

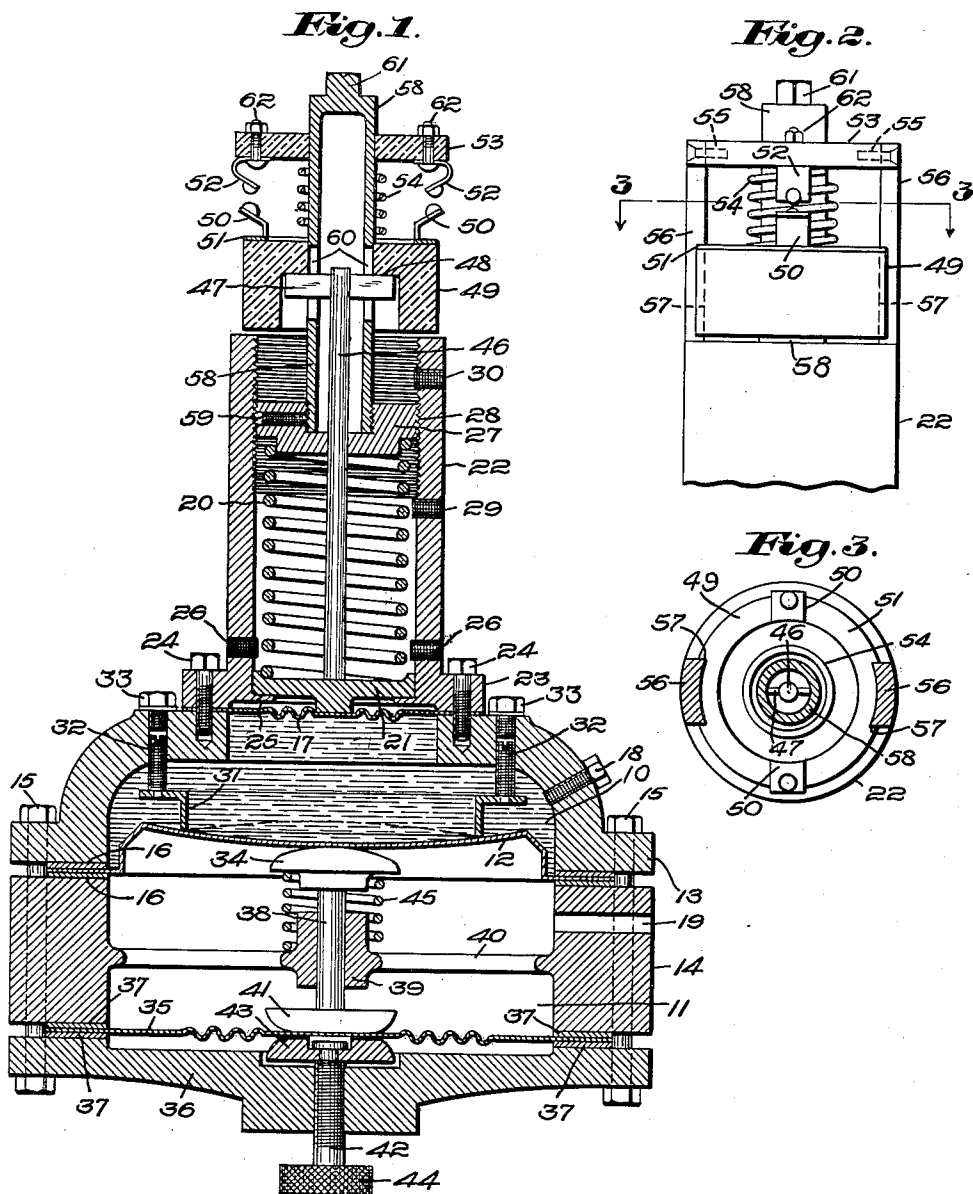
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FLUID PRESSURE RESPONSIVE DEVICE

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FLUID PRESSURE RESPONSIVE DEVICE

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This invention relates to improvements in fluid-pressure responsive devices, of the class which employ resilient, snapping diaphragms designed to move abruptly in response to pressure changes. Such devices commonly employ an adjustable diaphragm-loading spring, acting more or less directly on the diaphragm to vary the pressure at which the latter will respond. Such methods of adjustment not only tend to impair the characteristics of the diaphragm, but the range of adjustment within which satisfactory operation is possible is comparatively small. In the device described herein, there is disclosed adjusting means which permits of adjustment over wide ranges, with no impairment of the operating characteristics of the diaphragm. Moreover, the characteristics of the diaphragm-loading means of the present invention are such that the movement of the diaphragm is multiplied before it reaches the device which it actuates. This is highly desirable in case the device to be actuated is an electric switch. The invention also relates to novel and improved means for variably limiting the range of movement of the snapping diaphragm.

The invention will be best understood by reference to the following description, when taken in connection with the accompanying drawing of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is a sectional view of a fluid-pressure responsive device embodying the invention, taken in the plane containing the main axis of the device;

Fig. 2 is a side elevation of the upper portion of the device; and

Fig. 3 is a sectional view on line 3—3 of Fig. 2.

Referring to the drawing, and to the embodiment of the invention which is illustrated therein, there is shown a fluid-pressure responsive device presenting two pressure-fluid chambers 10 and 11, having a common wall comprising a resilient, buckling or snapping diaphragm 12, adapted to

buckle in opposite directions, but prevented by its own resiliency from remaining in a medial position. The chambers are formed by and within a casing, herein conveniently comprising two bodies or shells 13 and 14, suitably secured to each other as by bolts 15, while packing rings 16 above and below the margin of the diaphragm prevent leakage, these rings being held under compression by the bolts.

The chamber 10 is sealed, and has another wall comprising a non-resilient diaphragm 17, herein of much smaller area than that of the diaphragm 12, as a result of which a certain movement of the latter results in a much greater movement of the former. The chamber 10 is provided with a filling plug 18, removal of which enables the chamber to be filled with an appropriate fluid causing movement of one diaphragm to be transmitted to the other. In the present example, this fluid is a liquid such as oil. The liquid, being incompressible, transmits the motion without loss due to compression, which would be occasioned by the use of a compressible gas. The diaphragm 12 is actuated by pressure-fluid admitted to the chamber 11 through a passage 19 leading to the exterior.

Referring again to the diaphragm 17, the latter receives the thrust of a diaphragm-loading spring 20, herein through a movable abutment 21 interposed between the spring and the diaphragm. As shown, this abutment and the spring are contained in a cylindrical shell 22, suitably secured to the shell 13, as by providing the former with a flange 23 to receive cap-screws 24 which secure the two shells together and clamp the margin of the diaphragm 17 therebetween. An annular shoulder 25, presented by the shell 22, limits movement of the abutment 21 in one direction, while stops, herein screws 26 threaded through the circumferential wall of the shell 22, limit movement of the abutment in the opposite direction, thereby protecting the diaphragm against injury due to too great movement.

By imposing the load of the spring through the movable abutment 21 upon the

diaphragm 17, the load is communicated by the confined liquid to and is distributed upon the snapping diaphragm 12, without impairing the characteristics of the latter. On the other hand, by simply making the diaphragm 17 of smaller area than the diaphragm 12, the motion of the latter is multiplied, without the use of external mechanical agencies. The adjustable loading of the diaphragm is conveniently accomplished in the present example by interposing the spring between the movable abutment 21 and an abutment 27, which, though fixed in the operation of the device, is adjustable as by the use of a screw-thread 28 between the abutment 27 and the shell 22. By turning the abutment 27 in the proper direction, the spring pressure may be varied at will, within maximum and minimum limits predetermined by stops, herein screws 29 and 30, threaded through the circumferential wall of the shell 22. By the use of these stops, the maximum and minimum loads imposed by the spring upon the snapping diaphragms are predetermined. It should of course be understood that this adjustable loading is applied uniformly over the surface of the diaphragm 12. The total force which must be applied by means of the spring is comparatively small, because the area of the diaphragm 17 to which the force is applied is much smaller than the whole area of the diaphragm 12.

As an additional means of control of the snapping diaphragm 12, there is provided within the chamber 10 an abutment in the form of a ring 31, conveniently adjustable by screws 32 threaded into the shell 13, and rendered accessible for adjustment by first removing sealing screws 33. By adjusting the position of the ring relatively to the diaphragm, the spread and the pressure level of the fluid pressure controlled by the snapping diaphragm may be varied simultaneously.

Another method of adjustment is obtainable through the use of an adjustable abutment 34, which limits downward movement of the diaphragm 12. This abutment is conveniently adjustable from the exterior of the device, but without the use of packing, by providing the chamber 11 with a wall comprising a non-resilient diaphragm 35, which is clamped between the shell 14 and a cover-plate 36, by the same bolts which secure the shells 13 and 14 together. Gaskets or packing rings 37 between the upper and lower faces of the margin of the diaphragm 35 and the shell 14 and cover-plate 36 prevent leakage at this point.

The abutment 34, as shown, is a head which is suitably formed on or secured to one end of a stem 38, which is guided by an appropriate guide 39, herein presented by a spider 40. Suitably formed on or se-

cured to the lower end of the stem 38 is a head 41, which engages the diaphragm 35. Thus, it is apparent that by the use of a stop below the diaphragm 35, downward travel of the snapping diaphragm 12 may be limited. This is conveniently accomplished in the present case by the use of an adjusting screw 42, threaded into the cover-plate 36. As shown, this screw has its inner end swivelled to a head 43, secured as by soldering to the under side of the diaphragm 35, and at the exterior of the device, there is a knurled head 44, which may be grasped to turn the screw. Still another means of control of the diaphragm is through the use of a spring 45, interposed between the head 34 and the spider 40. This gives a type of control over the operating pressure which is sometimes desirable.

While the device may be used to actuate various devices, there is shown in the drawing a switch mechanism intended to open and close a circuit such as that of a motor for driving a compressor in a refrigeration system with which the chamber 11 communicates. This mechanism will now be described, reference being had at first to Fig. 1. Resting upon the movable spring abutment 21 is a plunger 46, which extends through and is guided by the adjustable spring abutment 27. To this rod there is secured a cross-member or cross-head 47, upon which rests a shoulder 48 presented by an insulating member 49, which carries a pair of switch contacts 50, electrically connected to each other, as by a ring 51. These contacts are adapted to make and break connection with contacts 52 carried by a second insulating member 53, separation of one pair of contacts from the other being normally maintained by a spring 54, interposed between the insulating members 49 and 53, said spring constantly exerting a downward thrust upon the member 49, and thus through the cross-head 47 maintaining engagement of the rod 46 with the abutment 21. This, of course, presupposes that the insulating member 53 is suitably held against upward displacement. This is conveniently accomplished by securing the member 53 by suitable means such as screws 55 to upwardly-extending projections 56 presented by the shell 22. These projections extend through grooves 57 presented by the insulating member 49, and prevent rotation of the latter. A sleeve 58 extends axially through the insulating members 49 and 53, and is suitably secured, as by a set-screw 59 to the abutment 27. The sleeve is provided with vertical slots 60, in which the cross-head 47 plays up and down. The upper end of the sleeve is suitably formed, as by the provision of a polygonal head 61 for rotation of the adjustable spring abut-

ment 27. The contacts 52 are appropriately secured to the insulating member 53, as by binding posts 62, intended to be connected to the controllers of the motor which drives the refrigerant compressor.

Having thus described one embodiment of the invention, but without limiting ourselves thereto, what we claim and desire by Letters Patent to secure is:

1. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a resilient, snapping diaphragm, a constantly open passage to conduct fluid into and out of one of said chambers for the continuous admission of pressure fluid to actuate said diaphragm, the other chamber being sealed and having a wall comprising a second diaphragm having no connection with said snapping diaphragm, a liquid within said other chamber between said diaphragm and presenting the sole means to transmit motion from one diaphragm to the other, and means actuated by said second diaphragm.

2. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers having a fluid sealed therein and having another wall comprising a second diaphragm having no connection with the first-mentioned diaphragm, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, and means actuated by said second diaphragm.

3. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm of smaller area than the first, a fluid between said diaphragms constituting the sole operative connection to transmit movement from one to the other, there being a passage leading from the other chamber to the exterior, loading means for said second diaphragm, and means independent of said loading means and actuated by said second diaphragm.

4. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm, a fluid between said diaphragms constituting the sole operative connection to transmit movement from one to the other, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, loading means exerting a pressure on said second diaphragm in the direction of the first diaphragm, and means independent of

said loading means and actuated by said second diaphragm in the opposite direction.

5. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm of smaller area than the first, a fluid between said diaphragms constituting the sole operative connection to transmit movement from one to the other, there being a passage leading from the other chamber to the exterior, loading means exerting a pressure on said second diaphragm in the direction of the first diaphragm, and means actuated by said second diaphragm.

6. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm of smaller area than the first, a fluid between said diaphragms constituting the sole operative connection to transmit movement from one to the other, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, a loading spring exerting a pressure on said second diaphragm in the direction of the first diaphragm, means for adjusting said spring to vary said pressure, and means independent of said spring and actuated by said second diaphragm.

7. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm, loading means for said second diaphragm, a liquid within said sealed chamber to transmit movement from one diaphragm to the other, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, and means independent of said loading means and actuated by said second diaphragm.

8. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm of smaller area than the first, loading means for said second diaphragm, a liquid within said sealed chamber to transmit movement from one diaphragm to the other, there being a constantly open passage leading from the other chamber to the exterior for the admission of pressure fluid to operate the first-mentioned diaphragm and means independent of said loading means and actuated by said second diaphragm.

9. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having another wall comprising a second diaphragm, a liquid within said sealed chamber to transmit movement from one diaphragm to the other, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, loading means exerting a pressure on said second diaphragm in the direction of the first diaphragm, and means independent of said loading means and actuated by said second diaphragm in the opposite direction.

10. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, a fluid between said diaphragms constituting the sole operative connection to transmit movement from one to the other, there being a constantly open passage leading from the other chamber to the exterior for the continuous admission of pressure fluid to operate the first-mentioned diaphragm, means to limit movement of the first-mentioned diaphragm, and means independent of the first-mentioned means and actuated by said second diaphragm.

11. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm having no connection with the first-mentioned diaphragm, there being a passage leading from the other chamber to the exterior, an abutment to limit movement of the first-mentioned diaphragm, means accessible from the exterior of the device to adjust said abutment, and means actuated by said second diaphragm.

12. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, there being a passage leading from the other chamber to the exterior, abutments to limit movement of the first-mentioned diaphragm in opposite directions, means accessible from the exterior of the device to adjust one of said abutments, means accessible from the exterior of the device to adjust the other abutment, and means actuated by said second diaphragm.

13. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, the

second chamber having a wall comprising a third diaphragm, there being a passage leading from said second chamber to the exterior, an abutment interposed between the first and third diaphragms, and means disposed externally of said second chamber to limit movement of the first diaphragm toward the third diaphragm.

14. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, the second chamber having a wall comprising a third diaphragm, there being a passage leading from said second chamber to the exterior, an abutment interposed between the first and third diaphragms, and means disposed externally of said second chamber adjustably to limit movement of the first diaphragm toward the third diaphragm.

15. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, the second chamber having a wall comprising a third diaphragm, there being a passage leading from said second chamber to the exterior, a plunger interposed between the first and third diaphragms, a spring to cause said plunger to follow the first diaphragm, and means to limit movement of said plunger under the influence of the first diaphragm.

16. In a pressure-fluid responsive device, the combination of two chambers having a common wall comprising a diaphragm, one of said chambers being sealed and having a wall comprising a second diaphragm, a loading spring exerting a pressure on the second diaphragm in the direction of the first diaphragm, a movable abutment interposed between said spring and the second diaphragm, means to limit movement of said abutment under the influence of the second diaphragm, there being a passage leading from the second chamber to the exterior, and means actuated by the second diaphragm.

In testimony whereof, we have signed our names to this specification.

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