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2,824,920

PRESSURE SENSITIVE CONTROL DEVICE

Filed Sept. 6, 1955

2 Sheets-Sheet 1

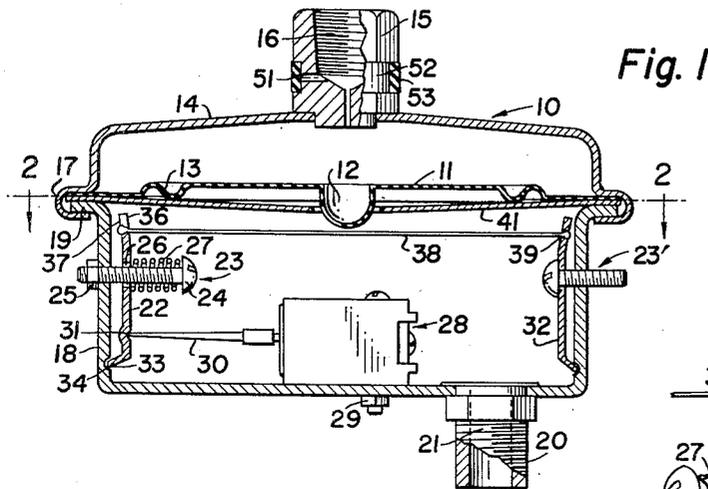


Fig. 1

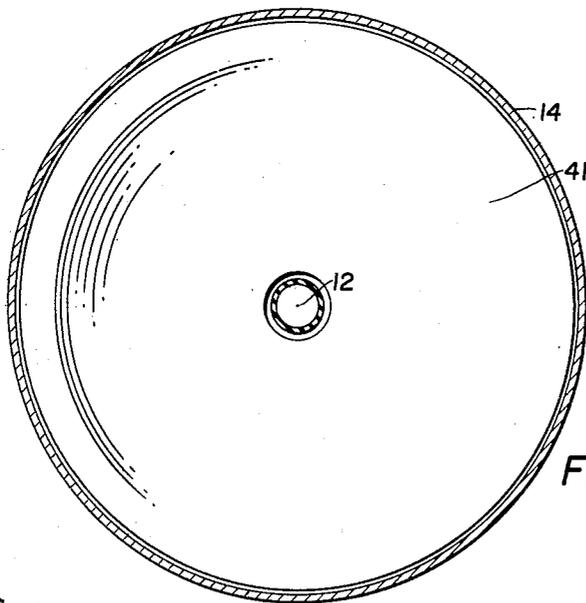


Fig. 2

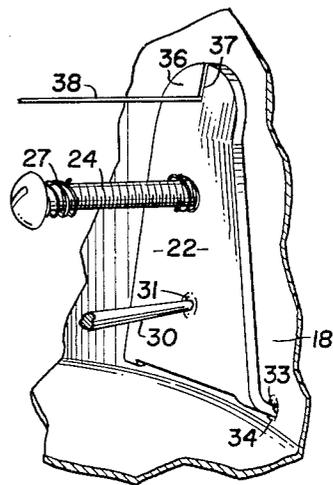


Fig. 4

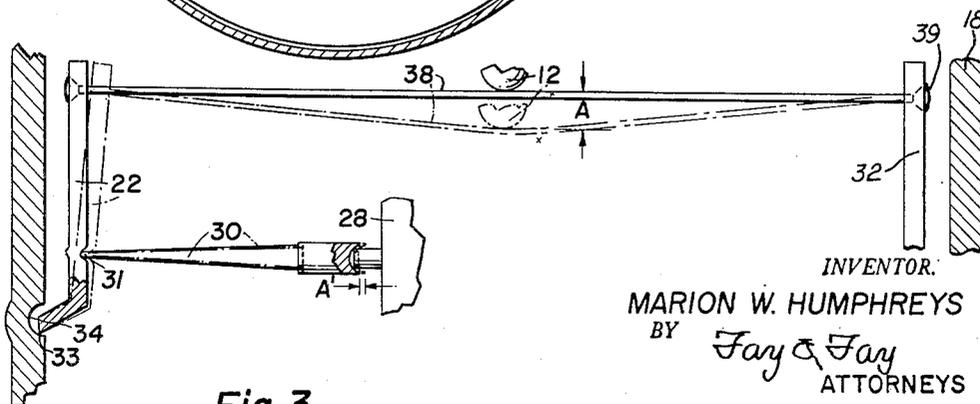


Fig. 3

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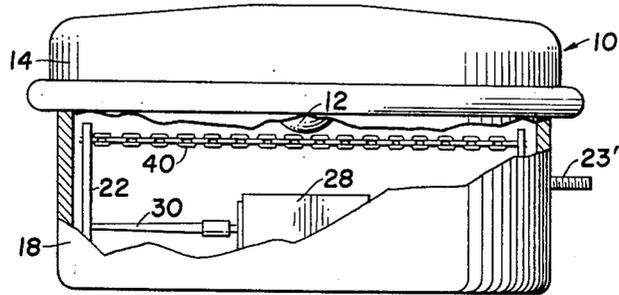


Fig. 5

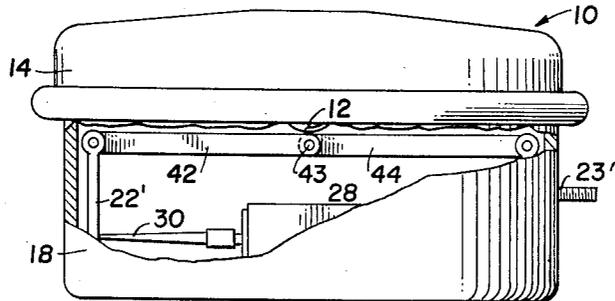


Fig. 6

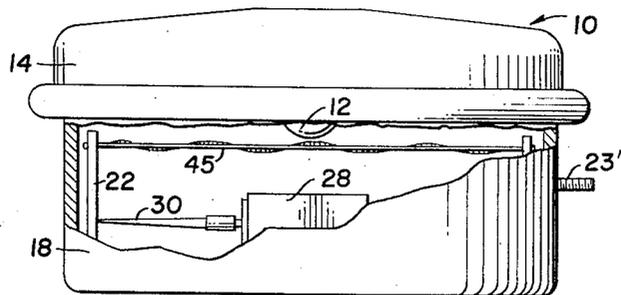


Fig. 7

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PRESSURE SENSITIVE CONTROL DEVICE

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11 Claims. (Cl. 200—83)

This invention, relating as indicated to a pressure sensitive control device, is particularly directed to a novel combination of a thin and flexible diaphragm contacting a flexible longitudinal element to actuate a sensitive electrical or electro-mechanical switching device.

In the general art of diaphragm switches and the like there is need for a very sensitive switch for controlling fluids such as air pressure, granular solids, gas or liquid in some container, a device for recording slight pressure differentials, perhaps of the order of 1/2 inch of water or 1 mm. of mercury. These devices must also be capable of considerable over pressure and must not be damaged by such pressure.

This invention relates to a diaphragming element of an extremely low moment of inertia formed of thin and flexible material, such as plastic or elastomer, with a more rigid nose portion or a dimple, perhaps formed by pre-crimping the plastic in the nose portion. Said diaphragm is backed up by a flexible longitudinal element or cord, such as nylon, vegetable fiber or the like, and possibly even a chain, a number of links or a thin ribbon. Said cord is adapted to actuate a lever arm and said lever arm will actuate an electrical or electro-mechanical switching device which will respond in respect to a slight movement or pressure. Said switching device may be one of the type known as "Micro" switches.

A further advantage of said invention is that the thin and flexible diaphragm element is backed up by a backup plate to absorb the over pressure to prevent damage to the diaphragm. In addition, the flexible longitudinal element may be adjusted partially to overcome the pressure in the switching device so that a lesser movement of the diaphragm and of the flexible longitudinal element will actuate the switch. In addition, the element may be loosened to sag and a greater movement of the diaphragm may be required to actuate the switch.

An object of this invention is to produce a new, improved pressure sensitive control device for fluids, fluid differential pressures and the like. A further object of this invention is to produce a new and sensitive, adjustable diaphragm device for using slight pressure differentials to magnify the pressure on a flexible diaphragm to a flexible longitudinal element, which in turn actuates a lever and sensitive electrical or electro-mechanical switching device.

A further object of this invention is to produce a new and improved pressure sensitive control device involving an improved diaphragm structure, said diaphragm being of extremely low moment of inertia with a hard yet thin and flexible extension from said diaphragm together with means for recording the pressure changes in the diaphragm. A further object of this invention is to produce a new and improved pressure sensitive control device employing a low moment of inertia diaphragm and a flexible longitudinal element, a shallow backup plate and means for actuating an electrical or electro-mechanical switching device to record said movements of the diaphragm, said backup plate serving to reinforce the diaphragm against over pressures.

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A further object of this invention is to produce an adjustable pressure sensitive control device employing a diaphragm, a flexible longitudinal element stretched between points and adjacent said diaphragm, whereby adjustment in and attached to the flexible longitudinal element adapt it to be used with the spring pressure in the electro-mechanical switching device. The flexible longitudinal element may be used with stronger spring units to provide an electro-mechanical switching device operable over a greater range of pressures.

To the accomplishment of the foregoing and related ends the said invention then consists of the means hereinafter fully described and particularly pointed out in the claims; the following description setting forth in detail one approved means of carrying out the invention, such disclosed means, however, constituting but one of the various ways in which the principles of the invention may be used.

In the drawings:

Fig. 1 is a cross-sectional view of my invention axially through the diaphragm;

Fig. 2 is a cross-sectional view along the lines 2—2 of Fig. 1 showing the diaphragm and the backup plate;

Fig. 3 is an enlarged diagrammatic view of the leverage mechanism showing the flexible longitudinal element, the pivoting means and the electro-mechanical switching device;

Fig. 4 is a fragmentary, partial view of the lever arm, pivot points and push rod;

Fig. 5 is an alternate modification of Fig. 1 employing a chain as a flexible longitudinal element;

Fig. 6 is a modification shown in the fragmentary view of Fig. 1 showing a pivoted link combination, and

Fig. 7 is a further modification of Fig. 1 shown in fragmentary form, a ribbon as a flexible longitudinal element.

In the drawings, 10 indicates generally a pressure sensitive control device. The diaphragm proper is shown at 11 and may be of plastic and should have a very low moment of inertia in order to avoid actuation through vibration and may have a hardened or stiffened nose portion 12, and a series of undulations to permit distention as shown at 13. These are around the entire circumference of the diaphragm. Said diaphragm is encased in an upper element or cover 14, having a threaded connection 15 in fluid connection with the chamber above the diaphragm. On said fluid connection there would be an aperture 51 shown through the drawing and an annular surface 52 having an elastic band closing said aperture, said elastic band being 53. The cover member 14 would be secured as by crimping the edge portion as shown at 17 around the case proper shown at 18, having a flange 19. The case has a lower opening as shown at 20, possibly threaded on the exterior side as shown at 21. Said openings 21 would pass through the case 18 and could be crimped or flanged to hold it in position. A lever arm 22 would be an element capable of slight sidewise movement and be mounted in connection with the case as with the adjustment means shown generally at 23. Adjustment means combines a bolt 24, nut 25, said bolt passing through an opening shown at 26 in said lever arm 22; said bolt having resilient means as at 27 to hold the bolt and nut in position relative to the lever arm; said resilient means holding against the head of the bolt and against the lever arm 22. Interiorly of said pressure sensitive control device is an electro-mechanical switching device as seen shown generally at 28, for which electrical contacts are not shown, secured to the case shown at 29; the contact for said switching device being the push rod 30, said push rod being fitted in a dimple 31 of the lever arm 22. The lever arm has a pivot contact shown at 33 in a dimple in the case, said dimple being shown at 34. The opposite

end of the lever is seen at 36 and has means for fastening a flexible linear element. The fastening means may comprise a slot or aperture in the lever arm, said slot or aperture being shown at 37. Connected in said slot is the flexible longitudinal element shown at 38, and the alternate modifications for this are seen in Figs. 5-7. The opposite end is connected to the other lever arm at 39, and said opposite end of the lever arm 22 may be adjusted by means of the adjustment shown generally at 23'. The diaphragm 11 has a similarly shaped backup plate, seen particularly in connection with Fig. 2.

Operation

The operation of the parts is approximately as follows: Connection 15 in the cover member 14 has an opening 16. This is connected to any source of pressure that may vary or is capable of varying. Upon change in pressure the diaphragm distends, and the undulation shown at 13 will flex. The entire diaphragm being a very low moment of inertia and having a hardened dimple will push down against the flexible longitudinal element 38. The backup plate 40 serves to prevent over pressures destroying the diaphragm. Vibrations upon the entire assembly are minimized because of the extremely low moment of inertia of the diaphragm. Distention of the flexible diaphragm causes flexing of the longitudinal element. Said element is attached at one end to lever arm 22, which has an adjustment means shown at 23. The opposite end of the lever arm 22 is pivoted in dimple 34 and moves as particularly shown in connection with Fig. 3. A distention of the diaphragm moving the nose portion 12 by the distance A as shown in Fig. 3 will cause a movement A'' by means of the lever arm and the push rod 30, connected by means of the dimple 31 to the lever arm. This will actuate the electro-mechanical switching device 28. The magnification by this means is extremely great, and said switching devices which can be made to actuate upon a movement of .001 to .005 inch will actuate at extremely low pressure, possibly of the order of a millimeter of mercury, and they may be adjusted to actuate at greater or lesser pressures. The most common range perhaps would be from ½ inch of water to 2 inches of water, which could be described as being that of a puff of air upon the diaphragm. The friction in this combination of components is extremely low because of the pivot point lever arm and the low friction in a diaphragm contacting a flexible linear element. For small movements of the diaphragm the movement is extremely slight, but whether the flexible longitudinal element is held taut or has pressure put on it or is permitted to sag is a matter of choice, and the element can be made more sensitive or less sensitive by adjusting means 23. In addition, it can be seen that by putting tension upon element 38 by means of 23' part of the spring tension which is required to actuate the switch 28 can be overcome so that a lesser amount of movement of the diaphragm as shown in Fig. 3 will actuate the switch. On the other hand, at the other extreme the element may be permitted to sag, and a considerable movement of the diaphragm will be required to actuate this switch. Since the area of the diaphragm is quite large and it is putting the force on the hardened nose portion, which contacts the flexible longitudinal element, it will be seen that the magnification is quite large in the system. By the combination of the positive adjustment 23' and the spring tension adjustment 23 various degrees of sensitivity can be achieved.

As an alternate means for the flexible longitudinal elements, Fig. 5 shows a chain element 40; Fig. 6 shows a plurality of pivoted links 41 on the left, pivoted as at 42 to a second link 43, and Fig. 7 shows a ribbon of nylon, metal or similar material as at 44, which may be used as a flexible longitudinal element.

In view of the backup plate 40, over pressures on the order of 20 pounds, more or less, may be accepted in the diaphragm even though the diaphragm is capable of actuating at pressures of ½ inch of water.

From the above description it will be seen that a pressure sensitive control device has been devised capable of operating under a variety of conditions and subject to some over pressure and adjustment of the pressure sensitivity. This is particularly necessary because of variations in the mechanical or electro-mechanical switching devices and the spring tension built into these devices so that within the limits of commercial tolerances a diaphragm switch has been devised which can be accommodated to these tolerances and also vary in working requirements. The device has a number of alternatives which are obvious to one experienced in the art of diaphragms and switches, and these may be employed following the general principles of the invention. It must be realized that the invention may be embodied in other specific forms without departing from the essential characteristics of the invention. All of these embodiments are intended to be included within the scope of the invention. The scope of the invention is indicated by the appended claims, rather than by the foregoing description and embodiments, and all changes which come within the meaning and range and equivalency of the claims are, therefore, intended to be embraced therein.

I claim:

1. A pressure sensitive control device comprising a flexible diaphragm member, a flexible longitudinal element adjacent said diaphragm member, said element being connected between several anchor points at least one of which shall be movable, whereby the flexible diaphragm member deflects the flexible longitudinal element causing the distance between the anchor points to shorten, and means in combination with the movement of said movable anchor point for actuating a mechanism.
2. The pressure sensitive control device of claim 1 in which the flexible longitudinal element is a thin and flexible linear element.
3. The pressure sensitive control device of claim 1 in which the flexible longitudinal element is a ribbon-like material.
4. The pressure sensitive control device of claim 1 in which the flexible longitudinal element is a chain.
5. The pressure sensitive control device of claim 1 in which the flexible longitudinal element is a series of pivoted links.
6. A pressure sensitive control device comprising a flexible diaphragm member, a flexible longitudinal element adjacent said diaphragm member, said diaphragm member being adapted to contact said longitudinal element, support means for said longitudinal element comprising a plurality of anchor points, at least one of which is movable, said movable anchor point being connected to a lever arm and system and to an electro-mechanical switching device, adjustment means on said movable anchor points to adjust the tension in the flexible longitudinal element, whereby distention in the diaphragm causes flexing in the longitudinal element actuating an anchor point to move the lever system and the electro-mechanical switching device, and further whereby said adjustment means can overcome some of the tension in the electro-mechanical switching device.
7. A pressure sensitive control device of claim 6 in which the lever arm is substantially perpendicular to the diaphragm.
8. The pressure sensitive control device of claim 6 in which the diaphragm element is characterized by an extremely low moment of inertia, whereby the diaphragm will not be affected by vibrational forces.
9. The pressure sensitive control device of claim 6 in which a backup member corresponds generally in shape to the distended position of the diaphragm.
10. A pressure sensitive control device of claim 9 in which the backup plate has an opening therein, in which said flexible longitudinal element may be positioned.
11. A pressure sensitive control device comprising a diaphragm member having a prestiffened dimple portion

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at the center thereof and a more flexible outer diaphragm element, support means for said diaphragm element, a flexible longitudinal element, support means for said flexible longitudinal element to hold the element adjacent said diaphragm, such support means comprising a lever arm, said lever arm adapted to actuate an electro-mechanical switching device, whereby distention in the diaphragm causes the stiffened dimple to push against the flexible longitudinal element operating the lever to actuate the switch.

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