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THROTTLE CLOSED POSITION LIMITER

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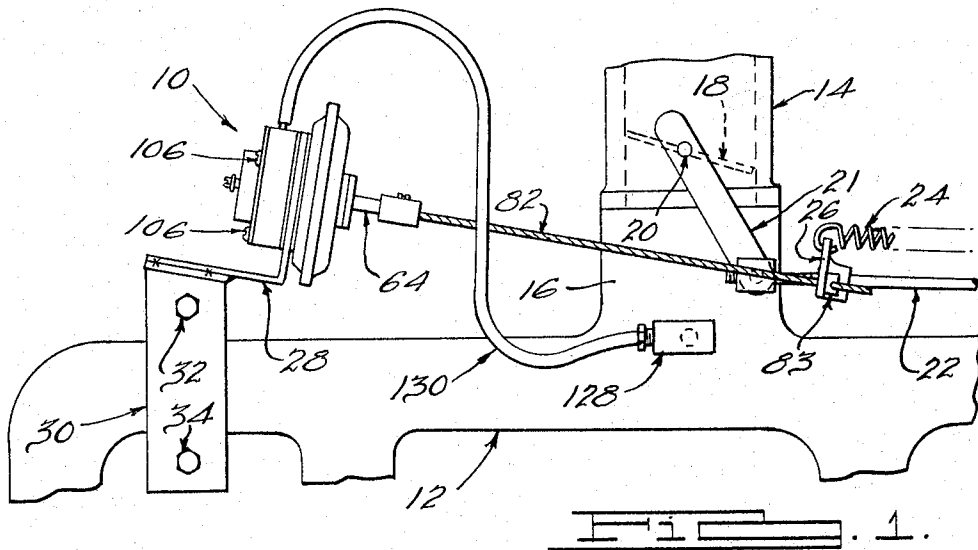
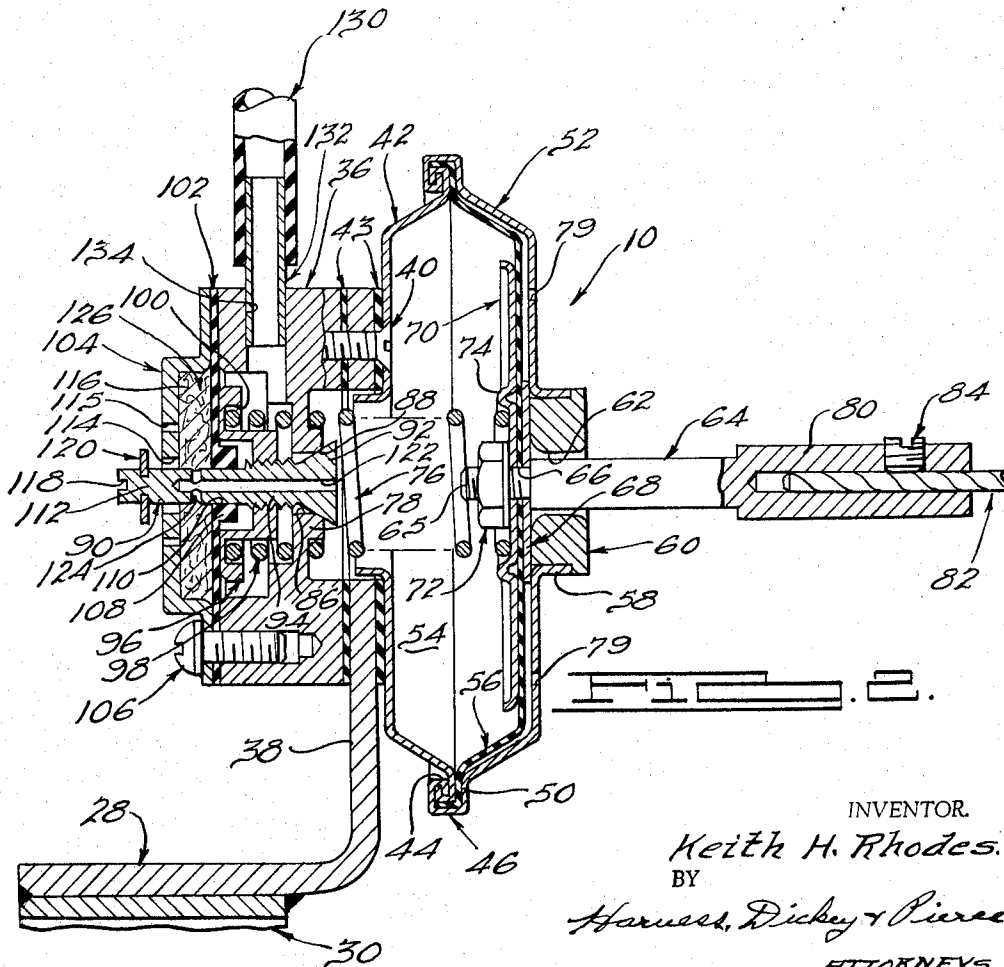


FIG. 1.



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THROTTLE CLOSED POSITION LIMITER

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8 Claims. (Cl. 123-103)

This invention relates generally to internal combustion engines, and more particularly, to a device for controlling the emission of hydrocarbons from an automotive engine.

In general, it is an object of the present invention to provide a device which is responsive to the manifold vacuum of an automotive engine to effect the opening or "cracking" of the engine's throttle plate during engine deceleration conditions, thus allowing the normal air-fuel mixture to pass from the engine's carburetion system into the intake manifold to reduce the manifold vacuum, and thereby effect a corresponding reduction in the emission of unburned hydrocarbons from the engine.

It is another object of the present invention to provide a manifold vacuum control device of the above character whose operation is entirely automatic.

It is still another object of the present invention to provide a manifold vacuum control device which operates to effectively reduce unburned hydrocarbon emission under substantially all engine deceleration conditions.

It is yet another object of the present invention to provide a manifold vacuum control device which has a negligible effect on the fuel economy of its associated automotive engine.

It is a further object of the present invention to provide a manifold vacuum control device of the above character which is readily adjustable and which may be operatively associated with automotive engines having either manual or automatic transmissions.

It is still a further object of the present invention to provide a manifold vacuum control device of the above character which may be combined with a catalytic exhaust gas purifier to provide a highly effective smog-reducing system.

It is yet another object of the present invention to provide a manifold vacuum control device characterized by an extremely simple construction and which may be conveniently installed on an automotive engine.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a side elevational view of a preferred embodiment of the manifold vacuum control device of the present invention as seen in operative association with the intake manifold and carburetor assembly of an internal combustion engine; and

FIGURE 2 is an enlarged cross-sectional view of the manifold vacuum control device illustrated in FIGURE 1.

Referring now to FIGURE 1 of the drawing, a manifold vacuum control device 10, in accordance with a preferred embodiment of the present invention, is shown in operative association with an intake manifold 12 of an automotive engine (not shown). The lower end of a carburetor housing 14 is mounted on an upwardly extending inlet section 16 of the manifold 12, and a throttle plate 18 is pivotably mounted within the housing 14 by a shaft 20. A throttle plate control arm 21 is connected at one end by the shaft 20 to the plate 18 and is connected at its opposite end to a throttle control rod 22 whose longitudinal movement is responsive to appropriate movement of the accelerator pedal (not shown) within the associated automotive vehicle. A return spring 24 is connected through a fitting or coupling 26 to the shaft

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22 and functions to normally maintain the throttle plate 18 in its closed position, as illustrated in FIGURE 1. The assembly 10 is rigidly attached through an appropriately shaped mounting bracket 28 to another bracket 30 which is in turn fastened to the automotive engine by bolts 32 and 34.

Referring now to FIGURE 2, it will be seen that the manifold vacuum control device 10 includes the valve housing, generally designated 36, which is preferably fabricated of a die casting of a strong, light weight material such as aluminum or the like. The housing 36 is generally circular in cross section and is mounted on the side of an upwardly extending section 38 of the mounting bracket 28 and is rigidly secured thereto by a plurality of circumferentially spaced screws, one of which is illustrated herein and designated 40, which extend through suitable apertures in the bracket section 38, the housing 36, and through an annular cup-shaped shell 42 that is attached to the bracket section 38 on the opposite side of the housing 36. Suitable gaskets, generally designated 43, are secured to the opposite sides of the bracket section 38 to provide an air-tight seal between the housing 36, the shell 42 and the bracket section 38. A flat annular flange section 44 is formed around the outer periphery of the shell 42 and is secured by a rolled seam or joint 46 to an annular flange section 50 of a second cup-shaped shell 52 which is of an identical construction as the shell 42. The space defined by the shells 42 and 52 forms a diaphragm chamber 54, and an annular diaphragm 56, which is preferably constructed of a flexible and deformable material such as synthetic rubber or the like, is secured within the chamber 54 by having its outer periphery compressed between the flange sections 44 and 50 of the shells 42 and 52. It may be noted that the outer periphery of the diaphragm 56 acts as a gasket means to provide an air-tight seal between the flange sections 44 and 50 of the shells 42 and 52.

The shell 52 is provided with a central opening around which is formed an annular outwardly extending flange section 58. Press fitted within the flange section 58 is a circular pull rod sleeve or guide 60 which is formed with a central bore 62. As illustrated in FIGURE 2, one end of an elongated cylindrical pull rod 64 extends through the bore 62 with a threaded inner end section 65 extending into the diaphragm chamber 54. The pull rod end section 65 extends through a central aperture 66 in the diaphragm 56, and the diaphragm 56 is secured to the end section 65 interjacent a diaphragm retainer ring 68 and an annular diaphragm retainer plate 70 by a nut 72 which is threaded on the end section 65. The retainer plate 70 is formed with an annular concentric shoulder section 74 within which is seated one end of a helical diaphragm retainer spring 76. The opposite end of the spring 76 extends through a central opening in the shell 42 and a coaxial opening in the upwardly extending section 38 of the mounting bracket 28, and is seated around an annular inwardly extending section 78 of the valve housing 36. It will be seen that the return spring 76 normally bears against the retainer plate 70, thereby yieldably maintaining the diaphragm 56 and the pull rod 64 in their respective positions illustrated in FIGURE 2.

A plurality of air bleed holes, two of which are illustrated herein and designated by the numeral 79, are formed in the shell 52 to communicate atmospheric air to and from the outer (right) side of the diaphragm 56. Also, it will be seen that the diameter of the bore 62 in the guide 60 is slightly larger than that portion of the pull rod 64 extending therethrough, such that atmospheric air may freely flow around the rod 64 and pass into the diaphragm chamber 54 between the shell 52 and the diaphragm 56.

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The outer (right) end of the pull rod 64 is formed with a sleeve section 80 within which one end of a pull cable 82 is rigidly fastened by a set screw 84. The opposite end of the cable 82 extends through and is freely slidable within an opening in the coupling 26. A throttle stop 83 is adjustably secured on the outer end of the pull cable 82 such that during engine decelerating conditions (when the automotive vehicle's accelerator pedal is not depressed), longitudinal movement of the cable 82 towards the device 10 will effect movement of both the control arm 21 and the throttle plate 18; however, during normal throttle operation of the engine 12, the coupling 26 will override the cable 82 and throttle control will be maintained solely through longitudinal movement of the rod 22 in response to manual operation of the vehicle's accelerator pedal. It will be apparent, of course, that a number of alternate forms of overriding type throttle-control device linkages may be satisfactorily used, and that the structure herein described is merely exemplary insofar as such linkage constructions are concerned.

Referring again to FIGURE 2, centrally formed in the valve housing section 78 is an annular valve bore 86, one (right) end of which is formed with a conically shaped valve seat 88. Extending coaxially of the bore 86, and being reciprocable therewithin, is a valve member 90 which is formed with a frusto-conical end section 92 that is adapted to engage the valve seat 88, thereby providing an air-tight seal between the diaphragm chamber 54 and the interior of the valve housing 36. The valve member 90 is also formed with a medial section 94 onto which is threaded an annular spring retainer cup 96. A valve spring 98, which is disposed circumjacent the valve member's medial section 94, extends between an annular recess 100 formed in the spring retainer cup 96 and the inwardly extending section 78 of the valve housing 36. It will be seen that the spring 98 resiliently forces the retainer cup 96 away from the valve housing section 78, thus yieldably maintaining the valve member's end section 92 engaged with the valve seat 88.

A flexible disk-shaped diaphragm 102, which is preferably fabricated from the same material as the diaphragm 56, is mounted on the side of the valve housing 36 opposite the shells 42 and 52 by an annular cup-shaped cover plate 104 and a plurality of circumferentially spaced screws 106 that extend through the outer peripheral sections of the diaphragm 102 and plate 104 and are screwed into the side of the valve housing 36. The diaphragm 100 is formed with a central sleeve section 108 that defines a central aperture 110 through which extends a cylindrical outer end section 112 of the valve member 90. It may be noted that the diameter of the aperture 110 is slightly smaller than the valve section 112 so that when it is inserted through the aperture 110, an air-tight seal is provided between the diaphragm 102 and the valve member 90. The cover plate 104 is also formed with a central opening 114 and a plurality of air bleed holes 115, the latter of which communicate atmospheric air to an annular chamber 116 defined by the cover plate 104 and the diaphragm 102. The outer end of the valve section 112 protrudes outwardly through the central opening 114 and it will be seen that the opening 114 is sufficiently large to permit air to flow to and from the chamber 116 around the valve section 112.

A diametrically extending slot 118 is formed in the outer end of the valve section 112 and a suitable tool such as a screwdriver or the like may be inserted therein to rotate the valve 90 and thereby adjust the relative axial position of the spring retaining cup 96 along the valve's threaded medial section 94. Also provided on the outer end of the valve section 112 is a retaining ring 120 which is preferably of the snap-on type and which is adapted to limit the axial inward movement of the valve member 90 through the opening 114.

As illustrated in FIGURE 2, the valve member 90 is formed with an axially extending bore 122 which com-

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municates the interior of the diaphragm chamber 54 with a diametrically extending bore 124 that is formed in the valve section 112 in the radial plane of the chamber 116. It will thus be seen that the inner (left) side of the diaphragm chamber 54 is communicable with the atmosphere through the valve bores 122 and 124, the chamber 116 and the opening 114 in the cover plate 104. It may be noted that the interior of the chamber 116 is filled with an air filtering material 126, preferably a reticulated polyester or polyether urethane foam, and thus the air passing into the chamber 116 through the openings 114 and 115 will be effectively filtered prior to passing through the bores 122 and 124 and into the diaphragm chamber 54.

Referring again to FIGURE 1, mounted on the side of the manifold 12 is a fitting 128 which communicates the interior of the manifold 12 with one end of a flexible vacuum line 130. The opposite end of the vacuum line 130 is stretched around the outer end of a hollow tube 132 that is press fitted within a suitable bore 134 which is formed in the top of the valve housing 36. It will thus be seen that the manifold vacuum existing within the manifold 12 will be transmitted through the vacuum line 130 and the tube 132 to the interior of the valve housing 36.

In operation, the assembly 10 is secured by brackets 28 and 38 to the automotive engine in a location that will allow the pull cable 82 a straight pull on the fitting 26, and the position of the stop 83 is adjusted such that the cable 82 is taut when the engine throttle plate 18 is in its closed or hot idling position. When the engine is idling, the position of the retainer cup 96 is adjusted by rotating the valve 90 such that the tension of the spring 98 is just sufficient to maintain the valve section 92 engaged with the valve seat 88.

When the manifold vacuum increases within the manifold 12, as upon deceleration of the automotive engine, the internal pressure within the valve housing 36 will decrease, whereby the pressure (atmosphere pressure) within the chamber 116 will exceed the pressure within the valve housing 36 and the diaphragm 102 will be forced inwardly, thereby biasing the cup 96 inwardly and unseating the valve member 90.

As the valve 90 becomes unseated, the air within the diaphragm chamber 54 is transferred through the valve bore 86, the interior of the valve housing 36 and out through the tube 132 and vacuum line 130, thereby effecting a vacuum within the chamber 54. Atmospheric pressure, which is communicated to the outer (right) side of the diaphragm 56 through the bore 62 and the bleed holes 79, then biases the diaphragm 56 and the retainer plate 70 inwardly against the resistance of the spring 76, thereby biasing the pull rod 64 inwardly through the guide 60 and effecting a corresponding inward movement of the pull cable 82. As the cable 82 moves toward the assembly 10, the lower end of the throttle arm 21 is rotated clockwise about the shaft 20 thereby opening or "cracking" the throttle plate 18, and thus limiting the manifold vacuum within the manifold 12. Experience has shown that a control device 10, properly designed in accordance with the principle of the present invention, will maintain the manifold vacuum at or below a level of approximately 22 inches Hg, thereby limiting the unburned hydrocarbon emission level to about 3000 parts/million or less.

When the automotive engine reaches an idling condition or begins to accelerate, the vacuum within the manifold 12 and the interior of the valve housing 36 is relieved, whereby the spring 98 biases the cup 96 to the left and reseats the valve 90. As the valve 90 becomes seated, the vacuum within the chamber 54 is relieved by virtue of atmospheric air passing into the chamber 54 from the chamber 116 and the bores 122 and 124, and the retainer spring 76 biases the diaphragm retainer plate 70 and the diaphragm 56 outward (to the right) to the position illustrated in FIGURE 2. As the retainer plate 70 moves to the right, the pull rod 64 and the cable 82 are also moved to the right, whereby subsequent movement of the throttle

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plate 18 is controlled by normal manual throttle operation.

The manifold vacuum control device 10 is designed to operate as an independent assembly in controlling the emission of unburned hydrocarbons during deceleration of the automotive engine with which it is associated. It has been found, however, that the control device 10 may be combined with an automotive exhaust system which includes an exhaust gas afterburner or catalytic converter, whereby the control device 10 functions to effectively limit the amount of hydrocarbon emissions entering the converter, and thereby limit the load on the converter to prevent the over-heating thereof.

While it will be apparent that the preferred embodiment herein illustrated is well calculated to fulfill the objects stated, it will be appreciated that the present invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A device for controlling the emissions in the exhaust gases of an internal combustion engine under certain operating conditions, said device being attachable as a unit to the engine and comprising housing means defining first and second fluid chambers connected by a fluid passage, the first of said chambers defining at least in part a fluid motor, an actuating member supported for movement with said first fluid chamber, said actuating member being adapted to be connected to a throttle valve of the internal combustion engine, said actuating member being movable between first and second positions in response to pressure changes within said first fluid chamber for moving the throttle valve between a normal idle position and a partially opened position, valve means interposed in said fluid passage for controlling the communication of pressure between said first and second fluid chambers, pressure responsive means in said second fluid chamber for moving said valve means between a normally closed position and an opened position when the pressure in said second fluid chamber falls below a predetermined value, said actuating member being movable between its first and second positions when said valve means is opened, and conduit means for interconnecting said second fluid chamber with the induction system of the engine posterior to the throttle valve.

2. A device as set forth in claim 1 wherein the first and second chambers are defined at least in part by a common housing member and the fluid passage is formed in said housing member.

3. A device as set forth in claim 1 further including atmospheric venting means extending between the first fluid chamber and the atmosphere for facilitating movement of the actuating member between its second position and its first position.

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4. A device as set forth in claim 3 wherein the atmospheric vent is formed by a passage extending through the valve means from the second chamber to the atmosphere.

5. A device for controlling the emissions in the exhaust gases of an internal combustion engine under certain operating conditions, said device being attachable as a unit to the engine and comprising housing means defining in part first and second fluid chambers connected by a fluid passage, a first flexible diaphragm extending across the mouth of the first of said chambers, biasing means for urging said first diaphragm to a first position, an actuating member supported for movement with said first diaphragm, said actuating member being adapted to be connected to a throttle valve of an internal combustion engine, the throttle valve being in a normal idle position when said first diaphragm is in its first position and being adapted to be moved to a partially opened position when said first diaphragm moves to a second position, valve means interposed in said fluid passage for controlling the communication of pressure between said first and second fluid chambers, a second flexible diaphragm extending cross the mouth of said second fluid chamber, means operatively connecting said second diaphragm to said valve means, means for biasing said second diaphragm and said valve means to a normal position in which said valve means is closed, and conduit means interconnecting said second fluid chamber with the induction system of the engine posterior to the throttle valve for opening said valve means and drawing said first diaphragm to its second position.

6. A device as set forth in claim 5 wherein the operative connection between the valve means and the second diaphragm includes an adjustable connection.

7. A device as set forth in claim 6 wherein the first and second fluid chambers are formed in part by a common housing member in which the fluid passage is formed.

8. A device as set forth in claim 7 wherein a cup-shaped member is affixed to the housing member for forming a further portion of the first fluid chamber, the first flexible diaphragm being affixed across the mouth of said cup-shaped member.

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