Sept. 20, 1960 W. L. CARLSON, JR 2,953,166

DIAPHRAGM SUPPORT

Filed Nov. 22, 1957

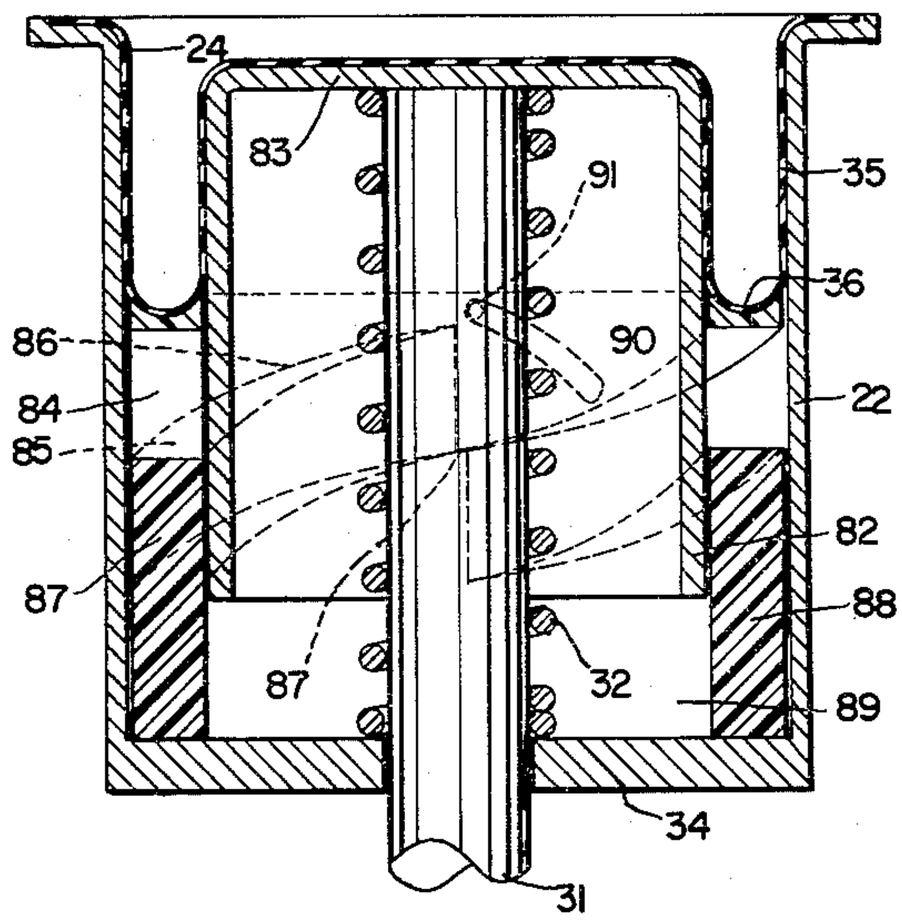


FIG. 1

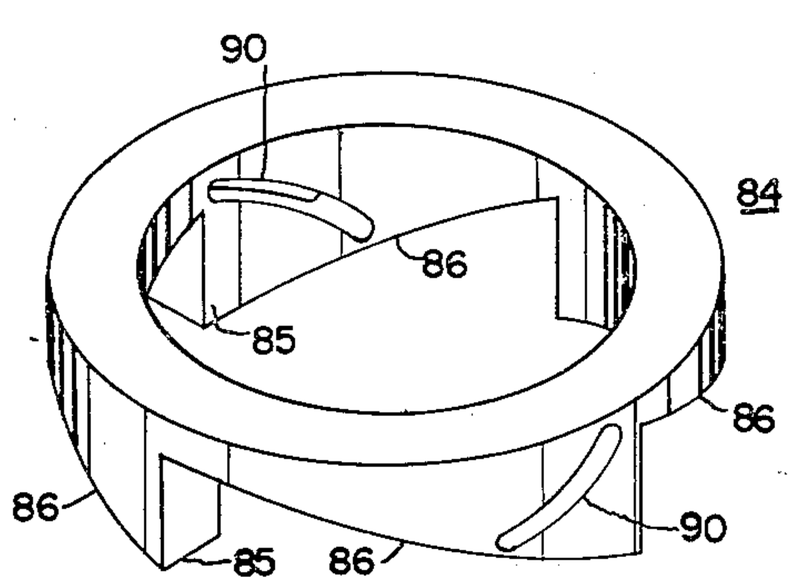
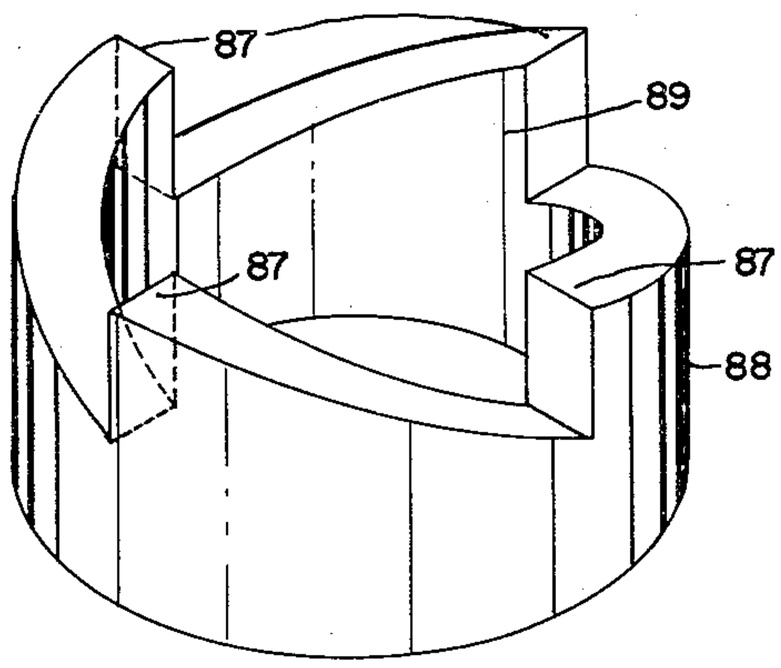


FIG. 2



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DIAPHRAGM SUPPORT

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1 Claim. (Cl. 137—788)

The present invention is directed to a type of diaphragm support for use in hydraulic actuators, and more specifically is directed to a support means for use in an actuator which may be utilized with highly corrosive conductive fluids such as conductive liquid metals.

In recent years numerous hydraulic systems have been developed utilizing conductive fluids such as mercury, sodium, potassium, and sodium-potassium mixtures. While most of the systems have utilized the conductive liquid metals as cooling media in heat transfer systems other applications have also arisen. An example of such a system is the combination of a pump and a plurality of variable volume chambers which are used to obtain motion when a conductive liquid metal is moved. Due to the corrosive nature of the sodium and potassium types of conductive liquid metals it has been necessary to engineer and build hydraulic actuators which are hermetically sealed and which have adequate safety features in case of a rupture of one of the hermetically sealed chambers. In order to use a hydraulic actuator which is filled, for example, with a sodium-potassium mixture in residential and commercial applications it is necessary to build an actuator which can adequately contain the corrosive fluid under all operating conditions. It is also necessary to supply a unit which has mechanical practicability and which is further economical to build.

It is the object of the present invention to disclose a diaphragm support for use with an actuator which is capable of handling highly corrosive types of liquid metals and other fluids in a hermetically sealed system.

A further object is to provide a diaphragm support for an actuator which utilizes a neutral fluid between the diaphragm and a bellows chamber as a leak resistant safety feature.

Yet another object of the present invention is to disclose a diaphragm support arrangement whereby the bight of the diaphragm is continuously supported so that the pressures applied to the active side of the unit can be safely retained regardless of the operating pressure.

These and other objects will become apparent when the three sheets of drawing accompanying the present specification are considered, wherein:

Figure 1 is a cross section of a diaphragm support means utilizing two relatively movable rings, and

Figure 2 is an isometric view of the two rings used in Figure 1.

In Figure 1, a diaphragm **24** lays across the top **83** of a piston **82**. A cylinder **22** is provided having a bottom plate **34**. An output shaft **31** passes through the bottom plate **34** and attaches to the top **83** of cylinder **82**. A coil spring **32** biases the piston **82** to its uppermost position, as shown, and is coiled around the shaft **31**. The bottom **36** of bight **35** of the diaphragm **24** is supported on a cylindrical member **84** made of an appropriate plastic material. The member **84** has four dominantly projecting teeth **85** whose slope **86** is selected to give the member **84** a particular rate of linear movement when rotated over the teeth **87** of the member **88**. The member **88** is a cylindrical plastic member having the teeth **87** cut in its upper surface and the slope of the teeth

87 is the same as the slope of the teeth **85**. The member **88** is placed inside of cylinder **22** and is attached by any convenient method to the bottom plate **34**. It is attached in such a manner that it can not rotate or be moved and its inner surface **89** acts as a guide for the cylinder **82**. The member **84** further has two slots **90** cut into two of the teeth **85** on opposite sides of the member **84**. These slots are engaged by a pin **91** which is attached to the outer surface of piston **82**.

The shaft **31** is fixed against rotation at the load to which it is attached (not shown) and thereby the pin **91** moves in a linear direction with the piston **82**. Since the pin **91** rides in slot **90** and moves in a linear manner only, it becomes apparent that the member **84** is caused to rotate as the pin is moved relative to it. When the diaphragm **24** is exposed to pressure and the piston **82** moves, the pin **91** moves in the groove **90** causing the block member **84** to rotate. Since the block **84** has sloped teeth **85** which mate with teeth **87** of member **88**, the block **84** rotates and slides along that slope. It is obvious therefore that the member **84** rides up and down in a parallel relationship to the movement of the piston **82**. By the proper selection of the slope **86** of teeth **85** and of teeth **87** it is possible to give the member **84** a movement which is one-half the linear rate of the movement of pistons **82**. It can thus be seen by properly selecting the dimensions and materials of the members **84** and **88** it is possible to yield a diaphragm support member which continuously supports the bottom **36** of the bight **35**, to in turn provide the safety required of the overall actuator.

The present application has been illustrative only of one of the many possible ways in which the bottom **36** of bight **35** can be supported continuously where a diaphragm **24** is used to seal a fluid tight chamber against a moving piston or cylinder. With this arrangement it is possible to build units which are hermetically sealed and capable of handling corrosive fluids such as liquid metals and which further provides a double safety chamber having the complete safety and strength required of it in the commercial world. It is obvious that many methods could be utilized to support the bottom **36** of bight **35** within the teaching disclosed and the applicant has provided an example only of one preferred embodiment. The applicant wishes to be limited in no way other than by the scope of the appended claim.

I claim as my invention:

In a device of the class described: cylinder means having a movable loose fitting piston means therein; pin means attached to said piston means; a diaphragm member sealing said cylinder means into two sections; said diaphragm member riding against said piston means and having a bight separating said piston and cylinder means; an annular bight support ring having a plurality of sloped teeth on a side opposite said bight and said ring in contact with said bight between said piston and cylinder means; a bottom ring in line with said support ring; said bottom ring having sloping teeth mating with said support ring teeth; one said ring having slot means; and said pin means engaging said slot means to cause one said ring to rotate as said piston means moves; said rings rotating relative to each other and moving towards each other at one half the lineal rate of movement of the piston means allowing said mating teeth to slide relative to each other and thereby continuously support said diaphragm member.

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