

15. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising a valve having a normally open flow path therethrough, pressure fluid operated means for closing said flow path when a predetermined pressure has been built up in said pressure fluid operated means, piping connecting said pressure fluid operated means and said flow path, and means connected in said piping to delay the building up of pressure in said pressure fluid operated means.

16. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising a valve having a normally open flow path therethrough, a member in the valve movable between two positions for opening and closing the flow path, pressure fluid operated means for moving said valve member into its closed position when a predetermined working pressure has been built up in the pressure fluid operated means, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said vapor flow path through the valve, and means connected in said by-pass line to delay the actuation of said pressure fluid operated means.

17. The combination with a fire extinguishing system comprising a source of supply of liquid carbon dioxide, piping extending from said source of supply to the point or points of discharge, liquid carbon dioxide discharge means connected to the piping at the points of discharge, and valve means in the piping adjacent the source of supply for admitting liquid carbon dioxide into the piping, of a plurality of normally open venting valves connected in the piping at spaced intervals between the said valve means and the discharge means for quickly emptying the pipes of carbon dioxide vapor that is formed therein as a result of flashing of the liquid carbon dioxide initially released into the piping, pressure fluid operated means for closing said venting valves as soon as a proper working pressure of carbon dioxide vapor has been built up therein, means forming a carbon dioxide flow path between each pressure fluid operated means and the piping upstream of this associated venting valve, and means located in said flow path for throttling the flow of carbon dioxide therethrough to delay the development of said working pressure in the pressure fluid operated means for a predetermined interval of time to prevent the premature closing of the venting valve.

18. In combination, a pipe line into which liquid carbon dioxide is released when required for discharge at a point of use served by said pipe line, a normally open vent valve connected to the pipe lines for release to the atmosphere of the vapor that is formed in the pipe line when liquid carbon dioxide is first released into the pipe line, pressure fluid operated means for closing said vent valve as soon as a proper working pressure of carbon dioxide vapor has been built up therein, means forming a carbon dioxide flow path between said pressure fluid operated means in the pipe line upstream of the vent valve, and means located in said flow path for throttling the flow of carbon dioxide therethrough to provide for the elapse of a predetermined length of time, after liquid carbon dioxide is released into the pipe line, before the said working pressure is built up in said pressure fluid operated means.

19. Means for venting vapor from a pipe line

into which liquid carbon dioxide is occasionally released, comprising a valve body having a carbon dioxide vapor flow path therethrough, a valve member in the valve body movable between two positions for opening and closing said flow path, resilient means normally holding said valve member in its open position, pressure fluid operated means for moving said valve member into its closed position when a predetermined working pressure has been built up therein, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said vapor flow path through the valve body, and means located in said by-pass line for throttling the flow of carbon dioxide therethrough to delay the development of the working pressure in the pressure fluid means for a predetermined interval of time after carbon dioxide has been delivered to the flow path through the valve body.

20. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising a valve body having a carbon dioxide vapor flow path therethrough, a valve member in the valve body movable between two positions for opening and closing said flow path, resilient means normally holding said valve member in its open position, pressure fluid operated means for moving said valve member into its closed position when a predetermined working pressure has been built up therein, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said vapor flow path through the valve body, means located in said by-pass line for throttling the flow of carbon dioxide therethrough to delay the development of the working pressure in the pressure fluid operated means for a predetermined interval of time after carbon dioxide has been delivered to the flow path through the valve body, and a receiver connected in the by-pass line between the throttling means and the pressure fluid operated means to increase the effective volumetric capacity of the pressure fluid operated means to further delay the development of said working pressure in the pressure fluid operated means.

21. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising a valve body having a carbon dioxide vapor flow path therethrough, a valve member in the valve body movable between two positions for opening and closing said flow path, resilient means normally holding said valve member in its open position, pressure fluid operated means for moving said valve member into its closed position when a predetermined working pressure has been built up therein, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said vapor flow path through the valve body, means located in said by-pass line for throttling the flow of carbon dioxide therethrough to delay the development of the working pressure in the pressure fluid operated means for a predetermined interval of time after carbon dioxide has been delivered to the flow path through the valve body, a receiver connected in the by-pass line between the throttling means and the pressure fluid operated means to increase the effective volumetric capacity of the pressure fluid operated means to further delay the development of said working pressure in the pressure fluid operated means, and means for slowly exhausting the vapor from the pressure fluid operated means, after the release of liquid carbon dioxide into said pipe line has ceased, to permit the resilient means to return the vent valve member to its open position.

22. Means for venting vapor from a pipe line into which liquid carbon dioxide is occasionally released, comprising a valve body having a carbon dioxide vapor flow path therethrough, a valve member in the valve body movable between two positions for opening and closing said flow paths, resilient means normally holding said valve member in its open position, pressure fluid operated means for moving said valve member into its closed position when a predetermined working pressure has been built up therein, means forming a carbon dioxide vapor by-pass line between the pressure fluid operated means and said vapor flow path through the valve body, means located in said by-pass line for throttling the flow of carbon dioxide therethrough to delay the development of the working pressure in the pressure fluid operated means for a predetermined interval of time after carbon dioxide has been delivered to the flow path through the valve body, a receiver connected in the by-pass line between the throttling means and the pressure fluid operated means to increase the effective volumetric capacity of the pressure fluid operated means to further delay the development of said working pressure in the pressure fluid operated means, and means for slowly exhausting the vapor from the pressure fluid operated means, after the release of liquid carbon dioxide into said pipe line has ceased, to permit the resilient means to return the vapor vent valve member to its open position.

WALTER W. VOSS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
625,759	Hargrave	May 30, 1899
2,261,080	Stellhorn	Oct. 28, 1941
2,356,990	Getz	Aug. 29, 1944