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ELECTRICALLY CONTROLLED ACTUATOR ASSEMBLY

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Fig 1

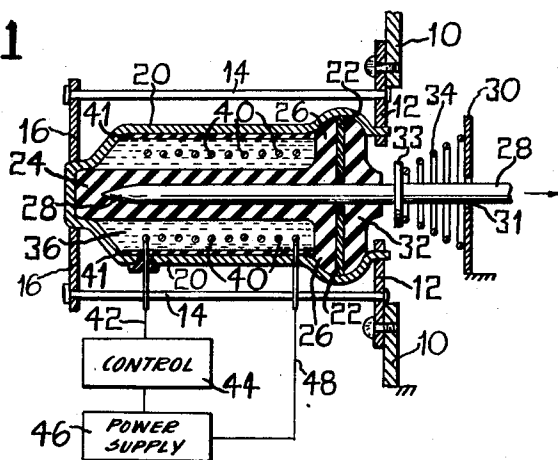


Fig 2

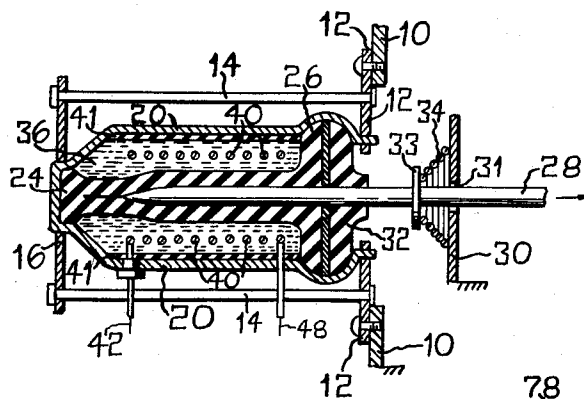


Fig 3

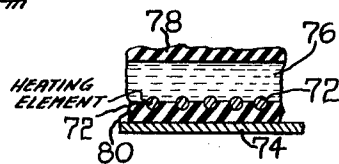
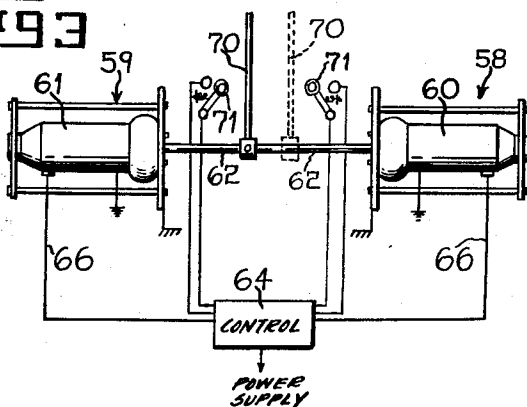


Fig 4

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ELECTRICALLY CONTROLLED ACTUATOR ASSEMBLY

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3 Claims. (Cl. 60—23)

This invention relates to an electrically controlled actuator assembly. This invention also relates to an electrically controlled actuator assembly, the actuator of which has an infinite number of operable positions and which has high power capacities. This invention also relates to an electrically controlled power actuator which is of small physical size. However, the invention is not so limited in that it may be of any suitable physical size.

There are numerous applications in which an actuator means having a large number of operable positions and which has large power capacities while being of small physical size is desirable. An actuator means of the electric solenoid type has been used for numerous purposes. However, an electric solenoid having large power capacities has necessarily been of large physical size. Furthermore, it is difficult and expensive to provide an electric solenoid mechanism having a large number of operable positions. Hence, it has not been possible or practical to use an electric solenoid in applications in which numerous operable positions and a large power requirement with small physical size has been necessary.

Small high speed motors with various types of gear reduction units have been used in attempts to provide large power requirements with a device of small physical size. However, it has been found that a motor with a gear reduction unit has required considerable space. The space required by the motor and its associated gear reduction unit has been excessive for many installations. Furthermore, it has been found that radio interference resulting from operation of such an actuator motor has been undesirable in numerous applications.

Hence it is an object of this invention to provide an actuator means which is of small physical size and is capable of producing large power output.

Another object of this invention is to provide a physically small powerful electrically controlled actuator assembly means which has an infinite number of operable positions.

Another object of this invention is to provide a small actuator means having large power capacities, which actuator means is relatively silent in operation and the operation of which does not result in radio interference.

Another object of this invention is to provide an actuator means, the rate of response of which is controllable.

Another object of this invention is to provide an actuator means which is long lived, has a minimum number of moving parts and which requires a negligible amount of servicing.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

Figure 1 is a side sectional view of an electrically controlled actuator assembly of this invention showing the actuator in a deenergized position.

Figure 2 is a side sectional view similar to that of Figure 1, showing the actuator in an energized position.

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Figure 3 is a side elevational view showing a preferred modification of an electrically controlled actuator assembly of this invention.

Figure 4 is a fragmentary side sectional view showing a means for mounting a heater element of an electrically controlled actuator assembly of this invention.

Referring to the drawing in detail an actuator assembly of this invention comprises a support structure 10 having a bracket 12 attached thereto. The bracket 12 has a plurality of rod members 14 extending therefrom. Attached to the extending end of the rod members 14 is a plate 16. Attached to the bracket 12 and the plate 16 and supported thereby is a casing or container 20. The casing or container 20 may be of any desired size or shape. Herein the casing or container 20 is shown as having somewhat irregularly shaped wall members. The end of the container 20 which is adjacent the bracket 12, is provided with an end wall 22, provided with an aperture therein.

Within the container 20 is an elongate elastic body 24 which is shown as extending between opposed end walls of the container 20. The elastic body 24 may be composed of any desirable elastic material such as rubber, or synthetic materials having the qualities of being substantially incompressible, but elastic, permitting flow of the material. The elastic body 24 is provided with a sealing flange 26 integral therewith and in engagement with the end wall 22. The elastic body 24 is provided with a longitudinal bore through a portion of the length thereof.

Within the longitudinal bore of the elastic body 24 is an actuator rod 28. The actuator rod 28 extends from the elastic body 24 through the aperture in the end wall 22 of the casing 20. The actuator rod 28 extends from the casing 20 and has a portion thereof slidably supported by a guide block 30 provided with an aperture 31. The actuator rod 28 thus has longitudinal movement with respect to the container 20.

Encircling the actuator rod 28, disposed externally of the container 20 and in adhesive engagement with the end wall 22 is an elastic sealing disc 32. The actuator rod 28 is slidably movable with respect to the sealing disc 32.

Attached to the actuator rod 28 adjacent the sealing disc 32 is a collar 33. Compressed between the collar 33 and the guide wall 30 is a helical spring 34 which encircles the actuator rod 28.

Within the container 20 and external of the elastic body 24 is a quantity of thermal responsive or thermal expansive material 36. This expansive material 36 may be any element or any combination of elements giving the material the physical property characteristics of a high coefficient of expansion over a given temperature range.

Disposed within the thermal responsive material 36 is a heater element 40 composed of any suitable material. The heater element 40 may be helical or of any other suitable formation. The heater element 40 is electrically insulated from the walls of the container 20 by any suitable means. Herein the means of insulation is shown as a liner 41 made of any suitable insulation material.

The heater element 40 is electrically attached at one end thereof to a conductor lead 42 connecting to a control unit 44. The control unit 44 is electrically attached to a power supply 46, as shown in Figure 1. The other end of the heater element 40 is attached directly to the power supply 46 by means of a conductor 48. However, it is to be understood that any other suitable means of supplying electrical energy to the heater element 40 may be used.

When the heater element 40 is energized by means of the power supply 46 and the control unit 44, the heat produced by the heater element 40 causes heating of the thermal responsive material 36. The thermal responsive

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material 36 thus expands. Expansion of the thermal responsive material 36 causes high values of pressure to be created within the container 20. Therefore, high pressures are exerted upon the elastic body 24 by the thermal responsive material 36. These pressures result in a squeezing action upon the elastic body which tends to close the bore within the elastic body 24. As the squeezing action closes the bore within the elastic body 24, the actuator rod 28 is forced to move outwardly from the container 20, as clearly shown in Figure 2.

Outward movement of the actuator rod 28 causes compression of the resilient spring member 34 which encircles the actuator rod 28.

When the heater element 40 is deenergized, cooling of the thermal responsive material 36 occurs, permitting contraction of the thermal responsive material 36. Contraction of the thermal responsive material 36 results in a decrease in the pressure exerted upon the elastic body 24 by the thermal responsive material 36. Thus the spring member 34 is able to cause inward return movement of the actuator rod 28 within the bore of the elastic body 24 so that the actuator rod 28 again assumes its normal position within the container 20 as shown in Figure 1.

The amount of outward movement of the actuator rod 28 from the container 20 may be governed by controlling the quantity of heat applied to the thermal responsive material 36 by means of the heater element 40. Also, the rate of response of the actuator rod 28 may be governed by controlling the quantity of heat applied to the thermal responsive material 36 by means of the heater element 40. Greater movement or more rapid response of the actuator rod 28 requires greater quantities of heat, which quantities of heat are controlled by the electrical energy supplied to the heater element 40, governed by means of any suitable control apparatus.

Figure 3 shows a preferred modification of the electrically controlled actuator assembly of this invention. In the modification, a pair of actuator assemblies 58 and 59 are disposed in spaced relation one from the other. The actuator assemblies 58 and 59 are provided with containers 60 and 61 respectively. The containers 60 and 61 are similar to the container 20 shown in Figure 1 with the contents thereof. A common actuator rod 62 extends into the container 60 and into the container 61.

A control unit 64 is connected to any suitable power supply. The control unit 64 is connected to the heater elements of the actuator assemblies 58 and 59 by means of electrical conductors 66.

When it is desired to move the actuator rod 62 to the left, as shown in Figure 3, the heater element within the container 60 is energized thus resulting in movement of the actuator rod 62 in a direction outwardly from the container 60. This outward movement from the container 60 of the actuator rod 62 causes the actuator rod 62 to be moved farther into the container 61.

Thus when it is desired to move the actuator rod 62 in a right hand direction, as shown in Figure 3, the control unit 64 energizes the heater element within the container 61 thus heating the thermal responsive material within the container 61 causing the elastic body within the container 61 to be squeezed, forcing the actuator rod 62 to move toward the container 60.

An arm member 70 is shown attached to the actuator rod 62 for movement thereby. The arm member 70 may be attached to any suitable means for operation by the electrically controlled actuator assembly shown in Figure 3.

A pair of limit switches 71 are shown engageable by the arm member 70 and electrically connected to the control unit 64 for indicating to the control unit 64 extreme positions of the arm member 70.

Figure 4 is an enlarged side sectional view showing a means for securing a heater element 72 within a container 74 provided with thermal responsive material 76 and an elastic body 78. Within the container 74 in engagement

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with the enclosing walls thereof is a liner 80 of insulating material which supports the heater element 72. It is to be understood that the heater element 72 within the casing or container of the actuator means of this invention may be disposed and secured within the container by any other suitable means.

Thus it is understood that the electrically controlled actuator assembly of this invention provides means by which a large amount of power can be provided when desired by means of an actuator assembly which is of small physical size. The actuator means of this invention has an infinite number of operable positions and the rate of response of the actuator means is controllable.

It is also to be understood that the thermal responsive material within a container or casing may be provided with heat from a source external of the casing or container member. If desired, heat may be applied both externally and internally of the container to provide desired response characteristics of the actuator rod.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. An electrically controlled actuator assembly comprising support structure, a container attached to the support structure, an elastic body disposed within the container, the elastic body having enclosing walls providing a bore therein, the container having an aperture therein aligned with the bore of the elastic body, an actuator rod snugly fitting within the bore of the elastic body and extending from the container through the aperture thereof, the actuator rod having a tapered end engageable with the end of the bore, thermal expansive material within the container exterior of the elastic body, an electric heating element disposed within the thermal expansive material and having means for connection to a source of electrical energy, energization of the electric heating element causing expansion of the expansive material, expansion of the expansive material causing a squeezing action upon the elastic body resulting in partial closing of the bore therein, the bore being first closed at the end thereof in which the tapered end of the rod is disposed as the enclosing walls move inwardly against the tapered end of the rod, the actuator rod thus being urged to move in a direction outwardly from the container.

2. In an actuator of the type having a controlled energizable heater element for operation thereof, a casing member, a body of elastic material within the casing member, the body of elastic material being provided with walls forming an elongate cavity therein open at one end thereof and extending a portion of the length thereof, the casing member being provided with an aperture in alignment with the open end of the cavity, an actuator rod extending through the aperture and into the cavity of the body of elastic material, the actuator rod snugly fitting within the cavity and in direct engagement with walls thereof, the actuator rod having a tapered end engageable with the wall at the end of the cavity, thermal responsive work producing material within the casing member surrounding the body, energization of the heater element causing expansion of the thermal responsive material thus exerting high pressures upon the walls of the body so that the walls initially in engagement with the tapered end of the actuator rod move into engagement one with the other, followed by increased closure of the cavity as the walls move one toward the other squeezing upon the tapered end of the rod and forcing the rod in a direction outwardly from the body.

3. Actuator apparatus of the type having energizable heater means for operation thereof comprising a con-

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tainer provided with an aperture therein, thermal responsive work producing material within the container, an elastic body within the container and within the thermal responsive material, the elastic body having wall members forming a cavity therein provided with an opening in direct communication with the aperture of the container, an actuator rod having a tapered end within the cavity, the actuator rod extending from the cavity and from the container through the aperture thereof, the rod fitting snugly within the cavity and in direct engagement with the wall members thereof, energization of the heater means causing expansion of the thermal responsive material causing high forces to be exerted upon the wall members of the elastic body causing the wall members in engagement with the tapered end of the rod to be

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forced one toward the other thus causing closing action of the cavity as the wall members are forced inwardly adjacent the tapered end of the rod and squeeze the rod in a direction from the container.

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