Nov. 4, 1969 A. TILLMAN 3,476,141

FLUID FLOW FUSE

Filed Jan. 13, 1967

FIG. 1.

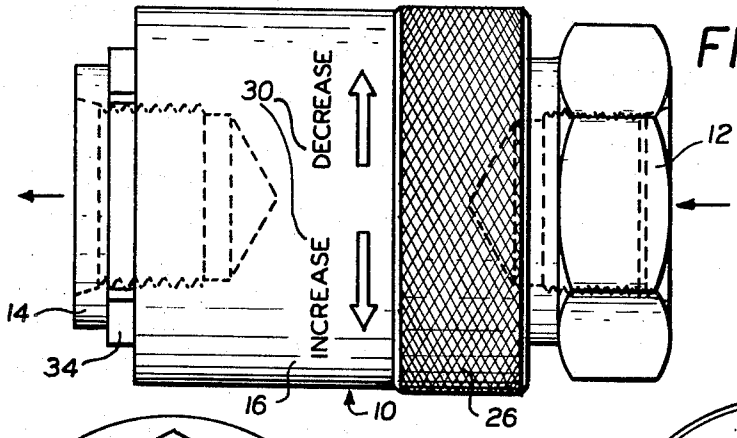


FIG. 2.

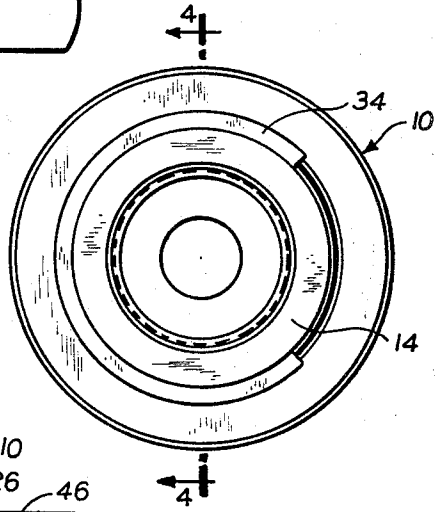


FIG. 3.

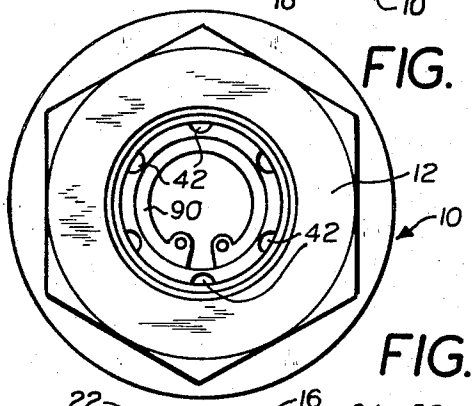
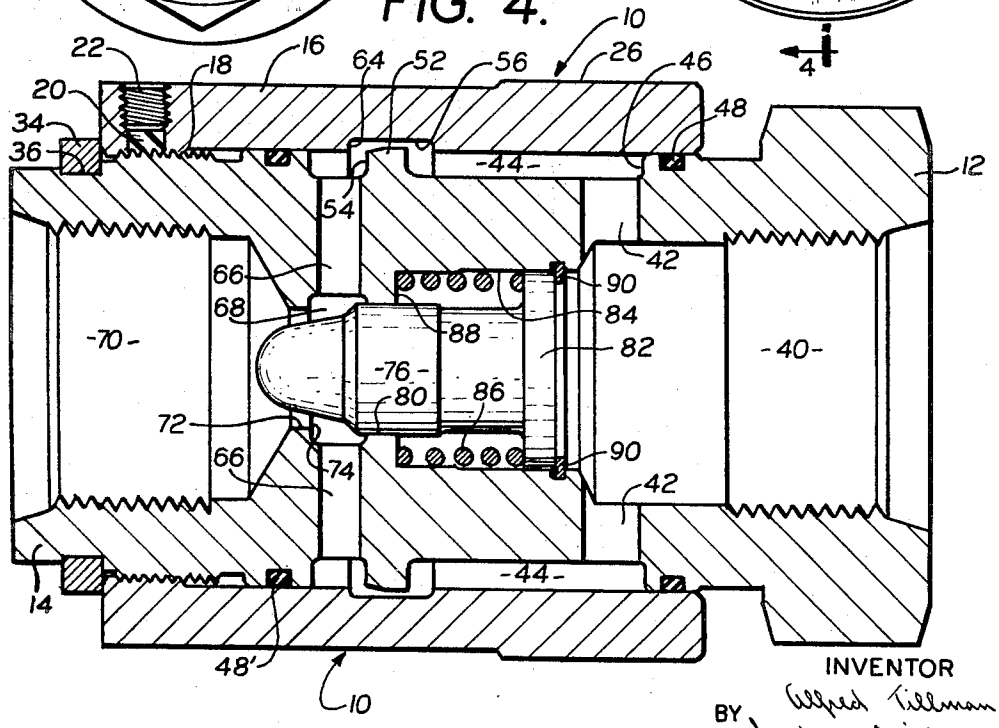


FIG. 4.



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FLUID FLOW FUSE

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U.S. Cl. 137—498 12 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure relates to an in-line fluid flow fuse which closes a flow passage when the flow through the fuse exceeds a predetermined rate. The fuse has a restricted flow passage upstream from a port that is opened and closed by a valve element, and the valve element is urged toward open position by a spring. A chamber in the housing, upstream from the restricted portion of the flow passage, has a movable wall such as a piston, exposed to the fluid pressure ahead of the restriction and connected with the valve element for closing the valve element when the pressure drop across the restriction exceeds a given value. This pressure drop is a function of the flow rate. A sleeve on the outside of the housing can be rotated to change the cross section of the restriction and thus adjust the fuse to operate at different flow rates.

Brief description of the invention

The principal object of this invention is to provide an improved fluid flow fuse for shutting off further flow through a fluid line if the rate of flow becomes excessive, as in the case of a bursted hose or other accident. The invention provides an in-line fuse which is not substantially larger in diameter than conventional fittings for the size of pipe with which the fuse is used.

An important feature of the invention is its adjustability to operate at different flow rates, and the adjustment of the flow rate from outside the housing. A sleeve surrounding the inner part of the housing of the fuse is movable to change the flow rate. In the preferred construction, the sleeve is threaded over an inner portion of the housing so that it moves axially when rotated, and this axial movement changes the restriction in the flow passage through the housing so that the pressure drop is increased or decreased, depending upon the direction of adjustment, at a given flow rate, and the valve element closes at a different flow rate. The actual force for closing the valve element can remain constant and this greatly simplifies the construction of the fuse.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

Brief description of the drawing

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views:

FIGURE 1 is a side elevation of a fluid flow fuse made in accordance with this invention;

FIGURE 2 is an end view of the fuse shown in FIGURE 1, the view being taken from the left in FIGURE 1;

FIGURE 3 is an end view of the other end of the flow fuse shown in FIGURE 1; and

FIGURE 4 is an enlarged sectional view of the fuse shown in the other figures.

Detailed description of the invention

The fluid flow fuse includes a housing **10** having an inlet fitting **12** at one end and an outlet fitting **14** at the other end. Both of these fittings are threaded to receive piping or other fittings of the fluid flow line in which the

fuse is used. In the preferred construction the fittings **12** and **14** are part of the inner portion of the housing **10**, and preferably of one-piece construction with the inner portion of the housing.

The housing **10** has an outer portion comprising a sleeve **16** which extends along most of the axial length of the fuse. This sleeve **16** has threads **18** which connect the sleeve with the inner portion of the housing, as shown in FIGURE 4. Rotation of the sleeve **16** causes it to move along its threaded connection with the inner portion of the housing and changes the axial position of the sleeve **16** with respect to the remainder of the fuse.

There is a plastic insert **20**, in an opening through the sleeve **16**, in contact with the threads on the inner portion of the housing. This insert **20** is pressed against the threads by a screw plug **22**, threaded into the sleeve opening, to maintain a substantial friction between the insert **20** and the threads on the inner portion of the housing. A circumferential knurled area **26** provides a convenient grip for rotating the sleeve **16** with respect to the inner portion of the housing; and the friction of the insert **20** serves to hold the sleeve in any adjusted position.

Legends **30** (FIGURE 1) on the outside of the sleeve **16** indicate the direction in which the sleeve must be rotated in order to increase or decrease the flow rate at which the fuse operates to shut off further flow. Axial movement of the sleeve **16** toward the left is limited by a snap ring **34** which fits into a groove **36** in the outlet fitting **14**. Limitation of the movement of the sleeve **16** in the other direction will be explained in connection with the adjustment of the flow passage through the fuse housing.

FIGURE 4 shows the flow passage through the housing, and this passage includes an axial portion **40** of substantial diameter within the inlet fitting **12**. At the inner end of this axial portion **40** there are a plurality of angularly spaced radial openings **42** which extend substantially normal to the axis of the flow fuse and which open through the wall of the inner portion of the housing into a circumferential recess **44**. This recess **44** is covered by the outer sleeve **16** and the clearance between the bottom of the recess **44** and the inner surface of the sleeve **16** constitutes a part of the fluid flow passage through the housing.

At one end of the recess **44** there is a shoulder **46** at which the diameter of the inner portion of the housing increases to substantially the inside diameter of the outer sleeve **16**, and at a short distance beyond this shoulder **46** there is a seal, preferably an O-ring **48**, located in a groove in the inner portion of the housing for preventing escape of fluid from the circumferential recess **44** to the outside of the housing.

At the other end of the circumferential recess **44**, there is a circumferential ridge **52** formed on the inner portion of the housing, and the left-hand side of the ridge **52** provides an annular face **54** which forms one side of another portion of the flow passage through the housing. The outer sleeve **16** has a circumferential groove **56** in its inner surface for providing a clearance for fluid flow around the periphery of the ridge **52**, and this groove **56** is of sufficient axial extent so that it provides clearance for fluid flow past the periphery of the ridge **52** for all adjusted positions of the outer sleeve **16**.

The left-hand side of the groove **56** provides an annular face **64** which confronts the face **54** along at least a part of the radial extent of the faces **54** and **64**. The clearance between these faces **54** and **64** changes progressively as the outer sleeve **16** is rotated to screw it one way or the other along the inner portion of the housing. For example, as the sleeve **16** moves toward the right in FIGURE 4, the face **64** moves closer to the face **54** and the cross section of the clearance between the faces **54** and **64** decreases.

Conversely, movement of the sleeve **16** toward the left increases the cross section of the clearance between the faces **54** and **64**. This clearance is an adjustable restriction in the flow passage through the fuse housing **10**, and by adjusting the cross section of this restriction, the pressure drop of the fluid flowing through the housing of the fuse can be increased or decreased.

There are other radial openings **66** at angularly spaced locations and extending through the wall of the inner portion of the housing from the region of the restriction faces **54** and **64** to a chamber **68** which, with the radial openings **66**, form another part of the fluid flow passage through the housing.

The fluid flow passage also includes an axial portion **70** in the outlet fitting **44**; and this axial portion **70** communicates with the chamber **68** through a port **72** which has a valve seat **74** at its inner end. A valve element **76**, in axial alignment with the port **72** and the axial portions **40** and **70** of the flow passage, is movable toward and from the seat **74** to command the passage of fluid through the port **72**.

The valve element **76** has a cylindrical portion which slides in a guide bearing **80** formed in the housing, and the valve element **76** is connected with a movable wall or piston **82** which reciprocates in a cylindrical chamber **84**. The valve element **76** is urged into open position by a spring **86** compressed between the piston **82** and a shoulder **88** formed by one end of the cylindrical chamber **84**. A snap ring **90** fits into a groove near one end of the cylindrical chamber **84** and limits movement of the piston **82** and the valve element **76** toward the right in FIGURE 4.

The cylindrical chamber **84** communicates with the axial portion **40** of the flow passage. Thus the piston **82** is exposed to pressure of the fluid in the housing upstream of the restriction in the flow passage between the annular faces **54** and **64**.

Whenever the pressure drop between the axial portion **40** of the flow passage and the portion of the flow passage downstream from the restriction is enough to overcome the force of the spring **86**, the valve element **76** moves into closed position. The actual force required to compress the spring **86** and to move the valve element **76** into closed position is always the same since there is no provision for adjusting the force of the spring **86**. However, the actual flow of fluid which will produce a force sufficient to compress the spring **86** depends upon the pressure drop in the flow passage, and more particularly in the portion of the flow passage at the restriction between the faces **54** and **64**. This spring-compressing pressure can be obtained at widely different rates of flow, depending upon changes in the cross section of the clearance between the faces **54** and **64**. Thus the fuse can be adjusted to close at different flow rates by merely rotating the outer sleeve **16** to screw it one way or another along the inner portion of the housing. The seal **48** at one end of the sleeve **16** and a corresponding seal **48'** near the other end of the sleeve, prevent escape of fluid from the housing without interfering with the rotation of the sleeve **16**.

What is claimed is:

1. A fluid flow fuse including a housing having a flow passage therethrough including a valve chamber, said passage having a port at one end of the valve chamber with a valve seat around the periphery thereof, a valve element in the valve chamber movable toward and from the port to control the flow of fluid through the housing, resilient means urging the valve element toward its open position, a portion of the valve chamber upstream from the seat having a movable wall which is exposed on its upstream side to an inlet pressure in the housing the flow passage having a portion of restricted cross section outside of the valve chamber and by-passing the movable wall and leading from a location upstream of the movable wall to a location in the valve chamber beyond the range of movement of the movable wall and downstream thereof,

and an operative connection between the movable wall and the valve element, for moving the valve element into closed position, the restriction of the flow passage being correlated with the movable wall and said resilient means to move the valve element into closed position when the flow rate through the restriction exceeds a given value.

2. The fluid flow fuse described in claim **1** characterized by a portion of said chamber being cylindrical, and the movable wall closing one end of said cylindrical portion and said operative connection extending axially of said cylindrical portion, the valve element, when in open position, being spaced from the valve seat by a distance that produces a further restriction of the flow passage and a second significant pressure drop for causing the valve to move into closed position when the pressure drop exceed said given value.

3. The fluid flow fuse described in claim **2**, characterized by the cylindrical portion having a shoulder at one end, and the movable wall being a piston in axial alignment with the valve seat, the piston and its operative connection with the valve element both being of integral construction with the valve element, the resilient means being a helical spring located in the cylindrical portion and compressed between the piston and the shoulder at one end of the cylindrical portion, the valve element extending into the fluid passage through the seat when the valve element is in open position, and restricting the fluid flow through the valve seat port to throttle further the flow of fluid from the restricted by-pass.

4. The fluid flow fuse described in claim **3** characterized by another shoulder at the other end of the cylindrical portion comprising a removable stop that locks into the cylindrical portion on the side of the piston opposite the spring.

5. A fluid fuse including a housing having a flow passage therethrough, said passage having a port with a valve seat around the periphery thereof, a valve element movable toward and from the port to control the flow of fluid through the housing, resilient means urging the valve element toward its open position, the housing having a portion of its flow passage, including at least a portion of the flow passage upstream from the valve seat, restricted so that a pressure drop occurs therein proportional to the rate of flow of fluid through the housing, a portion of the flow passage upstream from the restriction comprising a chamber having a movable wall which is exposed to the pressure in the housing before said pressure drop, and an operative connection between the movable wall and the valve element, the operative connection and the valve element being positioned for moving the valve element into closed position when the pressure drop across the restriction exceeds a given value, and characterized by adjustable means operative from outside of the housing for changing the minimum cross section of the restricted portion of the flow passage upstream from the valve seat to change the pressure drop and thereby change the flow rate at which the valve element closes against the valve seat to stop the flow through the flow passage.

6. The fluid flow fuse described in claim **5** characterized by the adjustable means including an outer sleeve portion of the housing rotatable on and surrounding at least a part of the length of an inner portion of the housing.

7. The fluid flow fuse described in claim **6** characterized by the restricted portion of the flow passage being a clearance between an inside surface of the sleeve portion and an outside surface of the inner portion of the housing, and the sleeve portion being threaded on the inner portion to obtain axial movement of the sleeve portion on the inner portion in response to rotation of the sleeve portion.

8. The fluid flow fuse described in claim **6** characterized by the restricted portion of the flow passage extending between confronting annular shoulders on the sleeve and on the inner portion of the housing, said

shoulders being movable toward and from one another to change the cross section of the clearance between them.

9. The fluid flow fuse described in claim **1** characterized by the housing including an inner portion and an outer portion movable with respect to the inner portion, inlet and outlet ports at opposite ends of the inner portion of the housing and in line with one another, making the fuse an in-line, the restricted portion of the flow passage being adjustable in cross section in response to movement of the outer portion of the housing on the inner portion.

10. The fluid flow fuse described in claim **9** characterized by the inner portion of the valve housing being of circular cross section, radial openings through the wall of the inner portion at axially spaced locations on the upsteam side of the valve seat, the outer portion of the housing being a sleeve that surrounds the inner portion and that has a clearance from the outer surface of the inner portion at the radial openings and along the axial distance between radial openings, said clearance constituting the restricted portion of the flow passage through the housing, and seals at opposite ends of said clearance.

11. The fluid flow fuse described in claim **9** characterized by a circumferential ridge on one, and a circumferential groove in the other, of confronting faces of the outer and inner portions of the housing and providing annular faces that form opposite sides of part of the length of the flow passage, the outer portion of the housing being threaded on the inner portion and movable axially thereon in response to relative rotation of the inner and outer portions with respect to one another to move the annular surfaces together or apart to change the restriction in the flow passage and means for controlling the friction of the outer portion on the inner portion of the housing.

12. The fluid flow fuse described in claim **1** characterized by the housing having outer and inner concentric portions with confronting faces having a clearance between them for a portion of their axial lengths, said clearance constituting a part of the length of the flow passage through the housing, a circumferential ridge on one, and a circumferential groove in the other of the confronting faces of the outer and inner portions of the housing and providing annular faces that form opposite sides of the restricted part of the length of the flow passage, the outer portion of the housing being threaded on the inner portion and movable axially thereon in response to relative relation of the inner and outer portions with respect to one another to move the annular surfaces together or apart to change the restriction in the flow passage, the axial width of the groove being greater than the axial width of the ridge to provide clearance for the flow of fluid along the side of the ridge opposite said annular surfaces.

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