Dec. 31, 1968 J. H. ANDRESEN, JR 3,419,038

FLOW CONTROLLER

Filed Oct. 19, 1966

FIG. 1.

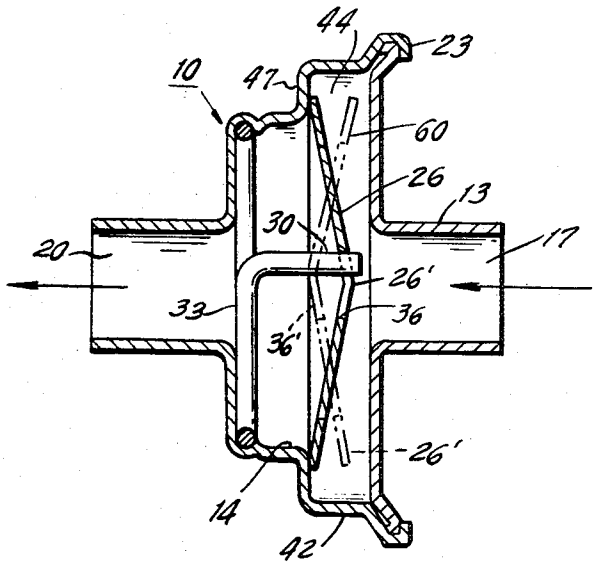


FIG. 2.

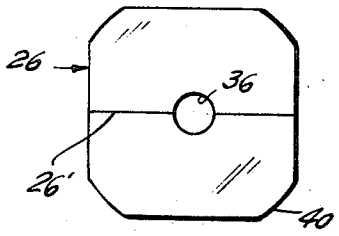


FIG. 3.

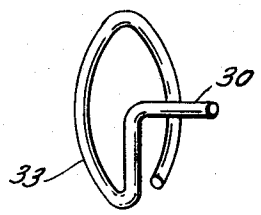


FIG. 4.

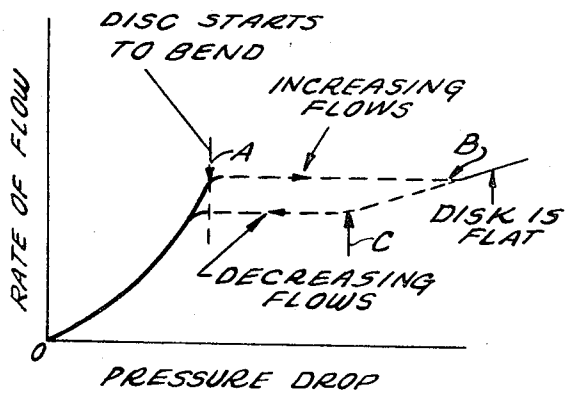
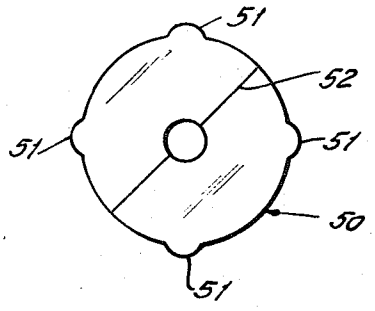


FIG. 5.



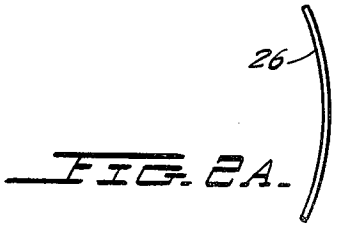


FIG. 2A.

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FLOW CONTROLLER

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Continuation-in-part of application Ser. No. 457,786, May 21, 1965. This application Oct. 19, 1966, Ser. No. 587,747

7 Claims. (Cl. 137—504)

This is a continuation-in-part of application Ser. No. 457,786 filed May 21, 1965 now abandoned.

This invention relates to flow controllers and more particularly to controllers for use at low pressures.

It is the object of the invention to provide a flow controller which functions automatically responsive to pressure and which will provide substantially uniform discharge over a substantial range of inlet-outlet pressure drop. It is a further object of the invention to provide a controller wherein, above and below a specific pressure drop range, the device performs in a manner similar to a fixed area orifice.

It is a still further object of the invention to provide a device of inherent characteristics such that it may be designed to varying dimensions to serve in applications which may vary over rather wide limits. It is yet another object of the invention to provide a device which is exceedingly simple in construction, durable and economical to manufacture.

Other objects and features of the invention will be apparent from the description to follow.

Briefly, the invention comprises a housing having an inlet port and an axially aligned outlet port and containing a flexible resilient element which is creased and which is so disposed and supported as to permit flow of fluid through a central aperture and around its rim. The element rim co-acts with a flange of the housing and flow can take place between the rim and the flange up to a certain inlet pressure. Excess pressure flattens the element so that the marginal rim area substantially closes off flow which then passes almost completely only through the central aperture, a fixed open area. The element is substantially unrestricted in its movement except for being supported to prevent the edge from engaging the annular wall of the honsing although this is not essential.

In one form of the invention, to be described below in detail, the element has its concave face downstream of flow. However, regulation characteristics may be varied by mounting the element in the housing so that the concave face is upstream.

A detailed description of the invention now follows in conjunction with the appended drawing in which:

FIGURE 1 is an elevation in cross-section of an assembly of the invention;

FIGURE 2 is a plan view of the regulator element to a smaller scale;

FIGURE 2A is an elevation in cross section of an alternate form of regulator element;

FIGURE 3 is a perspective of a ring-like bracket formed of wire rod for element support;

FIGURE 4 is a graph of pressure drop across the element vs. discharge rate, and

FIGURE 5 is a modified form of element.

Referring now to FIGURES 1–4, the invention comprises a housing **10** having an inlet section **13** and an outlet section **14** provided with respective ports such as inlet port **17** and outlet port **20**, the direction of flow being as indicated by the arrows. The housing sections may be formed of sheet metal and peripherally connected by rolled edge **23** in a well-known manner.

Within the housing there is a flexible element **26** which may be generally rectangular or may be a circular disk or may have any other geometric shape which permits

its entire rim to be pressed flat against the flange **47** to be described below. The flange is comprised of stainless steel or other material of suitable resilience and flexibility, in the nature of spring metal material.

The element **26** has a creased portion at **26'** and should be so formed, e.g., by annealing that it normally maintains its creased condition. It is within the contemplation of the invention to crease the disk **26** along more than one line, although all creases should face in the same direction. While the creased portion is usually fairly sharply defined (FIGURES 1 and 2), it might, in the alternative, be rounded somewhat within the contemplation of the invention (FIGURE 2A).

While the regulator element **26** normally has its concave portion facing downstream of flow, FIGURE 1, regulation characteristics may be varied by having the concave portion facing upstream, whereby an increasing pressure drop would similarly cause substantial flattening of element **60** against flange **47**. See phantom lines, FIGURE 1.

The element **26** may be supported at its center by a finger **30** integral with a bracket **33** in the form of a ring bent of resilient wire rod and sprung into place in the housing section **14** adjacent outlet port **20**. The finger **30** passes through an aperture **36** at the center of element **26** to maintain the element rim **40** clear of engagement with the annular portion **42** of the housing section as shown in FIGURE 1. Thus, the element is freely movable within the regulator chamber **44** and fluid can pass through aperture **36** and around rim margin **40** where such rim margin is adjacent the radial flange **47** of the outlet housing section. The finger **30** is of considerably smaller diameter than the aperture **36** so as not to substantially impede the flow therethrough and the element **26** is variably pressed against flange **47** at its marginal rim area **40** within the range of uniform discharge rate desired for a particular pressure drop range. Thus, fluid can flow peripherally over and around the edge of the rim margin **40** and between that margin and the flange **47**, the light engagement of the rim area and the flange providing sufficient passageway for fluid flow. As the pressure drop increases, the rim margin **40** is increasingly flattened against the flange **47**. After a particular increased pressure drop is reached, marginal flow is substantially cut off due to nearly full flattening of the rim margin **40** against flange **47**. Because the element **26** is creased and because the crease **26'** will never be completely flattened, the rim margin **40** of element **26** will never completely cut off the marginal flow.

The finger **30** is helpful in maintaining aperture **36** clear and although not necessary to the operation of the device, it helps keep the periphery of the element **26** free of sedimentation, which might collect at the bottom of the housing when the housing is mounted for horizontal flow as shown. Of course, the device could also be mounted for vertical flow.

Referring to FIGURE 4, a graph is shown depicting the operation of the invention. As the pressure drop increases from 0, to discharge rate is increasing. At about the point indicated by the arrow A, with increasing flow, the element **26** starts to flex and the rim **40** begins to press harder against flange **47** and progressively decreases, the passage therearound whereby flow is maintained substantially uniform up to the point B. The rim then substantially closes off flow therearound due to almost fully closing engagement with flange **47**. Flow is then mainly through the fixed orifice or aperture **36** which has the usual characteristic of increasing discharge with increasing pressure drop.

When pressure starts to decrease from the point B, the closing pressure on the element rim starts to decrease at about the pressure drop point C and thereafter effects

an increasing passageway to maintain the fairly uniform discharge rate shown. Thus, the pressure drop variation automatically compensates for itself by the degree of flattening of the rim area **40** against flange **47** to vary flow therearound for maintaining uniform discharge over a particular range.

In a working model of the invention, the element **26** is about 1⅝ inches long, is creased to provide an angle of approximately 160° between its upfolded portions, has a thickness of .009 inch and is made of stainless steel having spring characteristics, giving the results shown in FIGURE 4. In order to insure flow passage through aperture **36**, the working model has a ¼ inch diameter aperture, whereas the diameter of the finger **30** is of the order of .04 inch. The marginal rim area is about 25% of the flow blocking area of the disk, i.e., the total area less the aperture area. It is, of course, understood that spring characteristics are variable. Accordingly, selection of a particular spring characteristic of any sample would be made as a matter of design for the particular application of the regulator. It will be further appreciated that the design of the housing sections are not critical and may be approximately in proportion to the showing of FIGURE 1.

The modification of FIGURE 5 illustrates a flexible disk **50** substantially like the element **26** of FIGURE 2 except that four angularly spaced radial lobes **51** are provided. Such a disk can be set into the housing and the lobes will prevent the periphery of the disk from engaging the annular body **42** of the outlet housing, thereby eliminating the need for a bracket **33**. The disk **50** is creased at **52** and is otherwise essentially the same as element **26**.

It will be understood from all of the above that flow can occur and the invention can be operative even while the element margin is being flattened against the flange, inasmuch as the inlet pressure would normally be sufficient to cause what might be described as continuous peripheral leakage up to the point where the element margin is pressed almost to the flow stopping point. The invention is particularly useful for pressures in the range of 0.2 to 5 pounds per square inch drop with discharge rates from 1 to 5 gallons per minute. In such low ranges, prior art controllers are not particularly effective.

Having thus described the invention, it will be apparent that changes may be made without departing from the spirit thereof and, accordingly, it is not desired to restrict the invention to the precise illustration herein given except as set forth in the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A flow controller comprising a housing having an inlet and an outlet port and a controller element disposed intermediate said ports transversely of flow path therebetween, said controller element comprising a flexible member having a creased portion, said housing having a flange, said member having a marginal rim to engage said flange and to be maintained thereagainst by fluid pressure of predetermined degree while permitting flow between said marginal rim and said flange up to a pressure such that said marginal rim is pressed against said flange with sufficient force to close off said flow.

2. A controller as set forth in claim **1**, said member having an aperture therethrough to permit flow at all times, wherein said aperture is of a size that the flow therethrough combined with flow around said marginal rim effects a substantially uniform discharge at the outlet port for a predetermined range of pressure drop across said member.

3. In a controller as set forth in claim **2**, said member having a concave side, said concave side of said creased portion being disposed at the downstream side thereof, said member being of a thin flexible material so as to be increasingly flattened with increased pressure drop thereacross.

4. A controller as set forth in claim **3**, and a support member within said housing having a finger extending into said aperture and having a small cross-sectional area relative the area of said aperture so as not to substantially affect flow therethrough, said finger supporting said member to preclude edgewise engagement of said member with said housing.

5. A flow controller as set forth in claim **3** including means for preventing edgewise engagement of said marginal rim with said housing.

6. A flow controller as set forth in claim **2**, wherein said creased portion is rounded.

7. A controller as set forth in claim **2**, said member having a concave side, said concave side of said creased portion being disposed at the upstream side thereof, said member being of a thin flexible material so as to be increasingly flattened with increased pressure drop thereacross.

References Cited

UNITED STATES PATENTS

1,461,662	7/1923	Kawamura	137—495 XR
1,997,404	4/1935	Hamilton	137—504 XR
2,938,538	5/1960	Allen	137—504
3,226,505	12/1965	Lucas et al.	137—504 XR

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U.S. Cl. X.R.

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