

[54] **FLUID FLOW CONTROL DEVICE**
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[51] Int. Cl.²..... **F02P 5/10**
[58] Field of Search 123/117 A; 137/110, 512.1, 137/599, 599.1

3,678,907 7/1972 Vartanian 123/117 A
3,698,366 10/1972 Gropp 123/117 A
3,730,154 5/1973 Vartanian 123/117 A

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[57] **ABSTRACT**

A fluid flow control device is inserted in the vacuum lines connecting the carburetor spark and manifold vacuum ports to the ignition distributor adjusting servo actuator, the device having a number of orifices and one-way check valves to provide a different slow rate of pressure equalization during decelerations than during accelerations, for good performance as well as emission control.

[56] **References Cited**
UNITED STATES PATENTS
3,572,363 3/1971 Roach..... 137/110

5 Claims, 4 Drawing Figures

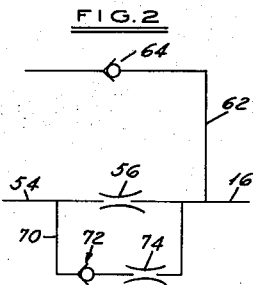
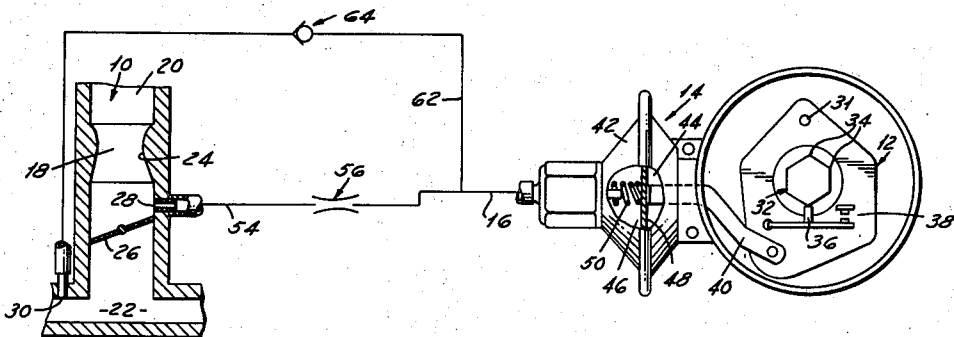


FIG. 1

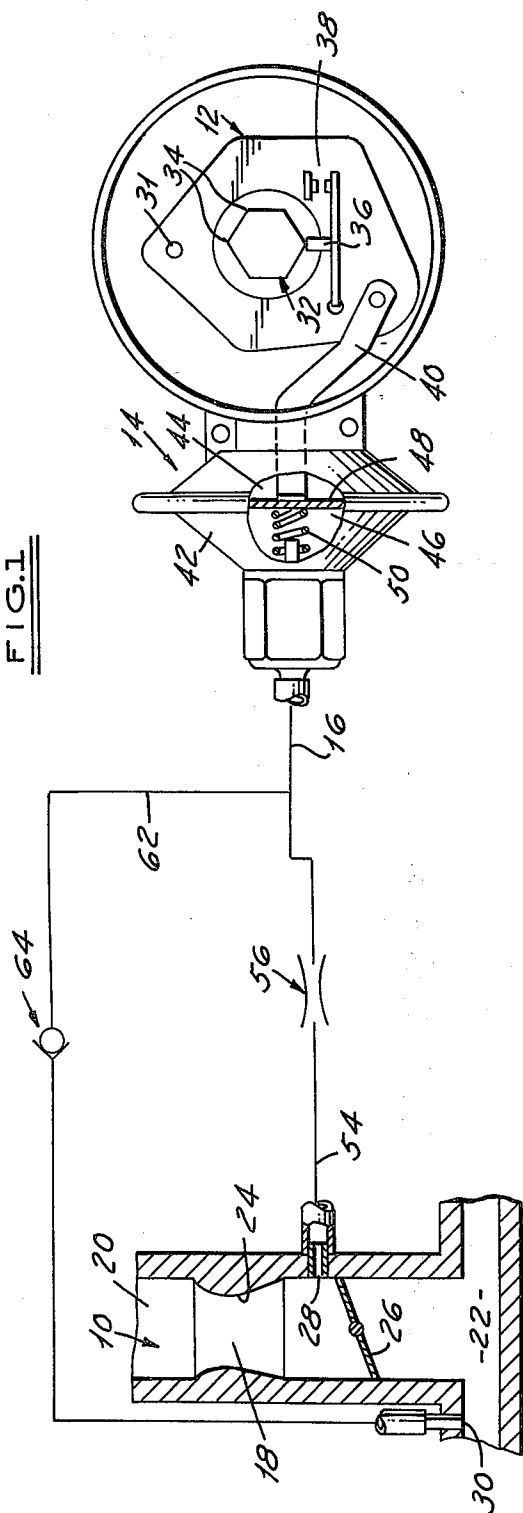


FIG. 2

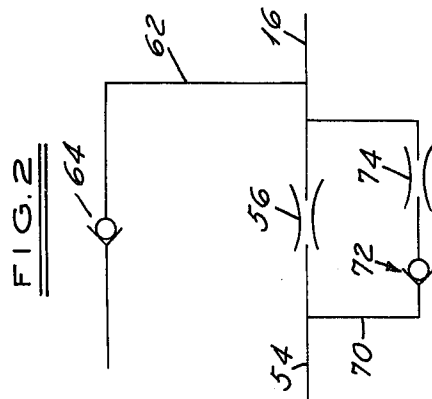


FIG. 1A

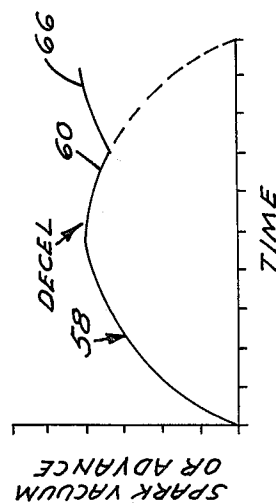
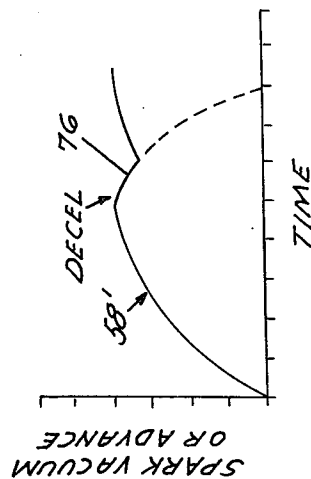


FIG. 2A



FLUID FLOW CONTROL DEVICE

This invention relates in general to an engine spark timing control. More particularly, it relates to one in which the rate of change of spark timing can vary between heavy vehicle accelerations and decelerations, for improved emissions and engine performance.

This invention is an improvement over the quick recovery spark timing control system shown in U.S. Pat. No. 3,698,366. The latter shows a spark timing control system in which a vacuum servo controlled by both carburetor spark port and manifold vacuum advances the ignition timing in opposition to a spring normally biasing the timing mechanism towards a retarded position. The vacuum line between the carburetor spark port and servo includes an orifice so that relatively slow vacuum changes during light vehicle accelerations will only be slowly communicated to the servo; likewise, decelerations will cause only a slow bleed of the vacuum from the servo to the spark port. As a result, a rapid recovery of the spark setting is provided upon light reacceleration after a momentary deceleration. It will be noted that the rate of deceleration change in vacuum, however, in this case is the same as the acceleration rate. Accordingly, the point at which reacceleration occurs may not be the most desirable ignition timing setting for engine performance purposes; also, the use of such a single device with a controlled rate of bleed restricts the device to particular characteristics.

It is an object of the invention, therefore, to provide a device of the type described above in which, however, a different rate of change of spark timing is provided at times for vehicle accelerations as compared to decelerations to provide a more selective control of the ignition timing and to improve the performance over that provided in U.S. Pat. No. 3,698,366.

The invention accomplishes the above objectives by providing an additional flow restriction device in series with a one-way pressure relief valve in a line bypassing a flow restriction between the carburetor spark port and the servo actuator adjusting the engine ignition timing, and operable in response to vehicle decelerations to provide a different rate of pressure equalization between the carburetor and servo actuator than during vehicle accelerations.

It is also an object of the invention to provide a spark timing control device providing a rapid recovery of the spark timing setting after a momentary vehicle deceleration, and one that provides improved performance by the spark timing being set more accurately or closer to the setting most desirous for the acceleration desired.

It is a still further object of the invention to provide an engine vacuum spark timing control device located between the carburetor spark port and the servo adjusting the ignition timing that at times provides a rate of equalization of pressures during decelerations that is faster than the rate of vacuum change during accelerations so that the spark advance setting moves more rapidly towards a retarded setting to provide the desired setting upon reaccelerations.

Other objects, features and advantages of the invention will become more apparent upon reference to the succeeding detailed description thereof, and by reference to the drawings showing the preferred embodiment thereof, wherein;

FIG. 1 illustrates schematically a known spark timing control shown in U.S. Pat. No. 3,698,366;

FIG. 1A graphically illustrates changes in spark vacuum or advance with time for the construction shown in FIG. 1;

FIG. 2 illustrates schematically a spark timing device embodying the invention; and,

FIG. 2A graphically illustrates changes in spark vacuum or advance with time of the device embodying the invention as compared to that shown in FIG. 1A.

FIG. 1 shows, schematically, a construction shown and described in the prior art in U.S. Pat. No. 3,698,366. Only those portions of an internal combustion engine that are normally associated with the engine distributor spark timing setting control are shown, such as a carburetor 10, a distributor breaker plate 12, a vacuum servo 14 to control the movement of breaker plate 12, and a line 16 between the carburetor and vacuum servo to automatically change the engine spark timing setting as a function of changes in carburetor vacuum spark port setting.

More specifically, carburetor 10 is shown as being of the downdraft type having the usual air/fuel induction passage 18. It has an atmospheric air inlet 20 at one end and is connected to an engine intake manifold 22 at the opposite end. Passage 18 contains the usual fixed area venturi 24 and a throttle valve 26. The latter is rotatably mounted on a part of the carburetor body across passage 18 in a manner to control the flow of air/fuel mixture into the intake manifold. Fuel would be inducted in the usual manner from a nozzle, not shown, projecting into or adjacent venturi 24, in a known manner.

Throttle valve 26 is shown in its engine idle speed position essentially closing induction passage 18, and is rotatable to a nearly vertical position essentially unblocking the passage. A spark port 28 is provided at a point just above the idle position of throttle valve 26, to be traversed by the edge of the throttle valve during part throttle opening movements. This will change the vacuum level in spark port 28 as a function of the rotative position of the throttle valve, the spark port reflecting essentially atmospheric pressure in the air inlet 20 upon closure of the throttle valve. An intake manifold vacuum sensing port 30 is also provided, for a purpose to be described.

As stated previously, the distributor, not shown, includes a breaker plate 12 that is pivotally mounted at 31 on a stationary portion of the distributor, and is movable with respect to a cam 32. The latter has peaks 34 corresponding to the number of engine cylinders. Each of the peaks cooperates with the follower 36 of a breaker point set 38 to make or break the spark connection in a known manner for each one-sixth, in this case, rotation of cam 32. Pivotal movement of breaker plate 12 in a counterclockwise spark retard setting direction, or in a clockwise spark advance setting, is provided by an actuator 40 slidably extending from vacuum servo 14.

Servo 14 may be of a conventional construction. It has a hollow housing 42 whose interior is divided into an atmospheric pressure chamber 44 and a vacuum chamber 46 by an annular flexible diaphragm 48. The diaphragm is fixedly secured to actuator 40, and is biased in a rightward retard direction by a compression spring 50. Chamber 44 has an atmospheric or ambient pressure vent, not shown, while the chamber 46 is connected by a bore, also not shown, to line 16.

During engine-off and other operating conditions to be described, atmospheric pressure exists on both sides

of the diaphragm 48, permitting spring 50 to force the actuator 40 to the lowest advance or a retard setting position. Application of vacuum to chamber 46 moves diaphragm 48 and actuator 40 toward the left to an engine spark timing advance position, by degree as a function of the change in vacuum level.

The prior art spark control device in FIG. 1 includes a main vacuum line 54 connected at one end to the carburetor spark port 28 and at its other end to line 16. The line 54 contains a fixed area flow restricting orifice 56, which delays the communication of a change in vacuum signal from one side of the restriction to the other at a rate according to the size and characteristics of the orifice. FIG. 1A illustrates, for example, a typical curve 58 showing the slow rise in vacuum level at servo chamber 46 upon opening of the throttle valve 26 exposing port 28 more and more to manifold vacuum. The descending portion 60 of the curve also shows the decay of vacuum at the servo chamber 46 at the same rate as the increase, during decelerations in which the atmospheric pressure at port 28 due to closing of the throttle valve only slowly bleeds down the vacuum signal through orifice 56. This provides a more rapid recovery to the previous advance setting than in conventional constructions in the event the throttle valve is again opened at some point prior to total bleeddown of the vacuum signal. In conventional constructions, closing of the throttle valve usually immediately strokes the servo diaphragm to the lowest spark retard setting.

The connection does contain a second or branch vacuum line 62 connected at one end to the manifold vacuum port 30 and at its other end to the vacuum line 16 in parallel with spark port line 54. Line 62 contains a spring closed one-way check or pressure relief valve 64 that opens only during heavy vehicle accelerations to immediately drop the spark timing to a lower advance setting, for performance. That is, during heavy accelerations, the manifold vacuum drops to nearly zero. The resultant high pressure overcomes the spring force of valve 64 to open the valve to immediately bleed the vacuum in servo chamber 46 to the same level and drop the engine spark timing to the appropriate level for this acceleration.

It will be noted from the above that in the prior art construction illustrated by FIGS. 1 and 1A, the spark timing changes during light vehicle accelerations and decelerations occur at the same rate, and that there is no latitude because of the fixed area of restriction 56 providing these controls. Therefore, if after a slight deceleration in which the servo vacuum has not decayed to zero, if the vehicle is then reaccelerated, the application of vacuum to the spark port 26 will then through the orifice 56 readvance the spark timing along the curve shown at 66. This advance setting of spark timing setting, however, may not be the most appropriate setting for the acceleration desired. That is, better performance may be obtained by having a lower advance setting, for example.

The invention accomplishes the above objective by providing a bypass line around the flow restricting orifice 56 so that the operating characteristics of the quick recovery system can be varied, and the rate of change of vacuum during decelerations at times can be controlled to be different than that during accelerations.

More specifically, as shown in FIG. 2, again, the spark control vacuum line 54 contains the fixed area orifice 56; and the manifold vacuum port 30 is connected to the servo chamber 46 by the vacuum line 62

containing the one-way check or pressure relief valve 64. However, in this case, a branch line 70 is provided around the orifice 56 for bypassing the orifice during deceleration operations. More specifically, the line 70 contains a second spring closed one-way pressure relief or check valve 72 in series with a second fixed area orifice or flow restriction 74. In this case, during vehicle decelerations, when the spark port senses essentially atmospheric pressure due to the closed throttle valve, or any pressure that is high enough to overcome the force of the spring of valve 72 and the pressure on the servo side of the valve 72, valve 72 will open and provide a combined bleed of the vacuum at the distributor servo chamber 46 through both orifices 74 and 56. This is illustrated in FIG. 2A by the portion 76 of the curve having a steeper angle than that shown at 60 in FIG. 1A. That is, the concurrent bleed of vacuum from the distributor servo through both orifices provides a faster drop in the ignition timing advance setting, and one that will provide the desired operation.

During light vehicle accelerations, the invention operates in the same manner as the prior art in that slowly increasing vacuum in spark port 28 causes the valve 72 to be closed by the higher pressure at the distributor servo 46 and the valve spring so that the bleeddown of the pressure at the servo occurs now only through the orifice 56 providing a rate of change of spark advance shown by the curve 58' the same as the curve 58 in FIG. 1A. Likewise, heavy vehicle accelerations decaying the manifold vacuum to nearly zero level will quickly pop off the one-way valve 64 and provide atmospheric or nearly atmospheric pressure at the servo chamber 46 to immediately drop the timing advance setting to a low advance or fully retarded position.

From the above, therefore, it will be seen that the invention provides a spark timing control device that permits more selectivity in controlling the rate of change of ignition timing during various phases of operation of the engine and provides greater performance capabilities than previously provided by the prior art devices; also, the device of the invention provides better emission control by providing a slow advance of the ignition timing during light vehicle accelerations, with better performance and yet rapid recovery of the ignition timing if the light vehicle accelerations are interrupted by momentary decelerations.

While the invention has been illustrated and described in its preferred embodiments, it will be clear to those skilled in the arts to which it pertains that many changes and modifications may be made thereto without departing from the scope of the invention.

I claim:

1. A fluid flow control device for use in a vacuum line connected to a source or pressure at one end varying between atmospheric and subatmospheric levels and at its other end to a fluid chamber, the device including a first flow restriction delaying communication of a pressure change at one rate from one side of the restriction to the other, a bypass line bypassing the first restriction and containing additional flow restriction means and other means in series with the additional flow restriction means rendering the latter operable concurrent with the first restriction in response to a predetermined change in pressure on one side of the first restriction relative to the pressure on the other side, to provide at times a different rate of equalization of pressures, a second line connected at one end to a second source of pressure varying between atmospheric and subatmo-

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spheric levels and at its other end to the fluid chamber, and further means in the second line operable in response to a predetermined pressure level at the second source to immediately equalize the pressures at the second source and fluid chamber regardless of the operativeness of the first restriction and additional restriction means.

2. A control device as in claim 1, the further means comprising a one-way check valve.

3. A control device as in claim 2, the other means comprising a one-way check valve.

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4. A control device as in claim 1, including means providing a controlled interconnection between the first and second sources.

5. A control device as in claim 3, the further means check valve being operable at a higher predetermined pressure level than the other means check valve for providing concurrent operation of the first and additional restriction means at pressure levels between the predetermined pressure levels of the other and further means.

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