March 22, 1966 E. R. SCHUMANN 3,241,805

VALVE

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Fig. 1

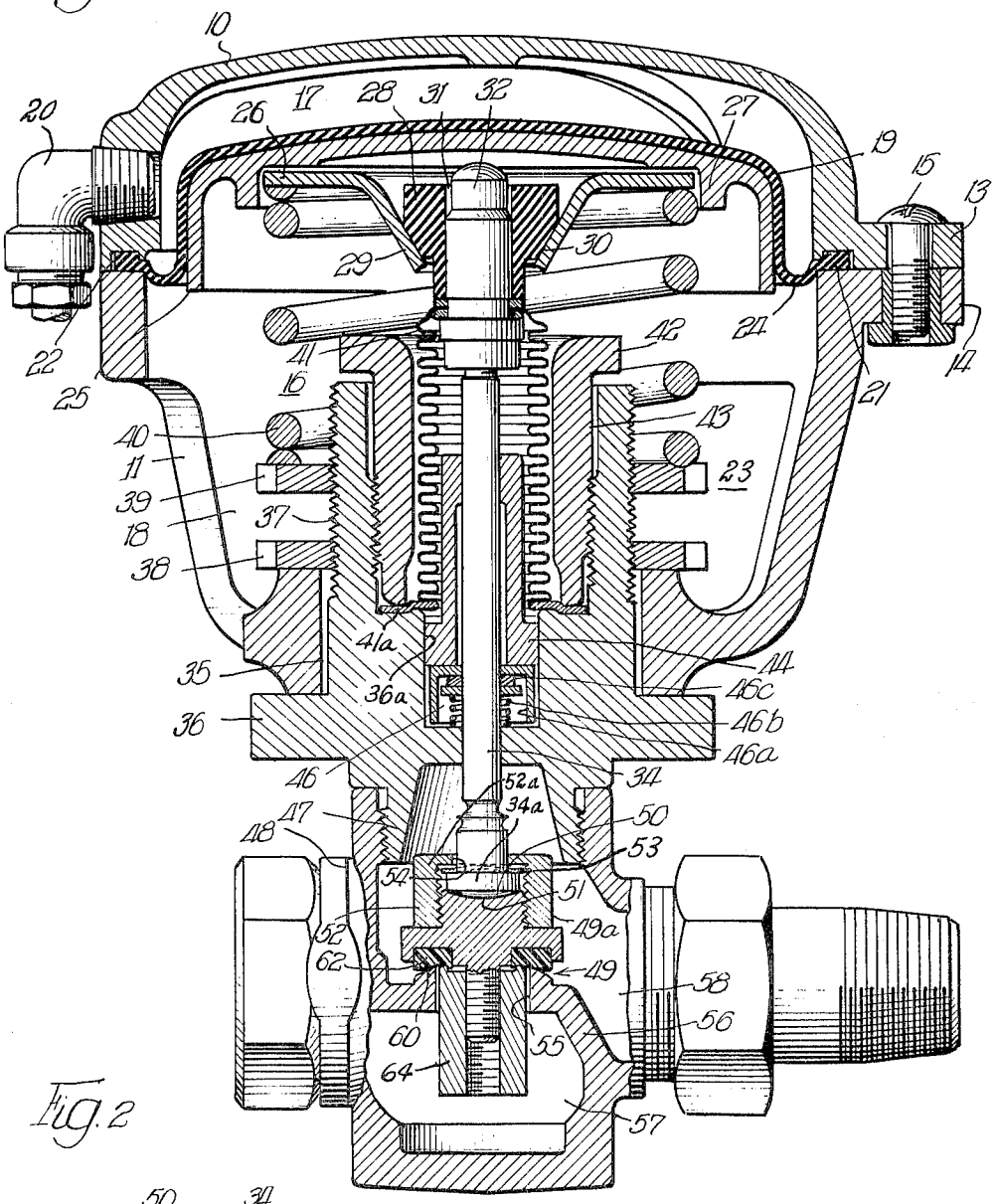
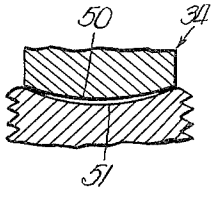


Fig. 2



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VALVE

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This invention pertains to control valves and in particular to control valves that are used in conjunction with air conditioning systems.

In air conditioning systems the control element generally consists in part of a valve member which is actuated by a temperature sensing device. This valve member regulates the flow of a medium, either a liquid or a gas, be it hot or cold, to the conditioning unit. The temperature sensing elements that are presently available commercially have been developed to the extent that they respond to minute changes in the measured variable such as heat. However, this accuracy of the sensing element cannot be fully appreciated unless the control valve which is actuated by the sensing element is comparably accurate. The valves that have been used heretofore, due to their mechanical nature, have been seriously limited due to hysteresis, friction, and other error inducing forces. Consequently, the accuracy with which an air conditioning system could be controlled was seriously limited by the control valve.

Therefore, it is an object of the invention to provide a control valve that is novel in construction.

Another object of the invention is to provide a control valve in which hysteresis and other error inducing forces are substantially eliminated.

A still further object of the invention is to provide a control valve that is adapted for use in an air conditioning system.

A still further object of the invention is to provide a control valve that is pneumatically operated and may be actuated by a pneumatic signal generating temperature sensitive device.

A still further object of the invention is to provide a control valve that is economical in construction and simple in operation. These objects and others will be apparent upon reading of the specification with reference to the following drawing.

In the drawing:

FIGURE 1 is a side elevational view in cross section of the control valve embodying the invention.

FIGURE 2 is a fragmentary sectional view.

Referring now to the drawing, there is shown a control valve provided with an upper casing member 10 and a complementary lower casing member 11. The two casing members 10 and 11 are secured together by the complementary flanges 13 and 14 and the usual nut and bolt arrangement 15. In their assembled position the casing members 10 and 11 form a chamber generally denoted by the numeral 16. This chamber is divided into an upper compartment 17 and a lower compartment 18 by the diaphragm member 19.

As will be seen later on, the diaphragm member 19 is generally under pressure other than atmospheric, in the upper compartment 17, provided by a suitable temperature sensing element which communicates thereto through the fixture 20. The lower compartment, however, is at atmospheric pressure due to the cutaway portions 23 in the casing member 11.

The diaphragm member 19 is secured in place by the annular bead 21 at its base which is received within the annular groove 22 in the upper casing member 10.

The diaphragm member 19 is molded into the shape of a conical frustum having a ribbed like convolution 24 at its base to prevent binding of the diaphragm as it is displaced either upwardly or downwardly. Although this is the preferred embodiment of the diaphragm, it is contemplated that other types and shapes of diaphragms may be used in the practice of the invention. Underlying the diaphragm 19 is a diaphragm support member 25 which receives and centrally positions the cup member 26 by the annular shoulder 27. The cup member 26 has a conical shaped chamber 29 which receives the bushing 28 provided with a spherical surface 30. The spherical surface 30 compensates for any misalignment between the diaphragm support member 25 and the valve stem, as will be explained more fully later on.

The bushing 28 has an internally threaded bore 31 which engages the threaded portion 33 near the upper end 32 of the valve stem 34. When the valve is in normal repose, the spherical surface 30 is seated within the conical surface 29 so that the end 32 is spaced from the support member 25.

The lower casing 11 is provided with the bore 35 which receives the guide member 36. The guide member 36 at its upper end is provided with the threaded portion 37 which receives the locknut 38 for holding the guide member 36 in place. A second locknut 39 is received on the threaded portion 37 and co-operates with the cup member 26 to confine the coil spring 40 therebetween, as shown in the drawing. It can be seen that the load on the coil spring can be adjusted by simply varying the height of the locknut 39 on the threaded portion 37.

A second guide member 44 is press fitted into the bore 36*a* so that the two guide members co-operate to prevent any misalignment of the stem 34. Although the two guide members 36 and 44 are precision fitted to the stem 34, it is possible that there will be some leakage from the fitting 48 along the stem 34. In order to prevent the controlled media from leaking into the lower compartment 18, the central portion of the stem is enclosed by the bellows 41. The bellows 41 is held in place as shown in the drawing by the bushing 42 which is threadably received within the bore 43 of the guide member 36. When the bushing 42 is tightened in its holding position, it abuts the stepped washer 41*a* which is secured to the lower end of the bellows 41, so as to hold the latter into sealing engagement with the guide member 44. It may also be desirable to provide a means for further reducing any leakage along the stem such as the spring and cup assembly, generally denoted by the numeral 46, as shown in the drawing. The cup member 46*a* provides a vertical support for the guide member 44 and serves to confine any leakage along the valve stem. The spring 46*b* holds the resilient washer 46*c* so as to provide a check valve arrangement. In this manner any fluid in the bellows 41 may be forced past the washer 46*c* against the force of the spring 46*b* when the bellows is compressed. On the other hand, fluid attempting to move in the other direction past the cup assembly will tend to increase the sealing engagement of the washer 46*c*.

The fitting 48 is incorporated into the conduit through which the measured variable such as steam, water, or air flows. A valve member, generally denoted by the numeral 49, co-operates with the fitting 48 to control the flow of the measured variable therethrough as actuated by the previously described diaphragm assembly. As shown in the drawing, the valve 49 is secured to the stem 34 by the connector assembly 49*a* which will compensate for any misalignment between the stem and the valve seat.

The connector assembly comprises two substantially complementary spherical surfaces 50 and 51 which are affixed to the valve stem 34 and the valve member 49, respectively. The spherical surfaces 50 and 51 are disposed within the housing member 52. A spring washer 53 is mounted between the housing member flange 52*a* and the valve stem flange 34*a* so as to bias the surfaces 50 and

51 into frictional engagement. The housing member 52 is provided with an aperture 54 through which extends the valve stem 34. The aperture 54 is considerably larger than the valve stem so that there is a controlled amount of play of the latter within the former. In this manner the valve stem 34 and the valve member 49 may be radially displaced with respect to each other. The frictional force between the two surfaces will prevent inadvertent return of the stem and the valve to their coaxial positions.

As a result of this construction the valve 49 may be adjusted with respect to the aperture 55 which is located in the partition 56 separating the inlet compartment 57 from the outlet compartment 58 of the fitting 48. If for some reason, as quite often happens, the stem 34 is not coaxial with the aperture 55 the valve 49 through the unique connector assembly 49*a* may be adjusted so that it becomes coaxial with the aperture 55 by simply adjusting the spherical surfaces 50 and 51 with respect to each other.

The valve 49 is adapted to seat when in the closed position on the surface 60 formed on the partition 56. The valve 49 is provided with a flexible ring 62 which engages the surface 60 so as to provide an impervious sealing engagement. Extending below the flexible ring 62 is the cylindrical plug 64 which cooperates with the aperture 55 to meter the flow therethrough. As a result of the subject invention the valve 49 and particularly the plug 64 may be accurately aligned with the aperture 55. This is true even though the valve stem 34 is not so aligned. Such alignment does not require the canting, although such is possible if necessary as will be explained hereafter, of the cylindrical plug 64 or any other part of the valve with result to the aperture and thus eliminates any tendency for the plug to rub on the portions of the partition 56 defining the aperture 55.

In the preferred embodiment the spherical surface 50 has a radius of curvature greater than that of the spherical surface 51. Thus when the two spherical surfaces 50 and 51 are in engagement there is ring contact therebetween. The ring contact permits some canting of the valve with respect to the stem much in the manner of a ball joint. Thus if the surface 60 is not perpendicular to the axis of the stem 34 the valve member 49 may be canted or rotated until the flexible ring 62 is normal to the surface 60. It will be understood however that the surfaces may have a configuration other than spherical. For example the surfaces may be planar.

Though certain elements and uses have been specified in the description of the invention, it is to be understood that these are merely by way of example and are not to be construed as limitations. It is contemplated that the valve may be modified within the scope of the claims without departing from the spirit of the invention.

I claim:

1. A control valve comprising: a member defining a valve seat; a valve member cooperative with said valve seat and having a resilient seating surface on one side for sealing said valve seat when said valve member is seated thereon, said valve member having on its side opposite from said resilient seating surface a concave drive thrust receiving surface in the form of a spherical sector; means for driving said valve member; a valve stem connecting said valve member and said means for driving said member, said valve stem having a convex drive thrust transmitting surface in the form of a spherical sector and in face to face engaging relationship with said concave surface, said convex surface having a larger radius of curvature than said concave surface such that said convex surface is adapted to engage in ring-type contact with said concave surface, said convex surface having its center of radius disposed an extended distance from the plane of said valve seat on the side thereof from which said valve member is driven, said concave surface being of limited arcuate extent so as to permit a lateral component of movement of said convex surface relative to said concave surface while said convex and concave surfaces are in ring-type contact; means for limiting lateral and angular shifting of said valve stem relative to said valve member; and means for resiliently biasing said concave and convex surfaces into frictional ring-type contact, whereby compensation for limited lateral or angular misalignment of said valve stem relative to said valve seat is enabled.

2. A control valve comprising: a member defining a valve seat; a valve member cooperative with said valve seat and having a resilient seating surface on one side for sealing said valve seat when said valve member is seated thereon, said valve member having on its side opposite from said resilient seating surface a concave drive thrust receiving surface in the form of a spherical sector; means for driving said valve member; a valve stem connecting said valve member and said means for driving said valve member, said valve stem having a convex drive thrust transmitting surface in the form of a spherical sector and in face to face engaging relationship with said concave surface, said convex surface having a larger radius of curvature than said concave surface such that said convex surface is adapted to engage in ring-type contact with said concave surface, said convex surface having its center of radius disposed an extended distance from the plane of said valve seat on the side thereof from which said valve member is driven, said concave surface being of limited arcuate extent so as to permit a lateral component of movement of said convex surface relative to said concave surface while said convex and concave surfaces are in ring-type contact; a housing member attached to said valve member so as to enclose said convex and concave surfaces, said housing member having an aperture therein through which said valve stem extends, said aperture being materially larger than said valve stem so as to permit a lateral component of movement of said valve stem within said aperture and in turn a lateral component of movement of said convex surface within said housing; and means disposed interior of said housing member and between said housing member and said valve stem for resiliently biasing said concave and convex surfaces into frictional ring contact, whereby compensation for limited lateral or angular misalignment of said valve stem relative to said valve seat is enabled.

3. A control valve comprising: a member defining a valve seat having a fluid flow aperture therethrough; a valve member cooperating with said valve seat, said valve member having a metering plug extending from one side thereof for occupying a position in said valve seat aperture to meter the flow through said valve seat aperture when said valve member is not seated on said valve seat aperture, said valve member having a resilient annular seating surface on said one side for sealing said valve seat when said valve member is seated thereon, said valve member further having on its side opposite from said metering plug a concave drive thrust receiving surface in the form of a spherical sector no greater than a hemisphere in arcuate extent; means for driving said valve member; a valve stem connecting said valve member and said means for driving said valve member, said valve stem having at one end and enlarged flange portion provided with a convex drive thrust transmitting surface in the form of a spherical sector no greater than a hemisphere in arcuate extent, said convex surface being disposed in face to face engaging relationship with said concave surface, said convex surface having a larger radius of curvature than said concave surface such that said convex surface is adapted to engage in ring type contact with said concave surface, said convex surface having its center of radius disposed an extended distance from the plane of said valve seat on the side thereof from which said valve member is driven; a cylindrical housing member attached to said valve member so as to enclose said convex and concave surfaces and said flange portion of said valve stem, said housing member having a flange portion overlying said flange portion

of said stem member, said flange portion of said housing member having an aperture therein through which said valve stem extends, said housing member flange aperture being materially larger than said valve stem so as to permit a limited lateral component of movement of said valve stem within said housing member flange aperture and in turn a limited lateral component of movement of said convex surface within said housing member; and a spring washer disposed about said valve stem between said flange portion of said valve stem and said flange portion of said housing member for resiliently biasing said concave and convex surfaces into frictional ring-type contact, whereby compensation for limited lateral or angular misalignment of said valve stem relative to said valve seat is enabled.

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