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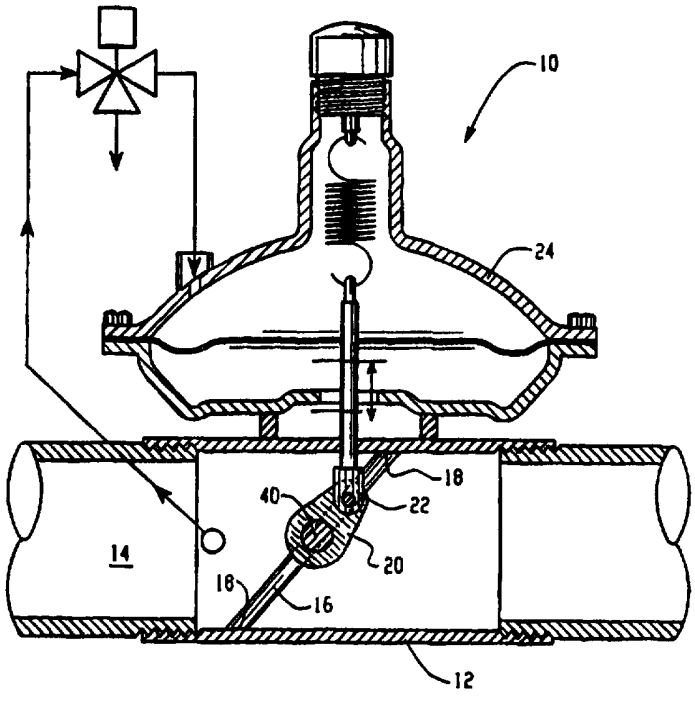
(54) Title: FLOW CONTROL VALVE WITH ELONGATED VALVE MEMBER

(57) Abstract

An actuated air valve includes a valve body in line with a flow passage (14) for admitting a flow of fluid. An elliptical valve member (16) is pivotally inclined at an angle relative to the centerline of the valve body when in the closed position.



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FLOW CONTROL VALVE WITH ELONGATED VALVE MEMBER

Background of The Invention

The present invention is directed to the field of valves, for example, valves used to cycle the flow of a gas. Several types of valves are known for cycling fluid flow in industrial applications, particularly combustion applications. Such valves typically include a mechanical actuation device that is mechanically linked to a butterfly-type valve. The most common butterfly-type valve is simply a circular disc which is arranged to pivot in an appropriately-sized cylindrical fluid passageway and pivoted using some type of mechanical actuator and linkage. The valve is closed when the surface of the disc is perpendicular to the direction of flow and open when the surface of the disc is parallel to the flow. There is thus 90 degrees of pivot in the stroke of this common butterfly-type valve. The length of the stroke thus represents the maximum amount of valve displacement, which relates directly to the energy required to operate the valve.

Typical 90° butterfly valves characteristically have sluggish non-linear response near the closed position. The response of such a

valve approximately follows a sinusoidal function, with a "flat" response near the closed and fully-open positions, and a substantially linear response from between 30% and 70% open. At or near the closed position, the valve shaft must pivot through a substantial angle before the valve opens sufficiently to change the flow rate by an appreciable amount. When such a common 90° valve is used for pressure control in fuel/air combustion (i.e. used to impulse a gas ratio regulator) the result is poor gas regulator tracking during transitions between low and high fire. Such poor tracking produces a flame which is too rich or too lean during transitions. A flame that is too lean is unstable while a flame that is too rich will produce undesirable emissions (such as carbon monoxide.)

Common butterfly-type valves are also known to "hang up" in the closed position when the disc gets jammed against the wall of the passageway. This results in an undesirable loss of valve control which causes delays in the heating cycle and may even require expensive disassembly and maintenance. In these ways, the valves and actuators of previous systems suffer from a number of drawbacks which

reduce their effectiveness of operation in burner systems.

Summary of The Invention

In view of the difficulties and drawbacks encountered with previous valves, it would be advantageous to provide a valve which solves the previous problems while providing more efficient operation.

Therefore, there is a need for a valve which has a shorter stroke, requiring less displacement, thus consuming less power to operate and reducing wear on the valve shaft bearing.

There is also a need for a valve which is less prone to being jammed against the wall of the fluid passageway.

There is also a need for a valve that is more responsive near the closed position, in order to improve regulator tracking.

These needs and others are realized by the valve of the present invention which includes a valve body in line with a flow passage for admitting a flow of fluid. A valve member is retained within the valve body and is varied between open and closed positions for respectively admitting and obstructing the flow of fluid. An actuation assembly is in mechanical connection with the valve member.

Displacement of the actuation assembly varies the position of the valve member.

The valve member of the present invention comprises an elongated, preferably elliptically-shaped valve disc which is inclined relative to the centerline of the valve body at a predetermined angle of less than 90 degrees when in the closed position. The elliptical valve disc is preferably shaped as a 45 degree ellipse and is inclined relative to the centerline of the valve body at a 45 degree angle when the disc is in the closed position.

As will be appreciated, the invention is capable of other and different embodiments, and its several details are capable of modifications in various respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive.

Brief Description of The Drawings

The embodiments of the invention will now be described by way of example only, with reference to the accompanying figures wherein the members bear like reference numerals and wherein:

Fig. 1 is a side-sectional view of a mechanically actuated valve as according to a preferred embodiment of the present invention.

Fig. 2 is an oblique view showing a detail of the elliptically-shaped valve disc as according to the present invention.

Detailed Description of The Invention

Referring now to the drawings which are for purposes of illustrating only the preferred embodiment of the invention and not for purposes of limiting the same. The figures show an air flow cycling valve which is actuated by a mechanical actuator. The present valve is especially suited for handling combustion air in a burner system.

Turning specifically to Fig. 1, the components of the valve assembly 10 of the present invention include a valve body 12, in line with a flow passage 14, for admitting and transmitting the flow of a fluid, preferably a gas such as combustion air. However, it will be appreciated that the present valve can be used with any fluid without departing from the invention. A valve member or disc 16 is pivotally retained within the valve body 12 and can be varied between an open position and a closed position for respectively admitting and obstructing the flow of fluid. The valve disc 16

can be actuated by any type of mechanical actuator 24. In the illustrated embodiment of Fig. 1, the actuator 24 is of the type shown in the related application to the present assignee entitled "DIAPHRAGM ACTUATED AIR CYCLE VALVE," U.S. Serial No. 08/614,962 filed March 11, 1996 and invented by Clive D. Lucas, Jeffrey C. Armour and Ahmed I. Sabet, the disclosure of which is hereby incorporated by reference.

In the preferred embodiment, the valve disc 16 is an elliptically-shaped butterfly valve disc (preferably in the shape of a 45 degree ellipse) which is retained within the valve body 12 at an angle of inclination appropriate to the respective elliptical shape, so as to effectively block a flow passage 14 having a circular cross section while at the closed position. For example, a 45 degree elliptical disc 16 is inclined at a 45 degree angle to the flow direction when in the closed position and a 30 degree ellipse is inclined at a 60 degree angle to the flow when in the closed position, etc. By using an appropriately shaped and oriented elliptical valve disc 16, the valve stroke can be greatly shortened, thus reducing the amount of energy required to open and close the valve 10. Also, the valve stroke is more responsive since the

"flat" part of the response function near the closed position is eliminated. This improves regulator tracking and helps maintain a flame more reliably on-ratio throughout valve cycling.

In the preferred embodiment, the edges of the valve disc 16 have a bevel 18. When the valve disc 16 is in the closed position, the bevelled surface 18 insures that the valve disc 16 makes surface contact with the walls of the valve body 12. Thus, the disc's edge is never at right angles to the wall. Further, the 45° stroke insures that the disc swing near the wall is reduced. In this way, the present valve disc 16 does not get wedged against the inside walls of the valve body.

The valve disc 16 of the present invention is mounted on a pivotable shaft 40 which is mechanically connected to an actuation assembly that is displaced in order to vary the position of the valve disc 16. The actuation assembly includes a linkage comprised of first and second linkage elements 20, 22 which connect the valve disc 16 to an actuator, which moves upwards and downwards in a reciprocating motion. The displacement produced by the mechanical actuator 24 is transmitted to the linkage 20, 22 which thereby converts the displacement force into a torque upon the valve

shaft 40 in order to pivot the valve disc 16 into the open position. The angle of inclination of the valve disc 16 in the closed position gives the linkage a significant mechanical advantage.

In an alternative embodiment, the present valve disc 16 can have any shape desired which would permit it to pivot within an appropriately-shaped valve body 12. For example, for a valve body 12 with a flow passage 14 having a square cross section, the valve disc 16 may have an appropriate rectangular shape which will permit the disc 16 to pivotally mount at an angle of inclination within the valve body 12. For any flow passage 14 having a uniform concave interior surface and a cross section with two orthogonal axes of symmetry, an inclined valve disc 16 may be provided in accordance with the present invention.

The valve disc 16 is elongated with respect to the cross section of the flow passage 14 and has two respective mutually orthogonal axes 30, 32. The first axis 30 is the pivot axis of the disc 16 and defines the width of the disc 16. It is preferably approximately equal in width to the flow passage 14. The second axis 32 defines the length of the valve disc 16 and wherein the second axis 32 is longer than the first axis 30 so as to

accommodate the desired inclination of the disc 16. In the case of the elliptically-shaped disc 16 described above, the first axis 30 corresponds to the minor axis of the elliptical shape and the second axis 32 corresponds to the major axis of the elliptical shape. The valve 16 can thereby be appropriately proportioned for any correspondingly-shaped flow passage 14 and desired inclination.

The present flow control valve offers many advantages over prior valve configurations. The actuation of the valve from the angle of inclination reduces stroke length and improves mechanical advantage over conventional 90 degree valves. The elongated disc 16 has superior flow response, particularly at low flow since the flow varies approximately linearly with disc rotation. Since the stroke is shorter, the inclined valve member 16 also reduces wear on the valve shaft bearing. The elongated disc 16 is also less susceptible to binding at the internal walls, due to the valve disc inclination in combination with the bevelled edge 18.

As described hereinabove, the present invention solves many problems associated with previous systems, and presents improved efficiency and operability. However, it will be appreciated

that various changes in the details, materials and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention may be made by those skilled in the art within the principle and scope of the invention as expressed by the appended claims.

We Claim:

1. A valve for adjusting the flow of a fluid, said valve comprising:

a valve body in line with a flow passage for admitting a flow of fluid;

a valve member retained within the valve body, said valve member being varied in position to control the flow of fluid, wherein the valve member comprises an elongated valve disc which is pivotally inclined relative to the centerline of the valve body at a predetermined angle of less than 90 degrees when in the closed position; and

an actuation assembly, in mechanical connection with the valve member, wherein said actuation assembly is displaced in order to vary the position of the valve member.

2. The valve of claim 1 wherein the mechanical connection to the valve member includes a linkage connecting the actuation assembly to the valve member so as to transmit the displacement.

3. The valve of claim 1 wherein the elongated valve disc has a first axis and a second axis, each mutually orthogonal to the other, and wherein the first axis defines the width of the disc and is approximately equal to the width of the flow

passage, and wherein the second axis defines the length of the valve disc wherein the valve disc pivots about the first axis and the second axis is longer than the first axis.

4. The valve of claim 3 wherein the elongated valve disc is elliptically-shaped with the first axis corresponding to the elliptical minor axis and the second axis corresponding to the elliptical major axis.

5. The valve of claim 4 wherein the elongated valve disc is shaped as a 45 degree ellipse which is inclined relative to the centerline of the valve body at a 45 degree angle when in the closed position.

6. The valve of claim 4 wherein the elliptical valve disc has a bevelled edge.

7. A valve member of the type which is retained within a valve body for adjusting the flow of a fluid, said valve member being varied in position to control the flow of fluid, wherein the valve member comprises an elongated valve disc which is pivotally inclined relative to the centerline of the valve body at a predetermined angle of less than 90 degrees when in the closed position.

8. The valve member of claim 7 wherein the elongated valve disc has a first axis and a second

axis, each mutually orthogonal to the other, and wherein the first axis defines the width of the disc and is approximately equal to the width of the flow passage, and wherein the second axis defines the length of the valve disc wherein the valve disc pivots about the first axis and the second axis is longer than the first axis.

9. The valve member of claim 8 wherein the elongated valve disc is elliptically-shaped with the first axis corresponding to the elliptical minor axis and the second axis corresponding to the elliptical major axis.

10. The valve member of claim 9 wherein the elliptical valve disc is shaped as a 45 degree ellipse which is inclined relative to the centerline of the valve body at a 45 degree angle when in the closed position.

11. The valve member of claim 10 wherein the elliptical valve disc has a bevelled edge.

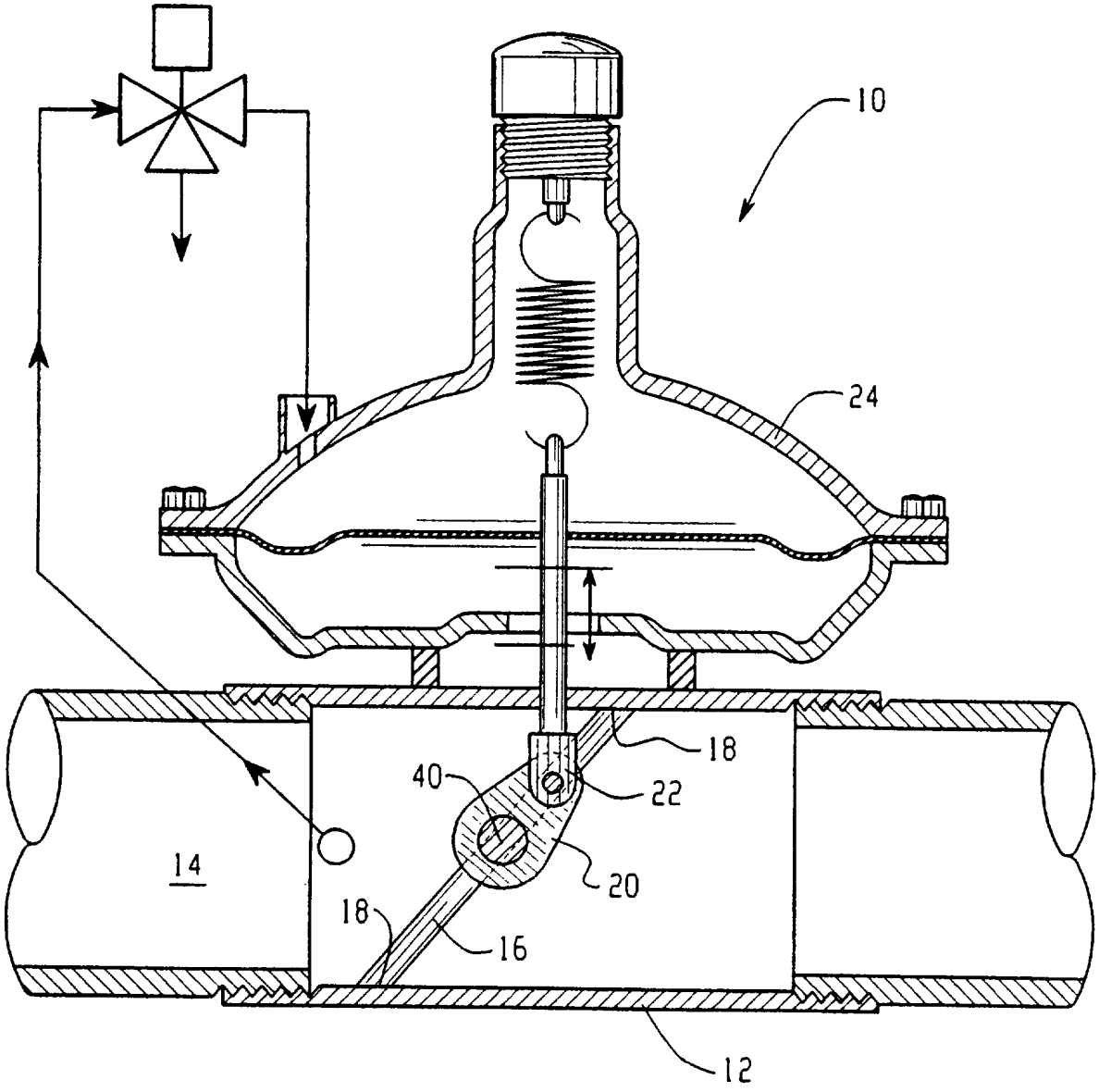

Fig. 1

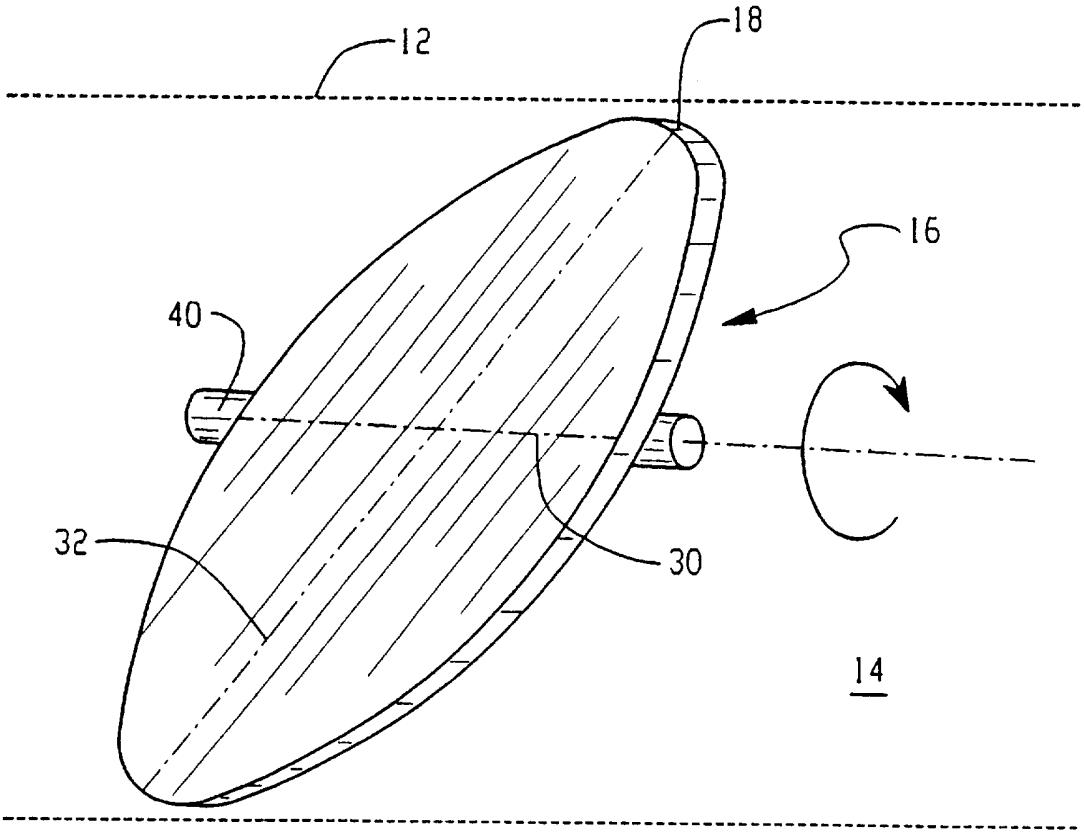

Fig. 2

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 97/02282

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16K1/22 F16K31/165

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20 35 024 A (UWE UNTERWASSER ELECTRIC GMBH) 20 January 1972 see figure 3	1-5,7-10
X	DE 760 111 C (JUNKER & RUH) 22 September 1952 see figure 1	1-11
X	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week 2106 6 July 1983 Derwent Publications Ltd., London, GB; Class Q66, AN H0366 XP002030488 & SU 943 456 A (MALEEV) , 15 December 1980 see abstract	1,3,4, 6-9,11
A	DE 26 08 139 A (ANEMOSTAT) 20 January 1977 see figure 1	1

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☒ Patent family members are listed in annex.

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Information on patent family members

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