Feb. 20, 1962 R. K. FRANK 3,021,828

VACUUM ACTUATED IGNITION TIMING DEVICE

Filed Feb. 16, 1961 2 Sheets-Sheet 1

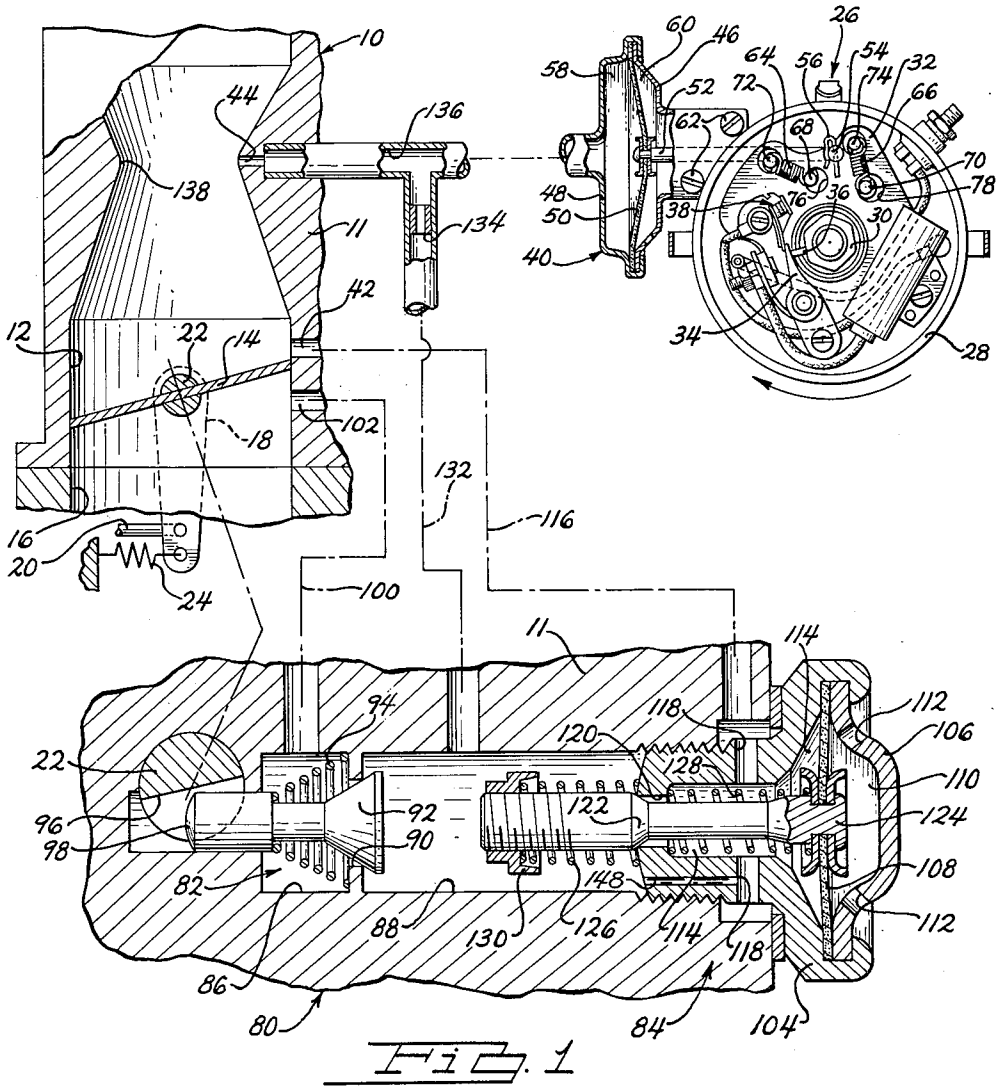


Fig. 1

INVENTOR.
ROBERT K. FRANK
BY
Walter Patarcha, Jr.
ATTORNEY

Feb. 20, 1962 R. K. FRANK 3,021,828

VACUUM ACTUATED IGNITION TIMING DEVICE

Filed Feb. 16, 1961 2 Sheets-Sheet 2

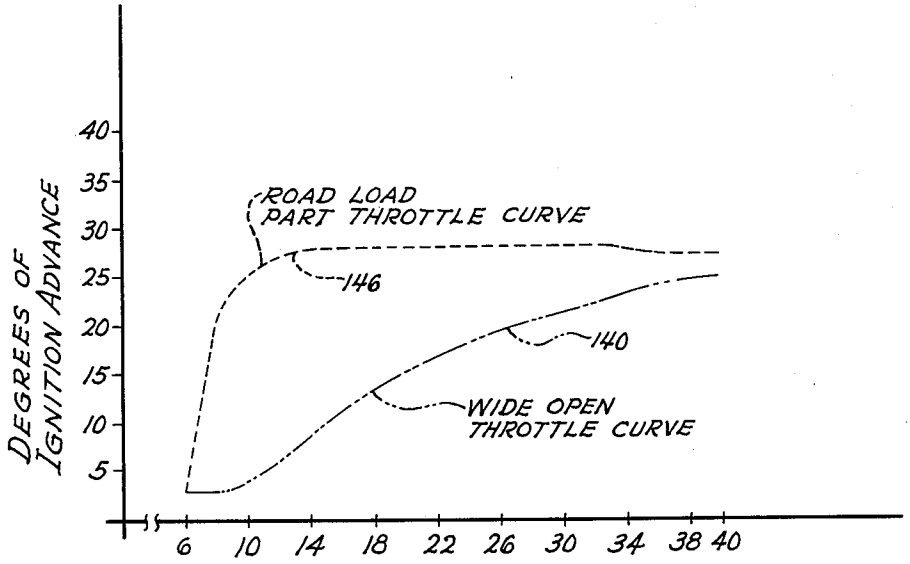


Fig. 2

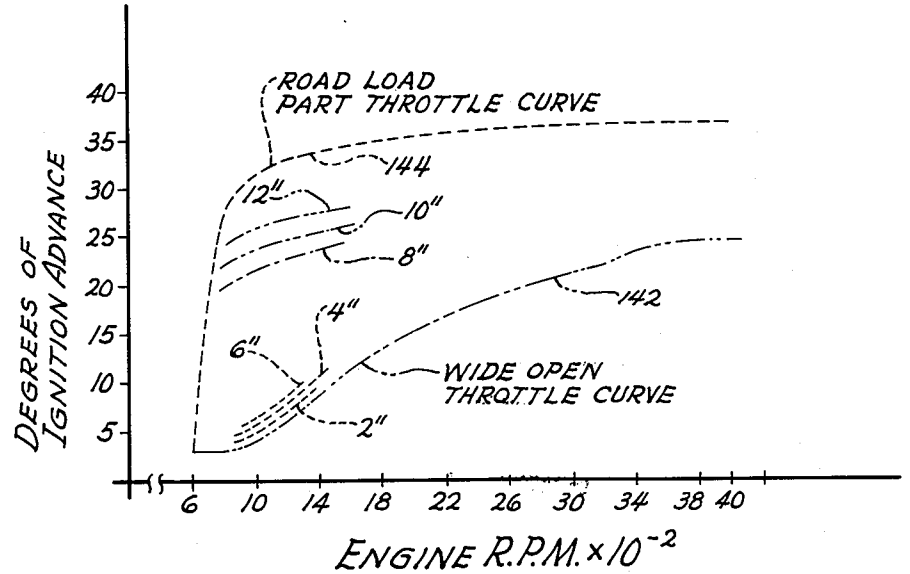


Fig. 3

INVENTOR.
ROBERT K. FRANK
BY
Walter Patronka, Jr.
ATTORNEY

United States Patent Office 3,021,828
Patented Feb. 20, 1962

3,021,828

VACUUM ACTUATED IGNITION TIMING DEVICE

Robert K. Frank, Mount Clemens, Mich., assignor to Holley Carburetor Company, Van Dyke, Mich., a corporation of Michigan

Filed Feb. 16, 1961, Ser. No. 89,848
3 Claims. (Cl. 123—117)

This invention relates generally to ignition distributors for internal combustion engines, and more specifically to those ignition distributors wherein the advance mechanism is controlled in accordance with engine manifold and carburetor venturi vacuums, commonly referred to as "full pressure distributors."

It is generally agreed that greater fuel economy and improved engine performance can be obtained by increasing the degree of ignition advance over that presently obtainable during periods of part throttle engine operation. However, this has not been possible with known constructions.

Full pressure distributors usually employ a flexible diaphragm, which is secured to a movable breaker plate and positioned by both the engine manifold vacuum and venturi vacuum. Springs are also provided for purposes of calibration by resisting the movement of the diaphragm. As a result of this general arrangement, it becomes obvious that the spring rate is a controlling factor regardless of which ever vacuum is the actuating force; that is, manifold or venturi vacuum. Consequently, the springs which establish the wide-open-throttle (W.O.T.) advance curve also serve to limit the part throttle advance curve.

Accordingly, the object of this invention is to provide means establishing the desired W.O.T. advance, but at the same time allowing greater ignition advances during part throttle engine operation.

Other objects and advantages will become more apparent when reference is made to the following written description and the attached drawings wherein:

FIGURE 1 is a fragmentary cross-sectional view of a carburetor constructed generally in accordance with the teachings of the invention and cooperating with an ignition distributor;

FIGURE 2 is a graph illustrating the road load part throttle and wide open throttle ignition advance curves of a conventional ignition system;

FIGURE 3 is a graph illustrating the road load part throttle and wide open throttle ignition advance curves for an ignition system constructed in accordance with the teachings of the invention.

Referring now in greater detail to the drawings, FIGURE 1 illustrates a carburetor 10 having an induction passage 12 with a throttle valve 14 therein controlling the flow therethrough to the intake manifold 16 of the engine. An actuating lever 18 may be suitably secured to the throttle shaft 22, and a rod 20 and spring 24 may be provided to cooperate with lever 18 for positioning the throttle valve 14.

The ignition distributor 26 may be comprised generally of a housing 28 having provision therein for the reception of a driving shaft to which a cam 30 is secured so as to rotate therewith. A breaker plate 32 mounted on a suitable bearing member is adapted to rotate about the driving shaft and cam 30. The breaker plate 32 carries thereon a breaker arm assembly 34 which includes a cam engaging portion 36 engageable by the rotating cam 30 to effect the make and break of the circuit at the contacts indicated at 38. The cam 30 and the shaft on which it is mounted are, of course, rotated in timed relation with the engine by means of any transmission means well known in the art.

The distributor advance mechanism is controlled generally by the pressure responsive device 40 which communicates by means of suitably conduitry with ports 42 and 44 in the carburetor 10 so as to sense engine manifold and carburetor venturi vacuum, respectively.

The pressure responsive device 40 may be substantially comprised of a housing 46 and a cover member 48 rigidly held together in a manner so as to peripherally secure a diaphragm member 50 therebetween. A member 52, connected at its one end to the diaphragm member 50, is adapted to be operatively engaged with the breaker plate 32, as by means of a hole formed therein for the reception of the end 54 of member 52. Any suitable retaining means such as a cotter pin 56 may be employed so as to prevent accidental disengagement between member 52 and breaker plate 32. Chamber 58 formed generally by cover 48 and diaphragm 50 is exposed to a source of vacuum, while the chamber 60 is vented to the atmosphere. The entire pressure responsive device 40 may, of course, be secured to the housing 28 by any suitable means such as screws 62.

Calibrating springs 64 and 66 are secured at one end to the anchor pins 68 and 70, which in turn are fixedly secured to the housing 28. The other ends of springs 64 and 66 are connected to the breaker plate spring posts 72 and 74. Openings 76 and 78 may of course be formed in the breaker plate 32 in order to provide the necessary clearance for anchor pins 68 and 70.

Other portions of the distributor such as the distributing rotor, upper distributor cap and various output terminals are neither shown nor described, since they form no part of this invention and are well known to those skilled in the art.

Valving means illustrated generally at 80 are provided in order to modify the vacuum which is ultimately communicated to chamber 58. The valving means are comprised generally of two independently actuated valve assemblies 82 and 84, which may be contained within the general structure of the carburetor body 11 if so desired.

Chambers 86 and 88 formed generally within the body 11 at times communicate with each other by means of an orifice 90 controlled by a valve member 92. A spring 94 normally urges the valve member 92 to the left, thereby maintaining the orifice 90 closed. The throttle shaft 22 may have a cam-like surface 96 formed thereon which will, at appropriate times, engage the end 98 of valve member 92 and urge it to the right against the force of spring 94, thereby opening orifice 90 and allowing communication between chambers 86 and 88. A conduit 100, communicating with chamber 86, has its other end terminating in a port 102 posterior to the throttle valve 14 when the latter is in its normally closed position.

Valve assembly 84, which may be threadably received within the chamber 88, is comprised of a housing portion 104 which cooperates with a cover member 106 to peripherally secure a pressure responsive diaphragm member 108 therebetween. Chamber 110, formed generally by the diaphragm 108 and cover 106 is vented to the atmosphere, as by ports 112, while chamber 114 on the opposite side of the diaphragm is in communication with the induction passage 12 by means of port 42, conduit 116 and radially formed passages 118 in the housing 104.

An orifice 120 formed in housing 104 provides communication at times between chambers 88 and 114, depending upon the position of the valve member 122. The valve member 122 has its one end 124 connected to the diaphragm 108 so as to be moved therewith. Springs 126 and 128 and adjustment member 130 are, of course, provided so as to enable selection of the particular vacuum value at which valve member 122 will be moved to the right and orifice 120 will be opened. A conduit 132, including a restriction 134 therein, communicates between

chamber 88 and conduit 136 which leads from port 44 to chamber 58 of the pressure responsive device 40.

Operation

Referring to FIGURE 1, let it be assumed that the engine is running at curb idle and the spark advance mechanism is in full retard. Under these conditions, the elements would assume positions as illustrated in FIGURE 1.

Springs 64 and 66, being anchored at one end to the housing 28 by means of anchor pins 68 and 70, respectively, and connected at their respective other ends to the breaker plate spring posts 72 and 74, urge the breaker plate 32 clockwise about the distributor shaft and cam 30 until the holes 108 and 110 formed in the plate 32 abut against the anchor pins 68 and 70. This causes the breaker arm assembly 34 to be rotated to a position whereby the cam 30 will contact the cam engaging portion 36 at a time when the respective pistons within the engine are most nearly at top dead center.

If the throttle valve 14 is moved to wide open position, the air flow past the venturi 138 causes a venturi vacuum at port 44 which is directed generally by means of conduit 136 to chamber 58. As engine speed increases with the throttle valve maintained at wide open position, the venturi vacuum increases, causing the diaphragm 50 to be moved in ever increasing amounts to the left thereby rotating the breaker plate 32 and the breaker arm assembly counter-clockwise about cam 30. This in turn causes the cam 30 to engage the cam engaging portion 36 at ever increasing degrees of engine crankshaft rotation ahead of when the engine pistons reach top dead center. This is usually referred to by those skilled in the art as degrees of ignition advance and is illustrated by curve 140 of FIGURE 2.

It should be noted that during this period of wide open throttle operation, the throttle shaft 22, by virtue of the action of its cam portion 96 during the last few degrees of movement towards wide open throttle position, has moved valve member 92 to the right so as to open orifice 90. As a consequence of this, conduit 132 is in communication with conduit 100 and port 102 which are at substantially atmospheric pressure. This results in a bleeding effect through restriction 134, causing a diminution of the venturi vacuum as sensed by diaphragm 50 and continuing to do so whenever the valve member 92 has opened orifice 90.

In view of the above, it becomes apparent that lighter calibrating springs 64 and 66 may be employed; this is because the effective force opposing them and created by the venturi vacuum has been materially diminished by causing orifice 90 to be opened so as to allow atmospheric pressure to bleed off the venturi vacuum.

If, for example, the throttle valve were opened slowly from its fully closed position to some part throttle position as required by normal road loads, the valve 92 would remain in its closed position and port 42 would be exposed to manifold vacuum.

The existing manifold vacuum would then be communicated by means of conduits 116 and 118 to chamber 114, causing the diaphragm 108 and valve 122 to move to the left. Since, as stated previously, the valve 92 is closed, the manifold vacuum is directed past restriction 134 to chamber 58 causing an increase in ignition advance. As a result of the provision of lighter or weaker calibrating springs, there is less resistance offered to the movement of the diaphragm 50, and consequently greater ignition advances at part throttle engine operating conditions is obtainable than with prior conventional ignition systems.

The graphs of FIGURES 2 and 3 are presented to illustrate the comparative advantage of the invention over that of conventional distributors. While curves 140 and 142 of FIGURES 2 and 3, respectively, are identical to each other; it can be seen from curve 144 that the invention provides for much greater ignition advance during part throttle engine operation.

To this point, the construction and operation of the invention have been described without reference to passage 148 and it is apparent that the invention is operative without passage 148, which was included in FIGURE 1 as a convenient way of disclosing a second embodiment.

Therefore, as an alternate construction to that already described, a calibrated passage 148 may be provided within the body member of 104 so as to continually communicate a small degree of manifold vacuum to conduit 132 during those periods of engine operation wherein the manifold vacuum as yet is insufficient to fully open valve 122 against the action of spring 128. The basic operation of the entire invention is still the same; the primary distinction is that in the absence of a calibrated bypass such as passage 148, no communication of manifold vacuum from port 42 to conduit 132 is possible until that predetermined value of manifold vacuum is attained which will completely open valve 122.

FIGURE 3 illustrates the effect of providing such a calibrated bypass passage as 148. That is, the advance curves for manifold vacuum values of 2, 4 and 6 inches of Hg are separated from each other by a relatively small increment. This is a direct result of the calibrated passage 148 because even though the passage is restrictive in nature, it nevertheless continually conveys a portion of the then existing manifold vacuum.

If the calibrated passage 148 were not provided, the advance curves for manifold vacuum values of 2, 4 and 6 inches of Hg would all fall on one curve, possibly on the two inch curve. This is, of course, assuming that the predetermined vacuum value for actuating the diaphragm 108 is eight inches of manifold vacuum.

Accordingly, it can be seen that in addition to providing greater ignition advance during periods of road load conditions, the invention also serves to lower the ignition advance curves for conditions of 2, 4 and 6 inches of Hg manifold vacuum, while still raising the curves for conditions such as 8, 10 and 12 inches of Hg manifold vacuum. The particular values can of course be selected by proper selection and calibration of valve 84. Consequently, the ignition advance curves can be controlled so as to avoid any particular area characteristic to the engine wherein undesirable detonation occurs.

Although but two embodiments of the invention have been disclosed and described, it is apparent that other modifications of the invention are possible within the scope of the appended claims.

What I claim as my invention is:

1. An ignition system for an internal combustion engine having an induction passage with a throttle valve controlling the flow of air therethrough; comprising an ignition distributor having a housing, a switch in said housing, a cam member normally rotatable in accordance with engine speed and adapted to intermittently open said switch for effecting a make and break of the ignition circuit, a breaker plate normally supporting said switch and having relative angular motion with respect to said housing; pressure responsive means secured to said housing and operatively connected to said breaker plate for rotating said breaker plate in accordance with engine requirements; a venturi formed in said induction passage upstream of said throttle valve; first conduit means communicating between the throat of said venturi and said pressure responsive means; second conduit means communicating between said induction passage at a point upstream of said throttle valve when said throttle valve is in its normally closed position and said first conduit means; first valve means connected serially in said second conduit means adapted to at times control the communication through said second conduit means; said first valve means comprising a diaphragm member, a valve member secured to said diaphram member and adapted to be positioned thereby, said diaphragm member being responsive to the vacuum sensed by said second conduit means at its point of communication with said induction passage and effective to move said

valve member in the opening direction upon the attainment of a predetermined vacuum valve; third conduit means communicating between said induction passage at a point downstream of said throttle valve when said throttle valve is in a substantially closed position and said second conduit means on the first conduit means side of said first valve means; second valve means connected serially in said third conduit means adapted to control the communication of said third conduit means with said second conduit means; and a cam member rotatably positioned in accordance with the position of said throttle valve and adapted to at times abut against and urge said second valve means in the opening direction so as to allow complete communication between said second and third conduit means.

2. An ignition system for an internal combustion engine having an induction passage with a throttle valve controlling the flow of air therethrough; comprising an ignition distributor having a housing, a switch in said housing, a cam member normally rotatable in accordance with engine speed and adapted to intermittently open said switch for effecting a make and break of the ignition circuit, a breaker plate normally supporting said switch and having relative angular motion with respect to said housing; pressure responsive means secured to said housing and operatively connected to said breaker plate for rotating said breaker plate in accordance with engine requirements; a venturi formed in said induction passage upstream of said throttle valve; first conduit means communicating between the throat of said venturi and said pressure responsive means; second conduit means communicating between said induction passage at a point upstream of said throttle valve when said throttle valve is in its normally closed position and said first conduit means; first valve means connected serially in said second conduit means adapted to at times control the communication through said second conduit means; said first valve means comprising a second pressure responsive member, a valve member secured to said second pressure responsive member and adapted to be positioned thereby, said second pressure responsive member being responsive to the vacuum sensed by said second conduit means at its point of communication with said induction passage and effective to move said valve member in the opening direction upon the attainment of a predetermined vacuum value; third conduit means communicating between said induction passage at a point downstream of said throttle valve when said throttle valve is in a substantially closed position and said second conduit means on the first conduit means side of said first valve means; and second valve means connected serially in said third conduit means adapted to allow complete communication of said third conduit means with said second conduit means whenever said throttle valve is in a substantially wide open position.

3. An ignition system for an internal combustion engine having an induction passage with a throttle valve controlling the flow of air therethrough; comprising a

throttle shaft; an ignition distributor having a housing, a switch in said housing, a cam member normally rotatable in accordance with engine speed and adapted to intermittently open said switch for effecting a make and break of the ignition circuit, a breaker plate normally supporting said switch and having relative angular motion with respect to said housing; pressure responsive means secured to said housing and operatively connected to said breaker plate for rotating said breaker plate in accordance with engine requirements; a venturi formed in said induction passage upstream of said throttle valve; first conduit means including a first restriction therein communicating between the throat of said venturi and said pressure responsive means; second conduit means including a second restriction therein communicating between said induction passage at a point upstream of said throttle valve when said throttle valve is in its normally closed position and said first conduit means at a point between said first restriction and said pressure responsive means; first valve means connected serially in said second conduit means adapted to at times control the communication through said second conduit means; said first valve means comprising a main body portion, a cover member, a diaphragm member, a valve member secured to said diaphragm member and adapted to be positioned thereby, a passageway formed through said main body portion providing a valve orifice adapted to cooperate with said valve member for controlling the transmission of vacuum therethrough, and spring means normally urging said diaphragm member in a direction so as to move said valve member in the closing direction, said diaphragm member being responsive to the vacuum sensed by said second conduit means at its point of communication with said induction passage and effective to move said valve member in the opening direction against the force of said spring means upon the attainment of a predetermined vacuum value; third conduit means communicating between said induction passage at a point downstream of said throttle valve when said throttle valve is in a substantially closed position and said second conduit means on the first conduit means side of said first valve means; second valve means connected serially in said third conduit means adapted to control the communication of said third conduit means with said second conduit means; and a cam member rotatable with said throttle shaft and adapted to at times abut against and urge said second valve means in the opening direction so as to allow complete communication between said second and third conduit means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,381,610	Mallory	Aug. 7, 1945
2,475,717	Ostling	July 12, 1949
2,867,197	McCollough	Jan. 6, 1959