Nov. 7, 1972 W. J. GRENIER 3,702,160

SUPPRESSOR DEVICE FOR AUTOMATIC ON-OFF SPRINKLER HEAD

Filed May 28, 1971 2 Sheets-Sheet 1

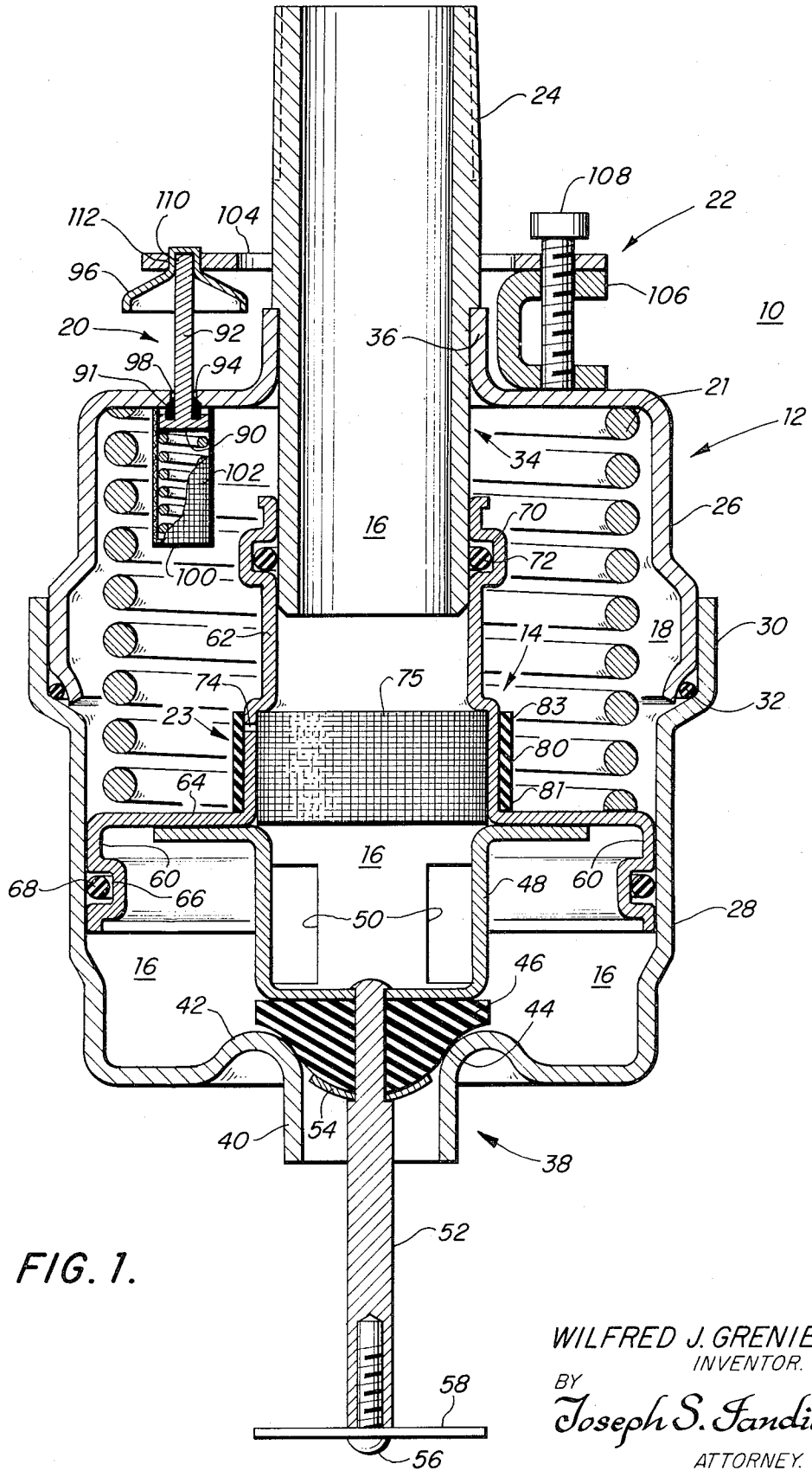


FIG. 1.

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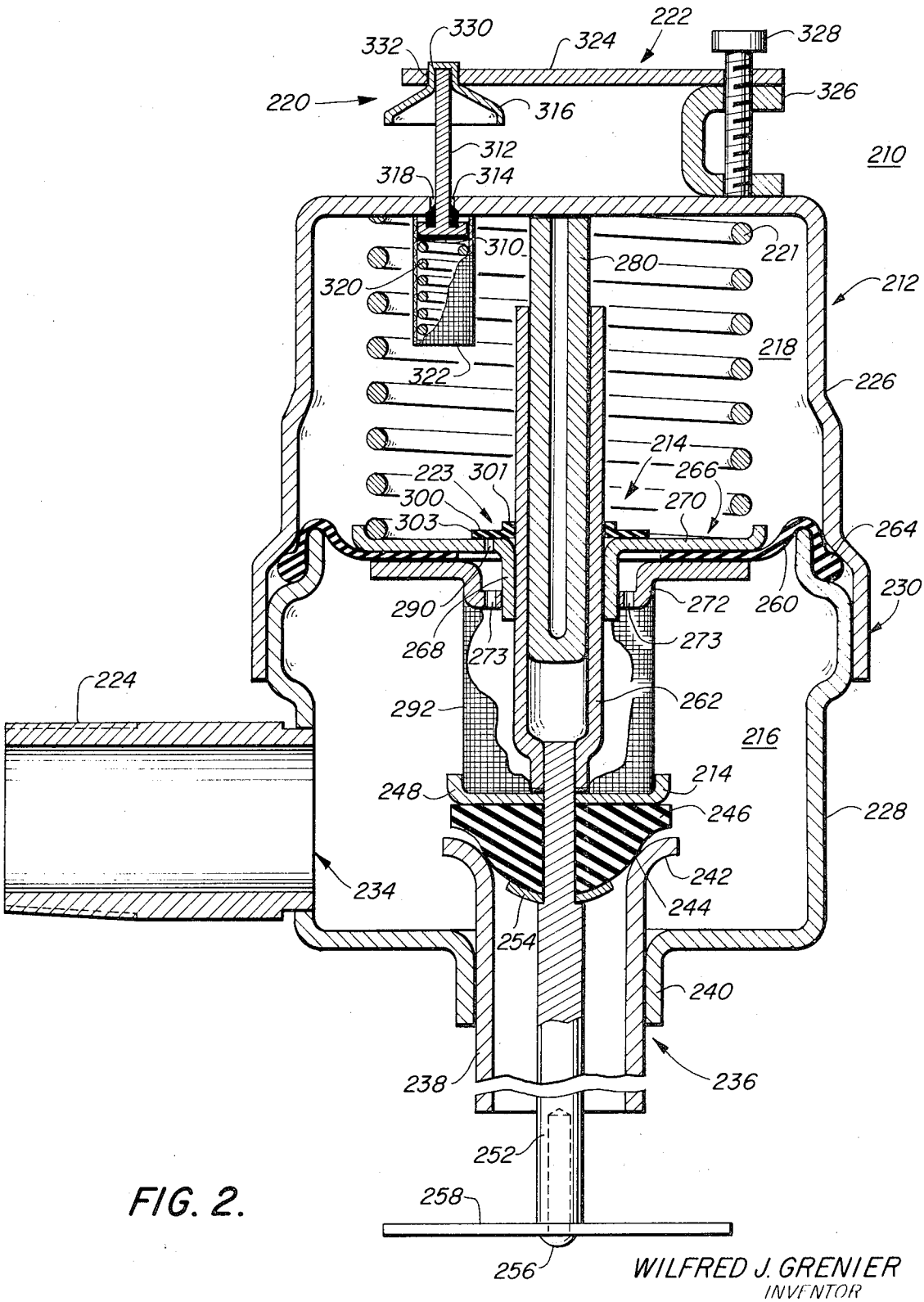


FIG. 2.

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SUPPRESSOR DEVICE FOR AUTOMATIC ON-OFF SPRINKLER HEAD

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U.S. Cl. 169—20 24 Claims

ABSTRACT OF THE DISCLOSURE

A suppressor device for a sprinkler head having a control chamber and a primary chamber interconnected by a passage including a unidirectional valve member for permitting flow through the passage from the primary chamber to the control chamber when the pressure in the primary chamber exceeds that in the control chamber and preventing flow in the other direction through the passage from the control chamber to the primary chamber when the pressure in the control chamber exceeds that in the primary chamber.

FIELD OF INVENTION

This invention relates to a suppressor device for an automatic on-off sprinkler head.

BACKGROUND OF THE INVENTION

Conventional sprinkler heads now in general use employ a plug of fusible material which, when subjected to temperatures above a predetermined level, melts and opens the head permitting water or other fire quenching fluid to escape and douse the fire. Since by operation of the head the plug is destroyed, the head remains on and continues to spue forth fluid even after the temperature has subsided. Recent activity in the field of sprinkler heads has produced an improved automatic on-off sprinkler head which turns on when the temperature reaches a predetermined level and automatically turns off when the temperature decreases below that level. One type of automatic on-off sprinkler head has a control chamber and a primary chamber which are flooded with the fluid. When the pressure in the chambers is more or less equal a spring bias force is permitted to close the head. The pressure in the chambers is permitted to equalize through an interconnecting passage. In the event of a fire a heat responsive device included in the head operates to vent the control chamber causing the pressure therein to be quickly decreased. The resulting pressure differential produces a force differential which enables the force developed by the pressure in the primary chamber to overcome the spring bias force and open the head. Since the sprinkler head is connected directly on line the head is constantly subject to variations in line pressure. Over a period of time the line pressure fluctuates upward and downward. If a decrease in pressure is gradual the pressure in the control chamber follows closely that in the primary chamber and little excess force is developed. If the decrease in pressure is sudden the pressure in the control chamber lags that in the primary chamber because of the time required for the pressures in the two chambers to equalize through the interconnecting passage. But this lag is not a problem in such cases because such a lag leaves the pressure in the control chamber higher than that in the primary chamber, and that condition can only produce a force that reinforces the closing force on the head. However, when increases in line pressure are considered the result is somewhat different. If an increase in pressure is gradual the pressure in the control chamber follows closely that in the primary chamber and little excess force is

developed. But if an increase is sudden the pressure rise in the control chamber lags that in the primary chamber because of the time required for the pressures to equalize through the interconnecting passage. The momentary greater pressure in the primary chamber can develop an excess force that opposes the closing force on the head. Thus if the increase in pressure is sufficiently sudden and sufficiently large the head may be improperly turned on. The chances of such an accidental turning on are increased when a sudden increase has followed a gradual decrease which has lowered the pressure in the control chamber.

SUMMARY OF INVENTION

It is therefore an object of this invention to provide a suppressor device for suppressing spurious operation of a sprinkler head due to variations in line pressure.

It is a further object of this invention to provide a suppressor device for reducing backflow from the control chamber to the primary chamber of a sprinkler head.

It is a further object of this invention to provide a suppressor device which permits each increase in line pressure to be communicated to the control chamber but prevents communication to the control chamber of each decrease in pressure.

This invention features a suppressor device for a sprinkler head having a primary chamber and a control chamber interconnected by a passage. A unidirectional valve member permits flow through the passage from the primary chamber to the control chamber when the pressure in the primary chamber exceeds that in the control chamber but prevents flow in the other direction through the passage from the control chamber to the primary chamber when the pressure of the control chamber exceeds that in the primary chamber.

DISCLOURE OF PREFERRED EMBODIMENTS

Other objects, features and advantages will occur from the following description of preferred embodiments and the accompanying drawings, in which:

FIG. 1 is a cross-sectional elevational view of an automatic on-off sprinkler head with a suppressor device according to this invention.

FIG. 2 is a cross-sectional elevational view of an alternative automatic on-off sprinkler head with a suppressor device according to this invention.

The sprinkler head of this invention may be constructed using a housing and a movable partition which sealingly engages with the housing to provide a primary chamber and a control chamber. The housing includes an inlet port and an outlet port in the primary chamber; the inlet port is adapted for connection with a source of fire quenching fluid which is distributed through the outlet port. A passage interconnecting the two chambers, preferably located in the partition, permits the fluid provided at the inlet port to fill the control chamber as well as the primary chamber. Thus the pressure in the two chambers equalizes and the resultant force on the partition is balanced. A valve element connected to the partition is provided to close the outlet port. A biasing device, such as a spring, is used to apply a positive force to the partition in this balanced condition to insure proper seating of the valve element with the outlet port. The outlet port may include a valve seat and the valve element may be made of resilient material to improve the valving action. A control valve in the control chamber is opened by a heat responsive device when a predetermined temperature is reached. Upon the opening of this control valve the fluid in the control chamber is vented to a lower pressure, usually atmospheric pressure, so that the pressure in the control chamber is substantially re-

duced relative to that in the primary chamber. The difference in pressure between the two chambers produces a resultant force on the partition sufficient to move it and so also move the valve element away from the outlet port. The sprinkler head is now on and discharges the fire quenching fluid. After the fire subsides and the temperature decreases the heat responsive device permits the control valve, usually spring loaded, to return to the closed position. The fluid entering through the inlet port enters through the passage interconnecting the chambers and fills the control chamber and enables the pressures in the two chambers to once again equalize. When the pressures are equalized the spring force moves the partition to position the valve element to close the outlet port and shut off the sprinkler head.

In one embodiment, FIG. 1, sprinkler head **10** includes a housing **12** with a partition **14** that creates two chambers, primary chamber **16** and control chamber **18**, a control valve **20**, spring **21**, heat responsive device **22**, and suppressor device **23**.

Housing **12** includes nipple **24**, upper section **26** and lower section **28** joined together at seam **30** where there may be located an O ring **32** for additional sealing. Inlet port **34** is formed by nipple **24** fitted in collar **36** and outlet port **38** is formed at collar **40**. Nipple **24** extends through control chamber **18** into primary chamber **16**. Raised shoulder **42** provides a valve seat **44** for valve element **46** connected to partition **14** by bracket **48** which is formed with large holes **50** to permit free flow of fluid therethrough. Valve element **46** is preferably formed of resilient material such as rubber and fastened in place by stem **52**. A rigid cap **54** may be used to prevent distortion of valve element **46**. At the lower end of stem **52** there is, secured by screw **56**, distributor plate **58** for distributing the fire quenching fluid.

Partition **14** includes cylindrical base **60**, cylindrical neck **62** and intermediate annular member **64**. Base **60** slidingly engages section **28** of housing **12** and has a channel **66** for retaining O ring **68**. Neck **62** slidingly engages nipple **24** and includes a channel **70** for retaining O ring **72**. Passage **74** interconnects chambers **16** and **18** to permit chamber **18** to fill from chamber **16** and to permit the pressures in the chambers to equalize. A screen **75** may be used to prevent dust particles from reaching passage **74**.

Suppressor device **23** may include a unidirectional check valve, cuff **80**, provided at passage **74** to help prevent sudden changes in line pressure in chamber **16** from accidentally turning on head **10**. Cuff **80** is a flap of resilient material, such as rubber, whose lower periphery **81** tightly grips the base of cylindrical neck **62** and whose upper periphery **83** is free to flap against neck **62** to seal the end of passage **74** in chamber **18**. Cuff **80** permits flow through passage **74** from chamber **16** to chamber **18** when line pressure increases but prevents back-flow from chamber **18** to chamber **16** when line pressure decreases. Suppressor device **23** provides two functions. It prevents back-flow from chamber **18** to chamber **16** when the line pressure in chamber **16** decreases. This back-flow, if permitted, would lower the pressure in chamber **18** and make the head more vulnerable to spurious operation by a subsequent sudden surge or increase in line pressure. Suppressor device **23** also enables an increase in line pressure in chamber **16** to be communicated through passage **74** to chamber **18** by pushing cuff **80** away from the end of passage **74**. A subsequent return to normal line pressure or decrease in line pressure in chamber **16** does not reduce the pressure in chamber **18** because cuff **80** prevents back-flow. Thus cuff **80** functions to accumulate in chamber **18** increases in line pressure in chamber **16**; chamber **18** thereby stores higher pressures and enhances the ability of the head to suppress unwanted operation caused by sudden surges or increases in line pressure.

Control valve **20** includes a valve element **90** on valve stem **92** which passes through vent hole **94** and supports hood **96**. Valve element **90** including resilient portion **91** is urged closed against seat **98** by spring **100** in screened enclosure **102**.

Heat responsive device **22** includes a bimetallic element **104** mounted on bracket **106** fastened to section **26** of housing **12**. Screw **108** threadably engages with holes in bimetallic element **104** and the top and bottom of bracket **106** to provide adjustment of bimetallic element **104**. The neck **110** of hood **96** is engaged in hole **112** in bimetallic element **104**.

In operation, at normal temperatures, control valve **20** is held closed by spring **100**; the pressure in chamber **18** is equal to that in chamber **16** so that the force exerted by spring **21** on partition **14** holds valve element **46** against seat **44** closing outlet port **38** and maintaining head **10** in the off condition. When the surrounding temperature increases to a predetermined level bimetallic element **104** reacts by moving downward at its free end thereby moving valve element **90** off its seat **98** and opening control valve **20**. The fluid in chamber **18** is thus vented to the atmosphere through vent hole **94** thereby reducing the pressure in chamber **18**. The difference in pressure thus created between chambers **16** and **18** produces a force on partition **14** sufficient to overcome that executed by spring **21** and partition **14** is moved upward. Valve element **46** fixed to partition **14** is likewise moved upward off of seat **44** and outlet port **38** is opened. Head **10** is now in the on condition and fire quenching fluid is discharged from outlet port **38** and distributed by distributor plate **58**.

After the fire is out and the temperature decreases, the free end of bimetallic element **104** moves upwardly and permits hood **96**, stem **92** and valve element **90** to move upward under the urging of spring **100** until valve element **90** is once again closed on seat **98**. When control valve **20** is closed, fluid entering through passage **74** begins to accumulate in chamber **18** and the pressure in chamber **18** approaches that in chamber **16**. When the pressures in the two chambers are substantially equal the force of spring **21** moves partition **14** downwardly and valve element **46** closes outlet port **38** restoring head **10** to the off condition.

In an alternative embodiment, FIG. 2, sprinkler head **210** includes a housing **212** with a partition **214** that creates two chambers, primary chamber **216** and control chamber **218**, a control valve **220**, the spring **221**, heat responsive device **222**, and suppressor device **223**.

Housing **212** may include a nipple **224**, upper section **226** and lower section **228** joined together at seam **230**. Housing **212** includes an inlet port **234** and an outlet port **236** in primary chamber **216**. Outlet port **236** may include outlet tube **238** fitted in collar **240**. Tube **238** may be formed with a flared end **242** to provide valve seat **244** for valve element **246** connected to partition **214** by bracket **248**. Valve element **246** is preferably formed of resilient material such as rubber and fastened in place by stem **252**. A rigid cap **254** may be used to prevent distortion of valve element **246**. At the lower end of stem **252** there is, secured by screw **256**, distributor plate **258** for distributing the fire quenching fluid.

Partition **214** includes diaphragm **260** and slide **262** connected therewith. Diaphragm **260** may be a resilient material such as rubber and may include a peripheral bead **264** which when gripped between sections **226** and **228** at seam **230** serves to support diaphragm **260** and slide **262**, and improve the seal between sections **226** and **228**. Slide **262** may be interconnected with diaphragm **260** by means of support member **266** having a collar **268** fixed to slide **262** and an annular area **270** engaged with diaphragm **260** and a second support member **272** fixed to slide **262** and also engaged with diaphragm **260**. Diaphragm **260** is held between members **266** and **272** by any

suitable means such as a friction fit, adhesive material or the like.

Slide **262** is a hollow tubular form which is adapted to slide on and sealingly engage guide **280** fixed to section **226**.

Passage **290** interconnects chambers **216** and **218** to permit chamber **218** to fill from chamber **216** and to permit the pressures in the chambers to equalize. Member **272** has a plurality of holes **273** in it to provide free flow of fluid therethrough and to insure communication between passage **290** and the rest of chamber **216**. A screen **292** may be used to prevent dirt particles from reaching pasage **290**.

Suppressor device **223** may include a unidirectional check valve, flat ring **300** provided at passage **290** to help prevent sudden changes in line pressure from accidentally turning on head **210** in the same manner as cuff **80**, FIG. 1. Ring **300** may be a flap of resilient material, such as rubber, whose inner periphery **302** tightly grips slide **262** and whose outer periphery **303** is free to flap against member **266** to seal the end of passage **290** in chamber **218**. Ring **300** permits flow through passage **290** from chamber **216** to chamber **218** when line pressure increases but prevents back-flow from chamber **218** to chamber **216** when line pressure decreases. Suppressor device **223** provides two functions. It prevents back-flow from chamber **218** to chamber **216** when the line pressure in chamber **216** decreases which back-flow would lower the pressure in chamber **218** and make the head more vulnerable to spurious operation by a subsequent sudden surge or increase in line pressure following the decrease in pressure. Suppressor device **223** also enables an increase in line pressure in chamber **216** to be communicated through passage **290** to chamber **218** by pushing ring **300** away from the end of passage **290**. A subsequent return to normal line pressure or decrease in line pressure in chamber **216** does not reduce the pressure in chamber **218** because ring **300** prevents back-flow. Thus ring **300** functions to accumulate in chamber **218** increases in line pressure in chamber **216**; chamber **218** thereby stores higher pressures and enhances its ability to suppress unwanted operation by sudden surges or increases in line pressure.

Control valve **220** includes a valve element **310** on valve Stem **312** which passes through vent hole **314** and supports hood **316**. Valve element **310** including resilient portion **311** is urged closed against seat **318** by spring **320** in screened enclosure **322**.

Heat responsive device **222** includes a bimetallic element **324** mounted on bracket **326** fastened to section **226** of housing **212**. Screw **328** is threadably engaged in holes in bimetallic element **324** and the top and bottom of bracket **326** to provide adjustment of bimetallic element **324**. The neck **330** of hood **316** is engaged in hole **332** in bimetallic element **334**.

In operation, at normal temperatures, control valve **220** is held closed by spring **320**, the pressure in chamber **218** is equal to that in chamber **216** so that the force exerted by spring **221** on partition **214** holds valve element **246** against seat **244** closing outlet port **236** and maintaining head **210** in the off condition. When the surrounding temperature increases to a predetermined level bimetallic element **324** reacts by moving downward at its free end thereby moving valve element **310** off its seat **318** and opening control valve **220**. The fluid in chamber **218** is thus vented to the atmosphere through vent hole **314** thereby reducing the pressure in chamber **218**. The difference in pressure thus created between chambers **216** and **218** produces a force on partition **214** sufficient to overcome that exerted by spring **221** and partition **214** is moved upward. Valve element **246** fixed to partition **214** is likewise moved upward off of seat **244** and outlet port **236** is opened. Head **210** is now in the on condition and fire quenching fluid is discharged from outlet port **236** and distributed by distributor plate **258**.

After the fire is out and the temperature decreases, the free end of bimetallic element **324** moves upwardly and permits hood **316**, stem **312** and valve element **310** to move upward under the urging of spring **320** until valve element **310** is once again closed on seat **318**. When control valve **220** is closed, fluid entering through passage **290** begins to accumulate in chamber **218** and the pressure in chamber **218** approaches that in chamber **216**. When the pressures in the two chambers are substantially equal the force of spring **221** moves partition **214** downwardly and valve element **246** closes outlet port **238** restoring head **210** to the off condition.

Other embodiments will occur to those who are skilled in the art and are within the following claims.

What is claimed is:

1. An automatic on-off sprinkler head comprising:
- a housing;
- a movable partition sealingly engaging said housing for dividing said housing into two chambers, a primary chamber and a control chamber; said housing including an inlet port in said primary chamber adapted for connection with a source of fire quenching fluid, and an outlet port in said primary chamber for dispensing fire quenching fluid;
- a control valve in said control chamber;
- a heat responsive device for operating said control valve to turn on the sprinkler head above a predetermined temperature and turn off the sprinkler head below that temperature;
- a valve element connected with said partition for closing said outlet port;
- biasing means for producing a force on said partition to urge said valve element to close said outlet port;
- a passage interconnecting said primary and control chambers for enabling equalization of pressure therein; and
- a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

2. The sprinkler head of claim **1** in which said unidirectional valve member includes a flap of resilient material mounted in said control chamber covering said passage.

3. The sprinkler head of claim **1** in which said movable partition includes a base for sealingly, slidingly engaging said housing and a neck for sealingly, slidingly engaging said inlet port and an intermediate member interconnecting said base and said neck.

4. The sprinkler head of claim **3** in which said base and said neck are generally cylindrical and said intermediate member is generally annular.

5. The sprinkler head of claim **3** in which said inlet port includes an inlet tube, extending through said control chamber into said primary chamber, for sealingly slidingly engaging said neck.

6. The sprinkler head of claim **1** in which said passage extends through said partition.

7. The sprinkler head of claim **1** in which said outlet port includes a valve seat for sealing engagement with said valve element.

8. The sprinkler head of claim **1** in which said valve element includes a resilient material.

9. The sprinnkler head of claim **1** in which said biasing means includes a spring member located in said control chamber.

10. The sprinkler head of claim **1** further including a distributor device for distributing the fluid discharged from said outlet port.

11. The sprinkler head of claim **1** in which said partition includes a diaphragm sealingly engaged with said housing.

12. The sprinkler head of claim 11 in which said partition further includes a slide member connected with said diaphragm.

13. The sprinkler head of claim 12 in which said slide member includes an intermediate member for interconnecting said slide member and said diaphragm.

14. The sprinkler head of claim 12 further including a guide member mounted within said housing for slidingly engaging said slide member.

15. An automatic on-off sprinkler head including a housing, a movable partition sealingly engaging said housing for dividing said housing into two chambers; a primary chamber and a control chamber, said housing including an inlet port in said primary chamber adapted for connection with a source of fire quenching fluid, and an outlet port in said primary chamber for dispensing fire quenching fluid, said movable partition including a base for sealingly slidingly engaging said housing, a neck for sealingly slidingly engaging said inlet port, and an intermediate member interconnecting said base and said neck, a control valve in said control chamber, a heat responsive device for operating said control valve to turn on said sprinkler head above a predetermined temperature, and turn off said sprinnkler head below that temperature, a valve element connected with said partition for closing said outlet port; biasing means for producing a force on said partition to urge said valve element to close said outlet port, a passage interconnecting said primary and control chambers for enabling equalization of pressure therein, and a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

16. The sprinkler head of claim 15 in which said unidirectional valve member includes a flap of resilient material mounted in said control chamber covering said passage.

17. An automatic on-off sprinkler head, including a housing, a movable partition sealingly engaging said housing for dividing said housing into two chambers: a primary chamber and a control chamber, said partition including a diaphragm sealingly engaged with said housing and a slide member connected with said diaphragm, said housing including an inlet port in said primary chamber adapted for connection with a source of fire quenching fluid and an outlet port in said primary chamber for dispensing fire quenching fluid and a guide member for slidingly, sealingly engaging said slide member, a control valve in said control chamber, a heat responsive device for operating said control valve to turn on said sprinkler head above a predetermined temperature, and turn off said sprinkler head below that temperature, a valve element connected with said partition for closing said outlet port biasing means for producing a force on said partition to urge said valve element to close said outlet port, a passage interconnecting said primary and control chambers for equalization of pressure therein, and a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

18. The sprinkler head of claim 17 in which said unidirectional valve member includes a flap of resilient material mounted in said control chamber covering said passage.

19. A suppressor device for a sprinkler head having a control chamber and a primary chamber interconnected by a passage comprising:

a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

20. The suppressor device of claim 19 in which said unidirectional valve member includes a flap of resilient material mounted in said control chamber covering said passage.

21. In an automatic on-off sprinkler head including a housing, a movable partition sealingly engaging said housing for dividing said housing into two chambers; a primary chamber and a control chamber, said housing including an inlet port in said primary chamber adapted for connection with a source of fire quenching fluid, and an outlet port in said primary chamber for dispensing fire quenching fluid, said movable partition including a base for sealingly slidingly engaging said housing, a neck for sealingly slidingly engaging said inlet port, and an intermediate member interconnecting said base and said neck, a control valve in said control chamber, a heat responsive device for operating said control valve to turn on said sprinkler head above a predetermined temperature, and turn off said sprinkler head below that temperature, a valve element connected with said partition for closing said outlet port; biasing means for producing a force on said partition to urge said valve element to close said outlet port, and a passage interconnecting said primary and control chambers for enabling equalization of pressure therein, the improvement comprising a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

22. The sprinkler head of claim 21 in which said unidirectional valve member includes a flap of resilient material mounted in said control chamber covering said passage.

23. In an automatic on-off sprinkler head including a housing, a movable partition sealingly engaging said housing for dividing said housing into two chambers; a primary chamber and a control chamber, said partition including a diaphragm sealingly engaged with said housing and a slide member connected with said diaphragm, said housing including an inlet port in said primary chamber adapted for connection with a source of fire quenching fluid and an outlet port in said primary chamber for dispensing fire quenching fluid and a guide member for slidingly, sealingly engaging said slide member, a control valve in said control chamber, a heat responsive device for operating said control valve to turn on said sprinkler head above a predetermined temperature, and turn off said sprinkler head below that temperature, a valve element connected with said partition for closing said outlet port, biasing means for producing a force on said partition to urge said valve element to close said outlet port, and a passage interconnecting said primary and control chambers for equalization of pressure therein, the improvement comprising a unidirectional valve member for permitting flow through said passage from said primary chamber to said control chamber when the pressure in said primary chamber exceeds that in said control chamber and preventing flow in the other direction through said passage from said control chamber to said primary chamber when the pressure in said control chamber exceeds that in said primary chamber.

24. The sprinkler head of claim 23 in which said unidirectional valve member includes a flap of resilient ma-

terial mounted in said control chamber covering said passage.

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