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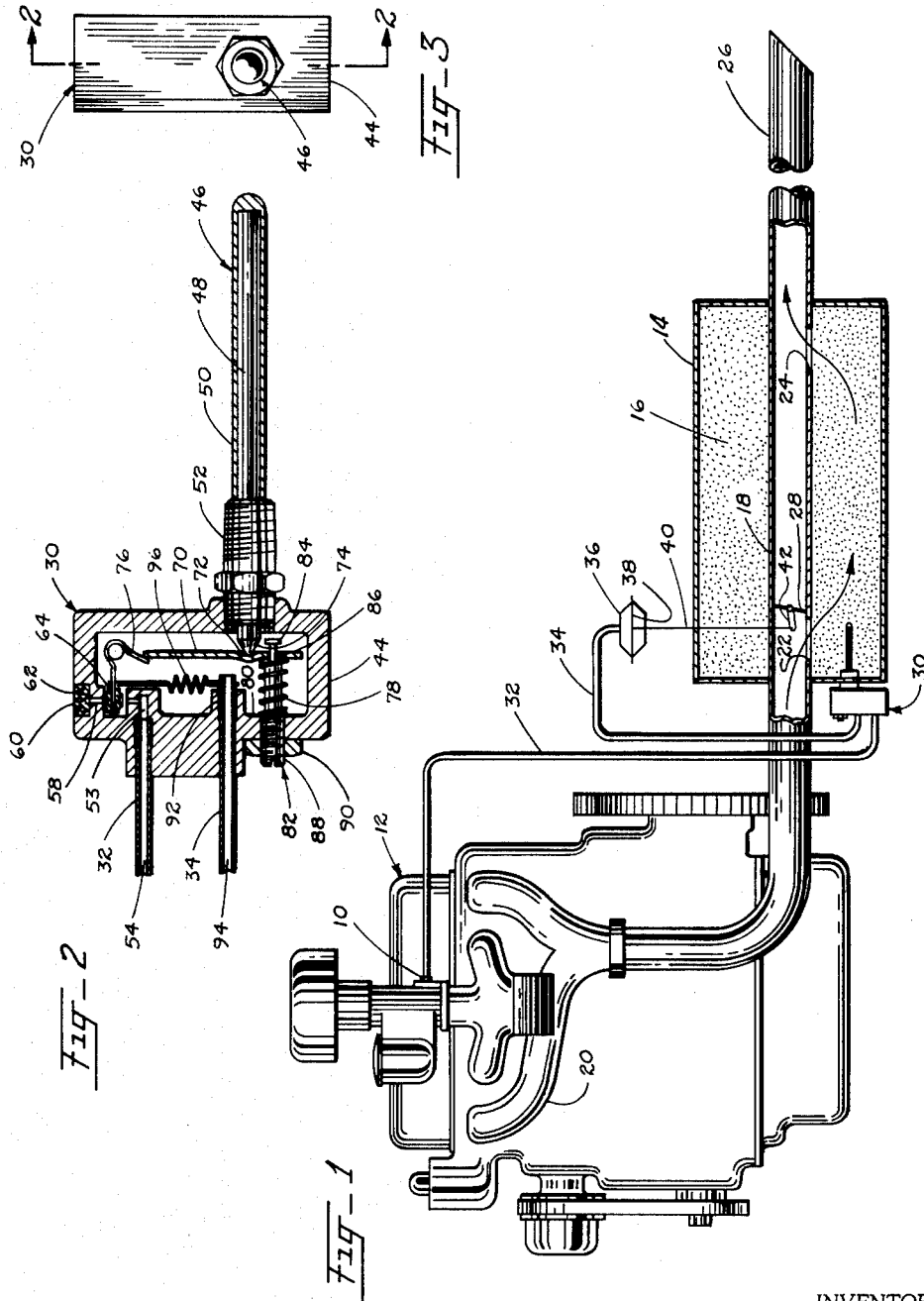
J. BORDEAUX ETAL

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DUAL PASSAGE THERMOSTATIC VALVE

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2 Sheets-Sheet 1



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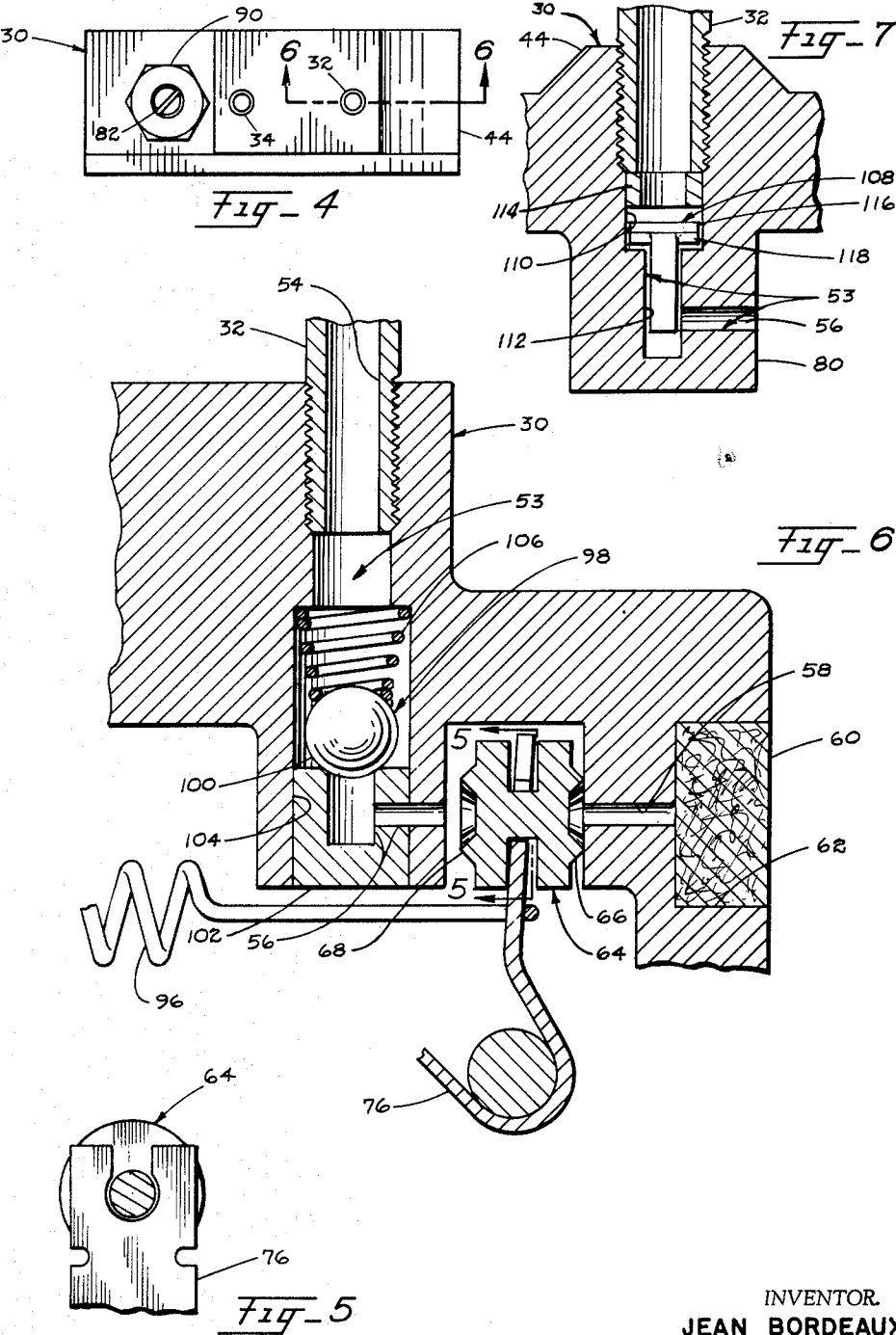
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DUAL PASSAGE THERMOSTATIC VALVE

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 6 Claims. (Cl. 236-102)

This invention relates to a device in a control system for purifying the exhaust gases of internal combustion engines and particularly refers to a control system in which the gases are catalytically treated to remove the offensive products of combustion; it has a primary object of providing a means for sensing the temperature of a treating device and rapidly causing gases to be shunted after a critical temperature has been reached.

In an effort to remove objectionable components of the exhaust gases in internal combustion engines, the catalytic muffler or afterburner has been used to render these exhaust gases innocuous. In the catalytic muffler, hydrocarbons are converted by catalytic combustion into carbon monoxide or carbon dioxide and water.

It is entirely possible to substantially eliminate the objectionable components of the exhaust gases by operating the catalytic muffler constantly, however, constant operation has a deleterious effect upon the life of the muffler and it would necessarily have to be replaced at very frequent intervals. The normal operating temperature of the catalytic muffler is between 1300° to 1500° Fahrenheit under normal conditions and at these temperatures, there is a normal tendency of rapid deterioration of the muffler. For this reason, there are many control devices which shunt the exhaust gases directly through the tail pipe around the muffler until the temperature of the interior of the catalyst is dropped to a level which is below the critical temperature. Thereafter, the muffler is operated in a cycling manner just below the temperature at which the muffler will start to deteriorate rapidly.

Therefore, it is appreciated that a balance must be struck to operate the catalytic muffler at a high efficiency level and yet not allow it to burn or deteriorate rapidly at this level of high efficiency. Some control systems in the past have commonly used vacuum to open and close a damper placed in the duct between the catalytic muffler and the tail pipe for shunting purposes. The previous attempts to solve this problem have used devices which do not operate rapidly enough such that the muffler can operate at its highly efficient level for a maximum period. The time needed to operate the previous control detracted from the time for treating the gases passing through the muffler.

The afterburner may also be used to eliminate the unburned hydrocarbon deposits and carbon monoxide content of exhaust gases. Most afterburners also require temperature control devices to prevent overheating of the entire system and the occupants of the vehicle. The present invention has been used to control the temperature limits of afterburners.

In accordance with the present invention, many of the undesired features of previous control systems for purifying exhaust gases have been overcome. It is therefore a further object of the present invention to provide a control which acts very rapidly with temperature changes such that a catalytic muffler may be bypassed very rapidly and therefore extend its useful life a great deal.

It is a feature of the present invention to provide a device having a thermally actuated means directly coupled with a sealing means for opening and closing an inlet to the control system.

It is a further feature of the present invention to provide a control device which may be operated for an extensive period of time without requiring extensive cleaning.

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It is still a further feature of the present invention to provide a control device which can be operated over a wide range of temperatures without putting undue strain upon the components of the control.

It is still a further feature of the present invention to provide a temperature adjustment which allows the control to be operated under a great range of temperatures.

Another object of the present invention is to provide a simple and inexpensive attachment which may be adapted to the exhaust gas system of existing automotive equipment.

The present invention comprehends broadly a control having a housing with a thermally responsive actuating means structurally connected to a sealing device which can alternately cover an inlet and an opening in the housing. By this structure the sealing means can connect a housing outlet to a vacuum source or other pressure source or seal this pressure source and allow the outlet to sense a different pressure such as atmospheric pressure. This alternative position of the sealing means would then operate a diaphragm very rapidly from one position to another position since the difference in pressures could be very great.

Other features and advantages not specifically enumerated above will be apparent after consideration of the following detailed description and the appended claims. The preferred form which the invention may assume is illustrated in the accompanying drawings in which:

FIGURE 1 is a schematic illustration, partially in longitudinal cross section of an internal combustion engine and a catalytic device utilizing the present invention to control the position of a damper for shunting engine exhaust through the catalytic bed or directly through the bypass and out the tail pipe;

FIGURE 2 is a longitudinal cross section of one embodiment of the present invention taken along line 2—2 of the FIGURE 3;

FIGURE 3 is a front elevation of the embodiment of the present invention illustrated in FIGURE 2;

FIGURE 4 is a rear elevation of the present invention illustrated in FIGURES 2 and 3;

FIGURE 5 is a partial cross sectional view taken along line 5—5 of FIGURE 6 and illustrates the manner of attaching the sealing means to a pivot lever;

FIGURE 6 is a partial cross sectional view on an enlarged scale taken along line 6—6 of FIGURE 4 and illustrates one embodiment of a valve to prevent vacuum loss and a sealing means; and

FIGURE 7 is a partial cross sectional view of another embodiment of a valve similar to that shown in FIGURE 6.

Referring now to FIGURE 1, reference numeral 10 designates generally, a source of vacuum which, in the case of internal combustion engines, may be found at the intake manifold or may be an independently operated vacuum pump. The internal combustion engine 12 is suitable for such things as automotive equipment, trucks, buses, or the like. As a part of the exhaust system for a vehicle, a generally cylindrical metal chamber 14 is provided and adapted to contain a suitable pelleted or granular catalyst bed 16. A suitable catalyst for this purpose is granulated, activated alumina impregnated with potassium dichromate, dried and calcinated at 1200° F.

The catalyst chamber 14 has an exhaust pipe or bypass passing therethrough which is a direct duct from the exhaust manifold 20 of the internal combustion engine 12. This conduit 18 has intake and exhaust ports 22 and 24, such that all or a portion of the engine exhaust may be ducted into the catalyst bed 16 and thereafter allowed to flow out the tail pipe 26 after the exhaust has been purified. A rotatable damper 28 is positioned between the intake port 22 and the exhaust port 24, of the by-

pass conduit 18, and is rotatably mounted therein. With the damper position shown in FIG. 1, it is obvious that the engine exhaust entering the chamber 14 will be ducted into the catalyst bed 16. Alternatively, with the damper positioned parallel to the conduit 18 (not shown), the exhaust gases are allowed to pass through the bypass conduit 18. A conventional muffler (not shown), may be positioned on the downstream side of the exhaust to muffle and deaden the discharging exhaust gases in a conventional manner before purging the gases to atmosphere.

A thermostatic control valve 30 is mounted on the forward portion of the catalyst chamber 14, and has an inlet conduit 32 connected thereto and leading from the vacuum source 10. An outlet conduit 34 is also attached to the valve 30 and is fixedly attached to a vacuum actuator 36 schematically illustrated and positioned above chamber 14 and having a movable diaphragm 38 therein. A wire 40 fixedly attached to the diaphragm 38 leads from the actuator 36 to a bell crank 42 mounted upon the damper 28 for operating purposes. Thus it may be seen that if the actuator 36 is subjected to a vacuum, the diaphragm 38 will be deflected upwardly, moving the wire 42 and the bell crank 40 and damper 28 clockwise to allow engine exhaust gases to flow directly through the bypass conduit 18.

It is to be understood that the arrangement of the catalyst bed 16, damper 28, and actuator 36 are only illustrative of how the present invention may be adapted to controlling the operation of a catalyst bed used to purify the exhaust gases of an internal combustion engine. Other arrangements of ducting the gases through the bed and for operating the ducting means, can be proposed by those skilled in the art such that the subject invention may be used to its best advantage.

Referring now to FIGURES 2-4, a preferred embodiment of the subject control device is illustrated. The device comprises a hollow closure or housing 44, having a thermal responsive actuating means associated therewith and having an inlet and outlet 32, 34 attached thereto as shown in FIGURE 2.

In order to sense the temperature within the catalyst bed, the thermal responsive actuating means used in the preferred embodiment is a conventional rod and tube arrangement 46, which is threadedly engaged into the housing 44. The rod 48 is slipped into the closed end tube 50 and for the present application, the rod is constructed of quartz, while the tube is made from stainless steel. This arrangement allows the present invention to be operated at temperatures in excess of 1800° F. Although the rod and tube arrangement is used as a preferred embodiment, other thermal responsive means may be used such as a bulb and bellows arrangement, or the thermal element disclosed in the patent to Branson 2,917,925, and assigned to the same assignee as the present invention. Any device, which transmits a mechanical movement with changes in temperature, may be used and may be substituted for the rod and tube arrangement.

The tube 50 has thereon a threaded portion 52 which may be used for mounting purposes in the catalyst chamber 14, although other attachment devices well known in the art may also serve this purpose. The position of the control device 30 should necessarily be in the area of the hottest portion of the catalyst bed 16 to thereby sense the upper temperatures or highest temperatures of the bed during operation. The temperature sensing element would necessarily extend into the bed in the area of the most extreme temperatures. The means for mounting the control device to the bed would certainly be a matter of choice.

As shown in FIGURES 2 and 6, the housing inlet comprises a passageway 54 through the inlet conduit 32, terminating in a transversely positioned passageway 56 in communication therewith. The housing or closure 44

has a passageway 58 positioned coaxially of the housing passageway 56, although this position may be changed to conform with the particular valving device for closing the housing inlet 53 and housing passageway 58.

The passageway 58 terminates in a filter 60 which is mounted in a cavity 62 in the housing 44. Since the housing passageway 58 is exposed to atmosphere and when the entire control device 30 is mounted beneath a motor vehicle, it may be subjected to contamination such as water, mud, foreign debris, and the like. The filter may be composed of a sintered bronze material having a 50 micron particulate size, such that water could not pass through the filter, although air or other gaseous material may freely flow through the filter.

Mounted between the housing inlet passageway 56 and the housing passageway 58, is a means for sealing the passageways which in this case takes the form of a disc 64 having faces on opposite sides forming two valve faces 66, 68 which can alternately seal the housing passageways 56 and 58, respectively. The sealing means illustrated has parallel or double valve faces for convenience sake. These valve faces do not necessarily have to be parallel; they may be at an angle to each other corresponding to the position of the housing inlet and the housing passageway. By positioning the housing inlet passageway 56 and housing passageway 58 in close relation thereto, there is but a minor movement of the disc 64, thereby allowing very fast operation of the control device 30 which will be explained hereinafter.

Referring now to FIGURES 5 and 6, for purposes of holding the disc in position and for pivoting the disc between the inlet passageway 56 and passageway 58, the pivot lever has a slot therein which snaps into the central portion of the disc, as illustrated in FIGURE 5. This is a convenient mounting device, although other equivalent devices may be used to attach the disc to a pivoting means. The lever has a central portion which is mounted upon a post extending from the housing cavity. One leg of the pivot bracket extends at approximately an acute angle with its opposite leg and provides a device for conveniently pivoting the disc and lever assembly.

As shown in FIGURES 2 and 6, for the purpose of transmitting motion from the thermal responsive actuating device, there is provided the beam or pivot lever 70 which has a depression 72 thereon which engages the nose 74 of the rod 48. One end of the lever 70 engages the pivot bracket 76 to thereby transmit longitudinal motion of the rod 48 and tube 50 movement. In order to keep the pivot lever 70 engaged with the rod 48, a resilient device such as the coil spring 78 is positioned between the lever 70 and the housing cavity wall 80. It should be noted that this resilient device provides for the overtravel of the rod 48 such that continued longitudinal movement of the rod will not overstress the sealing means or the pivot bracket 76, but will merely further compress the resilient device. An adjusting screw 82 has a head 84 which passes through an opening 86 in the pivot lever 70. The threaded portion 88 of the adjusting screw 82 passes through the housing 44 and is held in position by a lock nut 90 threadedly engaged therewith and abutting the exterior of the housing 44. Adjusting screw 82 may be rotated to change the relative position of the head 84 to the lever 70 such that outward movement of the rod 48 will prevent the lever from being dislodged therefrom. Actually, it is contemplated that the rod 48 will always be engaged with the lever depression 72 by constant resilient pressure being exerted thereon by the spring 78.

The outlet conduit 34 is threadedly engaged at 92 to the housing and has a passageway 94 therethrough that serves as the housing outlet.

For purposes of biasing the sealing device such as the disc 64 into engagement with the housing inlet passageway 56 resilient means in the form of a coil spring 96 is engaged to the outlet conduit extremity 34 and the pivot bracket 76.

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Referring now to FIGURE 6, for purposes of preventing a vacuum loss, a check valve 98 may be inserted within the housing inlet 53 such that the operation of the control valve 30 may be very smooth in operation. An example of a vacuum loss preventing device is a ball valve 100, seated within the plug 102 which is pressed or mounted like other suitable devices within the bore 104 of the housing 44. A resilient device such as the helical spring 106 biases the ball valve 100 upon its seat, unless it is displaced by a fluid pressure at the inlet conduit 32 which is lower than the pressure in the housing cavity 80.

Under normal operating conditions, a motor vehicle having an internal combustion engine operates with a vacuum of approximately 25-27 inches of mercury in the intake manifold. Under other conditions the vacuum in the intake manifold of the engine may drop below a vacuum of 25 inches of mercury so that when the control valve 30 is in a position as illustrated in FIGURE 2, the diaphragm 38 illustrated in FIGURE 1 would respond to the vacuum drop unless so prevented. This condition of loss in vacuum is usually temporary and may be caused during an acceleration from a complete stop or movement of the vehicle up an incline. Under these conditions of a temporary vacuum loss in the intake manifold, the vacuum may be kept at a maximum within the housing cavity 80 by using a device similar to that illustrated in FIGURE 6. During these conditions, the vacuum at the inlet conduit or above the ball valve will be at a level above that below the ball valve therefore allowing the valve to remain in the position of FIGURE 6, or in the closed position. This, therefore, does not allow the diaphragm of FIGURE 1 to unload and prevents abnormal cycling of the entire device which improves operation of the entire assembly.

Another embodiment of the vacuum loss preventing means is illustrated in FIGURE 7. In this embodiment, valve 30 has inlet conduit 32 threadedly engaged with housing 44 and in communication with the housing inlet 53. A floating poppet valve 108 is received by bore 110 and passage 112. Annulus 114 is pressed into bore 110 and restricts the upward travel of valve 108. The size of head 116 for valve 108 is slightly smaller than bore 110 to allow the passage of air around it. A resilient seal 118 encircles stem 120 and abuts head 116. A biasing means is not needed in this embodiment to retain the valve 108 on its seat due to the resiliency of seal 118 acting on the valve seal when the valve is subjected to a vacuum. Thus it may be seen that when housing cavity 80 is subjected to a vacuum, valve 108 will be seated. Valve 108 will remain seated even though the vacuum in inlet conduit 32 drops below the relative vacuum in housing cavity 80 because of the larger cross sectional area on the top of valve 108. Of course, if a vacuum differential exists across valve 108 for an extended period, the vacuum will leak out under seal 118 and valve 108 will open. However, it has been found empirically that it takes up to three minutes after all vacuum in inlet conduit 32 was removed that valve 108 would open. The advantages of this action have been previously described in relation to FIGURE 6.

Referring now to all the figures, the operation of the control device according to the present invention will now be described as applied to a control system for an automotive catalytic bed temperature control system. The catalytic bed 16 has basically two operating conditions, the first is a non-bypass condition in which the engine exhaust will pass through the catalytic bed before being ducted from the tailpipe 26. The second condition being a bypass condition in which the catalytic bed 16 is not used in any way due to an extreme temperature therein.

In the first condition, in the control of FIGURE 2, the disc 64 or sealing means will be biased against the inlet opening 56 allowing atmosphere to pass through the housing passageway 58 entering the outlet conduit 34. Atmospheric pressure is therefore subjected upon the dia-

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phragm 38 to allow the damper 28 to assume the position of FIGURE 1. This first condition exists when operating at a rate which does not give sufficient amount of hot engine exhaust to raise the temperature of the thermal responsive element at a temperature to shift the sealing device.

In the second condition, the damper 28 of FIGURE 1, assumes a position substantially parallel to the flow of engine exhaust in the bypass pipe and allows the engine exhaust to pass directly therethrough. This condition would be caused by an extreme temperature within the catalytic bed 16 such that the rod and tube arrangement 46 would force the lever 70, pivot bracket 76, and disc 64 into the position illustrated in FIGURES 2 and 6. In this position, the sealing disc 64 prevents atmosphere from entering the interior of the housing 44, whereby diaphragm 38 in FIGURE 1 is subjected to vacuum since inlet passageway 56 is opened.

In the first condition, the exhaust gases will continue to flow through the catalyst bed until a maximum allowable temperature in the bed 16 is reached at which time the tube 50 would expand due to temperature change in its vicinity thereby allowing the spring 78 to force the lever 70 against the rod 48 to the point that the lever 70 would rotate a minute distance clockwise on the fulcrum of the rod nose 74. As this rotation occurs less force is placed upon the pivot bracket 76, thereby allowing the spring 96 to bias the disc 64 to cover the housing inlet passageway 56 and thereby allowing atmospheric pressure to enter the housing passageway 58 to thereby unload the diaphragm 38, pivoting the damper 28 to allow the engine exhaust to pass directly through the bypass pipe 18. From this point on the control device will cycle between bypass and non-bypass conditions allowing the engine exhaust to alternately pass through the catalyst bed 16 and the bypass pipe 18 as the catalyst bed reaches a critical temperature and cools to a safe temperature. Inasmuch as the disc 64 travels only a small distance between controlling positions, the movement is rapid because of the biasing forces on opposite ends of the fulcrum lever 70; such rapid movement results in a rapid change between vacuum and pressure conditions on the diaphragm 38 whereby the damper 28 is also rapidly moved between extreme positions.

It should be noted that although a vacuum system has been described for operating the catalyst bed for an automotive operation, this same system could be operated on a pressure system, a hydraulic system, or a purely mechanical system with a minimum of change of the control device constructed in accordance with the present invention.

The present invention relates to a control device which can be used to operate a catalyst bed; however, other items may make use of the present invention which are unrelated to automotive installations or catalyst bed or afterburner use. Any application where temperatures is to be sensed to operate an external element to the ON, OFF, or to a plurality of positions may be utilized by using the present invention in its preferred embodiment or in equivalent structures.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that it is only illustrative and that various modifications may be made herein without departing from the scope and sphere of this invention as defined in appended claims.

We claim:

1. In a control device, the combination comprising a housing having an internal cavity defining a chamber, outlet means for said housing communicating with said chamber, inlet means for said housing communicating with a pneumatic source and including a first passageway leading to said chamber, a second passageway in said housing having one end leading to said chamber and having another end communicating with the atmosphere,

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- a single valve element movably disposed in said chamber for alternate control of said first and second passageways,
 lever means in said housing for effecting movement of said valve element between alternate controlling positions,
 temperature responsive means including a movable portion engaging said lever means whereby said valve element is moved in response to temperature variations, and
 check valve means in said inlet means preventing communication between said chamber and the first pneumatic source in response to variations in the first pneumatic source, said lever means comprising a pivot bracket carrying said valve element, spring means biasing said pivot bracket, a pivot lever for moving said bracket against said biasing means, resilient means for biasing said pivot lever, and means on said pivot lever engaging the movable portion of said temperature responsive means.
2. The invention as recited in claim 1 wherein said first and second passageways are adjacent each other so as to permit minimum movement of said valve element therebetween.
3. The invention as recited in claim 2 wherein said first and second passageways are coaxially disposed with said valve element therebetween.
4. The invention as recited in claim 3 wherein the pneu-

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matic source is a source of vacuum and wherein said second passageway includes filter means.

5. The invention as recited in claim 4 wherein said check valve means comprises a spring biased ball valve movably disposed in said inlet means to define vacuum loss preventing means.

6. The invention as recited in claim 4 wherein said check valve means comprises a floating poppet valve movably disposed in said inlet means to define vacuum loss preventing means.

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