United States Patent [19]

Julian

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[54] **VACUUM-OPERATED SPARK ADVANCE DEVICE**

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[73] Assignee: **General Motors Corporation,** Detroit, Mich.

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

[56] **References Cited**

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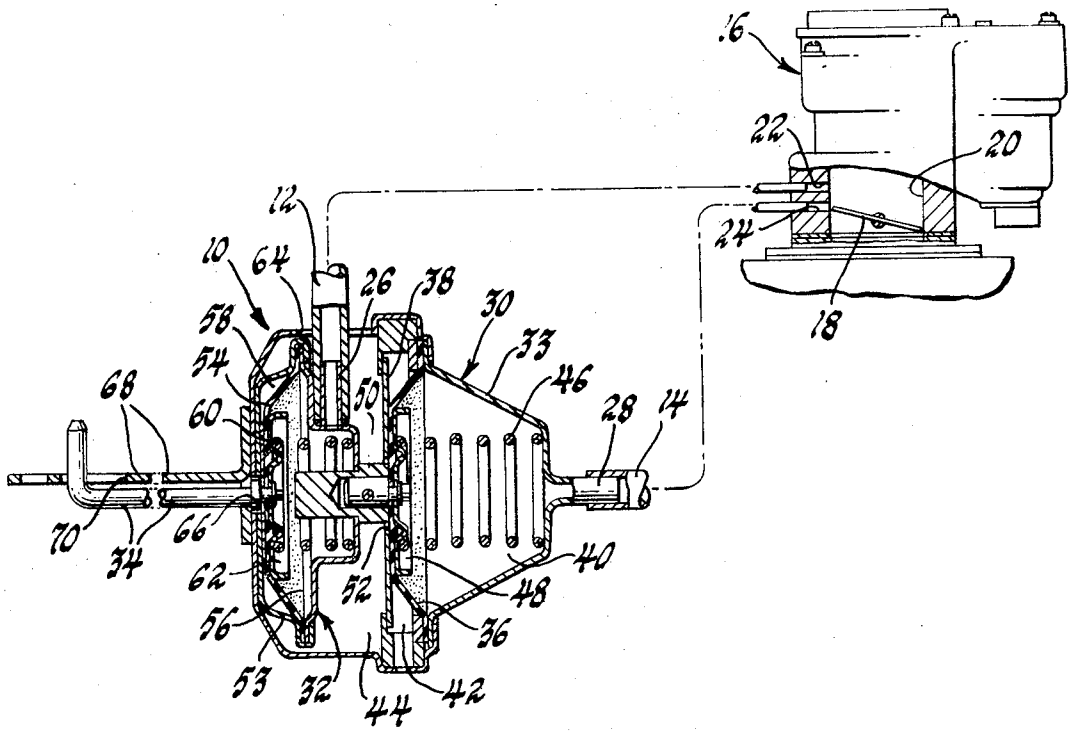
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[57] **ABSTRACT**

A spark advance device for an automobile ignition system having a pair of axially spaced vacuum operated actuators each of which houses a spring-biased diaphragm dividing the housing into a vacuum chamber and an atmospheric pressure chamber. The diaphragms of both actuators are adapted to move in the same direction when vacuum is applied to either actuator and the diaphragm of one actuator is connected to the housing of the other actuator while the diaphragm of the latter mentioned actuator has a control rod connected to the distributor of the ignition system. The arrangement is such that when vacuum is sequentially applied to the actuators, the control rod initially moves a predetermined distance to advance the spark and subsequently moves a further distance in the same direction to further advance the spark.

2 Claims, 2 Drawing Figures



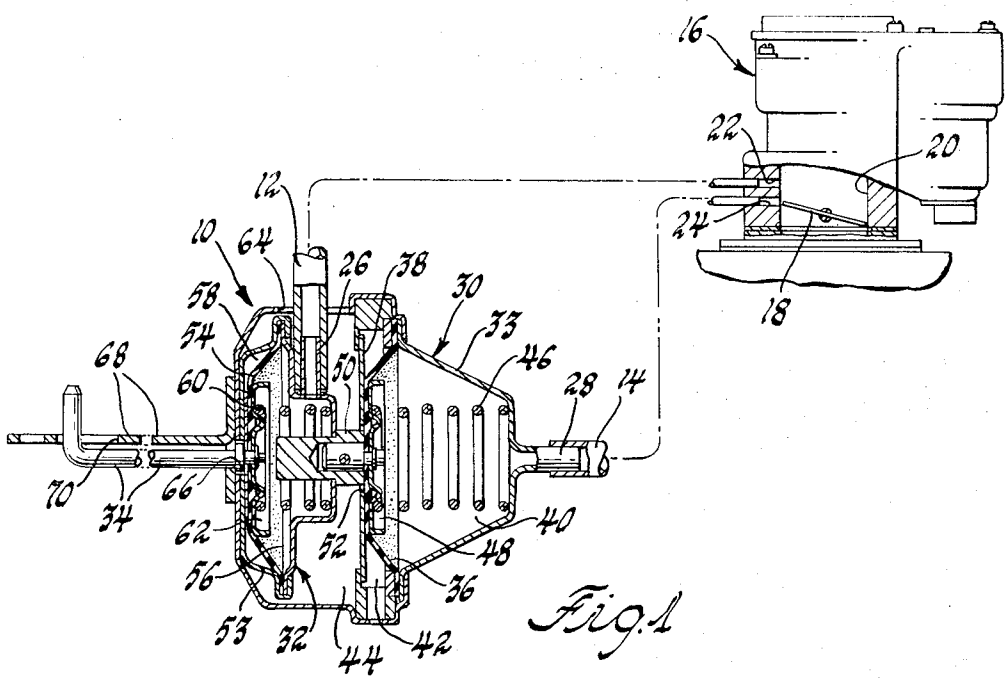

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Fig. 1

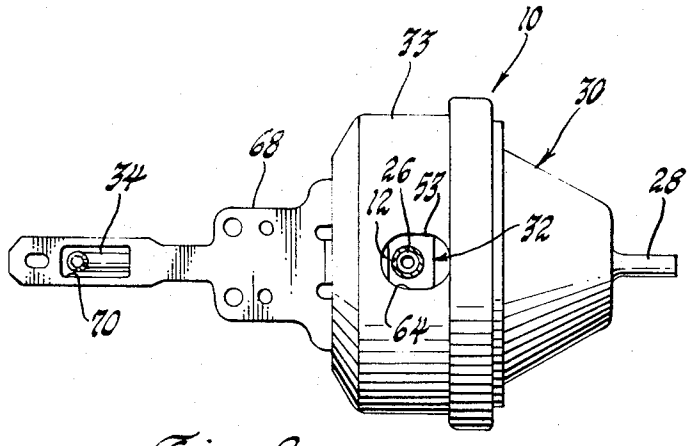

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Fig. 2

VACUUM-OPERATED SPARK ADVANCE DEVICE

This invention in general concerns a vacuum-operated spark advance device for varying the timing of an internal combustion engine in accordance with signals received from the carburetor. More specifically, the device made according to the invention serves to advance the spark of the ignition distributor in response to the movement of the throttle valve as the latter sequentially connects a pair of ports with the vacuum in the intake manifold.

Exhaust gas recirculation (EGR) systems are presently used with automobile engines to assure that exhaust emission levels are within the standards set by Federal Regulations. In the conventional EGR system, the EGR valve is closed so that no recirculation occurs when the engine is under closed-throttle and curb-idle conditions. When the throttle valve is rotated about **15** degrees from its closed position, however, vacuum is applied to the EGR valve, allowing the latter to open and provide recirculation.

In the case of some engines using the above described system, it has been found that some spark advance is required under curb-idle conditions for smooth engine operation and that an additional spark advance is needed when the EGR valve is opened in order to realize combustion of the recirculating air/fuel mixture.

Accordingly, the objects of the present invention are to provide a vacuum-operated device which is adapted to be connected to an ignition distributor and serves to advance the spark in two stages in response to movement of the throttle valve; to provide an ignition distributor control device having a pair of actuators which are vacuum operated and cooperate to provide two movements of a control rod in the same direction so as to successively advance the spark; to provide a device for varying the timing of the spark of an internal combustion engine that includes a pair of vacuum-operated motors which are axially spaced and interconnected in a manner whereby energization of one motor causes bodily movement of the other motor while energization of the other motor has no affect on the first motor; to provide a vacuum-operated motor having a pair of actuators located in tandem and in which the actuators are axially spaced from each other and in which a connecting rod joins the diaphragm of one motor to the housing of the other motor.

The above objects and others are realized by a device which in the preferred form comprises first and second vacuum-operated actuators located in tandem along a longitudinal axis adjacent the ignition distributor. The first actuator includes a housing which is divided by a spring-biased diaphragm and an apertured plate into a vacuum chamber and a pair of atmospheric chambers all of which are axially spaced along the aforementioned longitudinal axis. The second actuator also has a housing provided with a spring-biased diaphragm which divides the housing into a vacuum chamber and an atmospheric chamber, and is positioned as a unit within an atmospheric chamber of the first actuator. A support rod connects the diaphragm of the first actuator with the housing of the second actuator and a control rod is provided for connecting the diaphragm of the latter-mentioned actuator with the ignition distributor. Thus, when vacuum is sequentially applied to the vacuum chambers of the first and second actuators, the control rod is moved a predetermined distance to advance the spark followed by a further movement of the control rod to further advance the spark. This occurs as the throttle valve in the carburetor rotates and sequentially connects a pair of ports with the vacuum in the intake manifold.

A more complete understanding of this invention will be obtained from the following detail description when taken with the drawings in which:

FIG. **1** is a sectional view of a vacuum-operated spark advance device made according to the invention;

FIG. **2** is a plan view of the outer housing of the device shown in FIG. **1.**

Referring to the drawings and more particularly FIGS. **1** and **2** thereof a vacuum-operated spark advance device **10** made according to the invention is shown connected by a pair of vacuum hoses or conduits **12** and **14** to a carburetor **16** of an internal combustion engine. As is conventional, the carburetor **16** includes a throttle valve **18** located within an air intake passage **20.** The carburetor **16** serves to vaporize fuel supplied to the engine, and although not shown, the throttle valve **18** is controlled by suitable linkage connected to an accelerator pedal located within the vehicle. A pair of vertically spaced vacuum sensing ports **22** and **24** are formed in the carburetor **16** upstream of the throttle valve **18** and are respectively connected through the conduits **12** and **14** to outwardly projecting fittings **26** and **28** projecting from the device **10.**

At this juncture, it will be noted that the device **10** is intended to be mounted on the distributor housing and serves to control spark advance in accordance with the movement of the throttle valve **18.** Thus, when the throttle valve **18** is rotated clockwise approximately **5** degrees from the position shown to a curb-idle position, port **24** is connected with the intake manifold vacuum and the device **10** is energized, as will hereafter be described, causing the spark to be advanced a predetermined amount. Similarly, when the throttle is rotated further from the curb-idle position to a second position, port **22** is connected with the intake manifold vacuum and the device **10** causes the spark to be advanced further. It will also be noted that the ports **22** and **24** are shown in an exaggerated form in FIG. **1** and in reality would be of much smaller size relative to the throttle valve **18** and so located that the above-described movement of the throttle valve **18** would result in the ports **22** and **24,** and accordingly the device **10,** being sequentially connected with the intake manifold vacuum.

The device **10** includes a pair of vacuum-operated actuators **30** and **32** which are axially spaced along the longitudinal axis of the device and serve to position a control rod **34** which is adapted to be connected to the ignition distributor that advances the spark in accordance with signals provided by movement of the throttle valve as explained above. The actuator **30** comprises a sheet metal housing **33** the interior of which is divided by a diaphragm **36** and a perforated plate **38** into a vacuum chamber **40** and a pair of atmospheric chambers **42** and **44.** A coil spring **46** is located in the vacuum chamber **40** and normally biases the diaphragm **36** toward the plate **38** as shown. One end of the coil spring **46** is seated on the housing **33** adjacent fitting **28** while the other end is received within a support cup **48** which is secured to the diaphragm **36** by a rod **50** which extends through an opening **52** provided in the plate **38.** The rod **50** is axially aligned with the control rod **34** and is rigidly connected to and

serves as a support for the actuator **32** which is bodily located within the chamber **44.**

As in the case with the actuator **30,** the actuator **32** also includes a sheet metal housing **53** having a diaphragm **54** which divides the interior of the housing into a vacuum chamber **56** and an atmospheric chamber **58.** A coil spring **60** is located within the vacuum chamber **56** and has one end encircling the rod **50** and resting on the housing **53** while the other end is received by a support cup **62** secured to the diaphragm **54** by the inner end of the rod **34.**

It will be noted that chambers **40** and **56** of the actuators **30** and **32** are sealed by the diaphragms therein while chambers **42, 44** and **58** are connected with air at atmospheric pressure through opening such as those in the housings **33, 53** and plate **38** and indicated by reference numerals **52, 64,** and **66.** It will also be noted that the oblong opening **64** in the housing **33** serves to allow the conduit **12** to make its connection with the fitting **26** and also that the housing **33** is rigidly secured to an L-shaped bracket **68** which is intended to mount the device in a fixed position on the distributor. In addition, the bracket **68** has a slot **70** formed therein which receives the outer end of the rod **34** which is intended to control spark advance.

The operation of the device **10** is as follows:

When the throttle valve **18** rotates clockwise approximately **5** degrees to the curb-idle position shown in FIG. **1,** port **24** will sense the intake manifold vacuum which is transmitted via conduit **14** to the actuator **30** causing the diaphragm **36** is move to the right against the bias of the coil spring **46.** This results in rightward movement of the rod **50** and the attached actuator **32** a predetermined distance until the housing **53** contacts the plate **38.** As should be apparent, movement of the diaphragm **36** results in movement of the control rod **34** a similar distance and accordingly the spark is advanced. As the throttle valve **18** continues to rotate in a clockwise direction to the **15** degrees position the port **22** will then sense the intake manifold vacuum and cause vacuum to be applied to the chamber **58** of the actuator **32.** This causes the diaphragm **54** to be shifted to the right with further movement of the control rod **34** to further advance the spark. Thus as explained above, the device **10** provides for multi-position movement of the control rod **34** in the same direction so as to sequentially advance the spark in accordance with the two signals received from the carburetor.

Various changes and modifications can be made in this construction without departing from the spirit of the invention. Such changes and modifications are contemplated by the inventor and he does not wish to be limited except by the scope of the appended claims.

I claim:

1. A device adapted to be connected to an ignition distributor for varying the timing of the spark of an internal combustion engine, said device comprising a pair of vacuum-operated actuators located in tandem and axially spaced along a longitudinal axis, each of said actuators including a housing having a spring biased diaphragm dividing the housing into a first chamber adapted to be connected with a source of vacuum and a second chamber at atmospheric pressure, the first chambers of said actuators being so positioned relative to each other that the diaphragm of each actuator moves in the same direction when vacuum is applied to either of said first chambers, a first rod located along said longitudinal axis and having one end thereof adapted to be connected to the ignition distributor and the other end connected to the diaphragm of one of the actuators, a second rod axially aligned with the first rod and connecting the diaphragm of the other of the actuators to the housing of said one of the actuators so the latter actuator is moved as a unit together with the rod when the first chamber of the other of the actuators is connected to the source of vacuum, the first chambers of said actuators adapted to be successively connected with said source of vacuum so as to cause the rod to initially move in one direction to a first point to vary the timing of the spark and subsequently move in the same direction from said first point to a second point to further vary the timing of the spark.

2. A vacuum-operated spark advance device adapted to be connected to an ignition distributor of an internal combustion engine, said device comprising first and second actuators located in tandem along a longitudinal axis, said first actuator including a housing divided into first, second, and third chambers axially spaced along said longitudinal axis, a spring-biased diaphragm separating the first and second chambers and a rigid plate separating the second and third chambers, said first chamber adapted to be connected with a source of vacuum and the second and third chambers being at atmospheric pressure, said second actuator being located in said third chamber and having a housing divided by a spring-biased diaphragm into a first chamber adapted to be connected with said source of vacuum and a second chamber at atmospheric pressure, the first chambers of said first and second actuators being so positioned relative to each other that the diaphragm of each actuator moves in the same direction when vacuum is applied to either of said first chambers, a rod having one end thereof rigidly connected to the diaphragm of the second actuator, the other end of the rod extending through the housing of said first actuator and adapted to be connected to the ignition distributor, means connecting the diaphragm of said first actuator to the housing of said second actuator so the first actuator is moved as a unit together with the rod when the first chamber of the second actuator is connected to the source of vacuum, the first chambers of said actuators adapted to be successively connected with said source of vacuum so as to cause the rod to initially move in one direction to a first point to vary the timing of the spark and subsequently move in the same direction from said first point to a second point to further vary the timing of the spark.

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