Sept. 29, 1953 F. W. HOTTENROTH 2,653,629

VACUUM SWITCH

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Fig. 1

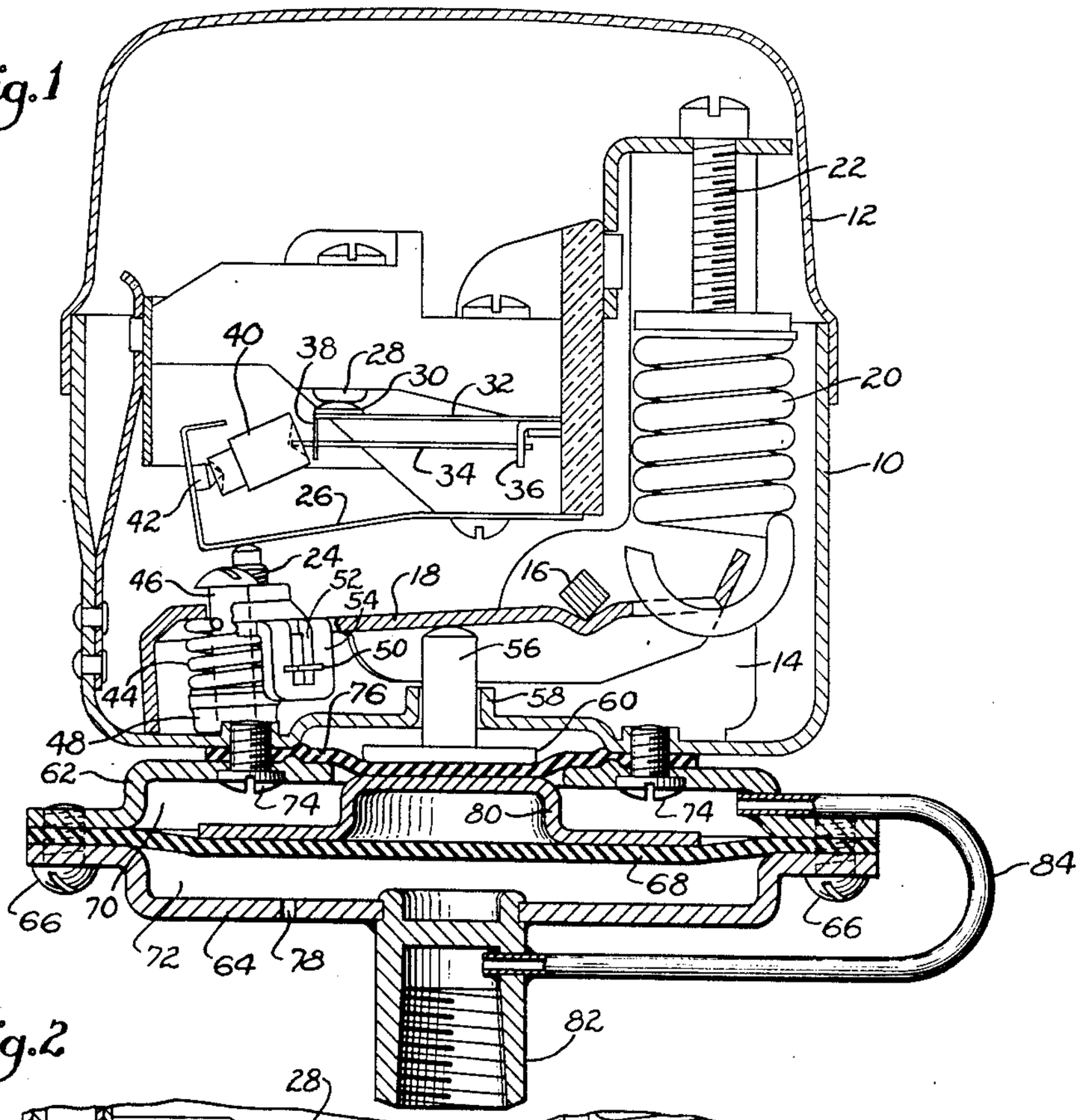
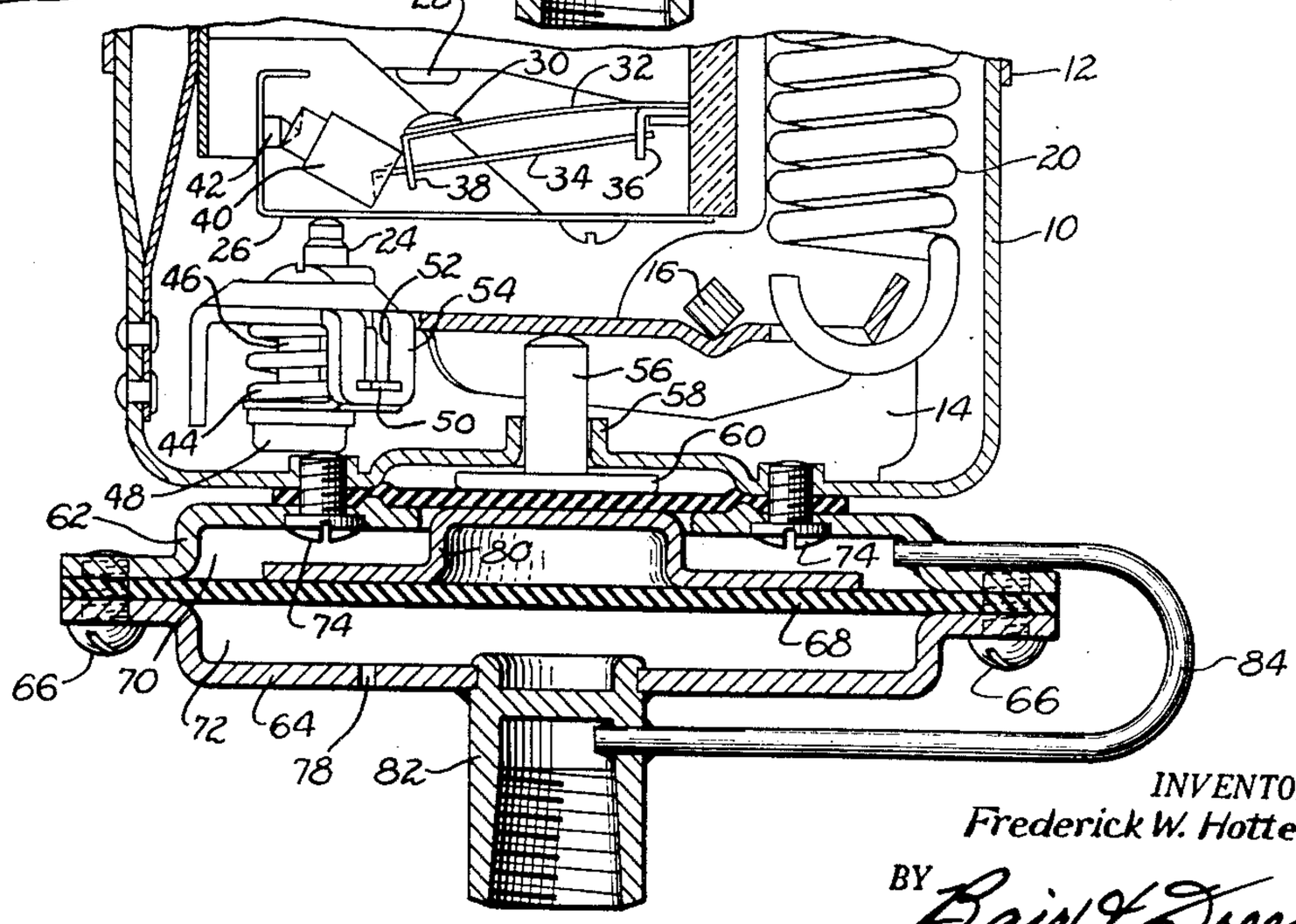


Fig. 2



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VACUUM SWITCH

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3 Claims. (Cl. 137—787)

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This invention relates to a vacuum switch and particularly a diaphragm or bellows construction to be used in connection with a control switch, control valve or the like.

One object of the invention is to eliminate the necessity of having a relatively large diaphragm and a relatively large compression spring acting against it in order for the diaphragm to respond in a sensitive manner to pressure less than atmospheric.

Another object is to provide a diaphragm construction that can be readily mounted on a regulation pressure control switch in place of the usual pressure diaphragm and thus convert the pressure switch into a vacuum switch without the necessity of revising the switch action.

More particularly, it is my object to provide a vacuum responsive unit having a pair of diaphragms of different areas or equivalent means such as a pair of bellows, the vacuum connection being made to the space between the diaphragms.

A further object is to provide a diaphragm unit for response to vacuum in which the housing for the unit may be secured to a regulation pressure control switch or the like with connection to the space between the diaphragms of the unit made at the outer end of the unit in the same position as the usual connection to a pressure diaphragm unit.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings, wherein:

Figure 1 is a vertical sectional view through a vacuum switch embodying my invention and showing the parts in the switch-closed position as a result of a decrease in vacuum or increase in pressure, and

Figure 2 is a view of part of Figure 1 showing the switch in the open position as a result of an increase in vacuum or decrease in pressure.

On the accompanying drawing I have used the reference numeral 10 to indicate a control switch housing having a cover 12. The usual pressure operated control switch mechanism of the character shown in the copending application of Rothwell and Strasser, Serial No. 71,196, filed January 15, 1949, now Patent No. 2,562,437, issued July 31, 1951, is contained in the housing 10—12 and comprises in general the following described mechanism.

A bracket 14 supports a knife edge pivot rod 16 against which a switch actuating lever 18 is engaged by a range spring 20 adjustable by means of a screw 22. The switch arm 18 carries a stud 24 for actuating a switch comprising an actuating spring blade 26 bent to normally assume the position of Figure 1, and stationary and movable contacts 28 and 30.

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The contact 30 is carried by a leaf spring blade 32 which is actuated by a blade 34 pivoted at one end to a bracket 36 and extending through an opening in an extension 38 of the switch blade 32. A spring extended toggle link 40 connects the blade 34 with a pointed element 42 on the actuating blade 26.

A differential widening spring 44 is mounted on a screw 46 on the lower end of which a nut 48 is mounted. The nut 48 has an extension 50 traveling in a slot 52 of a bracket 54 to prevent the nut from rotating when the screw 46 is adjusted for varying the tension of the spring 44.

An actuating pin 56 is slidable in a boss 58 of the housing and has a head 60 on its lower end. When the foregoing described switch mechanism is operated as a pressure switch, a diaphragm housing is secured to the housing 10 as shown in the copending application above referred to and has a pressure responsive diaphragm engaging the head 60. The pressure responsive switch may be converted to a vacuum responsive switch by means of my present invention comprising a diaphragm unit which will now be described, my unit being shown in heavy lines to distinguish it from the pressure switch mechanism thus far described.

I provide a diaphragm housing consisting of upper and lower formed plates 62 and 64 secured together by screws 66 with a relatively large diaphragm 68 between them. This diaphragm separates the housing 62—64 into two compartments designated 70 and 72, respectively.

The plate 62 is secured to the housing 10 by means of screws 74 with a relatively small diameter diaphragm 76 interposed between the two. This seals off the compartment 70 from atmosphere, whereas the compartment 72 is open to atmosphere by means of a vent opening 78.

Between the diaphragms 68 and 76, I provide a formed spacer plate 80. The compartment 70 is the one in my diaphragm unit to be made responsive to vacuum and any type of connection may be made to this space but preferably I provide a fitting 82 mounted on the outer end of the diaphragm housing and connected with the space 70 by a tube 84. The fitting is thus mounted in the usual position on the diaphragm hous-

ing so as to provide uniformity of installation for the vacuum switch the same as for the regulation pressure switch.

Practical operation

In the operation of my vacuum control device, when the pressure is atmospheric or at least less than the desired vacuum at which cut out of the switch occurs, the range spring **20** will depress the diaphragms **68** and **76** as illustrated in Figure 1 thus permitting the spring blade **26** to close the switch contacts **28** and **30**.

From the operation just described it is obvious that the switch is normally closed. The switch contacts may be connected with a motor that operates a vacuum pump or the like and the pump may evacuate a tank or other receptacle, the tank being hydraulically connected with the fitting **82** so that the diaphragm assembly responds to the vacuum created therein. If this vacuum increases (or the pressure decreases from atmospheric) there will be an upward movement of the large diaphragm **68** in proportion to the difference between its area and the area of the diaphragm **76**, the top of which is responsive to atmospheric pressure, and the bottom of the diaphragm **68** being likewise responsive to atmospheric pressure.

When the vacuum reaches the desired pressure level for stopping the motor of the vacuum pump it will have raised the diaphragm **68** and subsequently the spacer **80** and the actuating pin **56** to swing the switch actuating arm **18** as to the position of Figure 2 for effecting opening of the switch contacts **28** and **30** against the pull of the range spring **20**. The screw **22** of course can be adjusted for securing any desired degree of vacuum before the switch opens.

My arrangement is comparatively simple and by the use of a pair of diaphragms, one large and the other small, the vacuum causes response of the diaphragms at a pressure differential between the two diaphragms because of their different areas. The upward movement of the lower diaphragm is then transmitted through the spacer **80** to the upper diaphragm which in turn moves the actuating pin **56** for performing a control function such as operating the switch disclosed or a valve or any other control or indicating device.

The diaphragm assembly is so designed as to respond to maximum vacuum without the necessity of providing the usual oversize single vacuum responsive diaphragm together with the necessary heavy range spring. My vacuum responsive diaphragm unit can accordingly be substituted for a pressure diaphragm unit on a regulation pressure actuated control switch or valve without having to make any changes such as providing a heavier spring and reversing the switch action or valve action. From a manufacturing standpoint this is a substantial advantage and represents a considerable saving in manufacturing costs.

While I have shown and described diaphragms **68** and **76**, obviously a pair of bellows or equivalent means can be used and the diaphragms may operate any type of control or indicating device without departing from the real spirit and purpose of my invention. It is, therefore, my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim as my invention:

1. In a vacuum actuated control device, a diaphragm housing having an opening, a large diaphragm mounted therein and separating said diaphragm housing into two chambers sealed by the diaphragm relative to each other, a small diaphragm mounted in said opening and in sealing relation to the wall of said housing surrounding said opening, a vacuum connection to the space between said diaphragms, the small diaphragm being adapted to actuate a control element and responsive on its outside surface to atmospheric pressure, said large diaphragm being responsive on its outside surface to atmospheric pressure, and a spacer between said diaphragms comprising a disc against said large diaphragm and slightly smaller than it, said disc having a centrol embossed portion engaging said small diaphragm and slightly smaller than it.

2. In a control device of the character disclosed, a diaphragm housing, large and small diaphragms mounted therein, the small diaphragm being adapted for its outer surface to actuate a control element and responsive on the outside to atmospheric pressure, said large diaphragm being responsive on its outside to atmospheric pressure, a spacer between said diaphragms, and means for providing a vacuum connection to the space between said diaphragms comprising a fitting mounted on the outer surface of said diaphragm housing opposite said outer surface of said small diaphragm, and a hydraulic connection between said fitting and said chamber.

3. In a vacuum unit for connection to a control switch or the like, a small diaphragm, a large diaphragm spaced therefrom, means for connecting the peripheries of said diaphragms to form a chamber between them, said small diaphragm being adapted to contact an actuating element for said control switch, a spacer between said diaphragms, a cover for said large diaphragm, said cover and said means being connected together, said cover having an opening to atmosphere, a fitting mounted on said cover, and a hydraulic connection between said fitting and said chamber.

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