

March 12, 1963

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3,080,890

PRESSURE RESPONSIVE OPERATOR

Filed April 2, 1959

Fig. 1

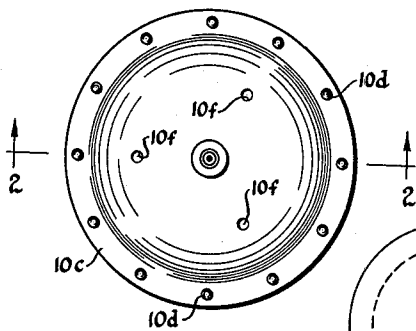


Fig. 2

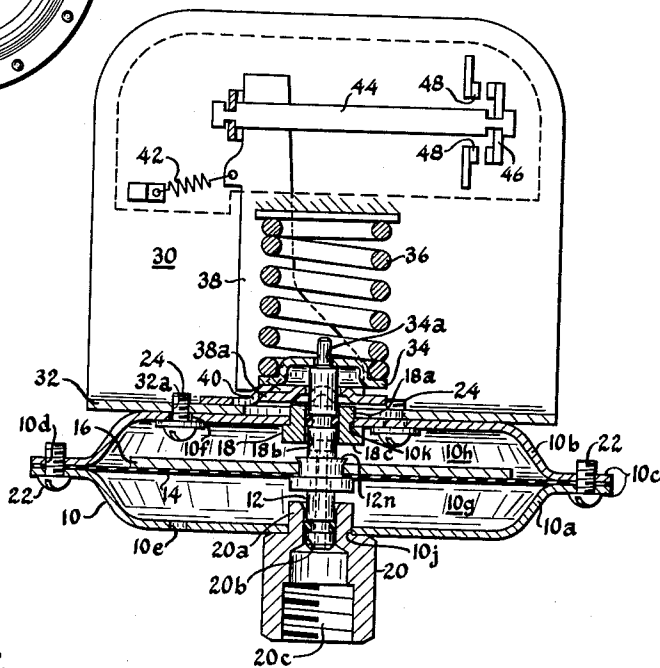
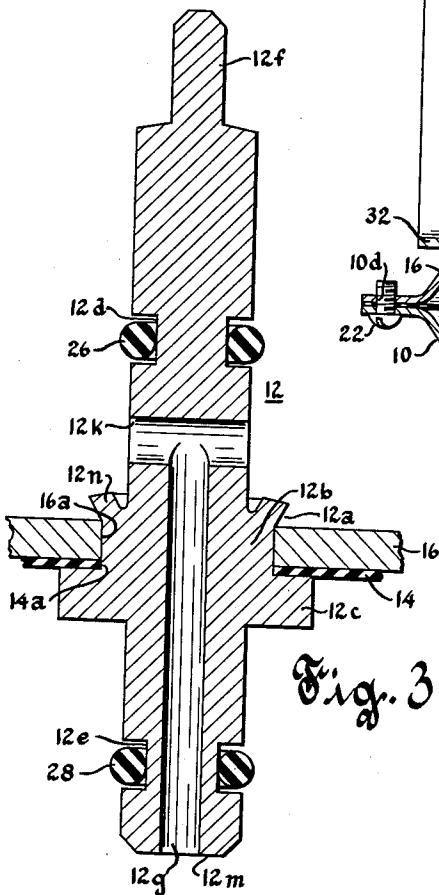


Fig. 3



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3,080,890

PRESSURE RESPONSIVE OPERATOR

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Filed Apr. 2, 1959, Ser. No. 803,763
1 Claim. (Cl. 137-784)

This invention relates to pressure responsive operators and more particularly to those for use in the vacuum range.

Pressure responsive operators designed for use in the vacuum range of pressure commonly employ two diaphragms, a main diaphragm for transmitting movement to an operating rod and a second diaphragm to afford a flexible seal about an opening in the vacuum chamber as the operating rod moves inwardly and outwardly thereof.

Therefore, a principal object of this invention is to provide an improved pressure responsive controller wherein the necessity of providing a second diaphragm to seal the vacuum chamber is eliminated.

A further object is to provide a controller of the aforesaid character in which the vacuum chamber may be evacuated through a pushrod element penetrating said vacuum chamber.

Another object is to provide a pressure responsive control device which is characterized by simplicity of design, low cost of manufacture, and extended operational life.

Other objects and advantages of the invention will hereinafter appear.

In the drawings:

FIGURE 1 is a top plan view of an electric switch controller constructed in accordance with my invention;

FIG. 2 is an elevational view partly in section taken along lines 2-2 of FIG. 1 and further schematically illustrating an attached switch mechanism; and

FIG. 3 is an enlarged sectional view of a subassembly shown in FIG. 2.

As best illustrated in FIG. 2, the operator device comprises a diaphragm housing 10, a pushrod 12, a flexible diaphragm 14, a diaphragm follower 16, an annular bearing bushing 18 and a fitting 20. Also shown in FIG. 2 are portions of one form of switch mechanism 30 suitably constructed for operation by my pressure responsive operator. The cooperation of certain parts of the switch mechanism 30 and the operator will be hereinafter described in detail.

The housing 10 comprises two symmetrically formed, shallow, bell-shaped members 10a and 10b. The latter are preferably formed of a metal such as steel or aluminum. The flanged peripheral portions 10c of members 10a and 10b are provided with radially spaced apertures 10d, best shown in FIG. 1, which are aligned to receive threaded screws 22. Additional apertures 10e and 10f are provided in housing members 10a and 10b, respectively. Apertures 10e are open to the atmosphere, while apertures 10f are aligned with like dimensioned apertures 32a in switch frame 32 to accommodate threaded fasteners 24 which secure the housing 10 to the switch frame 32. Housing member 10a is provided with a central circular opening 10j for receiving a reduced portion 20a of fitting 20. The bushing 18 has a reduced portion 18a which projects outwardly of housing 10 through a central opening 10k in member 10b. Fitting 20 and bushing 18 are preferably brazed to their respective housing members 10a and 10b to provide an airtight seal therebetween.

As shown in FIG. 2, diaphragm 14, which is circular and formed of a suitable resilient material, extends transversely of the assembled housing 10 bisecting the same into an upper chamber 10h and a lower chamber 10g. The outer periphery of diaphragm 14 is compressively

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sealed between the opposing flanged portions 10c of housing members 10a and 10b while the periphery of a central opening 14a therethrough is, as best shown in FIG. 3, compressively sealed between an annular flange 12a on pushrod 12 and the diaphragm follower 16.

As best illustrated in FIG. 3, the pushrod 12 is substantially cylindrical in shape and may be machined from a single piece of stock. A stepped body portion 12a comprising a portion 12b and an annular flange 12c is integrally formed intermediate the ends of the pushrod 12. The diaphragm follower 16 which comprises a flat, rigid disk overlying a greater portion of diaphragm 14 is permanently secured at its center to pushrod 12. As shown in FIG. 3, the inner peripheral wall of the centrally located opening 16a in the diaphragm follower 16 surrounds the portion 12b on the pushrod 12. The diaphragm 14 and diaphragm follower 16 are compressively held between the annular flange 12c and the outwardly flared portion 12n of the portion 12b. The flaring operation is completed subsequent to assembly of the diaphragm 14 and diaphragm follower 16 on the pushrod 12 and may be accomplished by ring staking or peening over the upper surface of the portion 12b.

Toroids or O-rings 26 and 28 are preferably formed of a resilient material, such as neoprene or Buna N synthetic rubber, and may be lubricated with pneumatic grease. The annular grooves 12d and 12e which are oppositely located outwardly of the midpoint of the pushrod along its longitudinal axis accommodate the toroids 26 and 28 and prevent their displacement upon longitudinal movement of the pushrod 12 within fitting 20 and bearing 18. When the above described parts are properly assembled as shown in FIG. 2, the grooved portions 12d and 12e of pushrod 12 which carry the toroids 26 and 28 are disposed within the aligned openings 18b and 20b of the bearing 18 and the fitting 20, respectively. The toroids are of such dimension to provide a sliding seal between the pushrod and the walls of openings 18b and 20b as the pushrod 12 reciprocates within said openings.

As shown in FIG. 2, a reduced end portion 12f of pushrod 12 extends upwardly into interfitted engagement with a central opening 34a in the spring gland 34 of the switch mechanism 30.

As best illustrated in FIG. 3, cylindrical bore 12g extends coaxially through the pushrod 12 from the lower end wall 12m thereof to a point intermediate the annular recess 12d and the annular shoulder 12b. Intersecting the innermost extreme of bore 12 is an aperture 12k which extends transversely through pushrod 12 and opens into chamber 10h. It will be understood that the longitudinal bore 12g and the transverse aperture 12k provide an airtight connection between the interior bore 20c of fitting 20 and the sealed chamber 10h.

An essential feature of this invention is the elimination of all exterior connections to the vacuum chamber 10h. As shown this result is achieved by providing a passageway through the pushrod 12 itself which functions as a vacuum connection to the vacuum chamber 10h.

In operation the interior bore 20c of fitting 20 is connected to a vessel, pipeline or other enclosure in which a pressure less than atmospheric is to be created and maintained by a vacuum producing device. As a vacuum is created in the interior bore 20c of fitting 20, the pressure in chamber 10h acting upon diaphragm 14 is reduced to less than atmospheric. As shown previously, the chamber 10g opens to atmosphere through the apertures 10e in housing member 10a; therefore, the underside of the flexible diaphragm 14 is continuously subjected to atmospheric pressure. The resulting pressure differential on opposite sides of the diaphragm 14 tends to flex the latter

upwardly. The diaphragm follower 16 is urged upwardly by the underlying diaphragm 14 thereby transmitting a force upwardly through pushrod 12 and spring gland 34 against the downward bias of compression spring 36 of the switch mechanism 30. As the pressure differential acting upon diaphragm 14 overcomes this downward bias of spring 36, the pushrod 12 carries the spring gland 34 out of engagement with an underlying portion 38a of the lever 38 which extends transversely of the switch housing 32, thereby permitting lever 38 to pivot in a counterclockwise direction about a pivot member 40 in response to the biasing action of spring 42. As lever 38 pivots in the manner just described, an insulating contact actuator bar 44 attached to the lever 38 moves its associated contactor 46 into circuit completing engagement with stationary contacts 48.

As the pressure differential acting upon diaphragm 14 decreases to a predetermined value, the biasing action of spring 36 forces the spring gland 34 downwardly into engagement with the aforementioned transverse portion 38a of lever 38 thereby pivoting the lever 38 in a clockwise direction and causing the contactor 46 to disengage from contacts 48.

Another distinct advantage of the disclosed vacuum switch is provided by employing a sliding seal between the housing 10b of the vacuum chamber 10h and the pushrod 12, thereby making it unnecessary to provide an additional diaphragm as a seal between the driving element of the controller and the switch mechanism housing 32.

Therefore, the vertical displacement of the pushrod 12 is limited to the normal distance shown in FIG. 2 between the upper surface of the flared portion 12n of the pushrod 12 and the lower surface 18c of the bearing 18. This distance is such that the aforescribed sliding seal between the pushrod 12 and the bearing 18 and fitting 20 is maintained when the pushrod is moved to its upper limit.

The aforescribed embodiment of my invention may be used with many known forms of switching mechanisms to translate the vertical displacement of the pushrod into a switching function. While one form of such a switch mechanism has been shown partially in diagrammatic form in FIG. 2, the structural details of an electric switch mechanism well suited for operation in response to my controlling device is disclosed in U.S. Patent No. 2,781,431.

Although my invention is particularly suited for operation as a vacuum sensing control device, from the foregoing description it will be apparent to one skilled in the art that this device is likewise adapted for operation as a positive pressure actuated controller. Furthermore, while the embodiment herein described in detail suggests that the controller is particularly well suited to actuate an electric switching mechanism, it is apparent that my invention will perform various mechanical as well as electrical control functions in response to a predetermined pressure differential.

I claim:

In a pressure responsive operator, in combination, a diaphragm housing comprising mating, bell-shaped members, a flexible diaphragm having its outer periphery secured between the mating surfaces of said bell-shaped members to divide said housing into a first chamber sealed to the atmosphere and a second chamber open to the atmosphere, a pushrod axially penetrating the end walls of said housing and said diaphragm, sealing means between said pushrod and said end walls comprising resilient toroidal gaskets seated in annular recesses in said pushrod, a diaphragm follower disk substantially overlying said diaphragm in said first chamber and movable therewith, said disk being rigidly attached at its center point to said pushrod, a fitting attached exteriorly of said second chamber, a vacuum connection between said fitting and said first chamber provided by a longitudinal bore intersected by a transverse aperture in said pushrod, said bore communicating with said fitting and said aperture communicating with said first chamber.

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