Dec. 4, 1962 L. J. SIRI 3,066,698

FLUID EXPANSION POWER ELEMENT

Filed Feb. 2, 1959

FIG. 1

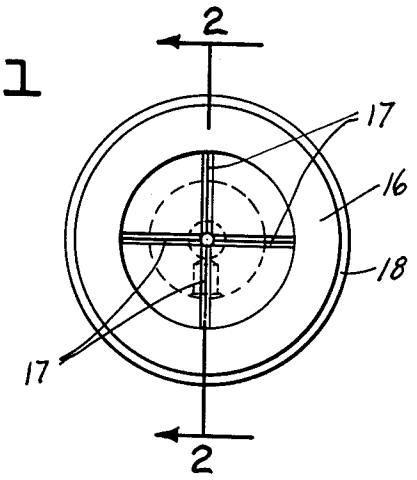


FIG. 2

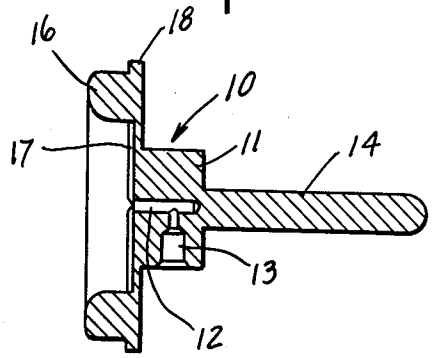
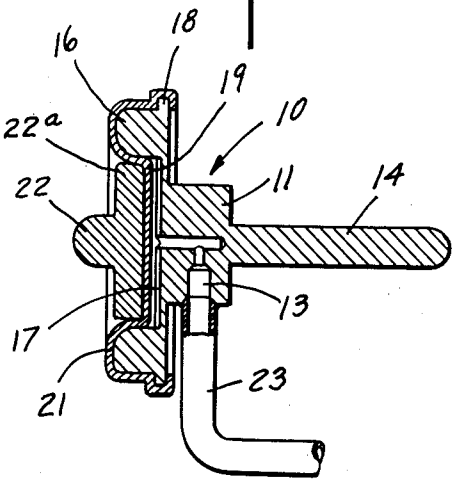


FIG. 3



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FLUID EXPANSION POWER ELEMENT

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This invention relates generally to power element or diaphragm assemblies and in particular to a power element of simplified construction particularly adapted for operation by thermal expansion of its liquid charge or fill.

As is well known, actuator elements of the type herein disclosed are used extensively for actuation of switches or other control apparatus which have application in the regulation of pressure and temperature in air conditioning, refrigeration and allied fields. In U.S. Patent 2,942,624 issued to Arthur L. Good on June 28, 1960, titled, "Pressure Responsive Actuator," and assigned to the assignee of the present invention, there is disclosed and claimed a power element of the type herein referred to. The present invention is embodied in a simplified and improved version of the power element described in said copending application.

It is an object of the present invention to provide a power element or diaphragm assembly which is of a two-piece, simplified construction lending itself to economical manufacture.

It is a further object of the present invention to provide a power element or diaphragm assembly constructed so that only a minimum volume of the liquid charge is accommodated in the assembly, thereby minimizing the effect of the temperature ambient to the power element on the response of the element to a temperature change at its remote bulb.

These and other objects will become apparent as the description proceeds with reference to the accompanying drawings in which:

FIG. 1 is an end view of a component of a power element embodying the present invention.

FIG. 2 is a side sectional view of the component shown in FIG. 1, the sectional view being taken along the line 2—2 of FIG. 1.

FIG. 3 is a cross-sectional view of a complete assembly embodying the present invention.

Referring to the drawings, there is generally indicated at **10** a support plate having a generally circular configuration and provided with a rearwardly extending boss **11**. The support plate has a central aperture **12** therein which communicates with a passage **13** formed in the rearwardly extending boss. A stem portion **14** extends from the boss **11** and may be utilized to mount the power element assembly in a control apparatus. Extending from the front face of the plate is an annular boss **16** formed integrally with the plate. The circular area of the plate bounded by the boss is provided with intersecting, radial grooves **17** which communicate with the aperture **12**. Plate **10** extends somewhat beyond the annular boss **16** to provide a peripheral ledge portion **18**.

As may best be seen in FIG. 3, a flexible metallic diaphragm **19** overlies the front face of the plate. The diaphragm is formed at its peripheral margin so as to embrace the ledge portion **18** of the plate and may be sealed thereto by any suitable means such as soft solder or epoxy resin. The diaphragm is formed with a single circumferential corrugation **21** which has a contour permitting the diaphragm to closely overly the annular boss **16** and be contiguous therewith when unstressed as shown in FIGURE 3. A thrust pin or actuating element **22** has a disc-shaped portion **22***a* which is disposed in contiguous, overlying relation to the central area of the diaphragm. It will be understood that the thrust element

22 serves to transmit motion of the diaphragm to a switch arm or similar component of the control structure into which the power element is incorporated.

A capillary tube **23** may be soldered or otherwise secured to the boss **11** so that its central bore communicates with the passage **13**. It will be understood that the pressure chambers formed by the outer face of the plate **10** and the diaphragm is adapted to be filled by a pressure transmitting fluid through the capillary tube **23**. The remote end of the tube **23** (not shown) may be joined to a temperature sensing bulb, the capillary pressure chamber and bulb providing a closed system containing a liquid having an appreciable thermal coefficient of expansion and serving to extend the diaphragm outwardly from the plate upon expansion of the liquid. It will be understood that the pressure chamber may respond to remote pressure changes rather than temperature changes in the bulb, such pressure changes being transmitted to the chamber by means of a pressure transmitting fluid in the capillary, as is well known in the art.

In liquid expansion devices of the type herein described, under ideal conditions, the movement of the thrust element **22** is directly proportional only to a change in temperature at the remote bulb. When the power element is formed so that it contains an appreciable amount of the actuating fluid, it will be evident that any change in the temperature ambient to this retained fluid causes it to expand or contract, thereby adding an increment of movement to the thrust element which is independent of the temperature at the remote bulb. Such a device thus responds both to the temperature at the remote bulb and to the temperature ambient to the power element. In the present invention this undesirable response of the power element to the temperature at the element itself is minimized. This feature is brought about by the presence of the boss **16** which fills the space defined by the annular corrugation in the diaphragm. The power element thus retains a minimum volume of fluid and is responsive solely to temperature changes at the remote bulb.

The construction whereby the boss **16** closely underlies the corrugation in the diaphragm also permits the diaphragm to flex in the area of the corrugation under pressure changes without bulging outwardly along its peripheral margin.

The power element assembly described is of simplified construction and has a minimum number of component parts thus lending itself to economical manufacture and assembly. While only a single power element has been described herein, it will be understood that the plate **10** might be formed so as to have corresponding annular bosses extending from its opposite faces. Both faces of the plate might then be enclosed by flexible diaphragms, the resulting assembly thus providing a dual power element both of whose outer walls are flexible.

It will be understood that the invention herein described might be modified and yet retain certain of its features. The scope of the invention is therefore to be limited only by the appended claims.

The invention claimed is:

1. A pressure responsive actuator comprising a first rigid plate having a circular configuration and a central aperture adapted to connect to a pressure transmitting fluid filled capillary tube, an annular boss extending from one face of said first plate and integrally formed therewith, said boss being disposed adjacent the marginal edge of said plate, the portion of said first plate extending beyond said boss providing an annular ledge, a flexible diaphragm overlying said one face of the plate and sealed to said annular ledge thereof, said diaphragm having a single circumferential corrugation therein enclosing said annular boss and contiguous therewith when unstressed,

the circular area of said diaphragm bounded by said corrugation closely overlying the central area of said first plate, and a second rigid plate disposed in contiguous, overlying relation to said circular area of the diaphragm, whereby the volume enclosed by said diaphragm and first plate is minimized while proportionally responding to the pressure of the pressure transmitting fluid and said corrugation is prevented from bulging as said diaphragm flexes in response to increased internal pressure.

2. A pressure responsive actuator comprising a first rigid plate having a circular configuration and a central aperture adapted to be connected to a pressure transmitting fluid filled capillary tube, an annular boss extending from one face of said first plate and integrally formed therewith, said boss being disposed adjacent the marginal edge of said plate, a flexible diaphragm overlying said one face of said first plate and sealed to the marginal edge thereof, said diaphragm having a single circumferential corrugation therein enclosing said annular boss and contiguous therewith when unstressed, the circular area of said diaphragm bounded by said corrugation closely overlying the central area of said first plate, and a second rigid plate disposed in contiguous, overlying relation to said circular area of the diaphragm, whereby the volume enclosed by said diaphragm and first plate is minimized while proportionally responding to the pressure of the pressure transmitting fluid and said corrugation is prevented from bulging as said diaphragm flexes in response to increased internal pressure.

3. A pressure responsive actuator comprising a first rigid plate having a circular configuration and a central aperture adapted to be connected to a pressure transmitting fluid filled tube, an annular boss extending from one face of said plate and integrally formed therewith, said boss being disposed adjacent the marginal edge of said first plate, a flexible diaphragm overlying said one face of said first plate and sealed to the marginal area thereof, said diaphragm having a circumferential corrugation therein enclosing said annular boss and contiguous therewith when unstressed, the circular area of said diaphragm bounded by said corrugation closely overlying the central area of said first plate, and a second rigid plate disposed in contiguous, overlying relation to said circular area of the diaphragm, whereby the volume enclosed by said diaphragm and said first plate is minimized while proportionally responding to the pressure of the pressure transmitting fluid and said corrugation is prevented from bulging as said diaphragm flexes in response to increased internal pressure.

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