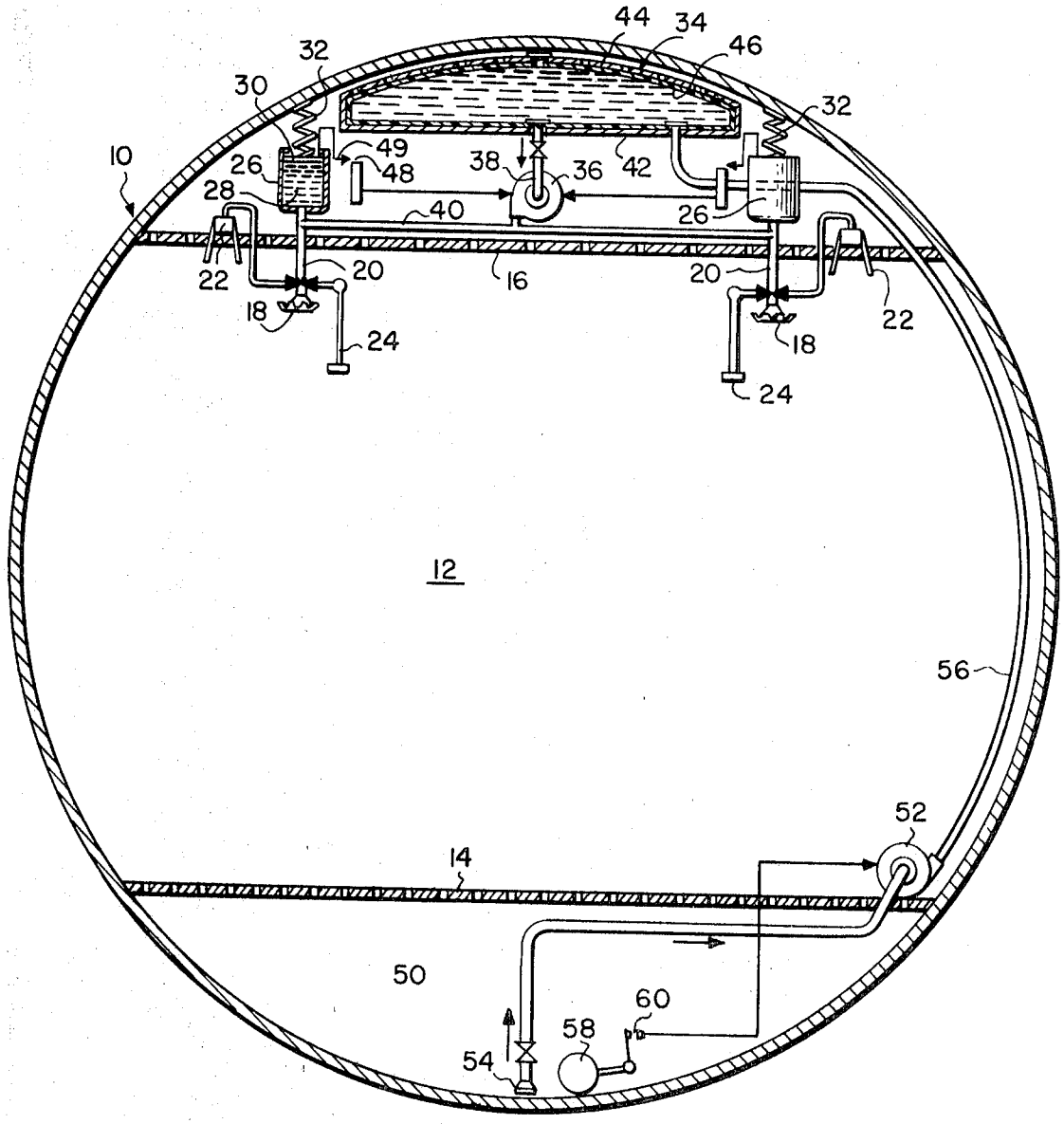
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FIRE PROTECTION SYSTEM FOR VARIABLE PRESSURE CHAMBERS

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FIRE PROTECTION SYSTEM FOR VARIABLE PRESSURE CHAMBERS

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ABSTRACT OF THE DISCLOSURE

A fire protection system for sealed chambers of the type found in such vehicles as diving bells, spaceships and the like wherein variations in ambient pressure occur. The system employs fixed sprinkler heads, each with its own reservoir for extinguishing agent to ensure an initial, instantaneous supply of agent upon actuation of the respective sprinkler heads. The head reservoirs include a pressure transmitting means together with an agent expelling means so that the agent therein is always under a pressure in excess of ambient pressure. The head reservoirs are supplied with agent from a main storage reservoir. Also an agent run-off is collected in a sump and returned to the storage reservoir to conserve agent and avoid flooding.

BACKGROUND OF THE INVENTION

This invention relates to fire protection systems for enclosures subject to variations in pressure and, more particularly, it concerns an improved fire protection system for pressurized enclosures or chambers of the type found in diving bells, submarines, aircraft, spaceships and the like.

Although there is an apparent need for reliable fire protection equipment in pressurized chambers of the type referred to above, a number of problems are encountered in this environment which are not presented in fire protection systems presently used in structures such as buildings and the like. For example, the occupied chambers in submersible vessels such as diving bells and submarines undergo wide variations in ambient pressure. Since the dispersion of a fire extinguishing agent must necessarily be predicted on a difference of agent storage pressure and ambient pressure, an increase in ambient pressure can result in inadequate dispersion of the agent from its storage vessel. Also, in the pressurized enclosures found in diving bells, spaceships or aircraft, it is imperative that a fire extinguishing system be capable of reaching a complete operative condition as quickly as possible to avoid the spreading of fire developing within the enclosure or possibly the development of the fire to a point where structural failures occur.

Fixed fire extinguishing systems of the type in which sprinkler or agent dispersion heads positioned in the space protected and actuated automatically in response to fire temperatures are desirable from the standpoint of reliability and avoidance of the need for human intervention. However, the fluid inertia of such systems heretofore available has resulted in a lag between the time fire temperatures develop and the time a totally efficient spray of fire extinguishing agent is brought to the burning fuel surfaces to extinguish the fire. Hence, in situations where quickness of fire extinguishment is vital, these systems fall short of optimum effectiveness.

Another factor which must be dealt with in the design of a fire prevention system for enclosures of a type mentioned is that of the limited space available in such enclosures. This factor not only contributes further to the need for quick fire extinguishment, but in addition poses problems from a standpoint of the space available for storing an extinguishing agent as well as a danger of flooding the chamber once the extinguishing agent is released. Because of these problems, conventional fire protection equipment is inadequate in vehicular enclosures where an artificial atmosphere is present.

SUMMARY OF THE INVENTION

In accordance with the present invention, a highly effective fixed fire extinguishing system is provided for limited space enclosures in which an artificial atmosphere is used and which are subjected to large variations in ambient pressure. The system contemplates the provision of one or more sprinkler heads for dispersing a fire extinguishing agent, each of which head is associated closely with an agent reservoir equipped with means for transmitting the pressure of the ambient atmosphere within the enclosure to the agent to be dispersed, together with an additional dispersing pressure developing means. The proximity of the reservoir to the sprinkler head minimizes fluid inertia and enables instant dispersion of the agent through the sprinkler head at a pressure differential which is constant regardless of ambient pressure differential. The reservoirs in close proximity to the sprinkler heads or "head reservoirs" are supplied with the extinguishing agent from a main storage reservoir under the combined influence of gravity and a pump automatically actuated in response to a reduction in the amount of agent contained in any one of the head reservoirs. In order to keep at a minimum the space requirements of the agent storage reservoir, and to avoid the deleterious effects of agent run-off, a recirculation system is provided by which the fire extinguishing agent run-off is collected in a sump within the enclosure and pumped back to the main storage reservoir.

Accordingly, among the objects of the present invention are: the provision of a highly effective fire protection system for enclosures subject to ambient pressure variation; the provision of such a fire extinguishing system which enables lightweight construction and conservation of space; the provision of a fire protection system of the type referred to in which fluid inertia of the system is kept at a minimum thereby giving rise to instantaneous actuation upon the detection of a fire; and the provision of a fire protection system for small enclosures in which possible damage by flooding or the like is avoided.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description to follow taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single figure in the drawing is a schematic cross-sectional view through a pressurized enclosure equipped with the fire protection system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing, the reference numeral **10** designates a closed exterior shell capable of withstanding pressure differentials such as those to which diving bells, submarines, aircraft, spaceships and other such vehicular structures might be exposed. Within the shell **10** is a working space **12** defined in part by a floor **14** and a ceiling **16**. The floor **14** and the ceiling **16**, in the embodiment depicted by the drawing, are perforated so as to insure uniform pressure throughout the interior of the shell **10**. It will be appreciated that in practice, the space within the shell **10** will be equipped with various equipment, depending on the intended function to be served by the shell, including means (not shown) for regulating the ambient temperature within the working space **12** and thus within the entire enclosure defined by the shell **10**.

In accordance with the fire protection system of the present invention, a pair of sprinkler or agent dispersion

heads 18 are shown suspended from the ceiling 16 on relatively short vertical pipes 20. Although two such heads are shown in the drawing, it is contemplated that the number of heads employed will vary with the size of the working space 12 to be protected. Although the sprinkler heads, in and of themselves, are conventional, in accordance with the present invention they are fitted to be opened or actuated either in response to a temperature responsive detector 22 or a manually actuated handle 24. The manually actuated handle is desirable in environments with which system of this invention is used to enable the sprinkler heads 18 to be actuated in advance of the time the temperature of a fire reaches the point where the detectors operate automatically to actuate the heads assuming an occupant of the space 12 detects a fire in its very initial stages.

In close proximity to each of the sprinkler heads 18 and in fluid communication with the upper end of the vertical pipes 20, there is provided a relatively small head reservoir 26 containing a supply of fire extinguishing agent 28 which may be a liquid such as water, a gas such as carbon dioxide, a foam producing agent, a fluidized mass of solid particles, or other suitable extinguishing agent. In order to maintain the agent 28 at the ambient pressure within the working space 12, movable fluid barrier means in the form of a piston follower 30 is received over the agent and within the reservoir 26. The piston 30, in practice, will be provided with a suitable hermetic seal (not shown) capable of making sliding engagement with the interior walls of the reservoir 26, and is biased downwardly by a helical compression spring 32 situated between the piston and the shell 10 in the embodiment shown. The spring 32, therefore, in conjunction with the pressure transmitting ability of the piston 30, insures that at all times the agent within the head reservoirs 26 will be under a pressure in excess of ambient pressure by an amount determined by the energy stored within the spring 32. Hence, at the instant a sprinkler head 18 is actuated either by the detector 22 or by the handle 24 associated therewith, an immediate supply of extinguishing agent is available to the particular head actuated. Moreover, the pressure differential between the inside of each head reservoir 26 and the working space 12 will always be at least that exerted by the spring 32 since any increase in pressure within the shell 12 will be transmitted through the piston 30 to the agent 28 in the reservoir 26.

To insure an adequate supply of fire extinguishing agent to the head reservoirs 26 and thus to the sprinkler heads 18, an agent storage reservoir 34 is positioned at the top of the space defined by the shell 10. The agent within the storage reservoir 34 is supplied under the combined effects of gravity and a pump-motor unit 36 having an inlet 38 and a discharge manifold 40 connected respectively to the vertical sprinkler head mounting pipes 20. To insure an immediate supply of extinguishing agent to the inlet pipe 38 of the pump-motor unit 36 and as well to inhibit evaporation of agent from the reservoir 34, the storage reservoir includes a structural container 42 of metal or the like and having apertures 44 on its upper side. Within the container 42 is a vapor impermeable, pressure transmitting flexible bag 46 to contain the agent 28 in the storage reservoir, at ambient pressure.

The transfer of agent from the reservoir 34 to the individual head reservoirs 26 is effected automatically by a switch 48 having one contact element 49 carried by the piston 30 so that as the piston descends within the reservoir 26 the switch 48 closes to energize an electrical circuit to the motor of the pump-motor unit 36. In this way, a continuous supply of agent is available to each of the head reservoirs 26.

Because of the limited space available within the shell 10, it is imperative that the size of the reservoir 34 be kept as small as possible while at the same time providing an effective supply of extinguishing agent. It is also important, because of the size limitations of the chamber within the shell 10, that some provision be made for handling excess liquid agent or run-off which occurs when the sprinkler heads are actuated to extinguish a fire. To this end, a sump chamber 50 is provided under the floor 14 for the collection of excess extinguishing agent resulting from actuation of the sprinkler heads. A second pump-motor unit 52 provided on the floor 14 of the space 12 has its inlet connected with an intake 54 positioned at the bottom of the sump 50 and its discharge outlet connected with a conduit 56 extending to the storage reservoir 34. A float unit 58 within the sump is arranged to close a switch 60 to actuate the motor of the unit 52 and recirculate extinguishing agent from the sump 50 back to the storage reservoir 34.

In operation, it will be apparent that as soon as any one of the sprinkler heads is actuated, either automatically under the control of the detector 22 or manually by the handle 24, the agent 28 within the respective head reservoir 26 will immediately be discharged into the space 12. The removal of agent 28 from the head reservoir 26 will cause the piston 30 to lower, thereby closing the switch 48 to energize the pump-motor unit 36. The unit 36 will operate to transfer agent from the storage receptacle 34 to the head reservoir(s) 26, thereby maintaining a constant supply to the sprinkler head(s) 18. Excess agent passing through the perforated floor 14 and collecting in the sump 50 will cause the float 58 to rise closing the switch 60 to actuate the pump-motor unit 52. When this occurs, the excess agent collected in the sump will be recirculated back to the storage reservoir 34.

Thus it will be appreciated that by this invention there is provided an extremely effective fire protection system for variable pressure enclosures or chambers and by which the above-mentioned objectives are completely fulfilled. Because the agent throughout the system is subjected to ambient pressure, adequate dispersion pressure for the agent is available at all times. Moreover, because of the facility for recirculating agent from the sump 50 back to the storage reservoir, no flooding of the space 12 can occur nor is an excess of agent required to be effective in extinguishing a fire within the space 12.

It will be apparent from those skilled in the art that various modifications and/or additions can be made to the fire protection system of this invention without departing from the true spirit thereof. Accordingly, it is expressly intended that the foregoing description is illustrative of a preferred embodiment only, not limiting, and that the true spirit and scope of the present invention be determined by reference to the appended claims.

We claim:

1. A fire extinguishing system for enclosures subject to variations in internal pressure, said system comprising: at least one sprinkler head for dispersing an extinguishing agent within the enclosure, a reservoir for an extinguishing agent, means to constantly transmit the internal pressure of the enclosure to said agent within said reservoir, pressurizing means to maintain said agent at pressures in excess of ambient pressure within the enclosure, and means establishing controlled agent communication between said reservoir and said sprinkler head.

2. The apparatus recited in claim 1 wherein said reservoir is in close proximity to said sprinkler head so as to minimize the fluid inertia of the system.

3. The apparatus recited in claim 2 including a further storage reservoir for said extinguishing agent, and means to transfer the agent from said further reservoir to said first mentioned reservoir automatically in response to a reduction in the amount of agent therein.

4. The apparatus recited in claim 1 wherein said pressure transmitting means comprises a follower piston positioned in said reservoir over the extinguishing agent, said piston being exposed to ambient pressure within the enclosure.

5. The apparatus recited in claim 4 wherein said pressurizing means comprises an energy storage device con-

nected to said piston and being operable to exert a force on said follower tending to expel the agent from said reservoir.

6. The apparatus recited in claim 5 wherein said energy storage device comprises a helical compression spring acting against the side of said piston exposed to ambient pressure.

7. In a closed chamber of a type provided internally with an artificial atmosphere subject to variations in pressure, a working space, and a fire protection system for said working space, said system comprising a storage reservoir for a fire extinguishing agent, a sprinkler head for dispersing the agent into said working space, a head reservoir for the agent separate from said storage reservoir said head reservoir being in close proximity to said sprinkler head and in direct fluid communication therewith, pressure transmitting means for maintaining the agent in said head reservoir at the ambient pressure of said working space irrespective of variations in said ambient pressure, agent expelling means to exert a pressure on the agent in said head reservoir in excess of ambient pressure, and means to transfer the agent from said storage reservoir to said head reservoir in response to a reduction in the amount of agent within said head reservoir.

8. The apparatus recited in claim 7 including means defining a sump beneath said working space to collect excess amounts of recirculatable agent dispersed within said working space and means to return excess agent collected in said sump to said storage reservoir.

9. The apparatus recited in claim 8 wherein said means to return said excess agent to said storage reservoir comprises a pump-motor unit having an intake in said sump and means for actuating said pump-motor unit in response to the level of agent in said sump.

10. The apparatus recited in claim 7 including pressure transmitting means in said storage reservoir to maintain the agent therein also at ambient pressure.

11. The apparatus recited in claim 7 wherein said pressure transmitting means comprises a movable piston in sealing engagement with the interior of said head reservoir, one side of said piston being in contact with the agent in said reservoir and the other side of said piston being exposed to ambient pressure.

12. The apparatus recited in claim 11 wherein said agent expelling means comprises an energy storage device connected to said other side of said piston and operable to exert a constant force against said piston.

13. The apparatus recited in claim 7 wherein said pressure transmitting means comprises a piston in slidable sealing engagement with the interior of said head reservoir, one side of said piston being in contact with said agent whereas the other side of said piston is exposed to ambient pressure and wherein said agent transferring means comprises a pump having its intake connected to said storage reservoir and its discharge in fluid communication with said head reservoir, and means carried by said piston for actuating said pump.

14. The apparatus recited in claim 7 including both manual and automatic means for actuating said sprinkler head.

15. The apparatus recited in claim 7 including a plurality of said sprinkler heads, and a head reservoir for each of said sprinkler heads.

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