

United States Patent

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[56]

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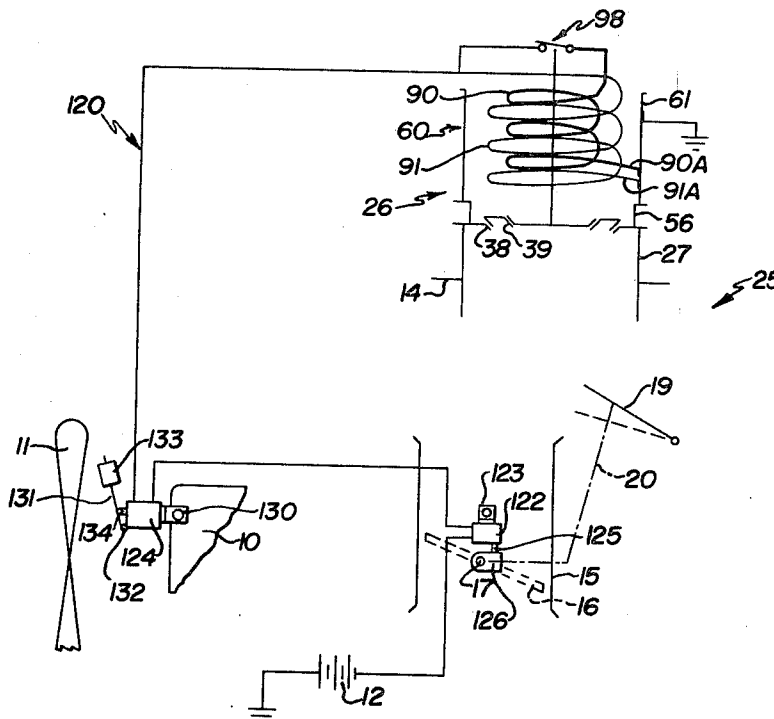
[54] VACUUM CONTROL APPARATUS
2 Claims, 4 Drawing Figs.

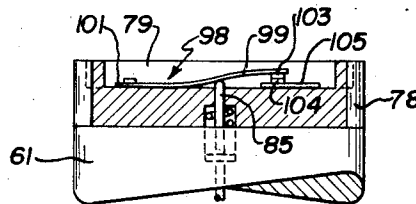
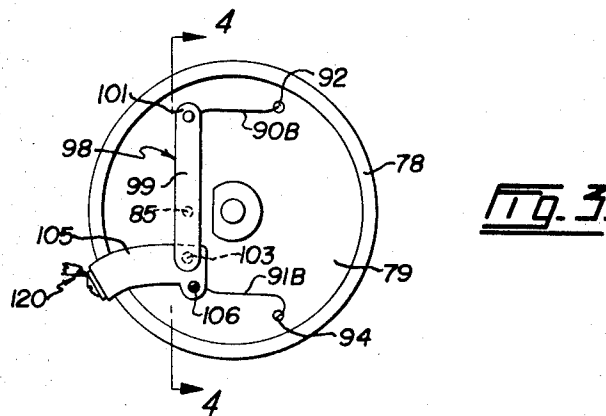
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ABSTRACT: A vacuum relieving apparatus having a solenoid operated valve controlled by an electric circuit including switches which are actuated to open the valve and supply air to the cylinders of an engine when the engine throttle valve setting is for idling speed and the engine revolutions exceed that of idling speed.





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VACUUM CONTROL APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to vacuum control apparatus which is particularly adapted for use on the motors of cars, trucks and other vehicles.

Excess vacuum is developed in a car engine whenever the vehicle decelerates with the throttle valve closed, since at this time the engine continues to turn over at quite a high rate of speed due to the momentum of the car and the driving action of the rear wheels. Because the throttle valve is closed, the engine cannot draw air through the intake manifold whereupon the engine operates as a suction pump which can build up a vacuum as high as around 27 inches of mercury. When this happens, excess gasoline is sucked into the engine and is not burned properly because of the shortage of air, the surplus fuel then causing crankcase dilution and excess engine wear due to lubricating oil being washed off engine parts. Some of this oil is burned in the cylinders so as to foul the spark plugs and cause smoking which pollutes the atmosphere. Thus, high-vacuum pressures reduce engine efficiency and have other harmful effects as well.

The use of vacuum relief valves for internal combustion engines has been suggested before but known valves have a number of disadvantages which may explain why they have not found more widespread use. Most conventional valves are vacuum operated; that is, they are held shut by springs and are caused to open when a predetermined amount of vacuum has built up in the engine. Thus the valves will open automatically whether or not it is desirable to have them open and this is completely unsatisfactory since it seriously interferes with the proper running of the engine. For example, at idling speed the required amount of vacuum is developed to open the valve but the engine will not operate effectively if the vacuum is suddenly released particularly when the engine is cold. Altitude, extreme weather conditions and the general condition of the engine all influence the operation of such valves and this too is undesirable. And also, the suddenness with which conventional valves open and close causes considerable noise which is objected to by many drivers who also are displeased with the sometimes jerky movements of the car resulting from the continuous opening and closing of the valves.

SUMMARY OF THE INVENTION

The above as well as other disadvantages of conventional valves are overcome by the present invention which provides electrically controlled apparatus which does not rely on a predetermined buildup of vacuum before it comes into operation. The control means is such that the apparatus will operate whenever the engine speed control mechanism is set for idle at a time when the engine r.p.m. is increased above idle due to acceleration of the vehicle. Vacuum is relieved before it is able to build up excessively and also in two stages so that relatively little power is required to operate the apparatus which is particularly quiet in operation. Since the apparatus cuts in and out automatically at precisely the right moments, it does not interfere with normal engine operation and actually improves overall engine efficiency. The engine is easier to start, there is less fuel and oil consumption as well as cylinder wear, and the spark plugs have a much longer operational life. A flooded engine is quickly cleared of excess fuel, engine backfiring and smoking during periods of deceleration are greatly reduced as is engine wear and oil contamination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of the vacuum control apparatus, in accordance with the present invention,
FIG. 2 is a vertical section of the solenoid operated valve,
FIG. 3 is a section taken on the line 3-3 of FIG. 2, and
FIG. 4 is a section taken on the line 4-4 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, the numeral 10 indicates an engine such as is used to power an automobile or truck. This internal combustion engine is equipped with the usual fan 11, battery 12, intake manifold 14, and carburetor 15. A throttle valve 16 is mounted on a rotatable shaft 17 which extends through the barrel of the carburetor 15, the valve being shown by dotted lines in a position which will allow the motor 10 to turn over at normal idling speed. The throttle valve 16 is adapted to be moved between the idling speed position shown and a full throttle position (not shown) by actuation of a gas pedal 19. For this purpose, the pedal 19 is operatively connected to the throttle shaft 17 by the usual assembly 20 of links and levers etc. which assembly, for the sake of convenience, is represented simply by a chain dotted line in FIG. 1 only.

The vacuum control apparatus which forms the basis of the present invention is indicated generally at 25 in FIG. 1 and this apparatus includes an air inlet valve 26. As shown best in FIG. 2, the air inlet valve generally indicated at 26 is adapted to be mounted on the intake manifold 14 and, for this purpose, valve body 27 is threaded as at 28 to enter a threaded opening 29, drilled and tapped into said manifold. A horizontal bar 32 extends across the bore 33 of the valve body 27 and this bar has a central opening 34.

The upper end of the valve body 27 has an outwardly projecting flange 37 and at the junction of this flange and the surface of the bore 33, there is a valve seat 38. A large valve member in the form of an annular disc 39 engages the seat 38. Valve disc 39 provides a concentric seat 41 for a small valve member in the form of a cylindrical plunger 42. A number of inclined and circumferentially spaced openings 46 extend through valve disc 39 from the seat 41 to the underside of said valve disc whereby to communicate with the bore 33.

Below the valve disc 39, the valve plunger 42 has a horizontal flange 48 and a spring 49 is interposed between this flange and the underside of said valve disc so as normally to retain said small valve plunger on the seat 41. Depending below the flange 48 is a stem 51 which slidably extends through the opening 34 in the horizontal bar 32. The valve plunger 42 has an upper end 52 and extending into this upper end is a central recess 53.

The flange 37 of the valve body 27 is fitted with a ring 56 having a row of side openings 57. Mounted on the ring 56 is a solenoid generally indicated by the numeral 60 and having a metal housing 61. The solenoid housing 61 preferably has inner and outer sidewalls 62 and 63 which are concentric to one another and also top and bottom walls 64 and 65. Inner wall 62 forms a cylinder 68 and the upper portion of the cylindrical valve plunger 42 is slidably received in this cylinder. A vertically disposed rod 70 is seated in the recess 53 of the valve plunger and the upper end of this rod slidably extends through an opening 71 formed in the top wall 64 of the solenoid housing. A spring 73 is fitted around the rod 70 between a flange 74 on said rod and the underside of the top wall 64 so as to resist upward movement of the valve plunger 42 within the cylinder 68.

Housing 61 is fitted with a dielectric cap 78 having an annular well 79 formed in the top face thereof and a central opening 80. The top wall 64 of the solenoid housing and the cap 78 are drilled to provide aligned openings 83 and 84 for a vertical pin 85. The lower end of the slidably mounted pin 85 normally projects a short distance into the cylinder 68 while the upper end of said pin is substantially flush with the bottom of the well 79. A spring 86 serves to bias the pin 85 towards the aforesaid position.

Solenoid 60 has a primary winding 90 and a secondary winding 91 which are enclosed within the housing 61 between the walls 62 and 63. The primary winding 90 is made up of a length of heavy wire which is wrapped around the wall 62 horizontally. One end 90A, see FIG. 1 only, of this wire is suitably grounded to the housing 61 and the opposite end 90B

of the primary winding wire projects upwardly through an opening 92 extending through both the wall 64 and the cap 78, see FIG. 3 only. The secondary winding 91 is formed of a relatively large number of turns of a finer wire wrapped horizontally around the primary winding 90. The secondary winding wire 91 also has an end 91A grounded to the housing 61 as shown in FIG. 1. The opposite end 91B of the wire forming the secondary winding projects upwardly through an opening 94, also formed in both the wall 64 and the cap 78 and shown in FIG. 3 only.

Referring now particularly to FIGS. 3 and 4, a contact breaker switch 98 is mounted in the well 79 and this switch has a flexible arm 99 one end of which is connected as at 101 to the end 90B of the primary winding 90. The opposite end of arm 99 is fitted with a contact breaker point 103, this point normally engaging a similar point 104, (FIG. 4) mounted on a conductor plate 105 carried by the cap 78. The end 91B of secondary winding 91 is electrically connected to the plate 105 as indicated at 106 in FIG. 3. The contact breaker arm 99 extends over the pin 85 with the contact breaker points 103 and 104 normally in engagement with one another. A cover 108 of a suitable insulating material is secured to the cap 78 to enclose the switch 98 and associated parts mounted within the well 79.

Preferably, the solenoid 60 is enclosed by an air filtering screen 110 which is mounted between lower and upper plates 111 and 112. The annular plate 111 engages the underside of the flange 37 while the circular plate 112 sits on the cover 108. Bolts 114 serve to clamp together the several parts of the screen 110 and to secure said screen to the solenoid operated valve 26. This screen 110 serves to filter air entering the bore 33, and therefore the intake manifold 14, through the openings 57 under control of the large and small valve members 39 and 42.

Referring again to FIG. 1, the apparatus 25 will be seen to include an electric circuit 120 which connects the solenoid 60 to a source of electric current which in a car or truck is the battery 12. The circuit generally indicated by the numeral 120 is provided with switches 122 and 124, these elements being connected in series by the circuit along with the battery 12 and solenoid 60.

Switch 122 is a normally open switch which is required to close whenever the gas pedal 19 is released to a position which will allow the engine 10 to idle. For this purpose, switch 122 may be mounted in a number of locations so as to be operated by the pedal 19 or part of the throttle valve actuating assembly 20 but, preferably, said switch is secured to the carburetor 15 by a bracket 123. This particular mounting places the operating plunger 125 of the switch in the path of an arm 126 mounted on the throttle shaft 17. Thus, whenever the gas pedal 19 is depressed, the switch 122 is allowed to open whereupon the circuit 120 is broken. As soon as the pedal 19 is released to an idling position, i.e., the position shown in dotted line in Fig. 1, the plunger 125 is contacted by the arm 126 and the switch is closed.

Switch 124 is a normally open switch which conveniently can be secured to the motor 10 by a bracket 130. An arm 131 is connected to the body of switch 124 by a hinge 132 and this arm is fitted with a sail 133. Hinge 132 will allow the arm 131 to swing only a limited distance forwardly. When the arm 131 is swung rearwardly, it engages and depresses an operating plunger 134 to close the switch 124. As shown in FIG. 1, switch 124 is located near the motor fan 11 so that the sail 133 is disposed in the path of the air stream from said fan. Whenever the motor 10 is operating at a predetermined speed above idling speed, the air stream from the fan 11 impinges on the sail 133 and causes the arm 131 to swing rearwardly whereby to depress the plunger 134 and close the switch 124. At engine idling speed, the fan 11 does not create a flow of air strong enough to swing the arm 131 rearwardly and therefore the switch 124 remains open. The circuit 120 extends from the switch 124 to the conductor plate 105 so that the primary and secondary windings of the solenoid 60 are energized when both switches 122 and 124 are closed.

In operation, the car fitted with the vacuum control apparatus 25 may be moving along at highway speed and come to a steep hill, which must be descended. The driver will release the gas pedal 19 whereupon the normally open switch 122 is closed. Engine 10 will continue to turn over at high speed due to the momentum of the car and the driving action of the rear wheels and this results in the large increase in vacuum within the manifold 14. Since engine r.p.m. remains high, the fan 11 keeps the sail switch 124 closed whereupon current flows from the battery 12 to the solenoid 60. Both the primary and secondary winding 90 and 91 are energized and the valve plunger 42 is raised to allow atmospheric air to go through the screen 110, openings 57 and 46, bore 33 and manifold 14, to the engine cylinders so as to at least partially relieve the abnormally high vacuum being developed by the decelerating vehicle.

Upward movement of the valve plunger 42 raises the pin 85 to lift the contact breaker arm 99 and open the contacts 103 and 104, whereupon the primary winding is deenergized. Very shortly after the small valve plunger 42 is raised, vacuum within the engine cylinder is reduced to a predetermined low value which allows the large valve disc 39 to open and vacuum is reduced still further so that the car can descend the hill without a large and prolonged buildup of vacuum in the engine which has so many undesirable side effects. By opening the valve 26 in stages, and deenergizing the primary winding 90 after the first stage, less power is required to operate the valve and there is less likelihood of the primary winding burning out.

From the foregoing, it will be seen that a particularly effective means has been provided for controlling excess vacuum developed by a car motor. Since the valve arrangement is electrically operated, there is no delay in the opening action and vacuum does not get a chance to build up to an excessive degree. The two stage solenoid operated valve 26 is held shut by atmospheric pressure pressing down on both the plunger 42 and disc 39 but, by opening the small valve member before the large valve member, this clamping pressure does not interfere with the successful operation of the valve. The primary winding 90 which consumes most of the electric current, is cut out of the electric circuit when switch 98 is opened by the opening action of the small valve member and this effects a considerable saving in power as well as prolonging the life of the solenoid which might eventually burn out otherwise if energized for too long a period. Vacuum is reduced to zero in two easy stages by the valve members 39 and 42, which are required to move only short distances and this provides for a particularly quiet operating mechanism. The complete relief of the vacuum ensures that oil is not washed off the cylinder walls and burned to cause spark plug fouling and air pollution as has hitherto been the case.

We claim:

1. Apparatus for controlling the vacuum of an internal combustion engine having an intake manifold and a gas pedal, comprising an inlet valve for admitting air to the intake manifold, said inlet valve having a first valve member and a second valve member of greater cross-sectional area than said first valve member, an operating solenoid for the inlet valve, said solenoid having a primary winding and a secondary winding, said first valve member being a cylindrical plunger having an upper end encircled by the primary and secondary windings, spring means urging each of said first and second valve members to closed position, an electric circuit connecting the primary and secondary windings to a source of electric current, first switch means in the electric circuit operable to close when the gas pedal is released to engine idling position, second switch means in the electric circuit operable to close when engine speed exceeds normal idling speed, said first and second switch means when closed simultaneously energizing the primary and secondary windings of the solenoid initially to move the first valve member to open position and subsequently to move the second valve member to open position, a normally closed switch connecting the primary winding into the electric

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circuit, and means actuated in response to the opening movement of the first valve member for opening the normally closed switch.

2. Apparatus as claimed in claim 1, in which said second switch means comprises a normally open switch having an operating plunger, an arm hingedly secured to the switch and

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carrying a sail, said switch being mountable in the path of the air stream from the engine fan whereby rotation of said engine fan at speeds above idling speed will swing the sail arm to depress the operating plunger and close the switch.

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