Oct. 29, 1957 J. K. LUND 2,811,314

VACUUM CONTROL VALVE

Original Filed June 24, 1950 2 Sheets-Sheet 1

Fig 1

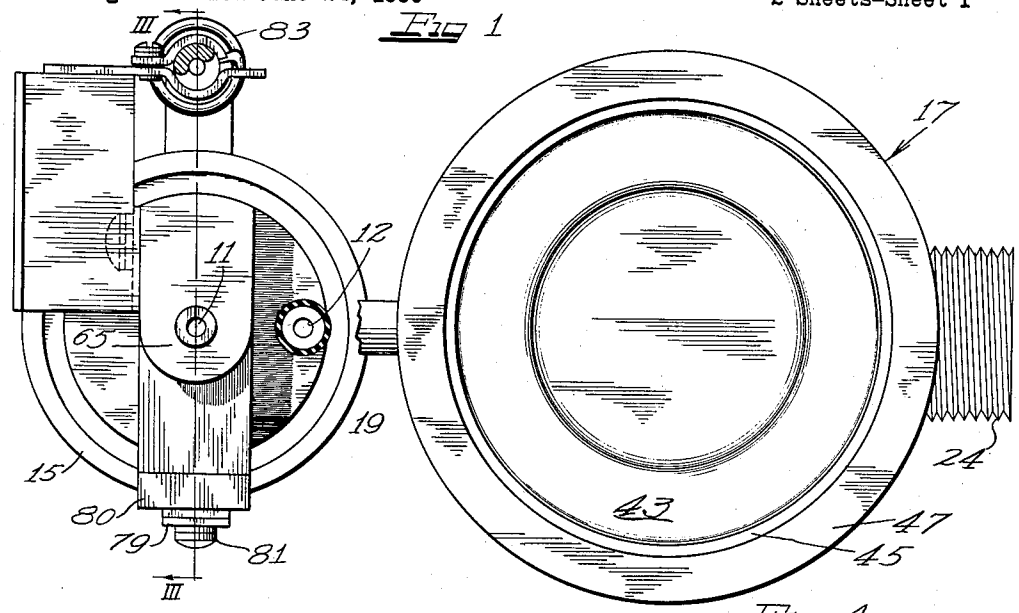


Fig 3

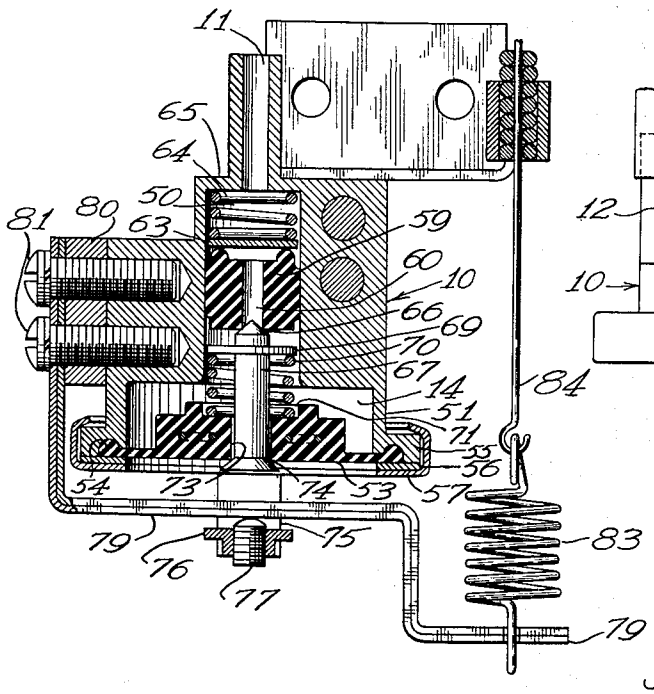
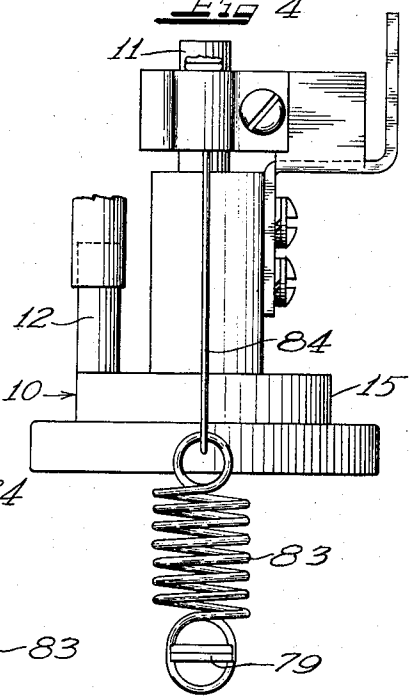


Fig 4



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Fig 2

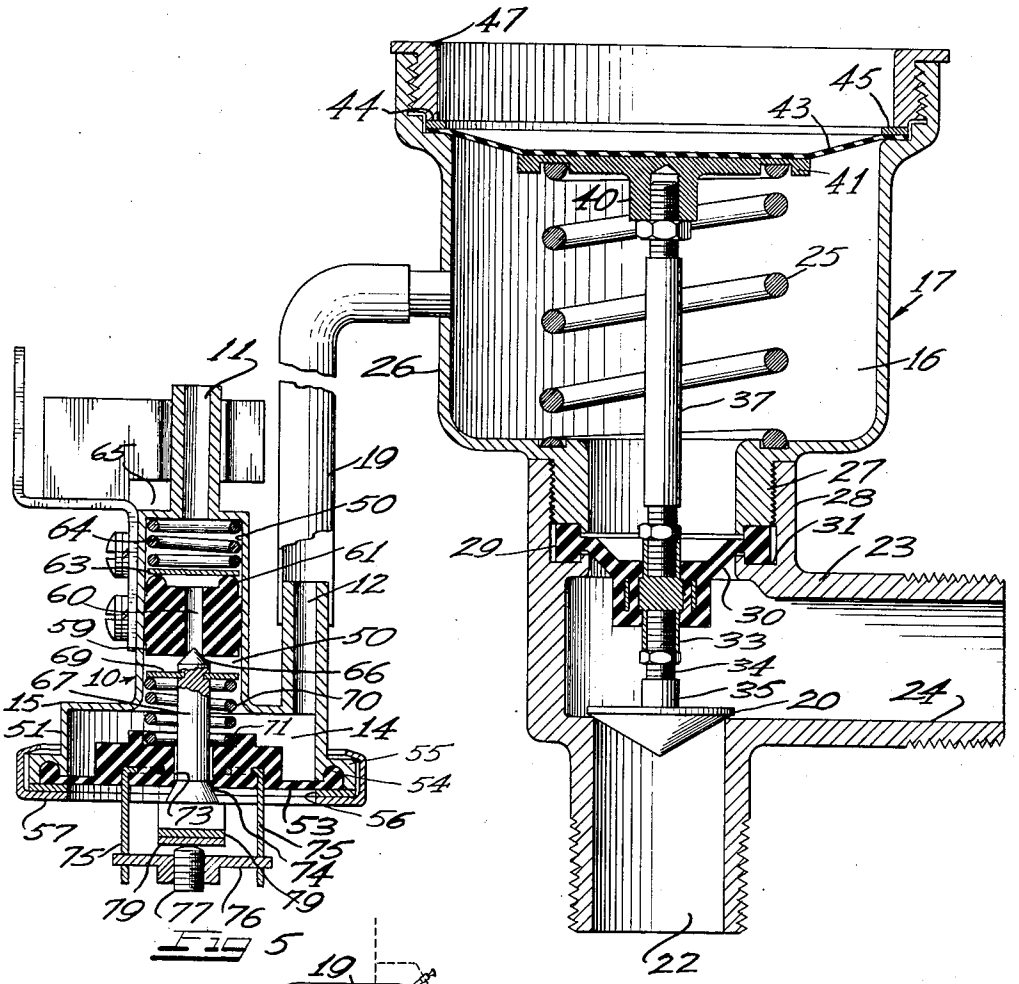
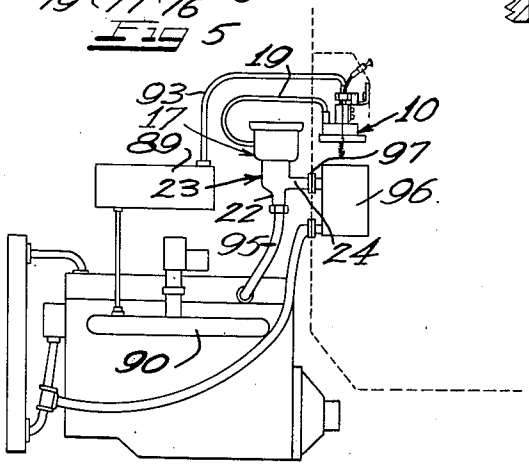


Fig 5



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United States Patent Office 2,811,314 Patented Oct. 29, 1957

2,811,314

VACUUM CONTROL VALVE

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Original application June 24, 1950, Serial No. 170,140, now Patent No. 2,668,014, dated February 2, 1954. Divided and this application May 14, 1953, Serial No. 355,091

3 Claims. (Cl. 236—87)

This invention relates to improvements in vacuum control devices and more particularly relates to a new and improved form of vacuum control valve and is a division of my pending application Serial No. 170,140, filed June 24, 1950, and entitled "Vacuum Control" and now Patent No. 2,668,014, dated February 2, 1954.

An object of my invention is to provide a simple and novel form of control valve arranged to control the vacuum of a vacuum motor in accordance with predetermined temperature changes.

A further and more specific object of my invention is to provide a novel form of vacuum equalizing and control valve to equalize the vacuum supplied by the intake manifold of an internal combustion engine, and varying the vacuum in accordance with temperature variations.

A further object of my invention is to provide a novel form of vacuum control valve particularly adapted to control the vacuum of a vacuum motor and arranged to cope with the variable vacuum conditions encountered in internal combustion engines, the intake of which is utilized as a source of vacuum for the vacuum motor.

A further object of my invention is to provide an inexpensive, simple and efficient form of temperature responsive vacuum control valve controlling the vacuum of a vacuum control device operated by an intake manifold of an internal combustion egine and having a vacuum equalizing and control chamber with valve means therein for increasing the vacuum within said control chamber or for admitting air therein to decrease the vacuum in said chamber, and utilizing a temperature responsive element to operate the valve means.

These and other objects of my invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

Figure 1 is a plan view of a vacuum control constructed in accordance with my invention with certain parts broken away and shown in section;

Figure 2 is a longitudinal sectional view taken through the vacuum control shown in Figure 1;

Figure 3 is a transverse sectional view taken substantially along lines III—III of Figure 1;

Figure 4 is a side view of the vacuum control valve shown in Figure 1; and

Figure 5 is a diagrammatic view showing a form of control having my invention embodied therein.

As shown on the drawings:

A vacuum control valve **10**, which may be mounted within a body of a car, is shown as having an outlet **11** leading therefrom which may be connected directly to the intake manifold of an internal combustion engine, which may serve as a source of vacuum. An inlet **12** leads to a vacuum equalizing and control chamber **14** formed in a casing **15** for the valve. The inlet **12** is connected to a vacuum chamber **16** of a vacuum motor **17** through a flexible conduit **19** and serves to evacuate the air from said chamber by suction and thus to create

a vacuum therein. The vacuum motor **17** is operatively connected with a valve **20** seated on the end of a fluid inlet **22** of a fitting **23** adapted to be connected to a source of hot water, such as the cooling system of an internal combustion engine for propelling a car. A fluid outlet **24** of the fitting **23** is herein shown as extending at right angles to the inlet **22** and may be connected to a car heater. The amount of heat given off by the hot water heater is thus varied by varying the volume of hot water supplied thereto, controlled by the valve **20**, the operation of which is controlled by the vacuum motor **17** operated by vacuum against a spring **25** therein.

The vacuum motor **17** is herein shown as being enclosed in a bowl like casing **26** having a reduced lower end portion **27**, threaded within an upright projection **28** of the fitting **23**. The lower end of the reduced end **27** of the casing **26** abuts the upper side of an annular flanged portion **29** of a diaphragm **30**, extending across the open portion of the upright end **28** of the fitting **23**. The reduced end **27** serves to clamp the diaphragm **30** in an annular recess **31** formed in the upright projection **28** and to hold said diaphragm to flex upon vertical movement of the valve **20** from one position to another.

The diaphragm **30** may be made from a suitable flexible material, such as rubber or neoprene, and has a coupling member **33** imbedded in its center and extending from opposite sides thereof. Opposite ends of coupling member **33** are herein shown as being internally threaded and the lower threaded end thereof has a threaded rod **34** threaded therein. The opposite end of the threaded rod **34** is threaded in an upright stem **35** of the valve **20**. The opposite or upper threaded end of the coupling **33** has the lower threaded end of a rod **37** threaded therein. The end of the rod **37** opposite the coupling **33** extends through the chamber **16** and is threaded in a depending boss **40** of a diaphragm plate **41**. The diaphragm plate **41** is herein shown as being secured to the under side of a flexible diaphragm **43**, closing the top of the vacuum chamber **16**. The diaphragm **43** may also be made from a suitable flexible material, such as rubber or neoprene and is clamped to an annular shouldered surface **44** of the casing **16** by means of an annular ring **45** engaging the top outer surface of said diaphragm **43** and an annular retaining nut **47** threaded in the open top portion of the casing **26** and engaging said ring **45**. The spring **25** is interposed between the bottom of the chamber **16** and the under side of the diaphragm plate **41** and serves to urge said plate and diaphragm in a direction to open the valve **20** and allow the free flow of liquid from the inlet **22** through the outlet **24** of the fitting, to and through the hot water heater of the car. Thus when the vacuum within the vacuum control chamber **16** is less than the pressure exerted by the spring **25** to open the valve **20**, said valve will open, and when the vacuum within said vacuum chamber exerts a greater inward pressure differential across the diaphragms **43** and **30** than the pressure exerted by the spring **25**, the valve **20** will close and block the passage of hot water to the car heater.

The vacuum control valve **10** is provided to control the amount of vacuum created in the vacuum chamber **16** by the suction of the intake manifold and also to equalize or regulate the vacuum in said chamber to cope with variable vacuum conditions caused by variations in engine loads, which vacuum may fluctuate from practically nothing to a maximum of approximately 25" of mercury. The vacuum control valve **10** may be located within the car body at a place preferably remote from the heater, yet convenient to the car engine and the vacuum motor **17**, as beneath the dashboard of the car on the opposite side of the car from the heater, when the heater is mount-

ed under the dashboard, or on the steering column of the car.

The casing 15 of the vacuum control valve has a reduced portion, the inside of which forms a valve chamber 50 communicating with the vacuum equalizing and control chamber 14 defined by the inner margins of an enlarged portion 51 of said casing. As herein shown, the outlet 11 leads from the outer end of the reduced portion 50 of the casing 15. The vacuum control chamber 14 opens to the opposite end of the valve casing from the outlet 11 and the open end thereof is shown as being closed by a flexible diaphragm 53. The flexible diaphragm 53 may be molded from rubber, neoprene or any other suitable flexible material and is shown as having an annular bead 54 extending inwardly from the outer side thereof and recessed within a corresponding recessed portion formed in a flanged end 55 of the casing 15. The diaphragm 53 is secured to the end of the casing 15 by means of an annular ring 56 abutting the outer side thereof on the opposite side thereof from the bead 54 and suitably clamped in engagement with said diaphragm, by means of a clamping ring 57.

A reduced passageway from the equalizing and control chamber 14 to the outlet 11 is formed in the valve chamber 50 of the casing 15 by means of a plug 59 mounted within said valve chamber and having a passageway 60 extending through its center. The plug 59 may be made from any suitable material and is herein shown as being made from a yieldable material such as rubber or neoprene. The face of the plug 59, adjacent the outlet 11 is shown as having an annular bead 61 projecting therefrom and forming a seat for a check valve closing the passageway 60. The check valve is herein shown as consisting of a disk 63 yieldably held in engagement with the bead 61 by a lightly loaded spring 64. The spring 64 is interposed between the opposite side of the disk 63 from the bead 61 and a reduced end portion 65 of the casing 15, which has the outlet 11 leading therefrom. The spring 64 loads the disk 63 relatively lightly to open when the suction in the outlet 11 is greater than the vacuum in the chamber 14 plus the force exerted by said spring.

The end of the passageway 60 opposite from the check valve formed by the disk 63 forms a seat for a valve 66 formed by the conical end of a valve stem 67. A snap ring 69 of considerably less diameter than the inside diameter of the valve chamber 50 is shown as being snapped on the stem 67 adjacent the conical end thereof and as being abutted at its side opposite the valve 66 by a compression spring 70. The compression spring 70 is seated in an annular recess 71, formed in an enlarged inwardly projecting central portion of the diaphragm 53, and urges the valve 66 into a closed position.

The diaphragm 53 has a passageway 73 leading therethrough from its inner to its outer side, through which extends the stem 67 of the valve 66. The end of the stem 67 opposite from the valve 66 is herein shown as being of an enlarged frusto conical formation and forms the valve 74 which may open to admit air at atmospheric pressure into the vacuum equalizing and control chamber 14, to reduce the vacuum therein, when the diaphragm 53 is flexed inwardly against the spring 70 by a predetermined vacuum within the chamber 14. A plurality of spaced hanger members 75, 75 having inwardly turned upper ends embedded within the diaphragm 53 anl depending therefrom are shown as having a cross bar 76 mounted thereon in vertically spaced relation with respect to the diaphragm 53 and casing 15. A bearing screw 77 is threaded through the center of the cross bar 76 from its outer end and has a rounded inner end abutting the bottom of a bi-metal temperature responsive element 79.

The bi-metal temperature responsive element 79, is shown in Figure 5 as extending downwardly along one side of the valve casing 15 in spaced relation with respect

thereto and as abutting the outer side of a spacer 80. The element 79 is secured to the casing 15 by means of machine screws 81—81 extending through said element and the spacer 80, and threaded within a side wall of the casing 15. The bi-metal element 79 extends inwardly across the bottom of the casing 15 in vertically spaced relation with respect to the diaphragm 53 between the hangers 75—75 into bearing engagement with the inner end of the bearing screw 77. The outer end of the element 79 is then shown as extending downwardly and then outwardly, and as having a tension spring 83 connected to its end, and extending upwardly therefrom. The tension of the spring 83 is adjustable to increase the force against which the element must react to open the valve 66, and thus to increase the temperature at which said valve will open. It is obvious from the foregoing that the bi-metal element 79 exerts a pressure against the bearing screw 77 and diaphragm 53, which is in balance with the differential in pressure across the diaphragm, except when a new control position is necessary due to a change in temperature within the car body.

The end of the tension spring 83 opposite from the bi-metal element 79 may be connected to an adjusting rod 84, arranged to vary the tension of said spring under the control of the driver of the car. The adjustng rod 84 may be an ordinary choke rod commonly used on cars.

When the outlet 11 is connected to the intake manifold of the engine of the car and the inlet 12 is connected to the chamber 16 of the vacuum motor 17, and the engine is running and the suction in the intake manifold becomes greater than the pressure exerted on the check valve disc 63 by the spring 64, said check valve disk will move to an open position. If the temperature in the car rises a predetermined amount, said bi-metal element will flex the diaphragm 53 outwardly and open the valve 66. This will create or increase the vacuum in the chamber 14 and the vacuum chamber 16 of the vacuum motor 17 to the point where said motor will close the valve 20 and block the passage of fluid to the heater of the car. When, however, the vacuum in the chamber 14 exceeds a predetermined value or the temperature in the car body is reduced to a point where it is necessary to supply heat to the car heater, the bi-metal element 79 will allow the vacuum in the chamber 14 to flex the diaphragm 53 inwardly against the spring 70, to open the valve 74 and allow air at atmospheric pressure to enter the chamber 14 and reduce the vacuum therein. Where it is necessary to supply heat to the car, determined by the setting of the bi-metal element 79, the vacuum will be reduced to a point where the spring 25 will open the valve 20. As the vacuum in the chamber 14 becomes balanced and the differential in pressure across the diaphragm 53, balances the outward force exerted by the bi-metal element 79, the valve 74 will again close. As the vacuum becomes too low for the temperature conditions for which the bi-metal element 79 is set, the valve 66 will open to increase the vacuum in the chamber 14 and effect closing of the valve 20.

The vacuum equalizing and control chamber 14 thus balances the pressure differential across the diaphragm 53 against the pressure exerted against said diaphragm by the bi-metal element 79, and said diaphragm and bi-metal element and the valves 74 and 66, serve to supply the required vacuum to the chamber 16 and also to compensate for varying vacuums in the intake manifold of the car.

Figure 5, diagrammatically shows a form in which the control of my invention may be embodied, which utilizes a vacuum tank 89, acting as an accumulator, to provide a more constant source of vacuum than can be obtained by directly connecting said vacuum control valve to the intake manifold of the car engine. The vacuum tank 89 may be of any well known form commonly used to provide a relatively constant vacuum to windshield wipers or the like, driven from the car engine, and while not

necessary, may be provided to correct extreme conditions where the vacuum in the intake manifold may be substantially zero and to prevent a lag in the closing of the valve **20** which ordinarily is not taken care of by the vacuum control valve **10**. In Figure 5, the vacuum tank **89** is shown as being connected to an intake manifold **90** of a car engine by means of a vacuum line **91**. A vacuum line **93** connects the tank **89** to the outlet **11** of a vacuum control valve **10**, which is shown in this figure as being mounted on the inside or underneath the dashboard of the car. The vacuum line **19** is connected from the inlet passageway **12** of the vacuum control valve **10** to the casing of the vacuum motor **17** in communication with the chamber **16** thereof. The inlet **22** of the fitting **23** is shown as being connected to a source of hot water from the engine block as by a conduit **95**, while the outlet **24** of said fitting is shown as supplying hot water to a car heater **96** through a conduit **97**. A conduit **99** connects the discharge side of the heater **96** to the return for the cooling system of the car engine.

It will be understood that various modifications and variations of the present invention may be effected without departing from the scope of the novel concepts thereof.

I claim as my invention:

1. In a vacuum control valve, a valve casing having a valve chamber therein, a member having a passageway extending therealong defining an outlet into said chamber, a check valve at one end of said member, closing said outlet upon a reduction in vacuum at the source below the vacuum in said chamber, a second valve engageable with the opposite end of said member from said check valve to close said outlet, a spring biasing said second valve in a direction to close said outlet, a vacuum equalizing chamber in communication with said outlet under the control of said second valve, an inlet into said vacuum equalizing chamber adapted to be connected to a device to be operated by vacuum, a diaphragm closing the end of said vacuum equalizing chamber opposite said passageway member, an opening to atmosphere through said diaphragm, a third valve connected with said second valve and cooperating with said opening to atmosphere, said third valve opening upon an increase in vacuum within said vacuum equalizing chamber beyond a predetermined value, and means connected with said diaphragm, for moving said diaphragm in a direction to open said second valve and close said third valve.

2. In a vacuum control valve, a valve casing having a valve chamber therein, a seating member in said chamber having a passageway leading therethrough, an outlet leading into said chamber on one side of said seating member, a check valve seating against said seating member on the side thereof adjacent said outlet, a thermally operated second valve engageable with the opposite end of said seating member, a vacuum equalizing chamber

communicating with said seating member on the opposite side thereof from said check valve, a spring biasing said thermally operated second valve toward a closed position, an inlet to said vacuum equalizing chamber adapted to be connected to a device to be operated by vacuum, a diaphragm closing the end of said vacuum equalizing chamber opposite said seating member and forming an end wall of said casing, said diaphragm having an opening leading therethrough to atmosphere, a third valve connected with said second valve and cooperating with the opening in said diaphragm, said spring biasing said diaphragm toward said third valve to close said opening, and a temperature responsive element connected with said diaphragm to open said second valve upon movement of said diaphragm outwardly with respect to said vacuum equalizing chamber to increase the vacuum therein, and said third valve opening upon movement of said diaphragm within said vacuum equalizing chamber to admit air at atmoshperic pressure thereinto and reduce the vacuum therein.

3. In a vacuum control valve, a valve casing having a valve chamber therein, a member having a passageway extending therealong defining an outlet into said chamber, a check valve maintaining said outlet closed upon reduction in vacuum at the source below the vacuum in said chamber, a thermally operated second valve engageable with the opposite end of said outlet from said check valve to close said outlet, a spring biasing said second valve in a direction to close said outlet, a vacuum equalizing chamber in communication with said outlet under the control of said second valve, an inlet into said vacuum equalizing chamber adapted to be connected to a device to be operated by vacuum, a diaphragm closing the end of said vacuum equalizing chamber opposite said passageway member, said diaphragm having an opening to atmosphere therethrough, a third valve connected with said second valve to close said opening to atmosphere, said third valve opening upon an increase in vacuum within said vacuum equalizing chamber beyond a predetermined value, and a thermally responsive element connected with said diaphragm, for moving said diaphragm in a direction to open said second valve and close said third valve upon predetermined temperature changes.

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