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[54] **FIRE EXTINGUISHING SYSTEM**

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[51] **Int. Cl.**.....**A62c 35/22**

[58] **Field of Search**.....169/1, 2, 5, 14, 169/26, 37, 41, 42

[56] **References Cited**

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[57] **ABSTRACT**

Disclosed is an automatic fire extinguishing system with a temperature controlled sprinkler head assembly. Included within the head is a reservoir containing a chemical fire extinguishing agent that combines with fluid flowing therethrough to form a medium with superior fire extinguishing qualities. A valve within the sprinkler head automatically and repeatedly opens in response to conditions associated with a fire and closes in response to a change in those conditions.

18 Claims, 3 Drawing Figures

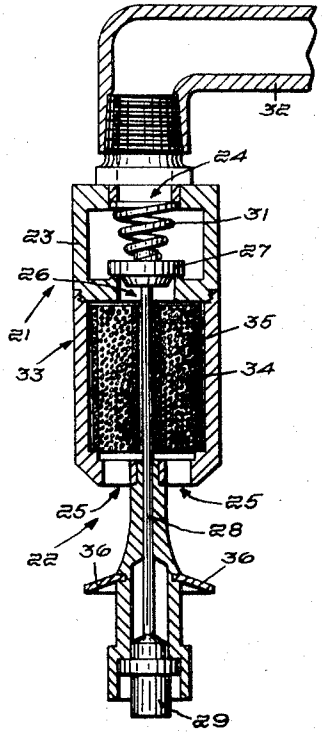


Fig. 1.

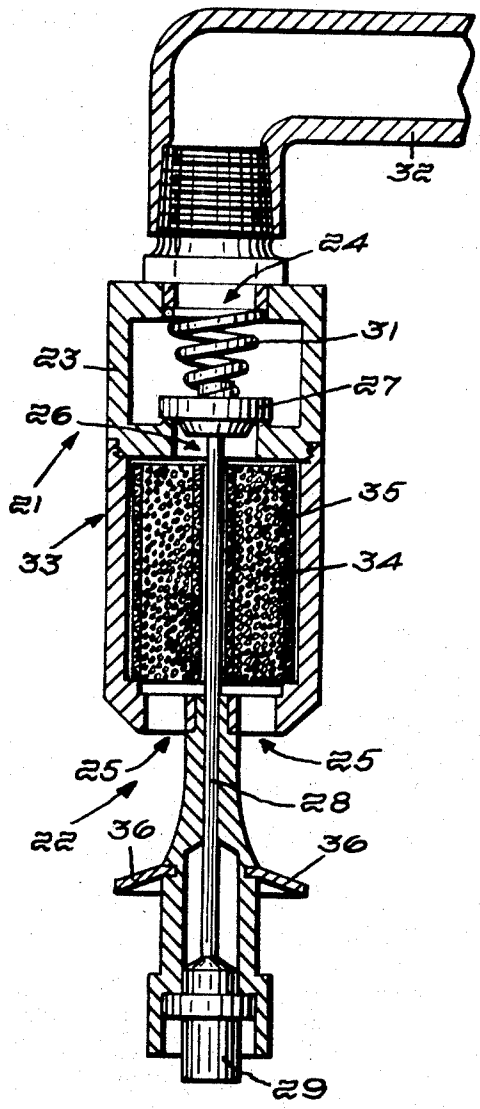


Fig. 2.

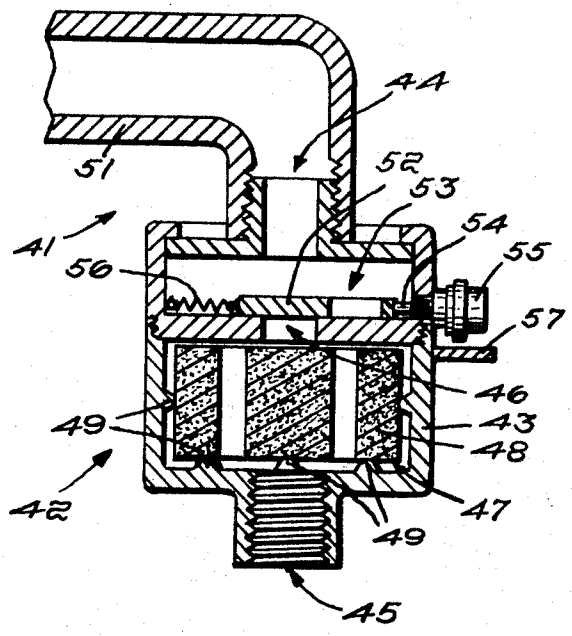
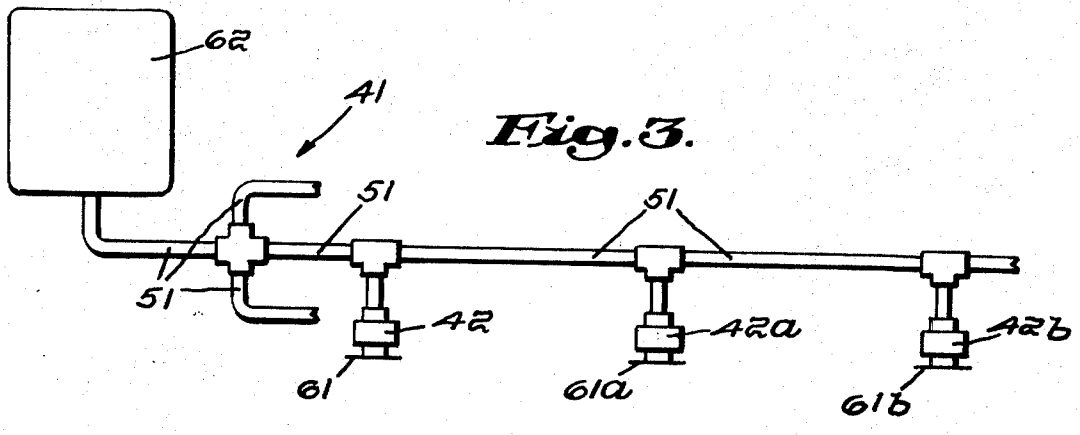


Fig. 3.



FIRE EXTINGUISHING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to sprinkler heads and automatic fire extinguishing systems and more particularly to such systems that utilize a chemical fire extinguishing medium.

Automatic fire extinguishing systems are useful for quickly controlling fires. The general acceptance of such systems is evidenced by their extensive use in commercial buildings such as factories, office buildings, apartment houses, stores etc. In addition, their use has expanded recently for the protection of homes in residential areas. Conventional systems usually include a plurality of individual sprinkler heads (valve and nozzle combinations) connected to a common water source, with each valve independently controlled by a temperature sensing element. As heat from a fire is detected by a temperature sensing element, the sprinkler associated therewith is activated. Unfortunately, the water delivered by the sprinklers is usually in quantities insufficient to extinguish fires and these conventional systems serve only to control or inhibit the spread of fires. Various chemical agents with fire extinguishing properties more efficient than those of water are available and systems to make use of these chemicals are known. Most such systems are generally similar to the water based systems, but utilize a tank containing the chemical agent as a fluid source. For protection of large areas, however, the costs of the supply tanks are excessive. Consequently, chemical extinguishing systems are generally employed only to protect areas of limited size or those retaining special types of costly equipment such as electronics which are highly sensitive to water damage. Also, many chemical agents are unstable in liquid form and therefore require special care and periodic replacement even if unused. Or the agent may be corrosive and consequently degrade the overall system in time. Because of these and other problems chemical systems are not widely used and water remains the most common extinguishing agent in automatic sprinkler systems.

The object of this invention therefore, is to provide an economical and efficient fire extinguishing system with enhanced fire control and extinguishing properties derived from the use of a chemical fire extinguishing agent.

SUMMARY OF THE INVENTION

This invention is characterized by automatic fire extinguishing system including a common source of fluid fire extinguishing agent connected to a plurality of sprinkler heads. Each sprinkler head includes a body that defines an inlet, an outlet and a fluid flow passage therebetween, and includes a reservoir within the passage. A solid chemical fire extinguishing agent in the reservoir combines with fluid flowing therethrough to provide a fire fighting medium with superior fire extinguishing qualities that can quickly contain or extinguish a fire. Also provided for each sprinkler is a valve that is responsive to a condition responsive actuator and selectively controls the flow of fluid through the passage. The actuator may be responsive to any of the conditions associated with fire. Provision in an automatic and quickly responsive system of the composite extinguishing medium is advantageous in that prompt extinguishment of a fire reduces damage to adjacent areas

by spreading fire, smoke or the water used in conventional systems. In addition, storage of the chemical agent in each head alleviates the above noted problems associated with prior chemical type extinguishing systems. A further advantage is that each individual sprinkler head in a system can be provided with a specific chemical agent most effective for protecting the materials in the area covered by that head.

The reservoir containing the solid chemical agent is positioned in the passage between the valve and the outlet so that contact between the liquid and solid fire extinguishing agents is prevented until the valve is actuated. This is advantageous in that the agents chosen for any individual application may react in such a way that the useful fire fighting properties of the resultant product persist for only a short period of time following combination. In the subject sprinkler head combination of the liquid and solid agents is prevented until the moment of use.

A feature of the invention is the inclusion of a support within the reservoir to properly center the solid agent, and thereby insure free flow of fluid through the passage and even exposure of the solid chemical agent to the fluid agent passing thereby. Two support embodiments are disclosed. One includes a cage composed of screen mesh to hold a particulate fire extinguishing agent in the path of fluid flow so as to cause the fluid to flow therethrough. The second embodiment comprises a plurality of shoulder spacers on the walls of the reservoir to maintain a predetermined minimum separation between the walls and a solid block of fire fighting agent, thereby assuring free flow of fluid agent between the block and the walls. It is obvious that free flow of the fluid fire extinguishing agent is desirable in that restricted flow will reduce the efficiency of the sprinkler head. The disclosed support systems for assuring free flow are simple, economical and reliable. In addition, the embodiments disclosed also insure proper exposure of the solid chemical fire fighting agent to the liquid fire fighting agent thereby insuring that the combination therebetween proceeds at a desirable known rate.

Another feature of the invention is the inclusion of an automatic closure spring mechanism for stopping the flow of fluid fire fighting agent when a fire is extinguished. Most conventional sprinkler heads are of the "one shot" type, and once a head is activated water continues to flow until the source is stopped. A problem with these previous systems is that of resultant water damage following small fires that are quickly extinguished or false actuations. For example, a grease fire in a kitchen may be confined to one frying pan and easily extinguished simply by placing a cover over the pan. If a conventional "one shot" valve were activated by the heat of that fire, fluid would continue to flow until cut off at its source. This superfluous water flow is even more significant in the present system because of the fire fighting efficiency of the chemical agent used. Although fires are rapidly extinguished by the subject system, a continued flow of fire fighting agent from a sprinkler the cause local damage equivalent to that which would be expected if the fire had been contained rather than extinguished. In order that damage may be truly minimized the subject valve is automatically closed by a condition signifying extinguishment of the fire, for example, a decrease in ambient temperature.

DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a sectioned elevation view of a sprinkler head including a reservoir with solid fire inhibiting agent therein;

FIG. 2 is another preferred embodiment of a sprinkler head with a reservoir containing a solid fire fighting agent; and

FIG. 3 is a schematic diagram of a preferred automatic fire extinguishing system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1 there is shown a fire extinguishing system **21** including a sprinkler head **22** with a body **23** that defines an inlet **24,** outlets **25** and a fluid flow passageway **26** therebetween. Connected to the inlet **24** is a fluid supply pipe **32** that conveys a fluid fire fighting agent from a fluid supply tank (not shown). A valve washer **27** in the passageway **26** is connected by a rod **28** to a condition sensor **29.** An expansible crystalline material within the sensor **29** exhibits a substantial volume increase in response to an ambient temperature increase to a temperature above a critical melting point, and in the event of such an increase the sensor, through the rod **28,** forces the valve washer **27** in an upward direction against the resistance of a bias closure spring **31** to an open position. When the ambient temperature falls below the critical melting point, the expansible material contracts, and the bias closure spring **31** forces the washer **27** to a closed position, thereby preventing further fluid flow through the passageway **26.** A more complete description of resettable valves will be found in the co-applicants' copending U. S. Application Ser. No. 143,394 filed May 14, 1971 and entitled "Automatic Fire Sprinkler Head". Between the valve washer **27** and the outlets **25** is a reservoir **33** containing crystalline solid fire inhibiting chemicals **34** within a torroidally shaped screen mesh support **35.** When the valve washer **27** is in the open position fluid flowing through the reservoir **33** also flows through the crystalline agent **34** and may react therewith. The wire mesh support **35** holds the agent **34** slightly separated from the inner walls of the reservoir **33** so that free flow of fluid therethrough is assured, yet proper interaction is provided. Disposed below the outlets **25** is a shield **36** to disperse the eflux from the sprinkler head **22.**

The sensor **29** is chosen with a critical melting point above normal ambient room temperature. Therefore, during operation of the embodiment **21** the ambient temperature is normally below the critical melting point so the sensor **29** remains inactivated, and the closure spring **31** holds the valve washer **27** in the closed position obstructing the fluid passage **26.** In the event of a fire, the ambient temperature will rise, and upon the temperature reaching the critical melting point the sensor **29** will become activated and through the rod **28** move the valve washer **27** to the open position. Fluid from the supply reservoir then proceeds from the pipe **32,** past the washer **27** and flows through and around the crystalline fire fighting agent **34.** The fluid in the tank and the agent **34** are chosen so as to react on contact to form an effective fire fighting agent. For example, the fluid in the reservoir may be water, and the solid fire fighting agent can be Aerosol® OT 100 percent (SPS No.8866) Surface Active Agent sold by American Cyanamid Co. Often such fluid and solid fire fighting agent combinations will be effective for only a brief period of time after combination. The sprinkler head **22** is advantageous in that combination is prevented until actuation of the sensor **29** in response to the presence of a fire. In the event that the fire is extinguished before human help is available the continued flow of fluid through the sprinkler head **22** serves no useful function and only causes further damage. Consequently, when the ambient temperature drops below the critical melting point due to extinguishment of the fire, the closure spring **31** forces the washer **27** to the closed position thereby causing a cessation of fluid flow.

Referring now to FIG. 2 there is shown a portion of an alternate fire extinguishing system **41** including a sprinkler head **42** with a body **43** that defines an inlet **44** and an outlet **45** with a fluid flow passage **46** therebetween. Within the passage **46** is a reservoir **47** containing a block of solid chemical fire fighting medium **48.** A plurality of spacing shoulders **49** on the inner walls of the reservoir **47** retain the chemical block **48** in a central position therein. A fluid supply pipe **51** connected to the inlet **44** provides fluid communication to a fluid supply (not shown) and a valve element **52** defining a valve opening **53** therein selectively controls the fluid flow through the passage **46.** An actuator rod **54** provides mechanical coupling of the valve element **52** to a condition responsive actuator **55.** In response to a specific predetermined condition the actuator **55,** through the rod **54,** displaces the valve element **52** so as to position the opening **53** within the passage **46,** thereby permitting fluid flow. such actuation is achieved only when the force exerted by the actuator **55** overcomes a counterforce exerted by a bias closure spring **56.** In response to a different predetermined temperature condition, for example, the condition of the ambient temperature falling below the critical melting point, the actuator **55** is reset by the force of the closure spring **56,** thereby stopping fluid flow through the passage **46.** Therefore, the valve element **52** is sensitive to a specific critical temperature and is moved to an open position in response to the ambient temperature rising above the critical temperature and is moved to a closed position in response to the ambient temperature falling below the critical temperature. A deflector (not shown) similar to those used in conventional fire extinguishing systems is attached below the outlet **45** to disperse fluid egressing therefrom. A small deflector **57** is disposed below the actuator **55** to prevent fluid from splashing onto the actuator and causing cooling. A more complete discussion of resettable valves is contained in the above cited application Ser. No. 143,394.

The critical temperature of the actuator **55** is chosen to be above normal room temperature. Therefore, during operation of the embodiment **41** the valve element **52** is normally in a closed position and there is no fluid flow within the passage **46.** Consequently, the fluid and the solid chemical agent **48** can be chosen to exhibit efficient fire fighting properties when combined even if such properties are evident for only a short period of time after combination. In the event of a fire, as the ambient temperature rises above the critical temperature, the actuator **55,** through the rod **54,** disposes the open-

ing 53 within the passage 46 thereby permitting fluid flow therethrough. Fluid proceeding from the pipe 51 through the passage 46 flows over and around the block 48, and may react therewith. The fire fighting agent resulting from the combination of the fluid and the chemical block 48 is dispersed upon the fire through the outlet 45. Inasmuch as the agent passing from the outlet 45 is a highly efficient fire fighter, the fire may be quickly extinguished and in order that damage be truly minimized the flow through the passage 46 must be stopped. This is accomplished automatically since the closure spring 56 moves the valve element 52 to a closed position as the ambient temperature falls after extinguishment of the fire. Consequently, the sprinkler head 42 distributes the composite fire fighting agent only in the presence of heat, and automatically ceases the distribution when such activating heat is removed. The spacing shoulders 49 insure free fluid flow around the block 48, such free flow being necessary for effective operation of the sprinkler head 42.

Referring next to FIG. 3 there is shown another view of the system 41 including the fluid supply pipe 51 and the sprinkler head 42 with a deflector 61 shown. As shown in FIG 3, the fluid supply pipe 51 connects the sprinkler head 42 to a fluid supply source 62 and also connects a plurality of other sprinkler heads 42*a* and 42*b* to the fluid supply source. In order that sufficient fluid pressure be available from the source 62, it is shown above the sprinkler heads 42, 42*a* and 42*b* in FIG 3. For example, the source 62 may be placed on the roof of the building sought to be protected. In addition to the sprinkler heads 42, 42*a* and 42*b*, additional heads may connected to the fluid supply 51 as needed to protect the entire building. All the sprinkler heads 42*a* and 42*b* are similar to the head 42. Therefore, only the sprinkler heads 42, 42*a* or 42*b* sensing an ambient temperature rise passed the critical temperature will be activated, and those activated will automatically turn off in response to a decreasing ambient temperature, as results from the extinguishment of a fire.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. For example, the condition sensors 29 and 55 can be made responsive to the presence of smoke rather than changes in ambient temperature. In addition, the sprinkler head 22 can be used in a multi-head system as described with respect to FIG. . It is to be understood, therefore, that the invention can be practiced otherwise than as specifically described.

What is claimed is:

1. Fire extinguishing apparatus comprising a sprinkler head which in turn comprises:
   a. a body portion defining an inlet, an outlet and a fluid flow passage therebetween; said passage comprising a reservoir portion adapted to retain a chemical fire extinguishing medium;
   b. supply means providing a fluid communication path between said inlet and a supply of fluid;
   c. a valve means disposed within said passage for selectively controlling the flow of fluids therethrough, said valve means operable to an open position to produce mixing of the extinguishing medium and fluid prior to discharge thereof through said outlet; and
   d. a condition responsive actatuor coupled to said valve means and for providing actuation thereof in response to a predetermined condition.

2. Fire extinguishing apparatus comprising a sprinkler head according to claim 1 wherein said reservoir portion is disposed in said passage between said valve means and said outlet.

3. Fire extinguishing apparatus comprising a sprinkler head according to claim 1 wherein said reservoir portion encloses support means for supporting the chemical fire extinguishing medium so as to be contacted by fluid flowing into said reservoir while permitting exit thereof from said outlet.

4. Fire extinguishing apparatus comprising a sprinkler head according to claim 3 wherein said support means comprises a screen mesh.

5. Fire extinguishing apparatus comprising a sprinkler head according to claim 3 wherein said support means comprises spacing means for spacing a block of fire extinguishing medium from the internal surface of said reservoir.

6. Fire extinguishing apparatus comprising a sprinkler head according to claim 1 wherein said condition responsive means comprises a temperature responsive sensor adapted to open said valve means in response to a given ambient temperature.

7. Fire extinguishing apparatus comprising a sprinkler head according to claim 1 further comprising closure means for automatically closing said valve in response to a different condition.

8. Fire extinguishing apparatus comprising a sprinkler head according to claim 6 further comprising a closure means for automatically closing said valve in response to a different ambient temperature.

9. Fire extinguishing apparatus comprising a sprinkler head according to claim 1 including a quantity of chemical fire extinguishing medium within said reservoir.

10. Fire extinguishing apparatus comprising a sprinkler head according to claim 9 wherein said quantity of chemical is in the form of a porous block.

11. Fire extinguishing apparatus comprising a sprinkler head according to claim 9 wherein said quantity of chemical is in crystalline form.

12. Fire extinguishing apparatus comprising a sprinkler head according to claim 14 including supply means providing a fluid communication path between said inlet and a fluid supply.

13. Fire extinguishing apparatus according to claim 12 including a plurality of additional sprinkler heads, each of said additional heads comprising:
   a. a body portion defining an inlet, an outlet and a fluid flow passage therebetween; said passage comprising a reservoir portion adapted to retain a chemical fire extinguishing medium;
   b. a valve means disposed within said passage for selectively controlling the flow of fluids therethrough; and
   c. a condition responsive actuator coupled to said valve means and for providing actuation thereof in response to a predetermined condition.

14. Fire extinguishing apparatus comprising a sprinkler head which in turn comprises:
   a. a body portion defining an inlet, an outlet and a fluid flow passage therebetween; said passage comprising a reservoir portion adapted to retain a chemical fire extinguishing medium;
   b. a valve means disposed within said passage for selectively controlling the flow of fluids therethrough; and

c. a combustion products responsive actuator coupled to said valve means and for providing actuation thereof in response to a predetermined condition, and wherein said reservoir portion is disposed in said passage between said valve means and said outlet.

15. Fire extinguishing apparatus comprising a sprinkler head according to claim **14** wherein said reservoir portion encloses support means for supporting the chemical fire extinguishing medium so as to be contacted by fluid flowing into said reservoir while permitting exit thereof from said outlet.

16. Fire extinguishing apparatus according to claim **14** including a plurality of additional sprinkler heads, each of said additional heads comprising:

a. a body portion defining an inlet, an outlet and a fluid flow passage therebetween; said passage comprising a reservoir portion adapted to retain a chemical fire extinguishing medium;

b. a valve means disposed within said passage for selectively controlling the flow of fluids therethrough; and

c. a combustion products responsive actuator coupled to said valve means and for providing actuation thereof in response to a predetermined condition, and wherein said reservoir portion is disposed in said passage between said valve means and said outlet.

17. Fire extinguishing apparatus comprising a sprinkler head according to claim **14** including a quantity of chemical fire extinguishing medium within said reservoir.

18. Fire extinguishing apparatus comprising a sprinkler head according to claim **17** wherein said quantity of chemical is in the form of a porous block.

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