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[54] **ENGINE DISTRIBUTOR SPARK ADVANCE SYSTEM**
2 Claims, 1 Drawing Fig.

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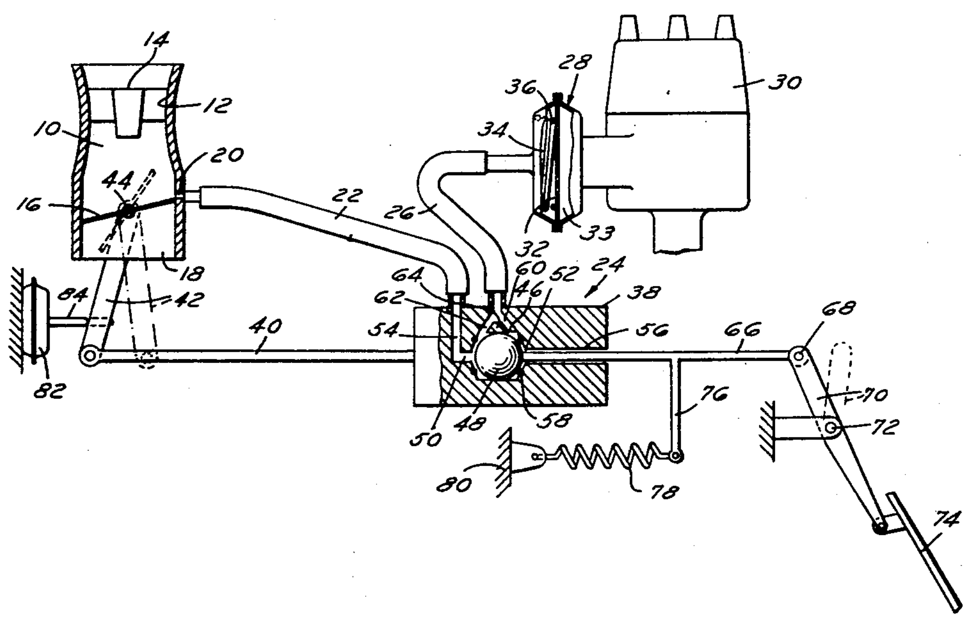
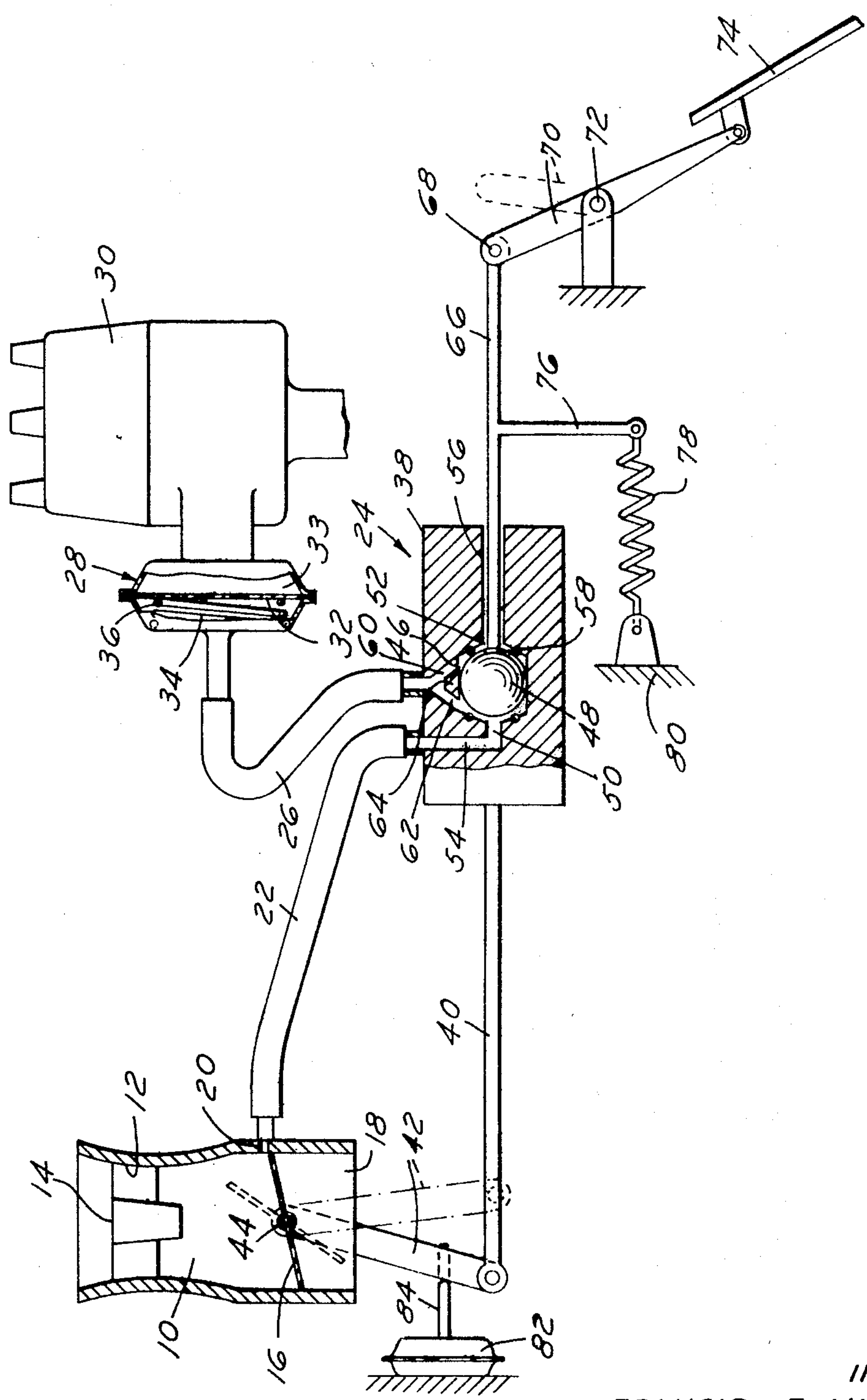
ABSTRACT: An internal-combustion engine has an ignition spark advance system that includes a valve controlling either a supply of air at atmospheric pressure to the vacuum servo moving the spark advance lever, or subjecting the servo to changing intake manifold vacuum; the valve being connected to and movable with the vehicle accelerator pedal; the valve body in which the valve slides being connected to the carburetor throttle valve; the system including a dashpot permitting slow closing of the throttle valve upon deceleration while simultaneously retarding the spark.





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ENGINE DISTRIBUTOR SPARK ADVANCE SYSTEM

This invention relates, in general, to a motor vehicle engine ignition system. More particularly, it relates to an engine spark advance and retard system that automatically controls the distributor spark advance or retard as a function of the changing conditions of operation of the engine.

Most automotive internal-combustion engines have some sort of an ignition spark advance or retard mechanism to automatically advance the spark as the speed of the engine increases to compensate for the constant burning rate of the fuel-air mixture. That is, some device must be provided that automatically ignites the air-fuel mixture sooner with a higher engine speed than before so that the fuel-air mixture, which has an essentially constant burn rate, will burn properly. This device has taken the form of a vacuum servo or motor that has a connection to the carburetor induction passage just above the idle speed position of the throttle valve. As engine speed increases, as indicated by opening movement of the throttle valve, the spark port is exposed to increasing vacuum, which advances the spark proportionally. During idle, the vacuum signal generally is cut off, and the return spring in the servo moves the distributor spark advance lever to a retard position.

A dashpot is often associated with a system of this type so as to retard the closing movement of the throttle valve during decelerations to prevent stalling of the engine. Upon decelerations of the vehicle from high speeds, however, the slowly closing throttle valve maintains vacuum on the advance diaphragm and thereby maintains the distributor spark advanced. This furnished more power to the vehicle than is desired or necessary, and reduces engine-braking effort.

An advantage does, however, exist with the use of a dashpot. During normal operation of the engine, with the throttle opened, the flow of fuel and air through the induction passage wets the passage completely with fuel. When the throttle valve is quickly closed to its idle speed position, therefore, rich mixture is present in the intake manifold. This may become a source of unburned hydrocarbons. At this time, the only air being brought into the induction passage is through the idle system, and since this supply is low, not enough air generally, therefore, will be added to the system to dilute the rich mixture sufficiently to prevent unburned hydrocarbons from being emitted into the air through the exhaust system.

The use of a dashpot maintains the throttle valve in an off idle position for a longer period of time during deceleration. When the throttle valve is operating at off idle position, the carburetor is normally calibrated for a leaner mixture; accordingly, air added at this time generally will be sufficient to dry out the intake manifold passage and, therefore, significantly reduce the possibility of unburned hydrocarbons being passed into the atmosphere.

The invention utilizes the advantageous features while eliminating the above disadvantages by providing a spark advance and retard system that maintains the spark retarded to its desired maximum amount during idle speed and deceleration conditions of the engine, while only slowly closing the throttle during decelerations, and yet automatically advances the spark as a function of the increase in vacuum occasioned by rotation of the throttle valve from its idle speed position.

More specifically, the invention includes a vacuum signal switch between the carburetor spark port and the distributor spark advance vacuum servo that is operatively moved upon release of the vehicle accelerator pedal to block the vacuum signal to the servo diaphragm during decelerations; while, however, permitting the action of a dashpot to slowly close the throttle valve and thereby lean out what would normally be a rich mixture in the carburetor passage. Depression of the throttle pedal automatically moves the vacuum signal switch to again connect the vacuum spark port and the advance diaphragm to automatically advance the spark in accordance with increases in engine speed and manifold vacuum.

It is an object of the invention, therefore, to provide a distributor vacuum spark advance and retard system that includes a switch means having relative movable parts connected both to the carburetor throttle valve and the vehicle accelerator pedal for controlling the flow of vacuum to the advance diaphragm as a function of engine-operating conditions.

Other objects, features, and advantages of the invention will become more apparent upon reference to the succeeding detailed description thereof, and to the drawings illustrating schematically a cross-sectional view of a distributor spark advance and retard system embodying the invention.

The FIGURE shows a portion **10** of the induction passage in a known type of downdraft carburetor. It contains the usual main or primary venturi section **12** and a booster venturi **14** discharging (by means not shown) a fuel-air mixture into passage **10**. Flow of the air-fuel mixture through passage **10** is controlled by a rotatably mounted throttle valve **16**. The lower passage portion **18** is adapted to be connected to the intake manifold (not shown) of the engine.

Valve **16** is shown in its engine idle speed position essentially closing passage **10**, and cutting off the intake manifold vacuum signal to a spark port **20** located just above the idle speed position of throttle valve **16**. Port **20** is connected by a line **22** through a control valve **24** and a line **26** to a vacuum servo **28**. Servo **28** controls the spark advance or retard setting of a distributor **30**. Control valve **24** will be described in more detail later. Suffice it to say at this point that it alternately applies vacuum from spark port **20** or air at atmospheric pressure to line **26** to automatically control the spark advance mechanism of distributor **30**.

The details of construction and operation of distributor **30** are known and believed to be unnecessary for an understanding of the invention. Suffice it to say that the distributor has the usual spark advance lever, not shown, secured to the diaphragm illustrated schematically at **32** in servo **28**. The diaphragm divides the servo into an air chamber **33** on the right-hand side, and a second chamber **34**. It is biased by a spring **36** towards the distributor to an initial maximum desired spark retard position. Leftward movement of the diaphragm **32** by a vacuum in chamber **34** moves the spark advance lever to automatically advance the spark in proportion to the change in vacuum.

The valve control **24** has a cylindrical or similarly shaped valve body **38** fixedly secured to a rod **40**. Rod **40** is pivotally connected to one end of a link **42** that, at its opposite end, is fixedly secured to the throttle shaft **44** so the two have a unitary rotation. Valve body **38** contains an essentially cylindrical bore **46** that slidably receives therein a ball valve member **48**. The ball valve cooperates by alternately seating against a pair of spherically shaped valve ports **50** and **52** connected respectively to a pair of fluid passages **54** and **56**. Each of the valve ports or seats contains a resilient o-ring-type sealing member **58** that compresses upon engagement of the ball valve therewith to seal the adjacent passage. Passage **54** is connected to vacuum tube **22**, while passage **56** is open, as indicated, to air at ambient pressure or atmospheric, as the case may be.

Valve body **38** has a pair of angled passages **60** that are joined at their outer ends to the tube **26**, and at their inner ends are each directed at one of the valve seats **50** and **52**. The annular valve body portion **64** defined between passages **60** and **62** serves as a guide for the movement of ball valve **48** in an axial direction, and minimizes misalignments at the O-ring seats. It also provides fluid interconnection between seats **50** and **52** and the tube **26** through the passages **60** and **62** rather than around the ball valve **48**.

Ball valve **48** is fixed to a rod or shaft **66** that is pivotally connected at **68** to one end of a conventional accelerator pedal mounted lever **70**. The latter is pivotally mounted near its midpoint at **72**, and contains a pivotally mounted pad **74** at its lower extremity. The ball valve rod **66** has an extension **76** secured by a throttle valve or accelerator return spring **78** to a stationary portion **80** of the engine.

Finally, a conventional slow return dashpot **82** having a rod **84** projects into the path of movement of throttle lever link **42** so as to be contracted thereby upon movement of the link **42** in a leftward or throttle valve closing direction. The details of construction and operation of the dashpot are not given since they are known and believed to be unnecessary for an understanding of the invention. Suffice it to say that the dashpot operates in a conventional manner providing a slow movement of rod **84** in a leftward direction, but a fast movement in the opposite direction.

In operation, with the engine idling, the parts will be in the positions shown. Throttle valve **16** will be in a closed position essentially cutting off the vacuum in the intake manifold passage portion **18** to spark port **20** and tube **22**. Also, the accelerator pedal return spring **78** will have moved ball valve **48** to seat against O-ring seal seat **50** blocking tube **22**. Simultaneously, this moves the valve body **38** and rod **40** to the left to position the throttle valve **16** as shown.

Air at atmospheric or ambient pressure enters through passage or port **56**, passes through port **52** and passage **60** into tube **26**. It then balances the air pressure in servo chamber **33** and permits the force of spring **36** to move the distributor advance lever to its maximum retard position. Therefore, during engine idle speed operation, the distributor will be in the desired maximum spark retard position.

When the accelerator pedal **74** is depressed leftwardly, rod **66** and ball valve **48** are moved to the right to seat the ball valve against O-ring **58** and close the atmospheric air line **56**. Simultaneously vacuum line **54** is opened to tube **26**. At the same time, continued rightward movement of ball valve **48** moves valve body **38** to crack open throttle valve **16** and admit vacuum in passage portion **18** to tube **22**. This, of course, immediately acts on the advance diaphragm **32** to begin advancing the distributor spark. Accordingly, the spark will be advanced in proportion to the opening of the throttle valve **16** to a maximum value desired.

During deceleration, accelerator pedal **74** is released, permitting return spring **78** to immediately move ball valve **48** to engage seat **50**, closing vacuum line **22** and opening atmospheric line **56**, to permit servo spring **36** to immediately move the distributor spark advance lever to the maximum retard position. At the same time, the leftward movement of ball valve **48** moves valve body **38** leftwardly in an attempt to close throttle valve **16** quickly. However, the dashpot rod **84** is engaged by link **42** when moving from the dotted line position indicated so that the throttle valve only closes slowly during this period. Therefore, while vacuum is still being admitted from the intake manifold to tube **22**, it is of no effect on the advance diaphragm since it is cut off from the tube **26** by seating of ball valve **48** against seat **50**. Accordingly, the slowly closing throttle valve will permit a drying out of the carburetor induction passage so that a much leaner mixture exists therein and one that can be efficiently burned in the combustion chamber so as to minimize the passage of unburned hydrocarbons into the exhaust system.

From the foregoing, therefore, it will be seen that the invention provides a distributor spark advance and retard mechanism that automatically provides a correct ignition advance or retard as a function of engine-operating conditions, while at the same time controlling the carburetor throttle valve during deceleration so as to minimize the formation of unburned hydrocarbons in the exhaust system of the engine.

While the invention has been illustrated in its preferred embodiment, 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. Distributor spark advance and retard control means for an internal-combustion engine comprising, in combination, a carburetor induction passage connected at one end to the intake manifold of said engine and to a source of fuel and air at the opposite end and having a venturi and a throttle valve rotatably mounted in said passage posterior of said venturi and movable from an idle speed position to variably control the flow of an air-fuel mixture through said passage, a spark control port connected to said passage on the air inlet side of said valve when in an idle speed position, said port being subjected at all times to vacuum from said manifold upon movement of said valve from said idle position, an operator movable accelerator means movable from a closed at rest position towards a wide-open throttle position, a distributor spark advance and retard vacuum servo actuator, first conduit means connected to said servo actuator, second conduit means connected to said spark port, and valve means interconnecting said conduit means and controlling flow of fluid therethrough, said valve means including a valve body secured to said throttle valve for movement thereof, a control valve variably movable within said valve body between one position connecting the vacuum at said spark port to said servo actuator to advance the spark timing as a function of changes in vacuum level and a second position connecting said servo actuator to air at essentially atmospheric pressure to retard said spark timing by blocking the vacuum to said second conduit means, linkage means connecting said control valve to said operator movable accelerator means, spring means operatively connected to and biasing said control valve to said second position and operatively biasing said throttle valve to said idle speed position, movement of said accelerator means in a throttle valve opening direction moving said control valve to said one position to advance said spark and also operatively moving said valve body to move said throttle valve away from said idle position to increase the vacuum level to said servo, second linkage means securing said valve body to said throttle valve, and time delay means in the path of movement in a throttle valve closing direction of said second linkage means engageable by said second linkage means upon movement of said accelerator pedal and first linkage means towards a closed position, the movement of said accelerator pedal to its closed position from an open position immediately moving said control valve to block the vacuum in said spark port from said servo and connect air to said servo while said time delay means is simultaneously slowly retarding the closing of said throttle valve to permit continued air flow through the carburetor induction passage to dry said passage.

2. A control as in claim **1**, said time delay means comprising a dashpot having a stem engageable by said linkage means.