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Livingston

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[54] **DISCHARGE HEAD HAVING A MAGNETIC PLUG RETAINING ASSEMBLY**

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[52] **U.S. Cl.** **169/37,** 251/65

[51] **Int. Cl.** **A62c 37/08**

[58] **Field of Search** ..... 251/65 X; 169/37–42, 20, 21

[56] **References Cited**

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[57] **ABSTRACT**

A pressure responsive discharge head wherein an expellable plug is disposed in the outlet of a body member having an inlet adapted for connection to a source of extinguishant. A magnetic assembly applies a magnetic force to retain the plug in the outlet in the absence of a predetermined fluid pressure in the body member sufficient to overcome the magnetic force.

22 Claims, 5 Drawing Figures

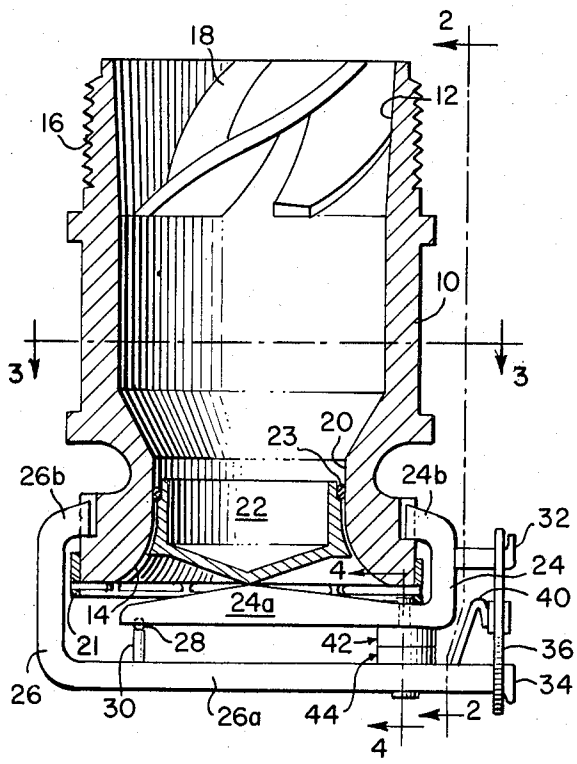


FIG. 1.

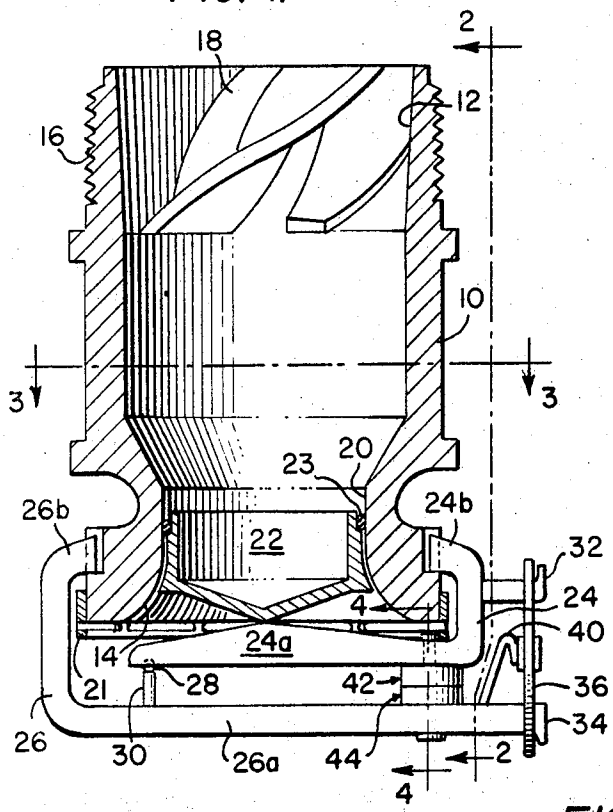


FIG. 2.

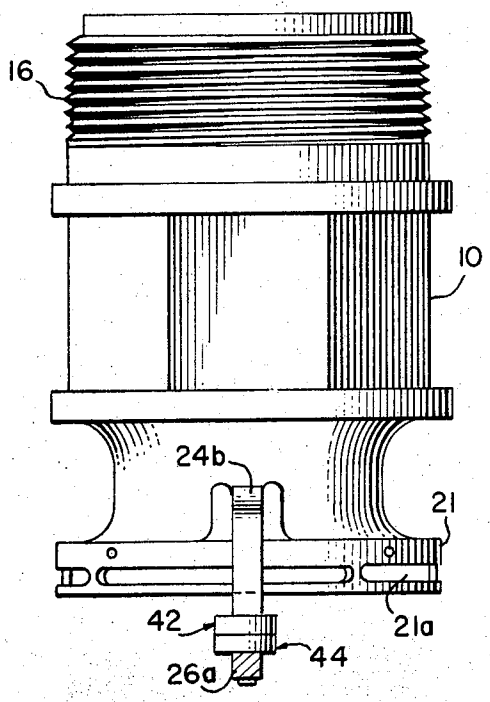


FIG. 4.

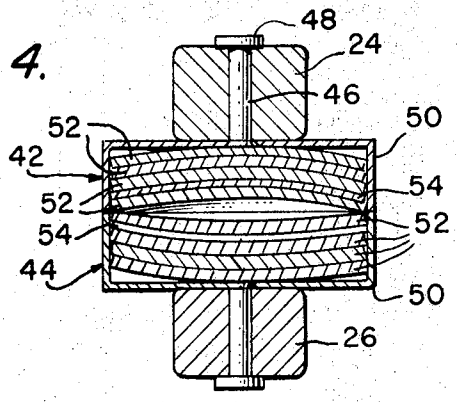


FIG. 3.

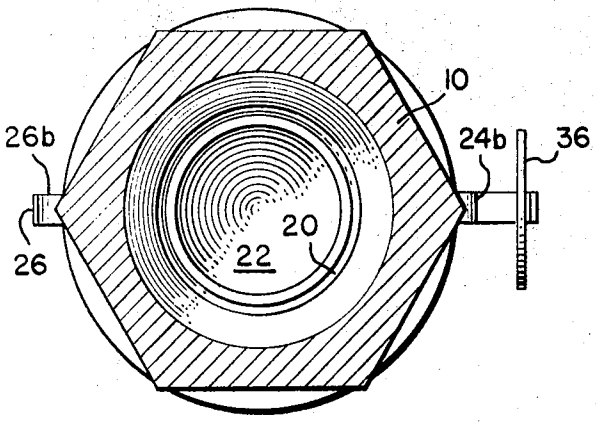
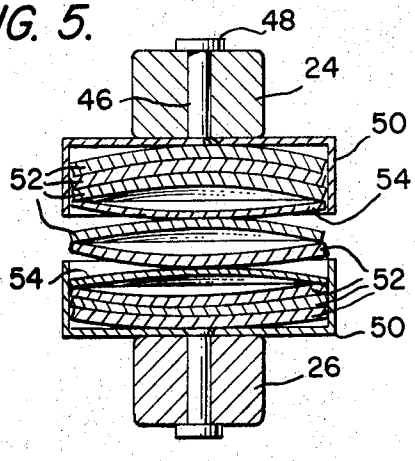


FIG. 5.



DISCHARGE HEAD HAVING A MAGNETIC PLUG RETAINING ASSEMBLY

BACKGROUND OF THE INVENTION

The invention relates to a discharge head and, more particularly, to a discharge head in which the discharge of fluid therefrom is controlled in response to the pressure of fluid in the head.

Several applications exist for a discharge head in which the flow therefrom is controllable in response to the fluid pressure existing in the head. For example, in applicant's U.S. Pat. No. 3,653,444, assigned to the same assignee as the present application, a fixed fire extinguishing system is disclosed which incorporates a plurality of direct discharge heads spaced apart greater distances and having larger outlet orifices when compared to conventional sprinkler heads, to enable greater quantities of water, or other extinguishant, to be delivered from each head at lower flow rates. Preferably, the heads are in the form of wide angle spray nozzles which develop a downwardly directed spray having large size droplets as compared to the droplets produced by the conventional sprinkler heads. According to one of the main features of the system disclosed in this patent, the number of nozzles activated to discharge the extinguishant is limited in order to prevent nozzles located a relatively long distance from the fire to rob more closely located nozzles of valuable extinguishant and extinguishant pressure, and in order to prevent unnecessary water damage.

With this arrangement, the first nozzle actuated by the fire has a much better possibility of extinguishing the fire, because of its ability to retain a predetermined discharge density and the increased ability of the larger droplets to penetrate the fire plume of a high challenge fire. Of course, if the heat of the fire spreads, a limited number of additional nozzles are actuated to help the first nozzle fight the fire and to wet down areas surrounding the fire to provide exposure protection to inhibit the spread of the fire, with the number of additional nozzles that are allowed to be actuated being limited to a small predetermined number in accordance with the foregoing.

According to a preferred embodiment of the above-mentioned system, the above is achieved by establishing a pressure floor so that a minimum pressure must exist at each nozzle before it will open, with the system being designed so that this minimum pressure will not be reached until a predetermined number of nozzles have been opened. The hardware used to establish the pressure floor includes an expellable plug normally blocking the outlet of the nozzle and adapted to be expelled from the nozzle to permit extinguishant flow therethrough upon both the fusing of a conventional temperature responsive device and the presence of a fluid pressure in the nozzles of a magnitude exceeding a predetermined value. In establishing the latter value, a helical compression spring is utilized to latch the expellable plug in a closed position. The design is such that the extinguishant pressure in the nozzle acts upon the helical spring and has to be of a value to overcome the force of the spring before the expellable plug can be released.

In U.S. Pat. application Ser. No. 346,454, filed Mar. 30, 1973, and also assigned to the same assignee as the present invention, a discharge head is disclosed which

incorporates the pressure floor feature discussed above in a different manner. In accordance with the latter disclosure, the expellable plug is maintained in a flow blocking position relative to the discharge head by means of a pair of fulcrummed levers. A fusible link maintains the levers in the plug retaining position and is responsive to a predetermined temperature for releasing the levers. A spring clip is also provided which maintains the levers in the plug retaining position by virtue of its inherent spring force which, if overcome by the fluid pressure in the body member, releases the lever. The spring clip is soldered relative to the levers by means of a fusible material to provide a failsafe or redundant thermal override which, upon the occurrence of the elevated temperature required to fuse the latter material, permits the plug to release from the head despite the fact that the pressure existing in the latter is insufficient to release the plug.

Although this design proved to be very worthwhile in many respects, it was difficult to ascertain the precise pressure at which the spring clip would permit release of the levers and therefore the plug. Also, the clip could not be readily adjusted to vary its spring force to accommodate changes in the pressure floor requirements for each head and/or system as a result of variations in the particular areas to be protected from fire.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a discharge head of the above type which incorporates all of the advantages of the heads discussed above, yet which enables the plug retaining force to be accurately and precisely obtained.

It is a further object of the present invention to provide a discharge head of the above type in which the plug retaining force can be varied in a relatively simple manner.

Towards the fulfillment of these and other objects, the discharge head of the present invention comprises a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means adapted to attain a position relative to said body member in which it prevents the discharge of fluid from said outlet, and magnetic means for applying a magnetic force to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force, to permit the discharge of fluid from said outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of the discharge head of the present invention as shown in a fully assembled condition;

FIG. 2 is a cross-sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is an enlarged cross-sectional view taken along the line 4—4 of FIG. 1; and

FIG. 5 is a view similar to FIG. 4 but showing the relative positions of the magnetic discs incorporated in the head of the present invention after actuation of the thermally responsive snap discs.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring specifically to FIGS. **1–3** of the drawings, the discharge head of the present invention consists of a hollow cylindrical body member **10** having an inlet **12** formed at one end thereof and an outlet **14** formed in the other end thereof.

The outer surface of the body member **10** is threaded as shown in **16** near the inlet end to permit the head to be connected to a conduit for supplying fluid, such as water, to the head. By way of example, the conduit could form a portion of a fire extinguishing system, in which case the fluid would be in the form of a fire extinguishant, such as water.

A swirl vane **18** is disposed inside the body member **10** near the inlet end **12** thereof for imparting a swirling action to the water as it passes through the head in a conventional manner. A portion of the inner surface of the body member **10** is of a reduced diameter to define a throat **20** which extends into a flared portion forming the outlet **14.**

As a result of the foregoing arrangement, water introduced into the inlet **12** is swirled as it passes through the body member **10** with its flow being accelerated as it passes through the throat portion **20** for discharge in a substantially conical discharge pattern from the outlet **14.**

As better shown in FIG. **2,** a ring assembly **21** is fastened to the outer surface of the body member **10** near the outlet opening **14** and defines a plurality of arcuate slots **21***a* which communicate with the interior of the body member **10.** As a result, a portion of the water passing through the body member **10** will be discharged from the slots **21***a* in a substantially radial direction to supplement the main discharge from the outlet **14.** In this manner, the radially extending discharge provides a "fill in" pattern between the main discharge from adjacent body members **10.**

The outlet **14** is normally closed by means of a cylindrical plug member **22** the outer surface of which has a portion of a diameter slightly less than that of the inner surface of throat **20,** and a portion defining a notch which receives a seal ring **23** engaging the inner surface of throat **20.**

The plug member **22** is retained in the position shown by means of a pair of levers **24** and **26.** In its plug retaining position, the lever **24** has a horizontal leg portion **24***a* engaging the plug **22,** and a shoulder portion **24***b* extending in a groove formed in the outer wall of the body member **10.** In a similar manner, the lever **26** has a horizontal extending leg portion **26***a* and a horizontal shoulder portion **26***b* also extending in a groove formed in the body member **10.** The leg portion **26***a* of the lever **26** is fulcrummed relative to the leg portion **24***a* of the lever **24** about a ball **28** resting on an adjustable pin **30** supported by the leg portion **26***a.*

A pair of tabs **32** and **34** extend from the levers **24** and **26,** respectively, in a spaced relationship. A fusible link **36,** formed of a material that is adapted to fuse, or melt, at a predetermined elevated temperature, connects the tabs **32** and **34,** and therefore maintains the levers **24** and **26** in their operative position shown, retaining the plug **22** in the outlet **14.**

A doubled-over leaf spring **40** is affixed at one end to the lever **26,** with the other doubled-over end portion engaging the link **36** to urge same outwardly from the body member **10,** for reasons that will be described in detail later.

A pair of magnetic assemblies shown in general by the reference numerals **42** and **44** are connected to the levers **24** and **26,** respectivley, and are better shown with reference to FIG. **3.** In particular, the magnetic assembly **42** consists of a stem **46** extending through a corresponding bore formed through the lever **24** and having a head **48** affixed to one end thereof for retaining the assembly relative to the lever. A cup-shaped support **50** is affixed to the other end of the stem **46** for receiving a plurality of stacked magnetic discs **52** therein. The magnetic discs **52** may be constructed in any conventional manner, such as by coating a ceramic disc with a magnetic material, or the like. A thermal responsive snap disc **54** is interposed between the two outermost magnetic discs **52** with all of the discs having a slightly concave form when viewed from the top with reference to FIG. **4.** The snap disc **54** is of a conventional design and is adapted to snap, or move, from its concave form shown in FIG. **4,** to a convex form as shown in FIG. **5** in response to a predetermined elevated temperature in its vicinity, which temperature is greater than that required to melt the link **36.** This movement separates the discs **52** adjacent the snap disc **54** for reasons that will be described in detail later. Since the magnetic assembly **44** is identical to that of the assembly **42,** the respective components are given the same reference numerals and will not be described in any further detail.

The magnetic assemblies **42** and **44** are mounted on the levers **24** and **26,** respectively, with their respective discs **52** in alignment. The design of the assemblies **42** and **44** are such that they create a magnetic force therebetween which normally connects the lever **26** to the lever **24** in the position shown in FIG. **1.**

In operation, the discharge head of the present invention is assembled in its operative position shown in FIGS. **1–4** with the levers **24** and **26** retaining the plug **22** in the outlet **14,** and being maintained in this position by means of the link **36** and the cooperating magnetic assemblies **42** and **44.**

Upon the occurrence of a predetermined elevated temperature in the vicinity of the link **36** in response to a fire breaking out in the space to be protected, the link **36** will start to melt. Upon the structural integrity of the link **36** decreasing a predetermined amount as a result of the melting, the leaf spring **40** will push the link outwardly to break its connection between the levers **24** and **26.** After this occurs, if the water pressure in the body member **10** acting on the plug **22** is sufficient to force the plug outwardly from the outlet **14** against the magnetic force provided by the magnetic assemblies **42** and **44** through the levers **24** and **26,** the levers will fall downwardly from their operative position shown in FIG. **1** by gravity, to permit the plug to discharge from the outlet.

In the event the fluid pressure in the body member **10** is not sufficient to overcome the magnetic force provided by the magnetic assemblies **42** and **44** after the link **36** melts, the levers **24** and **26** will remain in their operative positions retaining the plug **22** in the outlet **14.** This condition will be maintained unless the temperature rises to a value sufficient to actuate the snap discs **54** and thus cause them to snap from the position shown in FIG. **4** to the position of FIG. **5,** as discussed above. This latter movement will cause the magnetic

discs 52 adjacent the respective snap discs 54 to separate to an extent that they are no longer magnetically attracted, resulting in a breaking of the connection between the levers 24 and 26 provided by the magnetic assemblies 42 and 44.

As a result, the levers 24 and 26 will be released, thus permitting the plug member 22 to discharge from the outlet 14. The snap discs 54 thus provide a redundant, or failsafe, type of release in the event the fire builds to an extent that their actuation temperature is reached. It can be appreciated that, although only one snap disc 54 is essential to the above operation, two are employed in order to increase the reliability.

It is thus seen that the head of the present invention enables the plug retaining force to be accurately and precisely applied. Also, the plug retaining force can easily be varied by simply changing the type or number of magnetic discs in one or more of the assemblies 42 and 44. Further, with the several independent surfaces of cleavage available, the disconnect reliability of the magnetic assemblies 42 and 44 is high. Still further, since the lines of magnetic force are focused within the respective stacks of magnetic discs 52, the effect of hostile ambient conditions should be negligible. Still further, the use of the leaf spring 40 will prevent a premature partial melting of the link 36 and a possible rehardening of same in the event the temperature should drop after the link is partially melted, which, of course, would change the thermal characteristics of the link and affects its operational predictability.

Of course, other variations of the specific construction and arrangement of the discharge head disclosed above can be made by those skilled in the art without departing from the invention as defined in the appended claims.

I claim:

1. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, a plug means adapted to extend in said outlet in said flow preventing position and prevent the discharge of fluid from said outlet, a pair of fulcrummed levers for supporting said plug means relative to said body member in said outlet, and magnetic means for applying a magnetic force to said levers to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force to permit the discharge of fluid from said outlet.

2. The head of claim 1 further comprising a fusible link normally engaging said levers to maintain them in said position supporting said plug means, said fusible link being responsive to a predetermined temperature in the vicinity of said body member for releasing said engagement, said plug means releasing from said flow preventing position under the force of said fluid upon the existence of both said predetermined temperature and said predetermined fluid pressure.

3. The head of claim 1 wherein said magnetic means comprises a first magnetic assembly supported by one of said levers and a second magnetic assembly supported by the other of said levers, each of said magnetic assemblies including at least one magnetic member for creating said magnetic force.

4. The head of claim 3 wherein each magnetic assembly comprises a support member connected to a corresponding lever, said magnetic member being in the form of a magnetic disc supported by said support member.

5. The head of claim 4 wherein each support member has a cup-shaped portion and wherein there are a plurality of magnetic discs disposed in each cup-shaped portion.

6. The head of claim 5 wherein the number of magnetic discs disposed in said cup-shaped portion is variable to vary the value of said magnetic force.

7. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means adapted to attain a position relative to said body member in which it prevents the discharge of fluid from said outlet, magnetic means for applying a magnetic force to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force to permit the discharge of fluid from said outlet, and means responsive to a predetermined temperature in the vicinity of said body member for releasing said magnetic force despite the absence of said predetermined fluid pressure.

8. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, a plug means adapted to extend in said outlet in said flow preventing position and prevent the discharge of fluid from said outlet, a pair of fulcrummed levers for supporting said plug means relative to said body member in said outlet, magnetic means for applying a magnetic force to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force to permit the discharge of fluid from said outlet, and means responsive to a predetermined temperature in the vicinity of said body member for releasing said magnetic force despite the absence of said predetermined fluid pressure.

9. The head of claim 8 wherein corresponding faces of said discs are of a substantially concave shape and wherein said means for releasing said magnetic force comprises a snap disc disposed in its cup-shaped portion and having one face normally of a concave shape substantially corresponding to the shape of said discs, said snap-disc adapted to snap to a position where said one face is of a substantially convex shape in response to said predetermined temperature to separate said magnetic discs and overcome said magnetic force to permit the release of said levers from said position supporting said plug member, and the release of said plug member from said flow preventing position despite the absence of said predetermined fluid pressure.

10. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, a plug means adapted to extend in said outlet and prevent the discharge of fluid from said outlet, a pair of fulcrummed levers for supporting said plug means relative to said body member in said outlet, a fusible link normally engaging said

levers to maintain them in said position supporting said plug means, said fusible link being responsive to a predetermined temperature in the vicinity of said body member for releasing said engagement, and magnetic means for applying a magnetic force to said levers to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force, said plug means releasing from said flow preventing position under the force of said fluid upon the existence of both said predetermined temperature and said predetermined fluid pressure to permit the discharge of fluid from said outlet.

11. The head of claim **10** wherein said magnetic means comprises a first magnetic assembly supported by one of said levers and a second magnetic assembly supported by the other of said levers, each of said magnetic assemblies including at least one magnetic member for creating said magnetic force.

12. The head of claim **11** wherein each magnetic assembly comprises a support member connected to a corresponding lever, said magnetic member being in the form of a magnetic disc supported by said support member.

13. The head of claim **12** wherein each support member has a cup-shaped portion and wherein there are a plurality of magnetic discs disposed in each cup-shaped portion.

14. The head of claim **13** wherein the number of magnetic discs disposed in said cup-shaped portion is variable to vary the value of said magnetic force.

15. The head of claim **13** further comprising means responsive to an additional predetermined temperature in the vicinity of said body member for releasing said magnetic force despite the absence of said predetermined fluid pressure.

16. The head of claim **15** wherein corresponding faces of said discs are of a substantially concave shape and wherein said means for releasing said magnetic force comprises a snap disc disposed in its cup-shaped portion and having one face normally of a concave shape substantially corresponding to the shape of said discs, said snap-disc adapted to snap to a position wherein said one face is of a substantially convex shape in response to said additional predetermined temperature to separate said magnetic discs and overcome said magnetic force to permit the release of said levers from said position supporting said plug means and the release of said plug means from said flow preventing position despite the absence of said predetermined fluid pressure.

17. The head of claim **16** wherein the predetermined temperature to which said snap disc responds is greater than the predetermined temperature to which said fusible link responds.

18. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means adapted to attain a position relative to said body member in which it prevents the discharge of fluid from said outlet, and magnetic means for applying a magnetic force to retain said plug means in said flow preventing position, said magnetic means being adapted to release said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force to permit the discharge of fluid from said outlet, said magnetic force being variable.

19. A discharge head comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means adapted to attain a position relative to said body member in which it prevents the discharge of fluid from said outlet, thermal responsive means engaging said plug means for retaining said plug means in said discharge preventing position, said thermal responsive means permitting the release of said plug means from said body member in response to a predetermined temperature in the vicinity of said body member, and magnetic means for applying a magnetic force to retain said plug means in said discharge preventing position, said magnetic means permitting the release of said plug means from said flow preventing position in response to a predetermined fluid pressure existing in said body member sufficient to overcome said magnetic force, said plug means releasing from said flow preventing position under the force of said fluid upon the existence of both said predetermined temperature and said predetermined fluid pressure to permit the discharge of fluid from said outlet.

20. The head of claim **19** wherein said plug means is in the form of a plug member adapted to extend in said outlet in said flow preventing position.

21. The head of claim **20** wherein said thermal responsive means comprises a pair of fulcrummed levers for supporting said plug member relative to said body member in said outlet.

22. The head of claim **21** wherein said thermal responsive means further comprises a fusible link normally engaging said levers to maintain them in said position supporting said plug member, said fusible link releasing said engagement in response to said predetermined temperature.

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