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[54] CARBURETOR FUEL PUMP PRESSURE-ACTUATED SPARK TIMING CONTROL

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[52] **U.S. Cl.** ..... **123/117 A**
[51] **Int. Cl.** **F02p 5/10**
[58] **Field of Search** 123/117

[56] **References Cited**

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[57] **ABSTRACT**

The vacuum line between the carburetor spark port and the engine distributor breaker plate servo actuator includes an air bleed valve that is normally closed to permit normal advance of the engine timing as a function of spark port vacuum changes, but opens during vehicle accelerations to bleed air to the distributor servo to condition the timing for retarded operation; the bleed valve being opened in response to fuel pressure in the carburetor accelerating pump fuel well acting on a diaphragm attached to the valve during operation of the pump, and, of which the following is a specification.

13 Claims, 2 Drawing Figures

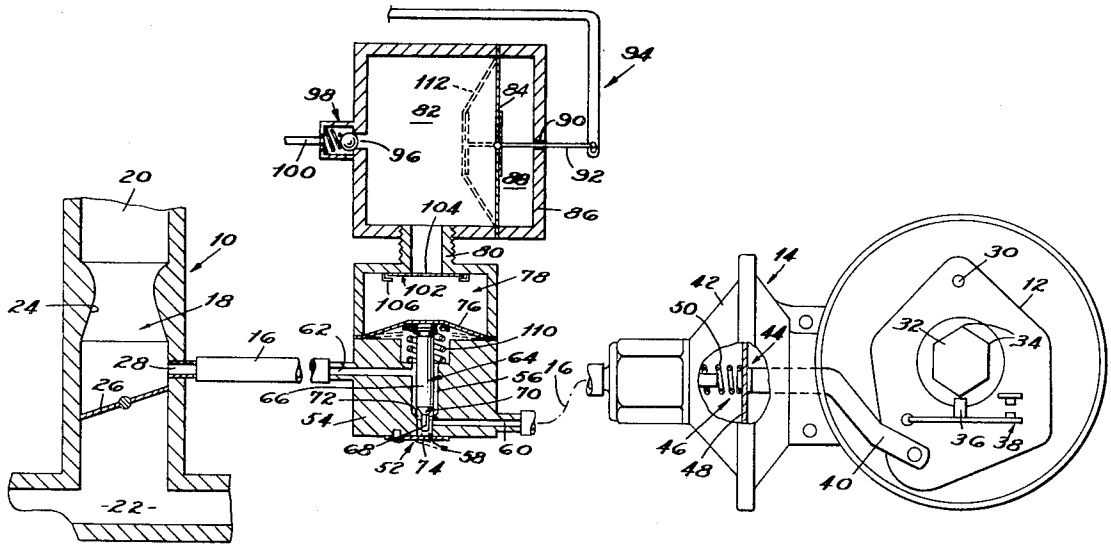


FIG. 1

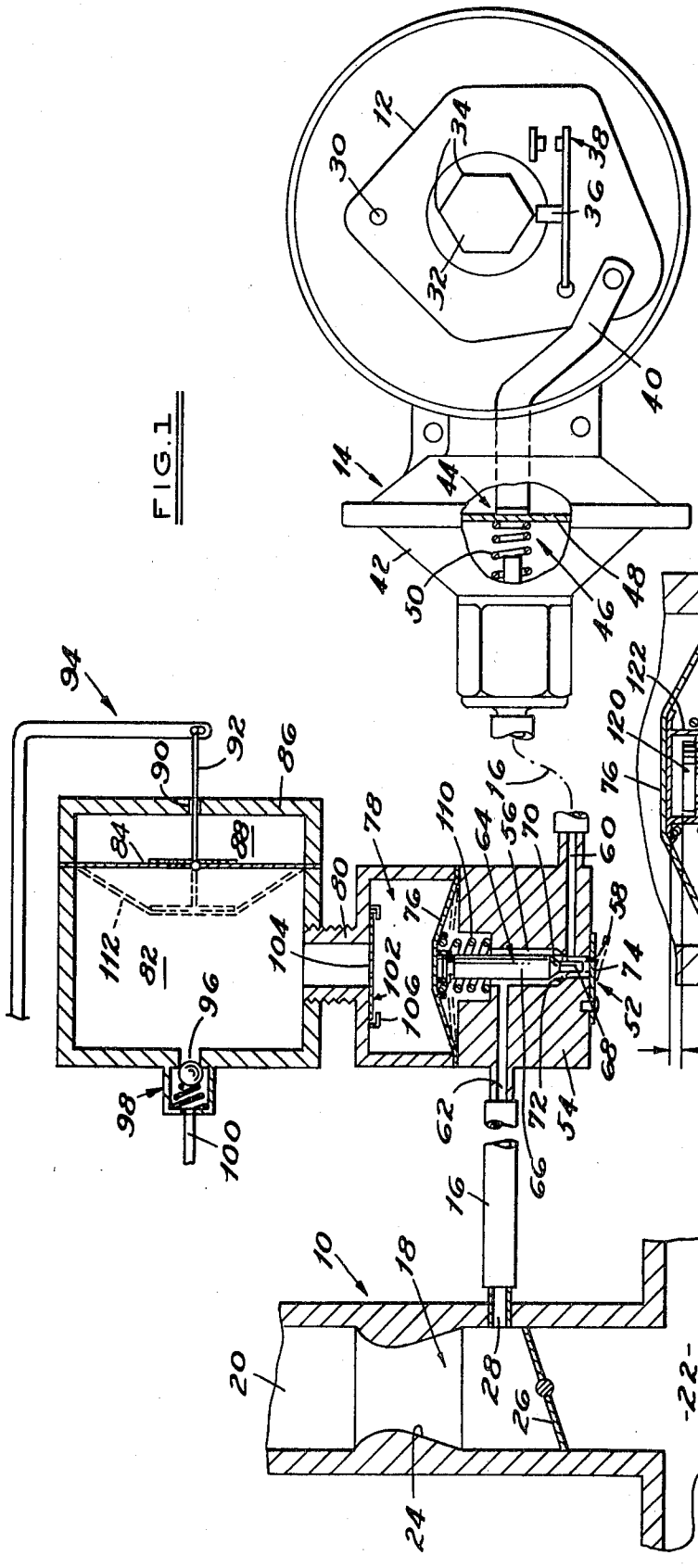
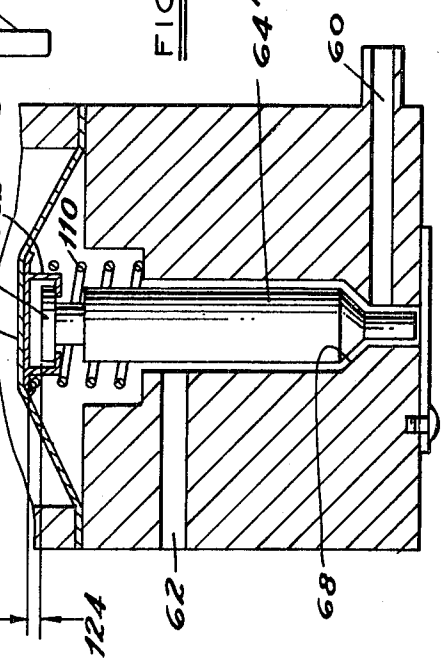


FIG. 2



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CARBURETOR FUEL PUMP PRESSURE-ACTUATED SPARK TIMING CONTROL

This invention relates, in general, to a device that aids in the reduction of exhaust emission pollutants from an internal combustion engine. More specifically, it relates to a mechanical spark timing control device that cuts off carburetor spark port vacuum to the distributor during vehicle accelerations to minimize the output of undesirable elements.

Most present day motor vehicles have some sort of a vacuum servo automatically controlling the advance or retard setting of the engine distributor breaker plate as a function of carburetor spark port vacuum to provide good engine performance as well as fuel economy during the different operating conditions of the engine. These vacuum servos, in their simplest forms, generally consist of a housing divided into atmospheric pressure and vacuum chambers by a flexible diaphragm connected to the distributor breaker plate. The diaphragm and breaker plate are normally spring biased to the lowest advance or retard spark timing setting, and carburetor spark port vacuum normally urges the diaphragm in a spark timing advance direction upon opening of the carburetor throttle valve in an engine speed increasing direction.

With the above construction, vehicle accelerations from an idle speed condition cause vacuum at the carburetor spark port to act on the one side of the servo diaphragm to immediately move the distributor breaker plate to an advanced setting. This provides a longer burning time for the fuel mixture before the optimum top or near top dead center position of the piston is attained, generally providing the most desirable operation. However, this longer time permits a buildup to higher combustion temperatures and pressures, which is undesirable insofar as the production of oxides of nitrogen and other undesirable elements are concerned.

It will be seen, therefore, that the conventional spark timing control systems may provide good performance and fuel economy, but do not necessarily minimize the output of undesirable exhaust gas elements.

Therefore, it is a primary object of the invention to provide an engine spark timing device that has the advantages of the conventional spark timing control system while minimizing the disadvantages; by providing a device that retards the spark timing during vehicle accelerations, to decrease NO_x output, while extending burning of the mixture into the exhaust system to reduce the amount of exhaust gas emission of other undesirable elements.

It is another object of the invention to provide an engine spark timing control system including a device that meets the requirements set out immediately above, by including a fuel pressure actuated, power-operated atmospheric pressure air bleed in the vacuum line to the distributor servo to cut off spark port vacuum during vehicle accelerations.

Other objects, features and advantages of the invention will become more apparent upon reference to the succeeding detailed description thereof, and to the drawing illustrating a preferred embodiment thereof; wherein the figure illustrates schematically a cross-sectional view of an engine spark timing control apparatus embodying the invention.

FIG. 1 shows, schematically, only those portions of an internal combustion engine that are normally associated with the engine distributor spark timing setting control; such as, for example, a carburetor **10**, a distributor breaker plate **12**, a vacuum servo **14** to control the movement of breaker plate **12**, and a line **16** connected between the carburetor and vacuum servo to automatically change the engine spark timing setting as a function of changes in engine vacuum spark port setting.

More specifically, carburetor **10** is shown as being of the downdraft type having the usual air-fuel induction passage **18** with an atmospheric air inlet **20** at one end and connected to the 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 passage **18**. A spark port **28** is provided at a point just above the idle position of throttle valve **26**, to be traversed by the throttle valve during its opening or part throttle 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 the essentially atmospheric pressure in the air inlet **20** upon closure of the throttle valve.

As stated previously, the distributor, not shown, includes a breaker plate **12** that is pivotally mounted at **30** on a stationary portion of the distributor, and movable with respect to cam **32**. The latter has six peaks **34** corresponding to the number of engine cylinders. Each peak cooperates with the follower **36** of a breaker point set **38** to make and 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 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.

Turning now to the invention, an air bleed device **52** is located in line **16** between servo **14** and spark port **28**. The device **52** includes a valve body **54** defining a three-passage fluid chamber **56**. Passage **58** is a vent and connects to atmospheric pressure. Passage **60** is connected to servo line **16**, and passage **62** is connected to spark port **28**.

A valve member **64** is sealingly mounted to slide through chamber **56**, as shown. It includes a main cylindrical body portion **66**, a reduced diameter end actuator portion **68**, and a conical intermediate portion **70**. The conical portion **70** is adapted to seat at times against a matingly formed portion **72** of body **54** to cut off vacuum flow from spark port **28** to servo chamber **46**. Simultaneously, the downward movement of valve **64** engages the end **68** with a flexible reedlike valve **74** to bend open the same and connect line **60** to atmospheric pressure. The valve **74** is fixedly riveted or otherwise mounted at one end to body **54**, as shown.

The upper end of valve **64** is fixed to an annular flexible diaphragm **76** that forms one wall of a fuel chamber **78**. Chamber **78** is connected by a hollow tube **80** to a second larger fuel chamber **82**. The latter in this case comprises the conventional fuel well for the accelerator pump of the carburetor **10**. Chamber **82** includes a second annular flexible diaphragm **84** sealingly secured across the walls of the hollow pump housing **86** to define chamber **82** and an air chamber **88**. The latter communicates with atmospheric air through a hole **90**.

Diaphragm **84** is secured to a link **92** that extends slidingly through hole **90** and is a portion of the conventional accelerator pump linkage **94**. The latter is operatively connected in a known manner to the carburetor throttle linkage to be actuated concurrently with the throttle upon movement of the conventional vehicle accelerator pedal by the operator.

Chamber **82** has a fuel outlet port **96** closed by a ball check valve assembly **98**. Upon increase in the fuel pressure in chamber **82**, fuel is forced past assembly **98** into a line **100** leading to the carburetor passage **18** through known means not shown.

Chamber 82 would be kept supplied in a known manner with fuel at all times from the carburetor main fuel bowl through an inlet check valve assembly similar to assembly 98 but operable in the opposite direction.

Completing the construction, flow between chambers 78 and 82 through tube 80 is controlled by a flat plate type valve 102. The valve contains an orifice or flow restriction 104, and has a floating movement within a lipped annular retainer 106. When seated against tube 80 as shown, communication between chambers 78 and 82 is by way of orifice 104 only. Unseating of the valve 102 allows a free flow of fuel between chambers.

In operation, at engine startup, both fuel chambers 78 and 82 are at ambient fuel pressure and both sides of the servo 14 are at atmospheric pressure. Accordingly, a spring 110, seated between housing 54 and diaphragm 76, has biased valve 64 upwardly to permit bleed valve 74 to close and the distributor breaker plate 12 has been rotated by spring 50 to its maximum retard spark timing position.

The condition described above also is applicable during engine idle speed operation, in that the pressure in spark port 28 then is essentially atmospheric, or that in the air inlet portion 20.

Assume now that the vehicle accelerates, throttle valve 26 rotating counterclockwise. Immediately, spark port 28 is subject to vacuum in the intake manifold 22. Though low, vacuum acting through chamber 56 would normally permit the atmospheric pressure in chamber 44 to compress spring 50 and move the breaker plate 12 towards a spark timing advance position. However, movement of the throttle valve linkage simultaneously moves the accelerator pump linkage 94. This does two things. First, movement of diaphragm 84 to the dotted line position 112 pressurizes chamber 82. Valve assembly 98 then unseats to squirt a controlled amount of fuel to the carburetor induction passage. Secondly, valve 104 unseats to quickly communicate the fuel pressure in chamber 82 to chamber 78. This moves diaphragm 76 downwardly against spring 110 to seat valve 64 to block line 62 while simultaneously opening bleed valve 74. This maintains passage 60 at atmospheric pressure and, therefore, servo chamber 46. Accordingly, breaker plate 12 is maintained in the maximum engine spark retard position.

As the acceleration of the vehicle proceeds, the decay in fuel pressure in chamber 82 reaches the point where the spring 110 starts moving diaphragm 76 upwardly. This will cause plate valve 102 to seat against tube 80 and cause a slow bleed of fuel into chamber 82. This causes a slow closing of air bleed valve 74 with a consequential slow buildup of vacuum in line 60 from the spark port 28. When the fuel pressures in chambers 78 and 82 are equal, the spark timing plate 12 will assume the advance position dictated by the vacuum in line 62. Makeup of fuel in chamber 82 is of course provided by the fuel inlet check valve assembly previously described but not shown.

If, during the accelerating operation, the throttle valve is suddenly moved to a closed position, indicating a decelerating operation, the accelerating pump linkage 94 is returned to the full line position by spring means not shown. This decays the pressure in chamber 82, shuts check valve assembly 98, opens the fuel inlet check valve, not shown, and permits spring 110 to move diaphragm 76 upwardly, seating valve 102. This upward movement unseats valve 64 and closes bleed valve 74. However, since essentially atmospheric pressure is prevalent at spark port 28, the breaker plate 12 will be maintained at a maximum retard setting.

FIG. 2 shows a modification to the construction of valve 64 in FIG. 1 to provide a delay in the movement of valve 64 onto or off the seat 72, if desired. In this case, the upper end of valve 64' has a T-shaped extension 120, the base of which is confined for movement in a channel member 122 fixed to diaphragm 76. When chamber 78 is pressurized, diaphragm 76 will move downwardly the distance 124 before valve 64' will be moved. Conversely, upward movement of valve 64' will be delayed until diaphragm 76 has been moved by spring 110 the distance 124.

From the above, it will be seen that the invention conditions the engine spark timing for a maximum retard setting during vehicle accelerations. It will also be seen that the device permits normal advance of the spark timing.

I claim:

1. A motor vehicle spark timing control system comprising, an engine carburetor having an accelerator pump containing fuel, an induction passage containing a spark port located above the idle speed position of a throttle valve controlling flow through the passage and subject to the depression in the carburetor as a function of the movement of the throttle valve from its idle speed position, an engine distributor having a breaker plate pivotally movable in opposite directions to advance and retard the spark timing, vacuum-controlled servo means connected to said breaker plate for moving the same, and control means between said spark port and servo means to control the application of vacuum from said spark port to said servo means, said control means including conduit means connecting the vacuum at said spark port to said servo means for effecting variable movement of said breaker plate from a maximum retard setting at closed throttle valve idle speed position to a maximum advance setting at high spark port off-idle vacuum levels, and an air bleed means openable by and in response to an increase in fuel pressure in said accelerator pump upon operation thereof to bleed air to said servo means to position said breaker plate at a maximum retard setting.

2. A control system as in claim 1, said accelerator pump including a manually operable linkage connected to a piston means movable in a first chamber containing fuel, said chamber having a first restricted outlet and a second outlet connected to a second chamber containing fuel, said second chamber being defined in part by a wall connected to said air bleed means and movable in one direction upon an increase in the pressure of said fuel in said chambers, said air bleed means including a normally closed vent openable by said wall upon movement thereof in said one direction.

3. A control system as in claim 1, said accelerator pump and air bleed means including first and second interconnected chambers containing fuel, accelerator pump linkage actuated means in said first chamber movable to pressurize the fuel in said chambers, means in one of said chambers to bleed fuel therefrom, and movable spring-biased means in said second chamber defining a wall thereof connected to said air bleed means for an opening movement of said air bleed means upon pressurization of said chambers, said fuel bleed means providing a slow return movement of said wall to a non-air-bleeding position.

4. A control system as in claim 3, including means interconnecting said chambers comprising slow-fast rate flow means permitting unrestricted flow in one direction and a restricted delayed flow in the opposite direction.

5. A control system as in claim 4, said flow means comprising a valve in the interconnection between chambers unseatable by fuel pressure in one direction thereagainst to a position for free fuel flow between said chambers, said valve containing an orifice for limited communication at all times between said chambers and upon seating of said valve by fuel pressure thereagainst in the opposite direction.

6. A control system as in claim 5, said valve comprising a floatable flat plate.

7. A control system as in claim 1, said air bleed means including a reciprocable spring-biased valve movable into and operably out of said conduit means and operably connected to the fuel in said accelerator pump so as to be movable thereby in one direction in response to changes in pressure thereof, an atmospheric airport connected to said conduit means, said valve in one position opening said airport to connect atmospheric pressure to said servo means while blocking flow from said spark port to retard said timing, and in a second position blocking said airport while connecting said spark port and servo means to advance said timing as a function of spark port vacuum changes.

8. A control system as in claim 7, said airport including a valve normally closing said airport and engageable and movable by said valve to open said port upon movement of said valve to said one position.

9. A control system as in claim 7, including a lost motion connection between said valve and the fuel in said accelerator pump effecting a delay in the movement of said valve.

10. A control system as in claim 7, said accelerator pump including first and second interconnected chambers containing fuel, accelerator pump linkage actuated means in said first chamber movable to pressurize the fuel in said chambers, means in one of said chambers to bleed fuel therefrom, and movable spring-biased means in said second chamber defining a wall thereof connected to said air bleed means for an opening movement of said air bleed means upon pressurization of said chambers, said fuel bleed means providing a slow return movement of said wall to a non-air-bleeding position.

11. A control system as in claim 10, including means interconnecting said chambers comprising slow-fast rate flow means permitting unrestricted flow in one direction and a restricted delayed flow in the opposite direction.

12. A control system as in claim 11, said flow means comprising a valve in the interconnection between chambers unseatable by fuel pressure in one direction thereagainst to a position for free fuel flow between said chambers, said valve containing an orifice for limited communication at all times between said chambers and upon seating of said valve by fuel pressure thereagainst in the opposite direction.

13. A control system as in claim 12, said valve comprising a floatable flat plate.

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